MCUXpresso SDK Documentation

Release 25.09.00-pvw2

NXP
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This documentation contains information specific to the imx95lpd5evk19 board.

Chapter 1

IMX95LPD5EVK-19

1.1 Overview

MCU device and part on board is shown below:

- Device: MIMX9596
- PartNumber: MIMX9596AVZXN

1.2 Getting Started with MCUXpresso SDK Package

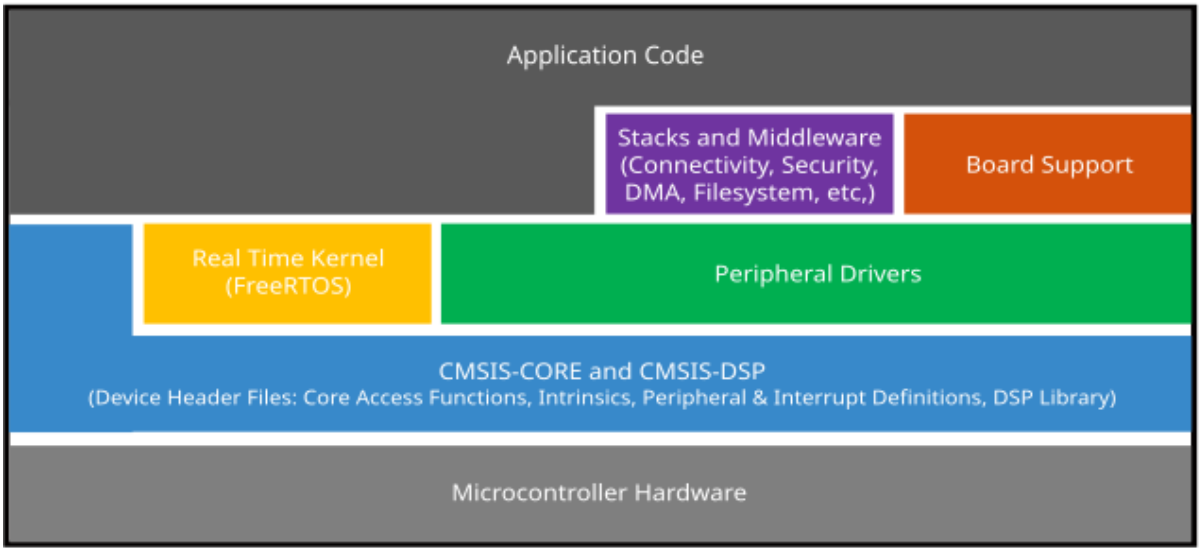
1.2.1 Getting Started with Package

Overview

The NXP MCUXpresso software and tools offer comprehensive development solutions designed to optimize, ease and help accelerate embedded system development of applications based on general purpose, crossover and Bluetooth-enabled MCUs from NXP. The MCUXpresso SDK includes a flexible set of peripheral drivers designed to speed up and simplify development of embedded applications. Along with the peripheral drivers, the MCUXpresso SDK provides an extensive and rich set of example applications covering everything from basic peripheral use case examples to demo applications. The MCUXpresso SDK also contains optional RTOS integrations such as FreeRTOS and Azure RTOS, and device stack to support rapid development on devices.

For supported toolchain versions, see *MCUXpresso SDK Release Notes for IMX95LPD5EVK-19 (document MCUXSDKIMX95LPD5EVK19RN)*.

For the latest version of this and other MCUXpresso SDK documents, see the MCUXpresso SDK homepage MCUXpresso-SDK: Software Development Kit for MCUXpresso.



MCUXpresso SDK board support folders

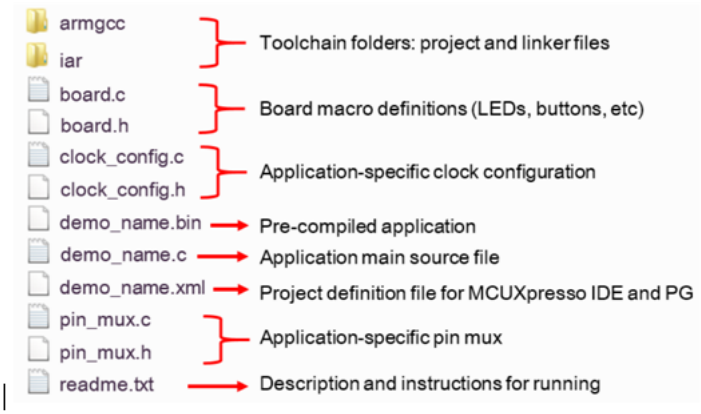
MCUXpresso SDK board support provides example applications for NXP development and evaluation boards for Arm Cortex-M cores. Board support packages are found inside of the top level boards folder, and each supported board has its own folder (MCUXpresso SDK package can support multiple boards). Within each <board_name> folder there are various sub-folders to classify the type of examples they contain. These include (but are not limited to):

- cmsis_driver_examples: Simple applications intended to concisely illustrate how to use CMSIS drivers.
- demo_apps: Full-featured applications intended to highlight key functionality and use cases of the target MCU. These applications typically use multiple MCU peripherals and may leverage stacks and middleware.
- driver_examples: Simple applications intended to concisely illustrate how to use the MCUXpresso SDK's peripheral drivers for a single use case.
- rtos_examples: Basic FreeRTOS OS examples showcasing the use of various RTOS objects (semaphores, queues, and so on) and interfacing with the MCUXpresso SDK's RTOS drivers
- multicore_examples: Simple applications intended to concisely illustrate how to use middleware/multicore stack.

Example application structure This section describes how the various types of example applications interact with the other components in the MCUXpresso SDK. To get a comprehensive understanding of all MCUXpresso SDK components and folder structure, see *MCUXpresso SDK API Reference Manual*.

Each <board_name> folder in the boards directory contains a comprehensive set of examples that are relevant to that specific piece of hardware. Although we use the hello_world_sm example (part of the demo_apps folder), the same general rules apply to any type of example in the <board_name> folder.

In the hello_world_sm application folder you see the following contents:



All files in the application folder are specific to that example, so it is easy to copy and paste an existing example to start developing a custom application based on a project provided in the MCUXpresso SDK.

Parent topic:*MCUXpresso SDK board support folders*

Locating example application source files When opening an example application in any of the supported IDEs, a variety of source files are referenced. The MCUXpresso SDK devices folder is the central component to all example applications. It means the examples reference the same source files and, if one of these files is modified, it could potentially impact the behavior of other examples.

The main areas of the MCUXpresso SDK tree used in all example applications are:

- devices/<device_name>: The device's CMSIS header file, MCUXpresso SDK feature file and a few other files
- devices/<device_name>/cmsis_drivers: All the CMSIS drivers for your specific MCU
- devices/<device_name>/drivers: All of the peripheral drivers for your specific MCU
- devices/<device_name>/<tool_name>: Toolchain-specific startup code, including vector table definitions
- devices/<device_name>/utilities: Items such as the debug console that are used by many of the example applications
- devices/<devices_name>/project_template: Project template used in CMSIS PACK new project creation

For examples containing an RTOS, there are references to the appropriate source code. RTOSes are in the rtos folder. The core files of each of these are shared, so modifying one could have potential impacts on other projects that depend on that file.

Parent topic:*MCUXpresso SDK board support folders*

Toolchain introduction

The MCUXpresso SDK release for i.MX 95 includes the build system to be used with some toolchains. In this chapter, the toolchain support is presented and detailed.

Compiler/Debugger The MCUXpresso SDK i.MX 95 release supports building and debugging with the toolchains listed in Table 1.

The user can choose the appropriate one for development.

For supported toolchain versions, see MCUXpresso SDK Release Notes for for IMX95LPD5EVK-19, IMX95LP4XEVK-15, and IMX95VERDINEVK (*document: MCUXSDKIMX95SERIESRN*).

- Arm GCC + SEGGER J-Link GDB Server. This is a command line tool option and it supports both Windows OS and Linux OS.
- IAR Embedded Workbench for Arm and SEGGER J-Link software. The IAR Embedded Workbench is an IDE integrated with editor, compiler, debugger, and other components. The SEGGER J-Link software provides the driver for the J-Link Plus debugger probe and supports the device to attach, debug, and download.

Compiler/Debugger	Supported host OS	Debug probe	Tool website
ArmGCC/J-Link GDB server	Windows OS/Linux OS	J-Link Plus	developer.arm.com/open-source/gnu-toolchain/gnu-rm

www.segger.com

| |IAR/J-Link|Windows OS|J-Link Plus|www.iar.com

www.segger.com

|

Download the corresponding tools for the specific host OS from the website.

Note:

- To support i.MX 95, the patch for IAR and Segger J-Link must be installed. To get the patch, download it from the NXP website or contact your local field applications engineer (FAE) or the sales representative.

Parent topic:*Toolchain introduction*

Build a demo application using Arm GCC

This section describes the steps to configure the command-line Arm GCC tools to build, run, and debug demo applications. Additionally, this section lists the necessary driver libraries provided in the MCUXpresso SDK. The hello_world_sm demo application targeted for the IMX95 series hardware platform is used as an example, though these steps can be applied to any board, demo, or example application in the MCUXpresso SDK.

Linux OS host The following sections provide steps to run a demo compiled with Arm GCC on Linux host.

Set up toolchain This section contains the steps to install the necessary components required to build and run a MCUXpresso SDK demo application with the Arm GCC toolchain, as supported by the MCUXpresso SDK.

Install GCC Arm embedded toolchain Download and run the installer from the GNU Arm Embedded Toolchain Downloads page. The GNU Arm embedded toolchain contains the GCC compiler, libraries, and other tools required for bare-metal software development. The GCC toolchain should correspond to the latest supported version, as described in the MCUXpresso SDK Release Notes for IMX95 Series (document MCUXSDKIMX95SERIESRN).

Parent topic: Set up toolchain

Add a new system environment variable for ARMGCC_DIR Create a new system environment variable and name it ARMGCC_DIR. The value of this variable should point to the Arm GCC embedded toolchain installation path. For this example, the path is: $ export ARMGCC_DIR=<path_to_GNUARM_GCC_installation_dir>.

Parent topic: Set up toolchain

Parent topic: Linux OS host

Build an example application To build an example application, follow these steps.

1. Change the directory to the example application project directory, which has a path similar to the following: <install_dir>/boards/<board_name>/<example_type>/<application_name>/armgcc. For example, the exact path is: <install_dir>/boards/imx95lpd5evk19/demo_apps/hello_ world_sm/armgcc.
2. Run the build_debug.sh script at the command-line to perform the build. The output is shown as below:

```
$ ./build_debug.sh
-- TOOLCHAIN_DIR:
-- BUILD_TYPE: debug
-- TOOLCHAIN_DIR:
-- BUILD_TYPE: debug
-- The ASM compiler identification is GNU
-- Found assembler:
-- Configuring done
-- Generating done
-- Build files have been written to:
Scanning dependencies of target hello_world.elf
< -- skipping lines -- >
[100%] Linking C executable debug/hello_world.elf
[100%] Built target hello_world.elf
```

Note: build_debug/release.sh are ram target, build_ddr_debug/release.sh are ddr target (only imx95lpd5evk19 hello_world_sm support ddr target this release, the same as iar).

Parent topic: Linux OS host

Parent topic:*Build a demo application using Arm GCC*

Windows OS host The following sections provide steps to run a demo compiled with Arm GCC on Windows OS host.

Set up toolchain This section contains the steps to install the necessary components required to build and run a MCUXpresso SDK demo application with the Arm GCC toolchain on Windows OS, as supported by the MCUXpresso SDK.

Install GCC Arm embedded toolchain Download and run the installer from the GNU Arm Embedded Toolchain Downloads page. The GNU Arm embedded toolchain contains the GCC compiler, libraries, and other tools required for bare-metal software development. The GCC toolchain should correspond to the latest supported version, as described in MCUXpresso SDK Release Notes for IMX95 Series(document MCUXSDKIMX95SERIESRN).

Parent topic: Set up toolchain

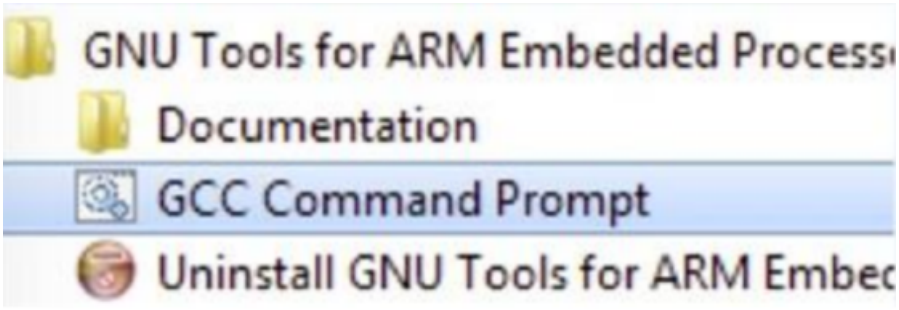
Add a new system environment variable for ARMGCC_DIR Create a new system environment variable and name it ARMGCC_DIR. The value of this variable should point to the Arm GCC embedded toolchain installation path. For this example, the path is: C:\Program Files (x86)\GNU Arm Embedded Toolchain\9 2020-q2-update. Reference the installation folder of the GNU Arm GCC embedded tools for the exact path.

Parent topic: Set up toolchain

Parent topic: Windows OS host

Build an example application To build an example application, follow these steps.

1. Open the GCC Arm embedded toolchain command window. To launch the window on the Windows operating system, select **Start**-> **Programs**-> **GNU Tools ARM Embedded <version>**-> **GCC Command Prompt**.



2. Change the directory to the example application project directory, which has a path similar to the following: <install_dir>/boards/<board_name>/<example_type>/<application_name>/armgcc. For this example, the exact path is: <install_dir>/boards/imx95lpd5evk19/demo_apps/hello_world/armgcc.

3. Type build_debug.bat at the command-line or double-click the build_debug.bat file in Windows. Explorer to perform the build. The output is as shown in *Figure 2*.

```
[100%] Linking C executable debug/hello_world_sm_cm7.elf
Memory region         Used Size  Region Size  %age Used
    m_interrupts:        1612 B         2 KB     78.71%
          m_text:       18060 B       254 KB      6.94%
m_m33_suspend_ram:          0 GB         8 KB      0.00%
m_a55_suspend_ram:          0 GB         8 KB      0.00%
          m_data:        4072 B       104 KB      3.82%
        m_ncache:          0 GB        64 KB      0.00%
      m_reserved:          0 GB        56 KB      0.00%
       m_rsc_tbl:          0 GB        16 KB      0.00%
m_rsc_tbl_in_dram:          0 GB        16 KB      0.00%
[100%] Built target hello_world_sm_cm7.elf
```

Parent topic: Windows OS host

Parent topic:*Build a demo application using Arm GCC*

Build a demo application with IAR

This section describes the steps to run the example applications provided in the MCUXpresso SDK. The demo application targeted for the i.MX 95 hardware platform is used as an example, although these steps can be applied to any example application in the MCUXpresso SDK.

Build an example application The following steps guide you through opening the hello_world example application. These steps may change slightly for other example applications, as some of these applications may have additional layers of folders in their paths.

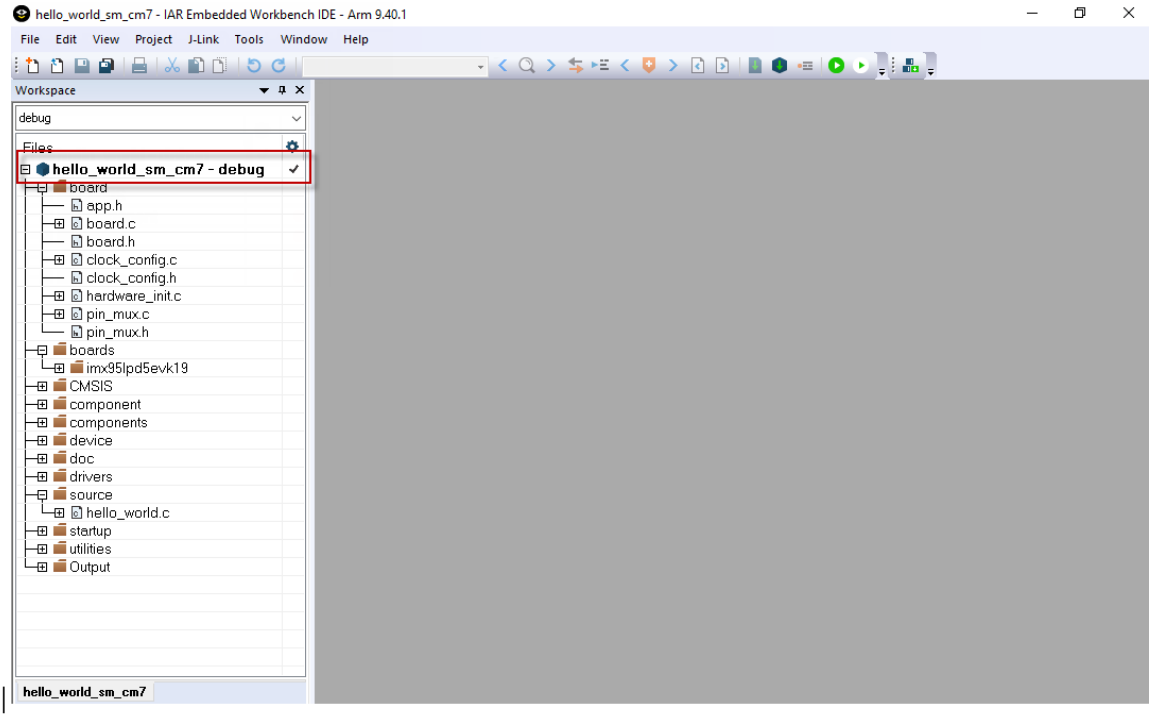
1. If not already done, open the desired demo application workspace. Most example application workspace files can be located using the following path:

   ```
   <install_dir>/boards/<board_name>/<example_type>/<application_name>/iar
   ```

   Using the i.MX 95 LPD EVK board as an example, the workspace is located in:

   ```
   <install_dir>/boards/imx95lpd5evk19/demo_apps/hello_world/cm7/hello_world_cm7.eww
   ```

2. Select the desired build target from the drop-down. For this example, select **hello_world\ – debug**.
3. To build the demo application, click **Make**.



4. The build completes without errors.

Parent topic:*Build a demo application with IAR*

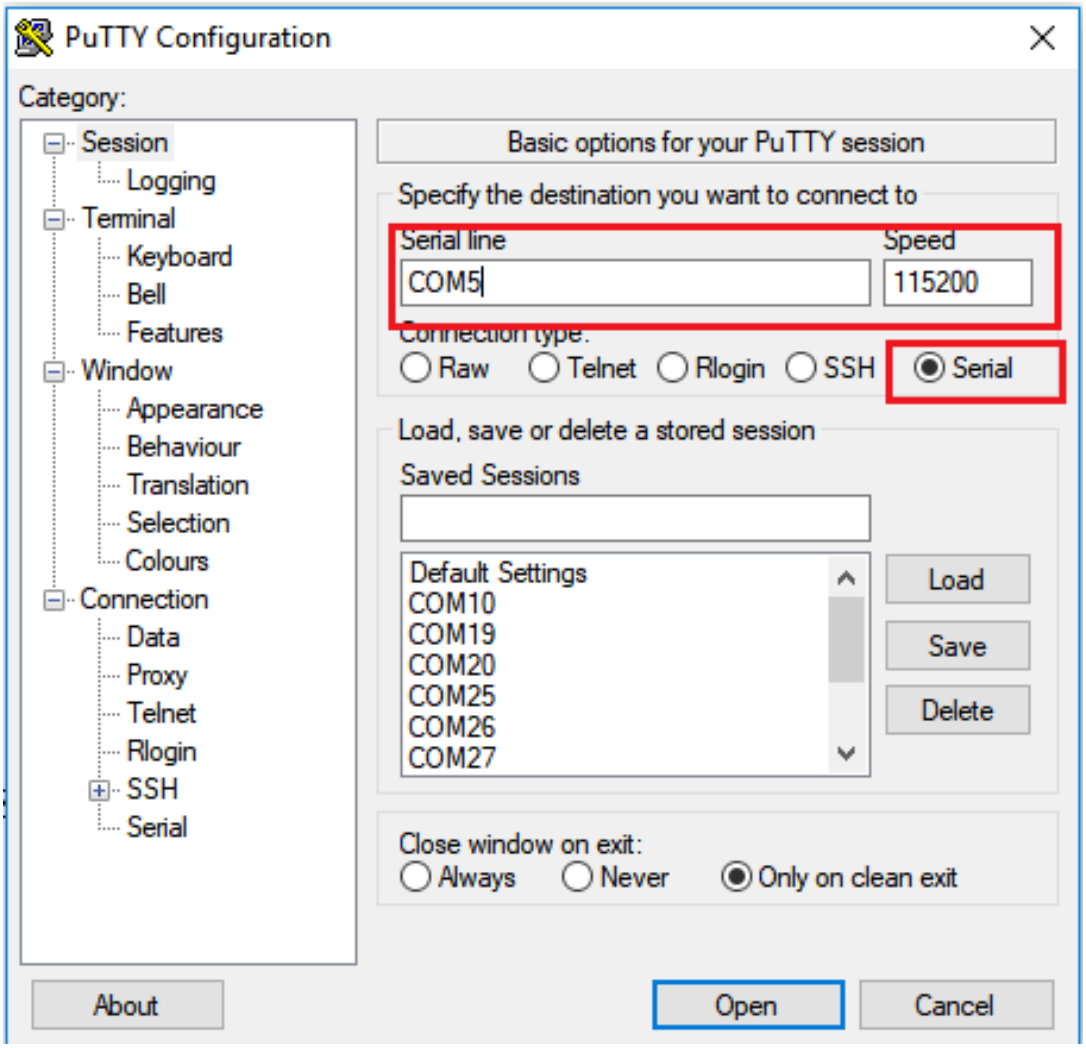
Run a demo application

This section describes the steps to download the flash.bin to sd and emmc, run the example applications provided in the MCUXpresso SDK. The hello_world_sm demo application targeted for the i.MX 95 hardware platform is used as an example, although these steps can be applied to any example application in the MCUXpresso SDK.

Connect LPUART on board to console on PC To download and run the application, perform these steps:

1. Connect the development platform to your PC via USB cable between the DBG USB connector (J31) and the PC. It provides console output.

2. Open the terminal application on the PC, such as PuTTY or TeraTerm, and connect to the debug COM port (to determine the COM port number, see How to determine COM port). Configure the terminal with these settings:
    1. 115200 baud rate
    2. No parity
    3. 8 data bits
    4. 1 stop bit |



|

Parent topic:*Run a demo application*

Make a flash.bin

1. Get the boot images and the imx-mkimage source repository from corresponding Linux BSP release. The boot images required to be put into imx-mkimage/i.MX95 are:

    - oei-m33-tcm.bin

    - oei-m33-ddr.bin

    - m33_image.bin (m33_image-mx95alt.bin/m33_image-mx95evk.bin/m33_image-mx95netc. bin)

    - lpddr5_dmem_qb_v202311.bin (lpddr4x_dmem_qb_v202311.bin for IMX95LP4XEVK-15)

    - lpddr5_dmem_v202311.bin (lpddr4x_dmem_v202311.bin for IMX95LP4XEVK-15)

    - lpddr5_imem_qb_v202311.bin (lpddr4x_imem_qb_v202311.bin for IMX95LP4XEVK-15)

- lpddr5_imem_v202311.bin (lpddr4x_imem_v202311.bin for IMX95LP4XEVK-15)

- u-boot.bin

- u-boot-spl.bin

- bl31.bin

- tee.bin

- mx95a0-ahab-container.img

Note:

- mx95evk for m33_image.bin is used for rpmsg str echo, rpmsg ping pong and power_mode_switch_rtos.
- mx95netc for m33_image.bin is used for netc_share_sm.
- mx95alt for m33_image.bin is used for almost other examples.

2. Copy binary built by ARMGCC/IAR into imx-mkimage/i.MX95, and rename it to m7_image.bin.
3. make image for ram target.
   1. Make flash.bin with imx-mkimage.

      make SOC=iMX95 OEI=YES flash_all LPDDR_TYPE=lpddr5 (boot A core and M7)

      or

      make SOC=iMX95 OEI=YES flash_lpboot_sm_m7 LPDDR_TYPE=lpddr5 (does not boot A core, just boot M7)

   2. Make image for ddr target:

      make SOC=i.MX95 OEI=YES flash_m7_ddr LPDDR_TYPE=lpddr5

      make SOC=iMX95 OEI=YES flash_lpboot_sm_m7 LPDDR_TYPE=lpddr5

   Note: For IMX95LP4XEVK-15, LPDDR_TYPE=lpddr4x.
4. Burn flash.bin to MicroSD/eMMC at 32 K(0x8000) offset with dd or HxD or UUU and then plug the MicroSD card to the board.

   For example:

   - Burn flash.bin to Micro SD card with dd

     dd if=flash.bin of=/dev/sdh bs=1k seek=32 && sync

   - Burn flash.bin to SD/eMMC with UUU
     1. Connect USB Type-C port to PC through the USB cable. It is used for downloading firmware of the board.
     2. Switch to serial downloader mode; boot core is cortex-m33. sd: uuu -b sd imx-boot-imx95-19x19-lpddr5-evk-sd.bin-flash_all new-flash.bin
     3. Burn flash.bin with uuu.

        emmc: uuu -b emmc imx-boot-imx95-19x19-lpddr5-evk-sd.bin-flash_all new-flash.bin

     Note:

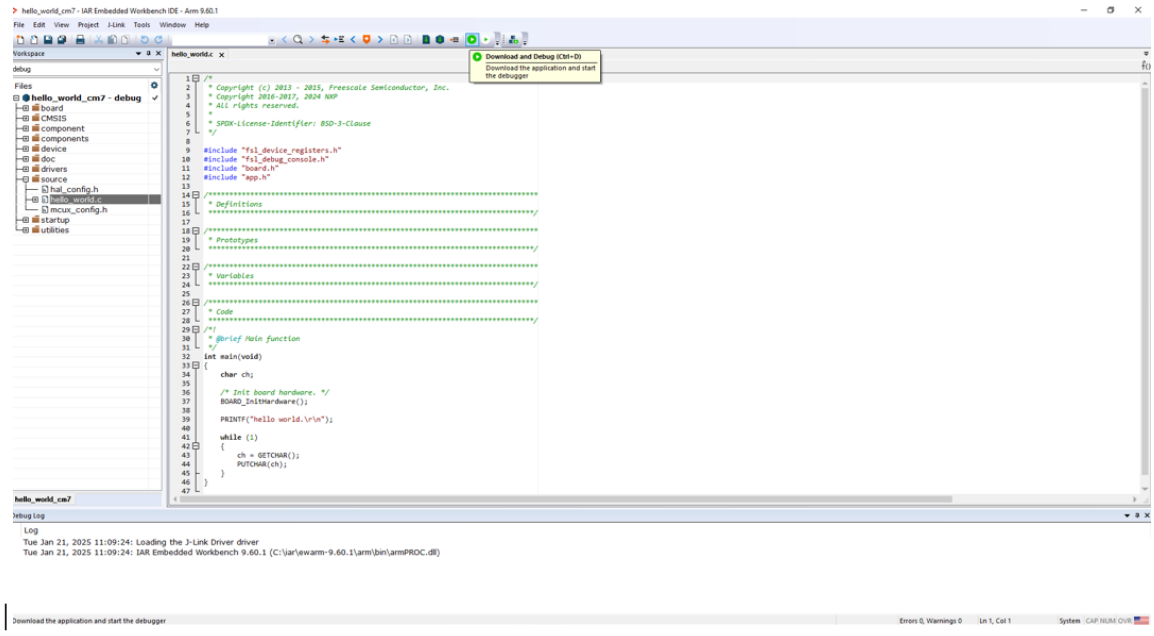
     – imx-boot-imx95-19x19-lpddr5-evk-sd.bin-flash_all (imx-boot-imx95-15x15-lpddr4x-evk-sd.bin-flash_all for IMX95LP4XEVK-15 and imx-boot-imx95-19x19-verdin-sd.bin-flash_all for imx95verdinevk). Get it from linux bsp.

     – new-flash.bin. Generate it yourself.
5. Change the boot mode to SW7[1:4] = 1011 for sd boot, SW7[1:4] = 1010 for emmc boot.
6. Power on the board .

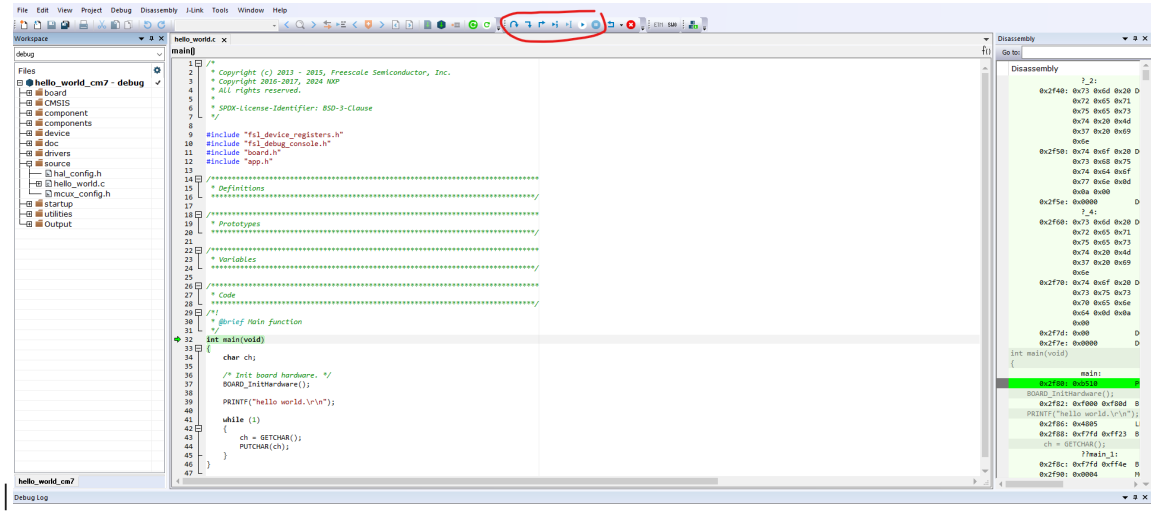
Parent topic:*Run a demo application*

Debug an demo application with IAR To debug an application with IAR, perform these steps:

1. download the patch for IAR and Segger J-Link from the NXP website, install it as readme in the patch.
2. burn a flash.bin to board, see *Run a demo application*, make sure the size of M7 binary in flash.bin not less than the binary you want to debug.
3. power on the board, make sure the M7 is booted by SM
4. Open hello world example with IAR, click **download and debug** to debug



5. click button such as **step over** to debug



Parent topic:*Run a demo application*

1.3 Getting Started with MCUXpresso SDK GitHub

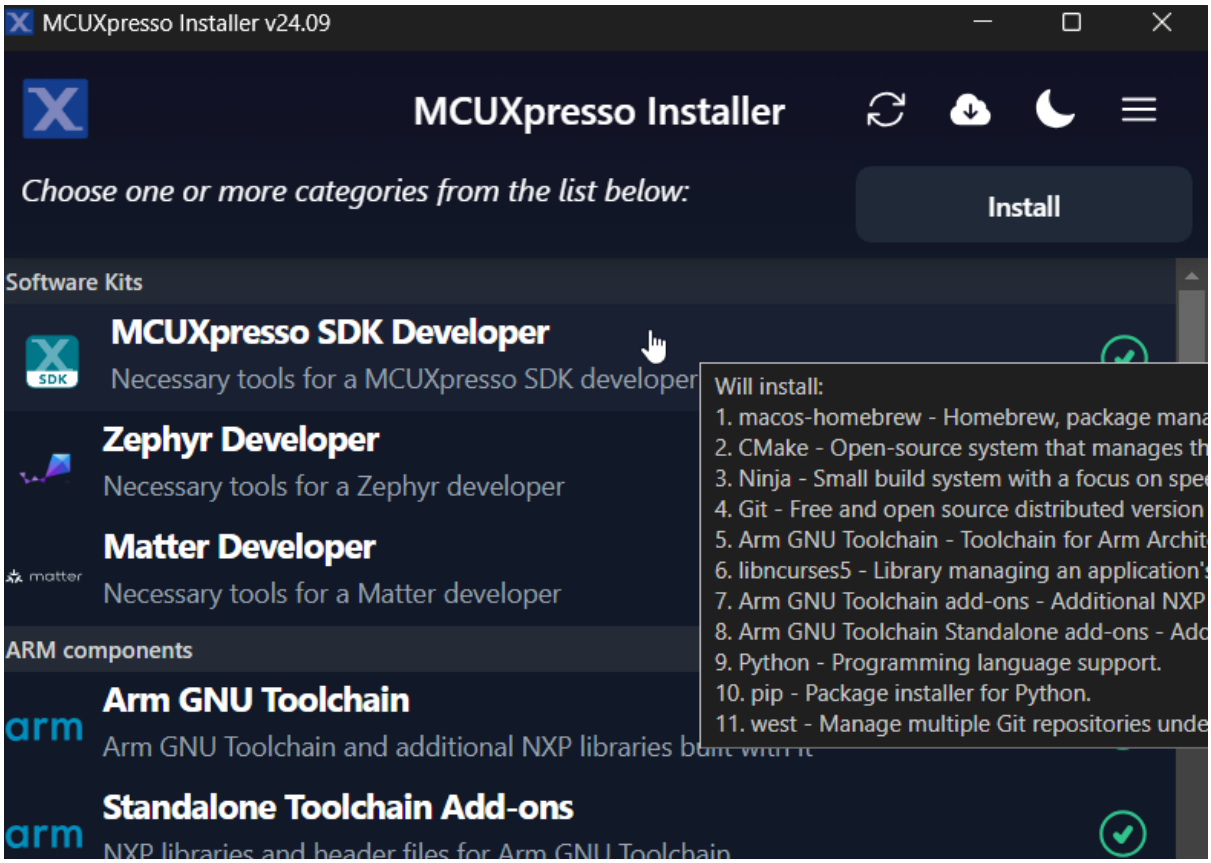
1.3.1 Getting Started with MCUXpresso SDK Repository

Installation

NOTE

If the installation instruction asks/selects whether to have the tool installation path added to the PATH variable, agree/select the choice. This option ensures that the tool can be used in any terminal in any path. *Verify the installation* after each tool installation.

Install Prerequisites with MCUXpresso Installer The MCUXpresso Installer offers a quick and easy way to install the basic tools needed. The MCUXpresso Installer can be obtained from https://github.com/nxp-mcuxpresso/vscode-for-mcux/wiki/Dependency-Installation. The MCUXpresso Installer is an automated installation process, simply select MCUXpresso SDK Developer from the menu and click install. If you prefer to install the basic tools manually, refer to the next section.



Alternative: Manual Installation

Basic tools

Git Git is a free and open source distributed version control system. Git is designed to handle everything from small to large projects with speed and efficiency. To install Git, visit the official Git website. Download the appropriate version(you may use the latest one) for your operating system (Windows, macOS, Linux). Then run the installer and follow the installation instructions.

User `git --version` to check the version if you have a version installed.

Then configure your username and email using the commands:

```
git config --global user.name "Your Name"
git config --global user.email "youremail@example.com"
```

Python Install python 3.10 or latest. Follow the Python Download guide.

Use python --version to check the version if you have a version installed.

West Please use the west version equal or greater than 1.2.0

```
# Note: you can add option '--default-timeout=1000' if you meet connection issue. Or you may set a different␣
↪source using option '-i'.
# for example, in China you could try: pip install -U west -i https://pypi.tuna.tsinghua.edu.cn/simple
pip install -U west
```

Build And Configuration System

CMake It is strongly recommended to use CMake version equal or later than 3.30.0. You can get latest CMake distributions from the official CMake download page.

For Windows, you can directly use the .msi installer like cmake-3.31.4-windows-x86_64.msi to install.

For Linux, CMake can be installed using the system package manager or by getting binaries from the official CMake download page.

After installation, you can use cmake --version to check the version.

Ninja Please use the ninja version equal or later than 1.12.1.

By default, Windows comes with the Ninja program. If the default Ninja version is too old, you can directly download the ninja binary and register the ninja executor location path into your system path variable to work.

For Linux, you can use your system package manager or you can directly download the ninja binary to work.

After installation, you can use ninja --version to check the version.

Kconfig MCUXpresso SDK uses Kconfig python implementation. We customize it based on our needs and integrate it into our build and configuration system. The Kconfiglib sources are placed under mcuxsdk/scripts/kconfig folder.

Please make sure *python* environment is setup ready then you can use the Kconfig.

Ruby Our build system supports IDE project generation for iar, mdk, codewarrior and xtensa to provide OOBE from build to debug. This feature is implemented with ruby. You can follow the guide ruby environment setup to setup the ruby environment. Since we provide a built-in portable ruby, it is just a simple one cmd installation.

If you only work with CLI, you can skip this step.

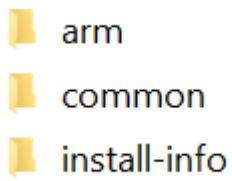
Toolchain MCUXpresso SDK supports all mainstream toolchains for embedded development. You can install your used or interested toolchains following the guides.

Toolchain	Download and Installation Guide	Note
Armgcc	Arm GNU Toolchain Install Guide	ARMGCC is default toolchain
IAR	IAR Installation and Licensing quick reference guide	
MDK	MDK Installation	
Armclang	Installing Arm Compiler for Embedded	
Zephyr	Zephyr SDK	
Codewarrior	NXP CodeWarrior	
Xtensa	Tensilica Tools	
NXP S32Compiler RISC-V Zen-V	NXP Website	

After you have installed the toolchains, register them in the system environment variables. This will allow the west build to recognize them:

Toolchain	Environment Variable	Example	Cmd Line Argument
Armgcc	ARMGCC_DIR	C:\armgcc for windows/usr for Linux. Typically arm-none-eabi-* is installed under /usr/bin	–toolchain armgcc
IAR	IAR_DIR	C:\iar\ewarm-9.60.3 for Windows/opt/iarsystems/bxarm-9.60.3 for Linux	–toolchain iar
MDK	MDK_DIR	C:\Keil_v5 for Windows.MDK IDE is not officially supported with Linux.	–toolchain mdk
Armclang	ARMCLANG_DIR	C:\ArmCompilerforEmbedded6.22 for Windows/opt/ArmCompilerforEmbedded6.21 for Linux	–toolchain mdk
Zephyr	ZEPHYR_SDK	c:\NXP\zephyr-sdk-<version> for windows/opt/zephyr-sdk-<version> for Linux	–toolchain zephyr
CodeWarrior	CW_DIR	C:\Freescale\CW MCU v11.2 for windowsCodeWarrior is not supported with Linux	–toolchain codewarrior
Xtensa	XCC_DIR	C:\xtensa\XtDevTools\install\tools\RI-2023.11-win32\XtensaTools for windows/opt/xtensa/XtDevTools/install/tools/RI-2023.11-Linux/XtensaTools for Linux	–toolchain xtensa
NXP S32Compiler RISC-V Zen-V	RISCVLLVM_DIR	C:\riscv-llvm-win32_b298_b298_2024.08.12 for Windows/opt/riscv-llvm-Linux-x64_b298_b298_2024.08.12 for Linux	–toolchain riscvllvm

- The <toolchain>_DIR is the root installation folder, not the binary location folder. For IAR, it is directory containing following installation folders:



- MDK IDE using armclang toolchain only officially supports Windows. In Linux, please directly use armclang toolchain by setting ARMCLANG_DIR. In Windows, since most Keil users will install MDK IDE instead of standalone armclang toolchain, the MDK_DIR has higher priority than ARMCLANG_DIR.
- For Xtensa toolchain, please set the XTENSA_CORE environment variable. Here's an example list:

Device Core	XTENSA_CORE
RT500 fusion1	nxp_rt500_RI23_11_newlib
RT600 hifi4	nxp_rt600_RI23_11_newlib
RT700 hifi1	rt700_hifi1_RI23_11_nlib
RT700 hifi4	t700_hifi4_RI23_11_nlib
i.MX8ULP fusion1	fusion_nxp02_dsp_prod

- In Windows, the short path is used in environment variables. If any toolchain is using the long path, you can open a command window from the toolchain folder and use below command to get the short path: for %i in (.) do echo %~fsi

Tool installation check Once installed, open a terminal or command prompt and type the associated command to verify the installation.

If you see the version number, you have successfully installed the tool. Else, check whether the tool's installation path is added into the PATH variable. You can add the installation path to the PATH with the commands below:

- Windows: Open command prompt or powershell, run below command to show the user PATH variable.

```
reg query HKEY_CURRENT_USER\Environment /v PATH
```

The tool installation path should be C:\Users\xxx\AppData\Local\Programs\Git\cmd. If the path is not seen in the output from above, append the path value to the PATH variable with the command below:

```
reg add HKEY_CURRENT_USER\Environment /v PATH /d "%PATH%;C:\Users\xxx\AppData\
↪Local\Programs\Git\cmd"
```

Then close the command prompt or powershell and verify the tool command again.

- Linux:
  1. Open the $HOME/.bashrc file using a text editor, such as vim.
  2. Go to the end of the file.
  3. Add the line which appends the tool installation path to the PATH variable and export PATH at the end of the file. For example, export PATH="/Directory1:$PATH".
  4. Save and exit.

5. Execute the script with source .bashrc or reboot the system to make the changes live. To verify the changes, run echo $PATH.

- macOS:
  1. Open the $HOME/.bash_profile file using a text editor, such as nano.
  2. Go to the end of the file.
  3. Add the line which appends the tool installation path to the PATH variable and export PATH at the end of the file. For example, export PATH="/Directory1:$PATH".
  4. Save and exit.
  5. Execute the script with source .bash_profile or reboot the system to make the changes live. To verify the changes, run echo $PATH.

Get MCUXpresso SDK Repo

Establish SDK Workspace To get the MCUXpresso SDK repository, use the west tool to clone the manifest repository and checkout all the west projects.

```
# Initialize west with the manifest repository
west init -m https://github.com/nxp-mcuxpresso/mcuxsdk-manifests/ mcuxpresso-sdk

# Update the west projects
cd mcuxpresso-sdk
west update

# Allow the usage of west extensions provided by MCUXpresso SDK
west config commands.allow_extensions true
```

Install Python Dependency(If do tool installation manually) To create a Python virtual environment in the west workspace core repo directory mcuxsdk, follow these steps:

1. Navigate to the core directory:

   ```
   cd mcuxsdk
   ```

2. [Optional] Create and activate the virtual environment: If you don't want to use the python virtual environment, skip this step. **We strongly suggest you use venv to avoid conflicts with other projects using python.**

   ```
   python -m venv .venv

   # For Linux/MacOS
   source .venv/bin/activate

   # For Windows
   .\.venv\Scripts\activate
   # If you are using powershell and see the issue that the activate script cannot be run.
   # You may fix the issue by opening the powershell as administrator and run below command:
   powershell Set-ExecutionPolicy RemoteSigned
   # then run above activate command again.
   ```

   Once activated, your shell will be prefixed with (.venv). The virtual environment can be deactivated at any time by running deactivate command.

   Remember to activate the virtual environment every time you start working in this directory. If you are using some modern shell like zsh, there are some powerful plugins to help you auto switch venv among workspaces. For example, zsh-autoswitch-virtualenv.

3. Install the required Python packages:

```
# Note: you can add option '--default-timeout=1000' if you meet connection issue. Or you may set a␣
↪different source using option '-i'.
# for example, in China you could try: pip3 install -r mcuxsdk/scripts/requirements.txt -i https://pypi.
↪tuna.tsinghua.edu.cn/simple
pip install -r scripts/requirements.txt
```

Explore Contents

This section helps you build basic understanding of current fundamental project content and guides you how to build and run the provided example project in whole SDK delivery.

Folder View The whole MCUXpresso SDK project, after you have done the `west init` and `west update` operations follow the guideline at *Getting Started Guide*, have below folder structure:

Folder	Description
manifests	Manifest repo, contains the manifest file to initialize and update the west workspace.
mcuxsdk	The MCUXpresso SDK source code, examples, middleware integration and script files.

All the projects record in the Manifest repo are checked out to the folder `mcuxsdk/`, the layout of mcuxsdk folder is shown as below:

Folder	Description
arch	Arch related files such as ARM CMSIS core files, RISC-V files and the build files related to the architecture.
cmake	The cmake modules, files which organize the build system.
components	Software components.
devices	Device support package which categorized by device series. For each device, header file, feature file, startup file and linker files are provided, also device specific drivers are included.
docs	Documentation source and build configuration for this sphinx built online documentation.
drivers	Peripheral drivers.
examples	Various demos and examples, support files on different supported boards. For each board support, there are board configuration files.
middleware	Middleware components integrated into SDK.
rtos	Rtos components integrated into SDK.
scripts	Script files for the west extension command and build system support.
svd	Svd files for devices, this is optional because of large size. Customers run `west manifest config group.filter +optional` and `west update mcux-soc-svd` to get this folder.

Examples Project The examples project is part of the whole SDK delivery, and locates in the folder `mcuxsdk/examples` of west workspace.

Examples files are placed in folder of `<example_category>`, these examples include (but are not limited to)

- demo_apps: Basic demo set to start using SDK, including hello_world and led_blinky.
- driver_examples: Simple applications that show how to use the peripheral drivers for a single use case. These applications typically only use a single peripheral but there are cases where multiple peripherals are used (for example, SPI transfer using DMA).

Board porting layers are placed in folder of _boards/<board_name> which aims at providing the board specific parts for examples code mentioned above.

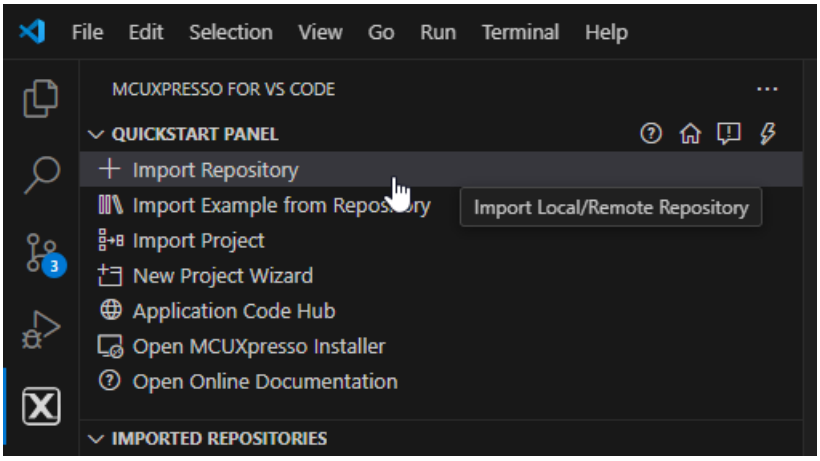
Run a demo using MCUXpresso for VS Code

This section explains how to configure MCUXpresso for VS Code to build, run, and debug example applications. This guide uses the hello_world demo application as an example. However, these steps can be applied to any example application in the MCUXpresso SDK.

Build an example application This section assumes that the user has already obtained the SDK as outlined in *Get MCUXpresso SDK Repo*.

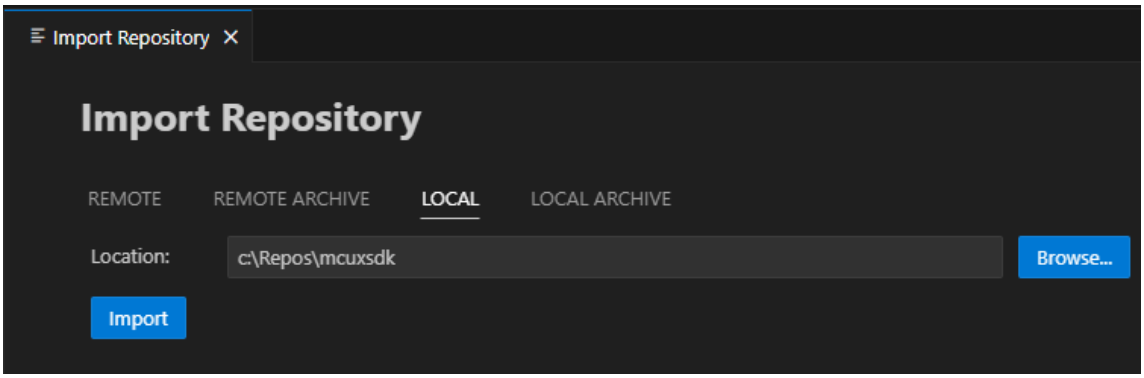
To build an example application:

1. Import the SDK into your workspace. Click **Import Repository** from the **QUICKSTART PANEL**.

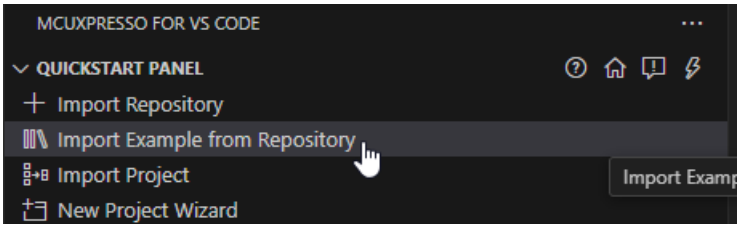


Note: You can import the SDK in several ways. Refer to MCUXpresso for VS Code Wiki for details.

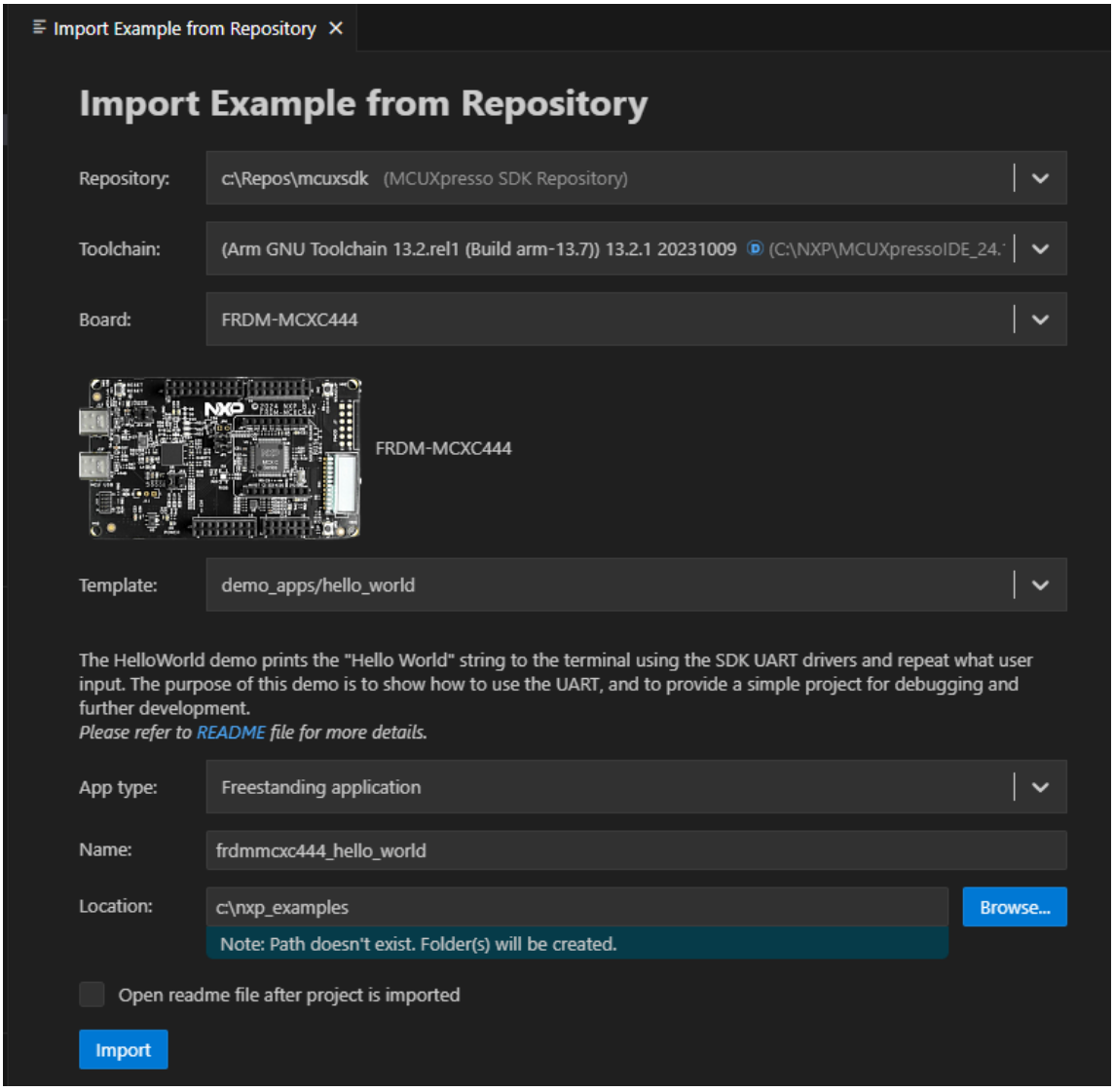
Select **Local** if you've already obtained the SDK as seen in *Get MCUXpresso SDK Repo*. Select your location and click **Import**.



2. Click **Import Example from Repository** from the **QUICKSTART PANEL**.

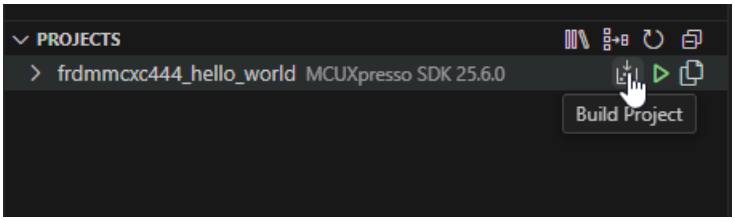


In the dropdown menu, select the MCUXpresso SDK, the Arm GNU Toolchain, your board, template, and application type. Click **Import**.

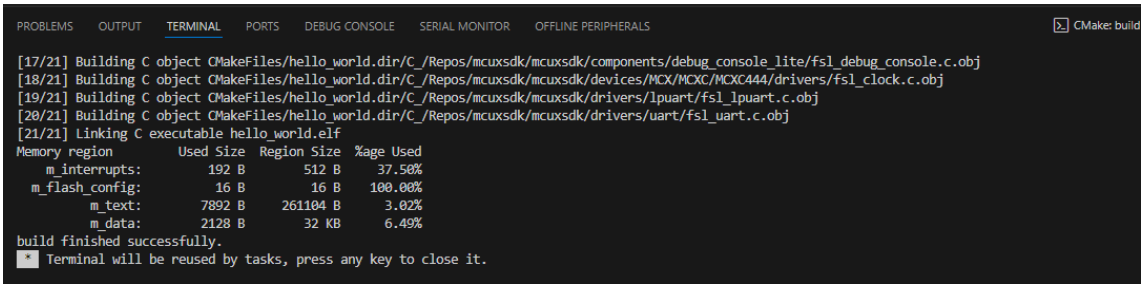


Note: The MCUXpresso SDK projects can be imported as **Repository applications** or **Free-standing applications**. The difference between the two is the import location. Projects imported as Repository examples will be located inside the MCUXpresso SDK, whereas Free-standing examples can be imported to a user-defined location. Select between these by designating your selection in the **App type** dropdown menu.

3. VS Code will prompt you to confirm if the imported files are trusted. Click **Yes**.
4. Navigate to the **PROJECTS** view. Find your project and click the **Build Project** icon.

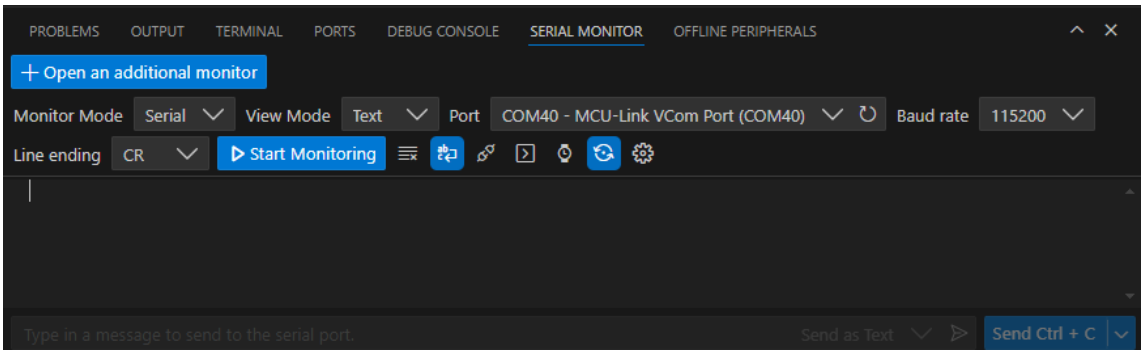


The integrated terminal will open at the bottom and will display the build output.

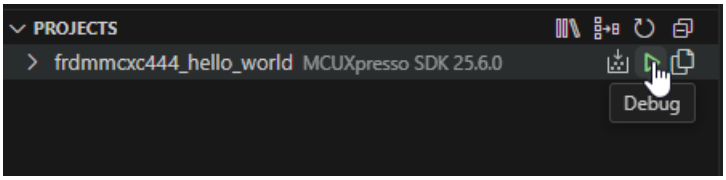


Run an example application **Note:** for full details on MCUXpresso for VS Code debug probe support, see MCUXpresso for VS Code Wiki.

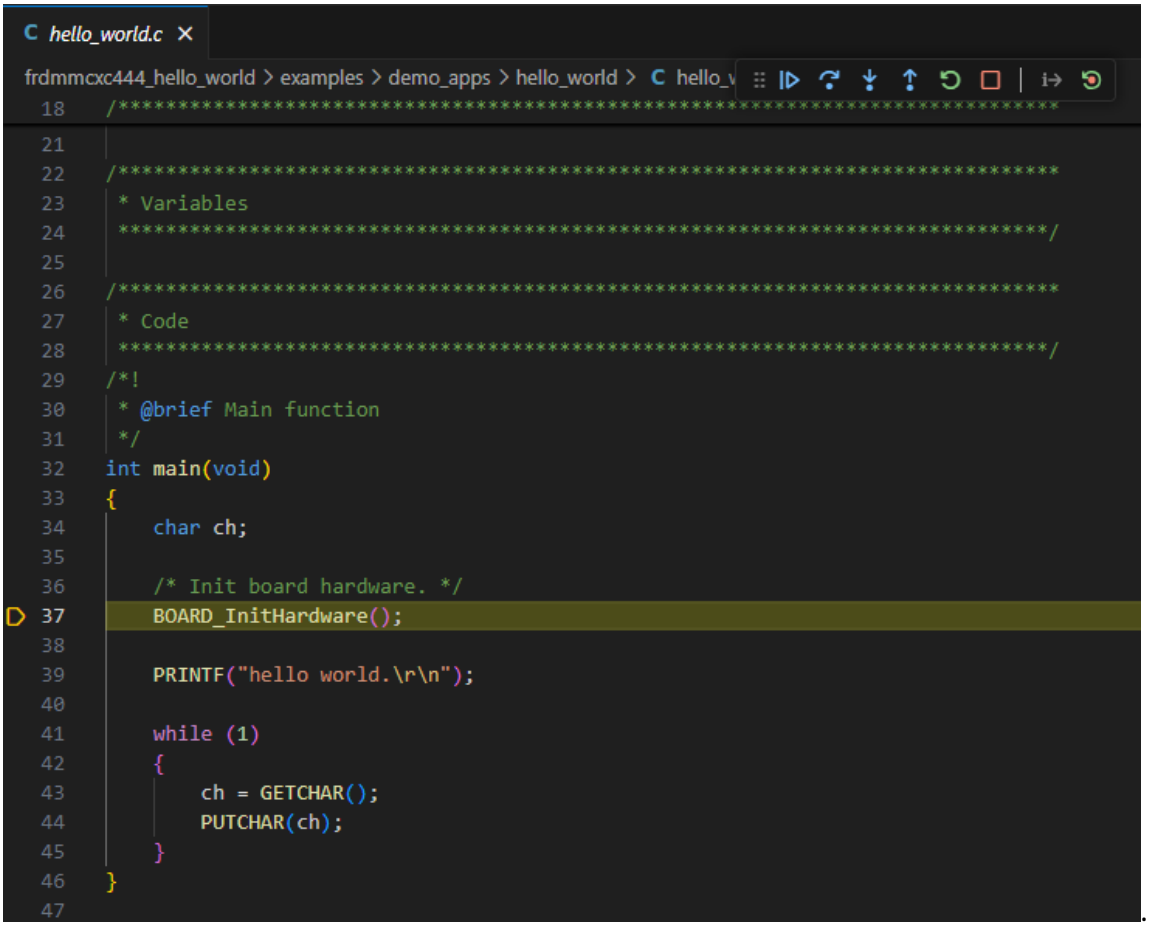
1. Open the **Serial Monitor** from the VS Code's integrated terminal. Select the VCom Port for your device and set the baud rate to 115200.



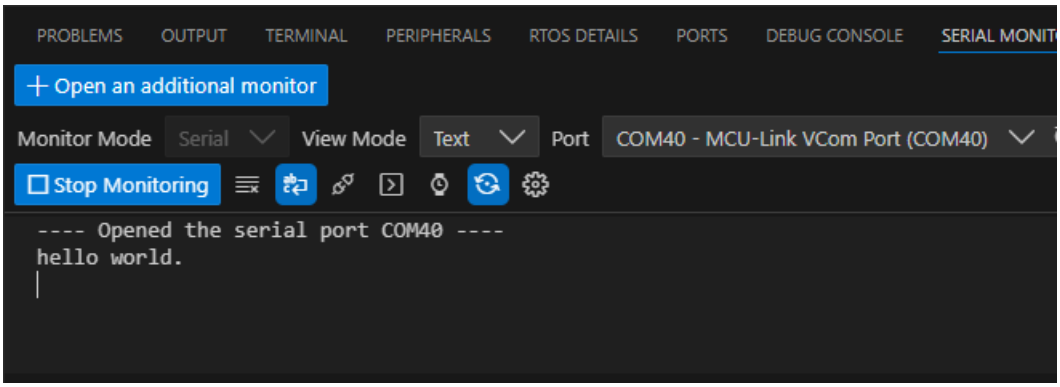
2. Navigate to the **PROJECTS** view and click the play button to initiate a debug session.



The debug session will begin. The debug controls are initially at the top.



3. Click **Continue** on the debug controls to resume execution of the code. Observe the output on the **Serial Monitor**.



Running a demo using ARMGCC CLI/IAR/MDK

Supported Boards Use the west extension `west list_project` to understand the board support scope for a specified example. All supported build command will be listed in output:

```
west list_project -p examples/demo_apps/hello_world [-t armgcc]

INFO: [  1][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
↪evk9mimx8ulp -Dcore_id=cm33]
INFO: [  2][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
↪evkbimxrt1050]
INFO: [  3][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
```

(continues on next page)

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```
↪evkbmimxrt1060]
INFO: [  4][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
↪evkbmimxrt1170 -Dcore_id=cm4]
INFO: [  5][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
↪evkbmimxrt1170 -Dcore_id=cm7]
INFO: [  6][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
↪evkcmimxrt1060]
INFO: [  7][west build -p always examples/demo_apps/hello_world --toolchain armgcc --config release -b␣
↪evkmcimx7ulp]
...
```

The supported toolchains and build targets for an example are decided by the example-self example.yml and board example.yml, please refer Example Toolchains and Targets for more details.

Build the project Use west build -h to see help information for west build command. Compared to zephyr's west build, MCUXpresso SDK's west build command provides following additional options for mcux examples:

- --toolchain: specify the toolchain for this build, default armgcc.
- --config: value for CMAKE_BUILD_TYPE. If not provided, build system will get all the example supported build targets and use the first debug target as the default one. Please refer Example Toolchains and Targets for more details about example supported build targets.

Here are some typical usages for generating a SDK example:

```
# Generate example with default settings, default used device is the mainset MK22F51212
west build -b frdmk22f examples/demo_apps/hello_world

# Just print cmake commands, do not execute it
west build -b frdmk22f examples/demo_apps/hello_world --dry-run

# Generate example with other toolchain like iar, default armgcc
west build -b frdmk22f examples/demo_apps/hello_world --toolchain iar

# Generate example with other config type
west build -b frdmk22f examples/demo_apps/hello_world --config release

# Generate example with other devices with --device
west build -b frdmk22f examples/demo_apps/hello_world --device MK22F12810 --config release
```

For multicore devices, you shall specify the corresponding core id by passing the command line argument -Dcore_id. For example

```
west build -b evkbmimxrt1170 examples/demo_apps/hello_world --toolchain iar -Dcore_id=cm7 --config␣
↪flexspi_nor_debug
```

For shield, please use the --shield to specify the shield to run, like

```
west build -b mimxrt700evk --shield a8974 examples/issdk_examples/sensors/fxls8974cf/fxls8974cf_poll -
↪Dcore_id=cm33_core0
```

Sysbuild(System build) To support multicore project building, we ported Sysbuild from Zephyr. It supports combine multiple projects for compilation. You can build all projects by adding --sysbuild for main application. For example:

```
west build -b evkbmimxrt1170 --sysbuild ./examples/multicore_examples/hello_world/primary -Dcore_
↪id=cm7  --config flexspi_nor_debug --toolchain=armgcc -p always
```

For more details, please refer to System build.

Config a Project Example in MCUXpresso SDK is configured and tested with pre-defined configuration. You can follow steps blow to change the configuration.

1. Run cmake configuration

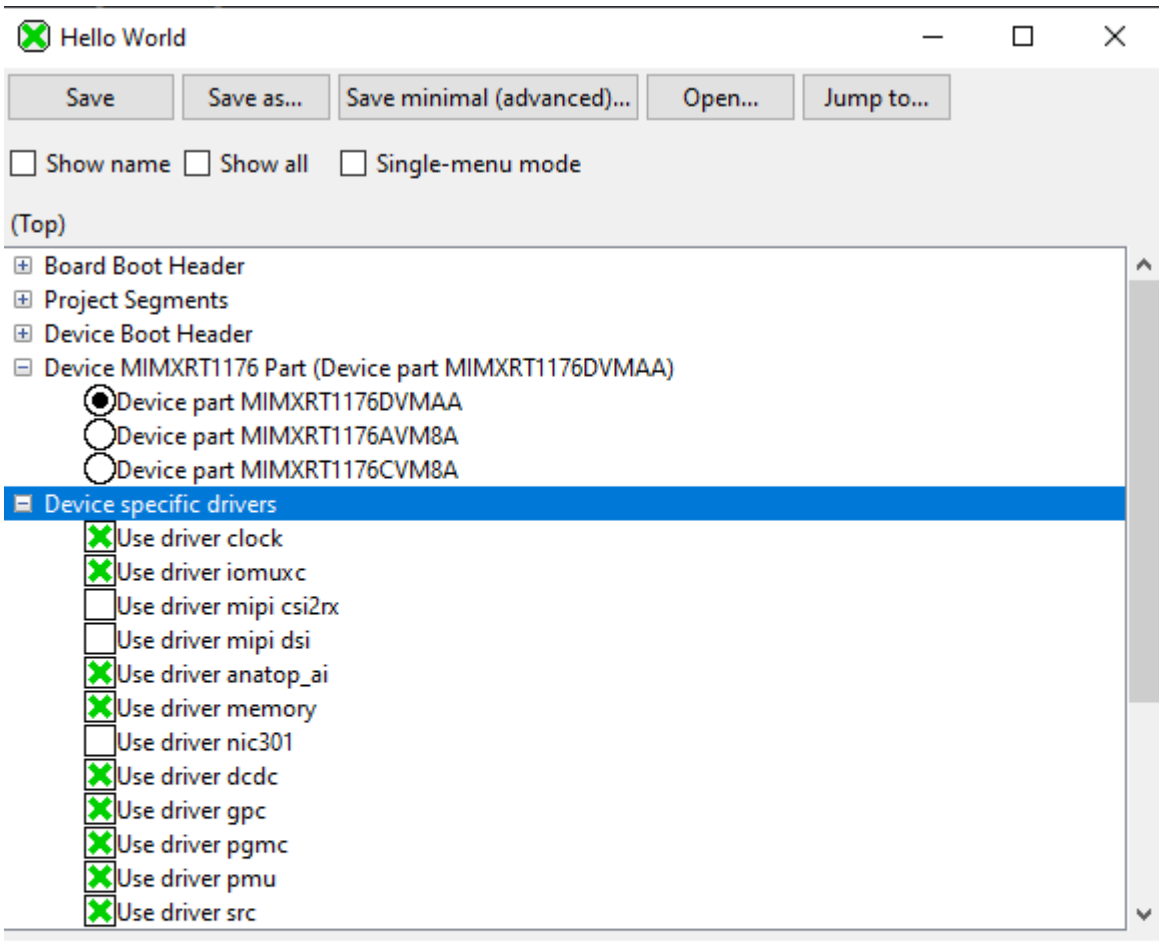
```
west build -b evkbmimxrt1170 examples/demo_apps/hello_world -Dcore_id=cm7 --cmake-only -p
```

Please note the project will be built without `--cmake-only` parameter.

2. Run guiconfig target

```
west build -t guiconfig
```

Then you will get the Kconfig GUI launched, like




```
Kconfig definition, with parent deps. propagated to 'depends on'
===============================================================

At D:/sdk_next/mcuxsdk\devices\../devices/RT/RT1170/MIMXRT1176\drivers/Kconfig:5
Included via D:/sdk_next/mcuxsdk/examples/demo_apps/hello_world/Kconfig:6 ->
D:/sdk_next/mcuxsdk/Kconfig.mcuxpresso:9 -> D:/sdk_next/mcuxsdk\devices/Kconfig:1
-> D:/sdk_next/mcuxsdk\devices\../devices/RT/RT1170/MIMXRT1176/Kconfig:8
Menu path: (Top)

menu "Device specific drivers"
```

You can reconfigure the project by selecting/deselecting Kconfig options.

After saving and closing the Kconfig GUI, you can directly run `west build` to build with the new configuration.

Flash ***Note***: Please refer Flash and Debug The Example to enable west flash/debug support.

Flash the hello_world example:

```
west flash -r linkserver
```

Debug Start a gdb interface by following command:

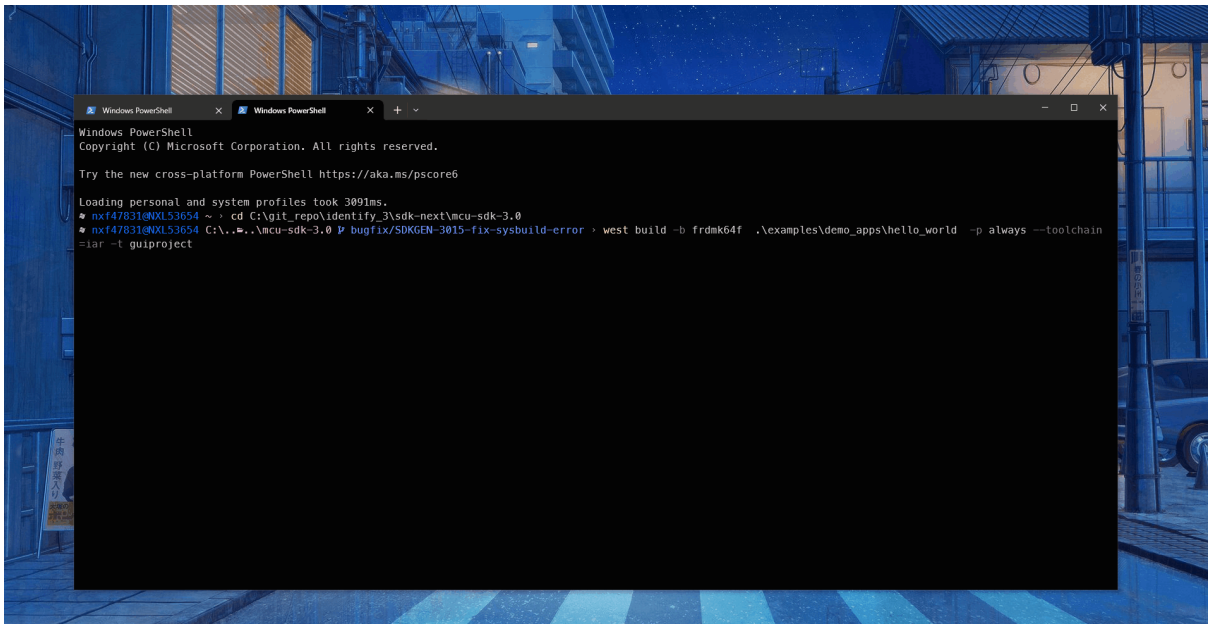
```
west debug -r linkserver
```

Work with IDE Project The above build functionalities are all with CLI. If you want to use the toolchain IDE to work to enjoy the better user experience especially for debugging or you are already used to develop with IDEs like IAR, MDK, Xtensa and CodeWarrior in the embedded world, you can play with our IDE project generation functionality.

This is the cmd to generate the evkbmimxrt1170 hello_world IAR IDE project files.

```
west build -b evkbmimxrt1170 examples/demo_apps/hello_world --toolchain iar -Dcore_id=cm7 --config␣
↪flexspi_nor_debug -p always -t guiproject
```

By default, the IDE project files are generated in mcuxsdk/build/<toolchain> folder, you can open the project file with the IDE tool to work:



Note, please follow the *Installation* to setup the environment especially make sure that *ruby* has been installed.

1.4 Release Notes

1.4.1 MCUXpresso SDK Release Notes

Overview

The MCUXpresso SDK is a comprehensive software enablement package designed to simplify and accelerate application development with Arm Cortex-M-based devices from NXP, including its general purpose, crossover and Bluetooth-enabled MCUs. MCUXpresso SW and Tools for DSC

further extends the SDK support to current 32-bit Digital Signal Controllers. The MCUXpresso SDK includes production-grade software with integrated RTOS (optional), integrated enabling software technologies (stacks and middleware), reference software, and more.

In addition to working seamlessly with the MCUXpresso IDE, the MCUXpresso SDK also supports and provides example projects for various toolchains. The Development tools chapter in the associated Release Notes provides details about toolchain support for your board. Support for the MCUXpresso Config Tools allows easy cloning of existing SDK examples and demos, allowing users to leverage the existing software examples provided by the SDK for their own projects.

Underscoring our commitment to high quality, the MCUXpresso SDK is MISRA compliant and checked with Coverity static analysis tools. For details on MCUXpresso SDK, see MCUXpresso-SDK: Software Development Kit for MCUXpresso.

MCUXpresso SDK

As part of the MCUXpresso software and tools, MCUXpresso SDK is the evolution of Kinetis SDK, includes support for LPC, DSC,PN76, and i.MX System-on-Chip (SoC). The same drivers, APIs, and middleware are still available with support for Kinetis, LPC, DSC, and i.MX silicon. The MCUXpresso SDK adds support for the MCUXpresso IDE, an Eclipse-based toolchain that works with all MCUXpresso SDKs. Easily import your SDK into the new toolchain to access to all of the available components, examples, and demos for your target silicon. In addition to the MCUXpresso IDE, support for the MCUXpresso Config Tools allows easy cloning of existing SDK examples and demos, allowing users to leverage the existing software examples provided by the SDK for their own projects.

In order to maintain compatibility with legacy Freescale code, the filenames and source code in MCUXpresso SDK containing the legacy Freescale prefix FSL has been left as is. The FSL prefix has been redefined as the NXP Foundation Software Library.

Development tools

The MCUXpresso SDK was tested with following development tools. Same versions or above are recommended.

- IAR Embedded Workbench for Arm, version is 9.60.4
- MCUXpresso for VS Code v25.06
- GCC Arm Embedded Toolchain 14.2.x

Supported development system

This release supports board and devices listed in following table. The board and devices in bold were tested in this release.

Development boards	MCU devices			
IMX95LPD5EVK-19	MIMX9596AVTXN, MIMX9596CVYXN, MIMX9596DVZXN, MIMX9596DVYXQ	MIMX9596AVYXN, MIMX9596CVZXN, MIMX9596XVTXN,	**MIMX9596AVZXN**, MIMX9596DVTXN, MIMX9596XVYXN,	MIMX9596CVTXN, MIMX9596DVYXN, MIMX9596XVZXN,

MCUXpresso SDK release package

The MCUXpresso SDK release package content is aligned with the silicon subfamily it supports. This includes the boards, CMSIS, devices, middleware, and RTOS support.

Device support The device folder contains the whole software enablement available for the specific System-on-Chip (SoC) subfamily. This folder includes clock-specific implementation, device register header files, device register feature header files, and the system configuration source files. Included with the standard SoC support are folders containing peripheral drivers, toolchain support, and a standard debug console. The device-specific header files provide a direct access to the microcontroller peripheral registers. The device header file provides an overall SoC memory mapped register definition. The folder also includes the feature header file for each peripheral on the microcontroller. The toolchain folder contains the startup code and linker files for each supported toolchain. The startup code efficiently transfers the code execution to the main() function.

Board support The boards folder provides the board-specific demo applications, driver examples, and middleware examples.

Demo application and other examples The demo applications demonstrate the usage of the peripheral drivers to achieve a system level solution. Each demo application contains a readme file that describes the operation of the demo and required setup steps. The driver examples demonstrate the capabilities of the peripheral drivers. Each example implements a common use case to help demonstrate the driver functionality.

RTOS

FreeRTOS Real-time operating system for microcontrollers from Amazon

Middleware

CMSIS DSP Library The MCUXpresso SDK is shipped with the standard CMSIS development pack, including the prebuilt libraries.

VoiceSpot VoiceSpot is a highly accurate, small memory and MIPS profile wake word engine supporting custom voice trigger words and phrases. MCUXpresso SDK version of VoiceSpot is trained to “Hey NXP” wake word only and has 25 hour trial timeout.

Voice Seeker (no AEC) VoiceSeeker is a multi-microphone voice control audio front-end signal processing solution. VoiceSeeker is not featuring acoustic echo cancellation (AEC).

USB Type-C PD Stack See the *MCUXpresso SDK USB Type-C PD Stack User’s Guide* (document MCUXSDKUSBPDUG) for more information

USB Host, Device, OTG Stack See the MCUXpresso SDK USB Stack User’s Guide (document MCUXSDKUSBSUG) for more information.

TinyCBOR Concise Binary Object Representation (CBOR) Library

PKCS#11 The PKCS#11 standard specifies an application programming interface (API), called "Cryptoki," for devices that hold cryptographic information and perform cryptographic functions. Cryptoki follows a simple object based approach, addressing the goals of technology independence (any kind of device) and resource sharing (multiple applications accessing multiple devices), presenting to applications a common, logical view of the device called a "cryptographic token".

Multicore Multicore Software Development Kit

lwIP The lwIP TCP/IP stack is pre-integrated with MCUXpresso SDK and runs on top of the MCUXpresso SDK Ethernet driver with Ethernet-capable devices/boards.

For details, see the *lwIP TCPIP Stack and MCUXpresso SDK Integration User's Guide* (document MCUXSDKLWIPUG).

lwIP is a small independent implementation of the TCP/IP protocol suite.

llhttp HTTP parser llhttp

Release contents

Provides an overview of the MCUXpresso SDK release package contents and locations.

Deliverable	Location
Boards	INSTALL_DIR/boards
Demo Applications	INSTALL_DIR/boards/<board_name>/demo_apps
Driver Examples	INSTALL_DIR/boards/<board_name>/driver_examples
eIQ examples	INSTALL_DIR/boards/<board_name>/eiq_examples
Board Project Template for MCUXpresso IDE NPW	INSTALL_DIR/boards/<board_name>/project_template
Driver, SoC header files, extension header files and feature header files, utilities	INSTALL_DIR/devices/<device_name>
CMSIS drivers	INSTALL_DIR/devices/<device_name>/cmsis_drivers
Peripheral drivers	INSTALL_DIR/devices/<device_name>/drivers
Toolchain linker files and startup code	INSTALL_DIR/devices/<device_name>/<toolchain_nam
Utilities such as debug console	INSTALL_DIR/devices/<device_name>/utilities
Device Project Template for MCUXpresso IDE NPW	INSTALL_DIR/devices/<device_name>/project_templat
CMSIS Arm Cortex-M header files, DSP library source	INSTALL_DIR/CMSIS
Components and board device drivers	INSTALL_DIR/components
RTOS	INSTALL_DIR/rtos
Release Notes, Getting Started Document and other documents	INSTALL_DIR/docs
Tools such as shared cmake files	INSTALL_DIR/tools
Middleware	INSTALL_DIR/middleware

Known Issues

This section lists the known issues, limitations, and/or workarounds.

SEGGER J-Link debugger usage problem

When an M core software is already running, it is possible to get HardFault or data verification issue during loading image into TCM by debugger.

The following steps are recommended to use the J-Link debugger.

1. Configure switch SW5 to M core boot; low-power boot. Ensure that there is no image on the boot source.
2. Power the board and start the debugger for use.
3. To restart the debugger, stop the debugger, power off the board, and repeat step #2.

1.5 ChangeLog

1.5.1 MCUXpresso SDK Changelog

Board Support Files

board

[25.06.00]

- Initial version

clock_config

[25.06.00]

- Initial version

pin_mux

[25.06.00]

- Initial version

1.6 Driver API Reference Manual

This section provides a link to the Driver API RM, detailing available drivers and their usage to help you integrate hardware efficiently.

MIMX9596

1.7 Middleware Documentation

Find links to detailed middleware documentation for key components. While not all onboard middleware is covered, this serves as a useful reference for configuration and development.

1.7.1 Multicore

Multicore SDK

1.7.2 FreeRTOS

FreeRTOS

1.7.3 lwIP

lwIP

Chapter 2

MIMX9596

2.1 CACHE: ARMV7-M7 CACHE Memory Controller

static inline void L1CACHE_EnableICache(void)
Enables cortex-m7 L1 instruction cache.

static inline void L1CACHE_DisableICache(void)
Disables cortex-m7 L1 instruction cache.

static inline void L1CACHE_InvalidateICache(void)
Invalidate cortex-m7 L1 instruction cache.

void L1CACHE_InvalidateICacheByRange(uint32_t address, uint32_t size_byte)
Invalidate cortex-m7 L1 instruction cache by range.

Note: The start address and size_byte should be 32-byte(FSL_FEATURE_L1ICACHE_LINESIZE_BYTE) aligned. The startAddr here will be forced to align to L1 I-cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The start address of the memory to be invalidated.
- size_byte – The memory size.

static inline void L1CACHE_EnableDCache(void)
Enables cortex-m7 L1 data cache.

static inline void L1CACHE_DisableDCache(void)
Disables cortex-m7 L1 data cache.

static inline void L1CACHE_InvalidateDCache(void)
Invalidates cortex-m7 L1 data cache.

static inline void L1CACHE_CleanDCache(void)
Cleans cortex-m7 L1 data cache.

static inline void L1CACHE_CleanInvalidateDCache(void)
Cleans and Invalidates cortex-m7 L1 data cache.

static inline void L1CACHE_InvalidateDCacheByRange(uint32_t address, uint32_t size_byte)

Invalidates cortex-m7 L1 data cache by range.

Note: The start address and size_byte should be 32-byte(FSL_FEATURE_L1DCACHE_LINESIZE_BYTE) aligned. The startAddr here will be forced to align to L1 D-cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The start address of the memory to be invalidated.
- size_byte – The memory size.

static inline void L1CACHE_CleanDCacheByRange(uint32_t address, uint32_t size_byte)

Cleans cortex-m7 L1 data cache by range.

Note: The start address and size_byte should be 32-byte(FSL_FEATURE_L1DCACHE_LINESIZE_BYTE) aligned. The startAddr here will be forced to align to L1 D-cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The start address of the memory to be cleaned.
- size_byte – The memory size.

static inline void L1CACHE_CleanInvalidateDCacheByRange(uint32_t address, uint32_t size_byte)

Cleans and Invalidates cortex-m7 L1 data cache by range.

Note: The start address and size_byte should be 32-byte(FSL_FEATURE_L1DCACHE_LINESIZE_BYTE) aligned. The startAddr here will be forced to align to L1 D-cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The start address of the memory to be clean and invalidated.
- size_byte – The memory size.

void ICACHE_InvalidateByRange(uint32_t address, uint32_t size_byte)

Invalidates all instruction caches by range.

Both cortex-m7 L1 cache line and L2 PL310 cache line length is 32-byte.

Note: address and size should be aligned to cache line size 32-Byte due to the cache operation unit is one cache line. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be invalidated.

void DCACHE_InvalidateByRange(uint32_t address, uint32_t size_byte)

Invalidates all data caches by range.

Both cortex-m7 L1 cache line and L2 PL310 cache line length is 32-byte.

Note: address and size should be aligned to cache line size 32-Byte due to the cache operation unit is one cache line. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be invalidated.

void DCACHE_CleanByRange(uint32_t address, uint32_t size_byte)

Cleans all data caches by range.

Both cortex-m7 L1 cache line and L2 PL310 cache line length is 32-byte.

Note: address and size should be aligned to cache line size 32-Byte due to the cache operation unit is one cache line. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be cleaned.

void DCACHE_CleanInvalidateByRange(uint32_t address, uint32_t size_byte)

Cleans and Invalidates all data caches by range.

Both cortex-m7 L1 cache line and L2 PL310 cache line length is 32-byte.

Note: address and size should be aligned to cache line size 32-Byte due to the cache operation unit is one cache line. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be cleaned and invalidated.

FSL_CACHE_DRIVER_VERSION

cache driver version 2.0.4.

2.2 CAMERA MIX CSR: Camera Domain Block Control

uint32_t CAMERACSR_GetPixelDataIndex(*csi2rx_payload_t* datatype)

Get CAMERA CSR Pixel Data type index. This function get pinxe index by data type.

Parameters

- camera_csr – BLK_CTRL_CAMERAMIX module peripheral address.

void CAMERACSR_PixelFormatting(BLK_CTRL_CAMERAMIX_Type *camera_csr, *camera_csr_pixel_formatting_config_t* *config)

introduce function CAMERACSR_PixelFormatting. This function control the data process channel from CSI host to ISI pixel link module.

Parameters

- camera_csr – BLK_CTRL_CAMERAMIX module peripheral address.
- config – pixel link module camera_csr formatting configuration structure.

FSL_Camera_Csr_DRIVER_VERSION

Camera Csr driver version.

typedef struct *_camera_csr_pixel_formatting_config* camera_csr_pixel_formatting_config_t

CAMERA CSR configuration.

typedef struct *pixel_link_transfer_pixel_data* pixel_link_transfer_pixel_data_t

bool enablePixelDataRoute

whether enable pixel data route to a new channel.

bool enableNonPixelDataRoute

whether enable non-pixel data route to a new channel.

bool enableRAW32

whether enable RAW32 mode for specific channel which up to 4 pixels per clock cycle can be transported.

csi2rx_payload_t PixelDataType

transport pixel data type.

uint32_t NonPixelDataType

transport non-pixel data type.

uint8_t PixelDataNewVc

new virtual channel on which the pixel data are transported.

uint8_t NonPixelDataNewVc

new virtual channel on which the non pixel data are transported.

uint32_t mipiVc

virtual channel from csi host idi interface.

uint8_t csiinterface

csi ininterface number

csi2rx_payload_t datatype

uint8_t index

struct _camera_csr_pixel_formatting_config

#include <fsl_camera_csr.h> CAMERA CSR configuration.

struct pixel_link_transfer_pixel_data

#include <fsl_camera_csr.h>

2.3 Clock Driver

2.4 Csi2rx

enum _csi2rx_data_lane

CSI2RX data lanes.

Values:

enumerator kCSI2RX_DataLane0

Data lane 0.

enumerator kCSI2RX_DataLane1

Data lane 1.

enumerator kCSI2RX_DataLane2

Data lane 2.

enumerator kCSI2RX_DataLane3

Data lane 3.

enum _csi2rx_payload

CSI2RX payload type.

Values:

enumerator kCSI2RX_DataTypeFS

Frame Start.

enumerator kCSI2RX_DataTypeFE

Frame End.

enumerator kCSI2RX_DataTypeLS

Line Start.

enumerator kCSI2RX_DataTypeLE

Line End.

enumerator kCSI2RX_DataTypeEOT

End of transmission.

enumerator kCSI2RX_DataTypeGeneric1

Data type generic short 1.

enumerator kCSI2RX_DataTypeGeneric2

Data type generic short 2.

enumerator kCSI2RX_DataTypeGeneric3

Data type generic short 3.

enumerator kCSI2RX_DataTypeGeneric4

Data type generic short 4.

enumerator kCSI2RX_DataTypeGeneric5

Data type generic short 5.

enumerator kCSI2RX_DataTypeGeneric6

Data type generic short 6.

enumerator kCSI2RX_DataTypeGeneric7

Data type generic short 7.

enumerator kCSI2RX_DataTypeGeneric8
Data type generic short 8.

enumerator kCSI2RX_DataTypeNULL
NULL.

enumerator kCSI2RX_DataTypeBlanking
Blanking.

enumerator kCSI2RX_DataTypeEmbedded
Embedded.

enumerator kCSI2RX_DataTypeYUV420_8Bit
YUV420 8 bit.

enumerator kCSI2RX_DataTypeYUV420_10Bit
YUV420 10 bit.

enumerator kCSI2RX_DataTypeYUV420_8BitLegacy
Legacy YUV420 8 bit.

enumerator kCSI2RX_DataTypeYUV420_8BitCS
YUV420 8 bit CS.

enumerator kCSI2RX_DataTypeYUV420_10BitCS
YUV420 10 bit CS.

enumerator kCSI2RX_DataTypeYUV422_8Bit
YUV422 8 bit.

enumerator kCSI2RX_DataTypeYUV422_10Bit
YUV422 10 bit.

enumerator kCSI2RX_DataTypeRGB444
RGB444.

enumerator kCSI2RX_DataTypeRGB555
RGB555.

enumerator kCSI2RX_DataTypeRGB565
RGB565.

enumerator kCSI2RX_DataTypeRGB666
RGB666.

enumerator kCSI2RX_DataTypeRGB888
RGB888.

enumerator kCSI2RX_DataTypeRAW28
RAW28.

enumerator kCSI2RX_DataTypeRAW24
RAW24.

enumerator kCSI2RX_DataTypeRAW6
RAW6.

enumerator kCSI2RX_DataTypeRAW7
RAW7.

enumerator kCSI2RX_DataTypeRAW8
RAW8.

enumerator kCSI2RX_DataTypeRAW10
RAW10.

enumerator kCSI2RX_DataTypeRAW12
RAW12.

enumerator kCSI2RX_DataTypeRAW14
RAW14.

enumerator kCSI2RX_DataTypeRAW16
RAW16.

enumerator kCSI2RX_DataTypeRAW20
RAW20.

enumerator kCSI2RX_DataTypeUserDefined1
User defined 8-bit data type 1.

enumerator kCSI2RX_DataTypeUserDefined2
User defined 8-bit data type 2.

enumerator kCSI2RX_DataTypeUserDefined3
User defined 8-bit data type 3.

enumerator kCSI2RX_DataTypeUserDefined4
User defined 8-bit data type 4.

enumerator kCSI2RX_DataTypeUserDefined5
User defined 8-bit data type 5.

enumerator kCSI2RX_DataTypeUserDefined6
User defined 8-bit data type 6.

enumerator kCSI2RX_DataTypeUserDefined7
User defined 8-bit data type 7.

enumerator kCSI2RX_DataTypeUserDefined8
User defined 8-bit data type 8.

enum _csi2rx_bit_error
MIPI CSI2RX bit errors.

Values:

enumerator kCSI2RX_BitErrorEccTwoBit
ECC two bit error has occurred.

enumerator kCSI2RX_BitErrorEccOneBit
ECC one bit error has occurred.

enum _csi2rx_ppi_error
MIPI CSI2RX PPI error types.

Values:

enumerator kCSI2RX_PpiErrorSotHs
CSI2RX DPHY PPI error ErrSotHS.

enumerator kCSI2RX_PpiErrorSotSyncHs
CSI2RX DPHY PPI error ErrSotSync_HS.

enumerator kCSI2RX_PpiErrorEsc
CSI2RX DPHY PPI error ErrEsc.

enumerator kCSI2RX_PpiErrorSyncEsc
CSI2RX DPHY PPI error ErrSyncEsc.

enumerator kCSI2RX_PpiErrorControl
CSI2RX DPHY PPI error ErrControl.

enum _csi2rx_interrupt
MIPI CSI2RX interrupt.

Values:

enumerator kCSI2RX_InterruptphyFatal

enumerator kCSI2RX_InterruptPktFatal

enumerator kCSI2RX_InterruptBndryFrameFatal

enumerator kCSI2RX_InterruptSeqFrameFatal

enumerator kCSI2RX_InterruptCrcFrameFatal

enumerator kCSI2RX_InterruptDataId

enumerator kCSI2RX_InterruptEccCorrected

enumerator kCSI2RX_InterruptStPhy

enumerator kCSI2RX_InterruptStline

typedef enum *_csi2rx_payload* csi2rx_payload_t
CSI2RX payload type.

typedef struct *_pg_pattern_config* pg_pattern_config_t
CSI2RX pattern injection configuration.

typedef struct *_csi2rx_config* csi2rx_config_t
CSI2RX configuration.

typedef enum *_csi2rx_ppi_error* csi2rx_ppi_error_t
MIPI CSI2RX PPI error types.

uint32_t CSI2RX_GetInstance(CAMERA_MIPI_CSI2_Type *base)
Get the CSI instance from peripheral base address.

Parameters

- base – CSI peripheral base address.

Returns
CSI instance.

void MIPI_CSI2RX_Startup(CAMERA_MIPI_CSI2_Type *base)
introduce function MIPI_CSI2RX_Startup. This function start up the CSI host controller.

Parameters

- base – CSI2RX peripheral address.

status_t MIPI_CSI2RX_InitInterface(CAMERA_MIPI_CSI2_Type *base,
CAMERA_DSI_OR_CSI_PHY_CSR_Type *phybase,
csi2rx_config_t *config)
introduce function MIPI_CSI2RX_InitInterface. This function deal with CSI and PHY initialization.

Parameters

- base – CSI2RX peripheral address.

- phybase – PHY module periperal address.
- config – CSI2RX module configuration structure.

status_t MIPI_CSI2RX_Init(CAMERA_MIPI_CSI2_Type *base, CAMERA_DSI_OR_CSI_PHY_CSR_Type *phybase, *csi2rx_config_t* *config)

introduce function MIPI_CSI2RX_Init. The CSI host interface is basically configured and ready to receive sensor data after this function.

Parameters

- base – CSI2RX peripheral address.
- phybase – PHY module periperal address.
- config – CSI2RX module configuration structure.

void CSI2RX_Deinit(CAMERA_MIPI_CSI2_Type *base)

introduce function CSI2RX_Deinit. This function disables the CSI2 host and PHY module.

Parameters

- base – CSI2RX peripheral address.

FSL_CSI2RX_DRIVER_VERSION

CSI2RX driver version.

uint32_t pattern_vertical

Number of pattern vertical size.

uint32_t pattern_horizontal

Number of pattern horizontal size.

uint8_t pattern_data_type

Number of sent pattern data type.

uint32_t pattern_format

Number of pattern format.

uint32_t laneNum

Number of active lanes used for receiving data.

uint32_t vcnum

Number of used CSI host interface vittual channel.

csi2rx_payload_t datatype

Number of csi host channel received data type from sonsor.

bool pg_enable

Whether enable CSI host pattern generator, CSI will halt camera received data if enable it. Default disabled

pg_pattern_config_t pg_pattern

Number of active lanes used for receiving data.

uint32_t cfgclkfreqrange

Number of DPHY clock frequency.

uint32_t hsfreqrange

Number of DPHY frequency range, a lane operation range from 8Mbps to ?.

struct _pg_pattern_config

#include <fsl_dwc_mipi_csi2rx.h> CSI2RX pattern injection configuration.

struct _csi2rx_config

#include <fsl_dwc_mipi_csi2rx.h> CSI2RX configuration.

2.5 Dpu

void DPU_Init(DISPLAY_SEERIS_Type *base)

Initializes the DPU peripheral.

This function ungates the DPU clock.

Parameters

- base – DPU peripheral base address.

void DPU_Deinit(DISPLAY_SEERIS_Type *base)

Deinitializes the DPU peripheral.

This function gates the DPU clock.

Parameters

- base – DPU peripheral base address.

void DPU_PreparePathConfig(DISPLAY_SEERIS_Type *base)

Prepare the unit path configuration.

The DPU has a default path configuration. Before changing the configuration, this function could be used to break all the original path. This make sure one pixel engine unit is not used in multiple pipelines.

Parameters

- base – DPU peripheral base address.

void DPU_EnableInterrupts(DISPLAY_SEERIS_Type *base, uint8_t group, uint32_t mask)

brief Enable the selected DPU interrupts.

For example, to enable Store9 shadow load interrupt and Store9 frame complete interrupt, use like this:

code DPU_EnableInterrupts(DPU, 0, kDPU_Group0Store9ShadowLoadInterrupt | kDPU_Group0Store9FrameCompleteInterrupt); endcode

param base DPU peripheral base address. param group Interrupt group index. param mask The interrupts to enable, this is a logical OR of members in ref _dpu_interrupt. note Only the members in the same group could be OR'ed, at the same time, the parameter p group should be passed in correctly.

status_t DPU_EnableShadowLoad(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, bool enable)

Enable or disable the register shadowing for the DPU process units.

For example, to enable the shadowing of all RWS registers of the pipeline with endpoint Store9.

```
DPU_EnableShadowLoad(DPU, kDPU_PipelineStore9, true);
```

Parameters

- base – DPU peripheral base address.
- unit – The unit whose shadow load to enable or disable, see dpu_unit_t.
- enable – True to enable, false to disable.

Return values

- kStatus_Success – The shadow load is enabled or disabled successfully.
- kStatus_InvalidArgument – The unit does not support shadow load.

void DPU_SetUnitSrc(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t srcReg)

Set the DPU unit input source selection.

Sets the DPU unit input source, the input source is controlled by the register <unit>_dynamic in "Pixel Engin Top Level". This function writes the register <unit>_dynamic directly, please check the reference manual for the register details. This function only changes the input source control bits in register.

Parameters

- base – DPU peripheral base address.
- unit – The DPU pipeline unit.
- srcReg – The value written to register <unit>_dynamic. Could be generated using DPU_MAKE_SRC_REG1, DPU_MAKE_SRC_REG2, and DPU_MAKE_SRC_REG3.

void DPU_InitPipeline(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

Initialize the pipeline.

Parameters

- base – DPU peripheral base address.
- unit – The DPU pipeline unit.

void DPU_DeinitPipeline(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

Deinitializes the pipeline.

Power down the pipeline and disable the shadow load feature.

Parameters

- base – DPU peripheral base address.
- unit – The DPU pipeline unit.

void DPU_TriggerPipelineShadowLoad(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

Trigger the pipeline shadow load.

This function triggers the pipeline reconfiguration.

Parameters

- base – DPU peripheral base address.
- unit – The DPU pipeline unit.

void DPU_DstBufferGetDefaultConfig(*dpu_dst_buffer_config_t* *config)

Get the default configuration for Store unit.

The default value is:

```
config->baseAddr = 0U;
config->strideBytes = 0x500U;
config->bitsPerPixel = 32U,
config->pixelFormat = kDPU_PixelFormatARGB8888;
config->bufferHeight = 0U;
config->bufferWidth = 0U;
```

Parameters

- config – Pointer to the configuration.

void DPU_InitStore(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t srcReg)

brief Initialize the Store unit.

The valid input source of the store unit could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcHScaler9
- ref kDPU_UnitSrcVScaler9
- ref kDPU_UnitSrcFilter9
- ref kDPU_UnitSrcBlitBlend9
- ref kDPU_UnitSrcFetchDecode9
- ref kDPU_UnitSrcFetchRot9

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be Store unit here. param srcReg Input source selecte register value, pixencfg_extdstX_dynamic see ref DPU_MAKE_SRC_REG1.

status_t DPU_SetStoreDstBufferConfig(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_dst_buffer_config_t* *config)

Set the Store unit Destination buffer configuration.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be Store unit here.
- config – Pointer to the configuration.

Return values

- kStatus_Success – Initialization success.
- kStatus_InvalidArgument – Wrong argument.

void DPU_StartStore(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

Start the Store unit.

This function starts the Store unit to save the frame to output buffer. When the frame store completed, the interrupt flag kDPU_Group0Store9FrameCompleteInterrupt asserts.

This is an example shows how to use Store unit:

```
Initialize the Store unit, use FetchDecode9 output as its input.
DPU_InitStore(DPU, kDPU_Store9, DPU_MAKE_SRC_REG1(kDPU_UnitSrcFetchDecode9));

Configure the Store unit output buffer.
DPU_SetStoreDstBufferConfig(DPU, kDPU_Store9, &DstBufferConfig);

Configure FetchDecode9 unit, including source buffer setting and so on.
...

Initialize the Store9 pipeline
DPU_InitPipeline(DPU, kDPU_PipelineStore9);

DPU_ClearUserInterruptsPendingFlags(DPU, kDPU_Group0Store9ShadowLoadInterrupt);

Trigger the shadow load
DPU_TriggerPipelineShadowLoad(DPU, kDPU_PipelineStore9);

DPU_ClearUserInterruptsPendingFlags(DPU, kDPU_Group0Store9FrameCompleteInterrupt);

Start the Store9 to convert and output.
DPU_StartStore(DPU, kDPU_Store9);

Wait for Store 9 completed, this could also be monitored by interrupt.
while (!(kDPU_Group0Store9FrameCompleteInterrupt & DPU_GetUserInterruptsPendingFlags(DPU,␣
```

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(continued from previous page)

```
↪0))
{
}
```

For better performance, it is allowed to set next operation while current is still in progress. Upper layer could set next operation immediately after shadow load finished.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be Store unit here.

void DPU_InitBlitBlend(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t srcReg)

brief Initialize the BlitBlend unit.

The valid input primary source could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcHScaler9
- ref kDPU_UnitSrcVScaler9
- ref kDPU_UnitSrcFilter9
- ref kDPU_UnitSrcRop9

The valid input secondary source could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcFetchDecode9
- ref kDPU_UnitSrcFetchRot9

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be BlitBlend unit here. param srcReg Unit source selection, see ref DPU_MAKE_SRC_REG2.

void DPU_EnableBlitBlend(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, bool enable)

brief Enable or disable the BlitBlend unit.

The BlitBlend unit could be runtime enabled or disabled, when disabled, the primary input is output directly.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be BlitBlend unit here. param enable Pass true to enable, false to disable.

void DPU_LayerBlendGetDefaultConfig(*dpu_layer_blend_config_t* *config)

Get default configuration structure for LayerBlend.

The default value is:

```
config->constAlpha = 0U;
config->secAlphaBlendMode = kDPU_BlendOne;
config->primAlphaBlendMode = kDPU_BlendZero;
config->secColorBlendMode = kDPU_BlendOne;
config->primColorBlendMode = kDPU_BlendZero;
config->enableAlphaMask = true;
config->alphaMaskMode = kDPU_AlphaMaskPrim;
```

Parameters

- config – Pointer to the configuration structure.

void DPU_InitLayerBlend(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t srcReg)

brief Initialize the LayerBlend.

The valid primary source:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcConstFrame0
- ref kDPU_UnitSrcConstFrame1
- ref kDPU_UnitSrcConstFrame4
- ref kDPU_UnitSrcConstFrame5

The valid secondary source:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcHScaler4
- ref kDPU_UnitSrcVScaler4
- ref kDPU_UnitSrcMatrix4
- ref kDPU_UnitSrcFetchRot9
- ref kDPU_UnitSrcFetchlayer0
- ref kDPU_UnitSrcFetchlayer1
- ref kDPU_UnitSrcFetchYuv0-3

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be LayerBlend unit here. param srcReg Unit source selection, see ref DPU_MAKE_SRC_REG2.

void DPU_SetLayerBlendConfig(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_layer_blend_config_t* *config)

Set the LayerBlend unit configuration.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be LayerBlend unit here.
- config – Pointer to the configuration structure.

void DPU_EnableLayerBlend(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, bool enable)

Enable or disable the LayerBlend unit.

If enabled, the blend result is output, otherwise, the primary input is output.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be LayerBlend unit here.
- enable – Pass true to enable, false to disable.

void DPU_InitConstFrame(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

Initialize the ConstFrame unit.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be ConstFrame unit here.

void DPU_ConstFrameGetDefaultConfig(*dpu_const_frame_config_t* *config)

Get default configuration structure for ConstFrame unit.

The default value is:

```
config->frameHeight = 320U;
config->frameWidth = 480U;
config->constColor = DPU_MAKE_CONST_COLOR(0xFF, 0xFF, 0xFF, 0xFF);
```

Parameters

- config – Pointer to the configuration structure.

void DPU_SetConstFrameConfig(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_const_frame_config_t* *config)

Set the ConstFrame unit configuration.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be ConstFrame unit here.
- config – Pointer to the configuration structure.

void DPU_InitRop(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t srcReg)

brief Initialize the ROp unit.

The primary input source of the unit could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcFetchDecode9
- ref kDPU_UnitSrcFetchRot9

The secondary input source of the unit could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcFetchEco9

The tert input source of the unit could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcFetchDecode9
- ref kDPU_UnitSrcFetchRot9

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be Rop unit here. param srcReg Unit source selection, see ref DPU_MAKE_SRC_REG3.

void DPU_RopGetDefaultConfig(*dpu_rop_config_t* *config)

brief Get the default ROp unit configuration.

The default configuration is:

code config->controlFlags = 0U; config->alphaIndex = 0U; config->blueIndex = 0U; config->greenIndex = 0U; config->redIndex = 0U; endcode param config Pointer to the configuration structure.

void DPU_SetRopConfig(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_rop_config_t* *config)

brief Set the ROp unit configuration.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be Rop unit here. param config Pointer to the configuration structure.

void DPU_EnableRop(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, bool enable)

brief Enable or disable the ROp unit.

If disabled, only the primary input is output.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be Rop unit here. param enable Pass true to enable, false to disable.

void DPU_FetchUnitGetDefaultConfig(*dpu_fetch_unit_config_t* *config)

Get the default configuration for fetch unit.

The default value is:

```
config->srcReg = 0U;
config->frameHeight = 320U;
config->frameWidth = 480U;
```

Parameters

- config – Pointer to the configuration structure.

void DPU_SrcBufferGetDefaultConfig(*dpu_src_buffer_config_t* *config)

Get default configuration structure for fetch unit source buffer.

The default value is:

```
config->baseAddr = 0U;
config->strideBytes = 0x500U;
config->bitsPerPixel = 32U;
config->pixelFormat = kDPU_PixelFormatARGB8888;
config->bufferHeight = 0U;
config->bufferWidth = 0U;
config->constColor = DPU_MAKE_CONST_COLOR(0, 0, 0, 0);
```

Parameters

- config – Pointer to the configuration structure.

void DPU_InitFetchUnit(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_fetch_unit_config_t* *config)

brief Initialize the fetch unit.

This function initializes the fetch unit for the basic use, for other use case such as arbitrary warping, use the functions ref DPU_InitFetchUnitRot and ref DPU_InitWarpCoordinates.

The input source of fetch unit could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcFetchRot9
- ref kDPU_UnitSrcFetchEco2
- ref kDPU_UnitSrcFetchEco9
- ref kDPU_UnitSrcFetchEco0
- ref kDPU_UnitSrcFetchEco1
- ref kDPU_UnitSrcFetchYuv0

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be fetch unit here. param config Pointer to the configuration structure.

status_t DPU_SetFetchUnitSrcBufferConfig(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint8_t sublayer, const *dpu_src_buffer_config_t* *config)

Set the fetch unit sublayer source buffer.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be fetch unit here.
- sublayer – Sublayer index, should be 0 to 7.
- config – Pointer to the configuration structure.

Return values

- kStatus_Success – Initialization success.
- kStatus_InvalidArgument – Wrong argument.

void DPU_SetFetchUnitOffset(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint8_t sublayer, uint16_t offsetX, uint16_t offsetY)

brief Set the fetch unit sublayer offset.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be fetch unit here. param sublayer Sublayer index, should be 0 to 7. param offsetX Horizontal offset. param offsetY Vertical offset.

void DPU_EnableFetchUnitSrcBuffer(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint8_t sublayer, bool enable)

brief Enable or disable fetch unit sublayer source buffer.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be fetch unit here. param sublayer Sublayer index, should be 0 to 7. param enable True to enable, false to disable.

void DPU_SetFetchUnitClipColor(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, *dpu_clip_color_mode_t* clipColorMode, uint8_t sublayer)

brief Set the fetch unit clip color mode.

This function selects which color to take for pixels that do not lie inside the clip window of any layer.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be fetch unit here. param clipColorMode Select null color or use sublayer color. param sublayer Select which sublayer's color to use when p clipColorMode is ref kDPU_ClipColorSublayer.

void DPU_InitExtDst(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t srcReg)

brief Initialize the ExtDst unit.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be ExtDst unit here. param srcReg Input source selecte register value, pixencfg_extdstX_dynamic see ref DPU_MAKE_SRC_REG1. The valid source:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcLayerBlend1
- ref kDPU_UnitSrcLayerBlend2
- ref kDPU_UnitSrcLayerBlend3
- ref kDPU_UnitSrcLayerBlend4
- ref kDPU_UnitSrcLayerBlend5
- ref kDPU_UnitSrcLayerBlend6

void DPU_SetStoreDstBufferAddr(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint32_t baseAddr)

brief Set the Store unit Destination buffer base address.

This function is run time used for better performance.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be Store unit here. param baseAddr Base address of the Destination buffer to set.

void DPU_DisableInterrupts(DISPLAY_SEERIS_Type *base, uint8_t group, uint32_t mask)

brief Disable the selected DPU interrupts.

For example, to disable Store9 shadow load interrupt and Store9 frame complete interrupt, use like this:

code DPU_DisableInterrupts(DPU, 0, kDPU_Group0Store9ShadowLoadInterrupt | kDPU_Group0Store9FrameCompleteInterrupt); endcode

param base DPU peripheral base address. param group Interrupt group index. param mask The interrupts to disable, this is a logical OR of members in ref _dpu_interrupt. note Only the members in the same group could be OR'ed, at the same time, the parameter p group should be passed in correctly.

uint32_t DPU_GetInterruptsPendingFlags(DISPLAY_SEERIS_Type *base, uint8_t group)

brief Get the DPU interrupts pending status.

The pending status are returned as mask.

param base DPU peripheral base address. param group Interrupt group index. return The interrupts pending status mask value, see ref _dpu_interrupt.

void DPU_ClearInterruptsPendingFlags(DISPLAY_SEERIS_Type *base, uint8_t group, uint32_t mask)

brief Clear the specified DPU interrupts pending status.

For example, to disable Store9 shadow load interrupt and Store9 frame complete interrupt pending status, use like this:

code DPU_ClearInterruptsPendingFlags(DPU, 0, kDPU_Group0Store9ShadowLoadInterrupt | kDPU_Group0Store9FrameCompleteInterrupt); endcode

param base DPU peripheral base address. param group Interrupt group index. param mask The interrupt pending flags to clear, this is a logical OR of members in ref _dpu_interrupt. note Only the members in the same group could be OR'ed, at the same time, the parameter p group should be passed in correctly.

void DPU_DisplayTimingGetDefaultConfig(*dpu_display_timing_config_t* *config)

brief Get default configuration structure for display mode.

The default value is: code config->flags = kDPU_DisplayDeActiveHigh; config->width = 320U; config->hsw = 32U; config->hfp = 8U; config->hbp = 40U; config->height = 240U; config->vsw = 4U; config->vfp = 13U; config->vbp = 6U; endcode

param config Pointer to the configuration structure.

void DPU_InitDisplayTiming(DISPLAY_SEERIS_Type *base, uint8_t displayIndex, const *dpu_display_timing_config_t* *config)

brief Initialize the display timing.

param base DPU peripheral base address. param displayIndex Index of the display. param config Pointer to the configuration structure.

void DPU_DisplayGetDefaultConfig(*dpu_display_config_t* *config)

brief Get default configuration structure for display frame mode.

The default value is: code config->enablePrimAlpha = false; config->enableSecAlpha = false; config->displayMode = kDPU_DisplayTest; config->enablePrimAlphaInPanic = false; config->enableSecAlphaInPanic = false; config->displayModeInPanic = kDPU_DisplayTest; config->constRed = 0x3FFU; config->constGreen = 0x3FFU; config->constBlue = 0x3FFU; config->constAlpha = 1U; config->primAreaStartX = 1U; config->primAreaStartY = 1U; config->secAreaStartX = 1U; config->secAreaStartY = 1U; endcode

param config Pointer to the configuration structure.

void DPU_SetDisplayConfig(DISPLAY_SEERIS_Type *base, uint8_t displayIndex, const *dpu_display_config_t* *config)

brief Set the display mode.

param base DPU peripheral base address. param displayIndex Index of the display. param config Pointer to the configuration structure.

void DPU_StartDisplay(DISPLAY_SEERIS_Type *base, uint8_t displayIndex)

brief Start the display.

param base DPU peripheral base address. param displayIndex Index of the display.

void DPU_StopDisplay(DISPLAY_SEERIS_Type *base, uint8_t displayIndex)

brief Stop the display.

This function stops the display and wait the sequence complete.

param base DPU peripheral base address. param displayIndex Index of the display.

void DPU_TriggerDisplayShadowLoad(DISPLAY_SEERIS_Type *base, uint8_t displayIndex)

brief Trigger the display stream shadow load token.

Trigger the display stream shadow load token, then the shadow register will be loaded at the begining of next frame.

param base DPU peripheral base address. param displayIndex Display index.

void DPU_SetFetchUnitSrcBufferAddr(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, uint8_t sublayer, uint32_t baseAddr)

brief Set the fetch unit sublayer source buffer base address.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be fetch unit here. param sublayer Sublayer index, should be 0 to 7. param baseAddr Source buffer base address.

void DPU_InitDomainBlend(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

brief Initialize the Domainblend.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be DomainBlend unit here.

void DPU_TriggerDisplayDbShadowLoad(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

brief Trigger the display stream domainblend shadow load token.

Trigger the display stream shadow load token, then the shadow register will be loaded at the begining of next frame.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be DomainBlend unit here.

void DPU_InitScaler(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit)

Initialize the VScaler or HScaler unit.

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be HScaler or VScaler unit here.

void DPU_ScalerGetDefaultConfig(*dpu_scaler_config_t* *config)

Get default configuration structure for VScaler and HScaler.

The default value is:

```
config->srcReg = 0U;
config->inputSize = 0U;
config->outputSize = 0U;
```

Parameters

- config – Pointer to the configuration structure.

void DPU_SetScalerConfig(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_scaler_config_t* *config)

Set the VScaler or HScaler units configuration.

The valid input source could be:

- kDPU_UnitSrcNone
- kDPU_UnitSrcFetchYuv0-3
- kDPU_UnitSrcMatrix4
- kDPU_UnitSrcVScaler4
- kDPU_UnitSrcHScaler4
- kDPU_UnitSrcVScaler9
- kDPU_UnitSrcHScaler9
- kDPU_UnitSrcFilter9
- kDPU_UnitSrcMatrix9

Parameters

- base – DPU peripheral base address.
- unit – DPU unit, see dpu_unit_t, must be HScaler or VScaler unit here.
- config – Pointer to the configuration structure.

void DPU_FetcUnitGetDefaultWarpConfig(*dpu_warp_config_t* *config)

brief Get the default warp configuration for FetchWarp unit.

The default value is: code config->srcReg = 0U; config->frameHeight = 320U; config->frameWidth = 480U; config->warpBitsPerPixel = 0U; config->enableSymmetricOffset = false; config->coordMode = kDPU_WarpCoordinateModePNT; config->arbStartX = 0U; config->arbStartY = 0U; config->arbDeltaYY = 0U; config->arbDeltaYX = 0U; config->arbDeltaXY = 0U; config->arbDeltaXX = 0U; endcode

param config Pointer to the configuration structure.

status_t DPU_InitFetchUnitWarp(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_warp_config_t* *config)

brief Initialize the Warp function for FetchRot unit.

This function initializes the FetchWarp unit for the arbitrary warping.

The valid source of fetch warp unit could be:

- ref kDPU_UnitSrcNone
- ref kDPU_UnitSrcFetchEco9
- ref kDPU_UnitSrcFetchDecode9

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be FetchWarp unit here. param config Pointer to the configuration structure. retval kStatus_Success Initialization success. retval kStatus_InvalidArgument Wrong argument.

void DPU_CorrdinatesGetDefaultConfig(*dpu_coordinates_config_t* *config)

brief Get the default configuration structure for arbitrary warping re-sampling coordinates.

The default value is: code config->bitsPerPixel = 0U; config->strideBytes = 0x500U; config->baseAddr = 0U; config->frameHeight = 320U; config->frameWidth = 480U; endcode

param config Pointer to the configuration structure.

status_t DPU_InitWarpCoordinates(DISPLAY_SEERIS_Type *base, *dpu_unit_t* unit, const *dpu_coordinates_config_t* *config)

brief Initialize the arbitrary warping coordinates.

This function initializes the FetchEco unit, so that it could be used as the arbitrary warping coordinates.

param base DPU peripheral base address. param unit DPU unit, see ref dpu_unit_t, must be FetchEco here. param config Pointer to the configuration structure. retval kStatus_Success Initialization success. retval kStatus_InvalidArgument Wrong argument.

FSL_DPU_DRIVER_VERSION

Driver version.

DPU_PALETTE_ENTRY_NUM

DPU palette entery number.

DPU_FETCH_UNIT_BURST_LENGTH

DPU fetch unit burst length, should be less than 16.

DPU_FETCH_UNIT_BURST_SIZE

DPU fetch unit burst size.

If prefetch is used, the frame buffer stride and base address should be aligned to the burst size.

DPU_USE_GENERATE_HEADER

DPU_MAKE_SRC_REG1(src)

Macro for one input source unit.

DPU_MAKE_SRC_REG2(primSrc, secSrc)

Macro for two input source unit.

DPU_MAKE_SRC_REG3(primSrc, secSrc, tertSrc)

Macro for three input source unit.

Values:

enumerator kDPU_Pipeline

enumerator kDPU_BlitBlend

enumerator kDPU_Rop

enumerator kDPU_FetchRot

enumerator KDPU_FetchYuv

enumerator kDPU_FetchDecode

enumerator kDPU_FetchEco

enumerator kDPU_FetchLayer

enumerator kDPU_HScaler

enumerator kDPU_VScaler

enumerator kDPU_ConstFrame

enumerator kDPU_ExtDst

enumerator kDPU_LayerBlend

enumerator kDPU_Store

enumerator kDPU_DomainBlend

Values:

enumerator kDPU_UnitAttrIsFetch

enumerator kDPU_UnitAttrHasSrc

enumerator kDPU_UnitAttrNoShdow

enumerator kDPU_UnitAttrSubLayer

enum _dpu_unit

DPU units.

Values:

enumerator kDPU_PipelineStore9

enumerator kDPU_FetchDecode9

enumerator kDPU_FetchEco9

enumerator kDPU_Hscaler9

enumerator kDPU_Vscaler9

enumerator kDPU_FetchRot9

enumerator kDPU_Rop9

enumerator kDPU_BlitBlend9

enumerator kDPU_Store9

enumerator kDPU_PipelineExtDst0

enumerator kDPU_PipelineExtDst1

enumerator kDPU_PipelineExtDst4

enumerator kDPU_PipelineExtDst5

enumerator kDPU_ConstFrame0

enumerator kDPU_ExtDst0

enumerator kDPU_ConstFrame4

enumerator kDPU_ExtDst4

enumerator kDPU_ConstFrame1

enumerator kDPU_ExtDst1

enumerator kDPU_ConstFrame5

enumerator kDPU_ExtDst5

enumerator kDPU_FetchEco0

enumerator kDPU_FetchEco1

enumerator kDPU_FetchLayer0

enumerator kDPU_FetchLayer1

enumerator kDPU_FetchYuv0

enumerator kDPU_FetchYuv1

enumerator kDPU_FetchYuv3

enumerator kDPU_Hscaler4

enumerator kDPU_Vscaler4

enumerator kDPU_LayerBlend1

enumerator kDPU_LayerBlend2

enumerator kDPU_LayerBlend3

enumerator kDPU_LayerBlend4

enumerator kDPU_LayerBlend5

enumerator kDPU_LayerBlend6

enumerator kDPU_FetchYuv2

enumerator kDPU_FetchEco2

enumerator kDPU_DomainBlend0

enumerator kDPU_DomainBlend1

enum _dpu_interrupt

DPU interrupt.

Values:

enumerator kDPU_Group0Store9ShadowLoadInterrupt

Store9 shadow load interrupt.

enumerator kDPU_Group0Store9FrameCompleteInterrupt

Store9 frame complete interrupt.

enumerator kDPU_Group0Store9SeqCompleteInterrupt

Store9 sequence complete interrupt.

enumerator kDPU_Group0ExtDst0ShadowLoadInterrupt

ExtDst0 shadow load interrupt.

enumerator kDPU_Group0ExtDst0FrameCompleteInterrupt

ExtDst0 frame complete interrupt.

enumerator kDPU_Group0ExtDst0SeqCompleteInterrupt
ExtDst0 sequence complete interrupt.

enumerator kDPU_Group0ExtDst4ShadowLoadInterrupt
ExtDst4 shadow load interrupt.

enumerator kDPU_Group0ExtDst4FrameCompleteInterrupt
ExtDst4 frame complete interrupt.

enumerator kDPU_Group0ExtDst4SeqCompleteInterrupt
ExtDst4 sequence complete interrupt.

enumerator kDPU_Group0ExtDst1ShadowLoadInterrupt
ExtDst1 shadow load interrupt.

enumerator kDPU_Group0ExtDst1FrameCompleteInterrupt
ExtDst1 frame complete interrupt.

enumerator kDPU_Group0ExtDst1SeqCompleteInterrupt
ExtDst1 sequence complete interrupt.

enumerator kDPU_Group0ExtDst5ShadowLoadInterrupt
ExtDst5 shadow load interrupt.

enumerator kDPU_Group0ExtDst5FrameCompleteInterrupt
ExtDst5 frame complete interrupt.

enumerator kDPU_Group0ExtDst5SeqCompleteInterrupt
ExtDst5 sequence complete interrupt.

enumerator kDPU_Group0DomainBlend0ShadowLoadInterrupt
DomainBlend0 shadow load interrupt.

enumerator kDPU_Group0DomainBlend0FrameCompleteInterrupt
DomainBlend0 frame complete interrupt.

enumerator kDPU_Group0DomainBlend0SeqCompleteInterrupt
DomainBlend0 sequence complete interrupt.

enumerator kDPU_Group0DiSengcfgShadowLoad0Interrupt
DiSengcfg shadow load0 interrupt

enumerator kDPU_Group0DiSengcfgFrameComplete0Interrupt
DiSengcfg frame complete0 interrupt.

enumerator kDPU_Group0DiSengcfgSeqComplete0Interrupt
DiSengcfg sequence complete0 interrupt.

enumerator kDPU_Group0FrameGen0Int0Interrupt
FrameGen 0 interrupt 0.

enumerator kDPU_Group0FrameGen0Int1Interrupt
FrameGen 0 interrupt 1.

enumerator kDPU_Group0FrameGen0Int2Interrupt
FrameGen 0 interrupt 2.

enumerator kDPU_Group0FrameGen0Int3Interrupt
FrameGen 0 interrupt 3.

enumerator kDPU_Group0Sig0ShadowLoadInterrupt
Sig0 shadow load interrupt.

enumerator kDPU_Group0Sig0ValidInterrupt
Sig0 measurement valid interrupt.

enumerator kDPU_Group0Sig0ErrorInterrupt
Sig0 error interrupt.

enumerator kDPU_Group0Sig0ClusterErrorInterrupt
Sig0 cluster error interrupt.

enumerator kDPU_Group0Sig0ClusterMatchInterrupt
Sig0 cluster match interrupt.

enumerator kDPU_Group0Sig2ShadowLoadInterrupt
Sig2 shadow load interrupt.

enumerator kDPU_Group0Sig2ValidInterrupt
Sig2 measurement valid interrupt.

enumerator kDPU_Group1Sig2ErrorInterrupt
Sig2 error interrupt.

enumerator kDPU_Group1Sig2ClusterErrorInterrupt
Sig2 cluster error interrupt.

enumerator kDPU_Group1Sig2ClusterMatchInterrupt
Sig2 cluster match interrupt.

enumerator kDPU_Group1IdHash0ShadowLoadInterrupt
IdHash0 shadow load interrupt.

enumerator kDPU_Group1IdHash0ValidInterrupt
IdHash0 measurement valid interrupt.

enumerator kDPU_Group1IdHash0WindowsErrorInterrupt
IdHash0 windows error interrupt.

enumerator kDPU_Group1DomainBlend1ShadowLoadInterrupt
DomainBlend1 shadow load interrupt.

enumerator kDPU_Group1DomainBlend1FrameCompleteInterrupt
DomainBlend1 frame complete interrupt.

enumerator kDPU_Group1DomainBlend1SeqCompleteInterrupt
DomainBlend1 sequence complete interrupt.

enumerator kDPU_Group1DiSengcfgShadowLoad1Interrupt
DiSengcfg shadow load1 interrupt

enumerator kDPU_Group1DiSengcfgFrameComplete1Interrupt
DiSengcfg frame complete1 interrupt.

enumerator kDPU_Group1DiSengcfgSeqComplete1Interrupt
DiSengcfg sequence complete1 interrupt.

enumerator kDPU_Group1FrameGen1Int0Interrupt
FrameGen 1 interrupt 0.

enumerator kDPU_Group1FrameGen1Int1Interrupt
FrameGen 1 interrupt 1.

enumerator kDPU_Group1FrameGen1Int2Interrupt
FrameGen 1 interrupt 2.

enumerator kDPU_Group1FrameGen1Int3Interrupt
FrameGen 1 interrupt 3.

enumerator kDPU_Group1Sig1ShadowLoadInterrupt
Sig1 shadow load interrupt.

enumerator kDPU_Group1Sig1ValidInterrupt
Sig1 measurement valid interrupt.

enumerator kDPU_Group1Sig1ErrorInterrupt
Sig1 error interrupt.

enumerator kDPU_Group1Sig1ClusterErrorInterrupt
Sig1 cluster error interrupt.

enumerator kDPU_Group1Sig1ClusterMatchInterrupt
Sig1 cluster match interrupt.

enumerator kDPU_Group1CmdSeqErrorInterrupt
CmdSeq Error interrupt.

enumerator kDPU_Group1ComCtrlSw0Interrupt
ComCtrlSw0 interrupt.

enumerator kDPU_Group1ComCtrlSw1Interrupt
ComCtrlSw1 interrupt.

enumerator kDPU_Group1ComCtrlSw2Interrupt
ComCtrlSw1 interrupt.

enumerator kDPU_Group1ComCtrlSw3Interrupt
ComCtrlSw1 interrupt.

enumerator kDPU_Group1FrameGen0PrimSyncOnInterrupt
FrameGen 0 primary sync on interrupt.

enumerator kDPU_Group1FrameGen0PrimSyncOffInterrupt
FrameGen 0 primary sync off interrupt.

enumerator kDPU_Group1FrameGen0OverFlow0OnInterrupt
FrameGen 0 over flow0 on interrupt.

enumerator kDPU_Group1FrameGen0OverFlow0OffInterrupt
FrameGen 0 over flow0 off interrupt.

enumerator kDPU_Group1FrameGen0UnderRun0OnInterrupt
FrameGen 0 under run0 on interrupt.

enumerator kDPU_Group1FrameGen0UnderRun0OffInterrupt
FrameGen 0 under run0 off interrupt.

enumerator kDPU_Group2FrameGen0Threshold0RiseInterrupt
FrameGen 0 Threshold0 rise interrupt.

enumerator kDPU_Group2FrameGen0Threshold0FailInterrupt
FrameGen 0 Threshold0 fail interrupt.

enumerator kDPU_Group2FrameGen0OverFlow1OnInterrupt
FrameGen 0 over flow1 on interrupt.

enumerator kDPU_Group2FrameGen0OverFlow1OffInterrupt
FrameGen 0 over flow1 off interrupt.

enumerator kDPU_Group2FrameGen0UnderRun1OnInterrupt
FrameGen 0 under run1 on interrupt.

enumerator kDPU_Group2FrameGen0UnderRun1OffInterrupt
FrameGen 0 under run1 off interrupt.

enumerator kDPU_Group2FrameGen0Threshold1RiseInterrupt
FrameGen 0 Threshold1 rise interrupt.

enumerator kDPU_Group2FrameGen0Threshold1FailInterrupt
FrameGen 0 Threshold1 fail interrupt.

enumerator kDPU_Group2FrameGen1PrimSyncOnInterrupt
FrameGen 1 primary sync on interrupt.

enumerator kDPU_Group2FrameGen1PrimSyncOffInterrupt
FrameGen 1 primary sync off interrupt.

enumerator kDPU_Group2FrameGen1OverFlow0OnInterrupt
FrameGen 1 over flow0 on interrupt.

enumerator kDPU_Group2FrameGen1OverFlow0OffInterrupt
FrameGen 1 over flow0 off interrupt.

enumerator kDPU_Group2FrameGen1UnderRun0OnInterrupt
FrameGen 1 under run0 on interrupt.

enumerator kDPU_Group2FrameGen1UnderRun0OffInterrupt
FrameGen 1 under run0 off interrupt.

enumerator kDPU_Group2FrameGen1Threshold0RiseInterrupt
FrameGen 1 Threshold0 rise interrupt.

enumerator kDPU_Group2FrameGen1Threshold0FailInterrupt
FrameGen 1 Threshold0 fail interrupt.

enumerator kDPU_Group2FrameGen1OverFlow1OnInterrupt
FrameGen 1 over flow1 on interrupt.

enumerator kDPU_Group2FrameGen1OverFlow1OffInterrupt
FrameGen 1 over flow1 off interrupt.

enumerator kDPU_Group2FrameGen1UnderRun1OnInterrupt
FrameGen 1 under run1 on interrupt.

enumerator kDPU_Group2FrameGen1UnderRun1OffInterrupt
FrameGen 1 under run1 off interrupt.

enumerator kDPU_Group2FrameGen1Threshold1RiseInterrupt
FrameGen 1 Threshold1 rise interrupt.

enumerator kDPU_Group2FrameGen1Threshold1FailInterrupt
FrameGen 1 Threshold1 fail interrupt.

enum _dpu_unit_source
Values:

enumerator kDPU_UnitSrcNone
Disable the input source.

enumerator kDPU_UnitSrcRop9
The input source is Rop 9.

enumerator KDPU_UnitSrcExtDst0
The input source is ExtDst 0.

enumerator KDPU_UnitSrcExtDst4
The input source is ExtDst 4.

enumerator kDPU_UnitSrcBlitBlend9
The input source is BlitBlend 9.

enumerator kDPU_UnitSrcFetchRot9
The input source is Rot 9.

enumerator kDPU_UnitSrcFetchDecode9
The input source is fetch decode 9.

enumerator kDPU_UnitSrcFetchEco9
input source is fetch eco 9.

enumerator kDPU_UnitSrcHscaler9
The input source is HScaler 9.

enumerator kDPU_UnitSrcVScaler9
The input source is VScaler 9.

enumerator kDPU_UnitSrcFilter9
The input source is Filter 9.

enumerator kDPU_UnitSrcConstFrame0
The input source is ConstFrame 0.

enumerator kDPU_UnitSrcConstFrame4
The input source is ConstFrame 4.

enumerator kDPU_UnitSrcConstFrame1
The input source is ConstFrame 1.

enumerator kDPU_UnitSrcConstFrame5
The input source is ConstFrame 5.

enumerator kDPU_UnitSrcLayerBlend1
The input source is LayerBlend 1.

enumerator kDPU_UnitSrcLayerBlend2
The input source is LayerBlend 2.

enumerator kDPU_UnitSrcLayerBlend3
The input source is LayerBlend 3.

enumerator kDPU_UnitSrcLayerBlend4
The input source is LayerBlend 4.

enumerator kDPU_UnitSrcLayerBlend5
The input source is LayerBlend 5.

enumerator kDPU_UnitSrcLayerBlend6
The input source is LayerBlend 6.

enumerator kDPU_UnitSrcFetchLayer0
The input source is FetchLayer 0.

enumerator kDPU_UnitSrcFetchLayer1
The input source is FetchLayer 1.

enumerator kDPU_UnitSrcFetchYUV3
The input source is Fetchyuv 3.

enumerator kDPU_UnitSrcFetchYUV0
The input source is Fetchyuv 0.

enumerator kDPU_UnitSrcFetchYUV1
The input source is Fetchyuv 1.

enumerator kDPU_UnitSrcFetchYUV2
The input source is Fetchyuv 2.

enumerator kDPU_UnitSrcMatrix4
The input source is Matrix 4.

enumerator kDPU_UnitSrcHScaler4
The input source is HScaler 4.

enumerator kDPU_UnitSrcVScaler4
The input source is VScaler 4.

enumerator kDPU_UnitSrcFetchEco0
The input source is FetchEco 0.

enumerator kDPU_UnitSrcFetchEco1
The input source is FetchEco 1.

enumerator kDPU_UnitSrcFetchEco2
The input source is FetchEco 2.

enum _dpu_layer_blend_shadow_token_mode
LayerBlend unit shadow token generate mode.

Values:

enumerator kDPU_LayerBlendShadowTokenPrim
Generate shadow load token when token received from primary input.

enumerator kDPU_LayerBlendShadowTokenSec
Generate shadow load token when token received from secondary input.

enumerator kDPU_LayerBlendShadowTokenBoth
Generate shadow load token when token received from any input.

enum _dpu_layer_blend_shadow_load_mode
LayerBlend unit shadow load mode.

Values:

enumerator kDPU_LayerBlendShadowLoadPrim
Load shadows when token received from primary input.

enumerator kDPU_LayerBlendShadowLoadSec
Load shadows when token received from secondary input.

enumerator kDPU_LayerBlendShadowLoadBoth
Load shadows when token received from any input.

enum _dpu_pixel_format
DPU pixel format.

To support more pixel format, enhance this enum and the array s_dpuColorComponentFormats.

Values:

enumerator kDPU_PixelFormatGray8
8-bit gray.

enumerator kDPU_PixelFormatRGB565
RGB565, 16-bit per pixel.

enumerator kDPU_PixelFormatARGB8888
ARGB8888, 32-bit per pixel.

enumerator kDPU_PixelFormatRGB888
RGB888, 24-bit per pixel.

enumerator kDPU_PixelFormatARGB1555
ARGB1555, 16-bit per pixel.

enum _dpu_warp_coordinate_mode
FetchWarp unit warp coordinate mode.

Values:

enumerator kDPU_WarpCoordinateModePNT
Sample points positions are read from coordinate layer.

enumerator kDPU_WarpCoordinateModeDPNT
Sample points start position and delta are read from coordinate layer.

enumerator kDPU_WarpCoordinateModeDDPNT
Sample points initial value and delta increase value are read from coordinate layer.

enum _dpu_clip_color_mode
Define the color to take for pixels that do not lie inside the clip window of any layer.

Values:

enumerator kDPU_ClipColorNull
Use null color.

enumerator kDPU_ClipColorSublayer
Use color of sublayer.

enum _dpu_alpha_mask_mode
LayerBlend unit AlphaMask mode.

Values:

enumerator kDPU_AlphaMaskPrim
Areas with primary input alpha > 128 mapped to alpha 255, the rest mapped to 0.

enumerator kDPU_AlphaMaskSec
Areas with secondary input alpha > 128 mapped to alpha 255, the rest mapped to 0.

enumerator kDPU_AlphaMaskPrimOrSec
Primary and secondary OR'ed together.

enumerator kDPU_AlphaMaskPrimAndSec
Primary and secondary AND'ed together.

enumerator kDPU_AlphaMaskPrimInv
Primary input alpha inverted.

enumerator kDPU_AlphaMaskSecInv
Secondary input alpha inverted.

enumerator kDPU_AlphaMaskPrimOrSecInv
Primary and inverted secondary OR'ed together.

enumerator kDPU_AlphaMaskPrimAndSecInv
Primary and inverted secondary AND'ed together.

enum _dpu_blend_mode
LayerBlend unit alpha blend mode.

Values:

enumerator kDPU_BlendZero
OUT = IN * 0.

enumerator kDPU_BlendOne
OUT = IN * 1.

enumerator kDPU_BlendPrimAlpha
OUT = IN * ALPHA_primary.

enumerator kDPU_BlendPrimAlphaInv
OUT = IN * (1 - ALPHA_primary).

enumerator kDPU_BlendSecAlpha
OUT = IN * ALPHA_secondary.

enumerator kDPU_BlendSecAlphaInv
OUT = IN * (1 - ALPHA_secondary).

enumerator kDPU_BlendConstAlpha
OUT = IN * ALPHA_const.

enumerator kDPU_BlendConstAlphaInv
OUT = IN * (1 - ALPHA_const).

enum _dpu_display_timing_flags
Display timing configuration flags.

Values:

enumerator kDPU_DisplayPixelActiveHigh
Pixel data active high.

enumerator kDPU_DisplayDataEnableActiveHigh
Set to make data enable high active.

enumerator kDPU_DisplayDataEnableActiveLow
Set to make data enable high low.

enumerator kDPU_DisplayHsyncActiveHigh
Set to make HSYNC high active.

enumerator kDPU_DisplayHsyncActiveLow
Set to make HSYNC low active.

enumerator kDPU_DisplayVsyncActiveHigh
Set to make VSYNC high active.

enumerator kDPU_DisplayVsyncActiveLow
Set to make VSYNC low active.

enum _dpu_display_mode
Display mode, safety stream is the primary input, content stream is the secondary input.

Values:

enumerator kDPU_DisplayBlackBackground
Black background is shown.

enumerator kDPU_DisplayConstBackground
Const color background is shown.

enumerator kDPU_DisplayOnlyPrim
Only primary input is shown.

enumerator kDPU_DisplayOnlySec
Only secondary input is shown.

enumerator kDPU_DisplayPrimOnTop
Both inputs overlaid with primary on top.

enumerator kDPU_DisplaySecOnTop
Both inputs overlaid with secondary on top.

enumerator kDPU_DisplayTest
White background with test pattern shown.

enum _dpu_rop_flags
Values:

enumerator kDPU_RopAddRed
Set to add the red component, otherwise raster with operation index.

enumerator kDPU_RopAddGreen
Set to add the green component, otherwise raster with operation index.

enumerator kDPU_RopAddBlue
Set to add the blue component, otherwise raster with operation index.

enumerator kDPU_RopAddAlpha
Set to add the alpha component, otherwise raster with operation index.

enumerator kDPU_RopTertDiv2
In add mode, set this to divide tertiary port input by 2.

enumerator kDPU_RopSecDiv2
In add mode, set this to divide secondary port input by 2.

enumerator kDPU_RopPrimDiv2
In add mode, set this to divide primary port input by 2.

typedef enum *_dpu_unit* dpu_unit_t
DPU units.

typedef enum *_dpu_pixel_format* dpu_pixel_format_t
DPU pixel format.

To support more pixel format, enhance this enum and the array s_dpuColorComponentFormats.

typedef struct *_dpu_fetch_unit_config* dpu_fetch_unit_config_t
Configuration structure for fetch units.

typedef struct *_dpu_coordinates_config* dpu_coordinates_config_t
Configuration structure for the arbitrary warping re-sampling coordinates.

The coordinate layer supports:

- 32 bpp: 2 x s12.4 (signed fix-point)

- 24 bpp: 2 x s8.
- 16 bpp: 2 x s4.4
- 8 bpp: 2 x s0.4
- 4 bpp: 2 x s(-2).4 (means total value size = 2 bits and lowest bit = 2^-4)
- 2 bpp: 2 x s(-3).4
- 1 bpp: 1 x s(-3).4 (x and y alternating)

typedef enum *_dpu_warp_coordinate_mode* dpu_warp_coordinate_mode_t

FetchWarp unit warp coordinate mode.

typedef struct *_dpu_warp_config* dpu_warp_config_t

Warp configuration structure for FetchWarp unit.

typedef enum *_dpu_clip_color_mode* dpu_clip_color_mode_t

Define the color to take for pixels that do not lie inside the clip window of any layer.

typedef struct *_dpu_dst_buffer_config* dpu_dst_buffer_config_t

Store unit Destination buffer configuration structure.

Base address and stride alignment restrictions: 32 bpp: Base address and stride must be a multiple of 4 bytes. 16 bpp: Base address and stride must be a multiple of 2 bytes. others: any byte alignment allowed

typedef enum *_dpu_alpha_mask_mode* dpu_alpha_mask_mode_t

LayerBlend unit AlphaMask mode.

typedef enum *_dpu_blend_mode* dpu_blend_mode_t

LayerBlend unit alpha blend mode.

typedef struct *_dpu_layer_blend_config* dpu_layer_blend_config_t

LayerBlend unit configuration structure.

typedef struct *_dpu_const_frame_config* dpu_const_frame_config_t

ConstFrame unit configuration structure.

typedef struct *_dpu_display_timing_config* dpu_display_timing_config_t

Display timing configuration structure.

typedef enum *_dpu_display_mode* dpu_display_mode_t

Display mode, safety stream is the primary input, content stream is the secondary input.

typedef struct *_dpu_display_config* dpu_display_config_t

Display mode configuration structure.

typedef struct *_dpu_scaler_config* dpu_scaler_config_t

VScaler and HScaler configuration structure.

typedef struct *_dpu_rop_config* dpu_rop_config_t

Rop unit configuration structure.

typedef struct *_dpu_src_buffer_config* dpu_src_buffer_config_t

Fetch unit source buffer configuration structure.

Base address and stride alignment restrictions: 32 bpp: Base address and stride must be a multiple of 4 bytes. 16 bpp: Base address and stride must be a multiple of 2 bytes. others: any byte alignment allowed

Generally, the bitsPerPixel and pixelFormat specify the pixel format in frame buffer, they should match. But when the color palette is used, the bitsPerPixel specify the format in framebuffer, the pixelFormat specify the format in color palette entry.

DPU_MAKE_CONST_COLOR(red, green, blue, alpha)

Define the const value that write to <unit>_ConstantColor.

DPU_UNIT_TYPE_SHIFT

DPU_UNIT_TYPE_MASK

DPU_UNIT_ATTR_SHIFT

DPU_UNIT_ATTR_MASK

DPU_UNIT_OFFSET_SHIFT

DPU_UNIT_OFFSET_MASK

DPU_MAKE_UNIT_TYPE(type)

DPU_MAKE_UNIT_ATTR(attr)

DPU_MAKE_UNIT_OFFSET(offset)

DPU_GET_UNIT_TYPE(unit)

DPU_GET_UNIT_ATTR(unit)

DPU_GET_UNIT_OFFSET(unit)

DPU_MAKE_UNIT(type, attr, offset)

DPU_UNIT_OFFSET(unit)

DPU_COMCTRL_OFFSET

DPU_FETCH_DECODE9_OFFSET

DPU_FETCH_ROT9_OFFSET

DPU_FETCH_ECO9_OFFSET

DPU_ROP9_OFFSET

DPU_H_SCALER9_OFFSET

DPU_V_SCALER9_OFFSET

DPU_BLITBLEND9_OFFSET

DPU_STORE9_OFFSET

DPU_CONST_FRAME0_OFFSET

DPU_EXT_DST0_OFFSET

DPU_CONST_FRAME4_OFFSET

DPU_EXT_DST4_OFFSET

DPU_CONST_FRAME1_OFFSET

DPU_EXT_DST1_OFFSET

DPU_CONST_FRAME5_OFFSET

DPU_EXT_DST5_OFFSET

DPU_LAYER_BLEND1_OFFSET

DPU_LAYER_BLEND2_OFFSET

DPU_LAYER_BLEND3_OFFSET

DPU_LAYER_BLEND4_OFFSET

DPU_LAYER_BLEND5_OFFSET

DPU_DOMAIN_BLEND0_OFFSET

DPU_FRAME_GEN0_OFFSET

DPU_PIPELINE_EXTDST0_OFFSET

DPU_PIPELINE_EXTDST1_OFFSET

DPU_PIPELINE_EXTDST4_OFFSET

DPU_PIPELINE_EXTDST5_OFFSET

DPU_PIPELINE_STORE9_OFFSET

DPU_FETCH_ECO0_OFFSET

DPU_FETCH_ECO1_OFFSET

DPU_FETCH_ECO2_OFFSET

DPU_FETCH_LAYER0_OFFSET

DPU_FETCH_LAYER1_OFFSET

DPU_H_SCALER4_OFFSET

DPU_V_SCALER4_OFFSET

DPU_LAYER_BLEND6_OFFSET

DPU_FETCH_YUV0_OFFSET

DPU_FETCH_YUV1_OFFSET

DPU_FETCH_YUV2_OFFSET

DPU_FETCH_YUV3_OFFSET

DPU_DOMAIN_BLEND1_OFFSET

DPU_FRAME_GEN1_OFFSET

DPU_ID_HASH0_OFFSET

DPU_SIG0_OFFSET

DPU_SIG1_OFFSET

DPU_SIG2_OFFSET

DPU_DITHER0_CONFIG_OFFSET

DPU_DITHER1_CONFIG_OFFSET

DPU_ROP_CONTROL_Mode_MASK

DPU_ROP_CONTROL_RedMode_MASK

DPU_ROP_CONTROL_GreenMode_MASK

DPU_ROP_CONTROL_BlueMode_MASK

DPU_ROP_CONTROL_AlphaMode_MASK

DPU_ROP_CONTROL_TertDiv2_MASK

DPU_ROP_CONTROL_SecDiv2_MASK

DPU_ROP_CONTROL_PrimDiv2_MASK

DPU_DISENGCONF_POLARITYCTRL_PolEn_MASK

DPU_DISENGCONF_POLARITYCTRL_PolVs_MASK

DPU_DISENGCONF_POLARITYCTRL_PolHs_MASK

DPU_SIG_EVALUPPERLEFT_XEvalUpperLeft_SHIFT

DPU_SIG_EVALUPPERLEFT_YEvalUpperLeft_SHIFT

DPU_SIG_EVALLOWERRIGHT_XEvalLowerRight_SHIFT

DPU_SIG0_EVALLOWERRIGHT_YEvalLowerRight_SHIFT

DPU_SIG_SHADOWLOAD_ShdLdReq_MASK

DOMAINMASK_ENABLE

SHDLDREQSTICKY_ENABLE

struct _dpu_fetch_unit_config

#include <fsl_dpu.h> Configuration structure for fetch units.

Public Members

uint32_t srcReg

This value will be set to register pixengcfg_fetchX_dynamic to set the unit input source, see DPU_MAKE_SRC_REG1.

uint16_t frameHeight

Frame height.

uint16_t frameWidth

Frame width.

struct _dpu_coordinates_config

#include <fsl_dpu.h> Configuration structure for the arbitrary warping re-sampling coordinates.

The coordinate layer supports:

- 32 bpp: 2 x s12.4 (signed fix-point)
- 24 bpp: 2 x s8.
- 16 bpp: 2 x s4.4
- 8 bpp: 2 x s0.4
- 4 bpp: 2 x s(-2).4 (means total value size = 2 bits and lowest bit = 2^-4)

- 2 bpp: 2 x s(-3).4
- 1 bpp: 1 x s(-3).4 (x and y alternating)

Public Members

uint8_t bitsPerPixel
: Number of bits per pixel in the source buffer. Must be 1, 2, 4, 8, 16, 32.

uint16_t strideBytes
: Source buffer stride in bytes.

uint32_t baseAddr
: Source buffer base address.

uint16_t frameHeight
: Frame height.

uint16_t frameWidth
: Frame width.

struct __dpu__warp__config
: *#include <fsl_dpu.h>* Warp configuration structure for FetchWarp unit.

Public Members

uint32_t srcReg
: This value will be set to register pixengcfg_fetchX_dynamic to set the unit input source, see DPU_MAKE_SRC_REG1.

uint16_t frameHeight
: Frame height.

uint16_t frameWidth
: Frame width.

uint8_t warpBitsPerPixel
: Pixel bits of the coordinate layer.

bool enableSymmetricOffset
: Enables symmetric range for negative and positive coordinate values by adding an offset of +0.03125 internally to all coordinate input values. Recommended for small coordinate formats in DD_PNT mode.

dpu_warp_coordinate_mode_t coordMode
: Coordinate layer mode.

uint32_t arbStartX
: X of start point position. Signed 16.5 fix-point. Used in D_PNT and DD_PNT.

uint32_t arbStartY
: Y of start point position. Signed 16.5 fix-point. Used in D_PNT and DD_PNT.

uint8_t arbDeltaYY
: Y of vector between start and first sample point. Signed 3.5 fix-point. Used in DD_PNT.

uint8_t arbDeltaYX
: X of vector between start and first sample point. Signed 3.5 fix-point. Used in DD_PNT.

uint8_t arbDeltaXY

Y of vector between first and second sample point. Signed 3.5 fix-point. Used in DD_PNT.

uint8_t arbDeltaXX

X of vector between first and second sample point. Signed 3.5 fix-point. Used in DD_PNT.

struct __dpu__dst__buffer__config

#include <fsl_dpu.h> Store unit Destination buffer configuration structure.

Base address and stride alignment restrictions: 32 bpp: Base address and stride must be a multiple of 4 bytes. 16 bpp: Base address and stride must be a multiple of 2 bytes. others: any byte alignment allowed

Public Members

uint32_t baseAddr

Destination buffer base address, see alignment restrictions.

uint16_t strideBytes

Destination buffer stride in bytes, see alignment restrictions.

uint8_t bitsPerPixel

Bits per pixel.

dpu_pixel_format_t pixelFormat

Pixel format.

uint16_t bufferHeight

Buffer height.

uint16_t bufferWidth

Buffer width.

struct __dpu__layer__blend__config

#include <fsl_dpu.h> LayerBlend unit configuration structure.

Public Members

uint8_t constAlpha

The const alpha value used in blend.

dpu_blend_mode_t secAlphaBlendMode

Secondary (overlay) input alpha blending function.

dpu_blend_mode_t primAlphaBlendMode

Primary (background) input alpha blending function.

dpu_blend_mode_t secColorBlendMode

Secondary (overlay) input color blending function.

dpu_blend_mode_t primColorBlendMode

Primary (background) input color blending function.

uint32_t srcReg

This value will be set to pixengcfg_layerblendX_dynamic to set the unit input source, see DPU_MAKE_SRC_REG2.

bool enableAlphaMask
Enable AlphaMask feature.

dpu_alpha_mask_mode_t alphaMaskMode
AlphaMask mode, only valid when enableAlphaMask is true.

struct __dpu__const__frame__config
#include <fsl_dpu.h> ConstFrame unit configuration structure.

Public Members

uint16_t frameHeight
Frame height.

uint16_t frameWidth
Frame width.

uint32_t constColor
See DPU_MAKE_CONST_COLOR.

struct __dpu__display__timing__config
#include <fsl_dpu.h> Display timing configuration structure.

Public Members

uint16_t flags
OR'ed value of _dpu_display_timing_flags.

uint16_t width
Active width.

uint16_t hsw
HSYNC pulse width.

uint16_t hfp
Horizontal front porch.

uint16_t hbp
Horizontal back porch.

uint16_t height
Active height.

uint16_t vsw
VSYNC pulse width.

uint16_t vfp
Vrtical front porch.

uint16_t vbp
Vertical back porch.

struct __dpu__display__config
#include <fsl_dpu.h> Display mode configuration structure.

Public Members

bool enablePrimAlpha
: Enable primary input alpha for screen composition.

bool enableSecAlpha
: Enable secondary input alpha for screen composition.

dpu_display_mode_t displayMode
: Display mode.

bool enablePrimAlphaInPanic
: Enable primary input alpha for screen composition in panic mode.

bool enableSecAlphaInPanic
: Enable secondary input alpha for screen composition in panic mode.

dpu_display_mode_t displayModeInPanic
: Display mode in panic mode.

uint16_t constRed
: Const red value, 10-bit.

uint16_t constGreen
: Const green value, 10-bit.

uint16_t constBlue
: Const green value, 10-bit.

uint8_t constAlpha
: Const alpha value, 1-bit.

uint16_t primAreaStartX
: Primary screen upper left corner, x component. 14-bit , start from 1.

uint16_t primAreaStartY
: Primary screen upper left corner, y component. 14-bit, start from 1.

uint16_t secAreaStartX
: Secondary screen upper left corner, x component. 14-bit, start from 1.

uint16_t secAreaStartY
: Secondary screen upper left corner, y component. 14-bit, start from 1.

struct __dpu__scaler__config
: *#include <fsl_dpu.h>* VScaler and HScaler configuration structure.

Public Members

uint32_t srcReg
: This value will be set to register pixengcfg_slacer_dynamic to set the unit input source, see DPU_MAKE_SRC_REG1. When down-scaling horizontally, the path should be -> HScaler -> VScaler ->, When up-scaling horizontally, the path should be -> VScaler -> HScaler ->.

uint16_t inputSize
: For HScaler, it is frame width, for VScaler, it is frame height.

uint16_t outputSize
: For HScaler, it is frame width, for VScaler, it is frame height.

struct __dpu__rop__config
: *#include <fsl_dpu.h>* Rop unit configuration structure.

Public Members

uint32_t controlFlags
: Control flags, see _dpu_rop_flags.

uint8_t alphaIndex
: Alpha operation index.

uint8_t blueIndex
: Blue operation index.

uint8_t greenIndex
: Green operation index.

uint8_t redIndex
: Red operation index.

struct __dpu_src_buffer_config

#include <fsl_dpu.h> Fetch unit source buffer configuration structure.

Base address and stride alignment restrictions: 32 bpp: Base address and stride must be a multiple of 4 bytes. 16 bpp: Base address and stride must be a multiple of 2 bytes. others: any byte alignment allowed

Generally, the bitsPerPixel and pixelFormat specify the pixel format in frame buffer, they should match. But when the color palette is used, the bitsPerPixel specify the format in framebuffer, the pixelFormat specify the format in color palette entry.

Public Members

uint32_t baseAddr
: Source buffer base address, see alignment restrictions.

uint16_t strideBytes
: Source buffer stride in bytes, see alignment restrictions.

uint8_t bitsPerPixel
: Bits per pixel in frame buffer.

dpu_pixel_format_t pixelFormat
: Pixel format.

uint16_t bufferHeight
: Buffer height.

uint16_t bufferWidth
: Buffer width.

uint32_t constColor
: Const color shown in the region out of frame buffer, see DPU_MAKE_CONST_COLOR.

2.6 eDMA: Enhanced Direct Memory Access (eDMA) Controller Driver

void EDMA_Init(*EDMA_Type* *base, const *edma_config_t* *config)

Initializes the eDMA peripheral.

This function ungates the eDMA clock and configures the eDMA peripheral according to the configuration structure. All emda enabled request will be cleared in this function.

Note: This function enables the minor loop map feature.

Parameters

- base – eDMA peripheral base address.
- config – A pointer to the configuration structure, see "edma_config_t".

void EDMA_Deinit(*EDMA_Type* *base)

Deinitializes the eDMA peripheral.

This function gates the eDMA clock.

Parameters

- base – eDMA peripheral base address.

void EDMA_InstallTCD(*EDMA_Type* *base, uint32_t channel, *edma_tcd_t* *tcd)

Push content of TCD structure into hardware TCD register.

Parameters

- base – EDMA peripheral base address.
- channel – EDMA channel number.
- tcd – Point to TCD structure.

void EDMA_GetDefaultConfig(*edma_config_t* *config)

Gets the eDMA default configuration structure.

This function sets the configuration structure to default values. The default configuration is set to the following values.

```
config.enableContinuousLinkMode = false;
config.enableHaltOnError = true;
config.enableRoundRobinArbitration = false;
config.enableDebugMode = false;
```

Parameters

- config – A pointer to the eDMA configuration structure.

void EDMA_InitChannel(*EDMA_Type* *base, uint32_t channel, *edma_channel_config_t* *channelConfig)

EDMA Channel initialization.

Parameters

- base – eDMA4 peripheral base address.
- channel – eDMA4 channel number.
- channelConfig – pointer to user's eDMA4 channel config structure, see edma_channel_config_t for detail.

static inline void EDMA_SetChannelMemoryAttribute(*EDMA_Type* *base, uint32_t channel, *edma_channel_memory_attribute_t* writeAttribute, *edma_channel_memory_attribute_t* readAttribute)

Set channel memory attribute.

Parameters

- base – eDMA4 peripheral base address.
- channel – eDMA4 channel number.
- writeAttribute – Attributes associated with a write transaction.
- readAttribute – Attributes associated with a read transaction.

static inline void EDMA_SetChannelSignExtension(*EDMA_Type* *base, uint32_t channel, uint8_t position)

Set channel sign extension.

Parameters

- base – eDMA4 peripheral base address.
- channel – eDMA4 channel number.
- position – A non-zero value specifing the sign extend bit position. If 0, sign extension is disabled.

static inline void EDMA_SetChannelSwapSize(*EDMA_Type* *base, uint32_t channel, *edma_channel_swap_size_t* swapSize)

Set channel swap size.

Parameters

- base – eDMA4 peripheral base address.
- channel – eDMA4 channel number.
- swapSize – Swap occurs with respect to the specified transfer size. If 0, swap is disabled.

static inline void EDMA_SetChannelAccessType(*EDMA_Type* *base, uint32_t channel, *edma_channel_access_type_t* channelAccessType)

Set channel access type.

Parameters

- base – eDMA4 peripheral base address.
- channel – eDMA4 channel number.
- channelAccessType – eDMA4's transactions type on the system bus when the channel is active.

static inline void EDMA_SetChannelMux(*EDMA_Type* *base, uint32_t channel, uint32_t channelRequestSource)

Set channel request source.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- channelRequestSource – eDMA hardware service request source for the channel. User need to use the dma_request_source_t type as the input parameter. Note that devices may use other enum type to express dma request source and User can fined it in SOC header or fsl_edma_soc.h.

static inline uint32_t EDMA_GetChannelSystemBusInformation(*EDMA_Type* *base, uint32_t channel)

Gets the channel identification and attribute information on the system bus interface.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

Returns

The mask of the channel system bus information. Users need to use the _edma_channel_sys_bus_info type to decode the return variables.

static inline void EDMA_EnableChannelMasterIDReplication(*EDMA_Type* *base, uint32_t channel, bool enable)

Set channel master ID replication.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- enable – true is enable, false is disable.

static inline void EDMA_SetChannelProtectionLevel(*EDMA_Type* *base, uint32_t channel, *edma_channel_protection_level_t* level)

Set channel security level.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- level – security level.

void EDMA_ResetChannel(*EDMA_Type* *base, uint32_t channel)

Sets all TCD registers to default values.

This function sets TCD registers for this channel to default values.

Note: This function must not be called while the channel transfer is ongoing or it causes unpredictable results.

Note: This function enables the auto stop request feature.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

void EDMA_SetTransferConfig(*EDMA_Type* *base, uint32_t channel, const *edma_transfer_config_t* *config, *edma_tcd_t* *nextTcd)

Configures the eDMA transfer attribute.

This function configures the transfer attribute, including source address, destination address, transfer size, address offset, and so on. It also configures the scatter gather feature if the user supplies the TCD address. Example:

```
edma_transfer_t config;
edma_tcd_t tcd;
config.srcAddr = ..;
config.destAddr = ..;
...
EDMA_SetTransferConfig(DMA0, channel, &config, &stcd);
```

Note: If nextTcd is not NULL, it means scatter gather feature is enabled and DREQ bit is cleared in the previous transfer configuration, which is set in the eDMA_ResetChannel.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- config – Pointer to eDMA transfer configuration structure.
- nextTcd – Point to TCD structure. It can be NULL if users do not want to enable scatter/gather feature.

void EDMA_SetMinorOffsetConfig(*EDMA_Type* *base, uint32_t channel, const *edma_minor_offset_config_t* *config)

Configures the eDMA minor offset feature.

The minor offset means that the signed-extended value is added to the source address or destination address after each minor loop.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- config – A pointer to the minor offset configuration structure.

void EDMA_SetChannelPreemptionConfig(*EDMA_Type* *base, uint32_t channel, const *edma_channel_Preemption_config_t* *config)

Configures the eDMA channel preemption feature.

This function configures the channel preemption attribute and the priority of the channel.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number
- config – A pointer to the channel preemption configuration structure.

void EDMA_SetChannelLink(*EDMA_Type* *base, uint32_t channel, *edma_channel_link_type_t* type, uint32_t linkedChannel)

Sets the channel link for the eDMA transfer.

This function configures either the minor link or the major link mode. The minor link means that the channel link is triggered every time CITER decreases by 1. The major link means that the channel link is triggered when the CITER is exhausted.

Note: Users should ensure that DONE flag is cleared before calling this interface, or the configuration is invalid.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- type – A channel link type, which can be one of the following:
  - kEDMA_LinkNone
  - kEDMA_MinorLink
  - kEDMA_MajorLink
- linkedChannel – The linked channel number.

void EDMA_SetBandWidth(*EDMA_Type* *base, uint32_t channel, *edma_bandwidth_t* bandWidth)

Sets the bandwidth for the eDMA transfer.

Because the eDMA processes the minor loop, it continuously generates read/write sequences until the minor count is exhausted. The bandwidth forces the eDMA to stall after the completion of each read/write access to control the bus request bandwidth seen by the crossbar switch.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- bandWidth – A bandwidth setting, which can be one of the following:
  - kEDMABandwidthStallNone
  - kEDMABandwidthStall4Cycle
  - kEDMABandwidthStall8Cycle

void EDMA_SetModulo(*EDMA_Type* *base, uint32_t channel, *edma_modulo_t* srcModulo, *edma_modulo_t* destModulo)

Sets the source modulo and the destination modulo for the eDMA transfer.

This function defines a specific address range specified to be the value after (SADDR + SOFF)/(DADDR + DOFF) calculation is performed or the original register value. It provides the ability to implement a circular data queue easily.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- srcModulo – A source modulo value.
- destModulo – A destination modulo value.

static inline void EDMA_EnableAutoStopRequest(*EDMA_Type* *base, uint32_t channel, bool enable)

Enables an auto stop request for the eDMA transfer.

If enabling the auto stop request, the eDMA hardware automatically disables the hardware channel request.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- enable – The command to enable (true) or disable (false).

void EDMA_EnableChannelInterrupts(*EDMA_Type* *base, uint32_t channel, uint32_t mask)

Enables the interrupt source for the eDMA transfer.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- mask – The mask of interrupt source to be set. Users need to use the defined edma_interrupt_enable_t type.

void EDMA_DisableChannelInterrupts(*EDMA_Type* *base, uint32_t channel, uint32_t mask)

Disables the interrupt source for the eDMA transfer.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- mask – The mask of the interrupt source to be set. Use the defined edma_interrupt_enable_t type.

void EDMA_SetMajorOffsetConfig(*EDMA_Type* *base, uint32_t channel, int32_t sourceOffset, int32_t destOffset)

Configures the eDMA channel TCD major offset feature.

Adjustment value added to the source address at the completion of the major iteration count

Parameters

- base – eDMA peripheral base address.
- channel – edma channel number.
- sourceOffset – source address offset will be applied to source address after major loop done.
- destOffset – destination address offset will be applied to source address after major loop done.

void EDMA_ConfigChannelSoftwareTCD(*edma_tcd_t* *tcd, const *edma_transfer_config_t* *transfer)

Sets TCD fields according to the user's channel transfer configuration structure, edma_transfer_config_t.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_ConfigChannelSoftwareTCDExt

Application should be careful about the TCD pool buffer storage class,

- For the platform has cache, the software TCD should be put in non cache section
- The TCD pool buffer should have a consistent storage class.

Note: This function enables the auto stop request feature.

Parameters

- tcd – Pointer to the TCD structure.
- transfer – channel transfer configuration pointer.

void EDMA_TcdReset(*edma_tcd_t* *tcd)

Sets all fields to default values for the TCD structure.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdResetExt

This function sets all fields for this TCD structure to default value.

Note: This function enables the auto stop request feature.

Parameters

- tcd – Pointer to the TCD structure.

void EDMA_TcdSetTransferConfig(*edma_tcd_t* *tcd, const *edma_transfer_config_t* *config, *edma_tcd_t* *nextTcd)

Configures the eDMA TCD transfer attribute.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdSetTransferConfigExt

The TCD is a transfer control descriptor. The content of the TCD is the same as the hardware TCD registers. The TCD is used in the scatter-gather mode. This function configures the TCD transfer attribute, including source address, destination address, transfer size, address offset, and so on. It also configures the scatter gather feature if the user supplies the next TCD address. Example:

```
edma_transfer_t config = {
...
}
edma_tcd_t tcd __aligned(32);
edma_tcd_t nextTcd __aligned(32);
EDMA_TcdSetTransferConfig(&tcd, &config, &nextTcd);
```

Note: TCD address should be 32 bytes aligned or it causes an eDMA error.

Note: If the nextTcd is not NULL, the scatter gather feature is enabled and DREQ bit is cleared in the previous transfer configuration, which is set in the EDMA_TcdReset.

Parameters

- tcd – Pointer to the TCD structure.
- config – Pointer to eDMA transfer configuration structure.
- nextTcd – Pointer to the next TCD structure. It can be NULL if users do not want to enable scatter/gather feature.

void EDMA_TcdSetMinorOffsetConfig(*edma_tcd_t* *tcd, const *edma_minor_offset_config_t* *config)

Configures the eDMA TCD minor offset feature.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdSetMinorOffsetConfigExt

A minor offset is a signed-extended value added to the source address or a destination address after each minor loop.

Parameters

- tcd – A point to the TCD structure.
- config – A pointer to the minor offset configuration structure.

void EDMA_TcdSetChannelLink(*edma_tcd_t* *tcd, *edma_channel_link_type_t* type, uint32_t linkedChannel)

Sets the channel link for the eDMA TCD.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdSetChannelLinkExt

This function configures either a minor link or a major link. The minor link means the channel link is triggered every time CITER decreases by 1. The major link means that the channel link is triggered when the CITER is exhausted.

Note: Users should ensure that DONE flag is cleared before calling this interface, or the configuration is invalid.

Parameters

- tcd – Point to the TCD structure.
- type – Channel link type, it can be one of:
  - kEDMA_LinkNone
  - kEDMA_MinorLink
  - kEDMA_MajorLink
- linkedChannel – The linked channel number.

static inline void EDMA_TcdSetBandWidth(*edma_tcd_t* *tcd, *edma_bandwidth_t* bandWidth)

Sets the bandwidth for the eDMA TCD.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdSetBandWidthExt

Because the eDMA processes the minor loop, it continuously generates read/write sequences until the minor count is exhausted. The bandwidth forces the eDMA to stall after the completion of each read/write access to control the bus request bandwidth seen by the crossbar switch.

Parameters

- tcd – A pointer to the TCD structure.
- bandWidth – A bandwidth setting, which can be one of the following:
  - kEDMABandwidthStallNone
  - kEDMABandwidthStall4Cycle
  - kEDMABandwidthStall8Cycle

void EDMA_TcdSetModulo(*edma_tcd_t* *tcd, *edma_modulo_t* srcModulo, *edma_modulo_t* destModulo)

Sets the source modulo and the destination modulo for the eDMA TCD.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdSetModuloExt

This function defines a specific address range specified to be the value after (SADDR + SOFF)/(DADDR + DOFF) calculation is performed or the original register value. It provides the ability to implement a circular data queue easily.

Parameters

- tcd – A pointer to the TCD structure.
- srcModulo – A source modulo value.
- destModulo – A destination modulo value.

static inline void EDMA_TcdEnableAutoStopRequest(*edma_tcd_t* *tcd, bool enable)

Sets the auto stop request for the eDMA TCD.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdEnableAutoStopRequestExt

If enabling the auto stop request, the eDMA hardware automatically disables the hardware channel request.

Parameters

- tcd – A pointer to the TCD structure.
- enable – The command to enable (true) or disable (false).

void EDMA_TcdEnableInterrupts(*edma_tcd_t* *tcd, uint32_t mask)

Enables the interrupt source for the eDMA TCD.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdEnableInterruptsExt

Parameters

- tcd – Point to the TCD structure.
- mask – The mask of interrupt source to be set. Users need to use the defined edma_interrupt_enable_t type.

void EDMA_TcdDisableInterrupts(*edma_tcd_t* *tcd, uint32_t mask)

Disables the interrupt source for the eDMA TCD.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdDisableInterruptsExt

Parameters

- tcd – Point to the TCD structure.
- mask – The mask of interrupt source to be set. Users need to use the defined edma_interrupt_enable_t type.

void EDMA_TcdSetMajorOffsetConfig(*edma_tcd_t* *tcd, int32_t sourceOffset, int32_t destOffset)

Configures the eDMA TCD major offset feature.

@Note This API only supports EDMA4 TCD type. It can be used to support all types with extension API EDMA_TcdSetMajorOffsetConfigExt

Adjustment value added to the source address at the completion of the major iteration count

Parameters

- tcd – A point to the TCD structure.
- sourceOffset – source address offset wiil be applied to source address after major loop done.
- destOffset – destination address offset will be applied to source address after major loop done.

void EDMA_ConfigChannelSoftwareTCDExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, const *edma_transfer_config_t* *transfer)

Sets TCD fields according to the user's channel transfer configuration structure, edma_transfer_config_t.

Application should be careful about the TCD pool buffer storage class,

- For the platform has cache, the software TCD should be put in non cache section
- The TCD pool buffer should have a consistent storage class.

Note: This function enables the auto stop request feature.

Parameters

- base – eDMA peripheral base address.
- tcd – Pointer to the TCD structure.
- transfer – channel transfer configuration pointer.

void EDMA_TcdResetExt(*EDMA_Type* *base, *edma_tcd_t* *tcd)

Sets all fields to default values for the TCD structure.

This function sets all fields for this TCD structure to default value.

Note: This function enables the auto stop request feature.

Parameters

- base – eDMA peripheral base address.
- tcd – Pointer to the TCD structure.

void EDMA_TcdSetTransferConfigExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, const *edma_transfer_config_t* *config, *edma_tcd_t* *nextTcd)

Configures the eDMA TCD transfer attribute.

The TCD is a transfer control descriptor. The content of the TCD is the same as the hardware TCD registers. The TCD is used in the scatter-gather mode. This function configures the TCD transfer attribute, including source address, destination address, transfer size, address offset, and so on. It also configures the scatter gather feature if the user supplies the next TCD address. Example:

```
edma_transfer_t config = {
...
}
edma_tcd_t tcd __aligned(32);
edma_tcd_t nextTcd __aligned(32);
EDMA_TcdSetTransferConfig(&tcd, &config, &nextTcd);
```

Note: TCD address should be 32 bytes aligned or it causes an eDMA error.

Note: If the nextTcd is not NULL, the scatter gather feature is enabled and DREQ bit is cleared in the previous transfer configuration, which is set in the EDMA_TcdReset.

Parameters

- base – eDMA peripheral base address.
- tcd – Pointer to the TCD structure.
- config – Pointer to eDMA transfer configuration structure.
- nextTcd – Pointer to the next TCD structure. It can be NULL if users do not want to enable scatter/gather feature.

void EDMA_TcdSetMinorOffsetConfigExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, const *edma_minor_offset_config_t* *config)

Configures the eDMA TCD minor offset feature.

A minor offset is a signed-extended value added to the source address or a destination address after each minor loop.

Parameters

- base – eDMA peripheral base address.
- tcd – A point to the TCD structure.
- config – A pointer to the minor offset configuration structure.

void EDMA_TcdSetChannelLinkExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, *edma_channel_link_type_t* type, uint32_t linkedChannel)

Sets the channel link for the eDMA TCD.

This function configures either a minor link or a major link. The minor link means the channel link is triggered every time CITER decreases by 1. The major link means that the channel link is triggered when the CITER is exhausted.

Note: Users should ensure that DONE flag is cleared before calling this interface, or the configuration is invalid.

Parameters

- base – eDMA peripheral base address.
- tcd – Point to the TCD structure.
- type – Channel link type, it can be one of:
  - kEDMA_LinkNone
  - kEDMA_MinorLink
  - kEDMA_MajorLink
- linkedChannel – The linked channel number.

static inline void EDMA_TcdSetBandWidthExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, *edma_bandwidth_t* bandWidth)

Sets the bandwidth for the eDMA TCD.

Because the eDMA processes the minor loop, it continuously generates read/write sequences until the minor count is exhausted. The bandwidth forces the eDMA to stall after the completion of each read/write access to control the bus request bandwidth seen by the crossbar switch.

Parameters

- base – eDMA peripheral base address.
- tcd – A pointer to the TCD structure.
- bandWidth – A bandwidth setting, which can be one of the following:
  - kEDMABandwidthStallNone
  - kEDMABandwidthStall4Cycle
  - kEDMABandwidthStall8Cycle

void EDMA_TcdSetModuloExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, *edma_modulo_t* srcModulo, *edma_modulo_t* destModulo)

Sets the source modulo and the destination modulo for the eDMA TCD.

This function defines a specific address range specified to be the value after (SADDR + SOFF)/(DADDR + DOFF) calculation is performed or the original register value. It provides the ability to implement a circular data queue easily.

Parameters

- base – eDMA peripheral base address.
- tcd – A pointer to the TCD structure.
- srcModulo – A source modulo value.
- destModulo – A destination modulo value.

static inline void EDMA_TcdEnableAutoStopRequestExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, bool enable)

Sets the auto stop request for the eDMA TCD.

If enabling the auto stop request, the eDMA hardware automatically disables the hardware channel request.

Parameters

- base – eDMA peripheral base address.
- tcd – A pointer to the TCD structure.
- enable – The command to enable (true) or disable (false).

void EDMA_TcdEnableInterruptsExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, uint32_t mask)

Enables the interrupt source for the eDMA TCD.

Parameters

- base – eDMA peripheral base address.
- tcd – Point to the TCD structure.
- mask – The mask of interrupt source to be set. Users need to use the defined edma_interrupt_enable_t type.

void EDMA_TcdDisableInterruptsExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, uint32_t mask)

Disables the interrupt source for the eDMA TCD.

Parameters

- base – eDMA peripheral base address.
- tcd – Point to the TCD structure.
- mask – The mask of interrupt source to be set. Users need to use the defined edma_interrupt_enable_t type.

void EDMA_TcdSetMajorOffsetConfigExt(*EDMA_Type* *base, *edma_tcd_t* *tcd, int32_t sourceOffset, int32_t destOffset)

Configures the eDMA TCD major offset feature.

Adjustment value added to the source address at the completion of the major iteration count

Parameters

- base – eDMA peripheral base address.
- tcd – A point to the TCD structure.
- sourceOffset – source address offset wiil be applied to source address after major loop done.

- destOffset – destination address offset will be applied to source address after major loop done.

static inline void EDMA_EnableChannelRequest(*EDMA_Type* *base, uint32_t channel)

Enables the eDMA hardware channel request.

This function enables the hardware channel request.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

static inline void EDMA_DisableChannelRequest(*EDMA_Type* *base, uint32_t channel)

Disables the eDMA hardware channel request.

This function disables the hardware channel request.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

static inline void EDMA_TriggerChannelStart(*EDMA_Type* *base, uint32_t channel)

Starts the eDMA transfer by using the software trigger.

This function starts a minor loop transfer.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

uint32_t EDMA_GetRemainingMajorLoopCount(*EDMA_Type* *base, uint32_t channel)

Gets the remaining major loop count from the eDMA current channel TCD.

This function checks the TCD (Task Control Descriptor) status for a specified eDMA channel and returns the number of major loop count that has not finished.

Note: 1. This function can only be used to get unfinished major loop count of transfer without the next TCD, or it might be inaccuracy.

a. The unfinished/remaining transfer bytes cannot be obtained directly from registers while the channel is running. Because to calculate the remaining bytes, the initial NBYTES configured in DMA_TCDn_NBYTES_MLNO register is needed while the eDMA IP does not support getting it while a channel is active. In another word, the NBYTES value reading is always the actual (decrementing) NBYTES value the dma_engine is working with while a channel is running. Consequently, to get the remaining transfer bytes, a software-saved initial value of NBYTES (for example copied before enabling the channel) is needed. The formula to calculate it is shown below: RemainingBytes = RemainingMajorLoopCount * NBYTES(initially configured)

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

Returns

Major loop count which has not been transferred yet for the current TCD.

static inline uint32_t EDMA_GetErrorStatusFlags(*EDMA_Type* *base)

Gets the eDMA channel error status flags.

Parameters

- base – eDMA peripheral base address.

Returns

The mask of error status flags. Users need to use the _edma_error_status_flags type to decode the return variables.

uint32_t EDMA_GetChannelStatusFlags(*EDMA_Type* *base, uint32_t channel)

Gets the eDMA channel status flags.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.

Returns

The mask of channel status flags. Users need to use the _edma_channel_status_flags type to decode the return variables.

void EDMA_ClearChannelStatusFlags(*EDMA_Type* *base, uint32_t channel, uint32_t mask)

Clears the eDMA channel status flags.

Parameters

- base – eDMA peripheral base address.
- channel – eDMA channel number.
- mask – The mask of channel status to be cleared. Users need to use the defined _edma_channel_status_flags type.

void EDMA_CreateHandle(*edma_handle_t* *handle, *EDMA_Type* *base, uint32_t channel)

Creates the eDMA handle.

This function is called if using the transactional API for eDMA. This function initializes the internal state of the eDMA handle.

Parameters

- handle – eDMA handle pointer. The eDMA handle stores callback function and parameters.
- base – eDMA peripheral base address.
- channel – eDMA channel number.

void EDMA_InstallTCDMemory(*edma_handle_t* *handle, *edma_tcd_t* *tcdPool, uint32_t tcdSize)

Installs the TCDs memory pool into the eDMA handle.

This function is called after the EDMA_CreateHandle to use scatter/gather feature. This function shall only be used while users need to use scatter gather mode. Scatter gather mode enables EDMA to load a new transfer control block (tcd) in hardware, and automatically reconfigure that DMA channel for a new transfer. Users need to prepare tcd memory and also configure tcds using interface EDMA_SubmitTransfer.

Parameters

- handle – eDMA handle pointer.
- tcdPool – A memory pool to store TCDs. It must be 32 bytes aligned.
- tcdSize – The number of TCD slots.

void EDMA_SetCallback(*edma_handle_t* *handle, *edma_callback* callback, void *userData)

Installs a callback function for the eDMA transfer.

This callback is called in the eDMA IRQ handler. Use the callback to do something after the current major loop transfer completes. This function will be called every time one tcd finished transfer.

Parameters

- handle – eDMA handle pointer.
- callback – eDMA callback function pointer.
- userData – A parameter for the callback function.

void EDMA_PrepareTransferConfig(*edma_transfer_config_t* *config, void *srcAddr, uint32_t srcWidth, int16_t srcOffset, void *destAddr, uint32_t destWidth, int16_t destOffset, uint32_t bytesEachRequest, uint32_t transferBytes)

Prepares the eDMA transfer structure configurations.

This function prepares the transfer configuration structure according to the user input.

Note: The data address and the data width must be consistent. For example, if the SRC is 4 bytes, the source address must be 4 bytes aligned, or it results in source address error (SAE). User can check if 128 bytes support is available for specific instance by FSL_FEATURE_EDMA_INSTANCE_SUPPORT_128_BYTES_TRANSFERn.

Parameters

- config – The user configuration structure of type edma_transfer_t.
- srcAddr – eDMA transfer source address.
- srcWidth – eDMA transfer source address width(bytes).
- srcOffset – source address offset.
- destAddr – eDMA transfer destination address.
- destWidth – eDMA transfer destination address width(bytes).
- destOffset – destination address offset.
- bytesEachRequest – eDMA transfer bytes per channel request.
- transferBytes – eDMA transfer bytes to be transferred.

void EDMA_PrepareTransfer(*edma_transfer_config_t* *config, void *srcAddr, uint32_t srcWidth, void *destAddr, uint32_t destWidth, uint32_t bytesEachRequest, uint32_t transferBytes, *edma_transfer_type_t* type)

Prepares the eDMA transfer structure.

This function prepares the transfer configuration structure according to the user input.

Note: The data address and the data width must be consistent. For example, if the SRC is 4 bytes, the source address must be 4 bytes aligned, or it results in source address error (SAE).

Parameters

- config – The user configuration structure of type edma_transfer_t.
- srcAddr – eDMA transfer source address.

- srcWidth – eDMA transfer source address width(bytes).
- destAddr – eDMA transfer destination address.
- destWidth – eDMA transfer destination address width(bytes).
- bytesEachRequest – eDMA transfer bytes per channel request.
- transferBytes – eDMA transfer bytes to be transferred.
- type – eDMA transfer type.

void EDMA_PrepareTransferTCD(*edma_handle_t* *handle, *edma_tcd_t* *tcd, void *srcAddr, uint32_t srcWidth, int16_t srcOffset, void *destAddr, uint32_t destWidth, int16_t destOffset, uint32_t bytesEachRequest, uint32_t transferBytes, *edma_tcd_t* *nextTcd)

Prepares the eDMA transfer content descriptor.

This function prepares the transfer content descriptor structure according to the user input.

Note: The data address and the data width must be consistent. For example, if the SRC is 4 bytes, the source address must be 4 bytes aligned, or it results in source address error (SAE).

Parameters

- handle – eDMA handle pointer.
- tcd – Pointer to eDMA transfer content descriptor structure.
- srcAddr – eDMA transfer source address.
- srcWidth – eDMA transfer source address width(bytes).
- srcOffset – source address offset.
- destAddr – eDMA transfer destination address.
- destWidth – eDMA transfer destination address width(bytes).
- destOffset – destination address offset.
- bytesEachRequest – eDMA transfer bytes per channel request.
- transferBytes – eDMA transfer bytes to be transferred.
- nextTcd – eDMA transfer linked TCD address.

status_t EDMA_SubmitTransferTCD(*edma_handle_t* *handle, *edma_tcd_t* *tcd)

Submits the eDMA transfer content descriptor.

This function submits the eDMA transfer request according to the transfer content descriptor. In scatter gather mode, call this function will add a configured tcd to the circular list of tcd pool. The tcd pools is setup by call function EDMA_InstallTCDMemory before.

Typical user case:

a. submit single transfer

```
edma_tcd_t tcd;
EDMA_PrepareTransferTCD(handle, tcd, ....)
EDMA_SubmitTransferTCD(handle, tcd)
EDMA_StartTransfer(handle)
```

b. submit static link transfer,

```
edma_tcd_t tcd[2];
EDMA_PrepareTransferTCD(handle, &tcd[0], ....)
EDMA_PrepareTransferTCD(handle, &tcd[1], ....)
EDMA_SubmitTransferTCD(handle, &tcd[0])
EDMA_StartTransfer(handle)
```

c. submit dynamic link transfer

```
edma_tcd_t tcdpool[2];
EDMA_InstallTCDMemory(&g_DMA_Handle, tcdpool, 2);
edma_tcd_t tcd;
EDMA_PrepareTransferTCD(handle, tcd, ....)
EDMA_SubmitTransferTCD(handle, tcd)
EDMA_PrepareTransferTCD(handle, tcd, ....)
EDMA_SubmitTransferTCD(handle, tcd)
EDMA_StartTransfer(handle)
```

d. submit loop transfer

```
edma_tcd_t tcd[2];
EDMA_PrepareTransferTCD(handle, &tcd[0], ...,&tcd[1])
EDMA_PrepareTransferTCD(handle, &tcd[1], ..., &tcd[0])
EDMA_SubmitTransferTCD(handle, &tcd[0])
EDMA_StartTransfer(handle)
```

Parameters

- handle – eDMA handle pointer.
- tcd – Pointer to eDMA transfer content descriptor structure.

Return values

- kStatus_EDMA_Success – It means submit transfer request succeed.
- kStatus_EDMA_QueueFull – It means TCD queue is full. Submit transfer request is not allowed.
- kStatus_EDMA_Busy – It means the given channel is busy, need to submit request later.

status_t EDMA_SubmitTransfer(*edma_handle_t* *handle, const *edma_transfer_config_t* *config)

Submits the eDMA transfer request.

This function submits the eDMA transfer request according to the transfer configuration structure. In scatter gather mode, call this function will add a configured tcd to the circular list of tcd pool. The tcd pools is setup by call function EDMA_InstallTCDMemory before.

Parameters

- handle – eDMA handle pointer.
- config – Pointer to eDMA transfer configuration structure.

Return values

- kStatus_EDMA_Success – It means submit transfer request succeed.
- kStatus_EDMA_QueueFull – It means TCD queue is full. Submit transfer request is not allowed.
- kStatus_EDMA_Busy – It means the given channel is busy, need to submit request later.

status_t EDMA_SubmitLoopTransfer(*edma_handle_t* *handle, *edma_transfer_config_t* *transfer, uint32_t transferLoopCount)

Submits the eDMA scatter gather transfer configurations.

The function is target for submit loop transfer request, the ring transfer request means that the transfer request TAIL is link to HEAD, such as, A->B->C->D->A, or A->A

To use the ring transfer feature, the application should allocate several transfer object, such as

```
edma_channel_transfer_config_t transfer[2];
EDMA_TransferSubmitLoopTransfer(psHandle, &transfer, 2U);
```

Then eDMA driver will link transfer[0] and transfer[1] to each other

---

Note: Application should check the return value of this function to avoid transfer request submit failed

---

Parameters

- handle – eDMA handle pointer
- transfer – pointer to user's eDMA channel configure structure, see edma_channel_transfer_config_t for detail
- transferLoopCount – the count of the transfer ring, if loop count is 1, that means that the one will link to itself.

Return values

- kStatus_Success – It means submit transfer request succeed
- kStatus_EDMA_Busy – channel is in busy status
- kStatus_InvalidArgument – Invalid Argument

void EDMA_StartTransfer(*edma_handle_t* *handle)

eDMA starts transfer.

This function enables the channel request. Users can call this function after submitting the transfer request or before submitting the transfer request.

Parameters

- handle – eDMA handle pointer.

void EDMA_StopTransfer(*edma_handle_t* *handle)

eDMA stops transfer.

This function disables the channel request to pause the transfer. Users can call EDMA_StartTransfer() again to resume the transfer.

Parameters

- handle – eDMA handle pointer.

void EDMA_AbortTransfer(*edma_handle_t* *handle)

eDMA aborts transfer.

This function disables the channel request and clear transfer status bits. Users can submit another transfer after calling this API.

Parameters

- handle – DMA handle pointer.

static inline uint32_t EDMA_GetUnusedTCDNumber(*edma_handle_t* *handle)

Get unused TCD slot number.

This function gets current tcd index which is run. If the TCD pool pointer is NULL, it will return 0.

Parameters

- handle – DMA handle pointer.

Returns

The unused tcd slot number.

static inline uint32_t EDMA_GetNextTCDAddress(*edma_handle_t* *handle)

Get the next tcd address.

This function gets the next tcd address. If this is last TCD, return 0.

Parameters

- handle – DMA handle pointer.

Returns

The next TCD address.

void EDMA_HandleIRQ(*edma_handle_t* *handle)

eDMA IRQ handler for the current major loop transfer completion.

This function clears the channel major interrupt flag and calls the callback function if it is not NULL.

Note: For the case using TCD queue, when the major iteration count is exhausted, additional operations are performed. These include the final address adjustments and reloading of the BITER field into the CITER. Assertion of an optional interrupt request also occurs at this time, as does a possible fetch of a new TCD from memory using the scatter/gather address pointer included in the descriptor (if scatter/gather is enabled).

For instance, when the time interrupt of TCD[0] happens, the TCD[1] has already been loaded into the eDMA engine. As sga and sga_index are calculated based on the DLAST_SGA bitfield lies in the TCD_CSR register, the sga_index in this case should be 2 (DLAST_SGA of TCD[1] stores the address of TCD[2]). Thus, the “tcdUsed” updated should be (tcdUsed - 2U) which indicates the number of TCDs can be loaded in the memory pool (because TCD[0] and TCD[1] have been loaded into the eDMA engine at this point already.).

For the last two continuous ISRs in a scatter/gather process, they both load the last TCD (The last ISR does not load a new TCD) from the memory pool to the eDMA engine when major loop completes. Therefore, ensure that the header and tcdUsed updated are identical for them. tcdUsed are both 0 in this case as no TCD to be loaded.

See the “eDMA basic data flow” in the eDMA Functional description section of the Reference Manual for further details.

Parameters

- handle – eDMA handle pointer.

FSL_EDMA_DRIVER_VERSION

eDMA driver version

Version 2.10.6.

_edma_transfer_status eDMA transfer status

Values:

enumerator kStatus_EDMA_QueueFull
TCD queue is full.

enumerator kStatus_EDMA_Busy
Channel is busy and can't handle the transfer request.

enum _edma_transfer_size
eDMA transfer configuration

Values:

enumerator kEDMA_TransferSize1Bytes
Source/Destination data transfer size is 1 byte every time

enumerator kEDMA_TransferSize2Bytes
Source/Destination data transfer size is 2 bytes every time

enumerator kEDMA_TransferSize4Bytes
Source/Destination data transfer size is 4 bytes every time

enumerator kEDMA_TransferSize8Bytes
Source/Destination data transfer size is 8 bytes every time

enumerator kEDMA_TransferSize16Bytes
Source/Destination data transfer size is 16 bytes every time

enumerator kEDMA_TransferSize32Bytes
Source/Destination data transfer size is 32 bytes every time

enumerator kEDMA_TransferSize64Bytes
Source/Destination data transfer size is 64 bytes every time

enumerator kEDMA_TransferSize128Bytes
Source/Destination data transfer size is 128 bytes every time

enum _edma_modulo
eDMA modulo configuration

Values:

enumerator kEDMA_ModuloDisable
Disable modulo

enumerator kEDMA_Modulo2bytes
Circular buffer size is 2 bytes.

enumerator kEDMA_Modulo4bytes
Circular buffer size is 4 bytes.

enumerator kEDMA_Modulo8bytes
Circular buffer size is 8 bytes.

enumerator kEDMA_Modulo16bytes
Circular buffer size is 16 bytes.

enumerator kEDMA_Modulo32bytes
Circular buffer size is 32 bytes.

enumerator kEDMA_Modulo64bytes
Circular buffer size is 64 bytes.

enumerator kEDMA_Modulo128bytes
Circular buffer size is 128 bytes.

enumerator kEDMA_Modulo256bytes
Circular buffer size is 256 bytes.

enumerator kEDMA_Modulo512bytes
Circular buffer size is 512 bytes.

enumerator kEDMA_Modulo1Kbytes
Circular buffer size is 1 K bytes.

enumerator kEDMA_Modulo2Kbytes
Circular buffer size is 2 K bytes.

enumerator kEDMA_Modulo4Kbytes
Circular buffer size is 4 K bytes.

enumerator kEDMA_Modulo8Kbytes
Circular buffer size is 8 K bytes.

enumerator kEDMA_Modulo16Kbytes
Circular buffer size is 16 K bytes.

enumerator kEDMA_Modulo32Kbytes
Circular buffer size is 32 K bytes.

enumerator kEDMA_Modulo64Kbytes
Circular buffer size is 64 K bytes.

enumerator kEDMA_Modulo128Kbytes
Circular buffer size is 128 K bytes.

enumerator kEDMA_Modulo256Kbytes
Circular buffer size is 256 K bytes.

enumerator kEDMA_Modulo512Kbytes
Circular buffer size is 512 K bytes.

enumerator kEDMA_Modulo1Mbytes
Circular buffer size is 1 M bytes.

enumerator kEDMA_Modulo2Mbytes
Circular buffer size is 2 M bytes.

enumerator kEDMA_Modulo4Mbytes
Circular buffer size is 4 M bytes.

enumerator kEDMA_Modulo8Mbytes
Circular buffer size is 8 M bytes.

enumerator kEDMA_Modulo16Mbytes
Circular buffer size is 16 M bytes.

enumerator kEDMA_Modulo32Mbytes
Circular buffer size is 32 M bytes.

enumerator kEDMA_Modulo64Mbytes
Circular buffer size is 64 M bytes.

enumerator kEDMA_Modulo128Mbytes
Circular buffer size is 128 M bytes.

enumerator kEDMA_Modulo256Mbytes
Circular buffer size is 256 M bytes.

enumerator kEDMA_Modulo512Mbytes
Circular buffer size is 512 M bytes.

enumerator kEDMA_Modulo1Gbytes
Circular buffer size is 1 G bytes.

enumerator kEDMA_Modulo2Gbytes
Circular buffer size is 2 G bytes.

enum _edma_bandwidth
Bandwidth control.

Values:

enumerator kEDMA_BandwidthStallNone
No eDMA engine stalls.

enumerator kEDMA_BandwidthStall4Cycle
eDMA engine stalls for 4 cycles after each read/write.

enumerator kEDMA_BandwidthStall8Cycle
eDMA engine stalls for 8 cycles after each read/write.

enum _edma_channel_link_type
Channel link type.

Values:

enumerator kEDMA_LinkNone
No channel link

enumerator kEDMA_MinorLink
Channel link after each minor loop

enumerator kEDMA_MajorLink
Channel link while major loop count exhausted

_edma_channel_status_flags eDMA channel status flags.

Values:

enumerator kEDMA_DoneFlag
DONE flag, set while transfer finished, CITER value exhausted

enumerator kEDMA_ErrorFlag
eDMA error flag, an error occurred in a transfer

enumerator kEDMA_InterruptFlag
eDMA interrupt flag, set while an interrupt occurred of this channel

_edma_error_status_flags eDMA channel error status flags.

Values:

enumerator kEDMA_DestinationBusErrorFlag
Bus error on destination address

enumerator kEDMA_SourceBusErrorFlag
Bus error on the source address

enumerator kEDMA_ScatterGatherErrorFlag
Error on the Scatter/Gather address, not 32byte aligned.

enumerator kEDMA_NbytesErrorFlag
NBYTES/CITER configuration error

enumerator kEDMA_DestinationOffsetErrorFlag
Destination offset not aligned with destination size

enumerator kEDMA_DestinationAddressErrorFlag
Destination address not aligned with destination size

enumerator kEDMA_SourceOffsetErrorFlag
Source offset not aligned with source size

enumerator kEDMA_SourceAddressErrorFlag
Source address not aligned with source size

enumerator kEDMA_ErrorChannelFlag
Error channel number of the cancelled channel number

enumerator kEDMA_TransferCanceledFlag
Transfer cancelled

enumerator kEDMA_ValidFlag
No error occurred, this bit is 0. Otherwise, it is 1.

_edma_interrupt_enable eDMA interrupt source

Values:

enumerator kEDMA_ErrorInterruptEnable
Enable interrupt while channel error occurs.

enumerator kEDMA_MajorInterruptEnable
Enable interrupt while major count exhausted.

enumerator kEDMA_HalfInterruptEnable
Enable interrupt while major count to half value.

enum __edma_transfer_type
eDMA transfer type

Values:

enumerator kEDMA_MemoryToMemory
Transfer from memory to memory

enumerator kEDMA_PeripheralToMemory
Transfer from peripheral to memory

enumerator kEDMA_MemoryToPeripheral
Transfer from memory to peripheral

enumerator kEDMA_PeripheralToPeripheral
Transfer from Peripheral to peripheral

enum edma_channel_memory_attribute
eDMA channel memory attribute

Values:

enumerator kEDMA_ChannelNoWriteNoReadNoCacheNoBuffer
No write allocate, no read allocate, non-cacheable, non-bufferable.

enumerator kEDMA_ChannelNoWriteNoReadNoCacheBufferable
No write allocate, no read allocate, non-cacheable, bufferable.

enumerator kEDMA_ChannelNoWriteNoReadCacheableNoBuffer
No write allocate, no read allocate, cacheable, non-bufferable.

enumerator kEDMA_ChannelNoWriteNoReadCacheableBufferable
No write allocate, no read allocate, cacheable, bufferable.

enumerator kEDMA_ChannelNoWriteReadNoCacheNoBuffer
No write allocate, read allocate, non-cacheable, non-bufferable.

enumerator kEDMA_ChannelNoWriteReadNoCacheBufferable
No write allocate, read allocate, non-cacheable, bufferable.

enumerator kEDMA_ChannelNoWriteReadCacheableNoBuffer
No write allocate, read allocate, cacheable, non-bufferable.

enumerator kEDMA_ChannelNoWriteReadCacheableBufferable
No write allocate, read allocate, cacheable, bufferable.

enumerator kEDMA_ChannelWriteNoReadNoCacheNoBuffer
write allocate, no read allocate, non-cacheable, non-bufferable.

enumerator kEDMA_ChannelWriteNoReadNoCacheBufferable
write allocate, no read allocate, non-cacheable, bufferable.

enumerator kEDMA_ChannelWriteNoReadCacheableNoBuffer
write allocate, no read allocate, cacheable, non-bufferable.

enumerator kEDMA_ChannelWriteNoReadCacheableBufferable
write allocate, no read allocate, cacheable, bufferable.

enumerator kEDMA_ChannelWriteReadNoCacheNoBuffer
write allocate, read allocate, non-cacheable, non-bufferable.

enumerator kEDMA_ChannelWriteReadNoCacheBufferable
write allocate, read allocate, non-cacheable, bufferable.

enumerator kEDMA_ChannelWriteReadCacheableNoBuffer
write allocate, read allocate, cacheable, non-bufferable.

enumerator kEDMA_ChannelWriteReadCacheableBufferable
write allocate, read allocate, cacheable, bufferable.

enum _edma_channel_swap_size
eDMA4 channel swap size

Values:

enumerator kEDMA_ChannelSwapDisabled
Swap is disabled.

enumerator kEDMA_ChannelReadWith8bitSwap
Swap occurs with respect to the read 8bit.

enumerator kEDMA_ChannelReadWith16bitSwap
Swap occurs with respect to the read 16bit.

enumerator kEDMA_ChannelReadWith32bitSwap
Swap occurs with respect to the read 32bit.

enumerator kEDMA_ChannelWriteWith8bitSwap
Swap occurs with respect to the write 8bit.

enumerator kEDMA_ChannelWriteWith16bitSwap
Swap occurs with respect to the write 16bit.

enumerator kEDMA_ChannelWriteWith32bitSwap
Swap occurs with respect to the write 32bit.

eDMA channel system bus information, _edma_channel_sys_bus_info

Values:

enumerator kEDMA_PrivilegedAccessLevel
Privileged Access Level for DMA transfers. 0b - User protection level; 1b - Privileged protection level.

enumerator kEDMA_MasterId
DMA's master ID when channel is active and master ID replication is enabled.

enum _edma_channel_access_type
eDMA4 channel access type

Values:

enumerator kEDMA_ChannelDataAccess
Data access for eDMA4 transfers.

enumerator kEDMA_ChannelInstructionAccess
Instruction access for eDMA4 transfers.

enum _edma_channel_protection_level
eDMA4 channel protection level

Values:

enumerator kEDMA_ChannelProtectionLevelUser
user protection level for eDMA transfers.

enumerator kEDMA_ChannelProtectionLevelPrivileged
Privileged protection level eDMA transfers.

typedef enum *_edma_transfer_size* edma_transfer_size_t
eDMA transfer configuration

typedef enum *_edma_modulo* edma_modulo_t
eDMA modulo configuration

typedef enum *_edma_bandwidth* edma_bandwidth_t
Bandwidth control.

typedef enum *_edma_channel_link_type* edma_channel_link_type_t
Channel link type.

typedef enum *_edma_transfer_type* edma_transfer_type_t
eDMA transfer type

typedef struct *_edma_channel_Preemption_config* edma_channel_Preemption_config_t
eDMA channel priority configuration

typedef struct *_edma_minor_offset_config* edma_minor_offset_config_t
eDMA minor offset configuration

typedef enum *edma_channel_memory_attribute* edma_channel_memory_attribute_t

eDMA channel memory attribute

typedef enum *_edma_channel_swap_size* edma_channel_swap_size_t

eDMA4 channel swap size

typedef enum *_edma_channel_access_type* edma_channel_access_type_t

eDMA4 channel access type

typedef enum *_edma_channel_protection_level* edma_channel_protection_level_t

eDMA4 channel protection level

typedef struct *_edma_channel_config* edma_channel_config_t

eDMA4 channel configuration

typedef *edma_core_tcd_t* edma_tcd_t

eDMA TCD.

This structure is same as TCD register which is described in reference manual, and is used to configure the scatter/gather feature as a next hardware TCD.

typedef struct *_edma_transfer_config* edma_transfer_config_t

edma4 channel transfer configuration

The transfer configuration structure support full feature configuration of the transfer control descriptor.

1.To perform a simple transfer, below members should be initialized at least .srcAddr - source address .dstAddr - destination address .srcWidthOfEachTransfer - data width of source address .dstWidthOfEachTransfer - data width of destination address, normally it should be as same as srcWidthOfEachTransfer .bytesEachRequest - bytes to be transferred in each DMA request .totalBytes - total bytes to be transferred .srcOffsetOfEachTransfer - offset value in bytes unit to be applied to source address as each source read is completed .dstOffsetOfEachTransfer - offset value in bytes unit to be applied to destination address as each destination write is completed enablchannelRequest - channel request can be enabled together with transfer configure submission

2.The transfer configuration structure also support advance feature: Programmable source/destination address range(MODULO) Programmable minor loop offset Programmable major loop offset Programmable channel chain feature Programmable channel transfer control descriptor link feature

---

Note: User should pay attention to the transfer size alignment limitation

a. the bytesEachRequest should align with the srcWidthOfEachTransfer and the dstWidthOfEachTransfer that is to say bytesEachRequest % srcWidthOfEachTransfer should be 0

b. the srcOffsetOfEachTransfer and dstOffsetOfEachTransfer must be aligne with transfer width

c. the totalBytes should align with the bytesEachRequest

d. the srcAddr should align with the srcWidthOfEachTransfer

e. the dstAddr should align with the dstWidthOfEachTransfer

f. the srcAddr should align with srcAddrModulo if modulo feature is enabled

g. the dstAddr should align with dstAddrModulo if modulo feature is enabled If anyone of above condition can not be satisfied, the edma4 interfaces will generate assert error.

---

typedef struct *_edma_config* edma_config_t

eDMA global configuration structure.

typedef void (*edma_callback)(struct *_edma_handle* *handle, void *userData, bool transferDone, uint32_t tcds)

Define callback function for eDMA.

This callback function is called in the EDMA interrupt handle. In normal mode, run into callback function means the transfer users need is done. In scatter gather mode, run into callback function means a transfer control block (tcd) is finished. Not all transfer finished, users can get the finished tcd numbers using interface EDMA_GetUnusedTCDNumber.

Param handle
EDMA handle pointer, users shall not touch the values inside.

Param userData
The callback user parameter pointer. Users can use this parameter to involve things users need to change in EDMA callback function.

Param transferDone
If the current loaded transfer done. In normal mode it means if all transfer done. In scatter gather mode, this parameter shows is the current transfer block in EDMA register is done. As the load of core is different, it will be different if the new tcd loaded into EDMA registers while this callback called. If true, it always means new tcd still not loaded into registers, while false means new tcd already loaded into registers.

Param tcds
How many tcds are done from the last callback. This parameter only used in scatter gather mode. It tells user how many tcds are finished between the last callback and this.

typedef struct *_edma_handle* edma_handle_t

eDMA transfer handle structure

FSL_EDMA_DRIVER_EDMA4

eDMA driver name

EDMA_ALLOCATE_TCD(name, number)

Macro used for allocate edma TCD.

DMA_DCHPRI_INDEX(channel)

Compute the offset unit from DCHPRI3.

struct _edma_channel_Preemption_config

#include <fsl_edma.h> eDMA channel priority configuration

Public Members

bool enableChannelPreemption

If true: a channel can be suspended by other channel with higher priority

bool enablePreemptAbility

If true: a channel can suspend other channel with low priority

uint8_t channelPriority

Channel priority

struct _edma_minor_offset_config

#include <fsl_edma.h> eDMA minor offset configuration

Public Members

bool enableSrcMinorOffset
: Enable(true) or Disable(false) source minor loop offset.

bool enableDestMinorOffset
: Enable(true) or Disable(false) destination minor loop offset.

uint32_t minorOffset
: Offset for a minor loop mapping.

struct __edma__channel__config
: *#include <fsl_edma.h>* eDMA4 channel configuration

Public Members

edma_channel_Preemption_config_t channelPreemptionConfig
: channel preemption configuration

edma_channel_memory_attribute_t channelReadMemoryAttribute
: channel memory read attribute configuration

edma_channel_memory_attribute_t channelWriteMemoryAttribute
: channel memory write attribute configuration

edma_channel_swap_size_t channelSwapSize
: channel swap size configuration

edma_channel_access_type_t channelAccessType
: channel access type configuration

uint8_t channelDataSignExtensionBitPosition
: channel data sign extension bit psition configuration

uint32_t channelRequestSource
: hardware service request source for the channel

bool enableMasterIDReplication
: enable master ID replication

edma_channel_protection_level_t protectionLevel
: protection level

struct __edma__transfer__config
: *#include <fsl_edma.h>* edma4 channel transfer configuration

The transfer configuration structure support full feature configuration of the transfer control descriptor.

1.To perform a simple transfer, below members should be initialized at least .srcAddr - source address .dstAddr - destination address .srcWidthOfEachTransfer - data width of source address .dstWidthOfEachTransfer - data width of destination address, normally it should be as same as srcWidthOfEachTransfer .bytesEachRequest - bytes to be transferred in each DMA request .totalBytes - total bytes to be transferred .srcOffsetOfEachTransfer - offset value in bytes unit to be applied to source address as each source read is completed .dstOffsetOfEachTransfer - offset value in bytes unit to be applied to destination address as each destination write is completed enablchannelRequest - channel request can be enabled together with transfer configure submission

2.The transfer configuration structure also support advance feature: Programmable source/destination address range(MODULO) Programmable minor loop offset Programmable major loop offset Programmable channel chain feature Programmable channel transfer control descriptor link feature

---

Note: User should pay attention to the transfer size alignment limitation

a. the bytesEachRequest should align with the srcWidthOfEachTransfer and the dstWidthOfEachTransfer that is to say bytesEachRequest % srcWidthOfEachTransfer should be 0

b. the srcOffsetOfEachTransfer and dstOffsetOfEachTransfer must be aligne with transfer width

c. the totalBytes should align with the bytesEachRequest

d. the srcAddr should align with the srcWidthOfEachTransfer

e. the dstAddr should align with the dstWidthOfEachTransfer

f. the srcAddr should align with srcAddrModulo if modulo feature is enabled

g. the dstAddr should align with dstAddrModulo if modulo feature is enabled If anyone of above condition can not be satisfied, the edma4 interfaces will generate assert error.

Public Members

uint32_t srcAddr

Source data address.

uint32_t destAddr

Destination data address.

edma_transfer_size_t srcTransferSize

Source data transfer size.

edma_transfer_size_t destTransferSize

Destination data transfer size.

int16_t srcOffset

Sign-extended offset value in byte unit applied to the current source address to form the next-state value as each source read is completed

int16_t destOffset

Sign-extended offset value in byte unit applied to the current destination address to form the next-state value as each destination write is completed.

uint32_t minorLoopBytes

bytes in each minor loop or each request range: 1 - (2^30 -1) when minor loop mapping is enabled range: 1 - (2^10 - 1) when minor loop mapping is enabled and source or dest minor loop offset is enabled range: 1 - (2^32 - 1) when minor loop mapping is disabled

uint32_t majorLoopCounts

minor loop counts in each major loop, should be 1 at least for each transfer range: (0 - (2^15 - 1)) when minor loop channel link is disabled range: (0 - (2^9 - 1)) when minor loop channel link is enabled total bytes in a transfer = minorLoopCountsEachMajorLoop * bytesEachMinorLoop

uint16_t enabledInterruptMask

channel interrupt to enable, can be OR'ed value of _edma_interrupt_enable

edma_modulo_t srcAddrModulo
: source circular data queue range

int32_t srcMajorLoopOffset
: source major loop offset

edma_modulo_t dstAddrModulo
: destination circular data queue range

int32_t dstMajorLoopOffset
: destination major loop offset

bool enableSrcMinorLoopOffset
: enable source minor loop offset

bool enableDstMinorLoopOffset
: enable dest minor loop offset

int32_t minorLoopOffset
: burst offset, the offset will be applied after minor loop update

bool enableChannelMajorLoopLink
: channel link when major loop complete

uint32_t majorLoopLinkChannel
: major loop link channel number

bool enableChannelMinorLoopLink
: channel link when minor loop complete

uint32_t minorLoopLinkChannel
: minor loop link channel number

edma_tcd_t *linkTCD
: pointer to the link transfer control descriptor

struct __edma_config
: *#include <fsl_edma.h>* eDMA global configuration structure.

Public Members

bool enableContinuousLinkMode
: Enable (true) continuous link mode. Upon minor loop completion, the channel activates again if that channel has a minor loop channel link enabled and the link channel is itself.

bool enableMasterIdReplication
: Enable (true) master ID replication. If Master ID replication is disabled, the privileged protection level (supervisor mode) for eDMA4 transfers is used.

bool enableGlobalChannelLink
: Enable(true) channel linking is available and controlled by each channel's link settings.

bool enableHaltOnError
: Enable (true) transfer halt on error. Any error causes the HALT bit to set. Subsequently, all service requests are ignored until the HALT bit is cleared.

bool enableDebugMode
: Enable(true) eDMA4 debug mode. When in debug mode, the eDMA4 stalls the start of a new channel. Executing channels are allowed to complete.

bool enableRoundRobinArbitration
: Enable(true) channel linking is available and controlled by each channel's link settings.

edma_channel_config_t *channelConfig[1]
: channel preemption configuration

struct _edma_handle
: *#include <fsl_edma.h>* eDMA transfer handle structure

Public Members

edma_callback callback
: Callback function for major count exhausted.

void *userData
: Callback function parameter.

EDMA_ChannelType *channelBase
: eDMA peripheral channel base address.

EDMA_Type *base
: eDMA peripheral base address

EDMA_TCDType *tcdBase
: eDMA peripheral tcd base address.

edma_tcd_t *tcdPool
: Pointer to memory stored TCDs.

uint32_t channel
: eDMA channel number.

volatile int8_t header
: The first TCD index. Should point to the next TCD to be loaded into the eDMA engine.

volatile int8_t tail
: The last TCD index. Should point to the next TCD to be stored into the memory pool.

volatile int8_t tcdUsed
: The number of used TCD slots. Should reflect the number of TCDs can be used/loaded in the memory.

volatile int8_t tcdSize
: The total number of TCD slots in the queue.

2.7 eDMA core Driver

enum _edma_tcd_type
: eDMA tcd flag type

Values:

enumerator kEDMA_EDMA4Flag
: Data access for eDMA4 transfers.

enumerator kEDMA_EDMA5Flag
: Instruction access for eDMA4 transfers.

typedef struct *_edma_core_mp* edma_core_mp_t
edma core channel struture definition

typedef struct *_edma_core_channel* edma_core_channel_t
edma core channel struture definition

typedef enum *_edma_tcd_type* edma_tcd_type_t
eDMA tcd flag type

typedef struct *_edma5_core_tcd* edma5_core_tcd_t
edma5 core TCD struture definition

typedef struct *_edma4_core_tcd* edma4_core_tcd_t
edma4 core TCD struture definition

typedef struct *_edma_core_tcd* edma_core_tcd_t
edma core TCD struture definition

typedef *edma_core_channel_t* EDMA_ChannelType
EDMA typedef.

typedef *edma_core_tcd_t* EDMA_TCDType

typedef void EDMA_Type

DMA_CORE_MP_CSR_EDBG_MASK

DMA_CORE_MP_CSR_ERCA_MASK

DMA_CORE_MP_CSR_HAE_MASK

DMA_CORE_MP_CSR_HALT_MASK

DMA_CORE_MP_CSR_GCLC_MASK

DMA_CORE_MP_CSR_GMRC_MASK

DMA_CORE_MP_CSR_EDBG(**x**)

DMA_CORE_MP_CSR_ERCA(**x**)

DMA_CORE_MP_CSR_HAE(**x**)

DMA_CORE_MP_CSR_HALT(**x**)

DMA_CORE_MP_CSR_GCLC(**x**)

DMA_CORE_MP_CSR_GMRC(**x**)

DMA_CSR_INTMAJOR_MASK

DMA_CSR_INTHALF_MASK

DMA_CSR_DREQ_MASK

DMA_CSR_ESG_MASK

DMA_CSR_BWC_MASK

DMA_CSR_BWC(**x**)

DMA_CSR_START_MASK

DMA_CITER_ELINKNO_CITER_MASK

DMA_BITER_ELINKNO_BITER_MASK

DMA_CITER_ELINKNO_CITER_SHIFT

DMA_CITER_ELINKYES_CITER_MASK

DMA_CITER_ELINKYES_CITER_SHIFT

DMA_ATTR_SMOD_MASK

DMA_ATTR_DMOD_MASK

DMA_CITER_ELINKNO_ELINK_MASK

DMA_CSR_MAJORELINK_MASK

DMA_BITER_ELINKYES_ELINK_MASK

DMA_CITER_ELINKYES_ELINK_MASK

DMA_CSR_MAJORLINKCH_MASK

DMA_BITER_ELINKYES_LINKCH_MASK

DMA_CITER_ELINKYES_LINKCH_MASK

DMA_NBYTES_MLOFFYES_MLOFF_MASK

DMA_NBYTES_MLOFFYES_DMLOE_MASK

DMA_NBYTES_MLOFFYES_SMLOE_MASK

DMA_NBYTES_MLOFFNO_NBYTES_MASK

DMA_ATTR_DMOD(**x**)

DMA_ATTR_SMOD(**x**)

DMA_BITER_ELINKYES_LINKCH(**x**)

DMA_CITER_ELINKYES_LINKCH(**x**)

DMA_NBYTES_MLOFFYES_MLOFF(**x**)

DMA_NBYTES_MLOFFYES_DMLOE(**x**)

DMA_NBYTES_MLOFFYES_SMLOE(**x**)

DMA_NBYTES_MLOFFNO_NBYTES(**x**)

DMA_NBYTES_MLOFFYES_NBYTES(**x**)

DMA_ATTR_DSIZE(**x**)

DMA_ATTR_SSIZE(**x**)

DMA_CSR_DREQ(**x**)

DMA_CSR_MAJORLINKCH(**x**)

DMA_CH_MATTR_WCACHE(**x**)

DMA_CH_MATTR_RCACHE(**x**)

DMA_CH_CSR_SIGNEXT_MASK

DMA_CH_CSR_SIGNEXT_SHIFT

DMA_CH_CSR_SWAP_MASK

DMA_CH_CSR_SWAP_SHIFT

DMA_CH_SBR_INSTR_MASK

DMA_CH_SBR_INSTR_SHIFT

DMA_CH_MUX_SOURCE(x)

DMA_ERR_DBE_FLAG
: DMA error flag.

DMA_ERR_SBE_FLAG

DMA_ERR_SGE_FLAG

DMA_ERR_NCE_FLAG

DMA_ERR_DOE_FLAG

DMA_ERR_DAE_FLAG

DMA_ERR_SOE_FLAG

DMA_ERR_SAE_FLAG

DMA_ERR_ERRCHAN_FLAG

DMA_ERR_ECX_FLAG

DMA_ERR_FLAG

DMA_CLEAR_DONE_STATUS(base, channel)
: get/clear DONE bit

DMA_GET_DONE_STATUS(base, channel)

DMA_ENABLE_ERROR_INT(base, channel)
: enable/disable error interupt

DMA_DISABLE_ERROR_INT(base, channel)

DMA_CLEAR_ERROR_STATUS(base, channel)
: get/clear error status

DMA_GET_ERROR_STATUS(base, channel)

DMA_CLEAR_INT_STATUS(base, channel)
: get/clear INT status

DMA_GET_INT_STATUS(base, channel)

DMA_ENABLE_MAJOR_INT(base, channel)
: enable/dsiable MAJOR/HALF INT

DMA_ENABLE_HALF_INT(base, channel)

DMA_DISABLE_MAJOR_INT(base, channel)

DMA_DISABLE_HALF_INT(base, channel)

EDMA_TCD_ALIGN_SIZE
EDMA tcd align size.

EDMA_CORE_BASE(base)
EDMA base address convert macro.

EDMA_MP_BASE(base)

EDMA_CHANNEL_BASE(base, channel)

EDMA_TCD_BASE(base, channel)

EDMA_TCD_TYPE(x)
EDMA TCD type macro.

EDMA_TCD_SADDR(tcd, flag)
EDMA TCD address convert macro.

EDMA_TCD_SOFF(tcd, flag)

EDMA_TCD_ATTR(tcd, flag)

EDMA_TCD_NBYTES(tcd, flag)

EDMA_TCD_SLAST(tcd, flag)

EDMA_TCD_DADDR(tcd, flag)

EDMA_TCD_DOFF(tcd, flag)

EDMA_TCD_CITER(tcd, flag)

EDMA_TCD_DLAST_SGA(tcd, flag)

EDMA_TCD_CSR(tcd, flag)

EDMA_TCD_BITER(tcd, flag)

struct _edma_core_mp
#include <fsl_edma_core.h> edma core channel struture definition

Public Members

___IO uint32_t MP_CSR
Channel Control and Status, array offset: 0x10000, array step: 0x10000

___IO uint32_t MP_ES
Channel Error Status, array offset: 0x10004, array step: 0x10000

struct _edma_core_channel
#include <fsl_edma_core.h> edma core channel struture definition

Public Members

___IO uint32_t CH_CSR
Channel Control and Status, array offset: 0x10000, array step: 0x10000

___IO uint32_t CH_ES
Channel Error Status, array offset: 0x10004, array step: 0x10000

___IO uint32_t CH_INT
Channel Interrupt Status, array offset: 0x10008, array step: 0x10000

___IO uint32_t CH_SBR
Channel System Bus, array offset: 0x1000C, array step: 0x10000

___IO uint32_t CH_PRI
Channel Priority, array offset: 0x10010, array step: 0x10000

struct _edma5_core_tcd
#include <fsl_edma_core.h> edma5 core TCD struture definition

Public Members

___IO uint32_t SADDR
SADDR register, used to save source address

___IO uint32_t SADDR_HIGH
SADDR HIGH register, used to save source address

___IO uint16_t SOFF
SOFF register, save offset bytes every transfer

___IO uint16_t ATTR
ATTR register, source/destination transfer size and modulo

___IO uint32_t NBYTES
Nbytes register, minor loop length in bytes

___IO uint32_t SLAST
SLAST register

___IO uint32_t SLAST_SDA_HIGH
SLAST SDA HIGH register

___IO uint32_t DADDR
DADDR register, used for destination address

___IO uint32_t DADDR_HIGH
DADDR HIGH register, used for destination address

___IO uint32_t DLAST_SGA
DLASTSGA register, next tcd address used in scatter-gather mode

___IO uint32_t DLAST_SGA_HIGH
DLASTSGA HIGH register, next tcd address used in scatter-gather mode

___IO uint16_t DOFF
DOFF register, used for destination offset

___IO uint16_t CITER
CITER register, current minor loop numbers, for unfinished minor loop.

___IO uint16_t CSR
CSR register, for TCD control status

___IO uint16_t BITER
BITER register, begin minor loop count.

uint8_t RESERVED[16]
Aligned 64 bytes

struct _edma4_core_tcd
#include <fsl_edma_core.h> edma4 core TCD struture definition

Public Members

___IO uint32_t SADDR
SADDR register, used to save source address

___IO uint16_t SOFF
SOFF register, save offset bytes every transfer

___IO uint16_t ATTR
ATTR register, source/destination transfer size and modulo

___IO uint32_t NBYTES
Nbytes register, minor loop length in bytes

___IO uint32_t SLAST
SLAST register

___IO uint32_t DADDR
DADDR register, used for destination address

___IO uint16_t DOFF
DOFF register, used for destination offset

___IO uint16_t CITER
CITER register, current minor loop numbers, for unfinished minor loop.

___IO uint32_t DLAST_SGA
DLASTSGA register, next tcd address used in scatter-gather mode

___IO uint16_t CSR
CSR register, for TCD control status

___IO uint16_t BITER
BITER register, begin minor loop count.

struct _edma_core_tcd
#include <fsl_edma_core.h> edma core TCD struture definition

union MP_REGS

Public Members

struct *_edma_core_mp* EDMA5_REG

struct EDMA5_REG

Public Members

___IO uint32_t MP_INT_LOW
Channel Control and Status, array offset: 0x10008, array step: 0x10000

___I uint32_t MP_INT_HIGH
Channel Control and Status, array offset: 0x1000C, array step: 0x10000

___I uint32_t MP_HRS_LOW
Channel Control and Status, array offset: 0x10010, array step: 0x10000

___I uint32_t MP_HRS_HIGH
Channel Control and Status, array offset: 0x10014, array step: 0x10000

___IO uint32_t MP_STOPCH
Channel Control and Status, array offset: 0x10020, array step: 0x10000

___I uint32_t MP_SSR_LOW
Channel Control and Status, array offset: 0x10030, array step: 0x10000

___I uint32_t MP_SSR_HIGH
Channel Control and Status, array offset: 0x10034, array step: 0x10000

___IO uint32_t CH_GRPRI [64]
Channel Control and Status, array offset: 0x10100, array step: 0x10000

___IO uint32_t CH_MUX [64]
Channel Control and Status, array offset: 0x10200, array step: 0x10000

___IO uint32_t CH_PROT [64]
Channel Control and Status, array offset: 0x10400, array step: 0x10000

union CH_REGS

Public Members

struct *_edma_core_channel* EDMA5_REG

struct *_edma_core_channel* EDMA4_REG

struct EDMA5_REG

Public Members

___IO uint32_t CH_MATTR
Memory Attributes Register, array offset: 0x10018, array step: 0x8000

struct EDMA4_REG

Public Members

___IO uint32_t CH_MUX
Channel Multiplexor Configuration, array offset: 0x10014, array step: 0x10000

___IO uint16_t CH_MATTR
Memory Attributes Register, array offset: 0x10018, array step: 0x8000

union TCD_REGS

Public Members

edma4_core_tcd_t edma4_tcd

2.8 eDMA soc Driver

enum _dma_request_source
dma request source

Values:

enumerator DmaRequestDisabled
DSisabled

enumerator Dma3RequestMuxCAN1
CAN1

enumerator Dma3RequestMuxLPTMR1Request
LPTMR1 Request

enumerator Dma3RequestMuxELERequest
ELE Request

enumerator Dma3RequestMuxTPM1OverflowRequest
TPM1 Overflow Request

enumerator Dma3RequestMuxTPM2OverflowRequest
TPM2 Overflow Request

enumerator Dma3RequestMuxPDMRequest
PDM

enumerator Dma3RequestMuxADC1Request
ADC1

enumerator Dma3RequestMuxGPIO1Request0
GPIO1 channel 0

enumerator Dma3RequestMuxGPIO1Request1
GPIO1 channel 1

enumerator Dma3RequestMuxI3C1ToBusRequest
I3C1 To-bus Request

enumerator Dma3RequestMuxI3C1FromBusRequest
I3C1 From-bus Request

enumerator Dma3RequestMuxLPI2C1Tx
LPI2C1

enumerator Dma3RequestMuxLPI2C1Rx
LPI2C1

enumerator Dma3RequestMuxLPI2C2Tx
LPI2C2

enumerator Dma3RequestMuxLPI2C2Rx
LPI2C2

enumerator Dma3RequestMuxLPSPI1Tx
LPSPI1 Transmit

enumerator Dma3RequestMuxLPSPI1Rx
LPSPI1 Receive

enumerator Dma3RequestMuxLPSPI2Tx
LPSPI2 Transmit

enumerator Dma3RequestMuxLPSPI2Rx
LPSPI2 Receive

enumerator Dma3RequestMuxLPUART1Tx
LPUART1 Transmit

enumerator Dma3RequestMuxLPUART1Rx
LPUART1 Receive

enumerator Dma3RequestMuxLPUART2Tx
LPUART2 Transmit

enumerator Dma3RequestMuxLPUART2Rx
LPUART2 Receive

enumerator Dma3RequestMuxSai1Tx
SAI1 Transmit

enumerator Dma3RequestMuxSai1Rx
SAI1 Receive

enumerator Dma3RequestMuxTPM1Request0Request2
TPM1 request 0 and request 2

enumerator Dma3RequestMuxTPM1Request1Request3
TPM1 request 1 and request 3

enumerator Dma3RequestMuxTPM2Request0Request2
TPM2 request 0 and request 2

enumerator Dma3RequestMuxTPM2Request1Request3
TPM2 request 1 and request 3

enumerator Dma5RequestMuxCAN2
CAN2

enumerator Dma5RequestMuxGPIO2Request0
GPIO2 channel 0

enumerator Dma5RequestMuxGPIO2Request1
GPIO2 channel 1

enumerator Dma5RequestMuxGPIO3Request0
GPIO3 channel 0

enumerator Dma5RequestMuxGPIO3Request1
GPIO3 channel 1

enumerator Dma5RequestMuxI3C2ToBusRequest
I3C2 To-bus Request

enumerator Dma5RequestMuxI3C2FromBusRequest
I3C2 From-bus Request

enumerator Dma5RequestMuxLPI2C3Tx
LPI2C3

enumerator Dma5RequestMuxLPI2C3Rx
LPI2C3

enumerator Dma5RequestMuxLPI2C4Tx
LPI2C4

enumerator Dma5RequestMuxLPI2C4Rx
LPI2C2

enumerator Dma5RequestMuxLPSPI3Tx
LPSPI3 Transmit

enumerator Dma5RequestMuxLPSPI3Rx
LPSPI3 Receive

enumerator Dma5RequestMuxLPSPI4Tx
LPSPI4 Transmit

enumerator Dma5RequestMuxLPSPI4Rx
LPSPI4 Receive

enumerator Dma5RequestMuxLPTMR2Request
LPTMR2 Request

enumerator Dma5RequestMuxLPUART3Tx
LPUART3 Transmit

enumerator Dma5RequestMuxLPUART3Rx
LPUART3 Receive

enumerator Dma5RequestMuxLPUART4Tx
LPUART4 Transmit

enumerator Dma5RequestMuxLPUART4Rx
LPUART4 Receive

enumerator Dma5RequestMuxLPUART5Tx
LPUART5 Transmit

enumerator Dma5RequestMuxLPUART5Rx
LPUART5 Receive

enumerator Dma5RequestMuxLPUART6Tx
LPUART6 Transmit

enumerator Dma5RequestMuxLPUART6Rx
LPUART6 Receive

enumerator Dma5RequestMuxTPM3Request0Request2
TPM3 request 0 and request 2

enumerator Dma5RequestMuxTPM3Request1Request3
TPM3 request 1 and request 3

enumerator Dma5RequestMuxTPM3OverflowRequest
TPM3 Overflow request

enumerator Dma5RequestMuxTPM4Request0Request2
TPM4 request 0 and request 2

enumerator Dma5RequestMuxTPM4Request1Request3
TPM4 request 1 and request 3

enumerator Dma5RequestMuxTPM4OverflowRequest
TPM4 Overflow request

enumerator Dma5RequestMuxTPM5Request0Request2
TPM5 request 0 and request 2

enumerator Dma5RequestMuxTPM5Request1Request3
TPM5 request 1 and request 3

enumerator Dma5RequestMuxTPM5OverflowRequest
TPM5 Overflow request

enumerator Dma5RequestMuxTPM6Request0Request2
TPM6 request 0 and request 2

enumerator Dma5RequestMuxTPM6Request1Request3
TPM6 request 1 and request 3

enumerator Dma5RequestMuxTPM6OverflowRequest
TPM6 Overflow request

enumerator Dma5RequestMuxFlexIO1Request0
FlexIO1 Request0

enumerator Dma5RequestMuxFlexIO1Request1
FlexIO1 Request1

enumerator Dma5RequestMuxFlexIO1Request2
FlexIO1 Request2

enumerator Dma5RequestMuxFlexIO1Request3
FlexIO1 Request3

enumerator Dma5RequestMuxFlexIO1Request4
FlexIO1 Request4

enumerator Dma5RequestMuxFlexIO1Request5
FlexIO1 Request5

enumerator Dma5RequestMuxFlexIO1Request6
FlexIO1 Request6

enumerator Dma5RequestMuxFlexIO1Request7
FlexIO1 Request7

enumerator Dma5RequestMuxFlexIO2Request0
FlexIO2 Request0

enumerator Dma5RequestMuxFlexIO2Request1
FlexIO2 Request1

enumerator Dma5RequestMuxFlexIO2Request2
FlexIO2 Request2

enumerator Dma5RequestMuxFlexIO2Request3
FlexIO2 Request3

enumerator Dma5RequestMuxFlexIO2Request4
FlexIO2 Request4

enumerator Dma5RequestMuxFlexIO2Request5
FlexIO2 Request5

enumerator Dma5RequestMuxFlexIO2Request6
FlexIO2 Request6

enumerator Dma5RequestMuxFlexIO2Request7
FlexIO2 Request7

enumerator Dma5RequestMuxFlexSPI1Tx
FlexSPI1 Transmit

enumerator Dma5RequestMuxFlexSPI1Rx
FlexSPI1 Receive

enumerator Dma5RequestMuxGPIO5Request0
GPIO5 Request0

enumerator Dma5RequestMuxGPIO5Request1
GPIO5 Request1

enumerator Dma5RequestMuxCAN3
CAN3

enumerator Dma5RequestMuxSai2Tx
SAI2 Transmit

enumerator Dma5RequestMuxSai2Rx
SAI2 Receive

enumerator Dma5RequestMuxSai3Tx
SAI3 Transmit

enumerator Dma5RequestMuxSai3Rx
SAI3 Receive

enumerator Dma5RequestMuxGPIO4Request0
GPIO4 Request0

enumerator Dma5RequestMuxGPIO4Request1
GPIO4 Request1

enumerator Dma5RequestMuxeARCRequest0
eARC enhanced Audio Return Channel

enumerator Dma5RequestMuxeARCRequest1
eARC enhanced Audio Return Channel

enumerator Dma5RequestMuxSai4Tx
SAI4 Transmit

enumerator Dma5RequestMuxSai4Rx
SAI4 Receive

enumerator Dma5RequestMuxSai5Tx
SAI5 Transmit

enumerator Dma5RequestMuxSai5Rx
SAI5 Receive

enumerator Dma5RequestMuxLPI2C5Tx
LPI2C5

enumerator Dma5RequestMuxLPI2C5Rx
LPI2C5

enumerator Dma5RequestMuxLPI2C6Tx
LPI2C6

enumerator Dma5RequestMuxLPI2C6Rx
LPI2C6

enumerator Dma5RequestMuxLPI2C7Tx
LPI2C7

enumerator Dma5RequestMuxLPI2C7Rx
LPI2C7

enumerator Dma5RequestMuxLPI2C8Tx
LPI2C8

enumerator Dma5RequestMuxLPI2C8Rx
LPI2C8

enumerator Dma5RequestMuxLPSPI5Tx
LPSPI5 Transmit

enumerator Dma5RequestMuxLPSPI5Rx
LPSPI5 Receive

enumerator Dma5RequestMuxLPSPI6Tx
LPSPI6 Transmit

enumerator Dma5RequestMuxLPSPI6Rx
LPSPI6 Receive

enumerator Dma5RequestMuxLPSPI7Tx
LPSPI7 Transmit

enumerator Dma5RequestMuxLPSPI7Rx
LPSPI7 Receive

enumerator Dma5RequestMuxLPSPI8Tx
LPSPI8 Transmit

enumerator Dma5RequestMuxLPSPI8Rx
LPSPI8 Receive

enumerator Dma5RequestMuxLPUART7Tx
LPUART7 Transmit

enumerator Dma5RequestMuxLPUART7Rx
LPUART7 Receive

enumerator Dma5RequestMuxLPUART8Tx
LPUART8 Transmit

enumerator Dma5RequestMuxLPUART8Rx
LPUART8 Receive

enumerator Dma5RequestMuxCAN4
CAN4

enumerator Dma5RequestMuxCAN5
CAN5

typedef enum *_dma_request_source* dma_request_source_t
dma request source

Verify dma base and request source

FSL_EDMA_SOC_DRIVER_VERSION
Driver version 2.0.0.

FSL_EDMA_SOC_IP_DMA3
DMA IP version.

FSL_EDMA_SOC_IP_DMA5

EDMA_BASE_PTRS
DMA base table.

EDMA_CHN_IRQS

EDMA_CHANNEL_HAS_REQUEST_SOURCE(base, source)

EDMA_CHANNEL_OFFSET
EDMA base address convert macro.

EDMA_CHANNEL_ARRAY_STEP(base)

2.9 EIM: error injection module

FSL_ERM_DRIVER_VERSION
Driver version.

void EIM_Init(EIM_Type *base)
EIM module initialization function.

Parameters

- base – EIM base address.

void EIM_Deinit(EIM_Type *base)
De-initializes the EIM.

2.10 ERM: error recording module

void ERM_Init(ERM_Type *base)
ERM module initialization function.

Parameters

- base – ERM base address.

void ERM_Deinit(ERM_Type *base)
De-initializes the ERM.

static inline void ERM_EnableInterrupts(ERM_Type *base, erm_memory_channel_t channel, uint32_t mask)
ERM enable interrupts.

Parameters

- base – ERM peripheral base address.
- channel – memory channel.
- mask – single correction interrupt or non-correction interrupt enable to disable for one specific memory region. Refer to "_erm_interrupt_enable" enumeration.

static inline void ERM_DisableInterrupts(ERM_Type *base, erm_memory_channel_t channel, uint32_t mask)
ERM module disable interrupts.

Parameters

- base – ERM base address.
- channel – memory channel.

- mask – single correction interrupt or non-correction interrupt enable to disable for one specific memory region. Refer to "_erm_interrupt_enable" enumeration.

static inline uint32_t ERM_GetInterruptStatus(ERM_Type *base, erm_memory_channel_t channel)

Gets ERM interrupt flags.

Parameters

- base – ERM peripheral base address.

Returns

ERM event flags.

static inline void ERM_ClearInterruptStatus(ERM_Type *base, erm_memory_channel_t channel, uint32_t mask)

ERM module clear interrupt status flag.

Parameters

- base – ERM base address.
- mask – event flag to clear. Refer to "_erm_interrupt_flag" enumeration.

uint32_t ERM_GetMemoryErrorAddr(ERM_Type *base, erm_memory_channel_t channel)

ERM get memory error absolute address, which capturing the address of the last ECC event in Memory n.

Parameters

- base – ERM base address.
- channel – memory channel.

Return values

memory – error absolute address.

uint32_t ERM_GetSyndrome(ERM_Type *base, erm_memory_channel_t channel)

ERM get syndrome, which identifies the pertinent bit position on a correctable, single-bit data inversion or a non-correctable, single-bit address inversion. The syndrome value does not provide any additional diagnostic information on non-correctable, multi-bit inversions.

Parameters

- base – ERM base address.
- channel – memory channel.

Return values

syndrome – value.

uint32_t ERM_GetErrorCount(ERM_Type *base, erm_memory_channel_t channel)

ERM get error count, which records the count value of the number of correctable ECC error events for Memory n. Non-correctable errors are considered a serious fault, so the ERM does not provide any mechanism to count non-correctable errors. Only correctable errors are counted.

Parameters

- base – ERM base address.
- channel – memory channel.

Return values

error – count.

void ERM_ResetErrorCount(ERM_Type *base, erm_memory_channel_t channel)

ERM reset error count.

Parameters

- base – ERM base address.
- channel – memory channel.

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ERM interrupt configuration structure, default settings all disabled, _erm_interrupt_enable.

This structure contains the settings for all of the ERM interrupt configurations.

Values:

enumerator kERM_SingleCorrectionIntEnable

Single Correction Interrupt Notification enable.

enumerator kERM_NonCorrectableIntEnable

Non-Correction Interrupt Notification enable.

enumerator kERM_AllInterruptsEnable

All Interrupts enable

ERM interrupt status, _erm_interrupt_flag.

This provides constants for the ERM event status for use in the ERM functions.

Values:

enumerator kERM_SingleBitCorrectionIntFlag

Single-Bit Correction Event.

enumerator kERM_NonCorrectableErrorIntFlag

Non-Correctable Error Event.

enumerator kERM_AllIntsFlag

All Events.

2.11 FGPIO Driver

2.12 FlexCAN: Flex Controller Area Network Driver

2.13 FlexCAN Driver

bool FLEXCAN_IsInstanceHasFDMode(CAN_Type *base)

Determine whether the FlexCAN instance support CAN FD mode at run time.

Note: Use this API only if different soc parts share the SOC part name macro define. Otherwise, a different SOC part name can be used to determine at compile time whether the FlexCAN instance supports CAN FD mode or not. If need use this API to determine if CAN FD mode is supported, the FLEXCAN_Init function needs to be executed first, and then call this

API and use the return to value determines whether to supports CAN FD mode, if return true, continue calling FLEXCAN_FDInit to enable CAN FD mode.

Parameters

- base – FlexCAN peripheral base address.

Returns

return TRUE if instance support CAN FD mode, FALSE if instance only support classic CAN (2.0) mode.

status_t FLEXCAN_EnterFreezeMode(CAN_Type *base)

Enter FlexCAN Freeze Mode.

This function makes the FlexCAN work under Freeze Mode.

Parameters

- base – FlexCAN peripheral base address.

Returns

kStatus_Success Enter Freeze Mode successful kStatus_Timeout Timeout when wait for Freeze Mode Acknowledge

status_t FLEXCAN_ExitFreezeMode(CAN_Type *base)

Exit FlexCAN Freeze Mode.

This function makes the FlexCAN leave Freeze Mode.

Parameters

- base – FlexCAN peripheral base address.

Returns

kStatus_Success Enter Freeze Mode successful kStatus_Timeout Timeout when wait for Freeze Mode Acknowledge

uint32_t FLEXCAN_GetInstance(CAN_Type *base)

Get the FlexCAN instance from peripheral base address.

Parameters

- base – FlexCAN peripheral base address.

Returns

FlexCAN instance.

bool FLEXCAN_CalculateImprovedTimingValues(CAN_Type *base, uint32_t bitRate, uint32_t sourceClock_Hz, *flexcan_timing_config_t* *pTimingConfig)

Calculates the improved timing values by specific bit Rates for classical CAN.

This function use to calculates the Classical CAN timing values according to the given bit rate. The Calculated timing values will be set in CTRL1/CBT/ENCBT register. The calculation is based on the recommendation of the CiA 301 v4.2.0 and previous version document.

Parameters

- base – FlexCAN peripheral base address.
- bitRate – The classical CAN speed in bps defined by user, should be less than or equal to 1Mbps.
- sourceClock_Hz – The Source clock frequency in Hz.
- pTimingConfig – Pointer to the FlexCAN timing configuration structure.

Returns

TRUE if timing configuration found, FALSE if failed to find configuration.

void FLEXCAN_Init(CAN_Type *base, const *flexcan_config_t* *pConfig, uint32_t sourceClock_Hz)

Initializes a FlexCAN instance.

This function initializes the FlexCAN module with user-defined settings. This example shows how to set up the flexcan_config_t parameters and how to call the FLEXCAN_Init function by passing in these parameters.

```
flexcan_config_t flexcanConfig;
flexcanConfig.clkSrc                 = kFLEXCAN_ClkSrc0;
flexcanConfig.bitRate                = 1000000U;
flexcanConfig.maxMbNum               = 16;
flexcanConfig.enableLoopBack         = false;
flexcanConfig.enableSelfWakeup       = false;
flexcanConfig.enableIndividMask      = false;
flexcanConfig.enableDoze             = false;
flexcanConfig.disableSelfReception   = false;
flexcanConfig.enableListenOnlyMode   = false;
flexcanConfig.timingConfig           = timingConfig;
FLEXCAN_Init(CAN0, &flexcanConfig, 40000000UL);
```

Parameters

- base – FlexCAN peripheral base address.
- pConfig – Pointer to the user-defined configuration structure.
- sourceClock_Hz – FlexCAN Protocol Engine clock source frequency in Hz.

bool FLEXCAN_FDCalculateImprovedTimingValues(CAN_Type *base, uint32_t bitRate, uint32_t bitRateFD, uint32_t sourceClock_Hz, *flexcan_timing_config_t* *pTimingConfig)

Calculates the improved timing values by specific bit rates for CANFD.

This function use to calculates the CANFD timing values according to the given nominal phase bit rate and data phase bit rate. The Calculated timing values will be set in CBT/ENCBT and FDCBT/EDCBT registers. The calculation is based on the recommendation of the CiA 1301 v1.0.0 document.

Parameters

- base – FlexCAN peripheral base address.
- bitRate – The CANFD bus control speed in bps defined by user.
- bitRateFD – The CAN FD data phase speed in bps defined by user. Equal to bitRate means disable bit rate switching.
- sourceClock_Hz – The Source clock frequency in Hz.
- pTimingConfig – Pointer to the FlexCAN timing configuration structure.

Returns

TRUE if timing configuration found, FALSE if failed to find configuration

void FLEXCAN_FDInit(CAN_Type *base, const *flexcan_config_t* *pConfig, uint32_t sourceClock_Hz, *flexcan_mb_size_t* dataSize, bool brs)

Initializes a FlexCAN instance.

This function initializes the FlexCAN module with user-defined settings. This example shows how to set up the flexcan_config_t parameters and how to call the FLEXCAN_FDInit function by passing in these parameters.

```
flexcan_config_t flexcanConfig;
flexcanConfig.clkSrc                 = kFLEXCAN_ClkSrc0;
flexcanConfig.bitRate                = 1000000U;
flexcanConfig.bitRateFD              = 2000000U;
flexcanConfig.maxMbNum               = 16;
flexcanConfig.enableLoopBack         = false;
flexcanConfig.enableSelfWakeup       = false;
flexcanConfig.enableIndividMask      = false;
flexcanConfig.disableSelfReception = false;
flexcanConfig.enableListenOnlyMode = false;
flexcanConfig.enableDoze             = false;
flexcanConfig.timingConfig           = timingConfig;
FLEXCAN_FDInit(CAN0, &flexcanConfig, 80000000UL, kFLEXCAN_16BperMB, true);
```

Parameters

- base – FlexCAN peripheral base address.
- pConfig – Pointer to the user-defined configuration structure.
- sourceClock_Hz – FlexCAN Protocol Engine clock source frequency in Hz.
- dataSize – FlexCAN Message Buffer payload size. The actual transmitted or received CAN FD frame data size needs to be less than or equal to this value.
- brs – True if bit rate switch is enabled in FD mode.

void FLEXCAN_Deinit(CAN_Type *base)

De-initializes a FlexCAN instance.

This function disables the FlexCAN module clock and sets all register values to the reset value.

Parameters

- base – FlexCAN peripheral base address.

void FLEXCAN_GetDefaultConfig(*flexcan_config_t* *pConfig)

Gets the default configuration structure.

This function initializes the FlexCAN configuration structure to default values. The default values are as follows. flexcanConfig->clkSrc = kFLEXCAN_ClkSrc0; flexcanConfig->bitRate = 1000000U; flexcanConfig->bitRateFD = 2000000U; flexcanConfig->maxMbNum = 16; flexcanConfig->enableLoopBack = false; flexcanConfig->enableSelfWakeup = false; flexcanConfig->enableIndividMask = false; flexcanConfig->disableSelfReception = false; flexcanConfig->enableListenOnlyMode = false; flexcanConfig->enableDoze = false; flexcanConfig->enablePretendedeNetworking = false; flexcanConfig->enableMemoryErrorControl = true; flexcanConfig->enableNonCorrectableErrorEnterFreeze = true; flexcanConfig->enableTransceiverDelayMeasure = true; flexcanConfig->enableRemoteRequestFrameStored = true; flexcanConfig->payloadEndianness = kFLEXCAN_bigEndian; flexcanConfig.timingConfig = timingConfig;

Parameters

- pConfig – Pointer to the FlexCAN configuration structure.

void FLEXCAN_SetTimingConfig(CAN_Type *base, const *flexcan_timing_config_t* *pConfig)

Sets the FlexCAN classical CAN protocol timing characteristic.

This function gives user settings to classical CAN or CAN FD nominal phase timing characteristic. The function is for an experienced user. For less experienced users, call the FLEXCAN_SetBitRate() instead.

Note: Calling FLEXCAN_SetTimingConfig() overrides the bit rate set in FLEXCAN_Init() or FLEXCAN_SetBitRate().

Parameters

- base – FlexCAN peripheral base address.
- pConfig – Pointer to the timing configuration structure.

status_t FLEXCAN_SetBitRate(CAN_Type *base, uint32_t sourceClock_Hz, uint32_t bitRate_Bps)

Set bit rate of FlexCAN classical CAN frame or CAN FD frame nominal phase.

This function set the bit rate of classical CAN frame or CAN FD frame nominal phase base on FLEXCAN_CalculateImprovedTimingValues() API calculated timing values.

Note: Calling FLEXCAN_SetBitRate() overrides the bit rate set in FLEXCAN_Init().

Parameters

- base – FlexCAN peripheral base address.
- sourceClock_Hz – Source Clock in Hz.
- bitRate_Bps – Bit rate in Bps.

Returns

kStatus_Success - Set CAN baud rate (only Nominal phase) successfully.

void FLEXCAN_SetFDTimingConfig(CAN_Type *base, const *flexcan_timing_config_t* *pConfig)

Sets the FlexCAN CANFD data phase timing characteristic.

This function gives user settings to CANFD data phase timing characteristic. The function is for an experienced user. For less experienced users, call the FLEXCAN_SetFDBitRate() to set both Nominal/Data bit Rate instead.

Note: Calling FLEXCAN_SetFDTimingConfig() overrides the data phase bit rate set in FLEXCAN_FDInit()/FLEXCAN_SetFDBitRate().

Parameters

- base – FlexCAN peripheral base address.
- pConfig – Pointer to the timing configuration structure.

status_t FLEXCAN_SetFDBitRate(CAN_Type *base, uint32_t sourceClock_Hz, uint32_t bitRateN_Bps, uint32_t bitRateD_Bps)

Set bit rate of FlexCAN FD frame.

This function set the baud rate of FLEXCAN FD base on FLEXCAN_FDCalculateImprovedTimingValues() API calculated timing values.

Parameters

- base – FlexCAN peripheral base address.
- sourceClock_Hz – Source Clock in Hz.
- bitRateN_Bps – Nominal bit Rate in Bps.
- bitRateD_Bps – Data bit Rate in Bps.

Returns

kStatus_Success - Set CAN FD bit rate (include Nominal and Data phase) successfully.

void FLEXCAN_SetRxMbGlobalMask(CAN_Type *base, uint32_t mask)

Sets the FlexCAN receive message buffer global mask.

This function sets the global mask for the FlexCAN message buffer in a matching process. The configuration is only effective when the Rx individual mask is disabled in the FLEXCAN_Init().

Parameters

- base – FlexCAN peripheral base address.
- mask – Rx Message Buffer Global Mask value.

void FLEXCAN_SetRxFifoGlobalMask(CAN_Type *base, uint32_t mask)

Sets the FlexCAN receive FIFO global mask.

This function sets the global mask for FlexCAN FIFO in a matching process.

Parameters

- base – FlexCAN peripheral base address.
- mask – Rx Fifo Global Mask value.

void FLEXCAN_SetRxIndividualMask(CAN_Type *base, uint8_t maskIdx, uint32_t mask)

Sets the FlexCAN receive individual mask.

This function sets the individual mask for the FlexCAN matching process. The configuration is only effective when the Rx individual mask is enabled in the FLEXCAN_Init(). If the Rx FIFO is disabled, the individual mask is applied to the corresponding Message Buffer. If the Rx FIFO is enabled, the individual mask for Rx FIFO occupied Message Buffer is applied to the Rx Filter with the same index. Note that only the first 32 individual masks can be used as the Rx FIFO filter mask.

Parameters

- base – FlexCAN peripheral base address.
- maskIdx – The Index of individual Mask.
- mask – Rx Individual Mask value.

void FLEXCAN_SetTxMbConfig(CAN_Type *base, uint8_t mbIdx, bool enable)

Configures a FlexCAN transmit message buffer.

This function aborts the previous transmission, cleans the Message Buffer, and configures it as a Transmit Message Buffer.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The Message Buffer index.
- enable – Enable/disable Tx Message Buffer.
  - true: Enable Tx Message Buffer.
  - false: Disable Tx Message Buffer.

void FLEXCAN_SetRxMbConfig(CAN_Type *base, uint8_t mbIdx, const *flexcan_rx_mb_config_t* *pRxMbConfig, bool enable)

Configures a FlexCAN Receive Message Buffer.

This function cleans a FlexCAN build-in Message Buffer and configures it as a Receive Message Buffer. User should invoke this API when CTRL2[RRS]=1. When CTRL2[RRS]=1, frame's

ID is compared to the IDs of the receive mailboxes with the CODE field configured as kFLEXCAN_RxMbEmpty, kFLEXCAN_RxMbFull or kFLEXCAN_RxMbOverrun. Message buffer will store the remote frame in the same fashion of a data frame. No automatic remote response frame will be generated. User need to setup another message buffer to respond remote request.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The Message Buffer index.
- pRxMbConfig – Pointer to the FlexCAN Message Buffer configuration structure.
- enable – Enable/disable Rx Message Buffer.
  - true: Enable Rx Message Buffer.
  - false: Disable Rx Message Buffer.

void FLEXCAN_SetFDTxMbConfig(CAN_Type *base, uint8_t mbIdx, bool enable)

Configures a FlexCAN transmit message buffer.

This function aborts the previous transmission, cleans the Message Buffer, and configures it as a Transmit Message Buffer.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The Message Buffer index.
- enable – Enable/disable Tx Message Buffer.
  - true: Enable Tx Message Buffer.
  - false: Disable Tx Message Buffer.

void FLEXCAN_SetFDRxMbConfig(CAN_Type *base, uint8_t mbIdx, const *flexcan_rx_mb_config_t* *pRxMbConfig, bool enable)

Configures a FlexCAN Receive Message Buffer.

This function cleans a FlexCAN build-in Message Buffer and configures it as a Receive Message Buffer.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The Message Buffer index.
- pRxMbConfig – Pointer to the FlexCAN Message Buffer configuration structure.
- enable – Enable/disable Rx Message Buffer.
  - true: Enable Rx Message Buffer.
  - false: Disable Rx Message Buffer.

void FLEXCAN_SetRemoteResponseMbConfig(CAN_Type *base, uint8_t mbIdx, const *flexcan_frame_t* *pFrame)

Configures a FlexCAN Remote Response Message Buffer.

User should invoke this API when CTRL2[RRS]=0. When CTRL2[RRS]=0, frame's ID is compared to the IDs of the receive mailboxes with the CODE field configured as kFLEXCAN_RxMbRanswer. If there is a matching ID, then this mailbox content will be transmitted as response. The received remote request frame is not stored in receive buffer. It is only used to trigger a transmission of a frame in response.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The Message Buffer index.
- pFrame – Pointer to CAN message frame structure for response.

void FLEXCAN_SetRxFifoConfig(CAN_Type *base, const *flexcan_rx_fifo_config_t* *pRxFifoConfig, bool enable)

Configures the FlexCAN Legacy Rx FIFO.

This function configures the FlexCAN Rx FIFO with given configuration.

Note: Legacy Rx FIFO only can receive classic CAN message.

Parameters

- base – FlexCAN peripheral base address.
- pRxFifoConfig – Pointer to the FlexCAN Legacy Rx FIFO configuration structure. Can be NULL when enable parameter is false.
- enable – Enable/disable Legacy Rx FIFO.
  - true: Enable Legacy Rx FIFO.
  - false: Disable Legacy Rx FIFO.

void FLEXCAN_SetEnhancedRxFifoConfig(CAN_Type *base, const *flexcan_enhanced_rx_fifo_config_t* *pConfig, bool enable)

Configures the FlexCAN Enhanced Rx FIFO.

This function configures the Enhanced Rx FIFO with given configuration.

Note: Enhanced Rx FIFO support receive classic CAN or CAN FD messages, Legacy Rx FIFO and Enhanced Rx FIFO cannot be enabled at the same time.

Parameters

- base – FlexCAN peripheral base address.
- pConfig – Pointer to the FlexCAN Enhanced Rx FIFO configuration structure. Can be NULL when enable parameter is false.
- enable – Enable/disable Enhanced Rx FIFO.
  - true: Enable Enhanced Rx FIFO.
  - false: Disable Enhanced Rx FIFO.

void FLEXCAN_SetPNConfig(CAN_Type *base, const *flexcan_pn_config_t* *pConfig)

Configures the FlexCAN Pretended Networking mode.

This function configures the FlexCAN Pretended Networking mode with given configuration.

Parameters

- base – FlexCAN peripheral base address.
- pConfig – Pointer to the FlexCAN Rx FIFO configuration structure.

static inline uint64_t FLEXCAN_GetStatusFlags(CAN_Type *base)

Gets the FlexCAN module interrupt flags.

This function gets all FlexCAN status flags. The flags are returned as the logical OR value of the enumerators _flexcan_flags. To check the specific status, compare the return value with enumerators in _flexcan_flags.

Parameters

- base – FlexCAN peripheral base address.

Returns

FlexCAN status flags which are ORed by the enumerators in the _flexcan_flags.

static inline void FLEXCAN_ClearStatusFlags(CAN_Type *base, uint64_t mask)

Clears status flags with the provided mask.

This function clears the FlexCAN status flags with a provided mask. An automatically cleared flag can't be cleared by this function.

Parameters

- base – FlexCAN peripheral base address.
- mask – The status flags to be cleared, it is logical OR value of _flexcan_flags.

static inline void FLEXCAN_GetBusErrCount(CAN_Type *base, uint8_t *txErrBuf, uint8_t *rxErrBuf)

Gets the FlexCAN Bus Error Counter value.

This function gets the FlexCAN Bus Error Counter value for both Tx and Rx direction. These values may be needed in the upper layer error handling.

Parameters

- base – FlexCAN peripheral base address.
- txErrBuf – Buffer to store Tx Error Counter value.
- rxErrBuf – Buffer to store Rx Error Counter value.

static inline uint64_t FLEXCAN_GetMbStatusFlags(CAN_Type *base, uint64_t mask)

Gets the FlexCAN low 64 Message Buffer interrupt flags.

This function gets the interrupt flags of a given Message Buffers.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

Returns

The status of given Message Buffers.

static inline uint64_t FLEXCAN_GetHigh64MbStatusFlags(CAN_Type *base, uint64_t mask)

Gets the FlexCAN High 64 Message Buffer interrupt flags.

Valid only if the number of available MBs exceeds 64.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

Returns

The status of given Message Buffers.

static inline void FLEXCAN_ClearMbStatusFlags(CAN_Type *base, uint64_t mask)

Clears the FlexCAN low 64 Message Buffer interrupt flags.

This function clears the interrupt flags of a given Message Buffers.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

static inline void FLEXCAN_ClearHigh64MbStatusFlags(CAN_Type *base, uint64_t mask)

Clears the FlexCAN High 64 Message Buffer interrupt flags.

Valid only if the number of available MBs exceeds 64.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

void FLEXCAN_GetMemoryErrorReportStatus(CAN_Type *base, *flexcan_memory_error_report_status_t* *errorStatus)

Gets the FlexCAN Memory Error Report registers status.

This function gets the FlexCAN Memory Error Report registers status.

Parameters

- base – FlexCAN peripheral base address.
- errorStatus – Pointer to FlexCAN Memory Error Report registers status structure.

static inline uint8_t FLEXCAN_GetPNMatchCount(CAN_Type *base)

Gets the FlexCAN Number of Matches when in Pretended Networking.

This function gets the number of times a given message has matched the predefined filtering criteria for ID and/or PL before a wakeup event.

Parameters

- base – FlexCAN peripheral base address.

Returns

The number of received wake up msessages.

static inline uint32_t FLEXCAN_GetEnhancedFifoDataCount(CAN_Type *base)

Gets the number of FlexCAN Enhanced Rx FIFO available frames.

This function gets the number of CAN messages stored in the Enhanced Rx FIFO.

Parameters

- base – FlexCAN peripheral base address.

Returns

The number of available CAN messages stored in the Enhanced Rx FIFO.

static inline void FLEXCAN_EnableInterrupts(CAN_Type *base, uint64_t mask)

Enables FlexCAN interrupts according to the provided mask.

This function enables the FlexCAN interrupts according to the provided mask. The mask is a logical OR of enumeration members, see _flexcan_interrupt_enable.

Parameters

- base – FlexCAN peripheral base address.

- mask – The interrupts to enable. Logical OR of _flexcan_interrupt_enable.

static inline void FLEXCAN_DisableInterrupts(CAN_Type *base, uint64_t mask)

Disables FlexCAN interrupts according to the provided mask.

This function disables the FlexCAN interrupts according to the provided mask. The mask is a logical OR of enumeration members, see _flexcan_interrupt_enable.

Parameters

- base – FlexCAN peripheral base address.
- mask – The interrupts to disable. Logical OR of _flexcan_interrupt_enable.

static inline void FLEXCAN_EnableMbInterrupts(CAN_Type *base, uint64_t mask)

Enables FlexCAN low 64 Message Buffer interrupts.

This function enables the interrupts of given Message Buffers.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

static inline void FLEXCAN_EnableHigh64MbInterrupts(CAN_Type *base, uint64_t mask)

Enables FlexCAN high 64 Message Buffer interrupts.

Valid only if the number of available MBs exceeds 64.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

static inline void FLEXCAN_DisableMbInterrupts(CAN_Type *base, uint64_t mask)

Disables FlexCAN low 64 Message Buffer interrupts.

This function disables the interrupts of given Message Buffers.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

static inline void FLEXCAN_DisableHigh64MbInterrupts(CAN_Type *base, uint64_t mask)

Disables FlexCAN high 64 Message Buffer interrupts.

Valid only if the number of available MBs exceeds 64.

Parameters

- base – FlexCAN peripheral base address.
- mask – The ORed FlexCAN Message Buffer mask.

void FLEXCAN_EnableRxFifoDMA(CAN_Type *base, bool enable)

Enables or disables the FlexCAN Rx FIFO DMA request.

This function enables or disables the DMA feature of FlexCAN build-in Rx FIFO.

Parameters

- base – FlexCAN peripheral base address.
- enable – true to enable, false to disable.

static inline uintptr_t FLEXCAN_GetRxFifoHeadAddr(CAN_Type *base)

Gets the Rx FIFO Head address.

This function returns the FlexCAN Rx FIFO Head address, which is mainly used for the DMA/eDMA use case.

Parameters

- base – FlexCAN peripheral base address.

Returns

FlexCAN Rx FIFO Head address.

static inline *status_t* FLEXCAN_Enable(CAN_Type *base, bool enable)

Enables or disables the FlexCAN module operation.

This function enables or disables the FlexCAN module.

Parameters

- base – FlexCAN base pointer.
- enable – true to enable, false to disable.

Returns

kStatus_Success Enable FlexCAN module successful kStatus_Timeout Timeout when wait for Low-Power Mode Acknowledge

status_t FLEXCAN_WriteTxMb(CAN_Type *base, uint8_t mbIdx, const *flexcan_frame_t* *pTxFrame)

Writes a FlexCAN Message to the Transmit Message Buffer.

This function writes a CAN Message to the specified Transmit Message Buffer and changes the Message Buffer state to start CAN Message transmit. After that the function returns immediately.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The FlexCAN Message Buffer index.
- pTxFrame – Pointer to CAN message frame to be sent.

Return values

- kStatus_Success – - Write Tx Message Buffer Successfully.
- kStatus_Fail – - Tx Message Buffer is currently in use.

status_t FLEXCAN_ReadRxMb(CAN_Type *base, uint8_t mbIdx, *flexcan_frame_t* *pRxFrame)

Reads a FlexCAN Message from Receive Message Buffer.

This function reads a CAN message from a specified Receive Message Buffer. The function fills a receive CAN message frame structure with just received data and activates the Message Buffer again. The function returns immediately.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The FlexCAN Message Buffer index.
- pRxFrame – Pointer to CAN message frame structure for reception.

Return values

- kStatus_Success – - Rx Message Buffer is full and has been read successfully.
- kStatus_FLEXCAN_RxOverflow – - Rx Message Buffer is already overflowed and has been read successfully.

- kStatus_Fail – - Rx Message Buffer is empty.

status_t FLEXCAN_WriteFDTxMb(CAN_Type *base, uint8_t mbIdx, const *flexcan_fd_frame_t* *pTxFrame)

Writes a FlexCAN FD Message to the Transmit Message Buffer.

This function writes a CAN FD Message to the specified Transmit Message Buffer and changes the Message Buffer state to start CAN FD Message transmit. After that the function returns immediately.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The FlexCAN FD Message Buffer index.
- pTxFrame – Pointer to CAN FD message frame to be sent.

Return values

- kStatus_Success – - Write Tx Message Buffer Successfully.
- kStatus_Fail – - Tx Message Buffer is currently in use.

status_t FLEXCAN_ReadFDRxMb(CAN_Type *base, uint8_t mbIdx, *flexcan_fd_frame_t* *pRxFrame)

Reads a FlexCAN FD Message from Receive Message Buffer.

This function reads a CAN FD message from a specified Receive Message Buffer. The function fills a receive CAN FD message frame structure with just received data and activates the Message Buffer again. The function returns immediately.

Parameters

- base – FlexCAN peripheral base address.
- mbIdx – The FlexCAN FD Message Buffer index.
- pRxFrame – Pointer to CAN FD message frame structure for reception.

Return values

- kStatus_Success – - Rx Message Buffer is full and has been read successfully.
- kStatus_FLEXCAN_RxOverflow – - Rx Message Buffer is already overflowed and has been read successfully.
- kStatus_Fail – - Rx Message Buffer is empty.

status_t FLEXCAN_ReadRxFifo(CAN_Type *base, *flexcan_frame_t* *pRxFrame)

Reads a FlexCAN Message from Legacy Rx FIFO.

This function reads a CAN message from the FlexCAN Legacy Rx FIFO.

Parameters

- base – FlexCAN peripheral base address.
- pRxFrame – Pointer to CAN message frame structure for reception.

Return values

- kStatus_Success – - Read Message from Rx FIFO successfully.
- kStatus_Fail – - Rx FIFO is not enabled.

status_t FLEXCAN_ReadEnhancedRxFifo(CAN_Type *base, *flexcan_fd_frame_t* *pRxFrame)

Reads a FlexCAN Message from Enhanced Rx FIFO.

This function reads a CAN or CAN FD message from the FlexCAN Enhanced Rx FIFO.

Parameters

- base – FlexCAN peripheral base address.
- pRxFrame – Pointer to CAN FD message frame structure for reception.

Return values

- kStatus_Success – - Read Message from Rx FIFO successfully.
- kStatus_Fail – - Rx FIFO is not enabled.

status_t FLEXCAN_ReadPNWakeUpMB(CAN_Type *base, uint8_t mbIdx, *flexcan_frame_t* *pRxFrame)

Reads a FlexCAN Message from Wake Up MB.

This function reads a CAN message from the FlexCAN Wake up Message Buffers. There are four Wake up Message Buffers (WMBs) used to store incoming messages in Pretended Networking mode. The WMB index indicates the arrival order. The last message is stored in WMB3.

Parameters

- base – FlexCAN peripheral base address.
- pRxFrame – Pointer to CAN message frame structure for reception.
- mbIdx – The FlexCAN Wake up Message Buffer index. Range in 0x0 ~ 0x3.

Return values

- kStatus_Success – - Read Message from Wake up Message Buffer successfully.
- kStatus_Fail – - Wake up Message Buffer has no valid content.

status_t FLEXCAN_TransferFDSendBlocking(CAN_Type *base, uint8_t mbIdx, *flexcan_fd_frame_t* *pTxFrame)

Performs a polling send transaction on the CAN bus.

Note: A transfer handle does not need to be created before calling this API.

Parameters

- base – FlexCAN peripheral base pointer.
- mbIdx – The FlexCAN FD Message Buffer index.
- pTxFrame – Pointer to CAN FD message frame to be sent.

Return values

- kStatus_Success – - Write Tx Message Buffer Successfully.
- kStatus_Fail – - Tx Message Buffer is currently in use.
- kStatus_Timeout – - Failed to send frames within specific time.

status_t FLEXCAN_TransferFDReceiveBlocking(CAN_Type *base, uint8_t mbIdx, *flexcan_fd_frame_t* *pRxFrame)

Performs a polling receive transaction on the CAN bus.

Note: A transfer handle does not need to be created before calling this API.

Parameters

- base – FlexCAN peripheral base pointer.

- mbIdx – The FlexCAN FD Message Buffer index.
- pRxFrame – Pointer to CAN FD message frame structure for reception.

Return values

- kStatus_Success – - Rx Message Buffer is full and has been read successfully.
- kStatus_FLEXCAN_RxOverflow – - Rx Message Buffer is already overflowed and has been read successfully.
- kStatus_Fail – - Rx Message Buffer is empty.
- kStatus_Timeout – - Failed to receive frames within specific time.

status_t FLEXCAN_TransferFDSendNonBlocking(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_mb_transfer_t* *pMbXfer)

Sends a message using IRQ.

This function sends a message using IRQ. This is a non-blocking function, which returns right away. When messages have been sent out, the send callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- pMbXfer – FlexCAN FD Message Buffer transfer structure. See the flexcan_mb_transfer_t.

Return values

- kStatus_Success – Start Tx Message Buffer sending process successfully.
- kStatus_Fail – Write Tx Message Buffer failed.
- kStatus_FLEXCAN_TxBusy – Tx Message Buffer is in use.

status_t FLEXCAN_TransferFDReceiveNonBlocking(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_mb_transfer_t* *pMbXfer)

Receives a message using IRQ.

This function receives a message using IRQ. This is non-blocking function, which returns right away. When the message has been received, the receive callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- pMbXfer – FlexCAN FD Message Buffer transfer structure. See the flexcan_mb_transfer_t.

Return values

- kStatus_Success – - Start Rx Message Buffer receiving process successfully.
- kStatus_FLEXCAN_RxBusy – - Rx Message Buffer is in use.

void FLEXCAN_TransferFDAbortSend(CAN_Type *base, *flexcan_handle_t* *handle, uint8_t mbIdx)

Aborts the interrupt driven message send process.

This function aborts the interrupt driven message send process.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

- mbIdx – The FlexCAN FD Message Buffer index.

void FLEXCAN_TransferFDAbortReceive(CAN_Type *base, *flexcan_handle_t* *handle, uint8_t mbIdx)

Aborts the interrupt driven message receive process.

This function aborts the interrupt driven message receive process.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- mbIdx – The FlexCAN FD Message Buffer index.

status_t FLEXCAN_TransferSendBlocking(CAN_Type *base, uint8_t mbIdx, *flexcan_frame_t* *pTxFrame)

Performs a polling send transaction on the CAN bus.

Note: A transfer handle does not need to be created before calling this API.

Parameters

- base – FlexCAN peripheral base pointer.
- mbIdx – The FlexCAN Message Buffer index.
- pTxFrame – Pointer to CAN message frame to be sent.

Return values

- kStatus_Success – - Write Tx Message Buffer Successfully.
- kStatus_Fail – - Tx Message Buffer is currently in use.
- kStatus_Timeout – - Failed to send frames within specific time.

status_t FLEXCAN_TransferReceiveBlocking(CAN_Type *base, uint8_t mbIdx, *flexcan_frame_t* *pRxFrame)

Performs a polling receive transaction on the CAN bus.

Note: A transfer handle does not need to be created before calling this API.

Parameters

- base – FlexCAN peripheral base pointer.
- mbIdx – The FlexCAN Message Buffer index.
- pRxFrame – Pointer to CAN message frame structure for reception.

Return values

- kStatus_Success – - Rx Message Buffer is full and has been read successfully.
- kStatus_FLEXCAN_RxOverflow – - Rx Message Buffer is already overflowed and has been read successfully.
- kStatus_Fail – - Rx Message Buffer is empty.
- kStatus_Timeout – - Failed to receive frames within specific time.

status_t FLEXCAN_TransferReceiveFifoBlocking(CAN_Type *base, *flexcan_frame_t* *pRxFrame)

Performs a polling receive transaction from Legacy Rx FIFO on the CAN bus.

Note: A transfer handle does not need to be created before calling this API.

Parameters

- base – FlexCAN peripheral base pointer.
- pRxFrame – Pointer to CAN message frame structure for reception.

Return values

- kStatus_Success – - Read Message from Rx FIFO successfully.
- kStatus_Fail – - Rx FIFO is not enabled.
- kStatus_Timeout – - Failed to receive frames within specific time.

status_t FLEXCAN_TransferReceiveEnhancedFifoBlocking(CAN_Type *base, *flexcan_fd_frame_t* *pRxFrame)

Performs a polling receive transaction from Enhanced Rx FIFO on the CAN bus.

Note: A transfer handle does not need to be created before calling this API.

Parameters

- base – FlexCAN peripheral base pointer.
- pRxFrame – Pointer to CAN FD message frame structure for reception.

Return values

- kStatus_Success – - Read Message from Rx FIFO successfully.
- kStatus_Fail – - Rx FIFO is not enabled.
- kStatus_Timeout – - Failed to receive frames within specific time.

void FLEXCAN_TransferCreateHandle(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_transfer_callback_t* callback, void *userData)

Initializes the FlexCAN handle.

This function initializes the FlexCAN handle, which can be used for other FlexCAN transactional APIs. Usually, for a specified FlexCAN instance, call this API once to get the initialized handle.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- callback – The callback function.
- userData – The parameter of the callback function.

status_t FLEXCAN_TransferSendNonBlocking(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_mb_transfer_t* *pMbXfer)

Sends a message using IRQ.

This function sends a message using IRQ. This is a non-blocking function, which returns right away. When messages have been sent out, the send callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- pMbXfer – FlexCAN Message Buffer transfer structure. See the flexcan_mb_transfer_t.

Return values

- kStatus_Success – Start Tx Message Buffer sending process successfully.
- kStatus_Fail – Write Tx Message Buffer failed.
- kStatus_FLEXCAN_TxBusy – Tx Message Buffer is in use.

status_t FLEXCAN_TransferReceiveNonBlocking(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_mb_transfer_t* *pMbXfer)

Receives a message using IRQ.

This function receives a message using IRQ. This is non-blocking function, which returns right away. When the message has been received, the receive callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- pMbXfer – FlexCAN Message Buffer transfer structure. See the flexcan_mb_transfer_t.

Return values

- kStatus_Success – - Start Rx Message Buffer receiving process successfully.
- kStatus_FLEXCAN_RxBusy – - Rx Message Buffer is in use.

status_t FLEXCAN_TransferReceiveFifoNonBlocking(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_fifo_transfer_t* *pFifoXfer)

Receives a message from Rx FIFO using IRQ.

This function receives a message using IRQ. This is a non-blocking function, which returns right away. When all messages have been received, the receive callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- pFifoXfer – FlexCAN Rx FIFO transfer structure. See the flexcan_fifo_transfer_t.

Return values

- kStatus_Success – - Start Rx FIFO receiving process successfully.
- kStatus_FLEXCAN_RxFifoBusy – - Rx FIFO is currently in use.

status_t FLEXCAN_TransferGetReceiveFifoCount(CAN_Type *base, *flexcan_handle_t* *handle, size_t *count)

Gets the Legacy Rx Fifo transfer status during a interrupt non-blocking receive.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- count – Number of CAN messages receive so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

status_t FLEXCAN_TransferReceiveEnhancedFifoNonBlocking(CAN_Type *base, *flexcan_handle_t* *handle, *flexcan_fifo_transfer_t* *pFifoXfer)

Receives a message from Enhanced Rx FIFO using IRQ.

This function receives a message using IRQ. This is a non-blocking function, which returns right away. When all messages have been received, the receive callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- pFifoXfer – FlexCAN Rx FIFO transfer structure. See the ref flexcan_fifo_transfer_t.@

Return values

- kStatus_Success – - Start Rx FIFO receiving process successfully.
- kStatus_FLEXCAN_RxFifoBusy – - Rx FIFO is currently in use.

static inline *status_t* FLEXCAN_TransferGetReceiveEnhancedFifoCount(CAN_Type *base, *flexcan_handle_t* *handle, size_t *count)

Gets the Enhanced Rx Fifo transfer status during a interrupt non-blocking receive.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- count – Number of CAN messages receive so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

uint32_t FLEXCAN_GetTimeStamp(*flexcan_handle_t* *handle, uint8_t mbIdx)

Gets the detail index of Mailbox's Timestamp by handle.

Then function can only be used when calling non-blocking Data transfer (TX/RX) API, After TX/RX data transfer done (User can get the status by handler's callback function), we can get the detail index of Mailbox's timestamp by handle, Detail non-blocking data transfer API (TX/RX) contain. -FLEXCAN_TransferSendNonBlocking -FLEXCAN_TransferFDSendNonBlocking -FLEXCAN_TransferReceiveNonBlocking -FLEXCAN_TransferFDReceiveNonBlocking -FLEXCAN_TransferReceiveFifoNonBlocking

Parameters

- handle – FlexCAN handle pointer.
- mbIdx – The FlexCAN Message Buffer index.

Return values

the – index of mailbox 's timestamp stored in the handle.

void FLEXCAN_TransferAbortSend(CAN_Type *base, *flexcan_handle_t* *handle, uint8_t mbIdx)

Aborts the interrupt driven message send process.

This function aborts the interrupt driven message send process.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- mbIdx – The FlexCAN Message Buffer index.

void FLEXCAN_TransferAbortReceive(CAN_Type *base, *flexcan_handle_t* *handle, uint8_t mbIdx)

Aborts the interrupt driven message receive process.

This function aborts the interrupt driven message receive process.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- mbIdx – The FlexCAN Message Buffer index.

void FLEXCAN_TransferAbortReceiveFifo(CAN_Type *base, *flexcan_handle_t* *handle)

Aborts the interrupt driven message receive from Rx FIFO process.

This function aborts the interrupt driven message receive from Rx FIFO process.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

void FLEXCAN_TransferAbortReceiveEnhancedFifo(CAN_Type *base, *flexcan_handle_t* *handle)

Aborts the interrupt driven message receive from Enhanced Rx FIFO process.

This function aborts the interrupt driven message receive from Enhanced Rx FIFO process.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

void FLEXCAN_TransferHandleIRQ(CAN_Type *base, *flexcan_handle_t* *handle)

FlexCAN IRQ handle function.

This function handles the FlexCAN Error, the Message Buffer, and the Rx FIFO IRQ request.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

void FLEXCAN_MbHandleIRQ(CAN_Type *base, *flexcan_handle_t* *handle, uint32_t startMbIdx, uint32_t endMbIdx)

FlexCAN Message Buffer IRQ handle function.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- startMbIdx – First Message Buffer to handle.
- endMbIdx – Last Message Buffer to handle.

void FLEXCAN_EhancedRxFifoHandleIRQ(CAN_Type *base, *flexcan_handle_t* *handle)

FlexCAN Ehanced Rx FIFO IRQ handle function.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

void FLEXCAN_BusoffErrorHandleIRQ(CAN_Type *base, *flexcan_handle_t* *handle)

FlexCAN Bus Off, Error and Warning IRQ handle function.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

void FLEXCAN_PNWakeUpHandleIRQ(CAN_Type *base, *flexcan_handle_t* *handle)

FlexCAN Pretended Networking Wake-up IRQ handle function.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

void FLEXCAN_MemoryErrorHandleIRQ(CAN_Type *base, *flexcan_handle_t* *handle)

FlexCAN Memory Error IRQ handle function.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.

FSL_FLEXCAN_DRIVER_VERSION

FlexCAN driver version.

FlexCAN transfer status.

Values:

enumerator kStatus_FLEXCAN_TxBusy

Tx Message Buffer is Busy.

enumerator kStatus_FLEXCAN_TxIdle

Tx Message Buffer is Idle.

enumerator kStatus_FLEXCAN_TxSwitchToRx

Remote Message is send out and Message buffer changed to Receive one.

enumerator kStatus_FLEXCAN_RxBusy

Rx Message Buffer is Busy.

enumerator kStatus_FLEXCAN_RxIdle

Rx Message Buffer is Idle.

enumerator kStatus_FLEXCAN_RxOverflow

Rx Message Buffer is Overflowed.

enumerator kStatus_FLEXCAN_RxFifoBusy

Rx Message FIFO is Busy.

enumerator kStatus_FLEXCAN_RxFifoIdle

Rx Message FIFO is Idle.

enumerator kStatus_FLEXCAN_RxFifoOverflow
Rx Message FIFO is overflowed.

enumerator kStatus_FLEXCAN_RxFifoWarning
Rx Message FIFO is almost overflowed.

enumerator kStatus_FLEXCAN_RxFifoDisabled
Rx Message FIFO is disabled during reading.

enumerator kStatus_FLEXCAN_ErrorStatus
FlexCAN Module Error and Status.

enumerator kStatus_FLEXCAN_WakeUp
FlexCAN is waken up from STOP mode.

enumerator kStatus_FLEXCAN_UnHandled
UnHadled Interrupt asserted.

enumerator kStatus_FLEXCAN_RxRemote
Rx Remote Message Received in Mail box.

enumerator kStatus_FLEXCAN_RxFifoUnderflow
Enhanced Rx Message FIFO is underflow.

enumerator kStatus_FLEXCAN_MemoryError
FlexCAN Memory Error.

enum _flexcan_frame_format
FlexCAN frame format.

Values:

enumerator kFLEXCAN_FrameFormatStandard
Standard frame format attribute.

enumerator kFLEXCAN_FrameFormatExtend
Extend frame format attribute.

enum _flexcan_frame_type
FlexCAN frame type.

Values:

enumerator kFLEXCAN_FrameTypeData
Data frame type attribute.

enumerator kFLEXCAN_FrameTypeRemote
Remote frame type attribute.

enum _flexcan_clock_source
FlexCAN clock source.

Deprecated:
Do not use the kFLEXCAN_ClkSrcOs. It has been superceded kFLEXCAN_ClkSrc0

Do not use the kFLEXCAN_ClkSrcPeri. It has been superceded kFLEXCAN_ClkSrc1

Values:

enumerator kFLEXCAN_ClkSrcOsc
FlexCAN Protocol Engine clock from Oscillator.

enumerator kFLEXCAN_ClkSrcPeri
FlexCAN Protocol Engine clock from Peripheral Clock.

enumerator kFLEXCAN_ClkSrc0
FlexCAN Protocol Engine clock selected by user as SRC == 0.

enumerator kFLEXCAN_ClkSrc1
FlexCAN Protocol Engine clock selected by user as SRC == 1.

enum _flexcan_wake_up_source
FlexCAN wake up source.

Values:

enumerator kFLEXCAN_WakeupSrcUnfiltered
FlexCAN uses unfiltered Rx input to detect edge.

enumerator kFLEXCAN_WakeupSrcFiltered
FlexCAN uses filtered Rx input to detect edge.

enum _flexcan_rx_fifo_filter_type
FlexCAN Rx Fifo Filter type.

Values:

enumerator kFLEXCAN_RxFifoFilterTypeA
One full ID (standard and extended) per ID Filter element.

enumerator kFLEXCAN_RxFifoFilterTypeB
Two full standard IDs or two partial 14-bit ID slices per ID Filter Table element.

enumerator kFLEXCAN_RxFifoFilterTypeC
Four partial 8-bit Standard or extended ID slices per ID Filter Table element.

enumerator kFLEXCAN_RxFifoFilterTypeD
All frames rejected.

enum _flexcan_mb_size
FlexCAN Message Buffer Payload size.

Values:

enumerator kFLEXCAN_8BperMB
Selects 8 bytes per Message Buffer.

enumerator kFLEXCAN_16BperMB
Selects 16 bytes per Message Buffer.

enumerator kFLEXCAN_32BperMB
Selects 32 bytes per Message Buffer.

enumerator kFLEXCAN_64BperMB
Selects 64 bytes per Message Buffer.

enum _flexcan_fd_frame_length
FlexCAN CAN FD frame supporting data length (available DLC values).

For Tx, when the Data size corresponding to DLC value stored in the MB selected for transmission is larger than the MB Payload size, FlexCAN adds the necessary number of bytes with constant 0xCC pattern to complete the expected DLC. For Rx, when the Data size corresponding to DLC value received from the CAN bus is larger than the MB Payload size, the high order bytes that do not fit the Payload size will lose.

Values:

enumerator kFLEXCAN_0BperFrame
Frame contains 0 valid data bytes.

enumerator kFLEXCAN_1BperFrame
Frame contains 1 valid data bytes.

enumerator kFLEXCAN_2BperFrame
Frame contains 2 valid data bytes.

enumerator kFLEXCAN_3BperFrame
Frame contains 3 valid data bytes.

enumerator kFLEXCAN_4BperFrame
Frame contains 4 valid data bytes.

enumerator kFLEXCAN_5BperFrame
Frame contains 5 valid data bytes.

enumerator kFLEXCAN_6BperFrame
Frame contains 6 valid data bytes.

enumerator kFLEXCAN_7BperFrame
Frame contains 7 valid data bytes.

enumerator kFLEXCAN_8BperFrame
Frame contains 8 valid data bytes.

enumerator kFLEXCAN_12BperFrame
Frame contains 12 valid data bytes.

enumerator kFLEXCAN_16BperFrame
Frame contains 16 valid data bytes.

enumerator kFLEXCAN_20BperFrame
Frame contains 20 valid data bytes.

enumerator kFLEXCAN_24BperFrame
Frame contains 24 valid data bytes.

enumerator kFLEXCAN_32BperFrame
Frame contains 32 valid data bytes.

enumerator kFLEXCAN_48BperFrame
Frame contains 48 valid data bytes.

enumerator kFLEXCAN_64BperFrame
Frame contains 64 valid data bytes.

enum _flexcan_efifo_dma_per_read_length
FlexCAN Enhanced Rx Fifo DMA transfer per read length enumerations.

Values:

enumerator kFLEXCAN_1WordPerRead
Transfer 1 32-bit words (CS).

enumerator kFLEXCAN_2WordPerRead
Transfer 2 32-bit words (CS + ID).

enumerator kFLEXCAN_3WordPerRead
Transfer 3 32-bit words (CS + ID + 1~4 bytes data).

enumerator kFLEXCAN_4WordPerRead
Transfer 4 32-bit words (CS + ID + 5~8 bytes data).

enumerator kFLEXCAN_5WordPerRead
Transfer 5 32-bit words (CS + ID + 9~12 bytes data).

enumerator kFLEXCAN_6WordPerRead
Transfer 6 32-bit words (CS + ID + 13~16 bytes data).

enumerator kFLEXCAN_7WordPerRead
Transfer 7 32-bit words (CS + ID + 17~20 bytes data).

enumerator kFLEXCAN_8WordPerRead
Transfer 8 32-bit words (CS + ID + 21~24 bytes data).

enumerator kFLEXCAN_9WordPerRead
Transfer 9 32-bit words (CS + ID + 25~28 bytes data).

enumerator kFLEXCAN_10WordPerRead
Transfer 10 32-bit words (CS + ID + 29~32 bytes data).

enumerator kFLEXCAN_11WordPerRead
Transfer 11 32-bit words (CS + ID + 33~36 bytes data).

enumerator kFLEXCAN_12WordPerRead
Transfer 12 32-bit words (CS + ID + 37~40 bytes data).

enumerator kFLEXCAN_13WordPerRead
Transfer 13 32-bit words (CS + ID + 41~44 bytes data).

enumerator kFLEXCAN_14WordPerRead
Transfer 14 32-bit words (CS + ID + 45~48 bytes data).

enumerator kFLEXCAN_15WordPerRead
Transfer 15 32-bit words (CS + ID + 49~52 bytes data).

enumerator kFLEXCAN_16WordPerRead
Transfer 16 32-bit words (CS + ID + 53~56 bytes data).

enumerator kFLEXCAN_17WordPerRead
Transfer 17 32-bit words (CS + ID + 57~60 bytes data).

enumerator kFLEXCAN_18WordPerRead
Transfer 18 32-bit words (CS + ID + 61~64 bytes data).

enumerator kFLEXCAN_19WordPerRead
Transfer 19 32-bit words (CS + ID + 64 bytes data + ID HIT).

enum _flexcan_rx_fifo_priority
FlexCAN Enhanced/Legacy Rx FIFO priority.

The matching process starts from the Rx MB(or Enhanced/Legacy Rx FIFO) with higher priority. If no MB(or Enhanced/Legacy Rx FIFO filter) is satisfied, the matching process goes on with the Enhanced/Legacy Rx FIFO(or Rx MB) with lower priority.

Values:

enumerator kFLEXCAN_RxFifoPrioLow
Matching process start from Rx Message Buffer first.

enumerator kFLEXCAN_RxFifoPrioHigh
Matching process start from Enhanced/Legacy Rx FIFO first.

enum _flexcan_interrupt_enable

FlexCAN interrupt enable enumerations.

This provides constants for the FlexCAN interrupt enable enumerations for use in the FlexCAN functions.

Note: FlexCAN Message Buffers and Legacy Rx FIFO interrupts not included in.

Values:

enumerator kFLEXCAN_BusOffInterruptEnable

Bus Off interrupt, use bit 15.

enumerator kFLEXCAN_ErrorInterruptEnable

CAN Error interrupt, use bit 14.

enumerator kFLEXCAN_TxWarningInterruptEnable

Tx Warning interrupt, use bit 11.

enumerator kFLEXCAN_RxWarningInterruptEnable

Rx Warning interrupt, use bit 10.

enumerator kFLEXCAN_WakeUpInterruptEnable

Self Wake Up interrupt, use bit 26.

enumerator kFLEXCAN_FDErrorInterruptEnable

CAN FD Error interrupt, use bit 31.

enumerator kFLEXCAN_PNMatchWakeUpInterruptEnable

PN Match Wake Up interrupt, use high word bit 17.

enumerator kFLEXCAN_PNTimeoutWakeUpInterruptEnable

PN Timeout Wake Up interrupt, use high word bit 16. Enhanced Rx FIFO Underflow interrupt, use high word bit 31.

enumerator kFLEXCAN_ERxFifoUnderflowInterruptEnable

Enhanced Rx FIFO Overflow interrupt, use high word bit 30.

enumerator kFLEXCAN_ERxFifoOverflowInterruptEnable

Enhanced Rx FIFO Watermark interrupt, use high word bit 29.

enumerator kFLEXCAN_ERxFifoWatermarkInterruptEnable

Enhanced Rx FIFO Data Avilable interrupt, use high word bit 28.

enumerator kFLEXCAN_ERxFifoDataAvlInterruptEnable

enumerator kFLEXCAN_HostAccessNCErrorInterruptEnable

Host Access With Non-Correctable Errors interrupt, use high word bit 0.

enumerator kFLEXCAN_FlexCanAccessNCErrorInterruptEnable

FlexCAN Access With Non-Correctable Errors interrupt, use high word bit 2.

enumerator kFLEXCAN_HostOrFlexCanCErrorInterruptEnable

Host or FlexCAN Access With Correctable Errors interrupt, use high word bit 3.

enum _flexcan_flags

FlexCAN status flags.

This provides constants for the FlexCAN status flags for use in the FlexCAN functions.

Note: The CPU read action clears the bits corresponding to the FlEXCAN_ErrorFlag macro, therefore user need to read status flags and distinguish which error is occur using _flexcan_error_flags enumerations.

Values:

enumerator kFLEXCAN_ErrorOverrunFlag
Error Overrun Status.

enumerator kFLEXCAN_FDErrorIntFlag
CAN FD Error Interrupt Flag.

enumerator kFLEXCAN_BusoffDoneIntFlag
Bus Off process completed Interrupt Flag.

enumerator kFLEXCAN_SynchFlag
CAN Synchronization Status.

enumerator kFLEXCAN_TxWarningIntFlag
Tx Warning Interrupt Flag.

enumerator kFLEXCAN_RxWarningIntFlag
Rx Warning Interrupt Flag.

enumerator kFLEXCAN_IdleFlag
FlexCAN In IDLE Status.

enumerator kFLEXCAN_FaultConfinementFlag
FlexCAN Fault Confinement State.

enumerator kFLEXCAN_TransmittingFlag
FlexCAN In Transmission Status.

enumerator kFLEXCAN_ReceivingFlag
FlexCAN In Reception Status.

enumerator kFLEXCAN_BusOffIntFlag
Bus Off Interrupt Flag.

enumerator kFLEXCAN_ErrorIntFlag
CAN Error Interrupt Flag.

enumerator kFLEXCAN_WakeUpIntFlag
Self Wake-Up Interrupt Flag.

enumerator kFLEXCAN_ErrorFlag

enumerator kFLEXCAN_PNMatchIntFlag
PN Matching Event Interrupt Flag.

enumerator kFLEXCAN_PNTimeoutIntFlag
PN Timeout Event Interrupt Flag.

enumerator kFLEXCAN_ERxFifoUnderflowIntFlag
Enhanced Rx FIFO underflow Interrupt Flag.

enumerator kFLEXCAN_ERxFifoOverflowIntFlag
Enhanced Rx FIFO overflow Interrupt Flag.

enumerator kFLEXCAN_ERxFifoWatermarkIntFlag
Enhanced Rx FIFO watermark Interrupt Flag.

enumerator kFLEXCAN_ERxFifoDataAvlIntFlag
Enhanced Rx FIFO data available Interrupt Flag.

enumerator kFLEXCAN_ERxFifoEmptyFlag
Enhanced Rx FIFO empty status.

enumerator kFLEXCAN_ERxFifoFullFlag
Enhanced Rx FIFO full status.

enumerator kFLEXCAN_HostAccessNonCorrectableErrorIntFlag
Host Access With Non-Correctable Error Interrupt Flag.

enumerator kFLEXCAN_FlexCanAccessNonCorrectableErrorIntFlag
FlexCAN Access With Non-Correctable Error Interrupt Flag.

enumerator kFLEXCAN_CorrectableErrorIntFlag
Correctable Error Interrupt Flag.

enumerator kFLEXCAN_HostAccessNonCorrectableErrorOverrunFlag
Host Access With Non-Correctable Error Interrupt Overrun Flag.

enumerator kFLEXCAN_FlexCanAccessNonCorrectableErrorOverrunFlag
FlexCAN Access With Non-Correctable Error Interrupt Overrun Flag.

enumerator kFLEXCAN_CorrectableErrorOverrunFlag
Correctable Error Interrupt Overrun Flag.

enumerator kFLEXCAN_AllMemoryErrorIntFlag
All Memory Error Interrupt Flags.

enumerator kFLEXCAN_AllMemoryErrorFlag
All Memory Error Flags.

enum _flexcan_error_flags
FlexCAN error status flags.

The FlexCAN Error Status enumerations is used to report current error of the FlexCAN bus. This enumerations should be used with KFLEXCAN_ErrorFlag in _flexcan_flags enumerations to ditermine which error is generated.

Values:

enumerator kFLEXCAN_FDStuffingError
Stuffing Error.

enumerator kFLEXCAN_FDFormError
Form Error.

enumerator kFLEXCAN_FDCrcError
Cyclic Redundancy Check Error.

enumerator kFLEXCAN_FDBit0Error
Unable to send dominant bit.

enumerator kFLEXCAN_FDBit1Error
Unable to send recessive bit.

enumerator kFLEXCAN_TxErrorWarningFlag
Tx Error Warning Status.

enumerator kFLEXCAN_RxErrorWarningFlag
Rx Error Warning Status.

enumerator kFLEXCAN_StuffingError
Stuffing Error.

enumerator kFLEXCAN_FormError
Form Error.

enumerator kFLEXCAN_CrcError
Cyclic Redundancy Check Error.

enumerator kFLEXCAN_AckError
Received no ACK on transmission.

enumerator kFLEXCAN_Bit0Error
Unable to send dominant bit.

enumerator kFLEXCAN_Bit1Error
Unable to send recessive bit.

FlexCAN Legacy Rx FIFO status flags.

The FlexCAN Legacy Rx FIFO Status enumerations are used to determine the status of the Rx FIFO. Because Rx FIFO occupy the MB0 ~ MB7 (Rx Fifo filter also occupies more Message Buffer space), Rx FIFO status flags are mapped to the corresponding Message Buffer status flags.

Values:

enumerator kFLEXCAN_RxFifoOverflowFlag
Rx FIFO overflow flag.

enumerator kFLEXCAN_RxFifoWarningFlag
Rx FIFO almost full flag.

enumerator kFLEXCAN_RxFifoFrameAvlFlag
Frames available in Rx FIFO flag.

enum _flexcan_memory_error_type
FlexCAN Memory Error Type.

Values:

enumerator kFLEXCAN_CorrectableError
The memory error is correctable which means on bit error.

enumerator kFLEXCAN_NonCorrectableError
The memory error is non-correctable which means two bit errors.

enum _flexcan_memory_access_type
FlexCAN Memory Access Type.

Values:

enumerator kFLEXCAN_MoveOutFlexCanAccess
The memory error was detected during move-out FlexCAN access.

enumerator kFLEXCAN_MoveInAccess
The memory error was detected during move-in FlexCAN access.

enumerator kFLEXCAN_TxArbitrationAccess
The memory error was detected during Tx Arbitration FlexCAN access.

enumerator kFLEXCAN_RxMatchingAccess
The memory error was detected during Rx Matching FlexCAN access.

enumerator kFLEXCAN_MoveOutHostAccess
The memory error was detected during Rx Matching Host (CPU) access.

enum _flexcan_byte_error_syndrome
FlexCAN Memory Error Byte Syndrome.

Values:

enumerator kFLEXCAN_NoError
No bit error in this byte.

enumerator kFLEXCAN_ParityBits0Error
Parity bit 0 error in this byte.

enumerator kFLEXCAN_ParityBits1Error
Parity bit 1 error in this byte.

enumerator kFLEXCAN_ParityBits2Error
Parity bit 2 error in this byte.

enumerator kFLEXCAN_ParityBits3Error
Parity bit 3 error in this byte.

enumerator kFLEXCAN_ParityBits4Error
Parity bit 4 error in this byte.

enumerator kFLEXCAN_DataBits0Error
Data bit 0 error in this byte.

enumerator kFLEXCAN_DataBits1Error
Data bit 1 error in this byte.

enumerator kFLEXCAN_DataBits2Error
Data bit 2 error in this byte.

enumerator kFLEXCAN_DataBits3Error
Data bit 3 error in this byte.

enumerator kFLEXCAN_DataBits4Error
Data bit 4 error in this byte.

enumerator kFLEXCAN_DataBits5Error
Data bit 5 error in this byte.

enumerator kFLEXCAN_DataBits6Error
Data bit 6 error in this byte.

enumerator kFLEXCAN_DataBits7Error
Data bit 7 error in this byte.

enumerator kFLEXCAN_AllZeroError
All-zeros non-correctable error in this byte.

enumerator kFLEXCAN_AllOneError
All-ones non-correctable error in this byte.

enumerator kFLEXCAN_NonCorrectableErrors
Non-correctable error in this byte.

enum _flexcan_pn_match_source
FlexCAN Pretended Networking match source selection.

Values:

enumerator kFLEXCAN_PNMatSrcID
Message match with ID filtering.

enumerator kFLEXCAN_PNMatSrcIDAndData
Message match with ID filtering and payload filtering.

enum __flexcan_pn_match_mode
FlexCAN Pretended Networking mode match type.

Values:

enumerator kFLEXCAN_PNMatModeEqual
Match upon ID/Payload contents against an exact target value.

enumerator kFLEXCAN_PNMatModeGreater
Match upon an ID/Payload value greater than or equal to a specified target value.

enumerator kFLEXCAN_PNMatModeSmaller
Match upon an ID/Payload value smaller than or equal to a specified target value.

enumerator kFLEXCAN_PNMatModeRange
Match upon an ID/Payload value inside a range, greater than or equal to a specified lower limit, and smaller than or equal to a specified upper limit

typedef enum *_flexcan_frame_format* flexcan_frame_format_t
FlexCAN frame format.

typedef enum *_flexcan_frame_type* flexcan_frame_type_t
FlexCAN frame type.

typedef enum *_flexcan_clock_source* flexcan_clock_source_t
FlexCAN clock source.

Deprecated:
Do not use the kFLEXCAN_ClkSrcOs. It has been superceded kFLEXCAN_ClkSrc0

Do not use the kFLEXCAN_ClkSrcPeri. It has been superceded kFLEXCAN_ClkSrc1

typedef enum *_flexcan_wake_up_source* flexcan_wake_up_source_t
FlexCAN wake up source.

typedef enum *_flexcan_rx_fifo_filter_type* flexcan_rx_fifo_filter_type_t
FlexCAN Rx Fifo Filter type.

typedef enum *_flexcan_mb_size* flexcan_mb_size_t
FlexCAN Message Buffer Payload size.

typedef enum *_flexcan_efifo_dma_per_read_length* flexcan_efifo_dma_per_read_length_t
FlexCAN Enhanced Rx Fifo DMA transfer per read length enumerations.

typedef enum *_flexcan_rx_fifo_priority* flexcan_rx_fifo_priority_t
FlexCAN Enhanced/Legacy Rx FIFO priority.

The matching process starts from the Rx MB(or Enhanced/Legacy Rx FIFO) with higher priority. If no MB(or Enhanced/Legacy Rx FIFO filter) is satisfied, the matching process goes on with the Enhanced/Legacy Rx FIFO(or Rx MB) with lower priority.

typedef enum *_flexcan_memory_error_type* flexcan_memory_error_type_t
FlexCAN Memory Error Type.

typedef enum *_flexcan_memory_access_type* flexcan_memory_access_type_t
FlexCAN Memory Access Type.

typedef enum *_flexcan_byte_error_syndrome* flexcan_byte_error_syndrome_t

FlexCAN Memory Error Byte Syndrome.

typedef struct *_flexcan_memory_error_report_status* flexcan_memory_error_report_status_t

FlexCAN memory error register status structure.

This structure contains the memory access properties that caused a memory error access. It is used as the parameter of FLEXCAN_GetMemoryErrorReportStatus() function. And user can use FLEXCAN_GetMemoryErrorReportStatus to get the status of the last memory error access.

typedef struct *_flexcan_frame* flexcan_frame_t

FlexCAN message frame structure.

typedef struct *_flexcan_fd_frame* flexcan_fd_frame_t

CAN FD message frame structure.

The CAN FD message supporting up to sixty four bytes can be used for a data frame, depending on the length selected for the message buffers. The length should be a enumeration member, see _flexcan_fd_frame_length.

typedef struct *_flexcan_timing_config* flexcan_timing_config_t

FlexCAN protocol timing characteristic configuration structure.

typedef struct *_flexcan_config* flexcan_config_t

FlexCAN module configuration structure.

Deprecated:

Do not use the baudRate. It has been superceded bitRate

Do not use the baudRateFD. It has been superceded bitRateFD

typedef struct *_flexcan_rx_mb_config* flexcan_rx_mb_config_t

FlexCAN Receive Message Buffer configuration structure.

This structure is used as the parameter of FLEXCAN_SetRxMbConfig() function. The FLEXCAN_SetRxMbConfig() function is used to configure FlexCAN Receive Message Buffer. The function abort previous receiving process, clean the Message Buffer and activate the Rx Message Buffer using given Message Buffer setting.

typedef enum *_flexcan_pn_match_source* flexcan_pn_match_source_t

FlexCAN Pretended Networking match source selection.

typedef enum *_flexcan_pn_match_mode* flexcan_pn_match_mode_t

FlexCAN Pretended Networking mode match type.

typedef struct *_flexcan_pn_config* flexcan_pn_config_t

FlexCAN Pretended Networking configuration structure.

This structure is used as the parameter of FLEXCAN_SetPNConfig() function. The FLEXCAN_SetPNConfig() function is used to configure FlexCAN Networking work mode.

typedef struct *_flexcan_rx_fifo_config* flexcan_rx_fifo_config_t

FlexCAN Legacy Rx FIFO configuration structure.

typedef struct *_flexcan_enhanced_rx_fifo_std_id_filter* flexcan_enhanced_rx_fifo_std_id_filter_t

FlexCAN Enhanced Rx FIFO Standard ID filter element structure.

typedef struct *_flexcan_enhanced_rx_fifo_ext_id_filter* flexcan_enhanced_rx_fifo_ext_id_filter_t

FlexCAN Enhanced Rx FIFO Extended ID filter element structure.

typedef struct *_flexcan_enhanced_rx_fifo_config* flexcan_enhanced_rx_fifo_config_t
FlexCAN Enhanced Rx FIFO configuration structure.

typedef struct *_flexcan_mb_transfer* flexcan_mb_transfer_t
FlexCAN Message Buffer transfer.

typedef struct *_flexcan_fifo_transfer* flexcan_fifo_transfer_t
FlexCAN Rx FIFO transfer.

typedef struct *_flexcan_handle* flexcan_handle_t
FlexCAN handle structure definition.

typedef void (*flexcan_transfer_callback_t)(CAN_Type *base, *flexcan_handle_t* *handle, *status_t* status, uint64_t result, void *userData)

FLEXCAN_WAIT_TIMEOUT

FLEXCAN_POLLING_TIMEOUT
Max loops to wait for polling transfer.

FLEXCAN_MODULE_TIMEOUT
Max loops to wait for FlexCAN register access complete.

DLC_LENGTH_DECODE(dlc)
FlexCAN frame length helper macro.

FLEXCAN_ID_STD(id)
FlexCAN Frame ID helper macro.

Standard Frame ID helper macro.

FLEXCAN_ID_EXT(id)
Extend Frame ID helper macro.

FLEXCAN_RX_MB_STD_MASK(id, rtr, ide)
FlexCAN Rx Message Buffer Mask helper macro.

Standard Rx Message Buffer Mask helper macro.

FLEXCAN_RX_MB_EXT_MASK(id, rtr, ide)
Extend Rx Message Buffer Mask helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_A(id, rtr, ide)
FlexCAN Legacy Rx FIFO Mask helper macro.

Standard Rx FIFO Mask helper macro Type A helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_B_HIGH(id, rtr, ide)
Standard Rx FIFO Mask helper macro Type B upper part helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_B_LOW(id, rtr, ide)
Standard Rx FIFO Mask helper macro Type B lower part helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_C_HIGH(id)
Standard Rx FIFO Mask helper macro Type C upper part helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_C_MID_HIGH(id)
Standard Rx FIFO Mask helper macro Type C mid-upper part helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_C_MID_LOW(id)
Standard Rx FIFO Mask helper macro Type C mid-lower part helper macro.

FLEXCAN_RX_FIFO_STD_MASK_TYPE_C_LOW(id)
Standard Rx FIFO Mask helper macro Type C lower part helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_A(id, rtr, ide)
Extend Rx FIFO Mask helper macro Type A helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_B_HIGH(id, rtr, ide)
Extend Rx FIFO Mask helper macro Type B upper part helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_B_LOW(id, rtr, ide)
Extend Rx FIFO Mask helper macro Type B lower part helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_C_HIGH(id)
Extend Rx FIFO Mask helper macro Type C upper part helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_C_MID_HIGH(id)
Extend Rx FIFO Mask helper macro Type C mid-upper part helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_C_MID_LOW(id)
Extend Rx FIFO Mask helper macro Type C mid-lower part helper macro.

FLEXCAN_RX_FIFO_EXT_MASK_TYPE_C_LOW(id)
Extend Rx FIFO Mask helper macro Type C lower part helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_A(id, rtr, ide)
FlexCAN Rx FIFO Filter helper macro.

Standard Rx FIFO Filter helper macro Type A helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_B_HIGH(id, rtr, ide)
Standard Rx FIFO Filter helper macro Type B upper part helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_B_LOW(id, rtr, ide)
Standard Rx FIFO Filter helper macro Type B lower part helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_C_HIGH(id)
Standard Rx FIFO Filter helper macro Type C upper part helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_C_MID_HIGH(id)
Standard Rx FIFO Filter helper macro Type C mid-upper part helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_C_MID_LOW(id)
Standard Rx FIFO Filter helper macro Type C mid-lower part helper macro.

FLEXCAN_RX_FIFO_STD_FILTER_TYPE_C_LOW(id)
Standard Rx FIFO Filter helper macro Type C lower part helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_A(id, rtr, ide)
Extend Rx FIFO Filter helper macro Type A helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_B_HIGH(id, rtr, ide)
Extend Rx FIFO Filter helper macro Type B upper part helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_B_LOW(id, rtr, ide)
Extend Rx FIFO Filter helper macro Type B lower part helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_C_HIGH(id)
Extend Rx FIFO Filter helper macro Type C upper part helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_C_MID_HIGH(id)
Extend Rx FIFO Filter helper macro Type C mid-upper part helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_C_MID_LOW(id)
Extend Rx FIFO Filter helper macro Type C mid-lower part helper macro.

FLEXCAN_RX_FIFO_EXT_FILTER_TYPE_C_LOW(id)
Extend Rx FIFO Filter helper macro Type C lower part helper macro.

ENHANCED_RX_FIFO_FSCH(x)
FlexCAN Enhanced Rx FIFO Filter and Mask helper macro.

RTR_STD_HIGH(x)

RTR_STD_LOW(x)

RTR_EXT(x)

ID_STD_LOW(id)

ID_STD_HIGH(id)

ID_EXT(id)

FLEXCAN_ENHANCED_RX_FIFO_STD_MASK_AND_FILTER(id, rtr, id_mask, rtr_mask)
Standard ID filter element with filter + mask scheme.

FLEXCAN_ENHANCED_RX_FIFO_STD_FILTER_WITH_RANGE(id_upper, rtr, id_lower, rtr_mask)
Standard ID filter element with filter range.

FLEXCAN_ENHANCED_RX_FIFO_STD_TWO_FILTERS(id1, rtr1, id2, rtr2)
Standard ID filter element with two filters without masks.

FLEXCAN_ENHANCED_RX_FIFO_EXT_MASK_AND_FILTER_LOW(id, rtr)
Extended ID filter element with filter + mask scheme low word.

FLEXCAN_ENHANCED_RX_FIFO_EXT_MASK_AND_FILTER_HIGH(id_mask, rtr_mask)
Extended ID filter element with filter + mask scheme high word.

FLEXCAN_ENHANCED_RX_FIFO_EXT_FILTER_WITH_RANGE_LOW(id_upper, rtr)
Extended ID filter element with range scheme low word.

FLEXCAN_ENHANCED_RX_FIFO_EXT_FILTER_WITH_RANGE_HIGH(id_lower, rtr_mask)
Extended ID filter element with range scheme high word.

FLEXCAN_ENHANCED_RX_FIFO_EXT_TWO_FILTERS_LOW(id2, rtr2)
Extended ID filter element with two filters without masks low word.

FLEXCAN_ENHANCED_RX_FIFO_EXT_TWO_FILTERS_HIGH(id1, rtr1)
Extended ID filter element with two filters without masks high word.

FLEXCAN_PN_STD_MASK(id, rtr)
FlexCAN Pretended Networking ID Mask helper macro.

Standard Rx Message Buffer Mask helper macro.

FLEXCAN_PN_EXT_MASK(id, rtr)
Extend Rx Message Buffer Mask helper macro.

FLEXCAN_PN_INT_MASK(x)
FlexCAN interrupt/status flag helper macro.

FLEXCAN_PN_INT_UNMASK(x)

FLEXCAN_PN_STATUS_MASK(x)

FLEXCAN_PN_STATUS_UNMASK(x)

FLEXCAN_EFIFO_INT_MASK(x)

FLEXCAN_EFIFO_INT_UNMASK(x)

FLEXCAN_EFIFO_STATUS_MASK(x)

FLEXCAN_EFIFO_STATUS_UNMASK(x)

FLEXCAN_MECR_INT_MASK(x)

FLEXCAN_MECR_INT_UNMASK(x)

FLEXCAN_MECR_STATUS_MASK(x)

FLEXCAN_MECR_STATUS_UNMASK(x)

FLEXCAN_ERROR_AND_STATUS_INT_FLAG

FLEXCAN_PNWAKE_UP_FLAG

FLEXCAN_WAKE_UP_FLAG

FLEXCAN_MEMORY_ERROR_INT_FLAG

FLEXCAN_MEMORY_ENHANCED_RX_FIFO_INT_FLAG

E_RX_FIFO(base)

FlexCAN Enhanced Rx FIFO base address helper macro.

FLEXCAN_CALLBACK(x)

FlexCAN transfer callback function.

The FlexCAN transfer callback returns a value from the underlying layer. If the status equals to kStatus_FLEXCAN_ErrorStatus, the result parameter is the Content of FlexCAN status register which can be used to get the working status(or error status) of FlexCAN module. If the status equals to other FlexCAN Message Buffer transfer status, the result is the index of Message Buffer that generate transfer event. If the status equals to other FlexCAN Message Buffer transfer status, the result is meaningless and should be Ignored.

struct _flexcan_memory_error_report_status

#include <fsl_flexcan.h> FlexCAN memory error register status structure.

This structure contains the memory access properties that caused a memory error access. It is used as the parameter of FLEXCAN_GetMemoryErrorReportStatus() function. And user can use FLEXCAN_GetMemoryErrorReportStatus to get the status of the last memory error access.

Public Members

flexcan_memory_error_type_t errorType

The type of memory error that giving rise to the report.

flexcan_memory_access_type_t accessType

The type of memory access that giving rise to the memory error.

uint16_t accessAddress

The address where memory error detected.

uint32_t errorData

The raw data word read from memory with error.

struct _flexcan_frame

#include <fsl_flexcan.h> FlexCAN message frame structure.

struct _flexcan_fd_frame

#include <fsl_flexcan.h> CAN FD message frame structure.

The CAN FD message supporting up to sixty four bytes can be used for a data frame, depending on the length selected for the message buffers. The length should be a enumeration member, see _flexcan_fd_frame_length.

Public Members

uint32_t idhit

Note: ID HIT offset is changed dynamically according to data length code (DLC), when DLC is 15, they will be located below. Using FLEXCAN_FixEnhancedRxFifoFrameIdHit API is recommended to ensure this idhit value is correct. CAN Enhanced Rx FIFO filter hit id (This value is only used in Enhanced Rx FIFO receive mode).

struct _flexcan_timing_config

#include <fsl_flexcan.h> FlexCAN protocol timing characteristic configuration structure.

Public Members

uint16_t preDivider

Classic CAN or CAN FD nominal phase bit rate prescaler.

uint8_t rJumpwidth

Classic CAN or CAN FD nominal phase Re-sync Jump Width.

uint8_t phaseSeg1

Classic CAN or CAN FD nominal phase Segment 1.

uint8_t phaseSeg2

Classic CAN or CAN FD nominal phase Segment 2.

uint8_t propSeg

Classic CAN or CAN FD nominal phase Propagation Segment.

uint16_t fpreDivider

CAN FD data phase bit rate prescaler.

uint8_t frJumpwidth

CAN FD data phase Re-sync Jump Width.

uint8_t fphaseSeg1

CAN FD data phase Phase Segment 1.

uint8_t fphaseSeg2

CAN FD data phase Phase Segment 2.

uint8_t fpropSeg

CAN FD data phase Propagation Segment.

struct _flexcan_config

#include <fsl_flexcan.h> FlexCAN module configuration structure.

Deprecated:

Do not use the baudRate. It has been superceded bitRate

Do not use the baudRateFD. It has been superceded bitRateFD

Public Members

flexcan_clock_source_t clkSrc

Clock source for FlexCAN Protocol Engine.

flexcan_wake_up_source_t wakeupSrc

Wake up source selection.

uint8_t maxMbNum

The maximum number of Message Buffers used by user.

bool enableLoopBack

Enable or Disable Loop Back Self Test Mode.

bool enableTimerSync

Enable or Disable Timer Synchronization.

bool enableSelfWakeup

Enable or Disable Self Wakeup Mode.

bool enableIndividMask

Enable or Disable Rx Individual Mask and Queue feature.

bool disableSelfReception

Enable or Disable Self Reflection.

bool enableListenOnlyMode

Enable or Disable Listen Only Mode.

bool enableDoze

Enable or Disable Doze Mode.

bool enablePretendedeNetworking

Enable or Disable the Pretended Networking mode.

bool enableMemoryErrorControl

Enable or Disable the memory errors detection and correction mechanism.

bool enableNonCorrectableErrorEnterFreeze

Enable or Disable Non-Correctable Errors In FlexCAN Access Put Device In Freeze Mode.

bool enableTransceiverDelayMeasure

Enable or Disable the transceiver delay measurement, when it is enabled, then the secondary sample point position is determined by the sum of the transceiver delay measurement plus the enhanced TDC offset.

bool enableRemoteRequestFrameStored

true: Store Remote Request Frame in the same fashion of data frame. false: Generate an automatic Remote Response Frame.

struct __flexcan__rx__mb__config

#include <fsl_flexcan.h> FlexCAN Receive Message Buffer configuration structure.

This structure is used as the parameter of FLEXCAN_SetRxMbConfig() function. The FLEXCAN_SetRxMbConfig() function is used to configure FlexCAN Receive Message Buffer. The function abort previous receiving process, clean the Message Buffer and activate the Rx Message Buffer using given Message Buffer setting.

Public Members

uint32_t id

CAN Message Buffer Frame Identifier, should be set using FLEXCAN_ID_EXT() or FLEXCAN_ID_STD() macro.

flexcan_frame_format_t format

CAN Frame Identifier format(Standard of Extend).

flexcan_frame_type_t type

CAN Frame Type(Data or Remote for classical CAN only).

struct __flexcan__pn__config

#include <fsl_flexcan.h> FlexCAN Pretended Networking configuration structure.

This structure is used as the parameter of FLEXCAN_SetPNConfig() function. The FLEXCAN_SetPNConfig() function is used to configure FlexCAN Networking work mode.

Public Members

bool enableTimeout

Enable or Disable timeout event trigger wakeup.

uint16_t timeoutValue

The timeout value that generates a wakeup event, the counter timer is incremented based on 64 times the CAN Bit Time unit.

bool enableMatch

Enable or Disable match event trigger wakeup.

flexcan_pn_match_source_t matchSrc

Selects the match source (ID and/or data match) to trigger wakeup.

uint8_t matchNum

The number of times a given message must match the predefined ID and/or data before generating a wakeup event, range in 0x1 ~ 0xFF.

flexcan_pn_match_mode_t idMatchMode

The ID match type.

flexcan_pn_match_mode_t dataMatchMode

The data match type.

uint32_t idLower

The ID target values 1 which used either for ID match “equal to”, “smaller than”, “greater than” comparisons, or as the lower limit value in ID match “range detection”.

uint32_t idUpper

The ID target values 2 which used only as the upper limit value in ID match “range detection” or used to store the ID mask in “equal to”.

uint8_t lengthLower

The lower limit for length of data bytes which used only in data match “range detection”. Range in 0x0 ~ 0x8.

uint8_t lengthUpper

The upper limit for length of data bytes which used only in data match “range detection”. Range in 0x0 ~ 0x8.

struct _flexcan_rx_fifo_config

#include <fsl_flexcan.h> FlexCAN Legacy Rx FIFO configuration structure.

Public Members

uint32_t *idFilterTable

Pointer to the FlexCAN Legacy Rx FIFO identifier filter table.

uint8_t idFilterNum

The FlexCAN Legacy Rx FIFO Filter elements quantity.

flexcan_rx_fifo_filter_type_t idFilterType

The FlexCAN Legacy Rx FIFO Filter type.

flexcan_rx_fifo_priority_t priority

The FlexCAN Legacy Rx FIFO receive priority.

struct _flexcan_enhanced_rx_fifo_std_id_filter

#include <fsl_flexcan.h> FlexCAN Enhanced Rx FIFO Standard ID filter element structure.

Public Members

uint32_t filterType

FlexCAN internal Free-Running Counter Time Stamp.

uint32_t rtr1

CAN FD frame data length code (DLC), range see _flexcan_fd_frame_length, When the length <= 8, it equal to the data length, otherwise the number of valid frame data is not equal to the length value. user can use DLC_LENGTH_DECODE(length) macro to get the number of valid data bytes.

uint32_t std1

CAN Frame Type(DATA or REMOTE).

uint32_t rtr2

CAN Frame Identifier(STD or EXT format).

uint32_t std2

Substitute Remote request.

struct _flexcan_enhanced_rx_fifo_ext_id_filter

#include <fsl_flexcan.h> FlexCAN Enhanced Rx FIFO Extended ID filter element structure.

Public Members

uint32_t filterType

FlexCAN internal Free-Running Counter Time Stamp.

uint32_t rtr1

CAN FD frame data length code (DLC), range see _flexcan_fd_frame_length, When the length <= 8, it equal to the data length, otherwise the number of valid frame data is not equal to the length value. user can use DLC_LENGTH_DECODE(length) macro to get the number of valid data bytes.

uint32_t std1

CAN Frame Type(DATA or REMOTE).

uint32_t rtr2

CAN Frame Identifier(STD or EXT format).

uint32_t std2

Substitute Remote request.

struct __flexcan__enhanced__rx__fifo__config

#include <fsl_flexcan.h> FlexCAN Enhanced Rx FIFO configuration structure.

Public Members

uint32_t *idFilterTable

Pointer to the FlexCAN Enhanced Rx FIFO identifier filter table, each table member occupies 32 bit word, table size should be equal to idFilterNum. There are two types of Enhanced Rx FIFO filter elements that can be stored in table : extended-ID filter element (1 word, occupie 1 table members) and standard-ID filter element (2 words, occupies 2 table members), the extended-ID filter element needs to be placed in front of the table.

uint8_t idFilterPairNum

idFilterPairNum is the Enhanced Rx FIFO identifier filter element pair numbers, each pair of filter elements occupies 2 words and can consist of one extended ID filter element or two standard ID filter elements.

uint8_t extendIdFilterNum

The number of extended ID filter element items in the FlexCAN enhanced Rx FIFO identifier filter table, each extended-ID filter element occupies 2 words, extendIdFilterNum need less than or equal to idFilterPairNum.

uint8_t fifoWatermark

(fifoWatermark + 1) is the minimum number of CAN messages stored in the Enhanced RX FIFO which can trigger FIFO watermark interrupt or a DMA request.

flexcan_efifo_dma_per_read_length_t dmaPerReadLength

Define the length of each read of the Enhanced RX FIFO element by the DAM, see _flexcan_fd_frame_length.

flexcan_rx_fifo_priority_t priority

The FlexCAN Enhanced Rx FIFO receive priority.

struct __flexcan__mb__transfer

#include <fsl_flexcan.h> FlexCAN Message Buffer transfer.

Public Members

flexcan_frame_t *frame

The buffer of CAN Message to be transfer.

uint8_t mbIdx

The index of Message buffer used to transfer Message.

struct __flexcan__fifo__transfer

#include <fsl_flexcan.h> FlexCAN Rx FIFO transfer.

Public Members

flexcan_fd_frame_t *framefd

The buffer of CAN Message to be received from Enhanced Rx FIFO.

flexcan_frame_t *frame
The buffer of CAN Message to be received from Legacy Rx FIFO.

size_t frameNum
Number of CAN Message need to be received from Legacy or Ehanced Rx FIFO.

struct __flexcan_handle
#include <fsl_flexcan.h> FlexCAN handle structure.

Public Members

flexcan_transfer_callback_t callback
Callback function.

void *userData
FlexCAN callback function parameter.

flexcan_frame_t *volatile mbFrameBuf[CAN_WORD1_COUNT]
The buffer for received CAN data from Message Buffers.

flexcan_fd_frame_t *volatile mbFDFrameBuf[CAN_WORD1_COUNT]
The buffer for received CAN FD data from Message Buffers.

flexcan_frame_t *volatile rxFifoFrameBuf
The buffer for received CAN data from Legacy Rx FIFO.

flexcan_fd_frame_t *volatile rxFifoFDFrameBuf
The buffer for received CAN FD data from Ehanced Rx FIFO.

size_t rxFifoFrameNum
The number of CAN messages remaining to be received from Legacy or Ehanced Rx FIFO.

size_t rxFifoTransferTotalNum
Total CAN Message number need to be received from Legacy or Ehanced Rx FIFO.

volatile uint8_t mbState[CAN_WORD1_COUNT]
Message Buffer transfer state.

volatile uint8_t rxFifoState
Rx FIFO transfer state.

volatile uint32_t timestamp[CAN_WORD1_COUNT]
Mailbox transfer timestamp.

struct byteStatus

Public Members

bool byteIsRead
The byte n (0~3) was read or not. The type of error and which bit in byte (n) is affected by the error.

struct ___unnamed20___

Public Members

uint32_t timestamp
: FlexCAN internal Free-Running Counter Time Stamp.

uint32_t length
: CAN frame data length in bytes (Range: 0~8).

uint32_t type
: CAN Frame Type(DATA or REMOTE).

uint32_t format
: CAN Frame Identifier(STD or EXT format).

uint32_t ___pad0___
: Reserved.

uint32_t idhit
: CAN Rx FIFO filter hit id(This value is only used in Rx FIFO receive mode).

struct ___unnamed22___

Public Members

uint32_t id
: CAN Frame Identifier, should be set using FLEXCAN_ID_EXT() or FLEXCAN_ID_STD() macro.

uint32_t ___pad0___
: Reserved.

union ___unnamed24___

Public Members

struct _flexcan_frame

struct _flexcan_frame

struct ___unnamed26___

Public Members

uint32_t dataWord0
: CAN Frame payload word0.

uint32_t dataWord1
: CAN Frame payload word1.

struct ___unnamed28___

Public Members

uint8_t dataByte3
: CAN Frame payload byte3.

uint8_t dataByte2
: CAN Frame payload byte2.

uint8_t dataByte1
: CAN Frame payload byte1.

uint8_t dataByte0
: CAN Frame payload byte0.

uint8_t dataByte7
: CAN Frame payload byte7.

uint8_t dataByte6
: CAN Frame payload byte6.

uint8_t dataByte5
: CAN Frame payload byte5.

uint8_t dataByte4
: CAN Frame payload byte4.

struct ___unnamed30___

Public Members

uint32_t timestamp
: FlexCAN internal Free-Running Counter Time Stamp.

uint32_t length
: CAN FD frame data length code (DLC), range see _flexcan_fd_frame_length, When the length <= 8, it equal to the data length, otherwise the number of valid frame data is not equal to the length value. user can use DLC_LENGTH_DECODE(length) macro to get the number of valid data bytes.

uint32_t type
: CAN Frame Type(DATA only).

uint32_t format
: CAN Frame Identifier(STD or EXT format).

uint32_t srr
: Substitute Remote request.

uint32_t esi
: Error State Indicator.

uint32_t brs
: Bit Rate Switch.

uint32_t edl
: Extended Data Length.

struct ___unnamed32___

Public Members

uint32_t id
: CAN Frame Identifier, should be set using FLEXCAN_ID_EXT() or FLEXCAN_ID_STD() macro.

uint32_t ___pad0___
: Reserved.

union ___unnamed34___

Public Members

struct __flexcan__fd__frame

struct __flexcan__fd__frame

struct ___unnamed36___

Public Members

uint32_t dataWord[16]
CAN FD Frame payload, 16 double word maximum.

struct ___unnamed38___

Public Members

uint8_t dataByte3
CAN Frame payload byte3.

uint8_t dataByte2
CAN Frame payload byte2.

uint8_t dataByte1
CAN Frame payload byte1.

uint8_t dataByte0
CAN Frame payload byte0.

uint8_t dataByte7
CAN Frame payload byte7.

uint8_t dataByte6
CAN Frame payload byte6.

uint8_t dataByte5
CAN Frame payload byte5.

uint8_t dataByte4
CAN Frame payload byte4.

union ___unnamed40___

Public Members

struct __flexcan__config

struct __flexcan__config

struct ___unnamed42___

Public Members

uint32_t baudRate
FlexCAN bit rate in bps, for classical CAN or CANFD nominal phase.

uint32_t baudRateFD
FlexCAN FD bit rate in bps, for CANFD data phase.

struct ___unnamed44___

Public Members

uint32_t bitRate

FlexCAN bit rate in bps, for classical CAN or CANFD nominal phase.

uint32_t bitRateFD

FlexCAN FD bit rate in bps, for CANFD data phase.

union ___unnamed46___

Public Members

struct __flexcan__pn__config

< The data target values 1 which used either for data match “equal to”, “smaller than”, “greater than” comparisons, or as the lower limit value in data match “range

detection”.

struct __flexcan__pn__config

struct ___unnamed50___

< The data target values 1 which used either for data match “equal to”, “smaller than”, “greater than” comparisons, or as the lower limit value in data match “range

detection”.

Public Members

uint32_t lowerWord0

CAN Frame payload word0.

uint32_t lowerWord1

CAN Frame payload word1.

struct ___unnamed52___

Public Members

uint8_t lowerByte3

CAN Frame payload byte3.

uint8_t lowerByte2

CAN Frame payload byte2.

uint8_t lowerByte1

CAN Frame payload byte1.

uint8_t lowerByte0

CAN Frame payload byte0.

uint8_t lowerByte7

CAN Frame payload byte7.

uint8_t lowerByte6

CAN Frame payload byte6.

uint8_t lowerByte5

CAN Frame payload byte5.

uint8_t lowerByte4
CAN Frame payload byte4.

union ___unnamed48___

Public Members

struct __flexcan__pn__config

< The data target values 2 which used only as the upper limit value in data match “range

detection” or used to store the data mask in “equal to”.

struct __flexcan__pn__config

struct ___unnamed54___

< The data target values 2 which used only as the upper limit value in data match “range detection” or used to store the data mask in “equal to”.

Public Members

uint32_t upperWord0
CAN Frame payload word0.

uint32_t upperWord1
CAN Frame payload word1.

struct ___unnamed56___

Public Members

uint8_t upperByte3
CAN Frame payload byte3.

uint8_t upperByte2
CAN Frame payload byte2.

uint8_t upperByte1
CAN Frame payload byte1.

uint8_t upperByte0
CAN Frame payload byte0.

uint8_t upperByte7
CAN Frame payload byte7.

uint8_t upperByte6
CAN Frame payload byte6.

uint8_t upperByte5
CAN Frame payload byte5.

uint8_t upperByte4
CAN Frame payload byte4.

2.14 FlexCAN eDMA Driver

void FLEXCAN_TransferCreateHandleEDMA(CAN_Type *base, *flexcan_edma_handle_t* *handle, *flexcan_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *rxFifoEdmaHandle)

Initializes the FlexCAN handle, which is used in transactional functions.

Parameters

- base – FlexCAN peripheral base address.
- handle – Pointer to flexcan_edma_handle_t structure.
- callback – The callback function.
- userData – The parameter of the callback function.
- rxFifoEdmaHandle – User-requested DMA handle for Rx FIFO DMA transfer.

void FLEXCAN_PrepareTransfConfiguration(CAN_Type *base, *flexcan_fifo_transfer_t* *pFifoXfer, *edma_transfer_config_t* *pEdmaConfig)

Prepares the eDMA transfer configuration for FLEXCAN Legacy RX FIFO.

This function prepares the eDMA transfer configuration structure according to FLEXCAN Legacy RX FIFO.

Parameters

- base – FlexCAN peripheral base address.
- pFifoXfer – FlexCAN Rx FIFO EDMA transfer structure, see flexcan_fifo_transfer_t.
- pEdmaConfig – The user configuration structure of type edma_transfer_t.

status_t FLEXCAN_StartTransferDatafromRxFIFO(CAN_Type *base, *flexcan_edma_handle_t* *handle, *edma_transfer_config_t* *pEdmaConfig)

Start Transfer Data from the FLEXCAN Legacy Rx FIFO using eDMA.

This function to Update edma transfer confiugration and Start eDMA transfer

Parameters

- base – FlexCAN peripheral base address.
- handle – Pointer to flexcan_edma_handle_t structure.
- pEdmaConfig – The user configuration structure of type edma_transfer_t.

Return values

- kStatus_Success – if succeed, others failed.
- kStatus_FLEXCAN_RxFifoBusy – Previous transfer ongoing.

status_t FLEXCAN_TransferReceiveFifoEDMA(CAN_Type *base, *flexcan_edma_handle_t* *handle, *flexcan_fifo_transfer_t* *pFifoXfer)

Receives the CAN Message from the Legacy Rx FIFO using eDMA.

This function receives the CAN Message using eDMA. This is a non-blocking function, which returns right away. After the CAN Message is received, the receive callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – Pointer to flexcan_edma_handle_t structure.

- pFifoXfer – FlexCAN Rx FIFO EDMA transfer structure, see flexcan_fifo_transfer_t.

Return values

- kStatus_Success – if succeed, others failed.
- kStatus_FLEXCAN_RxFifoBusy – Previous transfer ongoing.

status_t FLEXCAN_TransferGetReceiveFifoCountEMDA(CAN_Type *base, *flexcan_edma_handle_t* *handle, size_t *count)

Gets the Legacy Rx Fifo transfer status during a interrupt non-blocking receive.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- count – Number of CAN messages receive so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

void FLEXCAN_TransferAbortReceiveFifoEDMA(CAN_Type *base, *flexcan_edma_handle_t* *handle)

Aborts the receive Legacy/Enhanced Rx FIFO process which used eDMA.

This function aborts the receive Legacy/Enhanced Rx FIFO process which used eDMA.

Parameters

- base – FlexCAN peripheral base address.
- handle – Pointer to flexcan_edma_handle_t structure.

status_t FLEXCAN_TransferReceiveEnhancedFifoEDMA(CAN_Type *base, *flexcan_edma_handle_t* *handle, *flexcan_fifo_transfer_t* *pFifoXfer)

Receives the CAN FD Message from the Enhanced Rx FIFO using eDMA.

This function receives the CAN FD Message using eDMA. This is a non-blocking function, which returns right away. After the CAN Message is received, the receive callback function is called.

Parameters

- base – FlexCAN peripheral base address.
- handle – Pointer to flexcan_edma_handle_t structure.
- pFifoXfer – FlexCAN Rx FIFO EDMA transfer structure, see flexcan_fifo_transfer_t.

Return values

- kStatus_Success – if succeed, others failed.
- kStatus_FLEXCAN_RxFifoBusy – Previous transfer ongoing.

static inline *status_t* FLEXCAN_TransferGetReceiveEnhancedFifoCountEMDA(CAN_Type *base, *flexcan_edma_handle_t* *handle, size_t *count)

Gets the Enhanced Rx Fifo transfer status during a interrupt non-blocking receive.

Parameters

- base – FlexCAN peripheral base address.
- handle – FlexCAN handle pointer.
- count – Number of CAN messages receive so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

FSL_FLEXCAN_EDMA_DRIVER_VERSION

FlexCAN EDMA driver version.

typedef struct *_flexcan_edma_handle* flexcan_edma_handle_t

typedef void (*flexcan_edma_transfer_callback_t)(CAN_Type *base, *flexcan_edma_handle_t* *handle, *status_t* status, void *userData)

FlexCAN transfer callback function.

struct _flexcan_edma_handle

#include <fsl_flexcan_edma.h> FlexCAN eDMA handle.

Public Members

flexcan_edma_transfer_callback_t callback

Callback function.

void *userData

FlexCAN callback function parameter.

edma_handle_t *rxFifoEdmaHandle

The EDMA handler for Rx FIFO.

volatile uint8_t rxFifoState

Rx FIFO transfer state.

size_t frameNum

The number of messages that need to be received.

flexcan_fd_frame_t *framefd

Point to the buffer of CAN Message to be received from Enhanced Rx FIFO.

2.15 FlexIO: FlexIO Driver

2.16 FlexIO Driver

void FLEXIO_GetDefaultConfig(*flexio_config_t* *userConfig)

Gets the default configuration to configure the FlexIO module. The configuration can used directly to call the FLEXIO_Configure().

Example:

```
flexio_config_t config;
FLEXIO_GetDefaultConfig(&config);
```

Parameters

- userConfig – pointer to flexio_config_t structure

void FLEXIO_Init(FLEXIO_Type *base, const *flexio_config_t* *userConfig)

Configures the FlexIO with a FlexIO configuration. The configuration structure can be filled by the user or be set with default values by FLEXIO_GetDefaultConfig().

Example

```
flexio_config_t config = {
.enableFlexio = true,
.enableInDoze = false,
.enableInDebug = true,
.enableFastAccess = false
};
FLEXIO_Configure(base, &config);
```

Parameters

- base – FlexIO peripheral base address
- userConfig – pointer to flexio_config_t structure

void FLEXIO_Deinit(FLEXIO_Type *base)

Gates the FlexIO clock. Call this API to stop the FlexIO clock.

Note: After calling this API, call the FLEXO_Init to use the FlexIO module.

Parameters

- base – FlexIO peripheral base address

uint32_t FLEXIO_GetInstance(FLEXIO_Type *base)

Get instance number for FLEXIO module.

Parameters

- base – FLEXIO peripheral base address.

void FLEXIO_Reset(FLEXIO_Type *base)

Resets the FlexIO module.

Parameters

- base – FlexIO peripheral base address

static inline void FLEXIO_Enable(FLEXIO_Type *base, bool enable)

Enables the FlexIO module operation.

Parameters

- base – FlexIO peripheral base address
- enable – true to enable, false to disable.

static inline uint32_t FLEXIO_ReadPinInput(FLEXIO_Type *base)

Reads the input data on each of the FlexIO pins.

Parameters

- base – FlexIO peripheral base address

Returns

FlexIO pin input data

static inline uint8_t FLEXIO_GetShifterState(FLEXIO_Type *base)

Gets the current state pointer for state mode use.

Parameters

- base – FlexIO peripheral base address

Returns

current State pointer

void FLEXIO_SetShifterConfig(FLEXIO_Type *base, uint8_t index, const *flexio_shifter_config_t* *shifterConfig)

Configures the shifter with the shifter configuration. The configuration structure covers both the SHIFTCTL and SHIFTCFG registers. To configure the shifter to the proper mode, select which timer controls the shifter to shift, whether to generate start bit/stop bit, and the polarity of start bit and stop bit.

Example

```
flexio_shifter_config_t config = {
.timerSelect = 0,
.timerPolarity = kFLEXIO_ShifterTimerPolarityOnPositive,
.pinConfig = kFLEXIO_PinConfigOpenDrainOrBidirection,
.pinPolarity = kFLEXIO_PinActiveLow,
.shifterMode = kFLEXIO_ShifterModeTransmit,
.inputSource = kFLEXIO_ShifterInputFromPin,
.shifterStop = kFLEXIO_ShifterStopBitHigh,
.shifterStart = kFLEXIO_ShifterStartBitLow
};
FLEXIO_SetShifterConfig(base, &config);
```

Parameters

- base – FlexIO peripheral base address
- index – Shifter index
- shifterConfig – Pointer to flexio_shifter_config_t structure

void FLEXIO_SetTimerConfig(FLEXIO_Type *base, uint8_t index, const *flexio_timer_config_t* *timerConfig)

Configures the timer with the timer configuration. The configuration structure covers both the TIMCTL and TIMCFG registers. To configure the timer to the proper mode, select trigger source for timer and the timer pin output and the timing for timer.

Example

```
flexio_timer_config_t config = {
.triggerSelect = FLEXIO_TIMER_TRIGGER_SEL_SHIFTnSTAT(0),
.triggerPolarity = kFLEXIO_TimerTriggerPolarityActiveLow,
.triggerSource = kFLEXIO_TimerTriggerSourceInternal,
.pinConfig = kFLEXIO_PinConfigOpenDrainOrBidirection,
.pinSelect = 0,
.pinPolarity = kFLEXIO_PinActiveHigh,
.timerMode = kFLEXIO_TimerModeDual8BitBaudBit,
.timerOutput = kFLEXIO_TimerOutputZeroNotAffectedByReset,
.timerDecrement = kFLEXIO_TimerDecSrcOnFlexIOClockShiftTimerOutput,
.timerReset = kFLEXIO_TimerResetOnTimerPinEqualToTimerOutput,
.timerDisable = kFLEXIO_TimerDisableOnTimerCompare,
.timerEnable = kFLEXIO_TimerEnableOnTriggerHigh,
.timerStop = kFLEXIO_TimerStopBitEnableOnTimerDisable,
.timerStart = kFLEXIO_TimerStartBitEnabled
};
FLEXIO_SetTimerConfig(base, &config);
```

Parameters

- base – FlexIO peripheral base address
- index – Timer index
- timerConfig – Pointer to the flexio_timer_config_t structure

static inline void FLEXIO_SetClockMode(FLEXIO_Type *base, uint8_t index, *flexio_timer_decrement_source_t* clocksource)

This function set the value of the prescaler on flexio channels.

Parameters

- base – Pointer to the FlexIO simulated peripheral type.
- index – Timer index
- clocksource – Set clock value

static inline void FLEXIO_EnableShifterStatusInterrupts(FLEXIO_Type *base, uint32_t mask)

Enables the shifter status interrupt. The interrupt generates when the corresponding SSF is set.

Note: For multiple shifter status interrupt enable, for example, two shifter status enable, can calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address
- mask – The shifter status mask which can be calculated by (1 « shifter index)

static inline void FLEXIO_DisableShifterStatusInterrupts(FLEXIO_Type *base, uint32_t mask)

Disables the shifter status interrupt. The interrupt won't generate when the corresponding SSF is set.

Note: For multiple shifter status interrupt enable, for example, two shifter status enable, can calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address
- mask – The shifter status mask which can be calculated by (1 « shifter index)

static inline void FLEXIO_EnableShifterErrorInterrupts(FLEXIO_Type *base, uint32_t mask)

Enables the shifter error interrupt. The interrupt generates when the corresponding SEF is set.

Note: For multiple shifter error interrupt enable, for example, two shifter error enable, can calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address
- mask – The shifter error mask which can be calculated by (1 « shifter index)

static inline void FLEXIO_DisableShifterErrorInterrupts(FLEXIO_Type *base, uint32_t mask)

Disables the shifter error interrupt. The interrupt won't generate when the corresponding SEF is set.

Note: For multiple shifter error interrupt enable, for example, two shifter error enable, can calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address
- mask – The shifter error mask which can be calculated by (1 « shifter index)

static inline void FLEXIO_EnableTimerStatusInterrupts(FLEXIO_Type *base, uint32_t mask)

Enables the timer status interrupt. The interrupt generates when the corresponding SSF is set.

Note: For multiple timer status interrupt enable, for example, two timer status enable, can calculate the mask by using ((1 « timer index0) | (1 « timer index1))

Parameters

- base – FlexIO peripheral base address
- mask – The timer status mask which can be calculated by (1 « timer index)

static inline void FLEXIO_DisableTimerStatusInterrupts(FLEXIO_Type *base, uint32_t mask)

Disables the timer status interrupt. The interrupt won't generate when the corresponding SSF is set.

Note: For multiple timer status interrupt enable, for example, two timer status enable, can calculate the mask by using ((1 « timer index0) | (1 « timer index1))

Parameters

- base – FlexIO peripheral base address
- mask – The timer status mask which can be calculated by (1 « timer index)

static inline uint32_t FLEXIO_GetShifterStatusFlags(FLEXIO_Type *base)

Gets the shifter status flags.

Parameters

- base – FlexIO peripheral base address

Returns

Shifter status flags

static inline void FLEXIO_ClearShifterStatusFlags(FLEXIO_Type *base, uint32_t mask)

Clears the shifter status flags.

Note: For clearing multiple shifter status flags, for example, two shifter status flags, can calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address

- mask – The shifter status mask which can be calculated by (1 « shifter index)

static inline uint32_t FLEXIO_GetShifterErrorFlags(FLEXIO_Type *base)

Gets the shifter error flags.

Parameters

- base – FlexIO peripheral base address

Returns

Shifter error flags

static inline void FLEXIO_ClearShifterErrorFlags(FLEXIO_Type *base, uint32_t mask)

Clears the shifter error flags.

Note: For clearing multiple shifter error flags, for example, two shifter error flags, can calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address
- mask – The shifter error mask which can be calculated by (1 « shifter index)

static inline uint32_t FLEXIO_GetTimerStatusFlags(FLEXIO_Type *base)

Gets the timer status flags.

Parameters

- base – FlexIO peripheral base address

Returns

Timer status flags

static inline void FLEXIO_ClearTimerStatusFlags(FLEXIO_Type *base, uint32_t mask)

Clears the timer status flags.

Note: For clearing multiple timer status flags, for example, two timer status flags, can calculate the mask by using ((1 « timer index0) | (1 « timer index1))

Parameters

- base – FlexIO peripheral base address
- mask – The timer status mask which can be calculated by (1 « timer index)

static inline void FLEXIO_EnableShifterStatusDMA(FLEXIO_Type *base, uint32_t mask, bool enable)

Enables/disables the shifter status DMA. The DMA request generates when the corresponding SSF is set.

Note: For multiple shifter status DMA enables, for example, calculate the mask by using ((1 « shifter index0) | (1 « shifter index1))

Parameters

- base – FlexIO peripheral base address
- mask – The shifter status mask which can be calculated by (1 « shifter index)

- enable – True to enable, false to disable.

uint32_t FLEXIO_GetShifterBufferAddress(FLEXIO_Type *base, *flexio_shifter_buffer_type_t* type, uint8_t index)

Gets the shifter buffer address for the DMA transfer usage.

Parameters

- base – FlexIO peripheral base address
- type – Shifter type of flexio_shifter_buffer_type_t
- index – Shifter index

Returns

Corresponding shifter buffer index

status_t FLEXIO_RegisterHandleIRQ(void *base, void *handle, *flexio_isr_t* isr)

Registers the handle and the interrupt handler for the FlexIO-simulated peripheral.

Parameters

- base – Pointer to the FlexIO simulated peripheral type.
- handle – Pointer to the handler for FlexIO simulated peripheral.
- isr – FlexIO simulated peripheral interrupt handler.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO type/handle/ISR table out of range.

status_t FLEXIO_UnregisterHandleIRQ(void *base)

Unregisters the handle and the interrupt handler for the FlexIO-simulated peripheral.

Parameters

- base – Pointer to the FlexIO simulated peripheral type.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO type/handle/ISR table out of range.

static inline void FLEXIO_ClearPortOutput(FLEXIO_Type *base, uint32_t mask)

Sets the output level of the multiple FLEXIO pins to the logic 0.

Parameters

- base – FlexIO peripheral base address
- mask – FLEXIO pin number mask

static inline void FLEXIO_SetPortOutput(FLEXIO_Type *base, uint32_t mask)

Sets the output level of the multiple FLEXIO pins to the logic 1.

Parameters

- base – FlexIO peripheral base address
- mask – FLEXIO pin number mask

static inline void FLEXIO_TogglePortOutput(FLEXIO_Type *base, uint32_t mask)

Reverses the current output logic of the multiple FLEXIO pins.

Parameters

- base – FlexIO peripheral base address
- mask – FLEXIO pin number mask

static inline void FLEXIO_PinWrite(FLEXIO_Type *base, uint32_t pin, uint8_t output)

Sets the output level of the FLEXIO pins to the logic 1 or 0.

Parameters

- base – FlexIO peripheral base address
- pin – FLEXIO pin number.
- output – FLEXIO pin output logic level.
  - 0: corresponding pin output low-logic level.
  - 1: corresponding pin output high-logic level.

static inline void FLEXIO_EnablePinOutput(FLEXIO_Type *base, uint32_t pin)

Enables the FLEXIO output pin function.

Parameters

- base – FlexIO peripheral base address
- pin – FLEXIO pin number.

static inline uint32_t FLEXIO_PinRead(FLEXIO_Type *base, uint32_t pin)

Reads the current input value of the FLEXIO pin.

Parameters

- base – FlexIO peripheral base address
- pin – FLEXIO pin number.

Return values

FLEXIO – port input value

- 0: corresponding pin input low-logic level.
- 1: corresponding pin input high-logic level.

static inline uint32_t FLEXIO_GetPinStatus(FLEXIO_Type *base, uint32_t pin)

Gets the FLEXIO input pin status.

Parameters

- base – FlexIO peripheral base address
- pin – FLEXIO pin number.

Return values

FLEXIO – port input status

- 0: corresponding pin input capture no status.
- 1: corresponding pin input capture rising or falling edge.

static inline void FLEXIO_SetPinLevel(FLEXIO_Type *base, uint8_t pin, bool level)

Sets the FLEXIO output pin level.

Parameters

- base – FlexIO peripheral base address
- pin – FlexIO pin number.
- level – FlexIO output pin level to set, can be either 0 or 1.

static inline bool FLEXIO_GetPinOverride(const FLEXIO_Type *const base, uint8_t pin)

Gets the enabled status of a FLEXIO output pin.

Parameters

- base – FlexIO peripheral base address

- pin – FlexIO pin number.

Return values

FlexIO – port enabled status

- 0: corresponding output pin is in disabled state.
- 1: corresponding output pin is in enabled state.

static inline void FLEXIO_ConfigPinOverride(FLEXIO_Type *base, uint8_t pin, bool enabled)

Enables or disables a FLEXIO output pin.

Parameters

- base – FlexIO peripheral base address
- pin – Flexio pin number.
- enabled – Enable or disable the FlexIO pin.

static inline void FLEXIO_ClearPortStatus(FLEXIO_Type *base, uint32_t mask)

Clears the multiple FLEXIO input pins status.

Parameters

- base – FlexIO peripheral base address
- mask – FLEXIO pin number mask

FSL_FLEXIO_DRIVER_VERSION

FlexIO driver version.

enum _flexio_timer_trigger_polarity

Define time of timer trigger polarity.

Values:

enumerator kFLEXIO_TimerTriggerPolarityActiveHigh

Active high.

enumerator kFLEXIO_TimerTriggerPolarityActiveLow

Active low.

enum _flexio_timer_trigger_source

Define type of timer trigger source.

Values:

enumerator kFLEXIO_TimerTriggerSourceExternal

External trigger selected.

enumerator kFLEXIO_TimerTriggerSourceInternal

Internal trigger selected.

enum _flexio_pin_config

Define type of timer/shifter pin configuration.

Values:

enumerator kFLEXIO_PinConfigOutputDisabled

Pin output disabled.

enumerator kFLEXIO_PinConfigOpenDrainOrBidirection

Pin open drain or bidirectional output enable.

enumerator kFLEXIO_PinConfigBidirectionOutputData

Pin bidirectional output data.

enumerator kFLEXIO_PinConfigOutput
Pin output.

enum _flexio_pin_polarity
Definition of pin polarity.

Values:

enumerator kFLEXIO_PinActiveHigh
Active high.

enumerator kFLEXIO_PinActiveLow
Active low.

enum _flexio_timer_mode
Define type of timer work mode.

Values:

enumerator kFLEXIO_TimerModeDisabled
Timer Disabled.

enumerator kFLEXIO_TimerModeDual8BitBaudBit
Dual 8-bit counters baud/bit mode.

enumerator kFLEXIO_TimerModeDual8BitPWM
Dual 8-bit counters PWM mode.

enumerator kFLEXIO_TimerModeSingle16Bit
Single 16-bit counter mode.

enumerator kFLEXIO_TimerModeDual8BitPWMLow
Dual 8-bit counters PWM Low mode.

enum _flexio_timer_output
Define type of timer initial output or timer reset condition.

Values:

enumerator kFLEXIO_TimerOutputOneNotAffectedByReset
Logic one when enabled and is not affected by timer reset.

enumerator kFLEXIO_TimerOutputZeroNotAffectedByReset
Logic zero when enabled and is not affected by timer reset.

enumerator kFLEXIO_TimerOutputOneAffectedByReset
Logic one when enabled and on timer reset.

enumerator kFLEXIO_TimerOutputZeroAffectedByReset
Logic zero when enabled and on timer reset.

enum _flexio_timer_decrement_source
Define type of timer decrement.

Values:

enumerator kFLEXIO_TimerDecSrcOnFlexIOClockShiftTimerOutput
Decrement counter on FlexIO clock, Shift clock equals Timer output.

enumerator kFLEXIO_TimerDecSrcOnTriggerInputShiftTimerOutput
Decrement counter on Trigger input (both edges), Shift clock equals Timer output.

enumerator kFLEXIO_TimerDecSrcOnPinInputShiftPinInput
Decrement counter on Pin input (both edges), Shift clock equals Pin input.

enumerator kFLEXIO_TimerDecSrcOnTriggerInputShiftTriggerInput
Decrement counter on Trigger input (both edges), Shift clock equals Trigger input.

enum _flexio_timer_reset_condition
Define type of timer reset condition.

Values:

enumerator kFLEXIO_TimerResetNever
Timer never reset.

enumerator kFLEXIO_TimerResetOnTimerPinEqualToTimerOutput
Timer reset on Timer Pin equal to Timer Output.

enumerator kFLEXIO_TimerResetOnTimerTriggerEqualToTimerOutput
Timer reset on Timer Trigger equal to Timer Output.

enumerator kFLEXIO_TimerResetOnTimerPinRisingEdge
Timer reset on Timer Pin rising edge.

enumerator kFLEXIO_TimerResetOnTimerTriggerRisingEdge
Timer reset on Trigger rising edge.

enumerator kFLEXIO_TimerResetOnTimerTriggerBothEdge
Timer reset on Trigger rising or falling edge.

enum _flexio_timer_disable_condition
Define type of timer disable condition.

Values:

enumerator kFLEXIO_TimerDisableNever
Timer never disabled.

enumerator kFLEXIO_TimerDisableOnPreTimerDisable
Timer disabled on Timer N-1 disable.

enumerator kFLEXIO_TimerDisableOnTimerCompare
Timer disabled on Timer compare.

enumerator kFLEXIO_TimerDisableOnTimerCompareTriggerLow
Timer disabled on Timer compare and Trigger Low.

enumerator kFLEXIO_TimerDisableOnPinBothEdge
Timer disabled on Pin rising or falling edge.

enumerator kFLEXIO_TimerDisableOnPinBothEdgeTriggerHigh
Timer disabled on Pin rising or falling edge provided Trigger is high.

enumerator kFLEXIO_TimerDisableOnTriggerFallingEdge
Timer disabled on Trigger falling edge.

enum _flexio_timer_enable_condition
Define type of timer enable condition.

Values:

enumerator kFLEXIO_TimerEnabledAlways
Timer always enabled.

enumerator kFLEXIO_TimerEnableOnPrevTimerEnable
Timer enabled on Timer N-1 enable.

enumerator kFLEXIO_TimerEnableOnTriggerHigh
Timer enabled on Trigger high.

enumerator kFLEXIO_TimerEnableOnTriggerHighPinHigh
Timer enabled on Trigger high and Pin high.

enumerator kFLEXIO_TimerEnableOnPinRisingEdge
Timer enabled on Pin rising edge.

enumerator kFLEXIO_TimerEnableOnPinRisingEdgeTriggerHigh
Timer enabled on Pin rising edge and Trigger high.

enumerator kFLEXIO_TimerEnableOnTriggerRisingEdge
Timer enabled on Trigger rising edge.

enumerator kFLEXIO_TimerEnableOnTriggerBothEdge
Timer enabled on Trigger rising or falling edge.

enum _flexio_timer_stop_bit_condition
Define type of timer stop bit generate condition.

Values:

enumerator kFLEXIO_TimerStopBitDisabled
Stop bit disabled.

enumerator kFLEXIO_TimerStopBitEnableOnTimerCompare
Stop bit is enabled on timer compare.

enumerator kFLEXIO_TimerStopBitEnableOnTimerDisable
Stop bit is enabled on timer disable.

enumerator kFLEXIO_TimerStopBitEnableOnTimerCompareDisable
Stop bit is enabled on timer compare and timer disable.

enum _flexio_timer_start_bit_condition
Define type of timer start bit generate condition.

Values:

enumerator kFLEXIO_TimerStartBitDisabled
Start bit disabled.

enumerator kFLEXIO_TimerStartBitEnabled
Start bit enabled.

enum _flexio_timer_output_state
FlexIO as PWM channel output state.

Values:

enumerator kFLEXIO_PwmLow
The output state of PWM channel is low

enumerator kFLEXIO_PwmHigh
The output state of PWM channel is high

enum _flexio_shifter_timer_polarity
Define type of timer polarity for shifter control.

Values:

enumerator kFLEXIO_ShifterTimerPolarityOnPositive
Shift on positive edge of shift clock.

enumerator kFLEXIO_ShifterTimerPolarityOnNegitive
Shift on negative edge of shift clock.

enum _flexio_shifter_mode
Define type of shifter working mode.

Values:

enumerator kFLEXIO_ShifterDisabled
Shifter is disabled.

enumerator kFLEXIO_ShifterModeReceive
Receive mode.

enumerator kFLEXIO_ShifterModeTransmit
Transmit mode.

enumerator kFLEXIO_ShifterModeMatchStore
Match store mode.

enumerator kFLEXIO_ShifterModeMatchContinuous
Match continuous mode.

enumerator kFLEXIO_ShifterModeState
SHIFTBUF contents are used for storing programmable state attributes.

enumerator kFLEXIO_ShifterModeLogic
SHIFTBUF contents are used for implementing programmable logic look up table.

enum _flexio_shifter_input_source
Define type of shifter input source.

Values:

enumerator kFLEXIO_ShifterInputFromPin
Shifter input from pin.

enumerator kFLEXIO_ShifterInputFromNextShifterOutput
Shifter input from Shifter N+1.

enum _flexio_shifter_stop_bit
Define of STOP bit configuration.

Values:

enumerator kFLEXIO_ShifterStopBitDisable
Disable shifter stop bit.

enumerator kFLEXIO_ShifterStopBitLow
Set shifter stop bit to logic low level.

enumerator kFLEXIO_ShifterStopBitHigh
Set shifter stop bit to logic high level.

enum _flexio_shifter_start_bit
Define type of START bit configuration.

Values:

enumerator kFLEXIO_ShifterStartBitDisabledLoadDataOnEnable
Disable shifter start bit, transmitter loads data on enable.

enumerator kFLEXIO_ShifterStartBitDisabledLoadDataOnShift
Disable shifter start bit, transmitter loads data on first shift.

enumerator kFLEXIO_ShifterStartBitLow
Set shifter start bit to logic low level.

enumerator kFLEXIO_ShifterStartBitHigh
Set shifter start bit to logic high level.

enum _flexio_shifter_buffer_type
Define FlexIO shifter buffer type.

Values:

enumerator kFLEXIO_ShifterBuffer
Shifter Buffer N Register.

enumerator kFLEXIO_ShifterBufferBitSwapped
Shifter Buffer N Bit Byte Swapped Register.

enumerator kFLEXIO_ShifterBufferByteSwapped
Shifter Buffer N Byte Swapped Register.

enumerator kFLEXIO_ShifterBufferBitByteSwapped
Shifter Buffer N Bit Swapped Register.

enumerator kFLEXIO_ShifterBufferNibbleByteSwapped
Shifter Buffer N Nibble Byte Swapped Register.

enumerator kFLEXIO_ShifterBufferHalfWordSwapped
Shifter Buffer N Half Word Swapped Register.

enumerator kFLEXIO_ShifterBufferNibbleSwapped
Shifter Buffer N Nibble Swapped Register.

enum _flexio_gpio_direction
FLEXIO gpio direction definition.

Values:

enumerator kFLEXIO_DigitalInput
Set current pin as digital input

enumerator kFLEXIO_DigitalOutput
Set current pin as digital output

enum _flexio_pin_input_config
FLEXIO gpio input config.

Values:

enumerator kFLEXIO_InputInterruptDisabled
Interrupt request is disabled.

enumerator kFLEXIO_InputInterruptEnable
Interrupt request is enable.

enumerator kFLEXIO_FlagRisingEdgeEnable
Input pin flag on rising edge.

enumerator kFLEXIO_FlagFallingEdgeEnable
Input pin flag on falling edge.

typedef enum *_flexio_timer_trigger_polarity* flexio_timer_trigger_polarity_t
Define time of timer trigger polarity.

typedef enum *_flexio_timer_trigger_source* flexio_timer_trigger_source_t
Define type of timer trigger source.

typedef enum *_flexio_pin_config* flexio_pin_config_t
Define type of timer/shifter pin configuration.

typedef enum *_flexio_pin_polarity* flexio_pin_polarity_t
Definition of pin polarity.

typedef enum *_flexio_timer_mode* flexio_timer_mode_t
Define type of timer work mode.

typedef enum *_flexio_timer_output* flexio_timer_output_t
Define type of timer initial output or timer reset condition.

typedef enum *_flexio_timer_decrement_source* flexio_timer_decrement_source_t
Define type of timer decrement.

typedef enum *_flexio_timer_reset_condition* flexio_timer_reset_condition_t
Define type of timer reset condition.

typedef enum *_flexio_timer_disable_condition* flexio_timer_disable_condition_t
Define type of timer disable condition.

typedef enum *_flexio_timer_enable_condition* flexio_timer_enable_condition_t
Define type of timer enable condition.

typedef enum *_flexio_timer_stop_bit_condition* flexio_timer_stop_bit_condition_t
Define type of timer stop bit generate condition.

typedef enum *_flexio_timer_start_bit_condition* flexio_timer_start_bit_condition_t
Define type of timer start bit generate condition.

typedef enum *_flexio_timer_output_state* flexio_timer_output_state_t
FlexIO as PWM channel output state.

typedef enum *_flexio_shifter_timer_polarity* flexio_shifter_timer_polarity_t
Define type of timer polarity for shifter control.

typedef enum *_flexio_shifter_mode* flexio_shifter_mode_t
Define type of shifter working mode.

typedef enum *_flexio_shifter_input_source* flexio_shifter_input_source_t
Define type of shifter input source.

typedef enum *_flexio_shifter_stop_bit* flexio_shifter_stop_bit_t
Define of STOP bit configuration.

typedef enum *_flexio_shifter_start_bit* flexio_shifter_start_bit_t
Define type of START bit configuration.

typedef enum *_flexio_shifter_buffer_type* flexio_shifter_buffer_type_t
Define FlexIO shifter buffer type.

typedef struct *_flexio_config_* flexio_config_t
Define FlexIO user configuration structure.

typedef struct *_flexio_timer_config* flexio_timer_config_t
Define FlexIO timer configuration structure.

typedef struct *_flexio_shifter_config* flexio_shifter_config_t
Define FlexIO shifter configuration structure.

typedef enum *_flexio_gpio_direction* flexio_gpio_direction_t

FLEXIO gpio direction definition.

typedef enum *_flexio_pin_input_config* flexio_pin_input_config_t

FLEXIO gpio input config.

typedef struct *_flexio_gpio_config* flexio_gpio_config_t

The FLEXIO pin configuration structure.

Each pin can only be configured as either an output pin or an input pin at a time. If configured as an input pin, use inputConfig param. If configured as an output pin, use outputLogic.

typedef void (*flexio_isr_t)(void *base, void *handle)

typedef for FlexIO simulated driver interrupt handler.

FLEXIO_Type *const s_flexioBases[]

Pointers to flexio bases for each instance.

const clock_ip_name_t s_flexioClocks[]

Pointers to flexio clocks for each instance.

void FLEXIO_SetPinConfig(FLEXIO_Type *base, uint32_t pin, *flexio_gpio_config_t* *config)

Configure a FLEXIO pin used by the board.

To Config the FLEXIO PIN, define a pin configuration, as either input or output, in the user file. Then, call the FLEXIO_SetPinConfig() function.

This is an example to define an input pin or an output pin configuration.

```
Define a digital input pin configuration,
flexio_gpio_config_t config =
{
  kFLEXIO_DigitalInput,
  0U,
  kFLEXIO_FlagRisingEdgeEnable | kFLEXIO_InputInterruptEnable,
}
Define a digital output pin configuration,
flexio_gpio_config_t config =
{
  kFLEXIO_DigitalOutput,
  0U,
  0U
}
```

Parameters

- base – FlexIO peripheral base address
- pin – FLEXIO pin number.
- config – FLEXIO pin configuration pointer.

FLEXIO_TIMER_TRIGGER_SEL_PININPUT(x)

Calculate FlexIO timer trigger.

FLEXIO_TIMER_TRIGGER_SEL_SHIFTnSTAT(x)

FLEXIO_TIMER_TRIGGER_SEL_TIMn(x)

struct _flexio_config_

#include <fsl_flexio.h> Define FlexIO user configuration structure.

Public Members

bool enableFlexio
: Enable/disable FlexIO module

bool enableInDoze
: Enable/disable FlexIO operation in doze mode

bool enableInDebug
: Enable/disable FlexIO operation in debug mode

bool enableFastAccess
: Enable/disable fast access to FlexIO registers, fast access requires the FlexIO clock to be at least twice the frequency of the bus clock.

struct __flexio_timer_config
: *#include <fsl_flexio.h>* Define FlexIO timer configuration structure.

Public Members

uint32_t triggerSelect
: The internal trigger selection number using MACROs.

flexio_timer_trigger_polarity_t triggerPolarity
: Trigger Polarity.

flexio_timer_trigger_source_t triggerSource
: Trigger Source, internal (see 'trgsel') or external.

flexio_pin_config_t pinConfig
: Timer Pin Configuration.

uint32_t pinSelect
: Timer Pin number Select.

flexio_pin_polarity_t pinPolarity
: Timer Pin Polarity.

flexio_timer_mode_t timerMode
: Timer work Mode.

flexio_timer_output_t timerOutput
: Configures the initial state of the Timer Output and whether it is affected by the Timer reset.

flexio_timer_decrement_source_t timerDecrement
: Configures the source of the Timer decrement and the source of the Shift clock.

flexio_timer_reset_condition_t timerReset
: Configures the condition that causes the timer counter (and optionally the timer output) to be reset.

flexio_timer_disable_condition_t timerDisable
: Configures the condition that causes the Timer to be disabled and stop decrementing.

flexio_timer_enable_condition_t timerEnable
: Configures the condition that causes the Timer to be enabled and start decrementing.

flexio_timer_stop_bit_condition_t timerStop
: Timer STOP Bit generation.

flexio_timer_start_bit_condition_t timerStart
: Timer STRAT Bit generation.

uint32_t timerCompare
: Value for Timer Compare N Register.

struct __flexio_shifter_config
: *#include <fsl_flexio.h>* Define FlexIO shifter configuration structure.

Public Members

uint32_t timerSelect
: Selects which Timer is used for controlling the logic/shift register and generating the Shift clock.

flexio_shifter_timer_polarity_t timerPolarity
: Timer Polarity.

flexio_pin_config_t pinConfig
: Shifter Pin Configuration.

uint32_t pinSelect
: Shifter Pin number Select.

flexio_pin_polarity_t pinPolarity
: Shifter Pin Polarity.

flexio_shifter_mode_t shifterMode
: Configures the mode of the Shifter.

uint32_t parallelWidth
: Configures the parallel width when using parallel mode.

flexio_shifter_input_source_t inputSource
: Selects the input source for the shifter.

flexio_shifter_stop_bit_t shifterStop
: Shifter STOP bit.

flexio_shifter_start_bit_t shifterStart
: Shifter START bit.

struct __flexio_gpio_config
: *#include <fsl_flexio.h>* The FLEXIO pin configuration structure.

Each pin can only be configured as either an output pin or an input pin at a time. If configured as an input pin, use inputConfig param. If configured as an output pin, use outputLogic.

Public Members

flexio_gpio_direction_t pinDirection
: FLEXIO pin direction, input or output

uint8_t outputLogic
: Set a default output logic, which has no use in input

uint8_t inputConfig
: Set an input config

2.17 FlexIO eDMA I2S Driver

void FLEXIO_I2S_TransferTxCreateHandleEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, *flexio_i2s_edma_callback_t* callback, void *userData, *edma_handle_t* *dmaHandle)

Initializes the FlexIO I2S eDMA handle.

This function initializes the FlexIO I2S master DMA handle which can be used for other FlexIO I2S master transactional APIs. Usually, for a specified FlexIO I2S instance, call this API once to get the initialized handle.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S eDMA handle pointer.
- callback – FlexIO I2S eDMA callback function called while finished a block.
- userData – User parameter for callback.
- dmaHandle – eDMA handle for FlexIO I2S. This handle is a static value allocated by users.

void FLEXIO_I2S_TransferRxCreateHandleEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, *flexio_i2s_edma_callback_t* callback, void *userData, *edma_handle_t* *dmaHandle)

Initializes the FlexIO I2S Rx eDMA handle.

This function initializes the FlexIO I2S slave DMA handle which can be used for other FlexIO I2S master transactional APIs. Usually, for a specified FlexIO I2S instance, call this API once to get the initialized handle.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S eDMA handle pointer.
- callback – FlexIO I2S eDMA callback function called while finished a block.
- userData – User parameter for callback.
- dmaHandle – eDMA handle for FlexIO I2S. This handle is a static value allocated by users.

void FLEXIO_I2S_TransferSetFormatEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, *flexio_i2s_format_t* *format, uint32_t srcClock_Hz)

Configures the FlexIO I2S Tx audio format.

Audio format can be changed in run-time of FlexIO I2S. This function configures the sample rate and audio data format to be transferred. This function also sets the eDMA parameter according to format.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S eDMA handle pointer
- format – Pointer to FlexIO I2S audio data format structure.
- srcClock_Hz – FlexIO I2S clock source frequency in Hz, it should be 0 while in slave mode.

status_t FLEXIO_I2S_TransferSendEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, *flexio_i2s_transfer_t* *xfer)

Performs a non-blocking FlexIO I2S transfer using DMA.

Note: This interface returned immediately after transfer initiates. Users should call FLEXIO_I2S_GetTransferStatus to poll the transfer status and check whether the FlexIO I2S transfer is finished.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S DMA handle pointer.
- xfer – Pointer to DMA transfer structure.

Return values

- kStatus_Success – Start a FlexIO I2S eDMA send successfully.
- kStatus_InvalidArgument – The input arguments is invalid.
- kStatus_TxBusy – FlexIO I2S is busy sending data.

status_t FLEXIO_I2S_TransferReceiveEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, *flexio_i2s_transfer_t* *xfer)

Performs a non-blocking FlexIO I2S receive using eDMA.

Note: This interface returned immediately after transfer initiates. Users should call FLEXIO_I2S_GetReceiveRemainingBytes to poll the transfer status and check whether the FlexIO I2S transfer is finished.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S DMA handle pointer.
- xfer – Pointer to DMA transfer structure.

Return values

- kStatus_Success – Start a FlexIO I2S eDMA receive successfully.
- kStatus_InvalidArgument – The input arguments is invalid.
- kStatus_RxBusy – FlexIO I2S is busy receiving data.

void FLEXIO_I2S_TransferAbortSendEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle)

Aborts a FlexIO I2S transfer using eDMA.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S DMA handle pointer.

void FLEXIO_I2S_TransferAbortReceiveEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle)

Aborts a FlexIO I2S receive using eDMA.

Parameters

- base – FlexIO I2S peripheral base address.

- handle – FlexIO I2S DMA handle pointer.

status_t FLEXIO_I2S_TransferGetSendCountEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, size_t *count)

Gets the remaining bytes to be sent.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S DMA handle pointer.
- count – Bytes sent.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

status_t FLEXIO_I2S_TransferGetReceiveCountEDMA(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, size_t *count)

Get the remaining bytes to be received.

Parameters

- base – FlexIO I2S peripheral base address.
- handle – FlexIO I2S DMA handle pointer.
- count – Bytes received.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

FSL_FLEXIO_I2S_EDMA_DRIVER_VERSION

FlexIO I2S EDMA driver version 2.1.9.

typedef struct *_flexio_i2s_edma_handle* flexio_i2s_edma_handle_t

typedef void (*flexio_i2s_edma_callback_t)(*FLEXIO_I2S_Type* *base, *flexio_i2s_edma_handle_t* *handle, *status_t* status, void *userData)

FlexIO I2S eDMA transfer callback function for finish and error.

struct _flexio_i2s_edma_handle

#include <fsl_flexio_i2s_edma.h> FlexIO I2S DMA transfer handle, users should not touch the content of the handle.

Public Members

edma_handle_t *dmaHandle

DMA handler for FlexIO I2S send

uint8_t bytesPerFrame

Bytes in a frame

uint8_t nbytes

eDMA minor byte transfer count initially configured.

uint32_t state
: Internal state for FlexIO I2S eDMA transfer

flexio_i2s_edma_callback_t callback
: Callback for users while transfer finish or error occurred

void *userData
: User callback parameter

edma_tcd_t tcd[(4U) + 1U]
: TCD pool for eDMA transfer.

flexio_i2s_transfer_t queue[(4U)]
: Transfer queue storing queued transfer.

size_t transferSize[(4U)]
: Data bytes need to transfer

volatile uint8_t queueUser
: Index for user to queue transfer.

volatile uint8_t queueDriver
: Index for driver to get the transfer data and size

2.18 FlexIO eDMA SPI Driver

status_t FLEXIO_SPI_MasterTransferCreateHandleEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_master_edma_handle_t* *handle, *flexio_spi_master_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *txHandle, *edma_handle_t* *rxHandle)

Initializes the FlexIO SPI master eDMA handle.

This function initializes the FlexIO SPI master eDMA handle which can be used for other FlexIO SPI master transactional APIs. For a specified FlexIO SPI instance, call this API once to get the initialized handle.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – Pointer to flexio_spi_master_edma_handle_t structure to store the transfer state.
- callback – SPI callback, NULL means no callback.
- userData – callback function parameter.
- txHandle – User requested eDMA handle for FlexIO SPI RX eDMA transfer.
- rxHandle – User requested eDMA handle for FlexIO SPI TX eDMA transfer.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO SPI eDMA type/handle table out of range.

status_t FLEXIO_SPI_MasterTransferEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_master_edma_handle_t* *handle, *flexio_spi_transfer_t* *xfer)

Performs a non-blocking FlexIO SPI transfer using eDMA.

Note: This interface returns immediately after transfer initiates. Call FLEXIO_SPI_MasterGetTransferCountEDMA to poll the transfer status and check whether the FlexIO SPI transfer is finished.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – Pointer to flexio_spi_master_edma_handle_t structure to store the transfer state.
- xfer – Pointer to FlexIO SPI transfer structure.

Return values

- kStatus_Success – Successfully start a transfer.
- kStatus_InvalidArgument – Input argument is invalid.
- kStatus_FLEXIO_SPI_Busy – FlexIO SPI is not idle, is running another transfer.

void FLEXIO_SPI_MasterTransferAbortEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_master_edma_handle_t* *handle)

Aborts a FlexIO SPI transfer using eDMA.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – FlexIO SPI eDMA handle pointer.

status_t FLEXIO_SPI_MasterTransferGetCountEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_master_edma_handle_t* *handle, size_t *count)

Gets the number of bytes transferred so far using FlexIO SPI master eDMA.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – FlexIO SPI eDMA handle pointer.
- count – Number of bytes transferred so far by the non-blocking transaction.

static inline void FLEXIO_SPI_SlaveTransferCreateHandleEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_edma_handle_t* *handle, *flexio_spi_slave_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *txHandle, *edma_handle_t* *rxHandle)

Initializes the FlexIO SPI slave eDMA handle.

This function initializes the FlexIO SPI slave eDMA handle.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.

- handle – Pointer to flexio_spi_slave_edma_handle_t structure to store the transfer state.
- callback – SPI callback, NULL means no callback.
- userData – callback function parameter.
- txHandle – User requested eDMA handle for FlexIO SPI TX eDMA transfer.
- rxHandle – User requested eDMA handle for FlexIO SPI RX eDMA transfer.

status_t FLEXIO_SPI_SlaveTransferEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_edma_handle_t* *handle, *flexio_spi_transfer_t* *xfer)

Performs a non-blocking FlexIO SPI transfer using eDMA.

Note: This interface returns immediately after transfer initiates. Call FLEXIO_SPI_SlaveGetTransferCountEDMA to poll the transfer status and check whether the FlexIO SPI transfer is finished.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – Pointer to flexio_spi_slave_edma_handle_t structure to store the transfer state.
- xfer – Pointer to FlexIO SPI transfer structure.

Return values

- kStatus_Success – Successfully start a transfer.
- kStatus_InvalidArgument – Input argument is invalid.
- kStatus_FLEXIO_SPI_Busy – FlexIO SPI is not idle, is running another transfer.

static inline void FLEXIO_SPI_SlaveTransferAbortEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_edma_handle_t* *handle)

Aborts a FlexIO SPI transfer using eDMA.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – Pointer to flexio_spi_slave_edma_handle_t structure to store the transfer state.

static inline *status_t* FLEXIO_SPI_SlaveTransferGetCountEDMA(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_edma_handle_t* *handle, size_t *count)

Gets the number of bytes transferred so far using FlexIO SPI slave eDMA.

Parameters

- base – Pointer to FLEXIO_SPI_Type structure.
- handle – FlexIO SPI eDMA handle pointer.
- count – Number of bytes transferred so far by the non-blocking transaction.

FSL_FLEXIO_SPI_EDMA_DRIVER_VERSION

FlexIO SPI EDMA driver version.

typedef struct *_flexio_spi_master_edma_handle* flexio_spi_master_edma_handle_t

typedef for flexio_spi_master_edma_handle_t in advance.

typedef *flexio_spi_master_edma_handle_t* flexio_spi_slave_edma_handle_t

Slave handle is the same with master handle.

typedef void (*flexio_spi_master_edma_transfer_callback_t)(*FLEXIO_SPI_Type* *base, *flexio_spi_master_edma_handle_t* *handle, *status_t* status, void *userData)

FlexIO SPI master callback for finished transmit.

typedef void (*flexio_spi_slave_edma_transfer_callback_t)(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_edma_handle_t* *handle, *status_t* status, void *userData)

FlexIO SPI slave callback for finished transmit.

struct _flexio_spi_master_edma_handle

#include <fsl_flexio_spi_edma.h> FlexIO SPI eDMA transfer handle, users should not touch the content of the handle.

Public Members

size_t transferSize

Total bytes to be transferred.

uint8_t nbytes

eDMA minor byte transfer count initially configured.

bool txInProgress

Send transfer in progress

bool rxInProgress

Receive transfer in progress

edma_handle_t *txHandle

DMA handler for SPI send

edma_handle_t *rxHandle

DMA handler for SPI receive

flexio_spi_master_edma_transfer_callback_t callback

Callback for SPI DMA transfer

void *userData

User Data for SPI DMA callback

2.19 FlexIO eDMA UART Driver

status_t FLEXIO_UART_TransferCreateHandleEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle, *flexio_uart_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *txEdmaHandle, *edma_handle_t* *rxEdmaHandle)

Initializes the UART handle which is used in transactional functions.

Parameters

- base – Pointer to FLEXIO_UART_Type.
- handle – Pointer to flexio_uart_edma_handle_t structure.

- callback – The callback function.
- userData – The parameter of the callback function.
- rxEdmaHandle – User requested DMA handle for RX DMA transfer.
- txEdmaHandle – User requested DMA handle for TX DMA transfer.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO SPI eDMA type/handle table out of range.

status_t FLEXIO_UART_TransferSendEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle, *flexio_uart_transfer_t* *xfer)

Sends data using eDMA.

This function sends data using eDMA. This is a non-blocking function, which returns right away. When all data is sent out, the send callback function is called.

Parameters

- base – Pointer to FLEXIO_UART_Type
- handle – UART handle pointer.
- xfer – UART eDMA transfer structure, see flexio_uart_transfer_t.

Return values

- kStatus_Success – if succeed, others failed.
- kStatus_FLEXIO_UART_TxBusy – Previous transfer on going.

status_t FLEXIO_UART_TransferReceiveEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle, *flexio_uart_transfer_t* *xfer)

Receives data using eDMA.

This function receives data using eDMA. This is a non-blocking function, which returns right away. When all data is received, the receive callback function is called.

Parameters

- base – Pointer to FLEXIO_UART_Type
- handle – Pointer to flexio_uart_edma_handle_t structure
- xfer – UART eDMA transfer structure, see flexio_uart_transfer_t.

Return values

- kStatus_Success – if succeed, others failed.
- kStatus_UART_RxBusy – Previous transfer on going.

void FLEXIO_UART_TransferAbortSendEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle)

Aborts the sent data which using eDMA.

This function aborts sent data which using eDMA.

Parameters

- base – Pointer to FLEXIO_UART_Type
- handle – Pointer to flexio_uart_edma_handle_t structure

void FLEXIO_UART_TransferAbortReceiveEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle)

Aborts the receive data which using eDMA.

This function aborts the receive data which using eDMA.

Parameters

- base – Pointer to FLEXIO_UART_Type
- handle – Pointer to flexio_uart_edma_handle_t structure

status_t FLEXIO_UART_TransferGetSendCountEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle, size_t *count)

Gets the number of bytes sent out.

This function gets the number of bytes sent out.

Parameters

- base – Pointer to FLEXIO_UART_Type
- handle – Pointer to flexio_uart_edma_handle_t structure
- count – Number of bytes sent so far by the non-blocking transaction.

Return values

- kStatus_NoTransferInProgress – transfer has finished or no transfer in progress.
- kStatus_Success – Successfully return the count.

status_t FLEXIO_UART_TransferGetReceiveCountEDMA(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle, size_t *count)

Gets the number of bytes received.

This function gets the number of bytes received.

Parameters

- base – Pointer to FLEXIO_UART_Type
- handle – Pointer to flexio_uart_edma_handle_t structure
- count – Number of bytes received so far by the non-blocking transaction.

Return values

- kStatus_NoTransferInProgress – transfer has finished or no transfer in progress.
- kStatus_Success – Successfully return the count.

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FlexIO UART EDMA driver version.

typedef struct *_flexio_uart_edma_handle* flexio_uart_edma_handle_t

typedef void (*flexio_uart_edma_transfer_callback_t)(*FLEXIO_UART_Type* *base, *flexio_uart_edma_handle_t* *handle, *status_t* status, void *userData)

UART transfer callback function.

struct _flexio_uart_edma_handle

#include <fsl_flexio_uart_edma.h> UART eDMA handle.

Public Members

flexio_uart_edma_transfer_callback_t callback
Callback function.

void *userData
UART callback function parameter.

size_t txDataSizeAll
Total bytes to be sent.

size_t rxDataSizeAll
Total bytes to be received.

edma_handle_t *txEdmaHandle
The eDMA TX channel used.

edma_handle_t *rxEdmaHandle
The eDMA RX channel used.

uint8_t nbytes
eDMA minor byte transfer count initially configured.

volatile uint8_t txState
TX transfer state.

volatile uint8_t rxState
RX transfer state

2.20 FlexIO I2C Master Driver

status_t FLEXIO_I2C_CheckForBusyBus(*FLEXIO_I2C_Type* *base)
Make sure the bus isn't already pulled down.

Check the FLEXIO pin status to see whether either of SDA and SCL pin is pulled down.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure..

Return values

- kStatus_Success –
- kStatus_FLEXIO_I2C_Busy –

status_t FLEXIO_I2C_MasterInit(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_config_t* *masterConfig, uint32_t srcClock_Hz)
Ungates the FlexIO clock, resets the FlexIO module, and configures the FlexIO I2C hardware configuration.

Example

```
FLEXIO_I2C_Type base = {
.flexioBase = FLEXIO,
.SDAPinIndex = 0,
.SCLPinIndex = 1,
.shifterIndex = {0,1},
.timerIndex = {0,1}
};
flexio_i2c_master_config_t config = {
.enableInDoze = false,
```

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```
.enableInDebug = true,
.enableFastAccess = false,
.baudRate_Bps = 100000
};
FLEXIO_I2C_MasterInit(base, &config, srcClock_Hz);
```

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- masterConfig – Pointer to flexio_i2c_master_config_t structure.
- srcClock_Hz – FlexIO source clock in Hz.

Return values

- kStatus_Success – Initialization successful
- kStatus_InvalidArgument – The source clock exceed upper range limitation

void FLEXIO_I2C_MasterDeinit(*FLEXIO_I2C_Type* *base)

De-initializes the FlexIO I2C master peripheral. Calling this API Resets the FlexIO I2C master shifer and timer config, module can't work unless the FLEXIO_I2C_MasterInit is called.

Parameters

- base – pointer to FLEXIO_I2C_Type structure.

void FLEXIO_I2C_MasterGetDefaultConfig(*flexio_i2c_master_config_t* *masterConfig)

Gets the default configuration to configure the FlexIO module. The configuration can be used directly for calling the FLEXIO_I2C_MasterInit().

Example:

```
flexio_i2c_master_config_t config;
FLEXIO_I2C_MasterGetDefaultConfig(&config);
```

Parameters

- masterConfig – Pointer to flexio_i2c_master_config_t structure.

static inline void FLEXIO_I2C_MasterEnable(*FLEXIO_I2C_Type* *base, bool enable)

Enables/disables the FlexIO module operation.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- enable – Pass true to enable module, false does not have any effect.

uint32_t FLEXIO_I2C_MasterGetStatusFlags(*FLEXIO_I2C_Type* *base)

Gets the FlexIO I2C master status flags.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure

Returns

Status flag, use status flag to AND _flexio_i2c_master_status_flags can get the related status.

void FLEXIO_I2C_MasterClearStatusFlags(*FLEXIO_I2C_Type* *base, uint32_t mask)

Clears the FlexIO I2C master status flags.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.

- mask – Status flag. The parameter can be any combination of the following values:
  - kFLEXIO_I2C_RxFullFlag
  - kFLEXIO_I2C_ReceiveNakFlag

void FLEXIO_I2C_MasterEnableInterrupts(*FLEXIO_I2C_Type* *base, uint32_t mask)

Enables the FlexIO i2c master interrupt requests.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- mask – Interrupt source. Currently only one interrupt request source:
  - kFLEXIO_I2C_TransferCompleteInterruptEnable

void FLEXIO_I2C_MasterDisableInterrupts(*FLEXIO_I2C_Type* *base, uint32_t mask)

Disables the FlexIO I2C master interrupt requests.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- mask – Interrupt source.

void FLEXIO_I2C_MasterSetBaudRate(*FLEXIO_I2C_Type* *base, uint32_t baudRate_Bps, uint32_t srcClock_Hz)

Sets the FlexIO I2C master transfer baudrate.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure
- baudRate_Bps – the baud rate value in HZ
- srcClock_Hz – source clock in HZ

void FLEXIO_I2C_MasterStart(*FLEXIO_I2C_Type* *base, uint8_t address, *flexio_i2c_direction_t* direction)

Sends START + 7-bit address to the bus.

Note: This API should be called when the transfer configuration is ready to send a START signal and 7-bit address to the bus. This is a non-blocking API, which returns directly after the address is put into the data register but the address transfer is not finished on the bus. Ensure that the kFLEXIO_I2C_RxFullFlag status is asserted before calling this API.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- address – 7-bit address.
- direction – transfer direction. This parameter is one of the values in flexio_i2c_direction_t:
  - kFLEXIO_I2C_Write: Transmit
  - kFLEXIO_I2C_Read: Receive

void FLEXIO_I2C_MasterStop(*FLEXIO_I2C_Type* *base)

Sends the stop signal on the bus.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.

void FLEXIO_I2C_MasterRepeatedStart(*FLEXIO_I2C_Type* *base)

Sends the repeated start signal on the bus.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.

void FLEXIO_I2C_MasterAbortStop(*FLEXIO_I2C_Type* *base)

Sends the stop signal when transfer is still on-going.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.

void FLEXIO_I2C_MasterEnableAck(*FLEXIO_I2C_Type* *base, bool enable)

Configures the sent ACK/NAK for the following byte.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- enable – True to configure send ACK, false configure to send NAK.

status_t FLEXIO_I2C_MasterSetTransferCount(*FLEXIO_I2C_Type* *base, uint16_t count)

Sets the number of bytes to be transferred from a start signal to a stop signal.

Note: Call this API before a transfer begins because the timer generates a number of clocks according to the number of bytes that need to be transferred.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- count – Number of bytes need to be transferred from a start signal to a re-start/stop signal

Return values

- kStatus_Success – Successfully configured the count.
- kStatus_InvalidArgument – Input argument is invalid.

static inline void FLEXIO_I2C_MasterWriteByte(*FLEXIO_I2C_Type* *base, uint32_t data)

Writes one byte of data to the I2C bus.

Note: This is a non-blocking API, which returns directly after the data is put into the data register but the data transfer is not finished on the bus. Ensure that the TxEmptyFlag is asserted before calling this API.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- data – a byte of data.

static inline uint8_t FLEXIO_I2C_MasterReadByte(*FLEXIO_I2C_Type* *base)

Reads one byte of data from the I2C bus.

Note: This is a non-blocking API, which returns directly after the data is read from the data register. Ensure that the data is ready in the register.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.

Returns
data byte read.

status_t FLEXIO_I2C_MasterWriteBlocking(*FLEXIO_I2C_Type* *base, const uint8_t *txBuff, uint8_t txSize)

Sends a buffer of data in bytes.

Note: This function blocks via polling until all bytes have been sent.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- txBuff – The data bytes to send.
- txSize – The number of data bytes to send.

Return values

- kStatus_Success – Successfully write data.
- kStatus_FLEXIO_I2C_Nak – Receive NAK during writing data.
- kStatus_FLEXIO_I2C_Timeout – Timeout polling status flags.

status_t FLEXIO_I2C_MasterReadBlocking(*FLEXIO_I2C_Type* *base, uint8_t *rxBuff, uint8_t rxSize)

Receives a buffer of bytes.

Note: This function blocks via polling until all bytes have been received.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- rxBuff – The buffer to store the received bytes.
- rxSize – The number of data bytes to be received.

Return values

- kStatus_Success – Successfully read data.
- kStatus_FLEXIO_I2C_Timeout – Timeout polling status flags.

status_t FLEXIO_I2C_MasterTransferBlocking(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_transfer_t* *xfer)

Performs a master polling transfer on the I2C bus.

Note: The API does not return until the transfer succeeds or fails due to receiving NAK.

Parameters

- base – pointer to FLEXIO_I2C_Type structure.
- xfer – pointer to flexio_i2c_master_transfer_t structure.

Returns
status of status_t.

status_t FLEXIO_I2C_MasterTransferCreateHandle(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_handle_t* *handle, *flexio_i2c_master_transfer_callback_t* callback, void *userData)

Initializes the I2C handle which is used in transactional functions.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- handle – Pointer to flexio_i2c_master_handle_t structure to store the transfer state.
- callback – Pointer to user callback function.
- userData – User param passed to the callback function.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO type/handle/isr table out of range.

status_t FLEXIO_I2C_MasterTransferNonBlocking(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_handle_t* *handle, *flexio_i2c_master_transfer_t* *xfer)

Performs a master interrupt non-blocking transfer on the I2C bus.

Note: The API returns immediately after the transfer initiates. Call FLEXIO_I2C_MasterTransferGetCount to poll the transfer status to check whether the transfer is finished. If the return status is not kStatus_FLEXIO_I2C_Busy, the transfer is finished.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure
- handle – Pointer to flexio_i2c_master_handle_t structure which stores the transfer state
- xfer – pointer to flexio_i2c_master_transfer_t structure

Return values

- kStatus_Success – Successfully start a transfer.
- kStatus_FLEXIO_I2C_Busy – FlexIO I2C is not idle, is running another transfer.

status_t FLEXIO_I2C_MasterTransferGetCount(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_handle_t* *handle, size_t *count)

Gets the master transfer status during a interrupt non-blocking transfer.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure.
- handle – Pointer to flexio_i2c_master_handle_t structure which stores the transfer state.
- count – Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.

- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.
- kStatus_Success – Successfully return the count.

void FLEXIO_I2C_MasterTransferAbort(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_handle_t* *handle)

Aborts an interrupt non-blocking transfer early.

Note: This API can be called at any time when an interrupt non-blocking transfer initiates to abort the transfer early.

Parameters

- base – Pointer to FLEXIO_I2C_Type structure
- handle – Pointer to flexio_i2c_master_handle_t structure which stores the transfer state

void FLEXIO_I2C_MasterTransferHandleIRQ(void *i2cType, void *i2cHandle)

Master interrupt handler.

Parameters

- i2cType – Pointer to FLEXIO_I2C_Type structure
- i2cHandle – Pointer to flexio_i2c_master_transfer_t structure

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FlexIO I2C transfer status.

Values:

enumerator kStatus_FLEXIO_I2C_Busy

I2C is busy doing transfer.

enumerator kStatus_FLEXIO_I2C_Idle

I2C is busy doing transfer.

enumerator kStatus_FLEXIO_I2C_Nak

NAK received during transfer.

enumerator kStatus_FLEXIO_I2C_Timeout

Timeout polling status flags.

enum _flexio_i2c_master_interrupt

Define FlexIO I2C master interrupt mask.

Values:

enumerator kFLEXIO_I2C_TxEmptyInterruptEnable

Tx buffer empty interrupt enable.

enumerator kFLEXIO_I2C_RxFullInterruptEnable

Rx buffer full interrupt enable.

enum _flexio_i2c_master_status_flags

Define FlexIO I2C master status mask.

Values:

enumerator kFLEXIO_I2C_TxEmptyFlag
Tx shifter empty flag.

enumerator kFLEXIO_I2C_RxFullFlag
Rx shifter full/Transfer complete flag.

enumerator kFLEXIO_I2C_ReceiveNakFlag
Receive NAK flag.

enum _flexio_i2c_direction
Direction of master transfer.

Values:

enumerator kFLEXIO_I2C_Write
Master send to slave.

enumerator kFLEXIO_I2C_Read
Master receive from slave.

typedef enum *_flexio_i2c_direction* flexio_i2c_direction_t
Direction of master transfer.

typedef struct *_flexio_i2c_type* FLEXIO_I2C_Type
Define FlexIO I2C master access structure typedef.

typedef struct *_flexio_i2c_master_config* flexio_i2c_master_config_t
Define FlexIO I2C master user configuration structure.

typedef struct *_flexio_i2c_master_transfer* flexio_i2c_master_transfer_t
Define FlexIO I2C master transfer structure.

typedef struct *_flexio_i2c_master_handle* flexio_i2c_master_handle_t
FlexIO I2C master handle typedef.

typedef void (*flexio_i2c_master_transfer_callback_t)(*FLEXIO_I2C_Type* *base, *flexio_i2c_master_handle_t* *handle, *status_t* status, void *userData)
FlexIO I2C master transfer callback typedef.

I2C_RETRY_TIMES
Retry times for waiting flag.

struct _flexio_i2c_type
#include <fsl_flexio_i2c_master.h> Define FlexIO I2C master access structure typedef.

Public Members

FLEXIO_Type *flexioBase
FlexIO base pointer.

uint8_t SDAPinIndex
Pin select for I2C SDA.

uint8_t SCLPinIndex
Pin select for I2C SCL.

uint8_t shifterIndex[2]
Shifter index used in FlexIO I2C.

uint8_t timerIndex[3]
Timer index used in FlexIO I2C.

uint32_t baudrate
Master transfer baudrate, used to calculate delay time.

struct __flexio_i2c_master_config
#include <fsl_flexio_i2c_master.h> Define FlexIO I2C master user configuration structure.

Public Members

bool enableMaster
Enables the FlexIO I2C peripheral at initialization time.

bool enableInDoze
Enable/disable FlexIO operation in doze mode.

bool enableInDebug
Enable/disable FlexIO operation in debug mode.

bool enableFastAccess
Enable/disable fast access to FlexIO registers, fast access requires the FlexIO clock to be at least twice the frequency of the bus clock.

uint32_t baudRate_Bps
Baud rate in Bps.

struct __flexio_i2c_master_transfer
#include <fsl_flexio_i2c_master.h> Define FlexIO I2C master transfer structure.

Public Members

uint32_t flags
Transfer flag which controls the transfer, reserved for FlexIO I2C.

uint8_t slaveAddress
7-bit slave address.

flexio_i2c_direction_t direction
Transfer direction, read or write.

uint32_t subaddress
Sub address. Transferred MSB first.

uint8_t subaddressSize
Size of sub address.

uint8_t volatile *data
Transfer buffer.

volatile size_t dataSize
Transfer size.

struct __flexio_i2c_master_handle
#include <fsl_flexio_i2c_master.h> Define FlexIO I2C master handle structure.

Public Members

flexio_i2c_master_transfer_t transfer
FlexIO I2C master transfer copy.

size_t transferSize
Total bytes to be transferred.

uint8_t state
Transfer state maintained during transfer.

flexio_i2c_master_transfer_callback_t completionCallback
Callback function called at transfer event. Callback function called at transfer event.

void *userData
Callback parameter passed to callback function.

bool needRestart
Whether master needs to send re-start signal.

2.21 FlexIO I2S Driver

void FLEXIO_I2S_Init(*FLEXIO_I2S_Type* *base, const *flexio_i2s_config_t* *config)
Initializes the FlexIO I2S.

This API configures FlexIO pins and shifter to I2S and configures the FlexIO I2S with a configuration structure. The configuration structure can be filled by the user, or be set with default values by FLEXIO_I2S_GetDefaultConfig().

Note: This API should be called at the beginning of the application to use the FlexIO I2S driver. Otherwise, any access to the FlexIO I2S module can cause hard fault because the clock is not enabled.

Parameters

- base – FlexIO I2S base pointer
- config – FlexIO I2S configure structure.

void FLEXIO_I2S_GetDefaultConfig(*flexio_i2s_config_t* *config)
Sets the FlexIO I2S configuration structure to default values.

The purpose of this API is to get the configuration structure initialized for use in FLEXIO_I2S_Init(). Users may use the initialized structure unchanged in FLEXIO_I2S_Init() or modify some fields of the structure before calling FLEXIO_I2S_Init().

Parameters

- config – pointer to master configuration structure

void FLEXIO_I2S_Deinit(*FLEXIO_I2S_Type* *base)
De-initializes the FlexIO I2S.

Calling this API resets the FlexIO I2S shifter and timer config. After calling this API, call the FLEXO_I2S_Init to use the FlexIO I2S module.

Parameters

- base – FlexIO I2S base pointer

static inline void FLEXIO_I2S_Enable(*FLEXIO_I2S_Type* *base, bool enable)
Enables/disables the FlexIO I2S module operation.

Parameters

- base – Pointer to FLEXIO_I2S_Type

- enable – True to enable, false dose not have any effect.

uint32_t FLEXIO_I2S_GetStatusFlags(*FLEXIO_I2S_Type* *base)

Gets the FlexIO I2S status flags.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure

Returns

Status flag, which are ORed by the enumerators in the _flexio_i2s_status_flags.

void FLEXIO_I2S_EnableInterrupts(*FLEXIO_I2S_Type* *base, uint32_t mask)

Enables the FlexIO I2S interrupt.

This function enables the FlexIO UART interrupt.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure
- mask – interrupt source

void FLEXIO_I2S_DisableInterrupts(*FLEXIO_I2S_Type* *base, uint32_t mask)

Disables the FlexIO I2S interrupt.

This function enables the FlexIO UART interrupt.

Parameters

- base – pointer to FLEXIO_I2S_Type structure
- mask – interrupt source

static inline void FLEXIO_I2S_TxEnableDMA(*FLEXIO_I2S_Type* *base, bool enable)

Enables/disables the FlexIO I2S Tx DMA requests.

Parameters

- base – FlexIO I2S base pointer
- enable – True means enable DMA, false means disable DMA.

static inline void FLEXIO_I2S_RxEnableDMA(*FLEXIO_I2S_Type* *base, bool enable)

Enables/disables the FlexIO I2S Rx DMA requests.

Parameters

- base – FlexIO I2S base pointer
- enable – True means enable DMA, false means disable DMA.

static inline uint32_t FLEXIO_I2S_TxGetDataRegisterAddress(*FLEXIO_I2S_Type* *base)

Gets the FlexIO I2S send data register address.

This function returns the I2S data register address, mainly used by DMA/eDMA.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure

Returns

FlexIO i2s send data register address.

static inline uint32_t FLEXIO_I2S_RxGetDataRegisterAddress(*FLEXIO_I2S_Type* *base)

Gets the FlexIO I2S receive data register address.

This function returns the I2S data register address, mainly used by DMA/eDMA.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure

Returns
FlexIO i2s receive data register address.

void FLEXIO_I2S_MasterSetFormat(*FLEXIO_I2S_Type* *base, *flexio_i2s_format_t* *format, uint32_t srcClock_Hz)

Configures the FlexIO I2S audio format in master mode.

Audio format can be changed in run-time of FlexIO I2S. This function configures the sample rate and audio data format to be transferred.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure
- format – Pointer to FlexIO I2S audio data format structure.
- srcClock_Hz – I2S master clock source frequency in Hz.

void FLEXIO_I2S_SlaveSetFormat(*FLEXIO_I2S_Type* *base, *flexio_i2s_format_t* *format)

Configures the FlexIO I2S audio format in slave mode.

Audio format can be changed in run-time of FlexIO I2S. This function configures the sample rate and audio data format to be transferred.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure
- format – Pointer to FlexIO I2S audio data format structure.

status_t FLEXIO_I2S_WriteBlocking(*FLEXIO_I2S_Type* *base, uint8_t bitWidth, uint8_t *txData, size_t size)

Sends data using a blocking method.

Note: This function blocks via polling until data is ready to be sent.

Parameters

- base – FlexIO I2S base pointer.
- bitWidth – How many bits in a audio word, usually 8/16/24/32 bits.
- txData – Pointer to the data to be written.
- size – Bytes to be written.

Return values

- kStatus_Success – Successfully write data.
- kStatus_FLEXIO_I2C_Timeout – Timeout polling status flags.

static inline void FLEXIO_I2S_WriteData(*FLEXIO_I2S_Type* *base, uint8_t bitWidth, uint32_t data)

Writes data into a data register.

Parameters

- base – FlexIO I2S base pointer.
- bitWidth – How many bits in a audio word, usually 8/16/24/32 bits.
- data – Data to be written.

status_t FLEXIO_I2S_ReadBlocking(*FLEXIO_I2S_Type* *base, uint8_t bitWidth, uint8_t *rxData, size_t size)

Receives a piece of data using a blocking method.

Note: This function blocks via polling until data is ready to be sent.

Parameters

- base – FlexIO I2S base pointer
- bitWidth – How many bits in a audio word, usually 8/16/24/32 bits.
- rxData – Pointer to the data to be read.
- size – Bytes to be read.

Return values

- kStatus_Success – Successfully read data.
- kStatus_FLEXIO_I2C_Timeout – Timeout polling status flags.

static inline uint32_t FLEXIO_I2S_ReadData(*FLEXIO_I2S_Type* *base)

Reads a data from the data register.

Parameters

- base – FlexIO I2S base pointer

Returns

Data read from data register.

void FLEXIO_I2S_TransferTxCreateHandle(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, *flexio_i2s_callback_t* callback, void *userData)

Initializes the FlexIO I2S handle.

This function initializes the FlexIO I2S handle which can be used for other FlexIO I2S transactional APIs. Call this API once to get the initialized handle.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure
- handle – Pointer to flexio_i2s_handle_t structure to store the transfer state.
- callback – FlexIO I2S callback function, which is called while finished a block.
- userData – User parameter for the FlexIO I2S callback.

void FLEXIO_I2S_TransferSetFormat(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, *flexio_i2s_format_t* *format, uint32_t srcClock_Hz)

Configures the FlexIO I2S audio format.

Audio format can be changed at run-time of FlexIO I2S. This function configures the sample rate and audio data format to be transferred.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – FlexIO I2S handle pointer.
- format – Pointer to audio data format structure.
- srcClock_Hz – FlexIO I2S bit clock source frequency in Hz. This parameter should be 0 while in slave mode.

void FLEXIO_I2S_TransferRxCreateHandle(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, *flexio_i2s_callback_t* callback, void *userData)

Initializes the FlexIO I2S receive handle.

This function initializes the FlexIO I2S handle which can be used for other FlexIO I2S transactional APIs. Call this API once to get the initialized handle.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure to store the transfer state.
- callback – FlexIO I2S callback function, which is called while finished a block.
- userData – User parameter for the FlexIO I2S callback.

status_t FLEXIO_I2S_TransferSendNonBlocking(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, *flexio_i2s_transfer_t* *xfer)

Performs an interrupt non-blocking send transfer on FlexIO I2S.

Note: The API returns immediately after transfer initiates. Call FLEXIO_I2S_GetRemainingBytes to poll the transfer status and check whether the transfer is finished. If the return status is 0, the transfer is finished.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure which stores the transfer state
- xfer – Pointer to flexio_i2s_transfer_t structure

Return values

- kStatus_Success – Successfully start the data transmission.
- kStatus_FLEXIO_I2S_TxBusy – Previous transmission still not finished, data not all written to TX register yet.
- kStatus_InvalidArgument – The input parameter is invalid.

status_t FLEXIO_I2S_TransferReceiveNonBlocking(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, *flexio_i2s_transfer_t* *xfer)

Performs an interrupt non-blocking receive transfer on FlexIO I2S.

Note: The API returns immediately after transfer initiates. Call FLEXIO_I2S_GetRemainingBytes to poll the transfer status to check whether the transfer is finished. If the return status is 0, the transfer is finished.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure which stores the transfer state
- xfer – Pointer to flexio_i2s_transfer_t structure

Return values

- kStatus_Success – Successfully start the data receive.

- kStatus_FLEXIO_I2S_RxBusy – Previous receive still not finished.
- kStatus_InvalidArgument – The input parameter is invalid.

void FLEXIO_I2S_TransferAbortSend(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle)

Aborts the current send.

Note: This API can be called at any time when interrupt non-blocking transfer initiates to abort the transfer in a early time.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure which stores the transfer state

void FLEXIO_I2S_TransferAbortReceive(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle)

Aborts the current receive.

Note: This API can be called at any time when interrupt non-blocking transfer initiates to abort the transfer in a early time.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure which stores the transfer state

status_t FLEXIO_I2S_TransferGetSendCount(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, size_t *count)

Gets the remaining bytes to be sent.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure which stores the transfer state
- count – Bytes sent.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

status_t FLEXIO_I2S_TransferGetReceiveCount(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, size_t *count)

Gets the remaining bytes to be received.

Parameters

- base – Pointer to FLEXIO_I2S_Type structure.
- handle – Pointer to flexio_i2s_handle_t structure which stores the transfer state
- count – Bytes recieved.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

Returns
count Bytes received.

void FLEXIO_I2S_TransferTxHandleIRQ(void *i2sBase, void *i2sHandle)

Tx interrupt handler.

Parameters

- i2sBase – Pointer to FLEXIO_I2S_Type structure.
- i2sHandle – Pointer to flexio_i2s_handle_t structure

void FLEXIO_I2S_TransferRxHandleIRQ(void *i2sBase, void *i2sHandle)

Rx interrupt handler.

Parameters

- i2sBase – Pointer to FLEXIO_I2S_Type structure.
- i2sHandle – Pointer to flexio_i2s_handle_t structure.

FSL_FLEXIO_I2S_DRIVER_VERSION

FlexIO I2S driver version 2.2.2.

FlexIO I2S transfer status.

Values:

enumerator kStatus_FLEXIO_I2S_Idle
FlexIO I2S is in idle state

enumerator kStatus_FLEXIO_I2S_TxBusy
FlexIO I2S Tx is busy

enumerator kStatus_FLEXIO_I2S_RxBusy
FlexIO I2S Tx is busy

enumerator kStatus_FLEXIO_I2S_Error
FlexIO I2S error occurred

enumerator kStatus_FLEXIO_I2S_QueueFull
FlexIO I2S transfer queue is full.

enumerator kStatus_FLEXIO_I2S_Timeout
FlexIO I2S timeout polling status flags.

enum _flexio_i2s_master_slave

Master or slave mode.

Values:

enumerator kFLEXIO_I2S_Master
Master mode

enumerator kFLEXIO_I2S_Slave
Slave mode

_flexio_i2s_interrupt_enable Define FlexIO FlexIO I2S interrupt mask.

Values:

enumerator kFLEXIO_I2S_TxDataRegEmptyInterruptEnable
Transmit buffer empty interrupt enable.

enumerator kFLEXIO_I2S_RxDataRegFullInterruptEnable
Receive buffer full interrupt enable.

_flexio_i2s_status_flags Define FlexIO FlexIO I2S status mask.

Values:

enumerator kFLEXIO_I2S_TxDataRegEmptyFlag
Transmit buffer empty flag.

enumerator kFLEXIO_I2S_RxDataRegFullFlag
Receive buffer full flag.

enum _flexio_i2s_sample_rate
Audio sample rate.

Values:

enumerator kFLEXIO_I2S_SampleRate8KHz
Sample rate 8000Hz

enumerator kFLEXIO_I2S_SampleRate11025Hz
Sample rate 11025Hz

enumerator kFLEXIO_I2S_SampleRate12KHz
Sample rate 12000Hz

enumerator kFLEXIO_I2S_SampleRate16KHz
Sample rate 16000Hz

enumerator kFLEXIO_I2S_SampleRate22050Hz
Sample rate 22050Hz

enumerator kFLEXIO_I2S_SampleRate24KHz
Sample rate 24000Hz

enumerator kFLEXIO_I2S_SampleRate32KHz
Sample rate 32000Hz

enumerator kFLEXIO_I2S_SampleRate44100Hz
Sample rate 44100Hz

enumerator kFLEXIO_I2S_SampleRate48KHz
Sample rate 48000Hz

enumerator kFLEXIO_I2S_SampleRate96KHz
Sample rate 96000Hz

enum _flexio_i2s_word_width
Audio word width.

Values:

enumerator kFLEXIO_I2S_WordWidth8bits
Audio data width 8 bits

enumerator kFLEXIO_I2S_WordWidth16bits
Audio data width 16 bits

enumerator kFLEXIO_I2S_WordWidth24bits
Audio data width 24 bits

enumerator kFLEXIO_I2S_WordWidth32bits
Audio data width 32 bits

typedef struct *_flexio_i2s_type* FLEXIO_I2S_Type
Define FlexIO I2S access structure typedef.

typedef enum *_flexio_i2s_master_slave* flexio_i2s_master_slave_t
Master or slave mode.

typedef struct *_flexio_i2s_config* flexio_i2s_config_t
FlexIO I2S configure structure.

typedef struct *_flexio_i2s_format* flexio_i2s_format_t
FlexIO I2S audio format, FlexIO I2S only support the same format in Tx and Rx.

typedef enum *_flexio_i2s_sample_rate* flexio_i2s_sample_rate_t
Audio sample rate.

typedef enum *_flexio_i2s_word_width* flexio_i2s_word_width_t
Audio word width.

typedef struct *_flexio_i2s_transfer* flexio_i2s_transfer_t
Define FlexIO I2S transfer structure.

typedef struct *_flexio_i2s_handle* flexio_i2s_handle_t

typedef void (*flexio_i2s_callback_t)(*FLEXIO_I2S_Type* *base, *flexio_i2s_handle_t* *handle, *status_t* status, void *userData)
FlexIO I2S xfer callback prototype.

I2S_RETRY_TIMES
Retry times for waiting flag.

FLEXIO_I2S_XFER_QUEUE_SIZE
FlexIO I2S transfer queue size, user can refine it according to use case.

struct _flexio_i2s_type
#include <fsl_flexio_i2s.h> Define FlexIO I2S access structure typedef.

Public Members

FLEXIO_Type *flexioBase
FlexIO base pointer

uint8_t txPinIndex
Tx data pin index in FlexIO pins

uint8_t rxPinIndex
Rx data pin index

uint8_t bclkPinIndex
Bit clock pin index

uint8_t fsPinIndex
Frame sync pin index

uint8_t txShifterIndex
Tx data shifter index

uint8_t rxShifterIndex
Rx data shifter index

uint8_t bclkTimerIndex
Bit clock timer index

uint8_t fsTimerIndex
Frame sync timer index

struct __flexio_i2s_config
#include <fsl_flexio_i2s.h> FlexIO I2S configure structure.

Public Members

bool enableI2S
Enable FlexIO I2S

flexio_i2s_master_slave_t masterSlave
Master or slave

flexio_pin_polarity_t txPinPolarity
Tx data pin polarity, active high or low

flexio_pin_polarity_t rxPinPolarity
Rx data pin polarity

flexio_pin_polarity_t bclkPinPolarity
Bit clock pin polarity

flexio_pin_polarity_t fsPinPolarity
Frame sync pin polarity

flexio_shifter_timer_polarity_t txTimerPolarity
Tx data valid on bclk rising or falling edge

flexio_shifter_timer_polarity_t rxTimerPolarity
Rx data valid on bclk rising or falling edge

struct __flexio_i2s_format
#include <fsl_flexio_i2s.h> FlexIO I2S audio format, FlexIO I2S only support the same format in Tx and Rx.

Public Members

uint8_t bitWidth
Bit width of audio data, always 8/16/24/32 bits

uint32_t sampleRate_Hz
Sample rate of the audio data

struct __flexio_i2s_transfer
#include <fsl_flexio_i2s.h> Define FlexIO I2S transfer structure.

Public Members

uint8_t *data
Data buffer start pointer

size_t dataSize
Bytes to be transferred.

struct _flexio_i2s_handle
#include <fsl_flexio_i2s.h> Define FlexIO I2S handle structure.

Public Members

uint32_t state
Internal state

flexio_i2s_callback_t callback
Callback function called at transfer event

void *userData
Callback parameter passed to callback function

uint8_t bitWidth
Bit width for transfer, 8/16/24/32bits

flexio_i2s_transfer_t queue[(4U)]
Transfer queue storing queued transfer

size_t transferSize[(4U)]
Data bytes need to transfer

volatile uint8_t queueUser
Index for user to queue transfer

volatile uint8_t queueDriver
Index for driver to get the transfer data and size

2.22 FlexIO SPI Driver

void FLEXIO_SPI_MasterInit(*FLEXIO_SPI_Type* *base, *flexio_spi_master_config_t* *masterConfig, uint32_t srcClock_Hz)

Ungates the FlexIO clock, resets the FlexIO module, configures the FlexIO SPI master hardware, and configures the FlexIO SPI with FlexIO SPI master configuration. The configuration structure can be filled by the user, or be set with default values by the FLEXIO_SPI_MasterGetDefaultConfig().

Example

```
FLEXIO_SPI_Type spiDev = {
.flexioBase = FLEXIO,
.SDOPinIndex = 0,
.SDIPinIndex = 1,
.SCKPinIndex = 2,
.CSnPinIndex = 3,
.shifterIndex = {0,1},
.timerIndex = {0,1}
};
flexio_spi_master_config_t config = {
.enableMaster = true,
.enableInDoze = false,
.enableInDebug = true,
```

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```
.enableFastAccess = false,
.baudRate_Bps = 500000,
.phase = kFLEXIO_SPI_ClockPhaseFirstEdge,
.direction = kFLEXIO_SPI_MsbFirst,
.dataMode = kFLEXIO_SPI_8BitMode
};
FLEXIO_SPI_MasterInit(&spiDev, &config, srcClock_Hz);
```

Note: 1.FlexIO SPI master only support CPOL = 0, which means clock inactive low. 2.For FlexIO SPI master, the input valid time is 1.5 clock cycles, for slave the output valid time is 2.5 clock cycles. So if FlexIO SPI master communicates with other spi IPs, the maximum baud rate is FlexIO clock frequency divided by 2*2=4. If FlexIO SPI master communicates with FlexIO SPI slave, the maximum baud rate is FlexIO clock frequency divided by (1.5+2.5)*2=8.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- masterConfig – Pointer to the flexio_spi_master_config_t structure.
- srcClock_Hz – FlexIO source clock in Hz.

void FLEXIO_SPI_MasterDeinit(*FLEXIO_SPI_Type* *base)

Resets the FlexIO SPI timer and shifter config.

Parameters

- base – Pointer to the FLEXIO_SPI_Type.

void FLEXIO_SPI_MasterGetDefaultConfig(*flexio_spi_master_config_t* *masterConfig)

Gets the default configuration to configure the FlexIO SPI master. The configuration can be used directly by calling the FLEXIO_SPI_MasterConfigure(). Example:

```
flexio_spi_master_config_t masterConfig;
FLEXIO_SPI_MasterGetDefaultConfig(&masterConfig);
```

Parameters

- masterConfig – Pointer to the flexio_spi_master_config_t structure.

void FLEXIO_SPI_SlaveInit(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_config_t* *slaveConfig)

Ungates the FlexIO clock, resets the FlexIO module, configures the FlexIO SPI slave hardware configuration, and configures the FlexIO SPI with FlexIO SPI slave configuration. The configuration structure can be filled by the user, or be set with default values by the FLEXIO_SPI_SlaveGetDefaultConfig().

Note: 1.Only one timer is needed in the FlexIO SPI slave. As a result, the second timer index is ignored. 2.FlexIO SPI slave only support CPOL = 0, which means clock inactive low. 3.For FlexIO SPI master, the input valid time is 1.5 clock cycles, for slave the output valid time is 2.5 clock cycles. So if FlexIO SPI slave communicates with other spi IPs, the maximum baud rate is FlexIO clock frequency divided by 3*2=6. If FlexIO SPI slave communicates with FlexIO SPI master, the maximum baud rate is FlexIO clock frequency divided by (1.5+2.5)*2=8. Example

```
FLEXIO_SPI_Type spiDev = {
.flexioBase = FLEXIO,
.SDOPinIndex = 0,
```

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```
.SDIPinIndex = 1,
.SCKPinIndex = 2,
.CSnPinIndex = 3,
.shifterIndex = {0,1},
.timerIndex = {0}
};
flexio_spi_slave_config_t config = {
.enableSlave = true,
.enableInDoze = false,
.enableInDebug = true,
.enableFastAccess = false,
.phase = kFLEXIO_SPI_ClockPhaseFirstEdge,
.direction = kFLEXIO_SPI_MsbFirst,
.dataMode = kFLEXIO_SPI_8BitMode
};
FLEXIO_SPI_SlaveInit(&spiDev, &config);
```

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- slaveConfig – Pointer to the flexio_spi_slave_config_t structure.

void FLEXIO_SPI_SlaveDeinit(*FLEXIO_SPI_Type* *base)

Gates the FlexIO clock.

Parameters

- base – Pointer to the FLEXIO_SPI_Type.

void FLEXIO_SPI_SlaveGetDefaultConfig(*flexio_spi_slave_config_t* *slaveConfig)

Gets the default configuration to configure the FlexIO SPI slave. The configuration can be used directly for calling the FLEXIO_SPI_SlaveConfigure(). Example:

```
flexio_spi_slave_config_t slaveConfig;
FLEXIO_SPI_SlaveGetDefaultConfig(&slaveConfig);
```

Parameters

- slaveConfig – Pointer to the flexio_spi_slave_config_t structure.

uint32_t FLEXIO_SPI_GetStatusFlags(*FLEXIO_SPI_Type* *base)

Gets FlexIO SPI status flags.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.

Returns

status flag; Use the status flag to AND the following flag mask and get the status.

- kFLEXIO_SPI_TxEmptyFlag
- kFLEXIO_SPI_RxEmptyFlag

void FLEXIO_SPI_ClearStatusFlags(*FLEXIO_SPI_Type* *base, uint32_t mask)

Clears FlexIO SPI status flags.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.

- mask – status flag The parameter can be any combination of the following values:
  - kFLEXIO_SPI_TxEmptyFlag
  - kFLEXIO_SPI_RxEmptyFlag

void FLEXIO_SPI_EnableInterrupts(*FLEXIO_SPI_Type* *base, uint32_t mask)

Enables the FlexIO SPI interrupt.

This function enables the FlexIO SPI interrupt.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- mask – interrupt source. The parameter can be any combination of the following values:
  - kFLEXIO_SPI_RxFullInterruptEnable
  - kFLEXIO_SPI_TxEmptyInterruptEnable

void FLEXIO_SPI_DisableInterrupts(*FLEXIO_SPI_Type* *base, uint32_t mask)

Disables the FlexIO SPI interrupt.

This function disables the FlexIO SPI interrupt.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- mask – interrupt source The parameter can be any combination of the following values:
  - kFLEXIO_SPI_RxFullInterruptEnable
  - kFLEXIO_SPI_TxEmptyInterruptEnable

void FLEXIO_SPI_EnableDMA(*FLEXIO_SPI_Type* *base, uint32_t mask, bool enable)

Enables/disables the FlexIO SPI transmit DMA. This function enables/disables the FlexIO SPI Tx DMA, which means that asserting the kFLEXIO_SPI_TxEmptyFlag does/doesn't trigger the DMA request.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- mask – SPI DMA source.
- enable – True means enable DMA, false means disable DMA.

static inline uint32_t FLEXIO_SPI_GetTxDataRegisterAddress(*FLEXIO_SPI_Type* *base, *flexio_spi_shift_direction_t* direction)

Gets the FlexIO SPI transmit data register address for MSB first transfer.

This function returns the SPI data register address, which is mainly used by DMA/eDMA.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- direction – Shift direction of MSB first or LSB first.

Returns

FlexIO SPI transmit data register address.

static inline uint32_t FLEXIO_SPI_GetRxDataRegisterAddress(*FLEXIO_SPI_Type* *base, *flexio_spi_shift_direction_t* direction)

Gets the FlexIO SPI receive data register address for the MSB first transfer.

This function returns the SPI data register address, which is mainly used by DMA/eDMA.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- direction – Shift direction of MSB first or LSB first.

Returns

FlexIO SPI receive data register address.

static inline void FLEXIO_SPI_Enable(*FLEXIO_SPI_Type* *base, bool enable)

Enables/disables the FlexIO SPI module operation.

Parameters

- base – Pointer to the FLEXIO_SPI_Type.
- enable – True to enable, false does not have any effect.

void FLEXIO_SPI_MasterSetBaudRate(*FLEXIO_SPI_Type* *base, uint32_t baudRate_Bps, uint32_t srcClockHz)

Sets baud rate for the FlexIO SPI transfer, which is only used for the master.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- baudRate_Bps – Baud Rate needed in Hz.
- srcClockHz – SPI source clock frequency in Hz.

static inline void FLEXIO_SPI_WriteData(*FLEXIO_SPI_Type* *base, *flexio_spi_shift_direction_t* direction, uint32_t data)

Writes one byte of data, which is sent using the MSB method.

Note: This is a non-blocking API, which returns directly after the data is put into the data register but the data transfer is not finished on the bus. Ensure that the TxEmptyFlag is asserted before calling this API.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- direction – Shift direction of MSB first or LSB first.
- data – 8/16/32 bit data.

static inline uint32_t FLEXIO_SPI_ReadData(*FLEXIO_SPI_Type* *base, *flexio_spi_shift_direction_t* direction)

Reads 8 bit/16 bit data.

Note: This is a non-blocking API, which returns directly after the data is read from the data register. Ensure that the RxFullFlag is asserted before calling this API.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.

- direction – Shift direction of MSB first or LSB first.

Returns
8 bit/16 bit data received.

status_t FLEXIO_SPI_WriteBlocking(*FLEXIO_SPI_Type* *base, *flexio_spi_shift_direction_t* direction, const uint8_t *buffer, size_t size)

Sends a buffer of data bytes.

Note: This function blocks using the polling method until all bytes have been sent.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- direction – Shift direction of MSB first or LSB first.
- buffer – The data bytes to send.
- size – The number of data bytes to send.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_FLEXIO_SPI_Timeout – The transfer timed out and was aborted.

status_t FLEXIO_SPI_ReadBlocking(*FLEXIO_SPI_Type* *base, *flexio_spi_shift_direction_t* direction, uint8_t *buffer, size_t size)

Receives a buffer of bytes.

Note: This function blocks using the polling method until all bytes have been received.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- direction – Shift direction of MSB first or LSB first.
- buffer – The buffer to store the received bytes.
- size – The number of data bytes to be received.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_FLEXIO_SPI_Timeout – The transfer timed out and was aborted.

status_t FLEXIO_SPI_MasterTransferBlocking(*FLEXIO_SPI_Type* *base, *flexio_spi_transfer_t* *xfer)

Receives a buffer of bytes.

Note: This function blocks via polling until all bytes have been received.

Parameters

- base – pointer to FLEXIO_SPI_Type structure
- xfer – FlexIO SPI transfer structure, see flexio_spi_transfer_t.

Return values

- kStatus_Success – Successfully create the handle.

- kStatus_FLEXIO_SPI_Timeout – The transfer timed out and was aborted.

void FLEXIO_SPI_FlushShifters(*FLEXIO_SPI_Type* *base)

Flush tx/rx shifters.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.

status_t FLEXIO_SPI_MasterTransferCreateHandle(*FLEXIO_SPI_Type* *base, *flexio_spi_master_handle_t* *handle, *flexio_spi_master_transfer_callback_t* callback, void *userData)

Initializes the FlexIO SPI Master handle, which is used in transactional functions.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_master_handle_t structure to store the transfer state.
- callback – The callback function.
- userData – The parameter of the callback function.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO type/handle/ISR table out of range.

status_t FLEXIO_SPI_MasterTransferNonBlocking(*FLEXIO_SPI_Type* *base, *flexio_spi_master_handle_t* *handle, *flexio_spi_transfer_t* *xfer)

Master transfer data using IRQ.

This function sends data using IRQ. This is a non-blocking function, which returns right away. When all data is sent out/received, the callback function is called.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_master_handle_t structure to store the transfer state.
- xfer – FlexIO SPI transfer structure. See flexio_spi_transfer_t.

Return values

- kStatus_Success – Successfully start a transfer.
- kStatus_InvalidArgument – Input argument is invalid.
- kStatus_FLEXIO_SPI_Busy – SPI is not idle, is running another transfer.

void FLEXIO_SPI_MasterTransferAbort(*FLEXIO_SPI_Type* *base, *flexio_spi_master_handle_t* *handle)

Aborts the master data transfer, which used IRQ.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_master_handle_t structure to store the transfer state.

status_t FLEXIO_SPI_MasterTransferGetCount(*FLEXIO_SPI_Type* *base, *flexio_spi_master_handle_t* *handle, size_t *count)

Gets the data transfer status which used IRQ.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_master_handle_t structure to store the transfer state.
- count – Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

void FLEXIO_SPI_MasterTransferHandleIRQ(void *spiType, void *spiHandle)

FlexIO SPI master IRQ handler function.

Parameters

- spiType – Pointer to the FLEXIO_SPI_Type structure.
- spiHandle – Pointer to the flexio_spi_master_handle_t structure to store the transfer state.

status_t FLEXIO_SPI_SlaveTransferCreateHandle(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_handle_t* *handle, *flexio_spi_slave_transfer_callback_t* callback, void *userData)

Initializes the FlexIO SPI Slave handle, which is used in transactional functions.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_slave_handle_t structure to store the transfer state.
- callback – The callback function.
- userData – The parameter of the callback function.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO type/handle/ISR table out of range.

status_t FLEXIO_SPI_SlaveTransferNonBlocking(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_handle_t* *handle, *flexio_spi_transfer_t* *xfer)

Slave transfer data using IRQ.

This function sends data using IRQ. This is a non-blocking function, which returns right away. When all data is sent out/received, the callback function is called.

Parameters

- handle – Pointer to the flexio_spi_slave_handle_t structure to store the transfer state.
- base – Pointer to the FLEXIO_SPI_Type structure.
- xfer – FlexIO SPI transfer structure. See flexio_spi_transfer_t.

Return values

- kStatus_Success – Successfully start a transfer.
- kStatus_InvalidArgument – Input argument is invalid.
- kStatus_FLEXIO_SPI_Busy – SPI is not idle; it is running another transfer.

static inline void FLEXIO_SPI_SlaveTransferAbort(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_handle_t* *handle)

Aborts the slave data transfer which used IRQ, share same API with master.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_slave_handle_t structure to store the transfer state.

static inline *status_t* FLEXIO_SPI_SlaveTransferGetCount(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_handle_t* *handle, size_t *count)

Gets the data transfer status which used IRQ, share same API with master.

Parameters

- base – Pointer to the FLEXIO_SPI_Type structure.
- handle – Pointer to the flexio_spi_slave_handle_t structure to store the transfer state.
- count – Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

void FLEXIO_SPI_SlaveTransferHandleIRQ(void *spiType, void *spiHandle)

FlexIO SPI slave IRQ handler function.

Parameters

- spiType – Pointer to the FLEXIO_SPI_Type structure.
- spiHandle – Pointer to the flexio_spi_slave_handle_t structure to store the transfer state.

FSL_FLEXIO_SPI_DRIVER_VERSION

FlexIO SPI driver version.

Error codes for the FlexIO SPI driver.

Values:

enumerator kStatus_FLEXIO_SPI_Busy

FlexIO SPI is busy.

enumerator kStatus_FLEXIO_SPI_Idle

SPI is idle

enumerator kStatus_FLEXIO_SPI_Error

FlexIO SPI error.

enumerator kStatus_FLEXIO_SPI_Timeout

FlexIO SPI timeout polling status flags.

enum _flexio_spi_clock_phase

FlexIO SPI clock phase configuration.

Values:

enumerator kFLEXIO_SPI_ClockPhaseFirstEdge

First edge on SPSCK occurs at the middle of the first cycle of a data transfer.

enumerator kFLEXIO_SPI_ClockPhaseSecondEdge

First edge on SPSCK occurs at the start of the first cycle of a data transfer.

enum _flexio_spi_shift_direction

FlexIO SPI data shifter direction options.

Values:

enumerator kFLEXIO_SPI_MsbFirst

Data transfers start with most significant bit.

enumerator kFLEXIO_SPI_LsbFirst

Data transfers start with least significant bit.

enum _flexio_spi_data_bitcount_mode

FlexIO SPI data length mode options.

Values:

enumerator kFLEXIO_SPI_8BitMode

8-bit data transmission mode.

enumerator kFLEXIO_SPI_16BitMode

16-bit data transmission mode.

enumerator kFLEXIO_SPI_32BitMode

32-bit data transmission mode.

enum _flexio_spi_interrupt_enable

Define FlexIO SPI interrupt mask.

Values:

enumerator kFLEXIO_SPI_TxEmptyInterruptEnable

Transmit buffer empty interrupt enable.

enumerator kFLEXIO_SPI_RxFullInterruptEnable

Receive buffer full interrupt enable.

enum _flexio_spi_status_flags

Define FlexIO SPI status mask.

Values:

enumerator kFLEXIO_SPI_TxBufferEmptyFlag

Transmit buffer empty flag.

enumerator kFLEXIO_SPI_RxBufferFullFlag

Receive buffer full flag.

enum _flexio_spi_dma_enable

Define FlexIO SPI DMA mask.

Values:

enumerator kFLEXIO_SPI_TxDmaEnable

Tx DMA request source

enumerator kFLEXIO_SPI_RxDmaEnable
Rx DMA request source

enumerator kFLEXIO_SPI_DmaAllEnable
All DMA request source

enum _flexio_spi_transfer_flags
Define FlexIO SPI transfer flags.

Note: Use kFLEXIO_SPI_csContinuous and one of the other flags to OR together to form the transfer flag.

Values:

enumerator kFLEXIO_SPI_8bitMsb
FlexIO SPI 8-bit MSB first

enumerator kFLEXIO_SPI_8bitLsb
FlexIO SPI 8-bit LSB first

enumerator kFLEXIO_SPI_16bitMsb
FlexIO SPI 16-bit MSB first

enumerator kFLEXIO_SPI_16bitLsb
FlexIO SPI 16-bit LSB first

enumerator kFLEXIO_SPI_32bitMsb
FlexIO SPI 32-bit MSB first

enumerator kFLEXIO_SPI_32bitLsb
FlexIO SPI 32-bit LSB first

enumerator kFLEXIO_SPI_csContinuous
Enable the CS signal continuous mode

typedef enum *_flexio_spi_clock_phase* flexio_spi_clock_phase_t
FlexIO SPI clock phase configuration.

typedef enum *_flexio_spi_shift_direction* flexio_spi_shift_direction_t
FlexIO SPI data shifter direction options.

typedef enum *_flexio_spi_data_bitcount_mode* flexio_spi_data_bitcount_mode_t
FlexIO SPI data length mode options.

typedef struct *_flexio_spi_type* FLEXIO_SPI_Type
Define FlexIO SPI access structure typedef.

typedef struct *_flexio_spi_master_config* flexio_spi_master_config_t
Define FlexIO SPI master configuration structure.

typedef struct *_flexio_spi_slave_config* flexio_spi_slave_config_t
Define FlexIO SPI slave configuration structure.

typedef struct *_flexio_spi_transfer* flexio_spi_transfer_t
Define FlexIO SPI transfer structure.

typedef struct *_flexio_spi_master_handle* flexio_spi_master_handle_t
typedef for flexio_spi_master_handle_t in advance.

typedef *flexio_spi_master_handle_t* flexio_spi_slave_handle_t
Slave handle is the same with master handle.

typedef void (*flexio_spi_master_transfer_callback_t)(*FLEXIO_SPI_Type* *base, *flexio_spi_master_handle_t* *handle, *status_t* status, void *userData)

FlexIO SPI master callback for finished transmit.

typedef void (*flexio_spi_slave_transfer_callback_t)(*FLEXIO_SPI_Type* *base, *flexio_spi_slave_handle_t* *handle, *status_t* status, void *userData)

FlexIO SPI slave callback for finished transmit.

FLEXIO_SPI_DUMMYDATA

FlexIO SPI dummy transfer data, the data is sent while txData is NULL.

SPI_RETRY_TIMES

Retry times for waiting flag.

FLEXIO_SPI_XFER_DATA_FORMAT(flag)

Get the transfer data format of width and bit order.

struct _flexio_spi_type

#include <fsl_flexio_spi.h> Define FlexIO SPI access structure typedef.

Public Members

FLEXIO_Type *flexioBase

FlexIO base pointer.

uint8_t SDOPinIndex

Pin select for data output. To set SDO pin in Hi-Z state, user needs to mux the pin as GPIO input and disable all pull up/down in application.

uint8_t SDIPinIndex

Pin select for data input.

uint8_t SCKPinIndex

Pin select for clock.

uint8_t CSnPinIndex

Pin select for enable.

uint8_t shifterIndex[2]

Shifter index used in FlexIO SPI.

uint8_t timerIndex[2]

Timer index used in FlexIO SPI.

struct _flexio_spi_master_config

#include <fsl_flexio_spi.h> Define FlexIO SPI master configuration structure.

Public Members

bool enableMaster

Enable/disable FlexIO SPI master after configuration.

bool enableInDoze

Enable/disable FlexIO operation in doze mode.

bool enableInDebug

Enable/disable FlexIO operation in debug mode.

bool enableFastAccess

Enable/disable fast access to FlexIO registers, fast access requires the FlexIO clock to be at least twice the frequency of the bus clock.

uint32_t baudRate_Bps

Baud rate in Bps.

flexio_spi_clock_phase_t phase

Clock phase.

flexio_spi_data_bitcount_mode_t dataMode

8bit or 16bit mode.

struct _flexio_spi_slave_config

#include <fsl_flexio_spi.h> Define FlexIO SPI slave configuration structure.

Public Members

bool enableSlave

Enable/disable FlexIO SPI slave after configuration.

bool enableInDoze

Enable/disable FlexIO operation in doze mode.

bool enableInDebug

Enable/disable FlexIO operation in debug mode.

bool enableFastAccess

Enable/disable fast access to FlexIO registers, fast access requires the FlexIO clock to be at least twice the frequency of the bus clock.

flexio_spi_clock_phase_t phase

Clock phase.

flexio_spi_data_bitcount_mode_t dataMode

8bit or 16bit mode.

struct _flexio_spi_transfer

#include <fsl_flexio_spi.h> Define FlexIO SPI transfer structure.

Public Members

const uint8_t *txData

Send buffer.

uint8_t *rxData

Receive buffer.

size_t dataSize

Transfer bytes.

uint8_t flags

FlexIO SPI control flag, MSB first or LSB first.

struct _flexio_spi_master_handle

#include <fsl_flexio_spi.h> Define FlexIO SPI handle structure.

Public Members

const uint8_t *txData
Transfer buffer.

uint8_t *rxData
Receive buffer.

size_t transferSize
Total bytes to be transferred.

volatile size_t txRemainingBytes
Send data remaining in bytes.

volatile size_t rxRemainingBytes
Receive data remaining in bytes.

volatile uint32_t state
FlexIO SPI internal state.

uint8_t bytePerFrame
SPI mode, 2bytes or 1byte in a frame

flexio_spi_shift_direction_t direction
Shift direction.

flexio_spi_master_transfer_callback_t callback
FlexIO SPI callback.

void *userData
Callback parameter.

bool isCsContinuous
Is current transfer using CS continuous mode.

uint32_t timer1Cfg
TIMER1 TIMCFG regiser value backup.

2.23 FlexIO UART Driver

status_t FLEXIO_UART_Init(*FLEXIO_UART_Type* *base, const *flexio_uart_config_t* *userConfig, uint32_t srcClock_Hz)

Ungates the FlexIO clock, resets the FlexIO module, configures FlexIO UART hardware, and configures the FlexIO UART with FlexIO UART configuration. The configuration structure can be filled by the user or be set with default values by FLEXIO_UART_GetDefaultConfig().

Example

```
FLEXIO_UART_Type base = {
.flexioBase = FLEXIO,
.TxPinIndex = 0,
.RxPinIndex = 1,
.shifterIndex = {0,1},
.timerIndex = {0,1}
};
flexio_uart_config_t config = {
.enableInDoze = false,
.enableInDebug = true,
.enableFastAccess = false,
.baudRate_Bps = 115200U,
```

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```
.bitCountPerChar = 8
};
FLEXIO_UART_Init(base, &config, srcClock_Hz);
```

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- userConfig – Pointer to the flexio_uart_config_t structure.
- srcClock_Hz – FlexIO source clock in Hz.

Return values

- kStatus_Success – Configuration success.
- kStatus_FLEXIO_UART_BaudrateNotSupport – Baudrate is not supported for current clock source frequency.

void FLEXIO_UART_Deinit(*FLEXIO_UART_Type* *base)

Resets the FlexIO UART shifter and timer config.

Note: After calling this API, call the FLEXO_UART_Init to use the FlexIO UART module.

Parameters

- base – Pointer to FLEXIO_UART_Type structure

void FLEXIO_UART_GetDefaultConfig(*flexio_uart_config_t* *userConfig)

Gets the default configuration to configure the FlexIO UART. The configuration can be used directly for calling the FLEXIO_UART_Init(). Example:

```
flexio_uart_config_t config;
FLEXIO_UART_GetDefaultConfig(&userConfig);
```

Parameters

- userConfig – Pointer to the flexio_uart_config_t structure.

uint32_t FLEXIO_UART_GetStatusFlags(*FLEXIO_UART_Type* *base)

Gets the FlexIO UART status flags.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.

Returns

FlexIO UART status flags.

void FLEXIO_UART_ClearStatusFlags(*FLEXIO_UART_Type* *base, uint32_t mask)

Gets the FlexIO UART status flags.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- mask – Status flag. The parameter can be any combination of the following values:
  - kFLEXIO_UART_TxDataRegEmptyFlag
  - kFLEXIO_UART_RxEmptyFlag

– kFLEXIO_UART_RxOverRunFlag

void FLEXIO_UART_EnableInterrupts(*FLEXIO_UART_Type* *base, uint32_t mask)

Enables the FlexIO UART interrupt.

This function enables the FlexIO UART interrupt.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- mask – Interrupt source.

void FLEXIO_UART_DisableInterrupts(*FLEXIO_UART_Type* *base, uint32_t mask)

Disables the FlexIO UART interrupt.

This function disables the FlexIO UART interrupt.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- mask – Interrupt source.

static inline uint32_t FLEXIO_UART_GetTxDataRegisterAddress(*FLEXIO_UART_Type* *base)

Gets the FlexIO UARt transmit data register address.

This function returns the UART data register address, which is mainly used by DMA/eDMA.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.

Returns

FlexIO UART transmit data register address.

static inline uint32_t FLEXIO_UART_GetRxDataRegisterAddress(*FLEXIO_UART_Type* *base)

Gets the FlexIO UART receive data register address.

This function returns the UART data register address, which is mainly used by DMA/eDMA.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.

Returns

FlexIO UART receive data register address.

static inline void FLEXIO_UART_EnableTxDMA(*FLEXIO_UART_Type* *base, bool enable)

Enables/disables the FlexIO UART transmit DMA. This function enables/disables the FlexIO UART Tx DMA, which means asserting the kFLEXIO_UART_TxDataRegEmptyFlag does/doesn't trigger the DMA request.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- enable – True to enable, false to disable.

static inline void FLEXIO_UART_EnableRxDMA(*FLEXIO_UART_Type* *base, bool enable)

Enables/disables the FlexIO UART receive DMA. This function enables/disables the FlexIO UART Rx DMA, which means asserting kFLEXIO_UART_RxDataRegFullFlag does/doesn't trigger the DMA request.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- enable – True to enable, false to disable.

static inline void FLEXIO_UART_Enable(*FLEXIO_UART_Type* *base, bool enable)

Enables/disables the FlexIO UART module operation.

Parameters

- base – Pointer to the FLEXIO_UART_Type.
- enable – True to enable, false does not have any effect.

static inline void FLEXIO_UART_WriteByte(*FLEXIO_UART_Type* *base, const uint8_t *buffer)

Writes one byte of data.

Note: This is a non-blocking API, which returns directly after the data is put into the data register. Ensure that the TxEmptyFlag is asserted before calling this API.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- buffer – The data bytes to send.

static inline void FLEXIO_UART_ReadByte(*FLEXIO_UART_Type* *base, uint8_t *buffer)

Reads one byte of data.

Note: This is a non-blocking API, which returns directly after the data is read from the data register. Ensure that the RxFullFlag is asserted before calling this API.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- buffer – The buffer to store the received bytes.

status_t FLEXIO_UART_WriteBlocking(*FLEXIO_UART_Type* *base, const uint8_t *txData, size_t txSize)

Sends a buffer of data bytes.

Note: This function blocks using the polling method until all bytes have been sent.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- txData – The data bytes to send.
- txSize – The number of data bytes to send.

Return values

- kStatus_FLEXIO_UART_Timeout – Transmission timed out and was aborted.
- kStatus_Success – Successfully wrote all data.

status_t FLEXIO_UART_ReadBlocking(*FLEXIO_UART_Type* *base, uint8_t *rxData, size_t rxSize)

Receives a buffer of bytes.

Note: This function blocks using the polling method until all bytes have been received.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- rxData – The buffer to store the received bytes.
- rxSize – The number of data bytes to be received.

Return values

- kStatus_FLEXIO_UART_Timeout – Transmission timed out and was aborted.
- kStatus_Success – Successfully received all data.

status_t FLEXIO_UART_TransferCreateHandle(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, *flexio_uart_transfer_callback_t* callback, void *userData)

Initializes the UART handle.

This function initializes the FlexIO UART handle, which can be used for other FlexIO UART transactional APIs. Call this API once to get the initialized handle.

The UART driver supports the "background" receiving, which means that users can set up a RX ring buffer optionally. Data received is stored into the ring buffer even when the user doesn't call the FLEXIO_UART_TransferReceiveNonBlocking() API. If there is already data received in the ring buffer, users can get the received data from the ring buffer directly. The ring buffer is disabled if passing NULL as ringBuffer.

Parameters

- base – to FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.
- callback – The callback function.
- userData – The parameter of the callback function.

Return values

- kStatus_Success – Successfully create the handle.
- kStatus_OutOfRange – The FlexIO type/handle/ISR table out of range.

void FLEXIO_UART_TransferStartRingBuffer(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, uint8_t *ringBuffer, size_t ringBufferSize)

Sets up the RX ring buffer.

This function sets up the RX ring buffer to a specific UART handle.

When the RX ring buffer is used, data received is stored into the ring buffer even when the user doesn't call the UART_ReceiveNonBlocking() API. If there is already data received in the ring buffer, users can get the received data from the ring buffer directly.

Note: When using the RX ring buffer, one byte is reserved for internal use. In other words, if ringBufferSize is 32, only 31 bytes are used for saving data.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.

- ringBuffer – Start address of ring buffer for background receiving. Pass NULL to disable the ring buffer.
- ringBufferSize – Size of the ring buffer.

void FLEXIO_UART_TransferStopRingBuffer(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle)

Aborts the background transfer and uninstalls the ring buffer.

This function aborts the background transfer and uninstalls the ring buffer.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.

status_t FLEXIO_UART_TransferSendNonBlocking(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, *flexio_uart_transfer_t* *xfer)

Transmits a buffer of data using the interrupt method.

This function sends data using an interrupt method. This is a non-blocking function, which returns directly without waiting for all data to be written to the TX register. When all data is written to the TX register in ISR, the FlexIO UART driver calls the callback function and passes the kStatus_FLEXIO_UART_TxIdle as status parameter.

Note: The kStatus_FLEXIO_UART_TxIdle is passed to the upper layer when all data is written to the TX register. However, it does not ensure that all data is sent out.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.
- xfer – FlexIO UART transfer structure. See flexio_uart_transfer_t.

Return values

- kStatus_Success – Successfully starts the data transmission.
- kStatus_UART_TxBusy – Previous transmission still not finished, data not written to the TX register.

void FLEXIO_UART_TransferAbortSend(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle)

Aborts the interrupt-driven data transmit.

This function aborts the interrupt-driven data sending. Get the remainBytes to find out how many bytes are still not sent out.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.

status_t FLEXIO_UART_TransferGetSendCount(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, size_t *count)

Gets the number of bytes sent.

This function gets the number of bytes sent driven by interrupt.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.
- count – Number of bytes sent so far by the non-blocking transaction.

Return values

- kStatus_NoTransferInProgress – transfer has finished or no transfer in progress.
- kStatus_Success – Successfully return the count.

status_t FLEXIO_UART_TransferReceiveNonBlocking(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, *flexio_uart_transfer_t* *xfer, size_t *receivedBytes)

Receives a buffer of data using the interrupt method.

This function receives data using the interrupt method. This is a non-blocking function, which returns without waiting for all data to be received. If the RX ring buffer is used and not empty, the data in ring buffer is copied and the parameter receivedBytes shows how many bytes are copied from the ring buffer. After copying, if the data in ring buffer is not enough to read, the receive request is saved by the UART driver. When new data arrives, the receive request is serviced first. When all data is received, the UART driver notifies the upper layer through a callback function and passes the status parameter kStatus_UART_RxIdle. For example, if the upper layer needs 10 bytes but there are only 5 bytes in the ring buffer, the 5 bytes are copied to xfer->data. This function returns with the parameter receivedBytes set to 5. For the last 5 bytes, newly arrived data is saved from the xfer->data[5]. When 5 bytes are received, the UART driver notifies upper layer. If the RX ring buffer is not enabled, this function enables the RX and RX interrupt to receive data to xfer->data. When all data is received, the upper layer is notified.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.
- xfer – UART transfer structure. See flexio_uart_transfer_t.
- receivedBytes – Bytes received from the ring buffer directly.

Return values

- kStatus_Success – Successfully queue the transfer into the transmit queue.
- kStatus_FLEXIO_UART_RxBusy – Previous receive request is not finished.

void FLEXIO_UART_TransferAbortReceive(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle)

Aborts the receive data which was using IRQ.

This function aborts the receive data which was using IRQ.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.

status_t FLEXIO_UART_TransferGetReceiveCount(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, size_t *count)

Gets the number of bytes received.

This function gets the number of bytes received driven by interrupt.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.
- handle – Pointer to the flexio_uart_handle_t structure to store the transfer state.
- count – Number of bytes received so far by the non-blocking transaction.

Return values

- kStatus_NoTransferInProgress – transfer has finished or no transfer in progress.
- kStatus_Success – Successfully return the count.

void FLEXIO_UART_TransferHandleIRQ(void *uartType, void *uartHandle)

FlexIO UART IRQ handler function.

This function processes the FlexIO UART transmit and receives the IRQ request.

Parameters

- uartType – Pointer to the FLEXIO_UART_Type structure.
- uartHandle – Pointer to the flexio_uart_handle_t structure to store the transfer state.

void FLEXIO_UART_FlushShifters(*FLEXIO_UART_Type* *base)

Flush tx/rx shifters.

Parameters

- base – Pointer to the FLEXIO_UART_Type structure.

FSL_FLEXIO_UART_DRIVER_VERSION

FlexIO UART driver version.

Error codes for the UART driver.

Values:

enumerator kStatus_FLEXIO_UART_TxBusy

Transmitter is busy.

enumerator kStatus_FLEXIO_UART_RxBusy

Receiver is busy.

enumerator kStatus_FLEXIO_UART_TxIdle

UART transmitter is idle.

enumerator kStatus_FLEXIO_UART_RxIdle

UART receiver is idle.

enumerator kStatus_FLEXIO_UART_ERROR

ERROR happens on UART.

enumerator kStatus_FLEXIO_UART_RxRingBufferOverrun

UART RX software ring buffer overrun.

enumerator kStatus_FLEXIO_UART_RxHardwareOverrun
UART RX receiver overrun.

enumerator kStatus_FLEXIO_UART_Timeout
UART times out.

enumerator kStatus_FLEXIO_UART_BaudrateNotSupport
Baudrate is not supported in current clock source

enum _flexio_uart_bit_count_per_char
FlexIO UART bit count per char.

Values:

enumerator kFLEXIO_UART_7BitsPerChar
7-bit data characters

enumerator kFLEXIO_UART_8BitsPerChar
8-bit data characters

enumerator kFLEXIO_UART_9BitsPerChar
9-bit data characters

enum _flexio_uart_interrupt_enable
Define FlexIO UART interrupt mask.

Values:

enumerator kFLEXIO_UART_TxDataRegEmptyInterruptEnable
Transmit buffer empty interrupt enable.

enumerator kFLEXIO_UART_RxDataRegFullInterruptEnable
Receive buffer full interrupt enable.

enum _flexio_uart_status_flags
Define FlexIO UART status mask.

Values:

enumerator kFLEXIO_UART_TxDataRegEmptyFlag
Transmit buffer empty flag.

enumerator kFLEXIO_UART_RxDataRegFullFlag
Receive buffer full flag.

enumerator kFLEXIO_UART_RxOverRunFlag
Receive buffer over run flag.

typedef enum *_flexio_uart_bit_count_per_char* flexio_uart_bit_count_per_char_t
FlexIO UART bit count per char.

typedef struct *_flexio_uart_type* FLEXIO_UART_Type
Define FlexIO UART access structure typedef.

typedef struct *_flexio_uart_config* flexio_uart_config_t
Define FlexIO UART user configuration structure.

typedef struct *_flexio_uart_transfer* flexio_uart_transfer_t
Define FlexIO UART transfer structure.

typedef struct *_flexio_uart_handle* flexio_uart_handle_t

typedef void (*flexio_uart_transfer_callback_t)(*FLEXIO_UART_Type* *base, *flexio_uart_handle_t* *handle, *status_t* status, void *userData)

FlexIO UART transfer callback function.

UART_RETRY_TIMES

Retry times for waiting flag.

struct _flexio_uart_type

#include <fsl_flexio_uart.h> Define FlexIO UART access structure typedef.

Public Members

FLEXIO_Type *flexioBase

FlexIO base pointer.

uint8_t TxPinIndex

Pin select for UART_Tx.

uint8_t RxPinIndex

Pin select for UART_Rx.

uint8_t shifterIndex[2]

Shifter index used in FlexIO UART.

uint8_t timerIndex[2]

Timer index used in FlexIO UART.

struct _flexio_uart_config

#include <fsl_flexio_uart.h> Define FlexIO UART user configuration structure.

Public Members

bool enableUart

Enable/disable FlexIO UART TX & RX.

bool enableInDoze

Enable/disable FlexIO operation in doze mode

bool enableInDebug

Enable/disable FlexIO operation in debug mode

bool enableFastAccess

Enable/disable fast access to FlexIO registers, fast access requires the FlexIO clock to be at least twice the frequency of the bus clock.

uint32_t baudRate_Bps

Baud rate in Bps.

flexio_uart_bit_count_per_char_t bitCountPerChar

number of bits, 7/8/9 -bit

struct _flexio_uart_transfer

#include <fsl_flexio_uart.h> Define FlexIO UART transfer structure.

Public Members

size_t dataSize

Transfer size

struct __flexio_uart_handle

#include <fsl_flexio_uart.h> Define FLEXIO UART handle structure.

Public Members

const uint8_t *volatile txData
: Address of remaining data to send.

volatile size_t txDataSize
: Size of the remaining data to send.

uint8_t *volatile rxData
: Address of remaining data to receive.

volatile size_t rxDataSize
: Size of the remaining data to receive.

size_t txDataSizeAll
: Total bytes to be sent.

size_t rxDataSizeAll
: Total bytes to be received.

uint8_t *rxRingBuffer
: Start address of the receiver ring buffer.

size_t rxRingBufferSize
: Size of the ring buffer.

volatile uint16_t rxRingBufferHead
: Index for the driver to store received data into ring buffer.

volatile uint16_t rxRingBufferTail
: Index for the user to get data from the ring buffer.

flexio_uart_transfer_callback_t callback
: Callback function.

void *userData
: UART callback function parameter.

volatile uint8_t txState
: TX transfer state.

volatile uint8_t rxState
: RX transfer state

union ___unnamed228___

Public Members

uint8_t *data
: The buffer of data to be transfer.

uint8_t *rxData
: The buffer to receive data.

const uint8_t *txData
: The buffer of data to be sent.

2.24 FLEXSPI: Flexible Serial Peripheral Interface Driver

uint32_t FLEXSPI_GetInstance(FLEXSPI_Type *base)

Get the instance number for FLEXSPI.

Parameters

- base – FLEXSPI base pointer.

status_t FLEXSPI_CheckAndClearError(FLEXSPI_Type *base, uint32_t status)

Check and clear IP command execution errors.

Parameters

- base – FLEXSPI base pointer.
- status – interrupt status.

void FLEXSPI_Init(FLEXSPI_Type *base, const *flexspi_config_t* *config)

Initializes the FLEXSPI module and internal state.

This function enables the clock for FLEXSPI and also configures the FLEXSPI with the input configure parameters. Users should call this function before any FLEXSPI operations.

Parameters

- base – FLEXSPI peripheral base address.
- config – FLEXSPI configure structure.

void FLEXSPI_GetDefaultConfig(*flexspi_config_t* *config)

Gets default settings for FLEXSPI.

Parameters

- config – FLEXSPI configuration structure.

void FLEXSPI_Deinit(FLEXSPI_Type *base)

Deinitializes the FLEXSPI module.

Clears the FLEXSPI state and FLEXSPI module registers.

Parameters

- base – FLEXSPI peripheral base address.

void FLEXSPI_UpdateDllValue(FLEXSPI_Type *base, *flexspi_device_config_t* *config, *flexspi_port_t* port)

Update FLEXSPI DLL value depending on currently flexspi root clock.

Parameters

- base – FLEXSPI peripheral base address.
- config – Flash configuration parameters.
- port – FLEXSPI Operation port.

void FLEXSPI_SetFlashConfig(FLEXSPI_Type *base, *flexspi_device_config_t* *config, *flexspi_port_t* port)

Configures the connected device parameter.

This function configures the connected device relevant parameters, such as the size, command, and so on. The flash configuration value cannot have a default value. The user needs to configure it according to the connected device.

Parameters

- base – FLEXSPI peripheral base address.

- config – Flash configuration parameters.
- port – FLEXSPI Operation port.

void FLEXSPI_SoftwareReset(FLEXSPI_Type *base)

Software reset for the FLEXSPI logic.

This function sets the software reset flags for both AHB and buffer domain and resets both AHB buffer and also IP FIFOs.

Parameters

- base – FLEXSPI peripheral base address.

static inline void FLEXSPI_Enable(FLEXSPI_Type *base, bool enable)

Enables or disables the FLEXSPI module.

Parameters

- base – FLEXSPI peripheral base address.
- enable – True means enable FLEXSPI, false means disable.

void FLEXSPI_UpdateAhbBuffersSettings(FLEXSPI_Type *base, *flexspi_ahbBuffers_ctrl_t* *ptrAhbBufferCtrl)

Update all AHB buffers' settings, including buffer size, master ID.

Parameters

- base – FLEXSPI peripheral base address.
- ptrAhbBufferCtrl – Pointer to structure flexspi_ahbBuffers_ctrl_t which store all AHB buffers' settings.

static inline void FLEXSPI_EnableInterrupts(FLEXSPI_Type *base, uint32_t mask)

Enables the FLEXSPI interrupts.

Parameters

- base – FLEXSPI peripheral base address.
- mask – FLEXSPI interrupt source.

static inline void FLEXSPI_DisableInterrupts(FLEXSPI_Type *base, uint32_t mask)

Disable the FLEXSPI interrupts.

Parameters

- base – FLEXSPI peripheral base address.
- mask – FLEXSPI interrupt source.

static inline void FLEXSPI_EnableTxDMA(FLEXSPI_Type *base, bool enable)

Enables or disables FLEXSPI IP Tx FIFO DMA requests.

Parameters

- base – FLEXSPI peripheral base address.
- enable – Enable flag for transmit DMA request. Pass true for enable, false for disable.

static inline void FLEXSPI_EnableRxDMA(FLEXSPI_Type *base, bool enable)

Enables or disables FLEXSPI IP Rx FIFO DMA requests.

Parameters

- base – FLEXSPI peripheral base address.
- enable – Enable flag for receive DMA request. Pass true for enable, false for disable.

static inline uint32_t FLEXSPI_GetTxFifoAddress(FLEXSPI_Type *base)

Gets FLEXSPI IP tx fifo address for DMA transfer.

Parameters

- base – FLEXSPI peripheral base address.

Return values

The – tx fifo address.

static inline uint32_t FLEXSPI_GetRxFifoAddress(FLEXSPI_Type *base)

Gets FLEXSPI IP rx fifo address for DMA transfer.

Parameters

- base – FLEXSPI peripheral base address.

Return values

The – rx fifo address.

static inline void FLEXSPI_ResetFifos(FLEXSPI_Type *base, bool txFifo, bool rxFifo)

Clears the FLEXSPI IP FIFO logic.

Parameters

- base – FLEXSPI peripheral base address.
- txFifo – Pass true to reset TX FIFO.
- rxFifo – Pass true to reset RX FIFO.

static inline void FLEXSPI_GetFifoCounts(FLEXSPI_Type *base, size_t *txCount, size_t *rxCount)

Gets the valid data entries in the FLEXSPI FIFOs.

Parameters

- base – FLEXSPI peripheral base address.
- txCount – **[out]** Pointer through which the current number of bytes in the transmit FIFO is returned. Pass NULL if this value is not required.
- rxCount – **[out]** Pointer through which the current number of bytes in the receive FIFO is returned. Pass NULL if this value is not required.

static inline uint32_t FLEXSPI_GetInterruptStatusFlags(FLEXSPI_Type *base)

Get the FLEXSPI interrupt status flags.

Parameters

- base – FLEXSPI peripheral base address.

Return values

interrupt – status flag, use status flag to AND flexspi_flags_t could get the related status.

static inline void FLEXSPI_ClearInterruptStatusFlags(FLEXSPI_Type *base, uint32_t mask)

Get the FLEXSPI interrupt status flags.

Parameters

- base – FLEXSPI peripheral base address.
- mask – FLEXSPI interrupt source.

static inline *flexspi_arb_command_source_t* FLEXSPI_GetArbitratorCommandSource(FLEXSPI_Type *base)

Gets the trigger source of current command sequence granted by arbitrator.

Parameters

- base – FLEXSPI peripheral base address.

Return values

trigger – source of current command sequence.

static inline *flexspi_ip_error_code_t* FLEXSPI_GetIPCommandErrorCode(FLEXSPI_Type *base, uint8_t *index)

Gets the error code when IP command error detected.

Parameters

- base – FLEXSPI peripheral base address.
- index – Pointer to a uint8_t type variable to receive the sequence index when error detected.

Return values

error – code when IP command error detected.

static inline *flexspi_ahb_error_code_t* FLEXSPI_GetAHBCommandErrorCode(FLEXSPI_Type *base, uint8_t *index)

Gets the error code when AHB command error detected.

Parameters

- base – FLEXSPI peripheral base address.
- index – Pointer to a uint8_t type variable to receive the sequence index when error detected.

Return values

error – code when AHB command error detected.

static inline bool FLEXSPI_GetBusIdleStatus(FLEXSPI_Type *base)

Returns whether the bus is idle.

Parameters

- base – FLEXSPI peripheral base address.

Return values

- true – Bus is idle.
- false – Bus is busy.

void FLEXSPI_UpdateRxSampleClock(FLEXSPI_Type *base, *flexspi_read_sample_clock_t* clockSource)

Update read sample clock source.

Parameters

- base – FLEXSPI peripheral base address.
- clockSource – clockSource of type flexspi_read_sample_clock_t

void FLEXSPI_UpdateLUT(FLEXSPI_Type *base, uint32_t index, const uint32_t *cmd, uint32_t count)

Updates the LUT table.

Parameters

- base – FLEXSPI peripheral base address.
- index – From which index start to update. It could be any index of the LUT table, which also allows user to update command content inside a command. Each command consists of up to 8 instructions and occupy 4*32-bit memory.

- cmd – Command sequence array.
- count – Number of sequences.

static inline void FLEXSPI_WriteData(FLEXSPI_Type *base, uint32_t data, uint8_t fifoIndex)

Writes data into FIFO.

Parameters

- base – FLEXSPI peripheral base address
- data – The data bytes to send
- fifoIndex – Destination fifo index.

static inline uint32_t FLEXSPI_ReadData(FLEXSPI_Type *base, uint8_t fifoIndex)

Receives data from data FIFO.

Parameters

- base – FLEXSPI peripheral base address
- fifoIndex – Source fifo index.

Returns

The data in the FIFO.

status_t FLEXSPI_WriteBlocking(FLEXSPI_Type *base, uint8_t *buffer, size_t size)

Sends a buffer of data bytes using blocking method.

Note: This function blocks via polling until all bytes have been sent.

Parameters

- base – FLEXSPI peripheral base address
- buffer – The data bytes to send
- size – The number of data bytes to send

Return values

- kStatus_Success – write success without error
- kStatus_FLEXSPI_SequenceExecutionTimeout – sequence execution timeout
- kStatus_FLEXSPI_IpCommandSequenceError – IP command sequence error detected
- kStatus_FLEXSPI_IpCommandGrantTimeout – IP command grant timeout detected

status_t FLEXSPI_ReadBlocking(FLEXSPI_Type *base, uint8_t *buffer, size_t size)

Receives a buffer of data bytes using a blocking method.

Note: This function blocks via polling until all bytes have been sent.

Parameters

- base – FLEXSPI peripheral base address
- buffer – The data bytes to send
- size – The number of data bytes to receive

Return values

- kStatus_Success – read success without error
- kStatus_FLEXSPI_SequenceExecutionTimeout – sequence execution timeout
- kStatus_FLEXSPI_IpCommandSequenceError – IP command sequencen error detected
- kStatus_FLEXSPI_IpCommandGrantTimeout – IP command grant timeout detected

status_t FLEXSPI_TransferBlocking(FLEXSPI_Type *base, *flexspi_transfer_t* *xfer)

Execute command to transfer a buffer data bytes using a blocking method.

Parameters

- base – FLEXSPI peripheral base address
- xfer – pointer to the transfer structure.

Return values

- kStatus_Success – command transfer success without error
- kStatus_FLEXSPI_SequenceExecutionTimeout – sequence execution timeout
- kStatus_FLEXSPI_IpCommandSequenceError – IP command sequence error detected
- kStatus_FLEXSPI_IpCommandGrantTimeout – IP command grant timeout detected

void FLEXSPI_TransferCreateHandle(FLEXSPI_Type *base, *flexspi_handle_t* *handle, *flexspi_transfer_callback_t* callback, void *userData)

Initializes the FLEXSPI handle which is used in transactional functions.

Parameters

- base – FLEXSPI peripheral base address.
- handle – pointer to flexspi_handle_t structure to store the transfer state.
- callback – pointer to user callback function.
- userData – user parameter passed to the callback function.

status_t FLEXSPI_TransferNonBlocking(FLEXSPI_Type *base, *flexspi_handle_t* *handle, *flexspi_transfer_t* *xfer)

Performs a interrupt non-blocking transfer on the FLEXSPI bus.

Note: Calling the API returns immediately after transfer initiates. The user needs to call FLEXSPI_GetTransferCount to poll the transfer status to check whether the transfer is finished. If the return status is not kStatus_FLEXSPI_Busy, the transfer is finished. For FLEXSPI_Read, the dataSize should be multiple of rx watermark level, or FLEXSPI could not read data properly.

Parameters

- base – FLEXSPI peripheral base address.
- handle – pointer to flexspi_handle_t structure which stores the transfer state.
- xfer – pointer to flexspi_transfer_t structure.

Return values

- kStatus_Success – Successfully start the data transmission.
- kStatus_FLEXSPI_Busy – Previous transmission still not finished.

status_t FLEXSPI_TransferGetCount(FLEXSPI_Type *base, *flexspi_handle_t* *handle, size_t *count)

Gets the master transfer status during a interrupt non-blocking transfer.

Parameters

- base – FLEXSPI peripheral base address.
- handle – pointer to flexspi_handle_t structure which stores the transfer state.
- count – Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_InvalidArgument – count is Invalid.
- kStatus_Success – Successfully return the count.

void FLEXSPI_TransferAbort(FLEXSPI_Type *base, *flexspi_handle_t* *handle)

Aborts an interrupt non-blocking transfer early.

Note: This API can be called at any time when an interrupt non-blocking transfer initiates to abort the transfer early.

Parameters

- base – FLEXSPI peripheral base address.
- handle – pointer to flexspi_handle_t structure which stores the transfer state

void FLEXSPI_TransferHandleIRQ(FLEXSPI_Type *base, *flexspi_handle_t* *handle)

Master interrupt handler.

Parameters

- base – FLEXSPI peripheral base address.
- handle – pointer to flexspi_handle_t structure.

FSL_FLEXSPI_DRIVER_VERSION

FLEXSPI driver version.

Status structure of FLEXSPI.

Values:

enumerator kStatus_FLEXSPI_Busy

FLEXSPI is busy

enumerator kStatus_FLEXSPI_SequenceExecutionTimeout

Sequence execution timeout error occurred during FLEXSPI transfer.

enumerator kStatus_FLEXSPI_IpCommandSequenceError

IP command Sequence execution timeout error occurred during FLEXSPI transfer.

enumerator kStatus_FLEXSPI_IpCommandGrantTimeout

IP command grant timeout error occurred during FLEXSPI transfer.

CMD definition of FLEXSPI, use to form LUT instruction, _flexspi_command.

Values:

enumerator kFLEXSPI_Command_STOP
Stop execution, deassert CS.

enumerator kFLEXSPI_Command_SDR
Transmit Command code to Flash, using SDR mode.

enumerator kFLEXSPI_Command_RADDR_SDR
Transmit Row Address to Flash, using SDR mode.

enumerator kFLEXSPI_Command_CADDR_SDR
Transmit Column Address to Flash, using SDR mode.

enumerator kFLEXSPI_Command_MODE1_SDR
Transmit 1-bit Mode bits to Flash, using SDR mode.

enumerator kFLEXSPI_Command_MODE2_SDR
Transmit 2-bit Mode bits to Flash, using SDR mode.

enumerator kFLEXSPI_Command_MODE4_SDR
Transmit 4-bit Mode bits to Flash, using SDR mode.

enumerator kFLEXSPI_Command_MODE8_SDR
Transmit 8-bit Mode bits to Flash, using SDR mode.

enumerator kFLEXSPI_Command_WRITE_SDR
Transmit Programming Data to Flash, using SDR mode.

enumerator kFLEXSPI_Command_READ_SDR
Receive Read Data from Flash, using SDR mode.

enumerator kFLEXSPI_Command_LEARN_SDR
Receive Read Data or Preamble bit from Flash, SDR mode.

enumerator kFLEXSPI_Command_DATSZ_SDR
Transmit Read/Program Data size (byte) to Flash, SDR mode.

enumerator kFLEXSPI_Command_DUMMY_SDR
Leave data lines undriven by FlexSPI controller.

enumerator kFLEXSPI_Command_DUMMY_RWDS_SDR
Leave data lines undriven by FlexSPI controller, dummy cycles decided by RWDS.

enumerator kFLEXSPI_Command_DDR
Transmit Command code to Flash, using DDR mode.

enumerator kFLEXSPI_Command_RADDR_DDR
Transmit Row Address to Flash, using DDR mode.

enumerator kFLEXSPI_Command_CADDR_DDR
Transmit Column Address to Flash, using DDR mode.

enumerator kFLEXSPI_Command_MODE1_DDR
Transmit 1-bit Mode bits to Flash, using DDR mode.

enumerator kFLEXSPI_Command_MODE2_DDR
Transmit 2-bit Mode bits to Flash, using DDR mode.

enumerator kFLEXSPI_Command_MODE4_DDR
Transmit 4-bit Mode bits to Flash, using DDR mode.

enumerator kFLEXSPI_Command_MODE8_DDR
Transmit 8-bit Mode bits to Flash, using DDR mode.

enumerator kFLEXSPI_Command_WRITE_DDR
Transmit Programming Data to Flash, using DDR mode.

enumerator kFLEXSPI_Command_READ_DDR
Receive Read Data from Flash, using DDR mode.

enumerator kFLEXSPI_Command_LEARN_DDR
Receive Read Data or Preamble bit from Flash, DDR mode.

enumerator kFLEXSPI_Command_DATSZ_DDR
Transmit Read/Program Data size (byte) to Flash, DDR mode.

enumerator kFLEXSPI_Command_DUMMY_DDR
Leave data lines undriven by FlexSPI controller.

enumerator kFLEXSPI_Command_DUMMY_RWDS_DDR
Leave data lines undriven by FlexSPI controller, dummy cycles decided by RWDS.

enumerator kFLEXSPI_Command_JUMP_ON_CS
Stop execution, deassert CS and save operand[7:0] as the instruction start pointer for next sequence

enum _flexspi_pad
pad definition of FLEXSPI, use to form LUT instruction.

Values:

enumerator kFLEXSPI_1PAD
Transmit command/address and transmit/receive data only through DATA0/DATA1.

enumerator kFLEXSPI_2PAD
Transmit command/address and transmit/receive data only through DATA[1:0].

enumerator kFLEXSPI_4PAD
Transmit command/address and transmit/receive data only through DATA[3:0].

enumerator kFLEXSPI_8PAD
Transmit command/address and transmit/receive data only through DATA[7:0].

enum _flexspi_flags
FLEXSPI interrupt status flags.

Values:

enumerator kFLEXSPI_SequenceExecutionTimeoutFlag
Sequence execution timeout.

enumerator kFLEXSPI_AhbBusErrorFlag
AHB Bus error flag.

enumerator kFLEXSPI_SckStoppedBecauseTxEmptyFlag
SCK is stopped during command sequence because Async TX FIFO empty.

enumerator kFLEXSPI_SckStoppedBecauseRxFullFlag
SCK is stopped during command sequence because Async RX FIFO full.

enumerator kFLEXSPI_IpTxFifoWatermarkEmptyFlag
IP TX FIFO WaterMark empty.

enumerator kFLEXSPI_IpRxFifoWatermarkAvailableFlag
IP RX FIFO WaterMark available.

enumerator kFLEXSPI_AhbCommandSequenceErrorFlag
AHB triggered Command Sequences Error.

enumerator kFLEXSPI_IpCommandSequenceErrorFlag
IP triggered Command Sequences Error.

enumerator kFLEXSPI_AhbCommandGrantTimeoutFlag
AHB triggered Command Sequences Grant Timeout.

enumerator kFLEXSPI_IpCommandGrantTimeoutFlag
IP triggered Command Sequences Grant Timeout.

enumerator kFLEXSPI_IpCommandExecutionDoneFlag
IP triggered Command Sequences Execution finished.

enumerator kFLEXSPI_AllInterruptFlags
All flags.

enum __flexspi__read__sample__clock
FLEXSPI sample clock source selection for Flash Reading.

Values:

enumerator kFLEXSPI_ReadSampleClkLoopbackInternally
Dummy Read strobe generated by FlexSPI Controller and loopback internally.

enumerator kFLEXSPI_ReadSampleClkLoopbackFromDqsPad
Dummy Read strobe generated by FlexSPI Controller and loopback from DQS pad.

enumerator kFLEXSPI_ReadSampleClkLoopbackFromSckPad
SCK output clock and loopback from SCK pad.

enumerator kFLEXSPI_ReadSampleClkExternalInputFromDqsPad
Flash provided Read strobe and input from DQS pad.

enum __flexspi__cs__interval__cycle__unit
FLEXSPI interval unit for flash device select.

Values:

enumerator kFLEXSPI_CsIntervalUnit1SckCycle
Chip selection interval: CSINTERVAL * 1 serial clock cycle.

enumerator kFLEXSPI_CsIntervalUnit256SckCycle
Chip selection interval: CSINTERVAL * 256 serial clock cycle.

enum __flexspi__ahb__write__wait__unit
FLEXSPI AHB wait interval unit for writing.

Values:

enumerator kFLEXSPI_AhbWriteWaitUnit2AhbCycle
AWRWAIT unit is 2 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit8AhbCycle
AWRWAIT unit is 8 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit32AhbCycle
AWRWAIT unit is 32 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit128AhbCycle
AWRWAIT unit is 128 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit512AhbCycle
AWRWAIT unit is 512 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit2048AhbCycle
AWRWAIT unit is 2048 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit8192AhbCycle
AWRWAIT unit is 8192 ahb clock cycle.

enumerator kFLEXSPI_AhbWriteWaitUnit32768AhbCycle
AWRWAIT unit is 32768 ahb clock cycle.

enum _flexspi_ip_error_code
Error Code when IP command Error detected.

Values:

enumerator kFLEXSPI_IpCmdErrorNoError
No error.

enumerator kFLEXSPI_IpCmdErrorJumpOnCsInIpCmd
IP command with JMP_ON_CS instruction used.

enumerator kFLEXSPI_IpCmdErrorUnknownOpCode
Unknown instruction opcode in the sequence.

enumerator kFLEXSPI_IpCmdErrorSdrDummyInDdrSequence
Instruction DUMMY_SDR/DUMMY_RWDS_SDR used in DDR sequence.

enumerator kFLEXSPI_IpCmdErrorDdrDummyInSdrSequence
Instruction DUMMY_DDR/DUMMY_RWDS_DDR used in SDR sequence.

enumerator kFLEXSPI_IpCmdErrorInvalidAddress
Flash access start address exceed the whole flash address range (A1/A2/B1/B2).

enumerator kFLEXSPI_IpCmdErrorSequenceExecutionTimeout
Sequence execution timeout.

enumerator kFLEXSPI_IpCmdErrorFlashBoundaryAcrosss
Flash boundary crossed.

enum _flexspi_ahb_error_code
Error Code when AHB command Error detected.

Values:

enumerator kFLEXSPI_AhbCmdErrorNoError
No error.

enumerator kFLEXSPI_AhbCmdErrorJumpOnCsInWriteCmd
AHB Write command with JMP_ON_CS instruction used in the sequence.

enumerator kFLEXSPI_AhbCmdErrorUnknownOpCode
Unknown instruction opcode in the sequence.

enumerator kFLEXSPI_AhbCmdErrorSdrDummyInDdrSequence
Instruction DUMMY_SDR/DUMMY_RWDS_SDR used in DDR sequence.

enumerator kFLEXSPI_AhbCmdErrorDdrDummyInSdrSequence
Instruction DUMMY_DDR/DUMMY_RWDS_DDR used in SDR sequence.

enumerator kFLEXSPI_AhbCmdSequenceExecutionTimeout
Sequence execution timeout.

enum _flexspi_port
FLEXSPI operation port select.

Values:

enumerator kFLEXSPI_PortA1
Access flash on A1 port.

enumerator kFLEXSPI_PortA2
Access flash on A2 port.

enumerator kFLEXSPI_PortB1
Access flash on B1 port.

enumerator kFLEXSPI_PortB2
Access flash on B2 port.

enumerator kFLEXSPI_PortCount

enum _flexspi_arb_command_source
Trigger source of current command sequence granted by arbitrator.

Values:

enumerator kFLEXSPI_AhbReadCommand

enumerator kFLEXSPI_AhbWriteCommand

enumerator kFLEXSPI_IpCommand

enumerator kFLEXSPI_SuspendedCommand

enum _flexspi_command_type
Command type.

Values:

enumerator kFLEXSPI_Command
FlexSPI operation: Only command, both TX and Rx buffer are ignored.

enumerator kFLEXSPI_Config
FlexSPI operation: Configure device mode, the TX fifo size is fixed in LUT.

enumerator kFLEXSPI_Read

enumerator kFLEXSPI_Write

typedef enum *_flexspi_pad* flexspi_pad_t
pad definition of FLEXSPI, use to form LUT instruction.

typedef enum *_flexspi_flags* flexspi_flags_t
FLEXSPI interrupt status flags.

typedef enum *_flexspi_read_sample_clock* flexspi_read_sample_clock_t
FLEXSPI sample clock source selection for Flash Reading.

typedef enum *_flexspi_cs_interval_cycle_unit* flexspi_cs_interval_cycle_unit_t
FLEXSPI interval unit for flash device select.

typedef enum *_flexspi_ahb_write_wait_unit* flexspi_ahb_write_wait_unit_t
FLEXSPI AHB wait interval unit for writing.

typedef enum *_flexspi_ip_error_code* flexspi_ip_error_code_t
Error Code when IP command Error detected.

typedef enum *_flexspi_ahb_error_code* flexspi_ahb_error_code_t
Error Code when AHB command Error detected.

typedef enum *_flexspi_port* flexspi_port_t
FLEXSPI operation port select.

typedef enum *_flexspi_arb_command_source* flexspi_arb_command_source_t
Trigger source of current command sequence granted by arbitrator.

typedef enum *_flexspi_command_type* flexspi_command_type_t
Command type.

typedef struct *_flexspi_ahbBuffer_config* flexspi_ahbBuffer_config_t

typedef struct *_flexspi_ahbBuffers_ctrl* flexspi_ahbBuffers_ctrl_t
Structure to control all AHB buffers.

typedef struct *_flexspi_config* flexspi_config_t
FLEXSPI configuration structure.

typedef struct *_flexspi_device_config* flexspi_device_config_t
External device configuration items.

typedef struct *_flexspi_transfer* flexspi_transfer_t
Transfer structure for FLEXSPI.

typedef struct *_flexspi_handle* flexspi_handle_t

typedef void (*flexspi_transfer_callback_t)(FLEXSPI_Type *base, *flexspi_handle_t* *handle, *status_t* status, void *userData)
FLEXSPI transfer callback function.

typedef struct *_flexspi_addr_map_config* flexspi_addr_map_config_t
Address mapping configuration structure.

FSL_FEATURE_FLEXSPI_AHB_BUFFER_COUNT

FLEXSPI_LUT_SEQ(cmd0, pad0, op0, cmd1, pad1, op1)
Formula to form FLEXSPI instructions in LUT table.

struct _flexspi_ahbBuffer_config
#include <fsl_flexspi.h>

Public Members

uint8_t priority
This priority for AHB Master Read which this AHB RX Buffer is assigned.

uint8_t masterIndex
AHB Master ID the AHB RX Buffer is assigned.

uint16_t bufferSize
AHB buffer size in byte.

bool enablePrefetch
AHB Read Prefetch Enable for current AHB RX Buffer corresponding Master, allows prefetch disable/enable separately for each master.

struct _flexspi_ahbBuffers_ctrl
#include <fsl_flexspi.h> Structure to control all AHB buffers.

Public Members

flexspi_ahbBuffer_config_t buffer[FSL_FEATURE_FLEXSPI_AHB_BUFFER_COUNTn(0)]
Configurations of all AHB buffers.

struct _flexspi_config
#include <fsl_flexspi.h> FLEXSPI configuration structure.

Public Members

flexspi_read_sample_clock_t rxSampleClock
Sample Clock source selection for Flash Reading.

bool enableSckFreeRunning
Enable/disable SCK output free-running.

bool enableDoze
Enable/disable doze mode support.

bool enableHalfSpeedAccess
Enable/disable divide by 2 of the clock for half speed commands.

bool enableSameConfigForAll
Enable/disable same configuration for all connected devices when enabled, same configuration in FLASHA1CRx is applied to all.

uint16_t seqTimeoutCycle
Timeout wait cycle for command sequence execution, timeout after ahbGrantTimeoutCyle*1024 serial root clock cycles.

uint8_t ipGrantTimeoutCycle
Timeout wait cycle for IP command grant, timeout after ipGrantTimeoutCycle*1024 AHB clock cycles.

uint8_t txWatermark
FLEXSPI IP transmit watermark value.

uint8_t rxWatermark
FLEXSPI receive watermark value.

struct _flexspi_device_config
#include <fsl_flexspi.h> External device configuration items.

Public Members

uint32_t flexspiRootClk
FLEXSPI serial root clock.

bool isSck2Enabled
FLEXSPI use SCK2.

uint32_t flashSize
Flash size in KByte.

bool addressShift
Address shift.

flexspi_cs_interval_cycle_unit_t CSIntervalUnit
CS interval unit, 1 or 256 cycle.

uint16_t CSInterval
: CS line assert interval, multiply CS interval unit to get the CS line assert interval cycles.

uint8_t CSHoldTime
: CS line hold time.

uint8_t CSSetupTime
: CS line setup time.

uint8_t dataValidTime
: Data valid time for external device.

uint8_t columnspace
: Column space size.

bool enableWordAddress
: If enable word address.

uint8_t AWRSeqIndex
: Sequence ID for AHB write command.

uint8_t AWRSeqNumber
: Sequence number for AHB write command.

uint8_t ARDSeqIndex
: Sequence ID for AHB read command.

uint8_t ARDSeqNumber
: Sequence number for AHB read command.

flexspi_ahb_write_wait_unit_t AHBWriteWaitUnit
: AHB write wait unit.

uint16_t AHBWriteWaitInterval
: AHB write wait interval, multiply AHB write interval unit to get the AHB write wait cycles.

bool enableWriteMask
: Enable/Disable FLEXSPI drive DQS pin as write mask when writing to external device.

struct __flexspi__transfer
: *#include <fsl_flexspi.h>* Transfer structure for FLEXSPI.

Public Members

uint32_t deviceAddress
: Operation device address.

flexspi_port_t port
: Operation port.

flexspi_command_type_t cmdType
: Execution command type.

uint8_t seqIndex
: Sequence ID for command.

uint8_t SeqNumber
: Sequence number for command.

uint32_t *data
: Data buffer.

size_t dataSize
Data size in bytes.

struct __flexspi__handle
#include <fsl_flexspi.h> Transfer handle structure for FLEXSPI.

Public Members

uint32_t state
Internal state for FLEXSPI transfer

uint8_t *data
Data buffer.

size_t dataSize
Remaining Data size in bytes.

size_t transferTotalSize
Total Data size in bytes.

flexspi_transfer_callback_t completionCallback
Callback for users while transfer finish or error occurred

void *userData
FLEXSPI callback function parameter.

struct __flexspi__addr__map__config
#include <fsl_flexspi.h> Address mapping configuration structure.

Public Members

uint32_t addrStart
Remapping start address.

uint32_t addrEnd
Remapping end address.

uint32_t addrOffset
Address offset.

bool remapEnable
Enable address remapping.

struct ahbConfig

Public Members

uint8_t ahbGrantTimeoutCycle
Timeout wait cycle for AHB command grant, timeout after ahbGrantTimeoutCyle*1024 AHB clock cycles.

uint16_t ahbBusTimeoutCycle
Timeout wait cycle for AHB read/write access, timeout after ahbBusTimeoutCycle*1024 AHB clock cycles.

uint8_t resumeWaitCycle
Wait cycle for idle state before suspended command sequence resume, timeout after ahbBusTimeoutCycle AHB clock cycles.

flexspi_ahbBuffer_config_t buffer[FSL_FEATURE_FLEXSPI_AHB_BUFFER_COUNTn(0)]
AHB buffer size.

bool enableClearAHBBufferOpt
Enable/disable automatically clean AHB RX Buffer and TX Buffer when FLEXSPI returns STOP mode ACK.

bool enableReadAddressOpt
Enable/disable remove AHB read burst start address alignment limitation. when enable, there is no AHB read burst start address alignment limitation.

bool enableAHBPrefetch
Enable/disable AHB read prefetch feature, when enabled, FLEXSPI will fetch more data than current AHB burst.

bool enableAHBBufferable
Enable/disable AHB bufferable write access support, when enabled, FLEXSPI return before waiting for command execution finished.

bool enableAHBCachable
Enable AHB bus cachable read access support.

2.25 FLEXSPI eDMA Driver

void FLEXSPI_TransferCreateHandleEDMA(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle, *flexspi_edma_callback_t* callback, void *userData, *edma_handle_t* *txDmaHandle, *edma_handle_t* *rxDmaHandle)

Initializes the FLEXSPI handle for transfer which is used in transactional functions and set the callback.

Parameters

- base – FLEXSPI peripheral base address
- handle – Pointer to flexspi_edma_handle_t structure
- callback – FLEXSPI callback, NULL means no callback.
- userData – User callback function data.
- txDmaHandle – User requested DMA handle for TX DMA transfer.
- rxDmaHandle – User requested DMA handle for RX DMA transfer.

void FLEXSPI_TransferUpdateSizeEDMA(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle, *flexspi_edma_transfer_nsize_t* nsize)

Update FLEXSPI EDMA transfer source data transfer size(SSIZE) and destination data transfer size(DSIZE).

See also:

flexspi_edma_transfer_nsize_t .

Parameters

- base – FLEXSPI peripheral base address
- handle – Pointer to flexspi_edma_handle_t structure
- nsize – FLEXSPI DMA transfer data transfer size(SSIZE/DSIZE), by default the size is kFLEXPSI_EDMAnSize1Bytes(one byte).

status_t FLEXSPI_TransferEDMA(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle, *flexspi_transfer_t* *xfer)

Transfers FLEXSPI data using an eDMA non-blocking method.

This function writes/receives data to/from the FLEXSPI transmit/receive FIFO. This function is non-blocking.

Parameters

- base – FLEXSPI peripheral base address.
- handle – Pointer to flexspi_edma_handle_t structure
- xfer – FLEXSPI transfer structure.

Return values

- kStatus_FLEXSPI_Busy – FLEXSPI is busy transfer.
- kStatus_InvalidArgument – The watermark configuration is invalid, the watermark should be power of 2 to do successfully EDMA transfer.
- kStatus_Success – FLEXSPI successfully start edma transfer.

void FLEXSPI_TransferAbortEDMA(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle)

Aborts the transfer data using eDMA.

This function aborts the transfer data using eDMA.

Parameters

- base – FLEXSPI peripheral base address.
- handle – Pointer to flexspi_edma_handle_t structure

status_t FLEXSPI_TransferGetTransferCountEDMA(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle, size_t *count)

Gets the transferred counts of transfer.

Parameters

- base – FLEXSPI peripheral base address.
- handle – Pointer to flexspi_edma_handle_t structure.
- count – Bytes transfer.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

FSL_FLEXSPI_EDMA_DRIVER_VERSION

FLEXSPI EDMA driver version.

FLEXSPI EDMA driver.

FSL_FLEXSPI_EDMA_DRIVER_VERSION

FLEXSPI EDMA driver.

enum _flexspi_edma_ntransfer_size

eDMA transfer configuration

Values:

enumerator kFLEXPSI_EDMAnSize1Bytes

Source/Destination data transfer size is 1 byte every time

enumerator kFLEXPSI_EDMAnSize2Bytes
Source/Destination data transfer size is 2 bytes every time

enumerator kFLEXPSI_EDMAnSize4Bytes
Source/Destination data transfer size is 4 bytes every time

enumerator kFLEXPSI_EDMAnSize8Bytes
Source/Destination data transfer size is 8 bytes every time

enumerator kFLEXPSI_EDMAnSize32Bytes
Source/Destination data transfer size is 32 bytes every time

enum _flexspi_edma_ntransfer_size
eDMA transfer configuration

Values:

enumerator kFLEXPSI_EDMAnSize1Bytes
Source/Destination data transfer size is 1 byte every time

enumerator kFLEXPSI_EDMAnSize2Bytes
Source/Destination data transfer size is 2 bytes every time

enumerator kFLEXPSI_EDMAnSize4Bytes
Source/Destination data transfer size is 4 bytes every time

enumerator kFLEXPSI_EDMAnSize8Bytes
Source/Destination data transfer size is 8 bytes every time

enumerator kFLEXPSI_EDMAnSize32Bytes
Source/Destination data transfer size is 32 bytes every time

typedef struct *_flexspi_edma_handle* flexspi_edma_handle_t

typedef void (*flexspi_edma_callback_t)(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle, *status_t* status, void *userData)
FLEXSPI eDMA transfer callback function for finish and error.

typedef enum *_flexspi_edma_ntransfer_size* flexspi_edma_transfer_nsize_t
eDMA transfer configuration

typedef struct *_flexspi_edma_handle* flexspi_edma_handle_t

typedef void (*flexspi_edma_callback_t)(FLEXSPI_Type *base, *flexspi_edma_handle_t* *handle, *status_t* status, void *userData)
FLEXSPI eDMA transfer callback function for finish and error.

typedef enum *_flexspi_edma_ntransfer_size* flexspi_edma_transfer_nsize_t
eDMA transfer configuration

struct _flexspi_edma_handle
#include <fsl_flexspi_edma.h> FLEXSPI DMA transfer handle, users should not touch the content of the handle.

Public Members

edma_handle_t *txDmaHandle
eDMA handler for FLEXSPI Tx.

edma_handle_t *rxDmaHandle
eDMA handler for FLEXSPI Rx.

size_t transferSize
Bytes need to transfer.

flexspi_edma_transfer_nsize_t nsize
eDMA SSIZE/DSIZE in each transfer.

uint8_t nbytes
eDMA minor byte transfer count initially configured.

uint8_t count
The transfer data count in a DMA request.

uint32_t state
Internal state for FLEXSPI eDMA transfer.

flexspi_edma_callback_t completionCallback
A callback function called after the eDMA transfer is finished.

void *userData
User callback parameter

2.26 I3C: I3C Driver

FSL_I3C_DRIVER_VERSION
I3C driver version.

I3C status return codes.

Values:

enumerator kStatus_I3C_Busy
The master is already performing a transfer.

enumerator kStatus_I3C_Idle
The slave driver is idle.

enumerator kStatus_I3C_Nak
The slave device sent a NAK in response to an address.

enumerator kStatus_I3C_WriteAbort
The slave device sent a NAK in response to a write.

enumerator kStatus_I3C_Term
The master terminates slave read.

enumerator kStatus_I3C_HdrParityError
Parity error from DDR read.

enumerator kStatus_I3C_CrcError
CRC error from DDR read.

enumerator kStatus_I3C_ReadFifoError
Read from M/SRDATAB register when FIFO empty.

enumerator kStatus_I3C_WriteFifoError
Write to M/SWDATAB register when FIFO full.

enumerator kStatus_I3C_MsgError
Message SDR/DDR mismatch or read/write message in wrong state

enumerator kStatus_I3C_InvalidReq
Invalid use of request.

enumerator kStatus_I3C_Timeout
The module has stalled too long in a frame.

enumerator kStatus_I3C_SlaveCountExceed
The I3C slave count has exceed the definition in I3C_MAX_DEVCNT.

enumerator kStatus_I3C_IBIWon
The I3C slave event IBI or MR or HJ won the arbitration on a header address.

enumerator kStatus_I3C_OverrunError
Slave internal from-bus buffer/FIFO overrun.

enumerator kStatus_I3C_UnderrunError
Slave internal to-bus buffer/FIFO underrun

enumerator kStatus_I3C_UnderrunNak
Slave internal from-bus buffer/FIFO underrun and NACK error

enumerator kStatus_I3C_InvalidStart
Slave invalid start flag

enumerator kStatus_I3C_SdrParityError
SDR parity error

enumerator kStatus_I3C_S0S1Error
S0 or S1 error

enum _i3c_hdr_mode
I3C HDR modes.

Values:

enumerator kI3C_HDRModeNone

enumerator kI3C_HDRModeDDR

enumerator kI3C_HDRModeTSP

enumerator kI3C_HDRModeTSL

typedef enum *_i3c_hdr_mode* i3c_hdr_mode_t
I3C HDR modes.

typedef struct *_i3c_device_info* i3c_device_info_t
I3C device information.

I3C_RETRY_TIMES
Max loops to wait for I3C operation status complete.

This is the maximum number of loops to wait for I3C operation status complete. If set to 0, it will wait indefinitely.

I3C_MAX_DEVCNT

I3C_IBI_BUFF_SIZE

struct i3c_device_info
#include <fsl_i3c.h> I3C device information.

Public Members

uint8_t dynamicAddr
Device dynamic address.

uint8_t staticAddr
Static address.

uint8_t dcr
Device characteristics register information.

uint8_t bcr
Bus characteristics register information.

uint16_t vendorID
Device vendor ID(manufacture ID).

uint32_t partNumber
Device part number info

uint16_t maxReadLength
Maximum read length.

uint16_t maxWriteLength
Maximum write length.

uint8_t hdrMode
Support hdr mode, could be OR logic in i3c_hdr_mode.

2.27 I3C Common Driver

typedef struct *_i3c_config* i3c_config_t
Structure with settings to initialize the I3C module, could both initialize master and slave functionality.

This structure holds configuration settings for the I3C peripheral. To initialize this structure to reasonable defaults, call the I3C_GetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

uint32_t I3C_GetInstance(I3C_Type *base)
Get which instance current I3C is used.

Parameters

- base – The I3C peripheral base address.

void I3C_GetDefaultConfig(*i3c_config_t* *config)
Provides a default configuration for the I3C peripheral, the configuration covers both master functionality and slave functionality.

This function provides the following default configuration for I3C:

```
config->enableMaster                = kI3C_MasterCapable;
config->disableTimeout              = false;
config->hKeep                       = kI3C_MasterHighKeeperNone;
config->enableOpenDrainStop         = true;
config->enableOpenDrainHigh         = true;
config->baudRate_Hz.i2cBaud         = 400000U;
config->baudRate_Hz.i3cPushPullBaud = 12500000U;
```

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```
config->baudRate_Hz.i3cOpenDrainBaud = 2500000U;
config->masterDynamicAddress         = 0x0AU;
config->slowClock_Hz                 = 1000000U;
config->enableSlave                  = true;
config->vendorID                     = 0x11BU;
config->enableRandomPart             = false;
config->partNumber                   = 0;
config->dcr                          = 0;
config->bcr = 0;
config->hdrMode             = (uint8_t)kI3C_HDRModeDDR;
config->nakAllRequest       = false;
config->ignoreS0S1Error     = false;
config->offline             = false;
config->matchSlaveStartStop = false;
```

After calling this function, you can override any settings in order to customize the configuration, prior to initializing the common I3C driver with I3C_Init().

Parameters

- config – **[out]** User provided configuration structure for default values. Refer to i3c_config_t.

void I3C_Init(I3C_Type *base, const *i3c_config_t* *config, uint32_t sourceClock_Hz)

Initializes the I3C peripheral. This function enables the peripheral clock and initializes the I3C peripheral as described by the user provided configuration. This will initialize both the master peripheral and slave peripheral so that I3C module could work as pure master, pure slave or secondary master, etc. A software reset is performed prior to configuration.

Parameters

- base – The I3C peripheral base address.
- config – User provided peripheral configuration. Use I3C_GetDefaultConfig() to get a set of defaults that you can override.
- sourceClock_Hz – Frequency in Hertz of the I3C functional clock. Used to calculate the baud rate divisors, filter widths, and timeout periods.

struct _i3c_config

#include <fsl_i3c.h> Structure with settings to initialize the I3C module, could both initialize master and slave functionality.

This structure holds configuration settings for the I3C peripheral. To initialize this structure to reasonable defaults, call the I3C_GetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

Public Members

i3c_master_enable_t enableMaster

Enable master mode.

bool disableTimeout

Whether to disable timeout to prevent the ERRWARN.

i3c_master_hkeep_t hKeep

High keeper mode setting.

bool enableOpenDrainStop

Whether to emit open-drain speed STOP.

bool enableOpenDrainHigh
: Enable Open-Drain High to be 1 PPBAUD count for i3c messages, or 1 ODBAUD.

i3c_baudrate_hz_t baudRate_Hz
: Desired baud rate settings.

i3c_start_scl_delay_t startSclDelay
: I3C SCL delay after START.

i3c_start_scl_delay_t restartSclDelay
: I3C SCL delay after Repeated START.

uint8_t masterDynamicAddress
: Main master dynamic address configuration.

uint32_t maxWriteLength
: Maximum write length.

uint32_t maxReadLength
: Maximum read length.

bool enableSlave
: Whether to enable slave.

uint8_t staticAddr
: Static address.

uint16_t vendorID
: Device vendor ID(manufacture ID).

uint32_t partNumber
: Device part number info

uint8_t dcr
: Device characteristics register information.

uint8_t bcr
: Bus characteristics register information.

uint8_t hdrMode
: Support hdr mode, could be OR logic in enumeration:i3c_hdr_mode_t.

bool nakAllRequest
: Whether to reply NAK to all requests except broadcast CCC.

bool ignoreS0S1Error
: Whether to ignore S0/S1 error in SDR mode.

bool offline
: Whether to wait 60 us of bus quiet or HDR request to ensure slave track SDR mode safely.

bool matchSlaveStartStop
: Whether to assert start/stop status only the time slave is addressed.

2.28 I3C Master Driver

void I3C_MasterGetDefaultConfig(*i3c_master_config_t* *masterConfig)

Provides a default configuration for the I3C master peripheral.

This function provides the following default configuration for the I3C master peripheral:

```
masterConfig->enableMaster            = kI3C_MasterOn;
masterConfig->disableTimeout          = false;
masterConfig->hKeep                   = kI3C_MasterHighKeeperNone;
masterConfig->enableOpenDrainStop     = true;
masterConfig->enableOpenDrainHigh     = true;
masterConfig->baudRate_Hz             = 100000U;
masterConfig->busType                 = kI3C_TypeI2C;
```

After calling this function, you can override any settings in order to customize the configuration, prior to initializing the master driver with I3C_MasterInit().

Parameters

- masterConfig – **[out]** User provided configuration structure for default values. Refer to i3c_master_config_t.

void I3C_MasterInit(I3C_Type *base, const *i3c_master_config_t* *masterConfig, uint32_t sourceClock_Hz)

Initializes the I3C master peripheral.

This function enables the peripheral clock and initializes the I3C master peripheral as described by the user provided configuration. A software reset is performed prior to configuration.

Parameters

- base – The I3C peripheral base address.
- masterConfig – User provided peripheral configuration. Use I3C_MasterGetDefaultConfig() to get a set of defaults that you can override.
- sourceClock_Hz – Frequency in Hertz of the I3C functional clock. Used to calculate the baud rate divisors, filter widths, and timeout periods.

void I3C_MasterDeinit(I3C_Type *base)

Deinitializes the I3C master peripheral.

This function disables the I3C master peripheral and gates the clock. It also performs a software reset to restore the peripheral to reset conditions.

Parameters

- base – The I3C peripheral base address.

status_t I3C_MasterCheckAndClearError(I3C_Type *base, uint32_t status)

status_t I3C_MasterWaitForCtrlDone(I3C_Type *base, bool waitIdle)

status_t I3C_CheckForBusyBus(I3C_Type *base)

static inline void I3C_MasterEnable(I3C_Type *base, *i3c_master_enable_t* enable)

Set I3C module master mode.

Parameters

- base – The I3C peripheral base address.
- enable – Enable master mode.

void I3C_SlaveGetDefaultConfig(*i3c_slave_config_t* *slaveConfig)

Provides a default configuration for the I3C slave peripheral.

This function provides the following default configuration for the I3C slave peripheral:

```
slaveConfig->enableslave              = true;
```

After calling this function, you can override any settings in order to customize the configuration, prior to initializing the slave driver with I3C_SlaveInit().

Parameters

- slaveConfig – **[out]** User provided configuration structure for default values. Refer to i3c_slave_config_t.

void I3C_SlaveInit(I3C_Type *base, const *i3c_slave_config_t* *slaveConfig, uint32_t slowClock_Hz)

Initializes the I3C slave peripheral.

This function enables the peripheral clock and initializes the I3C slave peripheral as described by the user provided configuration.

Parameters

- base – The I3C peripheral base address.
- slaveConfig – User provided peripheral configuration. Use I3C_SlaveGetDefaultConfig() to get a set of defaults that you can override.
- slowClock_Hz – Frequency in Hertz of the I3C slow clock. Used to calculate the bus match condition values. If FSL_FEATURE_I3C_HAS_NO_SCONFIG_BAMATCH defines as 1, this parameter is useless.

void I3C_SlaveDeinit(I3C_Type *base)

Deinitializes the I3C slave peripheral.

This function disables the I3C slave peripheral and gates the clock.

Parameters

- base – The I3C peripheral base address.

static inline void I3C_SlaveEnable(I3C_Type *base, bool isEnable)

Enable/Disable Slave.

Parameters

- base – The I3C peripheral base address.
- isEnable – Enable or disable.

static inline uint32_t I3C_MasterGetStatusFlags(I3C_Type *base)

Gets the I3C master status flags.

A bit mask with the state of all I3C master status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_i3c_master_flags

Parameters

- base – The I3C peripheral base address.

Returns

State of the status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void I3C_MasterClearStatusFlags(I3C_Type *base, uint32_t statusMask)

Clears the I3C master status flag state.

The following status register flags can be cleared:

- kI3C_MasterSlaveStartFlag
- kI3C_MasterControlDoneFlag
- kI3C_MasterCompleteFlag
- kI3C_MasterArbitrationWonFlag
- kI3C_MasterSlave2MasterFlag

Attempts to clear other flags has no effect.

See also:

_i3c_master_flags.

Parameters

- base – The I3C peripheral base address.
- statusMask – A bitmask of status flags that are to be cleared. The mask is composed of _i3c_master_flags enumerators OR'd together. You may pass the result of a previous call to I3C_MasterGetStatusFlags().

static inline uint32_t I3C_MasterGetErrorStatusFlags(I3C_Type *base)

Gets the I3C master error status flags.

A bit mask with the state of all I3C master error status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_i3c_master_error_flags

Parameters

- base – The I3C peripheral base address.

Returns

State of the error status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void I3C_MasterClearErrorStatusFlags(I3C_Type *base, uint32_t statusMask)

Clears the I3C master error status flag state.

See also:

_i3c_master_error_flags.

Parameters

- base – The I3C peripheral base address.
- statusMask – A bitmask of error status flags that are to be cleared. The mask is composed of _i3c_master_error_flags enumerators OR'd together. You may pass the result of a previous call to I3C_MasterGetStatusFlags().

i3c_master_state_t I3C_MasterGetState(I3C_Type *base)

Gets the I3C master state.

Parameters

- base – The I3C peripheral base address.

Returns

I3C master state.

static inline uint32_t I3C_SlaveGetStatusFlags(I3C_Type *base)

Gets the I3C slave status flags.

A bit mask with the state of all I3C slave status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_i3c_slave_flags

Parameters

- base – The I3C peripheral base address.

Returns

State of the status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void I3C_SlaveClearStatusFlags(I3C_Type *base, uint32_t statusMask)

Clears the I3C slave status flag state.

The following status register flags can be cleared:

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag

Attempts to clear other flags has no effect.

See also:

_i3c_slave_flags.

Parameters

- base – The I3C peripheral base address.
- statusMask – A bitmask of status flags that are to be cleared. The mask is composed of _i3c_slave_flags enumerators OR'd together. You may pass the result of a previous call to I3C_SlaveGetStatusFlags().

static inline uint32_t I3C_SlaveGetErrorStatusFlags(I3C_Type *base)

Gets the I3C slave error status flags.

A bit mask with the state of all I3C slave error status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_i3c_slave_error_flags

Parameters

- base – The I3C peripheral base address.

Returns

State of the error status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void I3C_SlaveClearErrorStatusFlags(I3C_Type *base, uint32_t statusMask)

Clears the I3C slave error status flag state.

See also:

_i3c_slave_error_flags.

Parameters

- base – The I3C peripheral base address.
- statusMask – A bitmask of error status flags that are to be cleared. The mask is composed of _i3c_slave_error_flags enumerators OR'd together. You may pass the result of a previous call to I3C_SlaveGetErrorStatusFlags().

i3c_slave_activity_state_t I3C_SlaveGetActivityState(I3C_Type *base)

Gets the I3C slave state.

Parameters

- base – The I3C peripheral base address.

Returns

I3C slave activity state, refer i3c_slave_activity_state_t.

status_t I3C_SlaveCheckAndClearError(I3C_Type *base, uint32_t status)

static inline void I3C_MasterEnableInterrupts(I3C_Type *base, uint32_t interruptMask)

Enables the I3C master interrupt requests.

All flags except kI3C_MasterBetweenFlag and kI3C_MasterNackDetectFlag can be enabled as interrupts.

Parameters

- base – The I3C peripheral base address.
- interruptMask – Bit mask of interrupts to enable. See _i3c_master_flags for the set of constants that should be OR'd together to form the bit mask.

static inline void I3C_MasterDisableInterrupts(I3C_Type *base, uint32_t interruptMask)

Disables the I3C master interrupt requests.

All flags except kI3C_MasterBetweenFlag and kI3C_MasterNackDetectFlag can be enabled as interrupts.

Parameters

- base – The I3C peripheral base address.
- interruptMask – Bit mask of interrupts to disable. See _i3c_master_flags for the set of constants that should be OR'd together to form the bit mask.

static inline uint32_t I3C_MasterGetEnabledInterrupts(I3C_Type *base)

Returns the set of currently enabled I3C master interrupt requests.

Parameters

- base – The I3C peripheral base address.

Returns

A bitmask composed of _i3c_master_flags enumerators OR'd together to indicate the set of enabled interrupts.

static inline uint32_t I3C_MasterGetPendingInterrupts(I3C_Type *base)

Returns the set of pending I3C master interrupt requests.

Parameters

- base – The I3C peripheral base address.

Returns

A bitmask composed of _i3c_master_flags enumerators OR'd together to indicate the set of pending interrupts.

static inline void I3C_SlaveEnableInterrupts(I3C_Type *base, uint32_t interruptMask)

Enables the I3C slave interrupt requests.

Only below flags can be enabled as interrupts.

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag
- kI3C_SlaveRxReadyFlag
- kI3C_SlaveTxReadyFlag
- kI3C_SlaveDynamicAddrChangedFlag
- kI3C_SlaveReceivedCCCFlag
- kI3C_SlaveErrorFlag
- kI3C_SlaveHDRCommandMatchFlag
- kI3C_SlaveCCCHandledFlag
- kI3C_SlaveEventSentFlag

Parameters

- base – The I3C peripheral base address.
- interruptMask – Bit mask of interrupts to enable. See _i3c_slave_flags for the set of constants that should be OR'd together to form the bit mask.

static inline void I3C_SlaveDisableInterrupts(I3C_Type *base, uint32_t interruptMask)

Disables the I3C slave interrupt requests.

Only below flags can be disabled as interrupts.

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag

- kI3C_SlaveBusStopFlag
- kI3C_SlaveRxReadyFlag
- kI3C_SlaveTxReadyFlag
- kI3C_SlaveDynamicAddrChangedFlag
- kI3C_SlaveReceivedCCCFlag
- kI3C_SlaveErrorFlag
- kI3C_SlaveHDRCommandMatchFlag
- kI3C_SlaveCCCHandledFlag
- kI3C_SlaveEventSentFlag

Parameters

- base – The I3C peripheral base address.
- interruptMask – Bit mask of interrupts to disable. See _i3c_slave_flags for the set of constants that should be OR'd together to form the bit mask.

static inline uint32_t I3C_SlaveGetEnabledInterrupts(I3C_Type *base)

Returns the set of currently enabled I3C slave interrupt requests.

Parameters

- base – The I3C peripheral base address.

Returns

A bitmask composed of _i3c_slave_flags enumerators OR'd together to indicate the set of enabled interrupts.

static inline uint32_t I3C_SlaveGetPendingInterrupts(I3C_Type *base)

Returns the set of pending I3C slave interrupt requests.

Parameters

- base – The I3C peripheral base address.

Returns

A bitmask composed of _i3c_slave_flags enumerators OR'd together to indicate the set of pending interrupts.

static inline void I3C_MasterEnableDMA(I3C_Type *base, bool enableTx, bool enableRx, uint32_t width)

Enables or disables I3C master DMA requests.

Parameters

- base – The I3C peripheral base address.
- enableTx – Enable flag for transmit DMA request. Pass true for enable, false for disable.
- enableRx – Enable flag for receive DMA request. Pass true for enable, false for disable.
- width – DMA read/write unit in bytes.

static inline uint32_t I3C_MasterGetTxFifoAddress(I3C_Type *base, uint32_t width)

Gets I3C master transmit data register address for DMA transfer.

Parameters

- base – The I3C peripheral base address.
- width – DMA read/write unit in bytes.

Returns
The I3C Master Transmit Data Register address.

static inline uint32_t I3C_MasterGetRxFifoAddress(I3C_Type *base, uint32_t width)

Gets I3C master receive data register address for DMA transfer.

Parameters

- base – The I3C peripheral base address.
- width – DMA read/write unit in bytes.

Returns
The I3C Master Receive Data Register address.

static inline void I3C_SlaveEnableDMA(I3C_Type *base, bool enableTx, bool enableRx, uint32_t width)

Enables or disables I3C slave DMA requests.

Parameters

- base – The I3C peripheral base address.
- enableTx – Enable flag for transmit DMA request. Pass true for enable, false for disable.
- enableRx – Enable flag for receive DMA request. Pass true for enable, false for disable.
- width – DMA read/write unit in bytes.

static inline uint32_t I3C_SlaveGetTxFifoAddress(I3C_Type *base, uint32_t width)

Gets I3C slave transmit data register address for DMA transfer.

Parameters

- base – The I3C peripheral base address.
- width – DMA read/write unit in bytes.

Returns
The I3C Slave Transmit Data Register address.

static inline uint32_t I3C_SlaveGetRxFifoAddress(I3C_Type *base, uint32_t width)

Gets I3C slave receive data register address for DMA transfer.

Parameters

- base – The I3C peripheral base address.
- width – DMA read/write unit in bytes.

Returns
The I3C Slave Receive Data Register address.

static inline void I3C_MasterSetWatermarks(I3C_Type *base, *i3c_tx_trigger_level_t* txLvl, *i3c_rx_trigger_level_t* rxLvl, bool flushTx, bool flushRx)

Sets the watermarks for I3C master FIFOs.

Parameters

- base – The I3C peripheral base address.
- txLvl – Transmit FIFO watermark level. The kI3C_MasterTxReadyFlag flag is set whenever the number of words in the transmit FIFO reaches *txLvl*.
- rxLvl – Receive FIFO watermark level. The kI3C_MasterRxReadyFlag flag is set whenever the number of words in the receive FIFO reaches *rxLvl*.

- flushTx – true if TX FIFO is to be cleared, otherwise TX FIFO remains unchanged.
- flushRx – true if RX FIFO is to be cleared, otherwise RX FIFO remains unchanged.

static inline void I3C_MasterGetFifoCounts(I3C_Type *base, size_t *rxCount, size_t *txCount)

Gets the current number of bytes in the I3C master FIFOs.

Parameters

- base – The I3C peripheral base address.
- txCount – **[out]** Pointer through which the current number of bytes in the transmit FIFO is returned. Pass NULL if this value is not required.
- rxCount – **[out]** Pointer through which the current number of bytes in the receive FIFO is returned. Pass NULL if this value is not required.

static inline void I3C_SlaveSetWatermarks(I3C_Type *base, *i3c_tx_trigger_level_t* txLvl, *i3c_rx_trigger_level_t* rxLvl, bool flushTx, bool flushRx)

Sets the watermarks for I3C slave FIFOs.

Parameters

- base – The I3C peripheral base address.
- txLvl – Transmit FIFO watermark level. The kI3C_SlaveTxReadyFlag flag is set whenever the number of words in the transmit FIFO reaches *txLvl*.
- rxLvl – Receive FIFO watermark level. The kI3C_SlaveRxReadyFlag flag is set whenever the number of words in the receive FIFO reaches *rxLvl*.
- flushTx – true if TX FIFO is to be cleared, otherwise TX FIFO remains unchanged.
- flushRx – true if RX FIFO is to be cleared, otherwise RX FIFO remains unchanged.

static inline void I3C_SlaveGetFifoCounts(I3C_Type *base, size_t *rxCount, size_t *txCount)

Gets the current number of bytes in the I3C slave FIFOs.

Parameters

- base – The I3C peripheral base address.
- txCount – **[out]** Pointer through which the current number of bytes in the transmit FIFO is returned. Pass NULL if this value is not required.
- rxCount – **[out]** Pointer through which the current number of bytes in the receive FIFO is returned. Pass NULL if this value is not required.

void I3C_MasterSetBaudRate(I3C_Type *base, const *i3c_baudrate_hz_t* *baudRate_Hz, uint32_t sourceClock_Hz)

Sets the I3C bus frequency for master transactions.

The I3C master is automatically disabled and re-enabled as necessary to configure the baud rate. Do not call this function during a transfer, or the transfer is aborted.

Parameters

- base – The I3C peripheral base address.
- baudRate_Hz – Pointer to structure of requested bus frequency in Hertz.
- sourceClock_Hz – I3C functional clock frequency in Hertz.

static inline bool I3C_MasterGetBusIdleState(I3C_Type *base)

Returns whether the bus is idle.

Requires the master mode to be enabled.

Parameters

- base – The I3C peripheral base address.

Return values

- true – Bus is busy.
- false – Bus is idle.

status_t I3C_MasterStartWithRxSize(I3C_Type *base, *i3c_bus_type_t* type, uint8_t address, *i3c_direction_t* dir, uint8_t rxSize)

Sends a START signal and slave address on the I2C/I3C bus, receive size is also specified in the call.

This function is used to initiate a new master mode transfer. First, the bus state is checked to ensure that another master is not occupying the bus. Then a START signal is transmitted, followed by the 7-bit address specified in the a address parameter. Note that this function does not actually wait until the START and address are successfully sent on the bus before returning.

Parameters

- base – The I3C peripheral base address.
- type – The bus type to use in this transaction.
- address – 7-bit slave device address, in bits [6:0].
- dir – Master transfer direction, either kI3C_Read or kI3C_Write. This parameter is used to set the R/w bit (bit 0) in the transmitted slave address.
- rxSize – Read terminate size for the followed read transfer, limit to 255 bytes.

Return values

- kStatus_Success – START signal and address were successfully enqueued in the transmit FIFO.
- kStatus_I3C_Busy – Another master is currently utilizing the bus.

status_t I3C_MasterStart(I3C_Type *base, *i3c_bus_type_t* type, uint8_t address, *i3c_direction_t* dir)

Sends a START signal and slave address on the I2C/I3C bus.

This function is used to initiate a new master mode transfer. First, the bus state is checked to ensure that another master is not occupying the bus. Then a START signal is transmitted, followed by the 7-bit address specified in the *address* parameter. Note that this function does not actually wait until the START and address are successfully sent on the bus before returning.

Parameters

- base – The I3C peripheral base address.
- type – The bus type to use in this transaction.
- address – 7-bit slave device address, in bits [6:0].
- dir – Master transfer direction, either kI3C_Read or kI3C_Write. This parameter is used to set the R/w bit (bit 0) in the transmitted slave address.

Return values

- kStatus_Success – START signal and address were successfully enqueued in the transmit FIFO.
- kStatus_I3C_Busy – Another master is currently utilizing the bus.

status_t I3C_MasterRepeatedStartWithRxSize(I3C_Type *base, *i3c_bus_type_t* type, uint8_t address, *i3c_direction_t* dir, uint8_t rxSize)

Sends a repeated START signal and slave address on the I2C/I3C bus, receive size is also specified in the call.

This function is used to send a Repeated START signal when a transfer is already in progress. Like I3C_MasterStart(), it also sends the specified 7-bit address. Call this API also configures the read terminate size for the following read transfer. For example, set the rxSize = 2, the following read transfer will be terminated after two bytes of data received. Write transfer will not be affected by the rxSize configuration.

Note: This function exists primarily to maintain compatible APIs between I3C and I2C drivers, as well as to better document the intent of code that uses these APIs.

Parameters

- base – The I3C peripheral base address.
- type – The bus type to use in this transaction.
- address – 7-bit slave device address, in bits [6:0].
- dir – Master transfer direction, either kI3C_Read or kI3C_Write. This parameter is used to set the R/w bit (bit 0) in the transmitted slave address.
- rxSize – Read terminate size for the followed read transfer, limit to 255 bytes.

Return values

kStatus_Success – Repeated START signal and address were successfully enqueued in the transmit FIFO.

static inline *status_t* I3C_MasterRepeatedStart(I3C_Type *base, *i3c_bus_type_t* type, uint8_t address, *i3c_direction_t* dir)

Sends a repeated START signal and slave address on the I2C/I3C bus.

This function is used to send a Repeated START signal when a transfer is already in progress. Like I3C_MasterStart(), it also sends the specified 7-bit address.

Note: This function exists primarily to maintain compatible APIs between I3C and I2C drivers, as well as to better document the intent of code that uses these APIs.

Parameters

- base – The I3C peripheral base address.
- type – The bus type to use in this transaction.
- address – 7-bit slave device address, in bits [6:0].
- dir – Master transfer direction, either kI3C_Read or kI3C_Write. This parameter is used to set the R/w bit (bit 0) in the transmitted slave address.

Return values

kStatus_Success – Repeated START signal and address were successfully enqueued in the transmit FIFO.

status_t I3C_MasterSend(I3C_Type *base, const void *txBuff, size_t txSize, uint32_t flags)

Performs a polling send transfer on the I2C/I3C bus.

Sends up to *txSize* number of bytes to the previously addressed slave device. The slave may reply with a NAK to any byte in order to terminate the transfer early. If this happens, this function returns kStatus_I3C_Nak.

Parameters

- base – The I3C peripheral base address.
- txBuff – The pointer to the data to be transferred.
- txSize – The length in bytes of the data to be transferred.
- flags – Bit mask of options for the transfer. See enumeration _i3c_master_transfer_flags for available options.

Return values

- kStatus_Success – Data was sent successfully.
- kStatus_I3C_Busy – Another master is currently utilizing the bus.
- kStatus_I3C_Timeout – The module has stalled too long in a frame.
- kStatus_I3C_Nak – The slave device sent a NAK in response to an address.
- kStatus_I3C_WriteAbort – The slave device sent a NAK in response to a write.
- kStatus_I3C_MsgError – Message SDR/DDR mismatch or read/write message in wrong state.
- kStatus_I3C_WriteFifoError – Write to M/SWDATAB register when FIFO full.
- kStatus_I3C_InvalidReq – Invalid use of request.

status_t I3C_MasterReceive(I3C_Type *base, void *rxBuff, size_t rxSize, uint32_t flags)

Performs a polling receive transfer on the I2C/I3C bus.

Parameters

- base – The I3C peripheral base address.
- rxBuff – The pointer to the data to be transferred.
- rxSize – The length in bytes of the data to be transferred.
- flags – Bit mask of options for the transfer. See enumeration _i3c_master_transfer_flags for available options.

Return values

- kStatus_Success – Data was received successfully.
- kStatus_I3C_Busy – Another master is currently utilizing the bus.
- kStatus_I3C_Timeout – The module has stalled too long in a frame.
- kStatus_I3C_Term – The master terminates slave read.
- kStatus_I3C_HdrParityError – Parity error from DDR read.
- kStatus_I3C_CrcError – CRC error from DDR read.
- kStatus_I3C_MsgError – Message SDR/DDR mismatch or read/write message in wrong state.
- kStatus_I3C_ReadFifoError – Read from M/SRDATAB register when FIFO empty.

- kStatus_I3C_InvalidReq – Invalid use of request.

status_t I3C_MasterStop(I3C_Type *base)

Sends a STOP signal on the I2C/I3C bus.

This function does not return until the STOP signal is seen on the bus, or an error occurs.

Parameters

- base – The I3C peripheral base address.

Return values

- kStatus_Success – The STOP signal was successfully sent on the bus and the transaction terminated.
- kStatus_I3C_Busy – Another master is currently utilizing the bus.
- kStatus_I3C_Timeout – The module has stalled too long in a frame.
- kStatus_I3C_InvalidReq – Invalid use of request.

void I3C_MasterEmitRequest(I3C_Type *base, *i3c_bus_request_t* masterReq)

I3C master emit request.

Parameters

- base – The I3C peripheral base address.
- masterReq – I3C master request of type i3c_bus_request_t

static inline void I3C_MasterEmitIBIResponse(I3C_Type *base, *i3c_ibi_response_t* ibiResponse)

I3C master emit request.

Parameters

- base – The I3C peripheral base address.
- ibiResponse – I3C master emit IBI response of type i3c_ibi_response_t

void I3C_MasterRegisterIBI(I3C_Type *base, *i3c_register_ibi_addr_t* *ibiRule)

I3C master register IBI rule.

Parameters

- base – The I3C peripheral base address.
- ibiRule – Pointer to ibi rule description of type i3c_register_ibi_addr_t

void I3C_MasterGetIBIRules(I3C_Type *base, *i3c_register_ibi_addr_t* *ibiRule)

I3C master get IBI rule.

Parameters

- base – The I3C peripheral base address.
- ibiRule – Pointer to store the read out ibi rule description.

i3c_ibi_type_t I3C_GetIBIType(I3C_Type *base)

I3C master get IBI Type.

Parameters

- base – The I3C peripheral base address.

Return values

i3c_ibi_type_t – Type of i3c_ibi_type_t.

static inline uint8_t I3C_GetIBIAddress(I3C_Type *base)

I3C master get IBI Address.

Parameters

- base – The I3C peripheral base address.

Return values

The – 8-bit IBI address.

status_t I3C_MasterProcessDAASpecifiedBaudrate(I3C_Type *base, uint8_t *addressList, uint32_t count, *i3c_master_daa_baudrate_t* *daaBaudRate)

Performs a DAA in the i3c bus with specified temporary baud rate.

Parameters

- base – The I3C peripheral base address.
- addressList – The pointer for address list which is used to do DAA.
- count – The address count in the address list.
- daaBaudRate – The temporary baud rate in DAA process, NULL for using initial setting. The initial setting is set back between the completion of the DAA and the return of this function.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_I3C_Busy – Either another master is currently utilizing the bus, or a non-blocking transaction is already in progress.
- kStatus_I3C_SlaveCountExceed – The I3C slave count has exceed the definition in I3C_MAX_DEVCNT.

static inline *status_t* I3C_MasterProcessDAA(I3C_Type *base, uint8_t *addressList, uint32_t count)

Performs a DAA in the i3c bus.

Parameters

- base – The I3C peripheral base address.
- addressList – The pointer for address list which is used to do DAA.
- count – The address count in the address list. The initial setting is set back between the completion of the DAA and the return of this function.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_I3C_Busy – Either another master is currently utilizing the bus, or a non-blocking transaction is already in progress.
- kStatus_I3C_SlaveCountExceed – The I3C slave count has exceed the definition in I3C_MAX_DEVCNT.

i3c_device_info_t *I3C_MasterGetDeviceListAfterDAA(I3C_Type *base, uint8_t *count)

Get device information list after DAA process is done.

Parameters

- base – The I3C peripheral base address.
- count – **[out]** The pointer to store the available device count.

Returns

Pointer to the i3c_device_info_t array.

void I3C_MasterClearDeviceCount(I3C_Type *base)

Clear the global device count which represents current devices number on the bus. When user resets all dynamic addresses on the bus, should call this API.

Parameters

- base – The I3C peripheral base address.

status_t I3C_MasterTransferBlocking(I3C_Type *base, *i3c_master_transfer_t* *transfer)

Performs a master polling transfer on the I2C/I3C bus.

Note: The API does not return until the transfer succeeds or fails due to error happens during transfer.

Parameters

- base – The I3C peripheral base address.
- transfer – Pointer to the transfer structure.

Return values

- kStatus_Success – Data was received successfully.
- kStatus_I3C_Busy – Another master is currently utilizing the bus.
- kStatus_I3C_IBIWon – The I3C slave event IBI or MR or HJ won the arbitration on a header address.
- kStatus_I3C_Timeout – The module has stalled too long in a frame.
- kStatus_I3C_Nak – The slave device sent a NAK in response to an address.
- kStatus_I3C_WriteAbort – The slave device sent a NAK in response to a write.
- kStatus_I3C_Term – The master terminates slave read.
- kStatus_I3C_HdrParityError – Parity error from DDR read.
- kStatus_I3C_CrcError – CRC error from DDR read.
- kStatus_I3C_MsgError – Message SDR/DDR mismatch or read/write message in wrong state.
- kStatus_I3C_ReadFifoError – Read from M/SRDATAB register when FIFO empty.
- kStatus_I3C_WriteFifoError – Write to M/SWDATAB register when FIFO full.
- kStatus_I3C_InvalidReq – Invalid use of request.

status_t I3C_SlaveSend(I3C_Type *base, const void *txBuff, size_t txSize)

Performs a polling send transfer on the I3C bus.

Parameters

- base – The I3C peripheral base address.
- txBuff – The pointer to the data to be transferred.
- txSize – The length in bytes of the data to be transferred.

Returns

Error or success status returned by API.

status_t I3C_SlaveReceive(I3C_Type *base, void *rxBuff, size_t rxSize)

Performs a polling receive transfer on the I3C bus.

Parameters

- base – The I3C peripheral base address.
- rxBuff – The pointer to the data to be transferred.
- rxSize – The length in bytes of the data to be transferred.

Returns

Error or success status returned by API.

void I3C_MasterTransferCreateHandle(I3C_Type *base, *i3c_master_handle_t* *handle, const *i3c_master_transfer_callback_t* *callback, void *userData)

Creates a new handle for the I3C master non-blocking APIs.

The creation of a handle is for use with the non-blocking APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the I3C_MasterTransferAbort() API shall be called.

Note: The function also enables the NVIC IRQ for the input I3C. Need to notice that on some SoCs the I3C IRQ is connected to INTMUX, in this case user needs to enable the associated INTMUX IRQ in application.

Parameters

- base – The I3C peripheral base address.
- handle – **[out]** Pointer to the I3C master driver handle.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.

status_t I3C_MasterTransferNonBlocking(I3C_Type *base, *i3c_master_handle_t* *handle, *i3c_master_transfer_t* *transfer)

Performs a non-blocking transaction on the I2C/I3C bus.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.
- transfer – The pointer to the transfer descriptor.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_I3C_Busy – Either another master is currently utilizing the bus, or a non-blocking transaction is already in progress.

status_t I3C_MasterTransferGetCount(I3C_Type *base, *i3c_master_handle_t* *handle, size_t *count)

Returns number of bytes transferred so far.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.
- count – **[out]** Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_Success –
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

void I3C_MasterTransferAbort(I3C_Type *base, *i3c_master_handle_t* *handle)

Terminates a non-blocking I3C master transmission early.

Note: It is not safe to call this function from an IRQ handler that has a higher priority than the I3C peripheral's IRQ priority.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.

Return values

- kStatus_Success – A transaction was successfully aborted.
- kStatus_I3C_Idle – There is not a non-blocking transaction currently in progress.

void I3C_MasterTransferHandleIRQ(I3C_Type *base, void *intHandle)

Reusable routine to handle master interrupts.

Note: This function does not need to be called unless you are reimplementing the non-blocking API's interrupt handler routines to add special functionality.

Parameters

- base – The I3C peripheral base address.
- intHandle – Pointer to the I3C master driver handle.

enum _i3c_master_flags

I3C master peripheral flags.

The following status register flags can be cleared:

- kI3C_MasterSlaveStartFlag
- kI3C_MasterControlDoneFlag
- kI3C_MasterCompleteFlag
- kI3C_MasterArbitrationWonFlag
- kI3C_MasterSlave2MasterFlag

All flags except kI3C_MasterBetweenFlag and kI3C_MasterNackDetectFlag can be enabled as interrupts.

Note: These enums are meant to be OR'd together to form a bit mask.

Values:

enumerator kI3C_MasterBetweenFlag

Between messages/DAAs flag

enumerator kI3C_MasterNackDetectFlag
NACK detected flag

enumerator kI3C_MasterSlaveStartFlag
Slave request start flag

enumerator kI3C_MasterControlDoneFlag
Master request complete flag

enumerator kI3C_MasterCompleteFlag
Transfer complete flag

enumerator kI3C_MasterRxReadyFlag
Rx data ready in Rx buffer flag

enumerator kI3C_MasterTxReadyFlag
Tx buffer ready for Tx data flag

enumerator kI3C_MasterArbitrationWonFlag
Header address won arbitration flag

enumerator kI3C_MasterErrorFlag
Error occurred flag

enumerator kI3C_MasterSlave2MasterFlag
Switch from slave to master flag

enumerator kI3C_MasterClearFlags

enum _i3c_master_error_flags
I3C master error flags to indicate the causes.

Note: These enums are meant to be OR'd together to form a bit mask.

Values:

enumerator kI3C_MasterErrorNackFlag
Slave NACKed the last address

enumerator kI3C_MasterErrorWriteAbortFlag
Slave NACKed the write data

enumerator kI3C_MasterErrorParityFlag
Parity error from DDR read

enumerator kI3C_MasterErrorCrcFlag
CRC error from DDR read

enumerator kI3C_MasterErrorReadFlag
Read from MRDATAB register when FIFO empty

enumerator kI3C_MasterErrorWriteFlag
Write to MWDATAB register when FIFO full

enumerator kI3C_MasterErrorMsgFlag
Message SDR/DDR mismatch or read/write message in wrong state

enumerator kI3C_MasterErrorInvalidReqFlag
Invalid use of request

enumerator kI3C_MasterErrorTimeoutFlag
The module has stalled too long in a frame

enumerator kI3C_MasterAllErrorFlags
All error flags

enum _i3c_master_state
I3C working master state.

Values:

enumerator kI3C_MasterStateIdle
Bus stopped.

enumerator kI3C_MasterStateSlvReq
Bus stopped but slave holding SDA low.

enumerator kI3C_MasterStateMsgSdr
In SDR Message mode from using MWMSG_SDR.

enumerator kI3C_MasterStateNormAct
In normal active SDR mode.

enumerator kI3C_MasterStateDdr
In DDR Message mode.

enumerator kI3C_MasterStateDaa
In ENTDAA mode.

enumerator kI3C_MasterStateIbiAck
Waiting on IBI ACK/NACK decision.

enumerator kI3C_MasterStateIbiRcv
Receiving IBI.

enum _i3c_master_enable
I3C master enable configuration.

Values:

enumerator kI3C_MasterOff
Master off.

enumerator kI3C_MasterOn
Master on.

enumerator kI3C_MasterCapable
Master capable.

enum _i3c_master_hkeep
I3C high keeper configuration.

Values:

enumerator kI3C_MasterHighKeeperNone
Use PUR to hold SCL high.

enumerator kI3C_MasterHighKeeperWiredIn
Use pin_HK controls.

enumerator kI3C_MasterPassiveSDA
Hi-Z for Bus Free and hold SDA.

enumerator kI3C_MasterPassiveSDASCL
Hi-Z both for Bus Free, and can Hi-Z SDA for hold.

enum _i3c_bus_request

Emits the requested operation when doing in pieces vs. by message.

Values:

enumerator kI3C_RequestNone

No request.

enumerator kI3C_RequestEmitStartAddr

Request to emit start and address on bus.

enumerator kI3C_RequestEmitStop

Request to emit stop on bus.

enumerator kI3C_RequestIbiAckNack

Manual IBI ACK or NACK.

enumerator kI3C_RequestProcessDAA

Process DAA.

enumerator kI3C_RequestForceExit

Request to force exit.

enumerator kI3C_RequestAutoIbi

Hold in stopped state, but Auto-emit START,7E.

enum _i3c_bus_type

Bus type with EmitStartAddr.

Values:

enumerator kI3C_TypeI3CSdr

SDR mode of I3C.

enumerator kI3C_TypeI2C

Standard i2c protocol.

enumerator kI3C_TypeI3CDdr

HDR-DDR mode of I3C.

enum _i3c_ibi_response

IBI response.

Values:

enumerator kI3C_IbiRespAck

ACK with no mandatory byte.

enumerator kI3C_IbiRespNack

NACK.

enumerator kI3C_IbiRespAckMandatory

ACK with mandatory byte.

enumerator kI3C_IbiRespManual

Reserved.

enum _i3c_ibi_type

IBI type.

Values:

enumerator kI3C_IbiNormal

In-band interrupt.

enumerator kI3C_IbiHotJoin
slave hot join.

enumerator kI3C_IbiMasterRequest
slave master ship request.

enum _i3c_ibi_state
IBI state.

Values:

enumerator kI3C_IbiReady
In-band interrupt ready state, ready for user to handle.

enumerator kI3C_IbiDataBuffNeed
In-band interrupt need data buffer for data receive.

enumerator kI3C_IbiAckNackPending
In-band interrupt Ack/Nack pending for decision.

enum _i3c_direction
Direction of master and slave transfers.

Values:

enumerator kI3C_Write
Master transmit.

enumerator kI3C_Read
Master receive.

enum _i3c_tx_trigger_level
Watermark of TX int/dma trigger level.

Values:

enumerator kI3C_TxTriggerOnEmpty
Trigger on empty.

enumerator kI3C_TxTriggerUntilOneQuarterOrLess
Trigger on 1/4 full or less.

enumerator kI3C_TxTriggerUntilOneHalfOrLess
Trigger on 1/2 full or less.

enumerator kI3C_TxTriggerUntilOneLessThanFull
Trigger on 1 less than full or less.

enum _i3c_rx_trigger_level
Watermark of RX int/dma trigger level.

Values:

enumerator kI3C_RxTriggerOnNotEmpty
Trigger on not empty.

enumerator kI3C_RxTriggerUntilOneQuarterOrMore
Trigger on 1/4 full or more.

enumerator kI3C_RxTriggerUntilOneHalfOrMore
Trigger on 1/2 full or more.

enumerator kI3C_RxTriggerUntilThreeQuarterOrMore
Trigger on 3/4 full or more.

enum _i3c_rx_term_ops

I3C master read termination operations.

Values:

enumerator kI3C_RxTermDisable

Master doesn't terminate read, used for CCC transfer.

enumerator kI3C_RxAutoTerm

Master auto terminate read after receiving specified bytes(<=255).

enumerator kI3C_RxTermLastByte

Master terminates read at any time after START, no length limitation.

enum _i3c_start_scl_delay

I3C start SCL delay options.

Values:

enumerator kI3C_NoDelay

No delay.

enumerator kI3C_IncreaseSclHalfPeriod

Increases SCL clock period by 1/2.

enumerator kI3C_IncreaseSclOnePeriod

Increases SCL clock period by 1.

enumerator kI3C_IncreaseSclOneAndHalfPeriod

Increases SCL clock period by 1 1/2

enum _i3c_master_transfer_flags

Transfer option flags.

Note: These enumerations are intended to be OR'd together to form a bit mask of options for the _i3c_master_transfer::flags field.

Values:

enumerator kI3C_TransferDefaultFlag

Transfer starts with a start signal, stops with a stop signal.

enumerator kI3C_TransferNoStartFlag

Don't send a start condition, address, and sub address

enumerator kI3C_TransferRepeatedStartFlag

Send a repeated start condition

enumerator kI3C_TransferNoStopFlag

Don't send a stop condition.

enumerator kI3C_TransferWordsFlag

Transfer in words, else transfer in bytes.

enumerator kI3C_TransferDisableRxTermFlag

Disable Rx termination. Note: It's for I3C CCC transfer.

enumerator kI3C_TransferRxAutoTermFlag

Set Rx auto-termination. Note: It's adaptive based on Rx size(<=255 bytes) except in I3C_MasterReceive.

enumerator kI3C_TransferStartWithBroadcastAddr
Start transfer with 0x7E, then read/write data with device address.

typedef enum *_i3c_master_state* i3c_master_state_t
I3C working master state.

typedef enum *_i3c_master_enable* i3c_master_enable_t
I3C master enable configuration.

typedef enum *_i3c_master_hkeep* i3c_master_hkeep_t
I3C high keeper configuration.

typedef enum *_i3c_bus_request* i3c_bus_request_t
Emits the requested operation when doing in pieces vs. by message.

typedef enum *_i3c_bus_type* i3c_bus_type_t
Bus type with EmitStartAddr.

typedef enum *_i3c_ibi_response* i3c_ibi_response_t
IBI response.

typedef enum *_i3c_ibi_type* i3c_ibi_type_t
IBI type.

typedef enum *_i3c_ibi_state* i3c_ibi_state_t
IBI state.

typedef enum *_i3c_direction* i3c_direction_t
Direction of master and slave transfers.

typedef enum *_i3c_tx_trigger_level* i3c_tx_trigger_level_t
Watermark of TX int/dma trigger level.

typedef enum *_i3c_rx_trigger_level* i3c_rx_trigger_level_t
Watermark of RX int/dma trigger level.

typedef enum *_i3c_rx_term_ops* i3c_rx_term_ops_t
I3C master read termination operations.

typedef enum *_i3c_start_scl_delay* i3c_start_scl_delay_t
I3C start SCL delay options.

typedef struct *_i3c_register_ibi_addr* i3c_register_ibi_addr_t
Structure with setting master IBI rules and slave registry.

typedef struct *_i3c_baudrate* i3c_baudrate_hz_t
Structure with I3C baudrate settings.

typedef struct *_i3c_master_daa_baudrate* i3c_master_daa_baudrate_t
I3C DAA baud rate configuration.

typedef struct *_i3c_master_config* i3c_master_config_t
Structure with settings to initialize the I3C master module.

This structure holds configuration settings for the I3C peripheral. To initialize this structure to reasonable defaults, call the I3C_MasterGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

typedef struct *_i3c_master_transfer* i3c_master_transfer_t

typedef struct *_i3c_master_handle* i3c_master_handle_t

typedef struct *_i3c_master_transfer_callback* i3c_master_transfer_callback_t

i3c master callback functions.

typedef void (*i3c_master_isr_t)(I3C_Type *base, void *handle)

Typedef for master interrupt handler.

struct _i3c_register_ibi_addr

#include <fsl_i3c.h> Structure with setting master IBI rules and slave registry.

Public Members

uint8_t address[5]

Address array for registry.

bool i3cFastStart

Allow the START header to run as push-pull speed if all dynamic addresses take MSB 0.

bool ibiHasPayload

Whether the address array has mandatory IBI byte.

struct _i3c_baudrate

#include <fsl_i3c.h> Structure with I3C baudrate settings.

Public Members

uint32_t i2cBaud

Desired I2C baud rate in Hertz.

uint32_t i3cPushPullBaud

Desired I3C push-pull baud rate in Hertz.

uint32_t i3cOpenDrainBaud

Desired I3C open-drain baud rate in Hertz.

struct _i3c_master_daa_baudrate

#include <fsl_i3c.h> I3C DAA baud rate configuration.

Public Members

uint32_t sourceClock_Hz

FCLK, function clock in Hertz.

uint32_t i3cPushPullBaud

Desired I3C push-pull baud rate in Hertz.

uint32_t i3cOpenDrainBaud

Desired I3C open-drain baud rate in Hertz.

struct _i3c_master_config

#include <fsl_i3c.h> Structure with settings to initialize the I3C master module.

This structure holds configuration settings for the I3C peripheral. To initialize this structure to reasonable defaults, call the I3C_MasterGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

Public Members

i3c_master_enable_t enableMaster
: Enable master mode.

bool disableTimeout
: Whether to disable timeout to prevent the ERRWARN.

i3c_master_hkeep_t hKeep
: High keeper mode setting.

bool enableOpenDrainStop
: Whether to emit open-drain speed STOP.

bool enableOpenDrainHigh
: Enable Open-Drain High to be 1 PPBAUD count for i3c messages, or 1 ODBAUD.

i3c_baudrate_hz_t baudRate_Hz
: Desired baud rate settings.

i3c_start_scl_delay_t startSclDelay
: I3C SCL delay after START.

i3c_start_scl_delay_t restartSclDelay
: I3C SCL delay after Repeated START.

struct _i3c_master_transfer_callback
: *#include <fsl_i3c.h>* i3c master callback functions.

Public Members

void (*slave2Master)(I3C_Type *base, void *userData)
: Transfer complete callback

void (*ibiCallback)(I3C_Type *base, *i3c_master_handle_t* *handle, *i3c_ibi_type_t* ibiType, *i3c_ibi_state_t* ibiState)
: IBI event callback

void (*transferComplete)(I3C_Type *base, *i3c_master_handle_t* *handle, *status_t* completionStatus, void *userData)
: Transfer complete callback

struct _i3c_master_transfer
: *#include <fsl_i3c.h>* Non-blocking transfer descriptor structure.

  This structure is used to pass transaction parameters to the I3C_MasterTransferNonBlocking() API.

Public Members

uint32_t flags
: Bit mask of options for the transfer. See enumeration _i3c_master_transfer_flags for available options. Set to 0 or kI3C_TransferDefaultFlag for normal transfers.

uint8_t slaveAddress
: The 7-bit slave address.

i3c_direction_t direction
: Either kI3C_Read or kI3C_Write.

uint32_t subaddress
: Sub address. Transferred MSB first.

size_t subaddressSize
: Length of sub address to send in bytes. Maximum size is 4 bytes.

void *data
: Pointer to data to transfer.

size_t dataSize
: Number of bytes to transfer.

i3c_bus_type_t busType
: bus type.

i3c_ibi_response_t ibiResponse
: ibi response during transfer.

struct __i3c_master_handle
: *#include <fsl_i3c.h>* Driver handle for master non-blocking APIs.

Note: The contents of this structure are private and subject to change.

Public Members

uint8_t state
: Transfer state machine current state.

uint32_t remainingBytes
: Remaining byte count in current state.

i3c_rx_term_ops_t rxTermOps
: Read termination operation.

i3c_master_transfer_t transfer
: Copy of the current transfer info.

uint8_t ibiAddress
: Slave address which request IBI.

uint8_t *ibiBuff
: Pointer to IBI buffer to keep ibi bytes.

size_t ibiPayloadSize
: IBI payload size.

i3c_ibi_type_t ibiType
: IBI type.

i3c_master_transfer_callback_t callback
: Callback functions pointer.

void *userData
: Application data passed to callback.

2.29 I3C Master DMA Driver

void I3C_MasterTransferCreateHandleEDMA(I3C_Type *base, *i3c_master_edma_handle_t* *handle, const *i3c_master_edma_callback_t* *callback, void *userData, *edma_handle_t* *rxDmaHandle, *edma_handle_t* *txDmaHandle)

Create a new handle for the I3C master DMA APIs.

The creation of a handle is for use with the DMA APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the I3C_MasterTransferAbortDMA() API shall be called.

For devices where the I3C send and receive DMA requests are OR'd together, the *txDmaHandle* parameter is ignored and may be set to NULL.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.
- rxDmaHandle – Handle for the DMA receive channel. Created by the user prior to calling this function.
- txDmaHandle – Handle for the DMA transmit channel. Created by the user prior to calling this function.

status_t I3C_MasterTransferEDMA(I3C_Type *base, *i3c_master_edma_handle_t* *handle, *i3c_master_transfer_t* *transfer)

Performs a non-blocking DMA-based transaction on the I3C bus.

The callback specified when the *handle* was created is invoked when the transaction has completed.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.
- transfer – The pointer to the transfer descriptor.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_I3C_Busy – Either another master is currently utilizing the bus, or another DMA transaction is already in progress.

status_t I3C_MasterTransferGetCountEDMA(I3C_Type *base, *i3c_master_edma_handle_t* *handle, size_t *count)

Returns number of bytes transferred so far.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.
- count – **[out]** Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_Success –

- kStatus_NoTransferInProgress – There is not a DMA transaction currently in progress.

void I3C_MasterTransferAbortEDMA(I3C_Type *base, *i3c_master_edma_handle_t* *handle)

Terminates a non-blocking I3C master transmission early.

Note: It is not safe to call this function from an IRQ handler that has a higher priority than the DMA peripheral's IRQ priority.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C master driver handle.

void I3C_MasterTransferEDMAHandleIRQ(I3C_Type *base, void *i3cHandle)

Reusable routine to handle master interrupts.

Note: This function does not need to be called unless you are reimplementing the non-blocking API's interrupt handler routines to add special functionality.

Parameters

- base – The I3C peripheral base address.
- i3cHandle – Pointer to the I3C master DMA driver handle.

typedef struct *_i3c_master_edma_handle* i3c_master_edma_handle_t

typedef struct *_i3c_master_edma_callback* i3c_master_edma_callback_t

i3c master callback functions.

struct _i3c_master_edma_callback

#include <fsl_i3c_edma.h> i3c master callback functions.

Public Members

void (*slave2Master)(I3C_Type *base, void *userData)

Target asks for controller request.

void (*ibiCallback)(I3C_Type *base, *i3c_master_edma_handle_t* *handle, *i3c_ibi_type_t* ibiType, *i3c_ibi_state_t* ibiState)

IBI event callback.

void (*transferComplete)(I3C_Type *base, *i3c_master_edma_handle_t* *handle, *status_t* status, void *userData)

Transfer complete callback.

struct _i3c_master_edma_handle

#include <fsl_i3c_edma.h> Driver handle for master EDMA APIs.

Note: The contents of this structure are private and subject to change.

Public Members

I3C_Type *base
: I3C base pointer.

uint8_t state
: Transfer state machine current state.

uint32_t transferCount
: Indicates progress of the transfer

uint8_t subaddressBuffer[4]
: Saving subaddress command.

uint8_t subaddressCount
: Saving command count.

i3c_master_transfer_t transfer
: Copy of the current transfer info.

i3c_master_edma_callback_t callback
: Callback function pointer.

void *userData
: Application data passed to callback.

edma_handle_t *rxDmaHandle
: Handle for receive DMA channel.

edma_handle_t *txDmaHandle
: Handle for transmit DMA channel.

bool ibiFlag
: IBIWON flag.

uint8_t ibiAddress
: Slave address which request IBI.

uint8_t *ibiBuff
: Pointer to IBI buffer to keep ibi bytes.

size_t ibiPayloadSize
: IBI payload size.

i3c_ibi_type_t ibiType
: IBI type.

status_t result
: Transfer result.

2.30 I3C Slave Driver

void I3C_SlaveGetDefaultConfig(*i3c_slave_config_t* *slaveConfig)
: Provides a default configuration for the I3C slave peripheral.

  This function provides the following default configuration for the I3C slave peripheral:

```
slaveConfig->enableslave                = true;
```

  After calling this function, you can override any settings in order to customize the configuration, prior to initializing the slave driver with I3C_SlaveInit().

Parameters

- slaveConfig – **[out]** User provided configuration structure for default values. Refer to i3c_slave_config_t.

void I3C_SlaveInit(I3C_Type *base, const *i3c_slave_config_t* *slaveConfig, uint32_t slowClock_Hz)

Initializes the I3C slave peripheral.

This function enables the peripheral clock and initializes the I3C slave peripheral as described by the user provided configuration.

Parameters

- base – The I3C peripheral base address.
- slaveConfig – User provided peripheral configuration. Use I3C_SlaveGetDefaultConfig() to get a set of defaults that you can override.
- slowClock_Hz – Frequency in Hertz of the I3C slow clock. Used to calculate the bus match condition values. If FSL_FEATURE_I3C_HAS_NO_SCONFIG_BAMATCH defines as 1, this parameter is useless.

void I3C_SlaveDeinit(I3C_Type *base)

Deinitializes the I3C slave peripheral.

This function disables the I3C slave peripheral and gates the clock.

Parameters

- base – The I3C peripheral base address.

static inline void I3C_SlaveEnable(I3C_Type *base, bool isEnable)

Enable/Disable Slave.

Parameters

- base – The I3C peripheral base address.
- isEnable – Enable or disable.

static inline uint32_t I3C_SlaveGetStatusFlags(I3C_Type *base)

Gets the I3C slave status flags.

A bit mask with the state of all I3C slave status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_i3c_slave_flags

Parameters

- base – The I3C peripheral base address.

Returns

State of the status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void I3C_SlaveClearStatusFlags(I3C_Type *base, uint32_t statusMask)

Clears the I3C slave status flag state.

The following status register flags can be cleared:

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag

Attempts to clear other flags has no effect.

See also:

_i3c_slave_flags.

Parameters

- base – The I3C peripheral base address.
- statusMask – A bitmask of status flags that are to be cleared. The mask is composed of _i3c_slave_flags enumerators OR'd together. You may pass the result of a previous call to I3C_SlaveGetStatusFlags().

static inline uint32_t I3C_SlaveGetErrorStatusFlags(I3C_Type *base)

Gets the I3C slave error status flags.

A bit mask with the state of all I3C slave error status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_i3c_slave_error_flags

Parameters

- base – The I3C peripheral base address.

Returns

State of the error status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void I3C_SlaveClearErrorStatusFlags(I3C_Type *base, uint32_t statusMask)

Clears the I3C slave error status flag state.

See also:

_i3c_slave_error_flags.

Parameters

- base – The I3C peripheral base address.
- statusMask – A bitmask of error status flags that are to be cleared. The mask is composed of _i3c_slave_error_flags enumerators OR'd together. You may pass the result of a previous call to I3C_SlaveGetErrorStatusFlags().

i3c_slave_activity_state_t I3C_SlaveGetActivityState(I3C_Type *base)

Gets the I3C slave state.

Parameters

- base – The I3C peripheral base address.

Returns

I3C slave activity state, refer i3c_slave_activity_state_t.

status_t I3C_SlaveCheckAndClearError(I3C_Type *base, uint32_t status)

static inline void I3C_SlaveEnableInterrupts(I3C_Type *base, uint32_t interruptMask)

Enables the I3C slave interrupt requests.

Only below flags can be enabled as interrupts.

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag
- kI3C_SlaveRxReadyFlag
- kI3C_SlaveTxReadyFlag
- kI3C_SlaveDynamicAddrChangedFlag
- kI3C_SlaveReceivedCCCFlag
- kI3C_SlaveErrorFlag
- kI3C_SlaveHDRCommandMatchFlag
- kI3C_SlaveCCCHandledFlag
- kI3C_SlaveEventSentFlag

Parameters

- base – The I3C peripheral base address.
- interruptMask – Bit mask of interrupts to enable. See _i3c_slave_flags for the set of constants that should be OR'd together to form the bit mask.

static inline void I3C_SlaveDisableInterrupts(I3C_Type *base, uint32_t interruptMask)

Disables the I3C slave interrupt requests.

Only below flags can be disabled as interrupts.

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag
- kI3C_SlaveRxReadyFlag
- kI3C_SlaveTxReadyFlag
- kI3C_SlaveDynamicAddrChangedFlag
- kI3C_SlaveReceivedCCCFlag
- kI3C_SlaveErrorFlag
- kI3C_SlaveHDRCommandMatchFlag
- kI3C_SlaveCCCHandledFlag
- kI3C_SlaveEventSentFlag

Parameters

- base – The I3C peripheral base address.
- interruptMask – Bit mask of interrupts to disable. See _i3c_slave_flags for the set of constants that should be OR'd together to form the bit mask.

static inline uint32_t I3C_SlaveGetEnabledInterrupts(I3C_Type *base)

Returns the set of currently enabled I3C slave interrupt requests.

Parameters

- base – The I3C peripheral base address.

Returns

A bitmask composed of _i3c_slave_flags enumerators OR'd together to indicate the set of enabled interrupts.

static inline uint32_t I3C_SlaveGetPendingInterrupts(I3C_Type *base)

Returns the set of pending I3C slave interrupt requests.

Parameters

- base – The I3C peripheral base address.

Returns

A bitmask composed of _i3c_slave_flags enumerators OR'd together to indicate the set of pending interrupts.

static inline void I3C_SlaveEnableDMA(I3C_Type *base, bool enableTx, bool enableRx, uint32_t width)

Enables or disables I3C slave DMA requests.

Parameters

- base – The I3C peripheral base address.
- enableTx – Enable flag for transmit DMA request. Pass true for enable, false for disable.
- enableRx – Enable flag for receive DMA request. Pass true for enable, false for disable.
- width – DMA read/write unit in bytes.

static inline uint32_t I3C_SlaveGetTxFifoAddress(I3C_Type *base, uint32_t width)

Gets I3C slave transmit data register address for DMA transfer.

Parameters

- base – The I3C peripheral base address.
- width – DMA read/write unit in bytes.

Returns

The I3C Slave Transmit Data Register address.

static inline uint32_t I3C_SlaveGetRxFifoAddress(I3C_Type *base, uint32_t width)

Gets I3C slave receive data register address for DMA transfer.

Parameters

- base – The I3C peripheral base address.
- width – DMA read/write unit in bytes.

Returns

The I3C Slave Receive Data Register address.

static inline void I3C_SlaveSetWatermarks(I3C_Type *base, *i3c_tx_trigger_level_t* txLvl, *i3c_rx_trigger_level_t* rxLvl, bool flushTx, bool flushRx)

Sets the watermarks for I3C slave FIFOs.

Parameters

- base – The I3C peripheral base address.

- txLvl – Transmit FIFO watermark level. The kI3C_SlaveTxReadyFlag flag is set whenever the number of words in the transmit FIFO reaches *txLvl*.
- rxLvl – Receive FIFO watermark level. The kI3C_SlaveRxReadyFlag flag is set whenever the number of words in the receive FIFO reaches *rxLvl*.
- flushTx – true if TX FIFO is to be cleared, otherwise TX FIFO remains unchanged.
- flushRx – true if RX FIFO is to be cleared, otherwise RX FIFO remains unchanged.

static inline void I3C_SlaveGetFifoCounts(I3C_Type *base, size_t *rxCount, size_t *txCount)

Gets the current number of bytes in the I3C slave FIFOs.

Parameters

- base – The I3C peripheral base address.
- txCount – **[out]** Pointer through which the current number of bytes in the transmit FIFO is returned. Pass NULL if this value is not required.
- rxCount – **[out]** Pointer through which the current number of bytes in the receive FIFO is returned. Pass NULL if this value is not required.

status_t I3C_SlaveSend(I3C_Type *base, const void *txBuff, size_t txSize)

Performs a polling send transfer on the I3C bus.

Parameters

- base – The I3C peripheral base address.
- txBuff – The pointer to the data to be transferred.
- txSize – The length in bytes of the data to be transferred.

Returns

Error or success status returned by API.

status_t I3C_SlaveReceive(I3C_Type *base, void *rxBuff, size_t rxSize)

Performs a polling receive transfer on the I3C bus.

Parameters

- base – The I3C peripheral base address.
- rxBuff – The pointer to the data to be transferred.
- rxSize – The length in bytes of the data to be transferred.

Returns

Error or success status returned by API.

void I3C_SlaveTransferCreateHandle(I3C_Type *base, *i3c_slave_handle_t* *handle, *i3c_slave_transfer_callback_t* callback, void *userData)

Creates a new handle for the I3C slave non-blocking APIs.

The creation of a handle is for use with the non-blocking APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the I3C_SlaveTransferAbort() API shall be called.

Note: The function also enables the NVIC IRQ for the input I3C. Need to notice that on some SoCs the I3C IRQ is connected to INTMUX, in this case user needs to enable the associated INTMUX IRQ in application.

Parameters

- base – The I3C peripheral base address.
- handle – **[out]** Pointer to the I3C slave driver handle.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.

status_t I3C_SlaveTransferNonBlocking(I3C_Type *base, *i3c_slave_handle_t* *handle, uint32_t eventMask)

Starts accepting slave transfers.

Call this API after calling I2C_SlaveInit() and I3C_SlaveTransferCreateHandle() to start processing transactions driven by an I2C master. The slave monitors the I2C bus and pass events to the callback that was passed into the call to I3C_SlaveTransferCreateHandle(). The callback is always invoked from the interrupt context.

The set of events received by the callback is customizable. To do so, set the *eventMask* parameter to the OR'd combination of i3c_slave_transfer_event_t enumerators for the events you wish to receive. The kI3C_SlaveTransmitEvent and kI3C_SlaveReceiveEvent events are always enabled and do not need to be included in the mask. Alternatively, you can pass 0 to get a default set of only the transmit and receive events that are always enabled. In addition, the kI3C_SlaveAllEvents constant is provided as a convenient way to enable all events.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to struct: _i3c_slave_handle structure which stores the transfer state.
- eventMask – Bit mask formed by OR'ing together i3c_slave_transfer_event_t enumerators to specify which events to send to the callback. Other accepted values are 0 to get a default set of only the transmit and receive events, and kI3C_SlaveAllEvents to enable all events.

Return values

- kStatus_Success – Slave transfers were successfully started.
- kStatus_I3C_Busy – Slave transfers have already been started on this handle.

status_t I3C_SlaveTransferGetCount(I3C_Type *base, *i3c_slave_handle_t* *handle, size_t *count)

Gets the slave transfer status during a non-blocking transfer.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to i2c_slave_handle_t structure.
- count – **[out]** Pointer to a value to hold the number of bytes transferred. May be NULL if the count is not required.

Return values

- kStatus_Success –
- kStatus_NoTransferInProgress –

void I3C_SlaveTransferAbort(I3C_Type *base, *i3c_slave_handle_t* *handle)

Aborts the slave non-blocking transfers.

Note: This API could be called at any time to stop slave for handling the bus events.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to struct: _i3c_slave_handle structure which stores the transfer state.

Return values

- kStatus_Success –
- kStatus_I3C_Idle –

void I3C_SlaveTransferHandleIRQ(I3C_Type *base, void *intHandle)

Reusable routine to handle slave interrupts.

Note: This function does not need to be called unless you are reimplementing the non blocking API's interrupt handler routines to add special functionality.

Parameters

- base – The I3C peripheral base address.
- intHandle – Pointer to struct: _i3c_slave_handle structure which stores the transfer state.

enum _i3c_slave_flags

I3C slave peripheral flags.

The following status register flags can be cleared:

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag

Only below flags can be enabled as interrupts.

- kI3C_SlaveBusStartFlag
- kI3C_SlaveMatchedFlag
- kI3C_SlaveBusStopFlag
- kI3C_SlaveRxReadyFlag
- kI3C_SlaveTxReadyFlag
- kI3C_SlaveDynamicAddrChangedFlag
- kI3C_SlaveReceivedCCCFlag
- kI3C_SlaveErrorFlag
- kI3C_SlaveHDRCommandMatchFlag
- kI3C_SlaveCCCHandledFlag
- kI3C_SlaveEventSentFlag

Note: These enums are meant to be OR'd together to form a bit mask.

Values:

enumerator kI3C_SlaveNotStopFlag

Slave status not stop flag

enumerator kI3C_SlaveMessageFlag
Slave status message, indicating slave is listening to the bus traffic or responding

enumerator kI3C_SlaveRequiredReadFlag
Slave status required, either is master doing SDR read from slave, or is IBI pushing out.

enumerator kI3C_SlaveRequiredWriteFlag
Slave status request write, master is doing SDR write to slave, except slave in ENTDAA mode

enumerator kI3C_SlaveBusDAAFlag
I3C bus is in ENTDAA mode

enumerator kI3C_SlaveBusHDRModeFlag
I3C bus is in HDR mode

enumerator kI3C_SlaveBusStartFlag
Start/Re-start event is seen since the bus was last cleared

enumerator kI3C_SlaveMatchedFlag
Slave address(dynamic/static) matched since last cleared

enumerator kI3C_SlaveBusStopFlag
Stop event is seen since the bus was last cleared

enumerator kI3C_SlaveRxReadyFlag
Rx data ready in rx buffer flag

enumerator kI3C_SlaveTxReadyFlag
Tx buffer ready for Tx data flag

enumerator kI3C_SlaveDynamicAddrChangedFlag
Slave dynamic address has been assigned, re-assigned, or lost

enumerator kI3C_SlaveReceivedCCCFlag
Slave received Common command code

enumerator kI3C_SlaveErrorFlag
Error occurred flag

enumerator kI3C_SlaveHDRCommandMatchFlag
High data rate command match

enumerator kI3C_SlaveCCCHandledFlag
Slave received Common command code is handled by I3C module

enumerator kI3C_SlaveEventSentFlag
Slave IBI/P2P/MR/HJ event has been sent

enumerator kI3C_SlaveIbiDisableFlag
Slave in band interrupt is disabled.

enumerator kI3C_SlaveMasterRequestDisabledFlag
Slave master request is disabled.

enumerator kI3C_SlaveHotJoinDisabledFlag
Slave Hot-Join is disabled.

enumerator kI3C_SlaveClearFlags
All flags which are cleared by the driver upon starting a transfer.

enumerator kI3C_SlaveAllIrqFlags

enum _i3c_slave_error_flags

I3C slave error flags to indicate the causes.

Note: These enums are meant to be OR'd together to form a bit mask.

Values:

enumerator kI3C_SlaveErrorOverrunFlag
Slave internal from-bus buffer/FIFO overrun.

enumerator kI3C_SlaveErrorUnderrunFlag
Slave internal to-bus buffer/FIFO underrun

enumerator kI3C_SlaveErrorUnderrunNakFlag
Slave internal from-bus buffer/FIFO underrun and NACK error

enumerator kI3C_SlaveErrorTermFlag
Terminate error from master

enumerator kI3C_SlaveErrorInvalidStartFlag
Slave invalid start flag

enumerator kI3C_SlaveErrorSdrParityFlag
SDR parity error

enumerator kI3C_SlaveErrorHdrParityFlag
HDR parity error

enumerator kI3C_SlaveErrorHdrCRCFlag
HDR-DDR CRC error

enumerator kI3C_SlaveErrorS0S1Flag
S0 or S1 error

enumerator kI3C_SlaveErrorOverreadFlag
Over-read error

enumerator kI3C_SlaveErrorOverwriteFlag
Over-write error

enum _i3c_slave_event

I3C slave.event.

Values:

enumerator kI3C_SlaveEventNormal
Normal mode.

enumerator kI3C_SlaveEventIBI
In band interrupt event.

enumerator kI3C_SlaveEventMasterReq
Master request event.

enumerator kI3C_SlaveEventHotJoinReq
Hot-join event.

enum _i3c_slave_activity_state

I3C slave.activity state.

Values:

enumerator kI3C_SlaveNoLatency
Normal bus operation

enumerator kI3C_SlaveLatency1Ms
1ms of latency.

enumerator kI3C_SlaveLatency100Ms
100ms of latency.

enumerator kI3C_SlaveLatency10S
10s latency.

enum _i3c_slave_transfer_event
Set of events sent to the callback for non blocking slave transfers.

These event enumerations are used for two related purposes. First, a bit mask created by OR'ing together events is passed to I3C_SlaveTransferNonBlocking() in order to specify which events to enable. Then, when the slave callback is invoked, it is passed the current event through its *transfer* parameter.

Note: These enumerations are meant to be OR'd together to form a bit mask of events.

Values:

enumerator kI3C_SlaveAddressMatchEvent
Received the slave address after a start or repeated start.

enumerator kI3C_SlaveTransmitEvent
Callback is requested to provide data to transmit (slave-transmitter role).

enumerator kI3C_SlaveReceiveEvent
Callback is requested to provide a buffer in which to place received data (slave-receiver role).

enumerator kI3C_SlaveRequiredTransmitEvent
Callback is requested to provide a buffer in which to place received data (slave-receiver role).

enumerator kI3C_SlaveStartEvent
A start/repeated start was detected.

enumerator kI3C_SlaveHDRCommandMatchEvent
Slave Match HDR Command.

enumerator kI3C_SlaveCompletionEvent
A stop was detected, completing the transfer.

enumerator kI3C_SlaveRequestSentEvent
Slave request event sent.

enumerator kI3C_SlaveReceivedCCCEvent
Slave received CCC event, need to handle by application.

enumerator kI3C_SlaveAllEvents
Bit mask of all available events.

typedef enum *_i3c_slave_event* i3c_slave_event_t
I3C slave.event.

typedef enum *_i3c_slave_activity_state* i3c_slave_activity_state_t
I3C slave.activity state.

typedef struct *_i3c_slave_config* i3c_slave_config_t

Structure with settings to initialize the I3C slave module.

This structure holds configuration settings for the I3C peripheral. To initialize this structure to reasonable defaults, call the I3C_SlaveGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

typedef enum *_i3c_slave_transfer_event* i3c_slave_transfer_event_t

Set of events sent to the callback for non blocking slave transfers.

These event enumerations are used for two related purposes. First, a bit mask created by OR'ing together events is passed to I3C_SlaveTransferNonBlocking() in order to specify which events to enable. Then, when the slave callback is invoked, it is passed the current event through its *transfer* parameter.

Note: These enumerations are meant to be OR'd together to form a bit mask of events.

typedef struct *_i3c_slave_transfer* i3c_slave_transfer_t

I3C slave transfer structure.

typedef struct *_i3c_slave_handle* i3c_slave_handle_t

typedef void (*i3c_slave_transfer_callback_t)(I3C_Type *base, *i3c_slave_transfer_t* *transfer, void *userData)

Slave event callback function pointer type.

This callback is used only for the slave non-blocking transfer API. To install a callback, use the I3C_SlaveSetCallback() function after you have created a handle.

Param base
Base address for the I3C instance on which the event occurred.

Param transfer
Pointer to transfer descriptor containing values passed to and/or from the callback.

Param userData
Arbitrary pointer-sized value passed from the application.

typedef void (*i3c_slave_isr_t)(I3C_Type *base, void *handle)

Typedef for slave interrupt handler.

struct i3c_slave_config

#include <fsl_i3c.h> Structure with settings to initialize the I3C slave module.

This structure holds configuration settings for the I3C peripheral. To initialize this structure to reasonable defaults, call the I3C_SlaveGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

Public Members

bool enableSlave

Whether to enable slave.

uint8_t staticAddr

Static address.

uint16_t vendorID
: Device vendor ID(manufacture ID).

uint32_t partNumber
: Device part number info

uint8_t dcr
: Device characteristics register information.

uint8_t bcr
: Bus characteristics register information.

uint8_t hdrMode
: Support hdr mode, could be OR logic in enumeration:i3c_hdr_mode_t.

bool nakAllRequest
: Whether to reply NAK to all requests except broadcast CCC.

bool ignoreS0S1Error
: Whether to ignore S0/S1 error in SDR mode.

bool offline
: Whether to wait 60 us of bus quiet or HDR request to ensure slave track SDR mode safely.

bool matchSlaveStartStop
: Whether to assert start/stop status only the time slave is addressed.

uint32_t maxWriteLength
: Maximum write length.

uint32_t maxReadLength
: Maximum read length.

struct __i3c_slave_transfer
: *#include <fsl_i3c.h>* I3C slave transfer structure.

Public Members

uint32_t event
: Reason the callback is being invoked.

uint8_t *txData
: Transfer buffer

size_t txDataSize
: Transfer size

uint8_t *rxData
: Transfer buffer

size_t rxDataSize
: Transfer size

status_t completionStatus
: Success or error code describing how the transfer completed. Only applies for kI3C_SlaveCompletionEvent.

size_t transferredCount
: Number of bytes actually transferred since start or last repeated start.

struct _i3c_slave_handle

#include <fsl_i3c.h> I3C slave handle structure.

Note: The contents of this structure are private and subject to change.

Public Members

i3c_slave_transfer_t transfer
I3C slave transfer copy.

bool isBusy
Whether transfer is busy.

bool wasTransmit
Whether the last transfer was a transmit.

uint32_t eventMask
Mask of enabled events.

uint32_t transferredCount
Count of bytes transferred.

i3c_slave_transfer_callback_t callback
Callback function called at transfer event.

void *userData
Callback parameter passed to callback.

uint8_t txFifoSize
Tx Fifo size

2.31 I3C Slave DMA Driver

void I3C_SlaveTransferCreateHandleEDMA(I3C_Type *base, *i3c_slave_edma_handle_t* *handle, *i3c_slave_edma_callback_t* callback, void *userData, *edma_handle_t* *rxDmaHandle, *edma_handle_t* *txDmaHandle)

Create a new handle for the I3C slave DMA APIs.

The creation of a handle is for use with the DMA APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the I3C_SlaveTransferAbortDMA() API shall be called.

For devices where the I3C send and receive DMA requests are OR'd together, the *txDmaHandle* parameter is ignored and may be set to NULL.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C slave driver handle.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.
- rxDmaHandle – Handle for the DMA receive channel. Created by the user prior to calling this function.

- txDmaHandle – Handle for the DMA transmit channel. Created by the user prior to calling this function.

status_t I3C_SlaveTransferEDMA(I3C_Type *base, *i3c_slave_edma_handle_t* *handle, *i3c_slave_edma_transfer_t* *transfer, uint32_t eventMask)

Prepares for a non-blocking DMA-based transaction on the I3C bus.

The API will do DMA configuration according to the input transfer descriptor, and the data will be transferred when there's bus master requesting transfer from/to this slave. So the timing of call to this API need be aligned with master application to ensure the transfer is executed as expected. Callback specified when the *handle* was created is invoked when the transaction has completed.

Parameters

- base – The I3C peripheral base address.
- handle – Pointer to the I3C slave driver handle.
- transfer – The pointer to the transfer descriptor.
- eventMask – Bit mask formed by OR'ing together i3c_slave_transfer_event_t enumerators to specify which events to send to the callback. The transmit and receive events is not allowed to be enabled.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_I3C_Busy – Either another master is currently utilizing the bus, or another DMA transaction is already in progress.
- kStatus_Fail – The transaction can't be set.

void I3C_SlaveTransferAbortEDMA(I3C_Type *base, *i3c_slave_edma_handle_t* *handle)

Abort a slave edma non-blocking transfer in a early time.

Parameters

- base – I3C peripheral base address
- handle – pointer to i3c_slave_edma_handle_t structure

void I3C_SlaveTransferEDMAHandleIRQ(I3C_Type *base, void *i3cHandle)

Reusable routine to handle slave interrupts.

Note: This function does not need to be called unless you are reimplementing the non-blocking API's interrupt handler routines to add special functionality.

Parameters

- base – The I3C peripheral base address.
- i3cHandle – Pointer to the I3C slave DMA driver handle.

typedef struct *_i3c_slave_edma_handle* i3c_slave_edma_handle_t

typedef struct *_i3c_slave_edma_transfer* i3c_slave_edma_transfer_t

I3C slave transfer structure.

typedef void (*i3c_slave_edma_callback_t)(I3C_Type *base, *i3c_slave_edma_transfer_t* *transfer, void *userData)

Slave event callback function pointer type.

This callback is used only for the slave DMA transfer API.

Param base
Base address for the I3C instance on which the event occurred.

Param handle
Pointer to slave DMA transfer handle.

Param transfer
Pointer to transfer descriptor containing values passed to and/or from the callback.

Param userData
Arbitrary pointer-sized value passed from the application.

struct _i3c_slave_edma_transfer

#include <fsl_i3c_edma.h> I3C slave transfer structure.

Public Members

uint32_t event
Reason the callback is being invoked.

uint8_t *txData
Transfer buffer

size_t txDataSize
Transfer size

uint8_t *rxData
Transfer buffer

size_t rxDataSize
Transfer size

status_t completionStatus
Success or error code describing how the transfer completed. Only applies for kI3C_SlaveCompletionEvent.

struct _i3c_slave_edma_handle

#include <fsl_i3c_edma.h> I3C slave edma handle structure.

Note: The contents of this structure are private and subject to change.

Public Members

I3C_Type *base
I3C base pointer.

i3c_slave_edma_transfer_t transfer
I3C slave transfer copy.

bool isBusy
Whether transfer is busy.

bool wasTransmit
Whether the last transfer was a transmit.

uint32_t eventMask
Mask of enabled events.

i3c_slave_edma_callback_t callback
Callback function called at transfer event.

edma_handle_t *rxDmaHandle
Handle for receive DMA channel.

edma_handle_t *txDmaHandle
Handle for transmit DMA channel.

void *userData
Callback parameter passed to callback.

2.32 INTM: Interrupt Monitor Driver

FSL_INTM_DRIVER_VERSION
INTM driver version.

enum _intm_monitor
Interrupt monitors.

Values:

enumerator kINTM_Monitor1

enumerator kINTM_Monitor2

enumerator kINTM_Monitor3

enumerator kINTM_Monitor4

typedef enum *_intm_monitor* intm_monitor_t
Interrupt monitors.

typedef struct *_intm_monitor_config* intm_monitor_config_t
INTM interrupt source configuration structure.

typedef struct *_intm_config* intm_config_t
INTM configuration structure.

void INTM_GetDefaultConfig(*intm_config_t* *config)
Fill in the INTM config struct with the default settings.

The default values are:

```
config[0].irqnumber = NotAvail_IRQn;
config[0].maxtimer = 1000U;
config[1].irqnumber = NotAvail_IRQn;
config[1].maxtimer = 1000U;
config[2].irqnumber = NotAvail_IRQn;
config[2].maxtimer = 1000U;
config[3].irqnumber = NotAvail_IRQn;
config[3].maxtimer = 1000U;
config->enable = false;
```

Parameters

- config – Pointer to user's INTM config structure.

void INTM_Init(INTM_Type *base, const *intm_config_t* *config)

Ungates the INTM clock and configures the peripheral for basic operation.

Note: This API should be called at the beginning of the application using the INTM driver.

Parameters

- base – INTM peripheral base address
- config – Pointer to user's INTM config structure.

void INTM_Deinit(INTM_Type *base)

Disables the INTM module.

Parameters

- base – INTM peripheral base address

static inline void INTM_EnableCycleCount(INTM_Type *base, bool enable)

Enable the cycle count timer mode.

Monitor mode enables the cycle count timer on a monitored interrupt request for comparison to the latency register.

Parameters

- base – INTM peripheral base address.
- enable – Enable the cycle count or not.

static inline void INTM_AckIrq(INTM_Type *base, IRQn_Type irq)

Interrupt Acknowledge.

Call this function in ISR to acknowledge interrupt.

Parameters

- base – INTM peripheral base address.
- irq – Handle interrupt number.

static inline void INTM_SetInterruptRequestNumber(INTM_Type *base, *intm_monitor_t* intms, IRQn_Type irq)

Interrupt Request Select.

This function is used to set the interrupt request number to monitor or check.

Parameters

- base – INTM peripheral base address.
- intms – Programmable interrupt monitors.
- irq – Interrupt request number to monitor.

Returns

Select the interrupt request number to monitor.

static inline void INTM_SetMaxTime(INTM_Type *base, *intm_monitor_t* intms, uint32_t count)

Set the maximum count time.

This function is to set the maximum time from interrupt generation to confirmation.

Parameters

- base – INTM peripheral base address.
- intms – Programmable interrupt monitors.

- count – Timer maximum count.

static inline void INTM_ClearTimeCount(INTM_Type *base, *intm_monitor_t* intms)

Clear the timer period in units of count.

This function is used to clear the INTM_TIMERa register.

Parameters

- base – INTM peripheral base address.
- intms – Programmable interrupt monitors.

static inline uint32_t INTM_GetTimeCount(INTM_Type *base, *intm_monitor_t* intms)

Gets the timer period in units of count.

This function is used to get the number of INTM clock cycles from interrupt request to confirmation interrupt processing. If this number exceeds the set maximum time, will be an error signal.

Parameters

- base – INTM peripheral base address.
- intms – Programmable interrupt monitors.

static inline bool INTM_GetStatusFlags(INTM_Type *base, *intm_monitor_t* intms)

Interrupt monitor status.

This function indicates whether the INTM_TIMERa value has exceeded the INTM_LATENCYa value. If any interrupt source in INTM_TIMERa exceeds the programmed delay value, the monitor state can be cleared by calling the INTM_ClearTimeCount() API to clear the corresponding INTM_TIMERa register.

Parameters

- base – INTM peripheral base address.
- intms – Programmable interrupt monitors.

Returns

Whether INTM_TIMER value has exceeded INTM_LATENCY value. false:INTM_TIMER value has not exceeded the INTM_LATENCY value; true:INTM_TIMER value has exceeded the INTM_LATENCY value.

struct __intm_monitor_config

#include <fsl_intm.h> INTM interrupt source configuration structure.

Public Members

uint32_t maxtimer

Set the maximum timer

IRQn_Type irqnumber

Select the interrupt request number to monitor.

struct __intm_config

#include <fsl_intm.h> INTM configuration structure.

Public Members

bool enable

Interrupt source monitor config. enables the cycle count timer on a monitored interrupt request for comparison to the latency register.

2.33 IOMUXC: IOMUX Controller

static inline void IOMUXC_SetPinMux(uint32_t muxRegister, uint32_t muxMode, uint32_t inputRegister, uint32_t inputDaisy, uint32_t configRegister, uint32_t inputOnfield)

Sets the IOMUXC pin mux mode.

Note: The first five parameters can be filled with the pin function ID macros.

Parameters

- muxRegister – The pin mux register
- muxMode – The pin mux mode
- inputRegister – The select input register
- inputDaisy – The input daisy
- configRegister – The config register
- inputOn – The software input on

static inline void IOMUXC_SetPinConfig(uint32_t muxRegister, uint32_t muxMode, uint32_t inputRegister, uint32_t inputDaisy, uint32_t configRegister, uint32_t configValue)

Sets the IOMUXC pin configuration.

Note: The previous five parameters can be filled with the pin function ID macros.

Parameters

- muxRegister – The pin mux register
- muxMode – The pin mux mode
- inputRegister – The select input register
- inputDaisy – The input daisy
- configRegister – The config register
- configValue – The pin config value

FSL_IOMUXC_DRIVER_VERSION

IOMUXC driver version 1.0.0.

IOMUXC_PAD_DAP_TDI__JTAG_MUX_TDI

IOMUXC_PAD_DAP_TDI__MQS2_LEFT

IOMUXC_PAD_DAP_TDI__NETC_TMR_1588_ALARM1

IOMUXC_PAD_DAP_TDI__CAN2_TX

IOMUXC_PAD_DAP_TDI__FLEXIO2_FLEXIO_BIT30

IOMUXC_PAD_DAP_TDI__GPIO3_IO_BIT28

IOMUXC_PAD_DAP_TDI__LPUART5_RX

IOMUXC_PAD_DAP_TMS_SWDIO__JTAG_MUX_TMS

IOMUXC_PAD_DAP_TMS_SWDIO___CAN4_TX

IOMUXC_PAD_DAP_TMS_SWDIO___FLEXIO2_FLEXIO_BIT31

IOMUXC_PAD_DAP_TMS_SWDIO___GPIO3_IO_BIT29

IOMUXC_PAD_DAP_TMS_SWDIO___LPUART5_RTS_B

IOMUXC_PAD_DAP_TCLK_SWCLK___JTAG_MUX_TCK

IOMUXC_PAD_DAP_TCLK_SWCLK___CAN4_RX

IOMUXC_PAD_DAP_TCLK_SWCLK___FLEXIO1_FLEXIO_BIT30

IOMUXC_PAD_DAP_TCLK_SWCLK___GPIO3_IO_BIT30

IOMUXC_PAD_DAP_TCLK_SWCLK___LPUART5_CTS_B

IOMUXC_PAD_DAP_TDO_TRACESWO___JTAG_MUX_TDO

IOMUXC_PAD_DAP_TDO_TRACESWO___MQS2_RIGHT

IOMUXC_PAD_DAP_TDO_TRACESWO___NETC_TMR_1588_ALARM2

IOMUXC_PAD_DAP_TDO_TRACESWO___CAN2_RX

IOMUXC_PAD_DAP_TDO_TRACESWO___FLEXIO1_FLEXIO_BIT31

IOMUXC_PAD_DAP_TDO_TRACESWO___GPIO3_IO_BIT31

IOMUXC_PAD_DAP_TDO_TRACESWO___LPUART5_TX

IOMUXC_PAD_GPIO_IO00___GPIO2_IO_BIT0

IOMUXC_PAD_GPIO_IO00___LPI2C3_SDA

IOMUXC_PAD_GPIO_IO00___LPSPI6_PCS0

IOMUXC_PAD_GPIO_IO00___LPUART5_TX

IOMUXC_PAD_GPIO_IO00___LPI2C5_SDA

IOMUXC_PAD_GPIO_IO00___FLEXIO1_FLEXIO_BIT0

IOMUXC_PAD_GPIO_IO01___GPIO2_IO_BIT1

IOMUXC_PAD_GPIO_IO01___LPI2C3_SCL

IOMUXC_PAD_GPIO_IO01___LPSPI6_SIN

IOMUXC_PAD_GPIO_IO01___LPUART5_RX

IOMUXC_PAD_GPIO_IO01___LPI2C5_SCL

IOMUXC_PAD_GPIO_IO01___FLEXIO1_FLEXIO_BIT1

IOMUXC_PAD_GPIO_IO02___GPIO2_IO_BIT2

IOMUXC_PAD_GPIO_IO02___LPI2C4_SDA

IOMUXC_PAD_GPIO_IO02___LPSPI6_SOUT

IOMUXC_PAD_GPIO_IO02___LPUART5_CTS_B

IOMUXC_PAD_GPIO_IO02___LPI2C6_SDA

IOMUXC_PAD_GPIO_IO02___FLEXIO1_FLEXIO_BIT2

IOMUXC_PAD_GPIO_IO03___GPIO2_IO_BIT3

IOMUXC_PAD_GPIO_IO03___LPI2C4_SCL

IOMUXC_PAD_GPIO_IO03___LPSPI6_SCK

IOMUXC_PAD_GPIO_IO03___LPUART5_RTS_B

IOMUXC_PAD_GPIO_IO03___LPI2C6_SCL

IOMUXC_PAD_GPIO_IO03___FLEXIO1_FLEXIO_BIT3

IOMUXC_PAD_GPIO_IO04___GPIO2_IO_BIT4

IOMUXC_PAD_GPIO_IO04___TPM3_CH0

IOMUXC_PAD_GPIO_IO04___PDM_CLK

IOMUXC_PAD_GPIO_IO04___CAN4_TX

IOMUXC_PAD_GPIO_IO04___LPSPI7_PCS0

IOMUXC_PAD_GPIO_IO04___LPUART6_TX

IOMUXC_PAD_GPIO_IO04___LPI2C6_SDA

IOMUXC_PAD_GPIO_IO04___FLEXIO1_FLEXIO_BIT4

IOMUXC_PAD_GPIO_IO05___GPIO2_IO_BIT5

IOMUXC_PAD_GPIO_IO05___TPM4_CH0

IOMUXC_PAD_GPIO_IO05___PDM_BIT_STREAM_BIT0

IOMUXC_PAD_GPIO_IO05___CAN4_RX

IOMUXC_PAD_GPIO_IO05___LPSPI7_SIN

IOMUXC_PAD_GPIO_IO05___LPUART6_RX

IOMUXC_PAD_GPIO_IO05___LPI2C6_SCL

IOMUXC_PAD_GPIO_IO05___FLEXIO1_FLEXIO_BIT5

IOMUXC_PAD_GPIO_IO06___GPIO2_IO_BIT6

IOMUXC_PAD_GPIO_IO06___TPM5_CH0

IOMUXC_PAD_GPIO_IO06___PDM_BIT_STREAM_BIT1

IOMUXC_PAD_GPIO_IO06___LPSPI7_SOUT

IOMUXC_PAD_GPIO_IO06___LPUART6_CTS_B

IOMUXC_PAD_GPIO_IO06___LPI2C7_SDA

IOMUXC_PAD_GPIO_IO06___FLEXIO1_FLEXIO_BIT6

IOMUXC_PAD_GPIO_IO07___GPIO2_IO_BIT7

IOMUXC_PAD_GPIO_IO07___LPSPI3_PCS1

IOMUXC_PAD_GPIO_IO07___LPSPI7_SCK

IOMUXC_PAD_GPIO_IO07___LPUART6_RTS_B

IOMUXC_PAD_GPIO_IO07___LPI2C7_SCL

IOMUXC_PAD_GPIO_IO07___FLEXIO1_FLEXIO_BIT7

IOMUXC_PAD_GPIO_IO08___GPIO2_IO_BIT8

IOMUXC_PAD_GPIO_IO08___LPSPI3_PCS0

IOMUXC_PAD_GPIO_IO08___TPM6_CH0

IOMUXC_PAD_GPIO_IO08___LPUART7_TX

IOMUXC_PAD_GPIO_IO08___LPI2C7_SDA

IOMUXC_PAD_GPIO_IO08___FLEXIO1_FLEXIO_BIT8

IOMUXC_PAD_GPIO_IO09___GPIO2_IO_BIT9

IOMUXC_PAD_GPIO_IO09___LPSPI3_SIN

IOMUXC_PAD_GPIO_IO09___TPM3_EXTCLK

IOMUXC_PAD_GPIO_IO09___LPUART7_RX

IOMUXC_PAD_GPIO_IO09___LPI2C7_SCL

IOMUXC_PAD_GPIO_IO09___FLEXIO1_FLEXIO_BIT9

IOMUXC_PAD_GPIO_IO10___GPIO2_IO_BIT10

IOMUXC_PAD_GPIO_IO10___LPSPI3_SOUT

IOMUXC_PAD_GPIO_IO10___TPM4_EXTCLK

IOMUXC_PAD_GPIO_IO10___LPUART7_CTS_B

IOMUXC_PAD_GPIO_IO10___LPI2C8_SDA

IOMUXC_PAD_GPIO_IO10___FLEXIO1_FLEXIO_BIT10

IOMUXC_PAD_GPIO_IO11___GPIO2_IO_BIT11

IOMUXC_PAD_GPIO_IO11___LPSPI3_SCK

IOMUXC_PAD_GPIO_IO11___TPM5_EXTCLK

IOMUXC_PAD_GPIO_IO11___LPUART7_RTS_B

IOMUXC_PAD_GPIO_IO11___LPI2C8_SCL

IOMUXC_PAD_GPIO_IO11___FLEXIO1_FLEXIO_BIT11

IOMUXC_PAD_GPIO_IO12___GPIO2_IO_BIT12

IOMUXC_PAD_GPIO_IO12___TPM3_CH2

IOMUXC_PAD_GPIO_IO12___PDM_BIT_STREAM_BIT2

IOMUXC_PAD_GPIO_IO12___FLEXIO1_FLEXIO_BIT12

IOMUXC_PAD_GPIO_IO12___LPSPI8_PCS0

IOMUXC_PAD_GPIO_IO12___LPUART8_TX

IOMUXC_PAD_GPIO_IO12___LPI2C8_SDA

IOMUXC_PAD_GPIO_IO12___SAI3_RX_SYNC

IOMUXC_PAD_GPIO_IO13___GPIO2_IO_BIT13

IOMUXC_PAD_GPIO_IO13___TPM4_CH2

IOMUXC_PAD_GPIO_IO13___PDM_BIT_STREAM_BIT3

IOMUXC_PAD_GPIO_IO13___LPSPI8_SIN

IOMUXC_PAD_GPIO_IO13___LPUART8_RX

IOMUXC_PAD_GPIO_IO13___LPI2C8_SCL

IOMUXC_PAD_GPIO_IO13___FLEXIO1_FLEXIO_BIT13

IOMUXC_PAD_GPIO_IO14___GPIO2_IO_BIT14

IOMUXC_PAD_GPIO_IO14___LPUART3_TX

IOMUXC_PAD_GPIO_IO14___LPSPI8_SOUT

IOMUXC_PAD_GPIO_IO14___LPUART8_CTS_B

IOMUXC_PAD_GPIO_IO14___LPUART4_TX

IOMUXC_PAD_GPIO_IO14___FLEXIO1_FLEXIO_BIT14

IOMUXC_PAD_GPIO_IO15___GPIO2_IO_BIT15

IOMUXC_PAD_GPIO_IO15___LPUART3_RX

IOMUXC_PAD_GPIO_IO15___LPSPI8_SCK

IOMUXC_PAD_GPIO_IO15___LPUART8_RTS_B

IOMUXC_PAD_GPIO_IO15___LPUART4_RX

IOMUXC_PAD_GPIO_IO15___FLEXIO1_FLEXIO_BIT15

IOMUXC_PAD_GPIO_IO16___GPIO2_IO_BIT16

IOMUXC_PAD_GPIO_IO16___SAI3_TX_BCLK

IOMUXC_PAD_GPIO_IO16___PDM_BIT_STREAM_BIT2

IOMUXC_PAD_GPIO_IO16___LPUART3_CTS_B

IOMUXC_PAD_GPIO_IO16___LPSPI4_PCS2

IOMUXC_PAD_GPIO_IO16___LPUART4_CTS_B

IOMUXC_PAD_GPIO_IO16___FLEXIO1_FLEXIO_BIT16

IOMUXC_PAD_GPIO_IO17___GPIO2_IO_BIT17

IOMUXC_PAD_GPIO_IO17___SAI3_MCLK

IOMUXC_PAD_GPIO_IO17___LPUART3_RTS_B

IOMUXC_PAD_GPIO_IO17___LPSPI4_PCS1

IOMUXC_PAD_GPIO_IO17___LPUART4_RTS_B

IOMUXC_PAD_GPIO_IO17___FLEXIO1_FLEXIO_BIT17

IOMUXC_PAD_GPIO_IO18___GPIO2_IO_BIT18

IOMUXC_PAD_GPIO_IO18___SAI3_RX_BCLK

IOMUXC_PAD_GPIO_IO18___LPSPI5_PCS0

IOMUXC_PAD_GPIO_IO18___LPSPI4_PCS0

IOMUXC_PAD_GPIO_IO18___TPM5_CH2

IOMUXC_PAD_GPIO_IO18___FLEXIO1_FLEXIO_BIT18

IOMUXC_PAD_GPIO_IO19___GPIO2_IO_BIT19

IOMUXC_PAD_GPIO_IO19___SAI3_RX_SYNC

IOMUXC_PAD_GPIO_IO19___PDM_BIT_STREAM_BIT3

IOMUXC_PAD_GPIO_IO19___FLEXIO1_FLEXIO_BIT19

IOMUXC_PAD_GPIO_IO19___LPSPI5_SIN

IOMUXC_PAD_GPIO_IO19___LPSPI4_SIN

IOMUXC_PAD_GPIO_IO19___TPM6_CH2

IOMUXC_PAD_GPIO_IO19___SAI3_TX_DATA_BIT0

IOMUXC_PAD_GPIO_IO20___GPIO2_IO_BIT20

IOMUXC_PAD_GPIO_IO20___SAI3_RX_DATA_BIT0

IOMUXC_PAD_GPIO_IO20___PDM_BIT_STREAM_BIT0

IOMUXC_PAD_GPIO_IO20___LPSPI5_SOUT

IOMUXC_PAD_GPIO_IO20___LPSPI4_SOUT

IOMUXC_PAD_GPIO_IO20___TPM3_CH1

IOMUXC_PAD_GPIO_IO20___FLEXIO1_FLEXIO_BIT20

IOMUXC_PAD_GPIO_IO21___GPIO2_IO_BIT21

IOMUXC_PAD_GPIO_IO21___SAI3_TX_DATA_BIT0

IOMUXC_PAD_GPIO_IO21___PDM_CLK

IOMUXC_PAD_GPIO_IO21___FLEXIO1_FLEXIO_BIT21

IOMUXC_PAD_GPIO_IO21___LPSPI5_SCK

IOMUXC_PAD_GPIO_IO21___LPSPI4_SCK

IOMUXC_PAD_GPIO_IO21___TPM4_CH1

IOMUXC_PAD_GPIO_IO21___SAI3_RX_BCLK

IOMUXC_PAD_GPIO_IO22___GPIO2_IO_BIT22

IOMUXC_PAD_GPIO_IO22___USDHC3_CLK

IOMUXC_PAD_GPIO_IO22___SPDIF_IN

IOMUXC_PAD_GPIO_IO22___CAN5_TX

IOMUXC_PAD_GPIO_IO22___TPM5_CH1

IOMUXC_PAD_GPIO_IO22___TPM6_EXTCLK

IOMUXC_PAD_GPIO_IO22___LPI2C5_SDA

IOMUXC_PAD_GPIO_IO22___FLEXIO1_FLEXIO_BIT22

IOMUXC_PAD_GPIO_IO23___GPIO2_IO_BIT23

IOMUXC_PAD_GPIO_IO23___USDHC3_CMD

IOMUXC_PAD_GPIO_IO23___SPDIF_OUT

IOMUXC_PAD_GPIO_IO23___CAN5_RX

IOMUXC_PAD_GPIO_IO23___TPM6_CH1

IOMUXC_PAD_GPIO_IO23___LPI2C5_SCL

IOMUXC_PAD_GPIO_IO23___FLEXIO1_FLEXIO_BIT23

IOMUXC_PAD_GPIO_IO24___GPIO2_IO_BIT24

IOMUXC_PAD_GPIO_IO24___USDHC3_DATA0

IOMUXC_PAD_GPIO_IO24___TPM3_CH3

IOMUXC_PAD_GPIO_IO24___JTAG_MUX_TDO

IOMUXC_PAD_GPIO_IO24___LPSPI6_PCS1

IOMUXC_PAD_GPIO_IO24___FLEXIO1_FLEXIO_BIT24

IOMUXC_PAD_GPIO_IO25___GPIO2_IO_BIT25

IOMUXC_PAD_GPIO_IO25___USDHC3_DATA1

IOMUXC_PAD_GPIO_IO25___CAN2_TX

IOMUXC_PAD_GPIO_IO25___TPM4_CH3

IOMUXC_PAD_GPIO_IO25___JTAG_MUX_TCK

IOMUXC_PAD_GPIO_IO25___LPSPI7_PCS1

IOMUXC_PAD_GPIO_IO25___FLEXIO1_FLEXIO_BIT25

IOMUXC_PAD_GPIO_IO26___GPIO2_IO_BIT26

IOMUXC_PAD_GPIO_IO26___USDHC3_DATA2

IOMUXC_PAD_GPIO_IO26___PDM_BIT_STREAM_BIT1

IOMUXC_PAD_GPIO_IO26___FLEXIO1_FLEXIO_BIT26

IOMUXC_PAD_GPIO_IO26___TPM5_CH3

IOMUXC_PAD_GPIO_IO26___JTAG_MUX_TDI

IOMUXC_PAD_GPIO_IO26___LPSPI8_PCS1

IOMUXC_PAD_GPIO_IO26___SAI3_TX_SYNC

IOMUXC_PAD_GPIO_IO27___GPIO2_IO_BIT27

IOMUXC_PAD_GPIO_IO27___USDHC3_DATA3

IOMUXC_PAD_GPIO_IO27___CAN2_RX

IOMUXC_PAD_GPIO_IO27___TPM6_CH3

IOMUXC_PAD_GPIO_IO27___JTAG_MUX_TMS

IOMUXC_PAD_GPIO_IO27___LPSPI5_PCS1

IOMUXC_PAD_GPIO_IO27___FLEXIO1_FLEXIO_BIT27

IOMUXC_PAD_GPIO_IO28___GPIO2_IO_BIT28

IOMUXC_PAD_GPIO_IO28___LPI2C3_SDA

IOMUXC_PAD_GPIO_IO28___CAN3_TX

IOMUXC_PAD_GPIO_IO28___FLEXIO1_FLEXIO_BIT28

IOMUXC_PAD_GPIO_IO29___GPIO2_IO_BIT29

IOMUXC_PAD_GPIO_IO29___LPI2C3_SCL

IOMUXC_PAD_GPIO_IO29___CAN3_RX

IOMUXC_PAD_GPIO_IO29___FLEXIO1_FLEXIO_BIT29

IOMUXC_PAD_GPIO_IO30___GPIO2_IO_BIT30

IOMUXC_PAD_GPIO_IO30___LPI2C4_SDA

IOMUXC_PAD_GPIO_IO30___CAN5_TX

IOMUXC_PAD_GPIO_IO30___FLEXIO1_FLEXIO_BIT30

IOMUXC_PAD_GPIO_IO31___GPIO2_IO_BIT31

IOMUXC_PAD_GPIO_IO31___LPI2C4_SCL

IOMUXC_PAD_GPIO_IO31___CAN5_RX

IOMUXC_PAD_GPIO_IO31___FLEXIO1_FLEXIO_BIT31

IOMUXC_PAD_GPIO_IO32___GPIO5_IO_BIT12

IOMUXC_PAD_GPIO_IO32___PCIE1_CLKREQ_B

IOMUXC_PAD_GPIO_IO32___LPUART6_TX

IOMUXC_PAD_GPIO_IO32___LPSPI4_PCS2

IOMUXC_PAD_GPIO_IO33___GPIO5_IO_BIT13

IOMUXC_PAD_GPIO_IO33___LPUART6_RX

IOMUXC_PAD_GPIO_IO33___LPSPI4_PCS1

IOMUXC_PAD_GPIO_IO34___GPIO5_IO_BIT14

IOMUXC_PAD_GPIO_IO34___LPUART6_CTS_B

IOMUXC_PAD_GPIO_IO34___LPSPI4_PCS0

IOMUXC_PAD_GPIO_IO35___GPIO5_IO_BIT15

IOMUXC_PAD_GPIO_IO35___PCIE2_CLKREQ_B

IOMUXC_PAD_GPIO_IO35___LPUART6_RTS_B

IOMUXC_PAD_GPIO_IO35___LPSPI4_SIN

IOMUXC_PAD_GPIO_IO36___LPSPI4_SOUT

IOMUXC_PAD_GPIO_IO36___GPIO5_IO_BIT16

IOMUXC_PAD_GPIO_IO36___LPUART7_TX

IOMUXC_PAD_GPIO_IO37___GPIO5_IO_BIT17

IOMUXC_PAD_GPIO_IO37___LPUART7_RX

IOMUXC_PAD_GPIO_IO37___LPSPI4_SCK

IOMUXC_PAD_CCM_CLKO1___CLKO_1

IOMUXC_PAD_CCM_CLKO1___NETC_TMR_1588_TRIG1

IOMUXC_PAD_CCM_CLKO1___FLEXIO1_FLEXIO_BIT26

IOMUXC_PAD_CCM_CLKO1___GPIO3_IO_BIT26

IOMUXC_PAD_CCM_CLKO2___GPIO3_IO_BIT27

IOMUXC_PAD_CCM_CLKO2___CLKO_2

IOMUXC_PAD_CCM_CLKO2___NETC_TMR_1588_PP1

IOMUXC_PAD_CCM_CLKO2___FLEXIO1_FLEXIO_BIT27

IOMUXC_PAD_CCM_CLKO3___CLKO_3

IOMUXC_PAD_CCM_CLKO3___NETC_TMR_1588_TRIG2

IOMUXC_PAD_CCM_CLKO3___CAN3_TX

IOMUXC_PAD_CCM_CLKO3___FLEXIO2_FLEXIO_BIT28

IOMUXC_PAD_CCM_CLKO3___GPIO4_IO_BIT28

IOMUXC_PAD_CCM_CLKO4___CLKO_4

IOMUXC_PAD_CCM_CLKO4___NETC_TMR_1588_PP2

IOMUXC_PAD_CCM_CLKO4___CAN3_RX

IOMUXC_PAD_CCM_CLKO4___FLEXIO2_FLEXIO_BIT29

IOMUXC_PAD_CCM_CLKO4___GPIO4_IO_BIT29

IOMUXC_PAD_ENET1_MDC___NETC_MDC

IOMUXC_PAD_ENET1_MDC___LPUART3_DCD_B

IOMUXC_PAD_ENET1_MDC___I3C2_SCL

IOMUXC_PAD_ENET1_MDC___USB1_OTG_ID

IOMUXC_PAD_ENET1_MDC___FLEXIO2_FLEXIO_BIT0

IOMUXC_PAD_ENET1_MDC___GPIO4_IO_BIT0

IOMUXC_PAD_ENET1_MDIO___NETC_MDIO

IOMUXC_PAD_ENET1_MDIO___LPUART3_RIN_B

IOMUXC_PAD_ENET1_MDIO___I3C2_SDA

IOMUXC_PAD_ENET1_MDIO___USB1_OTG_PWR

IOMUXC_PAD_ENET1_MDIO___FLEXIO2_FLEXIO_BIT1

IOMUXC_PAD_ENET1_MDIO___GPIO4_IO_BIT1

IOMUXC_PAD_ENET1_TD3___ETH0_RGMII_TD3

IOMUXC_PAD_ENET1_TD3___CAN2_TX

IOMUXC_PAD_ENET1_TD3___USB2_OTG_ID

IOMUXC_PAD_ENET1_TD3___FLEXIO2_FLEXIO_BIT2

IOMUXC_PAD_ENET1_TD3___GPIO4_IO_BIT2

IOMUXC_PAD_ENET1_TD2___ETH0_RGMII_TD2

IOMUXC_PAD_ENET1_TD2___ETH0_RMII_REF50_CLK

IOMUXC_PAD_ENET1_TD2___CAN2_RX

IOMUXC_PAD_ENET1_TD2___USB2_OTG_OC

IOMUXC_PAD_ENET1_TD2___FLEXIO2_FLEXIO_BIT3

IOMUXC_PAD_ENET1_TD2___GPIO4_IO_BIT3

IOMUXC_PAD_ENET1_TD1___ETH0_RGMII_TD1

IOMUXC_PAD_ENET1_TD1___LPUART3_RTS_B

IOMUXC_PAD_ENET1_TD1___I3C2_PUR

IOMUXC_PAD_ENET1_TD1___USB1_OTG_OC

IOMUXC_PAD_ENET1_TD1___FLEXIO2_FLEXIO_BIT4

IOMUXC_PAD_ENET1_TD1___GPIO4_IO_BIT4

IOMUXC_PAD_ENET1_TD1___I3C2_PUR_B

IOMUXC_PAD_ENET1_TD1___ETH0_RMII_TXD1

IOMUXC_PAD_ENET1_TD0___ETH0_RGMII_TD0

IOMUXC_PAD_ENET1_TD0___LPUART3_TX

IOMUXC_PAD_ENET1_TD0___ETH0_RMII_TXD0

IOMUXC_PAD_ENET1_TD0___FLEXIO2_FLEXIO_BIT5

IOMUXC_PAD_ENET1_TD0___GPIO4_IO_BIT5

IOMUXC_PAD_ENET1_TX_CTL___ETH0_RGMII_TX_CTL

IOMUXC_PAD_ENET1_TX_CTL___LPUART3_DTR_B

IOMUXC_PAD_ENET1_TX_CTL___ETH0_RMII_TX_EN

IOMUXC_PAD_ENET1_TX_CTL___FLEXIO2_FLEXIO_BIT6

IOMUXC_PAD_ENET1_TX_CTL___GPIO4_IO_BIT6

IOMUXC_PAD_ENET1_TXC___ETH0_RGMII_TX_CLK

IOMUXC_PAD_ENET1_TXC___ENET_CLK_ROOT

IOMUXC_PAD_ENET1_TXC___FLEXIO2_FLEXIO_BIT7

IOMUXC_PAD_ENET1_TXC___GPIO4_IO_BIT7

IOMUXC_PAD_ENET1_RX_CTL___ETH0_RGMII_RX_CTL

IOMUXC_PAD_ENET1_RX_CTL___LPUART3_DSR_B

IOMUXC_PAD_ENET1_RX_CTL___ETH0_RMII_CRS_DV

IOMUXC_PAD_ENET1_RX_CTL___USB2_OTG_PWR

IOMUXC_PAD_ENET1_RX_CTL___FLEXIO2_FLEXIO_BIT8

IOMUXC_PAD_ENET1_RX_CTL___GPIO4_IO_BIT8

IOMUXC_PAD_ENET1_RXC___ETH0_RGMII_RX_CLK

IOMUXC_PAD_ENET1_RXC___ETH0_RMII_RX_ER

IOMUXC_PAD_ENET1_RXC___FLEXIO2_FLEXIO_BIT9

IOMUXC_PAD_ENET1_RXC___GPIO4_IO_BIT9

IOMUXC_PAD_ENET1_RD0___ETH0_RGMII_RD0

IOMUXC_PAD_ENET1_RD0___LPUART3_RX

IOMUXC_PAD_ENET1_RD0___ETH0_RMII_RXD0

IOMUXC_PAD_ENET1_RD0___FLEXIO2_FLEXIO_BIT10

IOMUXC_PAD_ENET1_RD0___GPIO4_IO_BIT10

IOMUXC_PAD_ENET1_RD1___ETH0_RGMII_RD1

IOMUXC_PAD_ENET1_RD1___LPUART3_CTS_B

IOMUXC_PAD_ENET1_RD1___ETH0_RMII_RXD1

IOMUXC_PAD_ENET1_RD1___LPTMR2_ALT1

IOMUXC_PAD_ENET1_RD1___FLEXIO2_FLEXIO_BIT11

IOMUXC_PAD_ENET1_RD1___GPIO4_IO_BIT11

IOMUXC_PAD_ENET1_RD2___ETH0_RGMII_RD2

IOMUXC_PAD_ENET1_RD2___ETH0_RMII_RX_ER

IOMUXC_PAD_ENET1_RD2___LPTMR2_ALT2

IOMUXC_PAD_ENET1_RD2___FLEXIO2_FLEXIO_BIT12

IOMUXC_PAD_ENET1_RD2___GPIO4_IO_BIT12

IOMUXC_PAD_ENET1_RD3___ETH0_RGMII_RD3

IOMUXC_PAD_ENET1_RD3___LPTMR2_ALT3

IOMUXC_PAD_ENET1_RD3___FLEXIO2_FLEXIO_BIT13

IOMUXC_PAD_ENET1_RD3___GPIO4_IO_BIT13

IOMUXC_PAD_ENET2_MDC___NETC_MDC

IOMUXC_PAD_ENET2_MDC___LPUART4_DCD_B

IOMUXC_PAD_ENET2_MDC___SAI2_RX_SYNC

IOMUXC_PAD_ENET2_MDC___FLEXIO2_FLEXIO_BIT14

IOMUXC_PAD_ENET2_MDC___GPIO4_IO_BIT14

IOMUXC_PAD_ENET2_MDIO___NETC_MDIO

IOMUXC_PAD_ENET2_MDIO___LPUART4_RIN_B

IOMUXC_PAD_ENET2_MDIO___SAI2_RX_BCLK

IOMUXC_PAD_ENET2_MDIO___FLEXIO2_FLEXIO_BIT15

IOMUXC_PAD_ENET2_MDIO___GPIO4_IO_BIT15

IOMUXC_PAD_ENET2_TD3___SAI2_RX_DATA_BIT0

IOMUXC_PAD_ENET2_TD3___FLEXIO2_FLEXIO_BIT16

IOMUXC_PAD_ENET2_TD3___GPIO4_IO_BIT16

IOMUXC_PAD_ENET2_TD3___ETH1_RGMII_TD3

IOMUXC_PAD_ENET2_TD2___ETH1_RGMII_TD2

IOMUXC_PAD_ENET2_TD2___ETH1_RMII_REF50_CLK

IOMUXC_PAD_ENET2_TD2___SAI2_RX_DATA_BIT1

IOMUXC_PAD_ENET2_TD2___SAI4_TX_SYNC

IOMUXC_PAD_ENET2_TD2___FLEXIO2_FLEXIO_BIT17

IOMUXC_PAD_ENET2_TD2___GPIO4_IO_BIT17

IOMUXC_PAD_ENET2_TD1___ETH1_RGMII_TD1

IOMUXC_PAD_ENET2_TD1___LPUART4_RTS_B

IOMUXC_PAD_ENET2_TD1___SAI2_RX_DATA_BIT2

IOMUXC_PAD_ENET2_TD1___SAI4_TX_BCLK

IOMUXC_PAD_ENET2_TD1___FLEXIO2_FLEXIO_BIT18

IOMUXC_PAD_ENET2_TD1___GPIO4_IO_BIT18

IOMUXC_PAD_ENET2_TD1___ETH1_RMII_TXD1

IOMUXC_PAD_ENET2_TD0___ETH1_RGMII_TD0

IOMUXC_PAD_ENET2_TD0___LPUART4_TX

IOMUXC_PAD_ENET2_TD0___SAI2_RX_DATA_BIT3

IOMUXC_PAD_ENET2_TD0___SAI4_TX_DATA_BIT0

IOMUXC_PAD_ENET2_TD0___FLEXIO2_FLEXIO_BIT19

IOMUXC_PAD_ENET2_TD0___GPIO4_IO_BIT19

IOMUXC_PAD_ENET2_TD0___ETH1_RMII_TXD0

IOMUXC_PAD_ENET2_TX_CTL___ETH1_RGMII_TX_CTL

IOMUXC_PAD_ENET2_TX_CTL___LPUART4_DTR_B

IOMUXC_PAD_ENET2_TX_CTL___SAI2_TX_SYNC

IOMUXC_PAD_ENET2_TX_CTL___ETH1_RMII_TX_EN

IOMUXC_PAD_ENET2_TX_CTL___FLEXIO2_FLEXIO_BIT20

IOMUXC_PAD_ENET2_TX_CTL___GPIO4_IO_BIT20

IOMUXC_PAD_ENET2_TXC___ETH1_RGMII_TX_CLK

IOMUXC_PAD_ENET2_TXC___ENET_CLK_ROOT

IOMUXC_PAD_ENET2_TXC___SAI2_TX_BCLK

IOMUXC_PAD_ENET2_TXC___FLEXIO2_FLEXIO_BIT21

IOMUXC_PAD_ENET2_TXC___GPIO4_IO_BIT21

IOMUXC_PAD_ENET2_RX_CTL___ETH1_RGMII_RX_CTL

IOMUXC_PAD_ENET2_RX_CTL___LPUART4_DSR_B

IOMUXC_PAD_ENET2_RX_CTL___SAI2_TX_DATA_BIT0

IOMUXC_PAD_ENET2_RX_CTL___FLEXIO2_FLEXIO_BIT22

IOMUXC_PAD_ENET2_RX_CTL___GPIO4_IO_BIT22

IOMUXC_PAD_ENET2_RX_CTL___ETH1_RMII_CRS_DV

IOMUXC_PAD_ENET2_RXC___ETH1_RGMII_RX_CLK

IOMUXC_PAD_ENET2_RXC___ETH1_RMII_RX_ER

IOMUXC_PAD_ENET2_RXC___SAI2_TX_DATA_BIT1

IOMUXC_PAD_ENET2_RXC___SAI4_RX_SYNC

IOMUXC_PAD_ENET2_RXC___FLEXIO2_FLEXIO_BIT23

IOMUXC_PAD_ENET2_RXC___GPIO4_IO_BIT23

IOMUXC_PAD_ENET2_RD0___ETH1_RGMII_RD0

IOMUXC_PAD_ENET2_RD0___LPUART4_RX

IOMUXC_PAD_ENET2_RD0___SAI2_TX_DATA_BIT2

IOMUXC_PAD_ENET2_RD0___SAI4_RX_BCLK

IOMUXC_PAD_ENET2_RD0___FLEXIO2_FLEXIO_BIT24

IOMUXC_PAD_ENET2_RD0___GPIO4_IO_BIT24

IOMUXC_PAD_ENET2_RD0___ETH1_RMII_RXD0

IOMUXC_PAD_ENET2_RD1___ETH1_RGMII_RD1

IOMUXC_PAD_ENET2_RD1___SPDIF_IN

IOMUXC_PAD_ENET2_RD1___SAI2_TX_DATA_BIT3

IOMUXC_PAD_ENET2_RD1___SAI4_RX_DATA_BIT0

IOMUXC_PAD_ENET2_RD1___FLEXIO2_FLEXIO_BIT25

IOMUXC_PAD_ENET2_RD1___GPIO4_IO_BIT25

IOMUXC_PAD_ENET2_RD1___ETH1_RMII_RXD1

IOMUXC_PAD_ENET2_RD2___ETH1_RGMII_RD2

IOMUXC_PAD_ENET2_RD2___LPUART4_CTS_B

IOMUXC_PAD_ENET2_RD2___SAI2_MCLK

IOMUXC_PAD_ENET2_RD2___MQS2_RIGHT

IOMUXC_PAD_ENET2_RD2___FLEXIO2_FLEXIO_BIT26

IOMUXC_PAD_ENET2_RD2___GPIO4_IO_BIT26

IOMUXC_PAD_ENET2_RD2___ETH1_RMII_RX_ER

IOMUXC_PAD_ENET2_RD3___ETH1_RGMII_RD3

IOMUXC_PAD_ENET2_RD3___SPDIF_OUT

IOMUXC_PAD_ENET2_RD3___SPDIF_IN

IOMUXC_PAD_ENET2_RD3___MQS2_LEFT

IOMUXC_PAD_ENET2_RD3___FLEXIO2_FLEXIO_BIT27

IOMUXC_PAD_ENET2_RD3___GPIO4_IO_BIT27

IOMUXC_PAD_SD1_CLK___FLEXIO1_FLEXIO_BIT8

IOMUXC_PAD_SD1_CLK___GPIO3_IO_BIT8

IOMUXC_PAD_SD1_CLK___USDHC1_CLK

IOMUXC_PAD_SD1_CMD___USDHC1_CMD

IOMUXC_PAD_SD1_CMD___FLEXIO1_FLEXIO_BIT9

IOMUXC_PAD_SD1_CMD___GPIO3_IO_BIT9

IOMUXC_PAD_SD1_DATA0___USDHC1_DATA0

IOMUXC_PAD_SD1_DATA0___FLEXIO1_FLEXIO_BIT10

IOMUXC_PAD_SD1_DATA0___GPIO3_IO_BIT10

IOMUXC_PAD_SD1_DATA1___USDHC1_DATA1

IOMUXC_PAD_SD1_DATA1___FLEXIO1_FLEXIO_BIT11

IOMUXC_PAD_SD1_DATA1___GPIO3_IO_BIT11

IOMUXC_PAD_SD1_DATA2___USDHC1_DATA2

IOMUXC_PAD_SD1_DATA2___FLEXIO1_FLEXIO_BIT12

IOMUXC_PAD_SD1_DATA2___GPIO3_IO_BIT12

IOMUXC_PAD_SD1_DATA2___PMIC_READY

IOMUXC_PAD_SD1_DATA3___USDHC1_DATA3

IOMUXC_PAD_SD1_DATA3___FLEXSPI1_A_SS1_B

IOMUXC_PAD_SD1_DATA3___FLEXIO1_FLEXIO_BIT13

IOMUXC_PAD_SD1_DATA3___GPIO3_IO_BIT13

IOMUXC_PAD_SD1_DATA4___USDHC1_DATA4

IOMUXC_PAD_SD1_DATA4___FLEXSPI1_A_DATA_BIT4

IOMUXC_PAD_SD1_DATA4___FLEXIO1_FLEXIO_BIT14

IOMUXC_PAD_SD1_DATA4___GPIO3_IO_BIT14

IOMUXC_PAD_SD1_DATA4___XSPI_DATA_BIT4

IOMUXC_PAD_SD1_DATA5___USDHC1_DATA5

IOMUXC_PAD_SD1_DATA5___FLEXSPI1_A_DATA_BIT5

IOMUXC_PAD_SD1_DATA5___USDHC1_RESET_B

IOMUXC_PAD_SD1_DATA5___FLEXIO1_FLEXIO_BIT15

IOMUXC_PAD_SD1_DATA5___GPIO3_IO_BIT15

IOMUXC_PAD_SD1_DATA5___XSPI_DATA_BIT5

IOMUXC_PAD_SD1_DATA6___USDHC1_DATA6

IOMUXC_PAD_SD1_DATA6___FLEXSPI1_A_DATA_BIT6

IOMUXC_PAD_SD1_DATA6___USDHC1_CD_B

IOMUXC_PAD_SD1_DATA6___FLEXIO1_FLEXIO_BIT16

IOMUXC_PAD_SD1_DATA6___GPIO3_IO_BIT16

IOMUXC_PAD_SD1_DATA6___XSPI_DATA_BIT6

IOMUXC_PAD_SD1_DATA7___USDHC1_DATA7

IOMUXC_PAD_SD1_DATA7___FLEXSPI1_A_DATA_BIT7

IOMUXC_PAD_SD1_DATA7___USDHC1_WP

IOMUXC_PAD_SD1_DATA7___FLEXIO1_FLEXIO_BIT17

IOMUXC_PAD_SD1_DATA7___GPIO3_IO_BIT17

IOMUXC_PAD_SD1_DATA7___XSPI_DATA_BIT7

IOMUXC_PAD_SD1_STROBE___USDHC1_STROBE

IOMUXC_PAD_SD1_STROBE___FLEXSPI1_A_DQS

IOMUXC_PAD_SD1_STROBE___FLEXIO1_FLEXIO_BIT18

IOMUXC_PAD_SD1_STROBE___GPIO3_IO_BIT18

IOMUXC_PAD_SD1_STROBE___XSPI_DQS

IOMUXC_PAD_SD2_VSELECT___USDHC2_VSELECT

IOMUXC_PAD_SD2_VSELECT___USDHC2_WP

IOMUXC_PAD_SD2_VSELECT___LPTMR2_ALT3

IOMUXC_PAD_SD2_VSELECT___FLEXIO1_FLEXIO_BIT19

IOMUXC_PAD_SD2_VSELECT___GPIO3_IO_BIT19

IOMUXC_PAD_SD2_VSELECT___EXT_CLK1

IOMUXC_PAD_SD3_CLK___USDHC3_CLK

IOMUXC_PAD_SD3_CLK___FLEXSPI1_A_SCLK

IOMUXC_PAD_SD3_CLK___SAI5_TX_DATA_BIT1

IOMUXC_PAD_SD3_CLK___SAI5_RX_DATA_BIT0

IOMUXC_PAD_SD3_CLK___FLEXIO1_FLEXIO_BIT20

IOMUXC_PAD_SD3_CLK___GPIO3_IO_BIT20

IOMUXC_PAD_SD3_CLK___XSPI_CLK

IOMUXC_PAD_SD3_CMD___USDHC3_CMD

IOMUXC_PAD_SD3_CMD___FLEXSPI1_A_SS0_B

IOMUXC_PAD_SD3_CMD___SAI5_TX_DATA_BIT2

IOMUXC_PAD_SD3_CMD___SAI5_RX_SYNC

IOMUXC_PAD_SD3_CMD___FLEXIO1_FLEXIO_BIT21

IOMUXC_PAD_SD3_CMD___GPIO3_IO_BIT21

IOMUXC_PAD_SD3_CMD___XSPI_CS

IOMUXC_PAD_SD3_DATA0___USDHC3_DATA0

IOMUXC_PAD_SD3_DATA0___FLEXSPI1_A_DATA_BIT0

IOMUXC_PAD_SD3_DATA0___SAI5_TX_DATA_BIT3

IOMUXC_PAD_SD3_DATA0___SAI5_RX_BCLK

IOMUXC_PAD_SD3_DATA0___FLEXIO1_FLEXIO_BIT22

IOMUXC_PAD_SD3_DATA0___GPIO3_IO_BIT22

IOMUXC_PAD_SD3_DATA0___XSPI_DATA_BIT0

IOMUXC_PAD_SD3_DATA1___USDHC3_DATA1

IOMUXC_PAD_SD3_DATA1___FLEXSPI1_A_DATA_BIT1

IOMUXC_PAD_SD3_DATA1___SAI5_RX_DATA_BIT1

IOMUXC_PAD_SD3_DATA1___SAI5_TX_DATA_BIT0

IOMUXC_PAD_SD3_DATA1___FLEXIO1_FLEXIO_BIT23

IOMUXC_PAD_SD3_DATA1___GPIO3_IO_BIT23

IOMUXC_PAD_SD3_DATA1___XSPI_DATA_BIT1

IOMUXC_PAD_SD3_DATA2___USDHC3_DATA2

IOMUXC_PAD_SD3_DATA2___FLEXSPI1_A_DATA_BIT2

IOMUXC_PAD_SD3_DATA2___SAI5_RX_DATA_BIT2

IOMUXC_PAD_SD3_DATA2___SAI5_TX_SYNC

IOMUXC_PAD_SD3_DATA2___FLEXIO1_FLEXIO_BIT24

IOMUXC_PAD_SD3_DATA2___GPIO3_IO_BIT24

IOMUXC_PAD_SD3_DATA2___XSPI_DATA_BIT2

IOMUXC_PAD_SD3_DATA3___USDHC3_DATA3

IOMUXC_PAD_SD3_DATA3___FLEXSPI1_A_DATA_BIT3

IOMUXC_PAD_SD3_DATA3___SAI5_RX_DATA_BIT3

IOMUXC_PAD_SD3_DATA3___SAI5_TX_BCLK

IOMUXC_PAD_SD3_DATA3___FLEXIO1_FLEXIO_BIT25

IOMUXC_PAD_SD3_DATA3___GPIO3_IO_BIT25

IOMUXC_PAD_SD3_DATA3___XSPI_DATA_BIT3

IOMUXC_PAD_XSPI1_DATA0___FLEXSPI1_A_DATA_BIT0

IOMUXC_PAD_XSPI1_DATA0___SAI2_TX_DATA_BIT4

IOMUXC_PAD_XSPI1_DATA0___SAI4_TX_BCLK

IOMUXC_PAD_XSPI1_DATA0___SAI4_RX_DATA_BIT1

IOMUXC_PAD_XSPI1_DATA0___XSPI_DATA_BIT0

IOMUXC_PAD_XSPI1_DATA0___GPIO5_IO_BIT0

IOMUXC_PAD_XSPI1_DATA1___FLEXSPI1_A_DATA_BIT1

IOMUXC_PAD_XSPI1_DATA1___SAI2_TX_DATA_BIT5

IOMUXC_PAD_XSPI1_DATA1___SAI4_TX_SYNC

IOMUXC_PAD_XSPI1_DATA1___SAI4_TX_DATA_BIT1

IOMUXC_PAD_XSPI1_DATA1___XSPI_DATA_BIT1

IOMUXC_PAD_XSPI1_DATA1___GPIO5_IO_BIT1

IOMUXC_PAD_XSPI1_DATA2___FLEXSPI1_A_DATA_BIT2

IOMUXC_PAD_XSPI1_DATA2___SAI2_TX_DATA_BIT6

IOMUXC_PAD_XSPI1_DATA2___SAI4_TX_DATA_BIT0

IOMUXC_PAD_XSPI1_DATA2___XSPI_DATA_BIT2

IOMUXC_PAD_XSPI1_DATA2___GPIO5_IO_BIT2

IOMUXC_PAD_XSPI1_DATA3___FLEXSPI1_A_DATA_BIT3

IOMUXC_PAD_XSPI1_DATA3___SAI2_TX_DATA_BIT7

IOMUXC_PAD_XSPI1_DATA3___SAI4_RX_DATA_BIT0

IOMUXC_PAD_XSPI1_DATA3___XSPI_DATA_BIT3

IOMUXC_PAD_XSPI1_DATA3___GPIO5_IO_BIT3

IOMUXC_PAD_XSPI1_DATA4___FLEXSPI1_A_DATA_BIT4

IOMUXC_PAD_XSPI1_DATA4___SAI5_TX_DATA_BIT0

IOMUXC_PAD_XSPI1_DATA4___SAI5_RX_DATA_BIT1

IOMUXC_PAD_XSPI1_DATA4___XSPI_DATA_BIT4

IOMUXC_PAD_XSPI1_DATA4___GPIO5_IO_BIT4

IOMUXC_PAD_XSPI1_DATA5___FLEXSPI1_A_DATA_BIT5

IOMUXC_PAD_XSPI1_DATA5___SAI5_TX_SYNC

IOMUXC_PAD_XSPI1_DATA5___SAI5_RX_DATA_BIT2

IOMUXC_PAD_XSPI1_DATA5___SAI2_RX_DATA_BIT6

IOMUXC_PAD_XSPI1_DATA5___XSPI_DATA_BIT5

IOMUXC_PAD_XSPI1_DATA5___GPIO5_IO_BIT5

IOMUXC_PAD_XSPI1_DATA6___FLEXSPI1_A_DATA_BIT6

IOMUXC_PAD_XSPI1_DATA6___SAI5_TX_BCLK

IOMUXC_PAD_XSPI1_DATA6___SAI5_RX_DATA_BIT3

IOMUXC_PAD_XSPI1_DATA6___SAI2_RX_DATA_BIT7

IOMUXC_PAD_XSPI1_DATA6___XSPI_DATA_BIT6

IOMUXC_PAD_XSPI1_DATA6___GPIO5_IO_BIT6

IOMUXC_PAD_XSPI1_DATA7___FLEXSPI1_A_DATA_BIT7

IOMUXC_PAD_XSPI1_DATA7___SAI5_RX_DATA_BIT0

IOMUXC_PAD_XSPI1_DATA7___SAI5_TX_DATA_BIT1

IOMUXC_PAD_XSPI1_DATA7___XSPI_DATA_BIT7

IOMUXC_PAD_XSPI1_DATA7___GPIO5_IO_BIT7

IOMUXC_PAD_XSPI1_DQS___FLEXSPI1_A_DQS

IOMUXC_PAD_XSPI1_DQS___SAI5_RX_SYNC

IOMUXC_PAD_XSPI1_DQS___SAI5_TX_DATA_BIT2

IOMUXC_PAD_XSPI1_DQS___SAI2_RX_DATA_BIT6

IOMUXC_PAD_XSPI1_DQS___XSPI_DQS

IOMUXC_PAD_XSPI1_DQS___GPIO5_IO_BIT8

IOMUXC_PAD_XSPI1_SCLK___FLEXSPI1_A_SCLK

IOMUXC_PAD_XSPI1_SCLK___SAI2_RX_DATA_BIT4

IOMUXC_PAD_XSPI1_SCLK___SAI4_RX_SYNC

IOMUXC_PAD_XSPI1_SCLK___EARC_DC_HPD_IN

IOMUXC_PAD_XSPI1_SCLK___XSPI_CLK

IOMUXC_PAD_XSPI1_SCLK___GPIO5_IO_BIT9

IOMUXC_PAD_XSPI1_SS0_B___FLEXSPI1_A_SS0_B

IOMUXC_PAD_XSPI1_SS0_B___SAI2_RX_DATA_BIT5

IOMUXC_PAD_XSPI1_SS0_B___SAI4_RX_BCLK

IOMUXC_PAD_XSPI1_SS0_B___EARC_CEC_OUT

IOMUXC_PAD_XSPI1_SS0_B___XSPI_CS

IOMUXC_PAD_XSPI1_SS0_B___GPIO5_IO_BIT10

IOMUXC_PAD_XSPI1_SS1_B___FLEXSPI1_A_SS1_B

IOMUXC_PAD_XSPI1_SS1_B___SAI5_RX_BCLK

IOMUXC_PAD_XSPI1_SS1_B___SAI5_TX_DATA_BIT3

IOMUXC_PAD_XSPI1_SS1_B___SAI2_RX_DATA_BIT7

IOMUXC_PAD_XSPI1_SS1_B___GPIO5_IO_BIT11

IOMUXC_PAD_SD2_CD_B___USDHC2_CD_B

IOMUXC_PAD_SD2_CD_B___NETC_TMR_1588_TRIG1

IOMUXC_PAD_SD2_CD_B___I3C2_SCL

IOMUXC_PAD_SD2_CD_B___FLEXIO1_FLEXIO_BIT0

IOMUXC_PAD_SD2_CD_B___GPIO3_IO_BIT0

IOMUXC_PAD_SD2_CLK___USDHC2_CLK

IOMUXC_PAD_SD2_CLK___NETC_TMR_1588_PP1

IOMUXC_PAD_SD2_CLK___I3C2_SDA

IOMUXC_PAD_SD2_CLK___FLEXIO1_FLEXIO_BIT1

IOMUXC_PAD_SD2_CLK___GPIO3_IO_BIT1

IOMUXC_PAD_SD2_CLK___OBSERVE_0

IOMUXC_PAD_SD2_CMD___USDHC2_CMD

IOMUXC_PAD_SD2_CMD___NETC_TMR_1588_TRIG2

IOMUXC_PAD_SD2_CMD___I3C2_PUR

IOMUXC_PAD_SD2_CMD___I3C2_PUR_B

IOMUXC_PAD_SD2_CMD___FLEXIO1_FLEXIO_BIT2

IOMUXC_PAD_SD2_CMD___GPIO3_IO_BIT2

IOMUXC_PAD_SD2_CMD___OBSERVE_1

IOMUXC_PAD_SD2_DATA0___USDHC2_DATA0

IOMUXC_PAD_SD2_DATA0___NETC_TMR_1588_PP2

IOMUXC_PAD_SD2_DATA0___CAN2_TX

IOMUXC_PAD_SD2_DATA0___FLEXIO1_FLEXIO_BIT3

IOMUXC_PAD_SD2_DATA0___GPIO3_IO_BIT3

IOMUXC_PAD_SD2_DATA0___OBSERVE_2

IOMUXC_PAD_SD2_DATA1___USDHC2_DATA1

IOMUXC_PAD_SD2_DATA1___NETC_TMR_1588_CLK

IOMUXC_PAD_SD2_DATA1___CAN2_RX

IOMUXC_PAD_SD2_DATA1___FLEXIO1_FLEXIO_BIT4

IOMUXC_PAD_SD2_DATA1___GPIO3_IO_BIT4

IOMUXC_PAD_SD2_DATA2___USDHC2_DATA2

IOMUXC_PAD_SD2_DATA2___NETC_TMR_1588_PP3

IOMUXC_PAD_SD2_DATA2___MQS2_RIGHT

IOMUXC_PAD_SD2_DATA2___FLEXIO1_FLEXIO_BIT5

IOMUXC_PAD_SD2_DATA2___GPIO3_IO_BIT5

IOMUXC_PAD_SD2_DATA3___USDHC2_DATA3

IOMUXC_PAD_SD2_DATA3___LPTMR2_ALT1

IOMUXC_PAD_SD2_DATA3___MQS2_LEFT

IOMUXC_PAD_SD2_DATA3___NETC_TMR_1588_ALARM1

IOMUXC_PAD_SD2_DATA3___FLEXIO1_FLEXIO_BIT6

IOMUXC_PAD_SD2_DATA3___GPIO3_IO_BIT6

IOMUXC_PAD_SD2_RESET_B___USDHC2_RESET_B

IOMUXC_PAD_SD2_RESET_B___LPTMR2_ALT2

IOMUXC_PAD_SD2_RESET_B___NETC_TMR_1588_GCLK

IOMUXC_PAD_SD2_RESET_B___FLEXIO1_FLEXIO_BIT7

IOMUXC_PAD_SD2_RESET_B___GPIO3_IO_BIT7

IOMUXC_PAD_I2C1_SCL___LPI2C1_SCL

IOMUXC_PAD_I2C1_SCL___I3C1_SCL

IOMUXC_PAD_I2C1_SCL___LPUART1_DCD_B

IOMUXC_PAD_I2C1_SCL___TPM2_CH0

IOMUXC_PAD_I2C1_SCL___UART_RX

IOMUXC_PAD_I2C1_SCL___GPIO1_IO_BIT0

IOMUXC_PAD_I2C1_SDA___LPI2C1_SDA

IOMUXC_PAD_I2C1_SDA___I3C1_SDA

IOMUXC_PAD_I2C1_SDA___LPUART1_RIN_B

IOMUXC_PAD_I2C1_SDA___TPM2_CH1

IOMUXC_PAD_I2C1_SDA___UART_TX

IOMUXC_PAD_I2C1_SDA___GPIO1_IO_BIT1

IOMUXC_PAD_I2C2_SCL___LPI2C2_SCL

IOMUXC_PAD_I2C2_SCL___I3C1_PUR

IOMUXC_PAD_I2C2_SCL___LPUART2_DCD_B

IOMUXC_PAD_I2C2_SCL___TPM2_CH2

IOMUXC_PAD_I2C2_SCL___SAI1_RX_SYNC

IOMUXC_PAD_I2C2_SCL___GPIO1_IO_BIT2

IOMUXC_PAD_I2C2_SCL___I3C1_PUR_B

IOMUXC_PAD_I2C2_SDA___LPI2C2_SDA

IOMUXC_PAD_I2C2_SDA___LPUART2_RIN_B

IOMUXC_PAD_I2C2_SDA___TPM2_CH3

IOMUXC_PAD_I2C2_SDA___SAI1_RX_BCLK

IOMUXC_PAD_I2C2_SDA___GPIO1_IO_BIT3

IOMUXC_PAD_UART1_RXD___LPUART1_RX

IOMUXC_PAD_UART1_RXD___S400_UART_RX

IOMUXC_PAD_UART1_RXD___LPSPI2_SIN

IOMUXC_PAD_UART1_RXD___TPM1_CH0

IOMUXC_PAD_UART1_RXD___GPIO1_IO_BIT4

IOMUXC_PAD_UART1_TXD___LPUART1_TX

IOMUXC_PAD_UART1_TXD___S400_UART_TX

IOMUXC_PAD_UART1_TXD___LPSPI2_PCS0

IOMUXC_PAD_UART1_TXD___TPM1_CH1

IOMUXC_PAD_UART1_TXD___GPIO1_IO_BIT5

IOMUXC_PAD_UART2_RXD___LPUART2_RX

IOMUXC_PAD_UART2_RXD___LPUART1_CTS_B

IOMUXC_PAD_UART2_RXD___LPSPI2_SOUT

IOMUXC_PAD_UART2_RXD___TPM1_CH2

IOMUXC_PAD_UART2_RXD___SAI1_MCLK

IOMUXC_PAD_UART2_RXD___GPIO1_IO_BIT6

IOMUXC_PAD_UART2_TXD___LPUART2_TX

IOMUXC_PAD_UART2_TXD___LPUART1_RTS_B

IOMUXC_PAD_UART2_TXD___LPSPI2_SCK

IOMUXC_PAD_UART2_TXD___TPM1_CH3

IOMUXC_PAD_UART2_TXD___GPIO1_IO_BIT7

IOMUXC_PAD_PDM_CLK___PDM_CLK

IOMUXC_PAD_PDM_CLK___MQS1_LEFT

IOMUXC_PAD_PDM_CLK___LPTMR1_ALT1

IOMUXC_PAD_PDM_CLK___GPIO1_IO_BIT8

IOMUXC_PAD_PDM_CLK___CAN1_TX

IOMUXC_PAD_PDM_BIT_STREAM0___PDM_BIT_STREAM_BIT0

IOMUXC_PAD_PDM_BIT_STREAM0___MQS1_RIGHT

IOMUXC_PAD_PDM_BIT_STREAM0___LPSPI1_PCS1

IOMUXC_PAD_PDM_BIT_STREAM0___TPM1_EXTCLK

IOMUXC_PAD_PDM_BIT_STREAM0___LPTMR1_ALT2

IOMUXC_PAD_PDM_BIT_STREAM0___GPIO1_IO_BIT9

IOMUXC_PAD_PDM_BIT_STREAM0___CAN1_RX

IOMUXC_PAD_PDM_BIT_STREAM1___PDM_BIT_STREAM_BIT1

IOMUXC_PAD_PDM_BIT_STREAM1___NMI_GLUE_NMI

IOMUXC_PAD_PDM_BIT_STREAM1___LPSPI2_PCS1

IOMUXC_PAD_PDM_BIT_STREAM1___TPM2_EXTCLK

IOMUXC_PAD_PDM_BIT_STREAM1___LPTMR1_ALT3

IOMUXC_PAD_PDM_BIT_STREAM1___GPIO1_IO_BIT10

IOMUXC_PAD_PDM_BIT_STREAM1___EXT_CLK1

IOMUXC_PAD_SAI1_TXFS___SAI1_TX_SYNC

IOMUXC_PAD_SAI1_TXFS___SAI1_TX_DATA_BIT1

IOMUXC_PAD_SAI1_TXFS___LPSPI1_PCS0

IOMUXC_PAD_SAI1_TXFS___LPUART2_DTR_B

IOMUXC_PAD_SAI1_TXFS___MQS1_LEFT

IOMUXC_PAD_SAI1_TXFS___GPIO1_IO_BIT11

IOMUXC_PAD_SAI1_TXC___SAI1_TX_BCLK

IOMUXC_PAD_SAI1_TXC___LPUART2_CTS_B

IOMUXC_PAD_SAI1_TXC___LPSPI1_SIN

IOMUXC_PAD_SAI1_TXC___LPUART1_DSR_B

IOMUXC_PAD_SAI1_TXC___CAN1_RX

IOMUXC_PAD_SAI1_TXC___GPIO1_IO_BIT12

IOMUXC_PAD_SAI1_TXD0___SAI1_TX_DATA_BIT0

IOMUXC_PAD_SAI1_TXD0___LPUART2_RTS_B

IOMUXC_PAD_SAI1_TXD0___LPSPI1_SCK

IOMUXC_PAD_SAI1_TXD0___LPUART1_DTR_B

IOMUXC_PAD_SAI1_TXD0___CAN1_TX

IOMUXC_PAD_SAI1_TXD0___GPIO1_IO_BIT13

IOMUXC_PAD_SAI1_RXD0___SAI1_RX_DATA_BIT0

IOMUXC_PAD_SAI1_RXD0___SAI1_MCLK

IOMUXC_PAD_SAI1_RXD0___LPSPI1_SOUT

IOMUXC_PAD_SAI1_RXD0___LPUART2_DSR_B

IOMUXC_PAD_SAI1_RXD0___MQS1_RIGHT

IOMUXC_PAD_SAI1_RXD0___GPIO1_IO_BIT14

IOMUXC_PAD_WDOG_ANY___WDOG_ANY

IOMUXC_PAD_WDOG_ANY___FCCU_EOUT1

IOMUXC_PAD_WDOG_ANY___GPIO1_IO_BIT15

IOMUXC_PAD_MUX_MODE_MASK

IOMUXC_PAD_MUX_MODE_SHIFT

IOMUXC_PAD_MUX_MODE(**x**)

IOMUXC_PAD_SION_MASK

IOMUXC_PAD_SION_SHIFT

IOMUXC_PAD_SION(**x**)

IOMUXC_PAD_DSE_MASK

IOMUXC_PAD_DSE_SHIFT

IOMUXC_PAD_DSE(**x**)

IOMUXC_PAD_FSEL1_MASK

IOMUXC_PAD_FSEL1_SHIFT

IOMUXC_PAD_FSEL1(x)

IOMUXC_PAD_PU_MASK

IOMUXC_PAD_PU_SHIFT

IOMUXC_PAD_PU(x)

IOMUXC_PAD_PD_MASK

IOMUXC_PAD_PD_SHIFT

IOMUXC_PAD_PD(x)

IOMUXC_PAD_OD_MASK

IOMUXC_PAD_OD_SHIFT

IOMUXC_PAD_OD(x)

IOMUXC_PAD_HYS_MASK

IOMUXC_PAD_HYS_SHIFT

IOMUXC_PAD_HYS(x)

IOMUXC_PAD_APC_MASK

IOMUXC_PAD_APC_SHIFT

IOMUXC_PAD_APC(x)

FSL_COMPONENT_ID

2.34 IRQSTEER: Interrupt Request Steering Driver

void IRQSTEER_Init(IRQSTEER_Type *base)

Initializes the IRQSTEER module.

This function enables the clock gate for the specified IRQSTEER.

Parameters

- base – IRQSTEER peripheral base address.

void IRQSTEER_Deinit(IRQSTEER_Type *base)

Deinitializes an IRQSTEER instance for operation.

The clock gate for the specified IRQSTEER is disabled.

Parameters

- base – IRQSTEER peripheral base address.

static inline void IRQSTEER_EnableInterrupt(IRQSTEER_Type *base, IRQn_Type irq)

Enables an interrupt source.

Parameters

- base – IRQSTEER peripheral base address.
- irq – Interrupt to be routed. The interrupt must be an IRQSTEER source.

static inline void IRQSTEER_DisableInterrupt(IRQSTEER_Type *base, IRQn_Type irq)

Disables an interrupt source.

Parameters

- base – IRQSTEER peripheral base address.
- irq – Interrupt source number. The interrupt must be an IRQSTEER source.

static inline bool IRQSTEER_InterruptIsEnabled(IRQSTEER_Type *base, IRQn_Type irq)

Check if an interrupt source is enabled.

Parameters

- base – IRQSTEER peripheral base address.
- irq – Interrupt to be queried. The interrupt must be an IRQSTEER source.

Returns

true if the interrupt is not masked, false otherwise.

static inline void IRQSTEER_SetInterrupt(IRQSTEER_Type *base, IRQn_Type irq, bool set)

Sets/Forces an interrupt.

Note: This function is not affected by the function IRQSTEER_DisableInterrupt and IRQSTEER_EnableInterrupt.

Parameters

- base – IRQSTEER peripheral base address.
- irq – Interrupt to be set/forced. The interrupt must be an IRQSTEER source.
- set – Switcher of the interrupt set/force function. "true" means to set. "false" means not (normal operation).

static inline void IRQSTEER_EnableMasterInterrupt(IRQSTEER_Type *base,
irqsteer_int_master_t intMasterIndex)

Enables a master interrupt. By default, all the master interrupts are enabled.

For example, to enable the interrupt sources of master 1:

```
IRQSTEER_EnableMasterInterrupt(IRQSTEER_M4_0, kIRQSTEER_InterruptMaster1);
```

Parameters

- base – IRQSTEER peripheral base address.
- intMasterIndex – Master index of interrupt sources to be routed, options available in enumeration irqsteer_int_master_t.

static inline void IRQSTEER_DisableMasterInterrupt(IRQSTEER_Type *base,
irqsteer_int_master_t intMasterIndex)

Disables a master interrupt.

For example, to disable the interrupt sources of master 1:

```
IRQSTEER_DisableMasterInterrupt(IRQSTEER_M4_0, kIRQSTEER_InterruptMaster1);
```

Parameters

- base – IRQSTEER peripheral base address.
- intMasterIndex – Master index of interrupt sources to be disabled, options available in enumeration irqsteer_int_master_t.

static inline bool IRQSTEER_IsInterruptSet(IRQSTEER_Type *base, IRQn_Type irq)

Checks the status of one specific IRQSTEER interrupt.

For example, to check whether interrupt from output 0 of Display 1 is set:

```
if (IRQSTEER_IsInterruptSet(IRQSTEER_DISPLAY1_INT_OUT0)
{
    ...
}
```

Parameters

- base – IRQSTEER peripheral base address.
- irq – Interrupt source status to be checked. The interrupt must be an IRQSTEER source.

Returns

The interrupt status. “true” means interrupt set. “false” means not.

static inline bool IRQSTEER_IsMasterInterruptSet(IRQSTEER_Type *base)

Checks the status of IRQSTEER master interrupt. The master interrupt status represents at least one interrupt is asserted or not among ALL interrupts.

Note: The master interrupt status is not affected by the function IRQSTEER_DisableMasterInterrupt.

Parameters

- base – IRQSTEER peripheral base address.

Returns

The master interrupt status. “true” means at least one interrupt set. “false” means not.

static inline uint32_t IRQSTEER_GetGroupInterruptStatus(IRQSTEER_Type *base, *irqsteer_int_group_t* intGroupIndex)

Gets the status of IRQSTEER group interrupt. The group interrupt status represents all the interrupt status within the group specified. This API aims for facilitating the status return of one set of interrupts.

Parameters

- base – IRQSTEER peripheral base address.
- intGroupIndex – Index of the interrupt group status to get.

Returns

The mask of the group interrupt status. Bit[n] set means the source with bit offset n in group intGroupIndex of IRQSTEER is asserted.

IRQn_Type IRQSTEER_GetMasterNextInterrupt(IRQSTEER_Type *base, *irqsteer_int_master_t* intMasterIndex)

Gets the next interrupt source (currently set) of one specific master.

Parameters

- base – IRQSTEER peripheral base address.

- intMasterIndex – Master index of interrupt sources, options available in enumeration irqsteer_int_master_t.

Returns

The current set next interrupt source number of one specific master. Return IRQSTEER_INT_Invalid if no interrupt set.

uint32_t IRQSTEER_GetMasterIrqCount(IRQSTEER_Type *base, *irqsteer_int_master_t* intMasterIndex)

Get the number of interrupt for a given master.

Parameters

- base – IRQSTEER peripheral base address.
- intMasterIndex – Master index of interrupt sources, options available in enumeration irqsteer_int_master_t.

Returns

Number of interrupts for a given master.

uint64_t IRQSTEER_GetMasterInterruptsStatus(IRQSTEER_Type *base, *irqsteer_int_master_t* intMasterIndex)

Get the status of the interrupts a master is in charge of.

What this function does is it takes the CHn_STATUS registers associated with the interrupts a master is in charge of and puts them in 64-bit variable. The order they are put in the 64-bit variable is the following: CHn_STATUS[i] : CHn_STATUS[i + 1], where CHn_STATUS[i + 1] is placed in the least significant half of the 64-bit variable. Assuming a master is in charge of 64 interrupts, the user may use the result of this function as such: BIT(i) & IRQSTEER_GetMasterInterrupts() to check if interrupt i is asserted.

Parameters

- base – IRQSTEER peripheral base address.
- intMasterIndex – Master index of interrupt sources, options available in enumeration irqsteer_int_master_t.

Returns

64-bit variable containing the status of the interrupts a master is in charge of.

FSL_IRQSTEER_DRIVER_VERSION

Driver version.

enum _irqsteer_int_group

IRQSTEER interrupt groups.

Values:

enumerator kIRQSTEER_InterruptGroup0

Interrupt Group 0: interrupt source 31 - 0

enumerator kIRQSTEER_InterruptGroup1

Interrupt Group 1: interrupt source 63 - 32

enumerator kIRQSTEER_InterruptGroup2

Interrupt Group 2: interrupt source 95 - 64

enumerator kIRQSTEER_InterruptGroup3

Interrupt Group 3: interrupt source 127 - 96

enumerator kIRQSTEER_InterruptGroup4

Interrupt Group 4: interrupt source 159 - 128

enumerator kIRQSTEER_InterruptGroup5
Interrupt Group 5: interrupt source 191 - 160

enumerator kIRQSTEER_InterruptGroup6
Interrupt Group 6: interrupt source 223 - 192

enumerator kIRQSTEER_InterruptGroup7
Interrupt Group 7: interrupt source 255 - 224

enumerator kIRQSTEER_InterruptGroup8
Interrupt Group 8: interrupt source 287 - 256

enumerator kIRQSTEER_InterruptGroup9
Interrupt Group 9: interrupt source 319 - 288

enumerator kIRQSTEER_InterruptGroup10
Interrupt Group 10: interrupt source 351 - 320

enumerator kIRQSTEER_InterruptGroup11
Interrupt Group 11: interrupt source 383 - 352

enumerator kIRQSTEER_InterruptGroup12
Interrupt Group 12: interrupt source 415 - 384

enumerator kIRQSTEER_InterruptGroup13
Interrupt Group 13: interrupt source 447 - 416

enumerator kIRQSTEER_InterruptGroup14
Interrupt Group 14: interrupt source 479 - 448

enumerator kIRQSTEER_InterruptGroup15
Interrupt Group 15: interrupt source 511 - 480

enum _irqsteer_int_master
IRQSTEER master interrupts mapping.

Values:

enumerator kIRQSTEER_InterruptMaster0
Interrupt Master 0: interrupt source 63 - 0

enumerator kIRQSTEER_InterruptMaster1
Interrupt Master 1: interrupt source 127 - 64

enumerator kIRQSTEER_InterruptMaster2
Interrupt Master 2: interrupt source 191 - 128

enumerator kIRQSTEER_InterruptMaster3
Interrupt Master 3: interrupt source 255 - 192

enumerator kIRQSTEER_InterruptMaster4
Interrupt Master 4: interrupt source 319 - 256

enumerator kIRQSTEER_InterruptMaster5
Interrupt Master 5: interrupt source 383 - 320

enumerator kIRQSTEER_InterruptMaster6
Interrupt Master 6: interrupt source 447 - 384

enumerator kIRQSTEER_InterruptMaster7
Interrupt Master 7: interrupt source 511 - 448

typedef enum *_irqsteer_int_group* irqsteer_int_group_t

IRQSTEER interrupt groups.

typedef enum *_irqsteer_int_master* irqsteer_int_master_t

IRQSTEER master interrupts mapping.

FSL_IRQSTEER_USE_DRIVER_IRQ_HANDLER

Use the IRQSTEER driver IRQ Handler or not.

When define as 1, IRQSTEER driver implements the IRQSTEER ISR, otherwise user shall implement it. Currently the IRQSTEER ISR is only available for Cortex-M platforms.

FSL_IRQSTEER_ENABLE_MASTER_INT

IRQSTEER_Init/IRQSTEER_Deinit enables/disables IRQSTEER master interrupt or not.

When define as 1, IRQSTEER_Init will enable the IRQSTEER master interrupt in system level interrupt controller (such as NVIC, GIC), IRQSTEER_Deinit will disable it. Otherwise IRQSTEER_Init/IRQSTEER_Deinit won't touch.

IRQSTEER_INT_SRC_REG_WIDTH

IRQSTEER interrupt source register width.

IRQSTEER_INT_MASTER_AGGREGATED_INT_NUM

IRQSTEER aggregated interrupt source number for each master.

IRQSTEER_INT_SRC_REG_INDEX(irq)

IRQSTEER interrupt source mapping register index.

IRQSTEER_INT_SRC_BIT_OFFSET(irq)

IRQSTEER interrupt source mapping bit offset.

IRQSTEER_INT_SRC_NUM(regIndex, bitOffset)

IRQSTEER interrupt source number.

2.35 ISI: Image Sensing Interface

void ISI_Init(ISI_Type *base)

Initializes the ISI peripheral.

This function ungates the ISI clock, it should be called before any other ISI functions.

Parameters

- base – ISI peripheral base address.

void ISI_Deinit(ISI_Type *base)

Deinitializes the ISI peripheral.

This function gates the ISI clock.

Parameters

- base – ISI peripheral base address.

void ISI_Reset(ISI_Type *base)

Reset the ISI peripheral.

This function resets the ISI channel processing pipeline similar to a hardware reset. The channel will need to be reconfigured after reset before it can be used.

Parameters

- base – ISI peripheral base address.

static inline uint32_t ISI_EnableInterrupts(ISI_Type *base, uint32_t mask)

Enables ISI interrupts.

Parameters

- base – ISI peripheral base address
- mask – Interrupt source, OR'ed value of _isi_interrupt.

Returns

OR'ed value of the enabled interrupts before calling this function.

static inline uint32_t ISI_DisableInterrupts(ISI_Type *base, uint32_t mask)

Disables ISI interrupts.

Parameters

- base – ISI peripheral base address
- mask – Interrupt source, OR'ed value of _isi_interrupt.

Returns

OR'ed value of the enabled interrupts before calling this function.

static inline uint32_t ISI_GetInterruptStatus(ISI_Type *base)

Get the ISI interrupt pending flags.

All interrupt pending flags are returned, upper layer could compare with the OR'ed value of _isi_interrupt. For example, to check whether memory read completed, use like this:

```
uint32_t mask = ISI_GetInterruptStatus(ISI);
if (mask & kISI_MemReadCompletedInterrupt)
{
    memory read completed
}
```

Parameters

- base – ISI peripheral base address

Returns

The OR'ed value of the pending interrupt flags. of _isi_interrupt.

static inline void ISI_ClearInterruptStatus(ISI_Type *base, uint32_t mask)

Clear ISI interrupt pending flags.

This function could clear one or more flags at one time, the flags to clear are passed in as an OR'ed value of _isi_interrupt. For example, to clear both line received interrupt flag and frame received flag, use like this:

```
ISI_ClearInterruptStatus(ISI, kISI_LineReceivedInterrupt | kISI_FrameReceivedInterrupt);
```

Parameters

- base – ISI peripheral base address
- mask – The flags to clear, it is OR'ed value of _isi_interrupt.

void ISI_SetScalerConfig(ISI_Type *base, uint16_t inputWidth, uint16_t inputHeight, uint16_t outputWidth, uint16_t outputHeight)

Set the ISI channel scaler configurations.

This function sets the scaling configurations. If the ISI channel is bypassed, then the scaling feature could not be used.

ISI only supports down scaling but not up scaling.

Note: Total bytes in one line after down scaling must be more than 256 bytes.

Parameters

- base – ISI peripheral base address
- inputWidth – Input image width.
- inputHeight – Input image height.
- outputWidth – Output image width.
- outputHeight – Output image height.

void ISI_SetColorSpaceConversionConfig(ISI_Type *base, const *isi_csc_config_t* *config)

Set the ISI color space conversion configurations.

This function sets the color space conversion configurations. After setting the configuration, use the function ISI_EnableColorSpaceConversion to enable this feature. If the ISI channel is bypassed, then the color space conversion feature could not be used.

Parameters

- base – ISI peripheral base address
- config – Pointer to the configuration structure.

void ISI_ColorSpaceConversionGetDefaultConfig(*isi_csc_config_t* *config)

Get the ISI color space conversion default configurations.

The default value is:

```
config->mode = kISI_CscYUV2RGB;
config->A1 = 0.0;
config->A2 = 0.0;
config->A3 = 0.0;
config->B1 = 0.0;
config->B2 = 0.0;
config->B3 = 0.0;
config->C1 = 0.0;
config->C2 = 0.0;
config->C3 = 0.0;
config->D1 = 0;
config->D2 = 0;
config->D3 = 0;
```

Parameters

- config – Pointer to the configuration structure.

static inline void ISI_EnableColorSpaceConversion(ISI_Type *base, bool enable)

Enable or disable the ISI color space conversion.

If the ISI channel is bypassed, then the color space conversion feature could not be used even enable using this function.

Note: The CSC is enabled by default. Disable it if it is not required.

Parameters

- base – ISI peripheral base address
- enable – True to enable, false to disable.

void ISI_SetCropConfig(ISI_Type *base, const *isi_crop_config_t* *config)

Set the ISI cropping configurations.

This function sets the cropping configurations. After setting the configuration, use the function ISI_EnableCrop to enable the feature. Cropping still works when the ISI channel is bypassed.

Note: The upper left corner and lower right corner should be configured base on the image resolution output from the scaler.

Parameters

- base – ISI peripheral base address
- config – Pointer to the configuration structure.

void ISI_CropGetDefaultConfig(*isi_crop_config_t* *config)

Get the ISI cropping default configurations.

The default value is:

```
config->upperLeftX = 0U;
config->upperLeftY = 0U;
config->lowerRightX = 0U;
config->lowerRightY = 0U;
```

Parameters

- config – Pointer to the configuration structure.

static inline void ISI_EnableCrop(ISI_Type *base, bool enable)

Enable or disable the ISI cropping.

If the ISI channel is bypassed, the cropping still works.

Parameters

- base – ISI peripheral base address
- enable – True to enable, false to disable.

static inline void ISI_SetGlobalAlpha(ISI_Type *base, uint8_t alpha)

Set the global alpha value.

Parameters

- base – ISI peripheral base address
- alpha – The global alpha value.

static inline void ISI_EnableGlobalAlpha(ISI_Type *base, bool enable)

Enable the global alpha insertion.

Alpha still works when channel bypassed.

Parameters

- base – ISI peripheral base address
- enable – True to enable, false to disable.

void ISI_SetRegionAlphaConfig(ISI_Type *base, uint8_t index, const *isi_region_alpha_config_t* *config)

Set the alpha value for region of interest.

Set the alpha insertion configuration for specific region of interest. The function ISI_EnableRegionAlpha could be used to enable the alpha insertion. Alpha insertion still works when channel bypassed.

Note: The upper left corner and lower right corner should be configured base on the image resolution output from the scaler.

Parameters

- base – ISI peripheral base address
- index – Index of the region of interest, Could be 0, 1, 2, and 3.
- config – Pointer to the configuration structure.

void ISI_RegionAlphaGetDefaultConfig(*isi_region_alpha_config_t* *config)

Get the regional alpha insertion default configurations.

The default configuration is:

```
config->upperLeftX = 0U;
config->upperLeftY = 0U;
config->lowerRightX = 0U;
config->lowerRightY = 0U;
config->alpha = 0U;
```

Parameters

- config – Pointer to the configuration structure.

void ISI_EnableRegionAlpha(ISI_Type *base, uint8_t index, bool enable)

Enable or disable the alpha value insertion for region of interest.

Alpha insertion still works when channel bypassed.

Parameters

- base – ISI peripheral base address
- index – Index of the region of interest, Could be 0, 1, 2, and 3.
- enable – True to enable, false to disable.

void ISI_SetInputMemConfig(ISI_Type *base, const *isi_input_mem_config_t* *config)

Set the input memory configuration.

Parameters

- base – ISI peripheral base address
- config – Pointer to the configuration structure.

void ISI_InputMemGetDefaultConfig(*isi_input_mem_config_t* *config)

Get the input memory default configurations.

The default configuration is:

```
config->adddr = 0U;
config->linePitchBytes = 0U;
config->framePitchBytes = 0U;
config->format = kISI_InputMemBGR8P;
```

Parameters

- config – Pointer to the configuration structure.

static inline void ISI_SetInputMemAddr(ISI_Type *base, uint32_t addr)

Set the input memory address.

This function only sets the input memory address, it is used for fast run-time setting.

Parameters

- base – ISI peripheral base address
- addr – Input memory address.

void ISI_TriggerInputMemRead(ISI_Type *base)

Trigger the ISI pipeline to read the input memory.

Parameters

- base – ISI peripheral base address

static inline void ISI_SetFlipMode(ISI_Type *base, *isi_flip_mode_t* mode)

Set the ISI channel flipping mode.

Parameters

- base – ISI peripheral base address
- mode – Flipping mode.

void ISI_SetOutputBufferAddr(ISI_Type *base, uint8_t index, uint32_t addrY, uint32_t addrU, uint32_t addrV)

Set the ISI output buffer address.

This function sets the output buffer address and trigger the ISI to shadow the address, it is used for fast run-time setting.

Parameters

- base – ISI peripheral base address
- index – Index of output buffer, could be 0 and 1.
- addrY – RGB or Luma (Y) output buffer address.
- addrU – Chroma (U/Cb/UV/CbCr) output buffer address.
- addrV – Chroma (V/Cr) output buffer address.

static inline void ISI_Start(ISI_Type *base)

Start the ISI channel.

Start the ISI channel to work, this function should be called after all channel configuration finished.

Parameters

- base – ISI peripheral base address

static inline void ISI_Stop(ISI_Type *base)

Stop the ISI channel.

Parameters

- base – ISI peripheral base address

FSL_ISI_DRIVER_VERSION

ISI driver version.

enum _isi_interrupt

ISI interrupts.

Values:

enumerator kISI_MemReadCompletedInterrupt
Input memory read completed.

enumerator kISI_LineReceivedInterrupt
Line received.

enumerator kISI_FrameReceivedInterrupt
Frame received.

enumerator kISI_AxiWriteErrorVInterrupt
AXI Bus write error when storing V data to memory.

enumerator kISI_AxiWriteErrorUInterrupt
AXI Bus write error when storing U data to memory.

enumerator kISI_AxiWriteErrorYInterrupt
AXI Bus write error when storing Y data to memory.

enumerator kISI_AxiReadErrorInterrupt
AXI Bus error when reading the input memory.

enumerator kISI_OverflowAlertVInterrupt
V output buffer overflow threshold accrossed.

enumerator kISI_ExcessOverflowVInterrupt
V output buffer excess overflow interrupt.

enumerator kISI_OverflowVInterrupt
V output buffer overflow interrupt.

enumerator kISI_OverflowAlertUInterrupt
U output buffer overflow threshold accrossed.

enumerator kISI_ExcessOverflowUInterrupt
U output buffer excess overflow interrupt.

enumerator kISI_OverflowUInterrupt
U output buffer overflow interrupt.

enumerator kISI_OverflowAlertYInterrupt
V output buffer overflow threshold accrossed.

enumerator kISI_ExcessOverflowYInterrupt
V output buffer excess overflow interrupt.

enumerator kISI_OverflowYInterrupt
V output buffer overflow interrupt.

enum _isi_output_format
ISI output image format.

Values:

enumerator kISI_OutputRGBA8888
RGBA8888.

enumerator kISI_OutputABGR8888
ABGR8888.

enumerator kISI_OutputARGB8888
ARGB8888.

enumerator kISI_OutputRGBX8888
RGBX8888 unpacked and MSB aligned in 32-bit.

enumerator kISI_OutputXBGR8888
XBGR8888 unpacked and LSB aligned in 32-bit.

enumerator kISI_OutputXRGB8888
XRGB8888 unpacked and LSB aligned in 32-bit.

enumerator kISI_OutputRGB888
RGB888 packed into 32-bit.

enumerator kISI_OutputBGR888
BGR888 packed into 32-bit.

enumerator kISI_OutputA2BGR10
BGR format with 2-bits alpha in MSB; 10-bits per color component.

enumerator kISI_OutputA2RGB10
RGB format with 2-bits alpha in MSB; 10-bits per color component.

enumerator kISI_OutputRGB565
RGB565 packed into 32-bit.

enumerator kISI_OutputRaw8
8-bit raw data packed into 32-bit.

enumerator kISI_OutputRaw10
10-bit raw data packed into 16-bit with 6 LSBs wasted.

enumerator kISI_OutputRaw10P
10-bit raw data packed into 32-bit.

enumerator kISI_OutputRaw12P
16-bit raw data packed into 16-bit with 4 LSBs wasted.

enumerator kISI_OutputRaw16P
16-bit raw data packed into 32-bit.

enumerator kISI_OutputYUV444_1P8P
8-bits per color component; 1-plane, YUV interleaved packed bytes.

enumerator kISI_OutputYUV444_2P8P
8-bits per color component; 2-plane, UV interleaved packed bytes.

enumerator kISI_OutputYUV444_3P8P
8-bits per color component; 3-plane, non-interleaved packed bytes.

enumerator kISI_OutputYUV444_1P8
8-bits per color component; 1-plane YUV interleaved unpacked bytes (8 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV444_1P10
10-bits per color component; 1-plane, YUV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV444_2P10
10-bits per color component; 2-plane, UV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV444_3P10
10-bits per color component; 3-plane, non-interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV444_1P10P

10-bits per color component; 1-plane, YUV interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV444_2P10P

10-bits per color component; 2-plane, UV interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV444_3P10P

10-bits per color component; 3-plane, non-interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV444_1P12

12-bits per color component; 1-plane, YUV interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV444_2P12

12-bits per color component; 2-plane, UV interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV444_3P12

12-bits per color component; 3-plane, non-interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV422_1P8P

8-bits per color component; 1-plane, YUV interleaved packed bytes.

enumerator kISI_OutputYUV422_2P8P

8-bits per color component; 2-plane, UV interleaved packed bytes.

enumerator kISI_OutputYUV422_3P8P

8-bits per color component; 3-plane, non-interleaved packed bytes.

enumerator kISI_OutputYUV422_1P10

10-bits per color component; 1-plane, YUV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV422_2P10

10-bits per color component; 2-plane, UV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV422_3P10

10-bits per color component; 3-plane, non-interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV422_1P10P

10-bits per color component; 1-plane, YUV interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV422_2P10P

10-bits per color component; 2-plane, UV interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV422_3P10P

10-bits per color component; 3-plane, non-interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV422_1P12

12-bits per color component; 1-plane, YUV interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV422_2P12

12-bits per color component; 2-plane, UV interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV422_3P12

12-bits per color component; 3-plane, non-interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV420_2P8P

8-bits per color component; 2-plane, UV interleaved packed bytes.

enumerator kISI_OutputYUV420_3P8P

8-bits per color component; 3-plane, non-interleaved packed bytes.

enumerator kISI_OutputYUV420_2P10

10-bits per color component; 2-plane, UV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV420_3P10

10-bits per color component; 3-plane, non-interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV420_2P10P

10-bits per color component; 2-plane, UV interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV420_3P10P

10-bits per color component; 3-plane, non-interleaved packed bytes (2 MSBs waste bits in 32-bit DWORD).

enumerator kISI_OutputYUV420_2P12

12-bits per color component; 2-plane, UV interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_OutputYUV420_3P12

12-bits per color component; 3-plane, non-interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enum _isi_chain_mode

ISI line buffer chain mode.

Values:

enumerator kISI_ChainDisable

No line buffers chained, for 2048 or less horizontal resolution.

enumerator kISI_ChainTwo

Line buffers of channel n and n+1 chained, for 4096 horizontal resolution.

enum _isi_deint_mode

ISI de-interlacing mode.

Values:

enumerator kISI_DeintDisable

No de-interlacing.

enumerator kISI_DeintWeaveOddOnTop

Weave de-interlacing (Odd, Even) method used.

enumerator kISI_DeintWeaveEvenOnTop

Weave de-interlacing (Even, Odd) method used.

enumerator kISI_DeintBlendingOddFirst
Blending or linear interpolation (Odd + Even).

enumerator kISI_DeintBlendingEvenFirst
Blending or linear interpolation (Even + Odd).

enumerator kISI_DeintDoublingOdd
Doubling odd frame and discard even frame.

enumerator kISI_DeintDoublingEven
Doubling even frame and discard odd frame.

enum _isi_threshold
ISI overflow panic alert threshold.

Values:

enumerator kISI_ThresholdDisable
No panic alert will be asserted.

enumerator kISI_Threshold25Percent
Panic will assert when the buffers are 25% full.

enumerator kISI_Threshold50Percent
Panic will assert when the buffers are 50% full.

enumerator kISI_Threshold75Percent
Panic will assert when the buffers are 75% full.

enum _isi_csc_mode
ISI color space conversion mode.

Values:

enumerator kISI_CscYUV2RGB
Convert YUV to RGB.

enumerator kISI_CscYCbCr2RGB
Convert YCbCr to RGB.

enumerator kISI_CscRGB2YUV
Convert RGB to YUV.

enumerator kISI_CscRGB2YCbCr
Convert RGB to YCbCr.

enum _isi_flip_mode
ISI flipping mode.

Values:

enumerator kISI_FlipDisable
Flip disabled.

enumerator kISI_FlipHorizontal
Horizontal flip.

enumerator kISI_FlipVertical
Vertical flip.

enumerator kISI_FlipBoth
Flip both direction.

enum _isi_input_mem_format

ISI image format of the input memory.

Values:

enumerator kISI_InputMemBGR888

BGR format with 8-bits per color component, packed into 32-bit, 24 bits per pixel.

enumerator kISI_InputMemRGB888

RGB format with 8-bits per color component, packed into 32-bit, 24 bits per pixel.

enumerator kISI_InputMemXRGB8888

RGB format with 8-bits per color component, unpacked and LSB aligned in 32-bit, 32 bits per pixel.

enumerator kISI_InputMemRGBX8888

RGB format with 8-bits per color component, unpacked and MSB alinged in 32-bit, 32 bits per pixel.

enumerator kISI_InputMemXBGR8888

BGR format with 8-bits per color component, unpacked and LSB aligned in 32-bit, 32 bits per pixel.

enumerator kISI_InputMemRGB565

RGB format with 5-bits of R, B; 6-bits of G (packed into 32-bit)

enumerator kISI_InputMemA2BGR10

BGR format with 2-bits alpha in MSB; 10-bits per color component.

enumerator kISI_InputMemA2RGB10

RGB format with 2-bits alpha in MSB; 10-bits per color component.

enumerator kISI_InputMemYUV444_1P8P

8-bits per color component; 1-plane, YUV interleaved packed bytes.

enumerator kISI_InputMemYUV444_1P10

10-bits per color component; 1-plane, YUV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_InputMemYUV444_1P10P

10-bits per color component; 1-plane, YUV interleaved packed bytes (2 MSBs waste bits in 32-bit WORD).

enumerator kISI_InputMemYUV444_1P12

12-bits per color component; 1-plane, YUV interleaved unpacked bytes (4 LSBs waste bits in 16-bit WORD).

enumerator kISI_InputMemYUV444_1P8

8-bits per color component; 1-plane YUV interleaved unpacked bytes (8 MSBs waste bits in 32-bit DWORD).

enumerator kISI_InputMemYUV422_1P8P

8-bits per color component; 1-plane YUV interleaved packed bytes.

enumerator kISI_InputMemYUV422_1P10

10-bits per color component; 1-plane, YUV interleaved unpacked bytes (6 LSBs waste bits in 16-bit WORD).

enumerator kISI_InputMemYUV422_1P12

12-bits per color component; 1-plane, YUV interleaved packed bytes (4 MSBs waste bits in 16-bit WORD).

typedef enum *_isi_output_format* isi_output_format_t
ISI output image format.

typedef enum *_isi_chain_mode* isi_chain_mode_t
ISI line buffer chain mode.

typedef enum *_isi_deint_mode* isi_deint_mode_t
ISI de-interlacing mode.

typedef enum *_isi_threshold* isi_threshold_t
ISI overflow panic alert threshold.

typedef struct *_isi_config* isi_config_t
ISI basic configuration.

typedef enum *_isi_csc_mode* isi_csc_mode_t
ISI color space conversion mode.

typedef struct *_isi_csc_config* isi_csc_config_t
ISI color space conversion configurations.

(a) RGB to YUV (or YCbCr) conversion

- Y = (A1 x R) + (A2 x G) + (A3 x B) + D1
- U = (B1 x R) + (B2 x G) + (B3 x B) + D2
- V = (C1 x R) + (C2 x G) + (C3 x B) + D3

(b) YUV (or YCbCr) to RGB conversion

- R = (A1 x (Y + D1)) + (A2 x (U + D2)) + (A3 x (V + D3))
- G = (B1 x (Y + D1)) + (B2 x (U + D2)) + (B3 x (V + D3))
- B = (C1 x (Y + D1)) + (C2 x (U + D2)) + (C3 x (V + D3))

Overflow for the three channels are saturated at 0x255 and underflow is saturated at 0x00.

typedef enum *_isi_flip_mode* isi_flip_mode_t
ISI flipping mode.

typedef struct *_isi_crop_config* isi_crop_config_t
ISI cropping configurations.

typedef struct *_isi_regoin_alpha_config* isi_region_alpha_config_t
ISI regional region alpha configurations.

typedef enum *_isi_input_mem_format* isi_input_mem_format_t
ISI image format of the input memory.

typedef struct *_isi_input_mem_config* isi_input_mem_config_t
ISI input memory configurations.

void ISI_SetConfig(ISI_Type *base, const *isi_config_t* *config)
Set the ISI channel basic configurations.

This function sets the basic configurations, generally the channel could be started to work after this function. To enable other features such as croping, flipping, please call the functions accordingly.

Parameters

- base – ISI peripheral base address
- config – Pointer to the configuration structure.

void ISI_GetDefaultConfig(*isi_config_t* *config)

Get the ISI channel default basic configurations.

The default value is:

```
config->isChannelBypassed = false;
config->isSourceMemory = false;
config->isYCbCr = false;
config->chainMode = kISI_ChainDisable;
config->deintMode = kISI_DeintDisable;
config->blankPixel = 0xFFU;
config->sourcePort = 0U;
config->mipiChannel = 0U;
config->inputHeight = 1080U;
config->inputWidth = 1920U;
config->outputFormat = kISI_OutputRGBA8888;
config->outputLinePitchBytes = 0U;
config->thresholdY = kISI_ThresholdDisable;
config->thresholdU = kISI_ThresholdDisable;
config->thresholdV = kISI_ThresholdDisable;
```

Parameters

- config – Pointer to the configuration structure.

struct _isi_config

#include <fsl_isi.h> ISI basic configuration.

Public Members

bool isChannelBypassed

Bypass the channel, if bypassed, the scaling and color space conversion could not work.

bool isSourceMemory

Whether the input source is memory or not.

bool isYCbCr

Whether the input source is YCbCr mode or not.

isi_chain_mode_t chainMode

The line buffer chain mode.

isi_deint_mode_t deintMode

The de-interlacing mode.

uint8_t blankPixel

The pixel to insert into image when overflow occors.

uint8_t sourcePort

Input source port selection.

uint8_t mipiChannel

MIPI virtual channel, ignored if input source is not MIPI CSI.

uint16_t inputHeight

Input image height(lines).

uint16_t inputWidth

Input image width(pixels).

isi_output_format_t outputFormat

Output image format.

isi_threshold_t thresholdY
Panic alert threshold for RGB or Luma (Y) buffer.

isi_threshold_t thresholdU
Panic alert threshold for Chroma (U/Cb/UV/CbCr) buffer.

isi_threshold_t thresholdV
Panic alert threshold for Chroma (V/Cr) buffer.

struct __isi_csc_config

#include <fsl_isi.h> ISI color space conversion configurations.

(a) RGB to YUV (or YCbCr) conversion

- Y = (A1 x R) + (A2 x G) + (A3 x B) + D1
- U = (B1 x R) + (B2 x G) + (B3 x B) + D2
- V = (C1 x R) + (C2 x G) + (C3 x B) + D3

(b) YUV (or YCbCr) to RGB conversion

- R = (A1 x (Y + D1)) + (A2 x (U + D2)) + (A3 x (V + D3))
- G = (B1 x (Y + D1)) + (B2 x (U + D2)) + (B3 x (V + D3))
- B = (C1 x (Y + D1)) + (C2 x (U + D2)) + (C3 x (V + D3))

Overflow for the three channels are saturated at 0x255 and underflow is saturated at 0x00.

Public Members

isi_csc_mode_t mode
Convertion mode.

float A1
Must be in the range of [-3.99609375, 3.99609375].

float A2
Must be in the range of [-3.99609375, 3.99609375].

float A3
Must be in the range of [-3.99609375, 3.99609375].

float B1
Must be in the range of [-3.99609375, 3.99609375].

float B2
Must be in the range of [-3.99609375, 3.99609375].

float B3
Must be in the range of [-3.99609375, 3.99609375].

float C1
Must be in the range of [-3.99609375, 3.99609375].

float C2
Must be in the range of [-3.99609375, 3.99609375].

float C3
Must be in the range of [-3.99609375, 3.99609375].

int32_t D1
Must be in the range of [-256, 255].

int32_t D2
Must be in the range of [-256, 255].

int32_t D3
Must be in the range of [-256, 255].

struct __isi_crop_config
#include <fsl_isi.h> ISI cropping configurations.

Public Members

uint16_t upperLeftX
X of upper left corner.

uint16_t upperLeftY
Y of upper left corner.

uint16_t lowerRightX
X of lower right corner.

uint16_t lowerRightY
Y of lower right corner.

struct __isi_regoin_alpha_config
#include <fsl_isi.h> ISI regional region alpha configurations.

Public Members

uint16_t upperLeftX
X of upper left corner.

uint16_t upperLeftY
Y of upper left corner.

uint16_t lowerRightX
X of lower right corner.

uint16_t lowerRightY
Y of lower right corner.

uint8_t alpha
Alpha value.

struct __isi_input_mem_config
#include <fsl_isi.h> ISI input memory configurations.

Public Members

uint32_t adddr
Address of the input memory.

uint16_t linePitchBytes
Line phtch in bytes.

uint16_t framePitchBytes
Frame phtch in bytes.

isi_input_mem_format_t format
Image format of the input memory.

2.36 Common Driver

FSL_COMMON_DRIVER_VERSION
: common driver version.

DEBUG_CONSOLE_DEVICE_TYPE_NONE
: No debug console.

DEBUG_CONSOLE_DEVICE_TYPE_UART
: Debug console based on UART.

DEBUG_CONSOLE_DEVICE_TYPE_LPUART
: Debug console based on LPUART.

DEBUG_CONSOLE_DEVICE_TYPE_LPSCI
: Debug console based on LPSCI.

DEBUG_CONSOLE_DEVICE_TYPE_USBCDC
: Debug console based on USBCDC.

DEBUG_CONSOLE_DEVICE_TYPE_FLEXCOMM
: Debug console based on FLEXCOMM.

DEBUG_CONSOLE_DEVICE_TYPE_IUART
: Debug console based on i.MX UART.

DEBUG_CONSOLE_DEVICE_TYPE_VUSART
: Debug console based on LPC_VUSART.

DEBUG_CONSOLE_DEVICE_TYPE_MINI_USART
: Debug console based on LPC_USART.

DEBUG_CONSOLE_DEVICE_TYPE_SWO
: Debug console based on SWO.

DEBUG_CONSOLE_DEVICE_TYPE_QSCI
: Debug console based on QSCI.

MIN(a, b)
: Computes the minimum of *a* and *b*.

MAX(a, b)
: Computes the maximum of *a* and *b*.

UINT16_MAX
: Max value of uint16_t type.

UINT32_MAX
: Max value of uint32_t type.

SDK_ATOMIC_LOCAL_ADD(addr, val)
: Add value *val* from the variable at address *address*.

SDK_ATOMIC_LOCAL_SUB(addr, val)
: Subtract value *val* to the variable at address *address*.

SDK_ATOMIC_LOCAL_SET(addr, bits)
: Set the bits specifiled by *bits* to the variable at address *address*.

SDK_ATOMIC_LOCAL_CLEAR(addr, bits)
: Clear the bits specifiled by *bits* to the variable at address *address*.

SDK_ATOMIC_LOCAL_TOGGLE(addr, bits)

Toggle the bits specifiled by *bits* to the variable at address *address*.

SDK_ATOMIC_LOCAL_CLEAR_AND_SET(addr, clearBits, setBits)

For the variable at address *address*, clear the bits specifiled by *clearBits* and set the bits specifiled by *setBits*.

SDK_ATOMIC_LOCAL_COMPARE_AND_SET(addr, expected, newValue)

For the variable at address *address*, check whether the value equal to *expected*. If value same as *expected* then update *newValue* to address and return **true** , else return **false** .

SDK_ATOMIC_LOCAL_TEST_AND_SET(addr, newValue)

For the variable at address *address*, set as *newValue* value and return old value.

USEC_TO_COUNT(us, clockFreqInHz)

Macro to convert a microsecond period to raw count value

COUNT_TO_USEC(count, clockFreqInHz)

Macro to convert a raw count value to microsecond

MSEC_TO_COUNT(ms, clockFreqInHz)

Macro to convert a millisecond period to raw count value

COUNT_TO_MSEC(count, clockFreqInHz)

Macro to convert a raw count value to millisecond

SDK_ISR_EXIT_BARRIER

SDK_L1DCACHE_ALIGN(var)

Macro to define a variable with L1 d-cache line size alignment

SDK_SIZEALIGN(var, alignbytes)

Macro to define a variable with L2 cache line size alignment

Macro to change a value to a given size aligned value

CACHE_LINE_DATA

enum _status_groups

Status group numbers.

Values:

enumerator kStatusGroup_Generic

Group number for generic status codes.

enumerator kStatusGroup_FLASH

Group number for FLASH status codes.

enumerator kStatusGroup_LPSPI

Group number for LPSPI status codes.

enumerator kStatusGroup_FLEXIO_SPI

Group number for FLEXIO SPI status codes.

enumerator kStatusGroup_DSPI

Group number for DSPI status codes.

enumerator kStatusGroup_FLEXIO_UART

Group number for FLEXIO UART status codes.

enumerator kStatusGroup_FLEXIO_I2C

Group number for FLEXIO I2C status codes.

enumerator kStatusGroup_LPI2C
Group number for LPI2C status codes.

enumerator kStatusGroup_UART
Group number for UART status codes.

enumerator kStatusGroup_I2C
Group number for UART status codes.

enumerator kStatusGroup_LPSCI
Group number for LPSCI status codes.

enumerator kStatusGroup_LPUART
Group number for LPUART status codes.

enumerator kStatusGroup_SPI
Group number for SPI status code.

enumerator kStatusGroup_XRDC
Group number for XRDC status code.

enumerator kStatusGroup_SEMA42
Group number for SEMA42 status code.

enumerator kStatusGroup_SDHC
Group number for SDHC status code

enumerator kStatusGroup_SDMMC
Group number for SDMMC status code

enumerator kStatusGroup_SAI
Group number for SAI status code

enumerator kStatusGroup_MCG
Group number for MCG status codes.

enumerator kStatusGroup_SCG
Group number for SCG status codes.

enumerator kStatusGroup_SDSPI
Group number for SDSPI status codes.

enumerator kStatusGroup_FLEXIO_I2S
Group number for FLEXIO I2S status codes

enumerator kStatusGroup_FLEXIO_MCULCD
Group number for FLEXIO LCD status codes

enumerator kStatusGroup_FLASHIAP
Group number for FLASHIAP status codes

enumerator kStatusGroup_FLEXCOMM_I2C
Group number for FLEXCOMM I2C status codes

enumerator kStatusGroup_I2S
Group number for I2S status codes

enumerator kStatusGroup_IUART
Group number for IUART status codes

enumerator kStatusGroup_CSI
Group number for CSI status codes

enumerator kStatusGroup_MIPI_DSI
Group number for MIPI DSI status codes

enumerator kStatusGroup_SDRAMC
Group number for SDRAMC status codes.

enumerator kStatusGroup_POWER
Group number for POWER status codes.

enumerator kStatusGroup_ENET
Group number for ENET status codes.

enumerator kStatusGroup_PHY
Group number for PHY status codes.

enumerator kStatusGroup_TRGMUX
Group number for TRGMUX status codes.

enumerator kStatusGroup_SMARTCARD
Group number for SMARTCARD status codes.

enumerator kStatusGroup_LMEM
Group number for LMEM status codes.

enumerator kStatusGroup_QSPI
Group number for QSPI status codes.

enumerator kStatusGroup_DMA
Group number for DMA status codes.

enumerator kStatusGroup_EDMA
Group number for EDMA status codes.

enumerator kStatusGroup_DMAMGR
Group number for DMAMGR status codes.

enumerator kStatusGroup_FLEXCAN
Group number for FlexCAN status codes.

enumerator kStatusGroup_LTC
Group number for LTC status codes.

enumerator kStatusGroup_FLEXIO_CAMERA
Group number for FLEXIO CAMERA status codes.

enumerator kStatusGroup_LPC_SPI
Group number for LPC_SPI status codes.

enumerator kStatusGroup_LPC_USART
Group number for LPC_USART status codes.

enumerator kStatusGroup_DMIC
Group number for DMIC status codes.

enumerator kStatusGroup_SDIF
Group number for SDIF status codes.

enumerator kStatusGroup_SPIFI
Group number for SPIFI status codes.

enumerator kStatusGroup_OTP
Group number for OTP status codes.

enumerator kStatusGroup_MCAN
Group number for MCAN status codes.

enumerator kStatusGroup_CAAM
Group number for CAAM status codes.

enumerator kStatusGroup_ECSPI
Group number for ECSPI status codes.

enumerator kStatusGroup_USDHC
Group number for USDHC status codes.

enumerator kStatusGroup_LPC_I2C
Group number for LPC_I2C status codes.

enumerator kStatusGroup_DCP
Group number for DCP status codes.

enumerator kStatusGroup_MSCAN
Group number for MSCAN status codes.

enumerator kStatusGroup_ESAI
Group number for ESAI status codes.

enumerator kStatusGroup_FLEXSPI
Group number for FLEXSPI status codes.

enumerator kStatusGroup_MMDC
Group number for MMDC status codes.

enumerator kStatusGroup_PDM
Group number for MIC status codes.

enumerator kStatusGroup_SDMA
Group number for SDMA status codes.

enumerator kStatusGroup_ICS
Group number for ICS status codes.

enumerator kStatusGroup_SPDIF
Group number for SPDIF status codes.

enumerator kStatusGroup_LPC_MINISPI
Group number for LPC_MINISPI status codes.

enumerator kStatusGroup_HASHCRYPT
Group number for Hashcrypt status codes

enumerator kStatusGroup_LPC_SPI_SSP
Group number for LPC_SPI_SSP status codes.

enumerator kStatusGroup_I3C
Group number for I3C status codes

enumerator kStatusGroup_LPC_I2C_1
Group number for LPC_I2C_1 status codes.

enumerator kStatusGroup_NOTIFIER
Group number for NOTIFIER status codes.

enumerator kStatusGroup_DebugConsole
Group number for debug console status codes.

enumerator kStatusGroup_SEMC
Group number for SEMC status codes.

enumerator kStatusGroup_ApplicationRangeStart
Starting number for application groups.

enumerator kStatusGroup_IAP
Group number for IAP status codes

enumerator kStatusGroup_SFA
Group number for SFA status codes

enumerator kStatusGroup_SPC
Group number for SPC status codes.

enumerator kStatusGroup_PUF
Group number for PUF status codes.

enumerator kStatusGroup_TOUCH_PANEL
Group number for touch panel status codes

enumerator kStatusGroup_VBAT
Group number for VBAT status codes

enumerator kStatusGroup_XSPI
Group number for XSPI status codes

enumerator kStatusGroup_PNGDEC
Group number for PNGDEC status codes

enumerator kStatusGroup_JPEGDEC
Group number for JPEGDEC status codes

enumerator kStatusGroup_AUDMIX
Group number for AUDMIX status codes

enumerator kStatusGroup_HAL_GPIO
Group number for HAL GPIO status codes.

enumerator kStatusGroup_HAL_UART
Group number for HAL UART status codes.

enumerator kStatusGroup_HAL_TIMER
Group number for HAL TIMER status codes.

enumerator kStatusGroup_HAL_SPI
Group number for HAL SPI status codes.

enumerator kStatusGroup_HAL_I2C
Group number for HAL I2C status codes.

enumerator kStatusGroup_HAL_FLASH
Group number for HAL FLASH status codes.

enumerator kStatusGroup_HAL_PWM
Group number for HAL PWM status codes.

enumerator kStatusGroup_HAL_RNG
Group number for HAL RNG status codes.

enumerator kStatusGroup_HAL_I2S
Group number for HAL I2S status codes.

enumerator kStatusGroup_HAL_ADC_SENSOR
Group number for HAL ADC SENSOR status codes.

enumerator kStatusGroup_TIMERMANAGER
Group number for TiMER MANAGER status codes.

enumerator kStatusGroup_SERIALMANAGER
Group number for SERIAL MANAGER status codes.

enumerator kStatusGroup_LED
Group number for LED status codes.

enumerator kStatusGroup_BUTTON
Group number for BUTTON status codes.

enumerator kStatusGroup_EXTERN_EEPROM
Group number for EXTERN EEPROM status codes.

enumerator kStatusGroup_SHELL
Group number for SHELL status codes.

enumerator kStatusGroup_MEM_MANAGER
Group number for MEM MANAGER status codes.

enumerator kStatusGroup_LIST
Group number for List status codes.

enumerator kStatusGroup_OSA
Group number for OSA status codes.

enumerator kStatusGroup_COMMON_TASK
Group number for Common task status codes.

enumerator kStatusGroup_MSG
Group number for messaging status codes.

enumerator kStatusGroup_SDK_OCOTP
Group number for OCOTP status codes.

enumerator kStatusGroup_SDK_FLEXSPINOR
Group number for FLEXSPINOR status codes.

enumerator kStatusGroup_CODEC
Group number for codec status codes.

enumerator kStatusGroup_ASRC
Group number for codec status ASRC.

enumerator kStatusGroup_OTFAD
Group number for codec status codes.

enumerator kStatusGroup_SDIOSLV
Group number for SDIOSLV status codes.

enumerator kStatusGroup_MECC
Group number for MECC status codes.

enumerator kStatusGroup_ENET_QOS
Group number for ENET_QOS status codes.

enumerator kStatusGroup_LOG
Group number for LOG status codes.

enumerator kStatusGroup_I3CBUS
Group number for I3CBUS status codes.

enumerator kStatusGroup_QSCI
Group number for QSCI status codes.

enumerator kStatusGroup_ELEMU
Group number for ELEMU status codes.

enumerator kStatusGroup_QUEUEDSPI
Group number for QSPI status codes.

enumerator kStatusGroup_POWER_MANAGER
Group number for POWER_MANAGER status codes.

enumerator kStatusGroup_IPED
Group number for IPED status codes.

enumerator kStatusGroup_ELS_PKC
Group number for ELS PKC status codes.

enumerator kStatusGroup_CSS_PKC
Group number for CSS PKC status codes.

enumerator kStatusGroup_HOSTIF
Group number for HOSTIF status codes.

enumerator kStatusGroup_CLIF
Group number for CLIF status codes.

enumerator kStatusGroup_BMA
Group number for BMA status codes.

enumerator kStatusGroup_NETC
Group number for NETC status codes.

enumerator kStatusGroup_ELE
Group number for ELE status codes.

enumerator kStatusGroup_GLIKEY
Group number for GLIKEY status codes.

enumerator kStatusGroup_AON_POWER
Group number for AON_POWER status codes.

enumerator kStatusGroup_AON_COMMON
Group number for AON_COMMON status codes.

enumerator kStatusGroup_ENDAT3
Group number for ENDAT3 status codes.

enumerator kStatusGroup_HIPERFACE
Group number for HIPERFACE status codes.

enumerator kStatusGroup_NPX
Group number for NPX status codes.

enumerator kStatusGroup_ELA_CSEC
Group number for ELA_CSEC status codes.

enumerator kStatusGroup_FLEXIO_T_FORMAT
Group number for T-format status codes.

enumerator kStatusGroup_FLEXIO_A_FORMAT
Group number for A-format status codes.

Generic status return codes.

Values:

enumerator kStatus_Success
Generic status for Success.

enumerator kStatus_Fail
Generic status for Fail.

enumerator kStatus_ReadOnly
Generic status for read only failure.

enumerator kStatus_OutOfRange
Generic status for out of range access.

enumerator kStatus_InvalidArgument
Generic status for invalid argument check.

enumerator kStatus_Timeout
Generic status for timeout.

enumerator kStatus_NoTransferInProgress
Generic status for no transfer in progress.

enumerator kStatus_Busy
Generic status for module is busy.

enumerator kStatus_NoData
Generic status for no data is found for the operation.

typedef int32_t status_t
Type used for all status and error return values.

void *SDK_Malloc(size_t size, size_t alignbytes)
Allocate memory with given alignment and aligned size.

This is provided to support the dynamically allocated memory used in cache-able region.

Parameters

- size – The length required to malloc.
- alignbytes – The alignment size.

Return values
The – allocated memory.

void SDK_Free(void *ptr)
Free memory.

Parameters

- ptr – The memory to be release.

void SDK_DelayAtLeastUs(uint32_t delayTime_us, uint32_t coreClock_Hz)
Delay at least for some time. Please note that, this API uses while loop for delay, different run-time environments make the time not precise, if precise delay count was needed, please implement a new delay function with hardware timer.

Parameters

- delayTime_us – Delay time in unit of microsecond.

- coreClock_Hz – Core clock frequency with Hz.

static inline *status_t* EnableIRQ(IRQn_Type interrupt)

Enable specific interrupt.

Enable LEVEL1 interrupt. For some devices, there might be multiple interrupt levels. For example, there are NVIC and intmux. Here the interrupts connected to NVIC are the LEVEL1 interrupts, because they are routed to the core directly. The interrupts connected to intmux are the LEVEL2 interrupts, they are routed to NVIC first then routed to core.

This function only enables the LEVEL1 interrupts. The number of LEVEL1 interrupts is indicated by the feature macro FSL_FEATURE_NUMBER_OF_LEVEL1_INT_VECTORS.

Parameters

- interrupt – The IRQ number.

Return values

- kStatus_Success – Interrupt enabled successfully
- kStatus_Fail – Failed to enable the interrupt

static inline *status_t* DisableIRQ(IRQn_Type interrupt)

Disable specific interrupt.

Disable LEVEL1 interrupt. For some devices, there might be multiple interrupt levels. For example, there are NVIC and intmux. Here the interrupts connected to NVIC are the LEVEL1 interrupts, because they are routed to the core directly. The interrupts connected to intmux are the LEVEL2 interrupts, they are routed to NVIC first then routed to core.

This function only disables the LEVEL1 interrupts. The number of LEVEL1 interrupts is indicated by the feature macro FSL_FEATURE_NUMBER_OF_LEVEL1_INT_VECTORS.

Parameters

- interrupt – The IRQ number.

Return values

- kStatus_Success – Interrupt disabled successfully
- kStatus_Fail – Failed to disable the interrupt

static inline *status_t* EnableIRQWithPriority(IRQn_Type interrupt, uint8_t priNum)

Enable the IRQ, and also set the interrupt priority.

Only handle LEVEL1 interrupt. For some devices, there might be multiple interrupt levels. For example, there are NVIC and intmux. Here the interrupts connected to NVIC are the LEVEL1 interrupts, because they are routed to the core directly. The interrupts connected to intmux are the LEVEL2 interrupts, they are routed to NVIC first then routed to core.

This function only handles the LEVEL1 interrupts. The number of LEVEL1 interrupts is indicated by the feature macro FSL_FEATURE_NUMBER_OF_LEVEL1_INT_VECTORS.

Parameters

- interrupt – The IRQ to Enable.
- priNum – Priority number set to interrupt controller register.

Return values

- kStatus_Success – Interrupt priority set successfully
- kStatus_Fail – Failed to set the interrupt priority.

static inline *status_t* IRQ_SetPriority(IRQn_Type interrupt, uint8_t priNum)

Set the IRQ priority.

Only handle LEVEL1 interrupt. For some devices, there might be multiple interrupt levels. For example, there are NVIC and intmux. Here the interrupts connected to NVIC are the LEVEL1 interrupts, because they are routed to the core directly. The interrupts connected to intmux are the LEVEL2 interrupts, they are routed to NVIC first then routed to core.

This function only handles the LEVEL1 interrupts. The number of LEVEL1 interrupts is indicated by the feature macro FSL_FEATURE_NUMBER_OF_LEVEL1_INT_VECTORS.

Parameters

- interrupt – The IRQ to set.
- priNum – Priority number set to interrupt controller register.

Return values

- kStatus_Success – Interrupt priority set successfully
- kStatus_Fail – Failed to set the interrupt priority.

static inline *status_t* IRQ_ClearPendingIRQ(IRQn_Type interrupt)

Clear the pending IRQ flag.

Only handle LEVEL1 interrupt. For some devices, there might be multiple interrupt levels. For example, there are NVIC and intmux. Here the interrupts connected to NVIC are the LEVEL1 interrupts, because they are routed to the core directly. The interrupts connected to intmux are the LEVEL2 interrupts, they are routed to NVIC first then routed to core.

This function only handles the LEVEL1 interrupts. The number of LEVEL1 interrupts is indicated by the feature macro FSL_FEATURE_NUMBER_OF_LEVEL1_INT_VECTORS.

Parameters

- interrupt – The flag which IRQ to clear.

Return values

- kStatus_Success – Interrupt priority set successfully
- kStatus_Fail – Failed to set the interrupt priority.

static inline uint32_t DisableGlobalIRQ(void)

Disable the global IRQ.

Disable the global interrupt and return the current primask register. User is required to provided the primask register for the EnableGlobalIRQ().

Returns
Current primask value.

static inline void EnableGlobalIRQ(uint32_t primask)

Enable the global IRQ.

Set the primask register with the provided primask value but not just enable the primask. The idea is for the convenience of integration of RTOS. some RTOS get its own management mechanism of primask. User is required to use the EnableGlobalIRQ() and DisableGlobalIRQ() in pair.

Parameters

- primask – value of primask register to be restored. The primask value is supposed to be provided by the DisableGlobalIRQ().

static inline bool _SDK_AtomicLocalCompareAndSet(uint32_t *addr, uint32_t expected, uint32_t newValue)

static inline uint32_t _SDK_AtomicTestAndSet(uint32_t *addr, uint32_t newValue)

FSL_DRIVER_TRANSFER_DOUBLE_WEAK_IRQ
: Macro to use the default weak IRQ handler in drivers.

MAKE_STATUS(group, code)
: Construct a status code value from a group and code number.

MAKE_VERSION(major, minor, bugfix)
: Construct the version number for drivers.

  The driver version is a 32-bit number, for both 32-bit platforms(such as Cortex M) and 16-bit platforms(such as DSC).

```
| Unused    || Major Version || Minor Version ||  Bug Fix    |
31       25  24          17  16          9  8           0
```

ARRAY_SIZE(x)
: Computes the number of elements in an array.

UINT64_H(X)
: Macro to get upper 32 bits of a 64-bit value

UINT64_L(X)
: Macro to get lower 32 bits of a 64-bit value

SUPPRESS_FALL_THROUGH_WARNING()
: For switch case code block, if case section ends without “break;” statement, there wil be fallthrough warning with compiler flag -Wextra or -Wimplicit-fallthrough=n when using armgcc. To suppress this warning, “SUPPRESS_FALL_THROUGH_WARNING();” need to be added at the end of each case section which misses “break;”statement.

MSDK_REG_SECURE_ADDR(x)
: Convert the register address to the one used in secure mode.

MSDK_REG_NONSECURE_ADDR(x)
: Convert the register address to the one used in non-secure mode.

MSDK_INVALID_IRQ_HANDLER
: Invalid IRQ handler address.

2.37 LDB: LVDS Display Bridge

void LDB_Init(LDB_Type *base, uint8_t diIndex, uint8_t dualpanelIndex, uint8_t datamap)
: brief Initializes the LDB module for LVDS port panel.

  param base LDB peripheral base address. param diIndex Display Input index. param dualpanelIndex dual panel index. param datamap 0 for SPWG 1 for JEIDA.

FSL_LDB_DRIVER_VERSION
: LDB driver version.

FSL_LDB_DRIVER_VERSION
: LDB driver version.

LVDS_DI_COUNT

LVDS_SPWG

LVDS_JEIDA

enum _ldb_output_bus

LDB output bus format.

Values:

enumerator kLDB_OutputRGB666_7Bit_SPWG

enumerator kLDB_OutputRGB888_7Bit_SPWG

enumerator kLDB_OutputRGB888_7Bit_JEIDA

enumerator kLDB_OutputRGB101010_10Bit_SPWG

enumerator kLDB_OutputRGB101010_10Bit_JEIDA

enum _ldb_input_flag

LDB input signal priority.

Values:

enumerator kLDB_InputVsyncActiveLow

VSYNC active low.

enumerator kLDB_InputVsyncActiveHigh

VSYNC active high.

enumerator kLDB_InputHsyncActiveLow

HSYNC active low.

enumerator kLDB_InputHsyncActiveHigh

HSYNC active high.

enumerator kLDB_InputDataLatchOnFallingEdge

Latch data on falling clock edge.

enumerator kLDB_InputDataLatchOnRisingEdge

Latch data on rising clock edge.

typedef enum *_ldb_output_bus* ldb_output_bus_t

LDB output bus format.

typedef struct *_ldb_channel_config* ldb_channel_config_t

LDB channel configuration.

void LDB_Init(LDB_Type *base)

Initializes the LDB module.

Parameters

- base – LDB peripheral base address.

void LDB_Deinit(LDB_Type *base)

De-initializes the LDB module.

Parameters

- base – LDB peripheral base address.

status_t LDB_InitChannel(LDB_Type *base, uint8_t channel, const *ldb_channel_config_t* *config)

Initializes the LDB channel.

Parameters

- base – LDB peripheral base address.
- channel – Channel index.

- config – Pointer to the configuration.

Returns
Return kStatus_Success if success.

void LDB_DeinitChannel(LDB_Type *base, uint8_t channel)
De-initializes the LDB channel.

Parameters

- base – LDB peripheral base address.
- channel – Channel index.

struct _ldb_channel_config
#include <fsl_ldb.h> LDB channel configuration.

Public Members

ldb_output_bus_t outputBus
Output bus format.

uint32_t inputFlag
Input flag, OR'ed value of _ldb_input_flag.

uint32_t pixelClock_Hz
Pixel clock in HZ.

2.38 Lin_lpuart_driver

FSL_LIN_LPUART_DRIVER_VERSION
LIN LPUART driver version.

enum _lin_lpuart_stop_bit_count
Values:

enumerator kLPUART_OneStopBit
One stop bit

enumerator kLPUART_TwoStopBit
Two stop bits

enum _lin_lpuart_flags
Values:

enumerator kLPUART_TxDataRegEmptyFlag
Transmit data register empty flag, sets when transmit buffer is empty

enumerator kLPUART_TransmissionCompleteFlag
Transmission complete flag, sets when transmission activity complete

enumerator kLPUART_RxDataRegFullFlag
Receive data register full flag, sets when the receive data buffer is full

enumerator kLPUART_IdleLineFlag
Idle line detect flag, sets when idle line detected

enumerator kLPUART_RxOverrunFlag
Receive Overrun, sets when new data is received before data is read from receive register

enumerator kLPUART_NoiseErrorFlag

Receive takes 3 samples of each received bit. If any of these samples differ, noise flag sets

enumerator kLPUART_FramingErrorFlag

Frame error flag, sets if logic 0 was detected where stop bit expected

enumerator kLPUART_ParityErrorFlag

If parity enabled, sets upon parity error detection

enumerator kLPUART_LinBreakFlag

LIN break detect interrupt flag, sets when LIN break char detected and LIN circuit enabled

enumerator kLPUART_RxActiveEdgeFlag

Receive pin active edge interrupt flag, sets when active edge detected

enumerator kLPUART_RxActiveFlag

Receiver Active Flag (RAF), sets at beginning of valid start bit

enumerator kLPUART_DataMatch1Flag

The next character to be read from LPUART_DATA matches MA1

enumerator kLPUART_DataMatch2Flag

The next character to be read from LPUART_DATA matches MA2

enumerator kLPUART_NoiseErrorInRxDataRegFlag

NOISY bit, sets if noise detected in current data word

enumerator kLPUART_ParityErrorInRxDataRegFlag

PARITY bit, sets if noise detected in current data word

enumerator kLPUART_TxFifoEmptyFlag

TXEMPT bit, sets if transmit buffer is empty

enumerator kLPUART_RxFifoEmptyFlag

RXEMPT bit, sets if receive buffer is empty

enumerator kLPUART_TxFifoOverflowFlag

TXOF bit, sets if transmit buffer overflow occurred

enumerator kLPUART_RxFifoUnderflowFlag

RXUF bit, sets if receive buffer underflow occurred

enum _lin_lpuart_interrupt_enable

Values:

enumerator kLPUART_LinBreakInterruptEnable

LIN break detect.

enumerator kLPUART_RxActiveEdgeInterruptEnable

Receive Active Edge.

enumerator kLPUART_TxDataRegEmptyInterruptEnable

Transmit data register empty.

enumerator kLPUART_TransmissionCompleteInterruptEnable

Transmission complete.

enumerator kLPUART_RxDataRegFullInterruptEnable

Receiver data register full.

enumerator kLPUART_IdleLineInterruptEnable
Idle line.

enumerator kLPUART_RxOverrunInterruptEnable
Receiver Overrun.

enumerator kLPUART_NoiseErrorInterruptEnable
Noise error flag.

enumerator kLPUART_FramingErrorInterruptEnable
Framing error flag.

enumerator kLPUART_ParityErrorInterruptEnable
Parity error flag.

enumerator kLPUART_TxFifoOverflowInterruptEnable
Transmit FIFO Overflow.

enumerator kLPUART_RxFifoUnderflowInterruptEnable
Receive FIFO Underflow.

enum _lin_lpuart_status
Values:

enumerator kStatus_LPUART_TxBusy
TX busy

enumerator kStatus_LPUART_RxBusy
RX busy

enumerator kStatus_LPUART_TxIdle
LPUART transmitter is idle.

enumerator kStatus_LPUART_RxIdle
LPUART receiver is idle.

enumerator kStatus_LPUART_TxWatermarkTooLarge
TX FIFO watermark too large

enumerator kStatus_LPUART_RxWatermarkTooLarge
RX FIFO watermark too large

enumerator kStatus_LPUART_FlagCannotClearManually
Some flag can't manually clear

enumerator kStatus_LPUART_Error
Error happens on LPUART.

enumerator kStatus_LPUART_RxRingBufferOverrun
LPUART RX software ring buffer overrun.

enumerator kStatus_LPUART_RxHardwareOverrun
LPUART RX receiver overrun.

enumerator kStatus_LPUART_NoiseError
LPUART noise error.

enumerator kStatus_LPUART_FramingError
LPUART framing error.

enumerator kStatus_LPUART_ParityError
LPUART parity error.

enum lin_lpuart_bit_count_per_char_t

Values:

enumerator LPUART_8_BITS_PER_CHAR

8-bit data characters

enumerator LPUART_9_BITS_PER_CHAR

9-bit data characters

enumerator LPUART_10_BITS_PER_CHAR

10-bit data characters

typedef enum *_lin_lpuart_stop_bit_count* lin_lpuart_stop_bit_count_t

static inline bool LIN_LPUART_GetRxDataPolarity(const LPUART_Type *base)

static inline void LIN_LPUART_SetRxDataPolarity(LPUART_Type *base, bool polarity)

static inline void LIN_LPUART_WriteByte(LPUART_Type *base, uint8_t data)

static inline void LIN_LPUART_ReadByte(const LPUART_Type *base, uint8_t *readData)

status_t LIN_LPUART_CalculateBaudRate(LPUART_Type *base, uint32_t baudRate_Bps, uint32_t srcClock_Hz, uint32_t *osr, uint16_t *sbr)

Calculates the best osr and sbr value for configured baudrate.

Parameters

- base – LPUART peripheral base address
- baudRate_Bps – user configuration structure of type #lin_user_config_t
- srcClock_Hz – pointer to the LIN_LPUART driver state structure
- osr – pointer to osr value
- sbr – pointer to sbr value

Returns

An error code or lin_status_t

void LIN_LPUART_SetBaudRate(LPUART_Type *base, uint32_t *osr, uint16_t *sbr)

Configure baudrate according to osr and sbr value.

Parameters

- base – LPUART peripheral base address
- osr – pointer to osr value
- sbr – pointer to sbr value

lin_status_t LIN_LPUART_Init(LPUART_Type *base, lin_user_config_t *linUserConfig, lin_state_t *linCurrentState, uint32_t linSourceClockFreq)

Initializes an LIN_LPUART instance for LIN Network.

The caller provides memory for the driver state structures during initialization. The user must select the LIN_LPUART clock source in the application to initialize the LIN_LPUART. This function initializes a LPUART instance for operation. This function will initialize the run-time state structure to keep track of the on-going transfers, initialize the module to user defined settings and default settings, set break field length to be 13 bit times minimum, enable the break detect interrupt, Rx complete interrupt, frame error detect interrupt, and enable the LPUART module transmitter and receiver

Parameters

- base – LPUART peripheral base address

- linUserConfig – user configuration structure of type #lin_user_config_t
- linCurrentState – pointer to the LIN_LPUART driver state structure

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_Deinit(LPUART_Type *base)

Shuts down the LIN_LPUART by disabling interrupts and transmitter/receiver.

Parameters

- base – LPUART peripheral base address

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_SendFrameDataBlocking(LPUART_Type *base, const uint8_t *txBuff, uint8_t txSize, uint32_t timeoutMSec)

Sends Frame data out through the LIN_LPUART module using blocking method. This function will calculate the checksum byte and send it with the frame data. Blocking means that the function does not return until the transmission is complete.

Parameters

- base – LPUART peripheral base address
- txBuff – source buffer containing 8-bit data chars to send
- txSize – the number of bytes to send
- timeoutMSec – timeout value in milli seconds

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_SendFrameData(LPUART_Type *base, const uint8_t *txBuff, uint8_t txSize)

Sends frame data out through the LIN_LPUART module using non-blocking method. This enables an a-sync method for transmitting data. Non-blocking means that the function returns immediately. The application has to get the transmit status to know when the transmit is complete. This function will calculate the checksum byte and send it with the frame data.

Parameters

- base – LPUART peripheral base address
- txBuff – source buffer containing 8-bit data chars to send
- txSize – the number of bytes to send

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_GetTransmitStatus(LPUART_Type *base, uint8_t *bytesRemaining)

Get status of an on-going non-blocking transmission While sending frame data using non-blocking method, users can use this function to get status of that transmission. This function return LIN_TX_BUSY while sending, or LIN_TIMEOUT if timeout has occurred, or return LIN_SUCCESS when the transmission is complete. The bytesRemaining shows number of bytes that still needed to transmit.

Parameters

- base – LPUART peripheral base address
- bytesRemaining – Number of bytes still needed to transmit

Returns
lin_status_t LIN_TX_BUSY, LIN_SUCCESS or LIN_TIMEOUT

lin_status_t LIN_LPUART_RecvFrmDataBlocking(LPUART_Type *base, uint8_t *rxBuff, uint8_t rxSize, uint32_t timeoutMSec)

Receives frame data through the LIN_LPUART module using blocking method. This function will check the checksum byte. If the checksum is correct, it will receive the frame data. Blocking means that the function does not return until the reception is complete.

Parameters

- base – LPUART peripheral base address
- rxBuff – buffer containing 8-bit received data
- rxSize – the number of bytes to receive
- timeoutMSec – timeout value in milli seconds

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_RecvFrmData(LPUART_Type *base, uint8_t *rxBuff, uint8_t rxSize)

Receives frame data through the LIN_LPUART module using non-blocking method. This function will check the checksum byte. If the checksum is correct, it will receive it with the frame data. Non-blocking means that the function returns immediately. The application has to get the receive status to know when the reception is complete.

Parameters

- base – LPUART peripheral base address
- rxBuff – buffer containing 8-bit received data
- rxSize – the number of bytes to receive

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_AbortTransferData(LPUART_Type *base)

Aborts an on-going non-blocking transmission/reception. While performing a non-blocking transferring data, users can call this function to terminate immediately the transferring.

Parameters

- base – LPUART peripheral base address

Returns
An error code or lin_status_t

lin_status_t LIN_LPUART_GetReceiveStatus(LPUART_Type *base, uint8_t *bytesRemaining)

Get status of an on-going non-blocking reception While receiving frame data using non-blocking method, users can use this function to get status of that receiving. This function return the current event ID, LIN_RX_BUSY while receiving and return LIN_SUCCESS, or timeout (LIN_TIMEOUT) when the reception is complete. The bytesRemaining shows number of bytes that still needed to receive.

Parameters

- base – LPUART peripheral base address
- bytesRemaining – Number of bytes still needed to receive

Returns
lin_status_t LIN_RX_BUSY, LIN_TIMEOUT or LIN_SUCCESS

lin_status_t LIN_LPUART_GoToSleepMode(LPUART_Type *base)

This function puts current node to sleep mode This function changes current node state to LIN_NODE_STATE_SLEEP_MODE.

Parameters

- base – LPUART peripheral base address

Returns

An error code or lin_status_t

lin_status_t LIN_LPUART_GotoIdleState(LPUART_Type *base)

Puts current LIN node to Idle state This function changes current node state to LIN_NODE_STATE_IDLE.

Parameters

- base – LPUART peripheral base address

Returns

An error code or lin_status_t

lin_status_t LIN_LPUART_SendWakeupSignal(LPUART_Type *base)

Sends a wakeup signal through the LIN_LPUART interface.

Parameters

- base – LPUART peripheral base address

Returns

An error code or lin_status_t

lin_status_t LIN_LPUART_MasterSendHeader(LPUART_Type *base, uint8_t id)

Sends frame header out through the LIN_LPUART module using a non-blocking method. This function sends LIN Break field, sync field then the ID with correct parity.

Parameters

- base – LPUART peripheral base address
- id – Frame Identifier

Returns

An error code or lin_status_t

lin_status_t LIN_LPUART_EnableIRQ(LPUART_Type *base)

Enables LIN_LPUART hardware interrupts.

Parameters

- base – LPUART peripheral base address

Returns

An error code or lin_status_t

lin_status_t LIN_LPUART_DisableIRQ(LPUART_Type *base)

Disables LIN_LPUART hardware interrupts.

Parameters

- base – LPUART peripheral base address

Returns

An error code or lin_status_t

lin_status_t LIN_LPUART_AutoBaudCapture(uint32_t instance)

This function capture bits time to detect break char, calculate baudrate from sync bits and enable transceiver if autobaud successful. This function should only be used in Slave. The timer should be in mode input capture of both rising and falling edges. The timer input capture pin should be externally connected to RXD pin.

Parameters

- instance – LPUART instance

Returns

lin_status_t

void LIN_LPUART_IRQHandler(LPUART_Type *base)

LIN_LPUART RX TX interrupt handler.

Parameters

- base – LPUART peripheral base address

Returns

void

LIN_LPUART_TRANSMISSION_COMPLETE_TIMEOUT

Max loops to wait for LPUART transmission complete.

When de-initializing the LIN LPUART module, the program shall wait for the previous transmission to complete. This parameter defines how many loops to check completion before return error. If defined as 0, driver will wait forever until completion.

AUTOBAUD_BAUDRATE_TOLERANCE

BIT_RATE_TOLERANCE_UNSYNC

BIT_DURATION_MAX_19200

BIT_DURATION_MIN_19200

BIT_DURATION_MAX_14400

BIT_DURATION_MIN_14400

BIT_DURATION_MAX_9600

BIT_DURATION_MIN_9600

BIT_DURATION_MAX_4800

BIT_DURATION_MIN_4800

BIT_DURATION_MAX_2400

BIT_DURATION_MIN_2400

TWO_BIT_DURATION_MAX_19200

TWO_BIT_DURATION_MIN_19200

TWO_BIT_DURATION_MAX_14400

TWO_BIT_DURATION_MIN_14400

TWO_BIT_DURATION_MAX_9600

TWO_BIT_DURATION_MIN_9600

TWO_BIT_DURATION_MAX_4800

TWO_BIT_DURATION_MIN_4800

TWO_BIT_DURATION_MAX_2400

TWO_BIT_DURATION_MIN_2400

AUTOBAUD_BREAK_TIME_MIN

2.39 LPI2C: Low Power Inter-Integrated Circuit Driver

void LPI2C_DriverIRQHandler(uint32_t instance)

LPI2C driver IRQ handler common entry.

This function provides the common IRQ request entry for LPI2C.

Parameters

- instance – LPI2C instance.

FSL_LPI2C_DRIVER_VERSION

LPI2C driver version.

LPI2C status return codes.

Values:

enumerator kStatus_LPI2C_Busy

The master is already performing a transfer.

enumerator kStatus_LPI2C_Idle

The slave driver is idle.

enumerator kStatus_LPI2C_Nak

The slave device sent a NAK in response to a byte.

enumerator kStatus_LPI2C_FifoError

FIFO under run or overrun.

enumerator kStatus_LPI2C_BitError

Transferred bit was not seen on the bus.

enumerator kStatus_LPI2C_ArbitrationLost

Arbitration lost error.

enumerator kStatus_LPI2C_PinLowTimeout

SCL or SDA were held low longer than the timeout.

enumerator kStatus_LPI2C_NoTransferInProgress

Attempt to abort a transfer when one is not in progress.

enumerator kStatus_LPI2C_DmaRequestFail

DMA request failed.

enumerator kStatus_LPI2C_Timeout

Timeout polling status flags.

IRQn_Type const kLpi2cIrqs[]

Array to map LPI2C instance number to IRQ number, used internally for LPI2C master interrupt and EDMA transactional APIs.

lpi2c_master_isr_t s_lpi2cMasterIsr

Pointer to master IRQ handler for each instance, used internally for LPI2C master interrupt and EDMA transactional APIs.

void *s_lpi2cMasterHandle[]

Pointers to master handles for each instance, used internally for LPI2C master interrupt and EDMA transactional APIs.

uint32_t LPI2C_GetInstance(LPI2C_Type *base)

Returns an instance number given a base address.

If an invalid base address is passed, debug builds will assert. Release builds will just return instance number 0.

Parameters

- base – The LPI2C peripheral base address.

Returns

LPI2C instance number starting from 0.

I2C_RETRY_TIMES

Retry times for waiting flag.

2.40 LPI2C Master Driver

void LPI2C_MasterGetDefaultConfig(*lpi2c_master_config_t* *masterConfig)

Provides a default configuration for the LPI2C master peripheral.

This function provides the following default configuration for the LPI2C master peripheral:

```
masterConfig->enableMaster            = true;
masterConfig->debugEnable             = false;
masterConfig->ignoreAck               = false;
masterConfig->pinConfig               = kLPI2C_2PinOpenDrain;
masterConfig->baudRate_Hz             = 100000U;
masterConfig->busIdleTimeout_ns       = 0;
masterConfig->pinLowTimeout_ns        = 0;
masterConfig->sdaGlitchFilterWidth_ns = 0;
masterConfig->sclGlitchFilterWidth_ns = 0;
masterConfig->hostRequest.enable      = false;
masterConfig->hostRequest.source      = kLPI2C_HostRequestExternalPin;
masterConfig->hostRequest.polarity    = kLPI2C_HostRequestPinActiveHigh;
```

After calling this function, you can override any settings in order to customize the configuration, prior to initializing the master driver with LPI2C_MasterInit().

Parameters

- masterConfig – **[out]** User provided configuration structure for default values. Refer to lpi2c_master_config_t.

void LPI2C_MasterInit(LPI2C_Type *base, const *lpi2c_master_config_t* *masterConfig, uint32_t sourceClock_Hz)

Initializes the LPI2C master peripheral.

This function enables the peripheral clock and initializes the LPI2C master peripheral as described by the user provided configuration. A software reset is performed prior to configuration.

Parameters

- base – The LPI2C peripheral base address.

- masterConfig – User provided peripheral configuration. Use LPI2C_MasterGetDefaultConfig() to get a set of defaults that you can override.
- sourceClock_Hz – Frequency in Hertz of the LPI2C functional clock. Used to calculate the baud rate divisors, filter widths, and timeout periods.

void LPI2C_MasterDeinit(LPI2C_Type *base)

Deinitializes the LPI2C master peripheral.

This function disables the LPI2C master peripheral and gates the clock. It also performs a software reset to restore the peripheral to reset conditions.

Parameters

- base – The LPI2C peripheral base address.

void LPI2C_MasterConfigureDataMatch(LPI2C_Type *base, const *lpi2c_data_match_config_t* *matchConfig)

Configures LPI2C master data match feature.

Parameters

- base – The LPI2C peripheral base address.
- matchConfig – Settings for the data match feature.

status_t LPI2C_MasterCheckAndClearError(LPI2C_Type *base, uint32_t status)

Convert provided flags to status code, and clear any errors if present.

Parameters

- base – The LPI2C peripheral base address.
- status – Current status flags value that will be checked.

Return values

- kStatus_Success –
- kStatus_LPI2C_PinLowTimeout –
- kStatus_LPI2C_ArbitrationLost –
- kStatus_LPI2C_Nak –
- kStatus_LPI2C_FifoError –

status_t LPI2C_CheckForBusyBus(LPI2C_Type *base)

Make sure the bus isn't already busy.

A busy bus is allowed if we are the one driving it.

Parameters

- base – The LPI2C peripheral base address.

Return values

- kStatus_Success –
- kStatus_LPI2C_Busy –

static inline void LPI2C_MasterReset(LPI2C_Type *base)

Performs a software reset.

Restores the LPI2C master peripheral to reset conditions.

Parameters

- base – The LPI2C peripheral base address.

static inline void LPI2C_MasterEnable(LPI2C_Type *base, bool enable)

Enables or disables the LPI2C module as master.

Parameters

- base – The LPI2C peripheral base address.
- enable – Pass true to enable or false to disable the specified LPI2C as master.

static inline uint32_t LPI2C_MasterGetStatusFlags(LPI2C_Type *base)

Gets the LPI2C master status flags.

A bit mask with the state of all LPI2C master status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_lpi2c_master_flags

Parameters

- base – The LPI2C peripheral base address.

Returns

State of the status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void LPI2C_MasterClearStatusFlags(LPI2C_Type *base, uint32_t statusMask)

Clears the LPI2C master status flag state.

The following status register flags can be cleared:

- kLPI2C_MasterEndOfPacketFlag
- kLPI2C_MasterStopDetectFlag
- kLPI2C_MasterNackDetectFlag
- kLPI2C_MasterArbitrationLostFlag
- kLPI2C_MasterFifoErrFlag
- kLPI2C_MasterPinLowTimeoutFlag
- kLPI2C_MasterDataMatchFlag

Attempts to clear other flags has no effect.

See also:

_lpi2c_master_flags.

Parameters

- base – The LPI2C peripheral base address.
- statusMask – A bitmask of status flags that are to be cleared. The mask is composed of _lpi2c_master_flags enumerators OR'd together. You may pass the result of a previous call to LPI2C_MasterGetStatusFlags().

static inline void LPI2C_MasterEnableInterrupts(LPI2C_Type *base, uint32_t interruptMask)

Enables the LPI2C master interrupt requests.

All flags except kLPI2C_MasterBusyFlag and kLPI2C_MasterBusBusyFlag can be enabled as interrupts.

Parameters

- base – The LPI2C peripheral base address.
- interruptMask – Bit mask of interrupts to enable. See _lpi2c_master_flags for the set of constants that should be OR'd together to form the bit mask.

static inline void LPI2C_MasterDisableInterrupts(LPI2C_Type *base, uint32_t interruptMask)

Disables the LPI2C master interrupt requests.

All flags except kLPI2C_MasterBusyFlag and kLPI2C_MasterBusBusyFlag can be enabled as interrupts.

Parameters

- base – The LPI2C peripheral base address.
- interruptMask – Bit mask of interrupts to disable. See _lpi2c_master_flags for the set of constants that should be OR'd together to form the bit mask.

static inline uint32_t LPI2C_MasterGetEnabledInterrupts(LPI2C_Type *base)

Returns the set of currently enabled LPI2C master interrupt requests.

Parameters

- base – The LPI2C peripheral base address.

Returns

A bitmask composed of _lpi2c_master_flags enumerators OR'd together to indicate the set of enabled interrupts.

static inline void LPI2C_MasterEnableDMA(LPI2C_Type *base, bool enableTx, bool enableRx)

Enables or disables LPI2C master DMA requests.

Parameters

- base – The LPI2C peripheral base address.
- enableTx – Enable flag for transmit DMA request. Pass true for enable, false for disable.
- enableRx – Enable flag for receive DMA request. Pass true for enable, false for disable.

static inline uint32_t LPI2C_MasterGetTxFifoAddress(LPI2C_Type *base)

Gets LPI2C master transmit data register address for DMA transfer.

Parameters

- base – The LPI2C peripheral base address.

Returns

The LPI2C Master Transmit Data Register address.

static inline uint32_t LPI2C_MasterGetRxFifoAddress(LPI2C_Type *base)

Gets LPI2C master receive data register address for DMA transfer.

Parameters

- base – The LPI2C peripheral base address.

Returns

The LPI2C Master Receive Data Register address.

static inline void LPI2C_MasterSetWatermarks(LPI2C_Type *base, size_t txWords, size_t rxWords)

Sets the watermarks for LPI2C master FIFOs.

Parameters

- base – The LPI2C peripheral base address.
- txWords – Transmit FIFO watermark value in words. The kLPI2C_MasterTxReadyFlag flag is set whenever the number of words in the transmit FIFO is equal or less than *txWords*. Writing a value equal or greater than the FIFO size is truncated.
- rxWords – Receive FIFO watermark value in words. The kLPI2C_MasterRxReadyFlag flag is set whenever the number of words in the receive FIFO is greater than *rxWords*. Writing a value equal or greater than the FIFO size is truncated.

static inline void LPI2C_MasterGetFifoCounts(LPI2C_Type *base, size_t *rxCount, size_t *txCount)

Gets the current number of words in the LPI2C master FIFOs.

Parameters

- base – The LPI2C peripheral base address.
- txCount – **[out]** Pointer through which the current number of words in the transmit FIFO is returned. Pass NULL if this value is not required.
- rxCount – **[out]** Pointer through which the current number of words in the receive FIFO is returned. Pass NULL if this value is not required.

void LPI2C_MasterSetBaudRate(LPI2C_Type *base, uint32_t sourceClock_Hz, uint32_t baudRate_Hz)

Sets the I2C bus frequency for master transactions.

The LPI2C master is automatically disabled and re-enabled as necessary to configure the baud rate. Do not call this function during a transfer, or the transfer is aborted.

Note: Please note that the second parameter is the clock frequency of LPI2C module, the third parameter means user configured bus baudrate, this implementation is different from other I2C drivers which use baudrate configuration as second parameter and source clock frequency as third parameter.

Parameters

- base – The LPI2C peripheral base address.
- sourceClock_Hz – LPI2C functional clock frequency in Hertz.
- baudRate_Hz – Requested bus frequency in Hertz.

static inline bool LPI2C_MasterGetBusIdleState(LPI2C_Type *base)

Returns whether the bus is idle.

Requires the master mode to be enabled.

Parameters

- base – The LPI2C peripheral base address.

Return values

- true – Bus is busy.
- false – Bus is idle.

status_t LPI2C_MasterStart(LPI2C_Type *base, uint8_t address, *lpi2c_direction_t* dir)

Sends a START signal and slave address on the I2C bus.

This function is used to initiate a new master mode transfer. First, the bus state is checked to ensure that another master is not occupying the bus. Then a START signal is transmitted,

followed by the 7-bit address specified in the *address* parameter. Note that this function does not actually wait until the START and address are successfully sent on the bus before returning.

Parameters

- base – The LPI2C peripheral base address.
- address – 7-bit slave device address, in bits [6:0].
- dir – Master transfer direction, either kLPI2C_Read or kLPI2C_Write. This parameter is used to set the R/w bit (bit 0) in the transmitted slave address.

Return values

- kStatus_Success – START signal and address were successfully enqueued in the transmit FIFO.
- kStatus_LPI2C_Busy – Another master is currently utilizing the bus.

static inline *status_t* LPI2C_MasterRepeatedStart(LPI2C_Type *base, uint8_t address, *lpi2c_direction_t* dir)

Sends a repeated START signal and slave address on the I2C bus.

This function is used to send a Repeated START signal when a transfer is already in progress. Like LPI2C_MasterStart(), it also sends the specified 7-bit address.

Note: This function exists primarily to maintain compatible APIs between LPI2C and I2C drivers, as well as to better document the intent of code that uses these APIs.

Parameters

- base – The LPI2C peripheral base address.
- address – 7-bit slave device address, in bits [6:0].
- dir – Master transfer direction, either kLPI2C_Read or kLPI2C_Write. This parameter is used to set the R/w bit (bit 0) in the transmitted slave address.

Return values

- kStatus_Success – Repeated START signal and address were successfully enqueued in the transmit FIFO.
- kStatus_LPI2C_Busy – Another master is currently utilizing the bus.

status_t LPI2C_MasterSend(LPI2C_Type *base, void *txBuff, size_t txSize)

Performs a polling send transfer on the I2C bus.

Sends up to *txSize* number of bytes to the previously addressed slave device. The slave may reply with a NAK to any byte in order to terminate the transfer early. If this happens, this function returns kStatus_LPI2C_Nak.

Parameters

- base – The LPI2C peripheral base address.
- txBuff – The pointer to the data to be transferred.
- txSize – The length in bytes of the data to be transferred.

Return values

- kStatus_Success – Data was sent successfully.
- kStatus_LPI2C_Busy – Another master is currently utilizing the bus.
- kStatus_LPI2C_Nak – The slave device sent a NAK in response to a byte.

- kStatus_LPI2C_FifoError – FIFO under run or over run.
- kStatus_LPI2C_ArbitrationLost – Arbitration lost error.
- kStatus_LPI2C_PinLowTimeout – SCL or SDA were held low longer than the timeout.

status_t LPI2C_MasterReceive(LPI2C_Type *base, void *rxBuff, size_t rxSize)

Performs a polling receive transfer on the I2C bus.

Parameters

- base – The LPI2C peripheral base address.
- rxBuff – The pointer to the data to be transferred.
- rxSize – The length in bytes of the data to be transferred.

Return values

- kStatus_Success – Data was received successfully.
- kStatus_LPI2C_Busy – Another master is currently utilizing the bus.
- kStatus_LPI2C_Nak – The slave device sent a NAK in response to a byte.
- kStatus_LPI2C_FifoError – FIFO under run or overrun.
- kStatus_LPI2C_ArbitrationLost – Arbitration lost error.
- kStatus_LPI2C_PinLowTimeout – SCL or SDA were held low longer than the timeout.

status_t LPI2C_MasterStop(LPI2C_Type *base)

Sends a STOP signal on the I2C bus.

This function does not return until the STOP signal is seen on the bus, or an error occurs.

Parameters

- base – The LPI2C peripheral base address.

Return values

- kStatus_Success – The STOP signal was successfully sent on the bus and the transaction terminated.
- kStatus_LPI2C_Busy – Another master is currently utilizing the bus.
- kStatus_LPI2C_Nak – The slave device sent a NAK in response to a byte.
- kStatus_LPI2C_FifoError – FIFO under run or overrun.
- kStatus_LPI2C_ArbitrationLost – Arbitration lost error.
- kStatus_LPI2C_PinLowTimeout – SCL or SDA were held low longer than the timeout.

status_t LPI2C_MasterTransferBlocking(LPI2C_Type *base, *lpi2c_master_transfer_t* *transfer)

Performs a master polling transfer on the I2C bus.

Note: The API does not return until the transfer succeeds or fails due to error happens during transfer.

Parameters

- base – The LPI2C peripheral base address.
- transfer – Pointer to the transfer structure.

Return values

- kStatus_Success – Data was received successfully.
- kStatus_LPI2C_Busy – Another master is currently utilizing the bus.
- kStatus_LPI2C_Nak – The slave device sent a NAK in response to a byte.
- kStatus_LPI2C_FifoError – FIFO under run or overrun.
- kStatus_LPI2C_ArbitrationLost – Arbitration lost error.
- kStatus_LPI2C_PinLowTimeout – SCL or SDA were held low longer than the timeout.

void LPI2C_MasterTransferCreateHandle(LPI2C_Type *base, *lpi2c_master_handle_t* *handle, *lpi2c_master_transfer_callback_t* callback, void *userData)

Creates a new handle for the LPI2C master non-blocking APIs.

The creation of a handle is for use with the non-blocking APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the LPI2C_MasterTransferAbort() API shall be called.

Note: The function also enables the NVIC IRQ for the input LPI2C. Need to notice that on some SoCs the LPI2C IRQ is connected to INTMUX, in this case user needs to enable the associated INTMUX IRQ in application.

Parameters

- base – The LPI2C peripheral base address.
- handle – **[out]** Pointer to the LPI2C master driver handle.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.

status_t LPI2C_MasterTransferNonBlocking(LPI2C_Type *base, *lpi2c_master_handle_t* *handle, *lpi2c_master_transfer_t* *transfer)

Performs a non-blocking transaction on the I2C bus.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to the LPI2C master driver handle.
- transfer – The pointer to the transfer descriptor.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_LPI2C_Busy – Either another master is currently utilizing the bus, or a non-blocking transaction is already in progress.

status_t LPI2C_MasterTransferGetCount(LPI2C_Type *base, *lpi2c_master_handle_t* *handle, size_t *count)

Returns number of bytes transferred so far.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to the LPI2C master driver handle.

- count – **[out]** Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_Success –
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

void LPI2C_MasterTransferAbort(LPI2C_Type *base, *lpi2c_master_handle_t* *handle)

Terminates a non-blocking LPI2C master transmission early.

Note: It is not safe to call this function from an IRQ handler that has a higher priority than the LPI2C peripheral's IRQ priority.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to the LPI2C master driver handle.

void LPI2C_MasterTransferHandleIRQ(LPI2C_Type *base, void *lpi2cMasterHandle)

Reusable routine to handle master interrupts.

Note: This function does not need to be called unless you are reimplementing the non-blocking API's interrupt handler routines to add special functionality.

Parameters

- base – The LPI2C peripheral base address.
- lpi2cMasterHandle – Pointer to the LPI2C master driver handle.

enum _lpi2c_master_flags

LPI2C master peripheral flags.

The following status register flags can be cleared:

- kLPI2C_MasterEndOfPacketFlag
- kLPI2C_MasterStopDetectFlag
- kLPI2C_MasterNackDetectFlag
- kLPI2C_MasterArbitrationLostFlag
- kLPI2C_MasterFifoErrFlag
- kLPI2C_MasterPinLowTimeoutFlag
- kLPI2C_MasterDataMatchFlag

All flags except kLPI2C_MasterBusyFlag and kLPI2C_MasterBusBusyFlag can be enabled as interrupts.

Note: These enums are meant to be OR'd together to form a bit mask.

Values:

enumerator kLPI2C_MasterTxReadyFlag

Transmit data flag

enumerator kLPI2C_MasterRxReadyFlag
Receive data flag

enumerator kLPI2C_MasterEndOfPacketFlag
End Packet flag

enumerator kLPI2C_MasterStopDetectFlag
Stop detect flag

enumerator kLPI2C_MasterNackDetectFlag
NACK detect flag

enumerator kLPI2C_MasterArbitrationLostFlag
Arbitration lost flag

enumerator kLPI2C_MasterFifoErrFlag
FIFO error flag

enumerator kLPI2C_MasterPinLowTimeoutFlag
Pin low timeout flag

enumerator kLPI2C_MasterDataMatchFlag
Data match flag

enumerator kLPI2C_MasterBusyFlag
Master busy flag

enumerator kLPI2C_MasterBusBusyFlag
Bus busy flag

enumerator kLPI2C_MasterClearFlags
All flags which are cleared by the driver upon starting a transfer.

enumerator kLPI2C_MasterIrqFlags
IRQ sources enabled by the non-blocking transactional API.

enumerator kLPI2C_MasterErrorFlags
Errors to check for.

enum _lpi2c_direction
Direction of master and slave transfers.

Values:

enumerator kLPI2C_Write
Master transmit.

enumerator kLPI2C_Read
Master receive.

enum _lpi2c_master_pin_config
LPI2C pin configuration.

Values:

enumerator kLPI2C_2PinOpenDrain
LPI2C Configured for 2-pin open drain mode

enumerator kLPI2C_2PinOutputOnly
LPI2C Configured for 2-pin output only mode (ultra-fast mode)

enumerator kLPI2C_2PinPushPull
LPI2C Configured for 2-pin push-pull mode

enumerator kLPI2C_4PinPushPull
LPI2C Configured for 4-pin push-pull mode

enumerator kLPI2C_2PinOpenDrainWithSeparateSlave
LPI2C Configured for 2-pin open drain mode with separate LPI2C slave

enumerator kLPI2C_2PinOutputOnlyWithSeparateSlave
LPI2C Configured for 2-pin output only mode(ultra-fast mode) with separate LPI2C slave

enumerator kLPI2C_2PinPushPullWithSeparateSlave
LPI2C Configured for 2-pin push-pull mode with separate LPI2C slave

enumerator kLPI2C_4PinPushPullWithInvertedOutput
LPI2C Configured for 4-pin push-pull mode(inverted outputs)

enum _lpi2c_host_request_source
LPI2C master host request selection.

Values:

enumerator kLPI2C_HostRequestExternalPin
Select the LPI2C_HREQ pin as the host request input

enumerator kLPI2C_HostRequestInputTrigger
Select the input trigger as the host request input

enum _lpi2c_host_request_polarity
LPI2C master host request pin polarity configuration.

Values:

enumerator kLPI2C_HostRequestPinActiveLow
Configure the LPI2C_HREQ pin active low

enumerator kLPI2C_HostRequestPinActiveHigh
Configure the LPI2C_HREQ pin active high

enum _lpi2c_data_match_config_mode
LPI2C master data match configuration modes.

Values:

enumerator kLPI2C_MatchDisabled
LPI2C Match Disabled

enumerator kLPI2C_1stWordEqualsM0OrM1
LPI2C Match Enabled and 1st data word equals MATCH0 OR MATCH1

enumerator kLPI2C_AnyWordEqualsM0OrM1
LPI2C Match Enabled and any data word equals MATCH0 OR MATCH1

enumerator kLPI2C_1stWordEqualsM0And2ndWordEqualsM1
LPI2C Match Enabled and 1st data word equals MATCH0, 2nd data equals MATCH1

enumerator kLPI2C_AnyWordEqualsM0AndNextWordEqualsM1
LPI2C Match Enabled and any data word equals MATCH0, next data equals MATCH1

enumerator kLPI2C_1stWordAndM1EqualsM0AndM1
LPI2C Match Enabled and 1st data word and MATCH0 equals MATCH0 and MATCH1

enumerator kLPI2C_AnyWordAndM1EqualsM0AndM1
LPI2C Match Enabled and any data word and MATCH0 equals MATCH0 and MATCH1

enum _lpi2c_master_transfer_flags

Transfer option flags.

Note: These enumerations are intended to be OR'd together to form a bit mask of options for the _lpi2c_master_transfer::flags field.

Values:

enumerator kLPI2C_TransferDefaultFlag

Transfer starts with a start signal, stops with a stop signal.

enumerator kLPI2C_TransferNoStartFlag

Don't send a start condition, address, and sub address

enumerator kLPI2C_TransferRepeatedStartFlag

Send a repeated start condition

enumerator kLPI2C_TransferNoStopFlag

Don't send a stop condition.

typedef enum *_lpi2c_direction* lpi2c_direction_t

Direction of master and slave transfers.

typedef enum *_lpi2c_master_pin_config* lpi2c_master_pin_config_t

LPI2C pin configuration.

typedef enum *_lpi2c_host_request_source* lpi2c_host_request_source_t

LPI2C master host request selection.

typedef enum *_lpi2c_host_request_polarity* lpi2c_host_request_polarity_t

LPI2C master host request pin polarity configuration.

typedef struct *_lpi2c_master_config* lpi2c_master_config_t

Structure with settings to initialize the LPI2C master module.

This structure holds configuration settings for the LPI2C peripheral. To initialize this structure to reasonable defaults, call the LPI2C_MasterGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

typedef enum *_lpi2c_data_match_config_mode* lpi2c_data_match_config_mode_t

LPI2C master data match configuration modes.

typedef struct *_lpi2c_match_config* lpi2c_data_match_config_t

LPI2C master data match configuration structure.

typedef struct *_lpi2c_master_transfer* lpi2c_master_transfer_t

LPI2C master descriptor of the transfer.

typedef struct *_lpi2c_master_handle* lpi2c_master_handle_t

LPI2C master handle of the transfer.

typedef void (*lpi2c_master_transfer_callback_t)(LPI2C_Type *base, *lpi2c_master_handle_t* *handle, *status_t* completionStatus, void *userData)

Master completion callback function pointer type.

This callback is used only for the non-blocking master transfer API. Specify the callback you wish to use in the call to LPI2C_MasterTransferCreateHandle().

Param base
The LPI2C peripheral base address.

Param handle
Pointer to the LPI2C master driver handle.

Param completionStatus
Either kStatus_Success or an error code describing how the transfer completed.

Param userData
Arbitrary pointer-sized value passed from the application.

typedef void (*lpi2c_master_isr_t)(LPI2C_Type *base, void *handle)

Typedef for master interrupt handler, used internally for LPI2C master interrupt and EDMA transactional APIs.

struct _lpi2c_master_config

#include <fsl_lpi2c.h> Structure with settings to initialize the LPI2C master module.

This structure holds configuration settings for the LPI2C peripheral. To initialize this structure to reasonable defaults, call the LPI2C_MasterGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

Public Members

bool enableMaster
Whether to enable master mode.

bool enableDoze
Whether master is enabled in doze mode.

bool debugEnable
Enable transfers to continue when halted in debug mode.

bool ignoreAck
Whether to ignore ACK/NACK.

lpi2c_master_pin_config_t pinConfig
The pin configuration option.

uint32_t baudRate_Hz
Desired baud rate in Hertz.

uint32_t busIdleTimeout_ns
Bus idle timeout in nanoseconds. Set to 0 to disable.

uint32_t pinLowTimeout_ns
Pin low timeout in nanoseconds. Set to 0 to disable.

uint8_t sdaGlitchFilterWidth_ns
Width in nanoseconds of glitch filter on SDA pin. Set to 0 to disable.

uint8_t sclGlitchFilterWidth_ns
Width in nanoseconds of glitch filter on SCL pin. Set to 0 to disable.

struct *_lpi2c_master_config* hostRequest
Host request options.

struct _lpi2c_match_config

#include <fsl_lpi2c.h> LPI2C master data match configuration structure.

Public Members

lpi2c_data_match_config_mode_t matchMode
Data match configuration setting.

bool rxDataMatchOnly
When set to true, received data is ignored until a successful match.

uint32_t match0
Match value 0.

uint32_t match1
Match value 1.

struct __lpi2c_master_transfer
#include <fsl_lpi2c.h> Non-blocking transfer descriptor structure.

This structure is used to pass transaction parameters to the LPI2C_MasterTransferNonBlocking() API.

Public Members

uint32_t flags
Bit mask of options for the transfer. See enumeration _lpi2c_master_transfer_flags for available options. Set to 0 or kLPI2C_TransferDefaultFlag for normal transfers.

uint16_t slaveAddress
The 7-bit slave address.

lpi2c_direction_t direction
Either kLPI2C_Read or kLPI2C_Write.

uint32_t subaddress
Sub address. Transferred MSB first.

size_t subaddressSize
Length of sub address to send in bytes. Maximum size is 4 bytes.

void *data
Pointer to data to transfer.

size_t dataSize
Number of bytes to transfer.

struct __lpi2c_master_handle
#include <fsl_lpi2c.h> Driver handle for master non-blocking APIs.

Note: The contents of this structure are private and subject to change.

Public Members

uint8_t state
Transfer state machine current state.

uint16_t remainingBytes
Remaining byte count in current state.

uint8_t *buf
Buffer pointer for current state.

uint16_t commandBuffer[6]

LPI2C command sequence. When all 6 command words are used: Start&addr&write[1 word] + subaddr[4 words] + restart&addr&read[1 word]

lpi2c_master_transfer_t transfer

Copy of the current transfer info.

lpi2c_master_transfer_callback_t completionCallback

Callback function pointer.

void *userData

Application data passed to callback.

struct hostRequest

Public Members

bool enable

Enable host request.

lpi2c_host_request_source_t source

Host request source.

lpi2c_host_request_polarity_t polarity

Host request pin polarity.

2.41 LPI2C Master DMA Driver

void LPI2C_MasterCreateEDMAHandle(LPI2C_Type *base, *lpi2c_master_edma_handle_t* *handle, *edma_handle_t* *rxDmaHandle, *edma_handle_t* *txDmaHandle, *lpi2c_master_edma_transfer_callback_t* callback, void *userData)

Create a new handle for the LPI2C master DMA APIs.

The creation of a handle is for use with the DMA APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the LPI2C_MasterTransferAbortEDMA() API shall be called.

For devices where the LPI2C send and receive DMA requests are OR'd together, the *txDmaHandle* parameter is ignored and may be set to NULL.

Parameters

- base – The LPI2C peripheral base address.
- handle – **[out]** Pointer to the LPI2C master driver handle.
- rxDmaHandle – Handle for the eDMA receive channel. Created by the user prior to calling this function.
- txDmaHandle – Handle for the eDMA transmit channel. Created by the user prior to calling this function.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.

status_t LPI2C_MasterTransferEDMA(LPI2C_Type *base, *lpi2c_master_edma_handle_t* *handle, *lpi2c_master_transfer_t* *transfer)

Performs a non-blocking DMA-based transaction on the I2C bus.

The callback specified when the *handle* was created is invoked when the transaction has completed.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to the LPI2C master driver handle.
- transfer – The pointer to the transfer descriptor.

Return values

- kStatus_Success – The transaction was started successfully.
- kStatus_LPI2C_Busy – Either another master is currently utilizing the bus, or another DMA transaction is already in progress.

status_t LPI2C_MasterTransferGetCountEDMA(LPI2C_Type *base, *lpi2c_master_edma_handle_t* *handle, size_t *count)

Returns number of bytes transferred so far.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to the LPI2C master driver handle.
- count – **[out]** Number of bytes transferred so far by the non-blocking transaction.

Return values

- kStatus_Success –
- kStatus_NoTransferInProgress – There is not a DMA transaction currently in progress.

status_t LPI2C_MasterTransferAbortEDMA(LPI2C_Type *base, *lpi2c_master_edma_handle_t* *handle)

Terminates a non-blocking LPI2C master transmission early.

Note: It is not safe to call this function from an IRQ handler that has a higher priority than the eDMA peripheral's IRQ priority.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to the LPI2C master driver handle.

Return values

- kStatus_Success – A transaction was successfully aborted.
- kStatus_LPI2C_Idle – There is not a DMA transaction currently in progress.

typedef struct *_lpi2c_master_edma_handle* lpi2c_master_edma_handle_t

LPI2C master EDMA handle of the transfer.

typedef void (*lpi2c_master_edma_transfer_callback_t)(LPI2C_Type *base, *lpi2c_master_edma_handle_t* *handle, *status_t* completionStatus, void *userData)

Master DMA completion callback function pointer type.

This callback is used only for the non-blocking master transfer API. Specify the callback you wish to use in the call to LPI2C_MasterCreateEDMAHandle().

Param base
The LPI2C peripheral base address.

Param handle
Handle associated with the completed transfer.

Param completionStatus
Either kStatus_Success or an error code describing how the transfer completed.

Param userData
Arbitrary pointer-sized value passed from the application.

struct __lpi2c_master_edma_handle

#include <fsl_lpi2c_edma.h> Driver handle for master DMA APIs.

Note: The contents of this structure are private and subject to change.

Public Members

LPI2C_Type *base

LPI2C base pointer.

bool isBusy

Transfer state machine current state.

uint8_t nbytes

eDMA minor byte transfer count initially configured.

uint16_t commandBuffer[20]

LPI2C command sequence. When all 10 command words are used: Start&addr&write[1 word] + subaddr[4 words] + restart&addr&read[1 word] + receive&Size[4 words]

lpi2c_master_transfer_t transfer

Copy of the current transfer info.

lpi2c_master_edma_transfer_callback_t completionCallback

Callback function pointer.

void *userData

Application data passed to callback.

edma_handle_t *rx

Handle for receive DMA channel.

edma_handle_t *tx

Handle for transmit DMA channel.

edma_tcd_t tcds[3]

Software TCD. Three are allocated to provide enough room to align to 32-bytes.

2.42 LPI2C Slave Driver

void LPI2C_SlaveGetDefaultConfig(*lpi2c_slave_config_t* *slaveConfig)

Provides a default configuration for the LPI2C slave peripheral.

This function provides the following default configuration for the LPI2C slave peripheral:

```
slaveConfig->enableSlave              = true;
slaveConfig->address0                 = 0U;
slaveConfig->address1                 = 0U;
slaveConfig->addressMatchMode         = kLPI2C_MatchAddress0;
slaveConfig->filterDozeEnable         = true;
slaveConfig->filterEnable             = true;
slaveConfig->enableGeneralCall        = false;
slaveConfig->sclStall.enableAck       = false;
slaveConfig->sclStall.enableTx        = true;
slaveConfig->sclStall.enableRx        = true;
slaveConfig->sclStall.enableAddress   = true;
slaveConfig->ignoreAck                = false;
slaveConfig->enableReceivedAddressRead = false;
slaveConfig->sdaGlitchFilterWidth_ns  = 0;
slaveConfig->sclGlitchFilterWidth_ns  = 0;
slaveConfig->dataValidDelay_ns        = 0;
slaveConfig->clockHoldTime_ns         = 0;
```

After calling this function, override any settings to customize the configuration, prior to initializing the master driver with LPI2C_SlaveInit(). Be sure to override at least the *address0* member of the configuration structure with the desired slave address.

Parameters

- slaveConfig – **[out]** User provided configuration structure that is set to default values. Refer to lpi2c_slave_config_t.

void LPI2C_SlaveInit(LPI2C_Type *base, const *lpi2c_slave_config_t* *slaveConfig, uint32_t sourceClock_Hz)

Initializes the LPI2C slave peripheral.

This function enables the peripheral clock and initializes the LPI2C slave peripheral as described by the user provided configuration.

Parameters

- base – The LPI2C peripheral base address.
- slaveConfig – User provided peripheral configuration. Use LPI2C_SlaveGetDefaultConfig() to get a set of defaults that you can override.
- sourceClock_Hz – Frequency in Hertz of the LPI2C functional clock. Used to calculate the filter widths, data valid delay, and clock hold time.

void LPI2C_SlaveDeinit(LPI2C_Type *base)

Deinitializes the LPI2C slave peripheral.

This function disables the LPI2C slave peripheral and gates the clock. It also performs a software reset to restore the peripheral to reset conditions.

Parameters

- base – The LPI2C peripheral base address.

static inline void LPI2C_SlaveReset(LPI2C_Type *base)

Performs a software reset of the LPI2C slave peripheral.

Parameters

- base – The LPI2C peripheral base address.

static inline void LPI2C_SlaveEnable(LPI2C_Type *base, bool enable)

Enables or disables the LPI2C module as slave.

Parameters

- base – The LPI2C peripheral base address.
- enable – Pass true to enable or false to disable the specified LPI2C as slave.

static inline uint32_t LPI2C_SlaveGetStatusFlags(LPI2C_Type *base)

Gets the LPI2C slave status flags.

A bit mask with the state of all LPI2C slave status flags is returned. For each flag, the corresponding bit in the return value is set if the flag is asserted.

See also:

_lpi2c_slave_flags

Parameters

- base – The LPI2C peripheral base address.

Returns

State of the status flags:

- 1: related status flag is set.
- 0: related status flag is not set.

static inline void LPI2C_SlaveClearStatusFlags(LPI2C_Type *base, uint32_t statusMask)

Clears the LPI2C status flag state.

The following status register flags can be cleared:

- kLPI2C_SlaveRepeatedStartDetectFlag
- kLPI2C_SlaveStopDetectFlag
- kLPI2C_SlaveBitErrFlag
- kLPI2C_SlaveFifoErrFlag

Attempts to clear other flags has no effect.

See also:

_lpi2c_slave_flags.

Parameters

- base – The LPI2C peripheral base address.
- statusMask – A bitmask of status flags that are to be cleared. The mask is composed of _lpi2c_slave_flags enumerators OR'd together. You may pass the result of a previous call to LPI2C_SlaveGetStatusFlags().

static inline void LPI2C_SlaveEnableInterrupts(LPI2C_Type *base, uint32_t interruptMask)

Enables the LPI2C slave interrupt requests.

All flags except kLPI2C_SlaveBusyFlag and kLPI2C_SlaveBusBusyFlag can be enabled as interrupts.

Parameters

- base – The LPI2C peripheral base address.

- interruptMask – Bit mask of interrupts to enable. See _lpi2c_slave_flags for the set of constants that should be OR'd together to form the bit mask.

static inline void LPI2C_SlaveDisableInterrupts(LPI2C_Type *base, uint32_t interruptMask)

Disables the LPI2C slave interrupt requests.

All flags except kLPI2C_SlaveBusyFlag and kLPI2C_SlaveBusBusyFlag can be enabled as interrupts.

Parameters

- base – The LPI2C peripheral base address.
- interruptMask – Bit mask of interrupts to disable. See _lpi2c_slave_flags for the set of constants that should be OR'd together to form the bit mask.

static inline uint32_t LPI2C_SlaveGetEnabledInterrupts(LPI2C_Type *base)

Returns the set of currently enabled LPI2C slave interrupt requests.

Parameters

- base – The LPI2C peripheral base address.

Returns

A bitmask composed of _lpi2c_slave_flags enumerators OR'd together to indicate the set of enabled interrupts.

static inline void LPI2C_SlaveEnableDMA(LPI2C_Type *base, bool enableAddressValid, bool enableRx, bool enableTx)

Enables or disables the LPI2C slave peripheral DMA requests.

Parameters

- base – The LPI2C peripheral base address.
- enableAddressValid – Enable flag for the address valid DMA request. Pass true for enable, false for disable. The address valid DMA request is shared with the receive data DMA request.
- enableRx – Enable flag for the receive data DMA request. Pass true for enable, false for disable.
- enableTx – Enable flag for the transmit data DMA request. Pass true for enable, false for disable.

static inline bool LPI2C_SlaveGetBusIdleState(LPI2C_Type *base)

Returns whether the bus is idle.

Requires the slave mode to be enabled.

Parameters

- base – The LPI2C peripheral base address.

Return values

- true – Bus is busy.
- false – Bus is idle.

static inline void LPI2C_SlaveTransmitAck(LPI2C_Type *base, bool ackOrNack)

Transmits either an ACK or NAK on the I2C bus in response to a byte from the master.

Use this function to send an ACK or NAK when the kLPI2C_SlaveTransmitAckFlag is asserted. This only happens if you enable the sclStall.enableAck field of the lpi2c_slave_config_t configuration structure used to initialize the slave peripheral.

Parameters

- base – The LPI2C peripheral base address.

- ackOrNack – Pass true for an ACK or false for a NAK.

static inline void LPI2C_SlaveEnableAckStall(LPI2C_Type *base, bool enable)

Enables or disables ACKSTALL.

When enables ACKSTALL, software can transmit either an ACK or NAK on the I2C bus in response to a byte from the master.

Parameters

- base – The LPI2C peripheral base address.
- enable – True will enable ACKSTALL,false will disable ACKSTALL.

static inline uint32_t LPI2C_SlaveGetReceivedAddress(LPI2C_Type *base)

Returns the slave address sent by the I2C master.

This function should only be called if the kLPI2C_SlaveAddressValidFlag is asserted.

Parameters

- base – The LPI2C peripheral base address.

Returns

The 8-bit address matched by the LPI2C slave. Bit 0 contains the R/w direction bit, and the 7-bit slave address is in the upper 7 bits.

status_t LPI2C_SlaveSend(LPI2C_Type *base, void *txBuff, size_t txSize, size_t *actualTxSize)

Performs a polling send transfer on the I2C bus.

Parameters

- base – The LPI2C peripheral base address.
- txBuff – The pointer to the data to be transferred.
- txSize – The length in bytes of the data to be transferred.
- actualTxSize – **[out]**

Returns

Error or success status returned by API.

status_t LPI2C_SlaveReceive(LPI2C_Type *base, void *rxBuff, size_t rxSize, size_t *actualRxSize)

Performs a polling receive transfer on the I2C bus.

Parameters

- base – The LPI2C peripheral base address.
- rxBuff – The pointer to the data to be transferred.
- rxSize – The length in bytes of the data to be transferred.
- actualRxSize – **[out]**

Returns

Error or success status returned by API.

void LPI2C_SlaveTransferCreateHandle(LPI2C_Type *base, *lpi2c_slave_handle_t* *handle, *lpi2c_slave_transfer_callback_t* callback, void *userData)

Creates a new handle for the LPI2C slave non-blocking APIs.

The creation of a handle is for use with the non-blocking APIs. Once a handle is created, there is not a corresponding destroy handle. If the user wants to terminate a transfer, the LPI2C_SlaveTransferAbort() API shall be called.

Note: The function also enables the NVIC IRQ for the input LPI2C. Need to notice that on some SoCs the LPI2C IRQ is connected to INTMUX, in this case user needs to enable the associated INTMUX IRQ in application.

Parameters

- base – The LPI2C peripheral base address.
- handle – **[out]** Pointer to the LPI2C slave driver handle.
- callback – User provided pointer to the asynchronous callback function.
- userData – User provided pointer to the application callback data.

status_t LPI2C_SlaveTransferNonBlocking(LPI2C_Type *base, *lpi2c_slave_handle_t* *handle, uint32_t eventMask)

Starts accepting slave transfers.

Call this API after calling I2C_SlaveInit() and LPI2C_SlaveTransferCreateHandle() to start processing transactions driven by an I2C master. The slave monitors the I2C bus and pass events to the callback that was passed into the call to LPI2C_SlaveTransferCreateHandle(). The callback is always invoked from the interrupt context.

The set of events received by the callback is customizable. To do so, set the *eventMask* parameter to the OR'd combination of lpi2c_slave_transfer_event_t enumerators for the events you wish to receive. The kLPI2C_SlaveTransmitEvent and kLPI2C_SlaveReceiveEvent events are always enabled and do not need to be included in the mask. Alternatively, you can pass 0 to get a default set of only the transmit and receive events that are always enabled. In addition, the kLPI2C_SlaveAllEvents constant is provided as a convenient way to enable all events.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to lpi2c_slave_handle_t structure which stores the transfer state.
- eventMask – Bit mask formed by OR'ing together lpi2c_slave_transfer_event_t enumerators to specify which events to send to the callback. Other accepted values are 0 to get a default set of only the transmit and receive events, and kLPI2C_SlaveAllEvents to enable all events.

Return values

- kStatus_Success – Slave transfers were successfully started.
- kStatus_LPI2C_Busy – Slave transfers have already been started on this handle.

status_t LPI2C_SlaveTransferGetCount(LPI2C_Type *base, *lpi2c_slave_handle_t* *handle, size_t *count)

Gets the slave transfer status during a non-blocking transfer.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to i2c_slave_handle_t structure.
- count – **[out]** Pointer to a value to hold the number of bytes transferred. May be NULL if the count is not required.

Return values

- kStatus_Success –
- kStatus_NoTransferInProgress –

void LPI2C_SlaveTransferAbort(LPI2C_Type *base, *lpi2c_slave_handle_t* *handle)

Aborts the slave non-blocking transfers.

Note: This API could be called at any time to stop slave for handling the bus events.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to lpi2c_slave_handle_t structure which stores the transfer state.

void LPI2C_SlaveTransferHandleIRQ(LPI2C_Type *base, *lpi2c_slave_handle_t* *handle)

Reusable routine to handle slave interrupts.

Note: This function does not need to be called unless you are reimplementing the non blocking API's interrupt handler routines to add special functionality.

Parameters

- base – The LPI2C peripheral base address.
- handle – Pointer to lpi2c_slave_handle_t structure which stores the transfer state.

enum _lpi2c_slave_flags

LPI2C slave peripheral flags.

The following status register flags can be cleared:

- kLPI2C_SlaveRepeatedStartDetectFlag
- kLPI2C_SlaveStopDetectFlag
- kLPI2C_SlaveBitErrFlag
- kLPI2C_SlaveFifoErrFlag

All flags except kLPI2C_SlaveBusyFlag and kLPI2C_SlaveBusBusyFlag can be enabled as interrupts.

Note: These enumerations are meant to be OR'd together to form a bit mask.

Values:

enumerator kLPI2C_SlaveTxReadyFlag

Transmit data flag

enumerator kLPI2C_SlaveRxReadyFlag

Receive data flag

enumerator kLPI2C_SlaveAddressValidFlag

Address valid flag

enumerator kLPI2C_SlaveTransmitAckFlag

Transmit ACK flag

enumerator kLPI2C_SlaveRepeatedStartDetectFlag
Repeated start detect flag

enumerator kLPI2C_SlaveStopDetectFlag
Stop detect flag

enumerator kLPI2C_SlaveBitErrFlag
Bit error flag

enumerator kLPI2C_SlaveFifoErrFlag
FIFO error flag

enumerator kLPI2C_SlaveAddressMatch0Flag
Address match 0 flag

enumerator kLPI2C_SlaveAddressMatch1Flag
Address match 1 flag

enumerator kLPI2C_SlaveGeneralCallFlag
General call flag

enumerator kLPI2C_SlaveBusyFlag
Master busy flag

enumerator kLPI2C_SlaveBusBusyFlag
Bus busy flag

enumerator kLPI2C_SlaveClearFlags
All flags which are cleared by the driver upon starting a transfer.

enumerator kLPI2C_SlaveIrqFlags
IRQ sources enabled by the non-blocking transactional API.

enumerator kLPI2C_SlaveErrorFlags
Errors to check for.

enum _lpi2c_slave_address_match
LPI2C slave address match options.

Values:

enumerator kLPI2C_MatchAddress0
Match only address 0.

enumerator kLPI2C_MatchAddress0OrAddress1
Match either address 0 or address 1.

enumerator kLPI2C_MatchAddress0ThroughAddress1
Match a range of slave addresses from address 0 through address 1.

enum _lpi2c_slave_transfer_event
Set of events sent to the callback for non blocking slave transfers.

These event enumerations are used for two related purposes. First, a bit mask created by OR'ing together events is passed to LPI2C_SlaveTransferNonBlocking() in order to specify which events to enable. Then, when the slave callback is invoked, it is passed the current event through its *transfer* parameter.

Note: These enumerations are meant to be OR'd together to form a bit mask of events.

Values:

enumerator kLPI2C_SlaveAddressMatchEvent
Received the slave address after a start or repeated start.

enumerator kLPI2C_SlaveTransmitEvent
Callback is requested to provide data to transmit (slave-transmitter role).

enumerator kLPI2C_SlaveReceiveEvent
Callback is requested to provide a buffer in which to place received data (slave-receiver role).

enumerator kLPI2C_SlaveTransmitAckEvent
Callback needs to either transmit an ACK or NACK.

enumerator kLPI2C_SlaveRepeatedStartEvent
A repeated start was detected.

enumerator kLPI2C_SlaveCompletionEvent
A stop was detected, completing the transfer.

enumerator kLPI2C_SlaveAllEvents
Bit mask of all available events.

typedef enum *_lpi2c_slave_address_match* lpi2c_slave_address_match_t
LPI2C slave address match options.

typedef struct *_lpi2c_slave_config* lpi2c_slave_config_t
Structure with settings to initialize the LPI2C slave module.

This structure holds configuration settings for the LPI2C slave peripheral. To initialize this structure to reasonable defaults, call the LPI2C_SlaveGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

typedef enum *_lpi2c_slave_transfer_event* lpi2c_slave_transfer_event_t
Set of events sent to the callback for non blocking slave transfers.

These event enumerations are used for two related purposes. First, a bit mask created by OR'ing together events is passed to LPI2C_SlaveTransferNonBlocking() in order to specify which events to enable. Then, when the slave callback is invoked, it is passed the current event through its *transfer* parameter.

Note: These enumerations are meant to be OR'd together to form a bit mask of events.

typedef struct *_lpi2c_slave_transfer* lpi2c_slave_transfer_t
LPI2C slave transfer structure.

typedef struct *_lpi2c_slave_handle* lpi2c_slave_handle_t
LPI2C slave handle structure.

typedef void (*lpi2c_slave_transfer_callback_t)(LPI2C_Type *base, *lpi2c_slave_transfer_t* *transfer, void *userData)
Slave event callback function pointer type.

This callback is used only for the slave non-blocking transfer API. To install a callback, use the LPI2C_SlaveSetCallback() function after you have created a handle.

Param base
Base address for the LPI2C instance on which the event occurred.

Param transfer
Pointer to transfer descriptor containing values passed to and/or from the callback.

Param userData
Arbitrary pointer-sized value passed from the application.

struct __lpi2c_slave_config

#include <fsl_lpi2c.h> Structure with settings to initialize the LPI2C slave module.

This structure holds configuration settings for the LPI2C slave peripheral. To initialize this structure to reasonable defaults, call the LPI2C_SlaveGetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration structure can be made constant so it resides in flash.

Public Members

bool enableSlave
Enable slave mode.

uint8_t address0
Slave's 7-bit address.

uint8_t address1
Alternate slave 7-bit address.

lpi2c_slave_address_match_t addressMatchMode
Address matching options.

bool filterDozeEnable
Enable digital glitch filter in doze mode.

bool filterEnable
Enable digital glitch filter.

bool enableGeneralCall
Enable general call address matching.

struct *_lpi2c_slave_config* sclStall
SCL stall enable options.

bool ignoreAck
Continue transfers after a NACK is detected.

bool enableReceivedAddressRead
Enable reading the address received address as the first byte of data.

uint32_t sdaGlitchFilterWidth_ns
Width in nanoseconds of the digital filter on the SDA signal. Set to 0 to disable.

uint32_t sclGlitchFilterWidth_ns
Width in nanoseconds of the digital filter on the SCL signal. Set to 0 to disable.

uint32_t dataValidDelay_ns
Width in nanoseconds of the data valid delay.

uint32_t clockHoldTime_ns
Width in nanoseconds of the clock hold time.

struct __lpi2c_slave_transfer

#include <fsl_lpi2c.h> LPI2C slave transfer structure.

Public Members

lpi2c_slave_transfer_event_t event
Reason the callback is being invoked.

uint8_t receivedAddress
Matching address send by master.

uint8_t *data
Transfer buffer

size_t dataSize
Transfer size

status_t completionStatus
Success or error code describing how the transfer completed. Only applies for kLPI2C_SlaveCompletionEvent.

size_t transferredCount
Number of bytes actually transferred since start or last repeated start.

struct __lpi2c_slave_handle
#include <fsl_lpi2c.h> LPI2C slave handle structure.

Note: The contents of this structure are private and subject to change.

Public Members

lpi2c_slave_transfer_t transfer
LPI2C slave transfer copy.

bool isBusy
Whether transfer is busy.

bool wasTransmit
Whether the last transfer was a transmit.

uint32_t eventMask
Mask of enabled events.

uint32_t transferredCount
Count of bytes transferred.

lpi2c_slave_transfer_callback_t callback
Callback function called at transfer event.

void *userData
Callback parameter passed to callback.

struct sclStall

Public Members

bool enableAck
Enables SCL clock stretching during slave-transmit address byte(s) and slave-receiver address and data byte(s) to allow software to write the Transmit ACK Register before the ACK or NACK is transmitted. Clock stretching occurs when transmitting the 9th bit. When enableAckSCLStall is enabled, there is no need to set either enableRxDataSCLStall or enableAddressSCLStall.

bool enableTx

Enables SCL clock stretching when the transmit data flag is set during a slave-transmit transfer.

bool enableRx

Enables SCL clock stretching when receive data flag is set during a slave-receive transfer.

bool enableAddress

Enables SCL clock stretching when the address valid flag is asserted.

2.43 LPIT: Low-Power Interrupt Timer

enum _lpit_chnl

List of LPIT channels.

Note: Actual number of available channels is SoC-dependent

Values:

enumerator kLPIT_Chnl_0

LPIT channel number 0

enumerator kLPIT_Chnl_1

LPIT channel number 1

enumerator kLPIT_Chnl_2

LPIT channel number 2

enumerator kLPIT_Chnl_3

LPIT channel number 3

enum _lpit_timer_modes

Mode options available for the LPIT timer.

Values:

enumerator kLPIT_PeriodicCounter

Use the all 32-bits, counter loads and decrements to zero

enumerator kLPIT_DualPeriodicCounter

Counter loads, lower 16-bits decrement to zero, then upper 16-bits decrement

enumerator kLPIT_TriggerAccumulator

Counter loads on first trigger and decrements on each trigger

enumerator kLPIT_InputCapture

Counter loads with 0xFFFFFFFF, decrements to zero. It stores the inverse of the current value when a input trigger is detected

enum _lpit_trigger_select

Trigger options available.

This is used for both internal and external trigger sources. The actual trigger options available is SoC-specific, user should refer to the reference manual.

Values:

enumerator kLPIT_Trigger_TimerChn0
Channel 0 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn1
Channel 1 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn2
Channel 2 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn3
Channel 3 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn4
Channel 4 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn5
Channel 5 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn6
Channel 6 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn7
Channel 7 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn8
Channel 8 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn9
Channel 9 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn10
Channel 10 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn11
Channel 11 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn12
Channel 12 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn13
Channel 13 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn14
Channel 14 is selected as a trigger source

enumerator kLPIT_Trigger_TimerChn15
Channel 15 is selected as a trigger source

enum _lpit_trigger_source
Trigger source options available.

Values:

enumerator kLPIT_TriggerSource_External
Use external trigger input

enumerator kLPIT_TriggerSource_Internal
Use internal trigger

enum _lpit_interrupt_enable

List of LPIT interrupts.

Note: Number of timer channels are SoC-specific. See the SoC Reference Manual.

Values:

enumerator kLPIT_Channel0TimerInterruptEnable

Channel 0 Timer interrupt

enumerator kLPIT_Channel1TimerInterruptEnable

Channel 1 Timer interrupt

enumerator kLPIT_Channel2TimerInterruptEnable

Channel 2 Timer interrupt

enumerator kLPIT_Channel3TimerInterruptEnable

Channel 3 Timer interrupt

enum _lpit_status_flags

List of LPIT status flags.

Note: Number of timer channels are SoC-specific. See the SoC Reference Manual.

Values:

enumerator kLPIT_Channel0TimerFlag

Channel 0 Timer interrupt flag

enumerator kLPIT_Channel1TimerFlag

Channel 1 Timer interrupt flag

enumerator kLPIT_Channel2TimerFlag

Channel 2 Timer interrupt flag

enumerator kLPIT_Channel3TimerFlag

Channel 3 Timer interrupt flag

typedef enum *_lpit_chnl* lpit_chnl_t

List of LPIT channels.

Note: Actual number of available channels is SoC-dependent

typedef enum *_lpit_timer_modes* lpit_timer_modes_t

Mode options available for the LPIT timer.

typedef enum *_lpit_trigger_select* lpit_trigger_select_t

Trigger options available.

This is used for both internal and external trigger sources. The actual trigger options available is SoC-specific, user should refer to the reference manual.

typedef enum *_lpit_trigger_source* lpit_trigger_source_t

Trigger source options available.

typedef enum *_lpit_interrupt_enable* lpit_interrupt_enable_t

List of LPIT interrupts.

Note: Number of timer channels are SoC-specific. See the SoC Reference Manual.

typedef enum *_lpit_status_flags* lpit_status_flags_t

List of LPIT status flags.

Note: Number of timer channels are SoC-specific. See the SoC Reference Manual.

typedef struct *_lpit_chnl_params* lpit_chnl_params_t

Structure to configure the channel timer.

typedef struct *_lpit_config* lpit_config_t

LPIT configuration structure.

This structure holds the configuration settings for the LPIT peripheral. To initialize this structure to reasonable defaults, call the LPIT_GetDefaultConfig() function and pass a pointer to the configuration structure instance.

The configuration structure can be made constant so as to reside in flash.

FSL_LPIT_DRIVER_VERSION

Version 2.1.2

LPIT_RESET_STATE_DELAY

Delay used in LPIT_Reset.

The macro value should be larger than 4 * core clock / LPIT peripheral clock.

void LPIT_Init(LPIT_Type *base, const *lpit_config_t* *config)

Ungates the LPIT clock and configures the peripheral for a basic operation.

This function issues a software reset to reset all channels and registers except the Module Control register.

Note: This API should be called at the beginning of the application using the LPIT driver.

Parameters

- base – LPIT peripheral base address.
- config – Pointer to the user configuration structure.

void LPIT_Deinit(LPIT_Type *base)

Disables the module and gates the LPIT clock.

Parameters

- base – LPIT peripheral base address.

void LPIT_GetDefaultConfig(*lpit_config_t* *config)

Fills in the LPIT configuration structure with default settings.

The default values are:

```
config->enableRunInDebug = false;
config->enableRunInDoze = false;
```

Parameters

- config – Pointer to the user configuration structure.

status_t LPIT_SetupChannel(LPIT_Type *base, *lpit_chnl_t* channel, const *lpit_chnl_params_t* *chnlSetup)

Sets up an LPIT channel based on the user's preference.

This function sets up the operation mode to one of the options available in the enumeration lpit_timer_modes_t. It sets the trigger source as either internal or external, trigger selection and the timers behaviour when a timeout occurs. It also chains the timer if a prior timer if requested by the user.

Parameters

- base – LPIT peripheral base address.
- channel – Channel that is being configured.
- chnlSetup – Configuration parameters.

static inline void LPIT_EnableInterrupts(LPIT_Type *base, uint32_t mask)

Enables the selected PIT interrupts.

Parameters

- base – LPIT peripheral base address.
- mask – The interrupts to enable. This is a logical OR of members of the enumeration lpit_interrupt_enable_t

static inline void LPIT_DisableInterrupts(LPIT_Type *base, uint32_t mask)

Disables the selected PIT interrupts.

Parameters

- base – LPIT peripheral base address.
- mask – The interrupts to enable. This is a logical OR of members of the enumeration lpit_interrupt_enable_t

static inline uint32_t LPIT_GetEnabledInterrupts(LPIT_Type *base)

Gets the enabled LPIT interrupts.

Parameters

- base – LPIT peripheral base address.

Returns

The enabled interrupts. This is the logical OR of members of the enumeration lpit_interrupt_enable_t

static inline uint32_t LPIT_GetStatusFlags(LPIT_Type *base)

Gets the LPIT status flags.

Parameters

- base – LPIT peripheral base address.

Returns

The status flags. This is the logical OR of members of the enumeration lpit_status_flags_t

static inline void LPIT_ClearStatusFlags(LPIT_Type *base, uint32_t mask)

Clears the LPIT status flags.

Parameters

- base – LPIT peripheral base address.
- mask – The status flags to clear. This is a logical OR of members of the enumeration lpit_status_flags_t

static inline void LPIT_SetTimerPeriod(LPIT_Type *base, *lpit_chnl_t* channel, uint32_t ticks)

Sets the timer period in units of count.

Timers begin counting down from the value set by this function until it reaches 0, at which point it generates an interrupt and loads this register value again. Writing a new value to this register does not restart the timer. Instead, the value is loaded after the timer expires.

Note: User can call the utility macros provided in fsl_common.h to convert to ticks.

Parameters

- base – LPIT peripheral base address.
- channel – Timer channel number.
- ticks – Timer period in units of ticks.

static inline void LPIT_SetTimerValue(LPIT_Type *base, *lpit_chnl_t* channel, uint32_t ticks)

Sets the timer period in units of count.

In the Dual 16-bit Periodic Counter mode, the counter will load and then the lower 16-bits will decrement down to zero, which will assert the output pre-trigger. The upper 16-bits will then decrement down to zero, which will negate the output pre-trigger and set the timer interrupt flag.

Note: Set TVAL register to 0 or 1 is invalid in compare mode.

Parameters

- base – LPIT peripheral base address.
- channel – Timer channel number.
- ticks – Timer period in units of ticks.

static inline uint32_t LPIT_GetCurrentTimerCount(LPIT_Type *base, *lpit_chnl_t* channel)

Reads the current timer counting value.

This function returns the real-time timer counting value, in a range from 0 to a timer period.

Note: User can call the utility macros provided in fsl_common.h to convert ticks to microseconds or milliseconds.

Parameters

- base – LPIT peripheral base address.
- channel – Timer channel number.

Returns

Current timer counting value in ticks.

static inline void LPIT_StartTimer(LPIT_Type *base, *lpit_chnl_t* channel)

Starts the timer counting.

After calling this function, timers load the period value and count down to 0. When the timer reaches 0, it generates a trigger pulse and sets the timeout interrupt flag.

Parameters

- base – LPIT peripheral base address.

- channel – Timer channel number.

static inline void LPIT_StopTimer(LPIT_Type *base, *lpit_chnl_t* channel)

Stops the timer counting.

Parameters

- base – LPIT peripheral base address.
- channel – Timer channel number.

static void LPIT_ResetStateDelay(void)

Short wait for LPIT state reset.

After clear or set LPIT_EN, there should be delay longer than 4 LPIT functional clock.

Parameters

- count – Delay count.

static inline void LPIT_Reset(LPIT_Type *base)

Performs a software reset on the LPIT module.

This resets all channels and registers except the Module Control Register.

Parameters

- base – LPIT peripheral base address.

struct _lpit_chnl_params

#include <fsl_lpit.h> Structure to configure the channel timer.

Public Members

bool chainChannel

true: Timer chained to previous timer; false: Timer not chained

lpit_timer_modes_t timerMode

Timers mode of operation.

lpit_trigger_select_t triggerSelect

Trigger selection for the timer

lpit_trigger_source_t triggerSource

Decides if we use external or internal trigger.

bool enableReloadOnTrigger

true: Timer reloads when a trigger is detected; false: No effect

bool enableStopOnTimeout

true: Timer will stop after timeout; false: does not stop after timeout

bool enableStartOnTrigger

true: Timer starts when a trigger is detected; false: decrement immediately

struct _lpit_config

#include <fsl_lpit.h> LPIT configuration structure.

This structure holds the configuration settings for the LPIT peripheral. To initialize this structure to reasonable defaults, call the LPIT_GetDefaultConfig() function and pass a pointer to the configuration structure instance.

The configuration structure can be made constant so as to reside in flash.

Public Members

bool enableRunInDebug

true: Timers run in debug mode; false: Timers stop in debug mode

bool enableRunInDoze

true: Timers run in doze mode; false: Timers stop in doze mode

2.44 LPSPI: Low Power Serial Peripheral Interface

2.45 LPSPI Peripheral driver

void LPSPI_MasterInit(LPSPI_Type *base, const *lpspi_master_config_t* *masterConfig, uint32_t srcClock_Hz)

Initializes the LPSPI master.

Parameters

- base – LPSPI peripheral address.
- masterConfig – Pointer to structure lpspi_master_config_t.
- srcClock_Hz – Module source input clock in Hertz

void LPSPI_MasterGetDefaultConfig(*lpspi_master_config_t* *masterConfig)

Sets the lpspi_master_config_t structure to default values.

This API initializes the configuration structure for LPSPI_MasterInit(). The initialized structure can remain unchanged in LPSPI_MasterInit(), or can be modified before calling the LPSPI_MasterInit(). Example:

```
lpspi_master_config_t masterConfig;
LPSPI_MasterGetDefaultConfig(&masterConfig);
```

Parameters

- masterConfig – pointer to lpspi_master_config_t structure

void LPSPI_SlaveInit(LPSPI_Type *base, const *lpspi_slave_config_t* *slaveConfig)

LPSPI slave configuration.

Parameters

- base – LPSPI peripheral address.
- slaveConfig – Pointer to a structure lpspi_slave_config_t.

void LPSPI_SlaveGetDefaultConfig(*lpspi_slave_config_t* *slaveConfig)

Sets the lpspi_slave_config_t structure to default values.

This API initializes the configuration structure for LPSPI_SlaveInit(). The initialized structure can remain unchanged in LPSPI_SlaveInit() or can be modified before calling the LPSPI_SlaveInit(). Example:

```
lpspi_slave_config_t slaveConfig;
LPSPI_SlaveGetDefaultConfig(&slaveConfig);
```

Parameters

- slaveConfig – pointer to lpspi_slave_config_t structure.

void LPSPI_Deinit(LPSPI_Type *base)

De-initializes the LPSPI peripheral. Call this API to disable the LPSPI clock.

Parameters

- base – LPSPI peripheral address.

void LPSPI_Reset(LPSPI_Type *base)

Restores the LPSPI peripheral to reset state. Note that this function sets all registers to reset state. As a result, the LPSPI module can't work after calling this API.

Parameters

- base – LPSPI peripheral address.

uint32_t LPSPI_GetInstance(LPSPI_Type *base)

Get the LPSPI instance from peripheral base address.

Parameters

- base – LPSPI peripheral base address.

Returns

LPSPI instance.

static inline void LPSPI_Enable(LPSPI_Type *base, bool enable)

Enables the LPSPI peripheral and sets the MCR MDIS to 0.

Parameters

- base – LPSPI peripheral address.
- enable – Pass true to enable module, false to disable module.

static inline uint32_t LPSPI_GetStatusFlags(LPSPI_Type *base)

Gets the LPSPI status flag state.

Parameters

- base – LPSPI peripheral address.

Returns

The LPSPI status(in SR register).

static inline uint8_t LPSPI_GetTxFifoSize(LPSPI_Type *base)

Gets the LPSPI Tx FIFO size.

Parameters

- base – LPSPI peripheral address.

Returns

The LPSPI Tx FIFO size.

static inline uint8_t LPSPI_GetRxFifoSize(LPSPI_Type *base)

Gets the LPSPI Rx FIFO size.

Parameters

- base – LPSPI peripheral address.

Returns

The LPSPI Rx FIFO size.

static inline uint32_t LPSPI_GetTxFifoCount(LPSPI_Type *base)

Gets the LPSPI Tx FIFO count.

Parameters

- base – LPSPI peripheral address.

Returns
The number of words in the transmit FIFO.

static inline uint32_t LPSPI_GetRxFifoCount(LPSPI_Type *base)

Gets the LPSPI Rx FIFO count.

Parameters

- base – LPSPI peripheral address.

Returns
The number of words in the receive FIFO.

static inline void LPSPI_ClearStatusFlags(LPSPI_Type *base, uint32_t statusFlags)

Clears the LPSPI status flag.

This function clears the desired status bit by using a write-1-to-clear. The user passes in the base and the desired status flag bit to clear. The list of status flags is defined in the _lpspi_flags. Example usage:

```
LPSPI_ClearStatusFlags(base, kLPSPI_TxDataRequestFlag|kLPSPI_RxDataReadyFlag);
```

Parameters

- base – LPSPI peripheral address.
- statusFlags – The status flag used from type _lpspi_flags.

static inline uint32_t LPSPI_GetTcr(LPSPI_Type *base)

static inline void LPSPI_EnableInterrupts(LPSPI_Type *base, uint32_t mask)

Enables the LPSPI interrupts.

This function configures the various interrupt masks of the LPSPI. The parameters are base and an interrupt mask. Note that, for Tx fill and Rx FIFO drain requests, enabling the interrupt request disables the DMA request.

```
LPSPI_EnableInterrupts(base, kLPSPI_TxInterruptEnable | kLPSPI_RxInterruptEnable );
```

Parameters

- base – LPSPI peripheral address.
- mask – The interrupt mask; Use the enum _lpspi_interrupt_enable.

static inline void LPSPI_DisableInterrupts(LPSPI_Type *base, uint32_t mask)

Disables the LPSPI interrupts.

```
LPSPI_DisableInterrupts(base, kLPSPI_TxInterruptEnable | kLPSPI_RxInterruptEnable );
```

Parameters

- base – LPSPI peripheral address.
- mask – The interrupt mask; Use the enum _lpspi_interrupt_enable.

static inline void LPSPI_EnableDMA(LPSPI_Type *base, uint32_t mask)

Enables the LPSPI DMA request.

This function configures the Rx and Tx DMA mask of the LPSPI. The parameters are base and a DMA mask.

```
LPSPI_EnableDMA(base, kLPSPI_TxDmaEnable | kLPSPI_RxDmaEnable);
```

Parameters

- base – LPSPI peripheral address.
- mask – The interrupt mask; Use the enum _lpspi_dma_enable.

static inline void LPSPI_DisableDMA(LPSPI_Type *base, uint32_t mask)

Disables the LPSPI DMA request.

This function configures the Rx and Tx DMA mask of the LPSPI. The parameters are base and a DMA mask.

```
SPI_DisableDMA(base, kLPSPI_TxDmaEnable | kLPSPI_RxDmaEnable);
```

Parameters

- base – LPSPI peripheral address.
- mask – The interrupt mask; Use the enum _lpspi_dma_enable.

static inline uint32_t LPSPI_GetTxRegisterAddress(LPSPI_Type *base)

Gets the LPSPI Transmit Data Register address for a DMA operation.

This function gets the LPSPI Transmit Data Register address because this value is needed for the DMA operation. This function can be used for either master or slave mode.

Parameters

- base – LPSPI peripheral address.

Returns

The LPSPI Transmit Data Register address.

static inline uint32_t LPSPI_GetRxRegisterAddress(LPSPI_Type *base)

Gets the LPSPI Receive Data Register address for a DMA operation.

This function gets the LPSPI Receive Data Register address because this value is needed for the DMA operation. This function can be used for either master or slave mode.

Parameters

- base – LPSPI peripheral address.

Returns

The LPSPI Receive Data Register address.

bool LPSPI_CheckTransferArgument(LPSPI_Type *base, *lpspi_transfer_t* *transfer, bool isEdma)

Check the argument for transfer .

Parameters

- base – LPSPI peripheral address.
- transfer – the transfer struct to be used.
- isEdma – True to check for EDMA transfer, false to check interrupt non-blocking transfer

Returns

Return true for right and false for wrong.

static inline void LPSPI_SetMasterSlaveMode(LPSPI_Type *base, *lpspi_master_slave_mode_t* mode)

Configures the LPSPI for either master or slave.

Note that the CFGR1 should only be written when the LPSPI is disabled (LPSPIx_CR_MEN = 0).

Parameters

- base – LPSPI peripheral address.

- mode – Mode setting (master or slave) of type lpspi_master_slave_mode_t.

static inline void LPSPI_SelectTransferPCS(LPSPI_Type *base, *lpspi_which_pcs_t* select)

Configures the peripheral chip select used for the transfer.

Parameters

- base – LPSPI peripheral address.
- select – LPSPI Peripheral Chip Select (PCS) configuration.

static inline void LPSPI_SetPCSContinous(LPSPI_Type *base, bool IsContinous)

Set the PCS signal to continuous or uncontinuous mode.

Note: In master mode, continuous transfer will keep the PCS asserted at the end of the frame size, until a command word is received that starts a new frame. So PCS must be set back to uncontinuous when transfer finishes. In slave mode, when continuous transfer is enabled, the LPSPI will only transmit the first frame size bits, after that the LPSPI will transmit received data back (assuming a 32-bit shift register).

Parameters

- base – LPSPI peripheral address.
- IsContinous – True to set the transfer PCS to continuous mode, false to set to uncontinuous mode.

static inline bool LPSPI_IsMaster(LPSPI_Type *base)

Returns whether the LPSPI module is in master mode.

Parameters

- base – LPSPI peripheral address.

Returns

Returns true if the module is in master mode or false if the module is in slave mode.

static inline void LPSPI_FlushFifo(LPSPI_Type *base, bool flushTxFifo, bool flushRxFifo)

Flushes the LPSPI FIFOs.

Parameters

- base – LPSPI peripheral address.
- flushTxFifo – Flushes (true) the Tx FIFO, else do not flush (false) the Tx FIFO.
- flushRxFifo – Flushes (true) the Rx FIFO, else do not flush (false) the Rx FIFO.

static inline void LPSPI_SetFifoWatermarks(LPSPI_Type *base, uint32_t txWater, uint32_t rxWater)

Sets the transmit and receive FIFO watermark values.

This function allows the user to set the receive and transmit FIFO watermarks. The function does not compare the watermark settings to the FIFO size. The FIFO watermark should not be equal to or greater than the FIFO size. It is up to the higher level driver to make this check.

Parameters

- base – LPSPI peripheral address.
- txWater – The TX FIFO watermark value. Writing a value equal or greater than the FIFO size is truncated.

- rxWater – The RX FIFO watermark value. Writing a value equal or greater than the FIFO size is truncated.

static inline void LPSPI_SetAllPcsPolarity(LPSPI_Type *base, uint32_t mask)

Configures all LPSPI peripheral chip select polarities simultaneously.

Note that the CFGR1 should only be written when the LPSPI is disabled (LPSPIx_CR_MEN = 0).

This is an example: PCS0 and PCS1 set to active low and other PCSs set to active high. Note that the number of PCS is device-specific.

```
LPSPI_SetAllPcsPolarity(base, kLPSPI_Pcs0ActiveLow | kLPSPI_Pcs1ActiveLow);
```

Parameters

- base – LPSPI peripheral address.
- mask – The PCS polarity mask; Use the enum _lpspi_pcs_polarity.

static inline void LPSPI_SetFrameSize(LPSPI_Type *base, uint32_t frameSize)

Configures the frame size.

The minimum frame size is 8-bits and the maximum frame size is 4096-bits. If the frame size is less than or equal to 32-bits, the word size and frame size are identical. If the frame size is greater than 32-bits, the word size is 32-bits for each word except the last (the last word contains the remainder bits if the frame size is not divisible by 32). The minimum word size is 2-bits. A frame size of 33-bits (or similar) is not supported.

Note 1: The transmit command register should be initialized before enabling the LPSPI in slave mode, although the command register does not update until after the LPSPI is enabled. After it is enabled, the transmit command register should only be changed if the LPSPI is idle.

Note 2: The transmit and command FIFO is a combined FIFO that includes both transmit data and command words. That means the TCR register should be written to when the Tx FIFO is not full.

Parameters

- base – LPSPI peripheral address.
- frameSize – The frame size in number of bits.

uint32_t LPSPI_MasterSetBaudRate(LPSPI_Type *base, uint32_t baudRate_Bps, uint32_t srcClock_Hz, uint32_t *tcrPrescaleValue)

Sets the LPSPI baud rate in bits per second.

This function takes in the desired bitsPerSec (baud rate) and calculates the nearest possible baud rate without exceeding the desired baud rate and returns the calculated baud rate in bits-per-second. It requires the caller to provide the frequency of the module source clock (in Hertz). Note that the baud rate does not go into effect until the Transmit Control Register (TCR) is programmed with the prescale value. Hence, this function returns the prescale tcrPrescaleValue parameter for later programming in the TCR. The higher level peripheral driver should alert the user of an out of range baud rate input.

Note that the LPSPI module must first be disabled before configuring this. Note that the LPSPI module must be configured for master mode before configuring this.

Parameters

- base – LPSPI peripheral address.
- baudRate_Bps – The desired baud rate in bits per second.
- srcClock_Hz – Module source input clock in Hertz.

- tcrPrescaleValue – The TCR prescale value needed to program the TCR.

Returns

The actual calculated baud rate. This function may also return a "0" if the LPSPI is not configured for master mode or if the LPSPI module is not disabled.

void LPSPI_MasterSetDelayScaler(LPSPI_Type *base, uint32_t scaler, *lpspi_delay_type_t* whichDelay)

Manually configures a specific LPSPI delay parameter (module must be disabled to change the delay values).

This function configures the following: SCK to PCS delay, or PCS to SCK delay, or The configurations must occur between the transfer delay.

The delay names are available in type lpspi_delay_type_t.

The user passes the desired delay along with the delay value. This allows the user to directly set the delay values if they have pre-calculated them or if they simply wish to manually increment the value.

Note that the LPSPI module must first be disabled before configuring this. Note that the LPSPI module must be configured for master mode before configuring this.

Parameters

- base – LPSPI peripheral address.
- scaler – The 8-bit delay value 0x00 to 0xFF (255).
- whichDelay – The desired delay to configure, must be of type lpspi_delay_type_t.

uint32_t LPSPI_MasterSetDelayTimes(LPSPI_Type *base, uint32_t delayTimeInNanoSec, *lpspi_delay_type_t* whichDelay, uint32_t srcClock_Hz)

Calculates the delay based on the desired delay input in nanoseconds (module must be disabled to change the delay values).

This function calculates the values for the following: SCK to PCS delay, or PCS to SCK delay, or The configurations must occur between the transfer delay.

The delay names are available in type lpspi_delay_type_t.

The user passes the desired delay and the desired delay value in nano-seconds. The function calculates the value needed for the desired delay parameter and returns the actual calculated delay because an exact delay match may not be possible. In this case, the closest match is calculated without going below the desired delay value input. It is possible to input a very large delay value that exceeds the capability of the part, in which case the maximum supported delay is returned. It is up to the higher level peripheral driver to alert the user of an out of range delay input.

Note that the LPSPI module must be configured for master mode before configuring this. And note that the delayTime = LPSPI_clockSource / (PRESCALE * Delay_scaler).

Parameters

- base – LPSPI peripheral address.
- delayTimeInNanoSec – The desired delay value in nano-seconds.
- whichDelay – The desired delay to configuration, which must be of type lpspi_delay_type_t.
- srcClock_Hz – Module source input clock in Hertz.

Returns

actual Calculated delay value in nano-seconds.

static inline void LPSPI_WriteData(LPSPI_Type *base, uint32_t data)

Writes data into the transmit data buffer.

This function writes data passed in by the user to the Transmit Data Register (TDR). The user can pass up to 32-bits of data to load into the TDR. If the frame size exceeds 32-bits, the user has to manage sending the data one 32-bit word at a time. Any writes to the TDR result in an immediate push to the transmit FIFO. This function can be used for either master or slave modes.

Parameters

- base – LPSPI peripheral address.
- data – The data word to be sent.

static inline uint32_t LPSPI_ReadData(LPSPI_Type *base)

Reads data from the data buffer.

This function reads the data from the Receive Data Register (RDR). This function can be used for either master or slave mode.

Parameters

- base – LPSPI peripheral address.

Returns

The data read from the data buffer.

void LPSPI_SetDummyData(LPSPI_Type *base, uint8_t dummyData)

Set up the dummy data.

Parameters

- base – LPSPI peripheral address.
- dummyData – Data to be transferred when tx buffer is NULL. Note: This API has no effect when LPSPI in slave interrupt mode, because driver will set the TXMSK bit to 1 if txData is NULL, no data is loaded from transmit FIFO and output pin is tristated.

void LPSPI_MasterTransferCreateHandle(LPSPI_Type *base, *lpspi_master_handle_t* *handle, *lpspi_master_transfer_callback_t* callback, void *userData)

Initializes the LPSPI master handle.

This function initializes the LPSPI handle, which can be used for other LPSPI transactional APIs. Usually, for a specified LPSPI instance, call this API once to get the initialized handle.

Parameters

- base – LPSPI peripheral address.
- handle – LPSPI handle pointer to lpspi_master_handle_t.
- callback – DSPI callback.
- userData – callback function parameter.

status_t LPSPI_MasterTransferBlocking(LPSPI_Type *base, *lpspi_transfer_t* *transfer)

LPSPI master transfer data using a polling method.

This function transfers data using a polling method. This is a blocking function, which does not return until all transfers have been completed.

Note: The transfer data size should be integer multiples of bytesPerFrame if bytesPerFrame is less than or equal to 4. For bytesPerFrame greater than 4: The transfer data size should be equal to bytesPerFrame if the bytesPerFrame is not integer multiples of 4. Otherwise, the transfer data size can be an integer multiple of bytesPerFrame.

Parameters

- base – LPSPI peripheral address.
- transfer – pointer to lpspi_transfer_t structure.

Returns
status of status_t.

status_t LPSPI_MasterTransferNonBlocking(LPSPI_Type *base, *lpspi_master_handle_t* *handle, *lpspi_transfer_t* *transfer)

LPSPI master transfer data using an interrupt method.

This function transfers data using an interrupt method. This is a non-blocking function, which returns right away. When all data is transferred, the callback function is called.

Note: The transfer data size should be integer multiples of bytesPerFrame if bytesPerFrame is less than or equal to 4. For bytesPerFrame greater than 4: The transfer data size should be equal to bytesPerFrame if the bytesPerFrame is not integer multiples of 4. Otherwise, the transfer data size can be an integer multiple of bytesPerFrame.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_master_handle_t structure which stores the transfer state.
- transfer – pointer to lpspi_transfer_t structure.

Returns
status of status_t.

status_t LPSPI_MasterTransferGetCount(LPSPI_Type *base, *lpspi_master_handle_t* *handle, size_t *count)

Gets the master transfer remaining bytes.

This function gets the master transfer remaining bytes.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_master_handle_t structure which stores the transfer state.
- count – Number of bytes transferred so far by the non-blocking transaction.

Returns
status of status_t.

void LPSPI_MasterTransferAbort(LPSPI_Type *base, *lpspi_master_handle_t* *handle)

LPSPI master abort transfer which uses an interrupt method.

This function aborts a transfer which uses an interrupt method.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_master_handle_t structure which stores the transfer state.

void LPSPI_MasterTransferHandleIRQ(LPSPI_Type *base, *lpspi_master_handle_t* *handle)

LPSPI Master IRQ handler function.

This function processes the LPSPI transmit and receive IRQ.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_master_handle_t structure which stores the transfer state.

void LPSPI_SlaveTransferCreateHandle(LPSPI_Type *base, *lpspi_slave_handle_t* *handle, *lpspi_slave_transfer_callback_t* callback, void *userData)

Initializes the LPSPI slave handle.

This function initializes the LPSPI handle, which can be used for other LPSPI transactional APIs. Usually, for a specified LPSPI instance, call this API once to get the initialized handle.

Parameters

- base – LPSPI peripheral address.
- handle – LPSPI handle pointer to lpspi_slave_handle_t.
- callback – DSPI callback.
- userData – callback function parameter.

status_t LPSPI_SlaveTransferNonBlocking(LPSPI_Type *base, *lpspi_slave_handle_t* *handle, *lpspi_transfer_t* *transfer)

LPSPI slave transfer data using an interrupt method.

This function transfer data using an interrupt method. This is a non-blocking function, which returns right away. When all data is transferred, the callback function is called.

Note: The transfer data size should be integer multiples of bytesPerFrame if bytesPerFrame is less than or equal to 4. For bytesPerFrame greater than 4: The transfer data size should be equal to bytesPerFrame if the bytesPerFrame is not an integer multiple of 4. Otherwise, the transfer data size can be an integer multiple of bytesPerFrame.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_slave_handle_t structure which stores the transfer state.
- transfer – pointer to lpspi_transfer_t structure.

Returns
status of status_t.

status_t LPSPI_SlaveTransferGetCount(LPSPI_Type *base, *lpspi_slave_handle_t* *handle, size_t *count)

Gets the slave transfer remaining bytes.

This function gets the slave transfer remaining bytes.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_slave_handle_t structure which stores the transfer state.
- count – Number of bytes transferred so far by the non-blocking transaction.

Returns
status of status_t.

void LPSPI_SlaveTransferAbort(LPSPI_Type *base, *lpspi_slave_handle_t* *handle)

LPSPI slave aborts a transfer which uses an interrupt method.

This function aborts a transfer which uses an interrupt method.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_slave_handle_t structure which stores the transfer state.

void LPSPI_SlaveTransferHandleIRQ(LPSPI_Type *base, *lpspi_slave_handle_t* *handle)

LPSPI Slave IRQ handler function.

This function processes the LPSPI transmit and receives an IRQ.

Parameters

- base – LPSPI peripheral address.
- handle – pointer to lpspi_slave_handle_t structure which stores the transfer state.

bool LPSPI_WaitTxFifoEmpty(LPSPI_Type *base)

Wait for tx FIFO to be empty.

This function wait the tx fifo empty

Parameters

- base – LPSPI peripheral address.

Returns

true for the tx FIFO is ready, false is not.

void LPSPI_DriverIRQHandler(uint32_t instance)

LPSPI driver IRQ handler common entry.

This function provides the common IRQ request entry for LPSPI.

Parameters

- instance – LPSPI instance.

FSL_LPSPI_DRIVER_VERSION

LPSPI driver version.

Status for the LPSPI driver.

Values:

enumerator kStatus_LPSPI_Busy

LPSPI transfer is busy.

enumerator kStatus_LPSPI_Error

LPSPI driver error.

enumerator kStatus_LPSPI_Idle

LPSPI is idle.

enumerator kStatus_LPSPI_OutOfRange

LPSPI transfer out Of range.

enumerator kStatus_LPSPI_Timeout

LPSPI timeout polling status flags.

enum _lpspi_flags

LPSPI status flags in SPIx_SR register.

Values:

enumerator kLPSPI_TxDataRequestFlag

Transmit data flag

enumerator kLPSPI_RxDataReadyFlag
Receive data flag

enumerator kLPSPI_WordCompleteFlag
Word Complete flag

enumerator kLPSPI_FrameCompleteFlag
Frame Complete flag

enumerator kLPSPI_TransferCompleteFlag
Transfer Complete flag

enumerator kLPSPI_TransmitErrorFlag
Transmit Error flag (FIFO underrun)

enumerator kLPSPI_ReceiveErrorFlag
Receive Error flag (FIFO overrun)

enumerator kLPSPI_DataMatchFlag
Data Match flag

enumerator kLPSPI_ModuleBusyFlag
Module Busy flag

enumerator kLPSPI_AllStatusFlag
Used for clearing all w1c status flags

enum _lpspi_interrupt_enable
LPSPI interrupt source.

Values:

enumerator kLPSPI_TxInterruptEnable
Transmit data interrupt enable

enumerator kLPSPI_RxInterruptEnable
Receive data interrupt enable

enumerator kLPSPI_WordCompleteInterruptEnable
Word complete interrupt enable

enumerator kLPSPI_FrameCompleteInterruptEnable
Frame complete interrupt enable

enumerator kLPSPI_TransferCompleteInterruptEnable
Transfer complete interrupt enable

enumerator kLPSPI_TransmitErrorInterruptEnable
Transmit error interrupt enable(FIFO underrun)

enumerator kLPSPI_ReceiveErrorInterruptEnable
Receive Error interrupt enable (FIFO overrun)

enumerator kLPSPI_DataMatchInterruptEnable
Data Match interrupt enable

enumerator kLPSPI_AllInterruptEnable
All above interrupts enable.

enum _lpspi_dma_enable
LPSPI DMA source.

Values:

enumerator kLPSPI_TxDmaEnable
Transmit data DMA enable

enumerator kLPSPI_RxDmaEnable
Receive data DMA enable

enum _lpspi_master_slave_mode
LPSPI master or slave mode configuration.

Values:

enumerator kLPSPI_Master
LPSPI peripheral operates in master mode.

enumerator kLPSPI_Slave
LPSPI peripheral operates in slave mode.

enum _lpspi_which_pcs_config
LPSPI Peripheral Chip Select (PCS) configuration (which PCS to configure).

Values:

enumerator kLPSPI_Pcs0
PCS[0]

enumerator kLPSPI_Pcs1
PCS[1]

enumerator kLPSPI_Pcs2
PCS[2]

enumerator kLPSPI_Pcs3
PCS[3]

enum _lpspi_pcs_polarity_config
LPSPI Peripheral Chip Select (PCS) Polarity configuration.

Values:

enumerator kLPSPI_PcsActiveHigh
PCS Active High (idles low)

enumerator kLPSPI_PcsActiveLow
PCS Active Low (idles high)

enum _lpspi_pcs_polarity
LPSPI Peripheral Chip Select (PCS) Polarity.

Values:

enumerator kLPSPI_Pcs0ActiveLow
Pcs0 Active Low (idles high).

enumerator kLPSPI_Pcs1ActiveLow
Pcs1 Active Low (idles high).

enumerator kLPSPI_Pcs2ActiveLow
Pcs2 Active Low (idles high).

enumerator kLPSPI_Pcs3ActiveLow
Pcs3 Active Low (idles high).

enumerator kLPSPI_PcsAllActiveLow
Pcs0 to Pcs5 Active Low (idles high).

enum _lpspi_clock_polarity

LPSPI clock polarity configuration.

Values:

enumerator kLPSPI_ClockPolarityActiveHigh

CPOL=0. Active-high LPSPI clock (idles low)

enumerator kLPSPI_ClockPolarityActiveLow

CPOL=1. Active-low LPSPI clock (idles high)

enum _lpspi_clock_phase

LPSPI clock phase configuration.

Values:

enumerator kLPSPI_ClockPhaseFirstEdge

CPHA=0. Data is captured on the leading edge of the SCK and changed on the following edge.

enumerator kLPSPI_ClockPhaseSecondEdge

CPHA=1. Data is changed on the leading edge of the SCK and captured on the following edge.

enum _lpspi_shift_direction

LPSPI data shifter direction options.

Values:

enumerator kLPSPI_MsbFirst

Data transfers start with most significant bit.

enumerator kLPSPI_LsbFirst

Data transfers start with least significant bit.

enum _lpspi_host_request_select

LPSPI Host Request select configuration.

Values:

enumerator kLPSPI_HostReqExtPin

Host Request is an ext pin.

enumerator kLPSPI_HostReqInternalTrigger

Host Request is an internal trigger.

enum _lpspi_match_config

LPSPI Match configuration options.

Values:

enumerator kLPSI_MatchDisabled

LPSPI Match Disabled.

enumerator kLPSI_1stWordEqualsM0orM1

LPSPI Match Enabled.

enumerator kLPSI_AnyWordEqualsM0orM1

LPSPI Match Enabled.

enumerator kLPSI_1stWordEqualsM0and2ndWordEqualsM1

LPSPI Match Enabled.

enumerator kLPSI_AnyWordEqualsM0andNxtWordEqualsM1

LPSPI Match Enabled.

enumerator kLPSI_1stWordAndM1EqualsM0andM1
LPSPI Match Enabled.

enumerator kLPSI_AnyWordAndM1EqualsM0andM1
LPSPI Match Enabled.

enum _lpspi_pin_config
LPSPI pin (SDO and SDI) configuration.

Values:

enumerator kLPSPI_SdiInSdoOut
LPSPI SDI input, SDO output.

enumerator kLPSPI_SdiInSdiOut
LPSPI SDI input, SDI output.

enumerator kLPSPI_SdoInSdoOut
LPSPI SDO input, SDO output.

enumerator kLPSPI_SdoInSdiOut
LPSPI SDO input, SDI output.

enum _lpspi_data_out_config
LPSPI data output configuration.

Values:

enumerator kLpspiDataOutRetained
Data out retains last value when chip select is de-asserted

enumerator kLpspiDataOutTristate
Data out is tristated when chip select is de-asserted

enum _lpspi_transfer_width
LPSPI transfer width configuration.

Values:

enumerator kLPSPI_SingleBitXfer
1-bit shift at a time, data out on SDO, in on SDI (normal mode)

enumerator kLPSPI_TwoBitXfer
2-bits shift out on SDO/SDI and in on SDO/SDI

enumerator kLPSPI_FourBitXfer
4-bits shift out on SDO/SDI/PCS[3:2] and in on SDO/SDI/PCS[3:2]

enum _lpspi_delay_type
LPSPI delay type selection.

Values:

enumerator kLPSPI_PcsToSck
PCS-to-SCK delay.

enumerator kLPSPI_LastSckToPcs
Last SCK edge to PCS delay.

enumerator kLPSPI_BetweenTransfer
Delay between transfers.

enum _lpspi_transfer_config_flag_for_master

Use this enumeration for LPSPI master transfer configFlags.

Values:

enumerator kLPSPI_MasterPcs0

LPSPI master PCS shift macro , internal used. LPSPI master transfer use PCS0 signal

enumerator kLPSPI_MasterPcs1

LPSPI master PCS shift macro , internal used. LPSPI master transfer use PCS1 signal

enumerator kLPSPI_MasterPcs2

LPSPI master PCS shift macro , internal used. LPSPI master transfer use PCS2 signal

enumerator kLPSPI_MasterPcs3

LPSPI master PCS shift macro , internal used. LPSPI master transfer use PCS3 signal

enumerator kLPSPI_MasterPcsContinuous

Is PCS signal continuous

enumerator kLPSPI_MasterByteSwap

Is master swap the byte. For example, when want to send data 1 2 3 4 5 6 7 8 (suppose you set lpspi_shift_direction_t to MSB).

i. If you set bitPerFrame = 8 , no matter the kLPSPI_MasterByteSwapyou flag is used or not, the waveform is 1 2 3 4 5 6 7 8.

ii. If you set bitPerFrame = 16 : (1) the waveform is 2 1 4 3 6 5 8 7 if you do not use the kLPSPI_MasterByteSwap flag. (2) the waveform is 1 2 3 4 5 6 7 8 if you use the kLPSPI_MasterByteSwap flag.

iii. If you set bitPerFrame = 32 : (1) the waveform is 4 3 2 1 8 7 6 5 if you do not use the kLPSPI_MasterByteSwap flag. (2) the waveform is 1 2 3 4 5 6 7 8 if you use the kLPSPI_MasterByteSwap flag.

enum _lpspi_transfer_config_flag_for_slave

Use this enumeration for LPSPI slave transfer configFlags.

Values:

enumerator kLPSPI_SlavePcs0

LPSPI slave PCS shift macro , internal used. LPSPI slave transfer use PCS0 signal

enumerator kLPSPI_SlavePcs1

LPSPI slave PCS shift macro , internal used. LPSPI slave transfer use PCS1 signal

enumerator kLPSPI_SlavePcs2

LPSPI slave PCS shift macro , internal used. LPSPI slave transfer use PCS2 signal

enumerator kLPSPI_SlavePcs3

LPSPI slave PCS shift macro , internal used. LPSPI slave transfer use PCS3 signal

enumerator kLPSPI_SlaveByteSwap

Is slave swap the byte. For example, when want to send data 1 2 3 4 5 6 7 8 (suppose you set lpspi_shift_direction_t to MSB).

i. If you set bitPerFrame = 8 , no matter the kLPSPI_SlaveByteSwap flag is used or not, the waveform is 1 2 3 4 5 6 7 8.

ii. If you set bitPerFrame = 16 : (1) the waveform is 2 1 4 3 6 5 8 7 if you do not use the kLPSPI_SlaveByteSwap flag. (2) the waveform is 1 2 3 4 5 6 7 8 if you use the kLPSPI_SlaveByteSwap flag.

iii. If you set bitPerFrame = 32 : (1) the waveform is 4 3 2 1 8 7 6 5 if you do not use the kLPSPI_SlaveByteSwap flag. (2) the waveform is 1 2 3 4 5 6 7 8 if you use the kLPSPI_SlaveByteSwap flag.

enum _lpspi_transfer_state

LPSPI transfer state, which is used for LPSPI transactional API state machine.

Values:

enumerator kLPSPI_Idle

Nothing in the transmitter/receiver.

enumerator kLPSPI_Busy

Transfer queue is not finished.

enumerator kLPSPI_Error

Transfer error.

typedef enum *_lpspi_master_slave_mode* lpspi_master_slave_mode_t

LPSPI master or slave mode configuration.

typedef enum *_lpspi_which_pcs_config* lpspi_which_pcs_t

LPSPI Peripheral Chip Select (PCS) configuration (which PCS to configure).

typedef enum *_lpspi_pcs_polarity_config* lpspi_pcs_polarity_config_t

LPSPI Peripheral Chip Select (PCS) Polarity configuration.

typedef enum *_lpspi_clock_polarity* lpspi_clock_polarity_t

LPSPI clock polarity configuration.

typedef enum *_lpspi_clock_phase* lpspi_clock_phase_t

LPSPI clock phase configuration.

typedef enum *_lpspi_shift_direction* lpspi_shift_direction_t

LPSPI data shifter direction options.

typedef enum *_lpspi_host_request_select* lpspi_host_request_select_t

LPSPI Host Request select configuration.

typedef enum *_lpspi_match_config* lpspi_match_config_t

LPSPI Match configuration options.

typedef enum *_lpspi_pin_config* lpspi_pin_config_t

LPSPI pin (SDO and SDI) configuration.

typedef enum *_lpspi_data_out_config* lpspi_data_out_config_t

LPSPI data output configuration.

typedef enum *_lpspi_transfer_width* lpspi_transfer_width_t

LPSPI transfer width configuration.

typedef enum *_lpspi_delay_type* lpspi_delay_type_t

LPSPI delay type selection.

typedef struct *_lpspi_master_config* lpspi_master_config_t

LPSPI master configuration structure.

typedef struct *_lpspi_slave_config* lpspi_slave_config_t

LPSPI slave configuration structure.

typedef struct *_lpspi_master_handle* lpspi_master_handle_t

Forward declaration of the _lpspi_master_handle typedefs.

typedef struct *_lpspi_slave_handle* lpspi_slave_handle_t

Forward declaration of the _lpspi_slave_handle typedefs.

typedef void (*lpspi_master_transfer_callback_t)(LPSPI_Type *base, *lpspi_master_handle_t* *handle, *status_t* status, void *userData)

Master completion callback function pointer type.

Param base
LPSPI peripheral address.

Param handle
Pointer to the handle for the LPSPI master.

Param status
Success or error code describing whether the transfer is completed.

Param userData
Arbitrary pointer-dataSized value passed from the application.

typedef void (*lpspi_slave_transfer_callback_t)(LPSPI_Type *base, *lpspi_slave_handle_t* *handle, *status_t* status, void *userData)

Slave completion callback function pointer type.

Param base
LPSPI peripheral address.

Param handle
Pointer to the handle for the LPSPI slave.

Param status
Success or error code describing whether the transfer is completed.

Param userData
Arbitrary pointer-dataSized value passed from the application.

typedef struct *_lpspi_transfer* lpspi_transfer_t

LPSPI master/slave transfer structure.

volatile uint8_t g_lpspiDummyData[]

Global variable for dummy data value setting.

LPSPI_DUMMY_DATA

LPSPI dummy data if no Tx data.

Dummy data used for tx if there is not txData.

SPI_RETRY_TIMES

Retry times for waiting flag.

LPSPI_MASTER_PCS_SHIFT

LPSPI master PCS shift macro , internal used.

LPSPI_MASTER_PCS_MASK

LPSPI master PCS shift macro , internal used.

LPSPI_SLAVE_PCS_SHIFT

LPSPI slave PCS shift macro , internal used.

LPSPI_SLAVE_PCS_MASK

LPSPI slave PCS shift macro , internal used.

struct _lpspi_master_config

#include <fsl_lpspi.h> LPSPI master configuration structure.

Public Members

uint32_t baudRate
: Baud Rate for LPSPI.

uint32_t bitsPerFrame
: Bits per frame, minimum 8, maximum 4096.

lpspi_clock_polarity_t cpol
: Clock polarity.

lpspi_clock_phase_t cpha
: Clock phase.

lpspi_shift_direction_t direction
: MSB or LSB data shift direction.

uint32_t pcsToSckDelayInNanoSec
: PCS to SCK delay time in nanoseconds, setting to 0 sets the minimum delay. It sets the boundary value if out of range.

uint32_t lastSckToPcsDelayInNanoSec
: Last SCK to PCS delay time in nanoseconds, setting to 0 sets the minimum delay. It sets the boundary value if out of range.

uint32_t betweenTransferDelayInNanoSec
: After the SCK delay time with nanoseconds, setting to 0 sets the minimum delay. It sets the boundary value if out of range.

lpspi_which_pcs_t whichPcs
: Desired Peripheral Chip Select (PCS).

lpspi_pcs_polarity_config_t pcsActiveHighOrLow
: Desired PCS active high or low

lpspi_pin_config_t pinCfg
: Configures which pins are used for input and output data during single bit transfers.

lpspi_data_out_config_t dataOutConfig
: Configures if the output data is tristated between accesses (LPSPI_PCS is negated).

bool enableInputDelay
: Enable master to sample the input data on a delayed SCK. This can help improve slave setup time. Refer to device data sheet for specific time length.

struct __lpspi__slave__config
: *#include <fsl_lpspi.h>* LPSPI slave configuration structure.

Public Members

uint32_t bitsPerFrame
: Bits per frame, minimum 8, maximum 4096.

lpspi_clock_polarity_t cpol
: Clock polarity.

lpspi_clock_phase_t cpha
: Clock phase.

lpspi_shift_direction_t direction
: MSB or LSB data shift direction.

lpspi_which_pcs_t whichPcs
: Desired Peripheral Chip Select (pcs)

lpspi_pcs_polarity_config_t pcsActiveHighOrLow
: Desired PCS active high or low

lpspi_pin_config_t pinCfg
: Configures which pins are used for input and output data during single bit transfers.

lpspi_data_out_config_t dataOutConfig
: Configures if the output data is tristated between accesses (LPSPI_PCS is negated).

struct __lpspi__transfer
: *#include <fsl_lpspi.h>* LPSPI master/slave transfer structure.

Public Members

const uint8_t *txData
: Send buffer.

uint8_t *rxData
: Receive buffer.

volatile size_t dataSize
: Transfer bytes.

uint32_t configFlags
: Transfer transfer configuration flags. Set from _lpspi_transfer_config_flag_for_master if the transfer is used for master or _lpspi_transfer_config_flag_for_slave enumeration if the transfer is used for slave.

struct __lpspi__master__handle
: *#include <fsl_lpspi.h>* LPSPI master transfer handle structure used for transactional API.

Public Members

volatile bool isPcsContinuous
: Is PCS continuous in transfer.

volatile bool writeTcrInIsr
: A flag that whether should write TCR in ISR.

volatile bool isByteSwap
: A flag that whether should byte swap.

volatile bool isTxMask
: A flag that whether TCR[TXMSK] is set.

volatile uint16_t bytesPerFrame
: Number of bytes in each frame

volatile uint16_t frameSize
: Backup of TCR[FRAMESZ]

volatile uint8_t fifoSize
: FIFO dataSize.

volatile uint8_t rxWatermark
: Rx watermark.

volatile uint8_t bytesEachWrite
: Bytes for each write TDR.

volatile uint8_t bytesEachRead
: Bytes for each read RDR.

const uint8_t *volatile txData
: Send buffer.

uint8_t *volatile rxData
: Receive buffer.

volatile size_t txRemainingByteCount
: Number of bytes remaining to send.

volatile size_t rxRemainingByteCount
: Number of bytes remaining to receive.

volatile uint32_t writeRegRemainingTimes
: Write TDR register remaining times.

volatile uint32_t readRegRemainingTimes
: Read RDR register remaining times.

uint32_t totalByteCount
: Number of transfer bytes

uint32_t txBuffIfNull
: Used if the txData is NULL.

volatile uint8_t state
: LPSPI transfer state , _lpspi_transfer_state.

lpspi_master_transfer_callback_t callback
: Completion callback.

void *userData
: Callback user data.

struct __lpspi_slave_handle
: *#include <fsl_lpspi.h>* LPSPI slave transfer handle structure used for transactional API.

Public Members

volatile bool isByteSwap
: A flag that whether should byte swap.

volatile uint8_t fifoSize
: FIFO dataSize.

volatile uint8_t rxWatermark
: Rx watermark.

volatile uint8_t bytesEachWrite
: Bytes for each write TDR.

volatile uint8_t bytesEachRead
: Bytes for each read RDR.

const uint8_t *volatile txData
: Send buffer.

uint8_t *volatile rxData
: Receive buffer.

volatile size_t txRemainingByteCount
: Number of bytes remaining to send.

volatile size_t rxRemainingByteCount
: Number of bytes remaining to receive.

volatile uint32_t writeRegRemainingTimes
: Write TDR register remaining times.

volatile uint32_t readRegRemainingTimes
: Read RDR register remaining times.

uint32_t totalByteCount
: Number of transfer bytes

volatile uint8_t state
: LPSPI transfer state , _lpspi_transfer_state.

volatile uint32_t errorCount
: Error count for slave transfer.

lpspi_slave_transfer_callback_t callback
: Completion callback.

void *userData
: Callback user data.

2.46 LPSPI eDMA Driver

FSL_LPSPI_EDMA_DRIVER_VERSION
: LPSPI EDMA driver version.

DMA_MAX_TRANSFER_COUNT
: DMA max transfer size.

typedef struct *_lpspi_master_edma_handle* lpspi_master_edma_handle_t
: Forward declaration of the _lpspi_master_edma_handle typedefs.

typedef struct *_lpspi_slave_edma_handle* lpspi_slave_edma_handle_t
: Forward declaration of the _lpspi_slave_edma_handle typedefs.

typedef void (*lpspi_master_edma_transfer_callback_t)(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle, *status_t* status, void *userData)
: Completion callback function pointer type.

  Param base
  : LPSPI peripheral base address.

  Param handle
  : Pointer to the handle for the LPSPI master.

  Param status
  : Success or error code describing whether the transfer completed.

  Param userData
  : Arbitrary pointer-dataSized value passed from the application.

typedef void (*lpspi_slave_edma_transfer_callback_t)(LPSPI_Type *base, *lpspi_slave_edma_handle_t* *handle, *status_t* status, void *userData)

Completion callback function pointer type.

Param base
LPSPI peripheral base address.

Param handle
Pointer to the handle for the LPSPI slave.

Param status
Success or error code describing whether the transfer completed.

Param userData
Arbitrary pointer-dataSized value passed from the application.

void LPSPI_MasterTransferCreateHandleEDMA(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle, *lpspi_master_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *edmaRxRegToRxDataHandle, *edma_handle_t* *edmaTxDataToTxRegHandle)

Initializes the LPSPI master eDMA handle.

This function initializes the LPSPI eDMA handle which can be used for other LPSPI transactional APIs. Usually, for a specified LPSPI instance, call this API once to get the initialized handle.

Note that the LPSPI eDMA has a separated (Rx and Tx as two sources) or shared (Rx and Tx are the same source) DMA request source. (1) For a separated DMA request source, enable and set the Rx DMAMUX source for edmaRxRegToRxDataHandle and Tx DMAMUX source for edmaTxDataToTxRegHandle. (2) For a shared DMA request source, enable and set the Rx/Tx DMAMUX source for edmaRxRegToRxDataHandle.

Parameters

- base – LPSPI peripheral base address.
- handle – LPSPI handle pointer to lpspi_master_edma_handle_t.
- callback – LPSPI callback.
- userData – callback function parameter.
- edmaRxRegToRxDataHandle – edmaRxRegToRxDataHandle pointer to edma_handle_t.
- edmaTxDataToTxRegHandle – edmaTxDataToTxRegHandle pointer to edma_handle_t.

status_t LPSPI_MasterTransferEDMA(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle, *lpspi_transfer_t* *transfer)

LPSPI master transfer data using eDMA.

This function transfers data using eDMA. This is a non-blocking function, which returns right away. When all data is transferred, the callback function is called.

Note: The transfer data size should be an integer multiple of bytesPerFrame if bytesPerFrame is less than or equal to 4. For bytesPerFrame greater than 4: The transfer data size should be equal to bytesPerFrame if the bytesPerFrame is not an integer multiple of 4. Otherwise, the transfer data size can be an integer multiple of bytesPerFrame.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_master_edma_handle_t structure which stores the transfer state.

- transfer – pointer to lpspi_transfer_t structure.

Returns
status of status_t.

status_t LPSPI_MasterTransferPrepareEDMALite(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle, uint32_t configFlags)

LPSPI master config transfer parameter while using eDMA.

This function is preparing to transfer data using eDMA, work with LPSPI_MasterTransferEDMALite.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_master_edma_handle_t structure which stores the transfer state.
- configFlags – transfer configuration flags. _lpspi_transfer_config_flag_for_master.

Return values

- kStatus_Success – Execution successfully.
- kStatus_LPSPI_Busy – The LPSPI device is busy.

Returns
Indicates whether LPSPI master transfer was successful or not.

status_t LPSPI_MasterTransferEDMALite(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle, *lpspi_transfer_t* *transfer)

LPSPI master transfer data using eDMA without configs.

This function transfers data using eDMA. This is a non-blocking function, which returns right away. When all data is transferred, the callback function is called.

Note: This API is only for transfer through DMA without configuration. Before calling this API, you must call LPSPI_MasterTransferPrepareEDMALite to configure it once. The transfer data size should be an integer multiple of bytesPerFrame if bytesPerFrame is less than or equal to 4. For bytesPerFrame greater than 4: The transfer data size should be equal to bytesPerFrame if the bytesPerFrame is not an integer multiple of 4. Otherwise, the transfer data size can be an integer multiple of bytesPerFrame.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_master_edma_handle_t structure which stores the transfer state.
- transfer – pointer to lpspi_transfer_t structure, config field is not uesed.

Return values

- kStatus_Success – Execution successfully.
- kStatus_LPSPI_Busy – The LPSPI device is busy.
- kStatus_InvalidArgument – The transfer structure is invalid.

Returns
Indicates whether LPSPI master transfer was successful or not.

void LPSPI_MasterTransferAbortEDMA(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle)

LPSPI master aborts a transfer which is using eDMA.

This function aborts a transfer which is using eDMA.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_master_edma_handle_t structure which stores the transfer state.

status_t LPSPI_MasterTransferGetCountEDMA(LPSPI_Type *base, *lpspi_master_edma_handle_t* *handle, size_t *count)

Gets the master eDMA transfer remaining bytes.

This function gets the master eDMA transfer remaining bytes.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_master_edma_handle_t structure which stores the transfer state.
- count – Number of bytes transferred so far by the EDMA transaction.

Returns

status of status_t.

void LPSPI_SlaveTransferCreateHandleEDMA(LPSPI_Type *base, *lpspi_slave_edma_handle_t* *handle, *lpspi_slave_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *edmaRxRegToRxDataHandle, *edma_handle_t* *edmaTxDataToTxRegHandle)

Initializes the LPSPI slave eDMA handle.

This function initializes the LPSPI eDMA handle which can be used for other LPSPI transactional APIs. Usually, for a specified LPSPI instance, call this API once to get the initialized handle.

Note that LPSPI eDMA has a separated (Rx and Tx as two sources) or shared (Rx and Tx as the same source) DMA request source.

(1) For a separated DMA request source, enable and set the Rx DMAMUX source for edmaRxRegToRxDataHandle and Tx DMAMUX source for edmaTxDataToTxRegHandle. (2) For a shared DMA request source, enable and set the Rx/Rx DMAMUX source for edmaRxRegToRxDataHandle .

Parameters

- base – LPSPI peripheral base address.
- handle – LPSPI handle pointer to lpspi_slave_edma_handle_t.
- callback – LPSPI callback.
- userData – callback function parameter.
- edmaRxRegToRxDataHandle – edmaRxRegToRxDataHandle pointer to edma_handle_t.
- edmaTxDataToTxRegHandle – edmaTxDataToTxRegHandle pointer to edma_handle_t.

status_t LPSPI_SlaveTransferEDMA(LPSPI_Type *base, *lpspi_slave_edma_handle_t* *handle, *lpspi_transfer_t* *transfer)

LPSPI slave transfers data using eDMA.

This function transfers data using eDMA. This is a non-blocking function, which return right away. When all data is transferred, the callback function is called.

Note: The transfer data size should be an integer multiple of bytesPerFrame if bytesPerFrame is less than or equal to 4. For bytesPerFrame greater than 4: The transfer data size

should be equal to bytesPerFrame if the bytesPerFrame is not an integer multiple of 4. Otherwise, the transfer data size can be an integer multiple of bytesPerFrame.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_slave_edma_handle_t structure which stores the transfer state.
- transfer – pointer to lpspi_transfer_t structure.

Returns
status of status_t.

void LPSPI_SlaveTransferAbortEDMA(LPSPI_Type *base, *lpspi_slave_edma_handle_t* *handle)

LPSPI slave aborts a transfer which is using eDMA.

This function aborts a transfer which is using eDMA.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_slave_edma_handle_t structure which stores the transfer state.

status_t LPSPI_SlaveTransferGetCountEDMA(LPSPI_Type *base, *lpspi_slave_edma_handle_t* *handle, size_t *count)

Gets the slave eDMA transfer remaining bytes.

This function gets the slave eDMA transfer remaining bytes.

Parameters

- base – LPSPI peripheral base address.
- handle – pointer to lpspi_slave_edma_handle_t structure which stores the transfer state.
- count – Number of bytes transferred so far by the eDMA transaction.

Returns
status of status_t.

struct __lpspi_master_edma_handle

#include <fsl_lpspi_edma.h> LPSPI master eDMA transfer handle structure used for transactional API.

Public Members

volatile bool isPcsContinuous

Is PCS continuous in transfer.

volatile bool isByteSwap

A flag that whether should byte swap.

volatile uint8_t fifoSize

FIFO dataSize.

volatile uint8_t rxWatermark

Rx watermark.

volatile uint8_t bytesEachWrite

Bytes for each write TDR.

volatile uint8_t bytesEachRead
: Bytes for each read RDR.

volatile uint8_t bytesLastRead
: Bytes for last read RDR.

volatile bool isThereExtraRxBytes
: Is there extra RX byte.

const uint8_t *volatile txData
: Send buffer.

uint8_t *volatile rxData
: Receive buffer.

volatile size_t txRemainingByteCount
: Number of bytes remaining to send.

volatile size_t rxRemainingByteCount
: Number of bytes remaining to receive.

volatile uint32_t writeRegRemainingTimes
: Write TDR register remaining times.

volatile uint32_t readRegRemainingTimes
: Read RDR register remaining times.

uint32_t totalByteCount
: Number of transfer bytes

edma_tcd_t *lastTimeTCD
: Pointer to the lastTime TCD

bool isMultiDMATransmit
: Is there multi DMA transmit

volatile uint8_t dmaTransmitTime
: DMA Transfer times.

uint32_t lastTimeDataBytes
: DMA transmit last Time data Bytes

uint32_t dataBytesEveryTime
: Bytes in a time for DMA transfer, default is DMA_MAX_TRANSFER_COUNT

edma_transfer_config_t transferConfigRx
: Config of DMA rx channel.

edma_transfer_config_t transferConfigTx
: Config of DMA tx channel.

uint32_t txBuffIfNull
: Used if there is not txData for DMA purpose.

uint32_t rxBuffIfNull
: Used if there is not rxData for DMA purpose.

uint32_t transmitCommand
: Used to write TCR for DMA purpose.

volatile uint8_t state
: LPSPI transfer state , _lpspi_transfer_state.

uint8_t nbytes
: eDMA minor byte transfer count initially configured.

lpspi_master_edma_transfer_callback_t callback
: Completion callback.

void *userData
: Callback user data.

edma_handle_t *edmaRxRegToRxDataHandle
: edma_handle_t handle point used for RxReg to RxData buff

edma_handle_t *edmaTxDataToTxRegHandle
: edma_handle_t handle point used for TxData to TxReg buff

edma_tcd_t lpspiSoftwareTCD[3]
: SoftwareTCD, internal used

struct __lpspi_slave_edma_handle
: *#include <fsl_lpspi_edma.h>* LPSPI slave eDMA transfer handle structure used for transactional API.

Public Members

volatile bool isByteSwap
: A flag that whether should byte swap.

volatile uint8_t fifoSize
: FIFO dataSize.

volatile uint8_t rxWatermark
: Rx watermark.

volatile uint8_t bytesEachWrite
: Bytes for each write TDR.

volatile uint8_t bytesEachRead
: Bytes for each read RDR.

volatile uint8_t bytesLastRead
: Bytes for last read RDR.

volatile bool isThereExtraRxBytes
: Is there extra RX byte.

uint8_t nbytes
: eDMA minor byte transfer count initially configured.

const uint8_t *volatile txData
: Send buffer.

uint8_t *volatile rxData
: Receive buffer.

volatile size_t txRemainingByteCount
: Number of bytes remaining to send.

volatile size_t rxRemainingByteCount
: Number of bytes remaining to receive.

volatile uint32_t writeRegRemainingTimes
Write TDR register remaining times.

volatile uint32_t readRegRemainingTimes
Read RDR register remaining times.

uint32_t totalByteCount
Number of transfer bytes

uint32_t txBuffIfNull
Used if there is not txData for DMA purpose.

uint32_t rxBuffIfNull
Used if there is not rxData for DMA purpose.

volatile uint8_t state
LPSPI transfer state.

uint32_t errorCount
Error count for slave transfer.

lpspi_slave_edma_transfer_callback_t callback
Completion callback.

void *userData
Callback user data.

edma_handle_t *edmaRxRegToRxDataHandle
edma_handle_t handle point used for RxReg to RxData buff

edma_handle_t *edmaTxDataToTxRegHandle
edma_handle_t handle point used for TxData to TxReg

edma_tcd_t lpspiSoftwareTCD[2]
SoftwareTCD, internal used

2.47 LPTMR: Low-Power Timer

void LPTMR_Init(LPTMR_Type *base, const *lptmr_config_t* *config)
Ungates the LPTMR clock and configures the peripheral for a basic operation.

Note: This API should be called at the beginning of the application using the LPTMR driver.

Parameters

- base – LPTMR peripheral base address
- config – A pointer to the LPTMR configuration structure.

void LPTMR_Deinit(LPTMR_Type *base)
Gates the LPTMR clock.

Parameters

- base – LPTMR peripheral base address

void LPTMR_GetDefaultConfig(*lptmr_config_t* *config)

Fills in the LPTMR configuration structure with default settings.

The default values are as follows.

```
config->timerMode = kLPTMR_TimerModeTimeCounter;
config->pinSelect = kLPTMR_PinSelectInput_0;
config->pinPolarity = kLPTMR_PinPolarityActiveHigh;
config->enableFreeRunning = false;
config->bypassPrescaler = true;
config->prescalerClockSource = kLPTMR_PrescalerClock_1;
config->value = kLPTMR_Prescale_Glitch_0;
```

Parameters

- config – A pointer to the LPTMR configuration structure.

static inline void LPTMR_EnableInterrupts(LPTMR_Type *base, uint32_t mask)

Enables the selected LPTMR interrupts.

Parameters

- base – LPTMR peripheral base address
- mask – The interrupts to enable. This is a logical OR of members of the enumeration lptmr_interrupt_enable_t

static inline void LPTMR_DisableInterrupts(LPTMR_Type *base, uint32_t mask)

Disables the selected LPTMR interrupts.

Parameters

- base – LPTMR peripheral base address
- mask – The interrupts to disable. This is a logical OR of members of the enumeration lptmr_interrupt_enable_t.

static inline uint32_t LPTMR_GetEnabledInterrupts(LPTMR_Type *base)

Gets the enabled LPTMR interrupts.

Parameters

- base – LPTMR peripheral base address

Returns

The enabled interrupts. This is the logical OR of members of the enumeration lptmr_interrupt_enable_t

static inline uint32_t LPTMR_GetStatusFlags(LPTMR_Type *base)

Gets the LPTMR status flags.

Parameters

- base – LPTMR peripheral base address

Returns

The status flags. This is the logical OR of members of the enumeration lptmr_status_flags_t

static inline void LPTMR_ClearStatusFlags(LPTMR_Type *base, uint32_t mask)

Clears the LPTMR status flags.

Parameters

- base – LPTMR peripheral base address
- mask – The status flags to clear. This is a logical OR of members of the enumeration lptmr_status_flags_t.

static inline void LPTMR_SetTimerPeriod(LPTMR_Type *base, uint32_t ticks)

Sets the timer period in units of count.

Timers counts from 0 until it equals the count value set here. The count value is written to the CMR register.

Note:

a. The TCF flag is set with the CNR equals the count provided here and then increments.

b. Call the utility macros provided in the fsl_common.h to convert to ticks.

Parameters

- base – LPTMR peripheral base address
- ticks – A timer period in units of ticks

static inline uint32_t LPTMR_GetCurrentTimerCount(LPTMR_Type *base)

Reads the current timer counting value.

This function returns the real-time timer counting value in a range from 0 to a timer period.

Note: Call the utility macros provided in the fsl_common.h to convert ticks to usec or msec.

Parameters

- base – LPTMR peripheral base address

Returns

The current counter value in ticks

static inline void LPTMR_StartTimer(LPTMR_Type *base)

Starts the timer.

After calling this function, the timer counts up to the CMR register value. Each time the timer reaches the CMR value and then increments, it generates a trigger pulse and sets the timeout interrupt flag. An interrupt is also triggered if the timer interrupt is enabled.

Parameters

- base – LPTMR peripheral base address

static inline void LPTMR_StopTimer(LPTMR_Type *base)

Stops the timer.

This function stops the timer and resets the timer's counter register.

Parameters

- base – LPTMR peripheral base address

FSL_LPTMR_DRIVER_VERSION

Driver Version

enum _lptmr_pin_select

LPTMR pin selection used in pulse counter mode.

Values:

enumerator kLPTMR_PinSelectInput_0

Pulse counter input 0 is selected

enumerator kLPTMR_PinSelectInput_1
Pulse counter input 1 is selected

enumerator kLPTMR_PinSelectInput_2
Pulse counter input 2 is selected

enumerator kLPTMR_PinSelectInput_3
Pulse counter input 3 is selected

enum _lptmr_pin_polarity
LPTMR pin polarity used in pulse counter mode.

Values:

enumerator kLPTMR_PinPolarityActiveHigh
Pulse Counter input source is active-high

enumerator kLPTMR_PinPolarityActiveLow
Pulse Counter input source is active-low

enum _lptmr_timer_mode
LPTMR timer mode selection.

Values:

enumerator kLPTMR_TimerModeTimeCounter
Time Counter mode

enumerator kLPTMR_TimerModePulseCounter
Pulse Counter mode

enum _lptmr_prescaler_glitch_value
LPTMR prescaler/glitch filter values.

Values:

enumerator kLPTMR_Prescale_Glitch_0
Prescaler divide 2, glitch filter does not support this setting

enumerator kLPTMR_Prescale_Glitch_1
Prescaler divide 4, glitch filter 2

enumerator kLPTMR_Prescale_Glitch_2
Prescaler divide 8, glitch filter 4

enumerator kLPTMR_Prescale_Glitch_3
Prescaler divide 16, glitch filter 8

enumerator kLPTMR_Prescale_Glitch_4
Prescaler divide 32, glitch filter 16

enumerator kLPTMR_Prescale_Glitch_5
Prescaler divide 64, glitch filter 32

enumerator kLPTMR_Prescale_Glitch_6
Prescaler divide 128, glitch filter 64

enumerator kLPTMR_Prescale_Glitch_7
Prescaler divide 256, glitch filter 128

enumerator kLPTMR_Prescale_Glitch_8
Prescaler divide 512, glitch filter 256

enumerator kLPTMR_Prescale_Glitch_9
Prescaler divide 1024, glitch filter 512

enumerator kLPTMR_Prescale_Glitch_10
Prescaler divide 2048 glitch filter 1024

enumerator kLPTMR_Prescale_Glitch_11
Prescaler divide 4096, glitch filter 2048

enumerator kLPTMR_Prescale_Glitch_12
Prescaler divide 8192, glitch filter 4096

enumerator kLPTMR_Prescale_Glitch_13
Prescaler divide 16384, glitch filter 8192

enumerator kLPTMR_Prescale_Glitch_14
Prescaler divide 32768, glitch filter 16384

enumerator kLPTMR_Prescale_Glitch_15
Prescaler divide 65536, glitch filter 32768

enum _lptmr_prescaler_clock_select
LPTMR prescaler/glitch filter clock select.

Note: Clock connections are SoC-specific

Values:

enum _lptmr_interrupt_enable
List of the LPTMR interrupts.

Values:

enumerator kLPTMR_TimerInterruptEnable
Timer interrupt enable

enum _lptmr_status_flags
List of the LPTMR status flags.

Values:

enumerator kLPTMR_TimerCompareFlag
Timer compare flag

typedef enum *_lptmr_pin_select* lptmr_pin_select_t
LPTMR pin selection used in pulse counter mode.

typedef enum *_lptmr_pin_polarity* lptmr_pin_polarity_t
LPTMR pin polarity used in pulse counter mode.

typedef enum *_lptmr_timer_mode* lptmr_timer_mode_t
LPTMR timer mode selection.

typedef enum *_lptmr_prescaler_glitch_value* lptmr_prescaler_glitch_value_t
LPTMR prescaler/glitch filter values.

typedef enum *_lptmr_prescaler_clock_select* lptmr_prescaler_clock_select_t
LPTMR prescaler/glitch filter clock select.

Note: Clock connections are SoC-specific

typedef enum *_lptmr_interrupt_enable* lptmr_interrupt_enable_t

List of the LPTMR interrupts.

typedef enum *_lptmr_status_flags* lptmr_status_flags_t

List of the LPTMR status flags.

typedef struct *_lptmr_config* lptmr_config_t

LPTMR config structure.

This structure holds the configuration settings for the LPTMR peripheral. To initialize this structure to reasonable defaults, call the LPTMR_GetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration struct can be made constant so it resides in flash.

static inline void LPTMR_EnableTimerDMA(LPTMR_Type *base, bool enable)

Enable or disable timer DMA request.

Parameters

- base – base LPTMR peripheral base address
- enable – Switcher of timer DMA feature. “true” means to enable, “false” means to disable.

struct _lptmr_config

#include <fsl_lptmr.h> LPTMR config structure.

This structure holds the configuration settings for the LPTMR peripheral. To initialize this structure to reasonable defaults, call the LPTMR_GetDefaultConfig() function and pass a pointer to your configuration structure instance.

The configuration struct can be made constant so it resides in flash.

Public Members

lptmr_timer_mode_t timerMode

Time counter mode or pulse counter mode

lptmr_pin_select_t pinSelect

LPTMR pulse input pin select; used only in pulse counter mode

lptmr_pin_polarity_t pinPolarity

LPTMR pulse input pin polarity; used only in pulse counter mode

bool enableFreeRunning

True: enable free running, counter is reset on overflow False: counter is reset when the compare flag is set

bool bypassPrescaler

True: bypass prescaler; false: use clock from prescaler

lptmr_prescaler_clock_select_t prescalerClockSource

LPTMR clock source

lptmr_prescaler_glitch_value_t value

Prescaler or glitch filter value

2.48 LPUART: Low Power Universal Asynchronous Receiver/Transmitter Driver

2.49 LPUART Driver

static inline void LPUART_SoftwareReset(LPUART_Type *base)

Resets the LPUART using software.

This function resets all internal logic and registers except the Global Register. Remains set until cleared by software.

Parameters

- base – LPUART peripheral base address.

status_t LPUART_Init(LPUART_Type *base, const *lpuart_config_t* *config, uint32_t srcClock_Hz)

Initializes an LPUART instance with the user configuration structure and the peripheral clock.

This function configures the LPUART module with user-defined settings. Call the LPUART_GetDefaultConfig() function to configure the configuration structure and get the default configuration. The example below shows how to use this API to configure the LPUART.

```
lpuart_config_t lpuartConfig;
lpuartConfig.baudRate_Bps = 115200U;
lpuartConfig.parityMode = kLPUART_ParityDisabled;
lpuartConfig.dataBitsCount = kLPUART_EightDataBits;
lpuartConfig.isMsb = false;
lpuartConfig.stopBitCount = kLPUART_OneStopBit;
lpuartConfig.txFifoWatermark = 0;
lpuartConfig.rxFifoWatermark = 1;
LPUART_Init(LPUART1, &lpuartConfig, 20000000U);
```

Parameters

- base – LPUART peripheral base address.
- config – Pointer to a user-defined configuration structure.
- srcClock_Hz – LPUART clock source frequency in HZ.

Return values

- kStatus_LPUART_BaudrateNotSupport – Baudrate is not support in current clock source.
- kStatus_Success – LPUART initialize succeed

void LPUART_Deinit(LPUART_Type *base)

Deinitializes a LPUART instance.

This function waits for transmit to complete, disables TX and RX, and disables the LPUART clock.

Parameters

- base – LPUART peripheral base address.

void LPUART_GetDefaultConfig(*lpuart_config_t* *config)

Gets the default configuration structure.

This function initializes the LPUART configuration structure to a default value. The default values are: lpuartConfig->baudRate_Bps = 115200U; lpuartConfig->parityMode

= kLPUART_ParityDisabled; lpuartConfig->dataBitsCount = kLPUART_EightDataBits; lpuartConfig->isMsb = false; lpuartConfig->stopBitCount = kLPUART_OneStopBit; lpuartConfig->txFifoWatermark = 0; lpuartConfig->rxFifoWatermark = 1; lpuartConfig->rxIdleType = kLPUART_IdleTypeStartBit; lpuartConfig->rxIdleConfig = kLPUART_IdleCharacter1; lpuartConfig->enableTx = false; lpuartConfig->enableRx = false;

Parameters

- config – Pointer to a configuration structure.

status_t LPUART_SetBaudRate(LPUART_Type *base, uint32_t baudRate_Bps, uint32_t srcClock_Hz)

Sets the LPUART instance baudrate.

This function configures the LPUART module baudrate. This function is used to update the LPUART module baudrate after the LPUART module is initialized by the LPUART_Init.

```
LPUART_SetBaudRate(LPUART1, 115200U, 20000000U);
```

Parameters

- base – LPUART peripheral base address.
- baudRate_Bps – LPUART baudrate to be set.
- srcClock_Hz – LPUART clock source frequency in HZ.

Return values

- kStatus_LPUART_BaudrateNotSupport – Baudrate is not supported in the current clock source.
- kStatus_Success – Set baudrate succeeded.

void LPUART_Enable9bitMode(LPUART_Type *base, bool enable)

Enable 9-bit data mode for LPUART.

This function set the 9-bit mode for LPUART module. The 9th bit is not used for parity thus can be modified by user.

Parameters

- base – LPUART peripheral base address.
- enable – true to enable, flase to disable.

static inline void LPUART_SetMatchAddress(LPUART_Type *base, uint16_t address1, uint16_t address2)

Set the LPUART address.

This function configures the address for LPUART module that works as slave in 9-bit data mode. One or two address fields can be configured. When the address field's match enable bit is set, the frame it receices with MSB being 1 is considered as an address frame, otherwise it is considered as data frame. Once the address frame matches one of slave's own addresses, this slave is addressed. This address frame and its following data frames are stored in the receive buffer, otherwise the frames will be discarded. To un-address a slave, just send an address frame with unmatched address.

Note: Any LPUART instance joined in the multi-slave system can work as slave. The position of the address mark is the same as the parity bit when parity is enabled for 8 bit and 9 bit data formats.

Parameters

- base – LPUART peripheral base address.

- address1 – LPUART slave address1.
- address2 – LPUART slave address2.

static inline void LPUART_EnableMatchAddress(LPUART_Type *base, bool match1, bool match2)

Enable the LPUART match address feature.

Parameters

- base – LPUART peripheral base address.
- match1 – true to enable match address1, false to disable.
- match2 – true to enable match address2, false to disable.

static inline void LPUART_SetRxFifoWatermark(LPUART_Type *base, uint8_t water)

Sets the rx FIFO watermark.

Parameters

- base – LPUART peripheral base address.
- water – Rx FIFO watermark.

static inline void LPUART_SetTxFifoWatermark(LPUART_Type *base, uint8_t water)

Sets the tx FIFO watermark.

Parameters

- base – LPUART peripheral base address.
- water – Tx FIFO watermark.

static inline void LPUART_TransferEnable16Bit(*lpuart_handle_t* *handle, bool enable)

Sets the LPUART using 16bit transmit, only for 9bit or 10bit mode.

This function Enable 16bit Data transmit in lpuart_handle_t.

Parameters

- handle – LPUART handle pointer.
- enable – true to enable, false to disable.

uint32_t LPUART_GetStatusFlags(LPUART_Type *base)

Gets LPUART status flags.

This function gets all LPUART status flags. The flags are returned as the logical OR value of the enumerators _lpuart_flags. To check for a specific status, compare the return value with enumerators in the _lpuart_flags. For example, to check whether the TX is empty:

```
if (kLPUART_TxDataRegEmptyFlag & LPUART_GetStatusFlags(LPUART1))
{
    ...
}
```

Parameters

- base – LPUART peripheral base address.

Returns

LPUART status flags which are ORed by the enumerators in the _lpuart_flags.

status_t LPUART_ClearStatusFlags(LPUART_Type *base, uint32_t mask)

Clears status flags with a provided mask.

This function clears LPUART status flags with a provided mask. Automatically cleared flags can't be cleared by this function. Flags that can only cleared or set by hardware are: kLPUART_TxDataRegEmptyFlag, kLPUART_TransmissionCompleteFlag, kLPUART_RxDataRegFullFlag, kLPUART_RxActiveFlag, kLPUART_NoiseErrorFlag, kLPUART_ParityErrorFlag, kLPUART_TxFifoEmptyFlag,kLPUART_RxFifoEmptyFlag Note: This API should be called when the Tx/Rx is idle, otherwise it takes no effects.

Parameters

- base – LPUART peripheral base address.
- mask – the status flags to be cleared. The user can use the enumerators in the _lpuart_status_flag_t to do the OR operation and get the mask.

Return values

- kStatus_LPUART_FlagCannotClearManually – The flag can't be cleared by this function but it is cleared automatically by hardware.
- kStatus_Success – Status in the mask are cleared.

Returns

0 succeed, others failed.

void LPUART_EnableInterrupts(LPUART_Type *base, uint32_t mask)

Enables LPUART interrupts according to a provided mask.

This function enables the LPUART interrupts according to a provided mask. The mask is a logical OR of enumeration members. See the _lpuart_interrupt_enable. This examples shows how to enable TX empty interrupt and RX full interrupt:

```
LPUART_EnableInterrupts(LPUART1,kLPUART_TxDataRegEmptyInterruptEnable | kLPUART_
↪RxDataRegFullInterruptEnable);
```

Parameters

- base – LPUART peripheral base address.
- mask – The interrupts to enable. Logical OR of _lpuart_interrupt_enable.

void LPUART_DisableInterrupts(LPUART_Type *base, uint32_t mask)

Disables LPUART interrupts according to a provided mask.

This function disables the LPUART interrupts according to a provided mask. The mask is a logical OR of enumeration members. See _lpuart_interrupt_enable. This example shows how to disable the TX empty interrupt and RX full interrupt:

```
LPUART_DisableInterrupts(LPUART1,kLPUART_TxDataRegEmptyInterruptEnable | kLPUART_
↪RxDataRegFullInterruptEnable);
```

Parameters

- base – LPUART peripheral base address.
- mask – The interrupts to disable. Logical OR of _lpuart_interrupt_enable.

uint32_t LPUART_GetEnabledInterrupts(LPUART_Type *base)

Gets enabled LPUART interrupts.

This function gets the enabled LPUART interrupts. The enabled interrupts are returned as the logical OR value of the enumerators _lpuart_interrupt_enable. To check a specific interrupt enable status, compare the return value with enumerators in

_lpuart_interrupt_enable. For example, to check whether the TX empty interrupt is enabled:

```
uint32_t enabledInterrupts = LPUART_GetEnabledInterrupts(LPUART1);

if (kLPUART_TxDataRegEmptyInterruptEnable & enabledInterrupts)
{
    ...
}
```

Parameters

- base – LPUART peripheral base address.

Returns

LPUART interrupt flags which are logical OR of the enumerators in _lpuart_interrupt_enable.

static inline uintptr_t LPUART_GetDataRegisterAddress(LPUART_Type *base)

Gets the LPUART data register address.

This function returns the LPUART data register address, which is mainly used by the DMA/eDMA.

Parameters

- base – LPUART peripheral base address.

Returns

LPUART data register addresses which are used both by the transmitter and receiver.

static inline void LPUART_EnableTxDMA(LPUART_Type *base, bool enable)

Enables or disables the LPUART transmitter DMA request.

This function enables or disables the transmit data register empty flag, STAT[TDRE], to generate DMA requests.

Parameters

- base – LPUART peripheral base address.
- enable – True to enable, false to disable.

static inline void LPUART_EnableRxDMA(LPUART_Type *base, bool enable)

Enables or disables the LPUART receiver DMA.

This function enables or disables the receiver data register full flag, STAT[RDRF], to generate DMA requests.

Parameters

- base – LPUART peripheral base address.
- enable – True to enable, false to disable.

uint32_t LPUART_GetInstance(LPUART_Type *base)

Get the LPUART instance from peripheral base address.

Parameters

- base – LPUART peripheral base address.

Returns

LPUART instance.

static inline void LPUART_EnableTx(LPUART_Type *base, bool enable)

Enables or disables the LPUART transmitter.

This function enables or disables the LPUART transmitter.

Parameters

- base – LPUART peripheral base address.
- enable – True to enable, false to disable.

static inline void LPUART_EnableRx(LPUART_Type *base, bool enable)

Enables or disables the LPUART receiver.

This function enables or disables the LPUART receiver.

Parameters

- base – LPUART peripheral base address.
- enable – True to enable, false to disable.

static inline void LPUART_WriteByte(LPUART_Type *base, uint8_t data)

Writes to the transmitter register.

This function writes data to the transmitter register directly. The upper layer must ensure that the TX register is empty or that the TX FIFO has room before calling this function.

Parameters

- base – LPUART peripheral base address.
- data – Data write to the TX register.

static inline uint8_t LPUART_ReadByte(LPUART_Type *base)

Reads the receiver register.

This function reads data from the receiver register directly. The upper layer must ensure that the receiver register is full or that the RX FIFO has data before calling this function.

Parameters

- base – LPUART peripheral base address.

Returns

Data read from data register.

static inline uint8_t LPUART_GetRxFifoCount(LPUART_Type *base)

Gets the rx FIFO data count.

Parameters

- base – LPUART peripheral base address.

Returns

rx FIFO data count.

static inline uint8_t LPUART_GetTxFifoCount(LPUART_Type *base)

Gets the tx FIFO data count.

Parameters

- base – LPUART peripheral base address.

Returns

tx FIFO data count.

void LPUART_SendAddress(LPUART_Type *base, uint8_t address)

Transmit an address frame in 9-bit data mode.

Parameters

- base – LPUART peripheral base address.
- address – LPUART slave address.

status_t LPUART_WriteBlocking(LPUART_Type *base, const uint8_t *data, size_t length)

Writes to the transmitter register using a blocking method.

This function polls the transmitter register, first waits for the register to be empty or TX FIFO to have room, and writes data to the transmitter buffer, then waits for the dat to be sent out to the bus.

Parameters

- base – LPUART peripheral base address.
- data – Start address of the data to write.
- length – Size of the data to write.

Return values

- kStatus_LPUART_Timeout – Transmission timed out and was aborted.
- kStatus_Success – Successfully wrote all data.

status_t LPUART_WriteBlocking16bit(LPUART_Type *base, const uint16_t *data, size_t length)

Writes to the transmitter register using a blocking method in 9bit or 10bit mode.

Note: This function only support 9bit or 10bit transfer. Please make sure only 10bit of data is valid and other bits are 0.

Parameters

- base – LPUART peripheral base address.
- data – Start address of the data to write.
- length – Size of the data to write.

Return values

- kStatus_LPUART_Timeout – Transmission timed out and was aborted.
- kStatus_Success – Successfully wrote all data.

status_t LPUART_ReadBlocking(LPUART_Type *base, uint8_t *data, size_t length)

Reads the receiver data register using a blocking method.

This function polls the receiver register, waits for the receiver register full or receiver FIFO has data, and reads data from the TX register.

Parameters

- base – LPUART peripheral base address.
- data – Start address of the buffer to store the received data.
- length – Size of the buffer.

Return values

- kStatus_LPUART_RxHardwareOverrun – Receiver overrun happened while receiving data.
- kStatus_LPUART_NoiseError – Noise error happened while receiving data.

- kStatus_LPUART_FramingError – Framing error happened while receiving data.
- kStatus_LPUART_ParityError – Parity error happened while receiving data.
- kStatus_LPUART_Timeout – Transmission timed out and was aborted.
- kStatus_Success – Successfully received all data.

status_t LPUART_ReadBlocking16bit(LPUART_Type *base, uint16_t *data, size_t length)

Reads the receiver data register in 9bit or 10bit mode.

Note: This function only support 9bit or 10bit transfer.

Parameters

- base – LPUART peripheral base address.
- data – Start address of the buffer to store the received data by 16bit, only 10bit is valid.
- length – Size of the buffer.

Return values

- kStatus_LPUART_RxHardwareOverrun – Receiver overrun happened while receiving data.
- kStatus_LPUART_NoiseError – Noise error happened while receiving data.
- kStatus_LPUART_FramingError – Framing error happened while receiving data.
- kStatus_LPUART_ParityError – Parity error happened while receiving data.
- kStatus_LPUART_Timeout – Transmission timed out and was aborted.
- kStatus_Success – Successfully received all data.

void LPUART_TransferCreateHandle(LPUART_Type *base, *lpuart_handle_t* *handle, *lpuart_transfer_callback_t* callback, void *userData)

Initializes the LPUART handle.

This function initializes the LPUART handle, which can be used for other LPUART transactional APIs. Usually, for a specified LPUART instance, call this API once to get the initialized handle.

The LPUART driver supports the "background" receiving, which means that user can set up an RX ring buffer optionally. Data received is stored into the ring buffer even when the user doesn't call the LPUART_TransferReceiveNonBlocking() API. If there is already data received in the ring buffer, the user can get the received data from the ring buffer directly. The ring buffer is disabled if passing NULL as ringBuffer.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- callback – Callback function.
- userData – User data.

status_t LPUART_TransferSendNonBlocking(LPUART_Type *base, *lpuart_handle_t* *handle, *lpuart_transfer_t* *xfer)

Transmits a buffer of data using the interrupt method.

This function send data using an interrupt method. This is a non-blocking function, which returns directly without waiting for all data written to the transmitter register. When all data is written to the TX register in the ISR, the LPUART driver calls the callback function and passes the kStatus_LPUART_TxIdle as status parameter.

Note: The kStatus_LPUART_TxIdle is passed to the upper layer when all data are written to the TX register. However, there is no check to ensure that all the data sent out. Before disabling the TX, check the kLPUART_TransmissionCompleteFlag to ensure that the transmit is finished.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- xfer – LPUART transfer structure, see lpuart_transfer_t.

Return values

- kStatus_Success – Successfully start the data transmission.
- kStatus_LPUART_TxBusy – Previous transmission still not finished, data not all written to the TX register.
- kStatus_InvalidArgument – Invalid argument.

void LPUART_TransferStartRingBuffer(LPUART_Type *base, *lpuart_handle_t* *handle, uint8_t *ringBuffer, size_t ringBufferSize)

Sets up the RX ring buffer.

This function sets up the RX ring buffer to a specific UART handle.

When the RX ring buffer is used, data received is stored into the ring buffer even when the user doesn't call the UART_TransferReceiveNonBlocking() API. If there is already data received in the ring buffer, the user can get the received data from the ring buffer directly.

Note: When using RX ring buffer, one byte is reserved for internal use. In other words, if ringBufferSize is 32, then only 31 bytes are used for saving data.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- ringBuffer – Start address of ring buffer for background receiving. Pass NULL to disable the ring buffer.
- ringBufferSize – size of the ring buffer.

void LPUART_TransferStopRingBuffer(LPUART_Type *base, *lpuart_handle_t* *handle)

Aborts the background transfer and uninstalls the ring buffer.

This function aborts the background transfer and uninstalls the ring buffer.

Parameters

- base – LPUART peripheral base address.

- handle – LPUART handle pointer.

size_t LPUART_TransferGetRxRingBufferLength(LPUART_Type *base, *lpuart_handle_t* *handle)

Get the length of received data in RX ring buffer.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.

Returns

Length of received data in RX ring buffer.

void LPUART_TransferAbortSend(LPUART_Type *base, *lpuart_handle_t* *handle)

Aborts the interrupt-driven data transmit.

This function aborts the interrupt driven data sending. The user can get the remainBtyes to find out how many bytes are not sent out.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.

status_t LPUART_TransferGetSendCount(LPUART_Type *base, *lpuart_handle_t* *handle, uint32_t *count)

Gets the number of bytes that have been sent out to bus.

This function gets the number of bytes that have been sent out to bus by an interrupt method.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- count – Send bytes count.

Return values

- kStatus_NoTransferInProgress – No send in progress.
- kStatus_InvalidArgument – Parameter is invalid.
- kStatus_Success – Get successfully through the parameter count;

status_t LPUART_TransferReceiveNonBlocking(LPUART_Type *base, *lpuart_handle_t* *handle, *lpuart_transfer_t* *xfer, size_t *receivedBytes)

Receives a buffer of data using the interrupt method.

This function receives data using an interrupt method. This is a non-blocking function which returns without waiting to ensure that all data are received. If the RX ring buffer is used and not empty, the data in the ring buffer is copied and the parameter receivedBytes shows how many bytes are copied from the ring buffer. After copying, if the data in the ring buffer is not enough for read, the receive request is saved by the LPUART driver. When the new data arrives, the receive request is serviced first. When all data is received, the LPUART driver notifies the upper layer through a callback function and passes a status parameter kStatus_UART_RxIdle. For example, the upper layer needs 10 bytes but there are only 5 bytes in ring buffer. The 5 bytes are copied to xfer->data, which returns with the parameter receivedBytes set to 5. For the remaining 5 bytes, the newly arrived data is saved from xfer->data[5]. When 5 bytes are received, the LPUART driver notifies the upper layer. If the RX ring buffer is not enabled, this function enables the RX and RX interrupt to receive data to xfer->data. When all data is received, the upper layer is notified.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- xfer – LPUART transfer structure, see uart_transfer_t.
- receivedBytes – Bytes received from the ring buffer directly.

Return values

- kStatus_Success – Successfully queue the transfer into the transmit queue.
- kStatus_LPUART_RxBusy – Previous receive request is not finished.
- kStatus_InvalidArgument – Invalid argument.

void LPUART_TransferAbortReceive(LPUART_Type *base, *lpuart_handle_t* *handle)

Aborts the interrupt-driven data receiving.

This function aborts the interrupt-driven data receiving. The user can get the remainBytes to find out how many bytes not received yet.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.

status_t LPUART_TransferGetReceiveCount(LPUART_Type *base, *lpuart_handle_t* *handle, uint32_t *count)

Gets the number of bytes that have been received.

This function gets the number of bytes that have been received.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- count – Receive bytes count.

Return values

- kStatus_NoTransferInProgress – No receive in progress.
- kStatus_InvalidArgument – Parameter is invalid.
- kStatus_Success – Get successfully through the parameter count;

void LPUART_TransferHandleIRQ(LPUART_Type *base, void *irqHandle)

LPUART IRQ handle function.

This function handles the LPUART transmit and receive IRQ request.

Parameters

- base – LPUART peripheral base address.
- irqHandle – LPUART handle pointer.

void LPUART_TransferHandleErrorIRQ(LPUART_Type *base, void *irqHandle)

LPUART Error IRQ handle function.

This function handles the LPUART error IRQ request.

Parameters

- base – LPUART peripheral base address.
- irqHandle – LPUART handle pointer.

void LPUART_DriverIRQHandler(uint32_t instance)

LPUART driver IRQ handler common entry.

This function provides the common IRQ request entry for LPUART.

Parameters

- instance – LPUART instance.

FSL_LPUART_DRIVER_VERSION

LPUART driver version.

Error codes for the LPUART driver.

Values:

enumerator kStatus_LPUART_TxBusy

TX busy

enumerator kStatus_LPUART_RxBusy

RX busy

enumerator kStatus_LPUART_TxIdle

LPUART transmitter is idle.

enumerator kStatus_LPUART_RxIdle

LPUART receiver is idle.

enumerator kStatus_LPUART_TxWatermarkTooLarge

TX FIFO watermark too large

enumerator kStatus_LPUART_RxWatermarkTooLarge

RX FIFO watermark too large

enumerator kStatus_LPUART_FlagCannotClearManually

Some flag can't manually clear

enumerator kStatus_LPUART_Error

Error happens on LPUART.

enumerator kStatus_LPUART_RxRingBufferOverrun

LPUART RX software ring buffer overrun.

enumerator kStatus_LPUART_RxHardwareOverrun

LPUART RX receiver overrun.

enumerator kStatus_LPUART_NoiseError

LPUART noise error.

enumerator kStatus_LPUART_FramingError

LPUART framing error.

enumerator kStatus_LPUART_ParityError

LPUART parity error.

enumerator kStatus_LPUART_BaudrateNotSupport

Baudrate is not support in current clock source

enumerator kStatus_LPUART_IdleLineDetected

IDLE flag.

enumerator kStatus_LPUART_Timeout

LPUART times out.

enum _lpuart_parity_mode
LPUART parity mode.

Values:

enumerator kLPUART_ParityDisabled
Parity disabled

enumerator kLPUART_ParityEven
Parity enabled, type even, bit setting: PE|PT = 10

enumerator kLPUART_ParityOdd
Parity enabled, type odd, bit setting: PE|PT = 11

enum _lpuart_data_bits
LPUART data bits count.

Values:

enumerator kLPUART_EightDataBits
Eight data bit

enumerator kLPUART_SevenDataBits
Seven data bit

enum _lpuart_stop_bit_count
LPUART stop bit count.

Values:

enumerator kLPUART_OneStopBit
One stop bit

enumerator kLPUART_TwoStopBit
Two stop bits

enum _lpuart_transmit_cts_source
LPUART transmit CTS source.

Values:

enumerator kLPUART_CtsSourcePin
CTS resource is the LPUART_CTS pin.

enumerator kLPUART_CtsSourceMatchResult
CTS resource is the match result.

enum _lpuart_transmit_cts_config
LPUART transmit CTS configure.

Values:

enumerator kLPUART_CtsSampleAtStart
CTS input is sampled at the start of each character.

enumerator kLPUART_CtsSampleAtIdle
CTS input is sampled when the transmitter is idle

enum _lpuart_idle_type_select
LPUART idle flag type defines when the receiver starts counting.

Values:

enumerator kLPUART_IdleTypeStartBit
Start counting after a valid start bit.

enumerator kLPUART_IdleTypeStopBit
Start counting after a stop bit.

enum _lpuart_idle_config
LPUART idle detected configuration. This structure defines the number of idle characters that must be received before the IDLE flag is set.

Values:

enumerator kLPUART_IdleCharacter1
the number of idle characters.

enumerator kLPUART_IdleCharacter2
the number of idle characters.

enumerator kLPUART_IdleCharacter4
the number of idle characters.

enumerator kLPUART_IdleCharacter8
the number of idle characters.

enumerator kLPUART_IdleCharacter16
the number of idle characters.

enumerator kLPUART_IdleCharacter32
the number of idle characters.

enumerator kLPUART_IdleCharacter64
the number of idle characters.

enumerator kLPUART_IdleCharacter128
the number of idle characters.

enum _lpuart_interrupt_enable
LPUART interrupt configuration structure, default settings all disabled.

This structure contains the settings for all LPUART interrupt configurations.

Values:

enumerator kLPUART_LinBreakInterruptEnable
LIN break detect. bit 7

enumerator kLPUART_RxActiveEdgeInterruptEnable
Receive Active Edge. bit 6

enumerator kLPUART_TxDataRegEmptyInterruptEnable
Transmit data register empty. bit 23

enumerator kLPUART_TransmissionCompleteInterruptEnable
Transmission complete. bit 22

enumerator kLPUART_RxDataRegFullInterruptEnable
Receiver data register full. bit 21

enumerator kLPUART_IdleLineInterruptEnable
Idle line. bit 20

enumerator kLPUART_RxOverrunInterruptEnable
Receiver Overrun. bit 27

enumerator kLPUART_NoiseErrorInterruptEnable
Noise error flag. bit 26

enumerator kLPUART_FramingErrorInterruptEnable
Framing error flag. bit 25

enumerator kLPUART_ParityErrorInterruptEnable
Parity error flag. bit 24

enumerator kLPUART_Match1InterruptEnable
Parity error flag. bit 15

enumerator kLPUART_Match2InterruptEnable
Parity error flag. bit 14

enumerator kLPUART_TxFifoOverflowInterruptEnable
Transmit FIFO Overflow. bit 9

enumerator kLPUART_RxFifoUnderflowInterruptEnable
Receive FIFO Underflow. bit 8

enumerator kLPUART_AllInterruptEnable

enum _lpuart_flags
LPUART status flags.

This provides constants for the LPUART status flags for use in the LPUART functions.

Values:

enumerator kLPUART_TxDataRegEmptyFlag
Transmit data register empty flag, sets when transmit buffer is empty. bit 23

enumerator kLPUART_TransmissionCompleteFlag
Transmission complete flag, sets when transmission activity complete. bit 22

enumerator kLPUART_RxDataRegFullFlag
Receive data register full flag, sets when the receive data buffer is full. bit 21

enumerator kLPUART_IdleLineFlag
Idle line detect flag, sets when idle line detected. bit 20

enumerator kLPUART_RxOverrunFlag
Receive Overrun, sets when new data is received before data is read from receive register. bit 19

enumerator kLPUART_NoiseErrorFlag
Receive takes 3 samples of each received bit. If any of these samples differ, noise flag sets. bit 18

enumerator kLPUART_FramingErrorFlag
Frame error flag, sets if logic 0 was detected where stop bit expected. bit 17

enumerator kLPUART_ParityErrorFlag
If parity enabled, sets upon parity error detection. bit 16

enumerator kLPUART_LinBreakFlag
LIN break detect interrupt flag, sets when LIN break char detected and LIN circuit enabled. bit 31

enumerator kLPUART_RxActiveEdgeFlag
Receive pin active edge interrupt flag, sets when active edge detected. bit 30

enumerator kLPUART_RxActiveFlag
Receiver Active Flag (RAF), sets at beginning of valid start. bit 24

enumerator kLPUART_DataMatch1Flag
The next character to be read from LPUART_DATA matches MA1. bit 15

enumerator kLPUART_DataMatch2Flag
The next character to be read from LPUART_DATA matches MA2. bit 14

enumerator kLPUART_TxFifoEmptyFlag
TXEMPT bit, sets if transmit buffer is empty. bit 7

enumerator kLPUART_RxFifoEmptyFlag
RXEMPT bit, sets if receive buffer is empty. bit 6

enumerator kLPUART_TxFifoOverflowFlag
TXOF bit, sets if transmit buffer overflow occurred. bit 1

enumerator kLPUART_RxFifoUnderflowFlag
RXUF bit, sets if receive buffer underflow occurred. bit 0

enumerator kLPUART_AllClearFlags

enumerator kLPUART_AllFlags

typedef enum *_lpuart_parity_mode* lpuart_parity_mode_t
LPUART parity mode.

typedef enum *_lpuart_data_bits* lpuart_data_bits_t
LPUART data bits count.

typedef enum *_lpuart_stop_bit_count* lpuart_stop_bit_count_t
LPUART stop bit count.

typedef enum *_lpuart_transmit_cts_source* lpuart_transmit_cts_source_t
LPUART transmit CTS source.

typedef enum *_lpuart_transmit_cts_config* lpuart_transmit_cts_config_t
LPUART transmit CTS configure.

typedef enum *_lpuart_idle_type_select* lpuart_idle_type_select_t
LPUART idle flag type defines when the receiver starts counting.

typedef enum *_lpuart_idle_config* lpuart_idle_config_t
LPUART idle detected configuration. This structure defines the number of idle characters that must be received before the IDLE flag is set.

typedef struct *_lpuart_config* lpuart_config_t
LPUART configuration structure.

typedef struct *_lpuart_transfer* lpuart_transfer_t
LPUART transfer structure.

typedef struct *_lpuart_handle* lpuart_handle_t

typedef void (*lpuart_transfer_callback_t)(LPUART_Type *base, *lpuart_handle_t* *handle, *status_t* status, void *userData)
LPUART transfer callback function.

typedef void (*lpuart_isr_t)(LPUART_Type *base, void *handle)

void *s_lpuartHandle[]

const IRQn_Type s_lpuartTxIRQ[]

lpuart_isr_t s_lpuartIsr[]

UART_RETRY_TIMES
Retry times for waiting flag.

struct _lpuart_config
#include <fsl_lpuart.h> LPUART configuration structure.

Public Members

uint32_t baudRate_Bps
LPUART baud rate

lpuart_parity_mode_t parityMode
Parity mode, disabled (default), even, odd

lpuart_data_bits_t dataBitsCount
Data bits count, eight (default), seven

bool isMsb
Data bits order, LSB (default), MSB

lpuart_stop_bit_count_t stopBitCount
Number of stop bits, 1 stop bit (default) or 2 stop bits

uint8_t txFifoWatermark
TX FIFO watermark

uint8_t rxFifoWatermark
RX FIFO watermark

bool enableRxRTS
RX RTS enable

bool enableTxCTS
TX CTS enable

lpuart_transmit_cts_source_t txCtsSource
TX CTS source

lpuart_transmit_cts_config_t txCtsConfig
TX CTS configure

lpuart_idle_type_select_t rxIdleType
RX IDLE type.

lpuart_idle_config_t rxIdleConfig
RX IDLE configuration.

bool enableTx
Enable TX

bool enableRx
Enable RX

struct _lpuart_transfer
#include <fsl_lpuart.h> LPUART transfer structure.

Public Members

size_t dataSize
The byte count to be transfer.

struct __lpuart_handle

#include <fsl_lpuart.h> LPUART handle structure.

Public Members

volatile size_t txDataSize
: Size of the remaining data to send.

size_t txDataSizeAll
: Size of the data to send out.

volatile size_t rxDataSize
: Size of the remaining data to receive.

size_t rxDataSizeAll
: Size of the data to receive.

size_t rxRingBufferSize
: Size of the ring buffer.

volatile uint16_t rxRingBufferHead
: Index for the driver to store received data into ring buffer.

volatile uint16_t rxRingBufferTail
: Index for the user to get data from the ring buffer.

lpuart_transfer_callback_t callback
: Callback function.

void *userData
: LPUART callback function parameter.

volatile uint8_t txState
: TX transfer state.

volatile uint8_t rxState
: RX transfer state.

bool isSevenDataBits
: Seven data bits flag.

bool is16bitData
: 16bit data bits flag, only used for 9bit or 10bit data

union ___unnamed67___

Public Members

uint8_t *data
: The buffer of data to be transfer.

uint8_t *rxData
: The buffer to receive data.

uint16_t *rxData16
: The buffer to receive data.

const uint8_t *txData
: The buffer of data to be sent.

const uint16_t *txData16
The buffer of data to be sent.

union ___unnamed69___

Public Members

const uint8_t *volatile txData
Address of remaining data to send.

const uint16_t *volatile txData16
Address of remaining data to send.

union ___unnamed71___

Public Members

uint8_t *volatile rxData
Address of remaining data to receive.

uint16_t *volatile rxData16
Address of remaining data to receive.

union ___unnamed73___

Public Members

uint8_t *rxRingBuffer
Start address of the receiver ring buffer.

uint16_t *rxRingBuffer16
Start address of the receiver ring buffer.

2.50 LPUART eDMA Driver

void LPUART_TransferCreateHandleEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle, *lpuart_edma_transfer_callback_t* callback, void *userData, *edma_handle_t* *txEdmaHandle, *edma_handle_t* *rxEdmaHandle)

Initializes the LPUART handle which is used in transactional functions.

Note: This function disables all LPUART interrupts.

Parameters

- base – LPUART peripheral base address.
- handle – Pointer to lpuart_edma_handle_t structure.
- callback – Callback function.
- userData – User data.
- txEdmaHandle – User requested DMA handle for TX DMA transfer.
- rxEdmaHandle – User requested DMA handle for RX DMA transfer.

status_t LPUART_SendEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle, *lpuart_transfer_t* *xfer)

Sends data using eDMA.

This function sends data using eDMA. This is a non-blocking function, which returns right away. When all data is sent, the send callback function is called.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- xfer – LPUART eDMA transfer structure. See lpuart_transfer_t.

Return values

- kStatus_Success – if succeed, others failed.
- kStatus_LPUART_TxBusy – Previous transfer on going.
- kStatus_InvalidArgument – Invalid argument.

status_t LPUART_ReceiveEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle, *lpuart_transfer_t* *xfer)

Receives data using eDMA.

This function receives data using eDMA. This is non-blocking function, which returns right away. When all data is received, the receive callback function is called.

Parameters

- base – LPUART peripheral base address.
- handle – Pointer to lpuart_edma_handle_t structure.
- xfer – LPUART eDMA transfer structure, see lpuart_transfer_t.

Return values

- kStatus_Success – if succeed, others fail.
- kStatus_LPUART_RxBusy – Previous transfer ongoing.
- kStatus_InvalidArgument – Invalid argument.

void LPUART_TransferAbortSendEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle)

Aborts the sent data using eDMA.

This function aborts the sent data using eDMA.

Parameters

- base – LPUART peripheral base address.
- handle – Pointer to lpuart_edma_handle_t structure.

void LPUART_TransferAbortReceiveEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle)

Aborts the received data using eDMA.

This function aborts the received data using eDMA.

Parameters

- base – LPUART peripheral base address.
- handle – Pointer to lpuart_edma_handle_t structure.

status_t LPUART_TransferGetSendCountEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle, uint32_t *count)

Gets the number of bytes written to the LPUART TX register.

This function gets the number of bytes written to the LPUART TX register by DMA.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- count – Send bytes count.

Return values

- kStatus_NoTransferInProgress – No send in progress.
- kStatus_InvalidArgument – Parameter is invalid.
- kStatus_Success – Get successfully through the parameter count;

status_t LPUART_TransferGetReceiveCountEDMA(LPUART_Type *base, *lpuart_edma_handle_t* *handle, uint32_t *count)

Gets the number of received bytes.

This function gets the number of received bytes.

Parameters

- base – LPUART peripheral base address.
- handle – LPUART handle pointer.
- count – Receive bytes count.

Return values

- kStatus_NoTransferInProgress – No receive in progress.
- kStatus_InvalidArgument – Parameter is invalid.
- kStatus_Success – Get successfully through the parameter count;

void LPUART_TransferEdmaHandleIRQ(LPUART_Type *base, void *lpuartEdmaHandle)

LPUART eDMA IRQ handle function.

This function handles the LPUART tx complete IRQ request and invoke user callback. It is not set to static so that it can be used in user application.

Note: This function is used as default IRQ handler by double weak mechanism. If user's specific IRQ handler is implemented, make sure this function is invoked in the handler.

Parameters

- base – LPUART peripheral base address.
- lpuartEdmaHandle – LPUART handle pointer.

FSL_LPUART_EDMA_DRIVER_VERSION

LPUART EDMA driver version.

typedef struct *_lpuart_edma_handle* lpuart_edma_handle_t

typedef void (*lpuart_edma_transfer_callback_t)(LPUART_Type *base, *lpuart_edma_handle_t* *handle, *status_t* status, void *userData)

LPUART transfer callback function.

struct _lpuart_edma_handle

#include <fsl_lpuart_edma.h> LPUART eDMA handle.

Public Members

lpuart_edma_transfer_callback_t callback
Callback function.

void *userData
LPUART callback function parameter.

size_t rxDataSizeAll
Size of the data to receive.

size_t txDataSizeAll
Size of the data to send out.

edma_handle_t *txEdmaHandle
The eDMA TX channel used.

edma_handle_t *rxEdmaHandle
The eDMA RX channel used.

uint8_t nbytes
eDMA minor byte transfer count initially configured.

volatile uint8_t txState
TX transfer state.

volatile uint8_t rxState
RX transfer state

2.51 MCM: Miscellaneous Control Module

FSL_MCM_DRIVER_VERSION
MCM driver version.

Enum _mcm_interrupt_flag. Interrupt status flag mask. .

Values:

enumerator kMCM_CacheWriteBuffer
Cache Write Buffer Error Enable.

enumerator kMCM_ParityError
Cache Parity Error Enable.

enumerator kMCM_FPUInvalidOperation
FPU Invalid Operation Interrupt Enable.

enumerator kMCM_FPUDivideByZero
FPU Divide-by-zero Interrupt Enable.

enumerator kMCM_FPUOverflow
FPU Overflow Interrupt Enable.

enumerator kMCM_FPUUnderflow
FPU Underflow Interrupt Enable.

enumerator kMCM_FPUInexact
FPU Inexact Interrupt Enable.

enumerator kMCM_FPUInputDenormalInterrupt
FPU Input Denormal Interrupt Enable.

typedef union *_mcm_buffer_fault_attribute* mcm_buffer_fault_attribute_t
The union of buffer fault attribute.

typedef union *_mcm_lmem_fault_attribute* mcm_lmem_fault_attribute_t
The union of LMEM fault attribute.

static inline void MCM_EnableCrossbarRoundRobin(MCM_Type *base, bool enable)
Enables/Disables crossbar round robin.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable crossbar round robin.
  - **true** Enable crossbar round robin.
  - **false** disable crossbar round robin.

static inline void MCM_EnableInterruptStatus(MCM_Type *base, uint32_t mask)
Enables the interrupt.

Parameters

- base – MCM peripheral base address.
- mask – Interrupt status flags mask(_mcm_interrupt_flag).

static inline void MCM_DisableInterruptStatus(MCM_Type *base, uint32_t mask)
Disables the interrupt.

Parameters

- base – MCM peripheral base address.
- mask – Interrupt status flags mask(_mcm_interrupt_flag).

static inline uint16_t MCM_GetInterruptStatus(MCM_Type *base)
Gets the Interrupt status .

Parameters

- base – MCM peripheral base address.

static inline void MCM_ClearCacheWriteBufferErroStatus(MCM_Type *base)
Clears the Interrupt status .

Parameters

- base – MCM peripheral base address.

static inline uint32_t MCM_GetBufferFaultAddress(MCM_Type *base)
Gets buffer fault address.

Parameters

- base – MCM peripheral base address.

static inline void MCM_GetBufferFaultAttribute(MCM_Type *base, *mcm_buffer_fault_attribute_t* *bufferfault)
Gets buffer fault attributes.

Parameters

- base – MCM peripheral base address.

static inline uint32_t MCM_GetBufferFaultData(MCM_Type *base)

Gets buffer fault data.

Parameters

- base – MCM peripheral base address.

static inline void MCM_LimitCodeCachePeripheralWriteBuffering(MCM_Type *base, bool enable)

Limit code cache peripheral write buffering.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable limit code cache peripheral write buffering.
  - **true** Enable limit code cache peripheral write buffering.
  - **false** disable limit code cache peripheral write buffering.

static inline void MCM_BypassFixedCodeCacheMap(MCM_Type *base, bool enable)

Bypass fixed code cache map.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable bypass fixed code cache map.
  - **true** Enable bypass fixed code cache map.
  - **false** disable bypass fixed code cache map.

static inline void MCM_EnableCodeBusCache(MCM_Type *base, bool enable)

Enables/Disables code bus cache.

Parameters

- base – MCM peripheral base address.
- enable – Used to disable/enable code bus cache.
  - **true** Enable code bus cache.
  - **false** disable code bus cache.

static inline void MCM_ForceCodeCacheToNoAllocation(MCM_Type *base, bool enable)

Force code cache to no allocation.

Parameters

- base – MCM peripheral base address.
- enable – Used to force code cache to allocation or no allocation.
  - **true** Force code cache to no allocation.
  - **false** Force code cache to allocation.

static inline void MCM_EnableCodeCacheWriteBuffer(MCM_Type *base, bool enable)

Enables/Disables code cache write buffer.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable code cache write buffer.
  - **true** Enable code cache write buffer.
  - **false** Disable code cache write buffer.

static inline void MCM_ClearCodeBusCache(MCM_Type *base)

Clear code bus cache.

Parameters

- base – MCM peripheral base address.

static inline void MCM_EnablePcParityFaultReport(MCM_Type *base, bool enable)

Enables/Disables PC Parity Fault Report.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable PC Parity Fault Report.
  - **true** Enable PC Parity Fault Report.
  - **false** disable PC Parity Fault Report.

static inline void MCM_EnablePcParity(MCM_Type *base, bool enable)

Enables/Disables PC Parity.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable PC Parity.
  - **true** Enable PC Parity.
  - **false** disable PC Parity.

static inline void MCM_LockConfigState(MCM_Type *base)

Lock the configuration state.

Parameters

- base – MCM peripheral base address.

static inline void MCM_EnableCacheParityReporting(MCM_Type *base, bool enable)

Enables/Disables cache parity reporting.

Parameters

- base – MCM peripheral base address.
- enable – Used to enable/disable cache parity reporting.
  - **true** Enable cache parity reporting.
  - **false** disable cache parity reporting.

static inline uint32_t MCM_GetLmemFaultAddress(MCM_Type *base)

Gets LMEM fault address.

Parameters

- base – MCM peripheral base address.

static inline void MCM_GetLmemFaultAttribute(MCM_Type *base, *mcm_lmem_fault_attribute_t* *lmemFault)

Get LMEM fault attributes.

Parameters

- base – MCM peripheral base address.

static inline uint64_t MCM_GetLmemFaultData(MCM_Type *base)

Gets LMEM fault data.

Parameters

- base – MCM peripheral base address.

MCM_LMFATR_TYPE_MASK

MCM_LMFATR_MODE_MASK

MCM_LMFATR_BUFF_MASK

MCM_LMFATR_CACH_MASK

MCM_ISCR_STAT_MASK

FSL_COMPONENT_ID

union __mcm_buffer_fault_attribute

#include <fsl_mcm.h> The union of buffer fault attribute.

Public Members

uint32_t attribute

Indicates the faulting attributes, when a properly-enabled cache write buffer error interrupt event is detected.

struct *_mcm_buffer_fault_attribute._mcm_buffer_fault_attribut* attribute_memory

struct __mcm_buffer_fault_attribut

#include <fsl_mcm.h>

Public Members

uint32_t busErrorDataAccessType

Indicates the type of cache write buffer access.

uint32_t busErrorPrivilegeLevel

Indicates the privilege level of the cache write buffer access.

uint32_t busErrorSize

Indicates the size of the cache write buffer access.

uint32_t busErrorAccess

Indicates the type of system bus access.

uint32_t busErrorMasterID

Indicates the crossbar switch bus master number of the captured cache write buffer bus error.

uint32_t busErrorOverrun

Indicates if another cache write buffer bus error is detected.

union __mcm_lmem_fault_attribute

#include <fsl_mcm.h> The union of LMEM fault attribute.

Public Members

uint32_t attribute
Indicates the attributes of the LMEM fault detected.

struct *_mcm_lmem_fault_attribute._mcm_lmem_fault_attribut* attribute_memory

struct __mcm_lmem_fault_attribut
#include <fsl_mcm.h>

Public Members

uint32_t parityFaultProtectionSignal
Indicates the features of parity fault protection signal.

uint32_t parityFaultMasterSize
Indicates the parity fault master size.

uint32_t parityFaultWrite
Indicates the parity fault is caused by read or write.

uint32_t backdoorAccess
Indicates the LMEM access fault is initiated by core access or backdoor access.

uint32_t parityFaultSyndrome
Indicates the parity fault syndrome.

uint32_t overrun
Indicates the number of faultss.

2.52 Mipi_dsi

void DSI_Init(MIPI_DSI_Type *base, *dsi_config_t* *config)
Initializes the MIPI DSI host with the user configuration.

This function initializes the MIPI DSI host with the configuration, it should be called before other MIPI DSI driver functions.

Parameters

- base – MIPI DSI host peripheral base address.
- config – Pointer to the user configuration structure.

void DSI_Deinit(MIPI_DSI_Type *base)
Deinitializes an MIPI DSI host.

This function should be called after all bother MIPI DSI driver functions.

Parameters

- base – MIPI DSI host peripheral base address.

void DSI_GetDefaultConfig(*dsi_config_t* *config)
Gets the default configuration to initialize the MIPI DSI host.

The default value is:

```
config->mode = kDSI_CommandMode;
config->packageFlags = kDSI_DpiEnableAll;
config->enableNoncontinuousClk = true;
config->HsRxDeviceReady_ByteClk = 0U;
config->lpRxDeviceReady_ByteClk = 0U;
config->HsTxDeviceReady_ByteClk = 0U;
config->lpTxDeviceReady_ByteClk = 0U;
```

Parameters

- config – Pointer to a user-defined configuration structure.

uint32_t DSI_DphyGetPllDivider(uint32_t *m, uint32_t *n, uint32_t refClkFreq_Hz, uint32_t desiredOutFreq_Hz)

Calculates the D-PHY PLL dividers to generate the desired output frequency.

The phy byte clock frequency(byte count per second) is generated by multiplying the refClkFreq_Hz, the formula is as follows, m & n is configured by mediamix control block.

desiredOutFreq_Hz = refClkFreq_Hz * (M + 2) / (N + 1). M: 62 ~ 625 N: 0 ~ 15

Parameters

- m – Control of the feedback multiplication ratio.
- n – Control of the input frequency division ratio.
- refClkFreq_Hz – The D-PHY input reference clock frequency (REF_CLK).
- desiredOutFreq_Hz – Desired PLL output frequency.

Returns

The actually output frequency using the returned dividers. If can not find suitable dividers, return 0.

status_t DSI_PowerUp(MIPI_DSI_Type *base)

Power up the DSI.

Parameters

- base – MIPI DSI host peripheral base address.

Return values

- kStatus_Success – Data transfer finished with no error.
- kStatus_Timeout – Transfer failed because of timeout.

static inline void DSI_PowerDown(MIPI_DSI_Type *base)

Power down the DSI.

Parameters

- base – MIPI DSI host peripheral base address.

static inline void DSI_EnableInterrupts(MIPI_DSI_Type *base, uint32_t intGroup1, uint32_t intGroup2)

Enable the interrupts.

The interrupts to enable are passed in as OR'ed mask value of _dsi_interrupt.

Parameters

- base – MIPI DSI host peripheral base address.
- intGroup1 – Interrupts to enable in group 1.
- intGroup2 – Interrupts to enable in group 2.

static inline void DSI_DisableInterrupts(MIPI_DSI_Type *base, uint32_t intGroup1, uint32_t intGroup2)

Disable the interrupts.

The interrupts to disable are passed in as OR'ed mask value of _dsi_interrupt.

Parameters

- base – MIPI DSI host peripheral base address.
- intGroup1 – Interrupts to disable in group 1.
- intGroup2 – Interrupts to disable in group 2.

static inline void DSI_GetAndClearInterruptStatus(MIPI_DSI_Type *base, uint32_t *intGroup1, uint32_t *intGroup2)

Get and clear the interrupt status.

Parameters

- base – MIPI DSI host peripheral base address.
- intGroup1 – Group 1 interrupt status.
- intGroup2 – Group 2 interrupt status.

void DSI_SetDpiConfig(MIPI_DSI_Type *base, const *dsi_dpi_config_t* *config, uint8_t laneNum)

Configure the DPI interface.

This function sets the DPI interface configuration, it should be used in video mode.

Parameters

- base – MIPI DSI host peripheral base address.
- config – Pointer to the DPI interface configuration.
- laneNum – How may lanes in use.

void DSI_SetCommandModeConfig(MIPI_DSI_Type *base, const *dsi_command_config_t* *config, uint32_t phyByteClkFreq_Hz)

Configures the command mode configuration.

This function configures the timeout values for DSI command mode.

Parameters

- base – MIPI DSI host peripheral base address.
- config – Pointer to the command mode configuration structure.
- phyByteClkFreq_Hz – Byte clock frequency in each lane.

static inline void DSI_EnableCommandMode(MIPI_DSI_Type *base, bool enable)

Enables the command mode.

This function configures the timeout values for DSI command mode.

Parameters

- base – MIPI DSI host peripheral base address.
- enable – true to enable command mode and disable video mode, vise versa.

static inline void DSI_EnableVpgEnMode(MIPI_DSI_Type *base, bool enable)

Enables the VPG mode.

This function configures video mode pattern generator.

Parameters

- base – MIPI DSI host peripheral base address.

- enable – true to enable video mode pattern generator.

void DSI_GetDefaultDphyConfig(*dsi_dphy_config_t* *config, uint32_t phyByteClkFreq_Hz, uint8_t laneNum)

Gets the default D-PHY configuration.

Gets the default D-PHY configuration, the timing parameters are set according to D-PHY specification. User can use the configuration directly, or change the parameters according device specific requirements.

Parameters

- config – Pointer to the D-PHY configuration.
- phyByteClkFreq_Hz – Byte clock frequency in each lane.
- laneNum – How may lanes in use.

void DSI_InitDphy(MIPI_DSI_Type *base, const *dsi_dphy_config_t* *config)

Initializes the D-PHY.

This function configures the D-PHY timing and setups the D-PHY PLL based on user configuration. The default configuration can be obtained by calling the function DSI_GetDefaultDphyConfig.

Parameters

- base – MIPI DSI host peripheral base address.
- config – Pointer to the D-PHY configuration.

void DSI_SetPacketControl(MIPI_DSI_Type *base, uint8_t flags)

Configures the APB packet to send.

This function configures the next APB packet transfer feature. After configuration, user can write the payload by calling DSI_WriteTxPayload then call DSI_WriteTxHeader to start the tranasfer or just call DSI_WriteTxHeader alone if it is a short packet.

Parameters

- base – MIPI DSI host peripheral base address.
- flags – The transfer control flags, see ref _dsi_transfer_flags.

void DSI_WriteTxHeader(MIPI_DSI_Type *base, uint16_t wordCount, uint8_t virtualChannel, *dsi_tx_data_type_t* dataType)

Writes tx header to command FIFO. This will trigger the packet transfer.

Parameters

- base – MIPI DSI host peripheral base address.
- wordCount – For long packet, this is the byte count of the payload. For short packet, this is (data1 « 8) | data0.
- virtualChannel – Virtual channel.
- dataType – The packet data type, (DI).

void DSI_WriteTxPayload(MIPI_DSI_Type *base, const uint8_t *payload, uint16_t payloadSize)

Fills the long APB packet payload.

Write the long packet payload to TX FIFO.

Parameters

- base – MIPI DSI host peripheral base address.
- payload – Pointer to the payload.
- payloadSize – Payload size in byte.

void DSI_WriteTxPayloadExt(MIPI_DSI_Type *base, const uint8_t *payload, uint16_t payloadSize, bool sendDcsCmd, uint8_t dcsCmd)

Writes payload data to generic payload FIFO.

Write the long packet payload to TX FIFO. This function could be used in two ways

a. Include the DCS command in the 1st byte of payload. In this case, the DCS command is the first byte of payload. The parameter sendDcsCmd is set to false, the dcsCmd is not used. This function is the same as DSI_WriteTxPayload when used in this way.
b. The DCS command in not in payload, but specified by parameter dcsCmd. In this case, the parameter sendDcsCmd is set to true, the dcsCmd is the DCS command to send. The payload is sent after dcsCmd.

Parameters

- base – MIPI DSI host peripheral base address.
- payload – Pointer to the payload.
- payloadSize – Payload size in byte.
- sendDcsCmd – If set to true, the DCS command is specified by dcsCmd, otherwise the DCS command is included in the payload.
- dcsCmd – The DCS command to send, only used when sendDCSCmd is true.

void DSI_ReadRxData(MIPI_DSI_Type *base, uint8_t *payload, uint16_t payloadSize)

Reads the long APB packet payload.

Read the long packet payload from RX FIFO. This function reads directly from RX FIFO status. Upper layer should make sure the whole rx packet has been received.

Parameters

- base – MIPI DSI host peripheral base address.
- payload – Pointer to the payload buffer.
- payloadSize – Payload size in byte.

status_t DSI_TransferBlocking(MIPI_DSI_Type *base, *dsi_transfer_t* *xfer)

APB data transfer using blocking method.

Perform APB data transfer using blocking method. This function waits until all data send or received, or timeout happens.

Parameters

- base – MIPI DSI host peripheral base address.
- xfer – Pointer to the transfer structure.

Return values

- kStatus_Success – Data transfer finished with no error.
- kStatus_Timeout – Transfer failed because of timeout.
- kStatus_DSI_RxDataError – RX data error, user could use ref DSI_GetRxErrorStatus to check the error details.
- kStatus_DSI_PhyError – PHY error detected during transfer.
- kStatus_DSI_ErrorReportReceived – Error Report packet received, user could use ref DSI_GetAndClearHostStatus to check the error report status.
- kStatus_DSI_NotSupported – Transfer format not supported.

- kStatus_DSI_Fail – Transfer failed for other reasons.

uint16_t Pll_Set_Hs_Freqrange(uint32_t bnd_width)

Lookup table method to obtain HS frequency range of operation selection override.

Parameters

- bnd_width – band width frequncy in Hz

Returns

the hsfreqrange_ovr[6:0] value based on band width frequncy in hz.

uint16_t Pll_Set_Pll_Prop_Param(uint32_t pll_freq_sel)

Lookup table method to obtain PLL Proportional Charge Pump control.

Parameters

- pll_freq_sel – PLL frequency in Mhz

Returns

the pll_prop_cntrl_rw[5:0] value based on video Pll frequency in Mhz.

uint16_t Pll_Set_Sr_Osc_Freq_Target(uint32_t pll_freq_sel)

Lookup table method to obtain DDL target oscillation frequency.

Parameters

- pll_freq_sel – PLL frequency in Mhz

Returns

the sr_osc_freq_target[11:0] value based on video Pll frequency in Mhz.

uint32_t Pll_Set_Pll_Vco_Freq(uint32_t pll_freq_sel)

calculate VCO frequency.

Parameters

- pll_freq_sel – PLL frequency in Hz

Returns

the vco_freq_clk value

uint16_t Pll_Set_Pll_Vco_Param(uint32_t pll_freq_sel)

Lookup table method to obtain VCO parameter.

Parameters

- pll_freq_sel – PLL frequency in Mhz

Returns

the pll_vco_cntrl_ovr_rw[5:0] value based on video Pll frequency in Mhz. If can not find suitable value, return default value 63.

void DSI_ConfigDphy(MIPI_DSI_Type *base, uint32_t phyRefClkFreq_Hz, uint32_t dataRateFreq_Hz)

config to set Dphy.

Parameters

- phyRefClkFreq_Hz – Dphy reference clock frequency in Hz
- dataRateFreq_Hz – line rate clock frequency.

FSL_MIPI_DSI_DRIVER_VERSION

Error codes for the MIPI DSI driver.

Values:

enumerator kStatus_DSI_Busy
DSI is busy.

enumerator kStatus_DSI_EccMultiBitError
Multibit ECC error detected in rx packet.

enumerator kStatus_DSI_CrcError
CRC error detected in rx packet.

enumerator kStatus_DSI_PacketSizeError
Rx packet size error.

enumerator kStatus_DSI_EotMissingError
Received transmission does not end with an EoT packet.

enumerator kStatus_DSI_ErrorReportReceived
Error report package received.

enumerator kStatus_DSI_NotSupported
The transfer type not supported.

enumerator kStatus_DSI_PhyError
Physical layer error.

Status and interrupt mask of acknowledge error sent by device caused by host, belongs to interrupt group1. INT_ST0 bit0-bit15.

Values:

enumerator kDSI_ErrorReportSot
SoT error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportSotSync
SoT Sync error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportEotSync
EoT Sync error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportEscEntryCmd
Escape Mode Entry Command error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportLpSync
Low-power Transmit Sync error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportPeriphTo
Peripheral Timeout error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportFalseControl
False Control error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportDeviceSpecific1
The deice specific error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportEccOneBit
Single-bit ECC error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportEccMultiBit
Muiti-bit ECC error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportChecksum
Checksum error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportDataTypeUnrecognized
DSI data type not recognized error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportVcIdInvalid
Virtual channel ID invalid error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportTxLengthInvalid
Invalid transmission length error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportDeviceSpecific2
The deice specific error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportProtocolViolation
Protocol violation error detected in device's acknowledge error report.

enumerator kDSI_ErrorReportAll

Status and interrupt mask of error in phy layer, belongs to interrupt group1. INT_ST0 bit16-bit20.

Values:

enumerator kDSI_PhyErrorEscEntry
Escape entry error from Lane 0.

enumerator kDSI_PhyErrorLpSync
Low-power data transmission synchronization error from Lane 0.

enumerator kDSI_PhyErrorControl
Control error from Lane 0.

enumerator kDSI_PhyErrorLp0Connection
LP0 connection error from Lane 0.

enumerator kDSI_PhyErrorLp1Connection
LP1 connection error from Lane 0.

enumerator kDSI_PhyErrorAll

Timeout error interrupt and status, belongs to interrupt group2. INT_ST1 bit0-bit6.

Values:

enumerator kDSI_TimeoutErrorHtx
High Speed forward TX timeout detected.

enumerator kDSI_TimeoutErrorLrx
Reverse Low power data receive timeout detected.

Host receive packet error status, belongs to interrupt group2. INT_ST1 bit0-bit6.

Values:

enumerator kDSI_RxErrorEccOneBit
ECC single bit error detected.

enumerator kDSI_RxErrorEccMultiBit
ECC multi bit error detected.

enumerator kDSI_RxErrorCrc
CRC error detected.

enumerator kDSI_RxErrorPacketSize
Packet size error detected.

enumerator kDSI_RxErrorEotMissing
Host receives a transmission that does not end with an EoT packet.

enumerator kDSI_RxErrorAll

Host receive error status, belongs to interrupt group2. INT_ST1 bit7-bit12 bit19?

Values:

enumerator kDSI_DpiPayloadFifoOverflow
During a DPI pixel line storage, the payload FIFO overflow occurs.

enumerator kDSI_GenericCommandFifoOverflow
System writes a command through the Generic interface while FIFO is full causing overflow.

enumerator kDSI_GenericPayloadFifoOverflow
System writes a payload data through the Generic interface while FIFO is full causing payload FIFO overflow.

enumerator kDSI_GenericPayloadFifoUnderflow
System writes the packet header before the packet payload is completed loaded into the payload FIFO during a packet build causing payload FIFO underflow.

enumerator kDSI_GenericReadFifoUnderflow
System requests data before it is fully received causing underflow.

enumerator kDSI_GenericReadFifoOverflow
The Read FIFO size is not correctly dimensioned for the max rx packet size causing generic read FIFO overflow.

_dsi_dpi_package_flag Flags for DPI package composition.

Values:

enumerator kDSI_DpiEnableEotpTxHs
Enables the EoTp transmission in high-speed.

enumerator kDSI_DpiEnableEotpRx
Enables the EoTp reception.

enumerator kDSI_DpiEnableBta
Enables the Bus Turn-Around (BTA) request.

enumerator kDSI_DpiEnableEcc
Enables the ECC reception, error correction, and reporting.

enumerator kDSI_DpiEnableCrc
Enables the CRC reception and error reporting.

enumerator kDSI_DpiEnableEotpTxLp
Enables the EoTp transmission in low-power.

enumerator kDSI_DpiEnableAll

enum __dsi__operation__mode
MIPI DSI operation mode.

Values:

enumerator kDSI_VideoMode

Video mode.

enumerator kDSI_CommandMode

Command mode.

enum __dsi_dpi_color_coding

MIPI DPI interface color coding.

Values:

enumerator kDSI_DpiRGB16Bit

16-bit configuration 1. RGB565: XXXXXXXX_RRRRRGGG_GGGBBBBB.

enumerator kDSI_DpiRGB16BitLoose0

16-bit configuration 2. RGB565: XXXRRRRR_XXGGGGGG_XXXBBBBB.

enumerator kDSI_DpiRGB16BitLoose1

16-bit configuration 3. RGB565: XXRRRRRX_XXGGGGGG_XXBBBBBX.

enumerator kDSI_DpiRGB18Bit

18-bit configuration 1. RGB666: XXXXXXRR_RRRRGGGG_GGBBBBBB.

enumerator kDSI_DpiRGB18BitLoose

18-bit configuration 2. RGB666: XXRRRRRR_XXGGGGGG_XXBBBBBB.

enumerator kDSI_DpiRGB24Bit

24-bit configuration. RGB888: RRRRRRRR_GGGGGGGG_BBBBBBBB.

enumerator kDSI_DpiYCbCr20Bit

20-bit configuration. YCbCr422 loosely packed. CyCle1: YYYYYYYY_YYXXCbCbCbCb_CbCbCbCbCbCbXX, Cycle2: YYYYYYYY_YYXXCrCrCrCr_CrCrCrCrCrCrXX.

enumerator kDSI_DpiYCbCr24Bit

24-bit configuration. YCbCr422: CyCle1: YYYYYYYY_YYYYCbCbCbCb_CbCbCbCbCbCbCbCb, Cycle2: YYYYYYYY_YYYYCrCrCrCr_CrCrCrCrCrCrCrCr.

enumerator kDSI_DpiYCbCr16Bit

16-bit configuration. YCbCr422 loosely packed. CyCle1: YYYYYYYY_YYXXCbCbCbCb_CbCbCbCbCbCbXX, Cycle2: YYYYYYYY_XXXXCrCrCrCr_CrCrCrCrXXXX.

enumerator kDSI_DpiRGB30Bit

30-bit configuration. RGB10.10.10: XXRRRRRR_RRRRGGGG_GGGGGGBB_BBBBBBBB.

enumerator kDSI_DpiRGB36Bit

36-bit configuration. RGB12.12.12. CyCle1: XXXXXXRR_RRRRRRRR_RRGGGGGG, Cycle2: XXXXXXGG_GGGGBBBB_BBBBBBBB.

enumerator kDSI_DpiYCbCr12Bit

12-bit configuration. YCbCr420: CyCle1: Y1Y1Y1Y1Y1Y1Y1Y1_Y0Y0Y0Y0Y0Y0Y0Y0_CbCbCbCbCbCbCbC Cycle2: Y1Y1Y1Y1Y1Y1Y1Y1_Y0Y0Y0Y0Y0Y0Y0Y0_CrCrCrCrCrCrCrCr.

enumerator kDSI_DpiDcs24Bit

24-bit configuration with no specific coding.

_dsi_dpi_polarity_flag Flags for DPI signal polarity.

Values:

enumerator kDSI_DpiDataEnableActiveHigh
Data enable pin active high.

enumerator kDSI_DpiVsyncActiveHigh
VSYNC active high.

enumerator kDSI_DpiHsyncActiveHigh
HSYNC active high.

enumerator kDSI_DpiShutDownActiveHigh
Shutdown pin active high.

enumerator kDSI_DpiColorModeActiveHigh
Color mode pin active high.

enumerator kDSI_DpiDataEnableActiveLow
Data enable pin active low.

enumerator kDSI_DpiVsyncActiveLow
VSYNC active low.

enumerator kDSI_DpiHsyncActiveLow
HSYNC active low.

enumerator kDSI_DpiShutDownActiveLow
Shutdown pin active low.

enumerator kDSI_DpiColorModeActiveLow
Color mode pin active low.

enum _dsi_video_mode
DSI video mode.

Values:

enumerator kDSI_DpiNonBurstWithSyncPulse
Non-Burst mode with Sync Pulses.

enumerator kDSI_DpiNonBurstWithSyncEvent
Non-Burst mode with Sync Events.

enumerator kDSI_DpiBurst
Burst mode.

enum _dsi_video_pattern
Values:

enumerator kDSI_PatternDisable
Color bar pattern mode disabled.

enumerator kDSI_PatternVertical
Color bar pattern mode displayed vertically.

enumerator kDSI_PatternHorizontal
Color bar pattern mode displayed horizontally.

enum _dsi_tx_data_type
DSI TX data type.

Values:

enumerator kDSI_TxDataVsyncStart
V Sync start.

enumerator kDSI_TxDataVsyncEnd
V Sync end.

enumerator kDSI_TxDataHsyncStart
H Sync start.

enumerator kDSI_TxDataHsyncEnd
H Sync end.

enumerator kDSI_TxDataEoTp
End of transmission packet.

enumerator kDSI_TxDataCmOff
Color mode off.

enumerator kDSI_TxDataCmOn
Color mode on.

enumerator kDSI_TxDataShutDownPeriph
Shut down peripheral.

enumerator kDSI_TxDataTurnOnPeriph
Turn on peripheral.

enumerator kDSI_TxDataGenShortWrNoParam
Generic Short WRITE, no parameters.

enumerator kDSI_TxDataGenShortWrOneParam
Generic Short WRITE, one parameter.

enumerator kDSI_TxDataGenShortWrTwoParam
Generic Short WRITE, two parameter.

enumerator kDSI_TxDataGenShortRdNoParam
Generic Short READ, no parameters.

enumerator kDSI_TxDataGenShortRdOneParam
Generic Short READ, one parameter.

enumerator kDSI_TxDataGenShortRdTwoParam
Generic Short READ, two parameter.

enumerator kDSI_TxDataDcsShortWrNoParam
DCS Short WRITE, no parameters.

enumerator kDSI_TxDataDcsShortWrOneParam
DCS Short WRITE, one parameter.

enumerator kDSI_TxDataDcsShortRdNoParam
DCS Short READ, no parameters.

enumerator kDSI_TxDataSetMaxReturnPktSize
Set the Maximum Return Packet Size.

enumerator kDSI_TxDataNull
Null Packet, no data.

enumerator kDSI_TxDataBlanking
Blanking Packet, no data.

enumerator kDSI_TxDataGenLongWr
Generic long write.

enumerator kDSI_TxDataDcsLongWr
DCS Long Write/write_LUT Command Packet.

enumerator kDSI_TxDataLooselyPackedPixel20BitYCbCr
Loosely Packed Pixel Stream, 20-bit YCbCr, 4:2:2 Format.

enumerator kDSI_TxDataPackedPixel24BitYCbCr
Packed Pixel Stream, 24-bit YCbCr, 4:2:2 Format.

enumerator kDSI_TxDataPackedPixel16BitYCbCr
Packed Pixel Stream, 16-bit YCbCr, 4:2:2 Format.

enumerator kDSI_TxDataPackedPixel30BitRGB
Packed Pixel Stream, 30-bit RGB, 10-10-10 Format.

enumerator kDSI_TxDataPackedPixel36BitRGB
Packed Pixel Stream, 36-bit RGB, 12-12-12 Format.

enumerator kDSI_TxDataPackedPixel12BitYCrCb
Packed Pixel Stream, 12-bit YCbCr, 4:2:0 Format.

enumerator kDSI_TxDataPackedPixel16BitRGB
Packed Pixel Stream, 16-bit RGB, 5-6-5 Format.

enumerator kDSI_TxDataPackedPixel18BitRGB
Packed Pixel Stream, 18-bit RGB, 6-6-6 Format.

enumerator kDSI_TxDataLooselyPackedPixel18BitRGB
Loosely Packed Pixel Stream, 18-bit RGB, 6-6-6 Format.

enumerator kDSI_TxDataPackedPixel24BitRGB
Packed Pixel Stream, 24-bit RGB, 8-8-8 Format.

enum _dsi_rx_data_type
DSI RX data type.

Values:

enumerator kDSI_RxDataAckAndErrorReport
Acknowledge and Error Report

enumerator kDSI_RxDataEoTp
End of Transmission packet.

enumerator kDSI_RxDataGenShortRdResponseOneByte
Generic Short READ Response, 1 byte returned.

enumerator kDSI_RxDataGenShortRdResponseTwoByte
Generic Short READ Response, 2 byte returned.

enumerator kDSI_RxDataGenLongRdResponse
Generic Long READ Response.

enumerator kDSI_RxDataDcsLongRdResponse
DCS Long READ Response.

enumerator kDSI_RxDataDcsShortRdResponseOneByte
DCS Short READ Response, 1 byte returned.

enumerator kDSI_RxDataDcsShortRdResponseTwoByte
DCS Short READ Response, 2 byte returned.

_dsi_transfer_flags DSI transfer control flags.

Values:

enumerator kDSI_TransferUseLowPower
Use low power or not.

enumerator kDSI_TransferPerformBTA
Perform BTA or not at the end of a frame.

typedef enum *_dsi_operation_mode* dsi_operation_mode_t
MIPI DSI operation mode.

typedef struct *_dsi_config* dsi_config_t
MIPI DSI controller configuration.

typedef enum *_dsi_dpi_color_coding* dsi_dpi_color_coding_t
MIPI DPI interface color coding.

typedef enum *_dsi_video_mode* dsi_video_mode_t
DSI video mode.

typedef enum *_dsi_video_pattern* dsi_video_pattern_t

typedef struct *_dsi_dpi_config* dsi_dpi_config_t
MIPI DSI controller DPI interface configuration.

typedef struct *_dsi_command_config* dsi_command_config_t
MIPI DSI command mode configuration.

typedef struct *_dsi_dphy_config* dsi_dphy_config_t
MIPI DSI D-PHY configuration.

typedef enum *_dsi_tx_data_type* dsi_tx_data_type_t
DSI TX data type.

typedef enum *_dsi_rx_data_type* dsi_rx_data_type_t
DSI RX data type.

typedef struct *_dsi_transfer* dsi_transfer_t
Structure for the data transfer.

uint32_t DSI_GetInstance(MIPI_DSI_Type *base)
Gets the MIPI DSI host controller instance from peripheral base address.

Parameters

- base – MIPI DSI peripheral base address.

Returns
MIPI DSI instance.

TX_DPHY_TX_PLL_1

TX_DPHY_TX_PLL_5

TX_DPHY_TX_PLL_9

TX_DPHY_TX_PLL_13

TX_DPHY_TX_PLL_17

TX_DPHY_TX_PLL_22

TX_DPHY_TX_PLL_23

TX_DPHY_TX_PLL_24

TX_DPHY_TX_PLL_25

TX_DPHY_TX_PLL_27

TX_DPHY_TX_PLL_28

TX_DPHY_TX_PLL_29

TX_DPHY_TX_PLL_30

TX_DPHY_TX_PLL_31

TX_DPHY_TX_CB_0

TX_DPHY_TX_CB_1

TX_DPHY_TX_CB_2

TX_DPHY_TX_SLEW_5

TX_DPHY_TX_SLEW_6

TX_DPHY_TX_SLEW_7

TX_DPHY_TX_CLK_TERMLOWCAP

struct _dsi_config

#include <fsl_mipi_dsi.h> MIPI DSI controller configuration.

Public Members

dsi_operation_mode_t mode

DSI operation mode. MODE_CFG[cmd_video_mode]

uint8_t packageFlags

OR'ed value of _dsi_dpi_package_flag that controls DPI package composition. PCKHDL_CFG

bool enableNoncontinuousClk

Enables the automatic mechanism to stop providing clock in the clock lane when time allows. LPCLK_CTRL[auto_clklane_ctrl]

uint16_t HsRxDeviceReady_ByteClk

The min time the display device takes to process high-speed read from master before it can continue doing other stuff. The timer starts when D-PHY enters stop state and measured in lane byte clock. HS_RD_TO_CNT[hs_rd_to_cnt]

uint16_t lpRxDeviceReady_ByteClk

The min time the display device takes to process low-power read from master before it can continue doing other stuff. The timer starts when D-PHY enters stop state and measured in lane byte clock. LP_RD_TO_CNT[lp_rd_to_cnt]

uint16_t HsTxDeviceReady_ByteClk

The min time the display device takes to process high-speed write from master before it can continue doing other stuff. The timer starts when D-PHY enters stop state and measured in lane byte clock. HS_WR_TO_CNT[hs_wr_to_cnt]

uint16_t lpTxDeviceReady_ByteClk

The min time the display device takes to process low-power write from master before it can continue doing other stuff. The timer starts when D-PHY enters stop state and measured in lane byte clock. LP_WR_TO_CNT[lp_wr_to_cnt]

struct _dsi_dpi_config

#include <fsl_mipi_dsi.h> MIPI DSI controller DPI interface configuration.

Public Members

uint8_t virtualChannel

Virtual channel. DPI_VCID[dpi_vcid]

dsi_dpi_color_coding_t colorCoding

DPI color coding. DPI_COLOR_CODING

uint8_t polarityFlags

OR'ed value of _dsi_dpi_polarity_flag that controls signal polarity. DPI_CFG_POL

bool enablelpSwitch

Enable return to low-power inside the VSA/VBP/VFP/VACT/HBP/HFP period when timing allows. VID_MODE_CFG[bit8-13]

bool enableAck

Enable the request for an acknowledge response at the end of a frame. VID_MODE_CFG[frame_bta_ack_en]

dsi_video_mode_t videoMode

Video mode. VID_MODE_CFG[vid_mode_type]

uint16_t pixelPayloadSize

Color bar pattern. VID_MODE_CFG[vpg_orientation][vpg_en][vpg_mode=0] The number of pixels in a single video packet. For 18-bit not loosely packed data types, this number must be a multiple of 4, for YCbCr data types, it must be a multiple of 2. Recommended to set to the line size (in pixels). VID_PKT_SIZE

uint16_t vsw

Number of lines in vertical sync width. VID_VSA_LINES

uint16_t vbp

Number of lines in vertical back porch. VID_VBP_LINES

uint16_t vfp

Number of lines in vertical front porch. VID_VFP_LINES

uint16_t panelHeight

Number of lines in vertical active area. VID_VACTIVE_LINES

uint16_t hsw

Horizontal sync width, in dpi pixel clock. VID_HSA_TIME

uint16_t hbp

Horizontal back porch, in dpi pixel clock. VID_HBP_TIME

uint16_t hfp

Horizontal front porch, in dpi pixel clock. VID_HLINE_TIME = (hsw+hbp+hfp+width)

struct _dsi_command_config

#include <fsl_mipi_dsi.h> MIPI DSI command mode configuration.

Public Members

uint32_t escClkFreq_Hz

Escape clock frequencey in Hz.

uint16_t lpRxTo_Ns

Timeout value that triggers a low-power reception timeout contention detection. TO_CNT_CFG[lprx_to_cnt]

uint16_t hsTxTo_Ns

Timeout value that triggers a high-speed transmission timeout contention detection. In non-burst mode, the time should be larger than 1.1 times of one frame data transmission time, in burst mode it should be one line. TO_CNT_CFG[hstx_to_cnt]

uint16_t btaTo_Ns

The time period for which MIPI DSI host keeps the link still after completing a Bus Turnaround. BTA_TO_CNT[bta_to_cnt]

struct _dsi_dphy_config

#include <fsl_mipi_dsi.h> MIPI DSI D-PHY configuration.

Public Members

uint8_t numLanes

Number of lanes. The value range is from 1-4, lane 0-3. PHY_IF_CFG[n_lanes]

uint8_t tStopState_ByteClk

Minimum time that the PHY controller stays in stop state before a HS transmission. TODO in what unit? PHY_IF_CFG[phy_stop_wait_time]

uint16_t tClkHs2Lp_ByteClk

Maximum time that the D-PHY clock lane takes to go from high-speed to low-power in lane byte clock. PHY_TMR_LPCLK_CFG[phy_clkhs2lp_time]

uint16_t tClkLp2Hs_ByteClk

Maximum time that the D-PHY clock lane takes to go from low-power to high-speed in lane byte clock. PHY_TMR_LPCLK_CFG[phy_clklp2hs_time]

uint16_t tDataHs2Lp_ByteClk

Maximum time that the D-PHY data lane takes to go from high-speed to low-power in lane byte clock. PHY_TMR_CFG[phy_hs2lp_time]

uint16_t tDataLp2Hs_ByteClk

Maximum time that the D-PHY data lane takes to go from low-power to high-speed in lane byte clock. PHY_TMR_CFG[phy_lp2hs_time]

uint16_t maxRead_ByteClk

Maximum time required to perform a read command in lane byte clock. PHY_TMR_RD_CFG[max_rd_time]

struct _dsi_transfer

#include <fsl_mipi_dsi.h> Structure for the data transfer.

Public Members

uint8_t virtualChannel

Virtual channel.

dsi_tx_data_type_t txDataType
TX data type.

uint8_t flags
Flags to control the transfer, see _dsi_transfer_flags.

const uint8_t *txData
The TX data buffer.

uint8_t *rxData
The TX data buffer.

uint16_t txDataSize
Size of the TX data.

uint16_t rxDataSize
Size of the RX data.

bool sendDscCmd
If set to true, the DCS command is specified by dscCmd, otherwise the DCS command is included in the txData.

uint8_t dscCmd
The DCS command to send, only valid when sendDscCmd is true.

2.53 MIPI_DSI: MIPI DSI Host Controller

2.54 MSGINTR: Message Unit

2.55 MSGINTR Driver

2.56 MU: Messaging Unit

uint32_t MU_GetInstance(MU_Type *base)
Get the MU instance index.

Parameters

- base – MU peripheral base address.

Returns
MU instance index.

void MU_Init(MU_Type *base)
Initializes the MU module.

This function enables the MU clock only.

Parameters

- base – MU peripheral base address.

void MU_Deinit(MU_Type *base)
De-initializes the MU module.

This function disables the MU clock only.

Parameters

- base – MU peripheral base address.

static inline void MU_SendMsgNonBlocking(MU_Type *base, uint32_t regIndex, uint32_t msg)

Writes a message to the TX register.

This function writes a message to the specific TX register. It does not check whether the TX register is empty or not. The upper layer should make sure the TX register is empty before calling this function. This function can be used in ISR for better performance.

```
while (!(kMU_Tx0EmptyFlag & MU_GetStatusFlags(base))) { }  Wait for TX0 register empty.
MU_SendMsgNonBlocking(base, kMU_MsgReg0, MSG_VAL);  Write message to the TX0 register.
```

Parameters

- base – MU peripheral base address.
- regIndex – TX register index, see mu_msg_reg_index_t.
- msg – Message to send.

status_t MU_SendMsg(MU_Type *base, uint32_t regIndex, uint32_t msg)

Blocks to send a message.

This function waits until the TX register is empty and sends the message. If MU1_BUSY_POLL_COUNT is defined and non-zero, the function will timeout after the specified number of polling iterations and returns kStatus_Timeout.

Parameters

- base – MU peripheral base address.
- regIndex – MU message register, see mu_msg_reg_index_t.
- msg – Message to send.

Return values

- kStatus_Success – Message sent successfully.
- kStatus_Timeout – Timeout occurred while waiting for TX register to be empty.

Returns

status_t

static inline uint32_t MU_ReceiveMsgNonBlocking(MU_Type *base, uint32_t regIndex)

Reads a message from the RX register.

This function reads a message from the specific RX register. It does not check whether the RX register is full or not. The upper layer should make sure the RX register is full before calling this function. This function can be used in ISR for better performance.

```
uint32_t msg;
while (!(kMU_Rx0FullFlag & MU_GetStatusFlags(base)))
{
}  Wait for the RX0 register full.

msg = MU_ReceiveMsgNonBlocking(base, kMU_MsgReg0);  Read message from RX0 register.
```

Parameters

- base – MU peripheral base address.
- regIndex – RX register index, see mu_msg_reg_index_t.

Returns

The received message.

status_t MU_ReceiveMsgTimeout(MU_Type *base, uint32_t regIndex, uint32_t *readValue)

Blocks to receive a message with timeout protection.

This function waits until the RX register is full and receives the message. If MU_BUSY_POLL_COUNT is defined and non-zero, the function will timeout after the specified number of polling iterations and return kStatus_Timeout.

This function provides the same blocking behavior as MU_ReceiveMsg() but with additional timeout protection to prevent system hangs if the other core becomes unresponsive or if hardware issues occur.

Note: Both MU_ReceiveMsg() and MU_ReceiveMsgTimeout() are blocking functions. The difference is that this function includes timeout protection while MU_ReceiveMsg() waits indefinitely.

Parameters

- base – MU peripheral base address.
- regIndex – RX register index, see mu_msg_reg_index_t.
- readValue – Pointer to store the received message.

Return values

- kStatus_Success – Message received successfully.
- kStatus_InvalidArgument – Invalid readValue pointer.
- kStatus_Timeout – Timeout occurred while waiting for RX register to be full.

Returns

status_t

uint32_t MU_ReceiveMsg(MU_Type *base, uint32_t regIndex)

Blocks to receive a message (infinite wait, no timeout protection).

This function waits until the RX register is full and receives the message. This function will wait indefinitely until a message is received.

Note: Both MU_ReceiveMsg() and MU_ReceiveMsgTimeout() are blocking functions. The difference is that MU_ReceiveMsgTimeout() includes timeout protection while this function waits indefinitely.

Warning: This function does not include timeout protection and may cause system hangs if the other core becomes unresponsive. For applications requiring timeout protection, use MU_ReceiveMsgTimeout() instead.

Parameters

- base – MU peripheral base address.
- regIndex – RX register index, see mu_msg_reg_index_t.

Returns

The received message.

static inline void MU_SetFlagsNonBlocking(MU_Type *base, uint32_t flags)

Sets the 3-bit MU flags reflect on the other MU side.

This function sets the 3-bit MU flags directly. Every time the 3-bit MU flags are changed, the status flag kMU_FlagsUpdatingFlag asserts indicating the 3-bit MU flags are updating to the other side. After the 3-bit MU flags are updated, the status flag kMU_FlagsUpdatingFlag is cleared by hardware. During the flags updating period, the flags cannot be changed. The upper layer should make sure the status flag kMU_FlagsUpdatingFlag is cleared before calling this function.

```
while (kMU_FlagsUpdatingFlag & MU_GetStatusFlags(base))
{
}  Wait for previous MU flags updating.

MU_SetFlagsNonBlocking(base, 0U);  Set the mU flags.
```

Parameters

- base – MU peripheral base address.
- flags – The 3-bit MU flags to set.

status_t MU_SetFlags(MU_Type *base, uint32_t flags)

brief Blocks setting the 3-bit MU flags reflect on the other MU side.

This function blocks setting the 3-bit MU flags. Every time the 3-bit MU flags are changed, the status flag kMU_FlagsUpdatingFlag asserts indicating the 3-bit MU flags are updating to the other side. After the 3-bit MU flags are updated, the status flag kMU_FlagsUpdatingFlag is cleared by hardware. During the flags updating period, the flags cannot be changed. This function waits for the MU status flag kMU_FlagsUpdatingFlag cleared and sets the 3-bit MU flags.

If MU1_BUSY_POLL_COUNT is defined and non-zero, the function will timeout after the specified number of polling iterations and return kStatus_Timeout.

return status_t retval kStatus_Success Flags were set successfully. retval kStatus_Timeout Timeout occurred while waiting for flags to update.

Parameters

- base – MU peripheral base address.
- flags – The 3-bit MU flags to set.

static inline uint32_t MU_GetFlags(MU_Type *base)

Gets the current value of the 3-bit MU flags set by the other side.

This function gets the current 3-bit MU flags on the current side.

Parameters

- base – MU peripheral base address.

Returns

flags Current value of the 3-bit flags.

uint32_t MU_GetStatusFlags(MU_Type *base)

Gets the MU status flags.

This function returns the bit mask of the MU status flags. See _mu_status_flags.

```
uint32_t flags;
flags = MU_GetStatusFlags(base);  Get all status flags.
if (kMU_Tx0EmptyFlag & flags)
```

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```
{
    The TX0 register is empty. Message can be sent.
    MU_SendMsgNonBlocking(base, kMU_MsgReg0, MSG0_VAL);
}
if (kMU_Tx1EmptyFlag & flags)
{
    The TX1 register is empty. Message can be sent.
    MU_SendMsgNonBlocking(base, kMU_MsgReg1, MSG1_VAL);
}
```

If there are more than 4 general purpose interrupts, use MU_GetGeneralPurposeStatusFlags.

Parameters

- base – MU peripheral base address.

Returns

Bit mask of the MU status flags, see _mu_status_flags.

static inline uint32_t MU_GetInterruptsPending(MU_Type *base)

Gets the MU IRQ pending status of enabled interrupts.

This function returns the bit mask of the pending MU IRQs of enabled interrupts. Only these flags are checked. kMU_Tx0EmptyFlag kMU_Tx1EmptyFlag kMU_Tx2EmptyFlag kMU_Tx3EmptyFlag kMU_Rx0FullFlag kMU_Rx1FullFlag kMU_Rx2FullFlag kMU_Rx3FullFlag kMU_GenInt0Flag kMU_GenInt1Flag kMU_GenInt2Flag kMU_GenInt3Flag

Parameters

- base – MU peripheral base address.

Returns

Bit mask of the MU IRQs pending.

static inline void MU_ClearStatusFlags(MU_Type *base, uint32_t flags)

Clears the specific MU status flags.

This function clears the specific MU status flags. The flags to clear should be passed in as bit mask. See _mu_status_flags.

```
Clear general interrupt 0 and general interrupt 1 pending flags.
MU_ClearStatusFlags(base, kMU_GenInt0Flag | kMU_GenInt1Flag);
```

If there are more than 4 general purpose interrupts, use MU_ClearGeneralPurposeStatusFlags.

Parameters

- base – MU peripheral base address.
- flags – Bit mask of the MU status flags. See _mu_status_flags. Only the following flags can be cleared by software, other flags are cleared by hardware:
  - kMU_GenInt0Flag
  - kMU_GenInt1Flag
  - kMU_GenInt2Flag
  - kMU_GenInt3Flag
  - kMU_MuResetInterruptFlag
  - #kMU_OtherSideEnterRunInterruptFlag

- #kMU_OtherSideEnterHaltInterruptFlag
- #kMU_OtherSideEnterWaitInterruptFlag
- #kMU_OtherSideEnterStopInterruptFlag
- #kMU_OtherSideEnterPowerDownInterruptFlag
- #kMU_ResetAssertInterruptFlag
- #kMU_HardwareResetInterruptFlag

static inline void MU_EnableInterrupts(MU_Type *base, uint32_t interrupts)

Enables the specific MU interrupts.

This function enables the specific MU interrupts. The interrupts to enable should be passed in as bit mask. See _mu_interrupt_enable.

```
  Enable general interrupt 0 and TX0 empty interrupt.
MU_EnableInterrupts(base, kMU_GenInt0InterruptEnable | kMU_Tx0EmptyInterruptEnable);
```

If there are more than 4 general purpose interrupts, use MU_EnableGeneralPurposeInterrupts.

Parameters

- base – MU peripheral base address.
- interrupts – Bit mask of the MU interrupts. See _mu_interrupt_enable.

static inline void MU_DisableInterrupts(MU_Type *base, uint32_t interrupts)

Disables the specific MU interrupts.

This function disables the specific MU interrupts. The interrupts to disable should be passed in as bit mask. See _mu_interrupt_enable.

```
  Disable general interrupt 0 and TX0 empty interrupt.
MU_DisableInterrupts(base, kMU_GenInt0InterruptEnable | kMU_Tx0EmptyInterruptEnable);
```

If there are more than 4 general purpose interrupts, use MU_DisableGeneralPurposeInterrupts.

Parameters

- base – MU peripheral base address.
- interrupts – Bit mask of the MU interrupts. See _mu_interrupt_enable.

status_t MU_TriggerInterrupts(MU_Type *base, uint32_t interrupts)

Triggers interrupts to the other core.

This function triggers the specific interrupts to the other core. The interrupts to trigger are passed in as bit mask. See _mu_interrupt_trigger. The MU should not trigger an interrupt to the other core when the previous interrupt has not been processed by the other core. This function checks whether the previous interrupts have been processed. If not, it returns an error.

```
if (kStatus_Success != MU_TriggerInterrupts(base, kMU_GenInt0InterruptTrigger | kMU_
↪GenInt2InterruptTrigger))
{
    Previous general purpose interrupt 0 or general purpose interrupt 2
    has not been processed by the other core.
}
```

If there are more than 4 general purpose interrupts, use MU_TriggerGeneralPurposeInterrupts.

Parameters

- base – MU peripheral base address.
- interrupts – Bit mask of the interrupts to trigger. See _mu_interrupt_trigger.

Return values

- kStatus_Success – Interrupts have been triggered successfully.
- kStatus_Fail – Previous interrupts have not been accepted.

static inline void MU_EnableGeneralPurposeInterrupts(MU_Type *base, uint32_t interrupts)

Enables the MU general purpose interrupts.

This function enables the MU general purpose interrupts. The interrupts to enable should be passed in as bit mask of mu_general_purpose_interrupt_t. The function MU_EnableInterrupts only support general interrupt 0~3, this function supports all general interrupts.

For example, to enable general purpose interrupt 0 and 3, use like this:

```
MU_EnableGeneralPurposeInterrupts(MU, kMU_GeneralPurposeInterrupt0 | kMU_
↪GeneralPurposeInterrupt3);
```

Parameters

- base – MU peripheral base address.
- interrupts – Bit mask of the MU general purpose interrupts, see mu_general_purpose_interrupt_t.

static inline void MU_DisableGeneralPurposeInterrupts(MU_Type *base, uint32_t interrupts)

Disables the MU general purpose interrupts.

This function disables the MU general purpose interrupts. The interrupts to disable should be passed in as bit mask of mu_general_purpose_interrupt_t. The function MU_DisableInterrupts only support general interrupt 0~3, this function supports all general interrupts.

For example, to disable general purpose interrupt 0 and 3, use like this:

```
MU_EnableGeneralPurposeInterrupts(MU, kMU_GeneralPurposeInterrupt0 | kMU_
↪GeneralPurposeInterrupt3);
```

Parameters

- base – MU peripheral base address.
- interrupts – Bit mask of the MU general purpose interrupts. see mu_general_purpose_interrupt_t.

static inline uint32_t MU_GetGeneralPurposeStatusFlags(MU_Type *base)

Gets the MU general purpose interrupt status flags.

This function returns the bit mask of the MU general purpose interrupt status flags. MU_GetStatusFlags can only get general purpose interrupt status 0~3, this function can get all general purpose interrupts status.

This example shows to check whether general purpose interrupt 0 and 3 happened.

```
uint32_t flags;
flags = MU_GetGeneralPurposeStatusFlags(base);
if (kMU_GeneralPurposeInterrupt0 & flags)
{
}
if (kMU_GeneralPurposeInterrupt3 & flags)
```

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```
{
}
```

Parameters

- base – MU peripheral base address.

Returns

Bit mask of the MU general purpose interrupt status flags.

static inline void MU_ClearGeneralPurposeStatusFlags(MU_Type *base, uint32_t flags)

Clear the MU general purpose interrupt status flags.

This function clears the specific MU general purpose interrupt status flags. The flags to clear should be passed in as bit mask. mu_general_purpose_interrupt_t_mu_status_flags.

Example to clear general purpose interrupt 0 and general interrupt 1 pending flags.

```
MU_ClearGeneralPurposeStatusFlags(base, kMU_GeneralPurposeInterrupt0 | kMU_
↪GeneralPurposeInterrupt1);
```

Parameters

- base – MU peripheral base address.
- flags – Bit mask of the MU general purpose interrupt status flags. See mu_general_purpose_interrupt_t.

static inline uint32_t MU_GetRxStatusFlags(MU_Type *base)

Return the RX status flags in reverse numerical order.

This function return the RX status flags in reverse order. Note: RFn bits of SR[3-0](mu status register) are mapped in ascending numerical order: RF0 -> SR[0] RF1 -> SR[1] RF2 -> SR[2] RF3 -> SR[3] This function will return these bits in reverse numerical order(RF3->RF1) to comply with MU_GetRxStatusFlags() of mu driver. See MU_GetRxStatusFlags() from drivers/mu/fsl_mu.h

```
status_reg = MU_GetRxStatusFlags(base);
```

Parameters

- base – MU peripheral base address.

Returns

MU RX status flags in reverse order

status_t MU_TriggerGeneralPurposeInterrupts(MU_Type *base, uint32_t interrupts)

Triggers general purpose interrupts to the other core.

This function triggers the specific general purpose interrupts to the other core. The interrupts to trigger are passed in as bit mask. See mu_general_purpose_interrupt_t. The MU should not trigger an interrupt to the other core when the previous interrupt has not been processed by the other core. This function checks whether the previous interrupts have been processed. If not, it returns an error.

```
status_t status;
status = MU_TriggerGeneralPurposeInterrupts(base, kMU_GeneralPurposeInterrupt0 | kMU_
↪GeneralPurposeInterrupt2);

if (kStatus_Success != status)
{
    Previous general purpose interrupt 0 or general purpose interrupt 2
```

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```
    has not been processed by the other core.
}
```

Parameters

- base – MU peripheral base address.
- interrupts – Bit mask of the interrupts to trigger. See mu_general_purpose_interrupt_t.

Return values

- kStatus_Success – Interrupts have been triggered successfully.
- kStatus_Fail – Previous interrupts have not been accepted.

void MU_BootOtherCore(MU_Type *base, mu_core_boot_mode_t mode)

Boots the other core.

This function boots the other core with a boot configuration.

Parameters

- base – MU peripheral base address.
- mode – The other core boot mode.

void MU_HoldOtherCoreReset(MU_Type *base)

Holds the other core reset.

This function causes the other core to be held in reset following any reset event.

Parameters

- base – MU peripheral base address.

static inline *status_t* MU_ResetBothSides(MU_Type *base)

Resets the MU for both A side and B side.

This function resets the MU for both A side and B side. Before reset, it is recommended to interrupt processor B, because this function may affect the ongoing processor B programs.

If MU1_BUSY_POLL_COUNT is defined and non-zero, the function will timeout after the specified number of polling iterations if waiting for the other side to come out of reset takes too long.

Note: For some platforms, only MU side A could use this function, check reference manual for details.

Parameters

- base – MU peripheral base address.

Return values

- kStatus_Success – The MU was reset successfully.
- kStatus_Timeout – Timeout occurred while waiting for the other side to come out of reset.

Returns

status_t

status_t MU_HardwareResetOtherCore(MU_Type *base, bool waitReset, bool holdReset, mu_core_boot_mode_t bootMode)

Hardware reset the other core.

This function resets the other core, the other core could mask the hardware reset by calling MU_MaskHardwareReset. The hardware reset mask feature is only available for some platforms. This function could be used together with MU_BootOtherCore to control the other core reset workflow.

If MU1_BUSY_POLL_COUNT is defined and non-zero, the function will timeout after the specified number of polling iterations and return kStatus_Timeout if waiting for the other core to enter or exit reset takes too long.

Example 1: Reset the other core, and no hold reset

```
MU_HardwareResetOtherCore(MU_A, true, false, bootMode);
```

In this example, the core at MU side B will reset with the specified boot mode.

Example 2: Reset the other core and hold it, then boot the other core later. Here the other core enters reset, and the reset is hold

```
MU_HardwareResetOtherCore(MU_A, true, true, modeDontCare);
```

Current core boot the other core when necessary.

```
MU_BootOtherCore(MU_A, bootMode);
```

Note: The feature waitReset, holdReset, and bootMode might be not supported for some platforms. waitReset is only available for platforms that FSL_FEATURE_MU_NO_CORE_STATUS not defined as 1 and FSL_FEATURE_MU_HAS_RESET_ASSERT_INT not defined as 0. holdReset is only available for platforms that FSL_FEATURE_MU_HAS_RSTH not defined as 0. bootMode is only available for platforms that FSL_FEATURE_MU_HAS_BOOT not defined as 0.

Parameters

- base – MU peripheral base address.
- waitReset – Wait the other core enters reset. Only work when there is CSSR0[RAIP].
  - true: Wait until the other core enters reset, if the other core has masked the hardware reset, then this function will be blocked.
  - false: Don't wait the reset.
- holdReset – Hold the other core reset or not. Only work when there is CCR0[RSTH].
  - true: Hold the other core in reset, this function returns directly when the other core enters reset.
  - false: Don't hold the other core in reset, this function waits until the other core out of reset.
- bootMode – Boot mode of the other core, if holdReset is true, this parameter is useless.

Return values

- kStatus_Success – The other core was reset successfully.

- kStatus_Timeout – Timeout occurred while waiting for the other core to enter or exit reset.

Returns
status_t

FSL_MU_DRIVER_VERSION
MU driver version.

enum _mu_status_flags
MU status flags.

Values:

enumerator kMU_Tx0EmptyFlag
TX0 empty.

enumerator kMU_Tx1EmptyFlag
TX1 empty.

enumerator kMU_Tx2EmptyFlag
TX2 empty.

enumerator kMU_Tx3EmptyFlag
TX3 empty.

enumerator kMU_Rx0FullFlag
RX0 full.

enumerator kMU_Rx1FullFlag
RX1 full.

enumerator kMU_Rx2FullFlag
RX2 full.

enumerator kMU_Rx3FullFlag
RX3 full.

enumerator kMU_GenInt0Flag
General purpose interrupt 0 pending.

enumerator kMU_GenInt1Flag
General purpose interrupt 1 pending.

enumerator kMU_GenInt2Flag
General purpose interrupt 2 pending.

enumerator kMU_GenInt3Flag
General purpose interrupt 3 pending.

enumerator kMU_RxFullPendingFlag
Any RX full flag is pending.

enumerator kMU_TxEmptyPendingFlag
Any TX empty flag is pending.

enumerator kMU_GenIntPendingFlag
Any general interrupt flag is pending.

enumerator kMU_EventPendingFlag
MU event pending.

enumerator kMU_FlagsUpdatingFlag
MU flags update is on-going.

enumerator kMU_MuInResetFlag
MU of any side is in reset.

enumerator kMU_MuResetInterruptFlag
The other side initializes MU reset.

enum __mu_interrupt_enable
MU interrupt source to enable.

Values:

enumerator kMU_Tx0EmptyInterruptEnable
TX0 empty.

enumerator kMU_Tx1EmptyInterruptEnable
TX1 empty.

enumerator kMU_Tx2EmptyInterruptEnable
TX2 empty.

enumerator kMU_Tx3EmptyInterruptEnable
TX3 empty.

enumerator kMU_Rx0FullInterruptEnable
RX0 full.

enumerator kMU_Rx1FullInterruptEnable
RX1 full.

enumerator kMU_Rx2FullInterruptEnable
RX2 full.

enumerator kMU_Rx3FullInterruptEnable
RX3 full.

enumerator kMU_GenInt0InterruptEnable
General purpose interrupt 0.

enumerator kMU_GenInt1InterruptEnable
General purpose interrupt 1.

enumerator kMU_GenInt2InterruptEnable
General purpose interrupt 2.

enumerator kMU_GenInt3InterruptEnable
General purpose interrupt 3.

enumerator kMU_MuResetInterruptEnable
The other side initializes MU reset.

enum __mu_interrupt_trigger
MU interrupt that could be triggered to the other core.

Values:

enumerator kMU_GenInt0InterruptTrigger
General purpose interrupt 0.

enumerator kMU_GenInt1InterruptTrigger
General purpose interrupt 1.

enumerator kMU_GenInt2InterruptTrigger
General purpose interrupt 2.

enumerator kMU_GenInt3InterruptTrigger
General purpose interrupt 3.

enum _mu_msg_reg_index
MU message register index.

Values:

enumerator kMU_MsgReg0
Message register 0.

enumerator kMU_MsgReg1
Message register 1.

enumerator kMU_MsgReg2
Message register 2.

enumerator kMU_MsgReg3
Message register 3.

enum _mu_general_purpose_interrupt
MU general purpose interrupts.

Values:

enumerator kMU_GeneralPurposeInterrupt0
General purpose interrupt 0

enumerator kMU_GeneralPurposeInterrupt1
General purpose interrupt 1

enumerator kMU_GeneralPurposeInterrupt2
General purpose interrupt 2

enumerator kMU_GeneralPurposeInterrupt3
General purpose interrupt 3

typedef enum *_mu_msg_reg_index* mu_msg_reg_index_t
MU message register index.

typedef enum *_mu_general_purpose_interrupt* mu_general_purpose_interrupt_t
MU general purpose interrupts.

MU_CORE_INTR(intr)

MU_MISC_INTR(intr)

MU_TX_INTR(intr)

MU_RX_INTR(intr)

MU_GI_INTR(intr)

MU_GET_CORE_INTR(intrs)

MU_GET_TX_INTR(intrs)

MU_GET_RX_INTR(intrs)

MU_GET_GI_INTR(intrs)

MU_CORE_FLAG(flag)

MU_STAT_FLAG(flag)

MU_TX_FLAG(flag)

MU_RX_FLAG(flag)

MU_GI_FLAG(flag)

MU_GET_CORE_FLAG(flags)

MU_GET_STAT_FLAG(flags)

MU_GET_TX_FLAG(flags)

MU_GET_RX_FLAG(flags)

MU_GET_GI_FLAG(flags)

MU1_BUSY_POLL_COUNT

Maximum polling iterations for MU waiting loops.

This parameter defines the maximum number of iterations for any polling loop in the MU code before timing out and returning an error.

It applies to all waiting loops in MU driver, such as waiting for TX register to be empty or waiting for RX register to be full.

This is a count of loop iterations, not a time-based value.

If defined as 0, polling loops will continue indefinitely until their exit condition is met, which could potentially cause the system to hang if a core becomes unresponsive.

2.57 NETC driver

Status code for the NETC module.

Values:

enumerator kStatus_NETC_RxFrameEmpty

Rx BD ring empty.

enumerator kStatus_NETC_RxTsrResp

Rx timestamp reference response

enumerator kStatus_NETC_RxFrameError

Rx frame error.

enumerator kStatus_NETC_TxFrameOverLen

Tx frame over length.

enumerator kStatus_NETC_LackOfResource

Lack of resources to configure certain features.

enumerator kStatus_NETC_Unsupported

Unsupported operation/feature.

enumerator kStatus_NETC_RxHRZeroFrame

Rx frame host reason is zero

enumerator kStatus_NETC_RxHRNotZeroFrame

Rx frame host reason is not zero

enumerator kStatus_NETC_NotFound
No entry found in hardware tables

enumerator kStatus_NETC_EntryExists
An entry already exists in hardware tables

enum _netc_ep_event
Defines the common interrupt event for callback use.

Values:

enumerator kNETC_EPRxEvent
EP Rx interrupt event.

enumerator kNETC_EPTxEvent
EP Tx interrupt event.

enum _netc_ep_tx_status
Status for the transmit buffer descriptor.

Values:

enumerator kNETC_EPTxSuccess
Success transmission.

enumerator kNETC_EPTxProgramErr
Error exists in either the Tx BD, the Tx ring registers, or both.

enumerator kNETC_EPTxTsdDrop
The time defined in TX_START expired before frame could be transmitted.

enumerator kNETC_EPTxFrameSizeErr
Frame size error.

enumerator kNETC_EPTxNullAddr
Null address.

enumerator kNETC_EPTxInvalidLength
Invalid frame/buffer/chain length.

enumerator kNETC_EPTxSrcMacSpoofingDetect
Source MAC address spoofing detected.

enumerator kNETC_EPTxPortRestDrop
Frame dropped due to port reset.

enumerator kNETC_EPTxPortDisableDrop
Frame dropped due to port disable.

enumerator kNETC_EPTxVlanTpidDrop
VLAN TPID not allowed.

enumerator kNETC_EPTxSmsoParamErr
Programming error in buffer descriptor used for direct switch enqueue.

enumerator kNETC_EPTxFrameGateErr
Frame too large for time gating window.

enumerator kNETC_EPTxAxiReadErr
AXI read error.

enumerator kNETC_EPTxAxiWriteErr
AXI write error.

enumerator kNETC_EPTxMultiBitECCErr
Frame not transmitted(dropped) due to a multi-bit ECC error detected.

enumerator kNETC_EPTxParityErr
Parity error.

enumerator kNETC_EPTxSwCongestion
Frame dropped due to switch congestion.

enum _netc_vlan_tpid_select
Ethernet VLAN Tag protocol identifier.

Values:

enumerator kNETC_StanCvlan
0x8100.

enumerator kNETC_StanSvlan
0x88A8.

enumerator kNETC_CustomVlan1
CVLANR1[ETYPE]

enumerator kNETC_CustomVlan2
CVLANR2[ETYPE]

enum _netc_packet_type
Ethernet packet type enumerator.

Values:

enumerator kNETC_PacketUnicast

enumerator kNETC_PacketMulticast

enumerator kNETC_PacketBroadcast

enum _netc_host_reason
Host reason.

Values:

enumerator kNETC_RegularFrame

enumerator kNETC_IngressMirror

enumerator kNETC_MACLearning

enumerator kNETC_TimestampResp

enumerator kNETC_SoftwareDefHR0

enumerator kNETC_SoftwareDefHR1

enumerator kNETC_SoftwareDefHR2

enumerator kNETC_SoftwareDefHR3

enumerator kNETC_SoftwareDefHR4

enumerator kNETC_SoftwareDefHR5

enumerator kNETC_SoftwareDefHR6

enumerator kNETC_SoftwareDefHR7

enum _netc_msix_vector_ctrl
MSIX vector control field.

Values:

enumerator kNETC_MsixIntrMaskBit
MSIX vector control interrupt mask bit.

enum _netc_tx_ext_flags
METC Extension Transmit Buffer Descriptor Extension flags field.

Values:

enumerator kNETC_TxExtVlanInsert
Enable VLAN insert.

enumerator kNETC_TxExtTwoStepTs
Enable two-step timestamp offload.

typedef enum *_netc_ep_event* netc_ep_event_t
Defines the common interrupt event for callback use.

typedef enum *_netc_ep_tx_status* netc_ep_tx_status_t
Status for the transmit buffer descriptor.

typedef struct *_netc_vlan* netc_vlan_t
VLAN tag struct.

typedef enum *_netc_vlan_tpid_select* netc_vlan_tpid_select_t
Ethernet VLAN Tag protocol identifier.

typedef enum *_netc_packet_type* netc_packet_type_t
Ethernet packet type enumerator.

typedef enum *_netc_host_reason* netc_host_reason_t
Host reason.

typedef struct *_ep_buffer_struct* netc_buffer_struct_t
Buffer structure. Driver can send/receive one frame spread across multiple buffers.

typedef struct *_ep_frame_struct* netc_frame_struct_t
Frame structure for single Tx/Rx frame.

typedef struct *_netc_frame_attr_struct* netc_frame_attr_t
Frame attribute struct.

typedef struct *_netc_tx_frame_info_struct* netc_tx_frame_info_t
Frame attribute structure.

typedef enum *_netc_msix_vector_ctrl* netc_msix_vector_ctrl_t
MSIX vector control field.

typedef struct *_netc_msix_entry* netc_msix_entry_t
NETC MSIX entry structure.

typedef enum *_netc_tx_ext_flags* netc_tx_ext_flags_t
METC Extension Transmit Buffer Descriptor Extension flags field.

FSL_NETC_DRIVER_VERSION
Driver Version.

NETC_ADDR_LOW_32BIT(x)
Macro to divides an address into a low 32 bits and a possible high 32 bits.

NETC_ADDR_HIGH_32BIT(x)

struct _netc_vlan

#include <fsl_netc.h> VLAN tag struct.

Public Members

uint32_t vid

Vlan Identifier.

uint32_t dei

Drop Eligible indicator.

uint32_t pcp

Priority.

uint32_t tpid

Tag protocol identifier.

struct _ep_buffer_struct

#include <fsl_netc.h> Buffer structure. Driver can send/receive one frame spread across multiple buffers.

Public Members

void *buffer

Buffer address.

uint16_t length

Buffer data length.

struct _ep_frame_struct

#include <fsl_netc.h> Frame structure for single Tx/Rx frame.

Public Members

netc_buffer_struct_t *buffArray

Buffer array. Tx: [in]App sets, Rx: [in/out]App sets prepared array, driver sets back received buffers array.

uint16_t length

Buffer array length. Tx: [in]App sets, Rx: [in/out]App sets prepared array length, driver sets back received buffers array length.

struct _netc_frame_attr_struct

#include <fsl_netc.h> Frame attribute struct.

Public Members

bool isTsAvail

Rx frame timestamp is available or not.

bool isVlanExtracted

Rx frame VLAN header is available or not.

uint32_t timestamp

The timestamp of this Rx frame.

struct __netc_tx_frame_info_struct

#include <fsl_netc.h> Frame attribute structure.

Public Members

bool isTsAvail

Tx frame timestamp is available or not.

uint32_t timestamp

The timestamp of this Tx frame, valid when isTsAvail is true.

bool isTxTsIdAvail

Switch port Tx frame timestamp Identifier is available or not.

uint16_t txtsid

The Transmit Timestamp Identifier, valid when isTsIdAvail is true, use for Switch management ENETC direct frame which has specified a timestamp request.

void *context

Private context provided by the user.

netc_ep_tx_status_t status

Transmit status.

struct __netc_msix_entry

#include <fsl_netc.h> NETC MSIX entry structure.

Public Members

uint64_t msgAddr

Message address.

uint32_t msgData

Message data.

uint32_t control

Vector control, netc_msix_vector_ctrl_t.

2.58 Abbreviation in NETC driver

2.59 API layer

2.60 NETC Endpoint (EP) Driver

2.61 Endpoint (EP) Generic Configuration

typedef struct *_ep_handle* ep__handle_t

Endpoint handle.

typedef *status_t* (*ep__reclaim__cb_t)(*ep_handle_t* *handle, uint8_t ring, *netc_tx_frame_info_t* *frameInfo, void *userData)

Callback for reclaimed tx frames.

typedef void *(*ep_rx_alloc_cb_t)(*ep_handle_t* *handle, uint8_t ring, uint32_t length, void *userData)

Defines the EP Rx memory buffer alloc function pointer.

typedef void (*ep_rx_free_cb_t)(*ep_handle_t* *handle, uint8_t ring, void *address, void *userData)

Defines the EP Rx memory buffer free function pointer.

typedef *status_t* (*ep_get_link_status_cb_t)(*ep_handle_t* *handle, uint8_t *link)

Callback for getting link status.

typedef *status_t* (*ep_get_link_speed_cb_t)(*ep_handle_t* *handle, *netc_hw_mii_speed_t* *speed, *netc_hw_mii_duplex_t* *duplex)

Callback for getting link speed.

typedef *status_t* (*ep_preinit_vsi_cb_t)(*netc_enetc_hw_t* *hw, netc_hw_si_idx_t si)

Callback for vsi pre-init.

typedef struct *_ep_config* ep_config_t

Configuration for the endpoint handle.

typedef struct *_ep_config_const* ep_config_const_t

Configuration constant in handle.

status_t EP_Init(*ep_handle_t* *handle, uint8_t *macAddr, const *ep_config_t* *config, const *netc_bdr_config_t* *bdrConfig)

Initialize the endpoint with specified station interface.

Each station interface needs to call this API. In the case of a virtual station interface it's necessary that the physical station interface has been initialized beforehand.

Parameters

- handle –
- macAddr – Primary MAC address
- config – The user configuration
- bdrConfig – Array of buffer configurations (for each queue/ring)

Returns

status_t

status_t EP_Deinit(*ep_handle_t* *handle)

De-initialize the endpoint.

Parameters

- handle –

Returns

status_t

status_t EP_GetDefaultConfig(*ep_config_t* *config)

Get the default configuration.

Parameters

- config –

Returns

status_t

status_t EP_Up(*ep_handle_t* *handle, *netc_hw_mii_speed_t* speed, *netc_hw_mii_duplex_t* duplex)

Enable MAC transmission/reception To be called when the PHY link is up.

Parameters

- handle –
- speed –
- duplex –

Returns

status_t

status_t EP_Down(*ep_handle_t* *handle)

Disable MAC transmission/reception To be called when the PHY link is down.

Note: Must ensure all active Tx rings finish current transmission before call this API.

Parameters

- handle –

Returns

status_t

status_t EP_SetPrimaryMacAddr(*ep_handle_t* *handle, uint8_t *macAddr)

Set the Primary MAC address.

Parameters

- handle –
- macAddr –

Returns

status_t

static inline void EP_SetPortSpeed(*ep_handle_t* *handle, uint16_t pSpeed)

Set EP port speed.

Parameters

- handle –
- pSpeed –

struct _ep_config

#include <fsl_netc_endpoint.h> Configuration for the endpoint handle.

Public Members

netc_hw_si_idx_t si

Station interface index.

netc_hw_enetc_si_config_t siConfig

Station interface configuration.

uint8_t txPrioToTC[8]

Tx BD ring priority to Tx traffic class queue index mapping, range in TC0 ~ TC7.

netc_port_tx_tc_config_t txTcCfg[8]

Tx traffic class related configuration, vaild only on ENETC 0.

netc_ep_psfp_config_t psfpCfg
PSFP configuration,cover the ISI key construction profile and port ingress stream identification configuration.

bool enOuterAsInner
Enable use outer VLAN tag as the inner tag if only one tag is found.

netc_enetc_native_vlan_config_t rxOuterVLANCfg
Port outer native VLAN config.

netc_enetc_native_vlan_config_t rxInnerVLANCfg
Port inner native VLAN config.

netc_enetc_parser_config_t parserCfg
ENETC parser configuration.

uint32_t pauseOnThr
ENETC Port pause ON threshold value, value 0 means disables pause generation.

uint32_t pauseOffThr
ENETC Port pause OFF threshold value, value 0 means disables pause generation.

netc_msix_entry_t *msixEntry
MSIX table entry array.

uint8_t entryNum
MSIX entry number.

uint8_t cmdBdEntryIdx
MSIX entry index of command BD ring interrupt.

uint8_t siComEntryIdx
MSIX entry index of PSI-VSI communication interrupt.

uint8_t timerSyncEntryIdx
MSIX entry index of timer synchronous state change interrupt.

ep_reclaim_cb_t reclaimCallback
Callback for reclaimed Tx frames.

void *userData
User data, return in callback.

bool rxCacheMaintain
Enable/Disable Rx buffer cache maintain in driver.

bool txCacheMaintain
Enable/Disable Tx buffer cache maintain in driver.

bool rxZeroCopy
Enable/Disable zero-copy receive mode.

ep_rx_alloc_cb_t rxBuffAlloc
Callback function to alloc memory, must be provided for zero-copy Rx.

ep_rx_free_cb_t rxBuffFree
Callback function to free memory, must be provided for zero-copy Rx.

ep_preinit_vsi_cb_t preinitVsi
Callback function to pre-init VSI

netc_cmd_bdr_config_t cmdBdrConfig
Command BD ring configuration.

struct _ep_config_const

#include <fsl_netc_endpoint.h> Configuration constant in handle.

Public Members

netc_hw_si_idx_t si

Station interface index.

uint32_t rxRingUse

Number of Rx Rings to be used, when enable Rx ring group, this equal to the sum of all Rx group rings.

uint32_t txRingUse

Number of Tx Rings to be used, note that when SI is Switch management ENETC SI, the number not include Tx ring 0.

uint32_t rxBdrGroupNum

Rx BD ring group number, range in 0 ~ 2.

uint32_t ringPerBdrGroup

The ring number in every Rx BD ring group, range in 1 ~ 8, active when rxBdrGroupNum not equal zero.

bool rxCacheMaintain

Enable/Disable Rx buffer cache maintain in driver.

bool txCacheMaintain

Enable/Disable Tx buffer cache maintain in driver.

bool rxZeroCopy

Enable/Disable zero-copy receive mode.

uint8_t entryNum

MSIX entry number.

ep_reclaim_cb_t reclaimCallback

Callback for reclaimed Tx frames.

void *userData

User data, return in callback.

ep_rx_alloc_cb_t rxBuffAlloc

Callback function to alloc memory, must be provided for zero-copy Rx.

ep_rx_free_cb_t rxBuffFree

Callback function to free memory, must be provided for zero-copy Rx.

struct _ep_handle

#include <fsl_netc_endpoint.h> Handle for the endpoint Private internal data.

Public Members

netc_enetc_hw_t hw

Hardware register map resource.

netc_enetc_cap_t capability

ENETC capability.

ep_config_const_t cfg

Endpoint configuration constant.

netc_rx_bdr_t rxBdRing[1]
Receive buffer descriptor ring.

netc_tx_bdr_t txBdRing[1]
Transmit buffer descriptor ring.

netc_cmd_bdr_t cmdBdRing
Command BD ring handle for endpoint.

uint8_t unicastHashCount[64]
Unicast hash index collisions counter.

uint8_t multicastHashCount[64]
Multicast hash index collisions counter.

uint8_t vlanHashCount[64]
VLAN hash index collisions counter.

uint8_t macFilterCount[64]
mac address filter index collisions counter.

uint8_t vlanFilterCount[64]
vlan address filter index collisions counter.

ep_get_link_status_cb_t getLinkStatus
Callback to get link status

ep_get_link_speed_cb_t getLinkSpeed
Callback to get link speed

uint16_t vsiBitMapNotifyLinkStatus
VSI bit map for link status notify

uint16_t vsiBitMapNotifyLinkSpeed
VSI bit map for link speed notify

struct port

Public Members

netc_port_ethmac_t ethMac
Ethernet MAC configuration.

netc_port_common_t common
Port common configuration.

bool enableTg
Enable port time gate scheduling.

bool enPseudoMacTxPad
Enable pseudo MAC Port Transmit Padding, will pad the frame to a minimum of 60 bytes and append 4 octets of FCS.

2.62 Endpoint (EP) data path

typedef struct *_netc_ep_ipf_config* netc_ep_ipf_config_t
Port Ingress Filter config.

typedef struct *_netc_ep_psfp_config* netc_ep_psfp_config_t

PSFP config.

struct _netc_ep_ipf_config

#include <fsl_netc_endpoint.h> Port Ingress Filter config.

Public Members

netc_ipf_config_t dosCfg

Configuration for L2/3 DOS.

netc_port_ipf_config_t portConfig

Configuration for port connected to enetc peripheral.

struct _netc_ep_psfp_config

#include <fsl_netc_endpoint.h> PSFP config.

2.63 Endpoint (EP) Interrupt Module

enum _ep_interrupt_flag

Interrupt enable/disable flags.

The value of the enumerator is not necessary match the bit in register. All interrupts in Endpoint are merged into this enum except the BDR specific interrupt. TODO SITMRIER

Values:

enumerator kNETC_EPPSIResetInterruptEnable

enumerator kNETC_EPPSIMsgRxInterruptEnable

typedef enum *_ep_interrupt_flag* ep_interrupt_flag_t

Interrupt enable/disable flags.

The value of the enumerator is not necessary match the bit in register. All interrupts in Endpoint are merged into this enum except the BDR specific interrupt. TODO SITMRIER

static inline void EP_CleanTxIntrFlags(*ep_handle_t* *handle, uint16_t txFrameIntrMask, uint16_t txThresIntrMask)

Clean the SI transmit interrupt flags.

Parameters

- handle – The EP handle.
- txFrameIntrMask – IPV value to be mapped, bit x represents ring x.
- txThresIntrMask – The Rx BD ring index to be mapped, bit x represents ring x.

static inline void EP_CleanRxIntrFlags(*ep_handle_t* *handle, uint32_t rxIntrMask)

Clean the SI receive interrupt flags.

Parameters

- handle – The EP handle.
- rxIntrMask – Rx interrupt bit mask, bit x represents ring x.

status_t EP_MsixSetGlobalMask(*ep_handle_t* *handle, bool mask)

Set the global MSIX mask status.

This function masks/unmasks global MSIX message. Mask - All of the vectors are masked, regardless of their per-entry mask bit states. Unmask - Each entry's mask status determines whether the vector is masked or not.

Parameters

- handle – The EP handle
- mask – The mask state. True: Mask, False: Unmask.

Returns
status_t

status_t EP_MsixSetEntryMask(*ep_handle_t* *handle, uint8_t entryIdx, bool mask)

Set the MSIX entry mask status for specified entry.

This function masks/unmasks MSIX message for specified entry.

Parameters

- handle – The EP handle
- entryIdx – The entry index in the table.
- mask – The mask state. True: Mask, False: Unmask.

Returns
status_t

status_t EP_MsixGetPendingStatus(*ep_handle_t* *handle, uint8_t pbaIdx, uint64_t *status)

Get the MSIX pending status in MSIX PBA table.

This function is to get the entry pending status from MSIX PBA table. If interrupt occurs but masked by vector control of entry, pending bit in PBA will be set.

Parameters

- handle – The EP handle
- pbaIdx – The index of PBA array with 64-bit unit.
- status – Pending status bit mask, bit n for entry n.

Returns
status_t

2.64 Endpoint (EP) Table Management Module

status_t EP_CmdBDRInit(*ep_handle_t* *handle, const *netc_cmd_bdr_config_t* *config)

Initialize endpoint command BD ring.

Parameters

- handle –
- config – The command BD ring configuration

Returns
status_t

status_t EP_CmdBDRDeinit(*ep_handle_t* *handle)

Deinit endpoint command BD ring.

Parameters

- handle –

Returns
status_t

2.65 Endpoint (EP) PSI/VSI

void EP_PsiEnableInterrupt(*ep_handle_t* *handle, uint32_t mask, bool enable)

PSI enables/disables specified interrupt.

Parameters

- handle – The EP handle.
- mask – The interrupt mask, refer to netc_psi_msg_flags_t which should be OR'd together.
- enable – Enable/Disable the interrupt.

uint32_t EP_PsiGetStatus(*ep_handle_t* *handle)

PSI gets interrupt event flag status.

Parameters

- handle – The EP handle.

Returns
The interrupt mask, refer to netc_psi_msg_flags_t which should be OR'd together.

void EP_PsiClearStatus(*ep_handle_t* *handle, uint32_t mask)

PSI clears interrupt event flag.

Parameters

- handle – The EP handle.
- mask – The interrupt mask, refer to netc_psi_msg_flags_t which should be OR'd together.

status_t EP_PsiSendMsg(*ep_handle_t* *handle, uint16_t msg, *netc_vsi_number_t* vsi)

PSI sends message to specified VSI(s)

Parameters

- handle – The EP handle.
- msg – The message to be sent.
- vsi – The VSI number.

Returns
status_t

bool EP_PsiCheckTxBusy(*ep_handle_t* *handle, *netc_vsi_number_t* vsi)

PSI checks Tx busy flag which should be cleaned when VSI receive the message data.

Parameters

- handle – The EP handle.
- vsi – The VSI number.

Returns
The busy status of specified VSI.

status_t EP_PsiSetRxBuffer(*ep_handle_t* *handle, *netc_vsi_number_t* vsi, uint64_t buffAddr)

PSI sets Rx buffer to receive message from specified VSI.

Note: The buffer memory size should be big enough for the message data from VSI

Parameters

- handle – The EP handle.
- vsi – The VSI number.
- buffAddr – The buffer address to store message data from VSI.

status_t EP_PsiGetRxMsg(*ep_handle_t* *handle, *netc_vsi_number_t* vsi, *netc_psi_rx_msg_t* *msgInfo)

PSI gets Rx message from specified VSI.

Parameters

- handle – The EP handle.
- vsi – The VSI number.
- msgInfo – The Rx message information.

void EP_VsiEnableInterrupt(*ep_handle_t* *handle, uint32_t mask, bool enable)

Enable VSI interrupt.

Parameters

- handle – The EP handle.
- mask – The interrupt mask, see netc_vsi_msg_flags_t which should be OR'd together.
- enable – Enable/Disable interrupt.

uint32_t EP_VsiGetStatus(*ep_handle_t* *handle)

Get VSI interrupt status.

Parameters

- handle – The EP handle.

Returns

A bitmask composed of netc_vsi_msg_flags_t enumerators OR'd together.

void EP_VsiClearStatus(*ep_handle_t* *handle, uint32_t mask)

Clear VSI interrupt status.

Parameters

- handle – The EP handle.
- mask – The interrupt mask, see netc_vsi_msg_flags_t which should be OR'd together.

status_t EP_VsiSendMsg(*ep_handle_t* *handle, uint64_t msgAddr, uint32_t msgLen)

VSI sends message to PSI.

Parameters

- handle – The EP handle.
- msgAddr – Address to store message ready to be sent, must be 64 bytes aligned.
- msgLen – The message length, must be 32 bytes aligned.

Returns
status_t

void EP_VsiCheckTxStatus(*ep_handle_t* *handle, *netc_vsi_msg_tx_status_t* *status)

Check VSI Tx status.

Parameters

- handle – The EP handle.
- status – The VSI Tx status structure.

status_t EP_VsiReceiveMsg(*ep_handle_t* *handle, uint16_t *msg)

VSI receives message from PSI.

Parameters

- handle – The EP handle.
- msg – The message from PSI.

Returns
status_t

2.66 Endpoint (EP) Ingress data path configuration

static inline *status_t* EP_RxParserConfig(*ep_handle_t* *handle, *netc_port_parser_config_t* *config)

Configure Parser in Receive Data Path.

Parameters

- handle –
- config –

Returns
status_t

static inline *status_t* EP_RxVlanCInit(*ep_handle_t* *handle, const *netc_vlan_classify_config_t* *config)

Configure the customer vlan type.

Parameters

- handle –
- config –

Returns
status_t

static inline *status_t* EP_RxVlanCConfigPort(*ep_handle_t* *handle, *netc_port_vlan_classify_config_t* *config)

Configure the Accepted Vlan.

Parameters

- handle –
- config –

Returns
status_t

status_t EP_RxIPFInit(*ep_handle_t* *handle, *netc_ep_ipf_config_t* *config)

Enable / Disable Ingress Port Filtering.

Applied for both Switch and ENETC

Parameters

- handle –
- config – IPF general features

Returns
status_t

static inline uint32_t EP_RxIPFGetTableRemainWordNum(*ep_handle_t* *handle)

Get remaining available word number (words size is 6 bytes) of the ingress Port Filter Table.

Note: This is a ternary match table, and the entries can vary in size, from 2 to 14 words.

Parameters

- handle –

Returns
uint32_t

status_t EP_RxIPFAddTableEntry(*ep_handle_t* *handle, *netc_tb_ipf_config_t* *config, uint32_t *entryID)

Add an entry for the ingress Port Filter Table.

This function do an add & query with return hardware id which can be used as future query / delete / update.

Parameters

- handle –
- config – IPF instance configuaration
- entryID – The table entry ID read out

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxIPFUpdateTableEntry(*ep_handle_t* *handle, uint32_t entryID, *netc_tb_ipf_cfge_t* *cfg)

Update entry in the ingress Port Filter Table.

Parameters

- handle –
- entryID –
- cfg –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxIPFDelTableEntry(*ep_handle_t* *handle, uint32_t entryID)

Delete an entry for the ingress Port Filter Table.

Parameters

- handle –
- entryID – The table entry ID

Returns
status_t

status_t EP_RxIPFResetMatchCounter(*ep_handle_t* *handle, uint32_t entryID)

Reset the counter of an ingress port filter entry.

Parameters

- handle –
- entryID – The table entry ID

Returns
status_t

status_t EP_RxIPFGetMatchedCount(*ep_handle_t* *handle, uint32_t entryID, uint64_t *count)

Get the matched count for entry in IPF.

Parameters

- handle –
- entryID – The table entry ID
- count – A count of how many times this entry has been matched.

Returns
status_t

static inline *status_t* EP_RxPSFPInit(*ep_handle_t* *handle, const *netc_ep_psfp_config_t* *config)

Init the ENETC PSFP, inlcude.

Parameters

- handle –
- config –

Returns
status_t

static inline uint32_t EP_RxPSFPGetISITableRemainEntryNum(*ep_handle_t* *handle)

Get remaining available entry number (entry size is 24 bytes) of stream identification table.

Note: This is a Exact Match hash table, and it shares the remaining available entries with Ingress Stream Filter, table.

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddISITableEntry(*ep_handle_t* *handle, *netc_tb_isi_config_t* *config, uint32_t *entryID)

Add an entry into the stream identification table.

Parameters

- handle –
- config –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPDelISITableEntry(*ep_handle_t* *handle, uint32_t entryID)

Delete an entry in the stream identification table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

static inline uint32_t EP_RxPSFPGetISTableRemainEntryNum(*ep_handle_t* *handle)

Get remaining available entry number of ingress stream table.

Note: This is a dynamic bounded index table, the remaining entry can't be zero before add entry into it

---

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddISTableEntry(*ep_handle_t* *handle, *netc_tb_is_config_t* *config)

Add an entry into the ingress stream table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPUpdateISTableEntry(*ep_handle_t* *handle, *netc_tb_is_config_t* *config)

Update an entry in the ingress stream table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPDelISTableEntry(*ep_handle_t* *handle, uint32_t entryID)

Delete an entry in the stream identification table.

Parameters

- handle –
- entryID –

Returns
status_t

static inline uint32_t EP_RxPSFPGetISFTableRemainEntryNum(*ep_handle_t* *handle)

Get remaining available entry number (entry size is 24 bytes) of ingress stream filter table.

Note: This is a Exact Match hash table, and it shares the remaining available entries with Ingress Stream Identification table.

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddISFTableEntry(*ep_handle_t* *handle, *netc_tb_isf_config_t* *config, uint32_t *entryID)

Add an entry into the ingress stream filter table.

Parameters

- handle –
- config –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPUpdateISFTableEntry(*ep_handle_t* *handle, uint32_t entryID, *netc_tb_isf_cfge_t* *cfg)

Update an entry into the ingress stream filter table.

Parameters

- handle –
- entryID –
- cfg –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPDelISFTableEntry(*ep_handle_t* *handle, uint32_t entryID)

Del an entry into the stream filter table.

Parameters

- handle –
- entryID –

Returns
status_t

static inline uint32_t EP_RxPSFPGetRPTableRemainEntryNum(*ep_handle_t* *handle)

Get remaining available entry number of Rate Policer table.

Note: This is a dynamic bounded index table, the remaining entry can't be zero before add entry into it

---

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddRPTableEntry(*ep_handle_t* *handle, *netc_tb_rp_config_t* *config)

Add entry to Rate Policer table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPUpdateRPTableEntry(*ep_handle_t* *handle, *netc_tb_rp_config_t* *config)

Update entry in Rate Policer table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPAddOrUpdateRPTableEntry(*ep_handle_t* *handle, *netc_tb_rp_config_t* *config)

Add or update entry in Rate Policer table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPDelRPTableEntry(*ep_handle_t* *handle, uint32_t entryID)

Delete entry in the Rate Policer table.

Parameters

- handle –
- entryID –

Returns
status_t

status_t EP_RxPSFPGetRPStatistic(*ep_handle_t* *handle, uint32_t entryID, *netc_tb_rp_stse_t* *statis)

Get statistic of specified Rate Policer entry.

Parameters

- handle –
- entryID –
- statis –

Returns
status_t

Returns
See netc_cmd_error_t

static inline uint32_t EP_RxPSFPGetISCTableRemainEntryNum(*ep_handle_t* *handle)

Get remaining available entry number of ingress stream count table.

Note: This is a dynamic bounded index table, the remaining entry can't be zero before add entry into it

---

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddISCTableEntry(*ep_handle_t* *handle, uint32_t entryID)

Add entry in ingress stream count table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPGetISCStatistic(*ep_handle_t* *handle, uint32_t entryID, *netc_tb_isc_stse_t* *statistic)

Get ingress stream count statistic.

Parameters

- handle –
- entryID –
- statistic –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPResetISCStatistic(*ep_handle_t* *handle, uint32_t entryID)

Reset the count of the ingress stream count.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

static inline uint32_t EP_RxPSFPGetSGITableRemainEntryNum(*ep_handle_t* *handle)

Get remaining available entry number of stream gate instance table.

Note: This is a dynamic bounded index table, the remaining entry can't be zero before add entry into it

---

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddSGITableEntry(*ep_handle_t* *handle, *netc_tb_sgi_config_t* *config)

Add entry in stream gate instance table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPUpdateSGITableEntry(*ep_handle_t* *handle, *netc_tb_sgi_config_t* *config)

Update entry in stream gate instance table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPDelSGITableEntry(*ep_handle_t* *handle, uint32_t entryID)

Delete entry in stream gate instance table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPGetSGIState(*ep_handle_t* *handle, uint32_t entryID, *netc_tb_sgi_sgise_t* *state)

Get state of the stream gate instance for specified entry.

Parameters

- handle –
- entryID –
- state –

Returns
status_t

Returns
See netc_cmd_error_t

static inline uint32_t EP_RxPSFPGetSGCLTableRemainWordNum(*ep_handle_t* *handle)

Get remaining available words number of Stream Gate Control List table.

Note: This is a dynamic bounded index table, and number of words required for a stream gate control list is 1+N/2 where N is number of gate time slots in the stream gate control list. The remaining word should be greater than the want added entry size

---

Parameters

- handle –

Returns
uint32_t

status_t EP_RxPSFPAddSGCLTableEntry(*ep_handle_t* *handle, *netc_tb_sgcl_gcl_t* *config)

Add entry into Stream Gate Control List Table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPDelSGCLTableEntry(*ep_handle_t* *handle, uint32_t entryID)

Delete entry of Stream Gate Control List Table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPGetSGCLGateList(*ep_handle_t* *handle, *netc_tb_sgcl_gcl_t* *gcl, uint32_t length)

Get Stream Gate Control List Table entry gate control list.

Parameters

- handle –
- gcl –
- length –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxPSFPGetSGCLState(*ep_handle_t* *handle, uint32_t entryID, *netc_tb_sgcl_sgclse_t* *state)

Get state (ref count) for Stream Gate Control List table entry.

Parameters

- handle –
- entryID –
- state –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxL2MFInit(*ep_handle_t* *handle, *netc_si_l2mf_config_t* *config)

Init the L2 MAC Filter for a specified SI.

Parameters

- handle – EP handle
- config – The L2 MAC Filter configuration

Returns
status_t

status_t EP_RxL2MFAddHashEntry(*ep_handle_t* *handle, *netc_packet_type_t* type, uint8_t *macAddr)

Add entry into the MAC address hash filter with given MAC address Hardware layer will not maitain the counter of the hash filter. API layer shall cover this requirement.

Parameters

- handle – EP handle
- type – Unicast or multicast MAC address
- macAddr – MAC address to be added in filter table

Returns
status_t

status_t EP_RxL2MFDelHashEntry(*ep_handle_t* *handle, *netc_packet_type_t* type, uint8_t *macAddr)

Delete entry into the MAC address hash filter with given MAC address Hardware layer will not maitain the counter of the hash filter. API layer shall cover this requirement.

Parameters

- handle – EP handle
- type – Unicast or multicast MAC address
- macAddr – MAC address to be deleted from filter table

Returns
status_t

status_t EP_RxL2MFAddEMTableEntry(*ep_handle_t* *handle, uint32_t idx, uint8_t *macAddr)

Add entry into the MAC filter exact match table.

The entry is associated to the current Station Interface

Parameters

- handle –
- idx – Index in the entry table
- macAddr – MAC address for filter

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxL2MFDelEMTableEntry(*ep_handle_t* *handle, uint32_t idx)

Delete entry into the MAC filter exact match table.

Parameters

- handle – EP handle
- idx – Index in the entry table

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxL2VFInit(*ep_handle_t* *handle, *netc_si_l2vf_config_t* *config)

For VLAN filter, use inner vlan tag or outer vlan tag.

Parameters

- handle –
- config –

Returns
status_t

status_t EP_RxL2VFAddHashEntry(*ep_handle_t* *handle, uint16_t vlanId)

Add entry into the VLAN hash filter with given MAC address Hardware layer will not maitain the counter of the hash filter. API layer shall cover this requirement.

Parameters

- handle –
- vlanId – VLAN identifier for filter

Returns
status_t

status_t EP_RxL2VFDelHashEntry(*ep_handle_t* *handle, uint16_t vlanId)

Delete entry into the VLAN hash filter with given MAC address Hardware layer will not maitain the counter of the hash filter. API layer shall cover this requirement.

Parameters

- handle –
- vlanId – VLAN identifier for filter

Returns
status_t

status_t EP_RxL2VFAddEMTableEntry(*ep_handle_t* *handle, uint32_t idx, uint16_t vlanId, *netc_vlan_tpid_select_t* tpid)

Add entry into the MAC filter exact match table.

The entry is associated to the current Station Interface

Parameters

- handle –
- idx – Index in the entry table
- vlanId – VLAN identifier
- tpid – VLAN TPID

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_RxL2VFDelEMTableEntry(*ep_handle_t* *handle, uint32_t idx)

Delete entry into the VLAN filter exact match table.

Parameters

- handle –
- idx – Index in the entry table

Returns
status_t

Returns
See netc_cmd_error_t

static inline *status_t* EP_RxMapVlanToIpv(*ep_handle_t* *handle, *netc_vlan_t* vlan, uint8_t ipv)

Set the received Frame vlan to IPV mapping.

Parameters

- handle –
- vlan – Frame VLAN tag.

- ipv – The IPV value to be mapped.

Returns
status_t

static inline *status_t* EP_RxMapIpvToRing(*ep_handle_t* *handle, uint8_t ipv, uint8_t ring)

Set the IPV to Rx ring mapping.

Parameters

- handle –
- ipv – IPV value to be mapped.
- ring – The Rx BD ring index to be mapped.

Returns
status_t

static inline *status_t* EP_RxSetDefaultBDRGroup(*ep_handle_t* *handle, *netc_hw_enetc_si_rxr_group* groupIdx)

Set the default used receive Rx BD ring group.

Note: The IPV mapped ring index is the relative index inside the default used group.

Parameters

- handle –
- groupIdx – The default Rx group index.

Returns
status_t

2.67 Endpoint (EP) Statistic Module

enum _ep_flags

Status/interrupt detect flags merged to same set of enum. TODO SITMRIDR.

Values:

enumerator kNETC_EPTimerSyncedFlag

enumerator kNETC_EPICMBlockedFlag

enumerator kNETC_EPWakeOnLANActiveFlag

typedef enum *_ep_flags* ep_flags_t

Status/interrupt detect flags merged to same set of enum. TODO SITMRIDR.

static inline *status_t* EP_GetPortDiscardStatistic(*ep_handle_t* *handle, bool useTx, *netc_port_discard_statistic_t* *statistic)

Get the ENETC port discard statistic and reason.

Get the discarded count of frames and its reasons.

Parameters

- handle –
- useTx – true - Tx port. false - Rx port.
- statistic – pointer to the statistic data

Returns
status_t

static inline *status_t* EP_ClearPortDiscardReason(*ep_handle_t* *handle, bool useTx, uint32_t reason0, uint32_t reason1)

Clean the EP Port Rx discard reason. Set the related bits to 1 to clear the specific reasons.

Parameters

- handle –
- useTx – true - Tx port. false - Rx port.
- reason0 –
- reason1 –

Returns
status_t

static inline uint32_t EP_GetPortTGSListStatus(*ep_handle_t* *handle)

Get EP port time gate scheduling gate list status.

Parameters

- handle –

Returns
Port status flags which are ORed by the enumerators in the netc_port_tgsl_status_t

2.68 Endpoint (EP) Egress data path configuration

status_t EP_TxTGSConfigAdminGcl(*ep_handle_t* *handle, *netc_tb_tgs_gcl_t* *config)

Config the Time Gate Scheduling entry admin gate control list.

This function is used to program the Enhanced Scheduled Transmisson. (IEEE802.1Qbv)

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_TxPortTGSEnable(*ep_handle_t* *handle, bool enable, uint8_t gateState)

Enable the EP port time gate scheduling.

Parameters

- handle –
- enable –
- gateState –

Returns
status_t

status_t EP_TxtTGSGetOperGcl(*ep_handle_t* *handle, *netc_tb_tgs_gcl_t* *gcl, uint32_t length)

Get Time Gate Scheduling entry operation gate control list.

This function is used to read the Enhanced Scheduled Transmisson. (IEEE802.1Qbv)

Parameters

- handle –
- gcl –
- length –

Returns
status_t

Returns
See netc_cmd_error_t

status_t EP_TxTrafficClassConfig(*ep_handle_t* *handle, *netc_hw_tc_idx_t* tcIdx, const *netc_port_tx_tc_config_t* *config)

Config the TC (traffic class) property.

Parameters

- handle –
- tcIdx –
- config –

Returns
status_t

static inline void EP_TxTcConfigPreemption(*ep_handle_t* *handle, *netc_hw_tc_idx_t* tcIdx, const bool enable)

Config Preemption for each port TC (traffic class)

Parameters

- handle –
- tcIdx –
- enable –

static inline void EP_TxGetTcPreemption(*ep_handle_t* *handle, *netc_hw_tc_idx_t* tcIdx, bool *enabled)

Get Preemption configuration for each port TC (traffic class)

Parameters

- handle –
- tcIdx –
- enabled –

static inline void EP_TxPortEthMacConfigPreemption(*ep_handle_t* *handle, const *netc_port_preemption_config* *config)

Configure Preemption control configuration for an ethernet MAC.

Parameters

- handle –
- config –

static inline void EP_TxPortGetEthMacPreemption(*ep_handle_t* *handle, *netc_port_preemption_config* *config, *netc_port_phy_mac_preemption_status_t* *status)

Get Preemption configuration from ethernet MAC port.

Parameters

- handle –
- config –
- status –

2.69 Endpoint (EP) Transmit/Receive

enum _ep_rx_flags

Values:

enumerator kEP_RX_RSS_VALID

Request timestamp.

enumerator kEP_RX_VLAN_VALID

Specifiy frame departure time.

enumerator kEP_RX_TIMESTAMP_VALID

Enable port masquerading.

enum _ep_tx_opt_flags

Values:

enumerator kEP_TX_OPT_REQ_TS

Request timestamp (IEEE 1588 PTP two-step timestamp).

enumerator kEP_TX_OPT_VLAN_INSERT

Enable VLAN insert.

enumerator kEP_TX_OPT_START_TIME

Specifiy frame departure time.

typedef enum *_ep_rx_flags* ep_rx_flags_t

typedef enum *_ep_tx_opt_flags* ep_tx_opt_flags

typedef struct *_ep_tx_opt* ep_tx_opt

status_t EP_SendFrameCommon(*ep_handle_t* *handle, *netc_tx_bdr_t* *txBdRing, uint8_t hwRing, *netc_frame_struct_t* *frame, void *context, *netc_tx_bd_t* *txDesc, bool txCacheMaintain)

Common part for transfer regular frame or Switch management frame.

Note: This function is internal used. Please use EP_SendFrame() or SWT_SendFrame() API to send frames.

Parameters

- handle –
- txBdRing – The Transmit buffer descriptor ring handle

- hwRing – The hardware Tx ring index
- frame – The frame descriptor pointer
- context – Private context provided back by ep_reclaim_cb_t
- txDesc – Point to the Transmits BD Description array.
- txCacheMaintain – Enable/Disable Tx buffer Cache Maintain.

Return values

status_t –

status_t EP_SendFrame(*ep_handle_t* *handle, uint8_t ring, *netc_frame_struct_t* *frame, void *context, *ep_tx_opt* *opt)

Transmits a frame for specified ring. This API is zero-copy and requires the ep_reclaim_cb_t to be called to free the transmitted frame.

Parameters

- handle –
- ring – The ring index
- frame – The frame descriptor pointer
- context – Private context provided back by ep_reclaim_cb_t
- opt – Additional tx options. If NULL, default is tx timestamping enabled, no start time and no masquerading.

Return values

status_t –

static inline void EP_WaitUnitilTxComplete(*ep_handle_t* *handle, uint8_t ring)

Wait until the EP Tx ring has completed the transfer.

Note: Only call after EP_SendFrame() to do a no-interrupt transfer

---

Parameters

- handle –
- ring – The ring index

netc_tx_frame_info_t *EP_ReclaimTxDescCommon(*ep_handle_t* *handle, *netc_tx_bdr_t* *txBdRing, uint8_t hwRing, bool enCallback)

Common part of Reclaim tx descriptors for regular frame or Switch management frame.

Note: This function is internal used. Please use EP_ReclaimTxDescriptor() or SWT_ReclaimTxDescriptor() API to Reclaim tx descriptors.

Parameters

- handle –
- txBdRing – The Transmit buffer descriptor ring handle
- hwRing – The hardware Tx ring index
- enCallback – Enable/Disable call the Tx Reclaim callback functions.

void EP_ReclaimTxDescriptor(*ep_handle_t* *handle, uint8_t ring)

Reclaim tx descriptors. This function is used to update the tx descriptor status and get the tx timestamp. For each reclaimed transmit frame the ep_reclaim_cb_t is called.

This is called after being notified of a transmit completion from ISR. It runs until there are no more frames to be reclaimed in the BD ring.

Parameters

- handle –
- ring – The ring index

status_t EP_ReceiveFrameCommon(*ep_handle_t* *handle, *netc_rx_bdr_t* *rxBdRing, uint8_t ring, *netc_frame_struct_t* *frame, *netc_frame_attr_t* *attr, bool rxCacheMaintain)

Common part of receives one frame with zero copy from specified ring.

Note: This function is internal used. Please use EP_ReceiveFrame() or SWT_ReceiveFrame() API.

Parameters

- handle –
- rxBdRing – Rx BD ring handle
- ring – Ring index
- frame – Frame buffer point
- attr – Frame attribute pointer
- rxCacheMaintain – Enable/Disable Rx buffer Cache maintain

Returns

status_t

status_t EP_ReceiveFrame(*ep_handle_t* *handle, uint8_t ring, *netc_frame_struct_t* *frame, *netc_frame_attr_t* *attr)

Receives one frame with zero copy from specified ring.

Note: The sufficient rx frame data structure MUST be provided by appliction.

Parameters

- handle –
- ring – The ring index
- frame – The frame descriptor pointer
- attr – Frame attribute pointer

Returns

kStatus_Success Successfully receive a regular frame

Returns

kStatus_NETC_RxHRNotZeroFrame Frame in Rx BD ring is management frame, need call SWT_ReceiveFrame()

Returns
kStatus_NETC_RxTsrResp Frame in Rx BD ring is Transmit Timestamp Reference Response messages, need call SWT_GetTimestampRefResp() to get Transmit Timestamp Reference Response

Returns
kStatus_NETC_RxFrameEmpty Rx BD ring is empty

Returns
kStatus_NETC_RxFrameError Frame in Rx BD ring has error, need be dropped

Returns
kStatus_InvalidArgument Rx BD ring index is out of range

Returns
kStatus_NETC_LackOfResource Appliction provided buffer is not enough

void EP_DropFrame(*ep_handle_t* *handle, *netc_rx_bdr_t* *rxBdRing, uint8_t ring)

Drop one frame.

Note: This function is internal used.

Parameters

- handle –
- rxBdRing – Rx BD ring handle
- ring – Ring index

status_t EP_ReceiveFrameCopyCommon(*ep_handle_t* *handle, *netc_rx_bdr_t* *rxBdRing, uint8_t ring, void *buffer, uint32_t length, *netc_frame_attr_t* *attr, bool rxCacheMaintain)

Common part of receive regular frame or Switch management frame which will be copied in the provided buffer.

Note: This function is internal used. Please use EP_ReceiveFrameCopy() or SWT_ReceiveFrameCopy() API.

Parameters

- handle –
- rxBdRing – Rx BD ring handle
- ring – Ring index
- buffer – Buffer address
- length – Buffer length
- attr – Frame attribute pointer
- rxCacheMaintain – Enable/Disable Rx buffer Cache maintain

Returns
status_t

status_t EP_ReceiveFrameCopy(*ep_handle_t* *handle, uint8_t ring, void *buffer, uint32_t length, *netc_frame_attr_t* *attr)

Receives one frame which will be copied in the provided buffer from specified ring.

Note: The buffer size MUST be queried using EP_GetRxFrameSize() beforehand.

Parameters

- handle –
- ring – Ring index
- buffer – Buffer address
- length – Buffer length
- attr – Frame attribute pointer

Returns
kStatus_Success Successfully receive a regular frame

Returns
kStatus_InvalidArgument Rx BD ring index is out of range

status_t EP_GetRxFrameSizeCommon(*ep_handle_t* *handle, *netc_rx_bdr_t* *rxBdRing, uint32_t *length)

Common part of get pending frame size API for regular frame or Switch management frame.

Note: This function is internal used. Please use EP_GetRxFrameSize() or SWT_GetRxFrameSize() API.

Parameters

- handle –
- rxBdRing – Rx BD ring handle
- length – The length of the valid frame received.

Returns
status_t

status_t EP_GetRxFrameSize(*ep_handle_t* *handle, uint8_t ring, uint32_t *length)

Gets the size of the pending frame in the specified receive ring buffer.

Note: Frame size without FCS

Parameters

- handle – The ENET handler structure. This is the same handler pointer used in the ENET_Init.
- ring – The ring index
- length – The length of the valid frame received.

Returns
kStatus_Success Successfully get the length of a regular frame

Returns
kStatus_NETC_RxHRNotZeroFrame Frame in Rx BD ring is management frame, need call SWT_GetRxFrameSize() to get frame size

Returns
kStatus_NETC_RxTsrResp Frame in Rx BD ring is Transmit Timestamp Reference Response messages, need call SWT_GetTimestampRefResp() to get Transmit Timestamp Reference Response

Returns
kStatus_NETC_RxFrameEmpty Rx BD ring is empty

Returns
kStatus_NETC_RxFrameError Frame in Rx BD ring has error, need be dropped

Returns
kStatus_InvalidArgument Rx BD ring index is out of range

struct __ep__tx__opt

#include <fsl_netc_endpoint.h>

Public Members

uint32_t flags

A bitmask of ep_tx_opt_flags

uint32_t timestamp

Departure timestamp, used if kEP_TX_OPT_START_TIME is set

netc_enetc_vlan_tag_t vlan

VLAN tag which will be inserted, used if kEP_TX_OPT_VLAN_INSERT is set

2.70 Hardware layer

enum __netc__hw__enetc__idx

ENETC index enumerator.

Values:

enumerator kNETC_ENETC0

ENETC hardware 0

enumerator kNETC_ENETC1

ENETC hardware 0

enum __netc__hw__switch__idx

SWITCH index enumerator.

Values:

enumerator kNETC_SWITCH0

SWITCH hardware 0

enum __netc__hw__port__idx

Port Resource for the NETC module.

Values:

enumerator kNETC_ENETC0Port

MAC port for ENETC0

enumerator kNETC_ENETC1Port

Pseudo MAC port for ENETC1

enumerator kNETC_SWITCH0Port0
MAC port0 for SWITCH

enumerator kNETC_SWITCH0Port1
MAC port1 for SWITCH

enumerator kNETC_SWITCH0Port2
MAC port2 for SWITCH

enumerator kNETC_SWITCH0Port3
MAC port3 for SWITCH

enumerator kNETC_SWITCH0Port4
Pseudo port4 for SWITCH

enum _netc_hw_tc_idx
Traffic class enumerator.

Values:

enumerator kNETC_TxTC0
Traffic class 0

enumerator kNETC_TxTC1
Traffic class 1

enumerator kNETC_TxTC2
Traffic class 2

enumerator kNETC_TxTC3
Traffic class 3

enumerator kNETC_TxTC4
Traffic class 4

enumerator kNETC_TxTC5
Traffic class 5

enumerator kNETC_TxTC6
Traffic class 6

enumerator kNETC_TxTC7
Traffic class 7

enum _netc_hw_bdr_idx
Enumeration for the ENETC SI BDR identifier.

Values:

enumerator kNETC_BDR0

enumerator kNETC_BDR1

enumerator kNETC_BDR2

enumerator kNETC_BDR3

enumerator kNETC_BDR4

enumerator kNETC_BDR5

enumerator kNETC_BDR6

enumerator kNETC_BDR7

enumerator kNETC_BDR8

enumerator kNETC_BDR9

enumerator kNETC_BDR10

enumerator kNETC_BDR11

enumerator kNETC_BDR12

enumerator kNETC_BDR13

enum _netc_hw_swt_cbdr_idx

Switch command BD ring index enumerator.

Values:

enumerator kNETC_SWTCBDR0

Switch command BD ring 0

enumerator kNETC_SWTCBDR1

Switch command BD ring 1

enum _netc_hw_classs_queue_idx

Enumerator for ETM class queue identifier.

Values:

enumerator kNETC_ClassQueue0

ETM Class Queue 0

enumerator kNETC_ClassQueue1

ETM Class Queue 1

enumerator kNETC_ClassQueue2

ETM Class Queue 2

enumerator kNETC_ClassQueue3

ETM Class Queue 3

enumerator kNETC_ClassQueue4

ETM Class Queue 4

enumerator kNETC_ClassQueue5

ETM Class Queue 5

enumerator kNETC_ClassQueue6

ETM Class Queue 6

enumerator kNETC_ClassQueue7

ETM Class Queue 7

enum _netc_hw_congestion_group_idx

Enumerator for the ETM congestion group.

Values:

enumerator kNETC_CongGroup0

enumerator kNETC_CongGroup1

enum _netc_hw_mii_mode

Defines the MII/RGMII mode for data interface between the MAC and the PHY.

Values:

enumerator kNETC_XgmiiMode
XGMII mode for data interface.

enumerator kNETC_MiiMode
MII mode for data interface.

enumerator kNETC_GmiiMode
GMII mode for data interface.

enumerator kNETC_RmiiMode
RMII mode for data interface.

enumerator kNETC_RgmiiMode
RGMII mode for data interface.

enumerator kNETC_SgmiiMode
SGMII mode for data interface.

enum _netc_hw_mii_speed
Defines the speed for the *MII data interface.

Values:

enumerator kNETC_MiiSpeed10M
Speed 10 Mbps.

enumerator kNETC_MiiSpeed100M
Speed 100 Mbps.

enumerator kNETC_MiiSpeed1000M
Speed 1000 Mbps.

enumerator kNETC_MiiSpeed2500M
Speed 2500 Mbps.

enumerator kNETC_MiiSpeed5G
Speed 5Gbps.

enumerator kNETC_MiiSpeed10G
Speed 10Gbps Mbps.

enum _netc_hw_mii_duplex
Defines the half or full duplex for the MII data interface.

Values:

enumerator kNETC_MiiHalfDuplex
Half duplex mode.

enumerator kNETC_MiiFullDuplex
Full duplex mode.

typedef enum *_netc_hw_enetc_idx* netc_hw_enetc_idx_t
ENETC index enumerator.

typedef enum *_netc_hw_switch_idx* netc_hw_switch_idx_t
SWITCH index enumerator.

typedef enum *_netc_hw_port_idx* netc_hw_port_idx_t
Port Resource for the NETC module.

typedef enum *_netc_hw_tc_idx* netc_hw_tc_idx_t
Traffic class enumerator.

typedef enum *_netc_hw_bdr_idx* netc_hw_bdr_idx_t
Enumeration for the ENETC SI BDR identifier.

typedef enum *_netc_hw_swt_cbdr_idx* netc_hw_swt_cbdr_idx_t
Switch command BD ring index enumerator.

typedef enum *_netc_hw_classs_queue_idx* netc_hw_etm_class_queue_idx_t
Enumerator for ETM class queue identifier.

typedef enum *_netc_hw_congestion_group_idx* netc_hw_congestion_group_idx_t
Enumerator for the ETM congestion group.

typedef enum *_netc_hw_mii_mode* netc_hw_mii_mode_t
Defines the MII/RGMII mode for data interface between the MAC and the PHY.

typedef enum *_netc_hw_mii_speed* netc_hw_mii_speed_t
Defines the speed for the *MII data interface.

typedef enum *_netc_hw_mii_duplex* netc_hw_mii_duplex_t
Defines the half or full duplex for the MII data interface.

typedef struct *_netc_psfp_kc_profile* netc_isi_kc_rule_t
NETC PSFP kc profile configuration, the key size (not include the spmp and portp) is up to 16 bytes.

typedef struct *_netc_vlan_classify_config* netc_vlan_classify_config_t
NETC Vlan classification config.

typedef struct *_netc_qos_classify_profile* netc_qos_classify_profile_t
NETC Qos Classification profile file (vlan PCP/DEI to IPV/DR map)

typedef struct *_netc_ipf_config* netc_ipf_config_t
NETC Ingress Filter config.

typedef struct *_netc_func* netc_func_t
Register groups for the PCIe function.

typedef struct *_netc_port_hw* netc_port_hw_t
Register groups for the Port/Link hardware.

typedef struct *_netc_enetc_hw* netc_enetc_hw_t
Register group for the ENETC peripheral hardware.

typedef struct *_netc_timer_hw* netc_timer_hw_t
Register group for the Timer peripheral hardware.

typedef struct *_netc_mdio_hw* netc_mdio_hw_t
Register group for both EMDIO and port external MDIO.

getSiInstance(si)
Get SI information from netc_hw_si_idx_t.

The ENETC instance of this SI.

getSiNum(si)
The SI number in the ENETC.

getSiIdx(si)
The actaul index in the netc_hw_si_idx_t.

NETC_MSIX_TABLE_OFFSET
MSIX table address offset.

NETC_MSIX_TABLE_PBA_OFFSET
MSIX PBA address offset.

NETC_NANOSECOND_ONE_SECOND
Nanosecond in one second.

struct __netc_psfp_kc_profile
#include <fsl_netc.h> NETC PSFP kc profile configuration, the key size (not include the spmp and portp) is up to 16 bytes.

Public Members

bool etp
2 Byte Ethertype field present in the key

bool sqtp
1 Byte Sequence Tag present in the key

bool ipcpp
inner VLAN header's PCP field present in the key

bool ividp
inner VLAN ID present in the key

bool opcpp
outer VLAN header's PCP field present in the key

bool ovidp
outer VLAN ID present in the key

bool smacp
6 bytes of source MAC address present in the key

bool dmacp
6 bytes of destination MAC address present in the key

bool spmp
switch port masquerading flag present in the key

bool portp
source port present in the key

bool valid
Key Construction is valid

struct __netc_vlan_classify_config
#include <fsl_netc.h> NETC Vlan classification config.

Public Members

bool enableCustom1
Enable/Disable custom0 ether type

uint16_t custom1EtherType
Ethertype

bool enableCustom2
Enable/Disable custom0 ether type

uint16_t custom2EtherType
Ethertype

uint16_t preStandRTAGType
802.1CB draft 2.0 R-TAG Ethertype value. PSRTAGETR. Only applicable for switch

struct __netc_qos_classify_profile
#include <fsl_netc.h> NETC Qos Classification profile file (vlan PCP/DEI to IPV/DR map)

Public Members

uint8_t ipv[16]
Index is created from PCP (3 bits) + DEI (1 bit) field. Value is the mapped IPV for Qos.

uint8_t dr[16]
Index is created from PCP (3 bits) + DEI (1 bit) field. Value is the mapped DR for QoS.

struct __netc_ipf_config
#include <fsl_netc.h> NETC Ingress Filter config.

Public Members

bool l2DiscardMCSmac
DOSL2CR. Discard received frames with Multicast SMAC address

bool l2DiscardSmacEquDmac
DOSL2CR. Discard received frames with SMAC = DMAC

bool l3DiscardSipEquDip
DOSL3CR. Discard IPV3/IPV6 source address == destination address

struct __netc_func
#include <fsl_netc_hw.h> Register groups for the PCIe function.

struct __netc_port_hw
#include <fsl_netc_hw.h> Register groups for the Port/Link hardware.

Public Members

NETC_PORT_Type *port
Port Address

struct __netc_enetc_hw
#include <fsl_netc_hw.h> Register group for the ENETC peripheral hardware.

Public Members

netc_func_t func
PCIE function register

NETC_ENETC_Type *base
Base register of ENETC module

NETC_SW_ENETC_Type *common
Common register of ENETC module

netc_port_hw_t portGroup
Port register group

ENETC_GLOBAL_Type *global
Global NETC address

ENETC_SI_Type *si
Station Interfce for the P/V SI

netc_msix_entry_t *msixTable
MSIX table address

struct __netc__timer__hw
#include <fsl_netc_hw.h> Register group for the Timer peripheral hardware.

Public Members

ENETC_PCI_TYPE0_Type *func
PCIE function register

ENETC_PF_TMR_Type *base
Base register address for timer module

ENETC_GLOBAL_Type *global
Global NETC register address

netc_msix_entry_t *msixTable
MSIX table address

struct __netc__mdio__hw
#include <fsl_netc_hw.h> Register group for both EMDIO and port external MDIO.

Public Members

___IO uint32_t EMDIO_CFG
External MDIO configuration register, offset: 0x1C00

___IO uint32_t EMDIO_CTL
External MDIO interface control register, offset: 0x1C04

___IO uint32_t EMDIO_DATA
External MDIO interface data register, offset: 0x1C08

___IO uint32_t EMDIO_ADDR
External MDIO register address register, offset: 0x1C0C

___I uint32_t EMDIO_STAT
External MDIO status register, offset: 0x1C10

___IO uint32_t PHY_STATUS_CFG
PHY status configuration register, offset: 0x1C20

___IO uint32_t PHY_STATUS_CTL
PHY status control register, offset: 0x1C24

___I uint32_t PHY_STATUS_DATA
PHY status data register, offset: 0x1C28

___IO uint32_t PHY_STATUS_ADDR
PHY status register address register, offset: 0x1C2C

___IO uint32_t PHY_STATUS_EVENT
PHY status event register, offset: 0x1C30

___IO uint32_t PHY_STATUS_MASK
PHY status mask register, offset: 0x1C34

struct payload

Public Members

uint8_t lbMask
Payload Last Byte Mask

uint8_t fbMask
Payload First Byte Mask

uint8_t byteOffset
Payload Byte Offset where field extraction begins

uint8_t numBytes
Specify the size (numBytes + 1) of the payload key field

uint8_t pfp
Payload field Present

union ___unnamed200___

Public Members

ENETC_PCI_TYPE0_Type *pf
PSI function

ENETC_VF_PCI_TYPE0_Type *vf
VSI function

union ___unnamed202___

Public Members

NETC_ETH_LINK_Type *eth
MAC Port Address

2.71 Hardware Common Functions

static inline uint16_t EP_IncreaseIndex(uint16_t index, uint32_t max)

uint16_t NETC_SIGetVsiIndex(*netc_vsi_number_t* vsi)
Get the VSI index.

Parameters

- vsi – The VSI number.

static inline void NETC_IPFInit(NETC_SW_ENETC_Type *base, const *netc_ipf_config_t* *config)

Set layer2/3 Dos configuration.

Parameters

- base –
- config –

void NETC_PSFPKcProfileInit(NETC_SW_ENETC_Type *base, const *netc_isi_kc_rule_t* *rule, bool enKcPair1)

Initialize the Ingress Stream Identification Key construction rule profiles.

Parameters

- base –
- rule –
- enKcPair1 –

Returns

void

void NETC_RxVlanCInit(NETC_SW_ENETC_Type *base, const *netc_vlan_classify_config_t* *config, bool enRtag)

Initialize the customer vlan type.

Parameters

- base –
- config –
- enRtag –

Returns

void

void NETC_RxQosCInit(NETC_SW_ENETC_Type *base, const *netc_qos_classify_profile_t* *profile, bool enProfile1)

Initialize the ingress QoS classification.

Parameters

- base –
- profile –
- enProfile1 –

2.72 Hardware ENETC

typedef struct *_netc_enetc_vlan_tag_t* netc_enetc_vlan_tag_t

ENETC Port outer/inner VLAN tag.

typedef struct *_netc_enetc_discard_statistic* netc_enetc_port_discard_statistic_t

PORT discard count statistic.

typedef struct *_netc_enetc_native_vlan_config_t* netc_enetc_native_vlan_config_t

ENETC Port outer/inner native VLAN config.

typedef struct *_netc_enetc_parser_config_t* netc_enetc_parser_config_t

ENETC parser configuration.

typedef struct *_netc_enetc_cap* netc_enetc_cap_t

ENETC capability.

static inline bool NETC_EnetcHasManagement(NETC_ENETC_Type *base)

Check whether ENETC has switch management capability.

Parameters

- base – NETC peripheral base address.

Returns

true or false

void NETC_EnetcGetCapability(NETC_ENETC_Type *base, *netc_enetc_cap_t* *capability)

Get ENETC capability.

Parameters

- base – NETC peripheral base address.
- capability – Pointer to capability structure.

void NETC_EnetcSetSIMacAddr(NETC_ENETC_Type *base, uint8_t si, uint8_t *macAddr)

Set MAC address for specified VSI of ENETC.

Parameters

- base –
- macAddr –

status_t NETC_EnetcConfigureSI(NETC_ENETC_Type *base, uint8_t si, const *netc_hw_enetc_si_config_t* *psConfig)

Configure SI.

Parameters

- base – ENETC peripheral base address.
- si – The SI number
- psConfig – The SI configuration

Returns

status_t

status_t NETC_EnetcSetMsixEntryNum(NETC_ENETC_Type *base, uint8_t si, uint32_t msixNum)

Set SI MSIX table entry number.

Parameters

- base – ENETC peripheral base address.
- si – The SI number.
- msixNum – The MSIX table entry number.

Returns

status_t

static inline void NETC_EnetcEnableSI(NETC_ENETC_Type *base, uint8_t si, bool enable)

Enable/Disable specified SI.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- enable – Enable/Disable SI from ENETC layer.

void NETC_EnetcGetPortDiscardStatistic(NETC_ENETC_Type *base, *netc_enetc_port_discard_statistic_t* *statistic)

Get ENETC discard statistic data.

Parameters

- base – ENETC peripheral base address.
- statistic – Statistic data.

void NETC_EnetcEnablePromiscuous(NETC_ENETC_Type *base, uint8_t si, bool enableUCPromis, bool enableMCPromis)

Enable MAC promiscuous mode.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- enableUCPromis – Enable unicast frame promiscuous.
- enableMCPromis – Enable multicast frame promiscuous.

void NETC_EnetcConfigureVlanFilter(NETC_ENETC_Type *base, uint8_t si, *netc_si_l2vf_config_t* *config)

Configure VLAN filter.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- config – Enable untagged VLAN frame promiscuous.

void NETC_EnetcAddMacAddrHash(NETC_ENETC_Type *base, uint8_t si, *netc_packet_type_t* type, uint8_t hashIndex)

Add the hash filter for the MAC address.

Hardware layer will not maitain the counter of the hash filter. API layer shall cover this requirement.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- type – Unicast or multicast frame type.
- hashIndex – The calculated hash index of MAC address.

void NETC_EnetcDelMacAddrHash(NETC_ENETC_Type *base, uint8_t si, *netc_packet_type_t* type, uint8_t hashIndex)

Remove the hash filter for the MAC address.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- type – Unicast or multicast frame type.
- hashIndex – The calculated hash index of MAC address.

void NETC_EnetcAddVlanHash(NETC_ENETC_Type *base, uint8_t si, uint8_t hashIndex)

Add the hash filter for the VLAN.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- hashIndex – The calculated hash index of MAC address.

void NETC_EnetcDelVlanHash(NETC_ENETC_Type *base, uint8_t si, uint8_t hashIndex)

Remove the hash filter for the VLAN.

Parameters

- base – ENETC peripheral base address.
- si – SI index.
- hashIndex – The calculated hash index of MAC address.

static inline *status_t* NETC_EnetcPortEnableTSD(NETC_ENETC_Type *base, *netc_hw_tc_idx_t* tcIdx, bool isEnable)

Enable / Disable ENETC Port Time Specific Departure (TSD) feature.

It can't work with QBV CBS

Parameters

- base –
- tcIdx –
- isEnable –

Returns

status_t

static inline void NETC_EnetcPortSetNativeVLAN(NETC_ENETC_Type *base, const *netc_enetc_native_vlan_config_t* *config, bool isOuter)

Set ENETC Rx native outer/inner VLAN.

It is used for classification when untagged frames are received by the port.

Parameters

- base –
- config –
- isOunter –

static inline void NETC_EnetcSetParser(NETC_ENETC_Type *base, const *netc_enetc_parser_config_t* *config)

Set ENETC Parser configuration.

PARCSCR and PARCE0CR - PARCE3CR.

Parameters

- base –
- config –

static inline void NETC_EnetcEnableWakeOnLan(NETC_ENETC_Type *base, bool isEnable)

Enable / Disable ENETC Wake-on-LAN mode.

Only available on ENETC 0

Parameters

- base –
- isEnable –

Returns
status_t

struct __netc_enetc_vlan_tag_t

#include <fsl_netc.h> ENETC Port outer/inner VLAN tag.

Public Members

uint16_t pcp
Priority code point

uint16_t dei
Drop eligible indicator

uint16_t vid
VLAN identifier

netc_vlan_tpid_select_t tpid
Tag protocol identifier

struct __netc_enetc_discard_statistic

#include <fsl_netc.h> PORT discard count statistic.

Public Members

uint32_t ingressDR[4]
Discard count for port ingress congestion different DR

uint32_t broadcastReject
Broadcast frame drops count due to all SI enable broadcast reject

uint32_t smacPruning
Frames discard count due to port MAC source address pruning

uint32_t unicastMacFilt
Unicast frame discard count due to port MAC filtering

uint32_t multicastMacFilt
Multicast frame discard count due to MAC filtering

uint32_t unicastVlanFilt
Unicast frame discard count due to VLAN filtering

uint32_t multicastVlanFilt
Multicast frame discard count due to VLAN filtering

uint32_t boradcastVlanFilt
Broadcast frame discard count due to VLAN filtering

struct __netc_enetc_native_vlan_config_t

#include <fsl_netc.h> ENETC Port outer/inner native VLAN config.

Public Members

bool enUnderZeroVid
: Enable use the port default VLAN VID when the VID in the packet's is zero

bool enUnderNoVlan
: Enable use the port default VLAN VID when the VLAN tag is not present

netc_enetc_vlan_tag_t vlanTag
: Port native outer/inner VLAN tag, valid when enUnderZeroVid or enUnderNoVlan is true

struct __netc__enetc__parser__config__t
: *#include <fsl_netc.h>* ENETC parser configuration.

Public Members

bool disL3Checksum
: Disable Layer 3 IPv4 Header checksum validation.

bool disL4Checksum
: Disable Layer 4 TCP and UDP checksum validation.

struct __netc__enetc__cap
: *#include <fsl_netc_hw_enetc.h>* ENETC capability.

Public Members

bool funcSafety
: Support for safety capability.

bool wol
: Support for Wake-on-LAN in low-power mode.

bool rss
: Support for RSS.

bool tsd
: Support for time specific departure.

bool rfs
: Support for RFS.

uint32_t ipvNum
: IPV number.

uint32_t vsiNum
: VSI number.

uint32_t msixNum
: MSIX table vector/entry number.

uint32_t tcsNum
: Traffic class number.

uint16_t uchNum
: Unicast hash entry number.

uint16_t mchNum
: Multicast hash entry number.

uint16_t rxBdrNum
: Rx BD ring number.

uint16_t txBdrNum
: Tx BD ring number.

struct custEtype

Public Members

uint16_t etype
: Custom Ethertype value. Upon detecting this ether type the associated code point will be mapped to the parse summary as a Non IP code point.

bool en
: Enables the detection and mapping.

uint8_t cp
: This value is mapped to the parse summary as a Non IP code point.

2.73 Hardware Port

enum _netc_port_tgsl_status
: Port time gate scheduling gate list status.

Values:

enumerator kNETC_OperListActive
: Port operational gate control list is active.

enumerator kNETC_AdminListPending
: Administrative gate control list is pending (configured but not installed yet).

enum _netc_port_discard_tpye
: Port Tx/Rx discard counter in the datapath processing pipeline or bridge forwarding processing function.

Values:

enumerator kNETC_RxDiscard
: Discarded frames in the receive port datapath processing pipeline.

enumerator kNETC_TxDiscard
: Discarded frames in the egress datapath processing pipeline, only for switch.

enumerator kNETC_BridgeDiscard
: Discarded frames in the bridge forwarding processing function, only for switch.

enum _netc_port_tpidlist
: Defines Port TPID acceptance.

Values:

enumerator kNETC_OuterStanCvlan
: Accept outer Standard C-VLAN 0x8100.

enumerator kNETC_OuterStanSvlan
: Accept outer Standard S-VLAN 0x88A8.

enumerator kNETC_OuterCustomVlan1
Accept outer Custom VLAN as defined by CVLANR1[ETYPE].

enumerator kNETC_OuterCustomVlan2
Accept outer Custom VLAN as defined by CVLANR2[ETYPE].

enumerator kNETC_InnerStanCvlan
Accept inner Standard C-VLAN 0x8100.

enumerator kNETC_InnerStanSvlan
Accept inner Standard S-VLAN 0x88A8.

enumerator kNETC_InnerCustomVlan1
Accept inner Custom VLAN as defined by CVLANR1[ETYPE].

enumerator kNETC_InnerCustomVlan2
Accept inner Custom VLAN as defined by CVLANR2[ETYPE].

enum _netc_port_ts_select
Defines port timestamp selection.

Values:

enumerator kNETC_SyncTime
Synchronized time.

enumerator kNETC_FreeRunningTime
Free running time.

enum _netc_hw_preemption_mode
Port MAC preemption mode.

Values:

enumerator kNETC_PreemptDisable
Frame preemption is not enabled

enumerator kNETC_PreemptOn64B
Frame preemption is enabled, but transmit only preempts frames on 64B boundaries

enumerator kNETC_PreemptOn4B
Frame preemption is enabled, but transmit only preempts frames on 4B boundaries

enum _netc_hw_raf_size
Port MAC Remote Additional Fragment Size.

Values:

enumerator kNETC_RafSize64
Additional Fragment Size of 64 octets

enumerator kNETC_RafSize128
Additional Fragment Size of 128 octets

enumerator kNETC_RafSize256
Additional Fragment Size of 256 octets

enumerator kNETC_RafSize512
Additional Fragment Size of 512 octets

enum _netc_tc_sdu_type

Type of PDU/SDU (Protocol/Service Data Unit).

Note: Overhead values which adding to the transmitted frame of Length are specified by Port SDU config as follows:

- PPDU = add rxPpduBco/txPpduBco + rxMacsecBco/txMacsecBco bytes
- MPDU = add rxMacsecBco/txMacsecBco bytes
- MSDU = minus 16B (12B MAC Header + 4B FCS)

Values:

enumerator kNETC_PDU

Physical Layer PDU, Preamble, IFG, SFD along with MPDU. Not supported if cut-through frames are expected

enumerator kNETC_MPDU

MAC PDU, MAC Header, MSDU and FCS

enumerator kNETC_MSDU

MAC SDU, MPDU minus 12B MAC Header and 4B FCS. Not supported if cut-through frames are expected

enum _netc_port_sg_ogc_mode

Defines the Port's Stream Gate Open Gate Check mode.

Values:

enumerator kNETC_SGCheckSFD

Check whether frame SFD is within the open gate interval.

enumerator kNETC_SGCheckEntire

Check whether the entire frame is within the open gate interval.

enum _netc_port_intr_flags

Values:

enumerator kNETC_TxEmptyFlag

Tx FIFO empty flag.

enumerator kNETC_RxEmptyFlag

Rx FIFO empty flag.

enumerator kNETC_TxOverflowFlag

Tx overflow flag.

enumerator kNETC_TxUnderflowFlag

Tx underflow flag.

enumerator kNETC_RxOverflowFlag

Rx overflow flag.

enumerator kNETC_MagicPacketFlag

Magic packet detection indication flag.

enumerator kNETC_TxClkStopFlag

Tx clock stop detection flag.

enumerator kNETC_RxClkStopFlag

Rx clock stop detection flag.

enumerator kNETC_SpeedDuplexChangeFlag
Speed/Duplex Change flag

enumerator kNETC_MacMergeSMDErrFlag
MAC merge frame SMD error received event flag

enumerator kNETC_MacMergeAssemblyErrFlag
MAC merge frame assembly error event flag

enum _netc_port_loopback_mode_t
Defines the port MAC frame loopback mode.

Values:

enumerator kNETC_PortLpbWithExtTxClk
Port MAC frame loopback with external Tx clock.

enumerator kNETC_PortLpbWithIntTxClk
Port MAC frame loopback with internal Tx clock.

typedef enum *_netc_port_tgsl_status* netc_port_tgsl_status_t
Port time gate scheduling gate list status.

typedef enum *_netc_port_discard_tpye* netc_port_discard_tpye_t
Port Tx/Rx discard counter in the datapath processing pipeline or bridge forwarding processing function.

typedef enum *_netc_port_tpidlist* netc_port_tpidlist_t
Defines Port TPID acceptance.

typedef enum *_netc_port_ts_select* netc_port_ts_select_t
Defines port timestamp selection.

typedef struct *_netc_port_qos_mode* netc_port_qos_mode_t
Port Qos mode.

typedef struct *_netc_port_parser_config* netc_port_parser_config_t
Port Parser config.

typedef struct *_netc_port_tg_config* netc_port_tg_config_t
Port time gate config.

typedef struct *_netc_port_tg_preemption_config* netc_port_tg_preemption_config
Port time gate config when used with Frame Preemption.

typedef enum *_netc_hw_preemption_mode* netc_hw_preemption_mode_t
Port MAC preemption mode.

typedef enum *_netc_hw_raf_size* netc_hw_raf_size_t
Port MAC Remote Additional Fragment Size.

typedef struct *_netc_port_preemption_config* netc_port_preemption_config
Frame Preemption Portconfig.

typedef struct *_netc_port_tc_cbs_config* netc_port_tc_cbs_config_t
Configuration for the Credit Based Shaped for port TC.

Note: The 802.1Qav bandwidth availability parameters is is calculated as follows:

- idleSlope (bits) = portTxRate * bwWeight / 100
- sendSlope (bits) = portTxRate * (100 - bwWeight) / 100
- lowCredit (bits) = tcMaxFrameSize * (100 - bwWeight) / 100

- hiCredit (bits) calculation formula depends on the traffic class, Please refer to the Reference manual.
- hiCredit (credits) = (enetClockFrequency / portTxRate) * 100 * hiCredit (bits)

---

typedef enum *_netc_tc_sdu_type* netc_tc_sdu_type_t

Type of PDU/SDU (Protocol/Service Data Unit).

Note: Overhead values which adding to the transmitted frame of Length are specified by Port SDU config as follows:

- PPDU = add rxPpduBco/txPpduBco + rxMacsecBco/txMacsecBco bytes
- MPDU = add rxMacsecBco/txMacsecBco bytes
- MSDU = minus 16B (12B MAC Header + 4B FCS)

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typedef struct *_netc_port_tc_sdu_config* netc_port_tc_sdu_config_t

typedef struct *_netc_port_tx_tc_config* netc_port_tx_tc_config_t

Configuration for the port Tx Traffic Class.

typedef struct *_netc_port_discard_statistic* netc_port_discard_statistic_t

Switch or ENETC port Tx/Rx/Bridge discard statistic / reason.

typedef struct *_netc_port_vlan_classify_config* netc_port_vlan_classify_config_t

Port accepted Vlan classification config.

typedef struct *_netc_port_qos_classify_configs* netc_port_qos_classify_config_t

Port Qos Classification Config.

typedef struct *_netc_port_ipf_config_t* netc_port_ipf_config_t

Port Ingress Filter Config.

typedef struct *_netc_port_psfp_isi_config* netc_port_psfp_isi_config

PSFP port config.

Port ingress stream identification config

Note: The first stream identification find IS_EID has higher precedence value than the second, and the priority of the IS_EID found by the IPF is specified by the IPF entry RRR bit. The possible orderings are as follows

- RRR = 00b : IPF > enKC0 > enKC1 > defaultISEID
- RRR = 01b : enKC0 > IPF > enKC1 > defaultISEID
- RRR = 10b : enKC0 > enKC1 > IPF > defaultISEID

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typedef struct *_netc_port_ethmac* netc_port_ethmac_t

typedef enum *_netc_port_sg_ogc_mode* netc_port_sg_ogc_mode_t

Defines the Port's Stream Gate Open Gate Check mode.

typedef struct *_netc_port_common* netc_port_common_t

Port common configuration.

typedef enum *_netc_port_intr_flags* netc_port_intr_flags_t

typedef enum *_netc_port_loopback_mode_t* netc_port_loopback_mode_t

Defines the port MAC frame loopback mode.

status_t NETC_PortConfig(NETC_PORT_Type *base, const *netc_port_common_t* *config)

Configure specified PORT.

Parameters

- base – NETC port module base address.
- config – Port configuration structure.

Returns

status_t

void NETC_PortSetMacAddr(NETC_PORT_Type *base, const uint8_t *macAddr)

Set the MAC address.

Parameters

- handle –
- macAddr –

bool NETC_PortIsPseudo(NETC_PORT_Type *base)

Check whether this port a pseudo MAC port.

Parameters

- base – PORT peripheral base address.

void NETC_PortGetDiscardStatistic(NETC_PORT_Type *base, *netc_port_discard_tpye_t* discardType, *netc_port_discard_statistic_t* *statistic)

Get specified PORT discard counter.

Parameters

- base – NETC port module base address.
- discardType – Port discard type.
- statistic – pointer to the statistic data

void NETC_PortClearDiscardReason(NETC_PORT_Type *base, *netc_port_discard_tpye_t* discardType, uint32_t reason0, uint32_t reason1)

Clean the Port Rx discard reason. Set the related bits to 1 to clear the specific reasons.

Parameters

- base – NETC port module base address.
- discardType – Port discard type.
- reason0 –
- reason1 –

static inline uint32_t NETC_PortGetTGSListStatus(NETC_PORT_Type *base)

Get port time gate scheduling gate list status.

Parameters

- base – NETC port module base address.

Returns

Port status flags which are ORed by the enumerators in the netc_port_tgsl_status_t

void NETC_PortEthMacGracefulStop(NETC_PORT_Type *base)

Do graceful stop for Port Ethernet MAC receive/transmit.

Parameters

- base – NETC port module base address.

static inline void NETC_PortSetSpeed(NETC_PORT_Type *base, uint16_t pSpeed)

Set port speed.

Parameters

- base – NETC port module base address.
- pSpeed – Transmit Port Speed = 10Mbps * (pSpeed+1), Used by ETS, Qbu and to determine if cut-through is permissable.

NETC_PORT_MIN_FRAME_SIZE

The port supported minimum/maximum frame size.

NETC_PORT_MAX_FRAME_SIZE

struct _netc_port_qos_mode

#include <fsl_netc.h> Port Qos mode.

Public Members

uint8_t qosVlanMap

Transmit QoS to VLAN PCP Mapping Profile index, only active on switch port

uint8_t vlanQosMap

Receive VLAN PCP/DE to QoS Mapping Profile index, only active on switch port

uint8_t defaultIpv

Port default IPV

uint8_t defaultDr

Port default DR

bool enVlanInfo

Enable use VLAN info to determine IPV and DR (base on VLANIPVMPaR0/1 and VLAN-DRMPaR)

bool vlanTagSelect

True: Outer VLAN, False: Innner VLAN. Active when enVlanInfo is true

struct _netc_port_parser_config

#include <fsl_netc.h> Port Parser config.

Public Members

uint8_t l2PloadCount

L2 payload fields size in bytes

bool enableL3Parser

Enable/Disable parser for L3

uint8_t l3PayloadCount

L3 payload fields size in bytes

bool enableL4Parser

Enable/Disable parser for L4

uint8_t l4PayloadCount

L4 payload fields size in bytes

struct _netc_port_tg_config

#include <fsl_netc.h> Port time gate config.

Public Members

uint16_t advOffset

Advance time offset in ns.

uint32_t holdSkew

Hold-Skew in ns, not effective on ports connected to a pseudo-MAC

struct __netc_port_tg_preemption_config

#include <fsl_netc.h> Port time gate config when used with Frame Preemption.

Public Members

uint16_t holdAdvance

the amount of time in ns prior to the Set-And-Hold-MAC time slot for asserting a Hold request. Used with frame Preemption.

uint16_t releaseAdvance

the amount of time in ns prior to the Set-And-Release-MAC time slot for asserting a Release request. Used with Frame Preemption.

struct __netc_port_preemption_config

#include <fsl_netc.h> Frame Preemption Portconfig.

Public Members

bool enMergeVerify

Enable verify the merged preemption frame, need to enable when preemptMode is not zero

uint8_t mergeVerifyTime

The nominal wait time between verification attempts in milliseconds, range in 1 ~ 128

netc_hw_preemption_mode_t preemptMode

When set to not zero, PMAC frames may be preempted by EMAC frames

netc_hw_raf_size_t raf_size

Additional Fragment Size. Indicates the smallest sized fragments that can be sent on Tx

bool PreemptionActive

Local preemption active. Indicates whether preemption is active for this port. This bit will be set if preemption is both enabled and has completed the verification process

struct __netc_port_tc_cbs_config

#include <fsl_netc.h> Configuration for the Credit Based Shaped for port TC.

Note: The 802.1Qav bandwidth availability parameters is is calculated as follows:

- idleSlope (bits) = portTxRate * bwWeight / 100
- sendSlope (bits) = portTxRate * (100 - bwWeight) / 100
- lowCredit (bits) = tcMaxFrameSize * (100 - bwWeight) / 100
- hiCredit (bits) calculation formula depends on the traffic class, Please refer to the Reference manual.
- hiCredit (credits) = (enetClockFrequency / portTxRate) * 100 * hiCredit (bits)

Public Members

uint8_t bwWeight

Percentage units of the port transmit rate and the credit-based shaper (range from 0 ~ 100), the sum of all traffic class credit-based shaper's bandwidth cannot exceed 100

uint32_t hiCredit

The maximum allowed accumulation of credits when conflicting transfers occur, in credit units ((enetClockFrequency / portTxRate) * 100)

struct __netc_port_tc_sdu_config

#include <fsl_netc.h>

Public Members

bool enTxMaxSduCheck

Enable Tx Max SDU check for Store and Forward frames, the frame which greater than maxSduSized wiil be discarded, Cut-Through frames will always perform Max SDU check

netc_tc_sdu_type_t sduType

Specifies the type of PDU/SDU whose length is being validated as seen on the link

uint16_t maxSduSized

Transmit Maximum SDU size in bytes, the dequeued frame will be discarded when it SDU size exceeds this value

struct __netc_port_tx_tc_config

#include <fsl_netc.h> Configuration for the port Tx Traffic Class.

Public Members

bool enPreemption

Frames from traffic class are transmitted on the preemptable MAC, not supported on internal port (ENETC 1 port and Switch port 4)

bool enTcGate

Enable the traffic class gate when no gate control list is operational, or when time gate scheduling is disabled.

bool enableTsd

Enable Time Specific Departure traffic class, only applicable to ENETC

bool enableCbs

Enable Credit based shaper for traffic class

netc_port_tc_cbs_config_t cbsCfg

Configure transmit traffic class credit based shaper (PTC0CBSR0/PTC0CBSR1) if enableCbs set to ture

struct __netc_port_discard_statistic

#include <fsl_netc.h> Switch or ENETC port Tx/Rx/Bridge discard statistic / reason.

Public Members

uint32_t count

Count of discarded frames. PRXDCR, PTXDCR or BPDCR.

uint32_t reason0

Discard Reason. Find bit detail from PT/RXDCRR0 or BPDCRR0.

uint32_t reason1

Discard Reason. Find bit detail from PT/RXDCRR1 or BPDCRR1.

struct __netc__port__vlan__classify__config

#include <fsl_netc.h> Port accepted Vlan classification config.

Public Members

uint8_t innerMask

Bitmap identifying which TPIDs are acceptable as Inner VLAN tag. See PTAR

uint8_t outerMask

Bitmap identifying which TPIDs are acceptable as Outter VLAN tag. See PTAR

struct __netc__port__qos__classify__configs

#include <fsl_netc.h> Port Qos Classification Config.

Public Members

uint8_t vlanQosMap

Receive VLAN PCP/DE to QoS Mapping Profile index

uint8_t defaultIpv

Port default IPV

uint8_t defaultDr

Port default DR

bool enVlanInfo

Enable use VLAN info to determine IPV and DR ,base on VLAN to IPV map (VLANIPVMPaR0/1) and VLAN to DR map (VLANDRMPaR)

bool vlanTagSelect

True: Use received Outer VLAN, False: Use received Innner VLAN. Active when enVlanInfo is true

struct __netc__port__ipf__config__t

#include <fsl_netc.h> Port Ingress Filter Config.

Public Members

bool enL2Dos

Enable port L2 Ethernet DoS Protection

bool enL3Dos

Enable port L3 IP DoS Protection

bool enIPFTable

Enable port IPF lookup

struct __netc__port__psfp__isi__config

#include <fsl_netc.h> PSFP port config.

Port ingress stream identification config

Note: The first stream identification find IS_EID has higher precedence value than the second, and the priority of the IS_EID found by the IPF is specified by the IPF entry RRR bit. The possible orderings are as follows

- RRR = 00b : IPF > enKC0 > enKC1 > defaultISEID
- RRR = 01b : enKC0 > IPF > enKC1 > defaultISEID
- RRR = 10b : enKC0 > enKC1 > IPF > defaultISEID

Public Members

uint16_t defaultISEID

Default Ingress Stream Entry ID, has lower precedence value than ISI entry and IPF entry defined IS_EID. 0xFFFF means NULL

bool enKC1

Enable do the second stream identification with key construction rule 1 or rule 3

bool enKC0

Enable do the first stream identification with key construction rule 0 or rule 2

bool kcPair

Indicates which Key Construction pair to use for this port, false - user pair0. true - use pair1 only applicable for Switch

struct __netc__port__ethmac

#include <fsl_netc.h>

Public Members

bool enableRevMii

Enable RevMII mode.

netc_port_ts_select_t txTsSelect

Tx timestamp clock source.

bool isTsPointPhy

True: Timestamp is captured based on PHY SFD detect pulse on Rx and Tx for 2-step timestamping. False: Based on SFD detect at boundary of MAC merge layer and pins/protocol gaskets.

netc_hw_mii_mode_t miiMode

MII mode.

netc_hw_mii_speed_t miiSpeed

MII Speed.

netc_hw_mii_duplex_t miiDuplex

MII duplex.

bool enTxPad

Enable ETH MAC Tx Padding, which will pad the frame to a minimum of 60 bytes and append 4 octets of FCS.

uint8_t rxMinFrameSize

Receive Minimum Frame Length size in bytes, range in 18 ~ 64, received frames shorter than 18B are discarded silently. Both for express MAC and preemptable MAC.

uint16_t rxMaxFrameSize

Receive Maximum Frame Length size in bytes, up to 2000, received frames that exceed this stated maximum are truncated. Both for express MAC and preemptable MAC.

netc_port_preemption_config PreemptionConfig

Frame Preemption configuration

bool rgmiiClkStop

True: RGMII transmit clock is stoppable during low power idle. False: It's not stoppable.

bool enableHalfDuplexFlowCtrl

Enable/Disable half-duplex flow control.

uint16_t maxBackPressOn

Maximum amount of time backpressure can stay asserted before stopping to prevent excess defer on link partner, in byte times.

uint16_t minBackPressOff

Minimum amount of time backpressure will stay off after reaching the ON max, before backpressure can reassert after checking if icm_pause_notification is still or again asserted, in byte times.

uint32_t txWakeupTimeCycleEEE

Energy Efficient Ethernet feature. Defines the number of NETC cycles (which represents time) required by the PHY to wait before transmitting a new frame after the application has indicated it wants to end the low power state.

uint32_t txSleepTimeCycleEEE

Energy Efficient Ethernet feature. Defines the number of NETC cycles (which represents time) where Tx is idle before mac transmits low power EEE. A value of 0 does not activate low power EEE transmission.

struct __netc__port__common

#include <fsl_netc.h> Port common configuration.

Public Members

netc_port_vlan_classify_config_t acceptTpid

Port acceptable VLAN tpid configure.

netc_port_ts_select_t rxTsSelect

Eth MAC Rx or pseudo MAC Tx timestamp clock source

uint16_t pSpeed

Transmit Port Speed = 10Mbps * (pSpeed+1), Used by ETS, Qbu and to determine if cut-through is permissable

uint8_t rxMacsecBco

Port receive MACSec byte count overhead which due to MACSec encapsulation

uint8_t rxPpduBco

Port receive PPDU Byte count overhead which includes IPG, SFD and Preamble

uint8_t txMacsecBco

Port transmit MACSec byte count overhead which due to MACSec encapsulation

uint8_t txPpduBco

Port transmit PPDU Byte count overhead which includes IPG, SFD and Preamble

netc_port_sg_ogc_mode_t ogcMode

Stream Gate Open Gate Check mode, 0b is check whether SFD is within the open gate interval, 1b is check whether the entire frame is within the open gate interval

uint32_t pDelay

Link propagation delay in ns

uint8_t macAddr[6]

Port MAC address, used for Switch egress frame modification action or ENETC SI0 primary MAC address

netc_port_qos_classify_config_t qosMode

Port Rx Qos Classification config

netc_port_ipf_config_t ipfCfg

Port ingress port filter configuration

netc_port_tg_config_t timeGate

Port Tx time gate config

netc_port_parser_config_t parser

Port Rx Parser config

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enum _netc_port_phy_mac_type

Defines the Ethernet MAC physical port type.

Values:

enumerator kNETC_ExpressMAC

The MAC which handles express traffic when frame preemption is enabled or handles all traffic when frame preemption is disabled.

enumerator kNETC_PreemptableMAC

The MAC which handles preemptive traffic when frame preemption is enabled.

enum _netc_port_preemption_verify_status

Definesthe state of the mac merge sublayer with respect to verification as defined in IEEE Std 802.3br-2016.

Values:

enumerator kNETC_VerifyDisable

Verification is disabled

enumerator kNETC_VerifyInProgress

Verification is in progress

enumerator kNETC_VerifySuccess

Verification was successful

enumerator kNETC_VerifyFaile

Verification failed

enumerator kNETC_VerifyUndefined

Verification is in an undefined state

typedef enum *_netc_port_phy_mac_type* netc_port_phy_mac_type_t

Defines the Ethernet MAC physical port type.

typedef enum *_netc_port_preemption_verify_status* netc_port_preemption_verify_status_t

Definesthe state of the mac merge sublayer with respect to verification as defined in IEEE Std 802.3br-2016.

typedef struct *_netc_port_phy_mac_preemption_status* netc_port_phy_mac_preemption_status_t

Port MAC preemption Status.

typedef struct *_netc_port_phy_mac_traffic_statistic* netc_port_phy_mac_traffic_statistic_t

Ethernet MAC physical port traffic (Tx/Rx) statistics counters, when enable frame preemption, one physical MAC will be divided into a pMAC and a eMAC and statistics counters will also have two groups.

typedef struct *_netc_port_phy_mac_discard_statistic* netc_port_phy_mac_discard_statistic_t

Ethernet MAC physical port frame discard/errors status statistics counters, when enable frame preemption, one physical MAC will be divided into a pMAC and a eMAC and statistics counters will also have two groups.

typedef struct *_netc_port_phy_mac_preemption_statistic* netc_port_phy_mac_preemption_statistic_t

Ethernet physical MAC port preemption (Tx/Rx) related statistics counters.

typedef struct *_netc_port_pseudo_mac_traffic_statistic* netc_port_pseudo_mac_traffic_statistic_t

Ethernet pseudo MAC port traffic (Tx/Rx) statistics counters.

uint32_t NETC_GetPortMacInterruptFlags(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_type_t* macType)

Get port MAC interrupt flags.

Parameters

- base – NETC ETH link base register.
- mac – MAC type.

void NETC_ClearPortMacInterruptFlags(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_type_t* macType, uint32_t mask)

Clear port MAC interrupt flags.

Parameters

- base – NETC ETH link base register.
- mac – MAC type.
- mask – Bit mask of interrupts to enable. See netc_port_intr_flags_t for the set of constants that should be OR'd together to form the bit mask.

void NETC_EnablePortMacInterrupts(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_type_t* macType, uint32_t mask, bool enable)

Enable/Disable port MAC interrupts.

Parameters

- base – NETC ETH link base register.
- mac – MAC type.
- mask – Bit mask of interrupts to enable. See netc_port_intr_flags_t for the set of constants that should be OR'd together to form the bit mask.
- enable – Enable/Disable interrupts.

status_t NETC_PortEnableLoopback(NETC_ETH_LINK_Type *base, *netc_port_loopback_mode_t* loopMode, bool enable)

Enable/Disable Loopback for specified MAC.

Parameters

- base –
- loopMode –
- enable –

Returns
status_t

static inline *netc_hw_mii_mode_t* NETC_PortGetMIIMode(NETC_ETH_LINK_Type *base)

Get ethernet MAC port MII mode.

Parameters

- base – Ethernet MAC port peripheral base address.

Returns
netc_hw_mii_mode_t

status_t NETC_PortSetMII(NETC_ETH_LINK_Type *base, *netc_hw_mii_mode_t* miiMode, *netc_hw_mii_speed_t* speed, *netc_hw_mii_duplex_t* duplex)

Configure ethernet MAC interface mode, speed and duplex for specified PORT.

Parameters

- base – Ethernet MAC port peripheral base address.
- miiMode – The Ethernet MAC MII mode.
- speed – The Ethernet MAC speed.
- duplex – The Ethernet MAC duplex.

Returns
status_t

status_t NETC_PortSetMaxFrameSize(NETC_ETH_LINK_Type *base, uint16_t size)

Set the maximum supported received frame size.

Parameters

- base – Ethernet MAC port peripheral base address.
- size – Maximum frame size to set.

Returns
status_t

status_t NETC_PortConfigEthMac(NETC_ETH_LINK_Type *base, const *netc_port_ethmac_t* *config)

Configure ethernet MAC for specified PORT. Set the MII mode, speed/duplex, reverse mode, etc.

Parameters

- base – Ethernet MAC port peripheral base address.
- config – The Ethernet MAC configuration.

Returns
status_t

static inline void NETC_PortConfigEthMacPreemption(NETC_ETH_LINK_Type *base, const *netc_port_preemption_config* *config)

Configure ethernet MAC for Frame preemption on specified PORT.

Parameters

- base – Ethernet MAC port peripheral base address.

- config – The Ethernet MAC configuration.

Returns
status_t

static inline void NETC_PortSoftwareResetEthMac(NETC_ETH_LINK_Type *base)

Do software reset for Ethernet MAC.

Note: This can reset all statistic counters.

Parameters

- base – PORT MAC peripheral base address.

static inline void NETC_PortGetPhyMacPreemptionStatus(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_preemption_status_t* *status)

Get Ethernet MAC preemption status.

Parameters

- base – PORT MAC peripheral base address.
- status – Point to the buffer which store status.

static inline void NETC_PortGetPhyMacPreemptionControl(NETC_ETH_LINK_Type *base, *netc_port_preemption_config* *config)

Get Ethernet MAC preemption control parameters.

Parameters

- base – PORT MAC peripheral base address.
- config – Pointer to the NETC port preemption configuration.

void NETC_PortGetPhyMacTxStatistic(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_type_t* macType, *netc_port_phy_mac_traffic_statistic_t* *statistic)

Get Ethernet MAC Tx Traffic Statistics .

Parameters

- base – PORT MAC peripheral base address.
- macType – Express MAC or Preemptable MAC.
- status – Point to the buffer which store statistics.

void NETC_PortGetPhyMacRxStatistic(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_type_t* macType, *netc_port_phy_mac_traffic_statistic_t* *statistic)

Get Ethernet MAC Rx Traffic Statistics .

Parameters

- base – PORT MAC peripheral base address.
- macType – Express MAC or Preemptable MAC.
- status – Point to the buffer which store statistics.

void NETC_PortGetPhyMacDiscardStatistic(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_type_t* macType, *netc_port_phy_mac_discard_statistic_t* *statistic)

Get Ethernet MAC Rx/Tx Drops/Errors Statistics .

Parameters

- base – PORT MAC peripheral base address.

- macType – Express MAC or Preemptable MAC.
- status – Point to the buffer which store statistics.

void NETC_PortGetPhyMacPreemptionStatistic(NETC_ETH_LINK_Type *base, *netc_port_phy_mac_preemption_statistic_t* *statistic)

Get Ethernet Preemptable MAC preemption Statistics .

Parameters

- base – PORT MAC peripheral base address.
- status – Point to the buffer which store statistics.

status_t NETC_PortConfigTxIpgPreamble(NETC_ETH_LINK_Type *base, uint8_t preambleCnt, uint8_t ipgLen)

Configure the port MAC flexible preamble and IPG length.

Parameters

- base – PORT MAC peripheral base address.
- preambleCnt – Flexible Preamble Count. Valid values are 1 to 7(default).
- ipgLen – Transmit inter-packet gap value. Valid values are 4 to 24(default) with 12 being default.

Returns

status_t

struct __netc_port_phy_mac_preemption_status

#include <fsl_netc.h> Port MAC preemption Status.

Public Members

bool mergeActive

Transmit preemption is active or not

netc_port_preemption_verify_status_t verifyStatus

Transmit preemption is active or not

struct __netc_port_phy_mac_traffic_statistic

#include <fsl_netc.h> Ethernet MAC physical port traffic (Tx/Rx) statistics counters, when enable frame preemption, one physical MAC will be divided into a pMAC and a eMAC and statistics counters will also have two groups.

Public Members

uint64_t totalOctet

Count of MAC received/transmitted good/error Ethernet octets.

uint64_t validOctet

Count of MAC received/transmitted good Ethernet octets.

uint64_t pauseFrame

Count of MAC received/transmitted valid PAUSE frames.

uint64_t validFrame

Count of MAC received/transmitted valid frames.

uint64_t vlanFrame

Count of MAC received/transmitted valid VLAN tagged frames.

uint64_t unicastFrame

Count of MAC received/transmitted valid unicast frames.

uint64_t multicastFrame

Count of MAC received/transmitted valid multicast frames.

uint64_t boradcastFrame

Count of MAC received/transmitted valid broadcast frames.

uint64_t totalPacket

Count of MAC received/transmitted good/error packets.

uint64_t rxMinPacket

Count of MAC received min to 63-octet packets.

uint64_t total64BPacket

Count of MAC received/transmitted 64 octet packets.

uint64_t total65To127BPacket

Count of MAC received/transmitted 65 to 127 octet packets.

uint64_t total128To255BPacket

Count of MAC received/transmitted 128 to 255 octet packets.

uint64_t total256To511BPacket

Count of MAC received/transmitted 256 to 511 octet packets.

uint64_t total511To1023BPacket

Count of MAC received/transmitted 512 to 1023 octet packets.

uint64_t total1024To1522BPacket

Count of MAC received/transmitted 1024 to 1522 octet packets.

uint64_t total1523ToMaxBPacket

Count of MAC received/transmitted 1523 to Max octet packets.

uint64_t controlPacket

Count of MAC received/transmitted control packets.

struct __netc__port__phy__mac__discard__statistic

#include <fsl_netc.h> Ethernet MAC physical port frame discard/errors status statistics counters, when enable frame preemption, one physical MAC will be divided into a pMAC and a eMAC and statistics counters will also have two groups.

Public Members

uint64_t rxError

Count of MAC received error frames.

uint64_t rxUndersized

Count of MAC received undersized frames.

uint64_t rxOversized

Count of MAC received oversized frames.

uint64_t rxErrorFCS

Count of MAC received check sequence (FCS) error frames.

uint64_t rxFragment

Count of MAC frames which is shorter than the MIN length and received with a wrong FCS/CRC.

uint64_t rxJabber

Count of MAC frames which is larger than the MAX length and received with a wrong FCS/CRC.

uint64_t rxDiscard

Count of MAC drops frame.

uint64_t rxDiscardNoTruncated

Count of MAC non-truncated drops frame.

uint64_t txErrorFCS

Count of MAC transmitted bad FCS frames.

uint64_t txUndersized

Count of MAC transmitted less than 64B with good FCS frames.

struct __netc__port__phy__mac__preemption__statistic

#include <fsl_netc.h> Ethernet physical MAC port preemption (Tx/Rx) related statistics counters.

Public Members

uint32_t rxReassembledFrame

Count of MAC frames that were successfully reassembled and delivered to the MAC.

uint32_t rxReassembledError

Count of MAC frames with reassembly errors.

uint32_t rxMPacket

Count of the number of additional mPackets received due to preemption.

uint32_t rxSMDError

Count of received MAC frames / MAC frame fragments rejected due to unknown SMD.

uint32_t txPreemptionReq

Count of the number of tx preemption HOLD requests.

uint32_t txMPacket

Count of the number of additional mPackets transmitted due to preemption.

struct __netc__port__pseudo__mac__traffic__statistic

#include <fsl_netc.h> Ethernet pseudo MAC port traffic (Tx/Rx) statistics counters.

Public Members

uint64_t totalOctet

Count of MAC received/transmitted octets.

uint64_t unicastFrame

Count of MAC received/transmitted unicast frames.

uint64_t multicastFrame

Count of MAC received/transmitted multicast frames.

uint64_t boradcastFrame

Count of MAC received/transmitted broadcast frames .

2.75 Hardware Port Rx

static inline void NETC_PortSetParser(NETC_PORT_Type *base, const *netc_port_parser_config_t* *config)

Set port Parser.

Parameters

- base – PORT peripheral base address.
- config – The port Parser configuration.

static inline void NETC_PortSetVlanClassify(NETC_PORT_Type *base, const *netc_port_vlan_classify_config_t* *config)

Set port acceptable VLAN.

Parameters

- base – PORT peripheral base address.
- config – The port acceptable vlan classification configuration.

static inline *status_t* NETC_PortSetQosClassify(NETC_PORT_Type *base, const *netc_port_qos_classify_config_t* *config)

Set port Qos Classification.

Parameters

- base – PORT peripheral base address.
- config – The port QoS classification configuration.

Returns

status_t

static inline void NETC_PortSetIPF(NETC_PORT_Type *base, const *netc_port_ipf_config_t* *config)

Set port ingress filter.

Parameters

- base – PORT peripheral base address.
- config – The port ingress filter configuration.

static inline void NETC_PortSetISI(NETC_PORT_Type *base, const *netc_port_psfp_isi_config* *config)

Set port Ingress stream identification.

Parameters

- base – PORT peripheral base address.
- config – The port Ingress stream identification configuration.

2.76 Hardware Port Tx

static inline *status_t* NETC_PortConfigTGS(NETC_PORT_Type *base, const *netc_port_tg_config_t* *config)

Configure the port time gating Scheduling.

Parameters

- base –

- config –

Returns
status_t

status_t NETC_PortConfigTcCBS(NETC_PORT_Type *base, *netc_hw_tc_idx_t* tcIdx, const *netc_port_tc_cbs_config_t* *config)

Config the Credit-Based Shaper (CBS) for specified Port Traffic Class.

Parameters

- base –
- tcIdx –
- config –

Returns
status_t

static inline *status_t* NETC_PortConfigTcMaxSDU(NETC_PORT_Type *base, *netc_hw_tc_idx_t* tcIdx, const *netc_port_tc_sdu_config_t* *config)

Config the max Transmit max SDU for specified Port Traffic Class.

Parameters

- base –
- tcIdx –
- config –

Returns
status_t

static inline *status_t* NETC_PortGetTcMaxSDU(NETC_PORT_Type *base, *netc_hw_tc_idx_t* tcIdx, *netc_port_tc_sdu_config_t* *config)

Read the max Transmit max SDU for specified Port Traffic Class.

Parameters

- base –
- tcIdx –
- config –

Returns
status_t

static inline void NETC_PortConfigTcPreemption(NETC_PORT_Type *base, *netc_hw_tc_idx_t* tcIdx, const bool enable)

Config Frame Preemption for specified Port Traffic Class.

Parameters

- base – NETC PORT base peripheral address
- tcIdx – traffic class index
- enable – enable/disable feature on traffic class

static inline void NETC_PortGetTcPreemption(NETC_PORT_Type *base, *netc_hw_tc_idx_t* tcIdx, bool *enabled)

Get Frame Preemption configuration for specified Port Traffic Class.

Parameters

- base – NETC PORT base peripheral address

- tcIdx – traffic class index
- enabled – port tx traffic class enabled flag

static inline void NETC_PortGetTGSFPConfig(NETC_PORT_Type *base, *netc_port_tg_preemption_config* *config)

Get the port time gating Scheduling configuration specifc for when used with Frame Preemption.

Parameters

- base – NETC PORT base peripheral address
- config –

2.77 Hardware Station Interface(SI)

NETC_SI_TXDESCRIP_RD_FL(n)

Defines for read format.

NETC_SI_TXDESCRIP_RD_TSE_MASK

NETC_SI_TXDESCRIP_RD_TXSTART(n)

NETC_SI_TXDESCRIP_RD_DR(n)

NETC_SI_TXDESCRIP_RD_IPV(n)

NETC_SI_TXDESCRIP_RD_PORT(n)

NETC_SI_TXDESCRIP_RD_TSR_MASK

NETC_SI_TXDESCRIP_RD_SMSO_MASK

NETC_SI_TXDESCRIP_RD_FLQ(n)

enum _netc_hw_enetc_si_vlan_type

VLAN Ethertypes.

Values:

enumerator kNETC_ENETC_StanCVlan

Standard C-VLAN 0x8100.

enumerator kNETC_ENETC_StanSVlan

Standard S-VLAN 0x88A8.

enumerator kNETC_ENETC_CustomVlan1

Custom VLAN as defined by CVLANR1[ETYPE].

enumerator kNETC_ENETC_CustomVlan2

Custom VLAN as defined by CVLANR2[ETYPE].

enum _netc_hw_enetc_si_rxr_group

SI receive BD ring group index.

Values:

enumerator kNETC_SiBDRGroupOne

SI Rx BD ring group index one.

enumerator kNETC_SiBDRGroupTwo

SI Rx BD ring group index two.

enum _netc_tx_bdr_flags

Status/Interrupts flags for the TX BDR. Each flag get its own bit thus it support bit AND/OR operation.

Values:

enumerator kNETC_TxBDRSystemBusErrorFlag

enumerator kNETC_TxBDRBusyFlag

enumerator kNETC_TxBDRStatusFlagsMask

enum _netc_rx_bdr_flags

Status/Interrupts flags for the RX BDR. Each flag get its own bit thus it support bit AND/OR operation.

Values:

enumerator kNETC_RxBDRSystemBusErrorFlag

enumerator kNETC_RxBDREmptyFlag

enum _netc_psi_msg_flags_t

PSI message interrupt type.

Values:

enumerator kNETC_PsiRxMsgFromVsi1Flag

Message receive interrupt enable, initiated by VSI1.

enumerator kNETC_PsiRxMsgFromVsi2Flag

Message receive interrupt enable, initiated by VSI2.

enumerator kNETC_PsiFLRFromVsi1Flag

Function level reset interrupt enable, initiated by VSI1.

enum _netc_vsi_msg_flags

VSI message interrupt flags.

Values:

enumerator kNETC_VsiMsgTxFlag

Message sent to PSI has completed and response received.

enumerator kNETC_VsiMsgRxFlag

Message received from PSI.

enum _netc_vsi_number

VSI number bit map, VSI1 starts from bit1.

Values:

enumerator kNETC_Vsi1

enumerator kNETC_Vsi2

enum _enetc_si_bdr_priority

ENETC Station Interface BD Ring priority enumeration.

Values:

enumerator kNETC_SIBdrPriorityLowest

enumerator kNETC_SIBdrPriority0

enumerator kNETC_SIBdrPriority1

enumerator kNETC_SIBdrPriority2

enumerator kNETC_SIBdrPriority3

enumerator kNETC_SIBdrPriority4

enumerator kNETC_SIBdrPriority5

enumerator kNETC_SIBdrPriority6

enumerator kNETC_SIBdrPriority7

enumerator kNETC_SIBdrPriorityHighest

typedef enum *_netc_hw_enetc_si_vlan_type* netc_hw_enetc_si_vlan_type
VLAN Ethertypes.

typedef enum *_netc_hw_enetc_si_rxr_group* netc_hw_enetc_si_rxr_group
SI receive BD ring group index.

typedef struct *_netc_hw_enetc_si_config* netc_hw_enetc_si_config_t
Station Interface configuration.

typedef struct *_netc_si_l2mf_config* netc_si_l2mf_config_t
L2 Mac Filter Configuration for SI.

typedef struct *_netc_si_l2vf_config* netc_si_l2vf_config_t
L2 VLAN Filter Configuration for SI.

typedef struct *_netc_si_discard_statistic* netc_si_discard_statistic_t
SI frame drop statistic struct.

typedef struct *_netc_si_traffic_statistic* netc_si_traffic_statistic_t
SI traffic statistic struct.

typedef struct *_netc_si_config* netc_si_config_t
SI Configuration.

typedef union *_netc_tx_bd* netc_tx_bd_t
Transmit Buffer Descriptor format.

A union type cover the BD used as Standard/Extended/WriteBack format.

typedef union *_netc_rx_bd* netc_rx_bd_t
Receive Buffer Descriptor format.

typedef struct *_netc_tx_bdr_config* netc_tx_bdr_config_t
Configuration for the SI Tx Buffer Descriptor Ring Configuration.

typedef struct *_netc_tx_bdr* netc_tx_bdr_t
Transmit BD ring handler data structure.

typedef enum *_netc_tx_bdr_flags* netc_tx_bdr_flags_t
Status/Interrupts flags for the TX BDR. Each flag get its own bit thus it support bit AND/OR operation.

typedef struct *_netc_rx_bdr_config* netc_rx_bdr_config_t
Configuration for the SI Rx Buffer Descriptor Ring Configuration.

typedef struct *_netc_rx_bdr* netc_rx_bdr_t
Receive BD ring handler data structure.

typedef enum *_netc_rx_bdr_flags* netc_rx_bdr_flags_t

Status/Interrupts flags for the RX BDR. Each flag get its own bit thus it support bit AND/OR operation.

typedef struct *_netc_bdr_config* netc_bdr_config_t

Configuration for the buffer descriptors ring.

typedef enum *_netc_psi_msg_flags_t* netc_psi_msg_flags_t

PSI message interrupt type.

typedef enum *_netc_vsi_msg_flags* netc_vsi_msg_flags_t

VSI message interrupt flags.

typedef enum *_netc_vsi_number* netc_vsi_number_t

VSI number bit map, VSI1 starts from bit1.

typedef struct *_netc_psi_rx_msg* netc_psi_rx_msg_t

PSI receive message information.

typedef struct *_netc_vsi_msg_tx_status* netc_vsi_msg_tx_status_t

VSI message transmit status.

typedef enum *_enetc_si_bdr_priority* enetc_si_bdr_priority_t

ENETC Station Interface BD Ring priority enumeration.

static inline void NETC_ClearTxDescriptor(*netc_tx_bd_t* *txDesc)

static inline void NETC_CopyTxDescriptor(*netc_tx_bd_t* *txDescDst, *netc_tx_bd_t* *txDescSrc)

static inline void NETC_SIEnable(ENETC_SI_Type *base, bool enable)

Enable the Station Interface(SI)

Parameters

- base –

static inline void NETC_SIRxRingEnable(ENETC_SI_Type *base, uint8_t ring, bool enable)

Enable the specified Rx BD ring.

Parameters

- base –
- ring – The ring index.
- base – Enable/Disable the ring.

static inline void NETC_SIEnablePromisc(ENETC_SI_Type *base, *netc_packet_type_t* type, bool enable)

Enable/Disable unicast/multicast/boardcast promisc mode for specified SI.

Parameters

- base –
- type –
- enable –

static inline void NETC_SISetTxProducer(ENETC_SI_Type *base, uint8_t ring, uint16_t producer)

Set producer index of specified Tx BD ring.

Parameters

- base – SI base address.
- ring – BD ring index.

- producer – The producer index of specified ring.

static inline uint16_t NETC_SIGetTxConsumer(ENETC_SI_Type *base, uint8_t ring)

Get consumer index of specified Tx BD ring.

Parameters

- base – SI base address.
- ring – BD ring index.

Returns

consumer The consumer index of specified ring.

static inline void NETC_SISetRxConsumer(ENETC_SI_Type *base, uint8_t ring, uint16_t consumer)

Set consumer index of specified Rx BD ring.

Parameters

- base – SI base address.
- ring – BD ring index.
- consumer – The consumer index of specified ring.

static inline uint16_t NETC_SIGetRxProducer(ENETC_SI_Type *base, uint8_t ring)

Get producer index of specified Rx BD ring.

Parameters

- base – SI base address.
- ring – BD ring index.

Returns

producer The producer index of specified ring.

status_t NETC_SIConfigTxBDR(ENETC_SI_Type *base, uint8_t ring, const *netc_tx_bdr_config_t* *bdrConfig)

Configure the Transmit Buffer Descriptor Ring for specified SI.

Parameters

- base – SI base address.
- ring – BD ring index.
- bdrConfig – The BD ring configuration.

Returns

status_t

status_t NETC_SIConfigRxBDR(ENETC_SI_Type *base, uint8_t ring, const *netc_rx_bdr_config_t* *bdrConfig)

Configure the Rx Buffer Descriptor Ring for specified SI.

Parameters

- base – SI base address.
- ring – BD ring index.
- bdrConfig – The BD ring configuration.

Returns

status_t

static inline void NETC_SIMapVlanToIpv(ENETC_SI_Type *base, uint8_t pcpDei, uint8_t ipv)

Enable the mapping of VLAN to IPV.

Parameters

- base – SI base address.
- pcpDei – The VLAN tag pcp dei value (use NETC_VLAN_PCP_DEI_VALUE macro).
- ipv – The IPV value for this VLAN mapping.

static inline void NETC_SIEnableVlanToIpv(ENETC_SI_Type *base, bool enable)

Enable the mapping of VLAN to IPV.

Parameters

- base – SI base address.
- enable – Whether enable mapping.

Returns

status_t

static inline void NETC_SIMapIpvToRing(ENETC_SI_Type *base, uint8_t ipv, uint8_t ring)

Set the IPV to ring mapping.

Parameters

- base – SI base address.
- ipv – IPV value to be mapped.
- ring – The Rx BD ring index to be mapped.

Returns

status_t

static inline void NETC_SISetRxBDRGroup(ENETC_SI_Type *base, uint8_t groupNum, uint8_t ringPerGroup)

Set the group of Rx BD ring.

Parameters

- base – SI base address.
- groupNum – Total group number.
- ringPerGroup – Rings per group.

Returns

status_t

static inline void NETC_SISetDefaultRxBDRGroup(ENETC_SI_Type *base, *netc_hw_enetc_si_rxr_group* groupIdx)

Set the default used receive Rx BD ring group.

Note: The IPV mapped ring index is the relative index inside the default used group.

Parameters

- base – SI base address.
- groupNum – The default Rx group index.

Returns

status_t

static inline void NETC_SICleanTxIntrFlags(ENETC_SI_Type *base, uint16_t txFrameIntrMask, uint16_t txThresIntrMask)

Clean the SI transmit interrupt flags.

Parameters

- base – SI base address.
- txFrameIntrMask – IPV value to be mapped, bit x represents ring x.
- txThresIntrMask – The Rx BD ring index to be mapped, bit x represents ring x.

static inline void NETC_SICleanRxIntrFlags(ENETC_SI_Type *base, uint32_t rxIntrMask)

Clean the SI receive interrupt flags.

Parameters

- base – SI base address.
- rxIntrMask – Rx interrupt bit mask, bit x represents ring x.

void NETC_SIPsiEnableInterrupt(ENETC_SI_Type *base, uint32_t mask, bool enable)

PSI enables/disables specified interrupt.

Parameters

- base – SI base address.
- mask – The interrupt mask, refer to netc_psi_msg_flags_t which should be OR'd together.
- enable – Enable/Disable the interrupt.

static inline uint32_t NETC_SIPsiGetStatus(ENETC_SI_Type *base)

PSI gets interrupt event flag status.

Parameters

- base – SI base address.

Returns

The interrupt mask, refer to netc_psi_msg_flags_t which should be OR'd together.

static inline void NETC_SIPsiClearStatus(ENETC_SI_Type *base, uint32_t mask)

PSI clears interrupt event flag.

Parameters

- base – SI base address.
- mask – The interrupt mask, refer to netc_psi_msg_flags_t which should be OR'd together.

status_t NETC_SIPsiSendMsg(ENETC_SI_Type *base, uint16_t msg, *netc_vsi_number_t* vsi)

PSI sends message to specified VSI(s)

Parameters

- base – SI base address.
- msg – The message to be sent.
- vsi – The VSI number.

Returns

status_t

static inline bool NETC_SIPsiCheckTxBusy(ENETC_SI_Type *base, *netc_vsi_number_t* vsi)

PSI checks Tx busy flag which should be cleaned when VSI receive the message data.

Parameters

- base – SI base address.
- vsi – The VSI number.

Returns

The busy status of specified VSI.

status_t NETC_SIPsiSetRxBuffer(ENETC_SI_Type *base, *netc_vsi_number_t* vsi, uint64_t buffAddr)

PSI sets Rx buffer to receive message from specified VSI.

Note: The buffer memory size should be big enough for the message data from VSI

Parameters

- base – SI base address.
- vsi – The VSI number.
- buffAddr – The buffer address to store message data from VSI, must be 64 bytes aligned.

Returns

status_t

status_t NETC_SIPsiGetRxMsg(ENETC_SI_Type *base, *netc_vsi_number_t* vsi, *netc_psi_rx_msg_t* *msgInfo)

PSI gets Rx message from specified VSI.

Parameters

- base – SI base address.
- vsi – The VSI number.
- msgInfo – The Rx message information.

void NETC_SIVsiEnableInterrupt(ENETC_SI_Type *base, uint32_t mask, bool enable)

Enable VSI interrupt.

Parameters

- base – SI base address.
- mask – The interrupt mask, see netc_vsi_msg_flags_t which should be OR'd together.
- enable – Enable/Disable interrupt.

static inline uint32_t NETC_SIVsiGetStatus(ENETC_SI_Type *base)

Get VSI interrupt status.

Parameters

- base – SI base address.

Returns

A bitmask composed of netc_vsi_msg_flags_t enumerators OR'd together.

static inline void NETC_SIVsiClearStatus(ENETC_SI_Type *base, uint32_t mask)

Clear VSI interrupt status.

Parameters

- base – SI base address.
- mask – The interrupt mask, see netc_vsi_msg_flags_t which should be OR'd together.

status_t NETC_SIVsiSendMsg(ENETC_SI_Type *base, uint64_t msgAddr, uint32_t msgLen)

VSI sends message to PSI.

Parameters

- base – SI base address.
- msgAddr – Address to store message ready to be sent, must be 64 bytes aligned.
- msgLen – The message length, must be 32 bytes aligned.

Returns

status_t

void NETC_SIVsiCheckTxStatus(ENETC_SI_Type *base, *netc_vsi_msg_tx_status_t* *status)

Check VSI Tx status.

Parameters

- base – SI base address.
- status – The VSI Tx status structure.

status_t NETC_SIVsiReceiveMsg(ENETC_SI_Type *base, uint16_t *msg)

VSI receives message from PSI.

Parameters

- base – SI base address.
- msg – The message from PSI.

Returns

status_t

void NETC_SIGetDiscardStatistic(ENETC_SI_Type *base, *netc_si_discard_statistic_t* *statistic)

Get the discard statistic from SI layer.

Parameters

- base – SI base address.
- statistic – The statistic data.

void NETC_SIGetTrafficStatistic(ENETC_SI_Type *base, *netc_si_traffic_statistic_t* *statistic)

Get the traffic statistic from SI layer.

Parameters

- base – SI base address.
- statistic – The statistic data.

NETC_VLAN_PCP_DEI_VALUE(pcp, dei)

Macro to cover VLAN PCP, DEI value to internal used pcpDei value.

struct _netc_hw_enetc_si_config

#include <fsl_netc.h> Station Interface configuration.

Public Members

uint32_t bandWeight

Station interface traffic class bandwidth weight

uint32_t vlanCtrl

VLAN Ethertypes can be inserted by the SI driver, set with OR of netc_hw_enetc_si_vlan_type.

uint32_t antiSpoofEnable

Anti-spoofing enable

uint32_t vlanInsertEnable

Software SI-based VLAN Insertion enable, avtive when enSIBaseVlan is true

uint32_t vlanExtractEnable

SI-based VLAN removed from frame enable, avtive when enSIBaseVlan is true

uint32_t sourcePruneEnable

Source pruning enable

uint32_t rxRingUse

Number of Rx Rings to be used, when enable Rx ring group, this equal to the sum of all Rx group rings.

uint32_t txRingUse

Number of Tx Rings to be used, note that when SI is Switch management ENETC SI, the number not include Tx ring 0.

uint32_t valnToIpvEnable

Enable the VLAN PCP/DEI value (use NETC_VLAN_PCP_DEI_VALUE marco) to internal priority value mapping.

uint32_t rxBdrGroupNum

Rx BD ring group number, range in 0 ~ 2.

uint32_t ringPerBdrGroup

The ring number in every Rx BD ring group, range in 1 ~ 8, active when rxBdrGroupNum not equal zero.

netc_hw_enetc_si_rxr_group defaultRxBdrGroup

The selected Rx BD ring group, active when rxBdrGroupNum not equal zero.

uint8_t vlanToIpvMap[16]

Frame VLAN pcp|dei to IPV mapping, active when valnToIpvEnable is true.

uint8_t ipvToRingMap[8]

BD ring used within the default Rx BD ring group for IPV n, active when rxBdrGroupNum not equal zero.

uint8_t vsiTcToTC[8]

Maps the VSI traffic class to transmit traffic class, done after the ENETC txPrio to TC mapping, only available for VSI.

bool enSIBaseVlan

Enable use SI-based VLAN information.

netc_enetc_vlan_tag_t siBaseVlan

SI-based VLAN information, active when enSIBaseVlan is true.

struct __netc__si__l2mf__config

#include <fsl_netc.h> L2 Mac Filter Configuration for SI.

Public Members

bool macUCPromis
: Enable/Disable MAC unicast promiscuous.

bool macMCPromis
: Enable/Disable MAC multicast promiscuous.

bool rejectUC
: Reject Unicast.

bool rejectMC
: Reject Multicast.

bool rejectBC
: Reject Broadcast.

struct __netc_si_l2vf_config
: *#include <fsl_netc.h>* L2 VLAN Filter Configuration for SI.

Public Members

bool acceptUntagged
: Accept/Reject untagged frame.

bool enPromis
: Enable/Disable VLAN promiscuous.

bool useOuterVlanTag
: Use outer/inner VLAN tag for filtering.

struct __netc_si_discard_statistic
: *#include <fsl_netc.h>* SI frame drop statistic struct.

Public Members

uint32_t programError
: Due to programming error (non-existing BD ring or non-existing group, or SI disabled or BD ring disabled).

uint32_t busError
: Due to system bus error.

uint32_t lackBD[14]
: Due to lack of Rx BDs available.

struct __netc_si_traffic_statistic
: *#include <fsl_netc.h>* SI traffic statistic struct.

struct __netc_si_config
: *#include <fsl_netc.h>* SI Configuration.

Public Members

uint32_t tcBWWeight
: SI traffic class bandwidth weight.

union __netc_tx_bd
: *#include <fsl_netc.h>* Transmit Buffer Descriptor format.

A union type cover the BD used as Standard/Extended/WriteBack format.

Public Members

struct *_netc_tx_bd* standard

struct *_netc_tx_bd* ext

struct *_netc_tx_bd* writeback

uint64_t dword[2]

union __netc__rx__bd

#include <fsl_netc.h> Receive Buffer Descriptor format.

Public Members

struct *_netc_rx_bd* standard

struct *_netc_rx_bd* writeback

struct *_netc_rx_bd* ext

struct *_netc_rx_bd* resp

struct __netc__tx__bdr__config

#include <fsl_netc.h> Configuration for the SI Tx Buffer Descriptor Ring Configuration.

Public Members

uint32_t len

Size of BD ring which shall be multiple of 8 BD.

netc_tx_bd_t *bdArray

BDR base address which shall be 128 bytes aligned.

netc_tx_frame_info_t *dirtyArray

Tx cleanup ring.

bool enIntr

Enable/Disable completion interrupt.

bool enThresIntr

Enable/Disable threshold interrupt.

bool enCoalIntr

Enable/Disable interrupt coalescing.

uint32_t intrThreshold

Interrupt coalescing packet threshold.

uint32_t intrTimerThres

Interrupt coalescing timer threshold, specified in NETC clock cycles.

uint8_t msixEntryIdx

MSIX entry index of Tx ring interrupt.

bool isVlanInsert

Enable/Disable VLAN insert offload.

bool isUserCRC

Enable/Disable user provided the CRC32 - FCS at end of frame.

uint8_t wrrWeight
: Weight used for arbitration when rings have same priority.

uint8_t priority
: Priority of the Tx BDR.

struct __netc_tx_bdr
: *#include <fsl_netc.h>* Transmit BD ring handler data structure.

Public Members

netc_tx_bd_t *bdBase
: Tx BDR base address.

netc_tx_frame_info_t *dirtyBase
: Tx cleanup ring base address.

uint16_t producerIndex
: Current index for transmit.

uint16_t cleanIndex
: Current index for tx cleaning.

uint32_t len
: Length of this BD ring.

struct __netc_rx_bdr_config
: *#include <fsl_netc.h>* Configuration for the SI Rx Buffer Descriptor Ring Configuration.

Public Members

bool extendDescEn
: False - Use 16Bytes standard BD. True - Use 32Bytes extended BD.

netc_rx_bd_t *bdArray
: BD ring base address which shall be 128 bytes aligned.

uint32_t len
: BD ring length in the unit of 16Bytes standard BD. Shall be multiple of 8/16 for standard/exteneded BD.

uint64_t *buffAddrArray
: Rx buffers array with BD length(half of BD length if use exteneded BD).

uint16_t buffSize
: Size of all Rx buffers in this BD ring.

bool enThresIntr
: Enable/Disable threshold interrupt.

bool enCoalIntr
: Enable/Disable interrupt coalescing.

uint32_t intrThreshold
: Interrupt coalescing packet threshold.

uint32_t intrTimerThres
: Interrupt coalescing timer threshold, specified in NETC clock cycles.

uint8_t msixEntryIdx
: MSIX entry index of Rx ring interrupt.

bool disVlanPresent
: Disable/Enable VLAN in BD.

bool enVlanExtract
: Enable/Disable VLAN extract.

bool isKeepCRC
: Whether user provided the CRC32 - FCS at end of frame.

bool congestionMode
: False - lossy. True - lossless.

bool enHeaderAlign
: Enable/disable +2B alignment to frame.

struct __netc__rx__bdr
: *#include <fsl_netc.h>* Receive BD ring handler data structure.

Public Members

netc_rx_bd_t *bdBase
: Rx BDR base address.

bool extendDesc
: Use extended buffer descriptor.

uint16_t index
: Current index for read.

uint32_t len
: Length of this BD ring, unit of 16Bytes standard BD.

uint64_t *buffArray
: Rx buffers array of this ring.

uint32_t buffSize
: Rx buffers size for all BDs in this ring.

struct __netc__bdr__config
: *#include <fsl_netc.h>* Configuration for the buffer descriptors ring.

Public Members

netc_rx_bdr_config_t *rxBdrConfig
: Receive buffer ring configuration array.

netc_tx_bdr_config_t *txBdrConfig
: Transmit buffer ring configuration array.

struct __netc__psi__rx__msg
: *#include <fsl_netc.h>* PSI receive message information.

Public Members

uint8_t *msgBuff
: The buffer address application set before receiving message.

uint32_t msgLen
: Received message length.

struct __netc_vsi_msg_tx_status
: *#include <fsl_netc.h>* VSI message transmit status.

Public Members

bool txBusy
: The VSI Tx busy flag, become idle when the PSI receive and clear the related status.

bool isTxErr
: Tx error flag.

uint16_t msgCode
: The error code or user-defined content.

struct standard

Public Members

uint64_t addr
: Address of the buffer. Little Endian.

uint16_t bufLen
: Length of buffer specifying effective number of bytes.

uint16_t frameLen
: Length of Frame.

uint32_t flags
: Flags qualified setting.

uint32_t enableInterrupt
: Whether enable interrupt on complete of BD.

uint32_t isExtended
: Extended BD format flag.

uint32_t isFinal
: Final BD flag.

struct ext

Public Members

uint32_t timestamp
: IEEE1588 PTP one-step timestamp.

uint32_t ___pad0___
: Ignore 2-bit MSB.

uint16_t tpid
: VLAN TPID type, see netc_vlan_tpid_select_t.

uint16_t vid
: VLAN ID.

uint16_t dei
: VLAN DEI.

uint16_t pcp
: VLAN PCP.

uint8_t eFlags
: Tx extension flags.

uint8_t isFinal
: Final BD flag.

struct writeback

Public Members

uint32_t timestamp
: Timestamp write back.

uint32_t ___pad0___
: / Transmit timestamp identifier, only active on Switch management ENETC.

uint32_t status
: Status.

uint32_t written
: Write-back flag.

struct standard

Public Members

uint64_t addr
: Software write address.

struct writeback

Public Members

uint16_t internetChecksum
: Internet Checksum.

uint16_t parserSummary
: Parser Summary.

uint16_t bufLen
: Length of received buffer.

uint16_t vid
: VLAN ID.

uint16_t dei
: VLAN DEI.

uint16_t pcp
: VLAN PCP.

uint8_t tpid
: VLAN TPID.

uint8_t hr
: Host Reason.

uint8_t flags
: Rx information flags.

uint8_t error
: Rx error code.

uint8_t isReady
: Received data ready flag.

uint8_t isFinal
: Final BD flag.

union ___unnamed194___

Public Members

struct __netc_rx_bd

uint32_t rssHashSwt
: RSS hash while not used as switch management port.

struct ___unnamed196___

Public Members

uint32_t srcPort
: Source port received from switch management port.

uint32_t rssHash
: RSS Hash high field value.

struct ext

Public Members

uint32_t timestamp
: Rx Timestamp.

struct resp

Public Members

uint32_t timestamp
: Switch response timestamp.

uint16_t txtsid
: Transmit timestamp identifier.

uint32_t hr
: Host Reason.

uint32_t error
Error status code.

uint32_t isReady
Received data ready flag.

uint32_t isFinal
Final BD flag.

2.78 Hardware Switch

enum _netc_swt_port_bitmap
The switch port bitmap.

Values:

enumerator kNETC_SWTPort0Bit
Switch port0 bitmap

enumerator kNETC_SWTPort1Bit
Switch port1 bitmap

enumerator kNETC_SWTPort2Bit
Switch port2 bitmap

enumerator kNETC_SWTPort3Bit
Switch port3 bitmap

enumerator kNETC_SWTPort4Bit
Switch port4 (internal port) bitmap

enum _netc_swt_imr_dest_port
The switch ingress mirror destination port.

Values:

enumerator kNETC_SWTPort0
Switch port0

enumerator kNETC_SWTPort1
Switch port1

enumerator kNETC_SWTPort2
Switch port2

enumerator kNETC_SWTPort3
Switch port3

enumerator kNETC_SWTPort4
Switch port4

enumerator kNETC_SWTMPort
Switch management port

enum _netc_swt_mac_forward_mode
The switch MAC forwarding options.

Values:

enumerator kNETC_NoFDBLookUp
No FDB lookup is performed, the frame is flooded.

enumerator kNETC_FDBLookUpWithFlood

FDB lookup is performed, and if there is no match, the frame is flooded to the port bitmap in VLAN filter entry.

enumerator kNETC_FDBLookUpWithDiscard

FDB lookup is performed, and if there is no match, the frame is discarded.

enum _netc_swt_mac_learn_mode

The switch MAC learning options.

Values:

enumerator kNETC_DisableMACLearn

Disable MAC learning. SMAC FDB lookup is by-passed.

enumerator kNETC_HardwareMACLearn

Hardware MAC learning is enabled.

enumerator kNETC_SeSoftwareMACLearn

Software MAC learning secure. FDB lookup based on FID and SMAC is performed and if an entry is not found, the frame is redirected to the switch management port.

enumerator kNETC_UnseSoftwareMACLearn

Software MAC learning unsecure. FDB lookup based on FID and SMAC is performed and if an entry is not found, the frame is copied to the switch management port.

enumerator kNETC_DisableMACLearnWithSMAC

Disable MAC learning with SMAC validation. FDB lookup based on FID and SMAC is performed and if an entry is not found, the frame is discarded.

enum _netc_swt_port_tx_vlan_act

Switch transmit Bridge Port VLAN Tag Action.

Values:

enumerator kNETC_NoTxVlanModify

No egress VLAN modification performed

enumerator kNETC_TxDelOuterVlan

Delete outer VLAN tag

enumerator kNETC_TxReplOuterVlanVid

Replace outer VLAN tag's VID with 0; frame to be transmitted as a priority tag frame

enum _netc_swt_port_stg_mode

Switch port spanning tree group work mode.

Values:

enumerator kNETC_DiscardFrame

Tx or RX Frames on this port with current spanning tree group ID will be discarded

enumerator kNETC_LearnWithoutFowrad

RX Frames on this port with current spanning tree group ID will do Learn SMAC, but do not forward, Tx Frame will be discarded

enumerator kNETC_ForwardFrame

RX Frames on this port with current spanning tree group ID will do both MAC learning and forwarding, , Tx Frame will be forwarded.

typedef enum *_netc_swt_port_bitmap* netc_swt_port_bitmap_t

The switch port bitmap.

typedef enum *_netc_swt_imr_dest_port* netc_swt_imr_dest_port_t
The switch ingress mirror destination port.

typedef enum *_netc_swt_mac_forward_mode* netc_swt_mac_forward_mode_t
The switch MAC forwarding options.

typedef enum *_netc_swt_mac_learn_mode* netc_swt_mac_learn_mode_t
The switch MAC learning options.

typedef enum *_netc_swt_port_tx_vlan_act* netc_swt_port_tx_vlan_act_t
Switch transmit Bridge Port VLAN Tag Action.

typedef enum *_netc_swt_port_stg_mode* netc_swt_port_stg_mode_t
Switch port spanning tree group work mode.

typedef struct *_etc_swt_imr_config* netc_swt_imr_config_t
Switch Ingress mirror destination config.

typedef struct *_netc_swt_port_config* netc_swt_port_bridge_config_t
Switch port bridge configuration.

typedef struct *_netc_swt_port_fm_config* netc_swt_port_fm_config_t
Switch Port level Frame Modification configuration (PPCPDEIMR and PQOSMR[QVMP])

typedef struct *_netc_swt_default_vlan_filter* netc_swt_default_vlan_filter_t
Switch VLAN filter hash table default entry configuration, which determines the default entry when not found in VLAN filter lookup.

typedef struct *_netc_swt_bridge_config* netc_swt_bridge_config_t
Bridge config.

typedef struct *_netc_swt_psfp_config* netc_swt_psfp_config_t
Switch PSFP configuration.

typedef struct *_netc_qos_classify_config* netc_swt_qos_classify_config_t
Switch Qos Classification configuration (include two profiles)

typedef struct *_netc_swt_qos_to_vlan_config* netc_swt_qos_to_vlan_config_t
Switch QoS to PCP mapping and PCP to PCP mapping configuration when egress packet modification the VLAN tag.

typedef struct *_netc_switch_inuse_fdb_statistic* netc_switch_inuse_fdb_statistic_t
Switch static/dynamic FDB entries in-use statistic.

typedef struct *_netc_swt_port_sr_config* netc_swt_port_sr_config_t
Port seamless redundancy configuration.

struct __etc_swt_imr_config
#include <fsl_netc.h> Switch Ingress mirror destination config.

Public Members

bool enMirror
Enable ingress mirroring

netc_swt_imr_dest_port_t destPort
Port where ingress mirrored frames are sent

uint8_t dr
Mirrored packet's DR (drop resilience)

uint8_t ipv
: Mirrored packet's IPV (internal priority value)

uint8_t efmLengthChange
: Egress Frame Modification Frame Length change in 2s complement notation, Vaild if efmEntryID is noy null

uint16_t efmEntryID
: Egress Frame Modification Entry Id, note 0xFFFF is a Null Frame Modification Entry, Only applicable if destPort != kNETC_SWTMPort

struct __netc_swt_port_config
: *#include <fsl_netc.h>* Switch port bridge configuration.

Public Members

netc_swt_port_tx_vlan_act_t txVlanAction
: Only applies for the frame outer VLAN tag's VID is equal to the port default VID

bool isRxVlanAware
: Receive VLAN Aware Mode

bool acceptUntag
: Accept untagged frame

bool acceptPriorityTag
: Accept priority tagged frame (VID = 0)

bool acceptSingleTag
: Accept single tagged frame

bool acceptDoubleTag
: Accept double tagged frame (ounter and inner)

bool enSrcPortPrun
: Enable/Disable received frame be transmitted to same port it was received

bool enMacStationMove
: Enable/Disable received frame which ingress port not match the FDB entry Destination Port Bitmap

bool enBcastStormCtrl
: Enable/Disable Storm control for broadcast frames

bool enMcastStormCtrl
: Enable/Disable Storm control for multicast frames

bool enUnMcastStormCtrl
: Enable/Disable Storm control for unknown multicast frames

bool enUnUcastStormCtrl
: Enable/Disable Storm control for unknown unicast frames

uint32_t bcastRpEntryID
: Broadcast rate policer entry ID. Valid if enBroadStormCtrl = true

uint32_t mcastEntryID
: Known multicast rate policer entry ID. Valid if enBroadStormCtrl = true

uint32_t unMcastRpEntryID
: Unknown multicast policer entry ID. Valid if enUnMultiStormCtrl = true

uint32_t unUcastRpEntryID

Unknown unicast rate policer entry ID. Valid if enUnUniStormCtrl = true

uint16_t maxDynaFDBEntry

The maximium number of dynamic entries in the FDB table, 0 means no limit

struct __netc_swt_port_fm_config

#include <fsl_netc.h> Switch Port level Frame Modification configuration (PPCPDEIMR and PQOSMR[QVMP])

Public Members

bool ignoreFMMiscfg

Enable/Disable ignore the Frame Modification Misconfiguration Action

bool enEgressPcpMap

Enable egress frame modification of outer VLAN tag's PCP value is mapped to a new value based on egressPcpMap, used for Frame Modification VLAN Outer PCP action

bool enIngressPcpMap

Enable ingress frame modification of outer VLAN tag's PCP value is mapped to a new value based on egressPcpMap, used for Frame Modification VLAN Outer PCP action

bool enUpdateVlanDei

Enable update DR value in the outer VLAN based on DEnDEI field, used for egress Frame Modification Outer DEI action

uint8_t drToDeiMap

Mapping of internal QoS's DR value n to VLAN DEI, The 4 bits correspond to the DR3 ~ DR0, and 1 means DRn mapping to DEI 1, 0 means DRn mapping to DEI 0

uint8_t egressPcpMap

Egress PCP to PCP Mapping Profile instance, active when enEgressPcpMap is true

uint8_t ingressPcpMap

Ingress PCP to PCP Mapping Profile instance, active when enIngressPcpMap is true

uint8_t qosVlanMap

Transmit QoS to VLAN PCP Mapping Profile index, used for egress Frame Modification VLAN Add/Replace Action

struct __netc_swt_default_vlan_filter

#include <fsl_netc.h> Switch VLAN filter hash table default entry configuration, which determines the default entry when not found in VLAN filter lookup.

Public Members

bool enIPMFlood

Enable IP Multicast Flooding

bool enIPMFilter

Enable IP Multicast Filtering

uint8_t stgID

Spanning Tree Group Member ID, range in 0 ~ 15

uint8_t portMembership

The bit 0 ~ 4 correspond to the 5 ports, When bit set (0b1), means the port is a member of this VLAN. Port membership is used for source/destination pruning

bool enUseFilterID

Enable use the specified filterID as FID, otherwise will use the frame VID

uint16_t filterID

Used as a key value to do FDB table and the L2 IPV4 Multicast Filter table lookup. Valid if enUseFilterID is true

netc_swt_mac_forward_mode_t mfo

MAC forwarding options

netc_swt_mac_learn_mode_t mlo

MAC learning options

uint16_t baseETEID

Base Egress Treatment Entry ID

uint8_t etaPortBitmap

Egress Treatment Applicability Port. Valid if baseETEID is not null.

struct __netc__swt__bridge__config

#include <fsl_netc.h> Bridge config.

Public Members

netc_swt_default_vlan_filter_t dVFCfg

Default VLAN filter entry configuration when not found in VLAN filter lookup

struct __netc__swt__psfp__config

#include <fsl_netc.h> Switch PSFP configuration.

Public Members

netc_isi_kc_rule_t kcRule[4]

Key construction rules

struct __netc__qos__classify__config

#include <fsl_netc.h> Switch Qos Classification configuration (include two profiles)

struct __netc__swt__qos__to__vlan__config

#include <fsl_netc.h> Switch QoS to PCP mapping and PCP to PCP mapping configuration when egress packet modification the VLAN tag.

struct fsl__netc

#include <fsl_netc.h>

Public Members

uint8_t qos[32]

Index is created from IPV (3 bits) + DR (2 bits) field. Value is the mapped PCP for VLAN tag.

uint8_t pcp[8]

Index is created from outer PCP (3 bits) field. Value is the mapped PCP for VLAN tag.

struct __netc__switch__inuse__fdb__statistic

#include <fsl_netc.h> Switch static/dynamic FDB entries in-use statistic.

Public Members

uint16_t camEntries
: Number of FDB entries in-use in the CAM.

uint16_t staticEntries
: Number of static FDB entries in-use (both hash-based and CAM-based entries).

uint16_t dynamicEntries
: Number of dynamic FDB entries in-use (hash-based and CAM-based entries).

uint16_t dynamicEntriesHWM
: High water mark of dynamic entries in-use in the FDB table.

struct __netc_swt_port_sr_config
: *#include <fsl_netc.h>* Port seamless redundancy configuration.

struct defaultVlan

Public Members

uint32_t vid
: Vlan Identifier.

uint32_t dei
: Drop eligible indicator

uint32_t pcp
: Priority code point.

uint32_t tpid
: Tag protocol identifier, 0 = Standard C-VLAN 0x8100, 1 = Standard S-VLAN 0x88A8.

2.79 Hardware Table Access Functions

enum __netc_tb_index
: Table index.

Values:

enumerator kNETC_TGSTable
: Time Gate Scheduling table index

enumerator kNETC_RPTable
: Rate Policer table index

enumerator kNETC_IPFTable
: Ingress Port filter table index

enumerator kNETC_FDBTable
: FDB table index

enumerator kNETC_L2MCFTable
: L2 IPV4 Multicast Filter table index

enumerator kNETC_VFTable
: VLAN Filter table index

enumerator kNETC_ECQTable
ETM Class Queue table index

enumerator kNETC_ECSTable
ETM Class Scheduler table index

enumerator kNETC_ISITable
Ingress Stream Identification table index

enumerator kNETC_ISTable
Ingress Stream table index

enumerator kNETC_ISFTable
Ingress Stream Filter table index

enumerator kNETC_ETTable
Egress Treatment table index

enumerator kNETC_ISGTable
Ingress Sequence Generation table index

enumerator kNETC_ESRTable
Egress Sequence Recovery table index

enumerator kNETC_SGITable
Stream Gate Instance table index

enumerator kNETC_SGCLTable
Stream Gate Control List table index

enumerator kNETC_ISCTable
Ingress Stream Count table index

enumerator kNETC_ECTable
Egress Count table index

enumerator kNETC_FMTable
Frame Modification table index

enumerator kNETC_BPTable
Buffer Pool table index

enumerator kNETC_SBPTable
Shared Buffer Pool table index

enumerator kNETC_ECGTable
ETM Class Group table index

enumerator kNETC_FMDTable
Frame Modification Data table index

enum __netc_tb_cmd
Table management command operations.

Values:

enumerator kNETC_DeleteEntry
Delete operation

enumerator kNETC_UpdateEntry
Update operation

enumerator kNETC_QueryEntry
Query operation

enumerator kNETC_QueryAndDeleteEntry
Query operation followed by a delete operation

enumerator kNETC_QueryAndUpdateEntry
Query operation followed by a update operation

enumerator kNETC_AddEntry
Add operation

enumerator kNETC_AddOrUpdateEntry
If the entry exists, is update operation, if not exist, is the Add operation

enumerator kNETC_AddAndQueryEntry
Add operation followed by a query operation

enumerator kNETC_AddQueryAndUpdateEntry
Add operation followed by a query operation, Then, if the entry existed prior to the Add operation of this command, the Update operation will be performed.

enum _netc_tb_access_mode
Table Access Method.

Values:

enumerator kNETC_EntryIDMatch
Entry ID Match

enumerator kNETC_ExactKeyMatch
Exact Match Key Element Match

enumerator kNETC_Search
Search with search criteria

enumerator kNETC_TernaryKeyMatch
Ternary Match Key Element Match

enum _netc_cbd_version
NTMP version.

Values:

enumerator kNETC_NtmpV1_0
NTMP Version 1.0

enumerator kNETC_NtmpV2_0
NTMP Version 2.0

enum _netc_cmd_error
Table command response error status.

Values:

enumerator kNETC_FormatError
Format error : 1. Illegal class or command. 2. Invalid SF bit setting. 3. LENGTH is zero for long format. 4. LENGTH is too small for buffer size.

enumerator kNETC_SizeError
Size error : 1. Invalid table index, out of range. 2. Table overflow, no additional entries available.

enumerator kNETC_AccessError
Access violation error, the entity is not allowed to perform the task requested

enumerator kNETC_ClassError
Class specific error

enumerator kNETC_IntegrityError
Integrity error, the command did not execute due to a data integrity error (ECC on internal memory or AXI read/write error)

enumerator kNETC_InvTableID
Invalid table ID

enumerator kNETC_InvAccMethod
Invalid Access method

enumerator kNETC_TableIdxOutRange
Table index out of range

enumerator kNETC_DBNotEnough
Request data buffer size or response data buffer size is not sufficient

enumerator kNETC_InvCmd
Invalid command

enumerator kNETC_ReqDBError
Request Data buffer error

enumerator kNETC_MultiBitError
Multi-bit ECC or parity error observed during command processing

enumerator kNETC_HashEntryLimit
Exceeded hash entry limit

enumerator kNETC_HashChainLimit
Exceeded maximum hash collision chain limit and the CAM if present is full

enumerator kNETC_InvHWGenEntryID
Invalid ENTRY_ID for ENTRY_ID generated by hardware

enumerator kNETC_SrchResDBNotEnough
Search command filled the response data buffer before completing the command

enumerator kNETC_CmdIdxTableWithITM
Command for index table before OSR[ITM_STATE]=0

enumerator kNETC_InvQueryAction
Invalid Query action

enumerator kNETC_InvTableAccPrivilege
Invalid table access privilege

enumerator kNETC_ReadSysBusErr
System Bus Read Error

enumerator kNETC_WriteSysBusErr
System Bus Write Error

enumerator kNETC_ClientErr
Client encountered a fault

enumerator kNETC_TGSCmdIssue
Command issued when time gating function is disabled for the port.

enumerator kNETC_TGSUpdateExistList

Update action attempted on an existing admin gate control list. (should delete admin gate control list first before creating a new admin list)

enumerator kNETC_TGSUpdateOverLength

Update action attempted exceeds TGSTCAPR[MAX_GCL_LEN]

enumerator kNETC_TGSUpdateOverSize

Update action attempted exceeds TGSTCAPR[NUM_WORDS].

enumerator kNETC_TGSEntryNotEnough

Insufficient resources to perform the requested operation (not enough free time gate list entries)

enumerator kNETC_TGSUpdateNSList

Update action attempted with ADMIN_CYCLE_TIME, ADMIN_TIME_INTERVAL_GE_i or truncated ADMIN_TIME_INTERVAL_GE_n due ADMIN_CYCLE_TIME specified is not sufficient to transmit 64 byte of frame data + header overhead.

enumerator kNETC_TGSUpdateEarlierStartTime

Update action attempted with ADMIN_BASE_TIME specified s more than one second in the past from tcs advance time.

enumerator kNETC_TGSUpdateOverflowCycle

Update action attempted with ADMIN_CYCLE_TIME + ADMIN_CYCLE_TIME_EXT is greater than 2^32-1.

enumerator kNETC_TGSQueryBeforeListActive

Query action issued when config change occurred. Retry query.

enumerator kNETC_TGSUpdateInvGateValue

Update action attempted with ADMIN_HR_CB_GE_i set to an invalid value

enumerator kNETC_RPSDUTypeOutRange

SDU_TYPE specified in entry CFGE_DATA is out of range

enumerator kNETC_IPFInvHR

HR value not valid. Only checked if command issued from the Switch and FLTFA=0x2 or FLTFA=0x3

enumerator kNETC_IPFEntryNotFit

Entry being added does not fit in table

enumerator kNETC_IPFWithoutSTSE

CFGE_DATA update without STSE_DATA update

enumerator kNETC_IPFInvRPP

RPR set to a reserved value. Only checked if FLTA=0x2.

enumerator kNETC_IPFFLTATGTOutRange

FLTA_TGT is outside valid range and not NULL. Only checked if FLTA>0x0

enumerator kNETC_IPFInvSwtFLTA

FLTA=0x3 when command issued from the Switch.

enumerator kNETC_IPFInvEnetcFLTA

FLTFA>0x1 when command issued from an ENETC PF.

enumerator kNETC_FDBReachPortLimit

Failed to add or update and entry because the Port BPCR[DYN_LIMIT] has been reached

enumerator kNETC_FDBReachSwtLimit

Failed to add entry because the Switch FDBHTMCR[DYN_LIMIT] has been reached.

enumerator kNETC_FDBInvEPORT

EPORT value not valid. Only checked if (OETEID=0x1 OR CTD=0x1)

enumerator kNETC_FDBETEIDOutRange

ET_EID is out of range and not NULL. Only checked if OETEID>0x0

enumerator kNETC_FDBParityErr

Parity error encountered when adding guaranteed entry

enumerator kNETC_L2MCFInvEPORT

EPORT value not valid. Only checked if (OETEID=0x1 OR CTD=0x1)

enumerator kNETC_L2MCFETEIDOutRange

ET_EID is not NULL or within the valid range. Only checked if OETEID>0x0.

enumerator kNETC_L2MCFInvKEYTYPE

KEY_TYPE value not valid

enumerator kNETC_VFBASEETEIDOutRange

BASE_ET_EID is out of range or MLO is not valid.

enumerator kNETC_ECQCQ2CGMAPOutRange

CQ2CG_MAP value out-of-range in update command.

enumerator kNETC_ISIPortIDOutRange

Port ID specified in KEYE_DATA is out of range.

enumerator kNETC_ISIInvISEID

IS_EID in invalid.

enumerator kNETC_ISInvOpt

Option specified in one or more of the following fields is not valid – FA, CTD or ISQA, SDU_TYPE.

enumerator kNETC_ISInvID

One or more of following : 1. Entry IDs are not in valid range or Entry ID is not Null. 2. Check valid ranges specified for these Entry IDs in Ingress Stream table entry – RP_EID, SGI_EID, ISQ_EID, ET_EID or EPORT. 3. ET_EID is checked if (FA =010b .. 101b) & (OETEID!=0). 4. EPORT is checked if (FA = 010b .. 101b) & (OETEID= 0x1 OR CTD= 0x1). 5. HR is chked if FA = 001b, 100b, or 101b. HR specified cannot be 0x0

enumerator kNETC_ISInvFMEID

FM_EID format or index is out of range : 1. FM_EID format option type is invalid. 2. FM_EID format is option 1 and the Index is out of range and not Null, or FM_EID format is option 2 and VUDA or SQTA is out of range.

enumerator kNETC_ISFInvISEID

IS_EID in KEYE_DATA is invalid.

enumerator kNETC_ISFInvCFGE

Any of the following in CFGE_DATA is invalid : 1. One or more of following Entry IDs are not in valid range or Entry ID specified is not Null. Checks are performed for following Entry IDs CFGE DATA – RP_EID, SGI_EID, ISC_EID. 2. SDU_TYPE is invalid

enumerator kNETC_ETInvOpt

Command option specified is invalid or not supported. ESQA is not 00 or 10 (others are reserved), or ECA > 1 (reserved).

enumerator kNETC_ETInvFMEID

FM_EID format or index is out of range. Check performed is as follows : 1. EFM_EID format option type is invalid, or EFM_EID format is option 1 and the Index is out of range and not Null, or EFM_EID format is option 2 and VUDA or SQTA is out of range . 2. the Egress Counter Table index EC_EID is out of range. 3. The Egress Sequence Actions Target Entry ID ESQA_TGT_EID is out of range

enumerator kNETC_ISGInvQSTAG

SQ_TAG specified is not valid

enumerator kNETC_SGISGCLEIDOutRange

SGCL_EID specified in out of range for Add or Update operation.

enumerator kNETC_SGIInvSDUTYPE

SDU_TYPE is specified is invalid for Add or Update operation.

enumerator kNETC_SGISGCLEIDNotAlloc

Either the SGCL_EID specified as admin gate control list in Add or Update operation has not been allocated or SGCL_EID is not the first entry in gate control list or the reference count in SGCL entry is not 0.

enumerator kNETC_SGIInvSGCLEID

SGCL_EID specified for Update operation is in invalid.

enumerator kNETC_SGIInvADMINBASETIME

ADMIN_BASE_TIME specified for Add or Update operation is more than 2^30ns in the past.

enumerator kNETC_SGIInvCYCLETIME

Cumulated time value of CYCLE_TIME in Stream gate Control list plus CYCLE_TIME_EXT specified in Add or Update operation is >=2^30ns or CYCLE_TIME specified is 0.

enumerator kNETC_SGCLOverLength

Number words required for the LIST_LENGTH specified for the Add operation exceeds the number of words allocated for SGCL table

enumerator kNETC_SGCLTimeIntervalZero

TIME_INTERVAL_GE_N specified in Add operation is 0. Note that upper 2 bits of TIME_INTERVAL_GE_N are ignored, TIME_INTERVAL_GE_N[29:0] must not be 0.

enumerator kNETC_SGCLTimeIntervalOverflow

Cumulated time value of TIME_INTERVAL_GE_N[29:0] for the gate list specified in Add operation is >= 2^30ns.

enumerator kNETC_FMInvEMEID

FM_EID format is invalid

enumerator kNETC_FMOptOutRange

Following fields specified are out of range - MAC_HDR_ACT, VLAN_HDR_ACT, SQT_ACT, OUTER_PCP_DEI_ACT, PLD_ACT.

enumerator kNETC_FMFMDOutRange

FMD_EID,FMD_BYTES specified is out of range. When FMD_EID is not set to Null, valid range is FMD_EID[15:0]*24 + FMD_BYTES <= (FMDITCAPR[NUM_WORDS]*24).

enumerator kNETC_BPSBPEIDOutRange

SBP_EN is 1 and SBP_EID value is out-of-range in update command

enum _netc_fm_vlan_ud_act

Frame Modification VLAN Update/Delete Action.

Note: Misconfiguration error if replace or delete action is specified and if VLAN tag is not present in frame.

Values:

enumerator kNETC_NoUDVlanAction

No Update/Delete VLAN action

enumerator kNETC_ReplVlanPcpAndDei

Replace outer VLAN's PCP/DEI based on the port's PPCPDEIMR. The tag's original VID and TPID are preserved

enumerator kNETC_DelVlan

Delete outer VLAN Tag

enum _netc_fm_sqt_act

Frame Modification Sequence Tag Action.

Note: Must be set to 000b for Ingress frame modification, otherwise misconfiguration error..

Values:

enumerator kNETC_NoSqtAction

No SQT action

enumerator kNETC_ReomveRTag

Remove R-TAG/draft 2.0 R-TAG/HSR tag, If R-TAG/HSR tag not present, misconfiguration error.

enum _netc_fm_vlan_ar_act

Frame Modification VLAN Add/Replace Action.

Note: For ingress frame modificaion with 00b or 01b, use the ingress port to select PCP and DEI from the Bridge port default VLAN register (BPDVR). For egress frame modification with 00b or 01b, use the internal QoS associated with the frame (IPV, DR) to access the QoS to PCP mapping profile (PQOSMR[QVMP] , QOSVLANMPaR0/1/2/3) to set the new PCP value. Use internal DR associated with frame to access the DR to DEI mapping profile (PPCPDEIMR[DRnDEI]) to set the new DEI value.

Values:

enumerator kNETC_AddCVlanPcpAndDei

Add outer VLAN with VID and PCP/DEI updated as described above. TPID=0x8100

enumerator kNETC_AddSVlanPcpAndDei

Add outer VLAN with VID and PCP/DEI updated as described above. TPID=0x88A8

enumerator kNETC_ReplVidOnly

Replace VLAN with VID. The tag's original PCP, DEI and TPID are preserved

enumerator kNETC_ReplVidPcpAndDei

Replace VLAN with VID and PCP/DEI updated by port's PPCPDEIMR. The tag's original TPID is preserved

enum _netc_tb_eteid_access_mode

Define FDB/L2MCF/IS table entry access the primary Egress Treatment table entry group mode.

Note: The FDB/L2 IPv4 Multicast filter table has precedence over any assignment made via the Ingress Stream table. For Mulit port mode, the index to access the Egress Treatment table is computed by adding an offset to the base index of the Egress Treatment group. That offset is derived from the applicability bitmap as follows: starting from the lowest significant bit of the bitmap, the first encountered bit set to 1, corresponds to offset 0, and so on. This continues till the destination port location in the bitmap is reached

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Values:

enumerator kNETC_NoETAccess

No Egress Treatment table access

enumerator kNETC_SinglePortETAccess

Only frame sent to a special port (define in ePort) can access a single Egress Treatment table entry, the applicability bitmap specified by FDB/L2MCF/IS ePort field

enumerator kNETC_MulitPortPackedETAccess

Only frames sent to a special set of ports (ports set to 1 in ePortBitmap) can access the Egress Treatment table, the applicability bitmap = IS ePortBitmap field or FDB/L2MCF portBitmap field

enumerator kNETC_MulitPortAbsETAccess

Frames sent to all of ports can access the Egress Treatment table, means the applicability bitmap is set with 1 for all ports

enum _netc_tb_ipf_update_action

Ingress Port Filter Table Update Actions.

Values:

enumerator kNETC_IPFCfgEUpdate

Configuration Element Update

enumerator kNETC_IPFStsEUpdate

Statistics Element Update

enum _netc_tb_ipf_attr_mask

Ingress Port Filter frame attribute mask.

Values:

enumerator kNETC_IPFSwtPortMasMask

Switch port masquerading Mask

enumerator kNETC_IPFEthernetMask

Ethernet type Mask

enumerator kNETC_IPFOuterVlanMask

Outer VLAN Mask

enumerator kNETC_IPFInnerVlanMask

Inner VLAN Mask

enumerator kNETC_IPFSeqTagMask

Sequence Tag Code Mask

enumerator kNETC_IPFIpHeaderMask
IP Header Mask

enumerator kNETC_IPFIpVersionMask
IP Version Mask

enumerator kNETC_IPFIpExtMask
IPv4 option / IPv6 extension Mask

enumerator kNETC_IPFL4HeaderMask
L4 Code Mask

enumerator kNETC_IPFWakeOnLanMask
Wake-on-LAN Magic Packet Mask

enum _netc_tb_ipf_seq_tag
Ingress Port Filter frame attribute Sequence Tag Code.

Values:

enumerator kNETC_IPFNoRtag
R-TAG/HSR tag is not present

enumerator kNETC_IPFDraftRtag
802.1CB draft 2.0 R-TAG is present

enumerator kNETC_IPFRtag
802.1CB R-TAG is present

enumerator kNETC_IPFHsrTag
HSR Tag is present

enum _netc_tb_ipf_l4_header
Ingress Port Filter frame attribute L4 Header Code.

Values:

enumerator kNETC_IPFOtherL4
The L4 Header is considered as other L4 if it is not one of the following L4 Headers

enumerator kNETC_IPFTcp
TCP header is present

enumerator kNETC_IPFUdp
UDP header is present

enumerator kNETC_IPFSctp
SCTP header is present

enum _netc_tb_ipf_forward_action
Ingress port filter forwarding Action.

Values:

enumerator kNETC_IPFForwardDiscard
Frame be discard

enumerator kNETC_IPFForwardPermit
Frame be permit

enumerator kNETC_IPFRedirectToMgmtPort
Redirect frame to switch management port without any frame modification, Switch only

enumerator kNETC_IPFCopyToMgmtPort
Copy frame to switch management port without any frame modification, Switch only

enum _netc_tb_ipf_filter_action
Ingress port filter Filter Action.

Values:

enumerator kNETC_IPFNoAction
No action

enumerator kNETC_IPFWithRatePolicer
Rate action with the Rate Policer Entry ID (RP_EID) set to the value configured in the fltaTgt field

enumerator kNETC_IPFWithIngressStream
Ingress stream identification action where the Ingress Stream Entry ID (IS_EID) is set to the value configured in the fltaTgt field

enumerator kNETC_IPFWithL2Filtering
Setting a pre L2 filtering SI bitmap (set to the value configured in the fltaTgt) that will be used by the L2 filtering function to determine the final SI bitmap, ENETC only

enum _netc_tb_isi_key_type
Stream identification table key type.

Values:

enumerator kNETC_KCRule0
Use key construction rule 0 (ISIDKC0CR0)

enumerator kNETC_KCRule1
Use key construction rule 1 (ISIDKC1CR0)

enumerator kNETC_KCRule2
Use key construction rule 2 (ISIDKC2CR0). Only for SWITCH

enumerator kNETC_KCRule3
Use key construction rule 3 (ISIDKC3CR0). Only for SWITCH

enum _netc_tb_is_isq_action
Ingress Stream table Ingress Sequence Action.

Values:

enumerator kNETC_ISNotPerformFRER
Not perform Frame FRER sequence generation function

enumerator kNETC_ISPerformFRER
Perform Frame FRER sequence generation function

enum _netc_tb_is_forward_action
Ingress Stream table forwarding Action.

Values:

enumerator kNETC_ISDiscard
Frame be discard

enumerator kNETC_ISRedirectToMgmtPort
Frame be Re-direct frame to switch management port, Switch only

enumerator kNETC_ISAllow
Frame is allow without setting the pre L2 filtering SI bitmap, ENETC only

enumerator kNETC_ISAllowWithSIMap
Frame is allow with setting the pre L2 filtering SI bitmap to the value configured in the SI_MAP field, ENETC only

enumerator kNETC_ISStreamForward
Frame is forwarded to the port(s) specified in the EGRESS_PORT_BITMAP field, Switch only

enumerator kNETC_ISBridgeForward
Frame is do 802.1Q Bridge forwarding (VLAN processing and L2 forwarding), Switch only

enumerator kNETC_ISCopyToMgmtPortAndStream
Copy frame to switch management port with specified HR and stream forwarding, Switch only

enumerator kNETC_ISCopyToMgmtPortAndBridge
Copy frame to switch management port with specified HR and Bridge forwarding, Switch only

enum _netc_tb_is_ctd_mode
Ingress Stream table Cut-Through Disable mode.

Values:

enumerator kNETC_ISNoCTD
Do not override cut-through state

enumerator kNETC_ISSinglePortCTD
Disable cut-through for the outgoing port specified in the cfge ePort field

enumerator kNETC_ISAllPortCTD
Disable cut-through for all ports specified in cfge portBitmap field

enum _netc_tb_rp_update_action
Rate Policer Table Update Actions.

Values:

enumerator kNETC_RPCfgEUpdate
Configuration Element Update

enumerator kNETC_RPFeEUpdate
Functional Enable Element Update

enumerator kNETC_RPPsEUpdate
Policer State Element Update Element Update

enumerator kNETC_RPStsEUpdate
Statistics Element Update

enum _netc_tb_sgi_update_action
Stream Gate Instance table Update Actions.

Values:

enumerator kNETC_SGIAcfEUpdate
Admin Configuration Element

enumerator kNETC_SGICfgEUpdate
Configuration Element Update

enumerator kNETC_SGISgisEUpdate
Stream Gate Instance State Element Update

enum _netc_tb_sgi_state

Stream Gate Instance State.

Values:

enumerator kNETC_GSNotOper

Gate instance is not operational or Gate instance and lists are not valid

enumerator kNETC_GSUseDefaultParam

Gate instance is operational but no stream gate control list specified, use default Gate Instance parameters

enumerator kNETC_GSUseDefUntilAdminAct

Use default Gate Instance parameters until administrative stream gate control list takes effect

enumerator kNETC_GSUseOperUntilAdminAct

Use Operational stream gate control list until new administrative stream gate control list takes effect

enumerator kNETC_GSUseOperList

Operational stream gate control list is in effect

enum _netc_tb_fm_layer2_act

Frame Modification table Layer 2 Actions.

Note: This field must be set to 0 for traffic destined to a pseudo link. This field must be set to 0 for any device with ASIL-B safety requirements.

Values:

enumerator kNETC_UseL2HeaderAct

L2 actions are specified in L2 header action fields macHdrAct, vlanHdrAct and sqtAct

enumerator kNETC_UseSpecPlayload

The entire L2 PDU is replaced with fmdBytes of data specified in fmdEID, not applicable for ingress frame modifications

enum _netc_tb_fm_mac_header_act

Frame Modification table Layer 2 Header MAC Actions.

Note: Ingress frame modifications only support kNETC_NoAction or kNETC_ReplDmac.

Values:

enumerator kNETC_NoMacAction

No Mac header action

enumerator kNETC_ReplSmac

Replace SMAC with the contents of the port's PMAR0/1 register, The port is specified by smacPort field

enumerator kNETC_ReplSmacAndDmacAct1

Replace SMAC and DMAC, The content of SMAC is the same as kNETC_ReplaceSMAC, the DMAC is specified by dmac[6] field

enumerator kNETC_ReplSmacAndDmacAct2

Replace SMAC and DMAC, The content of SMAC is the same as kNETC_ReplaceSMAC, the DMAC is specified by frame's SMAC

enumerator kNETC_ReplDmac

Replace DMAC with specified dmac[6] field value

enumerator kNETC_SwapDmacAndSmac

Swap DMAC and SMAC

enum _netc_tb_fm_vlan_header_act

Frame Modification table Layer 2 VLAN Actions.

Note: For use Delete or Replace action, if no outer VLAN header is present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

Values:

enumerator kNETC_NoVlanAction

No VLAN header action

enumerator kNETC_DelOuterVlan

Delete outer VLAN header

enumerator kNETC_AddOuterVlan

Add outer VLAN header (new VLAN data will be inserted in the outer position), the VID, PCP, DEI and TPID values are specified by outerVidAct, outerPcpAct, outerDeiAct and outerTpidAct field

enumerator kNETC_ReplOuterVlan

Replace outer VLAN header, the VID, PCP, DEI and TPID values are specified by outerVidAct, outerPcpAct, outerDeiAct and outerTpidAct field

enum _netc_tb_fm_outer_vid_act

Frame Modification table Layer 2 outer VLAN VID Actions.

Note: For use kNETC_UseFrameVID action, if no outer VLAN header is present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

Values:

enumerator kNETC_UseFrameVid

Use the VID from the valid outer VLAN header of the received frame

enumerator kNETC_UseSpecVid

Use the VID specified in the outerVlanID field

enum _netc_tb_fm_outer_tpid_act

Frame Modification table Outer TPID action.

Note: For use kNETC_UseFrameTpid action, If outer VLAN header not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

Values:

enumerator kNETC_UseFrameTpid

Use TPID from outer VLAN header

enumerator kNETC_UseStdCVlan

Set TPID to Standard C-VLAN 0x8100

enumerator kNETC_UseStdSVlan
Set TPID to Standard S-VLAN 0x88A8

enumerator kNETC_UseCustomCVlan
Set TPID to Custom C-VLAN as defined by CVLANR1[ETYPE]

enumerator kNETC_UseCustomSVlan
Set TPID to Custom S-VLAN as defined by CVLANR2[ETYPE]

enum _netc_tb_fm_outer_pcp_act
Frame Modification table Outer PCP action.

Note: For use kNETC_UseFramePcp/kNETC_UseFramePcpMap action, If outer VLAN header not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

Values:

enumerator kNETC_UseFramePcp
Use PCP from frame outer VLAN header

enumerator kNETC_UseSpecPcp
Use the PCP specified in the outerVlanPcp field

enumerator kNETC_UseFramePcpMap
The PCP is mapping from frame outer VLAN PCP (do mapping according to the PCP to PCP mapping profile which specified in PPCPDEIMR[IPCPMP/EPCPMP])

enumerator kNETC_UseQosMap
The PCP is mapping from internal QoS (IPV, DR) (do mapping according to the QOS to PCP mapping profile which specified in QOSVLANMPaR0/1/2/3), not applicable for ingress frame modifications

enum _netc_tb_fm_outer_dei_act
Frame Modification table Outer DEI action.

Note: For use kNETC_UseFrameDei action, If outer VLAN header not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

Values:

enumerator kNETC_UseFrameDei
Use DEI from frame outer VLAN header

enumerator kNETC_UseSpecDei
Use the DEI specified in the outerVlanDei field

enumerator kNETC_UseDrMap
The DEI is mapping from internal DR (do mapping according to the DR to DEI mapping profile which specified in PPCPDEIMR[DRnDEI], not applicable for ingress frame modifications

enum _netc_tb_fm_payload_act
Frame Modification table Payload Actions.

Note: This field must be set to 0 for traffic destined to a pseudo link. This field must be set to 0 for any device with ASIL-B safety requirements.

Values:

enumerator kNETC_NoAction
No Action

enumerator kNETC_ReplAllEthPld
Remove entire Ethernet payload and insert with fmdBytes of data specified in fmdEID

enumerator kNETC_ReplPldWithOffset
Replace fmdBytes of raw data in the Ethernet payload starting at pldOffset, data specified in fmdEID

enum _netc_tb_fdb_update_action
FDB table Update Actions.

Values:

enumerator kNETC_FDBCfgEUpdate
Configuration Element Update

enumerator kNETC_FDBActEUpdate
Activity Element Update

enum _netc_tb_fdb_ctd_mode
FDB table Cut-Through Disable mode.

Values:

enumerator kNETC_FDBNoCTD
Do not override cut-through state

enumerator kNETC_FDBSinglePortCTD
Disable cut-through for the outgoing port specified in the cfge ePort field

enumerator kNETC_FDBAllPortCTD
Disable cut-through for all ports specified in cfge portBitmap field

enum _netc_tb_fdb_sc_keye_mc
FDB table search criteria Key Element Match Criteria.

Values:

enumerator kNETC_FDBKeyeMacthAny
Match any Key Element Criteria

enumerator kNETC_FDBKeyeMacthFID
Match Key Element FID

enumerator kNETC_FDBKeyeMacthMacMulticast
Match Key Element MAC Multicast bit (MAC_ADDR most significant byte's least significant bit)

enumerator kNETC_FDBKeyeMacthBoth
Match both FID field and MAC Multicast bit

enum _netc_tb_fdb_sc_cfge_mc
FDB table search criteria Configuration Element Match Criteria.

Values:

enumerator kNETC_FDBCfgeMacthAny
Match any Configuration Element Criteria

enumerator kNETC_FDBCfgeMacthDynamic
Match Configuration Element dynamic field

enumerator kNETC_FDBCfgeMacthPortBitmap
Match Configuration Element portBitmap field

enumerator kNETC_FDBCfgeMacthBoth
Match both dynamic field and portBitmap

enum _netc_tb_fdb_sc_acte_mc
FDB table search criteria Activity Element Match Criteria.

Values:

enumerator kNETC_FDBActeMacthAny
Match any Activity Element Criteria

enumerator kNETC_FDBActeMatchExact
Exact match with Activity Element

enum _netc_tb_l2mcf_key_type
L2 IPV4 Multicast Filter table key type.

Values:

enumerator kNETC_IPv4ASMKey
Key consists of a filtering ID (FID) and destination multicast IPv4 address

enumerator kNETC_IPv4SSMKey
Key consists of a filtering ID (FID), IPv4 source address and multicast IPv4 destination address

enum _etc_tb_l2mcf_sc_keye_mc
L2 IPV4 Multicast Filter table search criteria Key Element Match Criteria.

Values:

enumerator kNETC_L2MCFKeyeMacthAny
Match any Key Element Criteria

enumerator kNETC_L2MCFKeyeMacthFID
Match Key Element FID

enum _etc_tb_l2mcf_sc_cfge_mc
L2 IPV4 Multicast Filter table search criteria Configuration Element Match Criteria.

Values:

enumerator kNETC_L2MCFCfgeMacthAny
Match any Configuration Element Criteria

enumerator kNETC_L2MCFCfgeMacthDynamic
Match Configuration Element dynamic field

enumerator kNETC_L2MCFCfgeMacthPortBitmap
Match Configuration Element portBitmap field

enumerator kNETC_L2MCFCfgeMacthBoth
Match both dynamic field and portBitmap

enum _etc_tb_l2mcf_sc_acte_mc
FDB table search criteria Activity Element Match Criteria.

Values:

enumerator kNETC_L2MCFActeMacthAny
Match any Activity Element Criteria

enumerator kNETC_L2MCFActeMatchExact
Exact match with Activity Element

enum __netc_tb_iseqg_sqtag
Sequence Tag Type.

Values:

enumerator kNETC_SqDraftRTag
802.1CB draft 2.0 R-TAG.

enumerator kNETC_SqRTag
802.1CB R-TAG.

enumerator kNETC_SqHsrTag
HSR Tag.

enum __netc_tb_iseqg_update_action
Ingress Sequence Generation Table Update Actions.

Values:

enumerator kNETC_ISEQGCfgEUpdate
Configuration Element Update

enumerator kNETC_ISEQGSgsEUpdate
Sequence Generation Element Update

enum __netc_tb_eseqr_sqtag
Egress Sequence Recovery table Sequence Tag Type.

Values:

enumerator kNETC_AcceptAnyTag
Accept any incoming tag type (802.1CB draft 2.0 R-TAG, 802.1CB R-TAG or HSR Tag)

enumerator kNETC_AcceptDraftRTag
802.1CB draft 2.0 R-TAG.

enumerator kNETC_AcceptRTag
802.1CB R-TAG.

enumerator kNETC_AcceptHsrTag
HSR Tag.

enum __netc_tb_tgs_entry_id
Time Gate Scheduling table entry ID for switch and ENETC.

Values:

enumerator kNETC_TGSSwtPort0
Switch PORT 0 entry ID

enumerator kNETC_TGSSwtPort1
Switch PORT 1 entry ID

enumerator kNETC_TGSSwtPort2
Switch PORT 2 entry ID

enumerator kNETC_TGSSwtPort3
Switch PORT 3 entry ID

enumerator kNETC_TGSSwtPort4
Switch PORT 4 entry ID

enumerator kNETC_TGSEnetc0Port
ENETC 0 port entry ID

enumerator kNETC_TGSEnetc1Port
ENETC 1 port entry ID

enum __netc_tb_tgs_gate_type
Administrative gate operation type.

Values:

enumerator kNETC_SetGateStates
HoldRequest is unchanged

enumerator kNETC_SetAndHoldMac
HoldRequest is set to value hold, only active when enable preemption

enumerator kNETC_SetAndReleaseMac
HoldRequest is set to value release, only active when enable preemption

enum __netc_tb_et_efm_mode
Egress Frame Modification entry mode.

Values:

enumerator kNETC_NormalMode
Egress Frame Modification entry use normal/Default mode

enumerator kNETC_L2Act1
Egress Frame Modification entry l2Act = kNETC_UseSpecPlayload

enumerator kNETC_PldAct1
Egress Frame Modification entry pldAct = kNETC_ReplAllEthPld

enum __netc_tb_et_esq_act
Egress Sequence Actions.

Values:

enumerator kNETC_NoEsqAction
No Egress Sequence Action required

enumerator kNETC_HasEsqAction
Has Egress Sequence Recovery action

enum __netc_tb_et_ec_act
Egress Counter Action.

Values:

enumerator kNETC_NoEcCounter
Do not increment egress frame counter

enumerator kNETC_HasEcCounter
Increment egress frame counter

enum __netc_tb_etmcq_update_action
ETM Class Queue table Update Actions.

Values:

enumerator kNETC_CQCfgEUpdate
Configuration Element Update

enumerator kNETC_CQStsEUpdate

Statistics Element Update, all counters (except FRM_CNT) within the Statistics Element are reset

enum _netc_tb_etmcs_entry_id

ETM Class Scheduler table entry ID.

Values:

enumerator kNETC_CSSwtPort0

CS Switch PORT 0 entry ID

enumerator kNETC_CSSwtPort1

CS Switch PORT 1 entry ID

enumerator kNETC_CSSwtPort2

CS Switch PORT 2 entry ID

enumerator kNETC_CSSwtPort3

CS Switch PORT 3 entry ID

enumerator kNETC_CSSwtPort4

CS Switch PORT 4 entry ID

enum _netc_tb_etmcs_ca_assg

ETM Class Scheduler table Class queue assignment to scheduler inputs mode.

Values:

enumerator kNETC_CQ7AssignToSchedIn15

CQ 7 assignment to scheduler input 15, means all CQ use strict priority

enumerator kNETC_CQ7AssignToSchedIn14

CQ 7 assignment to scheduler input 14

enumerator kNETC_CQ7AssignToSchedIn13

CQ 7 assignment to scheduler input 13

enumerator kNETC_CQ7AssignToSchedIn12

CQ 7 assignment to scheduler input 12

enumerator kNETC_CQ7AssignToSchedIn11

CQ 7 assignment to scheduler input 11

enumerator kNETC_CQ7AssignToSchedIn10

CQ 7 assignment to scheduler input 10

enumerator kNETC_CQ7AssignToSchedIn9

CQ 7 assignment to scheduler input 9

enumerator kNETC_CQ7AssignToSchedIn8

CQ 7 assignment to scheduler input 8

enumerator kNETC_CQ7AssignToSchedIn7

CQ 7 assignment to scheduler input 7, means all CQ use weighted fair

enum _netc_tb_bp_fc_cfg

Buffer Pool Flow Control (FC) Configuration.

Values:

enumerator kNETC_FlowCtrlDisable

Flow Control disabled

enumerator kNETC_FlowCtrlWithBP
Flow Control enabled using only buffer pool FC state.

enumerator kNETC_FlowCtrlWithSBP
Flow Control enabled using only shared buffer pool FC state.

enumerator kNETC_FlowCtrlWithBPAndSBP
Flow Control enabled using both buffer pool and shared buffer pool FC state, only both 1 trigger the Flow Control ON

typedef enum *_netc_tb_index* netc_tb_index_t
Table index.

typedef enum *_netc_tb_cmd* netc_tb_cmd_t
Table management command operations.

typedef enum *_netc_tb_access_mode* netc_tb_access_mode_t
Table Access Method.

typedef enum *_netc_cbd_version* netc_cbd_version_t
NTMP version.

typedef enum *_netc_cmd_error* netc_cmd_error_t
Table command response error status.

typedef union *_netc_cmd_bd* netc_cmd_bd_t
The Switch/SI command BD data structure.

typedef struct *_netc_cmd_bdr_config* netc_cmd_bdr_config_t
Configuration for the Switch/SI command BD Ring Configuration.

typedef struct *_netc_cmd_bdr* netc_cmd_bdr_t
The Switch/SI command BD ring handle data structure.

typedef struct *_netc_tb_common_header* netc_tb_common_header_t
Table request data buffer common header.

typedef enum *_netc_fm_vlan_ud_act* netc_fm_vlan_ud_act_t
Frame Modification VLAN Update/Delete Action.

Note: Misconfiguration error if replace or delete action is specified and if VLAN tag is not present in frame.

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typedef enum *_netc_fm_sqt_act* netc_fm_sqt_act_t
Frame Modification Sequence Tag Action.

Note: Must be set to 000b for Ingress frame modification, otherwise misconfiguration error..

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typedef enum *_netc_fm_vlan_ar_act* netc_fm_vlan_ar_act_t
Frame Modification VLAN Add/Replace Action.

Note: For ingress frame modificaion with 00b or 01b, use the ingress port to select PCP and DEI from the Bridge port default VLAN register (BPDVR). For egress frame modification with 00b or 01b, use the internal QoS associated with the frame (IPV, DR) to access the QoS to PCP mapping profile (PQOSMR[QVMP] , QOSVLANMPaR0/1/2/3) to set the new PCP value. Use internal DR associated with frame to access the DR to DEI mapping profile (PPCPDEIMR[DRnDEI]) to set the new DEI value.

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typedef enum *_netc_tb_eteid_access_mode* netc_tb_eteid_access_mode_t

Define FDB/L2MCF/IS table entry access the primary Egress Treatment table entry group mode.

Note: The FDB/L2 IPv4 Multicast filter table has precedence over any assignment made via the Ingress Stream table. For Mulit port mode, the index to access the Egress Treatment table is computed by adding an offset to the base index of the Egress Treatment group. That offset is derived from the applicability bitmap as follows: starting from the lowest significant bit of the bitmap, the first encountered bit set to 1, corresponds to offset 0, and so on. This continues till the destination port location in the bitmap is reached

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typedef enum *_netc_tb_ipf_update_action* netc_tb_ipf_update_action_t

Ingress Port Filter Table Update Actions.

typedef enum *_netc_tb_ipf_attr_mask* netc_tb_ipf_attr_mask_t

Ingress Port Filter frame attribute mask.

typedef enum *_netc_tb_ipf_seq_tag* netc_tb_ipf_seq_tag_t

Ingress Port Filter frame attribute Sequence Tag Code.

typedef enum *_netc_tb_ipf_l4_header* netc_tb_ipf_l4_header_t

Ingress Port Filter frame attribute L4 Header Code.

typedef struct *_netc_tb_ipf_keye* netc_tb_ipf_keye_t

Ingress Port Filter key element.

typedef enum *_netc_tb_ipf_forward_action* netc_tb_ipf_forward_action_t

Ingress port filter forwarding Action.

typedef enum *_netc_tb_ipf_filter_action* netc_tb_ipf_filter_action_t

Ingress port filter Filter Action.

typedef struct *_netc_tb_ipf_cfge* netc_tb_ipf_cfge_t

Ingress port filter config element.

typedef struct *_netc_tb_ipf_stse* netc_tb_ipf_stse_t

Ingress port filter statistic element.

typedef struct *_netc_tb_ipf_req_data* netc_tb_ipf_req_data_t

Ingress port filter table entry config.

typedef struct *_netc_tb_ipf_rsp_data* netc_tb_ipf_rsp_data_t

Ingress port filter table response data.

typedef struct *_netc_tb_ipf_data* netc_tb_ipf_data_t

Ingress Port filter table data buffer.

typedef struct *_netc_tb_ipf_config* netc_tb_ipf_config_t

Ingress Port filter entry config.

typedef enum *_netc_tb_isi_key_type* netc_tb_isi_key_type

Stream identification table key type.

typedef struct *_netc_tb_isi_keye* netc_tb_isi_keye_t

Stream identification table key element.

typedef struct *_netc_tb_isi_cfge* netc_tb_isi_cfge_t

Stream identification table config element.

typedef struct *_netc_tb_isi_req_data* netc_tb_isi_req_data_t

Stream identification table request data buffer.

typedef struct *_netc_tb_isi_rsp_data* netc_tb_isi_rsp_data_t
Stream identification table request response data buffer.

typedef struct *_netc_tb_isi_data* netc_tb_isi_data_t
Stream identification table data buffer.

typedef struct *_netc_tb_isi_config* netc_tb_isi_config_t
Stream identification table entry config.

typedef enum *_netc_tb_is_isq_action* netc_tb_is_isq_action_t
Ingress Stream table Ingress Sequence Action.

typedef enum *_netc_tb_is_forward_action* netc_tb_is_forward_action_t
Ingress Stream table forwarding Action.

typedef enum *_netc_tb_is_ctd_mode* netc_tb_is_ctd_mode_t
Ingress Stream table Cut-Through Disable mode.

typedef *netc_tb_eteid_access_mode_t* netc_tb_is_oeteid_mode_t
Ingress Stream table Override ET_EID mode.

typedef struct *_netc_tb_is_cfge* netc_tb_is_cfge_t
Ingress Stream table config element.

typedef struct *_netc_tb_is_req_data* netc_tb_is_req_data_t
Ingress Stream table request data buffer.

typedef struct *_netc_tb_is_rsp_data* netc_tb_is_rsp_data_t
Ingress Stream table request response data buffer.

typedef struct *_netc_tb_is_data* netc_tb_is_data_t
Ingress Stream table data buffer.

typedef struct *_netc_tb_is_config* netc_tb_is_config_t
Ingress Stream table entry config.

typedef struct *_netc_tb_isf_keye* netc_tb_isf_keye_t
Ingress Stream Filter table key element.

typedef struct *_netc_tb_isf_cfge* netc_tb_isf_cfge_t
Ingress Stream Filter table config element.

typedef struct *_netc_tb_isf_req_data* netc_tb_isf_req_data_t
Ingress Stream Filter table request data buffer.

typedef struct *_netc_tb_isf_rsp_data* netc_tb_isf_rsp_data_t
Ingress Stream Filter table request response data buffer.

typedef struct *_netc_tb_isf_data* netc_tb_isf_data_t
Ingress Stream Filter table data buffer.

typedef struct *_netc_tb_isf_config* netc_tb_isf_config_t
Ingress Stream Filter table entry config.

typedef enum *_netc_tb_rp_update_action* netc_tb_rp_update_action_t
Rate Policer Table Update Actions.

typedef *netc_tc_sdu_type_t* netc_tb_rp_sdu_type_t
Rate Policer Table Protocol/Service Data Unit Type.

typedef struct *_netc_tb_rp_cfge* netc_tb_rp_cfge_t
Rate Policer table config element.

typedef struct *_netc_tb_rp_fee* netc_tb_rp_fee_t
Rate Policer table Function Enable element.

typedef struct *_netc_tb_rp_pse* netc_tb_rp_pse_t
Rate Policer table Policer State element.

typedef struct *_netc_tb_rp_stse* netc_tb_rp_stse_t
Rate Policer table statistic element.

typedef struct *_netc_tb_rp_req_data* netc_tb_rp_req_data_t
Rate Policer table request data buffer.

typedef struct *_netc_tb_rp_rsp_data* netc_tb_rp_rsp_data_t
Rate Policer table request response data buffer.

typedef struct *_netc_tb_rp_data* netc_tb_rp_data_t
Rate Policer table data buffer.

typedef struct *_netc_tb_rp_config* netc_tb_rp_config_t
Rate Policer table entry config.

typedef struct *_netc_tb_isc_stse* netc_tb_isc_stse_t
Ingress Stream Count table statistic element.

typedef struct *_netc_tb_isc_req_data* netc_tb_isc_req_data_t
Ingress Stream Count table request data buffer.

typedef struct *_netc_tb_isc_rsp_data* netc_tb_isc_rsp_data_t
Ingress Stream Count table request response data buffer.

typedef struct *_netc_tb_isc_data* netc_tb_isc_data_t
Ingress Stream Count table data buffer.

typedef enum *_netc_tb_sgi_update_action* netc_tb_sgi_update_action_t
Stream Gate Instance table Update Actions.

typedef *netc_tc_sdu_type_t* netc_tb_sgi_sdu_type_t
Stream Gate Instance table Protocol/Service Data Unit Type.

typedef enum *_netc_tb_sgi_state* netc_tb_sgi_state_t
Stream Gate Instance State.

typedef struct *_netc_tb_sgi_cfge* netc_tb_sgi_cfge_t
Stream Gate Instance table config element.

typedef struct *_netc_tb_sgi_acfge* netc_tb_sgi_acfge_t
Stream Gate Instance table Admin Configuration element.

typedef struct *_netc_tb_sgi_icfge* netc_tb_sgi_icfge_t
Stream Gate Instance table Initial Configuration element.

typedef struct *_netc_tb_sgi_sgise* netc_tb_sgi_sgise_t
Stream Gate Instance table stream gate instance state element.

typedef struct *_netc_tb_sgi_req_data* netc_tb_sgi_req_data_t
Stream Gate Instance table request data buffer.

typedef struct *_netc_tb_sgi_rsp_data* netc_tb_sgi_rsp_data_t
Stream Gate Instance table request response data buffer.

typedef struct *_netc_tb_sgi_data* netc_tb_sgi_data_t
Stream Gate Instance table data buffer.

typedef struct *_netc_tb_sgi_config* netc_tb_sgi_config_t

Stream Gate Instance table entry config.

typedef struct *_netc_sgcl_gate_entry* netc_sgcl_gate_entry_t

Defines the Stream Gate Control entry structure.

typedef struct *_netc_tb_sgcl_cfge* netc_tb_sgcl_cfge_t

Stream Gate Control List table config element.

typedef struct *_netc_tb_sgcl_sgclse* netc_tb_sgcl_sgclse_t

Stream Gate Control List table Stream Gate Control List State element.

typedef struct *_netc_tb_sgcl_req_data* netc_tb_sgcl_req_data_t

Stream Gate Control List table request data buffer.

typedef struct *_netc_tb_sgcl_rsp_data* netc_tb_sgcl_rsp_data_t

Stream Gate Control List table request response data buffer.

typedef struct *_netc_tb_sgcl_data* netc_tb_sgcl_data_t

Stream Gate Control List table data buffer.

typedef struct *_netc_tb_sgcl_gcl* netc_tb_sgcl_gcl_t

Stream Gate Control List table entry gate control list structure.

typedef enum *_netc_tb_fm_layer2_act* netc_tb_fm_layer2_act_t

Frame Modification table Layer 2 Actions.

Note: This field must be set to 0 for traffic destined to a pseudo link. This field must be set to 0 for any device with ASIL-B safety requirements.

---

typedef enum *_netc_tb_fm_mac_header_act* netc_tb_fm_mac_header_act_t

Frame Modification table Layer 2 Header MAC Actions.

Note: Ingress frame modifications only support kNETC_NoAction or kNETC_ReplDmac.

---

typedef enum *_netc_tb_fm_vlan_header_act* netc_tb_fm_vlan_header_act_t

Frame Modification table Layer 2 VLAN Actions.

Note: For use Delete or Replace action, if no outer VLAN header is present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

---

typedef enum *_netc_tb_fm_outer_vid_act* netc_tb_fm_outer_vid_act_t

Frame Modification table Layer 2 outer VLAN VID Actions.

Note: For use kNETC_UseFrameVID action, if no outer VLAN header is present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

---

typedef *netc_fm_sqt_act_t* netc_tb_fm_sqt_act_t

Frame Modification table Sequence Tag Action.

Note: For use kNETC_ReomveTag action, If R-TAG/draft 2.0 R-TAG/HSR tag not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

---

typedef enum *_netc_tb_fm_outer_tpid_act* netc_tb_fm_outer_tpid_act_t

Frame Modification table Outer TPID action.

Note: For use kNETC_UseFrameTpid action, If outer VLAN header not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

typedef enum *_netc_tb_fm_outer_pcp_act* netc_tb_fm_outer_pcp_act_t

Frame Modification table Outer PCP action.

Note: For use kNETC_UseFramePcp/kNETC_UseFramePcpMap action, If outer VLAN header not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

typedef enum *_netc_tb_fm_outer_dei_act* netc_tb_fm_outer_dei_act_t

Frame Modification table Outer DEI action.

Note: For use kNETC_UseFrameDei action, If outer VLAN header not present, then a misconfiguration event will be generated and handled according to the port's PFMCR register.

typedef enum *_netc_tb_fm_payload_act* netc_tb_fm_payload_act_t

Frame Modification table Payload Actions.

Note: This field must be set to 0 for traffic destined to a pseudo link. This field must be set to 0 for any device with ASIL-B safety requirements.

typedef struct *_netc_tb_fm_cfge* netc_tb_fm_cfge_t

Frame Modification table config element.

typedef struct *_netc_tb_fm_req_data* netc_tb_fm_req_data_t

Frame Modification table request data buffer.

typedef struct *_netc_tb_fm_rsp_data* netc_tb_fm_rsp_data_t

Frame Modification table request response data buffer.

typedef struct *_netc_tb_fm_data* netc_tb_fm_data_t

Frame Modification table data buffer.

typedef struct *_netc_tb_fm_config* netc_tb_fm_config_t

Frame Modification table entry config.

typedef struct *_netc_tb_fmd_req_data* netc_tb_fmd_req_data_t

Frame Modification Data table request data buffer.

typedef struct *_netc_tb_fmd_rsp_data* netc_tb_fmd_rsp_data_t

Frame Modification Data table request response data buffer.

typedef struct *_netc_tb_fmd_data* netc_tb_fmd_data_t

Frame Modification Data table data buffer.

typedef struct *_netc_tb_fmd_update_config* netc_tb_fmd_update_config_t

Frame Modification data table entry update config.

typedef struct *_netc_tb_fmd_query_buffer* netc_tb_fmd_query_buffer_t

Frame Modification data table entry query data buffer.

typedef struct *_netc_tb_vf_keye* netc_tb_vf_keye_t
Vlan Filter table key element.

typedef struct *_netc_tb_vf_cfge* netc_tb_vf_cfge_t
Vlan Filter table config element.

typedef struct *_netc_tb_vf_search_criteria* netc_tb_vf_search_criteria_t
Vlan Filter table search criteria format.

typedef struct *_netc_tb_vf_req_data* netc_tb_vf_req_data_t
Vlan Filter table request data buffer.

typedef struct *_netc_tb_vf_rsp_data* netc_tb_vf_rsp_data_t
Vlan Filter table request response data buffer.

typedef struct *_netc_tb_vf_data* netc_tb_vf_data_t
Vlan Filter table data buffer.

typedef struct *_netc_tb_vf_config* netc_tb_vf_config_t
Vlan Filter table entry config.

typedef enum *_netc_tb_fdb_update_action* netc_tb_fdb_update_action_t
FDB table Update Actions.

typedef *netc_tb_eteid_access_mode_t* netc_tb_fdb_oeteid_mode_t
FDB table entry defined the egress packet processing actions (will cover the actions which specified in the Egress Treatment table)

typedef enum *_netc_tb_fdb_ctd_mode* netc_tb_fdb_ctd_mode_t
FDB table Cut-Through Disable mode.

typedef struct *_netc_tb_fdb_keye* netc_tb_fdb_keye_t

typedef struct *_netc_tb_fdb_cfge* netc_tb_fdb_cfge_t
FDB table configuration element.

typedef struct *_netc_tb_fdb_acte* netc_tb_fdb_acte_t
FDB table Activity element.

typedef enum *_netc_tb_fdb_sc_keye_mc* netc_tb_fdb_sc_keye_mc_t
FDB table search criteria Key Element Match Criteria.

typedef enum *_netc_tb_fdb_sc_cfge_mc* netc_tb_fdb_sc_cfge_mc_t
FDB table search criteria Configuration Element Match Criteria.

typedef enum *_netc_tb_fdb_sc_acte_mc* netc_tb_fdb_sc_acte_mc_t
FDB table search criteria Activity Element Match Criteria.

typedef struct *_netc_tb_fdb_search_criteria* netc_tb_fdb_search_criteria_t
FDB table search criteria format.

typedef struct *_netc_tb_fdb_req_data* netc_tb_fdb_req_data_t
FDB table request data buffer.

typedef struct *_netc_tb_fdb_rsp_data* netc_tb_fdb_rsp_data_t
FDB table request response data buffer.

typedef struct *_netc_tb_fdb_data* netc_tb_fdb_data_t
FDB table data buffer.

typedef struct *_netc_tb_fdb_config* netc_tb_fdb_config_t
FDB table entry config.

typedef enum *_netc_tb_l2mcf_key_type* netc_tb_l2mcf_key_type_t
L2 IPV4 Multicast Filter table key type.

typedef struct *_netc_tb_l2mcf_keye* netc_tb_l2mcf_keye_t
L2 IPV4 Multicast Filter table key element.

typedef enum *_etc_tb_l2mcf_sc_keye_mc* etc_tb_l2mcf_sc_keye_mc_t
L2 IPV4 Multicast Filter table search criteria Key Element Match Criteria.

typedef enum *_etc_tb_l2mcf_sc_cfge_mc* etc_tb_l2mcf_sc_cfge_mc_t
L2 IPV4 Multicast Filter table search criteria Configuration Element Match Criteria.

typedef enum *_etc_tb_l2mcf_sc_acte_mc* etc_tb_l2mcf_sc_acte_mc_t
FDB table search criteria Activity Element Match Criteria.

typedef *netc_tb_fdb_cfge_t* netc_tb_l2mcf_cfge_t
L2 IPV4 Multicast Filter table config element.

typedef *netc_tb_fdb_acte_t* netc_tb_l2mcf_acte_t
L2 IPV4 Multicast Filter table activity lement.

typedef struct *_etc_tb_l2mcf_search_criteria* netc_tb_l2mcf_search_criteria_t
L2 IPV4 Multicast Filter table search criteria format.

typedef struct *_netc_tb_l2mcf_req_data* netc_tb_l2mcf_req_data_t
L2 IPV4 Multicast Filter table request data buffer.

typedef struct *_netc_tb_l2mcf_rsp_data* netc_tb_l2mcf_rsp_data_t
L2 IPV4 Multicast Filter table request response data buffer.

typedef struct *_netc_tb_l2mcf_data* netc_tb_l2mcf_data_t
L2 IPV4 Multicast Filter table data buffer.

typedef struct *_netc_tb_l2mcf_config* netc_tb_l2mcf_config_t
L2 IPV4 Multicast Filter table entry config.

typedef enum *_netc_tb_iseqg_sqtag* netc_tb_iseqg_sqtag_t
Sequence Tag Type.

typedef struct *_netc_tb_iseqg_cfge* netc_tb_iseqg_cfge_t
Ingress Sequence Generation table config element.

typedef struct *_netc_tb_iseqg_sgse* netc_tb_iseqg_sgse_t
Ingress Sequence Generation table Sequence generation state element.

typedef struct *_netc_tb_iseqg_req_data* netc_tb_iseqg_req_data_t
Ingress Sequence Generation table request data buffer.

typedef struct *_netc_tb_iseqg_rsp_data* netc_tb_iseqg_rsp_data_t
Ingress Sequence Generation table request response data buffer.

typedef struct *_netc_tb_iseqg_data* netc_tb_iseqg_data_t
Ingress Sequence Generation table data buffer.

typedef struct *_netc_tb_iseqg_config* netc_tb_iseqg_config_t
Ingress Sequence Generation table entry config.

typedef enum *_netc_tb_iseqg_update_action* netc_tb_iseqg_update_action_t
Ingress Sequence Generation Table Update Actions.

typedef enum *_netc_tb_eseqr_sqtag* netc_tb_eseqr_sqtag_t
Egress Sequence Recovery table Sequence Tag Type.

typedef struct *_netc_tb_eseqr_cfge* netc_tb_eseqr_cfge_t
Egress Sequence Recovery table config element.

typedef struct *_netc_tb_eseqr_stse* netc_tb_eseqr_stse_t
Egress Sequence Recovery table statistic element.

typedef struct *_netc_tb_eseqr_srse* netc_tb_eseqr_srse_t
Egress Sequence Recovery table sequence recovery state element.

typedef struct *_netc_tb_eseqr_req_data* netc_tb_eseqr_req_data_t
Egress Sequence Recovery table request data buffer.

typedef struct *_netc_tb_eseqr_rsp_data* netc_tb_eseqr_rsp_data_t
Egress Sequence Recovery table request response data buffer.

typedef struct *_netc_tb_eseqr_data* netc_tb_eseqr_data_t
Egress Sequence Recovery table data buffer.

typedef struct *_netc_tb_eseqr_config* netc_tb_eseqr_config_t
Egress Sequence Recovery table entry config.

typedef enum *_netc_tb_tgs_entry_id* netc_tb_tgs_entry_id_t
Time Gate Scheduling table entry ID for switch and ENETC.

typedef enum *_netc_tb_tgs_gate_type* netc_tb_tgs_gate_type_t
Administrative gate operation type.

typedef struct *_netc_tgs_gate_entry* netc_tgs_gate_entry_t
Defines the Time Gate Scheduling gate control entry structure.

typedef struct *_netc_tb_tgs_cfge* netc_tb_tgs_cfge_t
Time Gate Scheduling table config element.

typedef struct *_netc_tb_tgs_olse* netc_tb_tgs_olse_t
Time Gate Scheduling table statistic element.

typedef struct *_netc_tb_tgs_req_data* netc_tb_tgs_req_data_t
Time Gate Scheduling table request data buffer.

typedef struct *_netc_tb_tgs_rsp_data* netc_tb_tgs_rsp_data_t
Time Gate Scheduling table request response data buffer.

typedef struct *_netc_tb_tgs_data* netc_tb_tgs_data_t
Time Gate Scheduling table data buffer, set with max size.

typedef struct *_netc_tb_tgs_gcl* netc_tb_tgs_gcl_t
Time Gate Scheduling table entry gate control list structure.

typedef enum *_netc_tb_et_efm_mode* netc_tb_et_efm_mode_t
Egress Frame Modification entry mode.

typedef enum *_netc_tb_et_esq_act* netc_tb_et_esq_act_t
Egress Sequence Actions.

typedef enum *_netc_tb_et_ec_act* netc_tb_et_ec_act_t
Egress Counter Action.

typedef struct *_netc_tb_et_cfge* netc_tb_et_cfge_t
Egress Treatment table config element.

typedef struct *_netc_tb_et_req_data* netc_tb_et_req_data_t
Egress Treatment table request data buffer.

typedef struct *_netc_tb_et_rsp_data* netc_tb_et_rsp_data_t
Egress Treatment table request response data buffer.

typedef struct *_netc_tb_et_data* netc_tb_et_data_t
Egress Treatment table data buffer.

typedef struct *_netc_tb_et_config* netc_tb_et_config_t
Egress Treatment table entry config.

typedef enum *_netc_tb_etmcq_update_action* netc_tb_etmcq_update_action_t
ETM Class Queue table Update Actions.

typedef struct *_netc_tb_etmcq_cfge* netc_tb_etmcq_cfge_t
ETM Class Queue table config element.

typedef struct *_netc_tb_etmcq_stse* netc_tb_etmcq_stse_t
ETM Class Queue table statistic element.

typedef struct *_netc_tb_etmcq_req_data* netc_tb_etmcq_req_data_t
ETM Class Queue table request data buffer.

typedef struct *_netc_tb_etmcq_rsp_data* netc_tb_etmcq_rsp_data_t
ETM Class Queue table request response data buffer.

typedef struct *_netc_tb_etmcq_data* netc_tb_etmcq_data_t
ETM Class Queue table data buffer.

typedef struct *_netc_tb_etmcq_config* netc_tb_etmcq_config_t
ETM Class Queue table entry config.

typedef enum *_netc_tb_etmcs_entry_id* netc_tb_etmcs_entry_id_t
ETM Class Scheduler table entry ID.

typedef enum *_netc_tb_etmcs_ca_assg* netc_tb_etmcs_ca_assg_t
ETM Class Scheduler table Class queue assignment to scheduler inputs mode.

typedef struct *_netc_tb_etmcs_cfge* netc_tb_etmcs_cfge_t
ETM Class Scheduler table config element.

typedef struct *_netc_tb_etmcs_req_data* netc_tb_etmcs_req_data_t
ETM Class Scheduler table request data buffer.

typedef struct *_netc_tb_etmcs_rsp_data* netc_tb_etmcs_rsp_data_t
ETM Class Scheduler table request response data buffer.

typedef struct *_netc_tb_etmcs_data* netc_tb_etmcs_data_t
ETM Class Scheduler table data buffer.

typedef struct *_netc_tb_etmcs_config* netc_tb_etmcs_config_t
ETM Class Scheduler table entry config.

typedef struct *_netc_tb_etmcg_cfge* netc_tb_etmcg_cfge_t
ETM Congestion Group table config element.

typedef struct *_netc_tb_etmcg_stse* netc_tb_etmcg_stse_t
ETM Congestion Group table statistic element.

typedef struct *_netc_tb_etmcg_req_data* netc_tb_etmcg_req_data_t
ETM Congestion Group table request data buffer.

typedef struct *_netc_tb_etmcg_rsp_data* netc_tb_etmcg_rsp_data_t
ETM Congestion Group table request response data buffer.

typedef struct *_netc_tb_etmcg_data* netc_tb_etmcg_data_t
ETM Congestion Group table data buffer.

typedef struct *_netc_tb_etmcg_config* netc_tb_etmcg_config_t
ETM Congestion Group table entry config.

typedef struct *_netc_tb_ec_stse* netc_tb_ec_stse_t
Egress Count table statistic element.

typedef struct *_netc_tb_ec_req_data* netc_tb_ec_req_data_t
Egress Count table request data buffer.

typedef struct *_netc_tb_ec_rsp_data* netc_tb_ec_rsp_data_t
Egress Count table request response data buffer.

typedef struct *_netc_tb_ec_data* netc_tb_ec_data_t
Egress Count table data buffer.

typedef enum *_netc_tb_bp_fc_cfg* netc_tb_bp_fc_cfg_t
Buffer Pool Flow Control (FC) Configuration.

typedef struct *_netc_tb_bp_cfge* netc_tb_bp_cfge_t
Buffer Pool table config element.

typedef struct *_netc_tb_bp_bpse* netc_tb_bp_bpse_t
Buffer Pool table State Element Data.

typedef struct *_netc_tb_bp_req_data* netc_tb_bp_req_data_t
Buffer Pool table request data buffer.

typedef struct *_netc_tb_bp_rsp_data* netc_tb_bp_rsp_data_t
Buffer Pool table request response data buffer.

typedef struct *_netc_tb_bp_data* netc_tb_bp_data_t
Buffer Pool table data buffer.

typedef struct *_netc_tb_bp_config* netc_tb_bp_config_t
Buffer Pool table entry config.

typedef struct *_netc_tb_sbp_cfge* netc_tb_sbp_cfge_t
Shared Buffer Pool table config element.

typedef struct *_netc_tb_sbp_sbpse* netc_tb_sbp_sbpse_t
Shared Buffer Pool table State Element Data.

typedef struct *_netc_tb_sbp_req_data* netc_tb_sbp_req_data_t
Shared Buffer Pool table request data buffer.

typedef struct *_netc_tb_sbp_rsp_data* netc_tb_sbp_rsp_data_t
Shared Buffer Pool table request response data buffer.

typedef struct *_netc_tb_sbp_data* netc_tb_sbp_data_t
Shared Buffer Pool table data buffer.

typedef struct *_netc_tb_sbp_config* netc_tb_sbp_config_t
Shared Buffer Pool table entry config.

typedef union *_netc_tb_data_buffer* netc_tb_data_buffer_t
Table common data buffer.

typedef struct *_netc_cbdr_hw* netc_cbdr_hw_t
Register group for SI/Switch command bd ring.

typedef struct *_netc_cbdr_handle* netc_cbdr_handle_t

Handle for common part of EP/Switch NTMP.

status_t NETC_CmdBDRInit(*netc_cbdr_hw_t* *base, const *netc_cmd_bdr_config_t* *config)

Initialize the command BD ring.

Parameters

- base –
- config –

Returns
kStatus_Success

Returns
kStatus_Fail

status_t NETC_CmdBDRDeinit(*netc_cbdr_hw_t* *base)

Deinitialize the command BD ring.

Parameters

- base –

Returns
kStatus_Success

status_t NETC_CmdBDSendCommand(*netc_cbdr_hw_t* *base, *netc_cmd_bdr_t* *cbdr, *netc_cmd_bd_t* *cbd, *netc_cbd_version_t* version)

Send the Command Buffer Descriptor to operate on a NTMP table.

Parameters

- base –
- cbdr –
- cbd –
- version –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddIPFTableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_ipf_config_t* *config, uint32_t *entryID)

Add entry into the ingress Port Filter Table.

Parameters

- handle –
- config –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_UpdateIPFTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_ipf_cfge_t* *cfg)

Update entry in the ingress Port Filter Table.

Parameters

- handle –
- entryID –
- cfg –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QueryIPFTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_ipf_config_t* *config)

Query entry in the ingress Port Filter Table.

Parameters

- handle –
- entryID –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelIPFTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete an entry in the ingress Port Filter Table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_ResetIPFMatchCounter(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Reset the counter of an ingress port filter Table entry.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_GetIPFMatchedCount(*netc_cbdr_handle_t* *handle, uint32_t entryID, uint64_t *count)

Get the matched count of an ingress port filter Table entry.

Parameters

- handle –
- entryID –

- count –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddISITableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_isi_config_t* *config, uint32_t *entryID)

Add entry into Ingress Stream Identification table.

Parameters

- handle –
- config –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelISITableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete an entry in Ingress stream identification table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QueryISITableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_isi_config_t* *config)

Query Ingress Stream Identification table.

Parameters

- handle –
- entryID –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QueryISITableEntryWithKey(*netc_cbdr_handle_t* *handle, *netc_tb_isi_keye_t* *keye, *netc_tb_isi_rsp_data_t* *rsp)

Query Ingress Stream Identification table with key.

Parameters

- handle –
- keye –
- rsp –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddOrUpdateISTableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_is_config_t* *config, bool isAdd)

Add or update entry in Ingress Stream table.

Parameters

- handle –
- config –
- isAdd –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QueryISTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_is_config_t* *config)

Query Ingress Stream table.

Parameters

- handle –
- entryID –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelISTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete an entry in Ingress stream table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddISFTableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_isf_config_t* *config, uint32_t *entryID)

Add entry into ingress stream filter table.

Parameters

- handle –
- config –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_UpdateISFTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_isf_cfge_t* *cfg)

Update entry into ingress stream filter table.

Parameters

- handle –
- entryID –
- cfg –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelISFTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete an entry in Ingress stream filter table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QueryISFTableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_isf_keye_t* *keye, *netc_tb_isf_rsp_data_t* *rsp)

Query entry from the Ingress stream filter table.

Parameters

- handle –
- keye –
- rsp –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddISCTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Add entry in ingress stream count table.

Parameters

- handle –
- entryID –

Returns
status_t

status_t NETC_GetISCStatistic(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_isc_stse_t* *statistic)

Get ingress stream count statistic.

Parameters

- handle –
- entryID –
- statistic –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_ResetISCStatistic(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Reset the count of the ingress stream count.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddOrUpdateSGITableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_sgi_config_t* *config, bool isAdd)

Add or update entry in stream gate instance table.

Parameters

- handle –
- config –
- isAdd –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_ResetIRXOEXSGITableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Reset IRX and OEX flags in stream gate instance entry.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelSGITableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete entry in the stream gate instance table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_GetSGIState(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_sgi_sgise_t* *statis)

Get statistic of specified stream gate instance table entry.

Parameters

- handle –
- entryID –
- statis –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QuerySGITableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_sgi_config_t* *config)

Query entry from the stream gate instance table.

Parameters

- handle –
- entryID –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddSGCLTableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_sgcl_gcl_t* *config)

Add entry into Stream Gate Control List Table.

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelSGCLTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete entry of Stream Gate Control List Table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_GetSGCLGateList(*netc_cbdr_handle_t* *handle, *netc_tb_sgcl_gcl_t* *gcl, uint32_t length)

Get Stream Gate Control List Table entry gate control list.

Parameters

- handle –
- gcl –
- length –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_GetSGCLState(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_sgcl_sgclse_t* *state)

Get state (ref count) for Stream Gate Control List table entry.

Parameters

- handle –
- entryID –
- state –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_QueryRPTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_rp_rsp_data_t* *rsp)

Query entry from the Rate Policer table.

Parameters

- handle –
- entryID –
- rsp –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_AddOrUpdateRPTableEntry(*netc_cbdr_handle_t* *handle, *netc_tb_rp_config_t* *config, *netc_tb_cmd_t* cmd)

Add or update entry in Rate Policer table.

Parameters

- handle –
- config –

- cmd –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_DelRPTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Delete entry in the Rate Policer table.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_GetRPStatistic(*netc_cbdr_handle_t* *handle, uint32_t entryID, *netc_tb_rp_stse_t* *statis)

Get statistic of specified Rate Policer table entry.

Parameters

- handle –
- entryID –
- statis –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_ResetMRRPTableEntry(*netc_cbdr_handle_t* *handle, uint32_t entryID)

Reset mark red parameter of specified Rate Policer table entry.

Parameters

- handle –
- entryID –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_ConfigTGSAdminList(*netc_cbdr_handle_t* *handle, *netc_tb_tgs_gcl_t* *config)

Config the QBV (Time Gate Scheduling)

Parameters

- handle –
- config –

Returns
status_t

Returns
See netc_cmd_error_t

status_t NETC_GetTGSOperationList(*netc_cbdr_handle_t* *handle, *netc_tb_tgs_gcl_t* *gcl, uint32_t length)

Get time gate table operation list.

Parameters

- handle –
- gcl –
- length –

Returns
status_t

Returns
See netc_cmd_error_t

NETC_FD_EID_ENCODE_OPTION_0(entryId)

Frame Modification Entry ID encode options.

Note: sqta should be netc_fm_sqt_act_t type, vuda should be netc_fm_vlan_ud_act_t type and vara should be netc_fm_vlan_ar_act_t type.

NETC_FD_EID_ENCODE_OPTION_1(sqta, vuda)

NETC_FD_EID_ENCODE_OPTION_2(vara, vid)

NETC_ISI_VLAN_FRAME_KEY(valid, pcp, vid)

2 Bytes VLAN field which may added to the frame Key

NETC_TB_SGCL_MAX_ENTRY

Stream Gate Control List Table maximum gate control list length.

NETC_TB_FMD_UPDATE_CONFIG_LENGTH(x)

TFrame Modification Data table update config Data Buffer length, x is the number of update data bytes.

NETC_TB_TGS_MAX_ENTRY

Time Gate Scheduling Table maximum gate control list length (TGSTCAPR[MAX_GCL_LEN])

NETC_TB_ETM_CQ_ENTRY_ID(portID, cqID)

ETM Class Queue table entry ID macro, cqID is represents the Class Queue ID ,rang in 0 ~ 7, portID is Switch ID, rang in 0 ~ 4.

NETC_TB_ETM_CG_ENTRY_ID(portID, cgID)

ETM Congestion Group table entry ID macro, cgID is represents the Congestion Group ID ,rang in 0 ~ 7, portID is Switch ID, rang in 0 ~ 4.

NETC_TB_BP_THRESH(mant, exp)

Buffer pool and shared buffer pool threshold macro, the threshold = MANT*2^EXP, uint is internal memory words (avergae of 20 bytes each)

union _netc_cmd_bd

#include <fsl_netc.h> The Switch/SI command BD data structure.

Public Members

struct *_netc_cmd_bd* req

struct *_netc_cmd_bd* resp

struct *_netc_cmd_bd* generic

struct __netc_cmd_bdr_config

#include <fsl_netc.h> Configuration for the Switch/SI command BD Ring Configuration.

Public Members

netc_cmd_bd_t *bdBase

BDR base address which shall be 128 bytes aligned

uint16_t bdLength

Size of BD ring which shall be multiple of 8 BD

bool enCompInt

Enable/Disable command BD completion interrupt

struct __netc_cmd_bdr

#include <fsl_netc.h> The Switch/SI command BD ring handle data structure.

Public Members

netc_cmd_bd_t *bdBase

BDR base address which shall be 128 bytes aligned

uint16_t bdLength

Size of BD ring

uint16_t producerIndex

Current index for execution.

uint16_t cleanIndex

Current index for cleaning.

bool bdrEnable

Current command BD ring is enable or not.

struct __netc_tb_common_header

#include <fsl_netc.h> Table request data buffer common header.

Public Members

uint32_t updateActions

Update Actions

uint32_t queryActions

Query Actions

struct __netc_tb_ipf_keye

#include <fsl_netc.h> Ingress Port Filter key element.

Public Members

uint16_t precedence

Precedence value of an entry

struct *_netc_tb_ipf_keye* frameAttr

Frame Attribute flags

uint16_t frameAttrMask
: Frame attribute mask, set with OR of netc_tb_ipf_attr_mask_t

uint16_t dscp
: Differentiated Services Code Point

uint16_t dscpMask
: Differentiated Services Code Point Mask

uint16_t srcPort
: Source Port ID

uint16_t srcPortMask
: Source Port ID Mask

uint16_t outerVlanTCI
: Outer VLAN Tag Control Information

uint16_t outerVlanTCIMask
: Outer VLAN Tag Control Information Mask

uint8_t dmac[6]
: Destination MAC Address

uint8_t dmacMask[6]
: Destination MAC Address Mask

uint8_t smac[6]
: Source MAC Address

uint8_t smacMask[6]
: Source MAC Address Mask

uint16_t innerVlanTCI
: Inner VLAN Tag Control Information

uint16_t innerVlanTCIMask
: Inner VLAN Tag Control Information Mask

uint16_t etherType
: 2-byte EtherType

uint16_t etherTypeMask
: EtherType Mask

uint8_t IPProtocol
: IP Protocol

uint8_t IPProtocolMask
: IP Protocol Mask

uint8_t srcIPAddr[16]
: IP Source Address, Bits 127-0: IPv6 source address, Bits 127-96: IPv4 source address

uint8_t srcIPAddrMask[16]
: IP Source Address Mask

uint16_t l4SrcPort
: L4 Source Port

uint16_t l4SrcPortMask
: L4 Source Port Mask

uint8_t destIPAddr[16]
: IP Destination Address, Bits 127-0: IPv6 source address, Bits 127-96: IPv4 source address

uint8_t destIPAddrMask[16]
: IP Destination Address Mask

uint16_t l4DestPort
: L4 Destination Port

uint16_t l4DestPortMask
: L4 Destination Port Mask

struct __netc_tb_ipf_cfge
: *#include <fsl_netc.h>* Ingress port filter config element.

Public Members

uint32_t ipv
: Internal Priority Value

uint32_t oipv
: Overwrite IPV

uint32_t dr
: Drop Resilience

uint32_t odr
: Overwrite DR

netc_tb_ipf_forward_action_t fltfa
: Filter Forwarding action.

uint32_t imire
: Ingress Mirroring Enable

uint32_t wolte
: Wake-onLAN trigger enable

netc_tb_ipf_filter_action_t flta
: FIlter Action.

uint32_t rpr
: Relative Precedent Resolution

uint32_t ctd
: Cut through disable.

netc_host_reason_t hr
: Host Reason metadata when frame is redirected/copied to the switch management port

uint32_t timecape
: Timestam capture enable

uint32_t fltaTgt
: Target for selected switch forwarding action or filter action

struct __netc_tb_ipf_stse
: *#include <fsl_netc.h>* Ingress port filter statistic element.

Public Members

uint32_t matchCount[2]
A count of how many times this entry has been matched.

struct __netc_tb_ipf_req_data
#include <fsl_netc.h> Ingress port filter table entry config.

struct __netc_tb_ipf_rsp_data
#include <fsl_netc.h> Ingress port filter table response data.

Public Members

uint32_t entryID
Present only for commands which perform a query

netc_tb_ipf_keye_t keye
Present only for commands which perform a query

netc_tb_ipf_stse_t stse
Present only for commands which perform a query

netc_tb_ipf_cfge_t cfge
Present only for commands which perform a query

struct __netc_tb_ipf_data
#include <fsl_netc.h> Ingress Port filter table data buffer.

struct __netc_tb_ipf_config
#include <fsl_netc.h> Ingress Port filter entry config.

struct __netc_tb_isi_keye
#include <fsl_netc.h> Stream identification table key element.

Public Members

netc_tb_isi_key_type keyType
Define the key type used for the current isi entry

uint8_t srcPortID
Source Port ID, used when kc portp filed is 1. Only for SWITCH

uint8_t spm
Source Port Masquerading, used when kc spm filed is 1. Only for SWITCH

uint8_t framekey[16]
Frame portion of the key.

struct __netc_tb_isi_cfge
#include <fsl_netc.h> Stream identification table config element.

Public Members

uint32_t iSEID
Ingress stream entry ID, 0xFFFFFFFF means NULL

struct __netc_tb_isi_req_data
#include <fsl_netc.h> Stream identification table request data buffer.

struct __netc_tb_isi_rsp_data
#include <fsl_netc.h> Stream identification table request response data buffer.

Public Members

uint32_t entryID
: Only present for query command

netc_tb_isi_keye_t keye
: Only present for query command

netc_tb_isi_cfge_t cfge
: Only present for query command

struct __netc_tb_isi_data
: *#include <fsl_netc.h>* Stream identification table data buffer.

struct __netc_tb_isi_config
: *#include <fsl_netc.h>* Stream identification table entry config.

struct __netc_tb_is_cfge
: *#include <fsl_netc.h>* Ingress Stream table config element.

Public Members

uint32_t sfe
: Stream Filtering Enable

uint32_t ipv
: Internal Priority Value, active when opiv is set to 1

uint32_t oipv
: Override internal priority value

uint32_t dr
: Drop Resilience, active when odr is set to 1

uint32_t odr
: Overwrite DR

uint32_t imire
: Ingress Mirroring Enable, not applicable to ENETC

uint32_t timecape
: Timestamp Capture Enable, not applicable to ENETC

uint32_t sppd
: Source Port Pruning Disable, not applicable to ENETC

netc_tb_is_isq_action_t isqa
: Ingress Sequence Action, not applicable to ENETC

uint32_t orp
: Override Rate Policer ID

uint32_t osgi
: Override stream gate instance entry id (default is NULL)

netc_host_reason_t hr
: Host Reason when frame is redirected (fa = 01b) to the switch management port or copied to the switch management port (fa = 100b or 101b), value specified has to be a software defined Host Reason (8-15).

netc_tb_is_forward_action_t fa
: Forwad Option

netc_tc_sdu_type_t sduType

Service Data Unit Type to user for MSDU

uint32_t msdu

Maximum Service Data Unit

uint32_t ifmeLenChange

Ingress Frame Modification Entry Frame Length Change, specified in unit of bytes using a 2's complement notation

uint32_t eport

Egress Port which need do egress packet processing, active when oeteid is set to 1, not applicable to ENETC

netc_tb_is_oeteid_mode_t oETEID

Override ET_EID (Egress Treatment table entry, which specified egress packet processing actions)

netc_tb_is_ctd_mode_t ctd

Cut-Through Disable mode, valid if fa = 010b ~ 101b

uint32_t isqEID

Ingress Sequence Generation Entry ID, Valid when isqa is set to 1. 0xFFFF_FFFF is NULL. Not applicable to ENETC

uint32_t rpEID

Rate Policer Entry ID, Valid when orp =1. 0xFFFF_FFFF is NULL

uint32_t sgiEID

Stream Gate Instance Entry ID, Valid when osgi =1. 0xFFFF_FFFF is NULL

uint32_t ifmEID

Ingress Frame Modification Entry ID. 0xFFFF_FFFF is NULL

uint32_t etEID

Base Egress Treatment Entry ID for primary Egress Treatment group, Valid alid if fa = 010b ~ 101b. 0xFFFF_FFFF is NULL. Not applicable to ENETC

uint32_t iscEID

Ingress Stream counter Index. 0xFFFF_FFFF is NULL.

uint32_t ePortBitmap

Egress Port bitmap, identifies the ports to which the frame is to be forwarding or ET applicability port bitmap when oETEID = 10b. Not applicable to ENETC

uint32_t siMap

Station Interface Map, only valid for ENETC function when fa field is set to 10b

struct __netc_tb_is_req_data

#include <fsl_netc.h> Ingress Stream table request data buffer.

Public Members

netc_tb_is_cfge_t cfge

Only perform for update or add command

struct __netc_tb_is_rsp_data

#include <fsl_netc.h> Ingress Stream table request response data buffer.

Public Members

uint32_t entryID
: Only perform for query command

netc_tb_is_cfge_t cfge
: Only perform for query command

struct __netc_tb_is_data
: *#include <fsl_netc.h>* Ingress Stream table data buffer.

struct __netc_tb_is_config
: *#include <fsl_netc.h>* Ingress Stream table entry config.

struct __netc_tb_isf_keye
: *#include <fsl_netc.h>* Ingress Stream Filter table key element.

Public Members

uint32_t isEID
: Ingress Stream Entry ID

uint8_t pcp
: Priority Code Point, Outer VLAN TAG PCP of the received frame

struct __netc_tb_isf_cfge
: *#include <fsl_netc.h>* Ingress Stream Filter table config element.

Public Members

uint32_t ipv
: Internal Priority Value, active when opiv is set to 1

uint32_t oipv
: Override internal priority value

uint32_t dr
: Drop Resilience, active when odr is set to 1

uint32_t odr
: Overwrite DR

uint32_t imire
: Ingress Mirroring Enable, not applicable to ENETC

uint32_t timecape
: Timestamp Capture Enable, not applicable to ENETC

uint32_t osgi
: Override stream gate instance entry id

uint32_t ctd
: Cut-Through Disable, will disable cut-through for all destined ports when set 1, not applicable to ENETC

uint32_t orp
: Override Rate Policer (instance) ID

netc_tc_sdu_type_t sduType
: Service Data Unit Type to user for MSDU

uint32_t msdu
: Maximum Service Data Unit

uint32_t rpEID
: Rate Policer Entry ID, Valid when orp =1. 0xFFFF_FFFF is NULL

uint32_t sgiEID
: Stream Gate Instance Entry ID, Valid when osgi =1. 0xFFFF_FFFF is NULL

uint32_t iscEID
: Ingress Stream counter Index. 0xFFFF_FFFF is NULL.

struct __netc_tb_isf_req_data
: *#include <fsl_netc.h>* Ingress Stream Filter table request data buffer.

Public Members

netc_tb_isf_cfge_t cfge
: Only perform for update or add command

struct __netc_tb_isf_rsp_data
: *#include <fsl_netc.h>* Ingress Stream Filter table request response data buffer.

Public Members

uint32_t entryID
: Only perform for query command

netc_tb_isf_keye_t keye
: Only perform for query command

netc_tb_isf_cfge_t cfge
: Only perform for query command

struct __netc_tb_isf_data
: *#include <fsl_netc.h>* Ingress Stream Filter table data buffer.

struct __netc_tb_isf_config
: *#include <fsl_netc.h>* Ingress Stream Filter table entry config.

struct __netc_tb_rp_cfge
: *#include <fsl_netc.h>* Rate Policer table config element.

Public Members

uint32_t cir
: Committed information Rate

uint32_t cbs
: Commited Burst Size

uint32_t eir
: Excess information Rate

uint32_t ebs
: Excess Burst Size

uint32_t mren
: Mark All Frames Red Enable, Not valid when ndor=1

uint32_t doy
: Drop on Yellow enable

uint32_t cm
: Color mode, 0b = Color blind, 1b = Color aware

uint32_t cf
: Coupling flag, enables coupling the Committed (C) bucket and Excess (E) bucket

uint32_t ndor
: No drop on red

netc_tb_rp_sdu_type_t sduType
: Service Data Unit Type

uint32_t ___pad0___
: Reserved

struct __netc__tb__rp__fee
: *#include <fsl_netc.h>* Rate Policer table Function Enable element.

Public Members

uint8_t fen
: Function Enable

uint8_t ___pad0___
: Reserved

struct __netc__tb__rp__pse
: *#include <fsl_netc.h>* Rate Policer table Policer State element.

Public Members

uint8_t mr
: Mark Red Flag

uint8_t res0
: Reserved

struct __netc__tb__rp__stse
: *#include <fsl_netc.h>* Rate Policer table statistic element.

Public Members

uint32_t byteCount[2]
: Number of bytes received by the rate policer instance

uint32_t dropFrames[2]
: Number of frames dropped by the rate policer instance

uint32_t dr0GrnFrames[2]
: Number of frames marked green with DR=0 by the rate policer instance

uint32_t dr1GrnFrames[2]
: Number of frames marked green with DR=1 by the rate policer instance

uint32_t dr2GrnFrames[2]
: Number of frames marked yellow with DR=2 by the rate policer instance

uint32_t remarkYlwFrames[2]
Number of frames re-marked from green to yellow by the rate policer instance

uint32_t dr3RedFrames[2]
Number of frames marked red with DR=3 by the rate policer instance

uint32_t remarkRedFrames[2]
Number of frames re-marked from green or yellow to red by the rate policer instance

uint32_t lts
Last timestamp

uint32_t bci
Committed token bucket contents, integer portion (31 bits)

uint32_t bcs
Committed token bucket sign bit (1 bit)

uint32_t bcf
Committed token bucket contents, fractional portion (31 bits)

uint32_t bei
Excess token bucket contents, integer portion (32 bits)

uint32_t bef
Excess token bucket contents, fractional portion (31 bits)

uint32_t bes
Committed token bucket sign bit

struct __netc_tb_rp_req_data
#include <fsl_netc.h> Rate Policer table request data buffer.

struct __netc_tb_rp_rsp_data
#include <fsl_netc.h> Rate Policer table request response data buffer.

Public Members

uint32_t entryID
Present only for commands which perform a query

netc_tb_rp_stse_t stse
Present only for commands which perform a query

struct __netc_tb_rp_data
#include <fsl_netc.h> Rate Policer table data buffer.

struct __netc_tb_rp_config
#include <fsl_netc.h> Rate Policer table entry config.

struct __netc_tb_isc_stse
#include <fsl_netc.h> Ingress Stream Count table statistic element.

Public Members

uint32_t rxCount
Receive Count

uint32_t msduDropCount
MSDU Drop Count

uint32_t policerDropCount
: Policer Drop Count

uint32_t sgDropCount
: Stream Gating Drop Count

struct __netc_tb_isc_req_data
: *#include <fsl_netc.h>* Ingress Stream Count table request data buffer.

struct __netc_tb_isc_rsp_data
: *#include <fsl_netc.h>* Ingress Stream Count table request response data buffer.

struct __netc_tb_isc_data
: *#include <fsl_netc.h>* Ingress Stream Count table data buffer.

struct __netc_tb_sgi_cfge
: *#include <fsl_netc.h>* Stream Gate Instance table config element.

Public Members

uint8_t oexen
: Octets Exceeded (Gate Closed Due To Octets Exceeded function) Enable

uint8_t irxen
: Invalid Receive (Gate Closed Due To Invalid Rx) Enable

netc_tb_sgi_sdu_type_t sduType
: The type of PDU/SDU for Interval Octets Maximum check for Gate Entry

struct __netc_tb_sgi_acfge
: *#include <fsl_netc.h>* Stream Gate Instance table Admin Configuration element.

Public Members

uint32_t adminSgclEID
: Administrative Stream Gate Control List Entry ID, 0xFFFFFFFF is NULL

uint32_t adminBaseTime[2]
: Admin Base Time

uint32_t adminCycleTimeExt
: Admin Cycle Time Extension

struct __netc_tb_sgi_icfge
: *#include <fsl_netc.h>* Stream Gate Instance table Initial Configuration element.

Public Members

uint8_t ipv
: Internal Priority Value (IPV), Valid if oipv is 1

uint8_t oipv
: Override frame IPV, otherwise the IPV value is determined by the stream gate control list entry

uint8_t gst
: Specifies Gate State before the administrative stream gate control list takes affect, 0b = Closed; 1b = Open

uint8_t ctd

Specifies Cut Through disable status before the administrative stream gate control list takes affect , Not applicable to ENETC function

struct __netc_tb_sgi_sgise

#include <fsl_netc.h> Stream Gate Instance table stream gate instance state element.

Public Members

uint32_t operSgclEID

Operational Stream Gate Control List Entry ID

uint32_t configChangeTime[2]

Configuration Change Time

uint32_t operBaseTime[2]

Operational Base Time

uint32_t operCycleTimeExt

Oper Cycle Time Extension

uint32_t oex

Octets Exceeded Flag

uint32_t irx

Invalid Receive Flag

netc_tb_sgi_state_t state

Current Gate Instance State

struct __netc_tb_sgi_req_data

#include <fsl_netc.h> Stream Gate Instance table request data buffer.

struct __netc_tb_sgi_rsp_data

#include <fsl_netc.h> Stream Gate Instance table request response data buffer.

struct __netc_tb_sgi_data

#include <fsl_netc.h> Stream Gate Instance table data buffer.

struct __netc_tb_sgi_config

#include <fsl_netc.h> Stream Gate Instance table entry config.

struct __netc_sgcl_gate_entry

#include <fsl_netc.h> Defines the Stream Gate Control entry structure.

Public Members

uint32_t timeInterval

Time Interval for Gate Entry

uint32_t iom

Interval Octets Maximum for Gate Entry, specifies the maximum bytes (octets) allowed to pass (open), valid if iomen = 1

uint32_t ipv

Internal Priority Value for Gate Entry

uint32_t oipv

Override Internal Priority Value for Gate Entry

uint32_t ctd
: Cut Through Disable for Gate Entry

uint32_t iomen
: Interval Octet Maximum Enabled for Gate Entry, 0b = Don'track count, 1b = Track count

uint32_t gtst
: Gate State for Gate Entry, 0b = Closed; 1b = Open

struct __netc_tb_sgcl_cfge
: *#include <fsl_netc.h>* Stream Gate Control List table config element.

Public Members

uint32_t cycleTime
: Cycle Time

uint8_t listLength
: List Length

uint16_t extOipv
: Extension (means the stream gate control list ends and before cycleTime restarts) Override Internal Priority Value

uint16_t extIpv
: List Extension Internal Priority Value, valid if extOipv = 1

uint16_t extCtd
: Extension Cut Through Disabled, 0b = No action, 1b = Disabled

uint16_t extGtst
: Extension Gate State, 0b = closed, 1b = Open

struct __netc_tb_sgcl_sgclse
: *#include <fsl_netc.h>* Stream Gate Control List table Stream Gate Control List State element.

Public Members

uint8_t refCount
: Reference Count, 1 indicates that the gate control list is an administrative or an operational gate control list in a stream gate instance

struct __netc_tb_sgcl_req_data
: *#include <fsl_netc.h>* Stream Gate Control List table request data buffer.

struct __netc_tb_sgcl_rsp_data
: *#include <fsl_netc.h>* Stream Gate Control List table request response data buffer.

struct __netc_tb_sgcl_data
: *#include <fsl_netc.h>* Stream Gate Control List table data buffer.

struct __netc_tb_sgcl_gcl
: *#include <fsl_netc.h>* Stream Gate Control List table entry gate control list structure.

Public Members

uint16_t extOipv
: Extension (means the stream gate control list ends and before cycleTime restarts) Override Internal Priority Value

uint16_t extIpv
: List Extension Internal Priority Value, valid if extOipv = 1

uint16_t extCtd
: Extension Cut Through Disabled, 0b = No action, 1b = Disabled

uint16_t extGtst
: Extension Gate State, 0b = closed, 1b = Open

uint32_t cycleTime
: Cycle Time

uint32_t numEntries
: Control List entry numbers

netc_sgcl_gate_entry_t *gcList
: Pointer to stream gate control list array

struct __netc_tb_fm_cfge
: *#include <fsl_netc.h>* Frame Modification table config element.

Public Members

netc_tb_fm_layer2_act_t l2Act
: Layer 2 Actions

netc_tb_fm_mac_header_act_t macHdrAct
: Layer 2 Header MAC Actions

netc_tb_fm_vlan_header_act_t vlanHdrAct
: Layer 2 VLAN Actions

netc_tb_fm_outer_vid_act_t outerVidAct
: Outer VID Actions

netc_tb_fm_sqt_act_t sqtAct
: Sequence Tag Action, Not applicable for ingress frame modifications

uint16_t smacPort
: Source MAC Address Register Port, valid if macHdrAct=010b,011b,100b

uint8_t dmac[6]
: Destination MAC Address, valid if macHdrAct = 011b,101b

uint32_t outerVlanID
: Outer VLAN VID, valid if outerVidAct = 01b

uint32_t outerVlanPcp
: Outer VLAN PCP, valid if outerPcpAct = 01b

uint32_t outerVlanDei
: Outer VLAN DEI, valid if outerDeiAct = 01b

netc_tb_fm_outer_tpid_act_t outerTpidAct
: Outer TPID action

netc_tb_fm_outer_pcp_act_t outerPcpAct
: Outer PCP action

netc_tb_fm_outer_dei_act_t outerDeiAct
: Outer DEI action

netc_tb_fm_payload_act_t pldAct
: Payload Actions, Not applicable for ingress frame modifications

uint8_t pldOffset
: Payload Offset, valid if outerPldAct = 010b

uint16_t fmdBytes
: Frame Modification Bytes, valid if outerPldAct = 001b,010b or l2Act = 1b

uint32_t fmdEID
: Frame Modification Data Entry ID, valid if outerPldAct = 001b,010b or l2Act = 1b. 0xFFFF is null pointer

struct __netc_tb_fm_req_data
: *#include <fsl_netc.h>* Frame Modification table request data buffer.

struct __netc_tb_fm_rsp_data
: *#include <fsl_netc.h>* Frame Modification table request response data buffer.

struct __netc_tb_fm_data
: *#include <fsl_netc.h>* Frame Modification table data buffer.

struct __netc_tb_fm_config
: *#include <fsl_netc.h>* Frame Modification table entry config.

struct __netc_tb_fmd_req_data
: *#include <fsl_netc.h>* Frame Modification Data table request data buffer.

Public Members

uint8_t cfge[]
: Configuration Element Data size is variable

struct __netc_tb_fmd_rsp_data
: *#include <fsl_netc.h>* Frame Modification Data table request response data buffer.

Public Members

uint8_t cfge[]
: Configuration Element Data size is variable

struct __netc_tb_fmd_data
: *#include <fsl_netc.h>* Frame Modification Data table data buffer.

struct __netc_tb_fmd_update_config
: *#include <fsl_netc.h>* Frame Modification data table entry update config.

Public Members

uint32_t res
: Hold for request->commonHeader

uint8_t cfge[]
: Configuration Element Data size is variable

struct __netc_tb_fmd_query_buffer
: *#include <fsl_netc.h>* Frame Modification data table entry query data buffer.

Public Members

uint32_t entryID
: EntryID of the queried entry

uint8_t cfge[]
: Configuration Element Data size is variable

struct __netc_tb_vf_keye
: *#include <fsl_netc.h>* Vlan Filter table key element.

struct __netc_tb_vf_cfge
: *#include <fsl_netc.h>* Vlan Filter table config element.

Public Members

uint32_t portMembership
: Port Membership Bitmap

uint32_t stgID
: Spanning Tree Group Member ID

uint32_t fid
: Filtering ID

uint32_t mlo
: MAC Learning Options

uint32_t mfo
: MAC Forwarding Options

uint32_t ipmfe
: IP Multicast Filtering Enable

uint32_t ipmfle
: IP Multicast Flooding Enable

uint32_t etaPortBitmap
: Egress Treatment Applicability Port Bitmap for the secondary Egress Treatment group

uint32_t baseETEID
: Base Egress Treatment Entry ID for the secondary Egress Treatment group

struct __netc_tb_vf_search_criteria
: *#include <fsl_netc.h>* Vlan Filter table search criteria format.

Public Members

uint32_t resumeEntryId
: Resume Entry ID, when starting a search, pass the NULL Entry ID.

struct __netc_tb_vf_req_data
: *#include <fsl_netc.h>* Vlan Filter table request data buffer.

Public Members

netc_tb_vf_cfge_t cfge
: Present only for update or add commands

struct __netc_tb_vf_rsp_data
: *#include <fsl_netc.h>* Vlan Filter table request response data buffer.

Public Members

uint32_t status
: Present only for query command with search access method

uint32_t entryID
: Present only for query command

netc_tb_vf_keye_t keye
: Present only for query command

netc_tb_vf_cfge_t cfge
: Present only for query command

struct __netc_tb_vf_data
: *#include <fsl_netc.h>* Vlan Filter table data buffer.

struct __netc_tb_vf_config
: *#include <fsl_netc.h>* Vlan Filter table entry config.

struct __netc_tb_fdb_keye
: *#include <fsl_netc.h>*

Public Members

uint8_t macAddr[6]
: Destination MAC address of the frame for MAC forwarding lookups and the source MAC address of the frame for MAC learning lookups

uint32_t fid
: Filtering ID, is obtained from an ingress lookup into the VLAN Filter table

struct __netc_tb_fdb_cfge
: *#include <fsl_netc.h>* FDB table configuration element.

Public Members

uint32_t portBitmap
: Forwarding destination Port Bitmap and ET applicability port bitmap when oETEID = 10b

netc_tb_fdb_oeteid_mode_t oETEID
: Override ET_EID option

uint32_t ePort
: Egress Ports, active when oETEid = 01b or ctd = 01b

uint32_t iMirE
: Ingress Mirroring Enable

netc_tb_fdb_ctd_mode_t ctd
: Cut-Through Disable

uint32_t dynamic
: Static or Dynamic Entry, 0b = Static entry, 1b = Dynamic entry

uint32_t timeCapE
: Timestamp Capture Enable when set

uint32_t etEID

Base egress treatment table entry id for primary Egress Treatment group, is valid if the oETEID field is set to value other than kNETC_FDBNoEPP. 0xFFFFFFFF is NULL.

struct __netc_tb_fdb_acte

#include <fsl_netc.h> FDB table Activity element.

Public Members

uint8_t actCnt

Activity Counter

uint8_t actFlag

Activity Flag

struct __netc_tb_fdb_search_criteria

#include <fsl_netc.h> FDB table search criteria format.

Public Members

uint32_t resumeEntryId

Resume Entry ID, pass the NULL Entry ID when starting a search

netc_tb_fdb_keye_t keye

Key Element data which used to match against the table entries

netc_tb_fdb_cfge_t cfge

Configuration Element data which used to match against the table entries

struct __netc_tb_fdb_req_data

#include <fsl_netc.h> FDB table request data buffer.

Public Members

netc_tb_common_header_t commonHeader

Define update actions (use netc_tb_fdb_update_action_t) and query actions

netc_tb_fdb_cfge_t cfge

Present only for commands which perform an update or add

struct __netc_tb_fdb_rsp_data

#include <fsl_netc.h> FDB table request response data buffer.

Public Members

uint32_t status

RESUME_ENTRY_ID, valid only in responses for commands which use the Search Access Method

uint32_t entryID

Present only for query command

netc_tb_fdb_keye_t keye

Present only for query command

netc_tb_fdb_cfge_t cfge

Present only for query command

netc_tb_fdb_acte_t acte
Present only for query command

struct __netc__tb__fdb__data
#include <fsl_netc.h> FDB table data buffer.

struct __netc__tb__fdb__config
#include <fsl_netc.h> FDB table entry config.

struct __netc__tb__l2mcf__keye
#include <fsl_netc.h> L2 IPV4 Multicast Filter table key element.

Public Members

netc_tb_l2mcf_key_type_t keyType
Key Type

uint32_t fid
Filtering ID

uint32_t ipv4DestAddr
IPv4 Destination Address

uint32_t ipv4SrcAddr
IPv4 Source Address

struct __etc__tb__l2mcf__search__criteria
#include <fsl_netc.h> L2 IPV4 Multicast Filter table search criteria format.

Public Members

uint32_t resumeEntryId
Resume Entry ID, pass the NULL Entry ID when starting a search

netc_tb_l2mcf_keye_t keye
Key Element data which used to match against the table entries

netc_tb_l2mcf_cfge_t cfge
Configuration Element data which used to match against the table entries

struct __netc__tb__l2mcf__req__data
#include <fsl_netc.h> L2 IPV4 Multicast Filter table request data buffer.

struct __netc__tb__l2mcf__rsp__data
#include <fsl_netc.h> L2 IPV4 Multicast Filter table request response data buffer.

struct __netc__tb__l2mcf__data
#include <fsl_netc.h> L2 IPV4 Multicast Filter table data buffer.

struct __netc__tb__l2mcf__config
#include <fsl_netc.h> L2 IPV4 Multicast Filter table entry config.

struct __netc__tb__iseqg__cfge
#include <fsl_netc.h> Ingress Sequence Generation table config element.

Public Members

netc_tb_iseqg_sqtag_t sqTag
Sequence Tag Type.

uint8_t ___pad0___
Reserved.

struct __netc__tb__iseqg__sgse
#include <fsl_netc.h> Ingress Sequence Generation table Sequence generation state element.

Public Members

uint16_t sqgNum
Sequence Generation Number

struct __netc__tb__iseqg__req__data
#include <fsl_netc.h> Ingress Sequence Generation table request data buffer.

struct __netc__tb__iseqg__rsp__data
#include <fsl_netc.h> Ingress Sequence Generation table request response data buffer.

struct __netc__tb__iseqg__data
#include <fsl_netc.h> Ingress Sequence Generation table data buffer.

struct __netc__tb__iseqg__config
#include <fsl_netc.h> Ingress Sequence Generation table entry config.

struct __netc__tb__eseqr__cfge
#include <fsl_netc.h> Egress Sequence Recovery table config element.

Public Members

netc_tb_eseqr_sqtag_t sqTag
Sequence Tag, specify the expected sequence tag type in the frame

uint32_t sqrTnsq
Sequence Recovery Take No Sequence

uint32_t sqrAlg
Sequence Recovery Algorithm, 0b = Vector algorithm, 1b = Match algorithm

uint32_t sqrType
Sequence Recovery Function type, 0b = Sequence recovery function, 1b = Individual recovery function

uint32_t sqrHl
Sequence Recovery History Length, valid if sqrAlg = 0b

uint32_t sqrFwl
Sequence Recovery Future Window Length, valid if sqrAlg = 0b

uint32_t sqrTp
Sequence Timeout Period, the unit is 1.048576 milliseconds

struct __netc__tb__eseqr__stse
#include <fsl_netc.h> Egress Sequence Recovery table statistic element.

Public Members

uint32_t inOrderPackets[2]
: In Order Packets

uint32_t outOfOrderPackets[2]
: Out of Order Packets

uint32_t roguePackets[2]
: Rogue Packets

uint32_t duplicatePackets[2]
: Duplicate Packets

uint32_t lostPackets[2]
: Lost Packets

uint32_t taglessPackets[2]
: Tag-Less Packets

uint32_t esqrResetCounts
: Sequence Recovery Resets

struct __netc_tb_eseqr_srse
: *#include <fsl_netc.h>* Egress Sequence Recovery table sequence recovery state element.

Public Members

uint32_t sqrNum
: Sequence Recovery Number

uint32_t takeAny
: Take Any

uint32_t lce
: Lost Count Enable

uint32_t sqrTs
: Sequence Recovery Timestamp

uint32_t sqrHistory[4]
: Recovery History bit vector, each bit corresponding to sequence numbers, bit 1 means a packet with that sequence number has been previously received

struct __netc_tb_eseqr_req_data
: *#include <fsl_netc.h>* Egress Sequence Recovery table request data buffer.

struct __netc_tb_eseqr_rsp_data
: *#include <fsl_netc.h>* Egress Sequence Recovery table request response data buffer.

struct __netc_tb_eseqr_data
: *#include <fsl_netc.h>* Egress Sequence Recovery table data buffer.

struct __netc_tb_eseqr_config
: *#include <fsl_netc.h>* Egress Sequence Recovery table entry config.

struct __netc_tgs_gate_entry
: *#include <fsl_netc.h>* Defines the Time Gate Scheduling gate control entry structure.

Public Members

uint32_t interval
: Entry Time Interval

struct __netc_tb_tgs_cfge
: *#include <fsl_netc.h>* Time Gate Scheduling table config element.

Public Members

uint64_t adminBaseTime
: Administrative Base Time

uint32_t adminCycleTime
: Administrative Cycle Time

uint32_t adminCycleTimeExt
: Administrative Cycle Time Extension

uint32_t adminControlListLength
: Administrative Control List Length

netc_tgs_gate_entry_t adminGcl[]
: Administrative Gate control list

struct __netc_tb_tgs_olse
: *#include <fsl_netc.h>* Time Gate Scheduling table statistic element.

Public Members

uint64_t configChangeTime
: The time at which this operational gate control list became active

uint64_t configChangeError
: Count of error configuration changes

uint64_t operBaseTime
: Operational Base Time

uint32_t operCycleTime
: Operational Cycle Time

uint32_t operCycleTimeExt
: Operational Cycle Time Extension

uint32_t operControlListLength
: Operational Control List Length

netc_tgs_gate_entry_t operGcl[]
: Operational Gate control list

struct __netc_tb_tgs_req_data
: *#include <fsl_netc.h>* Time Gate Scheduling table request data buffer.

Public Members

netc_tb_tgs_cfge_t cfge
: Present only for commands which perform a update

struct __netc_tb_tgs_rsp_data
: *#include <fsl_netc.h>* Time Gate Scheduling table request response data buffer.

Public Members

uint32_t entryID
: Present only for commands which perform a query

netc_tb_tgs_cfge_t cfge
: Present only for commands which perform a query

netc_tb_tgs_olse_t olse
: Present only for commands which perform a query

struct __netc_tb_tgs_data
: *#include <fsl_netc.h>* Time Gate Scheduling table data buffer, set with max size.

struct __netc_tb_tgs_gcl
: *#include <fsl_netc.h>* Time Gate Scheduling table entry gate control list structure.

Public Members

uint64_t baseTime
: Base Time

uint32_t cycleTime
: Cycle Time

uint32_t extTime
: Cycle Time Extension

uint32_t numEntries
: Control List entry numbers

netc_tgs_gate_entry_t *gcList
: Pointer to time gate control list array

struct __netc_tb_et_cfge
: *#include <fsl_netc.h>* Egress Treatment table config element.

Public Members

netc_tb_et_efm_mode_t efmMode
: Egress Frame Modification mode

netc_tb_et_esq_act_t esqa
: Egress Sequence Actions

netc_tb_et_ec_act_t eca
: Egress Counter Action

uint8_t ___pad1___
: Reserve for data align

uint8_t efmLenChange
: Egress Frame Modification Length Change, specified in units of bytes using a 2's complement notation

uint16_t efmDataLen
: Egress Frame Modification Data Length

uint32_t efmEID
: Egress Frame Modification Entry Id

uint32_t ecEID
Egress Count Table Entry ID

uint32_t esqaTgtEID
Egress Sequence Actions Target Entry ID, active when esqa = 10b

struct __netc_tb_et_req_data
#include <fsl_netc.h> Egress Treatment table request data buffer.

struct __netc_tb_et_rsp_data
#include <fsl_netc.h> Egress Treatment table request response data buffer.

struct __netc_tb_et_data
#include <fsl_netc.h> Egress Treatment table data buffer.

struct __netc_tb_et_config
#include <fsl_netc.h> Egress Treatment table entry config.

struct __netc_tb_etmcq_cfge
#include <fsl_netc.h> ETM Class Queue table config element.

Public Members

netc_hw_etm_class_queue_idx_t cq2cgMap
Class Queue to Congestion Group Mapping

struct __netc_tb_etmcq_stse
#include <fsl_netc.h> ETM Class Queue table statistic element.

Public Members

uint32_t rejByteCnt[2]
Reject Byte Count

uint32_t rejFrameCnt[2]
Reject Frame Count

uint32_t deqByteCnt[2]
Dequeue Byte Count

uint32_t deqFrameCnt[2]
Dequeue Frame Count

uint32_t dropByteCnt[2]
Dropped Frames, Memory Lost

uint32_t dropFrameCnt[2]
Dropped Frames, Memory Recovered

uint32_t frmCnt
Frame Count

struct __netc_tb_etmcq_req_data
#include <fsl_netc.h> ETM Class Queue table request data buffer.

struct __netc_tb_etmcq_rsp_data
#include <fsl_netc.h> ETM Class Queue table request response data buffer.

struct __netc_tb_etmcq_data
#include <fsl_netc.h> ETM Class Queue table data buffer.

struct _netc_tb_etmcq_config

#include <fsl_netc.h> ETM Class Queue table entry config.

Public Members

uint32_t entryID

Need use NETC_TB_ETM_CQ_ENTRY_ID macro to create entry ID

struct _netc_tb_etmcs_cfge

#include <fsl_netc.h> ETM Class Scheduler table config element.

Public Members

netc_tb_etmcs_ca_assg_t cqAssg

Class Queue Assignment, input 0 to 7 are weighted fair whereby input 8 to 15 are strict priority

uint32_t oal

Overead accounting length

struct *_netc_tb_etmcs_cfge* wbfsWeight[8]

Weight for scheduler input 0 ~ 7, effective weight is: (2^x)/(1-(y/64))

struct _netc_tb_etmcs_req_data

#include <fsl_netc.h> ETM Class Scheduler table request data buffer.

Public Members

netc_tb_etmcs_entry_id_t entryID

One class scheduler entry per port

struct _netc_tb_etmcs_rsp_data

#include <fsl_netc.h> ETM Class Scheduler table request response data buffer.

struct _netc_tb_etmcs_data

#include <fsl_netc.h> ETM Class Scheduler table data buffer.

struct _netc_tb_etmcs_config

#include <fsl_netc.h> ETM Class Scheduler table entry config.

Public Members

netc_tb_etmcs_entry_id_t entryID

One class scheduler entry per port

struct _netc_tb_etmcg_cfge

#include <fsl_netc.h> ETM Congestion Group table config element.

Public Members

uint16_t tdDr0En

Tail drop enable for DR0 Frame

uint16_t tdDr1En

Tail drop enable for DR1 Frame

uint16_t tdDr2En
: Tail drop enable for DR2 Frame

uint16_t tdDr3En
: Tail drop enable for DR3 Frame

uint16_t oal
: Overhead accounting length, 2's complement value (range -2048 to +2047)

struct *_netc_tb_etmcg_cfge* tdDRThresh[4]
: Tail Drop Threshold (TA * 2^Tn) for DR0 ~ DR3 Frames, valid if tdDrnEn = 1b

struct _netc_tb_etmcg_stse
: *#include <fsl_netc.h>* ETM Congestion Group table statistic element.

Public Members

uint32_t byteCount[2]
: Number of bytes currently in use in all class queues that are members of this group.

struct _netc_tb_etmcg_req_data
: *#include <fsl_netc.h>* ETM Congestion Group table request data buffer.

struct _netc_tb_etmcg_rsp_data
: *#include <fsl_netc.h>* ETM Congestion Group table request response data buffer.

struct _netc_tb_etmcg_data
: *#include <fsl_netc.h>* ETM Congestion Group table data buffer.

struct _netc_tb_etmcg_config
: *#include <fsl_netc.h>* ETM Congestion Group table entry config.

Public Members

uint32_t entryID
: Need use NETC_TB_ETM_CG_ENTRY_ID macro to create entry ID

struct _netc_tb_ec_stse
: *#include <fsl_netc.h>* Egress Count table statistic element.

Public Members

uint32_t enqFrmCnt[2]
: Enqueued Frame Count

uint32_t rejFrmCnt[2]
: Rejected Frame Count

struct _netc_tb_ec_req_data
: *#include <fsl_netc.h>* Egress Count table request data buffer.

struct _netc_tb_ec_rsp_data
: *#include <fsl_netc.h>* Egress Count table request response data buffer.

struct _netc_tb_ec_data
: *#include <fsl_netc.h>* Egress Count table data buffer.

struct _netc_tb_bp_cfge
: *#include <fsl_netc.h>* Buffer Pool table config element.

Public Members

bool sbpEn

Shared Buffer Pool Enable, set true measn a shared buffer pool is associated with this buffer pool

netc_tb_bp_fc_cfg_t gcCfg

Flow Control (FC) Configuration

uint8_t pfcVector

Priority Flow Control (PFC) Vector, not support in NETC 3.0 and 3.1 version

uint16_t maxThresh

Maximum Threshold, value 0 means disable maximum threshold checking, use NETC_TB_BP_THRESH macro to set this value

uint16_t fcOnThresh

Flow Control On Threshold, If the buffer pool usage crosses this threshold, and if fcOnThresh is greater than fcOffThresh, the flow control state of the buffer pool is set to 1, use NETC_TB_BP_THRESH macro to set this value.

uint16_t fcOffThresh

Flow Control Off Threshold, If buffer pool usage drops to this threshold or below, the flow control state of the buffer pool is set to 0, , use NETC_TB_BP_THRESH macro to set this value

uint32_t sbpThresh

Shared Buffer Pool Threshold, use NETC_TB_BP_THRESH macro to set this value

uint32_t sbpEid

Shared Buffer Pool Entry ID, valid if sbpEn is true

uint32_t fcPorts

Flow Control Port bitmap, indicates which ports are to be flow controlled for this buffer pool

struct __netc_tb_bp_bpse

#include <fsl_netc.h> Buffer Pool table State Element Data.

Public Members

uint32_t amountUsed

Amount Used, number of internal memory words (average of 20 bytes each) currently in use in this buffer pool.

uint32_t amountUsedHWM

Amount Used High Watermark, value sticks at the highest AMOUNT_USED seen since the last watermark reset

uint32_t fcState

Flow Control (FC) State, ON (1) or OFF (0)

uint32_t bpd

Buffer Pool Disabled, 1 means the buffer pool has been disabled due to an uncorrectable ECC error

struct __netc_tb_bp_req_data

#include <fsl_netc.h> Buffer Pool table request data buffer.

struct __netc_tb_bp_rsp_data

#include <fsl_netc.h> Buffer Pool table request response data buffer.

struct _netc_tb_bp_data

#include <fsl_netc.h> Buffer Pool table data buffer.

struct _netc_tb_bp_config

#include <fsl_netc.h> Buffer Pool table entry config.

Public Members

uint32_t entryID

Buffer pool ID, range in 0 ~ (SWT_GetBPTableEntryNum() - 1)

netc_tb_bp_cfge_t cfge

Buffer Pool table config element

struct _netc_tb_sbp_cfge

#include <fsl_netc.h> Shared Buffer Pool table config element.

Public Members

uint32_t maxThresh

Maximum Threshold, If shared buffer pool usage is greater than or equal to this threshold, use NETC_TB_BP_THRESH macro to set this value

uint16_t fcOnThresh

Flow Control On Threshold, If the shared buffer pool usage crosses this threshold, and if fcOnThresh is greater than fcOffThresh, the flow control state of the buffer pool is set to 1, use NETC_TB_BP_THRESH macro to set this value.

uint16_t fcOffThresh

Flow Control Off Threshold, If shared buffer pool usage drops to this threshold or below, the flow control state of the buffer pool is set to 0, use NETC_TB_BP_THRESH macro to set this value

struct _netc_tb_sbp_sbpse

#include <fsl_netc.h> Shared Buffer Pool table State Element Data.

Public Members

uint32_t amountUsed

Amount Used, number of internal memory words (average of 20 bytes each) currently in use in this buffer pool.

uint32_t amountUsedHWM

Amount Used High Watermark, value sticks at the highest AMOUNT_USED seen since the last watermark reset

uint32_t fcState

Flow Control (FC) State, ON (1) or OFF (0)

struct _netc_tb_sbp_req_data

#include <fsl_netc.h> Shared Buffer Pool table request data buffer.

struct _netc_tb_sbp_rsp_data

#include <fsl_netc.h> Shared Buffer Pool table request response data buffer.

struct _netc_tb_sbp_data

#include <fsl_netc.h> Shared Buffer Pool table data buffer.

struct _netc_tb_sbp_config

#include <fsl_netc.h> Shared Buffer Pool table entry config.

Public Members

uint32_t entryID
: Shared Buffer pool ID, range in 0 ~ (SWT_GetSBPTableEntryNum() - 1)

netc_tb_sbp_cfge_t cfge
: Shared Buffer Pool table config element

union __netc_tb_data_buffer
: *#include <fsl_netc.h>* Table common data buffer.

Public Members

netc_tb_tgs_data_t tgs
: Time Gate Scheduling table data buffer

netc_tb_rp_data_t rp
: Rate Policer table data buffer

netc_tb_ipf_data_t ipf
: Ingress Port filter table data buffer

netc_tb_fdb_data_t fdb
: FDB table data buffer

netc_tb_l2mcf_data_t l2mcf
: L2 IPV4 Multicast Filter table data buffer

netc_tb_vf_data_t vf
: VLAN Filter table data buffer

netc_tb_isi_data_t isi
: Ingress Stream Identification table data buffer

netc_tb_is_data_t is
: Ingress Stream table data buffer

netc_tb_isf_data_t isf
: Ingress Stream Filter table data buffer

netc_tb_isc_data_t isc
: Ingress Stream Count table data buffer

netc_tb_sgi_data_t sgi
: Stream Gate Instance table data buffer

netc_tb_sgcl_data_t sgcl
: Stream Gate Control List table data buffer

netc_tb_fm_data_t fm
: Frame Modification table data buffer

netc_tb_fmd_data_t fmd
: Frame Modification Data table data buffer

netc_tb_et_data_t et
: Egress Treatment table data buffer

netc_tb_ec_data_t ec
: Egress Count table data buffer

netc_tb_etmcq_data_t cq
ETM Class Queue table data buffer

netc_tb_etmcs_data_t cs
ETM Class Scheduler table data buffer

netc_tb_etmcg_data_t cg
ETM Class Group table data buffer

netc_tb_iseqg_data_t iseqg
Ingress Sequence Generation table data buffer

netc_tb_eseqr_data_t eseqr
Egress Sequence Recovery table data buffer

netc_tb_bp_data_t bp
Buffer Pool table data buffer

netc_tb_sbp_data_t sbp
Shared Buffer Pool table data buffer

struct __netc_cbdr_hw
#include <fsl_netc_hw.h> Register group for SI/Switch command bd ring.

Public Members

___IO uint32_t CBDRMR
Command BDR mode register.

___I uint32_t CBDRSR
Command BDR status register.

___IO uint32_t CBDRBAR0
Command BDR base address register 0

___IO uint32_t CBDRBAR1
Command BDR base address register 1

___IO uint32_t CBDRPIR
Command BDR producer index register

___IO uint32_t CBDRCIR
Command BDR consumer index register

___IO uint32_t CBDRLENR
Command BDR length register

struct __netc_cbdr_handle
#include <fsl_netc_hw.h> Handle for common part of EP/Switch NTMP.

Public Members

netc_cbdr_hw_t *base
Point to hardware command bd ring register group.

netc_cmd_bdr_t *cmdr
Point to command BD ring handle.

netc_tb_data_buffer_t *buffer
Point to table common data buffer.

struct req

Public Members

uint64_t addr
: The request and response data buffers address

struct ___unnamed91___

Public Members

uint32_t resLength
: The length of the Response Data Buffer

uint32_t reqLength
: The length of the Request Data Buffer

struct ___unnamed93___

Public Members

netc_tb_cmd_t cmd
: Access table entry command, see netc_tb_cmd_t .

netc_tb_access_mode_t accessType
: Access table entry method, see netc_tb_access_mode_t.

uint32_t ___pad1___
: RSS Hash high field value.

uint32_t version
: Protocol Version.

uint32_t enCompInt
: Command Completion Interrupt.

uint32_t resReady
: Response Ready.

struct ___unnamed95___

Public Members

uint32_t npf
: NTMP Protocol Format.

struct resp

struct ___unnamed97___

Public Members

uint32_t numMatched
: Number of Entries Matched.

uint32_t error
: Error status.

uint32_t resReady
: Response Ready.

struct generic

Public Members

uint64_t addr
: Data.

uint32_t en
: Enable entry.

uint32_t siBitMap
: Station interfaces 15-0 for which this filter applies.

uint32_t index
: The index refers to an entry location within a table.

uint32_t length
: NA

uint32_t cmd
: Command.

uint32_t ___pad2___
: < Class of command.

uint32_t status
: Status.

uint32_t ci
: Completion interrupt.

uint32_t sf
: Short format.

struct frameAttr

Public Members

uint16_t swtPortMas
: Switch port masquerading, applicable only if the incoming port is designated as a switch management port

uint16_t ethernet
: Ethernet type Present

uint16_t outerVlan
: Outer VLAN Present

uint16_t innerVlan
: Inner VLAN Present

netc_tb_ipf_seq_tag_t seqTag
: Sequence Tag Code

uint16_t ipHeader
: IP Header Present

uint16_t ipVersion
: 0b = IPv4, 1b = IPv6

uint16_t ipExt
: IPv4 option / IPv6 extension present

netc_tb_ipf_l4_header_t l4Header
L4 Header code

uint16_t wakeOnLan
Wake-on-LAN Magic Packet Present

struct payload

Public Members

uint8_t data
Payload Byte n

uint8_t mask
Payload Byte n Mask

union ___unnamed101___

Public Members

netc_tb_ipf_keye_t keye

uint32_t entryID

uint32_t sCriteria

union ___unnamed103___

Public Members

netc_tb_ipf_req_data_t request

netc_tb_ipf_rsp_data_t response

union ___unnamed105___

Public Members

uint32_t entryID

uint32_t sCriteria

netc_tb_isi_keye_t keye

union ___unnamed107___

Public Members

netc_tb_isi_req_data_t request

netc_tb_isi_rsp_data_t response

union ___unnamed109___

Public Members

netc_tb_is_req_data_t request

netc_tb_is_rsp_data_t response

union ___unnamed111___

Public Members

uint32_t entryID

uint32_t sCriteria

netc_tb_isf_keye_t keye

union ___unnamed113___

Public Members

netc_tb_isf_req_data_t request

netc_tb_isf_rsp_data_t response

union ___unnamed115___

Public Members

netc_tb_rp_cfge_t cfge

Present only for commands which perform an update or add

struct __netc_tb_rp_req_data

struct ___unnamed117___

Public Members

netc_tb_rp_fee_t fee

Present only for commands which perform an update or add

union ___unnamed119___

Public Members

netc_tb_rp_cfge_t cfge

Present only for commands which perform a query

struct __netc_tb_rp_rsp_data

struct __netc_tb_rp_rsp_data

struct ___unnamed121___

Public Members

netc_tb_rp_fee_t fee

Present only for commands which perform a query

struct ___unnamed123___

Public Members

netc_tb_rp_pse_t pse

Present only for commands which perform a query

union ___unnamed125___

Public Members

netc_tb_rp_req_data_t request

netc_tb_rp_rsp_data_t response

union ___unnamed127___

Public Members

netc_tb_isc_req_data_t request

netc_tb_isc_rsp_data_t response

union ___unnamed129___

Public Members

netc_tb_sgi_sgise_t sgise

struct __netc_tb_sgi_rsp_data

struct ___unnamed131___

union ___unnamed133___

Public Members

netc_tb_sgi_req_data_t request

netc_tb_sgi_rsp_data_t response

union ___unnamed135___

Public Members

netc_tb_sgcl_req_data_t request

netc_tb_sgcl_rsp_data_t response

struct __netc_tb_sgcl_data

struct ___unnamed137___

union ___unnamed139___

Public Members

netc_tb_fm_req_data_t request

netc_tb_fm_rsp_data_t response

union ___unnamed141___

Public Members

netc_tb_fmd_req_data_t request

netc_tb_fmd_rsp_data_t response

union ___unnamed143___

Public Members

uint32_t entryID

netc_tb_vf_search_criteria_t sCriteria
Active when access method is kNETC_Search

netc_tb_vf_keye_t keye

union ___unnamed145___

Public Members

netc_tb_vf_req_data_t request

netc_tb_vf_rsp_data_t response

struct ___unnamed147___

Public Members

netc_tb_fdb_acte_t acte
Activity Element data which used to match against the table entries

netc_tb_fdb_sc_keye_mc_t keyeMc
Key Element data match criteria

netc_tb_fdb_sc_cfge_mc_t cfgeMc
Configuration Element data match criteria

netc_tb_fdb_sc_acte_mc_t acteMc
Activity Element data match criteria

union ___unnamed149___

Public Members

uint32_t entryID
Active when access method is kNETC_EntryIDMatch

netc_tb_fdb_keye_t keye
Active when access method is kNETC_ExactKeyMatch

netc_tb_fdb_search_criteria_t sCriteria
Active when access method is kNETC_Search

union ___unnamed151___

Public Members

netc_tb_fdb_req_data_t request

netc_tb_fdb_rsp_data_t response

struct ___unnamed153___

Public Members

netc_tb_l2mcf_acte_t acte
Activity Element data which used to match against the table entries

etc_tb_l2mcf_sc_keye_mc_t keyeMc
Key Element data match criteria

etc_tb_l2mcf_sc_cfge_mc_t cfgeMc
Configuration Element data match criteria

etc_tb_l2mcf_sc_acte_mc_t acteMc
Activity Element data match criteria

union ___unnamed155___

Public Members

uint32_t entryID

netc_tb_l2mcf_search_criteria_t sCriteria

netc_tb_l2mcf_keye_t keye

union ___unnamed157___

Public Members

netc_tb_l2mcf_req_data_t request

netc_tb_l2mcf_rsp_data_t response

union ___unnamed159___

Public Members

netc_tb_iseqg_req_data_t request

netc_tb_iseqg_rsp_data_t response

union ___unnamed161___

Public Members

netc_tb_eseqr_req_data_t request

netc_tb_eseqr_rsp_data_t response

union ___unnamed163___

Public Members

struct __netc_tgs_gate_entry

uint32_t gate

Entry Gate Mask

struct ___unnamed165___

Public Members

uint32_t tcGateState

Traffic Class Gate States for Gate Entry, 8 bits for 8 Traffic Class , 0b means Gate closed, 1b means Gate open

netc_tb_tgs_gate_type_t operType

Gate operation type (IEEE 802.1Q-2018) field for gate control list entry i

union ___unnamed167___

Public Members

netc_tb_tgs_req_data_t request

netc_tb_tgs_rsp_data_t response

struct __netc_tb_tgs_data

struct ___unnamed169___

union ___unnamed171___

Public Members

netc_tb_et_req_data_t request

netc_tb_et_rsp_data_t response

union ___unnamed173___

Public Members

netc_tb_etmcq_req_data_t request

netc_tb_etmcq_rsp_data_t response

struct wbfsWeight

Public Members

uint8_t xCode
: Weight code x value

uint8_t yCode
: Weight code y value

union ___unnamed176___

Public Members

netc_tb_etmcs_req_data_t request

netc_tb_etmcs_rsp_data_t response

struct tdDRThresh

Public Members

uint16_t tn
: TA

uint16_t ta
: Tn

union ___unnamed179___

Public Members

netc_tb_etmcg_req_data_t request

netc_tb_etmcg_rsp_data_t response

union ___unnamed181___

Public Members

netc_tb_ec_req_data_t request

netc_tb_ec_rsp_data_t response

union ___unnamed183___

Public Members

netc_tb_bp_req_data_t request

netc_tb_bp_rsp_data_t response

union ___unnamed185___

Public Members

netc_tb_sbp_req_data_t request

netc_tb_sbp_rsp_data_t response

2.80 NETC MDIO Driver

2.81 MDIO initialization module

enum _netc_mdio_type

Enumeration for the MAC port MDIO type.

Values:

enumerator kNETC_EMdio

Bound handle to EMDIO access, submodule of NETC.

enumerator kNETC_InternalMdio

Bound handle to MAC port internal MDIO access, submodule of EP/Switch.

enumerator kNETC_ExternalMdio

Bound handle to MAC port external MDIO access, submodule of EP/Switch.

typedef enum *_netc_mdio_type* netc_mdio_type_t

Enumeration for the MAC port MDIO type.

typedef struct *_netc_mdio* netc_mdio_t

Structure to choose MDIO entity(Internal/external MDIO for specified EP/Switch port)

typedef struct *_netc_mdio_handle* netc_mdio_handle_t

MDIO handle.

typedef struct *_netc_mdio_config* netc_mdio_config_t

MDIO configuration structure.

status_t NETC_MDIOInit(*netc_mdio_handle_t* *handle, *netc_mdio_config_t* *config)

Initialize the MDIO.

Note: The EMDIO can be used independently. The port internal/external MDIO is a part of EP/Switch, should be initialized and used after EP/Switch is enabled.

Parameters

- handle – MDIO handle.
- config – MDIO configuration.

Returns

status_t

struct _netc_mdio

#include <fsl_netc_mdio.h> Structure to choose MDIO entity(Internal/external MDIO for specified EP/Switch port)

Public Members

netc_mdio_type_t type

Internal or external MAC port MDIO.

netc_hw_eth_port_idx_t port

MDIO port index, only meaningful when port MDIO type is used.

struct _netc_mdio_handle

#include <fsl_netc_mdio.h> MDIO handle.

Public Members

netc_mdio_t mdio
MDIO identificator.

struct __netc_mdio_config
#include <fsl_netc_mdio.h> MDIO configuration structure.

Public Members

netc_mdio_t mdio
MDIO identificator.

uint32_t srcClockHz
MDIO reference clock for MDC frequency calculation.

bool isNegativeDriven
MDIO driven at positive(false)/negative(true) of MDC edge.

bool isPreambleDisable
Enable/Disable generation of MDIO preamble.

2.82 MDIO PHY status module

typedef struct *_netc_mdio_phy_status* netc_mdio_phy_status_t
PHY auto status check configuration structure.

status_t NETC_MDIOSetPhyStatusCheck(*netc_mdio_handle_t* *handle, *netc_mdio_phy_status_t* *config)
Setup the mechanism to check PHY status automatically This is a hardware mechanism to read specified PHY register in a configured time interval instead of polling the PHY in software.

Parameters

- handle – MDIO handle.
- config – The configuration of the PHY status automatical check.

Returns
status_t

void NETC_MDIOPhyStatusGetFlags(*netc_mdio_handle_t* *handle, uint16_t *low2HighMask, uint16_t *high2LowMask)
Get the PHY register bit status transition interrupt flag(s).

Parameters

- handle – MDIO handle.
- low2HighMask – The interrupt flag of a 0->1 transition on a corresponding bit of PHY register.
- high2LowMask – The interrupt flag of a 1->0 transition on a corresponding bit of PHY register.

void NETC_MDIOPhyStatusClearFlags(*netc_mdio_handle_t* *handle, uint16_t low2HighMask, uint16_t high2LowMask)
Clear the PHY register bit status transition interrupt flag(s).

Parameters

- handle – MDIO handle.
- low2HighMask – Clear the interrupt flag of a 0->1 transition on a corresponding bit of PHY register.
- high2LowMask – Clear the interrupt flag of a 1->0 transition on a corresponding bit of PHY register.

struct _netc_mdio_phy_status

#include <fsl_netc_mdio.h> PHY auto status check configuration structure.

Public Members

uint16_t interval

PHY status read interval in units of 1-2 ms. A value of 0 indicates disable.

bool isC45Used

PHY status read with Clause 22/45 MDIO access.

uint8_t phyOrPortAddr

MDIO PHY address(Clause 22) / port address(Clause 45).

uint8_t regiOrDevAddr

MDIO register address(Clause 22) / device address(Clause 45).

uint16_t c45RegiAddr

MDIO register address(Clause 45).

uint16_t enableIntrHigh2Low

Bit high-to-low event interrupt enable.

uint16_t enableIntrLow2High

Bit low-to-high event interrupt enable.

2.83 MDIO write/read module

status_t NETC_MDIOWrite(*netc_mdio_handle_t* *handle, uint8_t phyAddr, uint8_t regAddr, uint16_t data)

IEEE802.3 Clause 22 MDIO write data.

Parameters

- handle – MDIO handle.
- phyAddr – The PHY address.
- regAddr – The PHY register address.
- data – The data written to PHY.

Returns

status_t

status_t NETC_MDIORead(*netc_mdio_handle_t* *handle, uint8_t phyAddr, uint8_t regAddr, uint16_t *pData)

IEEE802.3 Clause 22 MDIO read data.

Parameters

- handle – MDIO handle.
- phyAddr – The PHY address.

- regAddr – The PHY register address.
- pData – The received data from PHY.

Returns
status_t

status_t NETC_MDIOC45Write(*netc_mdio_handle_t* *handle, uint8_t portAddr, uint8_t devAddr, uint16_t regAddr, uint16_t data)

IEEE802.3 Clause 45 MDIO write data.

Parameters

- handle – MDIO handle.
- portAddr – The MDIO port address(PHY address).
- devAddr – The device address.
- regAddr – The PHY register address.
- data – The data written to PHY.

Returns
status_t

status_t NETC_MDIOC45Read(*netc_mdio_handle_t* *handle, uint8_t portAddr, uint8_t devAddr, uint16_t regAddr, uint16_t *pData)

IEEE802.3 Clause 45 MDIO read data.

Parameters

- handle – MDIO handle.
- portAddr – The MDIO port address(PHY address).
- devAddr – The device address.
- regAddr – The PHY register address.
- pData – The received data from PHY.

Returns
status_t

2.84 NETC Timer Driver

2.85 Timer adjustment module

void NETC_TimerGetTime(ENETC_PF_TMR_Type *base, uint64_t *nanosecond)

Get the timer's current or default time.

Parameters

- base – NETC timer base address.
- nanosecond – Time in nanosecond.

void NETC_TimerGetCurrentTime(*netc_timer_handle_t* *handle, uint64_t *nanosecond)

Get the timer's current time.

Parameters

- handle – NETC timer handle.
- nanosecond – Time in nanosecond.

void NETC_TimerGetFreeRunningTime(*netc_timer_handle_t* *handle, uint64_t *nanosecond)

Get the timer's freerunning time.

Parameters

- handle – NETC timer handle.
- nanosecond – Time in nanosecond.

void NETC_TimerAddOffset(*netc_timer_handle_t* *handle, int64_t nanosecond)

Correct the current timer.

Note: Need stop all mechanims based on 1588 timers during call this API. To take time gate scheduling as example, if the port is enabled with TGS and it contains an operational list, user need to call SWT_TxPortTGSEnable()/SWT_TxPortTGSEnable() to disable the port time gate before call this API, and re-enable and configure the port TGS after the execution of this API.

Parameters

- handle – NETC timer handle.
- nanosecond – Time in nanosecond.

void NETC_TimerAdjustFreq(*netc_timer_handle_t* *handle, int32_t ppb)

Adjust the timer frequency.

Parameters

- handle – NETC timer handle.
- ppb – Parts per billion.

void NETC_TimerGetFrtSrtTime(*netc_timer_handle_t* *handle, uint64_t *frt, uint64_t *srt)

Get the free running and synchronized current time with an atomic read.

Parameters

- handle – NETC timer handle.
- frt – The free-running time in nanosecond.
- srt – The synchronized current time in nanosecond.

2.86 Timer initialization module

enum _netc_timer_irq_flags

Timer interrupt flags.

Values:

enumerator kNETC_TimerFiper1IrqFlag

Periodic pulse 1 interrupt.

enumerator kNETC_TimerFiper2IrqFlag

Periodic pulse 2 interrupt.

enumerator kNETC_TimerFiper3IrqFlag

Periodic pulse 3 interrupt.

enumerator kNETC_TimerAlarm1IrqFlag

Alarm 1 interrupt.

enumerator kNETC_TimerAlarm2IrqFlag
Alarm 2 interrupt.

enumerator kNETC_TimerExtTrig1ThresholdIrqFlag
External trigger 1 timestamp FIFO threshold hit interrupt.

enumerator kNETC_TimerExtTrig2ThresholdIrqFlag
External trigger 2 timestamp FIFO threshold hit interrupt.

enumerator kNETC_TimerExtTrig1TsAvailIrqFlag
External trigger 1 new timestamp available interrupt.

enumerator kNETC_TimerExtTrig2TsAvailIrqFlag
External trigger 2 new timestamp available interrupt.

enumerator kNETC_TimerExtTrig1OverflowIrqFlag
External trigger 1 timestamp FIFO overflow interrupt.

enumerator kNETC_TimerExtTrig2OverflowIrqFlag
External trigger 2 timestamp FIFO overflow interrupt.

enum _netc_timer_ref_clk
Enumeration for NETC timer reference clock.

Values:

enumerator kNETC_TimerExtRefClk

enumerator kNETC_TimerSystemClk

typedef enum *_netc_timer_irq_flags* netc_timer_irq_flags_t
Timer interrupt flags.

typedef struct *_netc_timer_handle* netc_timer_handle_t

typedef enum *_netc_timer_ref_clk* netc_timer_ref_clk_t
Enumeration for NETC timer reference clock.

typedef struct *_netc_timer_config* netc_timer_config_t
Structure to configure timer.

status_t NETC_TimerInit(*netc_timer_handle_t* *handle, const *netc_timer_config_t* *config)
Initialize the NETC PTP1588 timer.

Parameters

- handle – NETC timer handle.
- config – The configuration of the timer.

Returns
status_t

void NETC_TimerDeinit(*netc_timer_handle_t* *handle)
Deinitialize the NETC PTP1588 timer.

Parameters

- handle – NETC timer handle.

void NETC_TimerInitHandle(*netc_timer_handle_t* *handle)
Initialize a NETC PTP1588 timer handle.

Parameters

- handle – NETC timer handle.

void NETC_TimerEnable(*netc_timer_handle_t* *handle, bool enable)

Enable/Disable the NETC PTP1588 timer.

Parameters

- handle – NETC timer handle.
- enable – Whether enable the PTP1588 timer.

struct __netc_timer_handle

#include <fsl_netc_timer.h> Timer handler structure.

Public Members

netc_timer_hw_t hw

Hardware register map resource.

uint32_t timerFreq

Timer clock frequency(Hz).

uint8_t entryNum

MSIX entry number.

struct __netc_timer_config

#include <fsl_netc_timer.h> Structure to configure timer.

Public Members

bool clkOutputPhase

True: Inverted divided clock is output, False: Non-inverted divided clock is output.

bool clkInputPhase

True: Inverted frequency tuned timer input clock, False: Non-inverted frequency tuned timer input clock.

bool enableTimer

True: Enable 1588 timer, False: Disable 1588 timer, use default counter.

netc_timer_ref_clk_t clockSelect

Timer reference clock.

uint32_t refClkHz

Timer reference clock frequency in Hz.

int32_t defaultPpb

Default ppb.

netc_msix_entry_t *msixEntry

MSIX table entry array.

uint8_t entryNum

MSIX entry number.

2.87 Local time synchronization module

enum __netc_timer_alarm_index

Enumeration for NETC timer alarm index.

Values:

enumerator kNETC_TimerAlarm1

enumerator kNETC_TimerAlarm2

enum _netc_timer_fiper_index

Enumeration for NETC timer FIPER index.

Values:

enumerator kNETC_TimerFiper1

enumerator kNETC_TimerFiper2

enumerator kNETC_TimerFiper3

typedef enum *_netc_timer_alarm_index* netc_timer_alarm_index_t

Enumeration for NETC timer alarm index.

typedef struct *_netc_timer_alarm_t* netc_timer_alarm_t

Structure to configure timer alarm.

typedef enum *_netc_timer_fiper_index* netc_timer_fiper_index_t

Enumeration for NETC timer FIPER index.

typedef struct *_netc_timer_fiper_config* netc_timer_fiper_config_t

Structure to configure timer FIPER.

typedef struct *_netc_timer_fiper* netc_timer_fiper_t

Structure to set and start timer FIPER.

typedef struct *_netc_timer_ext_pulse_trig* netc_timer_ext_trig_t

Structure to configure external pulse trigger timestamp.

void NETC_TimerConfigureAlarm(*netc_timer_handle_t* *handle, *netc_timer_alarm_index_t* alarmId, const *netc_timer_alarm_t* *alarm)

Configure the timer alarm feature.

Parameters

- handle – NETC timer handle.
- alarmId – The alarm index.
- alarm – The timer alarm configuration structure.

void NETC_TimerStartAlarm(*netc_timer_handle_t* *handle, *netc_timer_alarm_index_t* alarmId, uint64_t nanosecond)

Start the alarm with specified time after alarm feature is configured This function can generate a pulse on a GPIO and/or an interrupt at specified future time. It also can trigger FIPER at specified time.

Parameters

- handle – NETC timer handle.
- alarmId – The alarm index.
- nanosecond – The time in nanosecond to generate alarm pulse.

void NETC_TimerStopAlarm(*netc_timer_handle_t* *handle, *netc_timer_alarm_index_t* alarmId)

Stop the alarm before/after it's fired This function can deactivate alarm.

Parameters

- handle – NETC timer handle.
- alarmId – The alarm index.

void NETC_TimerConfigureFIPER(*netc_timer_handle_t* *handle, const *netc_timer_fiper_config_t* *config)

Configure the timer FIPER feature.

Parameters

- handle – NETC timer handle.
- config – The timer FIPER configuration structure.

void NETC_TimerStartFIPER(*netc_timer_handle_t* *handle, *netc_timer_fiper_index_t* fiperId, const *netc_timer_fiper_t* *fiper)

Start the timer FIPER to generate pulse This function can generate a periodic(Fixed Period-FIPER) pulse on a GPIO pin and/or an interrupt to the host.

Parameters

- handle – NETC timer handle.
- fiperId – The timer FIPER index.
- fiper – The timer FIPER configuration structure.

void NETC_TimerStopFIPER(*netc_timer_handle_t* *handle, *netc_timer_fiper_index_t* fiperId)

Stop the timer FIPER to generate pulse.

Parameters

- handle – NETC timer handle.
- fiperId – The timer FIPER index.

void NETC_TimerConfigureExtPulseTrig(*netc_timer_handle_t* *handle, netc_timer_exttrig_index_t extTrigId, const *netc_timer_ext_trig_t* *extTrig)

Configure the external pulse trigger timestamp capture.

Parameters

- handle – NETC timer handle.
- extTrigId – The timer FIPER index.
- extTrig – The external pulse trigger configuration structure.

status_t NETC_TimerSetTsFifoThreshold(*netc_timer_handle_t* *handle, uint8_t threshold)

Set timestamp FIFO threshold of the external pulse trigger timestamp capture.

Parameters

- handle – NETC timer handle.
- threshold – Timestamp FIFO threshold.

Returns

status_t

status_t NETC_TimerReadExtPulseCaptureTime(*netc_timer_handle_t* *handle, netc_timer_exttrig_index_t extTrigId, uint64_t *nanosecond)

Read the timestamp captured by external pulse trigger in FIFO.

Parameters

- handle – NETC timer handle.
- extTrigId – The timer FIPER index.
- nanosecond – Timestamp in nanosecond.

Returns
status_t

static inline void NETC_TimerClearInterruptStatus(*netc_timer_handle_t* *handle, uint32_t flags)

Clear timer interrupt flags.

Parameters

- handle – NETC timer handle.
- flags – Timer interrupt flags. This is a logical OR of enumeration :: netc_timer_irq_flags_t.

status_t NETC_TimerMsixSetGlobalMask(*netc_timer_handle_t* *handle, bool mask)

Set the global MSIX mask status.

This function masks/unmasks global MSIX message. Mask - All of the vectors are masked, regardless of their per-entry mask bit states. Unmask - Each entry's mask status determines whether the vector is masked or not.

Parameters

- handle – The timer handle
- mask – The mask state. True: Mask, False: Unmask.

Returns
status_t

status_t NETC_TimerMsixSetEntryMask(*netc_timer_handle_t* *handle, uint8_t entryIdx, bool mask)

Set the MSIX entry mask status for specified entry.

This function masks/unmasks MSIX message for specified entry.

Parameters

- handle – NETC timer handle.
- entryIdx – The entry index in the table.
- mask – The mask state. True: Mask, False: Unmask.

Returns
status_t

status_t NETC_TimerMsixGetPendingStatus(*netc_timer_handle_t* *handle, uint8_t pbaIdx, uint64_t *status)

Get the MSIX pending status in MSIX PBA table.

This function is to get the entry pending status from MSIX PBA table. If interrupt occurs but masked by vector control of entry, pending bit in PBA will be set.

Parameters

- handle – NETC timer handle.
- pbaIdx – The index of PBA array with 64-bit unit.
- status – Pending status bit mask, bit n for entry n.

Returns
status_t

struct __netc_timer_alarm_t

#include <fsl_netc_timer.h> Structure to configure timer alarm.

Public Members

bool enableInterrupt

Enable/Disable ALARM interrupt enable.

bool polarity

True: Active low output, False: Active high output.

bool pulseGenSync

True: ALARM output asserted synchronous to timer generated clock, False: ALARM output asserted immediately.

uint8_t pulseWidth

Pulse width in number of timer generated clocks the alarm will be active for.

struct __netc__timer__fiper__config

#include <fsl_netc_timer.h> Structure to configure timer FIPER.

Public Members

bool startCondition

True: FIPER is enabled through timer enable and alarm getting set, False: FIPER is enabled through timer enable.

bool fiper1Loopback

True: FIPER1 pulse is looped back into Trigger1 input, False: Trigger1 input is based upon normal external trigger input.

bool fiper2Loopback

True: FIPER2 pulse is looped back into Trigger2 input, False: Trigger2 input is based upon normal external trigger input.

uint16_t prescale

Output FIPER pulse clock is generated by dividing the timer input clock by this number. Must be an even value.

struct __netc__timer__fiper

#include <fsl_netc_timer.h> Structure to set and start timer FIPER.

Public Members

bool enableInterrupt

Enable/Disable FIPER interrupt interrupt.

bool pulseGenSync

True: FIPER output asserted synchronous to timer generated clock, False: FIPER output asserted immediately.

uint8_t pulseWidth

FIPER pulse width.

uint32_t pulsePeriod

Interval of FIPER pulses.

struct __netc__timer__ext__pulse__trig

#include <fsl_netc_timer.h> Structure to configure external pulse trigger timestamp.

Public Members

bool polarity
Time stamp on the falling(true)/rising(false) edge of the external trigger.

bool enableFifoOverflowInterrupt
Enable/Disable FIFO Overflow interrupt.

bool enableFifoThresholdHitInterrupt
Enable/Disable FIFO Threshold Hit interrupt.

bool enableTsAvailInterrupt
Enable/Disable timestamp capture interrupt.

2.88 OTFAD: On The Fly AES-128 Decryption Driver

void OTFAD_GetDefaultConfig(*otfad_config_t* *config)
OTFAD module initialization function.

Parameters

- config – OTFAD configuration.

AT_QUICKACCESS_SECTION_CODE (void OTFAD_Init(OTFAD_Type *base, const otfad_config_t *config))
OTFAD module initialization function.

Parameters

- base – OTFAD base address.
- config – OTFAD configuration.

AT_QUICKACCESS_SECTION_CODE (void OTFAD_Deinit(OTFAD_Type *base))
Deinitializes the OTFAD.

static inline uint32_t OTFAD_GetOperateMode(OTFAD_Type *base)
OTFAD module get operate mode.

Parameters

- base – OTFAD base address.

static inline uint32_t OTFAD_GetStatus(OTFAD_Type *base)
OTFAD module get status.

Parameters

- base – OTFAD base address.

status_t OTFAD_SetEncryptionConfig(OTFAD_Type *base, const *otfad_encryption_config_t* *config)
OTFAD module set encryption configuration.

Note: if enable keyblob process, the first 256 bytes external memory is use for keyblob data, so this region shouldn't be in OTFAD region.

Parameters

- base – OTFAD base address.
- config – encryption configuration.

status_t OTFAD_GetEncryptionConfig(OTFAD_Type *base, *otfad_encryption_config_t* *config)

OTFAD module get encryption configuration.

Note: if enable keyblob process, the first 256 bytes external memory is use for keyblob data, so this region shouldn't be in OTFAD region.

Parameters

- base – OTFAD base address.
- config – encryption configuration.

status_t OTFAD_HitDetermination(OTFAD_Type *base, uint32_t address, uint8_t *contextIndex)

OTFAD module do hit determination.

Parameters

- base – OTFAD base address.
- address – the physical address space assigned to the QuadSPI(FlexSPI) module.
- contextIndex – hitted context region index.

Returns

status, such as kStatus_Success or kStatus_OTFAD_ResRegAccessMode.

FSL_OTFAD_DRIVER_VERSION

Driver version.

Status codes for the OTFAD driver.

Values:

enumerator kStatus_OTFAD_ResRegAccessMode

Restricted register mode

enumerator kStatus_OTFAD_AddressError

End address less than start address

enumerator kStatus_OTFAD_RegionOverlap

the OTFAD does not support any form of memory region overlap, for system accesses that hit in multiple contexts or no contexts, the fetched data is simply bypassed

enumerator kStatus_OTFAD_RegionMiss

For accesses that hit in a single context, but not the selected one

OTFAD context type.

Values:

enumerator kOTFAD_Context_0

context 0

enumerator kOTFAD_Context_1

context 1

enumerator kOTFAD_Context_2

context 2

enumerator kOTFAD_Context_3

context 3

OTFAD operate mode.

Values:

enumerator kOTFAD_NRM
Normal Mode

enumerator kOTFAD_SVM
Security Violation Mode

enumerator kOTFAD_LDM
Logically Disabled Mode

typedef struct *_otfad_encryption_config* otfad_encryption_config_t
OTFAD encryption configuration structure.

typedef struct *_otfad_config* otfad_config_t
OTFAD configuration structure.

struct _otfad_encryption_config
#include <fsl_otfad.h> OTFAD encryption configuration structure.

Public Members

bool valid
The context is valid or not

bool AESdecryption
AES decryption enable

uint8_t readOnly
read write attribute for the entire set of context registers

uint8_t contextIndex
OTFAD context index

uint32_t startAddr
Start address

uint32_t endAddr
End address

uint32_t key[4]
Encryption key

uint32_t counter[2]
Encryption counter

struct _otfad_config
#include <fsl_otfad.h> OTFAD configuration structure.

Public Members

bool forceSVM
Force entry into SVM after a write

bool forceLDM
Force entry into LDM after a write

bool restrictedRegAccess

Restricted register access enable

bool enableOTFAD

OTFAD has decryption enabled

2.89 PDM: Microphone Interface

2.90 PDM Driver

void PDM_Init(PDM_Type *base, const *pdm_config_t* *config)

Initializes the PDM peripheral.

Ungates the PDM clock, resets the module, and configures PDM with a configuration structure. The configuration structure can be custom filled or set with default values by PDM_GetDefaultConfig().

Note: This API should be called at the beginning of the application to use the PDM driver. Otherwise, accessing the PDM module can cause a hard fault because the clock is not enabled.

Parameters

- base – PDM base pointer
- config – PDM configuration structure.

void PDM_Deinit(PDM_Type *base)

De-initializes the PDM peripheral.

This API gates the PDM clock. The PDM module can't operate unless PDM_Init is called to enable the clock.

Parameters

- base – PDM base pointer

static inline void PDM_Reset(PDM_Type *base)

Resets the PDM module.

Parameters

- base – PDM base pointer

static inline void PDM_Enable(PDM_Type *base, bool enable)

Enables/disables PDM interface.

Parameters

- base – PDM base pointer
- enable – True means PDM interface is enabled, false means PDM interface is disabled.

static inline void PDM_EnableDebugMode(PDM_Type *base, bool enable)

Enables/disables debug mode for PDM. The PDM interface cannot enter debug mode once in Disable/Low Leakage or Low Power mode.

Parameters

- base – PDM base pointer

- enable – True means PDM interface enter debug mode, false means PDM interface in normal mode.

static inline void PDM_EnableInDebugMode(PDM_Type *base, bool enable)

Enables/disables PDM interface in debug mode.

Parameters

- base – PDM base pointer
- enable – True means PDM interface is enabled debug mode, false means PDM interface is disabled after after completing the current frame in debug mode.

static inline void PDM_EnterLowLeakageMode(PDM_Type *base, bool enable)

Enables/disables PDM interface disable/Low Leakage mode.

Parameters

- base – PDM base pointer
- enable – True means PDM interface is in disable/low leakage mode, False means PDM interface is in normal mode.

static inline void PDM_EnableChannel(PDM_Type *base, uint8_t channel, bool enable)

Enables/disables the PDM channel.

Parameters

- base – PDM base pointer
- channel – PDM channel number need to enable or disable.
- enable – True means enable PDM channel, false means disable.

void PDM_SetChannelConfig(PDM_Type *base, uint32_t channel, const *pdm_channel_config_t* *config)

PDM one channel configurations.

Parameters

- base – PDM base pointer
- config – PDM channel configurations.
- channel – channel number. after completing the current frame in debug mode.

status_t PDM_SetSampleRateConfig(PDM_Type *base, uint32_t sourceClock_HZ, uint32_t sampleRate_HZ)

PDM set sample rate.

Note: This function is depend on the configuration of the PDM and PDM channel, so the correct call sequence is

```
PDM_Init(base, pdmConfig)
PDM_SetChannelConfig(base, channel, &channelConfig)
PDM_SetSampleRateConfig(base, source, sampleRate)
```

Parameters

- base – PDM base pointer
- sourceClock_HZ – PDM source clock frequency.
- sampleRate_HZ – PDM sample rate.

status_t PDM_SetSampleRate(PDM_Type *base, uint32_t enableChannelMask, *pdm_df_quality_mode_t* qualityMode, uint8_t osr, uint32_t clkDiv)

PDM set sample rate.

Deprecated:

Do not use this function. It has been superceded by PDM_SetSampleRateConfig

Parameters

- base – PDM base pointer
- enableChannelMask – PDM channel enable mask.
- qualityMode – quality mode.
- osr – cic oversample rate
- clkDiv – clock divider

uint32_t PDM_GetInstance(PDM_Type *base)

Get the instance number for PDM.

Parameters

- base – PDM base pointer.

static inline uint32_t PDM_GetStatus(PDM_Type *base)

Gets the PDM internal status flag. Use the Status Mask in _pdm_internal_status to get the status value needed.

Parameters

- base – PDM base pointer

Returns

PDM status flag value.

static inline uint32_t PDM_GetFifoStatus(PDM_Type *base)

Gets the PDM FIFO status flag. Use the Status Mask in _pdm_fifo_status to get the status value needed.

Parameters

- base – PDM base pointer

Returns

FIFO status.

static inline uint32_t PDM_GetRangeStatus(PDM_Type *base)

Gets the PDM Range status flag. Use the Status Mask in _pdm_range_status to get the status value needed.

Parameters

- base – PDM base pointer

Returns

output status.

static inline void PDM_ClearStatus(PDM_Type *base, uint32_t mask)

Clears the PDM Tx status.

Parameters

- base – PDM base pointer

- mask – State mask. It can be a combination of the status between kPDM_StatusFrequencyLow and kPDM_StatusCh7FifoDataAvaliable.

static inline void PDM_ClearFIFOStatus(PDM_Type *base, uint32_t mask)

Clears the PDM Tx status.

Parameters

- base – PDM base pointer
- mask – State mask.It can be a combination of the status in _pdm_fifo_status.

static inline void PDM_ClearRangeStatus(PDM_Type *base, uint32_t mask)

Clears the PDM range status.

Parameters

- base – PDM base pointer
- mask – State mask. It can be a combination of the status in _pdm_range_status.

void PDM_EnableInterrupts(PDM_Type *base, uint32_t mask)

Enables the PDM interrupt requests.

Parameters

- base – PDM base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kPDM_ErrorInterruptEnable
  - kPDM_FIFOInterruptEnable

static inline void PDM_DisableInterrupts(PDM_Type *base, uint32_t mask)

Disables the PDM interrupt requests.

Parameters

- base – PDM base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kPDM_ErrorInterruptEnable
  - kPDM_FIFOInterruptEnable

static inline void PDM_EnableDMA(PDM_Type *base, bool enable)

Enables/disables the PDM DMA requests.

Parameters

- base – PDM base pointer
- enable – True means enable DMA, false means disable DMA.

static inline uint32_t PDM_GetDataRegisterAddress(PDM_Type *base, uint32_t channel)

Gets the PDM data register address.

This API is used to provide a transfer address for the PDM DMA transfer configuration.

Parameters

- base – PDM base pointer.
- channel – Which data channel used.

Returns

data register address.

void PDM_ReadFifo(PDM_Type *base, uint32_t startChannel, uint32_t channelNums, void *buffer, size_t size, uint32_t dataWidth)

PDM read fifo.

Note: : This function support 16 bit only for IP version that only supports 16bit.

Parameters

- base – PDM base pointer.
- startChannel – start channel number.
- channelNums – total enabled channelnums.
- buffer – received buffer address.
- size – number of samples to read.
- dataWidth – sample width.

void PDM_SetChannelGain(PDM_Type *base, uint32_t channel, *pdm_df_output_gain_t* gain)

Set the PDM channel gain.

Please note for different quality mode, the valid gain value is different, reference RM for detail.

Parameters

- base – PDM base pointer.
- channel – PDM channel index.
- gain – channel gain, the register gain value range is 0 - 15.

void PDM_SetHwvadConfig(PDM_Type *base, const *pdm_hwvad_config_t* *config)

Configure voice activity detector.

Parameters

- base – PDM base pointer
- config – Voice activity detector configure structure pointer .

static inline void PDM_ForceHwvadOutputDisable(PDM_Type *base, bool enable)

PDM hwvad force output disable.

Parameters

- base – PDM base pointer
- enable – true is output force disable, false is output not force.

static inline void PDM_ResetHwvad(PDM_Type *base)

PDM hwvad reset. It will reset VADNDATA register and will clean all internal buffers, should be called when the PDM isn't running.

Parameters

- base – PDM base pointer

static inline void PDM_EnableHwvad(PDM_Type *base, bool enable)

Enable/Disable Voice activity detector. Should be called when the PDM isn't running.

Parameters

- base – PDM base pointer.
- enable – True means enable voice activity detector, false means disable.

static inline void PDM_EnableHwvadInterrupts(PDM_Type *base, uint32_t mask)

Enables the PDM Voice Detector interrupt requests.

Parameters

- base – PDM base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kPDM_HWVADErrorInterruptEnable
  - kPDM_HWVADInterruptEnable

static inline void PDM_DisableHwvadInterrupts(PDM_Type *base, uint32_t mask)

Disables the PDM Voice Detector interrupt requests.

Parameters

- base – PDM base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kPDM_HWVADErrorInterruptEnable
  - kPDM_HWVADInterruptEnable

static inline void PDM_ClearHwvadInterruptStatusFlags(PDM_Type *base, uint32_t mask)

Clears the PDM voice activity detector status flags.

Parameters

- base – PDM base pointer
- mask – State mask,reference _pdm_hwvad_int_status.

static inline uint32_t PDM_GetHwvadInterruptStatusFlags(PDM_Type *base)

Clears the PDM voice activity detector status flags.

Parameters

- base – PDM base pointer

Returns

status, reference _pdm_hwvad_int_status

static inline uint32_t PDM_GetHwvadInitialFlag(PDM_Type *base)

Get the PDM voice activity detector initial flags.

Parameters

- base – PDM base pointer

Returns

initial flag.

static inline void PDM_EnableHwvadSignalFilter(PDM_Type *base, bool enable)

Enables/disables voice activity detector signal filter.

Parameters

- base – PDM base pointer
- enable – True means enable signal filter, false means disable.

void PDM_SetHwvadSignalFilterConfig(PDM_Type *base, bool enableMaxBlock, uint32_t signalGain)

Configure voice activity detector signal filter.

Parameters

- base – PDM base pointer
- enableMaxBlock – If signal maximum block enabled.
- signalGain – Gain value for the signal energy.

void PDM_SetHwvadNoiseFilterConfig(PDM_Type *base, const *pdm_hwvad_noise_filter_t* *config)

Configure voice activity detector noise filter.

Parameters

- base – PDM base pointer
- config – Voice activity detector noise filter configure structure pointer .

static inline void PDM_EnableHwvadZeroCrossDetector(PDM_Type *base, bool enable)

Enables/disables voice activity detector zero cross detector.

Parameters

- base – PDM base pointer
- enable – True means enable zero cross detector, false means disable.

void PDM_SetHwvadZeroCrossDetectorConfig(PDM_Type *base, const *pdm_hwvad_zero_cross_detector_t* *config)

Configure voice activity detector zero cross detector.

Parameters

- base – PDM base pointer
- config – Voice activity detector zero cross detector configure structure pointer .

static inline uint16_t PDM_GetNoiseData(PDM_Type *base)

Reads noise data.

Parameters

- base – PDM base pointer.

Returns

Data in PDM noise data register.

static inline void PDM_SetHwvadInternalFilterStatus(PDM_Type *base, *pdm_hwvad_filter_status_t* status)

set hwvad internal filter status . Note: filter initial status should be asserted for two more cycles, then set it to normal operation.

Parameters

- base – PDM base pointer.
- status – internal filter status.

void PDM_SetHwvadInEnvelopeBasedMode(PDM_Type *base, const *pdm_hwvad_config_t* *hwvadConfig, const *pdm_hwvad_noise_filter_t* *noiseConfig, const *pdm_hwvad_zero_cross_detector_t* *zcdConfig, uint32_t signalGain)

set HWVAD in envelope based mode . Recommand configurations,

```
  static const pdm_hwvad_config_t hwvadConfig = {
    .channel          = 0,
    .initializeTime   = 10U,
    .cicOverSampleRate = 0U,
    .inputGain        = 0U,
    .frameTime        = 10U,
    .cutOffFreq       = kPDM_HwvadHpfBypassed,
    .enableFrameEnergy = false,
    .enablePreFilter  = true,
};

  static const pdm_hwvad_noise_filter_t noiseFilterConfig = {
    .enableAutoNoiseFilter = false,
    .enableNoiseMin       = true,
    .enableNoiseDecimation = true,
    .noiseFilterAdjustment = 0U,
    .noiseGain            = 7U,
    .enableNoiseDetectOR  = true,
  };
```

Parameters

- base – PDM base pointer.
- hwvadConfig – internal filter status.
- noiseConfig – Voice activity detector noise filter configure structure pointer.
- zcdConfig – Voice activity detector zero cross detector configure structure pointer .
- signalGain – signal gain value.

void PDM_SetHwvadInEnergyBasedMode(PDM_Type *base, const *pdm_hwvad_config_t* *hwvadConfig, const *pdm_hwvad_noise_filter_t* *noiseConfig, const *pdm_hwvad_zero_cross_detector_t* *zcdConfig, uint32_t signalGain)

brief set HWVAD in energy based mode . Recommand configurations, code static const pdm_hwvad_config_t hwvadConfig = { .channel = 0, .initializeTime = 10U, .cicOverSampleRate = 0U, .inputGain = 0U, .frameTime = 10U, .cutOffFreq = kPDM_HwvadHpfBypassed, .enableFrameEnergy = true, .enablePreFilter = true, };

static const pdm_hwvad_noise_filter_t noiseFilterConfig = { .enableAutoNoiseFilter = true, .enableNoiseMin = false, .enableNoiseDecimation = false, .noiseFilterAdjustment = 0U, .noiseGain = 7U, .enableNoiseDetectOR = false, }; code param base PDM base pointer. param hwvadConfig internal filter status. param noiseConfig Voice activity detector noise filter configure structure pointer. param zcdConfig Voice activity detector zero cross detector configure structure pointer . param signalGain signal gain value, signal gain value should be properly according to application.

void PDM_EnableHwvadInterruptCallback(PDM_Type *base, *pdm_hwvad_callback_t* vadCallback, void *userData, bool enable)

Enable/Disable hwvad callback.

This function enable/disable the hwvad interrupt for the selected PDM peripheral.

Parameters

- base – Base address of the PDM peripheral.
- vadCallback – callback Pointer to store callback function, should be NULL when disable.
- userData – user data.

- enable – true is enable, false is disable.

Return values

None. –

void PDM_TransferCreateHandle(PDM_Type *base, *pdm_handle_t* *handle, *pdm_transfer_callback_t* callback, void *userData)

Initializes the PDM handle.

This function initializes the handle for the PDM transactional APIs. Call this function once to get the handle initialized.

Parameters

- base – PDM base pointer.
- handle – PDM handle pointer.
- callback – Pointer to the user callback function.
- userData – User parameter passed to the callback function.

status_t PDM_TransferSetChannelConfig(PDM_Type *base, *pdm_handle_t* *handle, uint32_t channel, const *pdm_channel_config_t* *config, uint32_t format)

PDM set channel transfer config.

Parameters

- base – PDM base pointer.
- handle – PDM handle pointer.
- channel – PDM channel.
- config – channel config.
- format – data format, support data width configurations,_pdm_data_width.

Return values

kStatus_PDM_ChannelConfig_Failed – or kStatus_Success.

status_t PDM_TransferReceiveNonBlocking(PDM_Type *base, *pdm_handle_t* *handle, *pdm_transfer_t* *xfer)

Performs an interrupt non-blocking receive transfer on PDM.

Note: This API returns immediately after the transfer initiates. Call the PDM_RxGetTransferStatusIRQ to poll the transfer status and check whether the transfer is finished. If the return status is not kStatus_PDM_Busy, the transfer is finished.

Parameters

- base – PDM base pointer
- handle – Pointer to the pdm_handle_t structure which stores the transfer state.
- xfer – Pointer to the pdm_transfer_t structure.

Return values

- kStatus_Success – Successfully started the data receive.
- kStatus_PDM_Busy – Previous receive still not finished.

void PDM_TransferAbortReceive(PDM_Type *base, *pdm_handle_t* *handle)

Aborts the current IRQ receive.

Note: This API can be called when an interrupt non-blocking transfer initiates to abort the transfer early.

Parameters

- base – PDM base pointer
- handle – Pointer to the pdm_handle_t structure which stores the transfer state.

void PDM_TransferHandleIRQ(PDM_Type *base, *pdm_handle_t* *handle)

Tx interrupt handler.

Parameters

- base – PDM base pointer.
- handle – Pointer to the pdm_handle_t structure.

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PDM return status.

Values:

enumerator kStatus_PDM_Busy

PDM is busy.

enumerator kStatus_PDM_CLK_LOW

PDM clock frequency low

enumerator kStatus_PDM_FIFO_ERROR

PDM FIFO underrun or overflow

enumerator kStatus_PDM_QueueFull

PDM FIFO underrun or overflow

enumerator kStatus_PDM_Idle

PDM is idle

enumerator kStatus_PDM_Output_ERROR

PDM is output error

enumerator kStatus_PDM_ChannelConfig_Failed

PDM channel config failed

enumerator kStatus_PDM_HWVAD_VoiceDetected

PDM hwvad voice detected

enumerator kStatus_PDM_HWVAD_Error

PDM hwvad error

enum _pdm_interrupt_enable

The PDM interrupt enable flag.

Values:

enumerator kPDM_ErrorInterruptEnable
PDM channel error interrupt enable.

enumerator kPDM_FIFOInterruptEnable
PDM channel FIFO interrupt

enum _pdm_internal_status
The PDM status.

Values:

enumerator kPDM_StatusDfBusyFlag
Decimation filter is busy processing data

enumerator kPDM_StatusFrequencyLow
Mic app clock frequency not high enough

enumerator kPDM_StatusCh0FifoDataAvaliable
channel 0 fifo data reached watermark level

enumerator kPDM_StatusCh1FifoDataAvaliable
channel 1 fifo data reached watermark level

enumerator kPDM_StatusCh2FifoDataAvaliable
channel 2 fifo data reached watermark level

enumerator kPDM_StatusCh3FifoDataAvaliable
channel 3 fifo data reached watermark level

enum _pdm_channel_enable_mask
PDM channel enable mask.

Values:

enumerator kPDM_EnableChannel0
channgel 0 enable mask

enumerator kPDM_EnableChannel1
channgel 1 enable mask

enumerator kPDM_EnableChannel2
channgel 2 enable mask

enumerator kPDM_EnableChannel3
channgel 3 enable mask

enumerator kPDM_EnableChannelAll

enum _pdm_fifo_status
The PDM fifo status.

Values:

enumerator kPDM_FifoStatusUnderflowCh0
channel0 fifo status underflow

enumerator kPDM_FifoStatusUnderflowCh1
channel1 fifo status underflow

enumerator kPDM_FifoStatusUnderflowCh2
channel2 fifo status underflow

enumerator kPDM_FifoStatusUnderflowCh3
channel3 fifo status underflow

enumerator kPDM_FifoStatusOverflowCh0
channel0 fifo status overflow

enumerator kPDM_FifoStatusOverflowCh1
channel1 fifo status overflow

enumerator kPDM_FifoStatusOverflowCh2
channel2 fifo status overflow

enumerator kPDM_FifoStatusOverflowCh3
channel3 fifo status overflow

enum _pdm_range_status
The PDM output status.

Values:

enumerator kPDM_RangeStatusUnderFlowCh0
channel0 range status underflow

enumerator kPDM_RangeStatusUnderFlowCh1
channel1 range status underflow

enumerator kPDM_RangeStatusUnderFlowCh2
channel2 range status underflow

enumerator kPDM_RangeStatusUnderFlowCh3
channel3 range status underflow

enumerator kPDM_RangeStatusOverFlowCh0
channel0 range status overflow

enumerator kPDM_RangeStatusOverFlowCh1
channel1 range status overflow

enumerator kPDM_RangeStatusOverFlowCh2
channel2 range status overflow

enumerator kPDM_RangeStatusOverFlowCh3
channel3 range status overflow

enum _pdm_dc_remover
PDM DC remover configurations.

Values:

enumerator kPDM_DcRemoverCutOff21Hz
DC remover cut off 21HZ

enumerator kPDM_DcRemoverCutOff83Hz
DC remover cut off 83HZ

enumerator kPDM_DcRemoverCutOff152Hz
DC remover cut off 152HZ

enumerator kPDM_DcRemoverBypass
DC remover bypass

enum _pdm_df_quality_mode
PDM decimation filter quality mode.

Values:

enumerator kPDM_QualityModeMedium
quality mode memdium

enumerator kPDM_QualityModeHigh
quality mode high

enumerator kPDM_QualityModeLow
quality mode low

enumerator kPDM_QualityModeVeryLow0
quality mode very low0

enumerator kPDM_QualityModeVeryLow1
quality mode very low1

enumerator kPDM_QualityModeVeryLow2
quality mode very low2

enum _pdm_qulaity_mode_k_factor
PDM quality mode K factor.

Values:

enumerator kPDM_QualityModeHighKFactor
high quality mode K factor = 1 / 2

enumerator kPDM_QualityModeMediumKFactor
medium/very low0 quality mode K factor = 2 / 2

enumerator kPDM_QualityModeLowKFactor
low/very low1 quality mode K factor = 4 / 2

enumerator kPDM_QualityModeVeryLow2KFactor
very low2 quality mode K factor = 8 / 2

enum _pdm_df_output_gain
PDM decimation filter output gain.

Values:

enumerator kPDM_DfOutputGain0
Decimation filter output gain 0

enumerator kPDM_DfOutputGain1
Decimation filter output gain 1

enumerator kPDM_DfOutputGain2
Decimation filter output gain 2

enumerator kPDM_DfOutputGain3
Decimation filter output gain 3

enumerator kPDM_DfOutputGain4
Decimation filter output gain 4

enumerator kPDM_DfOutputGain5
Decimation filter output gain 5

enumerator kPDM_DfOutputGain6
Decimation filter output gain 6

enumerator kPDM_DfOutputGain7
Decimation filter output gain 7

enumerator kPDM_DfOutputGain8
Decimation filter output gain 8

enumerator kPDM_DfOutputGain9
Decimation filter output gain 9

enumerator kPDM_DfOutputGain10
Decimation filter output gain 10

enumerator kPDM_DfOutputGain11
Decimation filter output gain 11

enumerator kPDM_DfOutputGain12
Decimation filter output gain 12

enumerator kPDM_DfOutputGain13
Decimation filter output gain 13

enumerator kPDM_DfOutputGain14
Decimation filter output gain 14

enumerator kPDM_DfOutputGain15
Decimation filter output gain 15

enum _pdm_data_width
PDM data width.

Values:

enumerator kPDM_DataWwidth24
PDM data width 24bit

enumerator kPDM_DataWwidth32
PDM data width 32bit

enum _pdm_hwvad_interrupt_enable
PDM voice activity detector interrupt type.

Values:

enumerator kPDM_HwvadErrorInterruptEnable
PDM channel HWVAD error interrupt enable.

enumerator kPDM_HwvadInterruptEnable
PDM channel HWVAD interrupt

enum _pdm_hwvad_int_status
The PDM hwvad interrupt status flag.

Values:

enumerator kPDM_HwvadStatusInputSaturation
HWVAD saturation condition

enumerator kPDM_HwvadStatusVoiceDetectFlag
HWVAD voice detect interrupt triggered

enum _pdm_hwvad_hpf_config
High pass filter configure cut-off frequency.

Values:

enumerator kPDM_HwvadHpfBypassed
High-pass filter bypass

enumerator kPDM_HwvadHpfCutOffFreq1750Hz
High-pass filter cut off frequency 1750HZ

enumerator kPDM_HwvadHpfCutOffFreq215Hz
High-pass filter cut off frequency 215HZ

enumerator kPDM_HwvadHpfCutOffFreq102Hz
High-pass filter cut off frequency 102HZ

enum _pdm_hwvad_filter_status
HWVAD internal filter status.

Values:

enumerator kPDM_HwvadInternalFilterNormalOperation
internal filter ready for normal operation

enumerator kPDM_HwvadInternalFilterInitial
interla filter are initial

enum _pdm_hwvad_zcd_result
PDM voice activity detector zero cross detector result.

Values:

enumerator kPDM_HwvadResultOREnergyBasedDetection
zero cross detector result will be OR with energy based detection

enumerator kPDM_HwvadResultANDEnergyBasedDetection
zero cross detector result will be AND with energy based detection

typedef enum *_pdm_dc_remover* pdm_dc_remover_t
PDM DC remover configurations.

typedef enum *_pdm_df_quality_mode* pdm_df_quality_mode_t
PDM decimation filter quality mode.

typedef enum *_pdm_df_output_gain* pdm_df_output_gain_t
PDM decimation filter output gain.

typedef struct *_pdm_channel_config* pdm_channel_config_t
PDM channel configurations.

typedef struct *_pdm_config* pdm_config_t
PDM user configuration structure.

typedef enum *_pdm_hwvad_hpf_config* pdm_hwvad_hpf_config_t
High pass filter configure cut-off frequency.

typedef enum *_pdm_hwvad_filter_status* pdm_hwvad_filter_status_t
HWVAD internal filter status.

typedef struct *_pdm_hwvad_config* pdm_hwvad_config_t
PDM voice activity detector user configuration structure.

typedef struct *_pdm_hwvad_noise_filter* pdm_hwvad_noise_filter_t
PDM voice activity detector noise filter user configuration structure.

typedef enum *_pdm_hwvad_zcd_result* pdm_hwvad_zcd_result_t
PDM voice activity detector zero cross detector result.

typedef struct *_pdm_hwvad_zero_cross_detector* pdm_hwvad_zero_cross_detector_t
PDM voice activity detector zero cross detector configuration structure.

typedef struct *_pdm_transfer* pdm_transfer_t

PDM SDMA transfer structure.

typedef struct *_pdm_handle* pdm_handle_t

PDM handle.

typedef void (*pdm_transfer_callback_t)(PDM_Type *base, *pdm_handle_t* *handle, *status_t* status, void *userData)

PDM transfer callback prototype.

typedef void (*pdm_hwvad_callback_t)(*status_t* status, void *userData)

PDM HWVAD callback prototype.

typedef struct *_pdm_hwvad_notification* pdm_hwvad_notification_t

PDM HWVAD notification structure.

PDM_XFER_QUEUE_SIZE

PDM XFER QUEUE SIZE.

struct _pdm_channel_config

#include <fsl_pdm.h> PDM channel configurations.

Public Members

pdm_dc_remover_t cutOffFreq

DC remover cut off frequency

pdm_df_output_gain_t gain

Decimation Filter Output Gain

struct _pdm_config

#include <fsl_pdm.h> PDM user configuration structure.

Public Members

bool enableDoze

This module will enter disable/low leakage mode if DOZEN is active with ipg_doze is asserted

bool enableFilterBypass

Switchable bypass path for the decimation filter

uint8_t fifoWatermark

Watermark value for FIFO

pdm_df_quality_mode_t qualityMode

Quality mode

uint8_t cicOverSampleRate

CIC filter over sampling rate

struct _pdm_hwvad_config

#include <fsl_pdm.h> PDM voice activity detector user configuration structure.

Public Members

uint8_t channel

Which channel uses voice activity detector

uint8_t initializeTime
: Number of frames or samples to initialize voice activity detector.

uint8_t cicOverSampleRate
: CIC filter over sampling rate

uint8_t inputGain
: Voice activity detector input gain

uint32_t frameTime
: Voice activity frame time

pdm_hwvad_hpf_config_t cutOffFreq
: High pass filter cut off frequency

bool enableFrameEnergy
: If frame energy enabled, true means enable

bool enablePreFilter
: If pre-filter enabled

struct __pdm_hwvad_noise_filter
: *#include <fsl_pdm.h>* PDM voice activity detector noise filter user configuration structure.

Public Members

bool enableAutoNoiseFilter
: If noise fileter automatically activated, true means enable

bool enableNoiseMin
: If Noise minimum block enabled, true means enabled

bool enableNoiseDecimation
: If enable noise input decimation

bool enableNoiseDetectOR
: Enables a OR logic in the output of minimum noise estimator block

uint32_t noiseFilterAdjustment
: The adjustment value of the noise filter

uint32_t noiseGain
: Gain value for the noise energy or envelope estimated

struct __pdm_hwvad_zero_cross_detector
: *#include <fsl_pdm.h>* PDM voice activity detector zero cross detector configuration structure.

Public Members

bool enableAutoThreshold
: If ZCD auto-threshold enabled, true means enabled.

pdm_hwvad_zcd_result_t zcdAnd
: Is ZCD result is AND'ed with energy-based detection, false means OR'ed

uint32_t threshold
: The adjustment value of the noise filter

uint32_t adjustmentThreshold
Gain value for the noise energy or envelope estimated

struct __pdm__transfer
#include <fsl_pdm.h> PDM SDMA transfer structure.

Public Members

volatile uint8_t *data
Data start address to transfer.

volatile size_t dataSize
Total Transfer bytes size.

struct __pdm__hwvad__notification
#include <fsl_pdm.h> PDM HWVAD notification structure.

struct __pdm__handle
#include <fsl_pdm.h> PDM handle structure.

Public Members

uint32_t state
Transfer status

pdm_transfer_callback_t callback
Callback function called at transfer event

void *userData
Callback parameter passed to callback function

pdm_transfer_t pdmQueue[(4U)]
Transfer queue storing queued transfer

size_t transferSize[(4U)]
Data bytes need to transfer

volatile uint8_t queueUser
Index for user to queue transfer

volatile uint8_t queueDriver
Index for driver to get the transfer data and size

uint32_t format
data format

uint8_t watermark
Watermark value

uint8_t startChannel
end channel

uint8_t channelNums
Enabled channel number

2.91 PDM EDMA Driver

void PDM_TransferInstallEDMATCDMemory(*pdm_edma_handle_t* *handle, void *tcdAddr, size_t tcdNum)

Install EDMA descriptor memory.

Parameters

- handle – Pointer to EDMA channel transfer handle.
- tcdAddr – EDMA head descriptor address.
- tcdNum – EDMA link descriptor address.

void PDM_TransferCreateHandleEDMA(PDM_Type *base, *pdm_edma_handle_t* *handle, *pdm_edma_callback_t* callback, void *userData, *edma_handle_t* *dmaHandle)

Initializes the PDM Rx eDMA handle.

This function initializes the PDM slave DMA handle, which can be used for other PDM master transactional APIs. Usually, for a specified PDM instance, call this API once to get the initialized handle.

Parameters

- base – PDM base pointer.
- handle – PDM eDMA handle pointer.
- callback – Pointer to user callback function.
- userData – User parameter passed to the callback function.
- dmaHandle – eDMA handle pointer, this handle shall be static allocated by users.

void PDM_TransferSetMultiChannelInterleaveType(*pdm_edma_handle_t* *handle, *pdm_edma_multi_channel_interleave_t* multiChannelInterleaveType)

Initializes the multi PDM channel interleave type.

This function initializes the PDM DMA handle member interleaveType, it shall be called only when application would like to use type kPDM_EDMAMultiChannelInterleavePerChannelBlock, since the default interleaveType is kPDM_EDMAMultiChannelInterleavePerChannelSample always

Parameters

- handle – PDM eDMA handle pointer.
- multiChannelInterleaveType – Multi channel interleave type.

void PDM_TransferSetChannelConfigEDMA(PDM_Type *base, *pdm_edma_handle_t* *handle, uint32_t channel, const *pdm_channel_config_t* *config)

Configures the PDM channel.

Parameters

- base – PDM base pointer.
- handle – PDM eDMA handle pointer.
- channel – channel index.
- config – pdm channel configurations.

status_t PDM_TransferReceiveEDMA(PDM_Type *base, *pdm_edma_handle_t* *handle, *pdm_edma_transfer_t* *xfer)

Performs a non-blocking PDM receive using eDMA.

Mcaro MCUX_SDK_PDM_EDMA_PDM_ENABLE_INTERNAL can control whether PDM is enabled internally or externally.

a. Scatter gather case: This functio support dynamic scatter gather and staic scatter gather, a. for the dynamic scatter gather case: Application should call PDM_TransferReceiveEDMA function continuously to make sure new receive request is submit before the previous one finish. b. for the static scatter gather case: Application should use the link transfer feature and make sure a loop link transfer is provided, such as:

```
pdm_edma_transfer_t pdmXfer[2] =
{
    {
    .data  = s_buffer,
    .dataSize = BUFFER_SIZE,
    .linkTransfer = &pdmXfer[1],
    },

    {
    .data  = &s_buffer[BUFFER_SIZE],
    .dataSize = BUFFER_SIZE,
    .linkTransfer = &pdmXfer[0]
    },
};
```

b. Multi channel case: This function support receive multi pdm channel data, for example, if two channel is requested,

```
PDM_TransferSetChannelConfigEDMA(DEMO_PDM, &s_pdmRxHandle_0, DEMO_PDM_
↪ENABLE_CHANNEL_0, &channelConfig);
PDM_TransferSetChannelConfigEDMA(DEMO_PDM, &s_pdmRxHandle_0, DEMO_PDM_
↪ENABLE_CHANNEL_1, &channelConfig);
PDM_TransferReceiveEDMA(DEMO_PDM, &s_pdmRxHandle_0, pdmXfer);
```

The output data will be formatted as below if handle->interleaveType =

Note: This interface returns immediately after the transfer initiates. Call the PDM_GetReceiveRemainingBytes to poll the transfer status and check whether the PDM transfer is finished.

---

void PDM_TransferTerminateReceiveEDMA(PDM_Type *base, *pdm_edma_handle_t* *handle)

Terminate all PDM receive.

This function will clear all transfer slots buffered in the pdm queue. If users only want to abort the current transfer slot, please call PDM_TransferAbortReceiveEDMA.

Parameters

- base – PDM base pointer.
- handle – PDM eDMA handle pointer.

void PDM_TransferAbortReceiveEDMA(PDM_Type *base, *pdm_edma_handle_t* *handle)

Aborts a PDM receive using eDMA.

This function only aborts the current transfer slots, the other transfer slots' information still kept in the handler. If users want to terminate all transfer slots, just call PDM_TransferTerminateReceiveEDMA.

Parameters

- base – PDM base pointer
- handle – PDM eDMA handle pointer.

status_t PDM_TransferGetReceiveCountEDMA(PDM_Type *base, *pdm_edma_handle_t* *handle, size_t *count)

Gets byte count received by PDM.

Parameters

- base – PDM base pointer
- handle – PDM eDMA handle pointer.
- count – Bytes count received by PDM.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is no non-blocking transaction in progress.

FSL_PDM_EDMA_DRIVER_VERSION

Version 2.6.5

enum _pdm_edma_multi_channel_interleave

pdm multi channel interleave type

Values:

enumerator kPDM_EDMAMultiChannelInterleavePerChannelSample

enumerator kPDM_EDMAMultiChannelInterleavePerChannelBlock

typedef struct *_pdm_edma_handle* pdm_edma_handle_t

PDM edma handler.

typedef enum *_pdm_edma_multi_channel_interleave* pdm_edma_multi_channel_interleave_t

pdm multi channel interleave type

typedef struct *_pdm_edma_transfer* pdm_edma_transfer_t

PDM edma transfer.

typedef void (*pdm_edma_callback_t)(PDM_Type *base, *pdm_edma_handle_t* *handle, *status_t* status, void *userData)

PDM eDMA transfer callback function for finish and error.

MCUX_SDK_PDM_EDMA_PDM_ENABLE_INTERNAL

the PDM enable position When calling PDM_TransferReceiveEDMA

struct _pdm_edma_transfer

#include <fsl_pdm_edma.h> PDM edma transfer.

Public Members

volatile uint8_t *data

Data start address to transfer.

volatile size_t dataSize
: Total Transfer bytes size.

struct *_pdm_edma_transfer* *linkTransfer
: linked transfer configurations

struct __pdm_edma_handle
: *#include <fsl_pdm_edma.h>* PDM DMA transfer handle, users should not touch the content of the handle.

Public Members

edma_handle_t *dmaHandle
: DMA handler for PDM send

uint8_t count
: The transfer data count in a DMA request

uint32_t receivedBytes
: total transfer count

uint32_t state
: Internal state for PDM eDMA transfer

pdm_edma_callback_t callback
: Callback for users while transfer finish or error occurs

bool isLoopTransfer
: loop transfer

void *userData
: User callback parameter

edma_tcd_t *tcd
: TCD pool for eDMA transfer.

uint32_t tcdNum
: TCD number

uint32_t tcdUser
: Index for user to queue transfer.

uint32_t tcdDriver
: Index for driver to get the transfer data and size

volatile uint32_t tcdUsedNum
: Index for user to queue transfer.

pdm_edma_multi_channel_interleave_t interleaveType
: multi channel transfer interleave type

uint8_t endChannel
: The last enabled channel

uint8_t channelNums
: total channel numbers

2.92 RGPIO: Rapid General-Purpose Input/Output Driver

FSL_RGPIO_DRIVER_VERSION
RGPIO driver version 2.1.0.

enum _rgpio_pin_direction
RGPIO direction definition.

Values:

enumerator kRGPIO_DigitalInput
Set current pin as digital input

enumerator kRGPIO_DigitalOutput
Set current pin as digital output

enum _rgpio_checker_attribute
RGPIO checker attribute.

Values:

enumerator kRGPIO_UsernonsecureRWUsersecureRWPrivilegedsecureRW
User nonsecure:Read+Write; User Secure:Read+Write; Privileged Secure:Read+Write

enumerator kRGPIO_UsernonsecureRUsersecureRWPrivilegedsecureRW
User nonsecure:Read; User Secure:Read+Write; Privileged Secure:Read+Write

enumerator kRGPIO_UsernonsecureNUsersecureRWPrivilegedsecureRW
User nonsecure:None; User Secure:Read+Write; Privileged Secure:Read+Write

enumerator kRGPIO_UsernonsecureRUsersecureRPrivilegedsecureRW
User nonsecure:Read; User Secure:Read; Privileged Secure:Read+Write

enumerator kRGPIO_UsernonsecureNUsersecureRPrivilegedsecureRW
User nonsecure:None; User Secure:Read; Privileged Secure:Read+Write

enumerator kRGPIO_UsernonsecureNUsersecureNPrivilegedsecureRW
User nonsecure:None; User Secure:None; Privileged Secure:Read+Write

enumerator kRGPIO_UsernonsecureNUsersecureNPrivilegedsecureR
User nonsecure:None; User Secure:None; Privileged Secure:Read

enumerator kRGPIO_UsernonsecureNUsersecureNPrivilegedsecureN
User nonsecure:None; User Secure:None; Privileged Secure:None

enumerator kRGPIO_IgnoreAttributeCheck
Ignores the attribute check

enum _rgpio_interrupt_sel
Configures the interrupt generation condition.

Values:

enumerator kRGPIO_InterruptOutput0
Interrupt/DMA request/trigger output 0.

enumerator kRGPIO_InterruptOutput1
Interrupt/DMA request/trigger output 1.

enumerator kRGPIO_InterruptOutput2
Interrupt/DMA request/trigger output 2.

enumerator kRGPIO_InterruptOutput3
Interrupt/DMA request/trigger output 3.

enum _rgpio_interrupt_config
Configures the interrupt generation condition.

Values:

enumerator kRGPIO_InterruptOrDMADisabled
Interrupt/DMA request is disabled.

enumerator kRGPIO_DMARisingEdge
DMA request on rising edge.

enumerator kRGPIO_DMAFallingEdge
DMA request on falling edge.

enumerator kRGPIO_DMAEitherEdge
DMA request on either edge.

enumerator kRGPIO_FlagRisingEdge
Flag sets on rising edge.

enumerator kRGPIO_FlagFallingEdge
Flag sets on falling edge.

enumerator kRGPIO_FlagEitherEdge
Flag sets on either edge.

enumerator kRGPIO_InterruptLogicZero
Interrupt when logic zero.

enumerator kRGPIO_InterruptRisingEdge
Interrupt on rising edge.

enumerator kRGPIO_InterruptFallingEdge
Interrupt on falling edge.

enumerator kRGPIO_InterruptEitherEdge
Interrupt on either edge.

enumerator kRGPIO_InterruptLogicOne
Interrupt when logic one.

enumerator kRGPIO_ActiveHighTriggerOutputEnable
Enable active high-trigger output.

enumerator kRGPIO_ActiveLowTriggerOutputEnable
Enable active low-trigger output.

typedef enum *_rgpio_pin_direction* rgpio_pin_direction_t
RGPIO direction definition.

typedef enum *_rgpio_checker_attribute* rgpio_checker_attribute_t
RGPIO checker attribute.

typedef enum *_rgpio_interrupt_sel* rgpio_interrupt_sel_t
Configures the interrupt generation condition.

typedef enum *_rgpio_interrupt_config* rgpio_interrupt_config_t
Configures the interrupt generation condition.

typedef struct *_rgpio_pin_config* rgpio_pin_config_t

The RGPIO pin configuration structure.

Each pin can only be configured as either an output pin or an input pin at a time. If configured as an input pin, leave the outputConfig unused. Note that in some use cases, the corresponding port property should be configured in advance with the PORT_SetPinConfig().

struct _rgpio_pin_config

#include <fsl_rgpio.h> The RGPIO pin configuration structure.

Each pin can only be configured as either an output pin or an input pin at a time. If configured as an input pin, leave the outputConfig unused. Note that in some use cases, the corresponding port property should be configured in advance with the PORT_SetPinConfig().

Public Members

rgpio_pin_direction_t pinDirection

RGPIO direction, input or output

uint8_t outputLogic

Set a default output logic, which has no use in input

2.93 RGPIO Driver

void RGPIO_PinInit(RGPIO_Type *base, uint32_t pin, const *rgpio_pin_config_t* *config)

Initializes a RGPIO pin used by the board.

To initialize the RGPIO, define a pin configuration, as either input or output, in the user file. Then, call the RGPIO_PinInit() function.

This is an example to define an input pin or an output pin configuration.

```
 Define a digital input pin configuration,
rgpio_pin_config_t config =
{
  kRGPIO_DigitalInput,
  0,
}
Define a digital output pin configuration,
rgpio_pin_config_t config =
{
  kRGPIO_DigitalOutput,
  0,
}
```

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- pin – RGPIO port pin number
- config – RGPIO pin configuration pointer

uint32_t RGPIO_GetInstance(RGPIO_Type *base)

Gets the RGPIO instance according to the RGPIO base.

Parameters

- base – RGPIO peripheral base pointer(PTA, PTB, PTC, etc.)

Return values
RGPIO – instance

static inline void RGPIO_PinWrite(RGPIO_Type *base, uint32_t pin, uint8_t output)
Sets the output level of the multiple RGPIO pins to the logic 1 or 0.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- pin – RGPIO pin number
- output – RGPIO pin output logic level.
  - 0: corresponding pin output low-logic level.
  - 1: corresponding pin output high-logic level.

static inline void RGPIO_WritePinOutput(RGPIO_Type *base, uint32_t pin, uint8_t output)
Sets the output level of the multiple RGPIO pins to the logic 1 or 0.

Deprecated:
Do not use this function. It has been superceded by RGPIO_PinWrite.

static inline void RGPIO_PortSet(RGPIO_Type *base, uint32_t mask)
Sets the output level of the multiple RGPIO pins to the logic 1.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number macro

static inline void RGPIO_SetPinsOutput(RGPIO_Type *base, uint32_t mask)
Sets the output level of the multiple RGPIO pins to the logic 1.

Deprecated:
Do not use this function. It has been superceded by RGPIO_PortSet.

static inline void RGPIO_PortClear(RGPIO_Type *base, uint32_t mask)
Sets the output level of the multiple RGPIO pins to the logic 0.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number macro

static inline void RGPIO_ClearPinsOutput(RGPIO_Type *base, uint32_t mask)
Sets the output level of the multiple RGPIO pins to the logic 0.

Deprecated:
Do not use this function. It has been superceded by RGPIO_PortClear.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number macro

static inline void RGPIO_PortToggle(RGPIO_Type *base, uint32_t mask)

Reverses the current output logic of the multiple RGPIO pins.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number macro

static inline void RGPIO_TogglePinsOutput(RGPIO_Type *base, uint32_t mask)

Reverses the current output logic of the multiple RGPIO pins.

Deprecated:

Do not use this function. It has been superceded by RGPIO_PortToggle.

static inline uint32_t RGPIO_PinRead(RGPIO_Type *base, uint32_t pin)

Reads the current input value of the RGPIO port.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- pin – RGPIO pin number

Return values

RGPIO – port input value

- 0: corresponding pin input low-logic level.
- 1: corresponding pin input high-logic level.

static inline uint32_t RGPIO_ReadPinInput(RGPIO_Type *base, uint32_t pin)

Reads the current input value of the RGPIO port.

Deprecated:

Do not use this function. It has been superceded by RGPIO_PinRead.

static inline void RGPIO_EnablePortInput(RGPIO_Type *base, uint32_t mask, bool enable)

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number mask
- enable – RGPIO digital input enable/disable flag.

void RGPIO_CheckAttributeBytes(RGPIO_Type *base, *rgpio_checker_attribute_t* attribute)

The RGPIO module supports a device-specific number of data ports, organized as 32-bit words. Each 32-bit data port includes a GACR register, which defines the byte-level attributes required for a successful access to the RGPIO programming model. The attribute controls for the 4 data bytes in the GACR follow a standard little endian data convention.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number macro

static inline void RGPIO_SetPinInterruptConfig(RGPIO_Type *base, uint32_t pin,
rgpio_interrupt_sel_t sel,
rgpio_interrupt_config_t config)

Configures the gpio pin interrupt/DMA request.

Parameters

- base – RGPIO peripheral base pointer.
- pin – RGPIO pin number.
- sel – RGPIO pin interrupt selection(0-3).
- config – RGPIO pin interrupt configuration.

static inline void _SetMultipleInterruptPinsConfig(RGPIO_Type *base, uint32_t mask,
rgpio_interrupt_sel_t sel,
rgpio_interrupt_config_t config)

Sets the gpio interrupt configuration in ICR register for multiple pins.

Parameters

- base – RGPIO peripheral base pointer (RGPIOA, RGPIOB, RGPIOC, and so on.)
- mask – RGPIO pin number macro.
- sel – RGPIO pin interrupt selection(0-3).
- config – RGPIO pin interrupt configuration.

static inline uint32_t RGPIO_GetPinsInterruptFlags(RGPIO_Type *base, *rgpio_interrupt_sel_t* sel)

Reads the whole gpio status flag.

If a pin is configured to generate the DMA request, the corresponding flag is cleared automatically at the completion of the requested DMA transfer. Otherwise, the flag remains set until a logic one is written to that flag. If configured for a level sensitive interrupt that remains asserted, the flag is set again immediately.

Parameters

- base – RGPIO peripheral base pointer.
- sel – RGPIO pin interrupt selection(0-3).

Returns

Current gpio interrupt status flags, for example, 0x00010001 means the pin 0 and 16 have the interrupt.

static inline void RGPIO_ClearPinsInterruptFlags(RGPIO_Type *base, *rgpio_interrupt_sel_t* sel,
uint32_t mask)

Clears the multiple pin interrupt status flag.

Parameters

- base – RGPIO peripheral base pointer.
- sel – RGPIO pin interrupt selection(0-3).
- mask – RGPIO pin number macro.

2.94 SAI: Serial Audio Interface

2.95 SAI Driver

void SAI_Init(I2S_Type *base)

Initializes the SAI peripheral.

This API gates the SAI clock. The SAI module can't operate unless SAI_Init is called to enable the clock.

Parameters

- base – SAI base pointer.

void SAI_Deinit(I2S_Type *base)

De-initializes the SAI peripheral.

This API gates the SAI clock. The SAI module can't operate unless SAI_TxInit or SAI_RxInit is called to enable the clock.

Parameters

- base – SAI base pointer.

void SAI_TxReset(I2S_Type *base)

Resets the SAI Tx.

This function enables the software reset and FIFO reset of SAI Tx. After reset, clear the reset bit.

Parameters

- base – SAI base pointer

void SAI_RxReset(I2S_Type *base)

Resets the SAI Rx.

This function enables the software reset and FIFO reset of SAI Rx. After reset, clear the reset bit.

Parameters

- base – SAI base pointer

void SAI_TxEnable(I2S_Type *base, bool enable)

Enables/disables the SAI Tx.

Parameters

- base – SAI base pointer.
- enable – True means enable SAI Tx, false means disable.

void SAI_RxEnable(I2S_Type *base, bool enable)

Enables/disables the SAI Rx.

Parameters

- base – SAI base pointer.
- enable – True means enable SAI Rx, false means disable.

static inline void SAI_TxSetBitClockDirection(I2S_Type *base, *sai_master_slave_t* masterSlave)

Set Rx bit clock direction.

Select bit clock direction, master or slave.

Parameters

- base – SAI base pointer.
- masterSlave – reference sai_master_slave_t.

static inline void SAI_RxSetBitClockDirection(I2S_Type *base, *sai_master_slave_t* masterSlave)

Set Rx bit clock direction.

Select bit clock direction, master or slave.

Parameters

- base – SAI base pointer.
- masterSlave – reference sai_master_slave_t.

static inline void SAI_RxSetFrameSyncDirection(I2S_Type *base, *sai_master_slave_t* masterSlave)

Set Rx frame sync direction.

Select frame sync direction, master or slave.

Parameters

- base – SAI base pointer.
- masterSlave – reference sai_master_slave_t.

static inline void SAI_TxSetFrameSyncDirection(I2S_Type *base, *sai_master_slave_t* masterSlave)

Set Tx frame sync direction.

Select frame sync direction, master or slave.

Parameters

- base – SAI base pointer.
- masterSlave – reference sai_master_slave_t.

void SAI_TxSetBitClockRate(I2S_Type *base, uint32_t sourceClockHz, uint32_t sampleRate, uint32_t bitWidth, uint32_t channelNumbers)

Transmitter bit clock rate configurations.

Parameters

- base – SAI base pointer.
- sourceClockHz – Bit clock source frequency.
- sampleRate – Audio data sample rate.
- bitWidth – Audio data bitWidth.
- channelNumbers – Audio channel numbers.

void SAI_RxSetBitClockRate(I2S_Type *base, uint32_t sourceClockHz, uint32_t sampleRate, uint32_t bitWidth, uint32_t channelNumbers)

Receiver bit clock rate configurations.

Parameters

- base – SAI base pointer.
- sourceClockHz – Bit clock source frequency.
- sampleRate – Audio data sample rate.
- bitWidth – Audio data bitWidth.
- channelNumbers – Audio channel numbers.

void SAI_TxSetBitclockConfig(I2S_Type *base, *sai_master_slave_t* masterSlave, *sai_bit_clock_t* *config)

Transmitter Bit clock configurations.

Parameters

- base – SAI base pointer.
- masterSlave – master or slave.
- config – bit clock other configurations, can be NULL in slave mode.

void SAI_RxSetBitclockConfig(I2S_Type *base, *sai_master_slave_t* masterSlave, *sai_bit_clock_t* *config)

Receiver Bit clock configurations.

Parameters

- base – SAI base pointer.
- masterSlave – master or slave.
- config – bit clock other configurations, can be NULL in slave mode.

void SAI_SetMasterClockConfig(I2S_Type *base, *sai_master_clock_t* *config)

Master clock configurations.

Parameters

- base – SAI base pointer.
- config – master clock configurations.

void SAI_TxSetFifoConfig(I2S_Type *base, *sai_fifo_t* *config)

SAI transmitter fifo configurations.

Parameters

- base – SAI base pointer.
- config – fifo configurations.

void SAI_RxSetFifoConfig(I2S_Type *base, *sai_fifo_t* *config)

SAI receiver fifo configurations.

Parameters

- base – SAI base pointer.
- config – fifo configurations.

void SAI_TxSetFrameSyncConfig(I2S_Type *base, *sai_master_slave_t* masterSlave, *sai_frame_sync_t* *config)

SAI transmitter Frame sync configurations.

Parameters

- base – SAI base pointer.
- masterSlave – master or slave.
- config – frame sync configurations, can be NULL in slave mode.

void SAI_RxSetFrameSyncConfig(I2S_Type *base, *sai_master_slave_t* masterSlave, *sai_frame_sync_t* *config)

SAI receiver Frame sync configurations.

Parameters

- base – SAI base pointer.
- masterSlave – master or slave.
- config – frame sync configurations, can be NULL in slave mode.

void SAI_TxSetSerialDataConfig(I2S_Type *base, *sai_serial_data_t* *config)

SAI transmitter Serial data configurations.

Parameters

- base – SAI base pointer.
- config – serial data configurations.

void SAI_RxSetSerialDataConfig(I2S_Type *base, *sai_serial_data_t* *config)

SAI receiver Serial data configurations.

Parameters

- base – SAI base pointer.
- config – serial data configurations.

void SAI_TxSetConfig(I2S_Type *base, *sai_transceiver_t* *config)

SAI transmitter configurations.

Parameters

- base – SAI base pointer.
- config – transmitter configurations.

void SAI_RxSetConfig(I2S_Type *base, *sai_transceiver_t* *config)

SAI receiver configurations.

Parameters

- base – SAI base pointer.
- config – receiver configurations.

void SAI_GetClassicI2SConfig(*sai_transceiver_t* *config, *sai_word_width_t* bitWidth, *sai_mono_stereo_t* mode, uint32_t saiChannelMask)

Get classic I2S mode configurations.

Parameters

- config – transceiver configurations.
- bitWidth – audio data bitWidth.
- mode – audio data channel.
- saiChannelMask – mask value of the channel to be enable.

void SAI_GetLeftJustifiedConfig(*sai_transceiver_t* *config, *sai_word_width_t* bitWidth, *sai_mono_stereo_t* mode, uint32_t saiChannelMask)

Get left justified mode configurations.

Parameters

- config – transceiver configurations.
- bitWidth – audio data bitWidth.
- mode – audio data channel.
- saiChannelMask – mask value of the channel to be enable.

void SAI_GetRightJustifiedConfig(*sai_transceiver_t* *config, *sai_word_width_t* bitWidth, *sai_mono_stereo_t* mode, uint32_t saiChannelMask)

Get right justified mode configurations.

Parameters

- config – transceiver configurations.

- bitWidth – audio data bitWidth.
- mode – audio data channel.
- saiChannelMask – mask value of the channel to be enable.

void SAI_GetTDMConfig(*sai_transceiver_t* *config, *sai_frame_sync_len_t* frameSyncWidth, *sai_word_width_t* bitWidth, uint32_t dataWordNum, uint32_t saiChannelMask)

Get TDM mode configurations.

Parameters

- config – transceiver configurations.
- frameSyncWidth – length of frame sync.
- bitWidth – audio data word width.
- dataWordNum – word number in one frame.
- saiChannelMask – mask value of the channel to be enable.

void SAI_GetDSPConfig(*sai_transceiver_t* *config, *sai_frame_sync_len_t* frameSyncWidth, *sai_word_width_t* bitWidth, *sai_mono_stereo_t* mode, uint32_t saiChannelMask)

Get DSP mode configurations.

DSP/PCM MODE B configuration flow for TX. RX is similiar but uses SAI_RxSetConfig instead of SAI_TxSetConfig:

```
SAI_GetDSPConfig(config, kSAI_FrameSyncLenOneBitClk, bitWidth, kSAI_Stereo, channelMask)
SAI_TxSetConfig(base, config)
```

Note: DSP mode is also called PCM mode which support MODE A and MODE B, DSP/PCM MODE A configuration flow. RX is similiar but uses SAI_RxSetConfig instead of SAI_TxSetConfig:

```
SAI_GetDSPConfig(config, kSAI_FrameSyncLenOneBitClk, bitWidth, kSAI_Stereo, channelMask)
config->frameSync.frameSyncEarly    = true;
SAI_TxSetConfig(base, config)
```

Parameters

- config – transceiver configurations.
- frameSyncWidth – length of frame sync.
- bitWidth – audio data bitWidth.
- mode – audio data channel.
- saiChannelMask – mask value of the channel to enable.

static inline uint32_t SAI_TxGetStatusFlag(I2S_Type *base)

Gets the SAI Tx status flag state.

Parameters

- base – SAI base pointer

Returns

SAI Tx status flag value. Use the Status Mask to get the status value needed.

static inline void SAI_TxClearStatusFlags(I2S_Type *base, uint32_t mask)

Clears the SAI Tx status flag state.

Parameters

- base – SAI base pointer
- mask – State mask. It can be a combination of the following source if defined:
  - kSAI_WordStartFlag
  - kSAI_SyncErrorFlag
  - kSAI_FIFOErrorFlag

static inline uint32_t SAI_RxGetStatusFlag(I2S_Type *base)

Gets the SAI Tx status flag state.

Parameters

- base – SAI base pointer

Returns

SAI Rx status flag value. Use the Status Mask to get the status value needed.

static inline void SAI_RxClearStatusFlags(I2S_Type *base, uint32_t mask)

Clears the SAI Rx status flag state.

Parameters

- base – SAI base pointer
- mask – State mask. It can be a combination of the following sources if defined.
  - kSAI_WordStartFlag
  - kSAI_SyncErrorFlag
  - kSAI_FIFOErrorFlag

void SAI_TxSoftwareReset(I2S_Type *base, *sai_reset_type_t* resetType)

Do software reset or FIFO reset .

FIFO reset means clear all the data in the FIFO, and make the FIFO pointer both to 0. Software reset means clear the Tx internal logic, including the bit clock, frame count etc. But software reset will not clear any configuration registers like TCR1~TCR5. This function will also clear all the error flags such as FIFO error, sync error etc.

Parameters

- base – SAI base pointer
- resetType – Reset type, FIFO reset or software reset

void SAI_RxSoftwareReset(I2S_Type *base, *sai_reset_type_t* resetType)

Do software reset or FIFO reset .

FIFO reset means clear all the data in the FIFO, and make the FIFO pointer both to 0. Software reset means clear the Rx internal logic, including the bit clock, frame count etc. But software reset will not clear any configuration registers like RCR1~RCR5. This function will also clear all the error flags such as FIFO error, sync error etc.

Parameters

- base – SAI base pointer
- resetType – Reset type, FIFO reset or software reset

void SAI_TxSetChannelFIFOMask(I2S_Type *base, uint8_t mask)

Set the Tx channel FIFO enable mask.

Parameters

- base – SAI base pointer
- mask – Channel enable mask, 0 means all channel FIFO disabled, 1 means channel 0 enabled, 3 means both channel 0 and channel 1 enabled.

void SAI_RxSetChannelFIFOMask(I2S_Type *base, uint8_t mask)

Set the Rx channel FIFO enable mask.

Parameters

- base – SAI base pointer
- mask – Channel enable mask, 0 means all channel FIFO disabled, 1 means channel 0 enabled, 3 means both channel 0 and channel 1 enabled.

void SAI_TxSetDataOrder(I2S_Type *base, *sai_data_order_t* order)

Set the Tx data order.

Parameters

- base – SAI base pointer
- order – Data order MSB or LSB

void SAI_RxSetDataOrder(I2S_Type *base, *sai_data_order_t* order)

Set the Rx data order.

Parameters

- base – SAI base pointer
- order – Data order MSB or LSB

void SAI_TxSetBitClockPolarity(I2S_Type *base, *sai_clock_polarity_t* polarity)

Set the Tx data order.

Parameters

- base – SAI base pointer
- polarity –

void SAI_RxSetBitClockPolarity(I2S_Type *base, *sai_clock_polarity_t* polarity)

Set the Rx data order.

Parameters

- base – SAI base pointer
- polarity –

void SAI_TxSetFrameSyncPolarity(I2S_Type *base, *sai_clock_polarity_t* polarity)

Set the Tx data order.

Parameters

- base – SAI base pointer
- polarity –

void SAI_RxSetFrameSyncPolarity(I2S_Type *base, *sai_clock_polarity_t* polarity)

Set the Rx data order.

Parameters

- base – SAI base pointer

- polarity –

void SAI_TxSetFIFOPacking(I2S_Type *base, *sai_fifo_packing_t* pack)

Set Tx FIFO packing feature.

Parameters

- base – SAI base pointer.
- pack – FIFO pack type. It is element of sai_fifo_packing_t.

void SAI_RxSetFIFOPacking(I2S_Type *base, *sai_fifo_packing_t* pack)

Set Rx FIFO packing feature.

Parameters

- base – SAI base pointer.
- pack – FIFO pack type. It is element of sai_fifo_packing_t.

static inline void SAI_TxSetFIFOErrorContinue(I2S_Type *base, bool isEnabled)

Set Tx FIFO error continue.

FIFO error continue mode means SAI will keep running while FIFO error occurred. If this feature not enabled, SAI will hang and users need to clear FEF flag in TCSR register.

Parameters

- base – SAI base pointer.
- isEnabled – Is FIFO error continue enabled, true means enable, false means disable.

static inline void SAI_RxSetFIFOErrorContinue(I2S_Type *base, bool isEnabled)

Set Rx FIFO error continue.

FIFO error continue mode means SAI will keep running while FIFO error occurred. If this feature not enabled, SAI will hang and users need to clear FEF flag in RCSR register.

Parameters

- base – SAI base pointer.
- isEnabled – Is FIFO error continue enabled, true means enable, false means disable.

static inline void SAI_TxEnableInterrupts(I2S_Type *base, uint32_t mask)

Enables the SAI Tx interrupt requests.

Parameters

- base – SAI base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kSAI_WordStartInterruptEnable
  - kSAI_SyncErrorInterruptEnable
  - kSAI_FIFOWarningInterruptEnable
  - kSAI_FIFORequestInterruptEnable
  - kSAI_FIFOErrorInterruptEnable

static inline void SAI_RxEnableInterrupts(I2S_Type *base, uint32_t mask)

Enables the SAI Rx interrupt requests.

Parameters

- base – SAI base pointer

- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kSAI_WordStartInterruptEnable
  - kSAI_SyncErrorInterruptEnable
  - kSAI_FIFOWarningInterruptEnable
  - kSAI_FIFORequestInterruptEnable
  - kSAI_FIFOErrorInterruptEnable

static inline void SAI_TxDisableInterrupts(I2S_Type *base, uint32_t mask)

Disables the SAI Tx interrupt requests.

Parameters

- base – SAI base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kSAI_WordStartInterruptEnable
  - kSAI_SyncErrorInterruptEnable
  - kSAI_FIFOWarningInterruptEnable
  - kSAI_FIFORequestInterruptEnable
  - kSAI_FIFOErrorInterruptEnable

static inline void SAI_RxDisableInterrupts(I2S_Type *base, uint32_t mask)

Disables the SAI Rx interrupt requests.

Parameters

- base – SAI base pointer
- mask – interrupt source The parameter can be a combination of the following sources if defined.
  - kSAI_WordStartInterruptEnable
  - kSAI_SyncErrorInterruptEnable
  - kSAI_FIFOWarningInterruptEnable
  - kSAI_FIFORequestInterruptEnable
  - kSAI_FIFOErrorInterruptEnable

static inline void SAI_TxEnableDMA(I2S_Type *base, uint32_t mask, bool enable)

Enables/disables the SAI Tx DMA requests.

Parameters

- base – SAI base pointer
- mask – DMA source The parameter can be combination of the following sources if defined.
  - kSAI_FIFOWarningDMAEnable
  - kSAI_FIFORequestDMAEnable
- enable – True means enable DMA, false means disable DMA.

static inline void SAI_RxEnableDMA(I2S_Type *base, uint32_t mask, bool enable)

Enables/disables the SAI Rx DMA requests.

Parameters

- base – SAI base pointer
- mask – DMA source The parameter can be a combination of the following sources if defined.
  - kSAI_FIFOWarningDMAEnable
  - kSAI_FIFORequestDMAEnable
- enable – True means enable DMA, false means disable DMA.

static inline uintptr_t SAI_TxGetDataRegisterAddress(I2S_Type *base, uint32_t channel)

Gets the SAI Tx data register address.

This API is used to provide a transfer address for the SAI DMA transfer configuration.

Parameters

- base – SAI base pointer.
- channel – Which data channel used.

Returns

data register address.

static inline uintptr_t SAI_RxGetDataRegisterAddress(I2S_Type *base, uint32_t channel)

Gets the SAI Rx data register address.

This API is used to provide a transfer address for the SAI DMA transfer configuration.

Parameters

- base – SAI base pointer.
- channel – Which data channel used.

Returns

data register address.

void SAI_WriteBlocking(I2S_Type *base, uint32_t channel, uint32_t bitWidth, uint8_t *buffer, uint32_t size)

Sends data using a blocking method.

Note: This function blocks by polling until data is ready to be sent.

Parameters

- base – SAI base pointer.
- channel – Data channel used.
- bitWidth – How many bits in an audio word; usually 8/16/24/32 bits.
- buffer – Pointer to the data to be written.
- size – Bytes to be written.

void SAI_WriteMultiChannelBlocking(I2S_Type *base, uint32_t channel, uint32_t channelMask, uint32_t bitWidth, uint8_t *buffer, uint32_t size)

Sends data to multi channel using a blocking method.

Note: This function blocks by polling until data is ready to be sent.

Parameters

- base – SAI base pointer.
- channel – Data channel used.
- channelMask – channel mask.
- bitWidth – How many bits in an audio word; usually 8/16/24/32 bits.
- buffer – Pointer to the data to be written.
- size – Bytes to be written.

static inline void SAI_WriteData(I2S_Type *base, uint32_t channel, uint32_t data)

Writes data into SAI FIFO.

Parameters

- base – SAI base pointer.
- channel – Data channel used.
- data – Data needs to be written.

void SAI_ReadBlocking(I2S_Type *base, uint32_t channel, uint32_t bitWidth, uint8_t *buffer, uint32_t size)

Receives data using a blocking method.

Note: This function blocks by polling until data is ready to be sent.

Parameters

- base – SAI base pointer.
- channel – Data channel used.
- bitWidth – How many bits in an audio word; usually 8/16/24/32 bits.
- buffer – Pointer to the data to be read.
- size – Bytes to be read.

void SAI_ReadMultiChannelBlocking(I2S_Type *base, uint32_t channel, uint32_t channelMask, uint32_t bitWidth, uint8_t *buffer, uint32_t size)

Receives multi channel data using a blocking method.

Note: This function blocks by polling until data is ready to be sent.

Parameters

- base – SAI base pointer.
- channel – Data channel used.
- channelMask – channel mask.
- bitWidth – How many bits in an audio word; usually 8/16/24/32 bits.
- buffer – Pointer to the data to be read.
- size – Bytes to be read.

static inline uint32_t SAI_ReadData(I2S_Type *base, uint32_t channel)

Reads data from the SAI FIFO.

Parameters

- base – SAI base pointer.
- channel – Data channel used.

Returns

Data in SAI FIFO.

void SAI_TransferTxCreateHandle(I2S_Type *base, *sai_handle_t* *handle, *sai_transfer_callback_t* callback, void *userData)

Initializes the SAI Tx handle.

This function initializes the Tx handle for the SAI Tx transactional APIs. Call this function once to get the handle initialized.

Parameters

- base – SAI base pointer
- handle – SAI handle pointer.
- callback – Pointer to the user callback function.
- userData – User parameter passed to the callback function

void SAI_TransferRxCreateHandle(I2S_Type *base, *sai_handle_t* *handle, *sai_transfer_callback_t* callback, void *userData)

Initializes the SAI Rx handle.

This function initializes the Rx handle for the SAI Rx transactional APIs. Call this function once to get the handle initialized.

Parameters

- base – SAI base pointer.
- handle – SAI handle pointer.
- callback – Pointer to the user callback function.
- userData – User parameter passed to the callback function.

void SAI_TransferTxSetConfig(I2S_Type *base, *sai_handle_t* *handle, *sai_transceiver_t* *config)

SAI transmitter transfer configurations.

This function initializes the Tx, include bit clock, frame sync, master clock, serial data and fifo configurations.

Parameters

- base – SAI base pointer.
- handle – SAI handle pointer.
- config – tranmitter configurations.

void SAI_TransferRxSetConfig(I2S_Type *base, *sai_handle_t* *handle, *sai_transceiver_t* *config)

SAI receiver transfer configurations.

This function initializes the Rx, include bit clock, frame sync, master clock, serial data and fifo configurations.

Parameters

- base – SAI base pointer.
- handle – SAI handle pointer.

- config – receiver configurations.

status_t SAI_TransferSendNonBlocking(I2S_Type *base, *sai_handle_t* *handle, *sai_transfer_t* *xfer)

Performs an interrupt non-blocking send transfer on SAI.

Note: This API returns immediately after the transfer initiates. Call the SAI_TxGetTransferStatusIRQ to poll the transfer status and check whether the transfer is finished. If the return status is not kStatus_SAI_Busy, the transfer is finished.

Parameters

- base – SAI base pointer.
- handle – Pointer to the sai_handle_t structure which stores the transfer state.
- xfer – Pointer to the sai_transfer_t structure.

Return values

- kStatus_Success – Successfully started the data receive.
- kStatus_SAI_TxBusy – Previous receive still not finished.
- kStatus_InvalidArgument – The input parameter is invalid.

status_t SAI_TransferReceiveNonBlocking(I2S_Type *base, *sai_handle_t* *handle, *sai_transfer_t* *xfer)

Performs an interrupt non-blocking receive transfer on SAI.

Note: This API returns immediately after the transfer initiates. Call the SAI_RxGetTransferStatusIRQ to poll the transfer status and check whether the transfer is finished. If the return status is not kStatus_SAI_Busy, the transfer is finished.

Parameters

- base – SAI base pointer
- handle – Pointer to the sai_handle_t structure which stores the transfer state.
- xfer – Pointer to the sai_transfer_t structure.

Return values

- kStatus_Success – Successfully started the data receive.
- kStatus_SAI_RxBusy – Previous receive still not finished.
- kStatus_InvalidArgument – The input parameter is invalid.

status_t SAI_TransferGetSendCount(I2S_Type *base, *sai_handle_t* *handle, size_t *count)

Gets a set byte count.

Parameters

- base – SAI base pointer.
- handle – Pointer to the sai_handle_t structure which stores the transfer state.
- count – Bytes count sent.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

status_t SAI_TransferGetReceiveCount(I2S_Type *base, *sai_handle_t* *handle, size_t *count)

Gets a received byte count.

Parameters

- base – SAI base pointer.
- handle – Pointer to the sai_handle_t structure which stores the transfer state.
- count – Bytes count received.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is not a non-blocking transaction currently in progress.

void SAI_TransferAbortSend(I2S_Type *base, *sai_handle_t* *handle)

Aborts the current send.

Note: This API can be called any time when an interrupt non-blocking transfer initiates to abort the transfer early.

Parameters

- base – SAI base pointer.
- handle – Pointer to the sai_handle_t structure which stores the transfer state.

void SAI_TransferAbortReceive(I2S_Type *base, *sai_handle_t* *handle)

Aborts the current IRQ receive.

Note: This API can be called when an interrupt non-blocking transfer initiates to abort the transfer early.

Parameters

- base – SAI base pointer
- handle – Pointer to the sai_handle_t structure which stores the transfer state.

void SAI_TransferTerminateSend(I2S_Type *base, *sai_handle_t* *handle)

Terminate all SAI send.

This function will clear all transfer slots buffered in the sai queue. If users only want to abort the current transfer slot, please call SAI_TransferAbortSend.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.

void SAI_TransferTerminateReceive(I2S_Type *base, *sai_handle_t* *handle)

Terminate all SAI receive.

This function will clear all transfer slots buffered in the sai queue. If users only want to abort the current transfer slot, please call SAI_TransferAbortReceive.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.

void SAI_TransferTxHandleIRQ(I2S_Type *base, *sai_handle_t* *handle)

Tx interrupt handler.

Parameters

- base – SAI base pointer.
- handle – Pointer to the sai_handle_t structure.

void SAI_TransferRxHandleIRQ(I2S_Type *base, *sai_handle_t* *handle)

Tx interrupt handler.

Parameters

- base – SAI base pointer.
- handle – Pointer to the sai_handle_t structure.

void SAI_DriverIRQHandler(uint32_t instance)

SAI driver IRQ handler common entry.

This function provides the common IRQ request entry for SAI.

Parameters

- instance – SAI instance.

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_sai_status_t, SAI return status.

Values:

enumerator kStatus_SAI_TxBusy

SAI Tx is busy.

enumerator kStatus_SAI_RxBusy

SAI Rx is busy.

enumerator kStatus_SAI_TxError

SAI Tx FIFO error.

enumerator kStatus_SAI_RxError

SAI Rx FIFO error.

enumerator kStatus_SAI_QueueFull

SAI transfer queue is full.

enumerator kStatus_SAI_TxIdle

SAI Tx is idle

enumerator kStatus_SAI_RxIdle

SAI Rx is idle

_sai_channel_mask,.sai channel mask value, actual channel numbers is depend soc specific

Values:

enumerator kSAI_Channel0Mask
channel 0 mask value

enumerator kSAI_Channel1Mask
channel 1 mask value

enumerator kSAI_Channel2Mask
channel 2 mask value

enumerator kSAI_Channel3Mask
channel 3 mask value

enumerator kSAI_Channel4Mask
channel 4 mask value

enumerator kSAI_Channel5Mask
channel 5 mask value

enumerator kSAI_Channel6Mask
channel 6 mask value

enumerator kSAI_Channel7Mask
channel 7 mask value

enum _sai_protocol
Define the SAI bus type.

Values:

enumerator kSAI_BusLeftJustified
Uses left justified format.

enumerator kSAI_BusRightJustified
Uses right justified format.

enumerator kSAI_BusI2S
Uses I2S format.

enumerator kSAI_BusPCMA
Uses I2S PCM A format.

enumerator kSAI_BusPCMB
Uses I2S PCM B format.

enum _sai_master_slave
Master or slave mode.

Values:

enumerator kSAI_Master
Master mode include bclk and frame sync

enumerator kSAI_Slave
Slave mode include bclk and frame sync

enumerator kSAI_Bclk_Master_FrameSync_Slave
bclk in master mode, frame sync in slave mode

enumerator kSAI_Bclk_Slave_FrameSync_Master
bclk in slave mode, frame sync in master mode

enum _sai_mono_stereo
Mono or stereo audio format.

Values:

enumerator kSAI_Stereo
Stereo sound.

enumerator kSAI_MonoRight
Only Right channel have sound.

enumerator kSAI_MonoLeft
Only left channel have sound.

enum _sai_data_order
SAI data order, MSB or LSB.

Values:

enumerator kSAI_DataLSB
LSB bit transferred first

enumerator kSAI_DataMSB
MSB bit transferred first

enum _sai_clock_polarity
SAI clock polarity, active high or low.

Values:

enumerator kSAI_PolarityActiveHigh
Drive outputs on rising edge

enumerator kSAI_PolarityActiveLow
Drive outputs on falling edge

enumerator kSAI_SampleOnFallingEdge
Sample inputs on falling edge

enumerator kSAI_SampleOnRisingEdge
Sample inputs on rising edge

enum _sai_sync_mode
Synchronous or asynchronous mode.

Values:

enumerator kSAI_ModeAsync
Asynchronous mode

enumerator kSAI_ModeSync
Synchronous mode (with receiver or transmit)

enumerator kSAI_ModeSyncWithOtherTx
Synchronous with another SAI transmit

enumerator kSAI_ModeSyncWithOtherRx
Synchronous with another SAI receiver

enum _sai_bclk_source

Bit clock source.

Values:

enumerator kSAI_BclkSourceBusclk

Bit clock using bus clock

enumerator kSAI_BclkSourceMclkOption1

Bit clock MCLK option 1

enumerator kSAI_BclkSourceMclkOption2

Bit clock MCLK option2

enumerator kSAI_BclkSourceMclkOption3

Bit clock MCLK option3

enumerator kSAI_BclkSourceMclkDiv

Bit clock using master clock divider

enumerator kSAI_BclkSourceOtherSai0

Bit clock from other SAI device

enumerator kSAI_BclkSourceOtherSai1

Bit clock from other SAI device

_sai_interrupt_enable_t, The SAI interrupt enable flag

Values:

enumerator kSAI_WordStartInterruptEnable

Word start flag, means the first word in a frame detected

enumerator kSAI_SyncErrorInterruptEnable

Sync error flag, means the sync error is detected

enumerator kSAI_FIFOWarningInterruptEnable

FIFO warning flag, means the FIFO is empty

enumerator kSAI_FIFOErrorInterruptEnable

FIFO error flag

enumerator kSAI_FIFORequestInterruptEnable

FIFO request, means reached watermark

_sai_dma_enable_t, The DMA request sources

Values:

enumerator kSAI_FIFOWarningDMAEnable

FIFO warning caused by the DMA request

enumerator kSAI_FIFORequestDMAEnable

FIFO request caused by the DMA request

_sai_flags, The SAI status flag

Values:

enumerator kSAI_WordStartFlag

Word start flag, means the first word in a frame detected

enumerator kSAI_SyncErrorFlag
Sync error flag, means the sync error is detected

enumerator kSAI_FIFOErrorFlag
FIFO error flag

enumerator kSAI_FIFORequestFlag
FIFO request flag.

enumerator kSAI_FIFOWarningFlag
FIFO warning flag

enum _sai_reset_type
The reset type.

Values:

enumerator kSAI_ResetTypeSoftware
Software reset, reset the logic state

enumerator kSAI_ResetTypeFIFO
FIFO reset, reset the FIFO read and write pointer

enumerator kSAI_ResetAll
All reset.

enum _sai_fifo_packing
The SAI packing mode The mode includes 8 bit and 16 bit packing.

Values:

enumerator kSAI_FifoPackingDisabled
Packing disabled

enumerator kSAI_FifoPacking8bit
8 bit packing enabled

enumerator kSAI_FifoPacking16bit
16bit packing enabled

enum _sai_sample_rate
Audio sample rate.

Values:

enumerator kSAI_SampleRate8KHz
Sample rate 8000 Hz

enumerator kSAI_SampleRate11025Hz
Sample rate 11025 Hz

enumerator kSAI_SampleRate12KHz
Sample rate 12000 Hz

enumerator kSAI_SampleRate16KHz
Sample rate 16000 Hz

enumerator kSAI_SampleRate22050Hz
Sample rate 22050 Hz

enumerator kSAI_SampleRate24KHz
Sample rate 24000 Hz

enumerator kSAI_SampleRate32KHz
Sample rate 32000 Hz

enumerator kSAI_SampleRate44100Hz
Sample rate 44100 Hz

enumerator kSAI_SampleRate48KHz
Sample rate 48000 Hz

enumerator kSAI_SampleRate96KHz
Sample rate 96000 Hz

enumerator kSAI_SampleRate192KHz
Sample rate 192000 Hz

enumerator kSAI_SampleRate384KHz
Sample rate 384000 Hz

enum _sai_word_width
Audio word width.

Values:

enumerator kSAI_WordWidth8bits
Audio data width 8 bits

enumerator kSAI_WordWidth16bits
Audio data width 16 bits

enumerator kSAI_WordWidth24bits
Audio data width 24 bits

enumerator kSAI_WordWidth32bits
Audio data width 32 bits

enum _sai_data_pin_state
sai data pin state definition

Values:

enumerator kSAI_DataPinStateTriState
transmit data pins are tri-stated when slots are masked or channels are disabled

enumerator kSAI_DataPinStateOutputZero
transmit data pins are never tri-stated and will output zero when slots are masked or channel disabled

enum _sai_fifo_combine
sai fifo combine mode definition

Values:

enumerator kSAI_FifoCombineDisabled
sai TX/RX fifo combine mode disabled

enumerator kSAI_FifoCombineModeEnabledOnRead
sai TX fifo combine mode enabled on FIFO reads

enumerator kSAI_FifoCombineModeEnabledOnWrite
sai TX fifo combine mode enabled on FIFO write

enumerator kSAI_RxFifoCombineModeEnabledOnWrite
sai RX fifo combine mode enabled on FIFO write

enumerator kSAI_RXFifoCombineModeEnabledOnRead
sai RX fifo combine mode enabled on FIFO reads

enumerator kSAI_FifoCombineModeEnabledOnReadWrite
sai TX/RX fifo combined mode enabled on FIFO read/writes

enum _sai_transceiver_type
sai transceiver type

Values:

enumerator kSAI_Transmitter
sai transmitter

enumerator kSAI_Receiver
sai receiver

enum _sai_frame_sync_len
sai frame sync len

Values:

enumerator kSAI_FrameSyncLenOneBitClk
1 bit clock frame sync len for DSP mode

enumerator kSAI_FrameSyncLenPerWordWidth
Frame sync length decided by word width

typedef enum *_sai_protocol* sai_protocol_t
Define the SAI bus type.

typedef enum *_sai_master_slave* sai_master_slave_t
Master or slave mode.

typedef enum *_sai_mono_stereo* sai_mono_stereo_t
Mono or stereo audio format.

typedef enum *_sai_data_order* sai_data_order_t
SAI data order, MSB or LSB.

typedef enum *_sai_clock_polarity* sai_clock_polarity_t
SAI clock polarity, active high or low.

typedef enum *_sai_sync_mode* sai_sync_mode_t
Synchronous or asynchronous mode.

typedef enum *_sai_bclk_source* sai_bclk_source_t
Bit clock source.

typedef enum *_sai_reset_type* sai_reset_type_t
The reset type.

typedef enum *_sai_fifo_packing* sai_fifo_packing_t
The SAI packing mode The mode includes 8 bit and 16 bit packing.

typedef struct *_sai_config* sai_config_t
SAI user configuration structure.

typedef enum *_sai_sample_rate* sai_sample_rate_t
Audio sample rate.

typedef enum *_sai_word_width* sai_word_width_t
Audio word width.

typedef enum *_sai_data_pin_state* sai_data_pin_state_t
: sai data pin state definition

typedef enum *_sai_fifo_combine* sai_fifo_combine_t
: sai fifo combine mode definition

typedef enum *_sai_transceiver_type* sai_transceiver_type_t
: sai transceiver type

typedef enum *_sai_frame_sync_len* sai_frame_sync_len_t
: sai frame sync len

typedef struct *_sai_transfer_format* sai_transfer_format_t
: sai transfer format

typedef struct *_sai_master_clock* sai_master_clock_t
: master clock configurations

typedef struct *_sai_fifo* sai_fifo_t
: sai fifo configurations

typedef struct *_sai_bit_clock* sai_bit_clock_t
: sai bit clock configurations

typedef struct *_sai_frame_sync* sai_frame_sync_t
: sai frame sync configurations

typedef struct *_sai_serial_data* sai_serial_data_t
: sai serial data configurations

typedef struct *_sai_transceiver* sai_transceiver_t
: sai transceiver configurations

typedef struct *_sai_transfer* sai_transfer_t
: SAI transfer structure.

typedef struct *_sai_handle* sai_handle_t

typedef void (*sai_transfer_callback_t)(I2S_Type *base, *sai_handle_t* *handle, *status_t* status, void *userData)
: SAI transfer callback prototype.

SAI_XFER_QUEUE_SIZE
: SAI transfer queue size, user can refine it according to use case.

FSL_SAI_HAS_FIFO_EXTEND_FEATURE
: sai fifo feature

struct sai_config
: *#include <fsl_sai.h>* SAI user configuration structure.

Public Members

sai_protocol_t protocol
: Audio bus protocol in SAI

sai_sync_mode_t syncMode
: SAI sync mode, control Tx/Rx clock sync

bool mclkOutputEnable
: Master clock output enable, true means master clock divider enabled

sai_bclk_source_t bclkSource
: Bit Clock source

sai_master_slave_t masterSlave
: Master or slave

struct __sai__transfer__format
: *#include <fsl_sai.h>* sai transfer format

Public Members

uint32_t sampleRate_Hz
: Sample rate of audio data

uint32_t bitWidth
: Data length of audio data, usually 8/16/24/32 bits

sai_mono_stereo_t stereo
: Mono or stereo

uint32_t masterClockHz
: Master clock frequency in Hz

uint8_t watermark
: Watermark value

uint8_t channel
: Transfer start channel

uint8_t channelMask
: enabled channel mask value, reference _sai_channel_mask

uint8_t endChannel
: end channel number

uint8_t channelNums
: Total enabled channel numbers

sai_protocol_t protocol
: Which audio protocol used

bool isFrameSyncCompact
: True means Frame sync length is configurable according to bitWidth, false means frame sync length is 64 times of bit clock.

struct __sai__master__clock
: *#include <fsl_sai.h>* master clock configurations

Public Members

bool mclkOutputEnable
: master clock output enable

uint32_t mclkHz
: target mclk frequency

uint32_t mclkSourceClkHz
: mclk source frequency

struct __sai__fifo
: *#include <fsl_sai.h>* sai fifo configurations

Public Members

bool fifoContinueOneError
: fifo continues when error occur

sai_fifo_combine_t fifoCombine
: fifo combine mode

sai_fifo_packing_t fifoPacking
: fifo packing mode

uint8_t fifoWatermark
: fifo watermark

struct __sai__bit__clock
: *#include <fsl_sai.h>* sai bit clock configurations

Public Members

bool bclkInputDelay
: bit clock actually used by the transmitter is delayed by the pad output delay, this has effect of decreasing the data input setup time, but increasing the data output valid time .

sai_clock_polarity_t bclkPolarity
: bit clock polarity

sai_bclk_source_t bclkSource
: bit Clock source

struct __sai__frame__sync
: *#include <fsl_sai.h>* sai frame sync configurations

Public Members

uint8_t frameSyncWidth
: frame sync width in number of bit clocks

bool frameSyncEarly
: TRUE is frame sync assert one bit before the first bit of frame FALSE is frame sync assert with the first bit of the frame

bool frameSyncGenerateOnDemand
: internal frame sync is generated when FIFO waring flag is clear

sai_clock_polarity_t frameSyncPolarity
: frame sync polarity

struct __sai__serial__data
: *#include <fsl_sai.h>* sai serial data configurations

Public Members

sai_data_pin_state_t dataMode
: sai data pin state when slots masked or channel disabled

sai_data_order_t dataOrder
: configure whether the LSB or MSB is transmitted first

uint8_t dataWord0Length
: configure the number of bits in the first word in each frame

uint8_t dataWordNLength
: configure the number of bits in the each word in each frame, except the first word

uint8_t dataWordLength
: used to record the data length for dma transfer

uint8_t dataFirstBitShifted
: Configure the bit index for the first bit transmitted for each word in the frame

uint8_t dataWordNum
: configure the number of words in each frame

uint32_t dataMaskedWord
: configure whether the transmit word is masked

struct __sai__transceiver
: *#include <fsl_sai.h>* sai transceiver configurations

Public Members

sai_serial_data_t serialData
: serial data configurations

sai_frame_sync_t frameSync
: ws configurations

sai_bit_clock_t bitClock
: bit clock configurations

sai_fifo_t fifo
: fifo configurations

sai_master_slave_t masterSlave
: transceiver is master or slave

sai_sync_mode_t syncMode
: transceiver sync mode

uint8_t startChannel
: Transfer start channel

uint8_t channelMask
: enabled channel mask value, reference _sai_channel_mask

uint8_t endChannel
: end channel number

uint8_t channelNums
: Total enabled channel numbers

struct __sai__transfer
: *#include <fsl_sai.h>* SAI transfer structure.

Public Members

uint8_t *data
: Data start address to transfer.

size_t dataSize
Transfer size.

struct _sai_handle
#include <fsl_sai.h> SAI handle structure.

Public Members

I2S_Type *base
base address

uint32_t state
Transfer status

sai_transfer_callback_t callback
Callback function called at transfer event

void *userData
Callback parameter passed to callback function

uint8_t bitWidth
Bit width for transfer, 8/16/24/32 bits

uint8_t channel
Transfer start channel

uint8_t channelMask
enabled channel mask value, refernece _sai_channel_mask

uint8_t endChannel
end channel number

uint8_t channelNums
Total enabled channel numbers

sai_transfer_t saiQueue[(4U)]
Transfer queue storing queued transfer

size_t transferSize[(4U)]
Data bytes need to transfer

volatile uint8_t queueUser
Index for user to queue transfer

volatile uint8_t queueDriver
Index for driver to get the transfer data and size

uint8_t watermark
Watermark value

2.96 SAI EDMA Driver

void SAI_TransferTxCreateHandleEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_edma_callback_t* callback, void *userData, *edma_handle_t* *txDmaHandle)

Initializes the SAI eDMA handle.

This function initializes the SAI master DMA handle, which can be used for other SAI master transactional APIs. Usually, for a specified SAI instance, call this API once to get the initialized handle.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- callback – Pointer to user callback function.
- userData – User parameter passed to the callback function.
- txDmaHandle – eDMA handle pointer, this handle shall be static allocated by users.

void SAI_TransferRxCreateHandleEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_edma_callback_t* callback, void *userData, *edma_handle_t* *rxDmaHandle)

Initializes the SAI Rx eDMA handle.

This function initializes the SAI slave DMA handle, which can be used for other SAI master transactional APIs. Usually, for a specified SAI instance, call this API once to get the initialized handle.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- callback – Pointer to user callback function.
- userData – User parameter passed to the callback function.
- rxDmaHandle – eDMA handle pointer, this handle shall be static allocated by users.

void SAI_TransferSetInterleaveType(*sai_edma_handle_t* *handle, *sai_edma_interleave_t* interleaveType)

Initializes the SAI interleave type.

This function initializes the SAI DMA handle member interleaveType, it shall be called only when application would like to use type kSAI_EDMAInterleavePerChannelBlock, since the default interleaveType is kSAI_EDMAInterleavePerChannelSample always

Parameters

- handle – SAI eDMA handle pointer.
- interleaveType – Multi channel interleave type.

void SAI_TransferTxSetConfigEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_transceiver_t* *saiConfig)

Configures the SAI Tx.

Note: SAI eDMA supports data transfer in a multiple SAI channels if the FIFO Combine feature is supported. To activate the multi-channel transfer enable SAI channels by filling the channelMask of sai_transceiver_t with the corresponding values of _sai_channel_mask enum, enable the FIFO Combine mode by assigning kSAI_FifoCombineModeEnabledOnWrite to the fifoCombine member of sai_fifo_combine_t which is a member of sai_transceiver_t. This is an example of multi-channel data transfer configuration step.

```
sai_transceiver_t config;
SAI_GetClassicI2SConfig(&config, kSAI_WordWidth16bits, kSAI_Stereo, kSAI_Channel0Mask|kSAI_
↪Channel1Mask);
config.fifo.fifoCombine = kSAI_FifoCombineModeEnabledOnWrite;
SAI_TransferTxSetConfigEDMA(I2S0, &edmaHandle, &config);
```

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- saiConfig – sai configurations.

void SAI_TransferRxSetConfigEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_transceiver_t* *saiConfig)

Configures the SAI Rx.

Note: SAI eDMA supports data transfer in a multiple SAI channels if the FIFO Combine feature is supported. To activate the multi-channel transfer enable SAI channels by filling the channelMask of sai_transceiver_t with the corresponding values of _sai_channel_mask enum, enable the FIFO Combine mode by assigning kSAI_FifoCombineModeEnabledOnRead to the fifoCombine member of sai_fifo_combine_t which is a member of sai_transceiver_t. This is an example of multi-channel data transfer configuration step.

```
sai_transceiver_t config;
SAI_GetClassicI2SConfig(&config, kSAI_WordWidth16bits, kSAI_Stereo, kSAI_Channel0Mask|kSAI_
↪Channel1Mask);
config.fifo.fifoCombine = kSAI_FifoCombineModeEnabledOnRead;
SAI_TransferRxSetConfigEDMA(I2S0, &edmaHandle, &config);
```

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- saiConfig – sai configurations.

status_t SAI_TransferSendEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_transfer_t* *xfer)

Performs a non-blocking SAI transfer using DMA.

This function support multi channel transfer,

a. for the sai IP support fifo combine mode, application should enable the fifo combine mode, no limitation on channel numbers

b. for the sai IP not support fifo combine mode, sai edma provide another solution which using EDMA modulo feature, but support 2 or 4 channels only.

Note: This interface returns immediately after the transfer initiates. Call SAI_GetTransferStatus to poll the transfer status and check whether the SAI transfer is finished.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- xfer – Pointer to the DMA transfer structure.

Return values

- kStatus_Success – Start a SAI eDMA send successfully.
- kStatus_InvalidArgument – The input argument is invalid.
- kStatus_TxBusy – SAI is busy sending data.

status_t SAI_TransferReceiveEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_transfer_t* *xfer)

Performs a non-blocking SAI receive using eDMA.

This function support multi channel transfer,

a. for the sai IP support fifo combine mode, application should enable the fifo combine mode, no limitation on channel numbers
b. for the sai IP not support fifo combine mode, sai edma provide another solution which using EDMA modulo feature, but support 2 or 4 channels only.

Note: This interface returns immediately after the transfer initiates. Call the SAI_GetReceiveRemainingBytes to poll the transfer status and check whether the SAI transfer is finished.

Parameters

- base – SAI base pointer
- handle – SAI eDMA handle pointer.
- xfer – Pointer to DMA transfer structure.

Return values

- kStatus_Success – Start a SAI eDMA receive successfully.
- kStatus_InvalidArgument – The input argument is invalid.
- kStatus_RxBusy – SAI is busy receiving data.

status_t SAI_TransferSendLoopEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_transfer_t* *xfer, uint32_t loopTransferCount)

Performs a non-blocking SAI loop transfer using eDMA.

Once the loop transfer start, application can use function SAI_TransferAbortSendEDMA to stop the loop transfer.

Note: This function support loop transfer only,such as A->B->...->A, application must be aware of that the more counts of the loop transfer, then more tcd memory required, as the function use the tcd pool in sai_edma_handle_t, so application could redefine the SAI_XFER_QUEUE_SIZE to determine the proper TCD pool size. This function support one sai channel only.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- xfer – Pointer to the DMA transfer structure, should be a array with elements counts >=1(loopTransferCount).
- loopTransferCount – the counts of xfer array.

Return values

- kStatus_Success – Start a SAI eDMA send successfully.
- kStatus_InvalidArgument – The input argument is invalid.

status_t SAI_TransferReceiveLoopEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, *sai_transfer_t* *xfer, uint32_t loopTransferCount)

Performs a non-blocking SAI loop transfer using eDMA.

Once the loop transfer start, application can use function SAI_TransferAbortReceiveEDMA to stop the loop transfer.

Note: This function support loop transfer only,such as A->B->...->A, application must be aware of that the more counts of the loop transfer, then more tcd memory required, as the function use the tcd pool in sai_edma_handle_t, so application could redefine the SAI_XFER_QUEUE_SIZE to determine the proper TCD pool size. This function support one sai channel only.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- xfer – Pointer to the DMA transfer structure, should be a array with elements counts >=1(loopTransferCount).
- loopTransferCount – the counts of xfer array.

Return values

- kStatus_Success – Start a SAI eDMA receive successfully.
- kStatus_InvalidArgument – The input argument is invalid.

void SAI_TransferTerminateSendEDMA(I2S_Type *base, *sai_edma_handle_t* *handle)

Terminate all SAI send.

This function will clear all transfer slots buffered in the sai queue. If users only want to abort the current transfer slot, please call SAI_TransferAbortSendEDMA.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.

void SAI_TransferTerminateReceiveEDMA(I2S_Type *base, *sai_edma_handle_t* *handle)

Terminate all SAI receive.

This function will clear all transfer slots buffered in the sai queue. If users only want to abort the current transfer slot, please call SAI_TransferAbortReceiveEDMA.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.

void SAI_TransferAbortSendEDMA(I2S_Type *base, *sai_edma_handle_t* *handle)

Aborts a SAI transfer using eDMA.

This function only aborts the current transfer slots, the other transfer slots' information still kept in the handler. If users want to terminate all transfer slots, just call SAI_TransferTerminateSendEDMA.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.

void SAI_TransferAbortReceiveEDMA(I2S_Type *base, *sai_edma_handle_t* *handle)

Aborts a SAI receive using eDMA.

This function only aborts the current transfer slots, the other transfer slots' information still kept in the handler. If users want to terminate all transfer slots, just call SAI_TransferTerminateReceiveEDMA.

Parameters

- base – SAI base pointer
- handle – SAI eDMA handle pointer.

status_t SAI_TransferGetSendCountEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, size_t *count)

Gets byte count sent by SAI.

Parameters

- base – SAI base pointer.
- handle – SAI eDMA handle pointer.
- count – Bytes count sent by SAI.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is no non-blocking transaction in progress.

status_t SAI_TransferGetReceiveCountEDMA(I2S_Type *base, *sai_edma_handle_t* *handle, size_t *count)

Gets byte count received by SAI.

Parameters

- base – SAI base pointer
- handle – SAI eDMA handle pointer.
- count – Bytes count received by SAI.

Return values

- kStatus_Success – Succeed get the transfer count.
- kStatus_NoTransferInProgress – There is no non-blocking transaction in progress.

uint32_t SAI_TransferGetValidTransferSlotsEDMA(I2S_Type *base, *sai_edma_handle_t* *handle)

Gets valid transfer slot.

This function can be used to query the valid transfer request slot that the application can submit. It should be called in the critical section, that means the application could call it in the corresponding callback function or disable IRQ before calling it in the application, otherwise, the returned value may not correct.

Parameters

- base – SAI base pointer
- handle – SAI eDMA handle pointer.

Return values
valid – slot count that application submit.

FSL_SAI_EDMA_DRIVER_VERSION
Version 2.7.3

enum _sai_edma_interleave
sai interleave type

Values:

enumerator kSAI_EDMAInterleavePerChannelSample

enumerator kSAI_EDMAInterleavePerChannelBlock

typedef struct *sai_edma_handle* sai_edma_handle_t

typedef void (*sai_edma_callback_t)(I2S_Type *base, *sai_edma_handle_t* *handle, *status_t* status, void *userData)
SAI eDMA transfer callback function for finish and error.

typedef enum *_sai_edma_interleave* sai_edma_interleave_t
sai interleave type

MCUX_SDK_SAI_EDMA_RX_ENABLE_INTERNAL
the SAI enable position When calling SAI_TransferReceiveEDMA

MCUX_SDK_SAI_EDMA_TX_ENABLE_INTERNAL
the SAI enable position When calling SAI_TransferSendEDMA

struct sai_edma_handle
#include <fsl_sai_edma.h> SAI DMA transfer handle, users should not touch the content of the handle.

Public Members

edma_handle_t *dmaHandle
DMA handler for SAI send

uint8_t nbytes
eDMA minor byte transfer count initially configured.

uint8_t bytesPerFrame
Bytes in a frame

uint8_t channelMask
Enabled channel mask value, reference _sai_channel_mask

uint8_t channelNums
total enabled channel nums

uint8_t channel
Which data channel

uint8_t count
The transfer data count in a DMA request

uint32_t state
Internal state for SAI eDMA transfer

sai_edma_callback_t callback
Callback for users while transfer finish or error occurs

void *userData
User callback parameter

uint8_t tcd[((4U) + 1U) * sizeof(*edma_tcd_t*)]
TCD pool for eDMA transfer.

sai_transfer_t saiQueue[(4U)]
Transfer queue storing queued transfer.

size_t transferSize[(4U)]
Data bytes need to transfer

sai_edma_interleave_t interleaveType
Transfer interleave type

volatile uint8_t queueUser
Index for user to queue transfer.

volatile uint8_t queueDriver
Index for driver to get the transfer data and size

2.97 SAR_ADC: SAR_ADC Module

void ADC_GetDefaultConfig(*adc_config_t* *config)
This function is used to get available predefined configurations for the ADC initialization.

Parameters

- config – Pointer to the ADC configuration structure, please refer to adc_config_t for details.

void ADC_Init(ADC_Type *base, const *adc_config_t* *config)
This function is used to initialize the ADC.

Parameters

- base – ADC peripheral base address.
- config – Pointer to the ADC configuration structure, please refer to adc_config_t for details.

void ADC_Deinit(ADC_Type *base)
This function is used to de-initialize the ADC.

Parameters

- base – ADC peripheral base address.

static inline void ADC_SetPowerDownMode(ADC_Type *base, bool enable)
This function is used to enter or exit power-down mode.

After the release of the reset, the ADC analog module will be kept in power-down mode by default. The power-down mode can be set anytime. However, ADC can enter the power-down mode successfully only after completion of an ongoing conversion (if there is one). In scan mode, the ongoing operation should be aborted manually before or after switching mode. If the power-down mode is entered by setting MCR[PWDN], the process running in the previous mode must be restarted manually (by setting the appropriate START bit in the MCR register) after exiting power-down mode.

Note: After setting the ADC mode, it is recommended to use the function ADC_GetAdcState to query whether the ADC has correctly entered the mode.

Parameters

- base – ADC peripheral base address.
- enable – Indicates whether to enter or exit power-down mode.
  - **true** Request to enter power-down mode.
  - **false** When ADC status is in power-down mode (MSR[ADCSTATUS] = 001b), start ADC transition to IDLE mode.

static inline void ADC_SetOperatingClock(ADC_Type *base, *adc_clock_frequency_t* clockSelect)

This function is used to select the ADC operating clock.

Note: Needs to enter power-down mode before changing the ADC internal operating clock.

Parameters

- base – ADC peripheral base address.
- clockSelect – ADC clock frequency selection, please refer to adc_clock_frequency_t for details.

static inline *adc_state_t* ADC_GetAdcState(ADC_Type *base)

This function is used to get the ADC state.

Parameters

- base – ADC peripheral base address.

Returns

ADC state, for possible states, please refer to adc_state_t for details.

static inline bool ADC_CheckAutoClockOffEnabled(ADC_Type *base)

This function is used to check whether the ADC auto clock-off feature has been enabled or not.

Parameters

- base – ADC peripheral base address.

Returns

ADC auto clock-off feature status.

- **true** Auto clock-off feature has been enabled.
- **false** Auto clock-off feature has not been enabled.

static inline uint8_t ADC_GetCurrentConvertedChannelId(ADC_Type *base)

This function is used to get the ID of the channel that is currently being converted.

Parameters

- base – ADC peripheral base address.

Returns

ADC channel ID that is currently being converted.

static inline bool ADC_CheckSelfTestConvInProcess(ADC_Type *base)

This function is used to check whether the self-test conversion is in process or not.

Parameters

- base – ADC peripheral base address.

Returns

Self-test conversion status.

- **true** Self-test conversion is in process.
- **false** Self-test conversion is not in process.

static inline bool ADC_CheckInjectConvInProcess(ADC_Type *base)

This function is used to check whether the inject conversion is in process or not.

Parameters

- base – ADC peripheral base address.

Returns

Inject conversion status.

- **true** Inject conversion is in process.
- **false** Inject conversion is not in process.

static inline bool ADC_CheckInjectConvAborted(ADC_Type *base)

This function is used to check whether the inject conversion has been aborted or not.

Parameters

- base – ADC peripheral base address.

Returns

Inject conversion abort status.

- **true** Injected conversion has been aborted.
- **false** Injected conversion has not been aborted.

static inline bool ADC_CheckNormalConvInProcess(ADC_Type *base)

This function is used to check whether the normal conversion is in process or not.

Parameters

- base – ADC peripheral base address.

Returns

Normal conversion status.

- **true** Normal conversion is in process.
- **false** Normal conversion is not in process.

static inline bool ADC_CheckCalibrationBusy(ADC_Type *base)

This function is used to check whether the ADC is executing calibration or ready for use.

Parameters

- base – ADC peripheral base address.

Returns

Calibration process status.

- **true** ADC is busy in a calibration process.
- **false** ADC is ready for use.

static inline bool ADC_CheckCalibrationFailed(ADC_Type *base)

This function is used to check whether the calibration has failed or passed.

Note: When the user clears the calibration failed status and then reads the status, it will display the calibration passed. At this time, the calibration may not be successful. The user must read the MSR[CALBUSY] bit by function ADC_CheckCalibrationBusy to perform a double check.

Returns
Normal conversion status.

- **true** Calibration failed.
- **false** Calibration passed (must be checked with CALBUSY = 0b).

static inline void ADC_ClearCalibrationFailedFlag(ADC_Type *base)

This function is used to clear the flag of calibration.

Parameters

- base – ADC peripheral base address.

static inline bool ADC_CheckCalibrationSuccessful(ADC_Type *base)

This function is used to check whether the calibration is successful or not.

Parameters

- base – ADC peripheral base address.

Returns
Normal conversion status.

- **true** Calibrated or calibration successful.
- **false** Uncalibrated or calibration unsuccessful.

void ADC_SetConvChainConfig(ADC_Type *base, const *adc_chain_config_t* *config)

This function is used to configure the chain.

Parameters

- base – ADC peripheral base address.
- config – Pointer to the chain configuration structure, please refer to adc_chain_config_t for details.

static inline void ADC_EnableSpecificChannelNormalConv(ADC_Type *base, uint8_t channelIndex)

This function is used to enable the specific ADC channel to execute normal conversion.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to enable the normal conversion.

static inline void ADC_DisableSpecificChannelNormalConv(ADC_Type *base, uint8_t channelIndex)

This function is used to disable the specific ADC channel to execute the normal conversion.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to disable the normal conversion.

static inline void ADC_EnableSpecificChannelInjectConv(ADC_Type *base, uint8_t channelIndex)

This function is used to enable the specific ADC channel to execute the inject conversion.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to enable the inject conversion.

static inline void ADC_DisableSpecificChannelInjectConv(ADC_Type *base, uint8_t channelIndex)

This function is used to disable the specific ADC channel to execute the inject conversion.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to disable the inject conversion.

static inline void ADC_SetConvMode(ADC_Type *base, *adc_conv_mode_t* convMode)

This function is used to set the ADC conversion mode.

Note: Before setting the conversion mode, users need to check whether the ADC is in the idle status through the function ADC_GetAdcState.

Parameters

- base – ADC peripheral base address.
- convMode – ADC conversion mode, please refer to adc_conv_mode_t for details.

static inline void ADC_StartConvChain(ADC_Type *base, *adc_conv_mode_t* convMode)

This function is used to start the ADC conversion chain to execute the conversion.

Note: Normal conversion supports two conversion modes, one is one-shot conversion mode, and the other is scan conversion mode. Normal conversion should usually be used to convert analog samples most of the time in an application, unless there is a special need. Inject conversion has a higher priority than normal conversion and it runs in one-shot mode only, it can be started in IDLE condition or when normal conversion is in process.

Parameters

- base – ADC peripheral base address.
- convMode – Pointer to the ADC conversion chain, please refer to adc_conv_mode_t for details.

static inline void ADC_StopConvChain(ADC_Type *base)

This function is used to stop scan in normal conversion scan operation mode.

Note: In scan operation mode, the MCR[NSTART] field remains high after setting. Clearing this field in scan operation mode causes the current chain conversion to finish, then stop the scan.

Parameters

- base – ADC peripheral base address.

static inline void ADC_AbortCurrentConvChain(ADC_Type *base)

This function is used to abort the conversion chain.

Abort the current chain of conversions by setting MCR[ABORTCHAIN]. In that case, the behavior of the ADC depends on MCR[MODE] (one-shot/scan conversion modes). In one-shot mode, MSR[NSTART] is automatically reset together with MCR[ABORTCHAIN], an end-of-chain interrupt is not generated in the case of an abort chain. In scan mode, a new chain is started. The end-of-conversion interrupt of the current aborted conversion is not generated but an end-of-chain interrupt is generated.

Note: Setting this field in an IDLE state (for example, no normal/inject conversion is in process) has no effect. In this case, the MCR[ABORTCHAIN] field is reset immediately.

Parameters

- base – ADC peripheral base address.

static inline void ADC_AbortCurrentConv(ADC_Type *base)

This function is used to abort the conversion channel.

Abort the current conversion and immediately start the conversion of the next channel of the chain. In the case of an abort operation, MSR[NSTART/JSTART] remains set if not in the last channel of the chain, and MCR[ABORT] is reset as soon as the channel is aborted. The end-of-conversion interrupt corresponds to the aborted channel is not generated. This behavior is true for normal or inject conversion modes. If the last channel of a chain is aborted, and the end-of-chain is reported, then an end-of-chain interrupt will be generated.

Note: This conversion can not abort while the self-test channel conversion is in process.

Parameters

- base – ADC peripheral base address.

static inline void ADC_EnableConvInt(ADC_Type *base, uint32_t mask)

This function is used to enable the ADC end-of-conversion and end-of-chain interrupts.

Parameters

- base – ADC peripheral base address.
- mask – Mask value to enable the ADC end-of-conversion and end-of-chain interrupts, please refer to _adc_conv_int_enable for details.

static inline void ADC_DisableConvInt(ADC_Type *base, uint32_t mask)

This function is used to disable the ADC end-of-conversion and end-of-chain interrupts.

Parameters

- base – ADC peripheral base address.
- mask – Mask value to disable the ADC end-of-conversion and end-of-chain interrupts, please refer to _adc_conv_int_enable for details.

static inline uint32_t ADC_GetConvIntStatus(ADC_Type *base)

This function is used to get the ADC end-of-conversion and end-of-chain interrupts status.

Parameters

- base – ADC peripheral base address.

Returns

ADC end-of-conversion and end-of-chain interrupts status mask.

static inline void ADC_ClearConvIntStatus(ADC_Type *base, uint32_t mask)

This function is used to clear the ADC end-of-conversion and end-of-chain interrupts status.

Parameters

- base – ADC peripheral base address.
- mask – Mask value for flags to be cleared, please refer to _adc_conv_int_flag for details.

static inline void ADC_EnableSpecificConvChannelInt(ADC_Type *base, uint8_t channelIndex)

This function is used to enable the specific ADC channel end-of-conversion interrupt.

Note: This function can only turn on the interrupt of a specific channel, if the interrupt occurs, the user also needs to turn on the global end-of-conversion interrupt by using function ADC_EnableConvInt

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Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to enable the end-of-conversion interrupt.

static inline void ADC_DisableSpecificConvChannelInt(ADC_Type *base, uint8_t channelIndex)

This function is used to disable the specific ADC channel end-of-conversion interrupt.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to disable the end-of-conversion interrupt.

static inline bool ADC_CheckSpecificConvChannelInt(ADC_Type *base, uint8_t channelIndex)

This function is used to check whether the specific conversion channel's end-of-conversion interrupt has been occured.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to check the end-of-conversion interrupt status.

Returns

Channel end-of-conversion interrupt status flag of the specific channel.

- **true** Channel end-of-conversion interrupt has been occured.
- **false** Channel end-of-conversion interrupt has not been occured.

static inline void ADC_ClearSpecificConvChannelInt(ADC_Type *base, uint8_t channelIndex)

This function is used to clear specific channel end-of-conversion interrupt flag.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to clear the end-of-conversion interrupt flag.

static inline void ADC_EnableDmaTransfer(ADC_Type *base)

This function is used to enable the DMA transfer function.

Note: This function is a master switch used to control whether the data converted by the ADC is transmitted through DMA. If the user configures DMA to transmit the conversion data of the channel during the chain channel configuration process, then the main switch of the DMA transmission must be turned on, otherwise, data transmission cannot be performed.

Parameters

- base – ADC peripheral base address.

static inline void ADC_DisableDmaTransfer(ADC_Type *base)

This function is used to disable the DMA transfer function.

Parameters

- base – ADC peripheral base address.

static inline void ADC_EnableSpecificConvChannelDmaTransfer(ADC_Type *base, uint8_t channelIndex)

This function is used to enable the specific ADC conversion channel's DMA transfer function.

Note: This function can only turn on the DMA transfer of a specific channel, before using the DMA transfer, the user needs to turn on the global DMA transfer by using the function ADC_EnableDmaTransfer.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to enable the DMA transfer function.

static inline void ADC_DisableSpecificConvChannelDmaTransfer(ADC_Type *base, uint8_t channelIndex)

This function is used to disable the specific ADC conversion channel's DMA transfer function.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to disable the DMA transfer function.

static inline void ADC_EnableSpecificConvChannelPresample(ADC_Type *base, uint8_t channelIndex)

This function is used to enable the specific ADC conversion channel's pre-sample function.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to enable the pre-sample function.

static inline void ADC_DisableSpecificConvChannelPresample(ADC_Type *base, uint8_t channelIndex)

This function is used to disable the specific ADC conversion channel's pre-sample function.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to disable the pre-sample function.

void ADC_SetAnalogWdgConfig(ADC_Type *base, const *adc_wdg_config_t* *config)

This function is used to configure the analog watchdog.

The analog watchdogs are used to monitor the conversion result to see if it is within defined limits, specified by a higher and a lower threshold value. After the conversion of the selected channel, a comparison is performed between the converted value and the threshold values. If the converted value is outside the threshold values, then a corresponding threshold violation interrupt is generated.

Parameters

- base – ADC peripheral base address.

- config – Pointer to the analog watchdog configuration structure, please refer to adc_wdg_config_t for details.

static inline void ADC_EnableSpecificConvChannelAnalogWdg(ADC_Type *base, uint8_t channelIndex)

This function is used to enable the specific ADC conversion channel's analog watchdog function.

Parameters

- base – ADC peripheral base address.
- channelIndex – Conversion channel index to enable the analog watchdog function.

static inline void ADC_DisableSpecificConvChannelAnalogWdg(ADC_Type *base, uint8_t channelIndex)

This function is used to disable the specific ADC conversion channel's analog watchdog function.

Parameters

- base – ADC peripheral base address.
- channelIndex – Conversion channel index to disable the analog watchdog function.

static inline bool ADC_CheckSpecificConvChannelOutofRange(ADC_Type *base, uint8_t channelIndex)

This function is used to check whether the specific conversion channel's converted data is out of range.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to check the converted data out of range status.

Returns

Converted data out of range status of the specific conversion channel.

- **true** Channel converted data is out of range.
- **false** Channel converted data is in range.

static inline void ADC_ClearSpecificConvChannelOutofRange(ADC_Type *base, uint8_t channelIndex)

This function is used to clear the specific conversion channel's converted data out-of-range flag.

Parameters

- base – ADC peripheral base address.
- channelIndex – Channel index to clear the converted data out of range flag.

static inline void ADC_EnableWdgThresholdInt(ADC_Type *base, uint32_t mask)

This function is used to enable the analog watchdog threshold low or/and high interrupts.

Parameters

- base – ADC peripheral base address.
- mask – Mask value to enable the analog watchdog threshold low or/and high interrupts, please refer to _adc_wdg_threshold_int_enable for details.

static inline void ADC_DisableWdgThresholdInt(ADC_Type *base, uint32_t mask)

This function is used to disable the analog watchdog threshold low or/and high interrupts.

Parameters

- base – ADC peripheral base address.
- mask – Mask value to disable the analog watchdog threshold low or/and high interrupts, please refer to _adc_wdg_threshold_int_enable for details.

static inline uint32_t ADC_GetWdgThresholdIntStatus(ADC_Type *base)

This function is used to get the analog watchdog threshold interrupts status.

Parameters

- base – ADC peripheral base address.

Returns

Analog watchdog threshold interrupts status mask.

static inline void ADC_ClearWdgThresholdIntStatus(ADC_Type *base, uint32_t mask)

This function is used to clear the analog watchdog threshold low or/and high interrupts status.

Parameters

- base – ADC peripheral base address.
- mask – Mask value for flags to be cleared, please refer to _adc_wdg_threshold_int_flag for details.

bool ADC_DoCalibration(ADC_Type *base, const *adc_calibration_config_t* *config)

This function is used to do the calibration.

The calibration is used to reduce or eliminate the various errors. In the calibration process, the calibration values for offset, gain, and capacitor mismatch are obtained. These calibration values (except gain calibration) are used in a result post-processing step to reduce or eliminate the various errors contribution effects. The gain calibration is used during the sample phase to define the additional charge to be loaded in order to compensate for the gain failure. Calibration must be performed after every power-up reset and whenever required in runtime operation. It is also recommended to run calibration if the operating conditions (particularly VrefH) change. Never apply functional reset during the calibration process. If applied, calibration must be rerun after exiting a reset condition; otherwise, the calibration-generated values and conversion results may be unspecified.

Note: This function executes a calibration sequence, it is recommended to run this sequence before using the ADC converter. The maximum clock frequency for the calibration is 40 MHz. Before calling this function, the user needs to ensure that the input clock is within 40MHz. The results of individual steps are also updated in the CALSTAT register (CALSTAT[STAT_n]). The result of the last failed step is dynamically updated in the same register.

Parameters

- base – ADC peripheral base address.
- config – Pointer to the calibration configuration structure, please refer to adc_calibration_config_t for details.

Returns

Status whether calibration is running passed or failed.

- **true** Calibration successful.
- **false** Calibration unsuccessful.

void ADC_SetUserOffsetAndGainConfig(ADC_Type *base, const *adc_user_offset_gain_config_t* *config)

This function is used to configure the user gain and offset.

Parameters

- base – ADC peripheral base address.
- config – Pointer to the user offset and gain configuration structure, please refer to adc_user_offset_gain_config_t for details.

void ADC_SetSelfTestConfig(ADC_Type *base, const *adc_self_test_config_t* *config)

This function is used to configure the ADC self-test.

The self-test is used to check at regular intervals whether ADC is operating correctly. When self-test is enabled, ADC automatically checks its components and flags any errors it finds. The test can be enabled to check the supply voltage (VDD), reference voltage (VrefH), and calibrated values.

Note: Before calling this function, please ensure the functional conversion is one-shot conversion mode normal conversion type and the operating clock are equal to bus frequency. ADC self-test should be run with MCR[ADCLKSE] bit set to 1. Self-test with ADCLKSE bit set to 0 can give erroneous results.

Parameters

- base – ADC peripheral base address.
- config – Pointer to the self-test configuration structure, please refer to adc_self_test_config_t for details.

void ADC_SetSelfTestWdgConfig(ADC_Type *base, const *adc_self_test_wdg_config_t* *config)

This function is used to configure the ADC self-test watchdog.

Parameters

- base – ADC peripheral base address.
- config – Pointer to the self-test watchdog configuration structure, please refer to adc_self_test_wdg_config_t for details.

void ADC_GetCalibrationLastFailedTestResult(ADC_Type *base, int16_t *result)

This function is used to get the test result for the last failed test.

Parameters

- base – ADC peripheral base address.
- result – Points to a 16-bit signed variable, and it is used to store the test result for the last failing test.

static inline uint16_t ADC_GetCalibrationStepsStatus(ADC_Type *base)

This function is used to get the status of the calibration steps.

Note: The status of calibration steps (step 0 to step 12) is stored in the CALSTAT register, and only the lower 12 bits are available in the returned result.

Parameters

- base – ADC peripheral base address.

Returns

ADC self-test interrupt status mask.

static inline void ADC_EnableSelfTest(ADC_Type *base)

This function is used to enable the ADC self-test.

Decides whether to enable the ADC self-test. The self-test test is enabled by setting STCR2[EN], this field must be set before starting normal conversion and should not be changed while the conversion is in process. This field should only be reset after the end-of-conversion of the last self-test channel has been received.

Note: ADC self-test should be run with MCR[ADCLKSE] bit set to 1. Self-test with ADCLKSE bit set to 0 can give erroneous results. In the case of Inject Conversion mode, test channel conversion is not performed. It is performed only during normal conversions.

Parameters

- base – ADC peripheral base address.

static inline void ADC_DisableSelfTest(ADC_Type *base)

This function is used to disable the ADC self-test.

Parameters

- base – ADC peripheral base address.

static inline void ADC_EnableSelfTestWdgThreshold(ADC_Type *base, *adc_self_test_wdg_threshold_t* wdgID)

This function is used to enable the ADC self-test watchdog threshold for algorithm S step 0/1/2 and algorithm C.

The user can pass kADC_SelfTestWdgThresholdForAlgSStep0 as parameter 'wdgID' to enable the self-test watchdog threshold function for algorithm S step 0; pass kADC_SelfTestWdgThresholdForAlgSStep1Integer as parameter 'wdgID' to enable the self-test watchdog threshold function for algorithm S step 1; pass kADC_SelfTestWdgThresholdForAlgSStep2 as parameter 'wdgID' to enable the self-test watchdog threshold function for algorithm S step 2; pass kADC_SelfTestWdgThresholdForAlgCStep0 as parameter 'wdgID' to enable the self-test watchdog threshold function for algorithm C; Other enumerations in adc_self_test_wdg_threshold_t have no use.

Parameters

- base – ADC peripheral base address.
- wdgID – Watchdog threshold index to enable, please refer to adc_self_test_wdg_threshold_t for details.

static inline void ADC_DisableSelfTestWdgThreshold(ADC_Type *base, *adc_self_test_wdg_threshold_t* wdgID)

This function is used to disable the ADC self-test watchdog threshold for algorithm S step 0/1/2 and algorithm C.

The user can pass kADC_SelfTestWdgThresholdForAlgSStep0 as parameter 'wdgID' to disable the self-test watchdog threshold function for algorithm S step 0; pass kADC_SelfTestWdgThresholdForAlgSStep1Integer as parameter 'wdgID' to disable the self-test watchdog threshold function for algorithm S step 1; pass kADC_SelfTestWdgThresholdForAlgSStep2 as parameter 'wdgID' to disable the self-test watchdog threshold function for algorithm S step 2; pass kADC_SelfTestWdgThresholdForAlgCStep0 as parameter 'wdgID' to disable the self-test watchdog threshold function for algorithm C; Other enumerations in adc_self_test_wdg_threshold_t have no use.

Parameters

- base – ADC peripheral base address.

- wdgID – Watchdog threshold index to disable, please refer to adc_self_test_wdg_threshold_t for details.

static inline void ADC_EnableSelfTestWdgTimer(ADC_Type *base, *adc_alg_type_t* wdgTimerType)

This function is used to enable the ADC self-test watchdog timer for algorithm S or/and algorithm C.

The user can pass kADC_SelfTestForAlgS as parameter 'wdgTimerType' to enable the watchdog timer for algorithm S; pass kADC_SelfTestForAlgC as parameter 'wdgTimerType' to enable the watchdog timer for algorithm C; pass kADC_SelfTestForAlgSAndC as parameter 'wdgTimerType' to enable the watchdog timer for algorithm S and C.

Parameters

- base – ADC peripheral base address.
- wdgTimerType – Watchdog timer type to enable, please refer to adc_alg_type_t for details.

static inline void ADC_DisableSelfTestWdgTimer(ADC_Type *base, *adc_alg_type_t* wdgTimerType)

This function is used to disable the ADC self-test watchdog timer.

The user can pass kADC_SelfTestForAlgS as parameter 'wdgTimerType' to disable the watchdog timer for algorithm S; pass kADC_SelfTestForAlgC as parameter 'wdgTimerType' to disable the watchdog timer for algorithm C; pass kADC_SelfTestForAlgSAndC as parameter 'wdgTimerType' to disable the watchdog timer for algorithm S and C.

Parameters

- base – ADC peripheral base address.
- wdgTimerType – Watchdog timer type to disable, please refer to adc_alg_type_t for details.

static inline void ADC_SetSelfTestWdgTimerVal(ADC_Type *base, *adc_wdg_timer_val_t* wdgTimerVal)

This function is used to set the ADC self-test watchdog timer value.

Parameters

- base – ADC peripheral base address.
- wdgTimerVal – Watchdog timer value, please refer to adc_wdg_timer_val_t for details.

static inline uint16_t ADC_GetSelfTestChannelConvFailedData(ADC_Type *base, *adc_self_test_wdg_threshold_t* type)

This function is used to get the ADC self-test channel converted data when ERR_S0/ERR_S1_INTEGER/ ERR_S1_FRACTION/ERR_S2/ERR_C occurred.

Note: The user can pass kADC_SelfTestWdgThresholdForAlgSStep0 as parameter 'type' to get the converted data when ERR_S0 occurred; pass kADC_SelfTestWdgThresholdForAlgSStep1Integer as parameter 'type' to get the converted data when ERR_S1_INTEGER occurred; pass kADC_SelfTestWdgThresholdForAlgSStep1Fraction as parameter 'type' to get the converted data when ERR_S1_FRACTION occurred; pass kADC_SelfTestWdgThresholdForAlgSStep2 as parameter 'type' to get the converted data when ERR_S2 occurred; pass kADC_SelfTestWdgThresholdForAlgCStep0 as parameter 'type' to get the converted data when ERR_C occurred; Other enumerations in adc_self_test_wdg_threshold_t have no use.

Parameters

- base – ADC peripheral base address.
- type – Watchdog threshold index to get the ADC self-test channel converted data, please refer to adc_self_test_wdg_threshold_t for details.

static inline void ADC_EnableSelfTestInt(ADC_Type *base, uint32_t mask)

This function is used to enable the ADC self-test-related interrupts.

Note: Watchdog timer feature is applicable only for scan operation mode and not for one-shot operation mode.

Parameters

- base – ADC peripheral base address.
- mask – Mask value to enable the ADC self-test related interrupts, please refer to _adc_self_test_int_enable for details.

static inline void ADC_DisableSelfTestInt(ADC_Type *base, uint32_t mask)

This function is used to disable the ADC self-test interrupt.

Parameters

- base – ADC peripheral base address.
- mask – Mask value to disable the ADC self-test related interrupts, please refer to _adc_self_test_int_enable for details.

static inline uint32_t ADC_GetSelfTestIntStatus(ADC_Type *base)

This function is used to get the ADC self-test interrupts status.

Parameters

- base – ADC peripheral base address.

Returns

ADC self-test related interrupts status mask.

static inline void ADC_ClearSelfTestIntStatus(ADC_Type *base, uint32_t mask)

This function is used to clear the ADC self-test interrupts status.

Parameters

- base – ADC peripheral base address.
- mask – Mask value for flags to be cleared, please refer to _adc_self_test_int_flag for details.

bool ADC_GetChannelConvResult(ADC_Type *base, *adc_conv_result_t* *result, uint8_t channelIndex)

This function is used to get the specific ADC channel's conversion result.

CDR[VALID] indicates whether a new conversion is available, this field is automatically reset to 0 when the data is read. CDR[OVERW] Indicates whether the previous conversion data was overwritten without having been read, in which case the overwritten data is lost.

Parameters

- base – SAR ADC peripheral base address.
- result – Pointer to SAR ADC channels conversion result structure, please refer to adc_conv_result_t for details.
- channelIndex – Channel index to get the conversion result.

Returns

Indicates whether the acquisition of the specific channel conversion result is successful or not.

- **true** Obtaining the specific channel conversion result successfully, and the conversion result is stored in the input parameter result.
- **false** Obtaining the specific channel conversion result failed.

bool ADC_GetSelfTestChannelConvData(ADC_Type *base, *adc_self_test_conv_result_t* *result)

This function is used to get the test channel converted data when algorithm S step 0, algorithm S step 2, or algorithm C step executes.

Parameters

- base – ADC peripheral base address.
- result – Pointer to the SAR ADC self-test channel conversion result structure, please refer to adc_self_test_conv_result_t for details.

Returns

Indicates whether the acquisition of the self-test channel conversion result is successful or not.

- **true** Obtaining the self-test channel conversion result successfully, and the conversion result is stored in the input parameter 'result'.
- **false** Obtaining the self-test channel conversion result failed.

bool ADC_GetSelfTestChannelConvDataForAlgSStep1(ADC_Type *base,
adc_self_test_conv_result_t *result)

This function is used to get the test channel converted data when algorithm S step 1 executes.

Parameters

- base – ADC peripheral base address.
- result – Pointer to the SAR ADC self-test channel conversion result structure, please refer to adc_self_test_conv_result_t for details.

Returns

Indicates whether the acquisition of the self-test channel conversion result is successful or not.

- **true** Obtaining the self-test channel conversion result successfully, and the conversion result is stored in the input parameter 'result'.
- **false** Obtaining the self-test channel conversion result failed.

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enum _adc_conv_int_enable

This enumeration provides the mask for the ADC end-of-conversion and end-of-chain interrupts enabling.

Values:

enumerator kADC_NormalConvChainEndIntEnable

Enable end of normal chain conversion interrupt.

enumerator kADC_NormalConvEndIntEnable

Enable end of normal conversion interrupt.

enumerator kADC_InjectConvChainEndIntEnable

Enable end of inject chain conversion interrupt.

enumerator kADC_InjectConvEndIntEnable
Enable end of inject conversion interrupt.

enum _adc_wdg_threshold_int_enable
This enumeration provides the mask for the ADC analog watchdog threshold interrupts enabling.

Values:

enumerator kADC_wdg0LowThresholdIntEnable
Enable watchdog 0 low threshold interrupt.

enumerator kADC_wdg0HighThresholdIntEnable
Enable watchdog 0 high threshold interrupt.

enumerator kADC_wdg1LowThresholdIntEnable
Enable watchdog 1 low threshold interrupt.

enumerator kADC_wdg1HighThresholdIntEnable
Enable watchdog 1 high threshold interrupt.

enumerator kADC_wdg2LowThresholdIntEnable
Enable watchdog 2 low threshold interrupt.

enumerator kADC_wdg2HighThresholdIntEnable
Enable watchdog 2 high threshold interrupt.

enumerator kADC_wdg3LowThresholdIntEnable
Enable watchdog 3 low threshold interrupt.

enumerator kADC_wdg3HighThresholdIntEnable
Enable watchdog 3 high threshold interrupt.

enumerator kADC_wdg4LowThresholdIntEnable
Enable watchdog 4 low threshold interrupt.

enumerator kADC_wdg4HighThresholdIntEnable
Enable watchdog 4 high threshold interrupt.

enumerator kADC_wdg5LowThresholdIntEnable
Enable watchdog 5 low threshold interrupt.

enumerator kADC_wdg5HighThresholdIntEnable
Enable watchdog 5 high threshold interrupt.

enumerator kADC_wdg6LowThresholdIntEnable
Enable watchdog 6 low threshold interrupt.

enumerator kADC_wdg6HighThresholdIntEnable
Enable watchdog 6 high threshold interrupt.

enumerator kADC_wdg7LowThresholdIntEnable
Enable watchdog 7 low threshold interrupt.

enumerator kADC_wdg7HighThresholdIntEnable
Enable watchdog 7 high threshold interrupt.

enum _adc_self_test_int_enable
This enumeration provides the mask for the ADC self-test related interrupts enabling.

Values:

enumerator kADC_AlgSStep0ErrIntEnable
Enable self-test algorithm S step0 error interrupt.

enumerator kADC_AlgSStep1ErrIntEnable
Enable self-test algorithm S step1 error interrupt.

enumerator kADC_AlgSStep2ErrIntEnable
Enable self-test algorithm S step2 error interrupt.

enumerator kADC_AlgCErrIntEnable
Enable self-test algorithm C error interrupt.

enumerator kADC_AlgSEndIntEnable
Enable self-test algorithm S end interrupt.

enumerator kADC_AlgCEndIntEnable
Enable self-test algorithm C end interrupt.

enumerator kADC_ConvEndIntEnable
Enable self-test conversion end interrupt.

enumerator kADC_WdgTimeErrIntEnable
Enable watchdog time error interrupt.

enumerator kADC_WdgSequenceErrIntEnable
Enable watchdog sequence error interrupt.

enum _adc_conv_int_flag
This enumeration provides the mask for the ADC end-of-conversion and end-of-chain interrupts flag.

Values:

enumerator kADC_NormalConvChainEndIntFlag
Indicates whether the end of normal chain conversion interrupt has occurred.

enumerator kADC_NormalConvEndIntFlag
Indicates whether the end of conversion interrupt has occurred.

enumerator kADC_InjectConvChainEndIntFlag
Indicates whether the end of inject chain conversion interrupt has occurred.

enumerator kADC_InjectConvEndIntFlag
Indicates whether the end of inject conversion interrupt has occurred.

enum _adc_wdg_threshold_int_flag
This enumeration provides the mask for the ADC analog watchdog threshold interrupts flag.

Values:

enumerator kADC_wdg0LowThresholdIntFlag
Indicates whether the watchdog 0 low threshold interrupt has occurred.

enumerator kADC_wdg0HighThresholdIntFlag
Indicates whether the watchdog 0 high threshold interrupt has occurred.

enumerator kADC_wdg1LowThresholdIntFlag
Indicates whether the watchdog 1 low threshold interrupt has occurred.

enumerator kADC_wdg1HighThresholdIntFlag
Indicates whether the watchdog 1 high threshold interrupt has occurred.

enumerator kADC_wdg2LowThresholdIntFlag
Indicates whether the watchdog 2 low threshold interrupt has occurred.

enumerator kADC_wdg2HighThresholdIntFlag
Indicates whether the watchdog 2 high threshold interrupt has occurred.

enumerator kADC_wdg3LowThresholdIntFlag
Indicates whether the watchdog 3 low threshold interrupt has occurred.

enumerator kADC_wdg3HighThresholdIntFlag
Indicates whether the watchdog 3 high threshold interrupt has occurred.

enumerator kADC_wdg4LowThresholdIntFlag
Indicates whether the watchdog 4 low threshold interrupt has occurred.

enumerator kADC_wdg4HighThresholdIntFlag
Indicates whether the watchdog 4 high threshold interrupt has occurred.

enumerator kADC_wdg5LowThresholdIntFlag
Indicates whether the watchdog 5 low threshold interrupt has occurred.

enumerator kADC_wdg5HighThresholdIntFlag
Indicates whether the watchdog 5 high threshold interrupt has occurred.

enumerator kADC_wdg6LowThresholdIntFlag
Indicates whether the watchdog 6 low threshold interrupt has occurred.

enumerator kADC_wdg6HighThresholdIntFlag
Indicates whether the watchdog 6 high threshold interrupt has occurred.

enumerator kADC_wdg7LowThresholdIntFlag
Indicates whether the watchdog 7 low threshold interrupt has occurred.

enumerator kADC_wdg7HighThresholdIntFlag
Indicates whether the watchdog 7 high threshold interrupt has occurred.

enum _adc_self_test_int_flag
This enumeration provides the mask for the ADC self-test-related interrupts flag.

Values:

enumerator kADC_AlgSStep0ErrIntFlag
Indicates whether the self-test algorithm S step0 error interrupt has occurred.

enumerator kADC_AlgSStep1ErrIntFlag
Indicates whether the self-test algorithm S step1 error interrupt has occurred.

enumerator kADC_AlgSStep2ErrIntFlag
Indicates whether the self-test algorithm S step2 error interrupt has occurred.

enumerator kADC_AlgCErrIntFlag
Indicates whether the self-test algorithm C error interrupt has occurred.

enumerator kADC_AlgSEndIntFlag
Indicates whether the algorithm S end interrupt has completed.

enumerator kADC_AlgCEndIntFlag
Indicates whether the algorithm C end interrupt has completed.

enumerator kADC_SelfTestConvEndIntFlag
Indicates whether the self-test end-of-conversion interrupt has completed.

enumerator kADC_OverWriteErrIntFlag
Indicates whether the overwrite error interrupt has occurred.

enumerator kADC_WdgTimeErrIntFlag
Indicates whether the watchdog time error interrupt has occurred.

enumerator kADC_WdgSequenceErrIntFlag
Indicates whether the watchdog sequence error interrupt has occurred.

enum _adc_ext_trig
This enumeration provides the selection of the ADC external trigger type.

Values:

enumerator kADC_ExtTrigDisable
Normal trigger input does not start a conversion.

enumerator kADC_ExtTrigFallingEdge
Normal trigger (falling edge) input starts a conversion.

enumerator kADC_ExtTrigRisingEdge
Normal trigger (rising edge) input starts a conversion.

enum _adc_state
This enumeration provides the selection of the ADC state.

Values:

enumerator kADC_AdcIdle
Indicates the ADC is in the IDLE state.

enumerator kADC_AdcPowerdown
Indicates the ADC is in the power-down state.

enumerator kADC_AdcWait
Indicates the ADC is in the wait state.

enumerator kADC_AdcBusyInCalibration
Indicates the ADC is in the calibration busy state.

enumerator kADC_AdcSample
Indicates the ADC is in the sample state.

enumerator kADC_AdcConv
Indicates the ADC is in the conversion state.

enum _adc_conv_mode
This enumeration provides the selection of the ADC conversion mode, including normal conversion one-shot mode, normal conversion scan mode, and inject conversion one-shot mode.

Values:

enumerator kADC_NormalConvOneShotMode
Normal conversion one-shot mode.

enumerator kADC_NormalConvScanMode
Normal conversion scan mode.

enumerator kADC_InjectConvOneShotMode
Inject conversion one-shot mode.

enum _adc_clock_frequency
This enumeration provides the selection of the ADC operating clock frequency, including half-bus frequency and full bus frequency.

Values:

enumerator kADC_HalfBusFrequency
Half of bus clock frequency.

enumerator kADC_FullBusFrequency
Equal to bus clock frequency.

enum _adc_conv_data_align
This enumeration provides the selection of the ADC conversion data alignment, including the right alignment and left alignment.

Values:

enumerator kADC_ConvDataRightAlign
Conversion data is right aligned.

enumerator kADC_ConvDataLeftAlign
Conversion data is left aligned.

enum _adc_presample_voltage_src
This enumeration provides the selection of the ADC internal analog input voltage sources for pre-sample, including DVDD0P8/2, AVDD1P8/4, VREFL_1p8 and VREFH_1p8.

Values:

enumerator kADC_PresampleVoltageSrcVREL
Use VREL as pre-sample voltage source.

enumerator kADC_PresampleVoltageSrcVREH
Use VREH as pre-sample voltage source.

enum _adc_dma_request_clear_src
This enumeration provides the selection of the DMA request clear sources, including clear by acknowledgment from the DMA controller and clear on a read of the data register.

Values:

enumerator kADC_DMARequestClearByAck
DMA request cleared by acknowledgment from DMA controller.

enumerator kADC_DMARequestClearOnRead
DMA request cleared on a read of the data register.

enum _adc_average_sample_numbers
This enumeration provides the selection of the ADC calibration averaging sample numbers, including 16, 32, 128, and 512 averaging samples.

Values:

enumerator kADC_AverageSampleNumbers16
Use 16 averaging samples during calibration.

enumerator kADC_AverageSampleNumbers32
Use 32 averaging samples during calibration.

enumerator kADC_AverageSampleNumbers128
Use 128 averaging samples during calibration.

enumerator kADC_AverageSampleNumbers512
Use 512 averaging samples during calibration.

enum _adc_sample_time
This enumeration provides the selection of the ADC sample time of calibration conversions, including 22, 8, 16 and 32 cycles of ADC_CLK.

Values:

enumerator kADC_SampleTime22

Use 22 cycles of ADC_CLK as sample time of calibration conversions.

enumerator kADC_SampleTime8

Use 8 cycles of ADC_CLK as sample time of calibration conversions.

enumerator kADC_SampleTime16

Use 16 cycles of ADC_CLK as sample time of calibration conversions.

enumerator kADC_SampleTime32

Use 32 cycles of ADC_CLK as sample time of calibration conversions.

enum _adc_wdg_threshold_int

This enumeration provides the selection of the ADC analog watchdog threshold low and high interrupt enable.

Values:

enumerator kADC_LowHighThresholdIntDisable

Enable the ADC analog watchdog low and high threshold interrupts.

enumerator kADC_LowThresholdIntEnable

Enable the ADC analog watchdog low threshold interrupt.

enumerator kADC_HighThresholdIntEnable

Enable the ADC analog watchdog high threshold interrupt.

enumerator kADC_LowHighThresholdIntEnable

Enable the ADC analog watchdog low and high threshold interrupts.

enum _adc_alg_type

This enumeration provides the selection of the ADC self-test algorithm type, including algorithm S, algorithm C and algorithm S and C.

Note: The meaning of enumeration member 'kADC_SelfTestForAlgSAndC' in different conversion modes is different, in the one-shot conversion mode, it means executing algorithm S; in the scan conversion mode, it means executing algorithm S and C.

Values:

enumerator kADC_SelfTestForAlgS

Use algorithm S for self-test.

enumerator kADC_SelfTestForAlgC

Use algorithm C for self-test.

enumerator kADC_SelfTestForAlgSAndC

Use algorithm S for one-shot conversion mode self-test, use algorithm S and algorithm C for scan conversion mode self-test.

enum _adc_self_test_wdg_threshold

This enumeration provides the selection of the ADC self-test watchdog thresholds for algorithm S step 0 - 2, and watchdog thresholds for algorithm C step 0 and step x (x = 1 - 11).

Values:

enumerator kADC_SelfTestWdgThresholdForAlgSStep0

Self-test watchdog threshold for the algorithm S step 0.

enumerator kADC_SelfTestWdgThresholdForAlgSStep1

Self-test watchdog threshold for the algorithm S step 1 fraction part.

enumerator kADC_SelfTestWdgThresholdForAlgSStep2
Self-test watchdog threshold for the algorithm S step 2.

enumerator kADC_SelfTestWdgThresholdForAlgCStep0
Self-test watchdog threshold for the algorithm C step 0.

enumerator kADC_SelfTestWdgThresholdForAlgCStepx
Self-test watchdog threshold for the algorithm C step x.

enum _adc_wdg_timer_val
This enumeration provides the selection of the ADC self-test watchdog timer value, including 0.1ms, 0.5ms, 1ms, 2ms, 5ms, 10ms, 20ms and 50ms.

Values:

enumerator kADC_SelfTestWdgTimerVal0
0.1ms ((0008h × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal1
0.5ms ((0027h × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal2
1ms ((004Eh × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal3
2ms ((009Ch × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal4
5ms ((0187h × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal5
10ms ((030Dh × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal6
20ms ((061Ah × Prescaler) cycles at 80 MHz).

enumerator kADC_SelfTestWdgTimerVal7
50ms ((0F42h × Prescaler) cycles at 80 MHz).

typedef enum *_adc_ext_trig* adc_ext_trig_t
This enumeration provides the selection of the ADC external trigger type.

typedef enum *_adc_state* adc_state_t
This enumeration provides the selection of the ADC state.

typedef enum *_adc_conv_mode* adc_conv_mode_t
This enumeration provides the selection of the ADC conversion mode, including normal conversion one-shot mode, normal conversion scan mode, and inject conversion one-shot mode.

typedef enum *_adc_clock_frequency* adc_clock_frequency_t
This enumeration provides the selection of the ADC operating clock frequency, including half-bus frequency and full bus frequency.

typedef enum *_adc_conv_data_align* adc_conv_data_align_t
This enumeration provides the selection of the ADC conversion data alignment, including the right alignment and left alignment.

typedef enum *_adc_presample_voltage_src* adc_presample_voltage_src_t
This enumeration provides the selection of the ADC internal analog input voltage sources for pre-sample, including DVDD0P8/2, AVDD1P8/4, VREFL_1p8 and VREFH_1p8.

typedef enum *_adc_dma_request_clear_src* adc_dma_request_clear_src_t

This enumeration provides the selection of the DMA request clear sources, including clear by acknowledgment from the DMA controller and clear on a read of the data register.

typedef enum *_adc_average_sample_numbers* adc_average_sample_numbers_t

This enumeration provides the selection of the ADC calibration averaging sample numbers, including 16, 32, 128, and 512 averaging samples.

typedef enum *_adc_sample_time* adc_sample_time_t

This enumeration provides the selection of the ADC sample time of calibration conversions, including 22, 8, 16 and 32 cycles of ADC_CLK.

typedef enum *_adc_wdg_threshold_int* adc_wdg_threshold_int_t

This enumeration provides the selection of the ADC analog watchdog threshold low and high interrupt enable.

typedef enum *_adc_alg_type* adc_alg_type_t

This enumeration provides the selection of the ADC self-test algorithm type, including algorithm S, algorithm C and algorithm S and C.

Note: The meaning of enumeration member 'kADC_SelfTestForAlgSAndC' in different conversion modes is different, in the one-shot conversion mode, it means executing algorithm S; in the scan conversion mode, it means executing algorithm S and C.

---

typedef enum *_adc_self_test_wdg_threshold* adc_self_test_wdg_threshold_t

This enumeration provides the selection of the ADC self-test watchdog thresholds for algorithm S step 0 - 2, and watchdog thresholds for algorithm C step 0 and step x (x = 1 - 11).

typedef enum *_adc_wdg_timer_val* adc_wdg_timer_val_t

This enumeration provides the selection of the ADC self-test watchdog timer value, including 0.1ms, 0.5ms, 1ms, 2ms, 5ms, 10ms, 20ms and 50ms.

typedef struct *_adc_config* adc_config_t

This structure is used to configure the ADC module.

typedef struct *_adc_channel_config* adc_channel_config_t

This structure is used to configure the ADC conversion channel.

typedef struct *_adc_chain_config* adc_chain_config_t

This structure is used to configure the ADC conversion chain.

typedef struct *_adc_wdg_config* adc_wdg_config_t

This structure is used to configure the ADC analog watchdog.

typedef struct *_adc_calibration_config* adc_calibration_config_t

This structure is used to configure the ADC calibration.

typedef struct *_adc_user_offset_gain_config* adc_user_offset_gain_config_t

This structure is used to configure the ADC user offset and gain.

typedef struct *_adc_self_test_config* adc_self_test_config_t

This structure is used to configure the ADC self-test.

typedef struct *_adc_self_test_wdg_config* adc_self_test_wdg_config_t

This structure is used to configure the ADC self-test watchdog for algorithm steps.

Note: The algorithm S step 2 only has the 'LowThrsholdVal'.

---

typedef struct *_adc_conv_result* adc_conv_result_t

This structure is used to save the result information when obtaining the conversion result.

typedef struct *_adc_self_test_conv_result* adc_self_test_conv_result_t

This structure is used to save the result information when obtaining the self-test channel conversion result.

Note: The member 'convData' is used to store self-test channel conversion results. Only when executing step 1 of algorithm S, member 'convDataFraction' will be used to store the fractional part data. When executing other algorithms, this member will not be used.

ADC_GROUP_COUNTS

ADC_THRESHOLD_COUNTS

ADC_SELF_TEST_THRESHOLD_COUNTS

GET_REGINDEX(channelIndex)

GET_BITINDEX(channelIndex)

REGISTER_READWRITE(baseRegister, shiftIndex)

REGISTER_READONLY(baseRegister, shiftIndex)

NCMR_IO(base, registerIndex)

JCMR_IO(base, registerIndex)

PSR_IO(base, registerIndex)

DMAR_IO(base, registerIndex)

CWSELR_IO(base, registerIndex)

CWENR_IO(base, registerIndex)

CIMR_IO(base, registerIndex)

CEOCFR_IO(base, registerIndex)

AWORR_IO(base, registerIndex)

STAWR_IO(base, registerIndex)

CEOCFR_I(base, registerIndex)

AWORR_I(base, registerIndex)

CDR_I(base, registerIndex)

WDG_SELECT_MASK(shiftIndex)

WDG_SELECT_SHIFT(shiftIndex)

WDG_SELECT(val, shiftIndex)

ADC_CDR_VALID_MASK

ADC_CDR_VALID_SHIFT

ADC_CDR_OVERW_MASK

ADC_CDR_OVERW_SHIFT

ADC_CDR_RESULT_MASK

ADC_CDR_RESULT_SHIFT

ADC_CDR_CDATA_MASK

ADC_CDR_CDATA_SHIFT

ADC_STAWR_AWDE_MASK

ADC_STAWR_THRL_MASK

ADC_STAWR_THRL_SHIFT

ADC_STAWR_THRL(val)

ADC_STAWR_THRH_MASK

ADC_STAWR_THRH_SHIFT

ADC_STAWR_THRH(val)

ADC_CALSTAT_MAX

ADC_CALSTAT_SIGN

struct _adc_config

#include <fsl_sar_adc.h> This structure is used to configure the ADC module.

Public Members

bool enableAutoClockOff

Decides whether to enable the ADC auto clock-off function, when set to true, the internal ADC clock is automatically switched off during IDLE mode to reduce power consumption (without going into power-down mode).

bool enableOverWrite

Decides whether to enable the latest conversion to overwrite the current value in the data registers.

bool enableConvertPresampleVal

Decides whether to convert the pre-sampled value, if enabled, pre-sampling is followed by the conversion, sampling will be bypassed and conversion of the pre-sampled data will be done.

adc_ext_trig_t extTrig

Specifies whether the normal trigger (with trigger type) input starts a conversion.

adc_conv_data_align_t convDataAlign

Selects the conversion data alignment.

adc_clock_frequency_t clockFrequency

Selects the ADC clock frequency.

adc_dma_request_clear_src_t dmaRequestClearSrc

Selects DMA request clear source.

adc_presample_voltage_src_t presampleVoltageSrc[1]

Selects analog input voltages for group 0 (corresponding to channel 0 to channel 31) and group 32 (corresponding to channel 32 to channel 63) pre-sampling.

uint8_t samplePhaseDuration[1]

Sets the sample phase duration in terms of the ADC controller clock for group 0 (corresponding to channel 0 to channel 31) and group 32 (corresponding to channel 32 to channel 63), the minimum acceptable value is 8, configuring to a value lower than 8 sets the sample period to 8 cycles.

struct _adc_channel_config

#include <fsl_sar_adc.h> This structure is used to configure the ADC conversion channel.

Public Members

uint8_t channelIndex

Sets the conversion channel index.

bool enableInt

Decides Whether to enable the interrupt function of the current conversion channel.

bool enablePresample

Decides whether to enable the pre-sample function of the current conversion channel.

bool enableDmaTransfer

Decides whether to enable the DMA transfer function of the current conversion channel.

bool enableWdg

Decides whether to enable the analog watchdog function of the current conversion channel.

uint8_t wdgIndex

Indicates which analog watchdog to provide the low and high threshold value.

struct _adc_chain_config

#include <fsl_sar_adc.h> This structure is used to configure the ADC conversion chain.

Public Members

adc_conv_mode_t convMode

Selects conversion mode.

bool enableGlobalChannelConvEndInt

Global control function to determine whether to enable the interrupt function of conversion channels.

bool enableChainConvEndInt

Decides whether to enable the current chain end-of-conversion interrupt.

uint8_t channelCount

Indicates the channel counts.

adc_channel_config_t *channelConfig

Chain channels configuration.

struct _adc_wdg_config

#include <fsl_sar_adc.h> This structure is used to configure the ADC analog watchdog.

Public Members

uint8_t wdgIndex
: Indicates the analog watchdog index

adc_wdg_threshold_int_t wdgThresholdInt
: Selects watchdog threshold low or/and high interrupt to enable/disable.

uint16_t lowThresholdVal
: Sets the ADC analog watchdog low threshold value.

uint16_t highThresholdVal
: Sets the ADC analog watchdog high threshold value.

struct __adc__calibration__config
: *#include <fsl_sar_adc.h>* This structure is used to configure the ADC calibration.

Public Members

bool enableAverage
: Decides whether to enable averaging of calibration time.

adc_sample_time_t sampleTime
: Selects sample time of calibration conversions.

adc_average_sample_numbers_t averageSampleNumbers
: Selects calibration averaging sample numbers.

struct __adc__user__offset__gain__config
: *#include <fsl_sar_adc.h>* This structure is used to configure the ADC user offset and gain.

Public Members

int8_t userOffset
: Sets user defined gain value.

int16_t userGain
: Sets user defined offset value.

struct __adc__self__test__config
: *#include <fsl_sar_adc.h>* This structure is used to configure the ADC self-test.

Public Members

adc_alg_type_t algType
: Selects the self-test algorithm.

uint8_t algSteps
: Sets the self-test algorithm steps, it should be programmed to zero in scan mode.

uint8_t algSSamplePhaseDuration
: Sets the self-test algorithm S conversion sampling phase duration.

uint8_t algCSamplePhaseDuration
: Sets the self-test algorithm C conversion sampling phase duration.

uint8_t baudRate
: Sets the baud rate for the selected algorithm in scan mode, must write to this field before enabling a self-test channel.

struct _adc_self_test_wdg_config

#include <fsl_sar_adc.h> This structure is used to configure the ADC self-test watchdog for algorithm steps.

Note: The algorithm S step 2 only has the 'LowThrsholdVal'.

Public Members

adc_self_test_wdg_threshold_t wdgThresholdId

Indicates the self-test watchdog index

uint16_t lowThrsholdVal

Sets the self-test watchdog low threshold value.

uint16_t highThrsholdVal

Sets the self-test watchdog high threshold value.

struct _adc_conv_result

#include <fsl_sar_adc.h> This structure is used to save the result information when obtaining the conversion result.

Public Members

bool overWrittenFlag

Indicates when conversion data was overwritten by a newer result, the new data is written or discarded according to MCR[OWREN].

uint8_t convMode

Indicates the mode of conversion for the corresponding channel.

uint16_t convData

Stores the conversion data corresponding to the internal channel.

struct _adc_self_test_conv_result

#include <fsl_sar_adc.h> This structure is used to save the result information when obtaining the self-test channel conversion result.

Note: The member 'convData' is used to store self-test channel conversion results. Only when executing step 1 of algorithm S, member 'convDataFraction' will be used to store the fractional part data. When executing other algorithms, this member will not be used.

Public Members

bool overWrittenFlag

Indicates when conversion data is overwritten by a newer result.

uint16_t convData

Stores the conversion data corresponding to the internal self-test channel.

uint16_t convDataFraction

This field is only used to store the fractional part conversion result.

2.98 SEMA42: Hardware Semaphores Driver

FSL_SEMA42_DRIVER_VERSION
SEMA42 driver version.

SEMA42 status return codes.

Values:

enumerator kStatus_SEMA42_Busy
SEMA42 gate has been locked by other processor.

enumerator kStatus_SEMA42_Reseting
SEMA42 gate reseting is ongoing.

enum _sema42_gate_status
SEMA42 gate lock status.

Values:

enumerator kSEMA42_Unlocked
The gate is unlocked.

enumerator kSEMA42_LockedByProc0
The gate is locked by processor 0.

enumerator kSEMA42_LockedByProc1
The gate is locked by processor 1.

enumerator kSEMA42_LockedByProc2
The gate is locked by processor 2.

enumerator kSEMA42_LockedByProc3
The gate is locked by processor 3.

enumerator kSEMA42_LockedByProc4
The gate is locked by processor 4.

enumerator kSEMA42_LockedByProc5
The gate is locked by processor 5.

enumerator kSEMA42_LockedByProc6
The gate is locked by processor 6.

enumerator kSEMA42_LockedByProc7
The gate is locked by processor 7.

enumerator kSEMA42_LockedByProc8
The gate is locked by processor 8.

enumerator kSEMA42_LockedByProc9
The gate is locked by processor 9.

enumerator kSEMA42_LockedByProc10
The gate is locked by processor 10.

enumerator kSEMA42_LockedByProc11
The gate is locked by processor 11.

enumerator kSEMA42_LockedByProc12
The gate is locked by processor 12.

enumerator kSEMA42_LockedByProc13

The gate is locked by processor 13.

enumerator kSEMA42_LockedByProc14

The gate is locked by processor 14.

typedef enum *_sema42_gate_status* sema42_gate_status_t

SEMA42 gate lock status.

void SEMA42_Init(SEMA42_Type *base)

Initializes the SEMA42 module.

This function initializes the SEMA42 module. It only enables the clock but does not reset the gates because the module might be used by other processors at the same time. To reset the gates, call either SEMA42_ResetGate or SEMA42_ResetAllGates function.

Parameters

- base – SEMA42 peripheral base address.

void SEMA42_Deinit(SEMA42_Type *base)

De-initializes the SEMA42 module.

This function de-initializes the SEMA42 module. It only disables the clock.

Parameters

- base – SEMA42 peripheral base address.

status_t SEMA42_TryLock(SEMA42_Type *base, uint8_t gateNum, uint8_t procNum)

Tries to lock the SEMA42 gate.

This function tries to lock the specific SEMA42 gate. If the gate has been locked by another processor, this function returns an error code.

Parameters

- base – SEMA42 peripheral base address.
- gateNum – Gate number to lock.
- procNum – Current processor number.

Return values

- kStatus_Success – Lock the sema42 gate successfully.
- kStatus_SEMA42_Busy – Sema42 gate has been locked by another processor.

status_t SEMA42_Lock(SEMA42_Type *base, uint8_t gateNum, uint8_t procNum)

Locks the SEMA42 gate.

This function locks the specific SEMA42 gate. If the gate has been locked by other processors, this function waits until it is unlocked and then lock it.

If SEMA42_BUSY_POLL_COUNT is defined and non-zero, the function will timeout after the specified number of polling iterations and return kStatus_Timeout.

Parameters

- base – SEMA42 peripheral base address.
- gateNum – Gate number to lock.
- procNum – Current processor number.

Return values

- kStatus_Success – The gate was successfully locked.

- kStatus_Timeout – Timeout occurred while waiting for the gate to be unlocked.

Returns
status_t

static inline void SEMA42_Unlock(SEMA42_Type *base, uint8_t gateNum)

Unlocks the SEMA42 gate.

This function unlocks the specific SEMA42 gate. It only writes unlock value to the SEMA42 gate register. However, it does not check whether the SEMA42 gate is locked by the current processor or not. As a result, if the SEMA42 gate is not locked by the current processor, this function has no effect.

Parameters

- base – SEMA42 peripheral base address.
- gateNum – Gate number to unlock.

static inline *sema42_gate_status_t* SEMA42_GetGateStatus(SEMA42_Type *base, uint8_t gateNum)

Gets the status of the SEMA42 gate.

This function checks the lock status of a specific SEMA42 gate.

Parameters

- base – SEMA42 peripheral base address.
- gateNum – Gate number.

Returns
status Current status.

status_t SEMA42_ResetGate(SEMA42_Type *base, uint8_t gateNum)

Resets the SEMA42 gate to an unlocked status.

This function resets a SEMA42 gate to an unlocked status.

Parameters

- base – SEMA42 peripheral base address.
- gateNum – Gate number.

Return values

- kStatus_Success – SEMA42 gate is reset successfully.
- kStatus_SEMA42_Reseting – Some other reset process is ongoing.

static inline *status_t* SEMA42_ResetAllGates(SEMA42_Type *base)

Resets all SEMA42 gates to an unlocked status.

This function resets all SEMA42 gate to an unlocked status.

Parameters

- base – SEMA42 peripheral base address.

Return values

- kStatus_Success – SEMA42 is reset successfully.
- kStatus_SEMA42_Reseting – Some other reset process is ongoing.

SEMA42_GATE_NUM_RESET_ALL

The number to reset all SEMA42 gates.

SEMA42_GATEn(base, n)

SEMA42 gate n register address.

The SEMA42 gates are sorted in the order 3, 2, 1, 0, 7, 6, 5, 4, ... not in the order 0, 1, 2, 3, 4, 5, 6, 7, ... The macro SEMA42_GATEn gets the SEMA42 gate based on the gate index.

The input gate index is XOR'ed with 3U: 0 ^ 3 = 3 1 ^ 3 = 2 2 ^ 3 = 1 3 ^ 3 = 0 4 ^ 3 = 7 5 ^ 3 = 6 6 ^ 3 = 5 7 ^ 3 = 4 ...

SEMA42_BUSY_POLL_COUNT

Maximum polling iterations for SEMA42 waiting loops.

This parameter defines the maximum number of iterations for any polling loop in the SEMA42 driver code before timing out and returning an error.

It applies to all waiting loops in SEMA42 driver, such as waiting for a gate to be unlocked, waiting for a reset to complete, or waiting for a resource to become available.

This is a count of loop iterations, not a time-based value.

If defined as 0, polling loops will continue indefinitely until their exit condition is met, which could potentially cause the system to hang if hardware doesn't respond or if a resource is never released.

2.99 SFA: Signal Frequency Analyser

void SFA_GetDefaultConfig(*sfa_config_t* *config)

Fill the SFA configuration structure with default settings.

The default values are:

```
config->mode = kSFA_FrequencyMeasurement0;
config->cutSelect = kSFA_CUTSelect0;
config->refSelect = kSFA_REFSelect0;
config->prediv = 0U;
config->trigStart = kSFA_TriggerStartSelect0;
config->startPolarity = kSFA_TriggerStartPolarityRiseEdge;
config->trigEnd = kSFA_TriggerEndSelect0;
config->endPolarity = kSFA_TriggerEndPolarityRiseEdge;
config->enableTrigMeasurement = false;
config->enableCUTPin = false;
config->cutTarget = 0xffffU;
config->refTarget = 0xffffffffU;
```

Parameters

- config – Pointer to the user configuration structure.

void SFA_Init(SFA_Type *base)

Initialize SFA.

Parameters

- base – SFA peripheral base address.

status_t SFA_Deinit(SFA_Type *base)

Clear counter, disable SFA and gate the SFA clock.

Parameters

- base – SFA peripheral base address.

Return values

- kStatus_Success – run success.
- kStatus_Timeout – timeout occurs.

static inline void SFA_EnableCUTPin(SFA_Type *base, bool enable)

Control the connection of the clock under test to an external pin.

Parameters

- base – SFA peripheral base address.
- enable – true: connect the clock under test and external pin. false: Disconnect the clock under test and external pin.

static inline uint32_t SFA_GetStatusFlags(SFA_Type *base)

Get SFA status flags.

Parameters

- base – SFA peripheral base address.

void SFA_ClearStatusFlag(SFA_Type *base, uint32_t mask)

Clear the SFA status flags.

Note: To clear kSFA_RefStoppedFlag, kSFA_CUTStoppedFlag, kSFA_MeasurementStartedFlag, and kSFA_ReferenceCounterTimeOutFlag, each counter will also be cleared.

Parameters

- base – SFA peripheral base address.
- mask – SFA status flag mask (see _sfa_status_flags for bit definition).

static inline void SFA_EnableInterrupts(SFA_Type *base, uint32_t mask)

Enable the selected SFA interrupt.

Parameters

- base – SFA peripheral base address.
- mask – The interrupt to enable (see _sfa_interrupts_enable for definition).

static inline void SFA_DisableInterrupts(SFA_Type *base, uint32_t mask)

Disable the selected SFA interrupt.

Parameters

- base – SFA peripheral base address.
- mask – The interrupt to disable (see _sfa_interrupts_enable for definition).

static inline uint8_t SFA_GetMode(SFA_Type *base)

Get SFA measurement mode.

Parameters

- base – SFA peripheral base address.

static inline uint8_t SFA_GetCUTPredivide(SFA_Type *base)

Get CUT predivide value.

Parameters

- base – SFA peripheral base address.

void SFA_InstallCallback(SFA_Type *base, *sfa_callback_t* function)

Install the callback function to be called when IRQ happens or measurement completes.

Parameters

- base – SFA peripheral base address.
- function – the SFA measure completed callback function.

void SFA_SetMeasureConfig(SFA_Type *base, const *sfa_config_t* *config)

Set Measurement options with the passed in configuration structure.

Parameters

- base – SFA peripheral base address.
- config – SFA configuration structure.

status_t SFA_MeasureBlocking(SFA_Type *base)

Start SFA measurement in blocking mode.

Parameters

- base – SFA peripheral base address.

Return values

- kStatus_SFA_MeasurementCompleted – SFA measure completes.
- kStatus_SFA_ReferenceCounterTimeout – reference counter timeout error happens.
- kStatus_SFA_CUTCounterTimeout – CUT counter time out happens.

void SFA_MeasureNonBlocking(SFA_Type *base)

Start measure sequence in NonBlocking mode.

This function performs nonblocking measurement by enabling sfa interrupt (Please enable the FreqGreaterThanMax and FreqLessThanMin interrupts individually as needed). The callback function must be installed before invoking this function.

Note: This function has different functions for different instances.

Parameters

- base – SFA peripheral base address.

void SFA_AbortMeasureSequence(SFA_Type *base)

Abort SFA measurement sequence.

Parameters

- base – SFA peripheral base address.

uint32_t SFA_CalculateFrequencyOrPeriod(SFA_Type *base, uint32_t refFrequency)

Calculate the frequency or period.

Parameters

- base – SFA peripheral base address.
- refFrequency – The reference clock frequency(BUS clock recommended).

static inline uint32_t SFA_GetCUTCounter(SFA_Type *base)

Get current count of the clock under test.

Parameters

- base – SFA peripheral base address.

static inline void SFA_SetCUTTargetCount(SFA_Type *base, uint32_t count)

Set the target count for the clock under test.

Parameters

- base – SFA peripheral base address.
- count – target count for CUT.

static inline uint32_t SFA_GetCUTTargetCount(SFA_Type *base)

Get the target count of the clock under test.

Parameters

- base – SFA peripheral base address.

static inline void SFA_SetCUTLowLimitClockCount(SFA_Type *base, uint32_t count)

Set CUT low limit clock count.

Parameters

- base – SFA peripheral base address.
- count – low limit count for CUT clock.

static inline uint32_t SFA_GetCUTLowLimitClockCount(SFA_Type *base)

Get CUT low limit clock count.

Parameters

- base – SFA peripheral base address.

static inline void SFA_SetCUTHighLimitClockCount(SFA_Type *base, uint32_t count)

Set CUT high limit clock count.

Parameters

- base – SFA peripheral base address.
- count – high limit count for CUT clock.

static inline uint32_t SFA_GetCUTHighLimitClockCount(SFA_Type *base)

Get CUT high limit clock count.

Parameters

- base – SFA peripheral base address.

static inline uint32_t SFA_GetREFCounter(SFA_Type *base)

Get current count of the reference clock.

Parameters

- base – SFA peripheral base address.

static inline void SFA_SetREFTargetCount(SFA_Type *base, uint32_t count)

Set the target count for the reference clock.

Parameters

- base – SFA peripheral base address.
- count – target count for reference clock.

static inline uint32_t SFA_GetREFTargetCount(SFA_Type *base)

Get the target count of the reference clock.

Parameters

- base – SFA peripheral base address.

static inline uint32_t SFA_GetREFStartCount(SFA_Type *base)

Get saved reference clock counter which is loaded when measurement start.

Parameters

- base – SFA peripheral base address.

static inline uint32_t SFA_GetREFEndCount(SFA_Type *base)

Get saved reference clock counter which is loaded when measurement complete.

Parameters

- base – SFA peripheral base address.

static inline void SFA_SetREFLowLimitClockCount(SFA_Type *base, uint32_t count)

Set REF low limit clock count.

Parameters

- base – SFA peripheral base address.
- count – low limit count for REF clock.

static inline uint32_t SFA_GetREFLowLimitClockCount(SFA_Type *base)

Get REF low limit clock count.

Parameters

- base – SFA peripheral base address.

static inline void SFA_SetREFHighLimitClockCount(SFA_Type *base, uint32_t count)

Set REF high limit clock count.

Parameters

- base – SFA peripheral base address.
- count – high limit count for REF clock.

static inline uint32_t SFA_GetREFHighLimitClockCount(SFA_Type *base)

Get REF high limit clock count.

Parameters

- base – SFA peripheral base address.

FSL_SFA_DRVIER_VERSION

SFA driver version 2.1.3.

SFA_MEASUREMENT_START_TIMEOUT

Max loops to wait for SFA measurement started.

This parameter defines how many loops to check completion before return timeout. If defined as 0, driver will wait forever until completion.

SFA_CUT_COUNTER_STOP_TIMEOUT

Max loops to wait for SFA CUT counter has stopped.

This parameter defines how many loops to check completion before return timeout. If defined as 0, driver will wait forever until completion.

SFA_REF_COUNTER_STOP_TIMEOUT

Max loops to wait for SFA REF counter has stopped.

This parameter defines how many loops to check completion before return timeout. If defined as 0, driver will wait forever until completion.

SFA status return codes.

enumeration _sfa_status

Values:

enumerator kStatus_SFA_MeasurementCompleted
Measurement completed

enumerator kStatus_SFA_ReferenceCounterTimeout
Reference counter timeout

enumerator kStatus_SFA_CUTCounterTimeout
CUT counter timeout

enumerator kStatus_SFA_CUTClockFreqLessThanMinLimit
CUT clock frequency less than minimum limit

enumerator kStatus_SFA_CUTClockFreqGreaterThanMaxLimit
CUT clock frequency greater than maximum limit

enum _sfa_status_flags

List of SFA status flags.

The following status register flags can be cleared on any write to REF_CNT.

- kSFA_RefStoppedFlag
- kSFA_CutStoppedFlag
- kSFA_MeasurementStartedFlag
- kSFA_ReferenceCounterTimeOutFlag

Note: These enums are meant to be OR'd together to from a bit mask.

Values:

enumerator kSFA_RefStoppedFlag
Reference counter stopped flag

enumerator kSFA_CutStoppedFlag
CUT counter stopped flag

enumerator kSFA_MeasurementStartedFlag
Measurement Started flag

enumerator kSFA_ReferenceCounterTimeOutFlag
Reference counter time out flag

enumerator kSFA_InterruptRequestFlag
SFA interrupt request flag

enumerator kSFA_FreqGreaterThanMaxInterruptFlag
FREQ_GT_MAX interrupt flag

enumerator kSFA_FreqLessThanMinInterruptFlag
FREQ_LT_MIN interrupt flag

enumerator kSFA_AllStatusFlags

enum _sfa_interrupts_enable

List of SFA interrupt.

Values:

enumerator kSFA_InterruptEnable

SFA interrupt enable

enumerator kSFA_FreqGreaterThanMaxInterruptEnable

FREQ_GT_MAX interrupt enable

enumerator kSFA_FreqLessThanMinInterruptEnable

FREQ_LT_MIN interrupt enable

enum _sfa_measurement_mode

List of SFA measurement mode(Please check the mode configuration according to the manual).

Values:

enumerator kSFA_FrequencyMeasurement0

Frequency measurement performed with REF frequency > CUT frequency

enumerator kSFA_FrequencyMeasurement1

Frequency measurement performed with REF frequency < CUT frequency

enumerator kSFA_CUTPeriodMeasurement

CUT period measurement performed

enumerator kSFA_TriggerBasedMeasurement

Trigger based measurement performed

enum _sfa_cut_select

List of CUT which is connected to the CUT counter (Please refer to the manual for configuration).

Values:

enumerator kSFA_CUTSelect0

enumerator kSFA_CUTSelect1

enumerator kSFA_CUTSelect2

enumerator kSFA_CUTSelect3

enumerator kSFA_CUTSelect4

enumerator kSFA_CUTSelect5

enumerator kSFA_CUTSelect6

enumerator kSFA_CUTSelect7

enumerator kSFA_CUTSelect8

enumerator kSFA_CUTSelect9

enumerator kSFA_CUTSelect10

enumerator kSFA_CUTSelect11

enumerator kSFA_CUTSelect12

enumerator kSFA_CUTSelect13

enumerator kSFA_CUTSelect14

enumerator kSFA_CUTSelect15

enum _sfa_ref_select

List of REF which is connected to the REF counter (Please refer to the manual for configuration).

Values:

enumerator kSFA_REFSelect0

enumerator kSFA_REFSelect1

enumerator kSFA_REFSelect2

enum _sfa_trigger_start_select

List of Signal MUX for Trigger Based Measurement Start.

Values:

enumerator kSFA_TriggerStartSelect0

enumerator kSFA_TriggerStartSelect1

enum _sfa_trigger_end_select

List of Signal MUX for Trigger Based Measurement End.

Values:

enumerator kSFA_TriggerEndSelect0

enumerator kSFA_TriggerEndSelect1

enum _sfa_trigger_start_polarity

List of Trigger Start Polarity.

Values:

enumerator kSFA_TriggerStartPolarityRiseEdge

Rising edge will begin the measurement sequence

enumerator kSFA_TriggerStartPolarityFallEdge

Falling edge will begin the measurement sequence

enum _sfa_trigger_end_polarity

List of Trigger End Polarity.

Values:

enumerator kSFA_TriggerEndPolarityRiseEdge

Rising edge will end the measurement sequence

enumerator kSFA_TriggerEndPolarityFallEdge

Falling edge will end the measurement sequence

typedef void (*sfa_callback_t)(*status_t* status)

sfa measure completion callback function pointer type

This callback can be used in non blocking IRQHandler. Specify the callback you want in the call to SFA_InstallCallback().

Param base

SFA peripheral base address.

Param status
The runtime measurement status. kStatus_SFA_MeasurementCompleted: The measurement completes. kStatus_SFA_ReferenceCounterTimeout: Reference counter timeout happenes. kStatus_SFA_CUTCounterTimeout: CUT counter timeout happenes.

typedef enum *_sfa_measurement_mode* sfa_measurement_mode_t

List of SFA measurement mode(Please check the mode configuration according to the manual).

typedef enum *_sfa_cut_select* sfa_cut_select_t

List of CUT which is connected to the CUT counter (Please refer to the manual for configuration).

typedef enum *_sfa_ref_select* sfa_ref_select_t

List of REF which is connected to the REF counter (Please refer to the manual for configuration).

typedef enum *_sfa_trigger_start_select* sfa_trigger_start_select_t

List of Signal MUX for Trigger Based Measurement Start.

typedef enum *_sfa_trigger_end_select* sfa_trigger_end_select_t

List of Signal MUX for Trigger Based Measurement End.

typedef enum *_sfa_trigger_start_polarity* sfa_trigger_start_polarity_t

List of Trigger Start Polarity.

typedef enum *_sfa_trigger_end_polarity* sfa_trigger_end_polarity_t

List of Trigger End Polarity.

typedef struct *_sfa_init_config* sfa_config_t

Structure with setting to initialize the SFA module.

This structure holds configuration setting for the SFA peripheral. To initialize this structure to reasonable defaults, call the SFA_GetDefaultConfig() function and pass a pointer to your configuration structure instance.

SFA_CUT_CLK_Enable(val)

struct _sfa_init_config

#include <fsl_sfa.h> Structure with setting to initialize the SFA module.

This structure holds configuration setting for the SFA peripheral. To initialize this structure to reasonable defaults, call the SFA_GetDefaultConfig() function and pass a pointer to your configuration structure instance.

Public Members

sfa_measurement_mode_t mode

measurement mode

sfa_cut_select_t cutSelect

Select clock connected to the clock under test counter

sfa_ref_select_t refSelect

Selcet REF connected the bus clock

uint8_t prediv

Integer divide of the Input CUT signal

sfa_trigger_start_select_t trigStart

Select the signal will be used to end a trigger based measurement

sfa_trigger_start_polarity_t startPolarity
Select the polarity of the start trigger signal

sfa_trigger_end_select_t trigEnd
Select the signal will be used to commence a trigger based measurement

sfa_trigger_end_polarity_t endPolarity
Select the polarity of the end trigger signal

bool enableTrigMeasurement
false: The measurement will start by default with a dummy write to the CUT counter; true : The measurement will start after receiving a dummy write to the REF_CNT followed by receiving the trigger edge

bool enableCUTPin
Control the connection of the clock under test to an external pin.

uint32_t refTarget
Reference counter target counts

uint32_t cutTarget
CUT counter target counts

2.100 TEMPSENSOR: Temperature Sensor Module

void TMPSNS_GetDefaultConfig(*tmpsns_config_t* *config)
This function is used to get predefined configurations for the tempsensor initialization.

Parameters

- config – Pointer to the tempsensor configuration structure, please refer to tmpsns_config_t for details.

void TMPSNS_Init(TMPSNS_Type *base, const *tmpsns_config_t* *config)
This function is used to initialize the tempsensor.

Parameters

- base – Tempsensor peripheral base address.
- config – Pointer to the tempsensor configuration structure, please refer to tmpsns_config_t for details.

void TMPSNS_Deinit(TMPSNS_Type *base)
This function is used to de-initialize the tempsensor.

Parameters

- base – Tempsensor peripheral base address.

void TMPSNS_NonSecure_DoThresholdConfig(TMPSNS_Type *base, const *tmpsns_threshold_config_t* *config)
This function is used to configure the thresholds.

Parameters

- base – Tempsensor peripheral base address.
- config – Pointer to the threshold configuration structure, please refer tmpsns_threshold_config_t for details.

void TMPSNS_Secure_DoThresholdConfig(TMPSNS_Type *base, const *tmpsns_threshold_config_t* *config)

This function is used to configure the thresholds.

Parameters

- base – Tempsensor peripheral base address.
- config – Pointer to the threshold configuration structure, please refer tmpsns_threshold_config_t for details.

float TMPSNS_NonSecure_GetCurrentTemperature(TMPSNS_Type *base)

This function is used to get the current temperature.

Parameters

- base – TMPSNS base pointer

Returns

Current temperature with degrees Celsius.

float TMPSNS_Secure_GetCurrentTemperature(TMPSNS_Type *base)

This function is used to get the current temperature.

Parameters

- base – TMPSNS base pointer

Returns

Current temperature with degrees Celsius.

static inline void TMPSNS_EnableTmpsns(TMPSNS_Type *base)

This function is used to enable the tempsensor.

Parameters

- base – Tempsensor peripheral base address.

static inline void TMPSNS_DisableTmpsns(TMPSNS_Type *base)

This function is used to disable the tempsensor.

Parameters

- base – Tempsensor peripheral base address.

static inline void TMPSNS_StartMeasurement(TMPSNS_Type *base)

This function is used to start the temperature measurement process.

Parameters

- base – Tempsensor peripheral base address.

static inline void TMPSNS_StopMeasurement(TMPSNS_Type *base)

This function is used to stop the temperature measurement process.

Parameters

- base – Tempsensor peripheral base address.

static inline void TMPSNS_NonSecure_EnableTmpsnsInt(TMPSNS_Type *base, uint32_t mask)

This function is used to enable the tempsensor interrupts.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for interrupts, please refer _tmpsns_nonsecure_int_enable for details.

static inline void TMPSNS_Secure_EnableTmpsnsInt(TMPSNS_Type *base, uint32_t mask)

This function is used to enable the tempsensor interrupts.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for interrupts, please refer _tmpsns_secure_int_enable for details.

static inline void TMPSNS_NonSecure_DisableTmpsnsInt(TMPSNS_Type *base, uint32_t mask)

This function is used to disable the tempsensor interrupts.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for interrupts, please refer _tmpsns_nonsecure_int_enable for details.

static inline void TMPSNS_Secure_DisableTmpsnsInt(TMPSNS_Type *base, uint32_t mask)

This function is used to disable the tempsensor interrupts.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for interrupts, please refer _tmpsns_secure_int_enable for details.

static inline void TMPSNS_NonSecure_ClearTmpsnsIntStatus(TMPSNS_Type *base, uint32_t mask)

This function clears the tempsensor threshold interrupt status flags.

Note: The mask can using member kTMPSNS_NonSecure_Threshold0IntStatus to clean threshold 0 interrupt flag, using member kTMPSNS_NonSecure_Threshold1IntStatus to clean threshold 1 interrupt flag, and use member kTMPSNS_NonSecure_Threshold2IntStatus to clear threshold 2 interrupt. The data ready 0 interrupt flag cannot be cleaned using this function.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for flags to be cleared, please refer to _tmpsns_nonsecure_status for details.

static inline void TMPSNS_Secure_ClearTmpsnsIntStatus(TMPSNS_Type *base, uint32_t mask)

This function clears the tempsensor threshold interrupt status flags.

Note: The mask can using member kTMPSNS_Secure_Threshold4IntStatus to clean threshold 4 interrupt flag and using member kTMPSNS_Secure_Threshold5IntStatus to clear threshold 5 interrupt. The data ready 1 interrupt flag cannot be cleaned using this function.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for flags to be cleared, please refer to _tmpsns_secure_status for details.

static inline uint32_t TMPSNS_NonSecure_GetTmpsnsStatus(TMPSNS_Type *base)

This function is used to get the tempsensor status.

Parameters

- base – Tempsensor peripheral base address.

Returns

tempsensor status mask.

static inline uint32_t TMPSNS_Secure_GetTmpsnsStatus(TMPSNS_Type *base)

This function is used to get the tempsensor status.

Parameters

- base – Tempsensor peripheral base address.

Returns

tempsensor status mask.

static inline void TMPSNS_NonSecure_SetFilterLength(TMPSNS_Type *base, uint8_t length)

This function is used to set the tempsensor filter length.

Parameters

- base – Tempsensor peripheral base address.
- length – Filter length to be set.

static inline void TMPSNS_Secure_SetFilterLength(TMPSNS_Type *base, uint8_t length)

This function is used to set the tempsensor filter length.

Parameters

- base – Tempsensor peripheral base address.
- length – Filter length to be set.

static inline void TMPSNS_NonSecure_ClearFilterCount(TMPSNS_Type *base, uint32_t mask)

This function is used to clear the tempsensor filter count.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for flags to be cleared, please refer _tmpsns_nonsecure_filter_count_clear for details.

static inline void TMPSNS_Secure_ClearFilterCount(TMPSNS_Type *base, uint32_t mask)

This function is used to clear the tempsensor filter count.

Parameters

- base – Tempsensor peripheral base address.
- mask – Mask value for flags to be cleared, please refer _tmpsns_secure_filter_count_clear for details.

static inline void TMPSNS_Secure_SetTrimVal(TMPSNS_Type *base, uint16_t valA, int16_t valB, uint16_t valAlpha, int16_t valOffset)

This function is used to set the trim values.

Parameters

- base – Tempsensor peripheral base address.
- valA – Controls trimming code, VAL_A, for the analog block.
- valB – Controls trimming code, VAL_B, for the analog block.
- valAlpha – Controls trimming code, VAL_ALPHA, for the analog block.

- valOffset – Controls trimming code, VAL_OFFSET, for the analog block.

FSL_TEMPSENSOR_DRIVER_VERSION

Tempsensor driver version 2.0.1.

enum _tmpsns_nonsecure_int_enable

This enumeration provides the type of tempsensor interrupt enablement.

Note: The threshold 0 interrupt is connected to the SRC.

Values:

enumerator kTMPSNS_NonSecure_Threshold0CmpIntEnable

Enable interrupt output event for the threshold0 comparator event.

enumerator kTMPSNS_NonSecure_Threshold1CmpIntEnable

Enable interrupt output event for the threshold1 comparator event.

enumerator kTMPSNS_NonSecure_Threshold2CmpIntEnable

Enable interrupt output event for the threshold2 comparator event.

enumerator kTMPSNS_NonSecure_DataReady0IntEnable

Enable interrupt output event when output data0 is ready after measurement completion.

enumerator kTMPSNS_NonSecure_AllIntEnable

Enable threshold 0, 1, 2, and data ready 0 interrupts.

enum _tmpsns_secure_int_enable

This enumeration provides the type of tempsensor interrupt enablement.

Values:

enumerator kTMPSNS_Secure_Threshold4CmpIntEnable

Enable interrupt output event for the threshold4 comparator event.

enumerator kTMPSNS_Secure_Threshold5CmpIntEnable

Enable interrupt output event for the threshold5 comparator event.

enumerator kTMPSNS_Secure_DataReady1IntEnable

Enable interrupt output event when output data1 is ready after measurement completion.

enumerator kTMPSNS_Secure_AllIntEnable

Enable thresholds 4, 5, and data ready 1 interrupt.

enum _tmpsns_nonsecure_status

This enumeration provides tempsensor status flags.

Values:

enumerator kTMPSNS_NonSecure_Idle0

Indicate whether the tempsensor is in an idle state or undergoing conversion.

enumerator kTMPSNS_NonSecure_DataReady0

Indicate whether new data is available on DATA0[DATA_VAL].

enumerator kTMPSNS_NonSecure_Threshold0CmpStatus

Indicate the state of the threshold0 comparator.

enumerator kTMPSNS_NonSecure_Threshold1CmpStatus

Indicate the state of the threshold1 comparator.

enumerator kTMPSNS_NonSecure_Threshold2CmpStatus
Indicate the state of the threshold2 comparator.

enumerator kTMPSNS_NonSecure_Threshold0IntStatus
Indicate whether a threshold0 comparator event (interrupt) occurred.

enumerator kTMPSNS_NonSecure_Threshold1IntStatus
Indicate whether a threshold1 comparator event (interrupt) occurred.

enumerator kTMPSNS_NonSecure_Threshold2IntStatus
Indicate whether a threshold2 comparator event (interrupt) occurred.

enum _tmpsns_secure_status
This enumeration provides tempsensor status flags.

Values:

enumerator kTMPSNS_Secure_Idle1
Indicate whether the tempsensor is in an idle state or undergoing conversion.

enumerator kTMPSNS_Secure_DataReady1
Indicate whether new data is available on DATA1[DATA_VAL].

enumerator kTMPSNS_Secure_Threshold4CmpStatus
Indicate the state of the threshold4 comparator.

enumerator kTMPSNS_Secure_Threshold5CmpStatus
Indicate the state of the threshold5 comparator.

enumerator kTMPSNS_Secure_Threshold4IntStatus
Indicate whether a threshold4 comparator event (interrupt) occurred.

enumerator kTMPSNS_Secure_Threshold5IntStatus
Indicate whether a threshold5 comparator event (interrupt) occurred.

enum _tmpsns_nonsecure_filter_count_clear
This enumeration provides the type of tempsensor filter counter clear.

Values:

enumerator kTMPSNS_NonSecure_Filter0CountClear
Clear the internal counter that counts the number of threshold violations corresponding to THR_CTRL01[TEMPERATURE_THRESHOLD0].

enumerator kTMPSNS_NonSecure_Filter1CountClear
Clear the internal counter that counts the number of threshold violations corresponding to THR_CTRL01[TEMPERATURE_THRESHOLD1].

enumerator kTMPSNS_NonSecure_Filter2CountClear
Clear the internal counter that counts the number of threshold violations corresponding to THR_CTRL23[TEMPERATURE_THRESHOLD2].

enumerator kTMPSNS_NonSecure_AllFilterCountClear
Clear threshold 0, 1, and 2 filter count.

enum _tmpsns_secure_filter_count_clear
This enumeration provides the type of tempsensor filter counter clear.

Values:

enumerator kTMPSNS_Secure_Filter4CountClear
Clears the internal counter that counts the number of threshold violations corresponding to THR_CTRL45[TEMPERATURE_THRESHOLD4].

enumerator kTMPSNS_Secure_Filter5CountClear

Clear the internal counter that counts the number of threshold violations corresponding to THR_CTRL45[TEMPERATURE_THRESHOLD5].

enumerator kTMPSNS_Secure_AllFilterCountClear

Clear thresholds 4, and 5 filter count.

enum _tmpsns_resolution_mode

This enumeration provides the selection of the tempsensor resolution modes, including mode 0 (0.59325ms), mode 1 (1.10525ms), mode 2 (2.12925ms), mode 3 (4.17725ms).

Values:

enumerator kTMPSNS_ResolutionMode0

0.59325ms.

enumerator kTMPSNS_ResolutionMode1

1.10525ms.

enumerator kTMPSNS_ResolutionMode2

2.12925ms.

enumerator kTMPSNS_ResolutionMode3

4.17725ms.

enum _tmpsns_measurement_mode

This enumeration provides the selection of the tempsensor measurement modes, including single one-shot mode, continuous mode and periodic one-shot mode.

Values:

enumerator kTMPSNS_SingleOneShotMode

Measures single temperature data after you start a measurement.

enumerator kTMPSNS_ContinuousMode

Continues to measure temperature data repeatedly at the conversion time rate.

enumerator kTMPSNS_PeriodicOneShotMode

Measures temperature data repeatedly at a periodic interval of time.

enum _tmpsns_thresholds

This enumeration provides the selection of the tempsensor thresholds, including thresholds 0, 1, 2, 4, and 5.

Note: Thresholds 4 and 5 are used only when secure registers can be accessed.

Values:

enumerator kTMPSNS_ThresholdCmp0

Threshold comparator 0.

enumerator kTMPSNS_ThresholdCmp1

Threshold comparator 1.

enumerator kTMPSNS_ThresholdCmp2

Threshold comparator 2.

enumerator kTMPSNS_ThresholdCmp4

Threshold comparator 4.

enumerator kTMPSNS_ThresholdCmp5

Threshold comparator 5.

enum _tmpsns_threshold_cmp_mode

This enumeration provides the selection of the tempsensor threshold comparator modes, including mode 0 (Less than or equal to the threshold), mode 1 (Greater than the threshold), mode 2 (High to low-temperature data transition at threshold) and mode 3 (Low to high-temperature data transition at threshold).

Values:

enumerator kTMPSNS_ThresholdCmpMode0

Less than or equal to the threshold.

enumerator kTMPSNS_ThresholdCmpMode1

Greater than threshold.

enumerator kTMPSNS_ThresholdCmpMode2

High to low temperature data transition at the threshold.

enumerator kTMPSNS_ThresholdCmpMode3

Low to high temperature data transition at the threshold.

typedef enum *_tmpsns_resolution_mode* tmpsns_resolution_mode_t

This enumeration provides the selection of the tempsensor resolution modes, including mode 0 (0.59325ms), mode 1 (1.10525ms), mode 2 (2.12925ms), mode 3 (4.17725ms).

typedef enum *_tmpsns_measurement_mode* tmpsns_measurement_mode_t

This enumeration provides the selection of the tempsensor measurement modes, including single one-shot mode, continuous mode and periodic one-shot mode.

typedef enum *_tmpsns_thresholds* tmpsns_thresholds_t

This enumeration provides the selection of the tempsensor thresholds, including thresholds 0, 1, 2, 4, and 5.

Note: Thresholds 4 and 5 are used only when secure registers can be accessed.

typedef enum *_tmpsns_threshold_cmp_mode* tmpsns_threshold_cmp_mode_t

This enumeration provides the selection of the tempsensor threshold comparator modes, including mode 0 (Less than or equal to the threshold), mode 1 (Greater than the threshold), mode 2 (High to low-temperature data transition at threshold) and mode 3 (Low to high-temperature data transition at threshold).

typedef struct *_tmpsns_config* tmpsns_config_t

This structure is used to configure the tempsensor module.

Note: All configurations of the tempsensor need to access secure registers (register address is offset by more than 0x200 relative to the peripheral base address). Before configuring the tempsensor, make sure you have permission to access these registers.

typedef struct *_tmpsns_threshold_config* tmpsns_threshold_config_t

This structure is used to configure the tempsensor threshold.

Note: Thresholds 4 and 5 are used only when secure registers can be accessed.

TMPSNS_CTRL_THR_MODE_MASK(index)

TMPSNS_CTRL_THR_MODE_SHIFT(index)

TMPSNS_CTRL_THR_MODE(index, mode)

TMPSNS_THR_CTRL_TEMPERATURE_THRESHOLD_MASK(index)

TMPSNS_THR_CTRL_TEMPERATURE_THRESHOLD_SHIFT(index)

TMPSNS_THR_CTRL_TEMPERATURE_THRESHOLD(index, value)

struct _tmpsns_config

#include <fsl_tempsensor.h> This structure is used to configure the tempsensor module.

Note: All configurations of the tempsensor need to access secure registers (register address is offset by more than 0x200 relative to the peripheral base address). Before configuring the tempsensor, make sure you have permission to access these registers.

Public Members

bool enableClockDivider

Decides whether to enable the clock divider.

uint8_t refClockDivider

Specifies the divider value for generating CONV_CLK from MODULE_CLK, the output clock frequency = input clock frequency / (DIV + 1).

uint8_t powerUpDealy

Sets the power-up delay on CONV_CLK for the analog block, see the chip data sheet for the tempsensor power-up time.

tmpsns_resolution_mode_t resolutionMode

Specifies the conversion time for different resolution modes, this parameter helps the user configure the length of the conversion time, longer conversion time translates into higher resolution.

tmpsns_measurement_mode_t measurementMode

Selects the measurement mode for the tempsensor, the mode could be changed only when the tempsensor does not measure, that is, when STAT[IDLE] = 1.

uint32_t measurementPeriod

Sets the target count (measurement period) on CONV_CLK for periodic trigger in periodic One-Shot conversion mode.

struct _tmpsns_threshold_config

#include <fsl_tempsensor.h> This structure is used to configure the tempsensor threshold.

Note: Thresholds 4 and 5 are used only when secure registers can be accessed.

Public Members

tmpsns_thresholds_t thresholdIndex

Indicates which threshold is selected.

tmpsns_threshold_cmp_mode_t thresholdCmpMode

Indicates which threshold comparator mode is selected.

float thresholdVal

Sets selected threshold's value.

2.101 TPM: Timer PWM Module

uint32_t TPM_GetInstance(TPM_Type *base)

Gets the instance from the base address.

Parameters

- base – TPM peripheral base address

Returns

The TPM instance

void TPM_Init(TPM_Type *base, const *tpm_config_t* *config)

Ungates the TPM clock and configures the peripheral for basic operation.

Note: This API should be called at the beginning of the application using the TPM driver.

Parameters

- base – TPM peripheral base address
- config – Pointer to user's TPM config structure.

void TPM_Deinit(TPM_Type *base)

Stops the counter and gates the TPM clock.

Parameters

- base – TPM peripheral base address

void TPM_GetDefaultConfig(*tpm_config_t* *config)

Fill in the TPM config struct with the default settings.

The default values are:

```
    config->prescale = kTPM_Prescale_Divide_1;
    config->useGlobalTimeBase = false;
    config->syncGlobalTimeBase = false;
    config->dozeEnable = false;
    config->dbgMode = false;
    config->enableReloadOnTrigger = false;
    config->enableStopOnOverflow = false;
    config->enableStartOnTrigger = false;
#if FSL_FEATURE_TPM_HAS_PAUSE_COUNTER_ON_TRIGGER
    config->enablePauseOnTrigger = false;
#endif
    config->triggerSelect = kTPM_Trigger_Select_0;
#if FSL_FEATURE_TPM_HAS_EXTERNAL_TRIGGER_SELECTION
    config->triggerSource = kTPM_TriggerSource_External;
    config->extTriggerPolarity = kTPM_ExtTrigger_Active_High;
#endif
#if defined(FSL_FEATURE_TPM_HAS_POL) && FSL_FEATURE_TPM_HAS_POL
    config->chnlPolarity = 0U;
#endif
```

Parameters

- config – Pointer to user's TPM config structure.

tpm_clock_prescale_t TPM_CalculateCounterClkDiv(TPM_Type *base, uint32_t counterPeriod_Hz, uint32_t srcClock_Hz)

Calculates the counter clock prescaler.

This function calculates the values for SC[PS].

return Calculated clock prescaler value.

Parameters

- base – TPM peripheral base address
- counterPeriod_Hz – The desired frequency in Hz which corresponding to the time when the counter reaches the mod value
- srcClock_Hz – TPM counter clock in Hz

status_t TPM_SetupPwm(TPM_Type *base, const *tpm_chnl_pwm_signal_param_t* *chnlParams, uint8_t numOfChnls, *tpm_pwm_mode_t* mode, uint32_t pwmFreq_Hz, uint32_t srcClock_Hz)

Configures the PWM signal parameters.

User calls this function to configure the PWM signals period, mode, dutycycle and edge. Use this function to configure all the TPM channels that will be used to output a PWM signal

Parameters

- base – TPM peripheral base address
- chnlParams – Array of PWM channel parameters to configure the channel(s)
- numOfChnls – Number of channels to configure, this should be the size of the array passed in
- mode – PWM operation mode, options available in enumeration tpm_pwm_mode_t
- pwmFreq_Hz – PWM signal frequency in Hz
- srcClock_Hz – TPM counter clock in Hz

Returns

kStatus_Success PWM setup successful kStatus_Error PWM setup failed kStatus_Timeout PWM setup timeout when write register CnV or MOD

status_t TPM_UpdatePwmDutycycle(TPM_Type *base, *tpm_chnl_t* chnlNumber, *tpm_pwm_mode_t* currentPwmMode, uint8_t dutyCyclePercent)

Update the duty cycle of an active PWM signal.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number. In combined mode, this represents the channel pair number
- currentPwmMode – The current PWM mode set during PWM setup
- dutyCyclePercent – New PWM pulse width, value should be between 0 to 100 0=inactive signal(0% duty cycle)... 100=active signal (100% duty cycle)

Returns

kStatus_Success if the PWM setup was successful, kStatus_Error on failure

void TPM_UpdateChnlEdgeLevelSelect(TPM_Type *base, *tpm_chnl_t* chnlNumber, uint8_t level)

Update the edge level selection for a channel.

Note: When the TPM has PWM pause level select feature (FSL_FEATURE_TPM_HAS_PAUSE_LEVEL_SELECT = 1), the PWM output cannot be turned

off by selecting the output level. In this case, must use TPM_DisableChannel API to close the PWM output.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number
- level – The level to be set to the ELSnB:ELSnA field; valid values are 00, 01, 10, 11. See the appropriate SoC reference manual for details about this field.

static inline uint8_t TPM_GetChannelContorlBits(TPM_Type *base, *tpm_chnl_t* chnlNumber)

Get the channel control bits value (mode, edge and level bit fileds).

This function disable the channel by clear all mode and level control bits.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number

Returns

The contorl bits value. This is the logical OR of members of the enumeration tpm_chnl_control_bit_mask_t.

static inline *status_t* TPM_DisableChannel(TPM_Type *base, *tpm_chnl_t* chnlNumber)

Dsiable the channel.

This function disable the channel by clear all mode and level control bits.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number

Returns

kStatus_Success PWM setup successful kStatus_Timeout PWM setup timeout when write register CnSC

static inline *status_t* TPM_EnableChannel(TPM_Type *base, *tpm_chnl_t* chnlNumber, uint8_t control)

Enable the channel according to mode and level configs.

This function enable the channel output according to input mode/level config parameters.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number
- control – The contorl bits value. This is the logical OR of members of the enumeration tpm_chnl_control_bit_mask_t.

Returns

kStatus_Success PWM setup successful kStatus_Timeout PWM setup timeout when write register CnSC

void TPM_SetupInputCapture(TPM_Type *base, *tpm_chnl_t* chnlNumber, *tpm_input_capture_edge_t* captureMode)

Enables capturing an input signal on the channel using the function parameters.

When the edge specified in the captureMode argument occurs on the channel, the TPM counter is captured into the CnV register. The user has to read the CnV register separately to get this value.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number
- captureMode – Specifies which edge to capture

status_t TPM_SetupOutputCompare(TPM_Type *base, *tpm_chnl_t* chnlNumber, *tpm_output_compare_mode_t* compareMode, uint32_t compareValue)

Configures the TPM to generate timed pulses.

When the TPM counter matches the value of compareVal argument (this is written into CnV reg), the channel output is changed based on what is specified in the compareMode argument.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number
- compareMode – Action to take on the channel output when the compare condition is met
- compareValue – Value to be programmed in the CnV register.

Returns

kStatus_Success PWM setup successful kStatus_Timeout PWM setup timeout when write register CnV

void TPM_SetupDualEdgeCapture(TPM_Type *base, *tpm_chnl_t* chnlPairNumber, const *tpm_dual_edge_capture_param_t* *edgeParam, uint32_t filterValue)

Configures the dual edge capture mode of the TPM.

This function allows to measure a pulse width of the signal on the input of channel of a channel pair. The filter function is disabled if the filterVal argument passed is zero.

Parameters

- base – TPM peripheral base address
- chnlPairNumber – The TPM channel pair number; options are 0, 1, 2, 3
- edgeParam – Sets up the dual edge capture function
- filterValue – Filter value, specify 0 to disable filter.

void TPM_SetupQuadDecode(TPM_Type *base, const *tpm_phase_params_t* *phaseAParams, const *tpm_phase_params_t* *phaseBParams, *tpm_quad_decode_mode_t* quadMode)

Configures the parameters and activates the quadrature decode mode.

Parameters

- base – TPM peripheral base address
- phaseAParams – Phase A configuration parameters
- phaseBParams – Phase B configuration parameters
- quadMode – Selects encoding mode used in quadrature decoder mode

static inline void TPM_SetChannelPolarity(TPM_Type *base, *tpm_chnl_t* chnlNumber, bool enable)

Set the input and output polarity of each of the channels.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number
- enable – true: Set the channel polarity to active high; false: Set the channel polarity to active low;

static inline void TPM_EnableChannelExtTrigger(TPM_Type *base, *tpm_chnl_t* chnlNumber, bool enable)

Enable external trigger input to be used by channel.

In input capture mode, configures the trigger input that is used by the channel to capture the counter value. In output compare or PWM mode, configures the trigger input used to modulate the channel output. When modulating the output, the output is forced to the channel initial value whenever the trigger is not asserted.

Note: No matter how many external trigger sources there are, only input trigger 0 and 1 are used. The even numbered channels share the input trigger 0 and the odd numbered channels share the second input trigger 1.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number
- enable – true: Configures trigger input 0 or 1 to be used by channel; false: Trigger input has no effect on the channel

void TPM_EnableInterrupts(TPM_Type *base, uint32_t mask)

Enables the selected TPM interrupts.

Parameters

- base – TPM peripheral base address
- mask – The interrupts to enable. This is a logical OR of members of the enumeration tpm_interrupt_enable_t

void TPM_DisableInterrupts(TPM_Type *base, uint32_t mask)

Disables the selected TPM interrupts.

Parameters

- base – TPM peripheral base address
- mask – The interrupts to disable. This is a logical OR of members of the enumeration tpm_interrupt_enable_t

uint32_t TPM_GetEnabledInterrupts(TPM_Type *base)

Gets the enabled TPM interrupts.

Parameters

- base – TPM peripheral base address

Returns

The enabled interrupts. This is the logical OR of members of the enumeration tpm_interrupt_enable_t

void TPM_RegisterCallBack(TPM_Type *base, *tpm_callback_t* callback)

Register callback.

If channel or overflow interrupt is enabled by the user, then a callback can be registered which will be invoked when the interrupt is triggered.

Parameters

- base – TPM peripheral base address
- callback – Callback function

static inline uint32_t TPM_GetChannelValue(TPM_Type *base, *tpm_chnl_t* chnlNumber)

Gets the TPM channel value.

Note: The TPM channel value contain the captured TPM counter value for the input modes or the match value for the output modes.

Parameters

- base – TPM peripheral base address
- chnlNumber – The channel number

Returns

The channle CnV regisyer value.

static inline uint32_t TPM_GetStatusFlags(TPM_Type *base)

Gets the TPM status flags.

Parameters

- base – TPM peripheral base address

Returns

The status flags. This is the logical OR of members of the enumeration tpm_status_flags_t

static inline void TPM_ClearStatusFlags(TPM_Type *base, uint32_t mask)

Clears the TPM status flags.

Parameters

- base – TPM peripheral base address
- mask – The status flags to clear. This is a logical OR of members of the enumeration tpm_status_flags_t

static inline *status_t* TPM_SetTimerPeriod(TPM_Type *base, uint32_t ticks)

Sets the timer period in units of ticks.

Timers counts from 0 until it equals the count value set here. The count value is written to the MOD register.

Note:

a. This API allows the user to use the TPM module as a timer. Do not mix usage of this API with TPM's PWM setup API's.

b. Call the utility macros provided in the fsl_common.h to convert usec or msec to ticks.

Parameters

- base – TPM peripheral base address

- ticks – A timer period in units of ticks, which should be equal or greater than 1.

Returns

kStatus_Success PWM setup successful kStatus_Timeout PWM setup timeout when write register CnSC

static inline uint32_t TPM_GetCurrentTimerCount(TPM_Type *base)

Reads the current timer counting value.

This function returns the real-time timer counting value in a range from 0 to a timer period.

Note: Call the utility macros provided in the fsl_common.h to convert ticks to usec or msec.

Parameters

- base – TPM peripheral base address

Returns

The current counter value in ticks

static inline void TPM_StartTimer(TPM_Type *base, *tpm_clock_source_t* clockSource)

Starts the TPM counter.

Parameters

- base – TPM peripheral base address
- clockSource – TPM clock source; once clock source is set the counter will start running

static inline *status_t* TPM_StopTimer(TPM_Type *base)

Stops the TPM counter.

Parameters

- base – TPM peripheral base address

Returns

kStatus_Success PWM setup successful kStatus_Timeout PWM setup timeout when write register CnSC

FSL_TPM_DRIVER_VERSION

TPM driver version 2.4.0.

enum _tpm_chnl

List of TPM channels.

Note: Actual number of available channels is SoC dependent

Values:

enumerator kTPM_Chnl_0

TPM channel number 0

enumerator kTPM_Chnl_1

TPM channel number 1

enumerator kTPM_Chnl_2

TPM channel number 2

enumerator kTPM_Chnl_3

TPM channel number 3

enumerator kTPM_Chnl_4
TPM channel number 4

enumerator kTPM_Chnl_5
TPM channel number 5

enumerator kTPM_Chnl_6
TPM channel number 6

enumerator kTPM_Chnl_7
TPM channel number 7

enum _tpm_pwm_mode
TPM PWM operation modes.

Values:

enumerator kTPM_EdgeAlignedPwm
Edge aligned PWM

enumerator kTPM_CenterAlignedPwm
Center aligned PWM

enumerator kTPM_CombinedPwm
Combined PWM (Edge-aligned, center-aligned, or asymmetrical PWMs can be obtained in combined mode using different software configurations)

enum _tpm_pwm_level_select
TPM PWM output pulse mode: high-true, low-true or no output.

Note: When the TPM has PWM pause level select feature, the PWM output cannot be turned off by selecting the output level. In this case, the channel must be closed to close the PWM output.

Values:

enumerator kTPM_HighTrue
High true pulses

enumerator kTPM_LowTrue
Low true pulses

enum _tpm_pwm_pause_level_select
TPM PWM output when first enabled or paused: set or clear.

Values:

enumerator kTPM_ClearOnPause
Clear Output when counter first enabled or paused.

enumerator kTPM_SetOnPause
Set Output when counter first enabled or paused.

enum _tpm_chnl_control_bit_mask
List of TPM channel modes and level control bit mask.

Values:

enumerator kTPM_ChnlELSnAMask
Channel ELSA bit mask.

enumerator kTPM_ChnlELSnBMask
Channel ELSB bit mask.

enumerator kTPM_ChnlMSAMask
Channel MSA bit mask.

enumerator kTPM_ChnlMSBMask
Channel MSB bit mask.

enum _tpm_trigger_select
Trigger sources available.

This is used for both internal & external trigger sources (external trigger sources available in certain SoC's)

Note: The actual trigger sources available is SoC-specific.

Values:

enumerator kTPM_Trigger_Select_0

enumerator kTPM_Trigger_Select_1

enumerator kTPM_Trigger_Select_2

enumerator kTPM_Trigger_Select_3

enumerator kTPM_Trigger_Select_4

enumerator kTPM_Trigger_Select_5

enumerator kTPM_Trigger_Select_6

enumerator kTPM_Trigger_Select_7

enumerator kTPM_Trigger_Select_8

enumerator kTPM_Trigger_Select_9

enumerator kTPM_Trigger_Select_10

enumerator kTPM_Trigger_Select_11

enumerator kTPM_Trigger_Select_12

enumerator kTPM_Trigger_Select_13

enumerator kTPM_Trigger_Select_14

enumerator kTPM_Trigger_Select_15

enum _tpm_trigger_source
Trigger source options available.

Note: This selection is available only on some SoC's. For SoC's without this selection, the only trigger source available is internal triger.

Values:

enumerator kTPM_TriggerSource_External
Use external trigger input

enumerator kTPM_TriggerSource_Internal
Use internal trigger (channel pin input capture)

enum _tpm_ext_trigger_polarity
External trigger source polarity.

Note: Selects the polarity of the external trigger source.

Values:

enumerator kTPM_ExtTrigger_Active_High
External trigger input is active high

enumerator kTPM_ExtTrigger_Active_Low
External trigger input is active low

enum _tpm_output_compare_mode
TPM output compare modes.

Values:

enumerator kTPM_NoOutputSignal
No channel output when counter reaches CnV

enumerator kTPM_ToggleOnMatch
Toggle output

enumerator kTPM_ClearOnMatch
Clear output

enumerator kTPM_SetOnMatch
Set output

enumerator kTPM_HighPulseOutput
Pulse output high

enumerator kTPM_LowPulseOutput
Pulse output low

enum _tpm_input_capture_edge
TPM input capture edge.

Values:

enumerator kTPM_RisingEdge
Capture on rising edge only

enumerator kTPM_FallingEdge
Capture on falling edge only

enumerator kTPM_RiseAndFallEdge
Capture on rising or falling edge

enum _tpm_quad_decode_mode
TPM quadrature decode modes.

Note: This mode is available only on some SoC's.

Values:

enumerator kTPM_QuadPhaseEncode
Phase A and Phase B encoding mode

enumerator kTPM_QuadCountAndDir
Count and direction encoding mode

enum _tpm_phase_polarity
TPM quadrature phase polarities.

Values:

enumerator kTPM_QuadPhaseNormal
Phase input signal is not inverted

enumerator kTPM_QuadPhaseInvert
Phase input signal is inverted

enum _tpm_clock_source
TPM clock source selection.

Values:

enumerator kTPM_SystemClock
System clock

enumerator kTPM_ExternalClock
External TPM_EXTCLK pin clock

enumerator kTPM_ExternalInputTriggerClock
Selected external input trigger clock

enum _tpm_clock_prescale
TPM prescale value selection for the clock source.

Values:

enumerator kTPM_Prescale_Divide_1
Divide by 1

enumerator kTPM_Prescale_Divide_2
Divide by 2

enumerator kTPM_Prescale_Divide_4
Divide by 4

enumerator kTPM_Prescale_Divide_8
Divide by 8

enumerator kTPM_Prescale_Divide_16
Divide by 16

enumerator kTPM_Prescale_Divide_32
Divide by 32

enumerator kTPM_Prescale_Divide_64
Divide by 64

enumerator kTPM_Prescale_Divide_128
Divide by 128

enum _tpm_interrupt_enable
List of TPM interrupts.

Values:

enumerator kTPM_Chnl0InterruptEnable
Channel 0 interrupt.

enumerator kTPM_Chnl1InterruptEnable
Channel 1 interrupt.

enumerator kTPM_Chnl2InterruptEnable
Channel 2 interrupt.

enumerator kTPM_Chnl3InterruptEnable
Channel 3 interrupt.

enumerator kTPM_Chnl4InterruptEnable
Channel 4 interrupt.

enumerator kTPM_Chnl5InterruptEnable
Channel 5 interrupt.

enumerator kTPM_Chnl6InterruptEnable
Channel 6 interrupt.

enumerator kTPM_Chnl7InterruptEnable
Channel 7 interrupt.

enumerator kTPM_TimeOverflowInterruptEnable
Time overflow interrupt.

enum _tpm_status_flags
List of TPM flags.

Values:

enumerator kTPM_Chnl0Flag
Channel 0 flag

enumerator kTPM_Chnl1Flag
Channel 1 flag

enumerator kTPM_Chnl2Flag
Channel 2 flag

enumerator kTPM_Chnl3Flag
Channel 3 flag

enumerator kTPM_Chnl4Flag
Channel 4 flag

enumerator kTPM_Chnl5Flag
Channel 5 flag

enumerator kTPM_Chnl6Flag
Channel 6 flag

enumerator kTPM_Chnl7Flag
Channel 7 flag

enumerator kTPM_TimeOverflowFlag
Time overflow flag

typedef enum *_tpm_chnl* tpm_chnl_t
List of TPM channels.

Note: Actual number of available channels is SoC dependent

typedef enum *_tpm_pwm_mode* tpm_pwm_mode_t
TPM PWM operation modes.

typedef enum *_tpm_pwm_level_select* tpm_pwm_level_select_t
TPM PWM output pulse mode: high-true, low-true or no output.

Note: When the TPM has PWM pause level select feature, the PWM output cannot be turned off by selecting the output level. In this case, the channel must be closed to close the PWM output.

typedef enum *_tpm_pwm_pause_level_select* tpm_pwm_pause_level_select_t
TPM PWM output when first enabled or paused: set or clear.

typedef enum *_tpm_chnl_control_bit_mask* tpm_chnl_control_bit_mask_t
List of TPM channel modes and level control bit mask.

typedef struct *_tpm_chnl_pwm_signal_param* tpm_chnl_pwm_signal_param_t
Options to configure a TPM channel's PWM signal.

typedef enum *_tpm_trigger_select* tpm_trigger_select_t
Trigger sources available.

This is used for both internal & external trigger sources (external trigger sources available in certain SoC's)

Note: The actual trigger sources available is SoC-specific.

typedef enum *_tpm_trigger_source* tpm_trigger_source_t
Trigger source options available.

Note: This selection is available only on some SoC's. For SoC's without this selection, the only trigger source available is internal triger.

typedef enum *_tpm_ext_trigger_polarity* tpm_ext_trigger_polarity_t
External trigger source polarity.

Note: Selects the polarity of the external trigger source.

typedef enum *_tpm_output_compare_mode* tpm_output_compare_mode_t
TPM output compare modes.

typedef enum *_tpm_input_capture_edge* tpm_input_capture_edge_t
TPM input capture edge.

typedef struct *_tpm_dual_edge_capture_param* tpm_dual_edge_capture_param_t
TPM dual edge capture parameters.

Note: This mode is available only on some SoC's.

typedef enum *_tpm_quad_decode_mode* tpm_quad_decode_mode_t
TPM quadrature decode modes.

Note: This mode is available only on some SoC's.

typedef enum *_tpm_phase_polarity* tpm_phase_polarity_t

TPM quadrature phase polarities.

typedef struct *_tpm_phase_param* tpm_phase_params_t

TPM quadrature decode phase parameters.

typedef enum *_tpm_clock_source* tpm_clock_source_t

TPM clock source selection.

typedef enum *_tpm_clock_prescale* tpm_clock_prescale_t

TPM prescale value selection for the clock source.

typedef struct *_tpm_config* tpm_config_t

TPM config structure.

This structure holds the configuration settings for the TPM peripheral. To initialize this structure to reasonable defaults, call the TPM_GetDefaultConfig() function and pass a pointer to your config structure instance.

The config struct can be made const so it resides in flash

typedef enum *_tpm_interrupt_enable* tpm_interrupt_enable_t

List of TPM interrupts.

typedef enum *_tpm_status_flags* tpm_status_flags_t

List of TPM flags.

typedef void (*tpm_callback_t)(TPM_Type *base)

TPM callback function pointer.

Param base
TPM peripheral base address.

static inline void TPM_Reset(TPM_Type *base)

Performs a software reset on the TPM module.

Reset all internal logic and registers, except the Global Register. Remains set until cleared by software.

Note: TPM software reset is available on certain SoC's only

Parameters

- base – TPM peripheral base address

void TPM_DriverIRQHandler(uint32_t instance)

TPM driver IRQ handler common entry.

This function provides the common IRQ request entry for TPM.

Parameters

- instance – TPM instance.

TPM_TIMEOUT

Max loops to wait for writing register.

When writing MOD CnV CnSC and SC register, driver will wait until register is updated. This parameter defines how many loops to check completion before return timeout. If defined as 0, driver will wait forever until completion.

TPM_MAX_COUNTER_VALUE(x)

Help macro to get the max counter value.

struct __tpm__chnl__pwm__signal__param

#include <fsl_tpm.h> Options to configure a TPM channel's PWM signal.

Public Members

tpm_chnl_t chnlNumber

TPM channel to configure. In combined mode (available in some SoC's), this represents the channel pair number

tpm_pwm_pause_level_select_t pauseLevel

PWM output level when counter first enabled or paused

tpm_pwm_level_select_t level

PWM output active level select

uint8_t dutyCyclePercent

PWM pulse width, value should be between 0 to 100 0=inactive signal(0% duty cycle)... 100=always active signal (100% duty cycle)

uint8_t firstEdgeDelayPercent

Used only in combined PWM mode to generate asymmetrical PWM. Specifies the delay to the first edge in a PWM period. If unsure, leave as 0. Should be specified as percentage of the PWM period, (dutyCyclePercent + firstEdgeDelayPercent) value should be not greate than 100.

bool enableComplementary

Used only in combined PWM mode. true: The combined channels output complementary signals; false: The combined channels output same signals;

tpm_pwm_pause_level_select_t secPauseLevel

Used only in combined PWM mode. Define the second channel output level when counter first enabled or paused

uint8_t deadTimeValue[2]

The dead time value for channel n and n+1 in combined complementary PWM mode. Deadtime insertion is disabled when this value is zero, otherwise deadtime insertion for channel n/n+1 is configured as (deadTimeValue * 4) clock cycles. deadTimeValue's available range is 0 ~ 15.

struct __tpm__dual__edge__capture__param

#include <fsl_tpm.h> TPM dual edge capture parameters.

Note: This mode is available only on some SoC's.

Public Members

bool enableSwap

true: Use channel n+1 input, channel n input is ignored; false: Use channel n input, channel n+1 input is ignored

tpm_input_capture_edge_t currChanEdgeMode

Input capture edge select for channel n

tpm_input_capture_edge_t nextChanEdgeMode

Input capture edge select for channel n+1

struct __tpm__phase__param

#include <fsl_tpm.h> TPM quadrature decode phase parameters.

Public Members

uint32_t phaseFilterVal
: Filter value, filter is disabled when the value is zero

tpm_phase_polarity_t phasePolarity
: Phase polarity

struct __tpm__config
: *#include <fsl_tpm.h>* TPM config structure.

  This structure holds the configuration settings for the TPM peripheral. To initialize this structure to reasonable defaults, call the TPM_GetDefaultConfig() function and pass a pointer to your config structure instance.

  The config struct can be made const so it resides in flash

Public Members

tpm_clock_prescale_t prescale
: Select TPM clock prescale value

bool useGlobalTimeBase
: true: The TPM channels use an external global time base (the local counter still use for generate overflow interrupt and DMA request); false: All TPM channels use the local counter as their timebase

bool syncGlobalTimeBase
: true: The TPM counter is synchronized to the global time base; false: disabled

tpm_trigger_select_t triggerSelect
: Input trigger to use for controlling the counter operation

tpm_trigger_source_t triggerSource
: Decides if we use external or internal trigger.

tpm_ext_trigger_polarity_t extTriggerPolarity
: when using external trigger source, need selects the polarity of it.

bool enableDoze
: true: TPM counter is paused in doze mode; false: TPM counter continues in doze mode

bool enableDebugMode
: true: TPM counter continues in debug mode; false: TPM counter is paused in debug mode

bool enableReloadOnTrigger
: true: TPM counter is reloaded on trigger; false: TPM counter not reloaded

bool enableStopOnOverflow
: true: TPM counter stops after overflow; false: TPM counter continues running after overflow

bool enableStartOnTrigger
: true: TPM counter only starts when a trigger is detected; false: TPM counter starts immediately

bool enablePauseOnTrigger
: true: TPM counter will pause while trigger remains asserted; false: TPM counter continues running

uint8_t chnlPolarity
: Defines the input/output polarity of the channels in POL register

2.102 TRDC: Trusted Resource Domain Controller

void TRDC_Init(*TRDC_Type* *base)

Initializes the TRDC module.

This function enables the TRDC clock.

Parameters

- base – TRDC peripheral base address.

void TRDC_Deinit(*TRDC_Type* *base)

De-initializes the TRDC module.

This function disables the TRDC clock.

Parameters

- base – TRDC peripheral base address.

static inline uint8_t TRDC_GetCurrentMasterDomainId(*TRDC_Type* *base)

Gets the domain ID of the current bus master.

Parameters

- base – TRDC peripheral base address.

Returns

Domain ID of current bus master.

void TRDC_GetHardwareConfig(*TRDC_Type* *base, *trdc_hardware_config_t* *config)

Gets the TRDC hardware configuration.

This function gets the TRDC hardware configurations, including number of bus masters, number of domains, number of MRCs and number of PACs.

Parameters

- base – TRDC peripheral base address.
- config – Pointer to the structure to get the configuration.

static inline void TRDC_SetDacGlobalValid(*TRDC_Type* *base)

Sets the TRDC DAC(Domain Assignment Controllers) global valid.

Once enabled, it will remain enabled until next reset.

Parameters

- base – TRDC peripheral base address.

static inline void TRDC_LockMasterDomainAssignment(*TRDC_Type* *base, uint8_t master)

Locks the bus master domain assignment register.

This function locks the master domain assignment. After it is locked, the register can't be changed until next reset.

Parameters

- base – TRDC peripheral base address.
- master – Which master to configure.

static inline void TRDC_SetMasterDomainAssignmentValid(*TRDC_Type* *base, uint8_t master, bool valid)

Sets the master domain assignment as valid or invalid.

This function sets the master domain assignment as valid or invalid.

Parameters

- base – TRDC peripheral base address.
- master – Which master to configure.
- valid – True to set valid, false to set invalid.

void TRDC_GetDefaultProcessorDomainAssignment(*trdc_processor_domain_assignment_t* *domainAssignment)

Gets the default master domain assignment for the processor bus master.

This function gets the default master domain assignment for the processor bus master. It should only be used for the processor bus masters, such as CORE0. This function sets the assignment as follows:

```
assignment->domainId          = 0U;
assignment->domainIdSelect    = kTRDC_DidMda;
assignment->lock              = 0U;
```

Parameters

- domainAssignment – Pointer to the assignment structure.

void TRDC_GetDefaultNonProcessorDomainAssignment(*trdc_non_processor_domain_assignment_t* *domainAssignment)

Gets the default master domain assignment for non-processor bus master.

This function gets the default master domain assignment for non-processor bus master. It should only be used for the non-processor bus masters, such as DMA. This function sets the assignment as follows:

```
assignment->domainId          = 0U;
assignment->privilegeAttr     = kTRDC_ForceUser;
assignment->secureAttr        = kTRDC_ForceSecure;
assignment->bypassDomainId    = 0U;
assignment->lock              = 0U;
```

Parameters

- domainAssignment – Pointer to the assignment structure.

void TRDC_SetProcessorDomainAssignment(*TRDC_Type* *base, const *trdc_processor_domain_assignment_t* *domainAssignment)

Sets the processor bus master domain assignment.

This function sets the processor master domain assignment as valid. One bus master might have multiple domain assignment registers. The parameter assignIndex specifies which assignment register to set.

Example: Set domain assignment for core 0.

```
trdc_processor_domain_assignment_t processorAssignment;

TRDC_GetDefaultProcessorDomainAssignment(&processorAssignment);

processorAssignment.domainId = 0;
processorAssignment.xxx      = xxx;
TRDC_SetMasterDomainAssignment(TRDC, &processorAssignment);
```

Parameters

- base – TRDC peripheral base address.
- domainAssignment – Pointer to the assignment structure.

static inline void TRDC_EnableProcessorDomainAssignment(*TRDC_Type* *base, bool enable)

Enables the processor bus master domain assignment.

Parameters

- base – TRDC peripheral base address.
- enable – True to enable, false to disable.

void TRDC_SetNonProcessorDomainAssignment(*TRDC_Type* *base, uint8_t master, const *trdc_non_processor_domain_assignment_t* *domainAssignment)

Sets the non-processor bus master domain assignment.

This function sets the non-processor master domain assignment as valid. One bus master might have multiple domain assignment registers. The parameter assignIndex specifies which assignment register to set.

Example: Set domain assignment for DMA0.

```
trdc_non_processor_domain_assignment_t nonProcessorAssignment;

TRDC_GetDefaultNonProcessorDomainAssignment(&nonProcessorAssignment);
nonProcessorAssignment.domainId = 1;
nonProcessorAssignment.xxx      = xxx;

TRDC_SetMasterDomainAssignment(TRDC, kTrdcMasterDma0, 0U, &nonProcessorAssignment);
```

Parameters

- base – TRDC peripheral base address.
- master – Which master to configure, refer to trdc_master_t in processor header file.
- domainAssignment – Pointer to the assignment structure.

void TRDC_GetDefaultIDAUConfig(*trdc_idau_config_t* *idauConfiguration)

Gets the default IDAU(Implementation-Defined Attribution Unit) configuration.

```
config->lockSecureVTOR    = false;
config->lockNonsecureVTOR = false;
config->lockSecureMPU     = false;
config->lockNonsecureMPU  = false;
config->lockSAU           = false;
```

Parameters

- idauConfiguration – Pointer to the configuration structure.

void TRDC_SetIDAU(*TRDC_Type* *base, const *trdc_idau_config_t* *idauConfiguration)

Sets the IDAU(Implementation-Defined Attribution Unit) control configuration.

Example: Lock the secure and non-secure MPU registers.

```
trdc_idau_config_t idauConfiguration;

TRDC_GetDefaultIDAUConfig(&idauConfiguration);

idauConfiguration.lockSecureMPU = true;
idauConfiguration.lockNonsecureMPU     = true;
TRDC_SetIDAU(TRDC, &idauConfiguration);
```

Parameters

- base – TRDC peripheral base address.
- idauConfiguration – Pointer to the configuration structure.

static inline void TRDC_EnableFlashLogicalWindow(*TRDC_Type* *base, bool enable)

Enables/disables the FLW(flash logical window) function.

Parameters

- base – TRDC peripheral base address.
- enable – True to enable, false to disable.

static inline void TRDC_LockFlashLogicalWindow(*TRDC_Type* *base)

Locks FLW registers. Once locked the registers can noy be updated until next reset.

Parameters

- base – TRDC peripheral base address.

static inline uint32_t TRDC_GetFlashLogicalWindowPbase(*TRDC_Type* *base)

Gets the FLW physical base address.

Parameters

- base – TRDC peripheral base address.

Returns

Physical address of the FLW function.

static inline void TRDC_GetSetFlashLogicalWindowSize(*TRDC_Type* *base, uint16_t size)

Sets the FLW size.

Parameters

- base – TRDC peripheral base address.
- size – Size of the FLW in unit of 32k bytes.

void TRDC_GetDefaultFlashLogicalWindowConfig(*trdc_flw_config_t* *flwConfiguration)

Gets the default FLW(Flsh Logical Window) configuration.

```
config->blockCount    = false;
config->arrayBaseAddr = false;
config->lock      = false;
config->enable    = false;
```

Parameters

- flwConfiguration – Pointer to the configuration structure.

void TRDC_SetFlashLogicalWindow(*TRDC_Type* *base, const *trdc_flw_config_t* *flwConfiguration)

Sets the FLW function's configuration.

```
trdc_flw_config_t flwConfiguration;

TRDC_GetDefaultIDAUConfig(&flwConfiguration);

flwConfiguration.blockCount = 32U;
flwConfiguration.arrayBaseAddr = 0xXXXXXXXX;
TRDC_SetIDAU(TRDC, &flwConfiguration);
```

Parameters

- base – TRDC peripheral base address.
- flwConfiguration – Pointer to the configuration structure.

status_t TRDC_GetAndClearFirstDomainError(*TRDC_Type* *base, *trdc_domain_error_t* *error)

Gets and clears the first domain error of the current domain.

This function gets the first access violation information for the current domain and clears the pending flag. There might be multiple access violations pending for the current domain. This function only processes the first error.

Parameters

- base – TRDC peripheral base address.
- error – Pointer to the error information.

Returns

If the access violation is captured, this function returns the kStatus_Success. The error information can be obtained from the parameter error. If no access violation is captured, this function returns the kStatus_NoData.

status_t TRDC_GetAndClearFirstSpecificDomainError(*TRDC_Type* *base, *trdc_domain_error_t* *error, uint8_t domainId)

Gets and clears the first domain error of the specific domain.

This function gets the first access violation information for the specific domain and clears the pending flag. There might be multiple access violations pending for the current domain. This function only processes the first error.

Parameters

- base – TRDC peripheral base address.
- error – Pointer to the error information.
- domainId – The error of which domain to get and clear.

Returns

If the access violation is captured, this function returns the kStatus_Success. The error information can be obtained from the parameter error. If no access violation is captured, this function returns the kStatus_NoData.

static inline void TRDC_SetMrcGlobalValid(*TRDC_Type* *base)

Sets the TRDC MRC(Memory Region Checkers) global valid.

Once enabled, it will remain enabled until next reset.

Parameters

- base – TRDC peripheral base address.

static inline uint8_t TRDC_GetMrcRegionNumber(*TRDC_Type* *base, uint8_t mrcIdx)

Gets the TRDC MRC(Memory Region Checkers) region number valid.

Parameters

- base – TRDC peripheral base address.
- mrcIdx – MRC index.

Returns

the region number of the given MRC instance

void TRDC_MrcSetMemoryAccessConfig(*TRDC_Type* *base, const *trdc_memory_access_control_config_t* *config, uint8_t mrcIdx, uint8_t regIdx)

Sets the memory access configuration for one of the access control register of one MRC.

Example: Enable the secure operations and lock the configuration for MRC0 region 1.

```
trdc_memory_access_control_config_t config;

config.securePrivX = true;
config.securePrivW = true;
config.securePrivR = true;
config.lock = true;
TRDC_SetMrcMemoryAccess(TRDC, &config, 0, 1);
```

Parameters

- base – TRDC peripheral base address.
- config – Pointer to the configuration structure.
- mrcIdx – MRC index.
- regIdx – Register number.

void TRDC_MrcEnableDomainNseUpdate(*TRDC_Type* *base, uint8_t mrcIdx, uint16_t domainMask, bool enable)

Enables the update of the selected domains.

After the domains' update are enabled, their regions' NSE bits can be set or clear.

Parameters

- base – TRDC peripheral base address.
- mrcIdx – MRC index.
- domainMask – Bit mask of the domains to be enabled.
- enable – True to enable, false to disable.

void TRDC_MrcRegionNseSet(*TRDC_Type* *base, uint8_t mrcIdx, uint16_t regionMask)

Sets the NSE bits of the selected regions for domains.

This function sets the NSE bits for the selected regions for the domains whose update are enabled.

Parameters

- base – TRDC peripheral base address.
- mrcIdx – MRC index.
- regionMask – Bit mask of the regions whose NSE bits to set.

void TRDC_MrcRegionNseClear(*TRDC_Type* *base, uint8_t mrcIdx, uint16_t regionMask)

Clears the NSE bits of the selected regions for domains.

This function clears the NSE bits for the selected regions for the domains whose update are enabled.

Parameters

- base – TRDC peripheral base address.
- mrcIdx – MRC index.
- regionMask – Bit mask of the regions whose NSE bits to clear.

void TRDC_MrcDomainNseClear(*TRDC_Type* *base, uint8_t mrcIdx, uint16_t domainMask)

Clears the NSE bits for all the regions of the selected domains.

This function clears the NSE bits for all regions of selected domains whose update are enabled.

Parameters

- base – TRDC peripheral base address.
- mrcIdx – MRC index.
- domainMask – Bit mask of the domains whose NSE bits to clear.

void TRDC_MrcSetRegionDescriptorConfig(*TRDC_Type* *base, const *trdc_mrc_region_descriptor_config_t* *config)

Sets the configuration for one of the region descriptor per domain per MRC instnce.

This function sets the configuration for one of the region descriptor, including the start and end address of the region, memory access control policy and valid.

Parameters

- base – TRDC peripheral base address.
- config – Pointer to region descriptor configuration structure.

static inline void TRDC_SetMbcGlobalValid(*TRDC_Type* *base)

Sets the TRDC MBC(Memory Block Checkers) global valid.

Once enabled, it will remain enabled until next reset.

Parameters

- base – TRDC peripheral base address.

void TRDC_GetMbcHardwareConfig(*TRDC_Type* *base, *trdc_slave_memory_hardware_config_t* *config, uint8_t mbcIdx, uint8_t slvIdx)

Gets the hardware configuration of the one of two slave memories within each MBC(memory block checker).

Parameters

- base – TRDC peripheral base address.
- config – Pointer to the structure to get the configuration.
- mbcIdx – MBC number.
- slvIdx – Slave number.

void TRDC_MbcSetNseUpdateConfig(*TRDC_Type* *base, const *trdc_mbc_nse_update_config_t* *config, uint8_t mbcIdx)

Sets the NSR update configuration for one of the MBC instance.

After set the NSE configuration, the configured memory area can be updateby NSE set/clear.

Parameters

- base – TRDC peripheral base address.
- config – Pointer to NSE update configuration structure.
- mbcIdx – MBC index.

void TRDC_MbcWordNseSet(*TRDC_Type* *base, uint8_t mbcIdx, uint32_t bitMask)

Sets the NSE bits of the selected configuration words according to NSE update configuration.

This function sets the NSE bits of the word for the configured regio, memory.

Parameters

- base – TRDC peripheral base address.
- mbcIdx – MBC index.
- bitMask – Mask of the bits whose NSE bits to set.

void TRDC_MbcWordNseClear(*TRDC_Type* *base, uint8_t mbcIdx, uint32_t bitMask)

Clears the NSE bits of the selected configuration words according to NSE update configuration.

This function sets the NSE bits of the word for the configured regio, memory.

Parameters

- base – TRDC peripheral base address.
- mbcIdx – MBC index.
- bitMask – Mask of the bits whose NSE bits to clear.

void TRDC_MbcNseClearAll(*TRDC_Type* *base, uint8_t mbcIdx, uint16_t domainMask, uint8_t slaveMask)

Clears all configuration words' NSE bits of the selected domain and memory.

Parameters

- base – TRDC peripheral base address.
- mbcIdx – MBC index.
- domainMask – Mask of the domains whose NSE bits to clear, 0b110 means clear domain 1&2.
- slaveMask – Mask of the slaves whose NSE bits to clear, 0x11 means clear all slave 0&1's NSE bits.

void TRDC_MbcSetMemoryAccessConfig(*TRDC_Type* *base, const *trdc_memory_access_control_config_t* *config, uint8_t mbcIdx, uint8_t rgdIdx)

Sets the memory access configuration for one of the region descriptor of one MBC.

Example: Enable the secure operations and lock the configuration for MRC0 region 1.

```
trdc_memory_access_control_config_t config;

config.securePrivX = true;
config.securePrivW = true;
config.securePrivR = true;
config.lock = true;
TRDC_SetMbcMemoryAccess(TRDC, &config, 0, 1);
```

Parameters

- base – TRDC peripheral base address.
- config – Pointer to the configuration structure.
- mbcIdx – MBC index.
- rgdIdx – Region descriptor number.

void TRDC_MbcSetMemoryBlockConfig(*TRDC_Type* *base, const *trdc_mbc_memory_block_config_t* *config)

Sets the configuration for one of the memory block per domain per MBC instnce.

This function sets the configuration for one of the memory block, including the memory access control policy and nse enable.

Parameters

- base – TRDC peripheral base address.
- config – Pointer to memory block configuration structure.

enum _trdc_did_sel

TRDC domain ID select method, the register bit TRDC_MDA_W0_0_DFMT0[DIDS], used for domain hit evaluation.

Values:

enumerator kTRDC_DidMda

Use MDAn[2:0] as DID.

enumerator kTRDC_DidInput

Use the input DID (DID_in) as DID.

enumerator kTRDC_DidMdaAndInput

Use MDAn[2] concatenated with DID_in[1:0] as DID.

enumerator kTRDC_DidReserved

Reserved.

enum _trdc_secure_attr

TRDC secure attribute, the register bit TRDC_MDA_W0_0_DFMT0[SA], used for bus master domain assignment.

Values:

enumerator kTRDC_ForceSecure

Force the bus attribute for this master to secure.

enumerator kTRDC_ForceNonSecure

Force the bus attribute for this master to non-secure.

enumerator kTRDC_MasterSecure

Use the bus master's secure/nonsecure attribute directly.

enumerator kTRDC_MasterSecure1

Use the bus master's secure/nonsecure attribute directly.

enum _trdc_privilege_attr

TRDC privileged attribute, the register bit TRDC_MDA_W0_x_DFMT1[PA], used for non-processor bus master domain assignment.

Values:

enumerator kTRDC_ForceUser

Force the bus attribute for this master to user.

enumerator kTRDC_ForcePrivilege

Force the bus attribute for this master to privileged.

enumerator kTRDC_MasterPrivilege

Use the bus master's attribute directly.

enumerator kTRDC_MasterPrivilege1

Use the bus master's attribute directly.

enum _trdc_controller

TRDC controller definition for domain error check. Each TRDC instance may have different MRC or MBC count, call TRDC_GetHardwareConfig to get the actual count.

Values:

enumerator kTRDC_MemBlockController0

Memory block checker 0.

enumerator kTRDC_MemBlockController1
Memory block checker 1.

enumerator kTRDC_MemBlockController2
Memory block checker 2.

enumerator kTRDC_MemBlockController3
Memory block checker 3.

enumerator kTRDC_MemRegionChecker0
Memory region checker 0.

enumerator kTRDC_MemRegionChecker1
Memory region checker 1.

enumerator kTRDC_MemRegionChecker2
Memory region checker 2.

enumerator kTRDC_MemRegionChecker3
Memory region checker 3.

enumerator kTRDC_MemRegionChecker4
Memory region checker 4.

enumerator kTRDC_MemRegionChecker5
Memory region checker 5.

enumerator kTRDC_MemRegionChecker6
Memory region checker 6.

enum _trdc_error_state
TRDC domain error state definition TRDC_MBCn_DERR_W1[EST] or TRDC_MRCn_DERR_W1[EST].

Values:

enumerator kTRDC_ErrorStateNone
No access violation detected.

enumerator kTRDC_ErrorStateNone1
No access violation detected.

enumerator kTRDC_ErrorStateSingle
Single access violation detected.

enumerator kTRDC_ErrorStateMulti
Multiple access violation detected.

enum _trdc_error_attr
TRDC domain error attribute definition TRDC_MBCn_DERR_W1[EATR] or TRDC_MRCn_DERR_W1[EATR].

Values:

enumerator kTRDC_ErrorSecureUserInst
Secure user mode, instruction fetch access.

enumerator kTRDC_ErrorSecureUserData
Secure user mode, data access.

enumerator kTRDC_ErrorSecurePrivilegeInst
Secure privileged mode, instruction fetch access.

enumerator kTRDC_ErrorSecurePrivilegeData
Secure privileged mode, data access.

enumerator kTRDC_ErrorNonSecureUserInst
NonSecure user mode, instruction fetch access.

enumerator kTRDC_ErrorNonSecureUserData
NonSecure user mode, data access.

enumerator kTRDC_ErrorNonSecurePrivilegeInst
NonSecure privileged mode, instruction fetch access.

enumerator kTRDC_ErrorNonSecurePrivilegeData
NonSecure privileged mode, data access.

enum __trdc_error_type
TRDC domain error access type definition TRDC_DERR_W1_n[ERW].

Values:

enumerator kTRDC_ErrorTypeRead
Error occurs on read reference.

enumerator kTRDC_ErrorTypeWrite
Error occurs on write reference.

enum __trdc_region_descriptor
The region descriptor enumeration, used to form a mask to set/clear the NSE bits for one or several regions.

Values:

enumerator kTRDC_RegionDescriptor0
Region descriptor 0.

enumerator kTRDC_RegionDescriptor1
Region descriptor 1.

enumerator kTRDC_RegionDescriptor2
Region descriptor 2.

enumerator kTRDC_RegionDescriptor3
Region descriptor 3.

enumerator kTRDC_RegionDescriptor4
Region descriptor 4.

enumerator kTRDC_RegionDescriptor5
Region descriptor 5.

enumerator kTRDC_RegionDescriptor6
Region descriptor 6.

enumerator kTRDC_RegionDescriptor7
Region descriptor 7.

enumerator kTRDC_RegionDescriptor8
Region descriptor 8.

enumerator kTRDC_RegionDescriptor9
Region descriptor 9.

enumerator kTRDC_RegionDescriptor10
Region descriptor 10.

enumerator kTRDC_RegionDescriptor11
Region descriptor 11.

enumerator kTRDC_RegionDescriptor12
Region descriptor 12.

enumerator kTRDC_RegionDescriptor13
Region descriptor 13.

enumerator kTRDC_RegionDescriptor14
Region descriptor 14.

enumerator kTRDC_RegionDescriptor15
Region descriptor 15.

enum _trdc_MRC_domain
The MRC domain enumeration, used to form a mask to enable/disable the update or clear all NSE bits of one or several domains.

Values:

enumerator kTRDC_MrcDomain0
Domain 0.

enumerator kTRDC_MrcDomain1
Domain 1.

enumerator kTRDC_MrcDomain2
Domain 2.

enumerator kTRDC_MrcDomain3
Domain 3.

enumerator kTRDC_MrcDomain4
Domain 4.

enumerator kTRDC_MrcDomain5
Domain 5.

enumerator kTRDC_MrcDomain6
Domain 6.

enumerator kTRDC_MrcDomain7
Domain 7.

enumerator kTRDC_MrcDomain8
Domain 8.

enumerator kTRDC_MrcDomain9
Domain 9.

enumerator kTRDC_MrcDomain10
Domain 10.

enumerator kTRDC_MrcDomain11
Domain 11.

enumerator kTRDC_MrcDomain12
Domain 12.

enumerator kTRDC_MrcDomain13
Domain 13.

enumerator kTRDC_MrcDomain14
Domain 14.

enumerator kTRDC_MrcDomain15
Domain 15.

enum _trdc_MBC_domain
The MBC domain enumeration, used to form a mask to enable/disable the update or clear NSE bits of one or several domains.

Values:

enumerator kTRDC_MbcDomain0
Domain 0.

enumerator kTRDC_MbcDomain1
Domain 1.

enumerator kTRDC_MbcDomain2
Domain 2.

enumerator kTRDC_MbcDomain3
Domain 3.

enumerator kTRDC_MbcDomain4
Domain 4.

enumerator kTRDC_MbcDomain5
Domain 5.

enumerator kTRDC_MbcDomain6
Domain 6.

enumerator kTRDC_MbcDomain7
Domain 7.

enum _trdc_MBC_memory
The MBC slave memory enumeration, used to form a mask to enable/disable the update or clear NSE bits of one or several memory block.

Values:

enumerator kTRDC_MbcSlaveMemory0
Memory 0.

enumerator kTRDC_MbcSlaveMemory1
Memory 1.

enumerator kTRDC_MbcSlaveMemory2
Memory 2.

enumerator kTRDC_MbcSlaveMemory3
Memory 3.

enum _trdc_MBC_bit
The MBC bit enumeration, used to form a mask to set/clear configured words' NSE.

Values:

enumerator kTRDC_MbcBit0
Bit 0.

enumerator kTRDC_MbcBit1
Bit 1.

enumerator kTRDC_MbcBit2
Bit 2.

enumerator kTRDC_MbcBit3
Bit 3.

enumerator kTRDC_MbcBit4
Bit 4.

enumerator kTRDC_MbcBit5
Bit 5.

enumerator kTRDC_MbcBit6
Bit 6.

enumerator kTRDC_MbcBit7
Bit 7.

enumerator kTRDC_MbcBit8
Bit 8.

enumerator kTRDC_MbcBit9
Bit 9.

enumerator kTRDC_MbcBit10
Bit 10.

enumerator kTRDC_MbcBit11
Bit 11.

enumerator kTRDC_MbcBit12
Bit 12.

enumerator kTRDC_MbcBit13
Bit 13.

enumerator kTRDC_MbcBit14
Bit 14.

enumerator kTRDC_MbcBit15
Bit 15.

enumerator kTRDC_MbcBit16
Bit 16.

enumerator kTRDC_MbcBit17
Bit 17.

enumerator kTRDC_MbcBit18
Bit 18.

enumerator kTRDC_MbcBit19
Bit 19.

enumerator kTRDC_MbcBit20
Bit 20.

enumerator kTRDC_MbcBit21
Bit 21.

enumerator kTRDC_MbcBit22
Bit 22.

enumerator kTRDC_MbcBit23
Bit 23.

enumerator kTRDC_MbcBit24
Bit 24.

enumerator kTRDC_MbcBit25
Bit 25.

enumerator kTRDC_MbcBit26
Bit 26.

enumerator kTRDC_MbcBit27
Bit 27.

enumerator kTRDC_MbcBit28
Bit 28.

enumerator kTRDC_MbcBit29
Bit 29.

enumerator kTRDC_MbcBit30
Bit 30.

enumerator kTRDC_MbcBit31
Bit 31.

typedef struct *_trdc_hardware_config* trdc_hardware_config_t
TRDC hardware configuration.

typedef struct *_trdc_slave_memory_hardware_config* trdc_slave_memory_hardware_config_t
Hardware configuration of the two slave memories within each MBC(memory block checker).

typedef enum *_trdc_did_sel* trdc_did_sel_t
TRDC domain ID select method, the register bit TRDC_MDA_W0_0_DFMT0[DIDS], used for domain hit evaluation.

typedef enum *_trdc_secure_attr* trdc_secure_attr_t
TRDC secure attribute, the register bit TRDC_MDA_W0_0_DFMT0[SA], used for bus master domain assignment.

typedef struct *_trdc_processor_domain_assignment* trdc_processor_domain_assignment_t
Domain assignment for the processor bus master.

typedef enum *_trdc_privilege_attr* trdc_privilege_attr_t
TRDC privileged attribute, the register bit TRDC_MDA_W0_x_DFMT1[PA], used for non-processor bus master domain assignment.

typedef struct *_trdc_non_processor_domain_assignment*
trdc_non_processor_domain_assignment_t
Domain assignment for the non-processor bus master.

typedef struct *_trdc_idau_config* trdc_idau_config_t
IDAU(Implementation-Defined Attribution Unit) configuration for TZ-M function control.

typedef struct *_trdc_flw_config* trdc_flw_config_t
FLW(Flash Logical Window) configuration.

typedef enum *_trdc_controller* trdc_controller_t
TRDC controller definition for domain error check. Each TRDC instance may have different MRC or MBC count, call TRDC_GetHardwareConfig to get the actual count.

typedef enum *_trdc_error_state* trdc_error_state_t

TRDC domain error state definition TRDC_MBCn_DERR_W1[EST] or TRDC_MRCn_DERR_W1[EST].

typedef enum *_trdc_error_attr* trdc_error_attr_t

TRDC domain error attribute definition TRDC_MBCn_DERR_W1[EATR] or TRDC_MRCn_DERR_W1[EATR].

typedef enum *_trdc_error_type* trdc_error_type_t

TRDC domain error access type definition TRDC_DERR_W1_n[ERW].

typedef struct *_trdc_domain_error* trdc_domain_error_t

TRDC domain error definition.

typedef struct *_trdc_memory_access_control_config* trdc_memory_access_control_config_t

Memory access control configuration for MBC/MRC.

typedef struct *_trdc_mrc_region_descriptor_config* trdc_mrc_region_descriptor_config_t

The configuration of each region descriptor per domain per MRC instance.

typedef struct *_trdc_mbc_nse_update_config* trdc_mbc_nse_update_config_t

The configuration of MBC NSE update.

typedef struct *_trdc_mbc_memory_block_config* trdc_mbc_memory_block_config_t

The configuration of each memory block per domain per MBC instance.

FSL_TRDC_DRIVER_VERSION

FSL_TRDC_DRIVER_VERSION

struct _trdc_hardware_config

#include <fsl_trdc.h> TRDC hardware configuration.

Public Members

uint8_t masterNumber

Number of bus masters.

uint8_t domainNumber

Number of domains.

uint8_t mbcNumber

Number of MBCs.

uint8_t mrcNumber

Number of MRCs.

struct _trdc_slave_memory_hardware_config

#include <fsl_trdc.h> Hardware configuration of the two slave memories within each MBC(memory block checker).

Public Members

uint32_t blockNum

Number of blocks.

uint32_t blockSize

Block size.

struct _trdc_processor_domain_assignment

#include <fsl_trdc.h> Domain assignment for the processor bus master.

Public Members

uint32_t domainId
: Domain ID.

uint32_t domainIdSelect
: Domain ID select method, see trdc_did_sel_t.

uint32_t ___pad0___
: Reserved.

uint32_t secureAttr
: Secure attribute, see trdc_secure_attr_t.

uint32_t ___pad1___
: Reserved.

uint32_t lock
: Lock the register.

uint32_t ___pad2___
: Reserved.

struct __trdc__non__processor__domain__assignment
: *#include <fsl_trdc.h>* Domain assignment for the non-processor bus master.

Public Members

uint32_t domainId
: Domain ID.

uint32_t privilegeAttr
: Privileged attribute, see trdc_privilege_attr_t.

uint32_t secureAttr
: Secure attribute, see trdc_secure_attr_t.

uint32_t bypassDomainId
: Bypass domain ID.

uint32_t ___pad0___
: Reserved.

uint32_t lock
: Lock the register.

uint32_t ___pad1___
: Reserved.

struct __trdc__idau__config
: *#include <fsl_trdc.h>* IDAU(Implementation-Defined Attribution Unit) configuration for TZ-M function control.

Public Members

uint32_t ___pad0___
: Reserved.

uint32_t lockSecureVTOR
: Disable writes to secure VTOR(Vector Table Offset Register).

uint32_t lockNonsecureVTOR
: Disable writes to non-secure VTOR, Application interrupt and Reset Control Registers.

uint32_t lockSecureMPU
: Disable writes to secure MPU(Memory Protection Unit) from software or from a debug agent connected to the processor in Secure state.

uint32_t lockNonsecureMPU
: Disable writes to non-secure MPU(Memory Protection Unit) from software or from a debug agent connected to the processor.

uint32_t lockSAU
: Disable writes to SAU(Security Attribution Unit) registers.

uint32_t ___pad1___
: Reserved.

struct __trdc__flw__config
: *#include <fsl_trdc.h>* FLW(Flash Logical Window) configuration.

Public Members

uint16_t blockCount
: Block count of the Flash Logic Window in 32KByte blocks.

uint32_t arrayBaseAddr
: Flash array base address of the Flash Logical Window.

bool lock
: Disable writes to FLW registers.

bool enable
: Enable FLW function.

struct __trdc__domain__error
: *#include <fsl_trdc.h>* TRDC domain error definition.

Public Members

trdc_controller_t controller
: Which controller captured access violation.

uint32_t address
: Access address that generated access violation.

trdc_error_state_t errorState
: Error state.

trdc_error_attr_t errorAttr
: Error attribute.

trdc_error_type_t errorType
: Error type.

uint8_t errorPort
: Error port.

uint8_t domainId
: Domain ID.

uint8_t slaveMemoryIdx
: The slave memory index. Only apply when violation in MBC.

struct __trdc__memory__access__control__config
: *#include <fsl_trdc.h>* Memory access control configuration for MBC/MRC.

Public Members

uint32_t nonsecureUsrX
: Allow nonsecure user execute access.

uint32_t nonsecureUsrW
: Allow nonsecure user write access.

uint32_t nonsecureUsrR
: Allow nonsecure user read access.

uint32_t ___pad0___
: Reserved.

uint32_t nonsecurePrivX
: Allow nonsecure privilege execute access.

uint32_t nonsecurePrivW
: Allow nonsecure privilege write access.

uint32_t nonsecurePrivR
: Allow nonsecure privilege read access.

uint32_t ___pad1___
: Reserved.

uint32_t secureUsrX
: Allow secure user execute access.

uint32_t secureUsrW
: Allow secure user write access.

uint32_t secureUsrR
: Allow secure user read access.

uint32_t ___pad2___
: Reserved.

uint32_t securePrivX
: Allownsecure privilege execute access.

uint32_t securePrivW
: Allownsecure privilege write access.

uint32_t securePrivR
: Allownsecure privilege read access.

uint32_t ___pad3___
: Reserved.

uint32_t lock
: Lock the configuration until next reset, only apply to access control register 0.

struct __trdc__mrc__region__descriptor__config
: *#include <fsl_trdc.h>* The configuration of each region descriptor per domain per MRC instance.

Public Members

uint8_t memoryAccessControlSelect
: Select one of the 8 access control policies for this region, for access cotrol policies see trdc_memory_access_control_config_t.

uint32_t startAddr
: Physical start address.

bool valid
: Lock the register.

bool nseEnable
: Enable non-secure accesses and disable secure accesses.

uint32_t endAddr
: Physical start address.

uint8_t mrcIdx
: The index of the MRC for this configuration to take effect.

uint8_t domainIdx
: The index of the domain for this configuration to take effect.

uint8_t regionIdx
: The index of the region for this configuration to take effect.

struct __trdc_mbc_nse_update_config
: *#include <fsl_trdc.h>* The configuration of MBC NSE update.

Public Members

uint32_t ___pad0___
: Reserved.

uint32_t wordIdx
: MBC configuration word index to be updated.

uint32_t ___pad1___
: Reserved.

uint32_t memorySelect
: Bit mask of the selected memory to be updated. _trdc_MBC_memory.

uint32_t ___pad2___
: Reserved.

uint32_t domianSelect
: Bit mask of the selected domain to be updated. _trdc_MBC_domain.

uint32_t ___pad3___
: Reserved.

uint32_t autoIncrement
: Whether to increment the word index after current word is updated using this configuration.

struct __trdc_mbc_memory_block_config
: *#include <fsl_trdc.h>* The configuration of each memory block per domain per MBC instance.

Public Members

uint32_t memoryAccessControlSelect
: Select one of the 8 access control policies for this memory block, for access cotrol policies see trdc_memory_access_control_config_t.

uint32_t nseEnable
: Enable non-secure accesses and disable secure accesses.

uint32_t mbcIdx
: The index of the MBC for this configuration to take effect.

uint32_t domainIdx
: The index of the domain for this configuration to take effect.

uint32_t slaveMemoryIdx
: The index of the slave memory for this configuration to take effect.

uint32_t memoryBlockIdx
: The index of the memory block for this configuration to take effect.

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typedef struct *_TRDC_General_Type* TRDC_General_Type
: TRDC general configuration register definition.

typedef struct *_TRDC_FLW_Type* TRDC_FLW_Type
: TRDC flash logical control register definition.

typedef struct *_TRDC_DomainError_Type* TRDC_DomainError_Type
: TRDC domain error register definition.

typedef struct *_TRDC_DomainAssignment_Type* TRDC_DomainAssignment_Type
: TRDC master domain assignment register definition.

typedef struct *_TRDC_MBC_Type* TRDC_MBC_Type
: TRDC MBC control register definition.

typedef struct *_TRDC_MRC_Type* TRDC_MRC_Type
: TRDC MRC control register definition. MRC_DOM0_RGD_W[region][word].

TRDC_GENERAL_BASE(base)
: TRDC base address convert macro.

TRDC_FLW_BASE(base)

TRDC_DOMAIN_ERROR_BASE(base)

TRDC_DOMAIN_ASSIGNMENT_BASE(base)

TRDC_MBC_BASE(base, instance)

TRDC_MRC_BASE(base, instance)

struct _TRDC_General_Type
: *#include <fsl_trdc_core.h>* TRDC general configuration register definition.

Public Members

___IO uint32_t TRDC_CR
TRDC Register, offset: 0x0

___I uint32_t TRDC_HWCFG0
TRDC Hardware Configuration Register 0, offset: 0xF0

___I uint32_t TRDC_HWCFG1
TRDC Hardware Configuration Register 1, offset: 0xF4

___I uint32_t TRDC_HWCFG2
TRDC Hardware Configuration Register 2, offset: 0xF8

___I uint32_t TRDC_HWCFG3
TRDC Hardware Configuration Register 3, offset: 0xFC

___I uint8_t DACFG [8]
Domain Assignment Configuration Register, array offset: 0x100, array step: 0x1

___IO uint32_t TRDC_IDAU_CR
TRDC IDAU Control Register, offset: 0x1C0

struct _TRDC_FLW_Type
#include <fsl_trdc_core.h> TRDC flash logical control register definition.

Public Members

___IO uint32_t TRDC_FLW_CTL
TRDC FLW Control, offset: 0x1E0

___I uint32_t TRDC_FLW_PBASE
TRDC FLW Physical Base, offset: 0x1E4

___IO uint32_t TRDC_FLW_ABASE
TRDC FLW Array Base, offset: 0x1E8

___IO uint32_t TRDC_FLW_BCNT
TRDC FLW Block Count, offset: 0x1EC

struct _TRDC_DomainError_Type
#include <fsl_trdc_core.h> TRDC domain error register definition.

Public Members

___IO uint32_t TRDC_FDID
TRDC Fault Domain ID, offset: 0x1FC

___I uint32_t TRDC_DERRLOC [16]
TRDC Domain Error Location Register, array offset: 0x200, array step: 0x4

struct _TRDC_DomainAssignment_Type
#include <fsl_trdc_core.h> TRDC master domain assignment register definition.

Public Members

___IO uint32_t PID [8]
Process Identifier, array offset: 0x700, array step: 0x4

struct _TRDC_MBC_Type
#include <fsl_trdc_core.h> TRDC MBC control register definition.

Public Members

___I uint32_t MBC_MEM_GLBCFG [4]

MBC Global Configuration Register, array offset: 0x10000, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_NSE_BLK_INDEX

MBC NonSecure Enable Block Index, array offset: 0x10010, array step: 0x2000

___O uint32_t MBC_NSE_BLK_SET

MBC NonSecure Enable Block Set, array offset: 0x10014, array step: 0x2000

___O uint32_t MBC_NSE_BLK_CLR

MBC NonSecure Enable Block Clear, array offset: 0x10018, array step: 0x2000

___O uint32_t MBC_NSE_BLK_CLR_ALL

MBC NonSecure Enable Block Clear All, array offset: 0x1001C, array step: 0x2000

___IO uint32_t MBC_MEMN_GLBAC [8]

MBC Global Access Control, array offset: 0x10020, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10040, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10140, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10180, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x101A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x101A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x101C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x101D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM0_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x101F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10240, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10340, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10380, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x103A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x103A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x103C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x103D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM1_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x103F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10440, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10540, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10580, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x105A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x105A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x105C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x105D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM2_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x105F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10640, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10740, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10780, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x107A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x107A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x107C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x107D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM3_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x107F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10840, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10940, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10980, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x109A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x109A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x109C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x109D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM4_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x109F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10A40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10B40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10B80, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10BA0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10BA8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10BC8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10BD0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM5_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10BF0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10C40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10D40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10D80, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10DA0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10DA8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10DC8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10DD0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM6_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10DF0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x10E40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x10F40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10F80, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10FA0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10FA8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10FC8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x10FD0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM7_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x10FF0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11040, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11140, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11180, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x111A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x111A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x111C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x111D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM8_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x111F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11240, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11340, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11380, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x113A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x113A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x113C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x113D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM9_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x113F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11440, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11540, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11580, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x115A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x115A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x115C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x115D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM10_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x115F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11640, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11740, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11780, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x117A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x117A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x117C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x117D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM11_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x117F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11840, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11940, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11980, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x119A0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x119A8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x119C8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x119D0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM12_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x119F0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11A40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11B40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11B80, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11BA0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11BA8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11BC8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11BD0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM13_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11BF0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11C40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11D40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11D80, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11DA0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11DA8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11DC8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11DD0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM14_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11DF0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM0_BLK_CFG_W [64]

MBC Memory Block Configuration Word, array offset: 0x11E40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM0_BLK_NSE_W [16]

MBC Memory Block NonSecure Enable Word, array offset: 0x11F40, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM1_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11F80, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM1_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11FA0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM2_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11FA8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM2_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11FC8, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM3_BLK_CFG_W [8]

MBC Memory Block Configuration Word, array offset: 0x11FD0, array step: index*0x2000, index2*0x4

___IO uint32_t MBC_DOM15_MEM3_BLK_NSE_W [2]

MBC Memory Block NonSecure Enable Word, array offset: 0x11FF0, array step: index*0x2000, index2*0x4

struct _TRDC_MRC_Type

#include <fsl_trdc_core.h> TRDC MRC control register definition. MRC_DOM0_RGD_W[region][word].

Public Members

___I uint32_t MRC_GLBCFG

MRC Global Configuration Register, array offset: 0x14000, array step: 0x1000

___IO uint32_t MRC_NSE_RGN_INDIRECT

MRC NonSecure Enable Region Indirect, array offset: 0x14010, array step: 0x1000

___O uint32_t MRC_NSE_RGN_SET

MRC NonSecure Enable Region Set, array offset: 0x14014, array step: 0x1000

___O uint32_t MRC_NSE_RGN_CLR

MRC NonSecure Enable Region Clear, array offset: 0x14018, array step: 0x1000

___O uint32_t MRC_NSE_RGN_CLR_ALL

MRC NonSecure Enable Region Clear All, array offset: 0x1401C, array step: 0x1000

___IO uint32_t MRC_GLBAC [8]

MRC Global Access Control, array offset: 0x14020, array step: index*0x1000, index2*0x4

___IO uint32_t MRC_DOM0_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14040, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM0_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x140C0, array step: 0x1000

___IO uint32_t MRC_DOM1_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14140, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM1_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x141C0, array step: 0x1000

___IO uint32_t MRC_DOM2_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14240, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM2_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x142C0, array step: 0x1000

___IO uint32_t MRC_DOM3_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14340, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM3_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x143C0, array step: 0x1000

___IO uint32_t MRC_DOM4_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14440, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM4_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x144C0, array step: 0x1000

___IO uint32_t MRC_DOM5_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14540, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM5_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x145C0, array step: 0x1000

___IO uint32_t MRC_DOM6_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14640, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM6_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x146C0, array step: 0x1000

___IO uint32_t MRC_DOM7_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14740, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM7_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x147C0, array step: 0x1000

___IO uint32_t MRC_DOM8_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14840, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM8_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x148C0, array step: 0x1000

___IO uint32_t MRC_DOM9_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14940, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM9_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x149C0, array step: 0x1000

___IO uint32_t MRC_DOM10_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14A40, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM10_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x14AC0, array step: 0x1000

___IO uint32_t MRC_DOM11_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14B40, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM11_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x14BC0, array step: 0x1000

___IO uint32_t MRC_DOM12_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14C40, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM12_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x14CC0, array step: 0x1000

___IO uint32_t MRC_DOM13_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14D40, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM13_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x14DC0, array step: 0x1000

___IO uint32_t MRC_DOM14_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14E40, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM14_RGD_NSE

MRC Region Descriptor NonSecure Enable, array offset: 0x14EC0, array step: 0x1000

___IO uint32_t MRC_DOM15_RGD_W [16][2]

MRC Region Descriptor Word 0..MRC Region Descriptor Word 1, array offset: 0x14F40, array step: index*0x1000, index2*0x8, index3*0x4

___IO uint32_t MRC_DOM15_RGD_NSE
MRC Region Descriptor NonSecure Enable, array offset: 0x14FC0, array step: 0x1000

struct MBC_DERR

Public Members

___I uint32_t W0
MBC Domain Error Word0 Register, array offset: 0x400, array step: 0x10

___I uint32_t W1
MBC Domain Error Word1 Register, array offset: 0x404, array step: 0x10

___O uint32_t W3
MBC Domain Error Word3 Register, array offset: 0x40C, array step: 0x10

struct MRC_DERR

Public Members

___I uint32_t W0
MRC Domain Error Word0 Register, array offset: 0x480, array step: 0x10

___I uint32_t W1
MRC Domain Error Word1 Register, array offset: 0x484, array step: 0x10

___O uint32_t W3
MRC Domain Error Word3 Register, array offset: 0x48C, array step: 0x10

union ___unnamed217___

Public Members

struct *_TRDC_DomainAssignment_Type* MDA_DFMT0[8]

struct *_TRDC_DomainAssignment_Type* MDA_DFMT1[8]

struct MDA_DFMT0

Public Members

___IO uint32_t MDA_W_DFMT0 [8]
DAC Master Domain Assignment Register, array offset: 0x800, array step: index*0x20, index2*0x4

struct MDA_DFMT1

Public Members

___IO uint32_t MDA_W_DFMT1 [1]
DAC Master Domain Assignment Register, array offset: 0x800, array step: index*0x20, index2*0x4

2.104 Trdc_soc

enum _trdc_master

Enumeration for TRDC master mapping.

Defines the enumeration for TRDC master resource collections.

Values:

enumerator kTRDC1_MasterReserved
Reserved

enumerator kTRDC1_MasterCM33
CM33

enumerator kTRDC1_MasterEDMA1
EDMA1

enumerator kTRDC1_MasterMTR_FBX
MTR FBX

enumerator kTRDC1_MasterMTR
MTR

enumerator kTRDC2_MasterReserved0
Reserved0

enumerator kTRDC2_MasterReserved1
Reserved1

enumerator kTRDC2_MasterDAP
DAP AHB_AP_SYS

enumerator kTRDC2_MasterCoreSight
CoreSight

enumerator kTRDC2_MasterEDMA2
EDMA2

enumerator kTRDC3_MasterUSDHC1
uSDHC1

enumerator kTRDC3_MasterUSDHC2
uSDHC2

enumerator kTRDC3_MasterTestPort
Test port

enumerator kTRDC3_MasterUSDHC3
USDHC3

enumerator kTRDC3_MasterENET0
ENET0

enumerator kTRDC3_MasterENET1
ENET1

enumerator kTRDC3_MasterENETQos
ENET Qos

enumerator kTRDC3_MasterCA55Read
CA55 read channel

enumerator kTRDC3_MasterCA55Write
CA55 write channel

enumerator kTRDC3_MasterNPUm0
NPU m0

enumerator kTRDC3_MasterNPUm1
NPU m1

enumerator kTRDC_MediaMix_MasterISI_M
ISI M

enumerator kTRDC_MediaMix_MasterISI_U_V
ISI U&V

enumerator kTRDC_MediaMix_MasterPXP
PXP

enumerator kTRDC_MediaMix_MasterLCDIF
Lcdif

enumerator kTRDC_HSIOMix_MasterUSB1
USB1

enumerator kTRDC_HSIOMix_MasterUSB2
USB2

typedef enum *_trdc_master* trdc_master_t
Enumeration for TRDC master mapping.

Defines the enumeration for TRDC master resource collections.

typedef void TRDC_Type
TRDC typedef.

FSL_TRDC_SOC_DRIVER_VERSION
Driver version 2.0.0.

TRDC_DACFG_NCM_MASK

TRDC_MBC_MEM_GLBCFG_NBLKS_MASK

TRDC_MBC_MEM_GLBCFG_SIZE_LOG2_MASK

TRDC_MBC_MEM_GLBCFG_SIZE_LOG2_SHIFT

TRDC_MBC_NSE_BLK_CLR_ALL_DID_SEL0_SHIFT

TRDC_MDA_W_DFMT0_LK1_MASK

TRDC_MDA_W_DFMT0_VLD_MASK

TRDC_MDA_W_DFMT1_LK1_MASK

TRDC_MDA_W_DFMT1_VLD_MASK

TRDC_MRC_DOM0_RGD_W_MRACSEL_MASK

TRDC_MRC_DOM0_RGD_W_NSE_MASK

TRDC_MRC_DOM0_RGD_W_VLD_MASK

TRDC_MRC_GLBCFG_NRGNS_MASK

TRDC__MRC__GLBCFG__NRGNS__SHIFT

TRDC__TRDC__CR__GVLDB__MASK

TRDC__TRDC__CR__GVLDM__MASK

TRDC__TRDC__CR__GVLDR__MASK

TRDC__TRDC__FLW__CTL__LK__MASK

TRDC__TRDC__FLW__CTL__V__MASK

TRDC__TRDC__HWCFG0__NDID__MASK

TRDC__TRDC__HWCFG0__NDID__SHIFT

TRDC__TRDC__HWCFG0__NMBC__MASK

TRDC__TRDC__HWCFG0__NMBC__SHIFT

TRDC__TRDC__HWCFG0__NMRC__MASK

TRDC__TRDC__HWCFG0__NMRC__SHIFT

TRDC__TRDC__HWCFG0__NMSTR__MASK

TRDC__TRDC__HWCFG0__NMSTR__SHIFT

TRDC__TRDC__HWCFG1__DID__MASK

TRDC__TRDC__HWCFG1__DID__SHIFT

TRDC__TRDC__IDAU__CR__VLD__MASK

TRDC__W1__EATR__MASK

TRDC__W1__EATR__SHIFT

TRDC__W1__EDID__MASK

TRDC__W1__EPORT__MASK

TRDC__W1__EPORT__SHIFT

TRDC__W1__ERW__MASK

TRDC__W1__ERW__SHIFT

TRDC__W1__EST__MASK

TRDC__W1__EST__SHIFT

TRDC__MBC__NSE__BLK__CLR__ALL__MEMSEL

TRDC__MRC__DOM0__RGD__W__MRACSEL

TRDC__MRC__DOM0__RGD__W__NSE

TRDC__MRC__DOM0__RGD__W__VLD

TRDC__TRDC__FDID__FDID

TRDC__TRDC__FLW__CTL__LK

TRDC__TRDC__FLW__CTL__V

TRDC_W3_RECR

TRDC_BASE_PTRS
: TRDC base table.

TRDC_GENERAL_OFFSET
: TRDC base address convert macro.

TRDC_FLW_OFFSET

TRDC_DOMAIN_ERROR_OFFSET

TRDC_DOMAIN_ASSIGNMENT_OFFSET

TRDC_MBC_OFFSET(x)

TRDC_MBC_ARRAY_STEP

TRDC_MRC_OFFSET(x)

TRDC_MRC_ARRAY_STEP

2.105 TRGMUX: Trigger Mux Driver

static inline void TRGMUX_LockRegister(TRGMUX_Type *base, uint32_t index)
: Sets the flag of the register which is used to mark writeable.

  The function sets the flag of the register which is used to mark writeable. Example:

```
TRGMUX_LockRegister(TRGMUX0,kTRGMUX_Trgmux0Dmamux0);
```

  Parameters

  - base – TRGMUX peripheral base address.
  - index – The index of the TRGMUX register, see the enum trgmux_device_t defined in <SOC>.h.

status_t TRGMUX_SetTriggerSource(TRGMUX_Type *base, uint32_t index, *trgmux_trigger_input_t* input, uint32_t trigger_src)
: Configures the trigger source of the appointed peripheral.

  The function configures the trigger source of the appointed peripheral. Example:

```
TRGMUX_SetTriggerSource(TRGMUX0, kTRGMUX_Trgmux0Dmamux0, kTRGMUX_TriggerInput0,
↪ kTRGMUX_SourcePortPin);
```

  Parameters

  - base – TRGMUX peripheral base address.
  - index – The index of the TRGMUX register, see the enum trgmux_device_t defined in <SOC>.h.
  - input – The MUX select for peripheral trigger input
  - trigger_src – The trigger inputs for various peripherals. See the enum trgmux_source_t defined in <SOC>.h.

  Return values

  - kStatus_Success – Configured successfully.

- kStatus_TRGMUX_Locked – Configuration failed because the register is locked.

FSL_TRGMUX_DRIVER_VERSION

TRGMUX driver version.

TRGMUX configure status.

Values:

enumerator kStatus_TRGMUX_Locked

Configure failed for register is locked

enum _trgmux_trigger_input

Defines the MUX select for peripheral trigger input.

Values:

enumerator kTRGMUX_TriggerInput0

The MUX select for peripheral trigger input 0

enumerator kTRGMUX_TriggerInput1

The MUX select for peripheral trigger input 1

enumerator kTRGMUX_TriggerInput2

The MUX select for peripheral trigger input 2

enumerator kTRGMUX_TriggerInput3

The MUX select for peripheral trigger input 3

typedef enum *_trgmux_trigger_input* trgmux_trigger_input_t

Defines the MUX select for peripheral trigger input.

2.106 TSTMR: Timestamp Timer Driver

FSL_TSTMR_DRIVER_VERSION

Version 2.0.3

static inline uint64_t TSTMR_ReadTimeStamp(TSTMR_Type *base)

Reads the time stamp.

This function reads the low and high registers and returns the 56-bit free running counter value. This can be read by software at any time to determine the software ticks. TSTMR registers can be read with 32-bit accesses only. The TSTMR LOW read should occur first, followed by the TSTMR HIGH read.

Parameters

- base – TSTMR peripheral base address.

Returns

The 56-bit time stamp value.

static inline void TSTMR_DelayUs(TSTMR_Type *base, uint64_t delayInUs)

Delays for a specified number of microseconds.

This function repeatedly reads the timestamp register and waits for the user-specified delay value.

Parameters

- base – TSTMR peripheral base address.

- delayInUs – Delay value in microseconds.

FSL_COMPONENT_ID

2.107 CACHE: CACHE Memory Controller

uint32_t XCACHE_GetInstanceByAddr(uint32_t address)

brief Returns an instance number given physical memory address.

param address The physical memory address.

Returns

XCACHE instance number starting from 0.

void XCACHE_EnableCache(XCACHE_Type *base)

Enables the cache.

Parameters

- base – XCACHE peripheral base address.

void XCACHE_DisableCache(XCACHE_Type *base)

Disables the cache.

Parameters

- base – XCACHE peripheral base address.

void XCACHE_InvalidateCache(XCACHE_Type *base)

Invalidates the cache.

Parameters

- base – XCACHE peripheral base address.

void XCACHE_InvalidateCacheByRange(uint32_t address, uint32_t size_byte)

Invalidates cache by range.

Note: Address and size should be aligned to "XCACHE_LINESIZE_BYTE". The startAddr here will be forced to align to XCACHE_LINESIZE_BYTE if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address of cache.
- size_byte – size of the memory to be invalidated, should be larger than 0, better to align with cache line size.

void XCACHE_CleanCache(XCACHE_Type *base)

Cleans the cache.

Parameters

- base – XCACHE peripheral base address.

void XCACHE_CleanCacheByRange(uint32_t address, uint32_t size_byte)

Cleans cache by range.

Note: Address and size should be aligned to "XCACHE_LINESIZE_BYTE". The startAddr here will be forced to align to XCACHE_LINESIZE_BYTE if startAddr is not aligned. For the

size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address of cache.
- size_byte – size of the memory to be cleaned, should be larger than 0, better to align with cache line size.

void XCACHE_CleanInvalidateCache(XCACHE_Type *base)

Cleans and invalidates the cache.

Parameters

- base – XCACHE peripheral base address.

void XCACHE_CleanInvalidateCacheByRange(uint32_t address, uint32_t size_byte)

Cleans and invalidate cache by range.

Note: Address and size should be aligned to "XCACHE_LINESIZE_BYTE". The startAddr here will be forced to align to XCACHE_LINESIZE_BYTE if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address of cache.
- size_byte – size of the memory to be Cleaned and Invalidated, should be larger than 0, better to align with cache line size.

static inline void ICACHE_InvalidateByRange(uint32_t address, uint32_t size_byte)

Invalidates instruction cache by range.

Note: Address and size should be aligned to XCACHE_LINESIZE_BYTE due to the cache operation unit FSL_FEATURE_XCACHE_LINESIZE_BYTE. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be invalidated, should be larger than 0, better to align with cache line size.

static inline void DCACHE_InvalidateByRange(uint32_t address, uint32_t size_byte)

Invalidates data cache by range.

Note: Address and size should be aligned to XCACHE_LINESIZE_BYTE due to the cache operation unit FSL_FEATURE_XCACHE_LINESIZE_BYTE. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be invalidated, should be larger than 0, better to align with cache line size.

static inline void DCACHE_CleanByRange(uint32_t address, uint32_t size_byte)

Clean data cache by range.

Note: Address and size should be aligned to XCACHE_LINESIZE_BYTE due to the cache operation unit FSL_FEATURE_XCACHE_LINESIZE_BYTE. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be cleaned, should be larger than 0, better to align with cache line size.

static inline void DCACHE_CleanInvalidateByRange(uint32_t address, uint32_t size_byte)

Cleans and Invalidates data cache by range.

Note: Address and size should be aligned to XCACHE_LINESIZE_BYTE due to the cache operation unit FSL_FEATURE_XCACHE_LINESIZE_BYTE. The startAddr here will be forced to align to the cache line size if startAddr is not aligned. For the size_byte, application should make sure the alignment or make sure the right operation order if the size_byte is not aligned.

Parameters

- address – The physical address.
- size_byte – size of the memory to be Cleaned and Invalidated, should be larger than 0, better to align with cache line size.

FSL_CACHE_DRIVER_VERSION

cache driver version.

XCACHE_LINESIZE_BYTE

cache line size.

Chapter 3

Middleware

3.1 Connectivity

3.1.1 lwIP

This is the NXP fork of the lwIP networking stack.

- For details about changes and additions made by NXP, see CHANGELOG.
- For details about the NXP porting layer, see *The NXP lwIP Port*.
- For usage and API of lwIP, use official documentation at http://www.nongnu.org/lwip/.

The NXP lwIP Port

Below is description of possible settings of the port layer and an overview of a few helper functions.

The best place for redefinition of any mentioned macro is lwipopts.h.

The declaration of every mentioned function is in ethernetif.h. Please check the doxygen comments of those functions before.

Link state Physical link state (up/down) and its speed and duplex must be read out from PHY over MDIO bus. Especially link information is useful for lwIP stack so it can for example send DHCP discovery immediately when a link becomes up.

To simplify this port layer offers a function ethernetif_probe_link() which reads those data from PHY and forwards them into lwIP stack.

In almost all examples this function is called every ETH_LINK_POLLING_INTERVAL_MS (1500ms) by a function probe_link_cyclic().

By setting ETH_LINK_POLLING_INTERVAL_MS to 0 polling will be disabled. On FreeRTOS, probe_link_cyclic() will be then called on an interrupt generated by PHY. GPIO port and pin for the interrupt line must be set in the ethernetifConfig struct passed to ethernetif_init(). On bare metal interrupts are not supported right now.

Rx task To improve the reaction time of the app, reception of packets is done in a dedicated task. The rx task stack size can be set by ETH_RX_TASK_STACK_SIZE macro, its priority by ETH_RX_TASK_PRIO.

If you want to save memory you can set reception to be done in an interrupt by setting ETH_DO_RX_IN_SEPARATE_TASK macro to 0.

Disabling Rx interrupt when out of buffers If ETH_DISABLE_RX_INT_WHEN_OUT_OF_BUFFERS is set to 1, then when the port gets out of Rx buffers, Rx enet interrupt will be disabled for a particular controller. Everytime Rx buffer is freed, Rx interrupt will be enabled.

This prevents your app from never getting out of Rx interrupt when the network is flooded with traffic.

ETH_DISABLE_RX_INT_WHEN_OUT_OF_BUFFERS is by default turned on, on FreeRTOS and off on bare metal.

Limit the number of packets read out from the driver at once on bare metal. You may define macro ETH_MAX_RX_PKTS_AT_ONCE to limit the number of received packets read out from the driver at once.

In case of heavy Rx traffic, lowering this number improves the realtime behaviour of an app. Increasing improves Rx throughput.

Setting it to value < 1 or not defining means “no limit”.

Helper functions If your application needs to wait for the link to become up you can use one of the following functions:

- ethernetif_wait_linkup()- Blocks until the link on the passed netif is not up.
- ethernetif_wait_linkup_array() - Blocks until the link on at least one netif from the passed list of netifs becomes up.

If your app needs to wait for the IPv4 address on a particular netif to become different than “ANY” address (255.255.255.255) function ethernetif_wait_ipv4_valid() does this.

3.2 MultiCore

3.2.1 Multicore SDK

Multicore Software Development Kit (MCSDK) is a Software Development Kit that provides comprehensive software support for NXP dual/multicore devices. The MCSDK is combined with the MCUXpresso SDK to make the software framework for easy development of multicore applications.

Multicore SDK (MCSDK) Release Notes

Overview These are the release notes for the NXP Multicore Software Development Kit (MCSDK) version 25.06.00.
This software package contains components for efficient work with multicore devices as well as for the
multiprocessor communication.

What is new

- eRPC CHANGELOG
- RPMsg-Lite CHANGELOG
- MCMgr CHANGELOG
- Supported evaluation boards (multicore examples):
  - LPCXpresso55S69
  - FRDM-K32L3A6
  - MIMXRT1170-EVKB
  - MIMXRT1160-EVK
  - MIMXRT1180-EVK
  - MCX-N5XX-EVK
  - MCX-N9XX-EVK
  - FRDM-MCXN947
  - MIMXRT700-EVK
  - KW47-EVK
  - KW47-LOC
  - FRDM-MCXW72
  - MCX-W72-EVK
- Supported evaluation boards (multiprocessor examples):
  - LPCXpresso55S36
  - FRDM-K22F
  - FRDM-K32L2B
  - MIMXRT685-EVK
  - MIMXRT1170-EVKB
  - MIMXRT1180
  - FRDM-MCXN236
  - FRDM-MCXC242
  - FRDM-MCXC444
  - MCX-N9XX-EVK
  - FRDM-MCXN947
  - MIMXRT700-EVK

Development tools The Multicore SDK (MCSDK) was compiled and tested with development tools referred in: Development tools

Release contents This table describes the release contents. Not all MCUXpresso SDK packages contain the whole set of these components.

Deliverable	Location
Multicore SDK location <MCSDK_dir>	<MCUXpressoSDK_install_dir>/middleware/multicore/
Documentation	<MCSDK_dir>/mcuxsdk-doc/
Embedded Remote Procedure Call component	<MCSDK_dir>/erpc/
Multicore Manager component	<MCSDK_dir>/mcmgr/
RPMsg-Lite	<MCSDK_dir>/rpmsg_lite/
Multicore demo applications	<MCUXpressoSDK_install_dir>/examples/multicore_examples/
Multiprocessor demo applications	<MCUXpressoSDK_install_dir>/examples/multiprocessor_examples/

Multicore SDK release overview Together, the Multicore SDK (MCSDK) and the MCUXpresso SDK (SDK) form a framework for the development of software for NXP multicore devices. The MCSDK release consists of the following elementary software components for multicore:

- Embedded Remote Procedure Call (eRPC)
- Multicore Manager (MCMGR) - included just in SDK for multicore devices
- Remote Processor Messaging - Lite (RPMsg-Lite) - included just in SDK for multicore devices

The MCSDK is also accompanied with documentation and several multicore and multiprocessor demo applications.

Demo applications The multicore demo applications demonstrate the usage of the MCSDK software components on supported multicore development boards.
The following multicore demo applications are located together with other MCUXpresso SDK examples in
the <MCUXpressoSDK_install_dir>/examples/multicore_examples subdirectories.

- erpc_matrix_multiply_mu
- erpc_matrix_multiply_mu_rtos
- erpc_matrix_multiply_rpmsg
- erpc_matrix_multiply_rpmsg_rtos
- erpc_two_way_rpc_rpmsg_rtos
- freertos_message_buffers
- hello_world
- multicore_manager
- rpmsg_lite_pingpong
- rpmsg_lite_pingpong_rtos
- rpmsg_lite_pingpong_tzm

The eRPC multicore component can be leveraged for inter-processor communication and remote procedure calls between SoCs / development boards.
The following multiprocessor demo applications are located together with other MCUXpresso SDK examples in
the <MCUXpressoSDK_install_dir>/examples/multiprocessor_examples subdirectories.

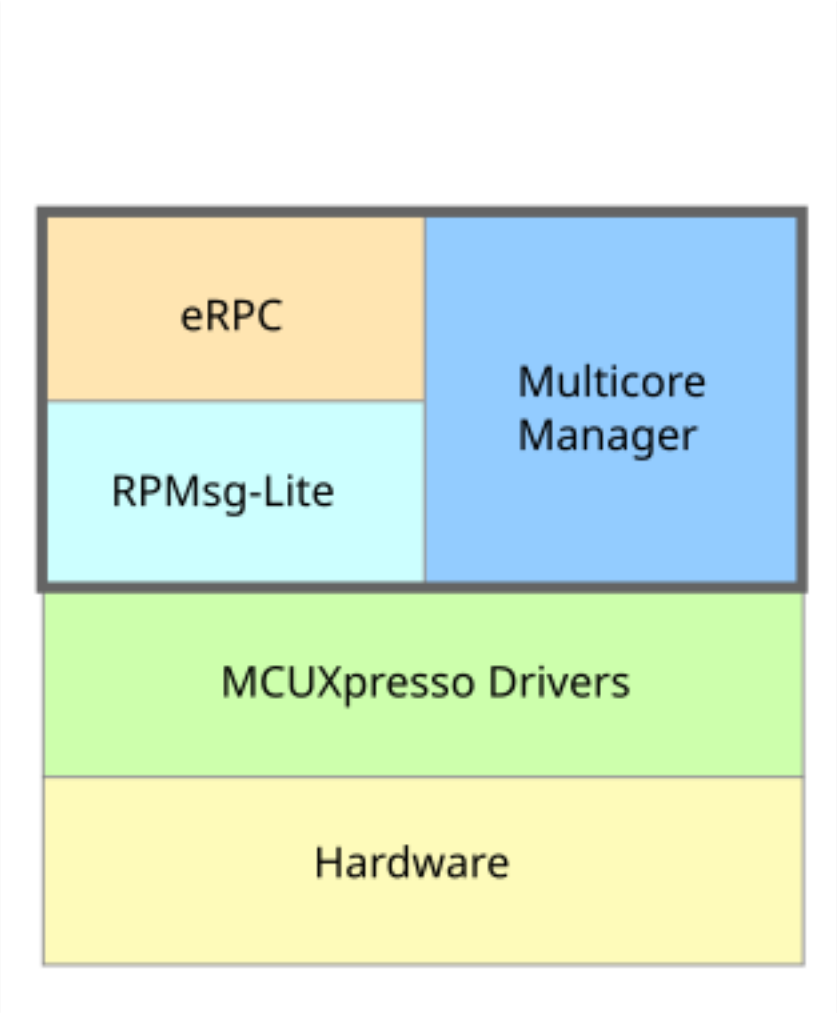
- erpc_client_matrix_multiply_spi
- erpc_server_matrix_multiply_spi

- erpc_client_matrix_multiply_uart
- erpc_server_matrix_multiply_uart
- erpc_server_dac_adc
- erpc_remote_control

Getting Started with Multicore SDK (MCSDK)

Overview Multicore Software Development Kit (MCSDK) is a Software Development Kit that provides comprehensive software support for NXP dual/multicore devices. The MCSDK is combined with the MCUXpresso SDK to make the software framework for easy development of multicore applications.

The following figure highlights the layers and main software components of the MCSDK.

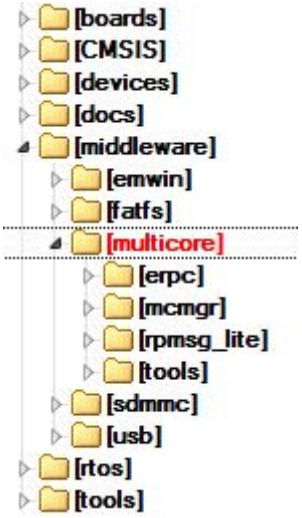


All the MCSDK-related files are located in <MCUXpressoSDK_install_dir>/middleware/multicore folder.

For supported toolchain versions, see the *Multicore SDK v25.06.00 Release Notes* (document MCSDKRN). For the latest version of this and other MCSDK documents, visit www.nxp.com.

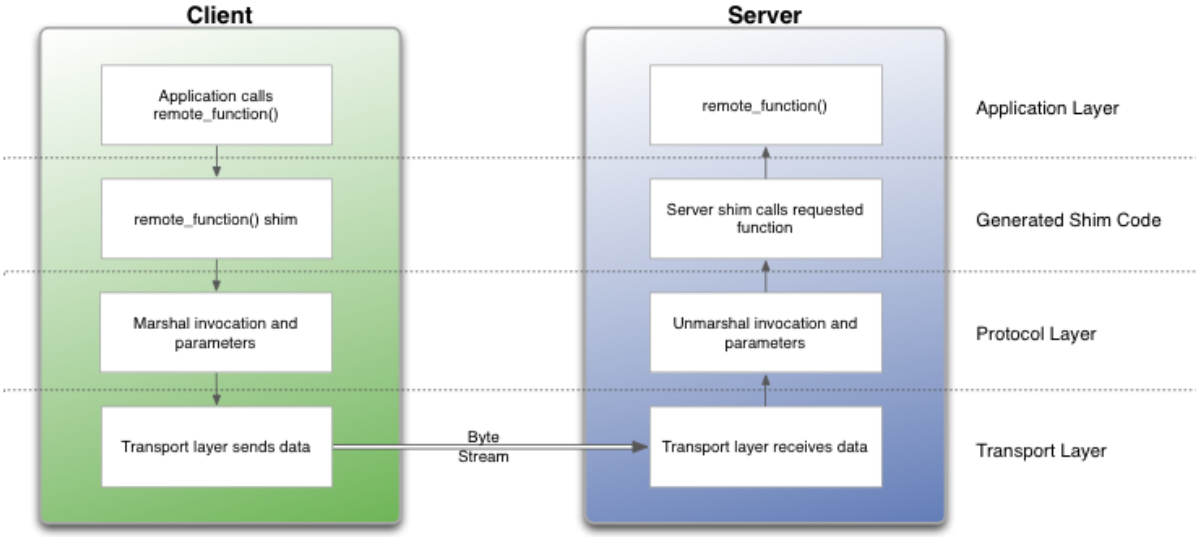
Multicore SDK (MCSDK) components The MCSDK consists of the following software components:

- **Embedded Remote Procedure Call (eRPC):** This component is a combination of a library and code generator tool that implements a transparent function call interface to remote services (running on a different core).
- **Multicore Manager (MCMGR):** This library maintains information about all cores and starts up secondary/auxiliary cores.
- **Remote Processor Messaging - Lite (RPMsg-Lite):** Inter-Processor Communication library.



Embedded Remote Procedure Call (eRPC) The Embedded Remote Procedure Call (eRPC) is the RPC system created by NXP. The RPC is a mechanism used to invoke a software routine on a remote system via a simple local function call.

When a remote function is called by the client, the function's parameters and an identifier for the called routine are marshaled (or serialized) into a stream of bytes. This byte stream is transported to the server through a communications channel (IPC, TPC/IP, UART, and so on). The server unmarshaled the parameters, determines which function was invoked, and calls it. If the function returns a value, it is marshaled and sent back to the client.



RPC implementations typically use a combination of a tool (erpcgen) and IDL (interface definition language) file to generate source code to handle the details of marshaling a function's parameters and building the data stream.

Main eRPC features:

- Scalable from BareMetal to Linux OS - configurable memory and threading policies.
- Focus on embedded systems - intrinsic support for C, modular, and lightweight implementation.
- Abstracted transport interface - RPMsg is the primary transport for multicore, UART, or SPI-based solutions can be used for multichip.

The eRPC library is located in the <MCUXpressoSDK_install_dir>/middleware/multicore/erpc folder. For detailed information about the eRPC, see the documentation available in the <MCUXpressoSDK_install_dir>/middleware/multicore/erpc/doc folder.

Multicore Manager (MCMGR) The Multicore Manager (MCMGR) software library provides a number of services for multicore systems.

The main MCMGR features:

- Maintains information about all cores in system.
- Secondary/auxiliary cores startup and shutdown.
- Remote core monitoring and event handling.

The MCMGR library is located in the <MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr folder. For detailed information about the MCMGR library, see the documentation available in the <MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr/doc folder.

Remote Processor Messaging Lite (RPMsg-Lite) RPMsg-Lite is a lightweight implementation of the RPMsg protocol. The RPMsg protocol defines a standardized binary interface used to communicate between multiple cores in a heterogeneous multicore system. Compared to the legacy OpenAMP implementation, RPMsg-Lite offers a code size reduction, API simplification, and improved modularity.

The main RPMsg protocol features:

- Shared memory interprocessor communication.
- Virtio-based messaging bus.
- Application-defined messages sent between endpoints.
- Portable to different environments/platforms.
- Available in upstream Linux OS.

The RPMsg-Lite library is located in the <MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg-lite folder. For detailed information about the RPMsg-Lite, see the RPMsg-Lite User's Guide located in the <MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg_lite/doc folder.

MCSDK demo applications Multicore and multiprocessor example applications are stored together with other MCUXpresso SDK examples, in the dedicated multicore subfolder.

Location	Folder
Multicore example projects	<MCUXpressoSDK_install_dir>/examples/multicore_examples/<application_name>/
Multiprocessor example projects	<MCUXpressoSDK_install_dir>/examples/multiprocessor_examples/<application_name>/

See the *Getting Started with MCUXpresso SDK* (document MCUXSDKGSUG) and *Getting Started with MCUXpresso SDK for XXX Derivatives* documents for more information about the MCUXpresso SDK example folder structure and the location of individual files that form the example

application projects. These documents also contain information about building, running, and debugging multicore demo applications in individual supported IDEs. Each example application also contains a readme file that describes the operation of the example and required setup steps.

Inter-Processor Communication (IPC) levels The MCSDK provides several mechanisms for Inter-Processor Communication (IPC). Particular ways and levels of IPC are described in this chapter.

IPC using low-level drivers

The NXP multicore SoCs are equipped with peripheral modules dedicated for data exchange between individual cores. They deal with the Mailbox peripheral for LPC parts and the Messaging Unit (MU) peripheral for Kinetis and i.MX parts. The common attribute of both modules is the ability to provide a means of IPC, allowing multiple CPUs to share resources and communicate with each other in a simple manner.

The most lightweight method of IPC uses the MCUXpresso SDK low-level drivers for these peripherals. Using the Mailbox/MU driver API functions, it is possible to pass a value from core to core via the dedicated registers (could be a scalar or a pointer to shared memory) and also to trigger inter-core interrupts for notifications.

For details about individual driver API functions, see the MCUXpresso SDK API Reference Manual of the specific multicore device. The MCUXpresso SDK is accompanied with the RPMsg-Lite documentation that shows how to use this API in multicore applications.

Messaging mechanism

On top of Mailbox/MU drivers, a messaging system can be implemented, allowing messages to send between multiple endpoints created on each of the CPUs. The RPMsg-Lite library of the MCSDK provides this ability and serves as the preferred MCUXpresso SDK messaging library. It implements ring buffers in shared memory for messages exchange without the need of a locking mechanism.

The RPMsg-Lite provides the abstraction layer and can be easily ported to different multicore platforms and environments (Operating Systems). The advantages of such a messaging system are ease of use (there is no need to study behavior of the used underlying hardware) and smooth application code portability between platforms due to unified messaging API.

However, this costs several kB of code and data memory. The MCUXpresso SDK is accompanied by the RPMsg-Lite documentation and several multicore examples. You can also obtain the latest RPMsg-Lite code from the GitHub account github.com/nxp-mcuxpresso/rpmsg-lite.

Remote procedure calls

To facilitate the IPC even more and to allow the remote functions invocation, the remote procedure call mechanism can be implemented. The eRPC of the MCSDK serves for these purposes and allows the ability to invoke a software routine on a remote system via a simple local function call. Utilizing different transport layers, it is possible to communicate between individual cores of multicore SoCs (via RPMsg-Lite) or between separate processors (via SPI, UART, or TCP/IP). The eRPC is mostly applicable to the MPU parts with enough of memory resources like i.MX parts.

The eRPC library allows you to export existing C functions without having to change their prototypes (in most cases). It is accompanied by the code generator tool that generates the shim code for serialization and invocation based on the IDL file with definitions of data types and remote interfaces (API).

If the communicating peer is running as a Linux OS user-space application, the generated code can be either in C/C++ or Python.

Using the eRPC simplifies the access to services implemented on individual cores. This way, the following types of applications running on dedicated cores can be easily interfaced:

- Communication stacks (USB, Thread, Bluetooth Low Energy, Zigbee)

- Sensor aggregation/fusion applications
- Encryption algorithms
- Virtual peripherals

The eRPC is publicly available from the following GitHub account: github.com/EmbeddedRPC/erpc. Also, the MCUXpresso SDK is accompanied by the eRPC code and several multicore and multiprocessor eRPC examples.

The mentioned IPC levels demonstrate the scalability of the Multicore SDK library. Based on application needs, different IPC techniques can be used. It depends on the complexity, required speed, memory resources, system design, and so on. The MCSDK brings users the possibility for quick and easy development of multicore and multiprocessor applications.

Changelog Multicore SDK

All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog, and this project adheres to Semantic Versioning.

[25.06.00]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.14.0
  - eRPC generator (erpcgen) v1.14.0
  - Multicore Manager (MCMgr) v5.0.0
  - RPMsg-Lite v5.2.0

[25.03.00]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.13.0
  - eRPC generator (erpcgen) v1.13.0
  - Multicore Manager (MCMgr) v4.1.7
  - RPMsg-Lite v5.1.4

[24.12.00]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.13.0
  - eRPC generator (erpcgen) v1.13.0
  - Multicore Manager (MCMgr) v4.1.6
  - RPMsg-Lite v5.1.3

[2.16.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.13.0
  - eRPC generator (erpcgen) v1.13.0

  - Multicore Manager (MCMgr) v4.1.5
  - RPMsg-Lite v5.1.2

[2.15.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.12.0
  - eRPC generator (erpcgen) v1.12.0
  - Multicore Manager (MCMgr) v4.1.5
  - RPMsg-Lite v5.1.1

[2.14.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.11.0
  - eRPC generator (erpcgen) v1.11.0
  - Multicore Manager (MCMgr) v4.1.4
  - RPMsg-Lite v5.1.0

[2.13.0_imxrt1180a0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.10.0
  - eRPC generator (erpcgen) v1.10.0
  - Multicore Manager (MCMgr) v4.1.3
  - RPMsg-Lite v5.0.0

[2.13.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.10.0
  - eRPC generator (erpcgen) v1.10.0
  - Multicore Manager (MCMgr) v4.1.3
  - RPMsg-Lite v5.0.0

[2.12.0_imx93]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.9.1
  - eRPC generator (erpcgen) v1.9.1
  - Multicore Manager (MCMgr) v4.1.2
  - RPMsg-Lite v4.0.1

[2.12.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.9.1
  - eRPC generator (erpcgen) v1.9.1
  - Multicore Manager (MCMgr) v4.1.2
  - RPMsg-Lite v4.0.0

[2.11.1]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.9.0
  - eRPC generator (erpcgen) v1.9.0
  - Multicore Manager (MCMgr) v4.1.1
  - RPMsg-Lite v3.2.1

[2.11.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.9.0
  - eRPC generator (erpcgen) v1.9.0
  - Multicore Manager (MCMgr) v4.1.1
  - RPMsg-Lite v3.2.0

[2.10.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.8.1
  - eRPC generator (erpcgen) v1.8.1
  - Multicore Manager (MCMgr) v4.1.1
  - RPMsg-Lite v3.1.2

[2.9.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.8.0
  - eRPC generator (erpcgen) v1.8.0
  - Multicore Manager (MCMgr) v4.1.1
  - RPMsg-Lite v3.1.1

[2.8.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.7.4
  - eRPC generator (erpcgen) v1.7.4
  - Multicore Manager (MCMgr) v4.1.0
  - RPMsg-Lite v3.1.0

[2.7.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.7.3
  - eRPC generator (erpcgen) v1.7.3
  - Multicore Manager (MCMgr) v4.1.0
  - RPMsg-Lite v3.0.0

[2.6.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.7.2
  - eRPC generator (erpcgen) v1.7.2
  - Multicore Manager (MCMgr) v4.0.3
  - RPMsg-Lite v2.2.0

[2.5.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.7.1
  - eRPC generator (erpcgen) v1.7.1
  - Multicore Manager (MCMgr) v4.0.2
  - RPMsg-Lite v2.0.2

[2.4.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.7.0
  - eRPC generator (erpcgen) v1.7.0
  - Multicore Manager (MCMgr) v4.0.1
  - RPMsg-Lite v2.0.1

[2.3.1]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.6.0
  - eRPC generator (erpcgen) v1.6.0
  - Multicore Manager (MCMgr) v4.0.0
  - RPMsg-Lite v1.2.0

[2.3.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.5.0
  - eRPC generator (erpcgen) v1.5.0
  - Multicore Manager (MCMgr) v3.0.0
  - RPMsg-Lite v1.2.0

[2.2.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.4.0
  - eRPC generator (erpcgen) v1.4.0
  - Multicore Manager (MCMgr) v2.0.1
  - RPMsg-Lite v1.1.0

[2.1.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.3.0
  - eRPC generator (erpcgen) v1.3.0

[2.0.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.2.0
  - eRPC generator (erpcgen) v1.2.0
  - Multicore Manager (MCMgr) v2.0.0
  - RPMsg-Lite v1.0.0

[1.1.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.1.0
  - Multicore Manager (MCMgr) v1.1.0
  - Open-AMP / RPMsg based on SHA1 ID 44b5f3c0a6458f3cf80 rev01

[1.0.0]

- Multicore SDK component versions:
  - embedded Remote Procedure Call (eRPC) v1.0.0
  - Multicore Manager (MCMgr) v1.0.0
  - Open-AMP / RPMsg based on SHA1 ID 44b5f3c0a6458f3cf80 rev00

Multicore SDK Components

RPMSG-Lite

MCUXpresso SDK : mcuxsdk-middleware-rpmsg-lite

Overview This repository is for MCUXpresso SDK RPMSG-Lite middleware delivery and it contains RPMSG-Lite component officially provided in NXP MCUXpresso SDK. This repository is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk for the complete delivery of MCUXpresso SDK to be able to build and run RPMSG-Lite examples that are based on mcux-sdk-middleware-rpmsg-lite component.

Documentation Overall details can be reviewed here: MCUXpresso SDK Online Documentation

Visit RPMSG-Lite - Documentation to review details on the contents in this sub-repo.

Setup Instructions on how to install the MCUXpresso SDK provided from GitHub via west manifest Getting Started with SDK - Detailed Installation Instructions

Contribution We welcome and encourage the community to submit patches directly to the rpmsg-lite project placed on github. Contributing can be managed via pull-requests. Before a pull-request is created the code should be tested and properly formatted.

RPMSG-Lite This documentation describes the RPMsg-Lite component, which is a lightweight implementation of the Remote Processor Messaging (RPMsg) protocol. The RPMsg protocol defines a standardized binary interface used to communicate between multiple cores in a heterogeneous multicore system.

Compared to the RPMsg implementation of the Open Asymmetric Multi Processing (OpenAMP) framework (https://github.com/OpenAMP/open-amp), the RPMsg-Lite offers a code size reduction, API simplification, and improved modularity. On smaller Cortex-M0+ based systems, it is recommended to use RPMsg-Lite.

The RPMsg-Lite is an open-source component developed by NXP Semiconductors and released under the BSD-compatible license.

For Further documentation, please look at doxygen documentation at: https://nxp-mcuxpresso.github.io/rpmsg-lite/

For overview please read RPMSG-Lite VirtIO Overview.

For RPMSG-Lite Design Considerations please read RPMSG-Lite Design Considerations.

Motivation to create RPMsg-Lite There are multiple reasons why RPMsg-Lite was developed. One reason is the need for the small footprint of the RPMsg protocol-compatible communication component, another reason is the simplification of extensive API of OpenAMP RPMsg implementation.

RPMsg protocol was not documented, and its only definition was given by the Linux Kernel and legacy OpenAMP implementations. This has changed with [1] which is a standardization protocol allowing multiple different implementations to coexist and still be mutually compatible.

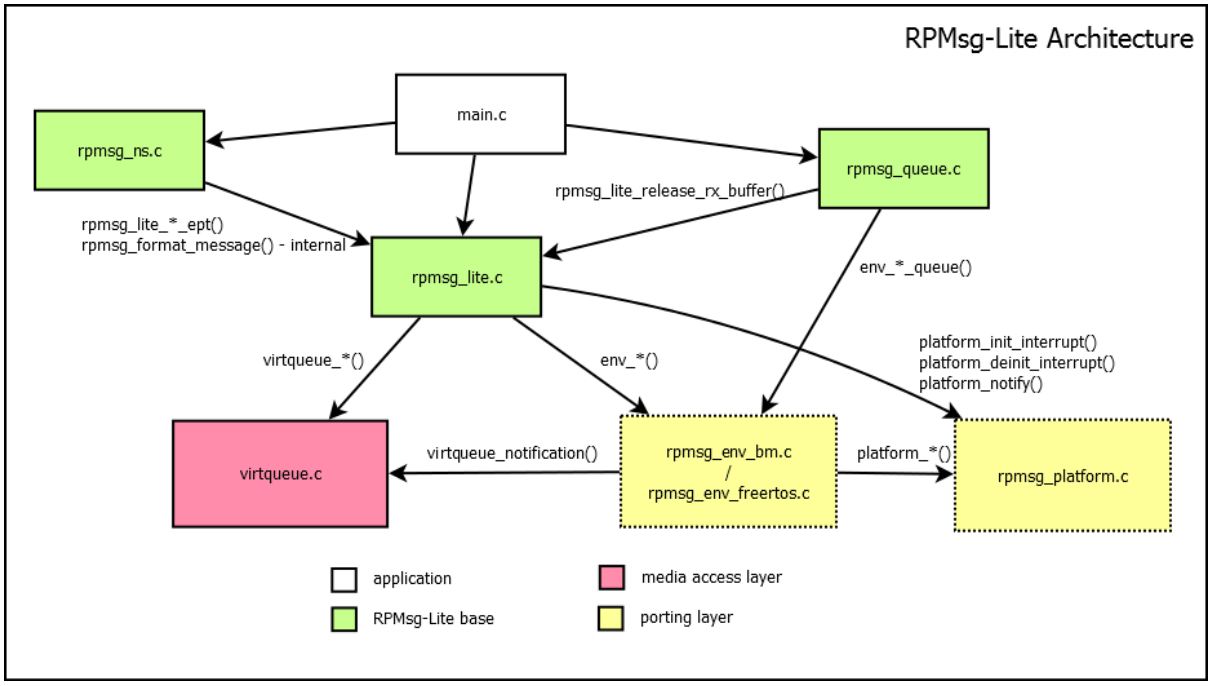
Small MCU-based systems often do not implement dynamic memory allocation. The creation of static API in RPMsg-Lite enables another reduction of resource usage. Not only does the dynamic allocation adds another 5 KB of code size, but also communication is slower and less deterministic, which is a property introduced by dynamic memory. The following table shows some rough comparison data between the OpenAMP RPMsg implementation and new RPMsg-Lite implementation:

Component / Configuration	Flash [B]	RAM [B]
OpenAMP RPMsg / Release (reference)	5547	456 + dynamic
RPMsg-Lite / Dynamic API, Release	3462	56 + dynamic
Relative Difference [%]	~62.4%	~12.3%
RPMsg-Lite / Static API (no malloc), Release	2926	352
Relative Difference [%]	~52.7%	~77.2%

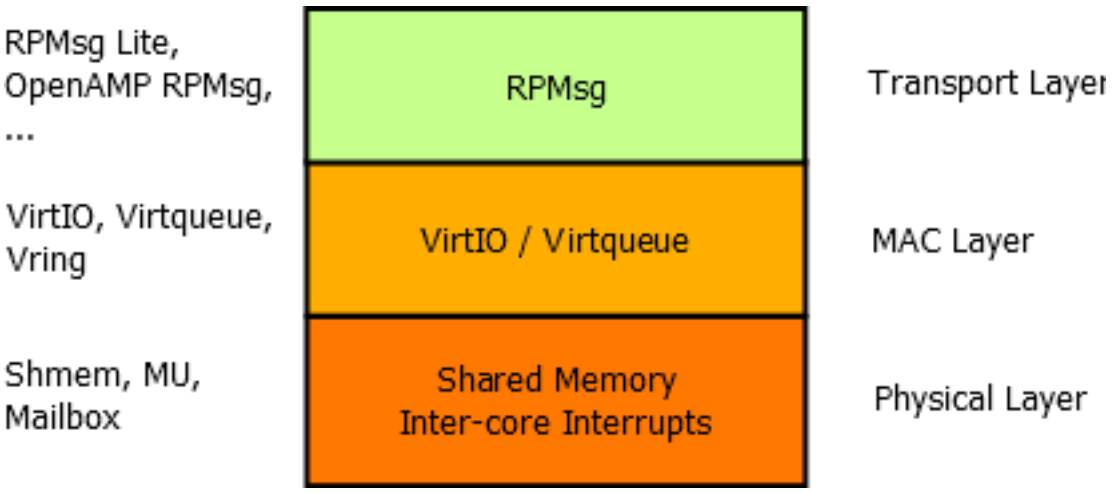
Implementation The implementation of RPMsg-Lite can be divided into three subcomponents, from which two are optional. The core component is situated in rpmsg_lite.c. Two optional components are used to implement a blocking receive API (in rpmsg_queue.c) and dynamic “named” endpoint creation and deletion announcement service (in rpmsg_ns.c).

The actual “media access” layer is implemented in virtqueue.c, which is one of the few files shared with the OpenAMP implementation. This layer mainly defines the shared memory model, and internally defines used components such as vring or virtqueue.

The porting layer is split into two sub-layers: the environment layer and the platform layer. The first sublayer is to be implemented separately for each environment. (The bare metal environment already exists and is implemented in rpmsg_env_bm.c, and the FreeRTOS environment is implemented in rpmsg_env_freertos.c etc.) Only the source file, which matches the used environment, is included in the target application project. The second sublayer is implemented in rpmsg_platform.c and defines low-level functions for interrupt enabling, disabling, and triggering mainly. The situation is described in the following figure:



RPMsg-Lite core sub-component This subcomponent implements a blocking send API and callback-based receive API. The RPMsg protocol is part of the transport layer. This is realized by using so-called endpoints. Each endpoint can be assigned a different receive callback function. However, it is important to notice that the callback is executed in an interrupt environment in current design. Therefore, certain actions like memory allocation are discouraged to execute in the callback. The following figure shows the role of RPMsg in an ISO/OSI-like layered model:



Queue sub-component (optional) This subcomponent is optional and requires implementation of the env_*_queue() functions in the environment porting layer. It uses a blocking receive API, which is common in RTOS-environments. It supports both copy and nocopy blocking receive functions.

Name Service sub-component (optional) This subcomponent is a minimum implementation of the name service which is present in the Linux Kernel implementation of RPMsg. It allows the communicating node both to send announcements about “named” endpoint (in other words, channel) creation or deletion and to receive these announcement taking any user-defined action

in an application callback. The endpoint address used to receive name service announcements is arbitrarily fixed to be 53 (0x35).

Usage The application should put the /rpmsg_lite/lib/include directory to the include path and in the application, include either the rpmsg_lite.h header file, or optionally also include the rpmsg_queue.h and/or rpmsg_ns.h files. Both porting sublayers should be provided for you by NXP, but if you plan to use your own RTOS, all you need to do is to implement your own environment layer (in other words, rpmsg_env_myrtos.c) and to include it in the project build.

The initialization of the stack is done by calling the rpmsg_lite_master_init() on the master side and the rpmsg_lite_remote_init() on the remote side. This initialization function must be called prior to any RPMsg-Lite API call. After the init, it is wise to create a communication endpoint, otherwise communication is not possible. This can be done by calling the rpmsg_lite_create_ept() function. It optionally accepts a last argument, where an internal context of the endpoint is created, just in case the RL_USE_STATIC_API option is set to 1. If not, the stack internally calls env_alloc() to allocate dynamic memory for it. In case a callback-based receiving is to be used, an ISR-callback is registered to each new endpoint with user-defined callback data pointer. If a blocking receive is desired (in case of RTOS environment), the rpmsg_queue_create() function must be called before calling rpmsg_lite_create_ept(). The queue handle is passed to the endpoint creation function as a callback data argument and the callback function is set to rpmsg_queue_rx_cb(). Then, it is possible to use rpmsg_queue_receive() function to listen on a queue object for incoming messages. The rpmsg_lite_send() function is used to send messages to the other side.

The RPMsg-Lite also implements no-copy mechanisms for both sending and receiving operations. These methods require specifics that have to be considered when used in an application.

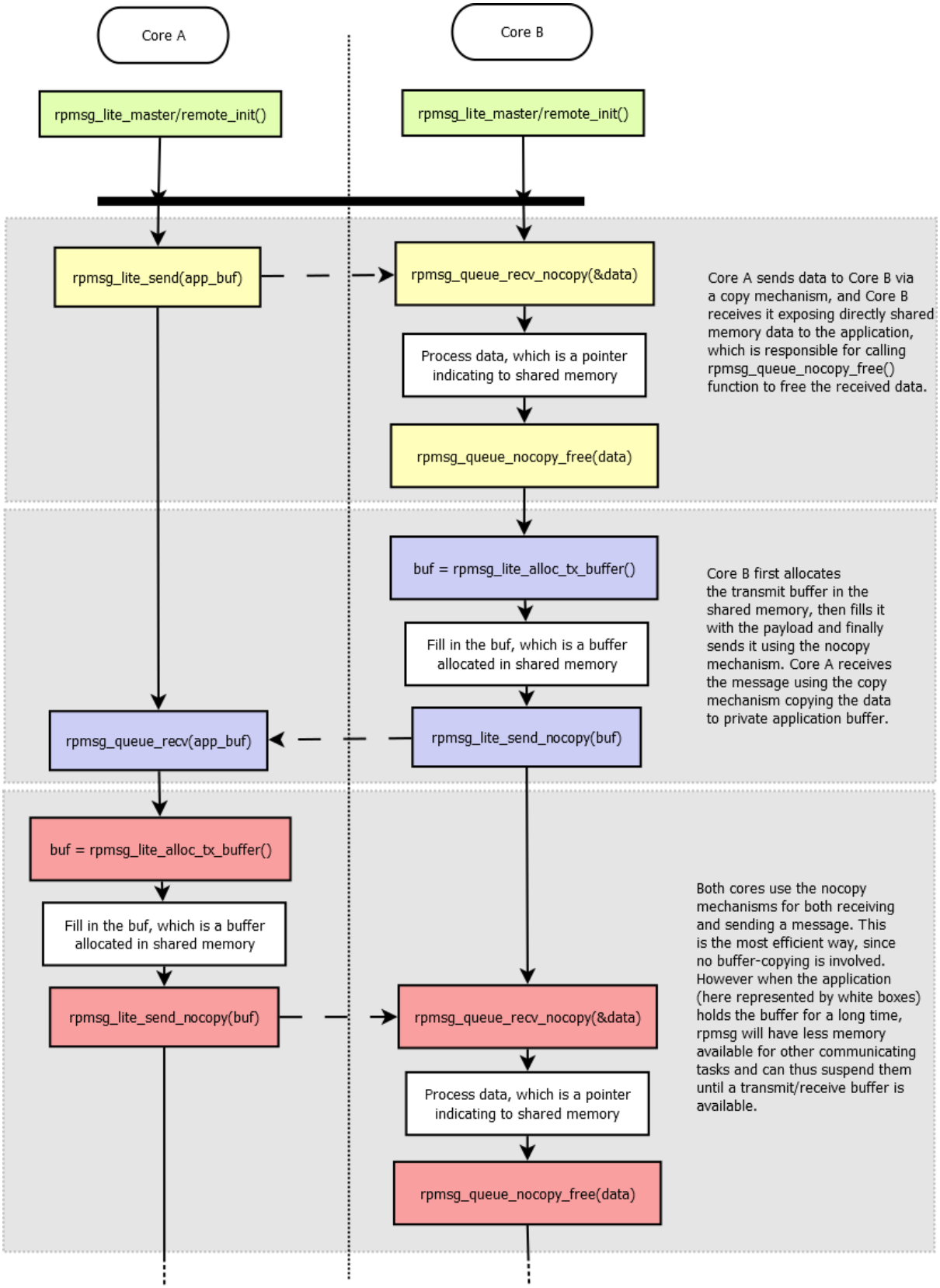
no-copy-send mechanism: This mechanism allows sending messages without the cost for copying data from the application buffer to the RPMsg/virtio buffer in the shared memory. The sequence of no-copy sending steps to be performed is as follows:

- Call the rpmsg_lite_alloc_tx_buffer() function to get the virtio buffer and provide the buffer pointer to the application.
- Fill the data to be sent into the pre-allocated virtio buffer. Ensure that the filled data does not exceed the buffer size (provided as the rpmsg_lite_alloc_tx_buffer() size output parameter).
- Call the rpmsg_lite_send_nocopy() function to send the message to the destination endpoint. Consider the cache functionality and the virtio buffer alignment. See the rpmsg_lite_send_nocopy() function description below.

no-copy-receive mechanism: This mechanism allows reading messages without the cost for copying data from the virtio buffer in the shared memory to the application buffer. The sequence of no-copy receiving steps to be performed is as follows:

- Call the rpmsg_queue_recv_nocopy() function to get the virtio buffer pointer to the received data.
- Read received data directly from the shared memory.
- Call the rpmsg_queue_nocopy_free() function to release the virtio buffer and to make it available for the next data transfer.

The user is responsible for destroying any RPMsg-Lite objects he has created in case of deinitialization. In order to do this, the function rpmsg_queue_destroy() is used to destroy a queue, rpmsg_lite_destroy_ept() is used to destroy an endpoint and finally, rpmsg_lite_deinit() is used to deinitialize the RPMsg-Lite intercore communication stack. Deinitialize all endpoints using a queue before deinitializing the queue. Otherwise, you are actively invalidating the used queue handle, which is not allowed. RPMsg-Lite does not check this internally, since its main aim is to be lightweight.



Examples RPMsg_Lite multicore examples are part of NXP MCUXpressoSDK packages. Visit https://mcuxpresso.nxp.com to configure, build and download these packages. To get the board list with multicore support (RPMsg_Lite included) use filtering based on Middleware and search for 'multicore' string. Once the selected package with the multicore middleware is downloaded,

see

<MCUXpressoSDK_install_dir>/boards/<board_name>/multicore_examples for RPMsg_Lite multicore examples with 'rpmsg_lite_' name prefix.

Another way of getting NXP MCUXpressoSDK RPMsg_Lite multicore examples is using the mcuxsdk-manifests Github repo. Follow the description how to use the West tool to clone and update the mcuxsdk-manifests repo in readme section. Once done the armgcc rpmsg_lite examples can be found in

mcuxsdk/examples/_<board_name>/multicore_examples

You can use the evkmimxrt1170 as the board_name for instance. Similar to MCUXpressoSDK packages the RPMsg_Lite examples use the 'rpmsg_lite_' name prefix.

Notes

Environment layers implementation Several environment layers are provided in lib/rpmsg_lite/porting/environment folder. Not all of them are fully tested however. Here is the list of environment layers that passed testing:

- rpmsg_env_bm.c
- rpmsg_env_freertos.c
- rpmsg_env_xos.c
- rpmsg_env_threadx.c

The rest of environment layers has been created and used in some experimental projects, it has been running well at the time of creation but due to the lack of unit testing there is no guarantee it is still fully functional.

Shared memory configuration It is important to correctly initialize/configure the shared memory for data exchange in the application. The shared memory must be accessible from both the master and the remote core and it needs to be configured as Non-Cacheable memory. Dedicated shared memory section in liker file is also a good practise, it is recommended to use linker files from MCUXpressSDK packages for NXP devices based applications. It needs to be ensured no other application part/component is unintentionally accessing this part of memory.

Configuration options The RPMsg-Lite can be configured at the compile time. The default configuration is defined in the rpmsg_default_config.h header file. This configuration can be customized by the user by including rpmsg_config.h file with custom settings. The following table summarizes all possible RPMsg-Lite configuration options.

Configuration option	Default value	Usage
RL_MS_PE	(1)	Delay in milliseconds used in non-blocking API functions for polling.
RL_BUFFE	(496)	Size of the buffer payload, it must be equal to (240, 496, 1008, ...) [2^n - 16]
RL_BUFFE	(2)	Number of the buffers, it must be power of two (2, 4, ...)
RL_API_H	(1)	Zero-copy API functions enabled/disabled.
RL_USE_S	(0)	Static API functions (no dynamic allocation) enabled/disabled.
RL_USE_D	(0)	Memory cache management of shared memory. Use in case of data cache is enabled for shared memory.
RL_CLEAF	(0)	Clearing used buffers before returning back to the pool of free buffers enabled/disabled.
RL_USE_M	(0)	When enabled IPC interrupts are managed by the Multicore Manager (IPC interrupts router), when disabled RPMsg-Lite manages IPC interrupts by itself.
RL_USE_E	(0)	When enabled the environment layer uses its own context. Required for some environments (QNX). The default value is 0 (no context, saves some RAM).
RL_DEBU(	(0)	When enabled buffer pointers passed to rpmsg_lite_send_nocopy() and rpmsg_lite_release_rx_buffer() functions (enabled by RL_API_HAS_ZEROCOPY config) are checked to avoid passing invalid buffer pointer. The default value is 0 (disabled). Do not use in RPMsg-Lite to Linux configuration.
RL_ALLO\	(0)	When enabled the opposite side is notified each time received buffers are consumed and put into the queue of available buffers. Enable this option in RPMsg-Lite to Linux configuration to allow unblocking of the Linux blocking send. The default value is 0 (RPMsg-Lite to RPMsg-Lite communication).
RL_ALLO\	(0)	It allows to define custom shared memory configuration and replacing the shared memory related global settings from rpmsg_config.h This is useful when multiple instances are running in parallel but different shared memory arrangement (vring size & alignment, buffers size & count) is required. The default value is 0 (all RPMsg_Lite instances use the same shared memory arrangement as defined by common config macros).
RL_ASSER	see rpmsg	Assert implementation.

How to format rpmsg-lite code To format code, use the application developed by Google, named *clang-format*. This tool is part of the llvm project. Currently, the clang-format 10.0.0 version is used for rpmsg-lite. The set of style settings used for clang-format is defined in the .clang-format file, placed in a root of the rpmsg-lite directory where Python script run_clang_format.py can be executed. This script executes the application named *clang-format.exe*. You need to have the path of this application in the OS's environment path, or you need to change the script.

References

[1] M. Novak, M. Cingel, Lockless Shared Memory Based Multicore Communication Protocol
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Changelog RPMSG-Lite All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog, and this project adheres to Semantic Versioning.

Unreleased

Fixed

- Fixed CERT-C INT31-C violation in platform_notify function in rpmsg_platform.c for imxrt700_m33, imxrt700_hifi4, imxrt700_hifi1 platforms

v5.2.0

Added

- Add MCXL20 porting layer and unit testing
- New utility macro RL_CALCULATE_BUFFER_COUNT_DOWN_SAFE to safely determine maximum buffer count within shared memory while preventing integer underflow.
- RT700 platform add support for MCMGR in DSPs

Changed

- Change rpmsg_platform.c to support new MCMGR API
- Improved input validation in initialization functions to properly handle insufficient memory size conditions.
- Refactored repeated buffer count calculation pattern for better code maintainability.
- To make sure that remote has already registered IRQ there is required App level IPC mechanism to notify master about it

Fixed

- Fixed env_wait_for_link_up function to handle timeout in link state checks for baremetal and qnx environment, RL_BLOCK mode can be used to wait indefinitely.
- Fixed CERT-C INT31-C violation by adding compile-time check to ensure RL_PLATFORM_HIGHEST_LINK_ID remains within safe range for 16-bit casting in virtqueue ID creation.
- Fixed CERT-C INT30-C violations by adding protection against unsigned integer underflow in shared memory calculations, specifically in shmem_length - (uint32_t)RL_VRING_OVERHEAD and shmem_length - 2U * shmem_config.vring_size expressions.
- Fixed CERT INT31-C violation in platform_interrupt_disable() and similar functions by replacing unsafe cast from uint32_t to int32_t with a return of 0 constant.
- Fixed unsigned integer underflow in rpmsg_lite_alloc_tx_buffer() where subtracting header size from buffer size could wrap around if buffer was too small, potentially leading to incorrect buffer sizing.
- Fixed CERT-C INT31-C violation in rpmsg_lite.c where size parameter was cast from uint32_t to uint16_t without proper validation.
  - Applied consistent masking approach to both size and flags parameters: (uint16_t)(value & 0xFFFFU).
  - This fix prevents potential data loss when size values exceed 65535.

- Fixed CERT INT31-C violation in env_memset functions by explicitly converting int32_t values to unsigned char using bit masking. This prevents potential data loss or misinterpretation when passing values outside the unsigned char range (0-255) to the standard memset() function.
- Fixed CERT-C INT31-C violations in RPMsg-Lite environment porting: Added validation checks for signed-to-unsigned integer conversions to prevent data loss and misinterpretation.
  - rpmsg_env_freertos.c: Added validation before converting int32_t to UBaseType_t.
  - rpmsg_env_qnx.c: Fixed format string and added validation before assigning to mqstat fields.
  - rpmsg_env_threadx.c: Added validation to prevent integer overflow and negative values.
  - rpmsg_env_xos.c: Added range checking before casting to uint16_t.
  - rpmsg_env_zephyr.c: Added validation before passing values to k_msgq_init.
- Fixed a CERT INT31-C compliance issue in env_get_current_queue_size() function where an unsigned queue count was cast to a signed int32_t without proper validation, which could lead to lost or misinterpreted data if queue size exceeded INT32_MAX.
- Fixed CERT INT31-C violation in rpmsg_platform.c where memcmp() return value (signed int) was compared with unsigned constant without proper type handling.
- Fixed CERT INT31-C violation in rpmsg_platform.c where casting from uint32_t to uint16_t could potentially result in data loss. Changed length variable type from uint16_t to uint32_t to properly handle memory address differences without truncation.
- Fixed potential integer overflow in env_sleep_msec() function in ThreadX environment implementation by rearranging calculation order in the sleep duration formula.
- Fixed CERT-C INT31-C violation in RPMsg-Lite where bitwise NOT operations on integer constants were performed in signed integer context before being cast to unsigned. This could potentially lead to misinterpreted data on imx943 platform.
- Added RL_MAX_BUFFER_COUNT (32768U) and RL_MAX_VRING_ALIGN (65536U) limit to ensure alignment values cannot contribute to integer overflow
- Fixed CERT INT31-C violation in vring_need_event(), added cast to uint16_t for each operand.

v5.1.4 - 27-Mar-2025

Added

- Add KW43B43 porting layer

Changed

- Doxygen bump to version 1.9.6

v5.1.3 - 13-Jan-2025

Added

- Memory cache management of shared memory. Enable with #define RL_USE_DCACHE (1) in rpmsg_config.h in case of data cache is used.
- Cmake/Kconfig support added.
- Porting layers for imx95, imxrt700, mcmxw71x, mcmxw72x, kw47b42 added.

v5.1.2 - 08-Jul-2024

Changed

- Zephyr-related changes.
- Minor Misra corrections.

v5.1.1 - 19-Jan-2024

Added

- Test suite provided.
- Zephyr support added.

Changed

- Minor changes in platform and env. layers, minor test code updates.

v5.1.0 - 02-Aug-2023

Added

- RPMsg-Lite: Added aarch64 support.

Changed

- RPMsg-Lite: Increased the queue size to (2 * RL_BUFFER_COUNT) to cover zero copy cases.
- Code formatting using LLVM16.

Fixed

- Resolved issues in ThreadX env. layer implementation.

v5.0.0 - 19-Jan-2023

Added

- Timeout parameter added to rpmsg_lite_wait_for_link_up API function.

Changed

- Improved debug check buffers implementation - instead of checking the pointer fits into shared memory check the presence in the VirtIO ring descriptors list.
- VRING_SIZE is set based on number of used buffers now (as calculated in vring_init) - updated for all platforms that are not communicating to Linux rpmsg counterpart.

Fixed

- Fixed wrong RL_VRING_OVERHEAD macro comment in platform.h files
- Misra corrections.

v4.0.0 - 20-Jun-2022

Added

- Added support for custom shared memory arrangement per the RPMsg_Lite instance.
- Introduced new rpmsg_lite_wait_for_link_up() API function - this allows to avoid using busy loops in rtos environments, GitHub PR #21.

Changed

- Adjusted rpmsg_lite_is_link_up() to return RL_TRUE/RL_FALSE.

v3.2.0 - 17-Jan-2022

Added

- Added support for i.MX8 MP multicore platform.

Changed

- Improved static allocations - allow OS-specific objects being allocated statically, GitHub PR #14.
- Aligned rpmsg_env_xos.c and some platform layers to latest static allocation support.

Fixed

- Minor Misra and typo corrections, GitHub PR #19, #20.

v3.1.2 - 16-Jul-2021

Added

- Addressed MISRA 21.6 rule violation in rpmsg_env.h (use SDK's PRINTF in MCUXpressoSDK examples, otherwise stdio printf is used).
- Added environment layers for XOS.
- Added support for i.MX RT500, i.MX RT1160 and i.MX RT1170 multicore platforms.

Fixed

- Fixed incorrect description of the rpmsg_lite_get_endpoint_from_addr function.

Changed

- Updated RL_BUFFER_COUNT documentation (issue #10).
- Updated imxrt600_hifi4 platform layer.

v3.1.1 - 15-Jan-2021

Added

- Introduced RL_ALLOW_CONSUMED_BUFFERS_NOTIFICATION config option to allow opposite side notification sending each time received buffers are consumed and put into the queue of available buffers.
- Added environment layers for Threadx.
- Added support for i.MX8QM multicore platform.

Changed

- Several MISRA C-2012 violations addressed.

v3.1.0 - 22-Jul-2020

Added

- Added support for several new multicore platforms.

Fixed

- MISRA C-2012 violations fixed (7.4).
- Fixed missing lock in rpmsg_lite_rx_callback() for QNX env.
- Correction of rpmsg_lite_instance structure members description.
- Address -Waddress-of-packed-member warnings in GCC9.

Changed

- Clang update to v10.0.0, code re-formatted.

v3.0.0 - 20-Dec-2019

Added

- Added support for several new multicore platforms.

Fixed

- MISRA C-2012 violations fixed, incl. data types consolidation.
- Code formatted.

v2.2.0 - 20-Mar-2019

Added

- Added configuration macro RL_DEBUG_CHECK_BUFFERS.
- Several MISRA violations fixed.
- Added environment layers for QNX and Zephyr.
- Allow environment context required for some environment (controlled by the RL_USE_ENVIRONMENT_CONTEXT configuration macro).
- Data types consolidation.

v1.1.0 - 28-Apr-2017

Added

- Supporting i.MX6SX and i.MX7D MPU platforms.
- Supporting LPC5411x MCU platform.
- Baremental and FreeRTOS support.
- Support of copy and zero-copy transfer.
- Support of static API (without dynamic allocations).

Multicore Manager

MCUXpresso SDK : mcuxsdk-middleware-mcmgr (Multicore Manager)

Overview This repository is for MCUXpresso SDK Multicore Manager middleware delivery and it contains Multicore Manager component officially provided in NXP MCUXpresso SDK. This repository is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk for the complete delivery of MCUXpresso SDK to be able to build and run Multicore Manager examples that are based on mcux-sdk-middleware-mcmgr component.

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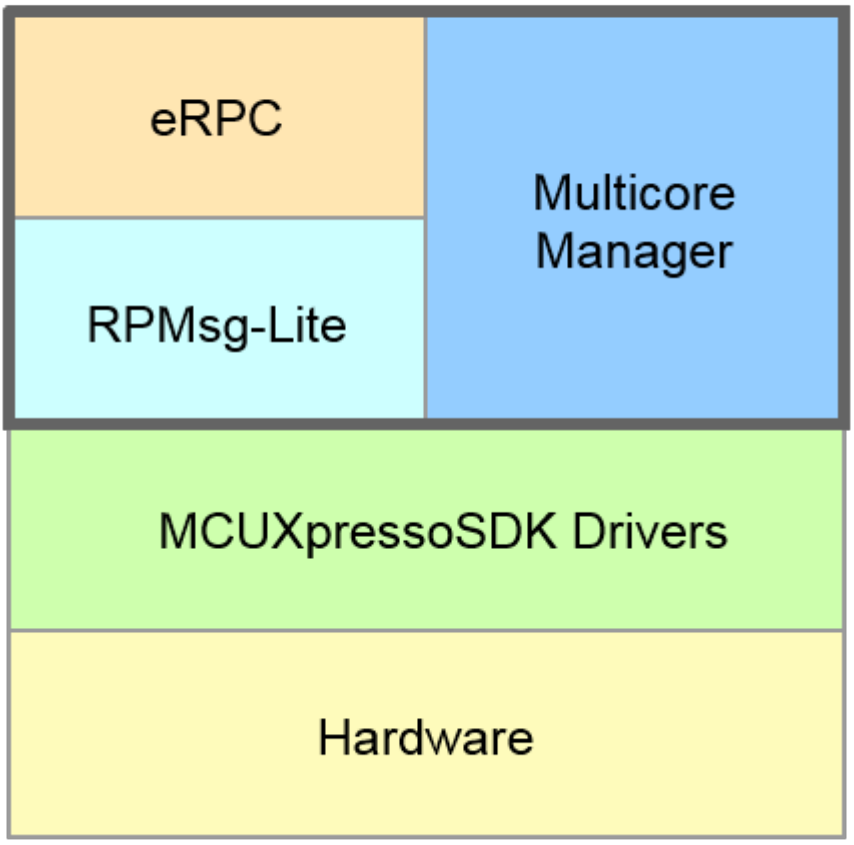
Setup Instructions on how to install the MCUXpresso SDK provided from GitHub via west manifest Getting Started with SDK - Detailed Installation Instructions

Contribution We welcome and encourage the community to submit patches directly to the mcmgr project placed on github. Contributing can be managed via pull-requests. Before a pull-request is created the code should be tested and properly formatted.

Multicore Manager (MCMGR) The Multicore Manager (MCMGR) software library provides a number of services for multicore systems. This library is distributed as a part of the Multicore SDK (MCSDK). Together, the MCSDK and the MCUXpresso SDK (SDK) form a framework for development of software for NXP multicore devices.

The MCMGR component is located in the <MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr directory.



The Multicore Manager provides the following major functions:

- Maintains information about all cores in system.
- Secondary/auxiliary core(s) startup and shutdown.
- Remote core monitoring and event handling.

For Further API documentation, please look at doxygen documentation at: https://nxp-mcuxpresso.github.io/mcux-mcmgr/

Usage of the MCMGR software component The main use case of MCMGR is the secondary/auxiliary core start. This functionality is performed by the public API function.

Example of MCMGR usage to start secondary core:

```
#include "mcmgr.h"

void main()
{
    /* Initialize MCMGR - low level multicore management library.
       Call this function as close to the reset entry as possible,
       (into the startup sequence) to allow CoreUp event triggering. */
    MCMGR_EarlyInit();

    /* Initialize MCMGR, install generic event handlers */
    MCMGR_Init();

    /* Boot secondary core application from the CORE1_BOOT_ADDRESS, pass "1" as startup data,␣
↪starting synchronously. */
    MCMGR_StartCore(kMCMGR_Core1, CORE1_BOOT_ADDRESS, 1, kMCMGR_Start_Synchronous);
.
.
.
    /* Stop secondary core execution. */
    MCMGR_StopCore(kMCMGR_Core1);
}
```

Some platforms allow stopping and re-starting the secondary core application again, using the MCMGR_StopCore / MCMGR_StartCore API calls. It is necessary to ensure the initially loaded image is not corrupted before re-starting, especially if it deals with the RAM target. Cache coherence has to be considered/ensured as well.

Another important MCMGR feature is the ability for remote core monitoring and handling of events such as reset, exception, and application events. Application-specific callback functions for events are registered by the MCMGR_RegisterEvent() API. Triggering these events is done using the MCMGR_TriggerEvent() API. mcmgr_event_type_t enums all possible event types.

An example of MCMGR usage for remote core monitoring and event handling. Code for the primary side:

```
#include "mcmgr.h"

#define APP_RPMSG_READY_EVENT_DATA  (1)
#define APP_NUMBER_OF_CORES (2)
#define APP_SECONDARY_CORE kMCMGR_Core1

/* Callback function registered via the MCMGR_RegisterEvent() and triggered by MCMGR_TriggerEvent()␣
↪called on the secondary core side */
void RPMsgRemoteReadyEventHandler(mcmgr_core_t coreNum, uint16_t eventData, void *context)
{
    uint16_t *data = &((uint16_t *)context)[coreNum];

    *data = eventData;
}

void main()
{
    uint16_t RPMsgRemoteReadyEventData[NUMBER_OF_CORES] = {0};

    /* Initialize MCMGR - low level multicore management library.
       Call this function as close to the reset entry as possible,
       (into the startup sequence) to allow CoreUp event triggering. */
    MCMGR_EarlyInit();
```

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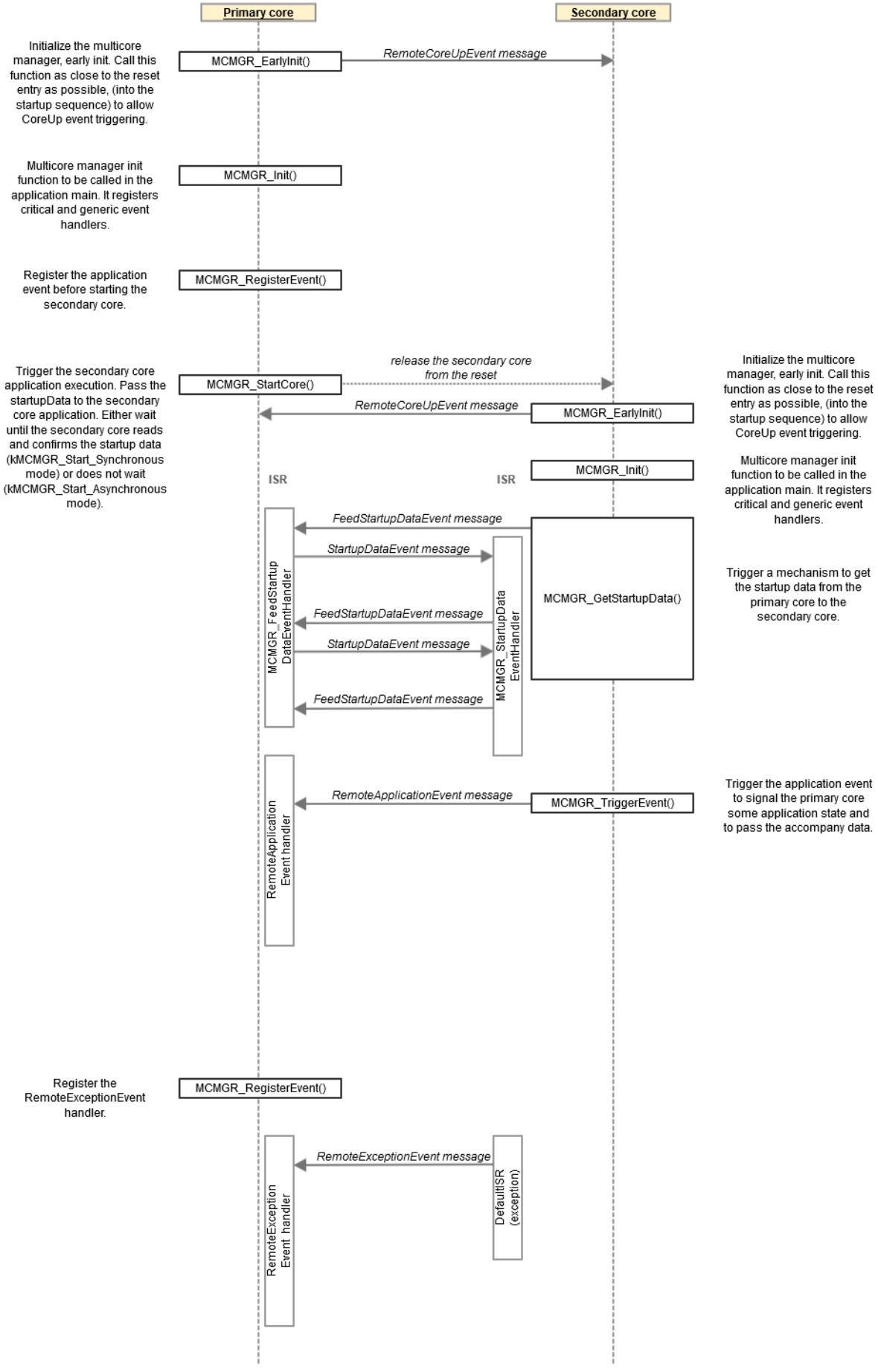
```
    /* Initialize MCMGR, install generic event handlers */
    MCMGR_Init();

    /* Register the application event before starting the secondary core */
    MCMGR_RegisterEvent(kMCMGR_RemoteApplicationEvent, RPMsgRemoteReadyEventHandler, (void␣
↪*)RPMsgRemoteReadyEventData);

    /* Boot secondary core application from the CORE1_BOOT_ADDRESS, pass rpmsg_lite_base address␣
↪as startup data, starting synchronously. */
    MCMGR_StartCore(APP_SECONDARY_CORE, CORE1_BOOT_ADDRESS, (uint32_t)rpmsg_lite_
↪base, kMCMGR_Start_Synchronous);

    /* Wait until the secondary core application signals the rpmsg remote has been initialized and is ready to␣
↪communicate. */
    while(APP_RPMSG_READY_EVENT_DATA != RPMsgRemoteReadyEventData[APP_SECONDARY_
↪CORE]) {};
.
.
.
}
```

Code for the secondary side:

```
#include "mcmgr.h"

#define APP_RPMSG_READY_EVENT_DATA  (1)

void main()
{
    /* Initialize MCMGR - low level multicore management library.
       Call this function as close to the reset entry as possible,
       (into the startup sequence) to allow CoreUp event triggering. */
    MCMGR_EarlyInit();

    /* Initialize MCMGR, install generic event handlers */
    MCMGR_Init();
.
.
.

    /* Signal the to other core that we are ready by triggering the event and passing the APP_RPMSG_
↪READY_EVENT_DATA */
    MCMGR_TriggerEvent(kMCMGR_Core0, kMCMGR_RemoteApplicationEvent, APP_RPMSG_
↪READY_EVENT_DATA);
.
.
.
}
```

MCMGR Data Exchange Diagram The following picture shows how the handshakes are supposed to work between the two cores in the MCMGR software.


Primary core
Secondary core
Initialize the multicore manager, early init. Call this function as close to the reset entry as possible, (into the startup sequence) to allow CoreUp event triggering.
MCMGR_EarlyInit()
RemoteCoreUpEvent message
Multicore manager init function to be called in the application main. It registers critical and generic event handlers.
MCMGR_Init()
Register the application event before starting the secondary core.
MCMGR_RegisterEvent()
Trigger the secondary core application execution. Pass the startupData to the secondary core application. Either wait until the secondary core reads and confirms the startup data (kMCMGR_Start_Synchronous mode) or does not wait (kMCMGR_Start_Asynchronous mode).
MCMGR_StartCore()
release the secondary core from the reset
RemoteCoreUpEvent message
MCMGR_EarlyInit()
Initialize the multicore manager, early init. Call this function as close to the reset entry as possible, (into the startup sequence) to allow CoreUp event triggering.
MCMGR_Init()
Multicore manager init function to be called in the application main. It registers critical and generic event handlers.
ISR
ISR
FeedStartupDataEvent message
StartupDataEvent message
FeedStartupDataEvent message
StartupDataEvent message
FeedStartupDataEvent message
MCMGR_FeedStartup DataEventHandler
MCMGR_StartupData EventHandler
MCMGR_GetStartupData()
Trigger a mechanism to get the startup data from the primary core to the secondary core.
RemoteApplicationEvent message
MCMGR_TriggerEvent()
RemoteApplication Event handler
Trigger the application event to signal the primary core some application state and to pass the accompany data.
Register the RemoteExceptionEvent handler.
MCMGR_RegisterEvent()
RemoteExceptionEvent message
RemoteException Event handler
DefaultISR (exception)

Changelog Multicore Manager All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog, and this project adheres to Semantic Versioning.

Unreleased

Added

Fixed

- Added CX flag into CMakeLists.txt to allow c++ build compatibility.

v5.0.0

Added

- Added MCMGR_BUSY_POLL_COUNT macro to prevent infinite polling loops in MCMGR operations.
- Implemented timeout mechanism for all polling loops in MCMGR code.
- Added support to handle more then two cores. Breaking API change by adding parameter coreNum specifying core number in functions bellow.
  - MCMGR_GetStartupData(uint32_t *startupData, mcmgr_core_t coreNum)
  - MCMGR_TriggerEvent(mcmgr_event_type_t type, uint16_t eventData, mcmgr_core_t coreNum)
  - MCMGR_TriggerEventForce(mcmgr_event_type_t type, uint16_t eventData, mcmgr_core_t coreNum)
  - typedef void (*mcmgr_event_callback_t)(uint16_t data, void *context, mcmgr_core_t coreNum);

  When registering the event with function MCMGR_RegisterEvent() user now needs to provide callbackData pointer to array of elements per every core in system (see README.md for example).In case of systems with only two cores the coreNum in callback can be ignored as events can arrive only from one core. Please see Porting guide for more details: PortingGuideTo_v5.md
- Updated all porting files to support new MCMGR API.
- Added new platform specific include file mcmgr_platform.h. It will contain common platform specific macros that can be then used in mcmgr and application. e.g. platform core count MCMGR_CORECOUNT 4.
- Move all header files to new inc directory.
- Added new platform-specific include files inc/platform/<platform_name>/mcmgr_platform.h.

Added

- Add MCXL20 porting layer and unit testing

v4.1.7

Fixed

- mcmgr_stop_core_internal() function now returns kStatus_MCMGR_NotImplemented status code instead of kStatus_MCMGR_Success when device does not support stop of secondary core. Ports affected: kw32w1, kw45b41, kw45b42, mcxw716, mcxw727.

[v4.1.6]

Added

- Multicore Manager moved to standalone repository.
- Add porting layers for imxrt700, mcmxw727, kw47b42.
- New MCMGR_ProcessDeferredRxIsr() API added.

[v4.1.5]

Added

- Add notification into MCMGR_EarlyInit and mcmgr_early_init_internal functions to avoid using uninitialized data in their implementations.

[v4.1.4]

Fixed

- Avoid calling tx isr callbacks when respective Messaging Unit Transmit Interrupt Enable flag is not set in the CR/TCR register.
- Messaging Unit RX and status registers are cleared after the initialization.

[v4.1.3]

Added

- Add porting layers for imxrt1180.

Fixed

- mu_isr() updated to avoid calling tx isr callbacks when respective Transmit Interrupt Enable flag is not set in the CR/TCR register.
- mcmgr_mu_internal.c code adaptation to new supported SoCs.

[v4.1.2]

Fixed

- Update mcmgr_stop_core_internal() implementations to set core state to kMCMGR_ResetCoreState.

[v4.1.0]

Fixed

- Code adjustments to address MISRA C-2012 Rules

[v4.0.3]

Fixed

- Documentation updated to describe handshaking in a graphic form.
- Minor code adjustments based on static analysis tool findings

[v4.0.2]

Fixed

- Align porting layers to the updated MCUXpressoSDK feature files.

[v4.0.1]

Fixed

- Code formatting, removed unused code

[v4.0.0]

Added

- Add new MCMGR_TriggerEventForce() API.

[v3.0.0]

Removed

- Removed MCMGR_LoadApp(), MCMGR_MapAddress() and MCMGR_SignalReady()

Modified

- Modified MCMGR_GetStartupData()

Added

- Added MCMGR_EarlyInit(), MCMGR_RegisterEvent() and MCMGR_TriggerEvent()
- Added the ability for remote core monitoring and event handling

[v2.0.1]

Fixed

- Updated to be Misra compliant.

[v2.0.0]

Added

- Support for lpcxpresso54114 board.

[v1.1.0]

Fixed

- Ported to KSDK 2.0.0.

[v1.0.0]

Added

- Initial release.

eRPC

MCUXpresso SDK : mcuxsdk-middleware-erpc

Overview This repository is for MCUXpresso SDK eRPC middleware delivery and it contains eRPC component officially provided in NXP MCUXpresso SDK. This repository is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk for the complete delivery of MCUXpresso SDK to be able to build and run eRPC examples that are based on mcux-sdk-middleware-erpc component.

Documentation Overall details can be reviewed here: MCUXpresso SDK Online Documentation

Visit eRPC - Documentation to review details on the contents in this sub-repo.

Setup Instructions on how to install the MCUXpresso SDK provided from GitHub via west manifest Getting Started with SDK - Detailed Installation Instructions

Contribution We welcome and encourage the community to submit patches directly to the eRPC project placed on github. Contributing can be managed via pull-requests. Before a pull-request is created the code should be tested and properly formatted.

---

eRPC

- *MCUXpresso SDK : mcuxsdk-middleware-erpc*
  - *Overview*
  - *Documentation*
  - *Setup*
  - *Contribution*
- *eRPC*
  - *About*
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  - *Building and installing*
    - *Requirements*
      - *Windows*
      - *Mac OS X*
    - *Building*
      - *CMake and KConfig*
      - *Make*
    - *Installing for Python*
  - *Known issues and limitations*
  - *Code providing*

About

eRPC (Embedded RPC) is an open source Remote Procedure Call (RPC) system for multichip embedded systems and heterogeneous multicore SoCs.

Unlike other modern RPC systems, such as the excellent Apache Thrift, eRPC distinguishes itself by being designed for tightly coupled systems, using plain C for remote functions, and having a small code size (<5kB). It is not intended for high performance distributed systems over a network.

eRPC does not force upon you any particular API style. It allows you to export existing C functions, without having to change their prototypes. (There are limits, of course.) And although the

internal infrastructure is written in C++, most users will be able to use only the simple C setup APIs shown in the examples below.

A code generator tool called erpcgen is included. It accepts input IDL files, having an .erpc extension, that have definitions of your data types and remote interfaces, and generates the shim code that handles serialization and invocation. erpcgen can generate either C/C++ or Python code.

Example .erpc file:

```
// Define a data type.
enum LEDName { kRed, kGreen, kBlue }

// An interface is a logical grouping of functions.
interface IO {
    // Simple function declaration with an empty reply.
    set_led(LEDName whichLed, bool onOrOff) -> void
}
```

Client side usage:

```
void example_client(void) {
    erpc_transport_t transport;
    erpc_mbf_t message_buffer_factory;
    erpc_client_t client_manager;

    /* Init eRPC client infrastructure */
    transport = erpc_transport_cmsis_uart_init(Driver_USART0);
    message_buffer_factory = erpc_mbf_dynamic_init();
    client_manager = erpc_client_init(transport, message_buffer_factory);

    /* init eRPC client IO service */
    initIO_client(client_manager);

    // Now we can call the remote function to turn on the green LED.
    set_led(kGreen, true);

    /* deinit objects */
    deinitIO_client();
    erpc_client_deinit(client_manager);
    erpc_mbf_dynamic_deinit(message_buffer_factory);
    erpc_transport_tcp_deinit(transport);
}
```

```
void example_client(void) {
    erpc_transport_t transport;
    erpc_mbf_t message_buffer_factory;
    erpc_client_t client_manager;

    /* Init eRPC client infrastructure */
    transport = erpc_transport_cmsis_uart_init(Driver_USART0);
    message_buffer_factory = erpc_mbf_dynamic_init();
    client_manager = erpc_client_init(transport, message_buffer_factory);

    /* scope for client service */
    {
        /* init eRPC client IO service */
        IO_client client(client_manager);

        // Now we can call the remote function to turn on the green LED.
        client.set_led(kGreen, true);
    }

    /* deinit objects */
```

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```
    erpc_client_deinit(client_manager);
    erpc_mbf_dynamic_deinit(message_buffer_factory);
    erpc_transport_tcp_deinit(transport);
}
```

Server side usage:

```
// Implement the remote function.
void set_led(LEDName whichLed, bool onOrOff) {
    // implementation goes here
}

void example_server(void) {
    erpc_transport_t transport;
    erpc_mbf_t message_buffer_factory;
    erpc_server_t server;
    erpc_service_t service = create_IO_service();

    /* Init eRPC server infrastructure */
    transport = erpc_transport_cmsis_uart_init(Driver_USART0);
    message_buffer_factory = erpc_mbf_dynamic_init();
    server = erpc_server_init(transport, message_buffer_factory);

    /* add custom service implementation to the server */
    erpc_add_service_to_server(server, service);

    // Run the server.
    erpc_server_run();

    /* deinit objects */
    destroy_IO_service(service);
    erpc_server_deinit(server);
    erpc_mbf_dynamic_deinit(message_buffer_factory);
    erpc_transport_tcp_deinit(transport);
}
```

```
// Implement the remote function.
class IO : public IO_interface
{
    /* eRPC call definition */
    void set_led(LEDName whichLed, bool onOrOff) override {
        // implementation goes here
    }
}

void example_server(void) {
    erpc_transport_t transport;
    erpc_mbf_t message_buffer_factory;
    erpc_server_t server;
    IO IOImpl;
    IO_service io(&IOImpl);

    /* Init eRPC server infrastructure */
    transport = erpc_transport_cmsis_uart_init(Driver_USART0);
    message_buffer_factory = erpc_mbf_dynamic_init();
    server = erpc_server_init(transport, message_buffer_factory);

    /* add custom service implementation to the server */
    erpc_add_service_to_server(server, &io);

    /* poll for requests */
```

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```
    erpc_status_t err = server.run();

    /* deinit objects */
    erpc_server_deinit(server);
    erpc_mbf_dynamic_deinit(message_buffer_factory);
    erpc_transport_tcp_deinit(transport);
}
```

A number of transports are supported, and new transport classes are easy to write.

Supported transports can be found in *erpc/erpc_c/transport* folder. E.g:

- CMSIS UART
- NXP Kinetis SPI and DSPI
- POSIX and Windows serial port
- TCP/IP (mostly for testing)
- NXP RPMsg-Lite / RPMsg TTY
- SPIdev Linux
- USB CDC
- NXP Messaging Unit

eRPC is available with an unrestrictive BSD 3-clause license. See the LICENSE file for the full license text.

Releases eRPC releases

Edge releases Edge releases can by found on eRPC CircleCI webpage. Choose build of interest, then platform target and choose ARTIFACTS tab. Here you can find binary application from chosen build.

Documentation Documentation is in the wiki section.

eRPC Infrastructure documentation

Examples *Example IDL* is available in the *examples/* folder.

Plenty of eRPC multicore and multiprocessor examples can be also found in NXP MCUXpressoSDK packages. Visit https://mcuxpresso.nxp.com to configure, build and download these packages.

To get the board list with multicore support (eRPC included) use filtering based on Middleware and search for 'multicore' string. Once the selected package with the multicore middleware is downloaded, see

<MCUXpressoSDK_install_dir>/boards/<board_name>/multicore_examples for eRPC multicore examples (RPMsg_Lite or Messaging Unit transports used) or

<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples for eRPC multiprocessor examples (UART or SPI transports used).

eRPC examples use the 'erpc_' name prefix.

Another way of getting NXP MCUXpressoSDK eRPC multicore and multiprocessor examples is using the mcux-sdk Github repo. Follow the description how to use the West tool to clone and

update the mcuxsdk repo in readme Overview section. Once done the armgcc eRPC examples can be found in

mcuxsdk/examples/<board_name>/multicore_examples or in

mcuxsdk/examples/<board_name>/multiprocessor_examples folders.

You can use the evkmimxrt1170 as the board_name for instance. Similar to MCUXpressoSDK packages the eRPC examples use the 'erpc_' name prefix.

References This section provides links to interesting erpc-based projects, articles, blogs or guides:

- erpc (EmbeddedRPC) getting started notes
- ERPC Linux Local Environment Construction and Use
- The New Wio Terminal eRPC Firmware

Directories *doc* - Documentation.

doxygen - Configuration and support files for running Doxygen over the eRPC C++ infrastructure and erpcgen code.

erpc_c - Holds C/C++ infrastructure for eRPC. This is the code you will include in your application.

erpc_python - Holds Python version of the eRPC infrastructure.

erpcgen - Holds source code for erpcgen and makefiles or project files to build erpcgen on Windows, Linux, and OS X.

erpcsniffer - Holds source code for erpcsniffer application.

examples - Several example IDL files.

mk - Contains common makefiles for building eRPC components.

test - Client/server tests. These tests verify the entire communications path from client to server and back.

utilities - Holds utilities which bring additional benefit to eRPC apps developers.

Building and installing These build instructions apply to host PCs and embedded Linux. For bare metal or RTOS embedded environments, you should copy the *erpc_c* directory into your application sources.

CMake and KConfig build:

It builds a static library of the eRPC C/C++ infrastructure, the erpcgen executable, and optionally the unit tests and examples.

CMake is compatible with gcc and clang. On Windows local MingGW downloaded by *script* can be used.

Make build:

It builds a static library of the eRPC C/C++ infrastructure, the erpcgen executable, and optionally the unit tests.

The makefiles are compatible with gcc or clang on Linux, OS X, and Cygwin. A Windows build of erpcgen using Visual Studio is also available in the *erpcgen/VisualStudio_v14* directory. There is also an Xcode project file in the *erpcgen* directory, which can be used to build erpcgen for OS X.

Requirements eRPC now support building **erpcgen**, **erpc_lib**, **tests** and **C examples** using CMake.

Requirements when using CMake:

- **CMake** (minimal version 3.20.0)
- Generator - **Make**, **Ninja**, ...
- **C/C++ compiler** - **GCC**, **CLANG**, ...
- **Binson** - https://www.gnu.org/software/bison/
- **Flex** - https://github.com/westes/flex/

Requirements when using Make:

- **Make**
- **C/C++ compiler** - **GCC**, **CLANG**, ...
- **Binson** - https://www.gnu.org/software/bison/
- **Flex** - https://github.com/westes/flex/

Windows Related steps to build **erpcgen** using **Visual Studio** are described in erpcgen/VisualStudio_v14/readme_erpcgen.txt.

To install MinGW, Bison, Flex locally on Windows:

```
./install_dependencies.ps1
* ```

#### Linux

```bash
./install_dependencies.sh
```

Mandatory for case, when build for different architecture is needed

- gcc-multilib, g++-multilib

Mac OS X

```
./install_dependencies.sh
```

Building

CMake and KConfig eRPC use CMake and KConfig to configurate and build eRPC related targets. KConfig can be edited by *prj.conf* or *menuconfig* when building.

Generate project, config and build. In *erpc/* execute:

```
cmake -B ./build # in erpc/build generate cmake project
cmake --build ./build --target menuconfig # Build menuconfig and configurate erpcgen, erpc_lib, tests and␣
↪examples
cmake --build ./build # Build all selected target from prj.conf/menuconfig
```

**CMake will use the system's default compilers and generator

If you want to use Windows and locally installed MinGW, use *CMake preset* :
```

```
cmake --preset mingw64 # Generate project in ./build using mingw64's make and compilers
cmake --build ./build --target menuconfig # Build menuconfig and configurate erpcgen, erpc_lib, tests and␣
↪examples
cmake --build ./build # Build all selected target from prj.conf/menuconfig
```

Make To build the library and erpcgen, run from the repo root directory:

```
make
```

To install the library, erpcgen, and include files, run:

```
make install
```

You may need to sudo the make install.

By default this will install into /usr/local. If you want to install elsewhere, set the PREFIX environment variable. Example for installing into /opt:

```
make install PREFIX=/opt
```

List of top level Makefile targets:

- erpc: build the liberpc.a static library
- erpcgen: build the erpcgen tool
- erpcsniffer: build the sniffer tool
- test: build the unit tests under the *test* directory
- all: build all of the above
- install: install liberpc.a, erpcgen, and include files

eRPC code is validated with respect to the C++ 11 standard.

Installing for Python To install the Python infrastructure for eRPC see instructions in the *erpc python readme*.

Known issues and limitations

- Static allocations controlled by the ERPC_ALLOCATION_POLICY config macro are not fully supported yet, i.e. not all erpc objects can be allocated statically now. It deals with the ongoing process and the full static allocations support will be added in the future.

Code providing Repository on Github contains two main branches: **main** and **develop**. Code is developed on **develop** branch. Release version is created via merging **develop** branch into **main** branch.

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eRPC Getting Started

Overview This *Getting Started User Guide* shows software developers how to use Remote Procedure Calls (RPC) in embedded multicore microcontrollers (eRPC).

The eRPC documentation is located in the *<MCUXpressoSDK_install_dir>/ middleware/multicore/erpc/doc* folder.

Create an eRPC application This section describes a generic way to create a client/server eRPC application:

1. **Design the eRPC application:** Decide which data types are sent between applications, and define functions that send/receive this data.
2. **Create the IDL file:** The IDL file contains information about data types and functions used in an eRPC application, and is written in the IDL language.
3. **Use the eRPC generator tool:** This tool takes an IDL file and generates the shim code for the client and the server-side applications.
4. **Create an eRPC application:**
    1. Create two projects, where one project is for the client side (primary core) and the other project is for the server side (secondary core).
    2. Add generated files for the client application to the client project, and add generated files for the server application to the server project.
    3. Add infrastructure files.
    4. Add user code for client and server applications.
    5. Set the client and server project options.
5. **Run the eRPC application:** Run both the server and the client applications. Make sure that the server has been run before the client request was sent.

A specific example follows in the next section.

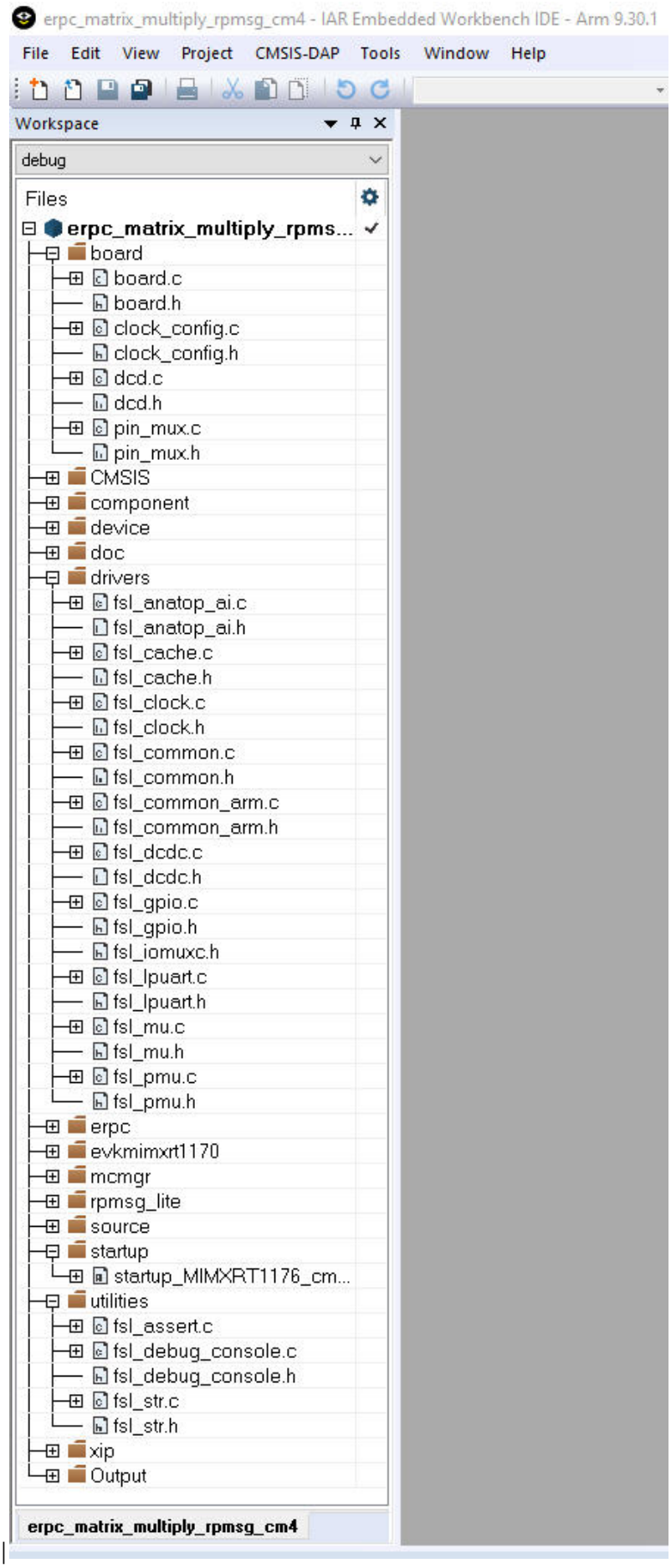
Multicore server application The “Matrix multiply” eRPC server project is located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg/cm4/iar

The project files for the eRPC server have the `_cm4` suffix.

Server project basic source files The startup files, board-related settings, peripheral drivers, and utilities belong to the basic project source files and form the skeleton of all MCUXpresso SDK applications. These source files are located in:

- *<MCUXpressoSDK_install_dir>/devices/<device>*
- *<MCUXpressoSDK_install_dir>/boards/<board_name>/multicore_examples/<example_name>/*


erpc_matrix_multiply_rpmsg_cm4 - IAR Embedded Workbench IDE - Arm 9.30.1
File Edit View Project CMSIS-DAP Tools Window Help
Workspace
debug
Files
erpc_matrix_multiply_rpms...
board
board.c
board.h
clock_config.c
clock_config.h
dcd.c
dcd.h
pin_mux.c
pin_mux.h
CMSIS
component
device
doc
drivers
fsl_anatop_ai.c
fsl_anatop_ai.h
fsl_cache.c
fsl_cache.h
fsl_clock.c
fsl_clock.h
fsl_common.c
fsl_common.h
fsl_common_arm.c
fsl_common_arm.h
fsl_dcdc.c
fsl_dcdc.h
fsl_gpio.c
fsl_gpio.h
fsl_iomuxc.h
fsl_lpuart.c
fsl_lpuart.h
fsl_mu.c
fsl_mu.h
fsl_pmu.c
fsl_pmu.h
erpc
evkmimxrt1170
mcmgr
rpmsg_lite
source
startup
startup_MIMXRT1176_cm...
utilities
fsl_assert.c
fsl_debug_console.c
fsl_debug_console.h
fsl_str.c
fsl_str.h
xip
Output
erpc_matrix_multiply_rpmsg_cm4

|

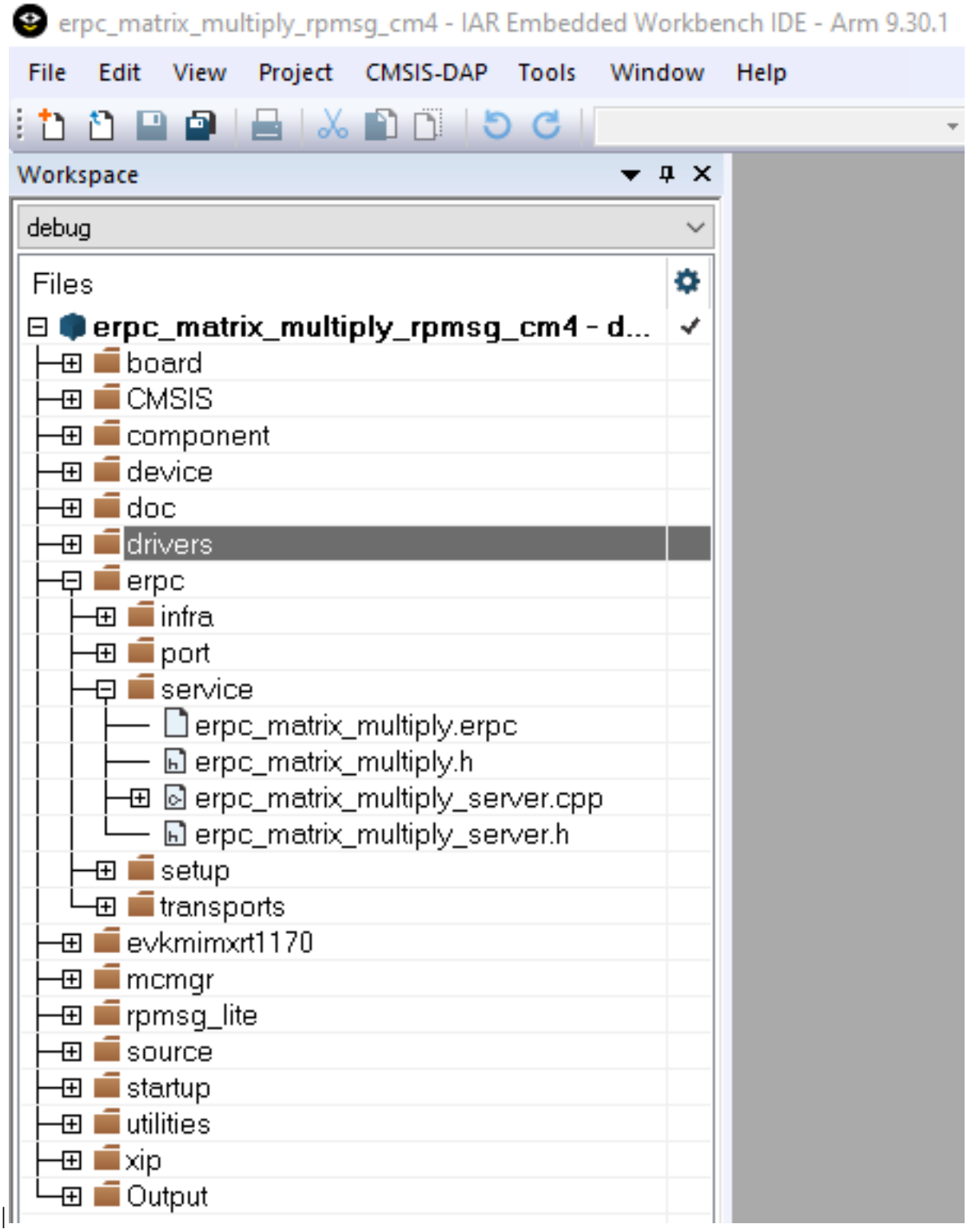
Parent topic: Multicore server application

Server related generated files The server-related generated files are:

- erpc_matric_multiply.h
- erpc_matrix_multiply_server.h
- erpc_matrix_multiply_server.cpp

The server-related generated files contain the shim code for functions and data types declared in the IDL file. These files also contain functions for the identification of client requested functions, data deserialization, calling requested function's implementations, and data serialization and return, if requested by the client. These shim code files can be found in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/s



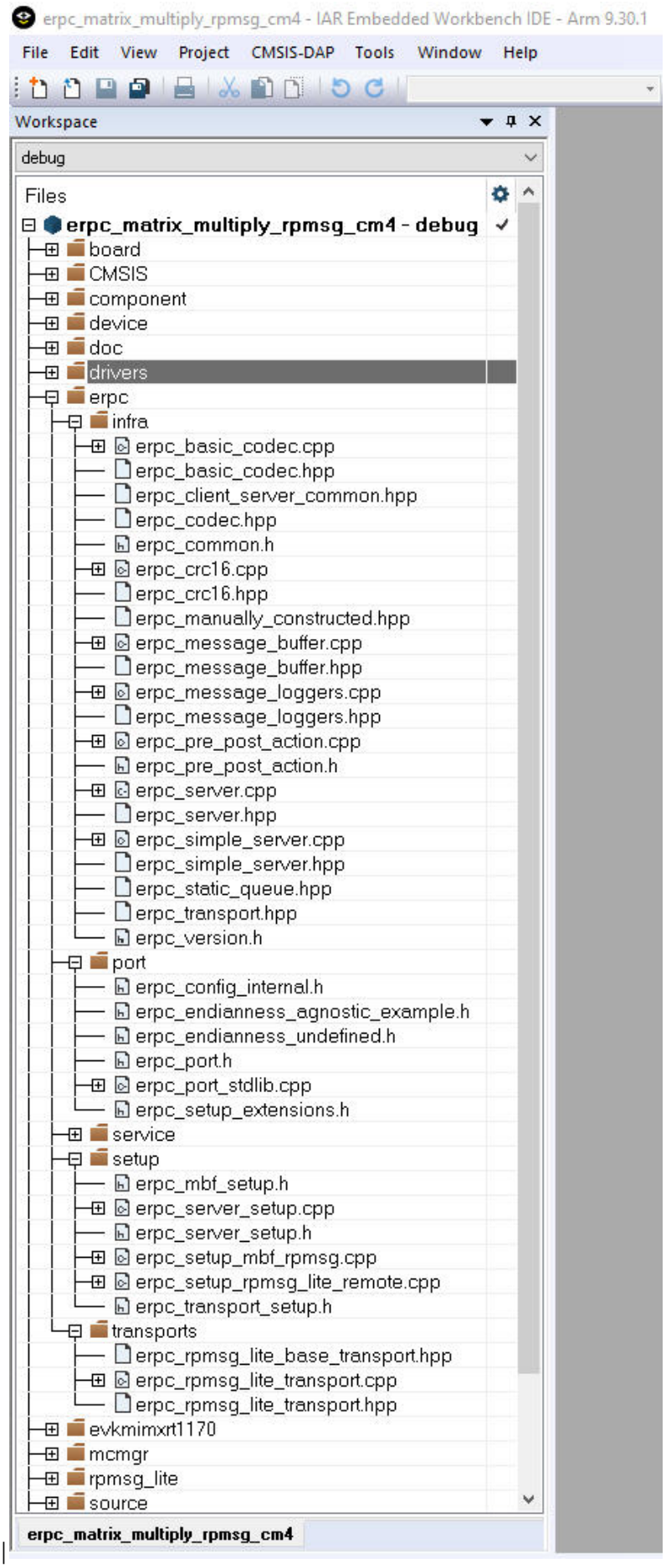
Parent topic: Multicore server application

Server infrastructure files The eRPC infrastructure files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/erpc/erpc_c

The **erpc_c** folder contains files for creating eRPC client and server applications in the *C/C++* language. These files are distributed into subfolders.

- The **infra** subfolder contains C++ infrastructure code used to build server and client applications.
  - Four files, erpc_server.hpp, erpc_server.cpp, erpc_simple_server.hpp, and erpc_simple_server.cpp, are used for running the eRPC server on the server-side applications. The simple server is currently the only implementation of the server, and its role is to catch client requests, identify and call requested functions, and send data back when requested.
  - Three files (erpc_codec.hpp, erpc_basic_codec.hpp, and erpc_basic_codec.cpp) are used for codecs. Currently, the basic codec is the initial and only implementation of the codecs.
  - The erpc_common.hpp file is used for common eRPC definitions, typedefs, and enums.
  - The erpc_manually_constructed.hpp file is used for allocating static storage for the used objects.
  - Message buffer files are used for storing serialized data: erpc_message_buffer.h and erpc_message_buffer.cpp.
  - The erpc_transport.h file defines the abstract interface for transport layer.
- The **port** subfolder contains the eRPC porting layer to adapt to different environments.
  - erpc_port.h file contains definition of erpc_malloc() and erpc_free() functions.
  - erpc_port_stdlib.cpp file ensures adaptation to stdlib.
  - erpc_config_internal.h internal erpc configuration file.
- The **setup** subfolder contains a set of plain C APIs that wrap the C++ infrastructure, providing client and server init and deinit routines that greatly simplify eRPC usage in C-based projects. No knowledge of C++ is required to use these APIs.
  - The erpc_server_setup.h and erpc_server_setup.cpp files needs to be added into the "Matrix multiply" example project to demonstrate the use of C-wrapped functions in this example.
  - The erpc_transport_setup.h and erpc_setup_rpmsg_lite_remote.cpp files needs to be added into the project in order to allow the C-wrapped function for transport layer setup.
  - The erpc_mbf_setup.h and erpc_setup_mbf_rpmsg.cpp files needs to be added into the project in order to allow message buffer factory usage.
- The **transports** subfolder contains transport classes for the different methods of communication supported by eRPC. Some transports are applicable only to host PCs, while others are applicable only to embedded or multicore systems. Most transports have corresponding client and server setup functions in the setup folder.
  - RPMsg-Lite is used as the transport layer for the communication between cores, erpc_rpmsg_lite_base_transport.hpp, erpc_rpmsg_lite_transport.hpp, and erpc_rpmsg_lite_transport.cpp files need to be added into the server project.


erpc_matrix_multiply_rpmsg_cm4 - IAR Embedded Workbench IDE - Arm 9.30.1
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erpc_message_loggers.cpp
erpc_message_loggers.hpp
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evkmimxrt1170
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erpc_matrix_multiply_rpmsg_cm4

|

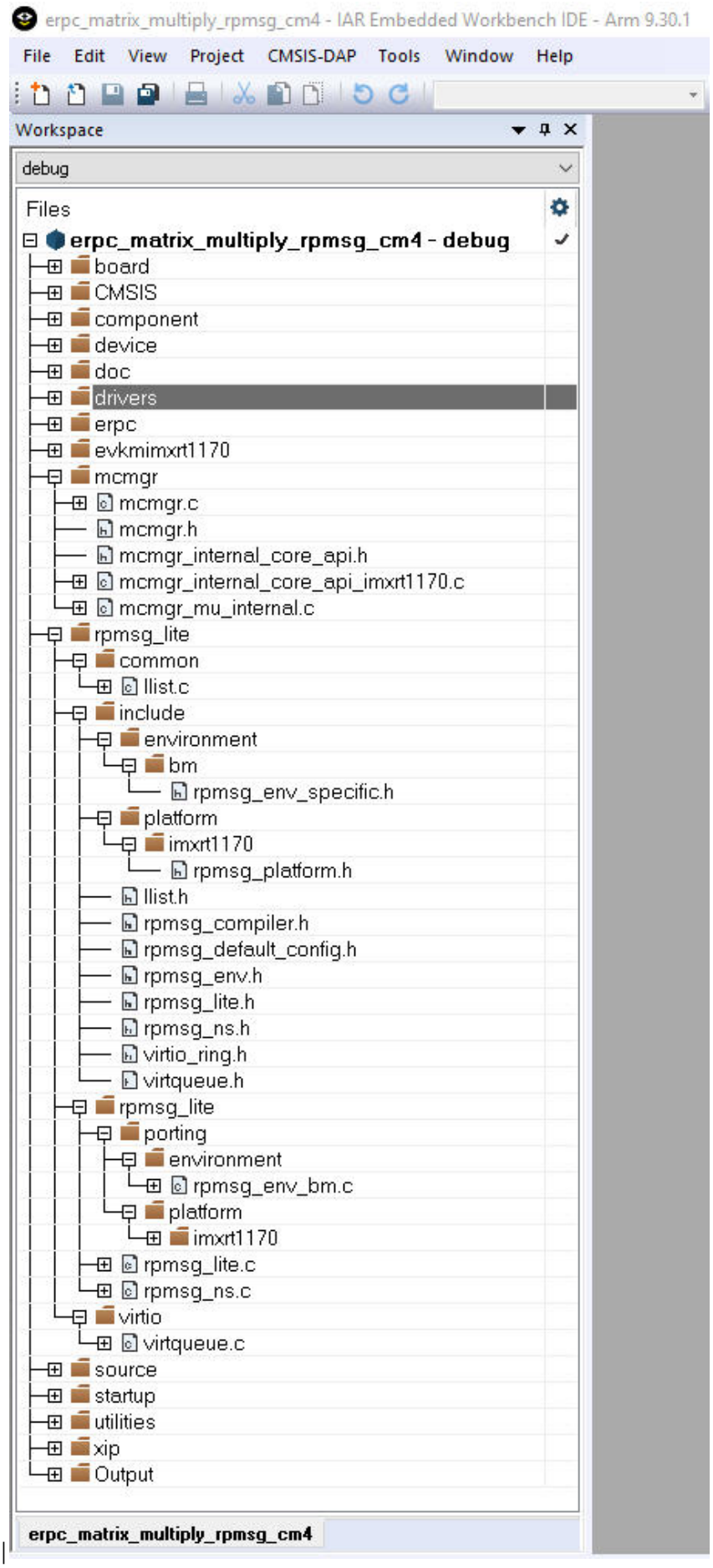
Parent topic: Multicore server application

Server multicore infrastructure files Because of the RPMsg-Lite (transport layer), it is also necessary to include RPMsg-Lite related files, which are in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg_lite/

The multicore example applications also use the Multicore Manager software library to control the secondary core startup and shutdown. These source files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr/


erpc_matrix_multiply_rpmsg_cm4 - IAR Embedded Workbench IDE - Arm 9.30.1
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mcmgr.c
mcmgr.h
mcmgr_internal_core_api.h
mcmgr_internal_core_api_imxrt1170.c
mcmgr_mu_internal.c
rpmsg_lite
common
llist.c
include
environment
bm
rpmsg_env_specific.h
platform
imxrt1170
rpmsg_platform.h
llist.h
rpmsg_compiler.h
rpmsg_default_config.h
rpmsg_env.h
rpmsg_lite.h
rpmsg_ns.h
virtio_ring.h
virtqueue.h
rpmsg_lite
porting
environment
rpmsg_env_bm.c
platform
imxrt1170
rpmsg_lite.c
rpmsg_ns.c
virtio
virtqueue.c
source
startup
utilities
xip
Output
erpc_matrix_multiply_rpmsg_cm4

|

Parent topic: Multicore server application

Server user code The server's user code is stored in the main_core1.c file, located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg/cm4

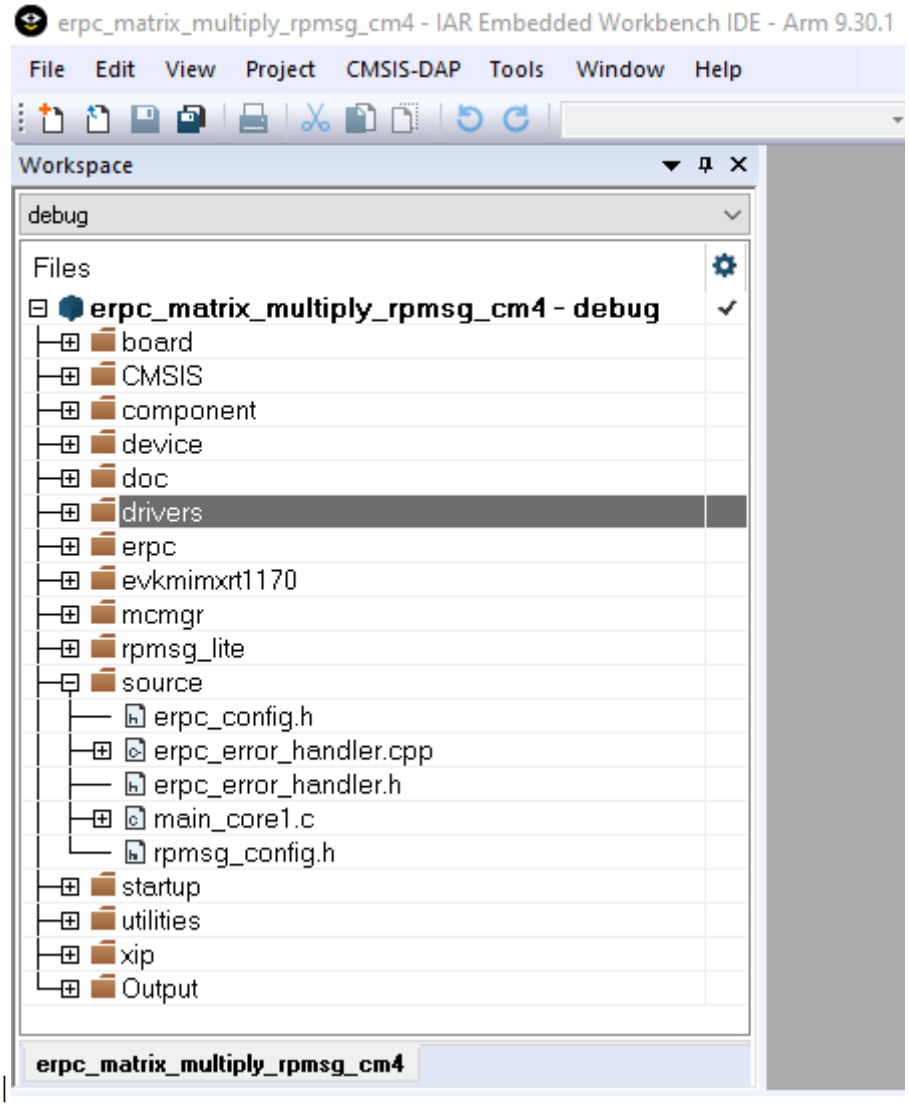
The main_core1.c file contains two functions:

- The **main()** function contains the code for the target board and eRPC server initialization. After the initialization, the matrix multiply service is added and the eRPC server waits for client's requests in the while loop.
- The **erpcMatrixMultiply()** function is the user implementation of the eRPC function defined in the IDL file.
- There is the possibility to write the application-specific eRPC error handler. The eRPC error handler of the matrix multiply application is implemented in the erpc_error_handler.h and erpc_error_handler.cpp files.

The eRPC-relevant code is captured in the following code snippet:

```
/* erpcMatrixMultiply function user implementation */
void erpcMatrixMultiply(const Matrix *matrix1, const Matrix *matrix2, Matrix *result_matrix)
{
  ...
}
int main()
{
  ...
  /* RPMsg-Lite transport layer initialization */
  erpc_transport_t transport;
  transport = erpc_transport_rpmsg_lite_remote_init(src, dst, (void*)startupData,
  ERPC_TRANSPORT_RPMSG_LITE_LINK_ID, SignalReady, NULL);
  ...
  /* MessageBufferFactory initialization */
  erpc_mbf_t message_buffer_factory;
  message_buffer_factory = erpc_mbf_rpmsg_init(transport);
  ...
  /* eRPC server side initialization */
  erpc_server_t server;
  server = erpc_server_init(transport, message_buffer_factory);
  ...
  /* Adding the service to the server */
  erpc_service_t service = create_MatrixMultiplyService_service();
  erpc_add_service_to_server(server, service);
  ...
  while (1)
  {
    /* Process eRPC requests */
    erpc_status_t status = erpc_server_poll(server);
    /* handle error status */
    if (status != kErpcStatus_Success)
    {
      /* print error description */
      erpc_error_handler(status, 0);
      ...
    }
    ...
  }
}
```

Except for the application main file, there are configuration files for the RPMsg-Lite (rpmsg_config.h) and eRPC (erpc_config.h), located in the *<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg* folder.



Parent topic: Multicore server application

Parent topic:*Create an eRPC application*

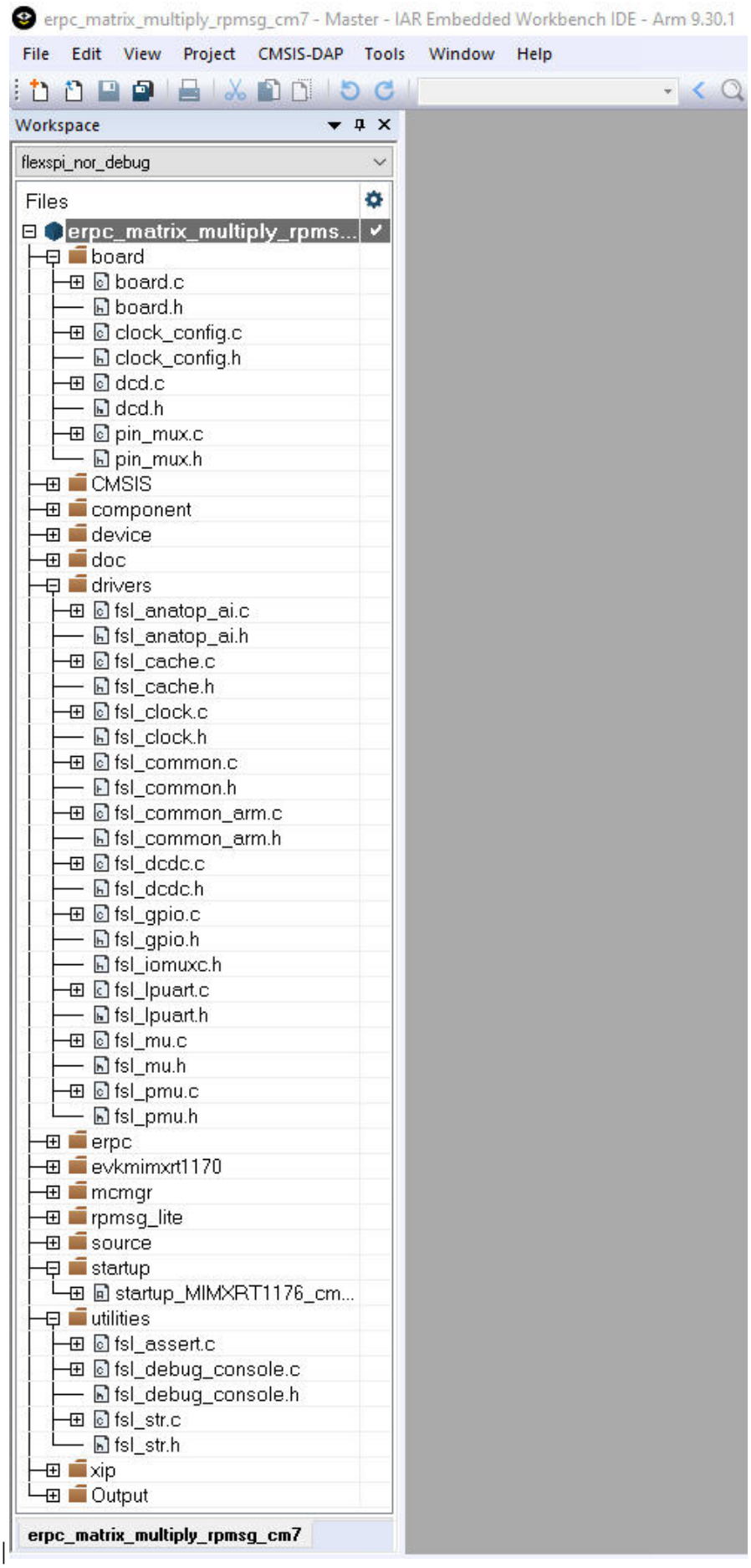
Multicore client application The "Matrix multiply" eRPC client project is located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg/cm7/iar

Project files for the eRPC client have the _cm7 suffix.

Client project basic source files The startup files, board-related settings, peripheral drivers, and utilities belong to the basic project source files and form the skeleton of all MCUXpresso SDK applications. These source files are located in the following folders:

- *<MCUXpressoSDK_install_dir>/devices/<device>*
- *<MCUXpressoSDK_install_dir>/boards/<board_name>/multicore_examples/<example_name>/*


erpc_matrix_multiply_rpmsg_cm7 - Master - IAR Embedded Workbench IDE - Arm 9.30.1
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fsl_cache.h
fsl_clock.c
fsl_clock.h
fsl_common.c
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fsl_common_arm.c
fsl_common_arm.h
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fsl_gpio.c
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fsl_iomuxc.h
fsl_lpuart.c
fsl_lpuart.h
fsl_mu.c
fsl_mu.h
fsl_pmu.c
fsl_pmu.h
erpc
evkmimxrt1170
mcmgr
rpmsg_lite
source
startup
startup_MIMXRT1176_cm...
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fsl_debug_console.h
fsl_str.c
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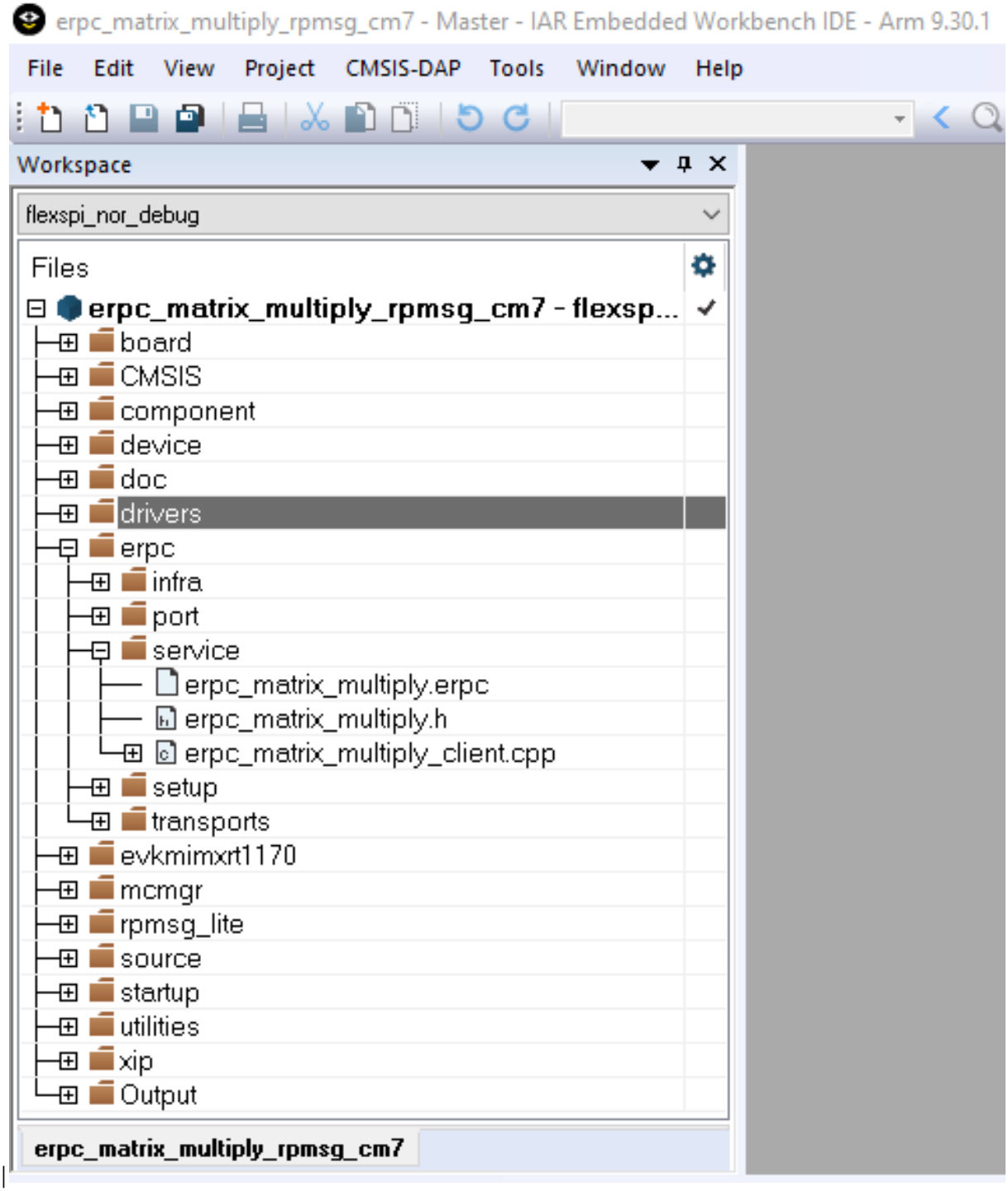
Parent topic: Multicore client application

Client-related generated files The client-related generated files are:

- erpc_matric_multiply.h
- erpc_matrix_multiply_client.cpp

These files contain the shim code for the functions and data types declared in the IDL file. These functions also call methods for codec initialization, data serialization, performing eRPC requests, and de-serializing outputs into expected data structures (if return values are expected). These shim code files can be found in the *<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/service/* folder.



Parent topic: Multicore client application

Client infrastructure files The eRPC infrastructure files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/erpc/erpc_c

The **erpc_c** folder contains files for creating eRPC client and server applications in the C/C++ language. These files are distributed into subfolders.

- The **infra** subfolder contains C++ infrastructure code used to build server and client applications.

- Two files, erpc_client_manager.h and erpc_client_manager.cpp, are used for managing the client-side application. The main purpose of the client files is to create, perform, and release eRPC requests.
- Three files (erpc_codec.hpp, erpc_basic_codec.hpp, and erpc_basic_codec.cpp) are used for codecs. Currently, the basic codec is the initial and only implementation of the codecs.
- erpc_common.h file is used for common eRPC definitions, typedefs, and enums.
- erpc_manually_constructed.hpp file is used for allocating static storage for the used objects.
- Message buffer files are used for storing serialized data: erpc_message_buffer.hpp and erpc_message_buffer.cpp.
- erpc_transport.hpp file defines the abstract interface for transport layer.

The **port** subfolder contains the eRPC porting layer to adapt to different environments.

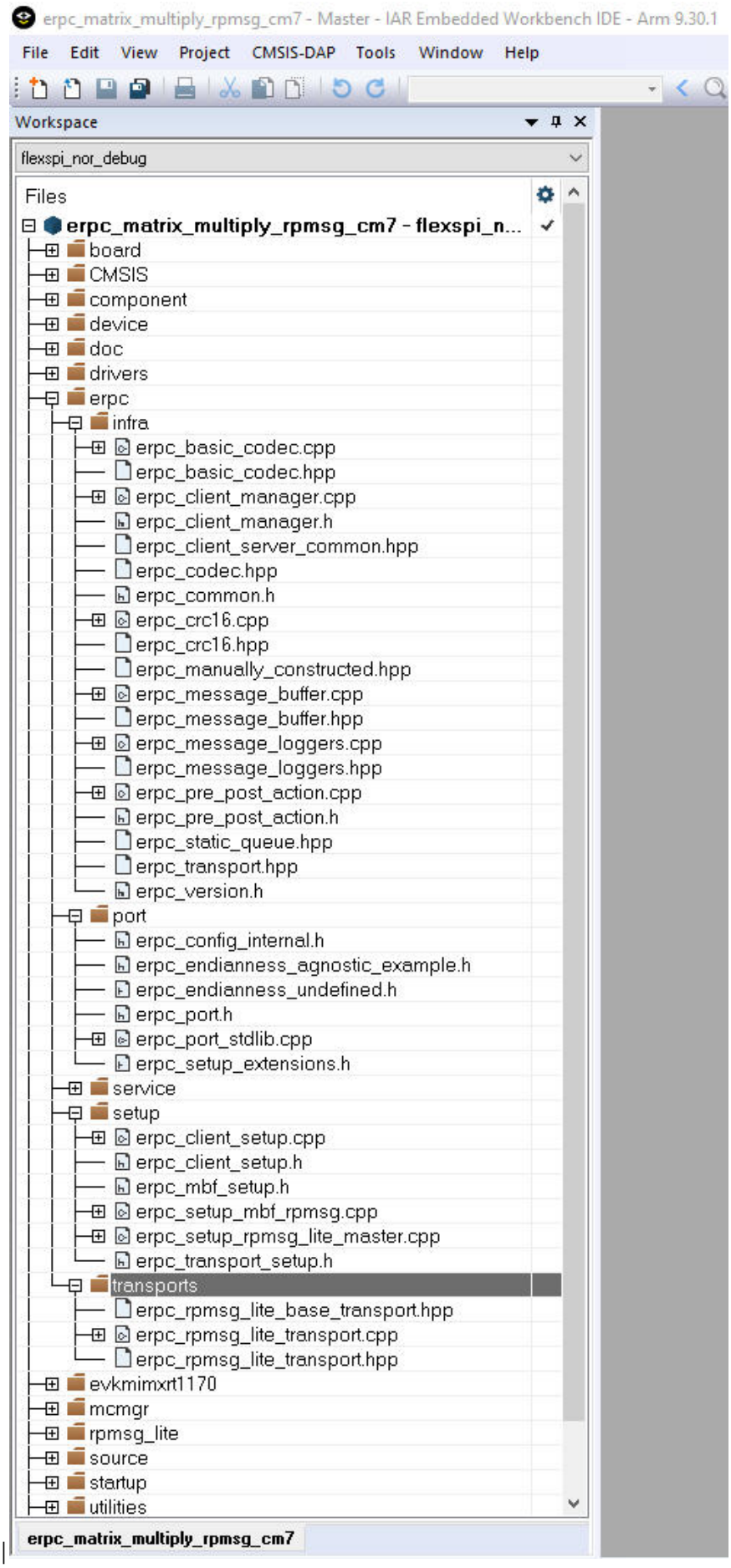
- erpc_port.h file contains definition of erpc_malloc() and erpc_free() functions.
- erpc_port_stdlib.cpp file ensures adaptation to stdlib.
- erpc_config_internal.h internal eRPC configuration file.

The **setup** subfolder contains a set of plain C APIs that wrap the C++ infrastructure, providing client and server init and deinit routines that greatly simplify eRPC usage in C-based projects. No knowledge of C++ is required to use these APIs.

- erpc_client_setup.h and erpc_client_setup.cpp files needs to be added into the "Matrix multiply" example project to demonstrate the use of C-wrapped functions in this example.
- erpc_transport_setup.h and erpc_setup_rpmsg_lite_master.cpp files needs to be added into the project in order to allow C-wrapped function for transport layer setup.
- erpc_mbf_setup.h and erpc_setup_mbf_rpmsg.cpp files needs to be added into the project in order to allow message buffer factory usage.

The **transports** subfolder contains transport classes for the different methods of communication supported by eRPC. Some transports are applicable only to host PCs, while others are applicable only to embedded or multicore systems. Most transports have corresponding client and server setup functions, in the setup folder.

- RPMsg-Lite is used as the transport layer for the communication between cores, erpc_rpmsg_lite_base_transport.hpp, erpc_rpmsg_lite_transport.hpp, and erpc_rpmsg_lite_transport.cpp files needs to be added into the client project.


erpc_matrix_multiply_rpmsg_cm7 - Master - IAR Embedded Workbench IDE - Arm 9.30.1
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erpc_message_buffer.hpp
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erpc_message_loggers.hpp
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erpc_pre_post_action.h
erpc_static_queue.hpp
erpc_transport.hpp
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erpc_rpmsg_lite_transport.cpp
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mcmgr
rpmsg_lite
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utilities
erpc_matrix_multiply_rpmsg_cm7

|

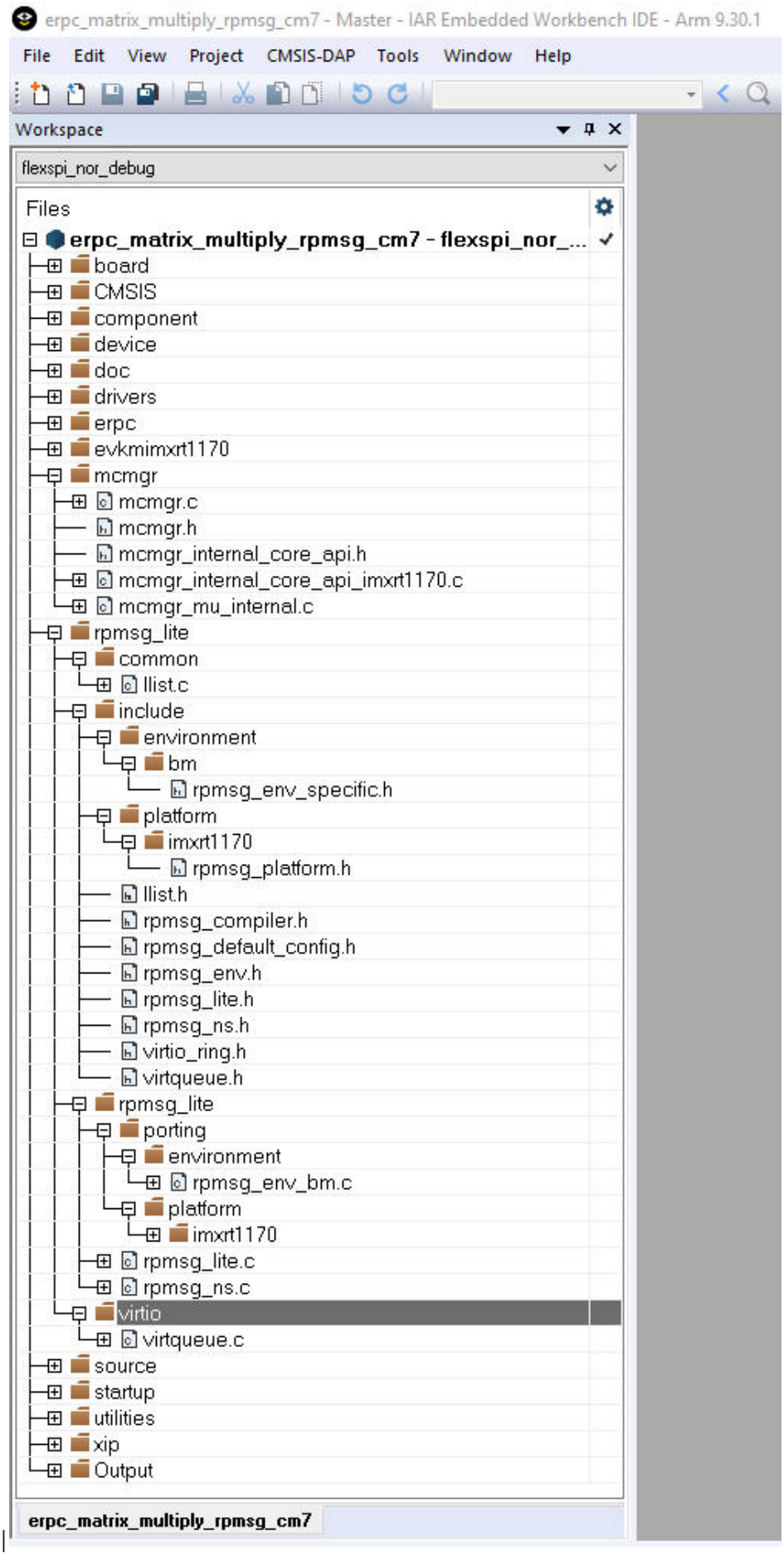
Parent topic: Multicore client application

Client multicore infrastructure files Because of the RPMsg-Lite (transport layer), it is also necessary to include RPMsg-Lite related files, which are in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg_lite/

The multicore example applications also use the Multicore Manager software library to control the secondary core startup and shutdown. These source files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr/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mcmgr_internal_core_api_imxrt1170.c
mcmgr_mu_internal.c
rpmsg_lite
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rpmsg_platform.h
llist.h
rpmsg_compiler.h
rpmsg_default_config.h
rpmsg_env.h
rpmsg_lite.h
rpmsg_ns.h
virtio_ring.h
virtqueue.h
rpmsg_lite
porting
environment
rpmsg_env_bm.c
platform
imxrt1170
rpmsg_lite.c
rpmsg_ns.c
virtio
virtqueue.c
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Parent topic: Multicore client application

Client user code The client's user code is stored in the main_core0.c file, located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_example/erpc_matrix_multiply_rpmsg/cm7

The main_core0.c file contains the code for target board and eRPC initialization.

- After initialization, the secondary core is released from reset.
- When the secondary core is ready, the primary core initializes two matrix variables.
- The erpcMatrixMultiply eRPC function is called to issue the eRPC request and get the result.

It is possible to write the application-specific eRPC error handler. The eRPC error handler of the matrix multiply application is implemented in erpc_error_handler.h and erpc_error_handler.cpp files.

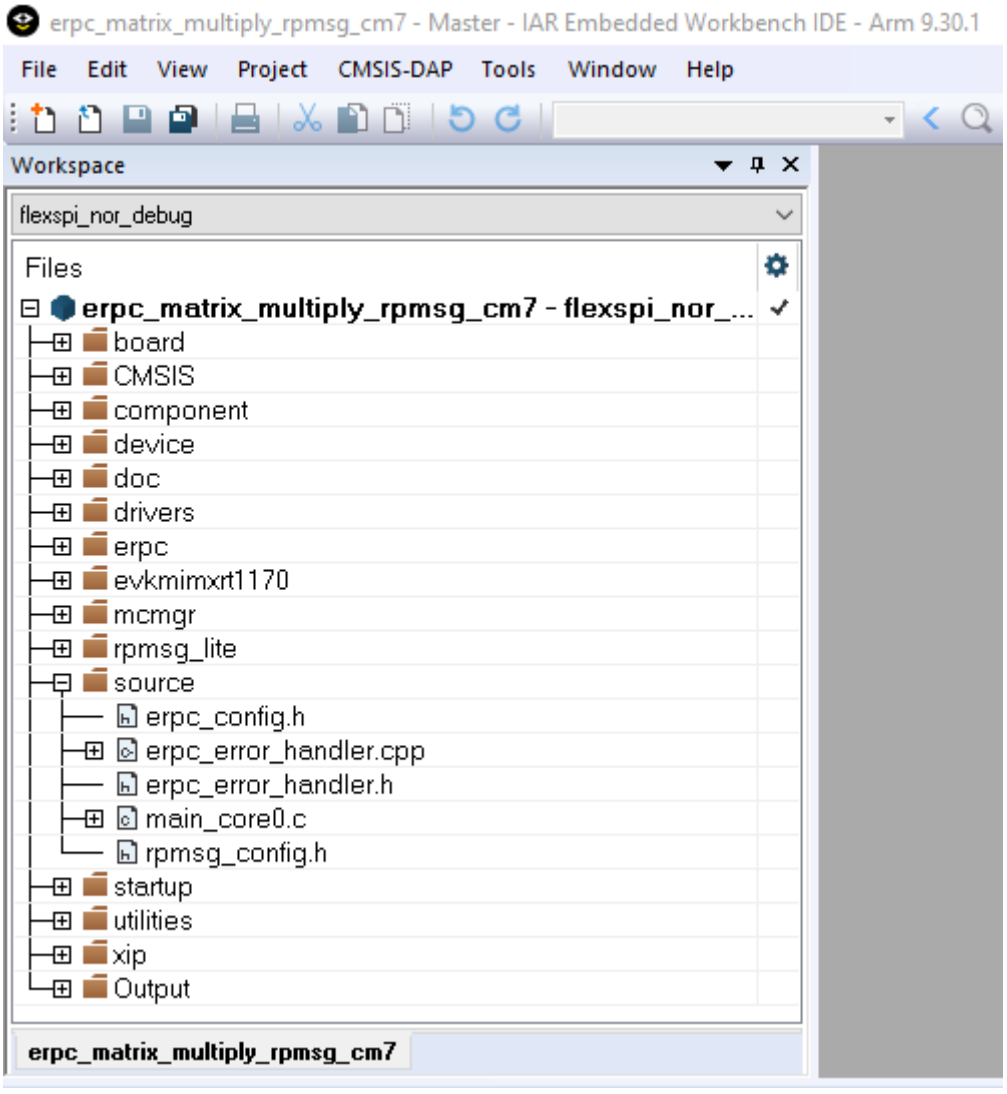
The matrix multiplication can be issued repeatedly, when pressing a software board button.

The eRPC-relevant code is captured in the following code snippet:

```
...
extern bool g_erpc_error_occurred;
...
/* Declare matrix arrays */
Matrix matrix1 = {0}, matrix2 = {0}, result_matrix = {0};
...
/* RPMsg-Lite transport layer initialization */
erpc_transport_t transport;
transport = erpc_transport_rpmsg_lite_master_init(src, dst,
ERPC_TRANSPORT_RPMSG_LITE_LINK_ID);
...
/* MessageBufferFactory initialization */
erpc_mbf_t message_buffer_factory;
message_buffer_factory = erpc_mbf_rpmsg_init(transport);
...
/* eRPC client side initialization */
erpc_client_t client;
client = erpc_client_init(transport, message_buffer_factory);
...
/* Set default error handler */
erpc_client_set_error_handler(client, erpc_error_handler);
...
while (1)
{
  /* Invoke the erpcMatrixMultiply function */
  erpcMatrixMultiply(matrix1, matrix2, result_matrix);
  ...
  /* Check if some error occured in eRPC */
  if (g_erpc_error_occurred)
  {
    /* Exit program loop */
    break;
  }
  ...
}
```

Except for the application main file, there are configuration files for the RPMsg-Lite (rpmsg_config.h) and eRPC (erpc_config.h), located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg



Parent topic: Multicore client application

Parent topic:*Create an eRPC application*

Multiprocessor server application The "Matrix multiply" eRPC server project for multiprocessor applications is located in the *<MCUXpressoSDK_install_dir»/boards/<board_name>/multiprocessor_examples/erpc_server_matrix_multiply_<transport_layer>* folder.

Most of the multiprocessor application setup is the same as for the multicore application. The multiprocessor server application requires server-related generated files (server shim code), server infrastructure files, and the server user code. There is no need for server multicore infrastructure files (MCMGR and RPMsg-Lite). The RPMsg-Lite transport layer is replaced either by SPI or UART transports. The following table shows the required transport-related files per each transport type.

|SPI|<eRPC base directory>/erpc_c/setup/erpc_setup_(d)spi_slave.cpp

<eRPC base directory>/erpc_c/transports/erpc_(d)spi_slave_transport.hpp

<eRPC base directory>/erpc_c/transports/erpc_(d)spi_slave_transport.cpp

| |UART|<eRPC base directory>/erpc_c/setup/erpc_setup_uart_cmsis.cpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.hpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.cpp

|

Server user code The server's user code is stored in the main_server.c file, located in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_server_matrix_multiply_<transport_layer>/* folder.

The eRPC-relevant code with UART as a transport is captured in the following code snippet:

```
/* erpcMatrixMultiply function user implementation */
void erpcMatrixMultiply(Matrix matrix1, Matrix matrix2, Matrix result_matrix)
{
  ...
}
int main()
{
  ...
  /* UART transport layer initialization, ERPC_DEMO_UART is the structure of CMSIS UART driver␣
↪operations */
  erpc_transport_t transport;
  transport = erpc_transport_cmsis_uart_init((void *)&ERPC_DEMO_UART);
  ...
  /* MessageBufferFactory initialization */
  erpc_mbf_t message_buffer_factory;
  message_buffer_factory = erpc_mbf_dynamic_init();
  ...
  /* eRPC server side initialization */
  erpc_server_t server;
  server = erpc_server_init(transport, message_buffer_factory);
  ...
  /* Adding the service to the server */
  erpc_service_t service = create_MatrixMultiplyService_service();
  erpc_add_service_to_server(server, service);
  ...
  while (1)
  {
    /* Process eRPC requests */
    erpc_status_t status = erpc_server_poll(server)
    /* handle error status */
    if (status != kErpcStatus_Success)
    {
      /* print error description */
      erpc_error_handler(status, 0);
      ...
    }
    ...
  }
}
```

Parent topic: Multiprocessor server application

Multiprocessor client application The "Matrix multiply" eRPC client project for multiprocessor applications is located in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_client_matrix_multiply_<transport_layer>/iar/* folder.

Most of the multiprocessor application setup is the same as for the multicore application. The multiprocessor server application requires client-related generated files (server shim code),

client infrastructure files, and the client user code. There is no need for client multicore infrastructure files (MCMGR and RPMsg-Lite). The RPMsg-Lite transport layer is replaced either by SPI or UART transports. The following table shows the required transport-related files per each transport type.

|SPI|<eRPC base directory>/erpc_c/setup/erpc_setup_(d)spi_master.cpp

<eRPC base directory>/erpc_c/transports/ erpc_(d)spi_master_transport.hpp

<eRPC base directory>/erpc_c/transports/ erpc_(d)spi_master_transport.cpp

| |UART|<eRPC base directory>/erpc_c/setup/erpc_setup_uart_cmsis.cpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.hpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.cpp

|

Client user code The client's user code is stored in the main_client.c file, located in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_client_matrix_multiply_<transport_layer>/* folder.

The eRPC-relevant code with UART as a transport is captured in the following code snippet:

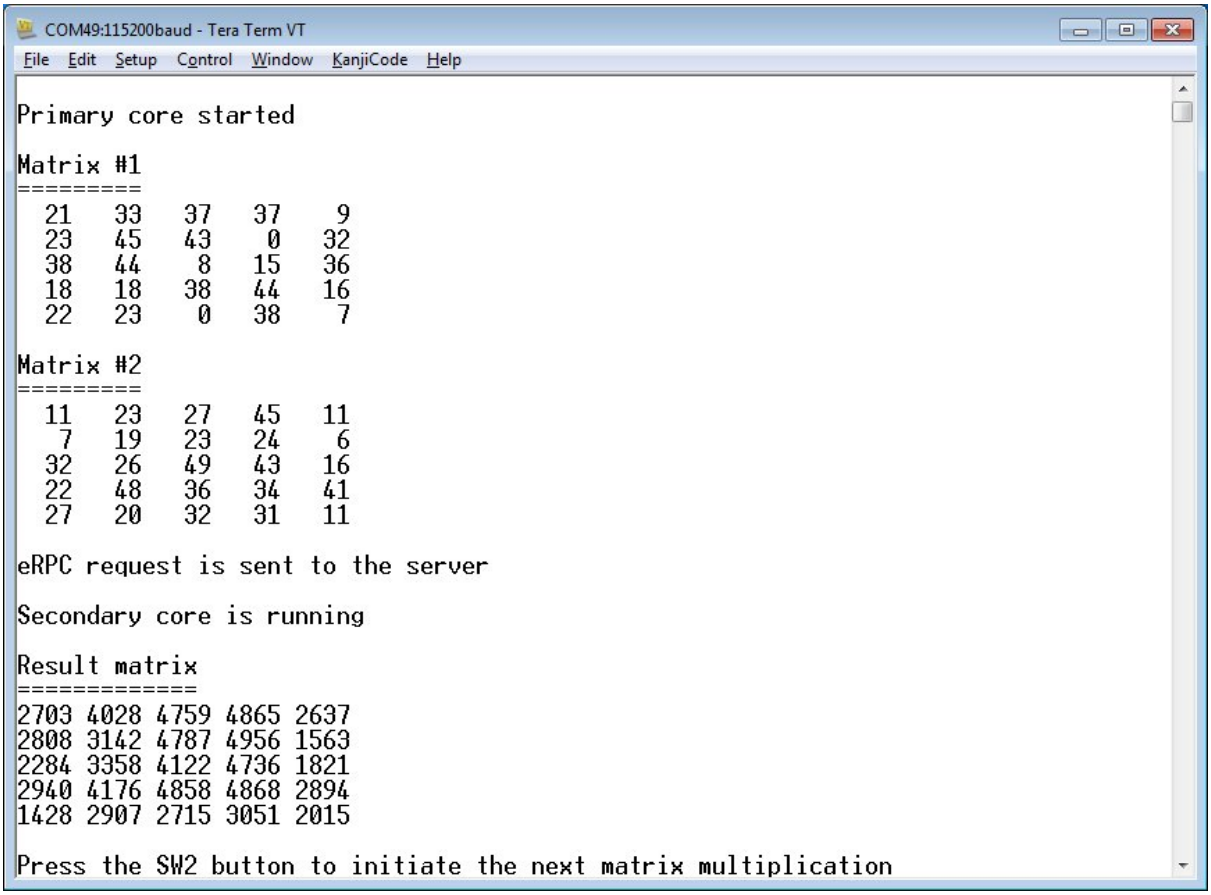
```
...
extern bool g_erpc_error_occurred;
...
/* Declare matrix arrays */
Matrix matrix1 = {0}, matrix2 = {0}, result_matrix = {0};
...
/* UART transport layer initialization, ERPC_DEMO_UART is the structure of CMSIS UART driver␣
↪operations */
erpc_transport_t transport;
transport = erpc_transport_cmsis_uart_init((void *)&ERPC_DEMO_UART);
...
/* MessageBufferFactory initialization */
erpc_mbf_t message_buffer_factory;
message_buffer_factory = erpc_mbf_dynamic_init();
...
/* eRPC client side initialization */
erpc_client_t client;
client = erpc_client_init(transport,message_buffer_factory);
...
/* Set default error handler */
erpc_client_set_error_handler(client, erpc_error_handler);
...
while (1)
{
  /* Invoke the erpcMatrixMultiply function */
  erpcMatrixMultiply(matrix1, matrix2, result_matrix);
  ...
  /* Check if some error occured in eRPC */
  if (g_erpc_error_occurred)
  {
    /* Exit program loop */
    break;
  }
  ...
}
```

Parent topic: Multiprocessor client application

Parent topic: Multiprocessor server application

Parent topic:*Create an eRPC application*

Running the eRPC application Follow the instructions in *Getting Started with MCUXpresso SDK* (document MCUXSDKGSUG) (located in the *<MCUXpressoSDK_install_dir>/docs* folder), to load both the primary and the secondary core images into the on-chip memory, and then effectively debug the dual-core application. After the application is running, the serial console should look like:



For multiprocessor applications that are running between PC and the target evaluation board or between two boards, follow the instructions in the accompanied example readme files that provide details about the proper board setup and the PC side setup (Python).

Parent topic:*Create an eRPC application*

Parent topic:*eRPC example*

eRPC example This section shows how to create an example eRPC application called “Matrix multiply”, which implements one eRPC function (matrix multiply) with two function parameters (two matrices). The client-side application calls this eRPC function, and the server side performs the multiplication of received matrices. The server side then returns the result.

For example, use the NXP MIMXRT1170-EVK board as the target dual-core platform, and the IAR Embedded Workbench for ARM (EWARM) as the target IDE for developing the eRPC example.

- The primary core (CM7) runs the eRPC client.
- The secondary core (CM4) runs the eRPC server.
- RPMsg-Lite (Remote Processor Messaging Lite) is used as the eRPC transport layer.

The “Matrix multiply” application can be also run in the multi-processor setup. In other words, the eRPC client running on one SoC comunicates with the eRPC server that runs on anothe SoC, utilizing different transport channels. It is possible to run the board-to-PC example (PC as the eRPC server and a board as the eRPC client, and vice versa) and also the board-to-board example. These multiprocessor examples are prepared for selected boards only.

|Multicore application source and project files|*<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore*
|Multiprocessor application source and project files|*<MCUXpressoSDK_install_dir>/boards/<board_name>/multi*

<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_server_matrix_multiply_<tr

| |eRPC source files|*<MCUXpressoSDK_install_dir>/middleware/multicore/erpc/*| |RPMsg-Lite source files|*<MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg_lite/*|

Designing the eRPC application The matrix multiply application is based on calling single eRPC function that takes 2 two-dimensional arrays as input and returns matrix multiplication results as another 2 two-dimensional array. The IDL file syntax supports arrays with the dimension length set by the number only (in the current eRPC implementation). Because of this, a variable is declared in the IDL dedicated to store information about matrix dimension length, and to allow easy maintenance of the user and server code.

For a simple use of the two-dimensional array, the alias name (new type definition) for this data type has is declared in the IDL. Declaring this alias name ensures that the same data type can be used across the client and server applications.

Parent topic:*eRPC example*

Creating the IDL file The created IDL file is located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/s

The created IDL file contains the following code:

```
program erpc_matrix_multiply
/*! This const defines the matrix size. The value has to be the same as the
Matrix array dimension. Do not forget to re-generate the erpc code once the
matrix size is changed in the erpc file */
const int32 matrix_size = 5;
/*! This is the matrix array type. The dimension has to be the same as the
matrix size const. Do not forget to re-generate the erpc code once the
matrix size is changed in the erpc file */
type Matrix = int32[matrix_size][matrix_size];
interface MatrixMultiplyService {
erpcMatrixMultiply(in Matrix matrix1, in Matrix matrix2, out Matrix result_matrix) ->
void
}
```

Details:

- The IDL file starts with the program name (*erpc_matrix_multiply*), and this program name is used in the naming of all generated outputs.
- The declaration and definition of the constant variable named *matrix_size* follows next. The *matrix_size* variable is used for passing information about the length of matrix dimensions to the client/server user code.
- The alias name for the two-dimensional array type (*Matrix*) is declared.
- The interface group *MatrixMultiplyService* is located at the end of the IDL file. This interface group contains only one function declaration *erpcMatrixMultiply*.
- As shown above, the function’s declaration contains three parameters of Matrix type: *matrix1* and *matrix2* are input parameters, while *result_matrix* is the output parameter. Additionally, the returned data type is declared as void.

When writing the IDL file, the following order of items is recommended:

1. Program name at the top of the IDL file.
2. New data types and constants declarations.
3. Declarations of interfaces and functions at the end of the IDL file.

Parent topic:*eRPC example*

Using the eRPC generator tool |Windows OS|<MCUXpressoSDK_install_dir>/middleware/multicore/tools/erp
|Linux OS|<MCUXpressoSDK_install_dir>/middleware/multicore/tools/erpcgen/Linux_x64

<MCUXpressoSDK_install_dir>/middleware/multicore/tools/erpcgen/Linux_x86

| |Mac OS|<MCUXpressoSDK_install_dir>/middleware/multicore/tools/erpcgen/Mac|

The files for the "Matrix multiply" example are pre-generated and already a part of the application projects. The following section describes how they have been created.

- The easiest way to create the shim code is to copy the erpcgen application to the same folder where the IDL file (*.erpc) is located; then run the following command:

  erpcgen <IDL_file>.erpc

- In the "Matrix multiply" example, the command should look like:

  erpcgen erpc_matrix_multiply.erpc

Additionally, another method to create the shim code is to execute the eRPC application using input commands:

- "-?"/"—help" – Shows supported commands.
- "-o <filePath>"/"—output<filePath>" – Sets the output directory.

For example,

```
<path_to_erpcgen>/erpcgen –o <path_to_output>
<path_to_IDL>/<IDL_file_name>.erpc
```

For the "Matrix multiply" example, when the command is executed from the default erpcgen location, it looks like:

erpcgen –o

../../../../../boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/service
../../../../../boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/service/erpc_matrix_mu

In both cases, the following four files are generated into the *<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/service folder.*

- erpc_matrix_multiply.h
- erpc_matrix_multiply_client.cpp
- erpc_matrix_multiply_server.h
- erpc_matrix_multiply_server.cpp

For multiprocessor examples, the eRPC file and pre-generated files can be found in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_common/erpc_matrix_multiply/serv* folder.

For Linux OS users:

- Do not forget to set the permissions for the eRPC generator application.
- Run the application as ./erpcgen... instead of as erpcgen ....

Parent topic:*eRPC example*

Create an eRPC application This section describes a generic way to create a client/server eRPC application:

1. **Design the eRPC application:** Decide which data types are sent between applications, and define functions that send/receive this data.
2. **Create the IDL file:** The IDL file contains information about data types and functions used in an eRPC application, and is written in the IDL language.
3. **Use the eRPC generator tool:** This tool takes an IDL file and generates the shim code for the client and the server-side applications.
4. **Create an eRPC application:**
    1. Create two projects, where one project is for the client side (primary core) and the other project is for the server side (secondary core).
    2. Add generated files for the client application to the client project, and add generated files for the server application to the server project.
    3. Add infrastructure files.
    4. Add user code for client and server applications.
    5. Set the client and server project options.
5. **Run the eRPC application:** Run both the server and the client applications. Make sure that the server has been run before the client request was sent.

A specific example follows in the next section.

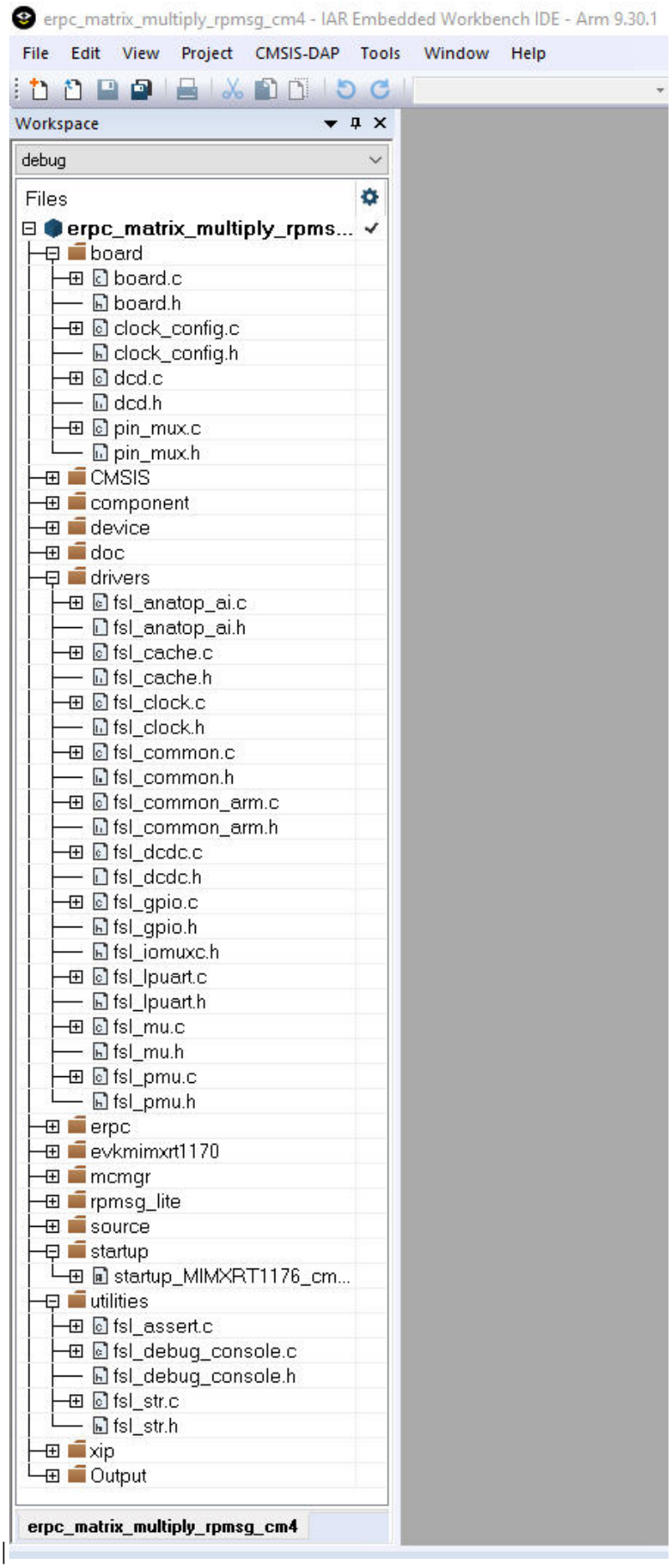
Multicore server application The “Matrix multiply” eRPC server project is located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg/cm4/iar

The project files for the eRPC server have the `_cm4` suffix.

Server project basic source files The startup files, board-related settings, peripheral drivers, and utilities belong to the basic project source files and form the skeleton of all MCUXpresso SDK applications. These source files are located in:

- *<MCUXpressoSDK_install_dir>/devices/<device>*
- *<MCUXpressoSDK_install_dir>/boards/<board_name>/multicore_examples/<example_name>/*


erpc_matrix_multiply_rpmsg_cm4 - IAR Embedded Workbench IDE - Arm 9.30.1
File Edit View Project CMSIS-DAP Tools Window Help
Workspace
debug
Files
erpc_matrix_multiply_rpms...
board
board.c
board.h
clock_config.c
clock_config.h
dcd.c
dcd.h
pin_mux.c
pin_mux.h
CMSIS
component
device
doc
drivers
fsl_anatop_ai.c
fsl_anatop_ai.h
fsl_cache.c
fsl_cache.h
fsl_clock.c
fsl_clock.h
fsl_common.c
fsl_common.h
fsl_common_arm.c
fsl_common_arm.h
fsl_dcdc.c
fsl_dcdc.h
fsl_gpio.c
fsl_gpio.h
fsl_iomuxc.h
fsl_lpuart.c
fsl_lpuart.h
fsl_mu.c
fsl_mu.h
fsl_pmu.c
fsl_pmu.h
erpc
evkmimxrt1170
mcmgr
rpmsg_lite
source
startup
startup_MIMXRT1176_cm...
utilities
fsl_assert.c
fsl_debug_console.c
fsl_debug_console.h
fsl_str.c
fsl_str.h
xip
Output
erpc_matrix_multiply_rpmsg_cm4

|

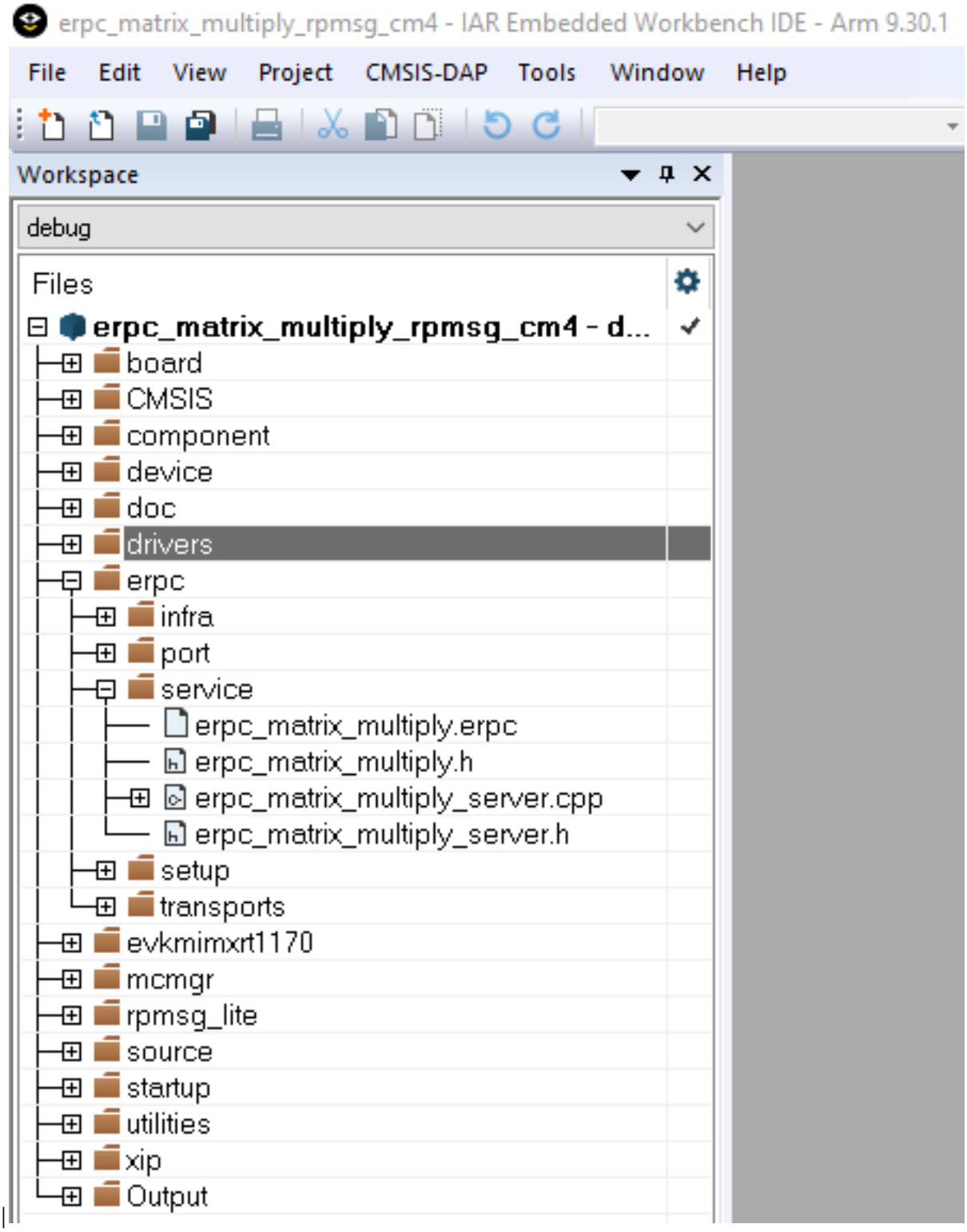
Parent topic: Multicore server application

Server related generated files The server-related generated files are:

- erpc_matric_multiply.h
- erpc_matrix_multiply_server.h
- erpc_matrix_multiply_server.cpp

The server-related generated files contain the shim code for functions and data types declared in the IDL file. These files also contain functions for the identification of client requested functions, data deserialization, calling requested function's implementations, and data serialization and return, if requested by the client. These shim code files can be found in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/s



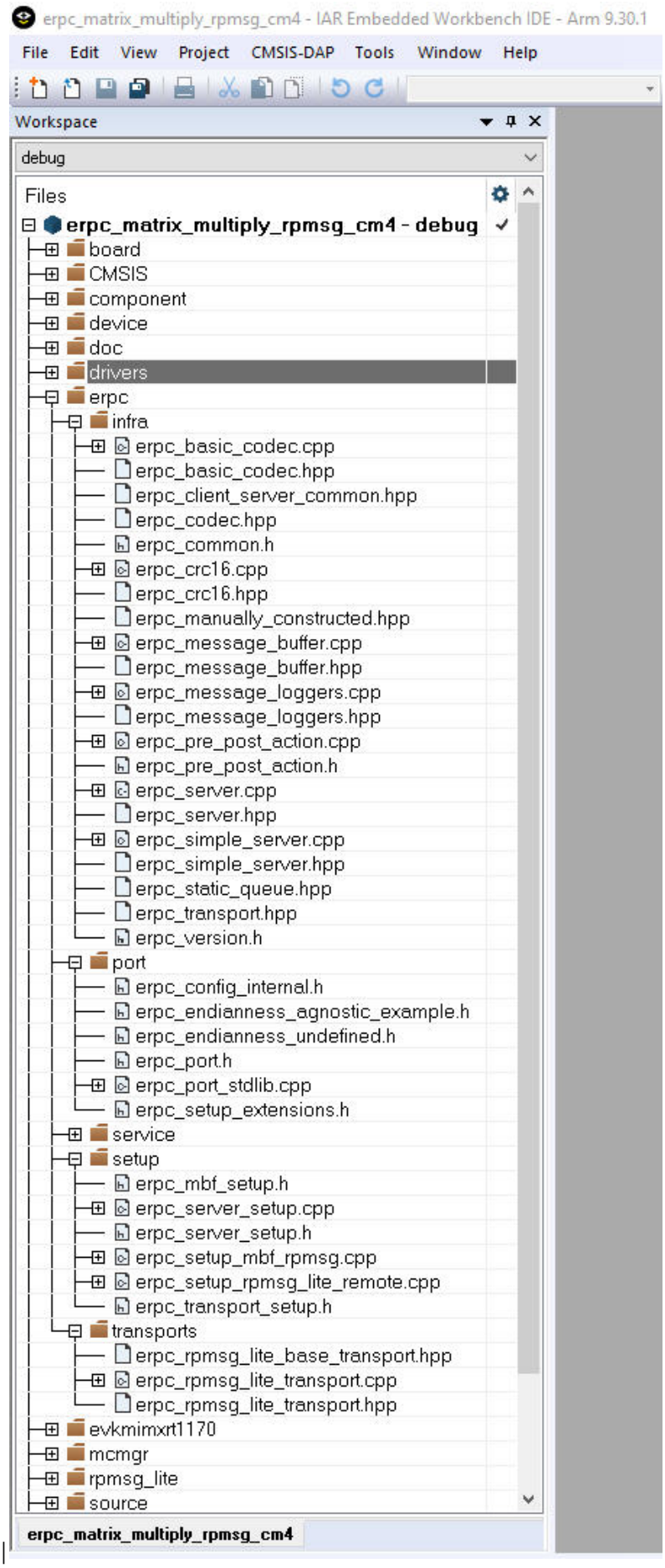
Parent topic: Multicore server application

Server infrastructure files The eRPC infrastructure files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/erpc/erpc_c

The **erpc_c** folder contains files for creating eRPC client and server applications in the *C/C++* language. These files are distributed into subfolders.

- The **infra** subfolder contains C++ infrastructure code used to build server and client applications.
  - Four files, erpc_server.hpp, erpc_server.cpp, erpc_simple_server.hpp, and erpc_simple_server.cpp, are used for running the eRPC server on the server-side applications. The simple server is currently the only implementation of the server, and its role is to catch client requests, identify and call requested functions, and send data back when requested.
  - Three files (erpc_codec.hpp, erpc_basic_codec.hpp, and erpc_basic_codec.cpp) are used for codecs. Currently, the basic codec is the initial and only implementation of the codecs.
  - The erpc_common.hpp file is used for common eRPC definitions, typedefs, and enums.
  - The erpc_manually_constructed.hpp file is used for allocating static storage for the used objects.
  - Message buffer files are used for storing serialized data: erpc_message_buffer.h and erpc_message_buffer.cpp.
  - The erpc_transport.h file defines the abstract interface for transport layer.
- The **port** subfolder contains the eRPC porting layer to adapt to different environments.
  - erpc_port.h file contains definition of erpc_malloc() and erpc_free() functions.
  - erpc_port_stdlib.cpp file ensures adaptation to stdlib.
  - erpc_config_internal.h internal erpc configuration file.
- The **setup** subfolder contains a set of plain C APIs that wrap the C++ infrastructure, providing client and server init and deinit routines that greatly simplify eRPC usage in C-based projects. No knowledge of C++ is required to use these APIs.
  - The erpc_server_setup.h and erpc_server_setup.cpp files needs to be added into the "Matrix multiply" example project to demonstrate the use of C-wrapped functions in this example.
  - The erpc_transport_setup.h and erpc_setup_rpmsg_lite_remote.cpp files needs to be added into the project in order to allow the C-wrapped function for transport layer setup.
  - The erpc_mbf_setup.h and erpc_setup_mbf_rpmsg.cpp files needs to be added into the project in order to allow message buffer factory usage.
- The **transports** subfolder contains transport classes for the different methods of communication supported by eRPC. Some transports are applicable only to host PCs, while others are applicable only to embedded or multicore systems. Most transports have corresponding client and server setup functions in the setup folder.
  - RPMsg-Lite is used as the transport layer for the communication between cores, erpc_rpmsg_lite_base_transport.hpp, erpc_rpmsg_lite_transport.hpp, and erpc_rpmsg_lite_transport.cpp files need to be added into the server project.


erpc_matrix_multiply_rpmsg_cm4 - IAR Embedded Workbench IDE - Arm 9.30.1
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infra
erpc_basic_codec.cpp
erpc_basic_codec.hpp
erpc_client_server_common.hpp
erpc_codec.hpp
erpc_common.h
erpc_crc16.cpp
erpc_crc16.hpp
erpc_manually_constructed.hpp
erpc_message_buffer.cpp
erpc_message_buffer.hpp
erpc_message_loggers.cpp
erpc_message_loggers.hpp
erpc_pre_post_action.cpp
erpc_pre_post_action.h
erpc_server.cpp
erpc_server.hpp
erpc_simple_server.cpp
erpc_simple_server.hpp
erpc_static_queue.hpp
erpc_transport.hpp
erpc_version.h
port
erpc_config_internal.h
erpc_endianness_agnostic_example.h
erpc_endianness_undefined.h
erpc_port.h
erpc_port_stdlib.cpp
erpc_setup_extensions.h
service
setup
erpc_mbf_setup.h
erpc_server_setup.cpp
erpc_server_setup.h
erpc_setup_mbf_rpmsg.cpp
erpc_setup_rpmsg_lite_remote.cpp
erpc_transport_setup.h
transports
erpc_rpmsg_lite_base_transport.hpp
erpc_rpmsg_lite_transport.cpp
erpc_rpmsg_lite_transport.hpp
evkmimxrt1170
mcmgr
rpmsg_lite
source
erpc_matrix_multiply_rpmsg_cm4

|

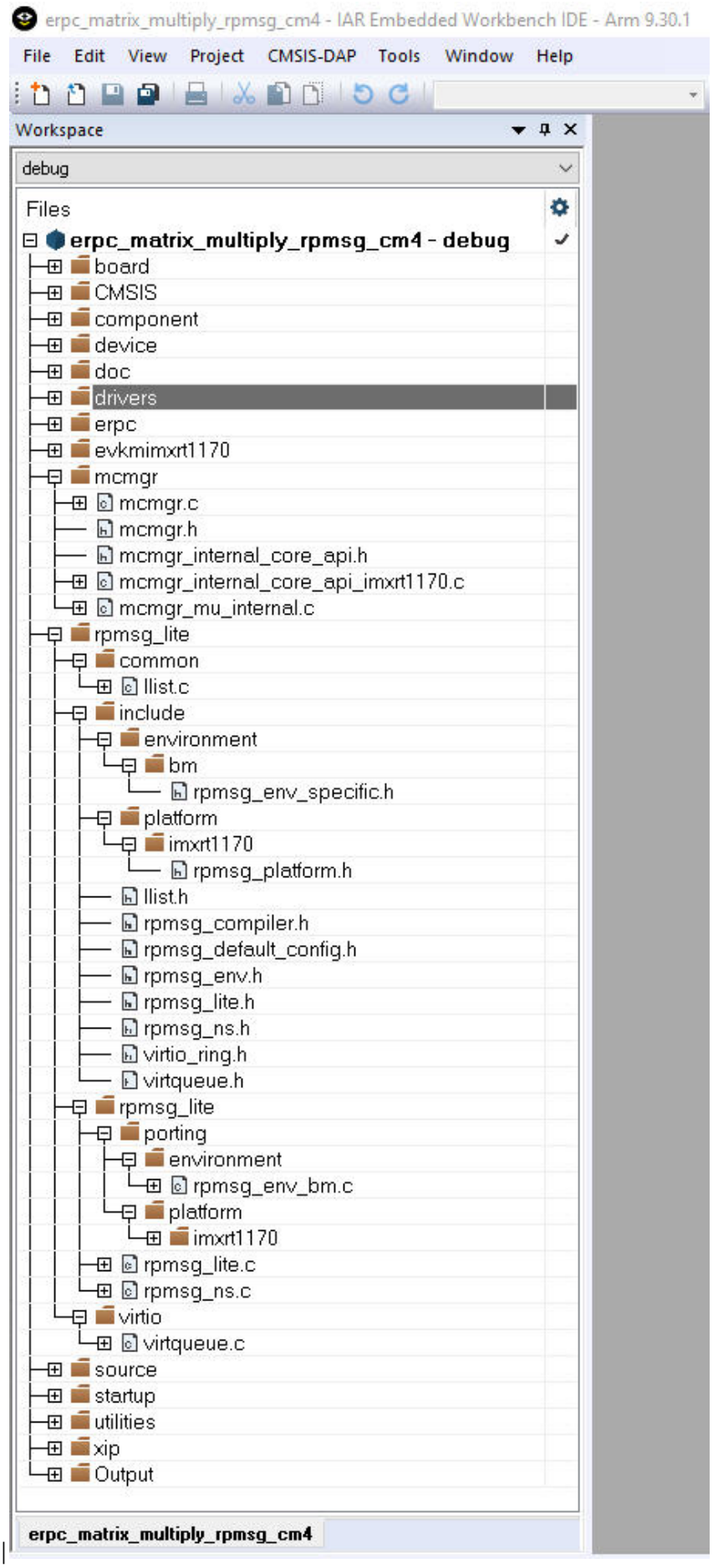
Parent topic: Multicore server application

Server multicore infrastructure files Because of the RPMsg-Lite (transport layer), it is also necessary to include RPMsg-Lite related files, which are in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg_lite/

The multicore example applications also use the Multicore Manager software library to control the secondary core startup and shutdown. These source files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr/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drivers
erpc
evkmimxrt1170
mcmgr
mcmgr.c
mcmgr.h
mcmgr_internal_core_api.h
mcmgr_internal_core_api_imxrt1170.c
mcmgr_mu_internal.c
rpmsg_lite
common
llist.c
include
environment
bm
rpmsg_env_specific.h
platform
imxrt1170
rpmsg_platform.h
llist.h
rpmsg_compiler.h
rpmsg_default_config.h
rpmsg_env.h
rpmsg_lite.h
rpmsg_ns.h
virtio_ring.h
virtqueue.h
rpmsg_lite
porting
environment
rpmsg_env_bm.c
platform
imxrt1170
rpmsg_lite.c
rpmsg_ns.c
virtio
virtqueue.c
source
startup
utilities
xip
Output
erpc_matrix_multiply_rpmsg_cm4

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Parent topic: Multicore server application

Server user code The server's user code is stored in the main_core1.c file, located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg/cm4

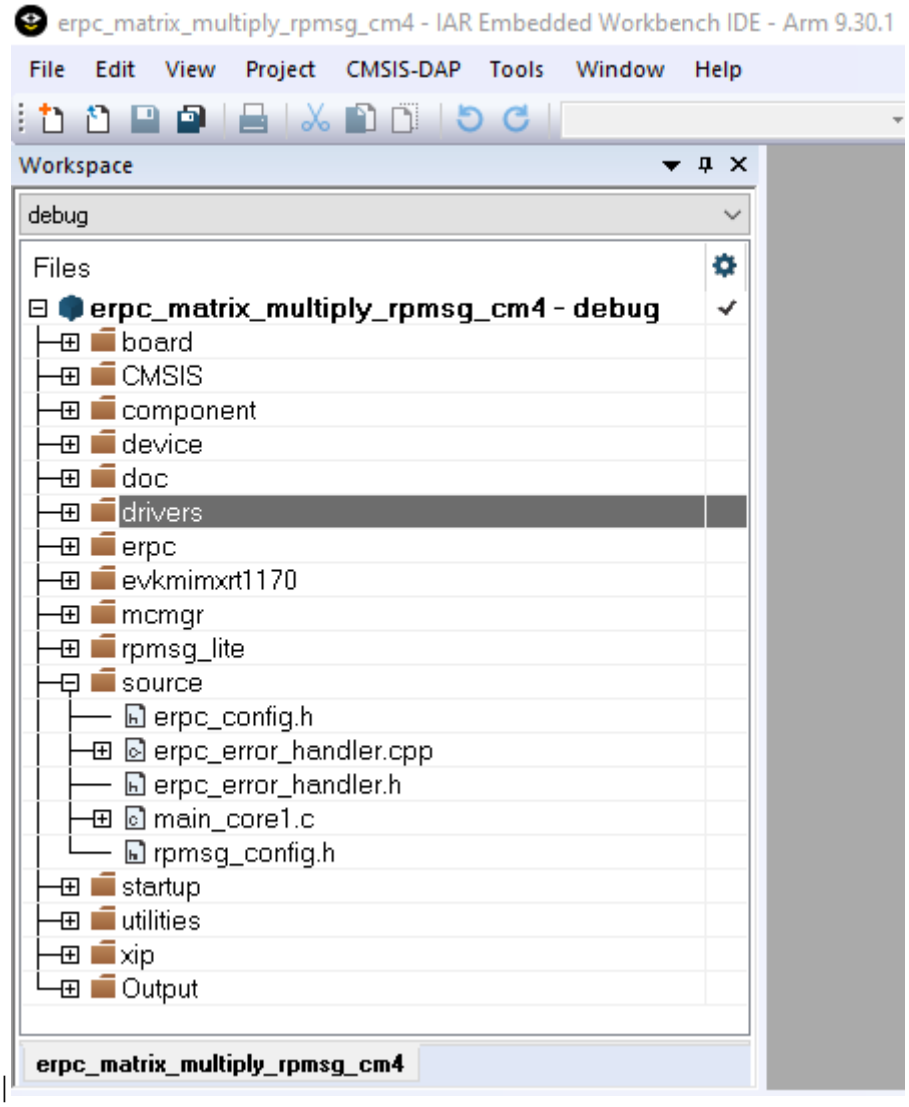
The main_core1.c file contains two functions:

- The **main()** function contains the code for the target board and eRPC server initialization. After the initialization, the matrix multiply service is added and the eRPC server waits for client's requests in the while loop.
- The **erpcMatrixMultiply()** function is the user implementation of the eRPC function defined in the IDL file.
- There is the possibility to write the application-specific eRPC error handler. The eRPC error handler of the matrix multiply application is implemented in the erpc_error_handler.h and erpc_error_handler.cpp files.

The eRPC-relevant code is captured in the following code snippet:

```
/* erpcMatrixMultiply function user implementation */
void erpcMatrixMultiply(const Matrix *matrix1, const Matrix *matrix2, Matrix *result_matrix)
{
  ...
}
int main()
{
  ...
  /* RPMsg-Lite transport layer initialization */
  erpc_transport_t transport;
  transport = erpc_transport_rpmsg_lite_remote_init(src, dst, (void*)startupData,
  ERPC_TRANSPORT_RPMSG_LITE_LINK_ID, SignalReady, NULL);
  ...
  /* MessageBufferFactory initialization */
  erpc_mbf_t message_buffer_factory;
  message_buffer_factory = erpc_mbf_rpmsg_init(transport);
  ...
  /* eRPC server side initialization */
  erpc_server_t server;
  server = erpc_server_init(transport, message_buffer_factory);
  ...
  /* Adding the service to the server */
  erpc_service_t service = create_MatrixMultiplyService_service();
  erpc_add_service_to_server(server, service);
  ...
  while (1)
  {
    /* Process eRPC requests */
    erpc_status_t status = erpc_server_poll(server);
    /* handle error status */
    if (status != kErpcStatus_Success)
    {
      /* print error description */
      erpc_error_handler(status, 0);
      ...
    }
    ...
  }
}
```

Except for the application main file, there are configuration files for the RPMsg-Lite (rpmsg_config.h) and eRPC (erpc_config.h), located in the *<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg* folder.



Parent topic: Multicore server application

Parent topic:*Create an eRPC application*

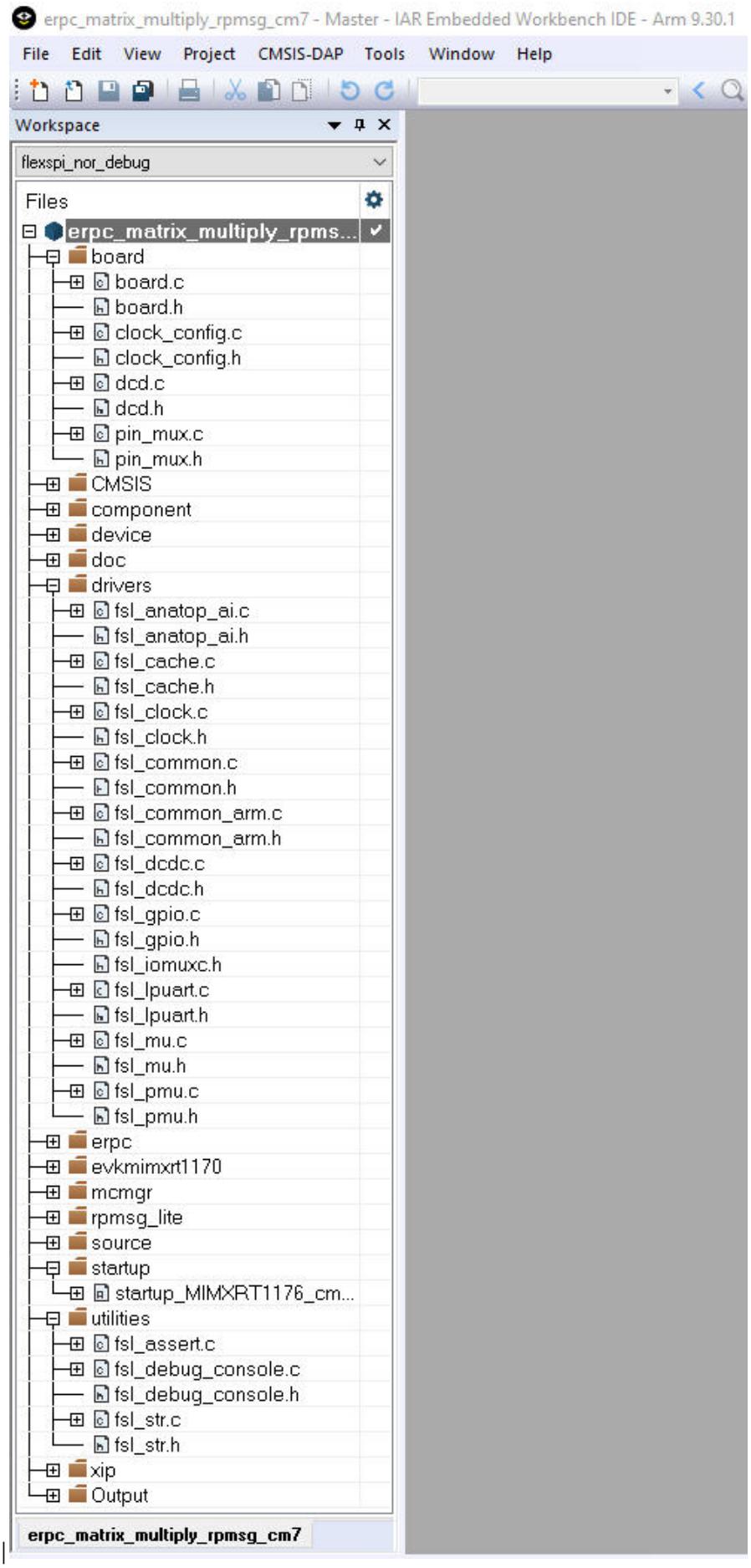
Multicore client application The "Matrix multiply" eRPC client project is located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg/cm7/iar

Project files for the eRPC client have the _cm7 suffix.

Client project basic source files The startup files, board-related settings, peripheral drivers, and utilities belong to the basic project source files and form the skeleton of all MCUXpresso SDK applications. These source files are located in the following folders:

- *<MCUXpressoSDK_install_dir>/devices/<device>*
- *<MCUXpressoSDK_install_dir>/boards/<board_name>/multicore_examples/<example_name>/*


erpc_matrix_multiply_rpmsg_cm7 - Master - IAR Embedded Workbench IDE - Arm 9.30.1
File Edit View Project CMSIS-DAP Tools Window Help
Workspace
flexspi_nor_debug
Files
erpc_matrix_multiply_rpms...
board
board.c
board.h
clock_config.c
clock_config.h
dcd.c
dcd.h
pin_mux.c
pin_mux.h
CMSIS
component
device
doc
drivers
fsl_anatop_ai.c
fsl_anatop_ai.h
fsl_cache.c
fsl_cache.h
fsl_clock.c
fsl_clock.h
fsl_common.c
fsl_common.h
fsl_common_arm.c
fsl_common_arm.h
fsl_dcdc.c
fsl_dcdc.h
fsl_gpio.c
fsl_gpio.h
fsl_iomuxc.h
fsl_lpuart.c
fsl_lpuart.h
fsl_mu.c
fsl_mu.h
fsl_pmu.c
fsl_pmu.h
erpc
evkmimxrt1170
mcmgr
rpmsg_lite
source
startup
startup_MIMXRT1176_cm...
utilities
fsl_assert.c
fsl_debug_console.c
fsl_debug_console.h
fsl_str.c
fsl_str.h
xip
Output
erpc_matrix_multiply_rpmsg_cm7

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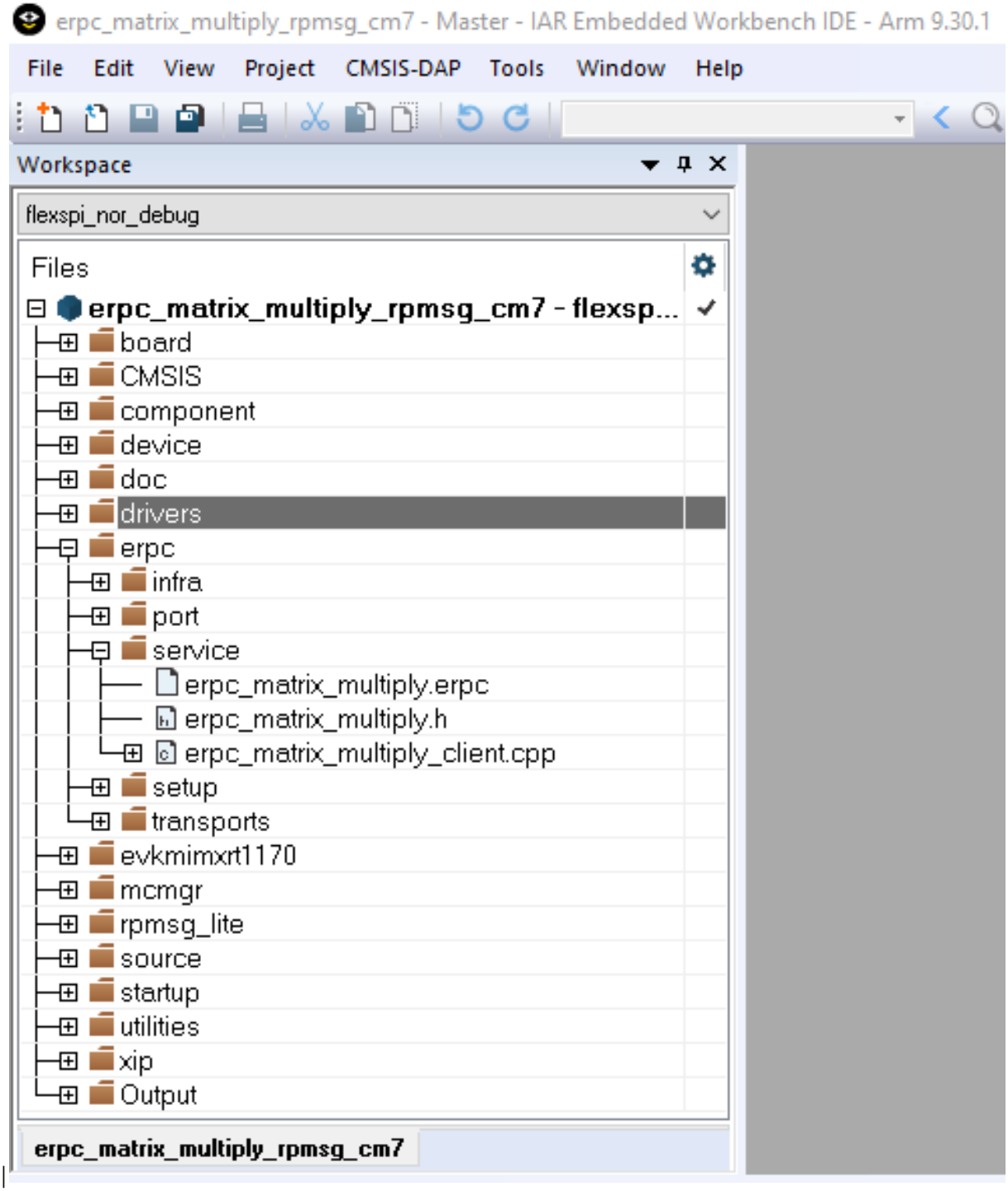
Parent topic: Multicore client application

Client-related generated files The client-related generated files are:

- erpc_matric_multiply.h
- erpc_matrix_multiply_client.cpp

These files contain the shim code for the functions and data types declared in the IDL file. These functions also call methods for codec initialization, data serialization, performing eRPC requests, and de-serializing outputs into expected data structures (if return values are expected). These shim code files can be found in the *<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_common/erpc_matrix_multiply/service/* folder.



Parent topic: Multicore client application

Client infrastructure files The eRPC infrastructure files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/erpc/erpc_c

The **erpc_c** folder contains files for creating eRPC client and server applications in the C/C++ language. These files are distributed into subfolders.

- The **infra** subfolder contains C++ infrastructure code used to build server and client applications.

- Two files, erpc_client_manager.h and erpc_client_manager.cpp, are used for managing the client-side application. The main purpose of the client files is to create, perform, and release eRPC requests.
- Three files (erpc_codec.hpp, erpc_basic_codec.hpp, and erpc_basic_codec.cpp) are used for codecs. Currently, the basic codec is the initial and only implementation of the codecs.
- erpc_common.h file is used for common eRPC definitions, typedefs, and enums.
- erpc_manually_constructed.hpp file is used for allocating static storage for the used objects.
- Message buffer files are used for storing serialized data: erpc_message_buffer.hpp and erpc_message_buffer.cpp.
- erpc_transport.hpp file defines the abstract interface for transport layer.

The **port** subfolder contains the eRPC porting layer to adapt to different environments.

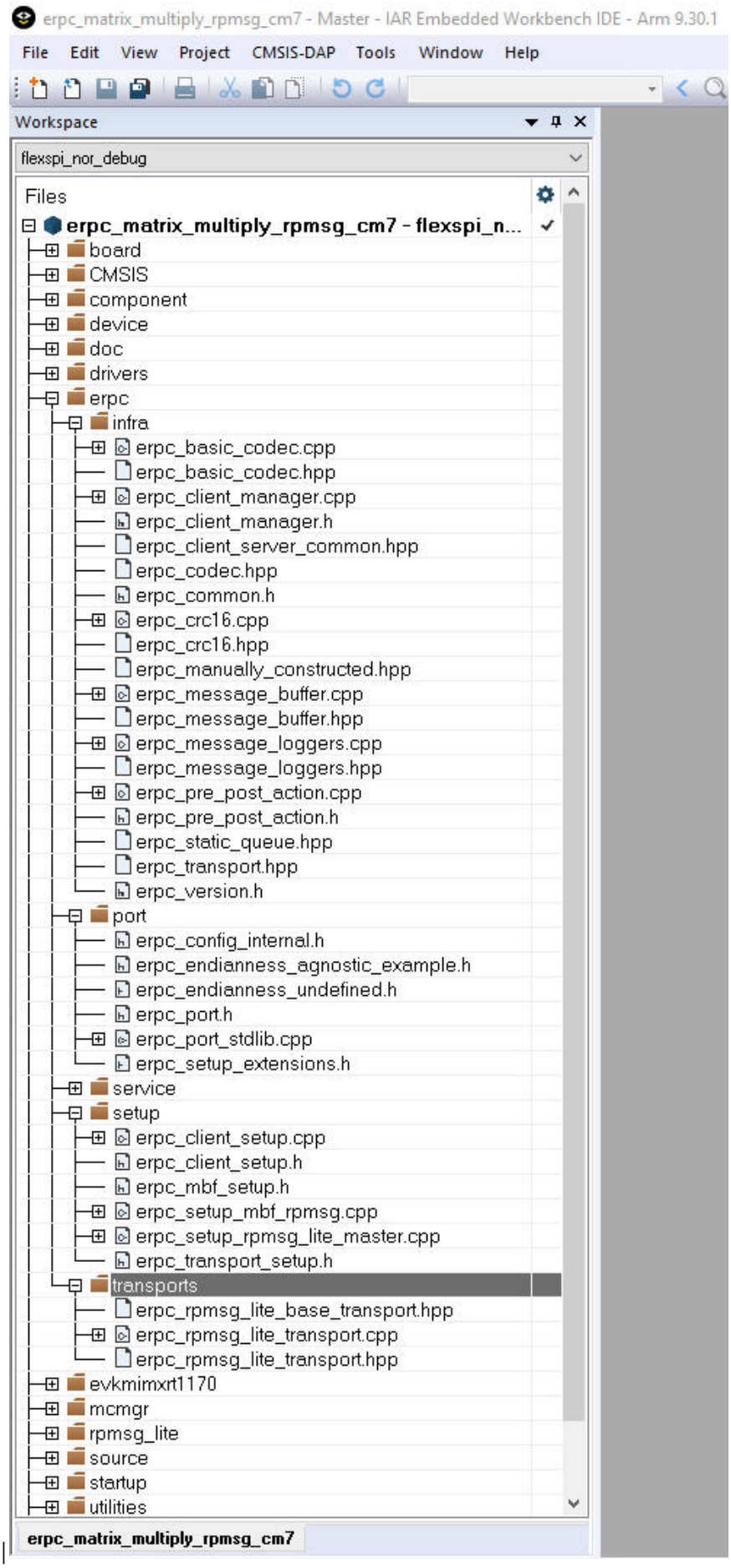
- erpc_port.h file contains definition of erpc_malloc() and erpc_free() functions.
- erpc_port_stdlib.cpp file ensures adaptation to stdlib.
- erpc_config_internal.h internal eRPC configuration file.

The **setup** subfolder contains a set of plain C APIs that wrap the C++ infrastructure, providing client and server init and deinit routines that greatly simplify eRPC usage in C-based projects. No knowledge of C++ is required to use these APIs.

- erpc_client_setup.h and erpc_client_setup.cpp files needs to be added into the "Matrix multiply" example project to demonstrate the use of C-wrapped functions in this example.
- erpc_transport_setup.h and erpc_setup_rpmsg_lite_master.cpp files needs to be added into the project in order to allow C-wrapped function for transport layer setup.
- erpc_mbf_setup.h and erpc_setup_mbf_rpmsg.cpp files needs to be added into the project in order to allow message buffer factory usage.

The **transports** subfolder contains transport classes for the different methods of communication supported by eRPC. Some transports are applicable only to host PCs, while others are applicable only to embedded or multicore systems. Most transports have corresponding client and server setup functions, in the setup folder.

- RPMsg-Lite is used as the transport layer for the communication between cores, erpc_rpmsg_lite_base_transport.hpp, erpc_rpmsg_lite_transport.hpp, and erpc_rpmsg_lite_transport.cpp files needs to be added into the client project.


erpc_matrix_multiply_rpmsg_cm7 - Master - IAR Embedded Workbench IDE - Arm 9.30.1
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drivers
erpc
infra
erpc_basic_codec.cpp
erpc_basic_codec.hpp
erpc_client_manager.cpp
erpc_client_manager.h
erpc_client_server_common.hpp
erpc_codec.hpp
erpc_common.h
erpc_crc16.cpp
erpc_crc16.hpp
erpc_manually_constructed.hpp
erpc_message_buffer.cpp
erpc_message_buffer.hpp
erpc_message_loggers.cpp
erpc_message_loggers.hpp
erpc_pre_post_action.cpp
erpc_pre_post_action.h
erpc_static_queue.hpp
erpc_transport.hpp
erpc_version.h
port
erpc_config_internal.h
erpc_endianness_agnostic_example.h
erpc_endianness_undefined.h
erpc_port.h
erpc_port_stdlib.cpp
erpc_setup_extensions.h
service
setup
erpc_client_setup.cpp
erpc_client_setup.h
erpc_mbf_setup.h
erpc_setup_mbf_rpmsg.cpp
erpc_setup_rpmsg_lite_master.cpp
erpc_transport_setup.h
transports
erpc_rpmsg_lite_base_transport.hpp
erpc_rpmsg_lite_transport.cpp
erpc_rpmsg_lite_transport.hpp
evkmimxrt1170
mcmgr
rpmsg_lite
source
startup
utilities
erpc_matrix_multiply_rpmsg_cm7

|

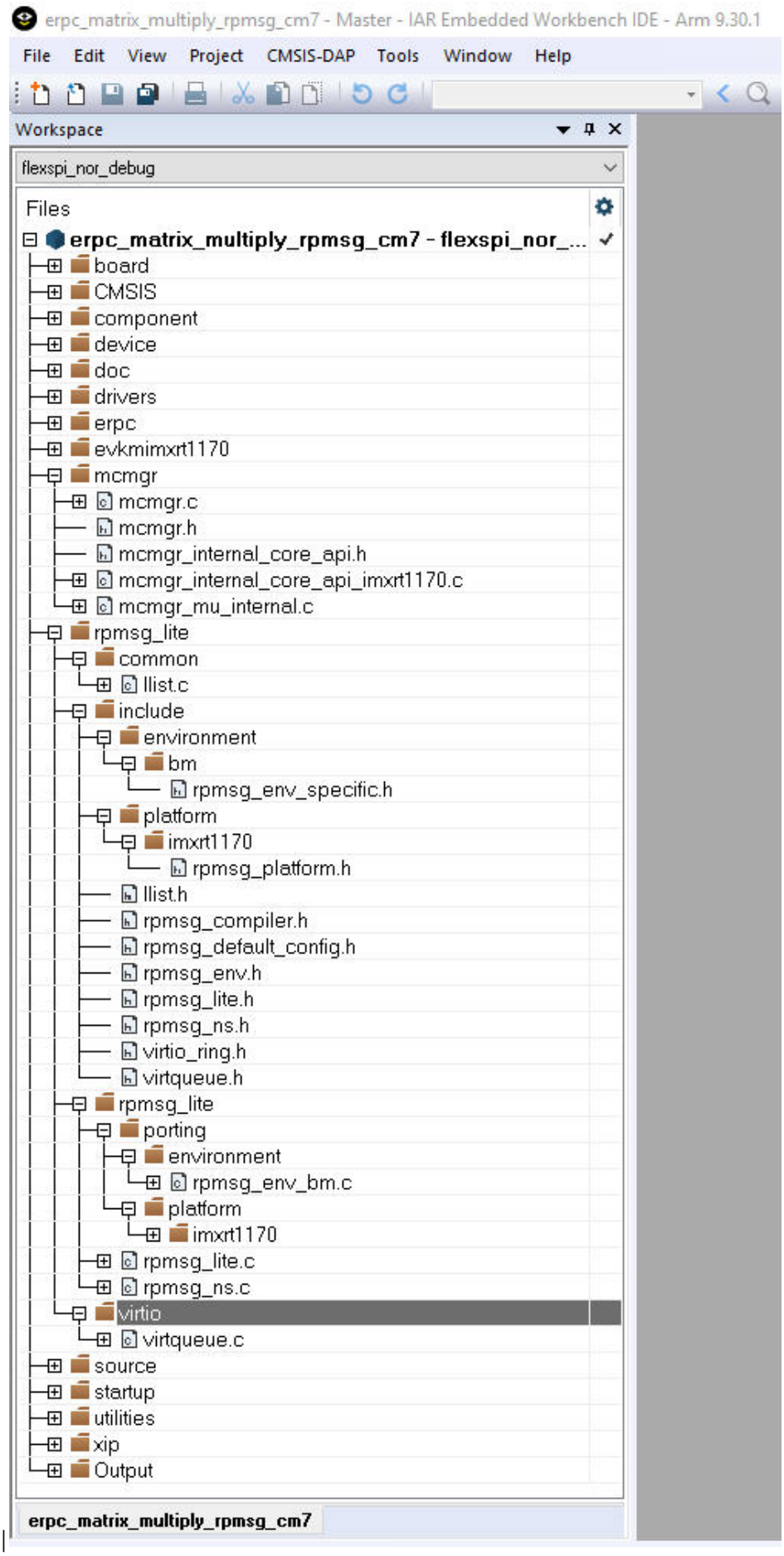
Parent topic: Multicore client application

Client multicore infrastructure files Because of the RPMsg-Lite (transport layer), it is also necessary to include RPMsg-Lite related files, which are in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/rpmsg_lite/

The multicore example applications also use the Multicore Manager software library to control the secondary core startup and shutdown. These source files are located in the following folder:

<MCUXpressoSDK_install_dir>/middleware/multicore/mcmgr/


erpc_matrix_multiply_rpmsg_cm7 - Master - IAR Embedded Workbench IDE - Arm 9.30.1
File Edit View Project CMSIS-DAP Tools Window Help
Workspace
flexspi_nor_debug
Files
erpc_matrix_multiply_rpmsg_cm7 - flexspi_nor_...
board
CMSIS
component
device
doc
drivers
erpc
evkmimxrt1170
mcmgr
mcmgr.c
mcmgr.h
mcmgr_internal_core_api.h
mcmgr_internal_core_api_imxrt1170.c
mcmgr_mu_internal.c
rpmsg_lite
common
llist.c
include
environment
bm
rpmsg_env_specific.h
platform
imxrt1170
rpmsg_platform.h
llist.h
rpmsg_compiler.h
rpmsg_default_config.h
rpmsg_env.h
rpmsg_lite.h
rpmsg_ns.h
virtio_ring.h
virtqueue.h
rpmsg_lite
porting
environment
rpmsg_env_bm.c
platform
imxrt1170
rpmsg_lite.c
rpmsg_ns.c
virtio
virtqueue.c
source
startup
utilities
xip
Output
erpc_matrix_multiply_rpmsg_cm7

|

Parent topic: Multicore client application

Client user code The client's user code is stored in the main_core0.c file, located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_example/erpc_matrix_multiply_rpmsg/cm7

The main_core0.c file contains the code for target board and eRPC initialization.

- After initialization, the secondary core is released from reset.
- When the secondary core is ready, the primary core initializes two matrix variables.
- The erpcMatrixMultiply eRPC function is called to issue the eRPC request and get the result.

It is possible to write the application-specific eRPC error handler. The eRPC error handler of the matrix multiply application is implemented in erpc_error_handler.h and erpc_error_handler.cpp files.

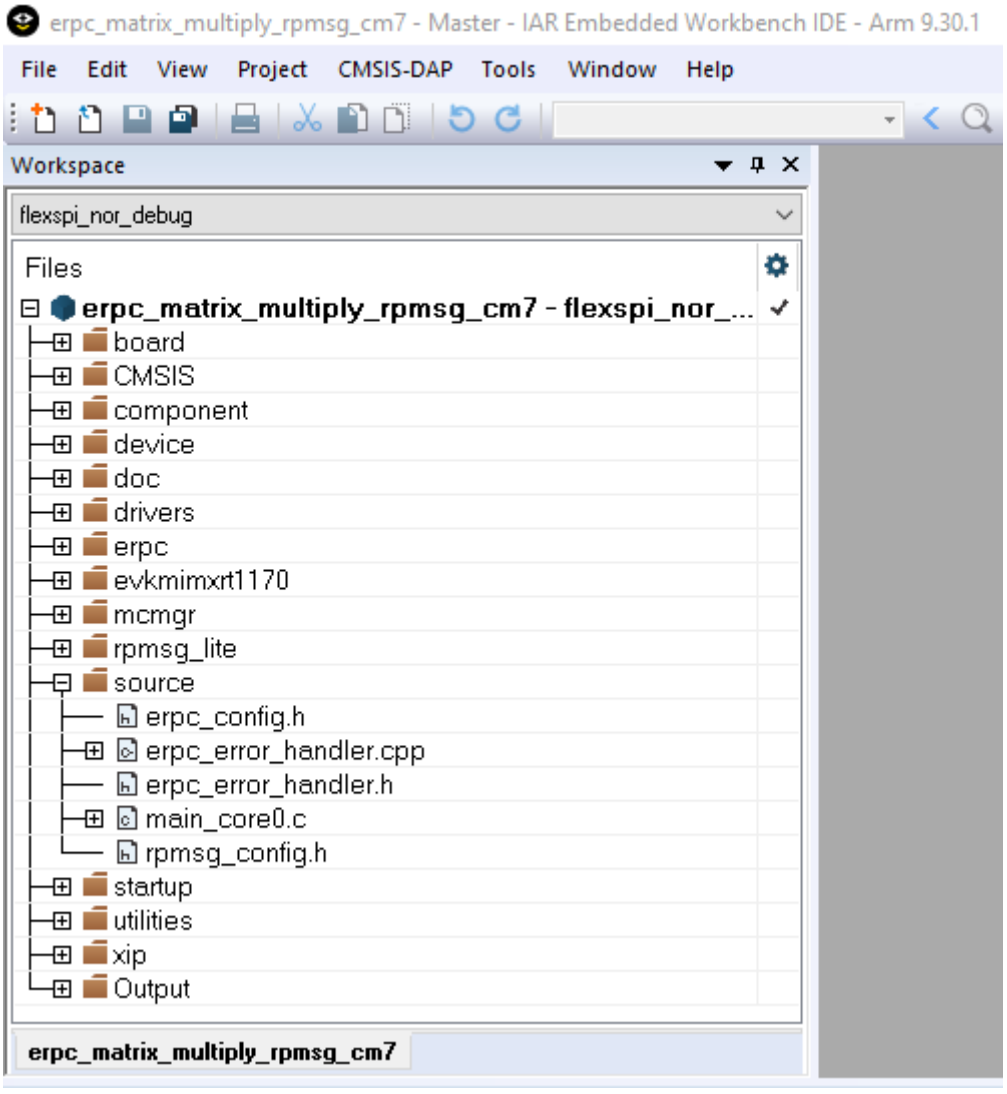
The matrix multiplication can be issued repeatedly, when pressing a software board button.

The eRPC-relevant code is captured in the following code snippet:

```
...
extern bool g_erpc_error_occurred;
...
/* Declare matrix arrays */
Matrix matrix1 = {0}, matrix2 = {0}, result_matrix = {0};
...
/* RPMsg-Lite transport layer initialization */
erpc_transport_t transport;
transport = erpc_transport_rpmsg_lite_master_init(src, dst,
ERPC_TRANSPORT_RPMSG_LITE_LINK_ID);
...
/* MessageBufferFactory initialization */
erpc_mbf_t message_buffer_factory;
message_buffer_factory = erpc_mbf_rpmsg_init(transport);
...
/* eRPC client side initialization */
erpc_client_t client;
client = erpc_client_init(transport, message_buffer_factory);
...
/* Set default error handler */
erpc_client_set_error_handler(client, erpc_error_handler);
...
while (1)
{
  /* Invoke the erpcMatrixMultiply function */
  erpcMatrixMultiply(matrix1, matrix2, result_matrix);
  ...
  /* Check if some error occured in eRPC */
  if (g_erpc_error_occurred)
  {
    /* Exit program loop */
    break;
  }
  ...
}
```

Except for the application main file, there are configuration files for the RPMsg-Lite (rpmsg_config.h) and eRPC (erpc_config.h), located in the following folder:

<MCUXpressoSDK_install_dir>/boards/evkmimxrt1170/multicore_examples/erpc_matrix_multiply_rpmsg



Parent topic: Multicore client application

Parent topic:*Create an eRPC application*

Multiprocessor server application The "Matrix multiply" eRPC server project for multiprocessor applications is located in the *<MCUXpressoSDK_install_dir»/boards/<board_name>/multiprocessor_examples/erpc_server_matrix_multiply_<transport_layer>* folder.

Most of the multiprocessor application setup is the same as for the multicore application. The multiprocessor server application requires server-related generated files (server shim code), server infrastructure files, and the server user code. There is no need for server multicore infrastructure files (MCMGR and RPMsg-Lite). The RPMsg-Lite transport layer is replaced either by SPI or UART transports. The following table shows the required transport-related files per each transport type.

|SPI|<eRPC base directory>/erpc_c/setup/erpc_setup_(d)spi_slave.cpp

<eRPC base directory>/erpc_c/transports/erpc_(d)spi_slave_transport.hpp

<eRPC base directory>/erpc_c/transports/erpc_(d)spi_slave_transport.cpp

| |UART|<eRPC base directory>/erpc_c/setup/erpc_setup_uart_cmsis.cpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.hpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.cpp

|

Server user code The server's user code is stored in the main_server.c file, located in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_server_matrix_multiply_<transport_layer>/* folder.

The eRPC-relevant code with UART as a transport is captured in the following code snippet:

```
/* erpcMatrixMultiply function user implementation */
void erpcMatrixMultiply(Matrix matrix1, Matrix matrix2, Matrix result_matrix)
{
  ...
}
int main()
{
  ...
  /* UART transport layer initialization, ERPC_DEMO_UART is the structure of CMSIS UART driver␣
↪operations */
  erpc_transport_t transport;
  transport = erpc_transport_cmsis_uart_init((void *)&ERPC_DEMO_UART);
  ...
  /* MessageBufferFactory initialization */
  erpc_mbf_t message_buffer_factory;
  message_buffer_factory = erpc_mbf_dynamic_init();
  ...
  /* eRPC server side initialization */
  erpc_server_t server;
  server = erpc_server_init(transport, message_buffer_factory);
  ...
  /* Adding the service to the server */
  erpc_service_t service = create_MatrixMultiplyService_service();
  erpc_add_service_to_server(server, service);
  ...
  while (1)
  {
    /* Process eRPC requests */
    erpc_status_t status = erpc_server_poll(server)
    /* handle error status */
    if (status != kErpcStatus_Success)
    {
      /* print error description */
      erpc_error_handler(status, 0);
      ...
    }
    ...
  }
}
```

Parent topic: Multiprocessor server application

Multiprocessor client application The "Matrix multiply" eRPC client project for multiprocessor applications is located in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_client_matrix_multiply_<transport_layer>/iar/* folder.

Most of the multiprocessor application setup is the same as for the multicore application. The multiprocessor server application requires client-related generated files (server shim code),

client infrastructure files, and the client user code. There is no need for client multicore infrastructure files (MCMGR and RPMsg-Lite). The RPMsg-Lite transport layer is replaced either by SPI or UART transports. The following table shows the required transport-related files per each transport type.

|SPI|<eRPC base directory>/erpc_c/setup/erpc_setup_(d)spi_master.cpp

<eRPC base directory>/erpc_c/transports/ erpc_(d)spi_master_transport.hpp

<eRPC base directory>/erpc_c/transports/ erpc_(d)spi_master_transport.cpp

| |UART|<eRPC base directory>/erpc_c/setup/erpc_setup_uart_cmsis.cpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.hpp

<eRPC base directory>/erpc_c/transports/erpc_uart_cmsis_transport.cpp

|

Client user code The client's user code is stored in the main_client.c file, located in the *<MCUXpressoSDK_install_dir>/boards/<board_name>/multiprocessor_examples/erpc_client_matrix_multiply_<transport_layer>/* folder.

The eRPC-relevant code with UART as a transport is captured in the following code snippet:

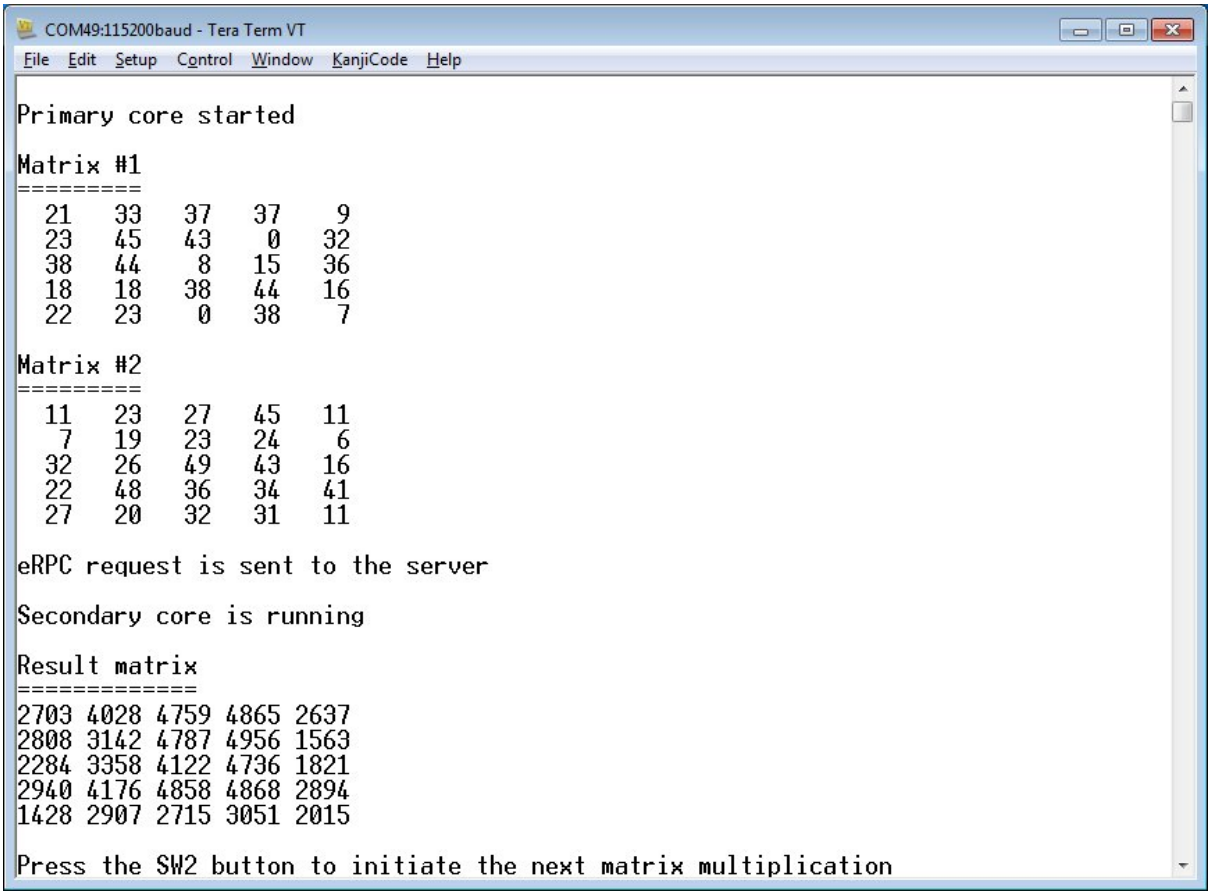
```
...
extern bool g_erpc_error_occurred;
...
/* Declare matrix arrays */
Matrix matrix1 = {0}, matrix2 = {0}, result_matrix = {0};
...
/* UART transport layer initialization, ERPC_DEMO_UART is the structure of CMSIS UART driver␣
↪operations */
erpc_transport_t transport;
transport = erpc_transport_cmsis_uart_init((void *)&ERPC_DEMO_UART);
...
/* MessageBufferFactory initialization */
erpc_mbf_t message_buffer_factory;
message_buffer_factory = erpc_mbf_dynamic_init();
...
/* eRPC client side initialization */
erpc_client_t client;
client = erpc_client_init(transport,message_buffer_factory);
...
/* Set default error handler */
erpc_client_set_error_handler(client, erpc_error_handler);
...
while (1)
{
  /* Invoke the erpcMatrixMultiply function */
  erpcMatrixMultiply(matrix1, matrix2, result_matrix);
  ...
  /* Check if some error occured in eRPC */
  if (g_erpc_error_occurred)
  {
    /* Exit program loop */
    break;
  }
  ...
}
```

Parent topic: Multiprocessor client application

Parent topic: Multiprocessor server application

Parent topic:*Create an eRPC application*

Running the eRPC application Follow the instructions in *Getting Started with MCUXpresso SDK* (document MCUXSDKGSUG) (located in the *<MCUXpressoSDK_install_dir>/docs* folder), to load both the primary and the secondary core images into the on-chip memory, and then effectively debug the dual-core application. After the application is running, the serial console should look like:



For multiprocessor applications that are running between PC and the target evaluation board or between two boards, follow the instructions in the accompanied example readme files that provide details about the proper board setup and the PC side setup (Python).

Parent topic:*Create an eRPC application*

Parent topic:*eRPC example*

Other uses for an eRPC implementation The eRPC implementation is generic, and its use is not limited to just embedded applications. When creating an eRPC application outside the embedded world, the same principles apply. For example, this manual can be used to create an eRPC application for a PC running the Linux operating system. Based on the used type of transport medium, existing transport layers can be used, or new transport layers can be implemented.

For more information and erpc updates see the github.com/EmbeddedRPC.

Note about the source code in the document Example code shown in this document has the following copyright and BSD-3-Clause license:

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Changelog eRPC All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog, and this project adheres to Semantic Versioning.

Unreleased

Added

Fixed

- Python code of the eRPC infrastructure was updated to match the proper python code style, add type annotations and improve readability.

1.14.0

Added

- Added Cmake/Kconfig support.
- Made java code jdk11 compliant, GitHub PR #432.
- Added imxrt1186 support into mu transport layer.
- erpcgen: Added assert for listType before usage, GitHub PR #406.

Fixed

- eRPC: Sources reformatted.
- erpc: Fixed typo in semaphore get (mutex -> semaphore), and write it can fail in case of timeout, GitHub PR #446.
- erpc: Free the arbitrated client token from client manager, GitHub PR #444.

- erpc: Fixed Makefile, install the erpc_simple_server header, GitHub PR #447.
- erpc_python: Fixed possible AttributeError and OSError on calling TCPTransport.close(), GitHub PR #438.
- Examples and tests consolidated.

1.13.0

Added

- erpc: Add BSD-3 license to endianness agnostic files, GitHub PR #417.
- eRPC: Add new Zephyr-related transports (zephyr_uart, zephyr_mbox).
- eRPC: Add new Zephyr-related examples.

Fixed

- eRPC,erpcgen: Fixing/improving markdown files, GitHub PR #395.
- eRPC: Fix Python client TCPTransports not being able to close, GitHub PR #390.
- eRPC,erpcgen: Align switch brackets, GitHub PR #396.
- erpc: Fix zephyr uart transport, GitHub PR #410.
- erpc: UART ZEPHYR Transport stop to work after a few transactions when using USB-CDC resolved, GitHub PR #420.

Removed

- eRPC,erpcgen: Remove cstbool library, GitHub PR #403.

1.12.0

Added

- eRPC: Add dynamic/static option for transport init, GitHub PR #361.
- eRPC,erpcgen: Winsock2 support, GitHub PR #365.
- eRPC,erpcgen: Feature/support multiple clients, GitHub PR #271.
- eRPC,erpcgen: Feature/buffer head - Framed transport header data stored in MessageBuffer, GitHub PR #378.
- eRPC,erpcgen: Add experimental Java support.

Fixed

- eRPC: Fix receive error value for spidev, GitHub PR #363.
- eRPC: UartTransport::init adaptation to changed driver.
- eRPC: Fix typo in assert, GitHub PR #371.
- eRPC,erpcgen: Move enums to enum classes, GitHub PR #379.
- eRPC: Fixed rpmsg tty transport to work with serial transport, GitHub PR #373.

1.11.0

Fixed

- eRPC: Makefiles update, GitHub PR #301.
- eRPC: Resolving warnings in Python, GitHub PR #325.
- eRPC: Python3.8 is not ready for usage of typing.Any type, GitHub PR #325.
- eRPC: Improved codec function to use reference instead of address, GitHub PR #324.
- eRPC: Fix NULL check for pending client creation, GitHub PR #341.
- eRPC: Replace sprintf with snprintf, GitHub PR #343.
- eRPC: Use MU_SendMsg blocking call in MU transport.
- eRPC: New LPSPI and LPI2C transport layers.
- eRPC: Freeing static objects, GitHub PR #353.
- eRPC: Fixed casting in deinit functions, GitHub PR #354.
- eRPC: Align LIBUSBSIO.GetNumPorts API use with libusbsio python module v. 2.1.11.
- erpcgen: Renamed temp variable to more generic one, GitHub PR #321.
- erpcgen: Add check that string read is not more than max length, GitHub PR #328.
- erpcgen: Move to g++ in pytest, GitHub PR #335.
- erpcgen: Use build=release for make, GitHub PR #334.
- erpcgen: Removed boost dependency, GitHub PR #346.
- erpcgen: Mingw support, GitHub PR #344.
- erpcgen: VS build update, GitHub PR #347.
- erpcgen: Modified name for common types macro scope, GitHub PR #337.
- erpcgen: Fixed memcpy for template, GitHub PR #352.
- eRPC,erpcgen: Change default build target to release + adding artefacts, GitHub PR #334.
- eRPC,erpcgen: Remove redundant includes, GitHub PR #338.
- eRPC,erpcgen: Many minor code improvements, GitHub PR #323.

1.10.0

Fixed

- eRPC: MU transport layer switched to blocking MU_SendMsg() API use.

1.10.0

Added

- eRPC: Add TCP_NODELAY option to python, GitHub PR #298.

Fixed

- eRPC: MUTransport adaptation to new supported SoCs.
- eRPC: Simplifying CI with installing dependencies using shell script, GitHub PR #267.
- eRPC: Using event for waiting for sock connection in TCP python server, formatting python code, C specific includes, GitHub PR #269.
- eRPC: Endianness agnostic update, GitHub PR #276.
- eRPC: Assertion added for functions which are returning status on freeing memory, GitHub PR #277.
- eRPC: Fixed closing arbitrator server in unit tests, GitHub PR #293.
- eRPC: Makefile updated to reflect the correct header names, GitHub PR #295.
- eRPC: Compare value length to used length() in reading data from message buffer, GitHub PR #297.
- eRPC: Replace EXPECT_TRUE with EXPECT_EQ in unit tests, GitHub PR #318.
- eRPC: Adapt rpmsg_lite based transports to changed rpmsg_lite_wait_for_link_up() API parameters.
- eRPC, erpcgen: Better distuingish which file can and cannot by linked by C linker, GitHub PR #266.
- eRPC, erpcgen: Stop checking if pointer is NULL before sending it to the erpc_free function, GitHub PR #275.
- eRPC, erpcgen: Changed api to count with more interfaces, GitHub PR #304.
- erpcgen: Check before reading from heap the buffer boundaries, GitHub PR #287.
- erpcgen: Several fixes for tests and CI, GitHub PR #289.
- erpcgen: Refactoring erpcgen code, GitHub PR #302.
- erpcgen: Fixed assigning const value to enum, GitHub PR #309.
- erpcgen: Enable runTesttest_enumErrorCode_allDirection, serialize enums as int32 instead of uint32.

1.9.1

Fixed

- eRPC: Construct the USB CDC transport, rather than a client, GitHub PR #220.
- eRPC: Fix premature import of package, causing failure when attempting installation of Python library in a clean environment, GitHub PR #38, #226.
- eRPC: Improve python detection in make, GitHub PR #225.
- eRPC: Fix several warnings with deprecated call in pytest, GitHub PR #227.
- eRPC: Fix freeing union members when only default need be freed, GitHub PR #228.
- eRPC: Fix making test under Linux, GitHub PR #229.
- eRPC: Assert costumizing, GitHub PR #148.
- eRPC: Fix corrupt clientList bug in TransportArbitrator, GitHub PR #199.
- eRPC: Fix build issue when invoking g++ with -Wno-error=free-nonheap-object, GitHub PR #233.
- eRPC: Fix inout cases, GitHub PR #237.

- eRPC: Remove ERPC_PRE_POST_ACTION dependency on return type, GitHub PR #238.
- eRPC: Adding NULL to ptr when codec function failed, fixing memcpy when fail is present during deserialization, GitHub PR #253.
- eRPC: MessageBuffer usage improvement, GitHub PR #258.
- eRPC: Get rid for serial and enum34 dependency (enum34 is in python3 since 3.4 (from 2014)), GitHub PR #247.
- eRPC: Several MISRA violations addressed.
- eRPC: Fix timeout for Freertos semaphore, GitHub PR #251.
- eRPC: Use of rpmsg_lite_wait_for_link_up() in rpmsg_lite based transports, GitHub PR #223.
- eRPC: Fix codec nullptr dereferencing, GitHub PR #264.
- erpcgen: Fix two syntax errors in erpcgen Python output related to non-encapsulated unions, improved test for union, GitHub PR #206, #224.
- erpcgen: Fix serialization of list/binary types, GitHub PR #240.
- erpcgen: Fix empty list parsing, GitHub PR #72.
- erpcgen: Fix templates for malloc errors, GitHub PR #110.
- erpcgen: Get rid of encapsulated union declarations in global scale, improve enum usage in unions, GitHub PR #249, #250.
- erpcgen: Fix compile error:UniqueIdChecker.cpp:156:104:'sort' was not declared, GitHub PR #265.

1.9.0

Added

- eRPC: Allow used LIBUSBSIO device index being specified from the Python command line argument.

Fixed

- eRPC: Improving template usage, GitHub PR #153.
- eRPC: run_clang_format.py cleanup, GitHub PR #177.
- eRPC: Build TCP transport setup code into liberpc, GitHub PR #179.
- eRPC: Fix multiple definitions of g_client error, GitHub PR #180.
- eRPC: Fix memset past end of buffer in erpc_setup_mbf_static.cpp, GitHub PR #184.
- eRPC: Fix deprecated error with newer pytest version, GitHub PR #203.
- eRPC, erpcgen: Static allocation support and usage of rpmsg static FreeRTOSs related APi, GitHub PR #168, #169.
- erpcgen: Remove redundant module imports in erpcgen, GitHub PR #196.

1.8.1

Added

- eRPC: New i2c_slave_transport trasnport introduced.

Fixed

- eRPC: Fix misra erpc c, GitHub PR #158.
- eRPC: Allow conditional compilation of message_loggers and pre_post_action.
- eRPC: (D)SPI slave transports updated to avoid busy loops in rtos environments.
- erpcgen: Re-implement EnumMember::hasValue(), GitHub PR #159.
- erpcgen: Fixing several misra issues in shim code, erpcgen and unit tests updated, GitHub PR #156.
- erpcgen: Fix bison file, GitHub PR #156.

1.8.0

Added

- eRPC: Support win32 thread, GitHub PR #108.
- eRPC: Add mbed support for malloc() and free(), GitHub PR #92.
- eRPC: Introduced pre and post callbacks for eRPC call, GitHub PR #131.
- eRPC: Introduced new USB CDC transport.
- eRPC: Introduced new Linux spidev-based transport.
- eRPC: Added formatting extension for VSC, GitHub PR #134.
- erpcgen: Introduce ustring type for unsigned char and force cast to char*, GitHub PR #125.

Fixed

- eRPC: Update makefile.
- eRPC: Fixed warnings and error with using MessageLoggers, GitHub PR #127.
- eRPC: Extend error msg for python server service handle function, GitHub PR #132.
- eRPC: Update CMSIS UART transport layer to avoid busy loops in rtos environments, introduce semaphores.
- eRPC: SPI transport update to allow usage without handshaking GPIO.
- eRPC: Native _WIN32 erpc serial transport and threading.
- eRPC: Arbitrator deadlock fix, TCP transport updated, TCP setup functions introduced, GitHub PR #121.
- eRPC: Update of matrix_multiply.py example: Add –serial and –baud argument, GitHub PR #137.
- eRPC: Update of .clang-format, GitHub PR #140.
- eRPC: Update of erpc_framed_transport.cpp: return error if received message has zero length, GitHub PR #141.
- eRPC, erpcgen: Fixed error messages produced by -Wall -Wextra -Wshadow -pedantic-errors compiler flags, GitHub PR #136, #139.
- eRPC, erpcgen: Core re-formatted using Clang version 10.
- erpcgen: Enable deallocation in server shim code when callback/function pointer used as out parameter in IDL.
- erpcgen: Removed '$' character from generated symbol name in '_$union' suffix, GitHub PR #103.

- erpcgen: Resolved mismatch between C++ and Python for callback index type, GitHub PR #111.
- erpcgen: Python generator improvements, GitHub PR #100, #118.
- erpcgen: Fixed error messages produced by -Wall -Wextra -Wshadow -pedantic-errors compiler flags, GitHub PR #136.

1.7.4

Added

- eRPC: Support MU transport unit testing.
- eRPC: Adding mbed os support.

Fixed

- eRPC: Unit test code updated to handle service add and remove operations.
- eRPC: Several MISRA issues in rpmsg-based transports addressed.
- eRPC: Fixed Linux/TCP acceptance tests in release target.
- eRPC: Minor documentation updates, code formatting.
- erpcgen: Whitespace removed from C common header template.

1.7.3

Fixed

- eRPC: Improved the test_callbacks logic to be more understandable and to allow requested callback execution on the server side.
- eRPC: TransportArbitrator::prepareClientReceive modified to avoid incorrect return value type.
- eRPC: The ClientManager and the ArbitratedClientManager updated to avoid performing client requests when the previous serialization phase fails.
- erpcgen: Generate the shim code for destroy of statically allocated services.

1.7.2

Added

- eRPC: Add missing doxygen comments for transports.

Fixed

- eRPC: Improved support of const types.
- eRPC: Fixed Mac build.
- eRPC: Fixed serializing python list.
- eRPC: Documentation update.

1.7.1

Fixed

- eRPC: Fixed semaphore in static message buffer factory.
- erpcgen: Fixed MU received error flag.
- erpcgen: Fixed tcp transport.

1.7.0

Added

- eRPC: List names are based on their types. Names are more deterministic.
- eRPC: Service objects are as a default created as global static objects.
- eRPC: Added missing doxygen comments.
- eRPC: Added support for 64bit numbers.
- eRPC: Added support of program language specific annotations.

Fixed

- eRPC: Improved code size of generated code.
- eRPC: Generating crc value is optional.
- eRPC: Fixed CMSIS Uart driver. Removed dependency on KSDK.
- eRPC: Forbid users use reserved words.
- eRPC: Removed outByref for function parameters.
- eRPC: Optimized code style of callback functions.

1.6.0

Added

- eRPC: Added @nullable support for scalar types.

Fixed

- eRPC: Improved code size of generated code.
- eRPC: Improved eRPC nested calls.
- eRPC: Improved eRPC list length variable serialization.

1.5.0

Added

- eRPC: Added support for unions type non-wrapped by structure.
- eRPC: Added callbacks support.
- eRPC: Added support @external annotation for functions.
- eRPC: Added support @name annotation.
- eRPC: Added Messaging Unit transport layer.
- eRPC: Added RPMSG Lite RTOS TTY transport layer.
- eRPC: Added version verification and IDL version verification between eRPC code and eRPC generated shim code.
- eRPC: Added support of shared memory pointer.
- eRPC: Added annotation to forbid generating const keyword for function parameters.
- eRPC: Added python matrix multiply example.
- eRPC: Added nested call support.
- eRPC: Added struct member “byref” option support.
- eRPC: Added support of forward declarations of structures
- eRPC: Added Python RPMsg Multiendpoint kernel module support
- eRPC: Added eRPC sniffer tool

1.4.0

Added

- eRPC: New RPMsg-Lite Zero Copy (RPMsgZC) transport layer.

Fixed

- eRPC: win_flex_bison.zip for windows updated.
- eRPC: Use one codec (instead of inCodec outCodec).

[1.3.0]

Added

- eRPC: New annotation types introduced (@length, @max_length, ...).
- eRPC: Support for running both erpc client and erpc server on one side.
- eRPC: New transport layers for (LP)UART, (D)SPI.
- eRPC: Error handling support.

[1.2.0]

Added

- eRPC source directory organization changed.
- Many eRPC improvements.

[1.1.0]

Added

- Multicore SDK 1.1.0 ported to KSDK 2.0.0.

[1.0.0]

Added

- Initial Release

Chapter 4

RTOS

4.1 FreeRTOS

4.1.1 FreeRTOS kernel

Open source RTOS kernel for small devices.

FreeRTOS kernel for MCUXpresso SDK Readme

FreeRTOS kernel for MCUXpresso SDK

Overview The purpose of this document is to describes the FreeRTOS kernel repo integration into the NXP MCUXpresso Software Development Kit: mcuxsdk. MCUXpresso SDK provides a comprehensive development solutions designed to optimize, ease, and help accelerate embedded system development of applications based on MCUs from NXP. This project involves the FreeRTOS kernel repo fork with:

- cmake and Kconfig support to allow the configuration and build in MCUXpresso SDK ecosystem
- FreeRTOS OS additions, such as FreeRTOS driver wrappers, RTOS ready FatFs file system, and the implementation of FreeRTOS tickless mode

The history of changes in FreeRTOS kernel repo for MCUXpresso SDK are summarized in *CHANGELOG_mcuxsdk.md* file.

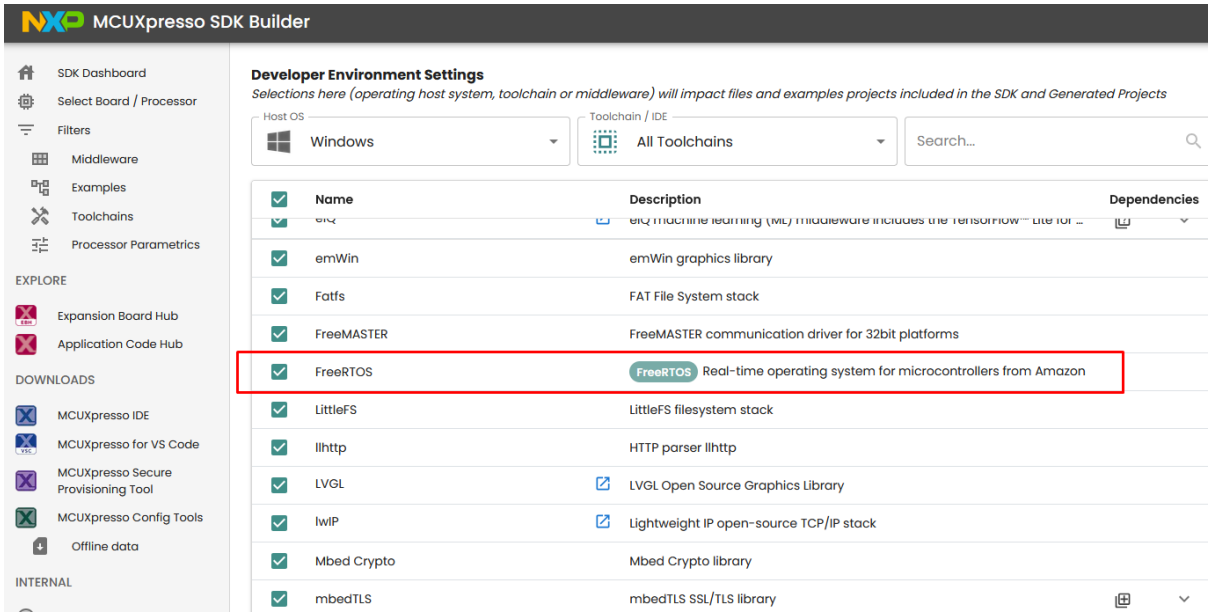
The MCUXpresso SDK framework also contains a set of FreeRTOS examples which show basic FreeRTOS OS features. This makes it easy to start a new FreeRTOS project or begin experimenting with FreeRTOS OS. Selected drivers and middleware are RTOS ready with related FreeRTOS adaptation layer.

FreeRTOS example applications The FreeRTOS examples are written to demonstrate basic FreeRTOS features and the interaction between peripheral drivers and the RTOS.

List of examples The list of freertos_examples, their description and availability for individual supported MCUXpresso SDK development boards can be obtained here: https://mcuxpresso.nxp.com/mcuxsdk/latest/html/examples/freertos_examples/index.html

Location of examples The FreeRTOS examples are located in mcuxsdk-examples repository, see the freertos_examples folder.

Once using MCUXpresso SDK zip packages created via the MCUXpresso SDK Builder the FreeRTOS kernel library and associated freertos_examples are added into final zip package once FreeRTOS components is selected on the Developer Environment Settings page:



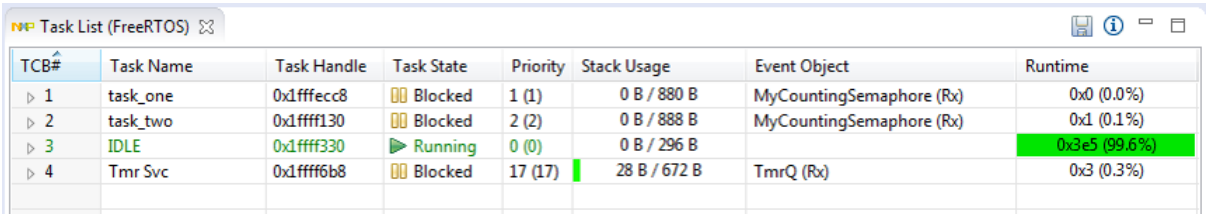
The FreeRTOS examples in MCUXpresso SDK zip packages are located in <MCUXpressoSDK_install_dir>/boards/<board_name>/freertos_examples/ subfolders.

Building a FreeRTOS example application For information how to use the cmake and Kconfig based build and configuration system and how to build freertos_examples visit: MCUXpresso SDK documentation for Build And Configuration MCUXpresso SDK Getting Start Guide

Tip: To list all FreeRTOS example projects and targets that can be built via the west build command, use this west list_project command in mcuxsdk workspace:

```
west list_project -p examples/freertos_examples
```

FreeRTOS aware debugger plugin NXP provides FreeRTOS task aware debugger for GDB. The plugin is compatible with Eclipse-based (MCUXpressoIDE) and is available after the installation.



FreeRTOS kernel for MCUXpresso SDK ChangeLog

Changelog FreeRTOS kernel for MCUXpresso SDK All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog, and this project adheres to Semantic Versioning.

[Unreleased]

Added

- Kconfig added CONFIG_FREERTOS_USE_CUSTOM_CONFIG_FRAGMENT config to optionally include custom FreeRTOSConfig fragment
  include file FreeRTOSConfig_frag.h. File must be provided by application.
- Added missing Kconfig option for configUSE_PICOLIBC_TLS.
- Add correct header files to build when configUSE_NEWLIB_REENTRANT and configUSE_PICOLIBC_TLS is selected in config.

[11.1.0_rev0]

- update amazon freertos version

[11.0.1_rev0]

- update amazon freertos version

[10.5.1_rev0]

- update amazon freertos version

[10.4.3_rev1]

- Apply CM33 security fix from 10.4.3-LTS-Patch-2. See rtos\freertos\freertos_kernel\History.txt
- Apply CM33 security fix from 10.4.3-LTS-Patch-1. See rtos\freertos\freertos_kernel\History.txt

[10.4.3_rev0]

- update amazon freertos version.

[10.4.3_rev0]

- update amazon freertos version.

[9.0.0_rev3]

- New features:
  - Tickless idle mode support for Cortex-A7. Add fsl_tickless_epit.c and fsl_tickless_generic.h in portable/IAR/ARM_CA9 folder.
  - Enabled float context saving in IAR for Cortex-A7. Added configUSE_TASK_FPU_SUPPORT macros. Modified port.c and portmacro.h in portable/IAR/ARM_CA9 folder.
- Other changes:
  - Transformed ARM_CM core specific tickless low power support into generic form under freertos/Source/portable/low_power_tickless/.

[9.0.0_rev2]

- New features:
  - Enabled MCUXpresso thread aware debugging. Add freertos_tasks_c_additions.h and configINCLUDE_FREERTOS_TASK_C_ADDITIONS_H and configFREERTOS_MEMORY_SCHEME macros.

[9.0.0_rev1]

- New features:
  - Enabled -flto optimization in GCC by adding **attribute**((used)) for vTaskSwitchContext.
  - Enabled KDS Task Aware Debugger. Apply FreeRTOS patch to enable configRECORD_STACK_HIGH_ADDRESS macro. Modified files are task.c and FreeRTOS.h.

[9.0.0_rev0]

- New features:
  - Example freertos_sem_static.
  - Static allocation support RTOS driver wrappers.
- Other changes:
  - Tickless idle rework. Support for different timers is in separated files (fsl_tickless_systick.c, fsl_tickless_lptmr.c).
  - Removed configuration option configSYSTICK_USE_LOW_POWER_TIMER. Low power timer is now selected by linking of apropriate file fsl_tickless_lptmr.c.
  - Removed configOVERRIDE_DEFAULT_TICK_CONFIGURATION in RVDS port. Use of **attribute**((weak)) is the preferred solution. Not same as _weak!

[8.2.3]

- New features:
  - Tickless idle mode support.
  - Added template application for Kinetis Expert (KEx) tool (template_application).
- Other changes:
  - Folder structure reduction. Keep only Kinetis related parts.

FreeRTOS kernel Readme

MCUXpresso SDK: FreeRTOS kernel This repository is a fork of FreeRTOS kernel (https://github.com/FreeRTOS/FreeRTOS-Kernel)(11.1.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable FreeRTOS kernel repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

For more information about the FreeRTOS kernel repo adoption see README_mcuxsdk.md: FreeRTOS kernel for MCUXpresso SDK Readme document.

Getting started This repository contains FreeRTOS kernel source/header files and kernel ports only. This repository is referenced as a submodule in FreeRTOS/FreeRTOS repository, which contains pre-configured demo application projects under FreeRTOS/Demo directory.

The easiest way to use FreeRTOS is to start with one of the pre-configured demo application projects. That way you will have the correct FreeRTOS source files included, and the correct include paths configured. Once a demo application is building and executing you can remove the demo application files, and start to add in your own application source files. See the FreeRTOS Kernel Quick Start Guide for detailed instructions and other useful links.

Additionally, for FreeRTOS kernel feature information refer to the Developer Documentation, and API Reference.

Also for contributing and creating a Pull Request please refer to *the instructions here*.

Getting help If you have any questions or need assistance troubleshooting your FreeRTOS project, we have an active community that can help on the FreeRTOS Community Support Forum.

To consume FreeRTOS-Kernel

Consume with CMake If using CMake, it is recommended to use this repository using FetchContent. Add the following into your project's main or a subdirectory's CMakeLists.txt:

- Define the source and version/tag you want to use:

```
FetchContent_Declare( freertos_kernel
  GIT_REPOSITORY https://github.com/FreeRTOS/FreeRTOS-Kernel.git
  GIT_TAG        main #Note: Best practice to use specific git-hash or tagged version
)
```

In case you prefer to add it as a git submodule, do:

```
git submodule add https://github.com/FreeRTOS/FreeRTOS-Kernel.git <path of the submodule>
git submodule update --init
```

- Add a freertos_config library (typically an INTERFACE library) The following assumes the directory structure:
  - include/FreeRTOSConfig.h

```
add_library(freertos_config INTERFACE)

target_include_directories(freertos_config SYSTEM
INTERFACE
    include
)

target_compile_definitions(freertos_config
  INTERFACE
    projCOVERAGE_TEST=0
)
```

In case you installed FreeRTOS-Kernel as a submodule, you will have to add it as a subdirectory:

```
add_subdirectory(${FREERTOS_PATH})
```

- Configure the FreeRTOS-Kernel and make it available
  - this particular example supports a native and cross-compiled build option.

```
set( FREERTOS_HEAP "4" CACHE STRING "" FORCE)
# Select the native compile PORT
set( FREERTOS_PORT "GCC_POSIX" CACHE STRING "" FORCE)
# Select the cross-compile PORT
if (CMAKE_CROSSCOMPILING)
  set(FREERTOS_PORT "GCC_ARM_CA9" CACHE STRING "" FORCE)
endif()

FetchContent_MakeAvailable(freertos_kernel)
```

- In case of cross compilation, you should also add the following to freertos_config:

```
target_compile_definitions(freertos_config INTERFACE ${definitions})
target_compile_options(freertos_config INTERFACE ${options})
```

Consuming stand-alone - Cloning this repository To clone using HTTPS:

```
git clone https://github.com/FreeRTOS/FreeRTOS-Kernel.git
```

Using SSH:

```
git clone git@github.com:FreeRTOS/FreeRTOS-Kernel.git
```

Repository structure

- The root of this repository contains the three files that are common to every port - list.c, queue.c and tasks.c. The kernel is contained within these three files. croutine.c implements the optional co-routine functionality - which is normally only used on very memory limited systems.
- The ./portable directory contains the files that are specific to a particular microcontroller and/or compiler. See the readme file in the ./portable directory for more information.
- The ./include directory contains the real time kernel header files.
- The ./template_configuration directory contains a sample FreeRTOSConfig.h to help jumpstart a new project. See the *FreeRTOSConfig.h* file for instructions.

Code Formatting FreeRTOS files are formatted using the "uncrustify" tool. The configuration file used by uncrustify can be found in the FreeRTOS/CI-CD-GitHub-Actions's uncrustify.cfg file.

Line Endings File checked into the FreeRTOS-Kernel repository use unix-style LF line endings for the best compatibility with git.

For optimal compatibility with Microsoft Windows tools, it is best to enable the git autocrlf feature. You can enable this setting for the current repository using the following command:

```
git config core.autocrlf true
```

Git History Optimizations Some commits in this repository perform large refactors which touch many lines and lead to unwanted behavior when using the git blame command. You can configure git to ignore the list of large refactor commits in this repository with the following command:

```
git config blame.ignoreRevsFile .git-blame-ignore-revs
```

Spelling and Formatting We recommend using Visual Studio Code, commonly referred to as VSCode, when working on the FreeRTOS-Kernel. The FreeRTOS-Kernel also uses cSpell as part of its spelling check. The config file for which can be found at *cspell.config.yaml* There is additionally a cSpell plugin for VSCode that can be used as well. .cSpellWords.txt contains words that are not traditionally found in an English dictionary. It is used by the spellchecker to verify the various jargon, variable names, and other odd words used in the FreeRTOS code base are correct. If your pull request fails to pass the spelling and you believe this is a mistake, then add the word to .cSpellWords.txt. When adding a word please then sort the list, which can be done by running the bash command: `sort -u .cSpellWords.txt -o .cSpellWords.txt` Note that only the FreeRTOS-Kernel Source Files, *include*, *portable/MemMang*, and *portable/Common* files are checked for proper spelling, and formatting at this time.

4.1.2 FreeRTOS drivers

This is set of NXP provided FreeRTOS reentrant bus drivers.

4.1.3 backoffalgorithm

Algorithm for calculating exponential backoff with jitter for network retry attempts.

Readme

MCUXpresso SDK: backoffAlgorithm Library This repository is a fork of backoffAlgorithm library (https://github.com/FreeRTOS/backoffalgorithm)(1.3.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable backoffAlgorithm repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

backoffAlgorithm Library This repository contains the backoffAlgorithm library, a utility library to calculate backoff period using an exponential backoff with jitter algorithm for retrying network operations (like failed network connection with server). This library uses the "Full Jitter" strategy for the exponential backoff with jitter algorithm. More information about the algorithm can be seen in the Exponential Backoff and Jitter AWS blog.

The backoffAlgorithm library is distributed under the *MIT Open Source License*.

Exponential backoff with jitter is typically used when retrying a failed network connection or operation request with the server. An exponential backoff with jitter helps to mitigate failed network operations with servers, that are caused due to network congestion or high request load on the server, by spreading out retry requests across multiple devices attempting network operations. Besides, in an environment with poor connectivity, a client can get disconnected at any time. A backoff strategy helps the client to conserve battery by not repeatedly attempting reconnections when they are unlikely to succeed.

See memory requirements for this library *here*.

backoffAlgorithm v1.3.0 source code is part of the FreeRTOS 202210.00 LTS release.

backoffAlgorithm v1.0.0 source code is part of the FreeRTOS 202012.00 LTS release.

Reference example The example below shows how to use the backoffAlgorithm library on a POSIX platform to retry a DNS resolution query for amazon.com.

```
#include "backoff_algorithm.h"
#include <stdlib.h>
#include <string.h>
#include <netdb.h>
#include <unistd.h>
#include <time.h>

/* The maximum number of retries for the example code. */
#define RETRY_MAX_ATTEMPTS            ( 5U )

/* The maximum back-off delay (in milliseconds) for between retries in the example. */
#define RETRY_MAX_BACKOFF_DELAY_MS    ( 5000U )

/* The base back-off delay (in milliseconds) for retry configuration in the example. */
#define RETRY_BACKOFF_BASE_MS         ( 500U )

int main()
{
    /* Variables used in this example. */
    BackoffAlgorithmStatus_t retryStatus = BackoffAlgorithmSuccess;
    BackoffAlgorithmContext_t retryParams;
    char serverAddress[] = "amazon.com";
    uint16_t nextRetryBackoff = 0;

    int32_t dnsStatus = -1;
    struct addrinfo hints;
    struct addrinfo ** pListHead = NULL;
    struct timespec tp;

    /* Add hints to retrieve only TCP sockets in getaddrinfo. */
    ( void ) memset( &hints, 0, sizeof( hints ) );

    /* Address family of either IPv4 or IPv6. */
    hints.ai_family = AF_UNSPEC;
    /* TCP Socket. */
    hints.ai_socktype = ( int32_t ) SOCK_STREAM;
    hints.ai_protocol = IPPROTO_TCP;

    /* Initialize reconnect attempts and interval. */
    BackoffAlgorithm_InitializeParams( &retryParams,
                                       RETRY_BACKOFF_BASE_MS,
                                       RETRY_MAX_BACKOFF_DELAY_MS,
                                       RETRY_MAX_ATTEMPTS );


    /* Seed the pseudo random number generator used in this example (with call to
     * rand() function provided by ISO C standard library) for use in backoff period
     * calculation when retrying failed DNS resolution. */

    /* Get current time to seed pseudo random number generator. */
    ( void ) clock_gettime( CLOCK_REALTIME, &tp );
    /* Seed pseudo random number generator with seconds. */
    srand( tp.tv_sec );

    do
    {
        /* Perform a DNS lookup on the given host name. */
        dnsStatus = getaddrinfo( serverAddress, NULL, &hints, pListHead );
```

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```
        /* Retry if DNS resolution query failed. */
        if( dnsStatus != 0 )
        {
            /* Generate a random number and get back-off value (in milliseconds) for the next retry.
             * Note: It is recommended to use a random number generator that is seeded with
             * device-specific entropy source so that backoff calculation across devices is different
             * and possibility of network collision between devices attempting retries can be avoided.
             *
             * For the simplicity of this code example, the pseudo random number generator, rand()
             * function is used. */
            retryStatus = BackoffAlgorithm_GetNextBackoff( &retryParams, rand(), &nextRetryBackoff );

            /* Wait for the calculated backoff period before the next retry attempt of querying DNS.
             * As usleep() takes nanoseconds as the parameter, we multiply the backoff period by 1000. */
            ( void ) usleep( nextRetryBackoff * 1000U );
        }
    } while( ( dnsStatus != 0 ) && ( retryStatus != BackoffAlgorithmRetriesExhausted ) );

    return dnsStatus;
}
```

Building the library A compiler that supports **C90 or later** such as *gcc* is required to build the library.

Additionally, the library uses a header file introduced in ISO C99, stdint.h. For compilers that do not provide this header file, the *source/include* directory contains *stdint.readme*, which can be renamed to stdint.h to build the backoffAlgorithm library.

For instance, if the example above is copied to a file named example.c, *gcc* can be used like so:

```
gcc -I source/include example.c source/backoff_algorithm.c -o example
./example
```

gcc can also produce an output file to be linked:

```
gcc -I source/include -c source/backoff_algorithm.c
```

Building unit tests

Checkout Unity Submodule By default, the submodules in this repository are configured with update=none in *.gitmodules*, to avoid increasing clone time and disk space usage of other repositories (like amazon-freertos that submodules this repository).

To build unit tests, the submodule dependency of Unity is required. Use the following command to clone the submodule:

```
git submodule update --checkout --init --recursive test/unit-test/Unity
```

Platform Prerequisites

- For running unit tests
  - C89 or later compiler like gcc
  - CMake 3.13.0 or later
- For running the coverage target, gcov is additionally required.

Steps to build Unit Tests

1. Go to the root directory of this repository. (Make sure that the **Unity** submodule is cloned as described *above*.)
2. Create build directory: `mkdir build && cd build`
3. Run *cmake* while inside build directory: `cmake -S ../test`
4. Run this command to build the library and unit tests: `make all`
5. The generated test executables will be present in `build/bin/tests` folder.
6. Run `ctest` to execute all tests and view the test run summary.

Contributing See *CONTRIBUTING.md* for information on contributing.

4.1.4 corehttp

C language HTTP client library designed for embedded platforms.

MCUXpresso SDK: coreHTTP Client Library

This repository is a fork of coreHTTP Client library (https://github.com/FreeRTOS/corehttp)(3.0.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable coreHTTP Client repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

coreHTTP Client Library

This repository contains a C language HTTP client library designed for embedded platforms. It has no dependencies on any additional libraries other than the standard C library, llhttp, and a customer-implemented transport interface. This library is distributed under the *MIT Open Source License*.

This library has gone through code quality checks including verification that no function has a GNU Complexity score over 8. This library has also undergone both static code analysis from Coverity static analysis, and validation of memory safety and data structure invariance through the CBMC automated reasoning tool.

See memory requirements for this library *here*.

coreHTTP v3.0.0 source code is part of the FreeRTOS 202210.00 LTS release.

coreHTTP v2.0.0 source code is part of the FreeRTOS 202012.00 LTS release.

coreHTTP Config File The HTTP client library exposes configuration macros that are required for building the library. A list of all the configurations and their default values are defined in *core_http_config_defaults.h*. To provide custom values for the configuration macros, a custom config file named `core_http_config.h` can be provided by the user application to the library.

By default, a `core_http_config.h` custom config is required to build the library. To disable this requirement and build the library with default configuration values, provide `HTTP_DO_NOT_USE_CUSTOM_CONFIG` as a compile time preprocessor macro.

The HTTP client library can be built by either:

- Defining a core_http_config.h file in the application, and adding it to the include directories for the library build. **OR**
- Defining the HTTP_DO_NOT_USE_CUSTOM_CONFIG preprocessor macro for the library build.

Building the Library The *httpFilePaths.cmake* file contains the information of all source files and header include paths required to build the HTTP client library.

As mentioned in the *previous section*, either a custom config file (i.e. core_http_config.h) OR HTTP_DO_NOT_USE_CUSTOM_CONFIG macro needs to be provided to build the HTTP client library.

For a CMake example of building the HTTP library with the httpFilePaths.cmake file, refer to the coverity_analysis library target in *test/CMakeLists.txt* file.

Building Unit Tests

Platform Prerequisites

- For running unit tests, the following are required:
  - **C90 compiler** like gcc
  - **CMake 3.13.0 or later**
  - **Ruby 2.0.0 or later** is required for this repository's CMock test framework.
- For running the coverage target, the following are required:
  - **gcov**
  - **lcov**

Steps to build Unit Tests

1. Go to the root directory of this repository.
2. Run the *cmake* command: cmake -S test -B build -DBUILD_CLONE_SUBMODULES=ON
3. Run this command to build the library and unit tests: make -C build all
4. The generated test executables will be present in build/bin/tests folder.
5. Run cd build && ctest to execute all tests and view the test run summary.

CBMC To learn more about CBMC and proofs specifically, review the training material here.

The test/cbmc/proofs directory contains CBMC proofs.

In order to run these proofs you will need to install CBMC and other tools by following the instructions here.

Reference examples The AWS IoT Device SDK for Embedded C repository contains demos of using the HTTP client library here on a POSIX platform. These can be used as reference examples for the library API.

Documentation

Existing Documentation For pre-generated documentation, please see the documentation linked in the locations below:

Location
AWS IoT Device SDK for Embedded C FreeRTOS.org

Note that the latest included version of coreHTTP may differ across repositories.

Generating Documentation The Doxygen references were created using Doxygen version 1.9.2. To generate the Doxygen pages, please run the following command from the root of this repository:

```
doxygen docs/doxygen/config.doxyfile
```

Contributing See *CONTRIBUTING.md* for information on contributing.

4.1.5 corejson

JSON parser.

Readme

MCUXpresso SDK: coreJSON Library This repository is a fork of coreJSON library (https://github.com/FreeRTOS/corejson)(3.2.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable coreJSON repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

coreJSON Library This repository contains the coreJSON library, a parser that strictly enforces the ECMA-404 JSON standard and is suitable for low memory footprint embedded devices. The coreJSON library is distributed under the *MIT Open Source License*.

This library has gone through code quality checks including verification that no function has a GNU Complexity score over 8, and checks against deviations from mandatory rules in the MISRA coding standard. Deviations from the MISRA C:2012 guidelines are documented under *MISRA Deviations*. This library has also undergone both static code analysis from Coverity static analysis, and validation of memory safety through the CBMC automated reasoning tool.

See memory requirements for this library *here*.

coreJSON v3.2.0 source code is part of the FreeRTOS 202210.00 LTS release.

coreJSON v3.0.0 source code is part of the FreeRTOS 202012.00 LTS release.

Reference example

```
#include <stdio.h>
#include "core_json.h"

int main()
{
    // Variables used in this example.
    JSONStatus_t result;
    char buffer[] = "{\"foo\":\"abc\",\"bar\":{\"foo\":\"xyz\"}}";
    size_t bufferLength = sizeof( buffer ) - 1;
    char queryKey[] = "bar.foo";
    size_t queryKeyLength = sizeof( queryKey ) - 1;
    char * value;
    size_t valueLength;

    // Calling JSON_Validate() is not necessary if the document is guaranteed to be valid.
    result = JSON_Validate( buffer, bufferLength );

    if( result == JSONSuccess )
    {
        result = JSON_Search( buffer, bufferLength, queryKey, queryKeyLength,
                              &value, &valueLength );
    }

    if( result == JSONSuccess )
    {
        // The pointer "value" will point to a location in the "buffer".
        char save = value[ valueLength ];
        // After saving the character, set it to a null byte for printing.
        value[ valueLength ] = '\0';
        // "Found: bar.foo -> xyz" will be printed.
        printf( "Found: %s -> %s\n", queryKey, value );
        // Restore the original character.
        value[ valueLength ] = save;
    }

    return 0;
}
```

A search may descend through nested objects when the queryKey contains matching key strings joined by a separator, .. In the example above, bar has the value {"foo":"xyz"}. Therefore, a search for query key bar.foo would output xyz.

Building coreJSON A compiler that supports **C90 or later** such as *gcc* is required to build the library.

Additionally, the library uses 2 header files introduced in ISO C99, stdbool.h and stdint.h. For compilers that do not provide this header file, the *source/include* directory contains *stdbool.readme* and *stdint.readme*, which can be renamed to stdbool.h and stdint.h respectively.

For instance, if the example above is copied to a file named example.c, *gcc* can be used like so:

```
gcc -I source/include example.c source/core_json.c -o example
./example
```

gcc can also produce an output file to be linked:

```
gcc -I source/include -c source/core_json.c
```

Documentation

Existing documentation For pre-generated documentation, please see the documentation linked in the locations below:

Location
AWS IoT Device SDK for Embedded C FreeRTOS.org

Note that the latest included version of the coreJSON library may differ across repositories.

Generating documentation The Doxygen references were created using Doxygen version 1.9.2. To generate the Doxygen pages, please run the following command from the root of this repository:

```
doxygen docs/doxygen/config.doxyfile
```

Building unit tests

Checkout Unity Submodule By default, the submodules in this repository are configured with `update=none` in *.gitmodules*, to avoid increasing clone time and disk space usage of other repositories (like amazon-freertos that submodules this repository).

To build unit tests, the submodule dependency of Unity is required. Use the following command to clone the submodule:

```
git submodule update --checkout --init --recursive test/unit-test/Unity
```

Platform Prerequisites

- For running unit tests
  - C90 compiler like gcc
  - CMake 3.13.0 or later
  - Ruby 2.0.0 or later is additionally required for the Unity test framework (that we use).
- For running the coverage target, gcov is additionally required.

Steps to build Unit Tests

1. Go to the root directory of this repository. (Make sure that the **Unity** submodule is cloned as described *above*.)
2. Create build directory: `mkdir build && cd build`
3. Run *cmake* while inside build directory: `cmake -S ../test`
4. Run this command to build the library and unit tests: `make all`
5. The generated test executables will be present in `build/bin/tests` folder.
6. Run `ctest` to execute all tests and view the test run summary.

CBMC To learn more about CBMC and proofs specifically, review the training material here.

The test/cbmc/proofs directory contains CBMC proofs.

In order to run these proofs you will need to install CBMC and other tools by following the instructions here.

Contributing See *CONTRIBUTING.md* for information on contributing.

4.1.6 coremqtt

MQTT publish/subscribe messaging library.

MCUXpresso SDK: coreMQTT Library

This repository is a fork of coreMQTT library (https://github.com/FreeRTOS/coremqtt)(2.1.1). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable coreMQTT repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

coreMQTT Client Library

This repository contains the coreMQTT library that has been optimized for a low memory footprint. The coreMQTT library is compliant with the MQTT 3.1.1 standard. It has no dependencies on any additional libraries other than the standard C library, a customer-implemented network transport interface, and *optionally* a user-implemented platform time function. This library is distributed under the *MIT Open Source License*.

This library has gone through code quality checks including verification that no function has a GNU Complexity score over 8, and checks against deviations from mandatory rules in the MISRA coding standard. Deviations from the MISRA C:2012 guidelines are documented under *MISRA Deviations*. This library has also undergone both static code analysis from Coverity static analysis, and validation of memory safety through the CBMC automated reasoning tool.

See memory requirements for this library *here*.

coreMQTT v2.1.1 source code is part of the FreeRTOS 202210.01 LTS release.

MQTT Config File The MQTT client library exposes build configuration macros that are required for building the library. A list of all the configurations and their default values are defined in *core_mqtt_config_defaults.h*. To provide custom values for the configuration macros, a custom config file named core_mqtt_config.h can be provided by the application to the library.

By default, a core_mqtt_config.h custom config is required to build the library. To disable this requirement and build the library with default configuration values, provide MQTT_DO_NOT_USE_CUSTOM_CONFIG as a compile time preprocessor macro.

Thus, the MQTT library can be built by either:

- Defining a core_mqtt_config.h file in the application, and adding it to the include directories list of the library
  OR
- Defining the MQTT_DO_NOT_USE_CUSTOM_CONFIG preprocessor macro for the library build.

Sending metrics to AWS IoT When establishing a connection with AWS IoT, users can optionally report the Operating System, Hardware Platform and MQTT client version information of their device to AWS. This information can help AWS IoT provide faster issue resolution and technical support. If users want to report this information, they can send a specially formatted string (see below) in the username field of the MQTT CONNECT packet.

Format

The format of the username string with metrics is:

```
<Actual_Username>?SDK=<OS_Name>&Version=<OS_Version>&Platform=<Hardware_Platform>&
↪MQTTLib=<MQTT_Library_name>@<MQTT_Library_version>
```

Where

- <Actual_Username> is the actual username used for authentication, if username and password are used for authentication. When username and password based authentication is not used, this is an empty value.
- <OS_Name> is the Operating System the application is running on (e.g. FreeRTOS)
- <OS_Version> is the version number of the Operating System (e.g. V10.4.3)
- <Hardware_Platform> is the Hardware Platform the application is running on (e.g. WinSim)
- <MQTT_Library_name> is the MQTT Client library being used (e.g. coreMQTT)
- <MQTT_Library_version> is the version of the MQTT Client library being used (e.g. 1.0.2)

Example

- Actual_Username = “iotuser”, OS_Name = FreeRTOS, OS_Version = V10.4.3, Hardware_Platform_Name = WinSim, MQTT_Library_Name = coremqtt, MQTT_Library_version = 2.1.1. If username is not used, then “iotuser” can be removed.

```
/* Username string:
 * iotuser?SDK=FreeRTOS&Version=v10.4.3&Platform=WinSim&MQTTLib=coremqtt@2.1.1
 */

#define OS_NAME                    ”FreeRTOS”
#define OS_VERSION                 ”V10.4.3”
#define HARDWARE_PLATFORM_NAME     ”WinSim”
#define MQTT_LIB                   ”coremqtt@2.1.1”

#define USERNAME_STRING            ”iotuser?SDK=” OS_NAME ”&Version=” OS_VERSION ”&
↪Platform=” HARDWARE_PLATFORM_NAME ”&MQTTLib=” MQTT_LIB
#define USERNAME_STRING_LENGTH     ( ( uint16_t ) ( sizeof( USERNAME_STRING ) - 1 ) )

MQTTConnectInfo_t connectInfo;
connectInfo.pUserName = USERNAME_STRING;
connectInfo.userNameLength = USERNAME_STRING_LENGTH;
mqttStatus = MQTT_Connect( pMqttContext, &connectInfo, NULL, CONNACK_RECV_TIMEOUT_MS,␣
↪pSessionPresent );
```

Upgrading to v2.0.0 and above With coreMQTT versions >=v2.0.0, there are breaking changes. Please refer to the *coreMQTT version >=v2.0.0 Migration Guide*.

Building the Library The *mqttFilePaths.cmake* file contains the information of all source files and the header include path required to build the MQTT library.

Additionally, the MQTT library requires two header files that are not part of the ISO C90 standard library, stdbool.h and stdint.h. For compilers that do not provide these header files, the

source/include directory contains the files *stdbool.readme* and *stdint.readme*, which can be renamed to stdbool.h and stdint.h, respectively, to provide the type definitions required by MQTT.

As mentioned in the previous section, either a custom config file (i.e. core_mqtt_config.h) OR MQTT_DO_NOT_USE_CUSTOM_CONFIG macro needs to be provided to build the MQTT library.

For a CMake example of building the MQTT library with the mqttFilePaths.cmake file, refer to the coverity_analysis library target in *test/CMakeLists.txt* file.

Building Unit Tests

Checkout CMock Submodule By default, the submodules in this repository are configured with update=none in *.gitmodules* to avoid increasing clone time and disk space usage of other repositories (like amazon-freertos that submodules this repository).

To build unit tests, the submodule dependency of CMock is required. Use the following command to clone the submodule:

```
git submodule update --checkout --init --recursive test/unit-test/CMock
```

Platform Prerequisites

- Docker

or the following:

- For running unit tests
  - **C90 compiler** like gcc
  - **CMake 3.13.0 or later**
  - **Ruby 2.0.0 or later** is additionally required for the CMock test framework (that we use).
- For running the coverage target, **gcov** and **lcov** are additionally required.

Steps to build Unit Tests

1. If using docker, launch the container:
   1. docker build -t coremqtt .
   2. docker run -it -v "$PWD":/workspaces/coreMQTT -w /workspaces/coreMQTT coremqtt
2. Go to the root directory of this repository. (Make sure that the **CMock** submodule is cloned as described *above*)
3. Run the *cmake* command: cmake -S test -B build
4. Run this command to build the library and unit tests: make -C build all
5. The generated test executables will be present in build/bin/tests folder.
6. Run cd build && ctest to execute all tests and view the test run summary.

CBMC To learn more about CBMC and proofs specifically, review the training material here.

The test/cbmc/proofs directory contains CBMC proofs.

In order to run these proofs you will need to install CBMC and other tools by following the instructions here.

Reference examples Please refer to the demos of the MQTT client library in the following locations for reference examples on POSIX and FreeRTOS platforms:

Platform	Location	Transport Interface Implementation
POSIX	AWS IoT Device SDK for Embedded C	POSIX sockets for TCP/IP and OpenSSL for TLS stack
FreeRTOS	FreeRTOS/FreeRTOS	FreeRTOS+TCP for TCP/IP and mbedTLS for TLS stack
FreeRTOS	FreeRTOS AWS Reference Integrations	Based on Secure Sockets Abstraction

Documentation

Existing Documentation For pre-generated documentation, please see the documentation linked in the locations below:

Location
AWS IoT Device SDK for Embedded C FreeRTOS.org

Note that the latest included version of coreMQTT may differ across repositories.

Generating Documentation The Doxygen references were created using Doxygen version 1.9.2. To generate the Doxygen pages, please run the following command from the root of this repository:

```
doxygen docs/doxygen/config.doxyfile
```

Contributing See *CONTRIBUTING.md* for information on contributing.

4.1.7 coremqtt-agent

The coreMQTT Agent library is a high level API that adds thread safety to the coreMQTT library.

Readme

MCUXpresso SDK: coreMQTT Agent Library This repository is a fork of coreMQTT Agent library (https://github.com/FreeRTOS/coremqtt-agent)(1.2.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable coreMQTT Agent repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

coreMQTT Agent Library The coreMQTT Agent library is a high level API that adds thread safety to the coreMQTT library. The library provides thread safe equivalents to the coreMQTT's APIs, greatly simplifying its use in multi-threaded environments. The coreMQTT Agent library manages the MQTT connection by serializing the access to the coreMQTT library and reducing implementation overhead (e.g., removing the need for the application to repeatedly call to MQTT_ProcessLoop). This allows your multi-threaded applications to share the same MQTT connection, and enables you to design an embedded application without having to worry about coreMQTT thread safety.

This library has gone through code quality checks including verification that no function has a GNU Complexity score over 8, and checks against deviations from mandatory rules in the MISRA coding standard. Deviations from the MISRA C:2012 guidelines are documented under *MISRA Deviations*. This library has also undergone both static code analysis from Coverity static analysis, and validation of memory safety through the CBMC automated reasoning tool.

See memory requirements for this library *here*.

Cloning this repository This repo uses Git Submodules to bring in dependent components.

To clone using HTTPS:

```
git clone https://github.com/FreeRTOS/coreMQTT-Agent.git --recurse-submodules
```

Using SSH:

```
git clone git@github.com:FreeRTOS/coreMQTT-Agent.git --recurse-submodules
```

If you have downloaded the repo without using the --recurse-submodules argument, you need to run:

```
git submodule update --init --recursive
```

coreMQTT Agent Library Configurations The MQTT Agent library uses the same core_mqtt_config.h configuration file as coreMQTT, with the addition of configuration constants listed at the top of *core_mqtt_agent.h* and *core_mqtt_agent_command_functions.h*. Documentation for these configurations can be found here.

To provide values for these configuration values, they must be either:

- Defined in core_mqtt_config.h used by coreMQTT **OR**
- Passed as compile time preprocessor macros

Porting the coreMQTT Agent Library In order to use the MQTT Agent library on a platform, you need to supply thread safe functions for the agent's *messaging interface*.

Messaging Interface Each of the following functions must be thread safe.

Function Pointer	Description
MQTTAgentMessageSend_t	A function that sends commands (as MQTTAgentCommand_t * pointers) to be received by MQTTAgent_CommandLoop. This can be implemented by pushing to a thread safe queue.
MQTTAgentMessageRecv_t	A function used by MQTTAgent_CommandLoop to receive MQTTAgentCommand_t * pointers that were sent by API functions. This can be implemented by receiving from a thread safe queue.
MQTTAgentCommandGet_t	A function that returns a pointer to an allocated MQTTAgentCommand_t structure, which is used to hold information and arguments for a command to be executed in MQTTAgent_CommandLoop(). If using dynamic memory, this can be implemented using malloc().
MQTTAgentCommandRelease_t	A function called to indicate that a command structure that had been allocated with the MQTTAgentCommandGet_t function pointer will no longer be used by the agent, so it may be freed or marked as not in use. If using dynamic memory, this can be implemented with free().

Reference implementations for the interface functions can be found in the *reference examples* below.

Additional Considerations

Static Memory If only static allocation is used, then the MQTTAgentCommandGet_t and MQTTAgentCommandRelease_t could instead be implemented with a pool of MQTTAgentCommand_t structures, with a queue or semaphore used to control access and provide thread safety. The below *reference examples* use static memory with a command pool.

Subscription Management The MQTT Agent does not track subscriptions for MQTT topics. The receipt of any incoming PUBLISH packet will result in the invocation of a single MQTTAgentIncomingPublishCallback_t callback, which is passed to MQTTAgent_Init() for initialization. If it is desired for different handlers to be invoked for different incoming topics, then the publish callback will have to manage subscriptions and fan out messages. A platform independent subscription manager example is implemented in the *reference examples* below.

Building the Library You can build the MQTT Agent source files that are in the *source* directory, and add *source/include* to your compiler's include path. Additionally, the MQTT Agent library requires the coreMQTT library, whose files follow the same source/ and source/include pattern as the agent library; its build instructions can be found here.

If using CMake, the *mqttAgentFilePaths.cmake* file contains the above information of the source files and the header include path from this repository. The same information is found for coreMQTT from mqttFilePaths.cmake in the *coreMQTT submodule*.

For a CMake example of building the MQTT Agent library with the mqttAgentFilePaths.cmake file, refer to the coverity_analysis library target in *test/CMakeLists.txt* file.

Building Unit Tests

Checkout CMock Submodule To build unit tests, the submodule dependency of CMock is required. Use the following command to clone the submodule:

```
git submodule update --checkout --init --recursive test/unit-test/CMock
```

Unit Test Platform Prerequisites

- For running unit tests
  - **C90 compiler** like gcc
  - **CMake 3.13.0 or later**
  - **Ruby 2.0.0 or later** is additionally required for the CMock test framework (that we use).
- For running the coverage target, **gcov** and **lcov** are additionally required.

Steps to build Unit Tests

1. Go to the root directory of this repository. (Make sure that the **CMock** submodule is cloned as described *above*)
2. Run the *cmake* command: `cmake -S test -B build`
3. Run this command to build the library and unit tests: `make -C build all`
4. The generated test executables will be present in `build/bin/tests` folder.
5. Run `cd build && ctest` to execute all tests and view the test run summary.

CBMC To learn more about CBMC and proofs specifically, review the training material here.

The `test/cbmc/proofs` directory contains CBMC proofs.

In order to run these proofs you will need to install CBMC and other tools by following the instructions here.

Reference examples Please refer to the demos of the MQTT Agent library in the following locations for reference examples on FreeRTOS platforms:

Location
coreMQTT Agent Demos FreeRTOS/FreeRTOS

Documentation The MQTT Agent API documentation can be found here.

Generating documentation The Doxygen references were created using Doxygen version 1.9.2. To generate the Doxygen pages yourself, please run the following command from the root of this repository:

```
doxygen docs/doxygen/config.doxyfile
```

Getting help You can use your Github login to get support from both the FreeRTOS community and directly from the primary FreeRTOS developers on our active support forum. You can find a list of frequently asked questions here.

Contributing See *CONTRIBUTING.md* for information on contributing.

License This library is licensed under the MIT License. See the *LICENSE* file.

4.1.8 corepkcs11

PKCS #11 key management library.

Readme

MCUXpresso SDK: corePKCS11 Library This repository is a fork of PKCS #11 key management library (https://github.com/FreeRTOS/corePKCS11/tree/v3.5.0)(v3.5.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable corepkcs11 repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

corePKCS11 Library PKCS #11 is a standardized and widely used API for manipulating common cryptographic objects. It is important because the functions it specifies allow application software to use, create, modify, and delete cryptographic objects, without ever exposing those objects to the application's memory. For example, FreeRTOS AWS reference integrations use a small subset of the PKCS #11 API to, among other things, access the secret (private) key necessary to create a network connection that is authenticated and secured by the Transport Layer Security (TLS) protocol – without the application ever 'seeing' the key.

The Cryptoki or PKCS #11 standard defines a platform-independent API to manage and use cryptographic tokens. The name, "PKCS #11", is used interchangeably to refer to the API itself and the standard which defines it.

This repository contains a software based mock implementation of the PKCS #11 interface (API) that uses the cryptographic functionality provided by Mbed TLS. Using a software mock enables rapid development and flexibility, but it is expected that the mock be replaced by an implementation specific to your chosen secure key storage in production devices.

Only a subset of the PKCS #11 standard is implemented, with a focus on operations involving asymmetric keys, random number generation, and hashing.

The targeted use cases include certificate and key management for TLS authentication and code-sign signature verification, on small embedded devices.

corePKCS11 is implemented on PKCS #11 v2.4.0, the full PKCS #11 standard can be found on the oasis website.

This library has gone through code quality checks including verification that no function has a GNU Complexity score over 8, and checks against deviations from mandatory rules in the MISRA coding standard. Deviations from the MISRA C:2012 guidelines are documented under *MISRA Deviations*. This library has also undergone both static code analysis from Coverity static analysis and validation of memory safety through the CBMC automated reasoning tool.

See memory requirements for this library *here*.

corePKCS11 v3.5.0 source code is part of the FreeRTOS 202210.00 LTS release.

corePKCS11 v3.0.0 source code is part of the FreeRTOS 202012.00 LTS release.

Purpose Generally vendors for secure cryptoprocessors such as Trusted Platform Module (TPM), Hardware Security Module (HSM), Secure Element, or any other type of secure hardware enclave, distribute a PKCS #11 implementation with the hardware. The purpose of the corePKCS11 software only mock library is therefore to provide a non hardware specific PKCS #11 implementation that allows for rapid prototyping and development before switching to a cryptoprocessor specific PKCS #11 implementation in production devices.

Since the PKCS #11 interface is defined as part of the PKCS #11 specification replacing this library with another implementation should require little porting effort, as the interface will not change. The system tests distributed in this repository can be leveraged to verify the behavior of a different implementation is similar to corePKCS11.

corePKCS11 Configuration The corePKCS11 library exposes preprocessor macros which must be defined prior to building the library. A list of all the configurations and their default values are defined in the doxygen documentation for this library.

Build Prerequisites

Library Usage For building the library the following are required:

- **A C99 compiler**
- **mbedcrypto** library from mbedtls version 2.x or 3.x.
- **pkcs11 API header(s)** available from OASIS or OpenSC

Optionally, variables from the pkcsFilePaths.cmake file may be referenced if your project uses cmake.

Integration and Unit Tests In order to run the integration and unit test suites the following are dependencies are necessary:

- **C Compiler**
- **CMake 3.13.0 or later**
- **Ruby 2.0.0 or later** required by CMock.
- **Python 3** required for configuring mbedtls.
- **git** required for fetching dependencies.
- **GNU Make** or **Ninja**

The *mbedtls*, *CMock*, and *Unity* libraries are downloaded and built automatically using the cmake FetchContent feature.

Coverage Measurement and Instrumentation The following software is required to run the coverage target:

- Linux, MacOS, or another POSIX-like environment.
- A recent version of **GCC** or **Clang** with support for gcov-like coverage instrumentation.
- **gcov** binary corresponding to your chosen compiler
- **lcov** from the Linux Test Project
- **perl** needed to run the lcov utility.

Coverage builds are validated on recent versions of Ubuntu Linux.

Running the Integration and Unit Tests

1. Navigate to the root directory of this repository in your shell.
2. Run **cmake** to construct a build tree: `cmake -S test -B build`
   - You may specify your preferred build tool by appending `-G'Unix Makefiles'` or `-GNinja` to the command above.
   - You may append `-DUNIT_TESTS=0` or `-DSYSTEM_TESTS=0` to disable Unit Tests or Integration Tests respectively.
3. Build the test binaries: `cmake --build ./build --target all`
4. Run `ctest --test-dir ./build` or `cmake --build ./build --target test` to run the tests without capturing coverage.
5. Run `cmake --build ./build --target coverage` to run the tests and capture coverage data.

CBMC To learn more about CBMC and proofs specifically, review the training material here.

The `test/cbmc/proofs` directory contains CBMC proofs.

In order to run these proofs you will need to install CBMC and other tools by following the instructions here.

Reference examples The FreeRTOS-Labs repository contains demos using the PKCS #11 library here using FreeRTOS on the Windows simulator platform. These can be used as reference examples for the library API.

Porting Guide Documentation for porting corePKCS11 to a new platform can be found on the AWS docs web page.

corePKCS11 is not meant to be ported to projects that have a TPM, HSM, or other hardware for offloading crypto-processing. This library is specifically meant to be used for development and prototyping.

Related Example Implementations These projects implement the PKCS #11 interface on real hardware and have similar behavior to corePKCS11. It is preferred to use these, over corePKCS11, as they allow for offloading Cryptography to separate hardware.

- ARM's Platform Security Architecture.
- Microchip's cryptoauthlib.
- Infineon's Optiga Trust X.

Documentation

Existing Documentation For pre-generated documentation, please see the documentation linked in the locations below:

Location
AWS IoT Device SDK for Embedded C
FreeRTOS.org

Note that the latest included version of corePKCS11 may differ across repositories.

Generating Documentation The Doxygen references were created using Doxygen version 1.9.2. To generate the Doxygen pages, please run the following command from the root of this repository:

```
doxygen docs/doxygen/config.doxyfile
```

Security See *CONTRIBUTING* for more information.

License This library is licensed under the MIT-0 License. See the LICENSE file.

4.1.9 freertos-plus-tcp

Open source RTOS FreeRTOS Plus TCP.

Readme

MCUXpresso SDK: FreeRTOS-Plus-TCP Library This repository is a fork of FreeRTOS-Plus-TCP library (https://github.com/FreeRTOS/freertos-plus-tcp)(4.0.0). Modifications have been made to adapt to NXP MCUXpresso SDK. CMakeLists.txt and Kconfig added to enable FreeRTOS-Plus-TCP repo sources build in MCUXpresso SDK. It is part of the MCUXpresso SDK overall delivery which is composed of several sub-repositories/projects. Navigate to the top/parent repository mcuxsdk-manifests(https://github.com/nxp-mcuxpresso/mcuxsdk-manifests) for the complete delivery of MCUXpresso SDK.

Introduction This branch contains unified IPv4 and IPv6 functionalities. Refer to the Getting started Guide (found here) for more details.

FreeRTOS-Plus-TCP Library FreeRTOS-Plus-TCP is a lightweight TCP/IP stack for FreeRTOS. It provides a familiar Berkeley sockets interface, making it as simple to use and learn as possible. FreeRTOS-Plus-TCP's features and RAM footprint are fully scalable, making FreeRTOS-Plus-TCP equally applicable to smaller lower throughput microcontrollers as well as larger higher throughput microprocessors.

This library has undergone static code analysis and checks for compliance with the MISRA coding standard. Any deviations from the MISRA C:2012 guidelines are documented under MISRA Deviations. The library is validated for memory safety and data structure invariance through the CBMC automated reasoning tool for the functions that parse data originating from the network. The library is also protocol tested using Maxwell protocol tester for both IPv4 and IPv6.

Getting started The easiest way to use the 4.0.0 version of FreeRTOS-Plus-TCP is to refer the Getting started Guide (found here) Another way is to start with the pre-configured demo application project (found in this directory). That way you will have the correct FreeRTOS source files included, and the correct include paths configured. Once a demo application is building and executing you can remove the demo application files, and start to add in your own application source files. See the FreeRTOS Kernel Quick Start Guide for detailed instructions and other useful links.

Additionally, for FreeRTOS-Plus-TCP source code organization refer to the Documentation, and API Reference.

Getting help If you have any questions or need assistance troubleshooting your FreeRTOS project, we have an active community that can help on the FreeRTOS Community Support Forum. Please also refer to FAQ for frequently asked questions.

Also see the Submitting a bugs/feature request section of CONTRIBUTING.md for more details.

Note: All the remaining sections are generic and applies to all the versions from V3.0.0 onwards.

Upgrading to V3.0.0 and V3.1.0 In version 3.0.0 or 3.1.0, the folder structure of FreeRTOS-Plus-TCP has changed and the files have been broken down into smaller logically separated modules. This change makes the code more modular and conducive to unit-tests. FreeRTOS-Plus-TCP V3.0.0 improves the robustness, security, and modularity of the library. Version 3.0.0 adds comprehensive unit test coverage for all lines and branches of code and has undergone protocol testing, and penetration testing by AWS Security to reduce the exposure to security vulnerabilities. Additionally, the source files have been moved to a source directory. This change requires modification of any existing project(s) to include the modified source files and directories. There are examples on how to use the new files and directory structure. For an example based on the Xilinx Zynq-7000, use the code in this branch and follow these instructions to build and run the demo.

FreeRTOS-Plus-TCP V3.1.0 source code(.c .h) is part of the FreeRTOS 202210.00 LTS release.

Generating pre V3.0.0 folder structure for backward compatibility: If you wish to continue using a version earlier than V3.0.0 i.e. continue to use your existing source code organization, a script is provided to generate the folder structure similar to this.

Note: After running the script, while the .c files will have same names as the pre V3.0.0 source, the files in the include directory will have different names and the number of files will differ as well. This should, however, not pose any problems to most projects as projects generally include all files in a given directory.

Running the script to generate pre V3.0.0 folder structure: For running the script, you will need Python version > 3.7. You can download/install it from here.

Once python is downloaded and installed, you can verify the version from your terminal/command window by typing python --version.

To run the script, you should switch to the FreeRTOS-Plus-TCP directory that was created using the *Cloning this repository* step above. And then run python <Path/to/the/script>/GenerateOriginalFiles.py.

To consume FreeRTOS+TCP

Consume with CMake If using CMake, it is recommended to use this repository using FetchContent. Add the following into your project's main or a subdirectory's CMakeLists.txt:

- Define the source and version/tag you want to use:

```
FetchContent_Declare( freertos_plus_tcp
  GIT_REPOSITORY https://github.com/FreeRTOS/FreeRTOS-Plus-TCP.git
  GIT_TAG        master #Note: Best practice to use specific git-hash or tagged version
  GIT_SUBMODULES "" # Don't grab any submodules since not latest
)
```

- Configure the FreeRTOS-Kernel and make it available
  - this particular example supports a native and cross-compiled build option.

```
set( FREERTOS_PLUS_FAT_DEV_SUPPORT OFF CACHE BOOL "" FORCE)
# Select the native compile PORT
set( FREERTOS_PLUS_FAT_PORT "POSIX" CACHE STRING "" FORCE)
# Select the cross-compile PORT
if (CMAKE_CROSSCOMPILING)
  # Eg. Zynq 2019_3 version of port
  set(FREERTOS_PLUS_FAT_PORT "ZYNQ_2019_3" CACHE STRING "" FORCE)
endif()

FetchContent_MakeAvailable(freertos_plus_tcp)
```

Consuming stand-alone This repository uses Git Submodules to bring in dependent components.

Note: If you download the ZIP file provided by GitHub UI, you will not get the contents of the submodules. (The ZIP file is also not a valid Git repository)

To clone using HTTPS:

```
git clone https://github.com/FreeRTOS/FreeRTOS-Plus-TCP.git ./FreeRTOS-Plus-TCP
cd ./FreeRTOS-Plus-TCP
git submodule update --checkout --init --recursive tools/CMock test/FreeRTOS-Kernel
```

Using SSH:

```
git clone git@github.com:FreeRTOS/FreeRTOS-Plus-TCP.git ./FreeRTOS-Plus-TCP
cd ./FreeRTOS-Plus-TCP
git submodule update --checkout --init --recursive tools/CMock test/FreeRTOS-Kernel
```

Porting The porting guide is available on this page.

Repository structure This repository contains the FreeRTOS-Plus-TCP repository and a number of supplementary libraries for testing/PR Checks. Below is the breakdown of what each directory contains:

- tools
  - This directory contains the tools and related files (CMock/uncrustify) required to run tests/checks on the TCP source code.
- tests
  - This directory contains all the tests (unit tests and CBMC) and the dependencies (FreeRTOS-Kernel/Litani-port) the tests require.
- source/portable
  - This directory contains the portable files required to compile the FreeRTOS-Plus-TCP source code for different hardware/compilers.
- source/include
  - The include directory has all the 'core' header files of FreeRTOS-Plus-TCP source.
- source
  - This directory contains all the [.c] source files.

Note At this time it is recommended to use BufferAllocation_2.c in which case it is essential to use the heap_4.c memory allocation scheme. See memory management.

Kernel sources The FreeRTOS Kernel Source is in FreeRTOS/FreeRTOS-Kernel repository, and it is consumed by testing/PR checks as a submodule in this repository.

The version of the FreeRTOS Kernel Source in use could be accessed at ./test/FreeRTOS-Kernel directory.

CBMC The test/cbmc/proofs directory contains CBMC proofs.

To learn more about CBMC and proofs specifically, review the training material here.

In order to run these proofs you will need to install CBMC and other tools by following the instructions here.