MCUXpresso SDK Documentation

Release 26.03.00-pvw2

NXP
Feb 20, 2026

Table of contents

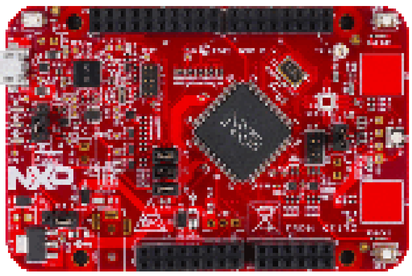
This documentation contains information specific to the frdmke17z board.

Chapter 1

FRDM-KE17Z

1.1 Overview

The FRDM-KE17Z Freedom Board is designed to work in standalone mode or as the main board of FRDM-TOUCH, FRDM-MC-LVBLDC, and Arduino boards. This Freedom board is compatible with DC 5v and 3.3v power supply and features a KE17Z, a device boasting up to 256KB Flash and 48KB SRAM, and numerous analog and digital peripherals.The onboard interfaces include an RGB LED, a 6-axis digital sensor, a 3-axis digital angular rate gyroscope, an ambient temperature sensor, and two capacitive touch pads.



MCU device and part on board is shown below:

- Device: MKE17Z7
- PartNumber: MKE17Z256VLL7

1.2 Getting Started with MCUXpresso SDK Package

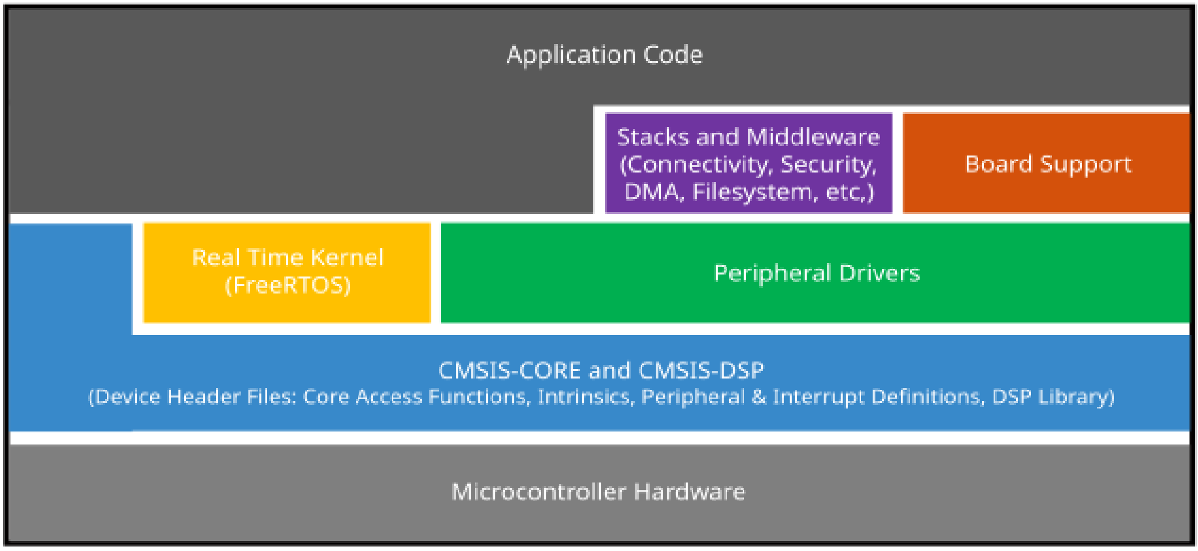
1.2.1 Getting Started with Package

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 full demo applications. The MCUXpresso SDK contains optional RTOS integrations such as FreeRTOS and Azure RTOS, and various other middleware to support rapid development.

For supported toolchain versions, see *MCUXpresso SDK Release Notes for FRDM-KE17Z* (document MCUXSDKKE17RN).

For more details about MCUXpresso SDK, see MCUXpresso Software Development Kit (SDK).



|

|

MCUXpresso SDK board support package folders

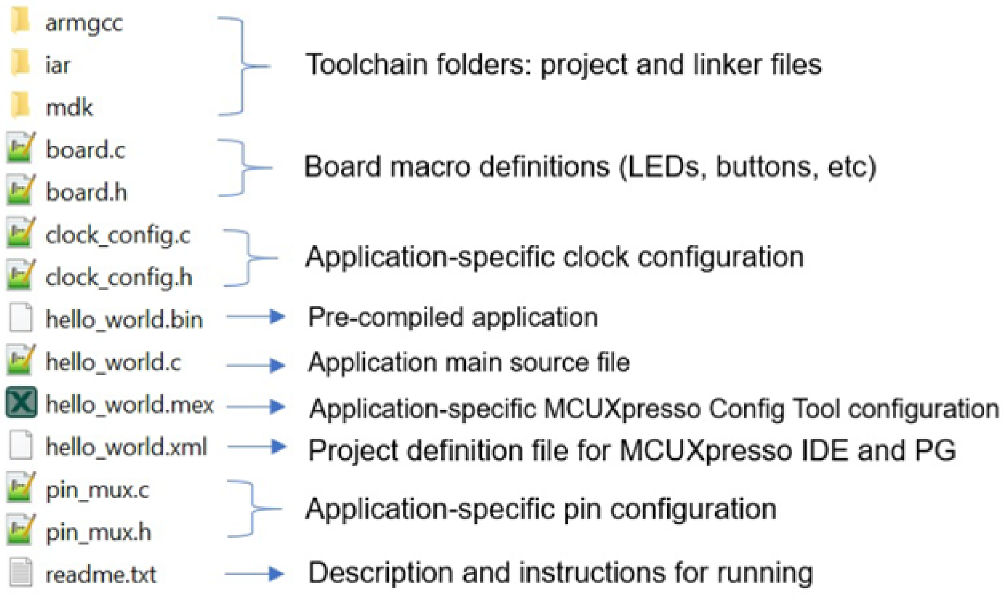
MCUXpresso SDK board support package provides example applications for NXP development and evaluation boards for Arm® Cortex®-M cores including Freedom, Tower System, and LPCXpresso boards. Board support packages are found inside the top level boards folder and each supported board has its own folder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

- cmsis_driver_examples: Simple applications intended to show how to use CMSIS drivers.
- demo_apps: Full-featured applications that 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 that show how to use the MCUXpresso SDK's 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 conversion using DMA).
- rtos_examples: Basic FreeRTOSTM OS examples that show the use of various RTOS objects (semaphores, queues, and so on) and interfaces with the MCUXpresso SDK's RTOS drivers

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 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 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 package 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 package folders*

Run a demo using MCUXpresso IDE

Note: Ensure that the MCUXpresso IDE toolchain is included when generating the MCUXpresso SDK package.

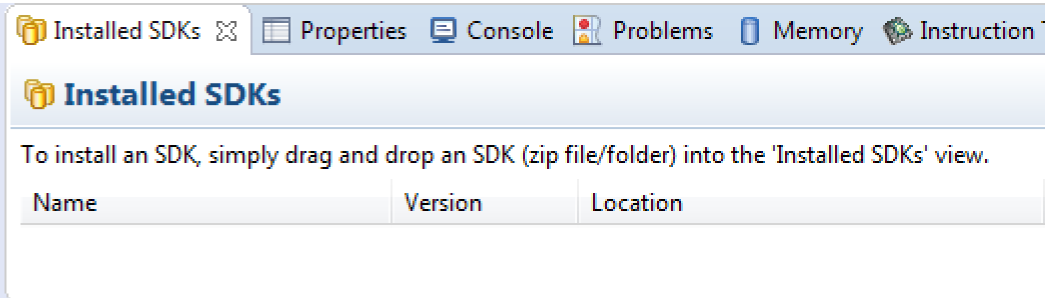
This section describes the steps required to configure MCUXpresso IDE to build, run, and debug example applications. The hello_world demo application targeted for the FRDM-KE17Z hardware platform is used as an example, though these steps can be applied to any example application in the MCUXpresso SDK.

Select the workspace location Every time MCUXpresso IDE launches, it prompts the user to select a workspace location. MCUXpresso IDE is built on top of Eclipse which uses workspace to store information about its current configuration, and in some use cases, source files for the projects are in the workspace. The location of the workspace can be anywhere, but it is recommended that the workspace be located outside of the MCUXpresso SDK tree.

Parent topic:*Run a demo using MCUXpresso IDE*

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

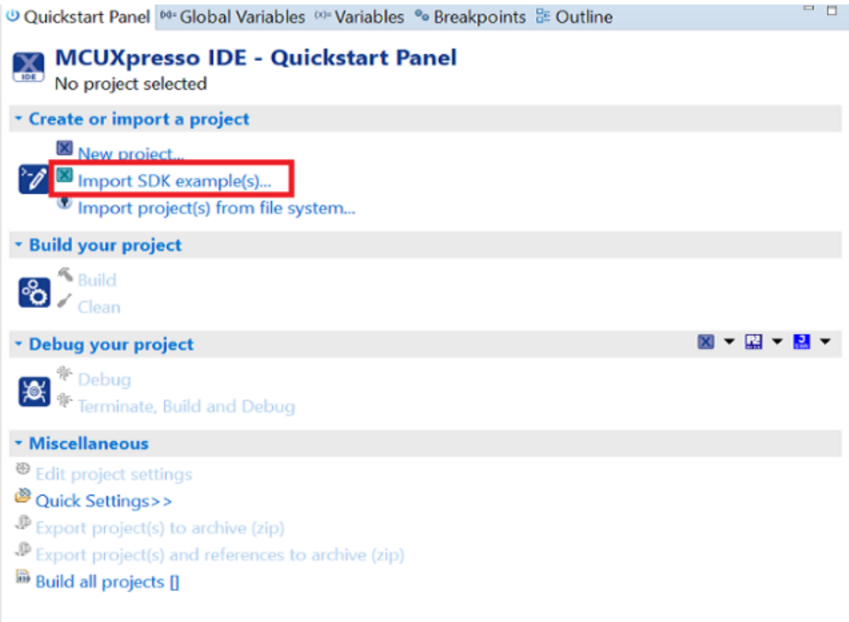
1. Drag and drop the SDK zip file into the **Installed SDKs** view to install an SDK. In the window that appears, click **OK** and wait until the import has finished.



|

|

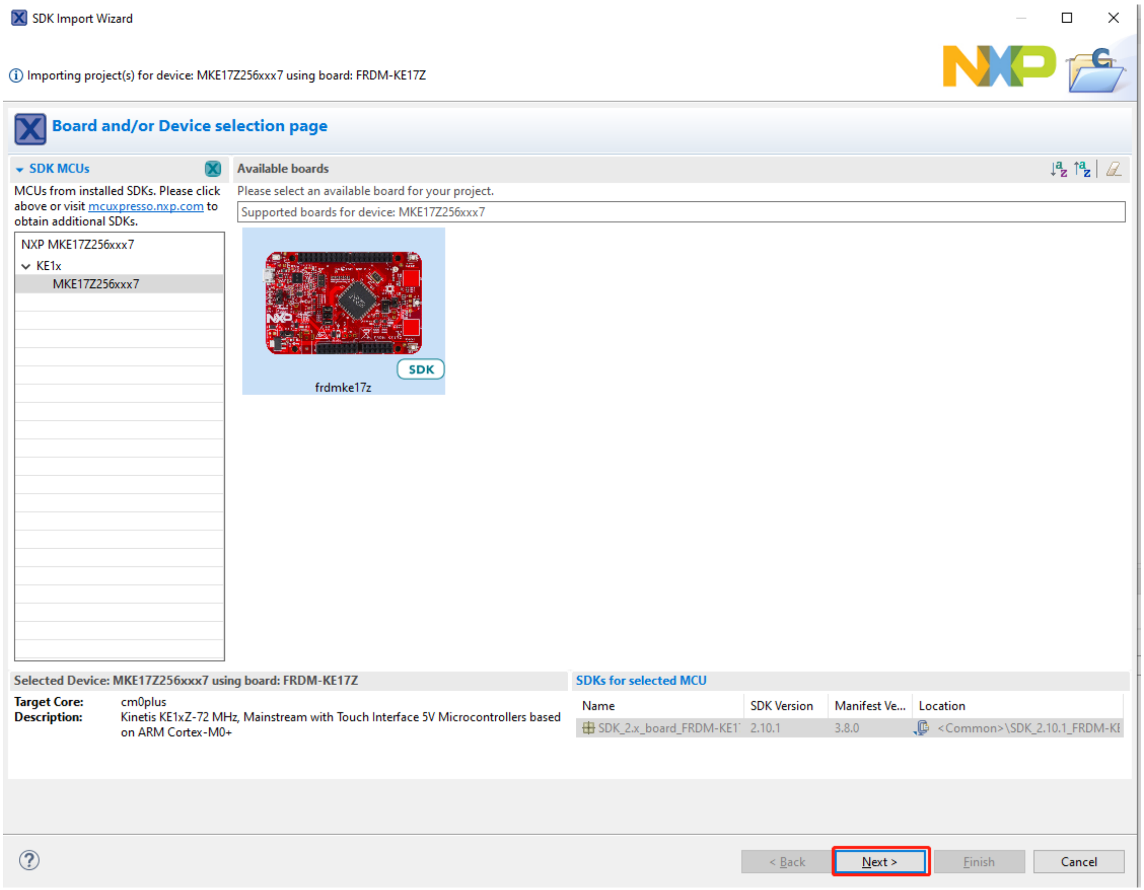
2. On the **Quickstart Panel**, click **Import SDK example(s)…**.



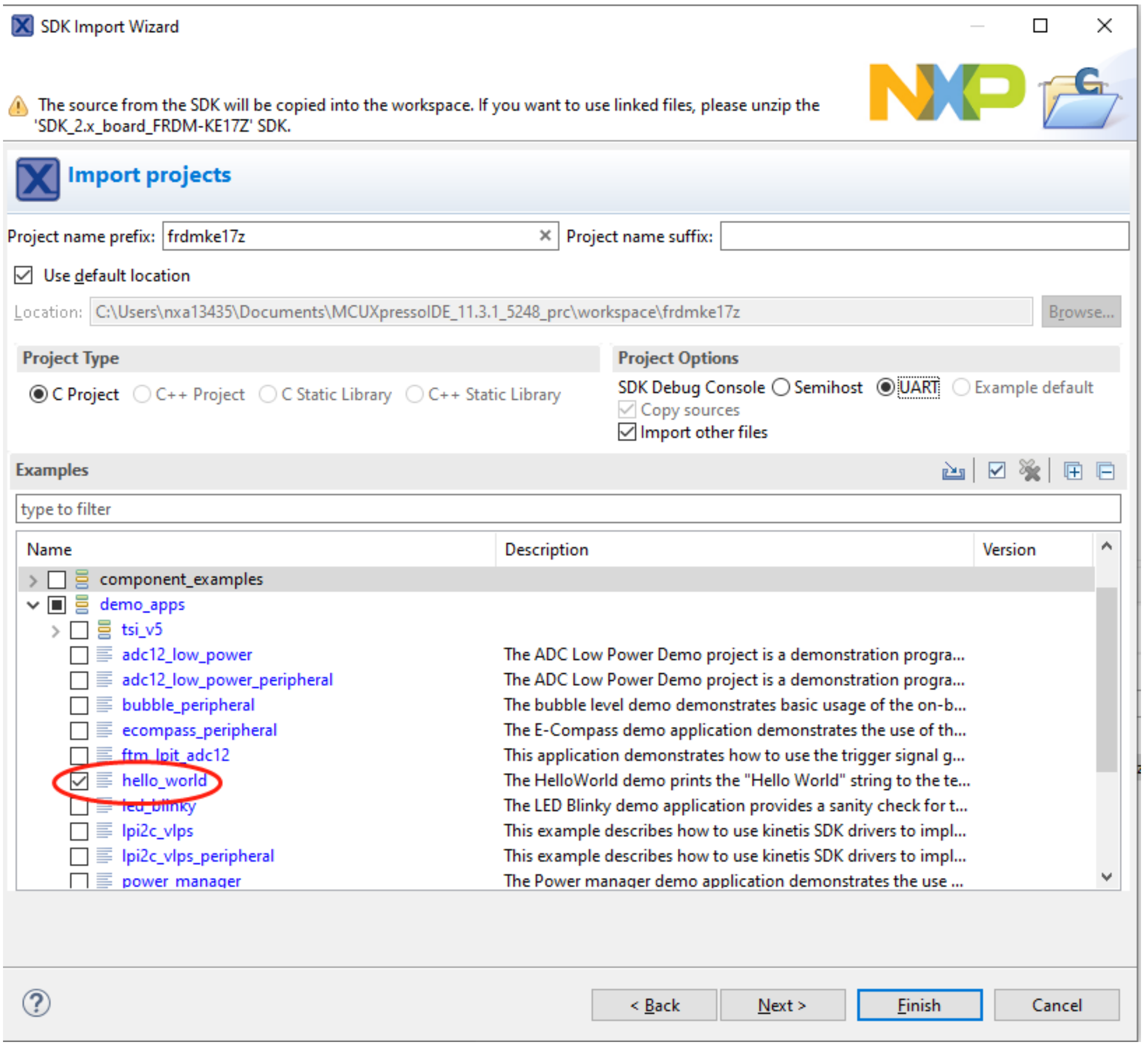
|

|

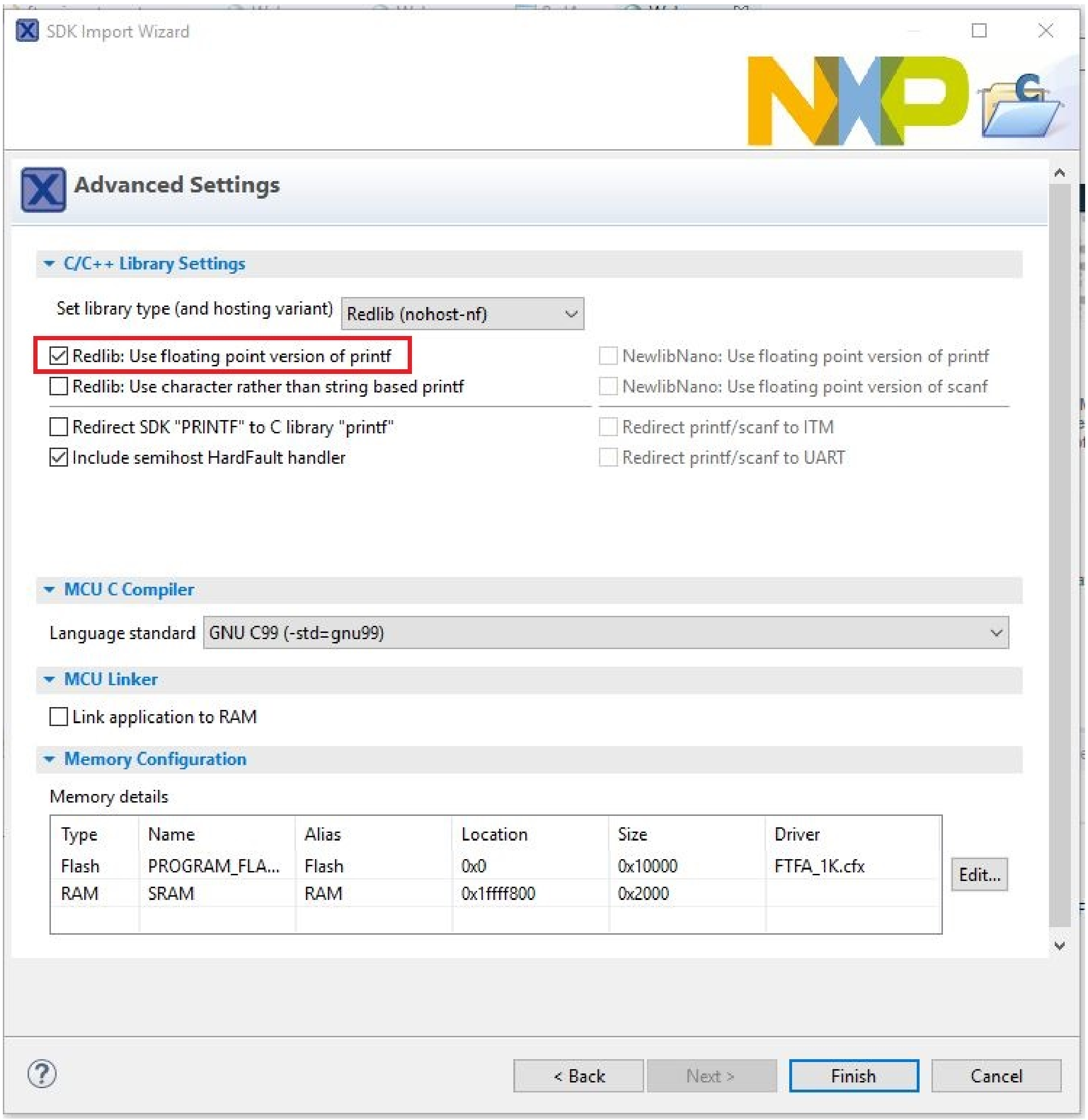
3. In the window that appears, expand the **KE1x** folder and select **MKE17Z256xxx7** . Then, select **frdmke17z** and click **Next**.



4. Expand the demo_apps folder and select hello_world . Then, click **Next** .



5. Ensure **Redlib: Use floating point version of printf** is selected if the example prints floating point numbers on the terminalfor demo applications such as adc_basic, adc_burst, adc_dma, and adc_interrupt. Otherwise, it is not necessary to select this option. Then, click **Finish**.



Parent topic: *Run a demo using MCUXpresso IDE*

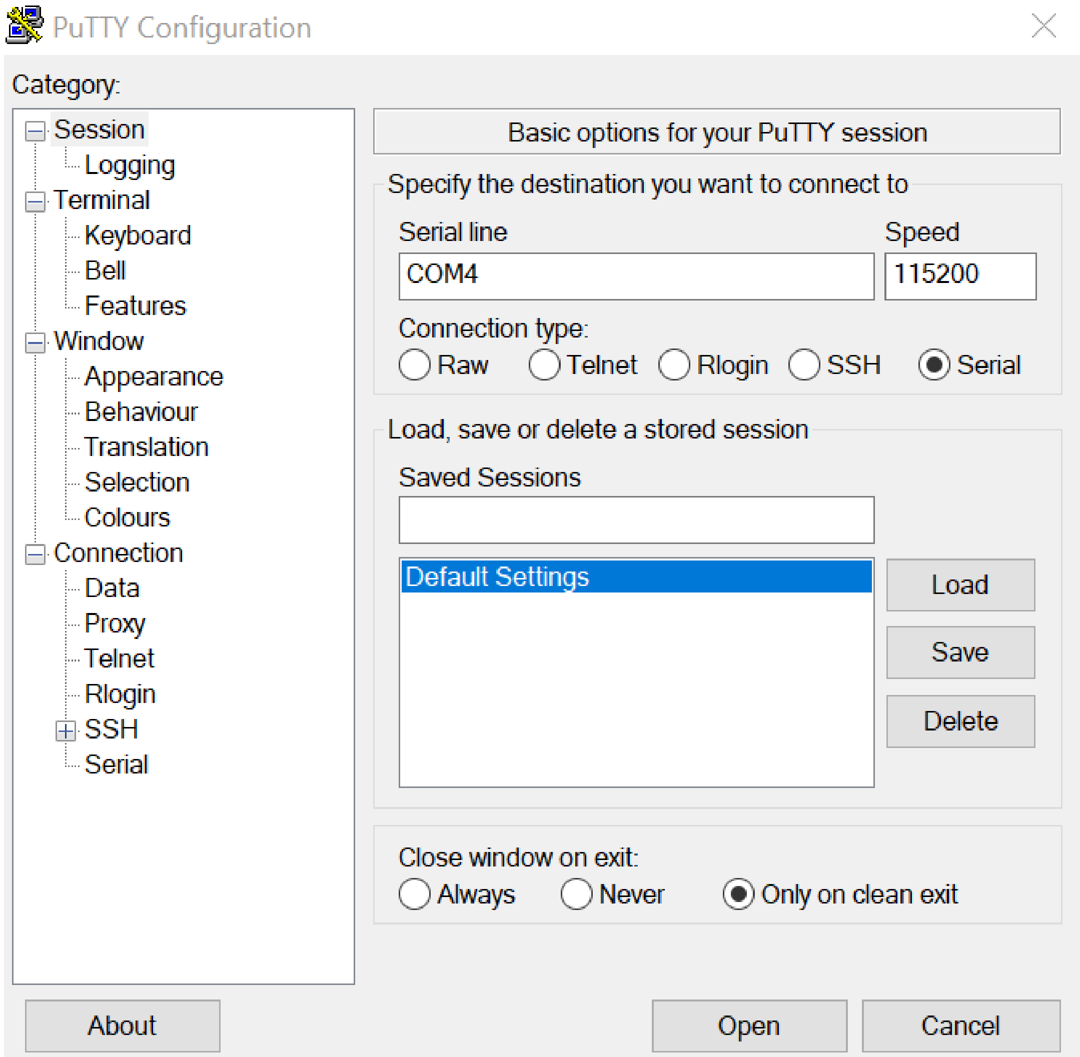
Run an example application For more information on debug probe support in the MCUXpresso IDE, see Community.

To download and run the application, perform the following steps:

1. See *Table 1* to determine the debug interface that comes loaded on your specific hardware platform.
   - For boards with the CMSIS-DAP/mbed/DAPLink interface, visit Windows serial configuration and follow the instructions to install the Windows operating system serial driver. If running on Linux OS, this step is not required.
   - For boards with a P&E Micro interface, visit PE micro and download and install the P&E Micro Hardware Interface Drivers package.
   - If using J-Link either a standalone debug pod or OpenSDA, install the J-Link software (drivers and utilities) from Segger.
2. Connect the development platform to your PC via a USB cable.

3. Open the terminal application on the PC, such as PuTTY or TeraTerm, and connect to the debug serial port number (to determine the COM port number, see *How to determine COM port*). Configure the terminal with these settings:

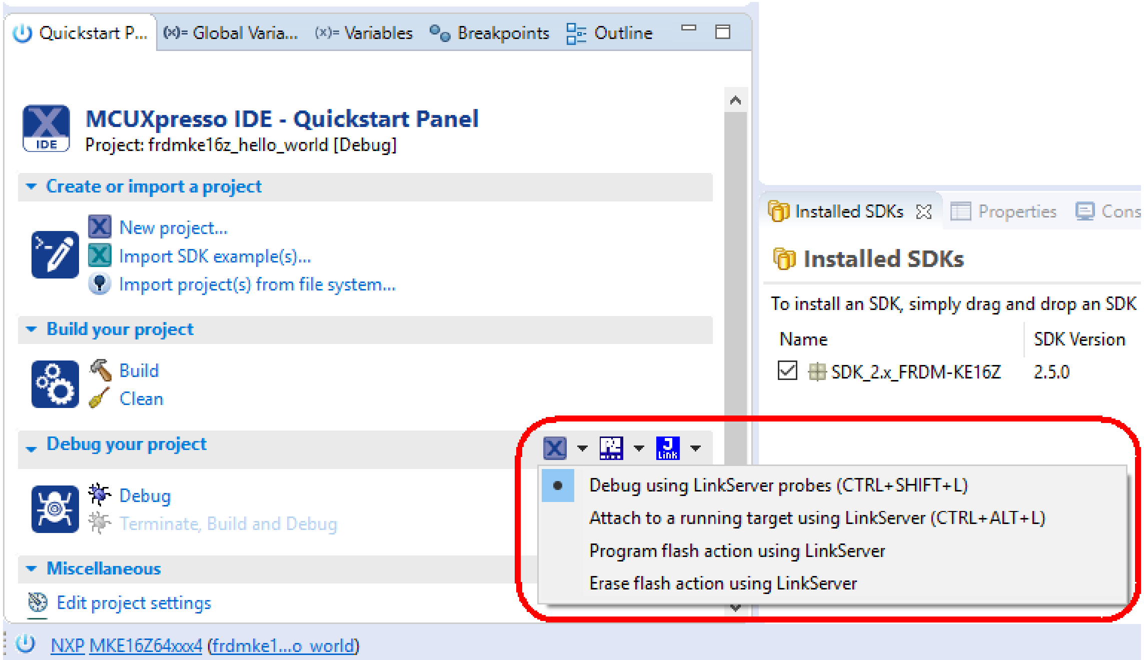
   1. 115200 or 9600 baud rate, depending on your board (reference BOARD_DEBUG_UART_BAUDRATE variable in board.h file)
   2. No parity
   3. 8 data bits



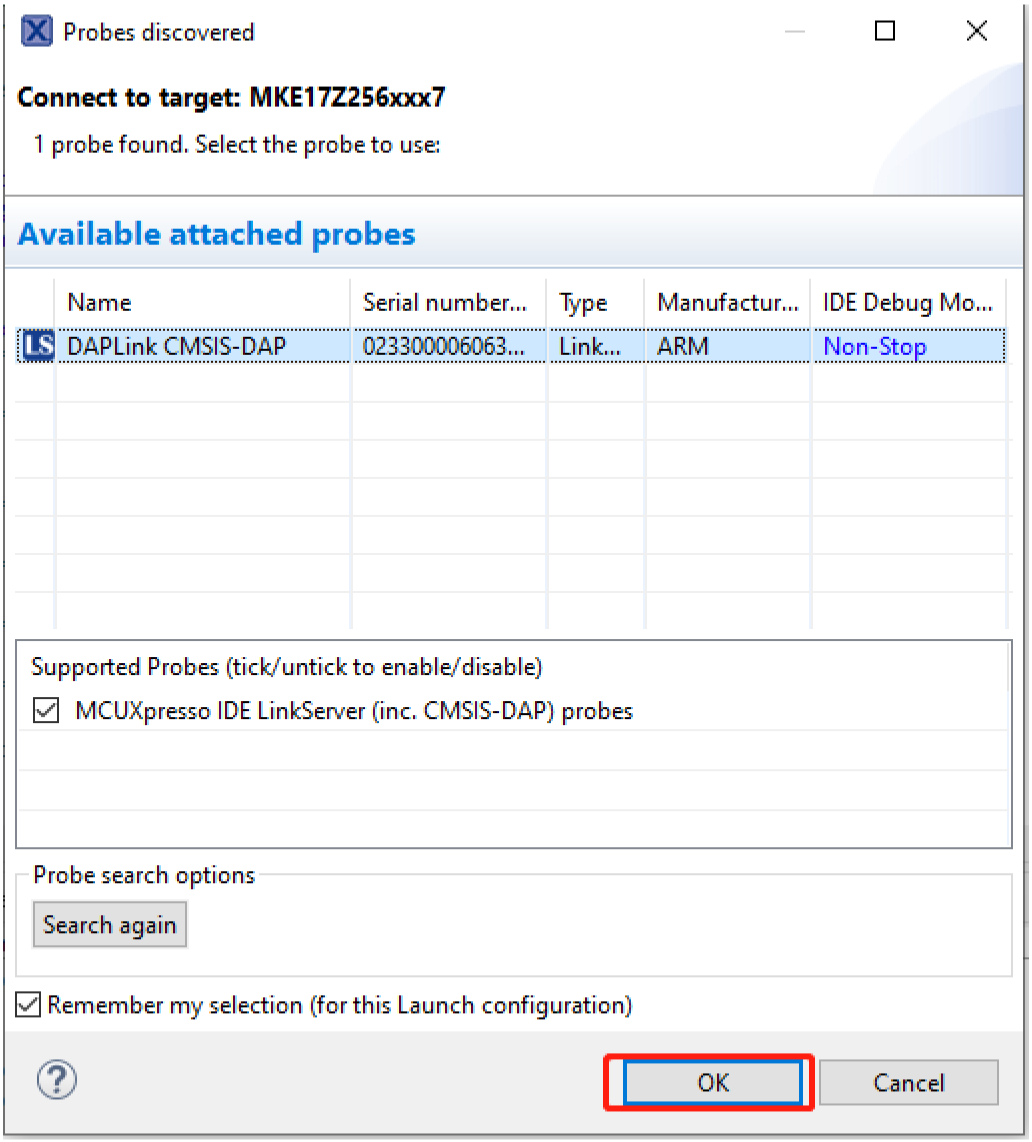
   4. 1 stop bit |

|

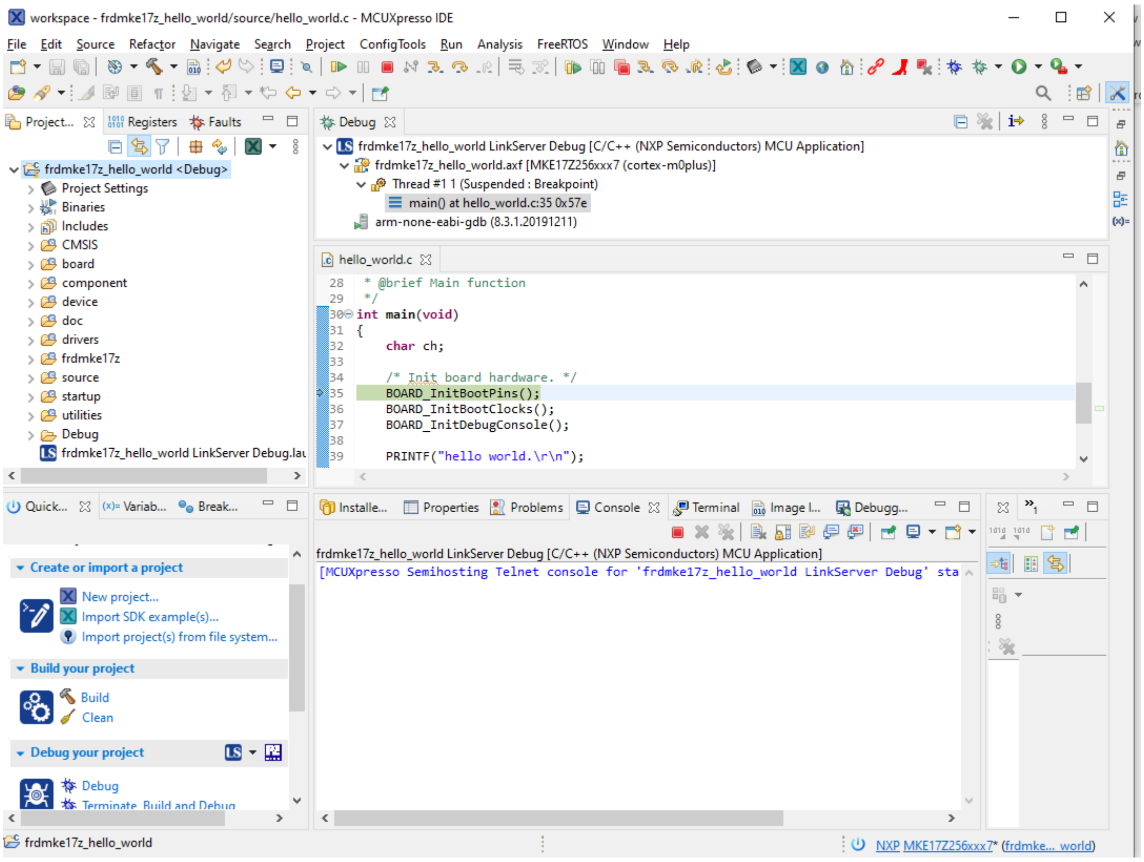
4. On the **Quickstart Panel**, click on **Debug** frdmke17z_demo_apps_hello_world [Debug] to launch the debug session.



5. The first time you debug a project, the **Debug Emulator Selection** dialog is displayed, showing all supported probes that are attached to your computer. Select the probe through which you want to debug and click **OK**. (For any future debug sessions, the stored probe selection is automatically used, unless the probe cannot be found.)

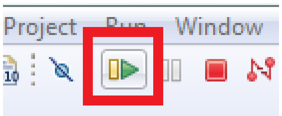


6. The application is downloaded to the target and automatically runs to main().



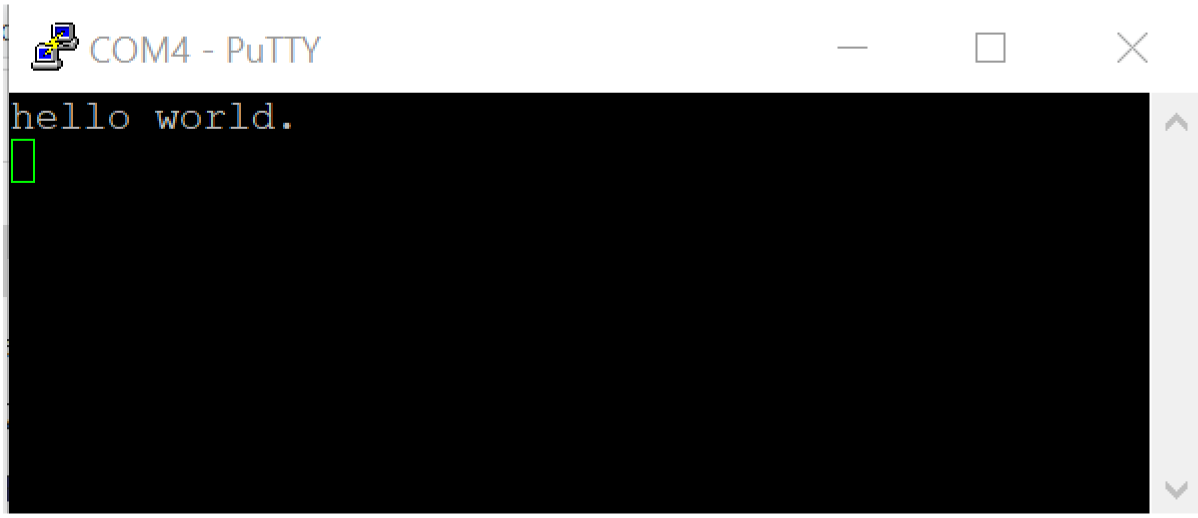
|

7. Start the application by clicking **Resume**.



|

The hello_world application is now running and a banner is displayed on the terminal. If this is not the case, check your terminal settings and connections.



|

Parent topic:*Run a demo using MCUXpresso IDE*

Run a demo application using IAR

This section describes the steps required to build, run, and debug example applications provided in the MCUXpresso SDK.

Note: IAR Embedded Workbench for Arm version 9.10.2 is used in the following example, and the IAR toolchain should correspond to the latest supported version, as described in the *MCUXpresso SDK Release Notes*.

Build an example application Perform the following steps to build the hello_world example application.

1. 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
   ```

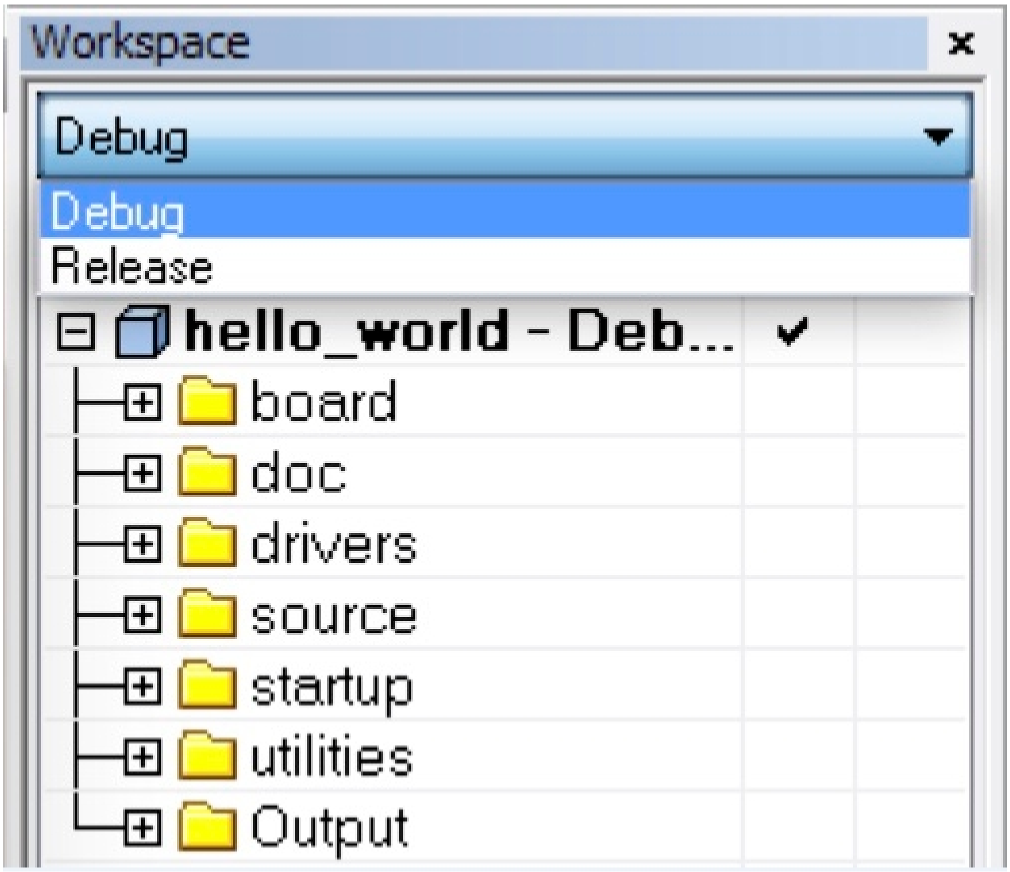
   Using the FRDM-KE17Z Freedom hardware platform as an example, the hello_world workspace is located in:

   ```
   <install_dir>/boards/frdmke17z/demo_apps/hello_world/iar/hello_world.eww
   ```

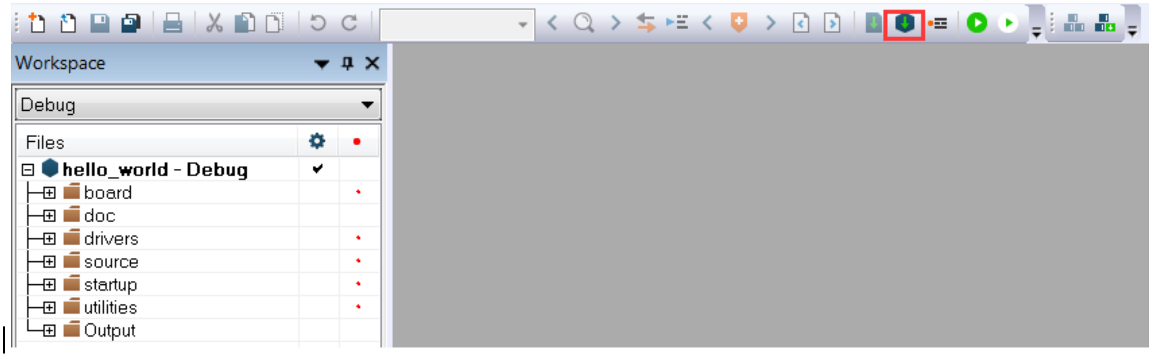
   Other example applications may have additional folders in their path.

2. Select the desired build target from the drop-down menu.

   For this example, select **hello_world – debug**.



3. To build the demo application, click **Make**, highlighted in red in Figure 2.



|

4. The build completes without errors.

Parent topic: *Run a demo application using IAR*

Run an example application To download and run the application, perform these steps:

1. See *Table 1* to determine the debug interface that comes loaded on your specific hardware platform.

   - For boards with the CMSIS-DAP/mbed/DAPLink interface, visit Windows serial configuration and follow the instructions to install the Windows operating system serial driver. If running on Linux OS, this step is not required.

   - For boards with a P&E Micro interface, visit PE micro and download and install the P&E Micro Hardware Interface Drivers package.

   - If using J-Link either a standalone debug pod or OpenSDA, install the J-Link software (drivers and utilities) from Segger.

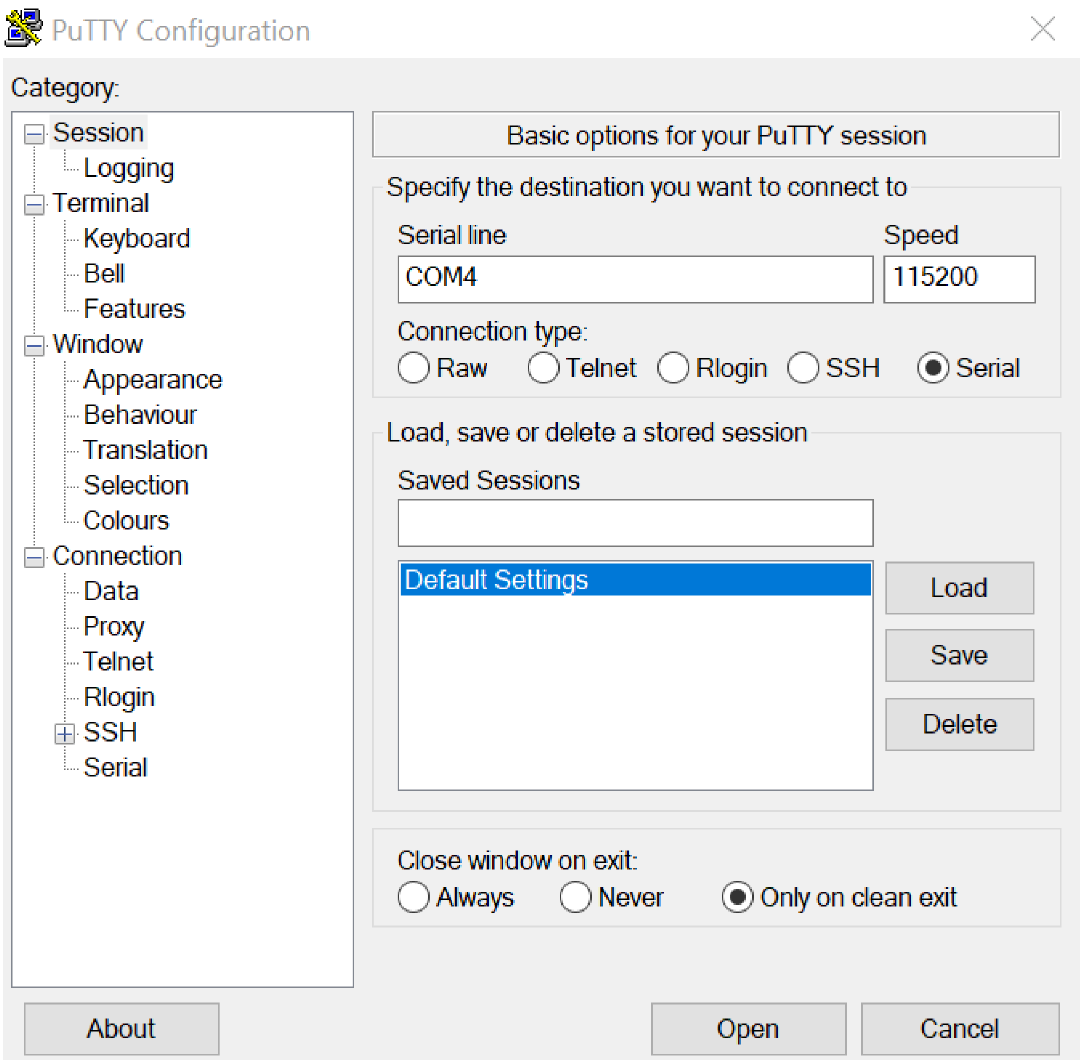
2. Connect the development platform to your PC via USB cable.

3. 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 or 9600 baud rate, depending on your board (reference BOARD_DEBUG_UART_BAUDRATE variable in the board.h file)

   2. No parity

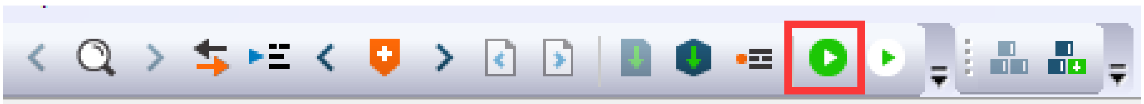
   3. 8 data bits



4. 1 stop bit |

|

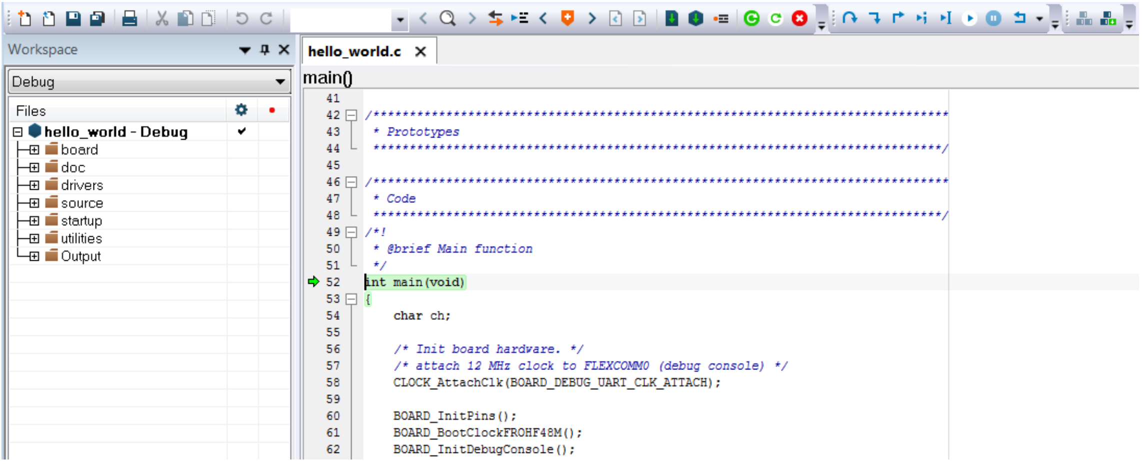
4. In IAR, click the **Download and Debug** button to download the application to the target.



|

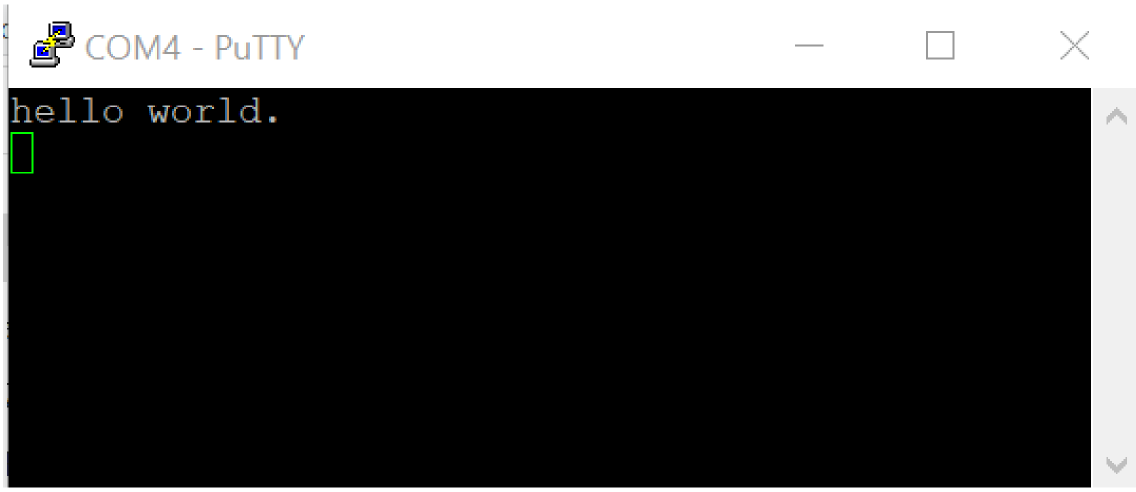
|

5. The application is then downloaded to the target and automatically runs to the main() function.



6. Run the code by clicking the **Go** button.

7. The hello_world application is now running and a banner is displayed on the terminal. If it does not appear, check your terminal settings and connections.



Parent topic:[*Run a demo application using IAR*]

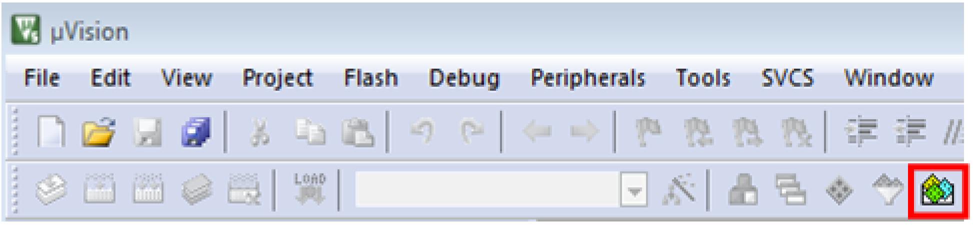
Run a demo using Keil® MDK/μVision

This section describes the steps required to build, run, and debug example applications provided in the MCUXpresso SDK.

The hello_world demo application targeted for the FRDM-KE17Z Freedom hardware platform is used as an example, although these steps can be applied to any demo or example application in the MCUXpresso SDK.

Install CMSIS device pack After the MDK tools are installed, Cortex® Microcontroller Software Interface Standard (CMSIS) device packs must be installed to fully support the device from a debug perspective. These packs include things such as memory map information, register definitions, and flash programming algorithms. Follow these steps to install the appropriate CMSIS pack.

1. Open the MDK IDE, which is called µVision. In the IDE, select the **Pack Installer** icon.



|

|

2. After the installation finishes, close the Pack Installer window and return to the µVision IDE.

Parent topic:[*Run a demo using Keil® MDK/µVision*]

Build an example application

1. Open the desired example application workspace in:

```
<install_dir>/boards/<board_name>/*<example\_type\>*/<application_name>/mdk
```

The workspace file is named as `<demo_name>.uvmpw`. For this specific example, the actual path is:

```
<install_dir>/boards/frdmke17z/demo_apps/hello_world/mdk/hello_world.uvmpw
```

2. To build the demo project, select **Rebuild**, as shown in Figure 1, highlighted in red.

|

|

3. The build completes without errors.

Parent topic:*Run a demo using Keil® MDK/µVision*

Run an example application

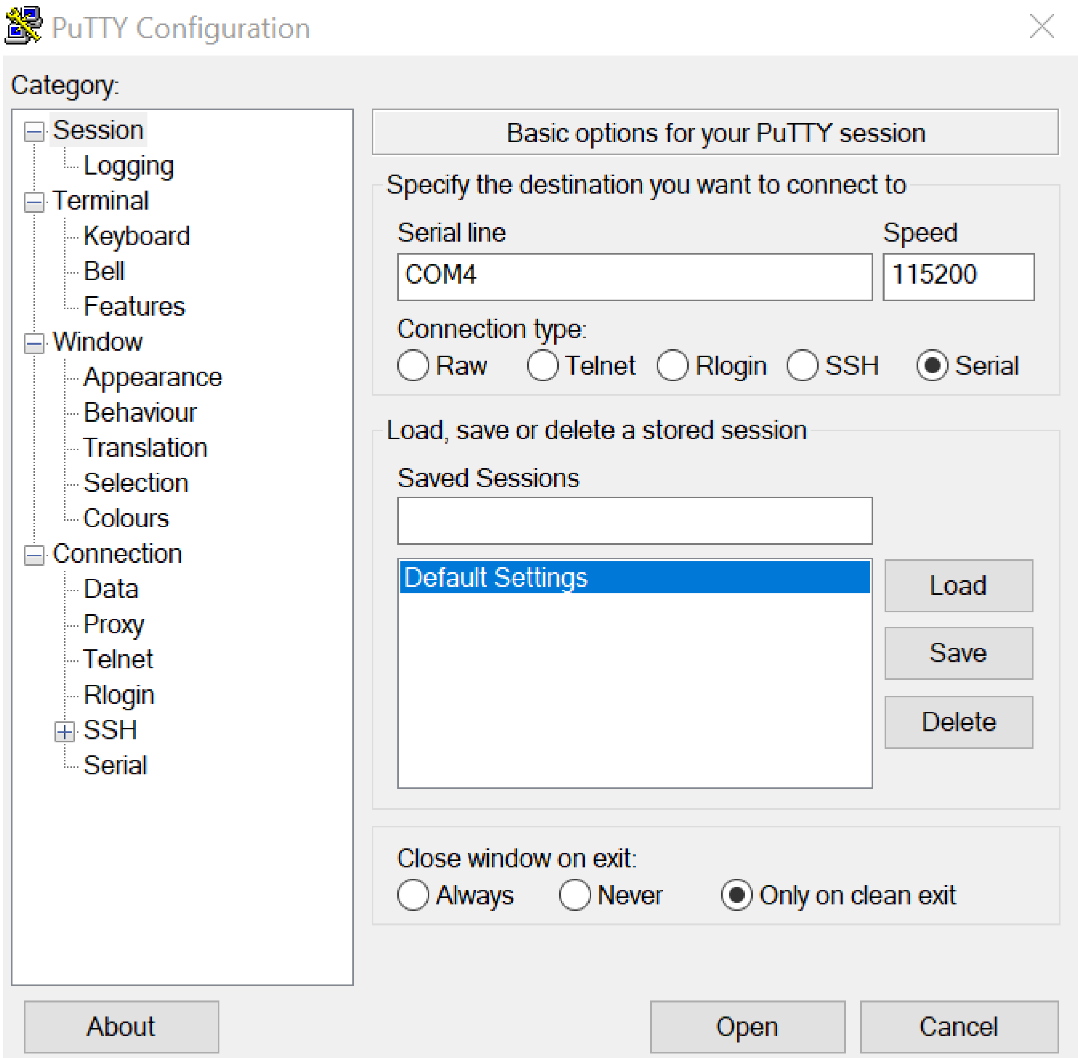
To download and run the application, perform these steps:

1. See *Table 1* to determine the debug interface that comes loaded on your specific hardware platform.

   - For boards with the CMSIS-DAP/mbed/DAPLink interface, visit Windows serial configuration and follow the instructions to install the Windows operating system serial driver. If running on Linux OS, this step is not required.
   - For boards with a P&E Micro interface, visit PE micro and download and install the P&E Micro Hardware Interface Drivers package.
   - If using J-Link either a standalone debug pod or OpenSDA, install the J-Link software (drivers and utilities) from Segger.

2. Connect the development platform to your PC via USB cable using OpenSDA USB connector.
3. Open the terminal application on the PC, such as PuTTY or TeraTerm and connect to the debug serial port number (to determine the COM port number, see *How to determine COM port*). Configure the terminal with these settings:

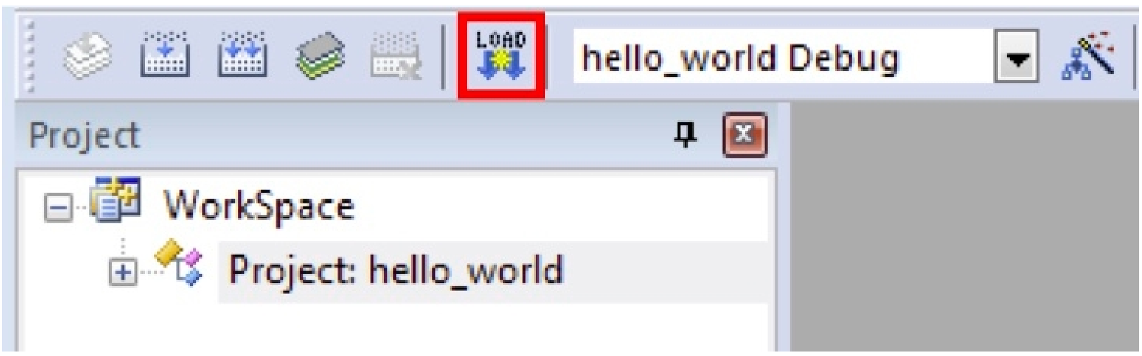
1. 115200 or 9600 baud rate, depending on your board (reference BOARD_DEBUG_UART_BAUDRATE variable in the board.h file)
2. No parity
3. 8 data bits



4. 1 stop bit |

|

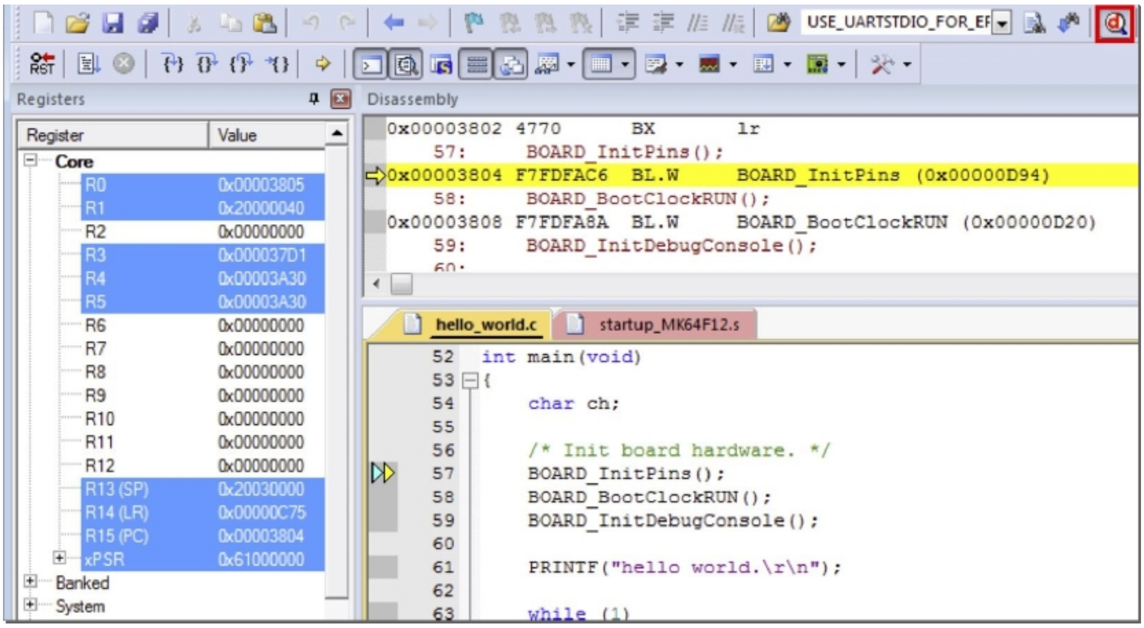
4. In µVision, after the application is built, click the **Download** button to download the application to the target.



|

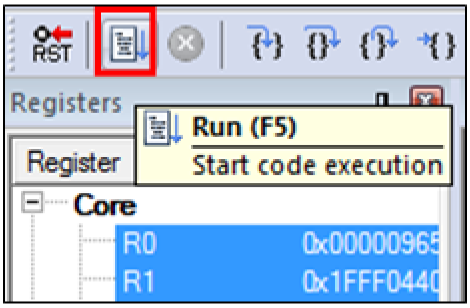
|

5. After clicking the **Download** button, the application downloads to the target and is running. To debug the application, click the **Start/Stop Debug Session** button, highlighted in red.



|

6. Run the code by clicking the **Run** button to start the application.



|

```
The `hello_world` application is now running and a banner is displayed on the terminal. If this does not
↪appear, check your terminal settings and connections.

|![](../images/text_display_hello_world.png "Text display of the hello_world demo")
```

|

Parent topic:*Run a demo using Keil® MDK/µVision*

Run a demo using ARMGCC / VSCODE

This section describes the steps to run an example application from the SDK archive using the ARMGCC / VSCODE toolchain.

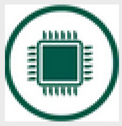
Refer to the *running a demo using MCUXpresso VSC* section for detailed instructions on setting up and configuring your project in Visual Studio Code.

Refer to the *CLI* section for detailed instructions on building and running your project from the command line.

MCUXpresso Config Tools

MCUXpresso Config Tools can help configure the processor and generate initialization code for the on chip peripherals. The tools are able to modify any existing example project, or create a new configuration for the selected board or processor. The generated code is designed to be used with MCUXpresso SDK version 2.x.

Table 1 describes the tools included in the MCUXpresso Config Tools.

Config Tool	Description	Image
Pins tool	For configurations of pin routing and pin electrical properties	
Clock tool	For system clock configurations	
Peripherals tools	For configurations of other peripherals	

MCUXpresso Config Tools can be accessed in the following products:

- **Integrated** in the MCUXpresso IDE. Config tools are integrated with both compiler and debugger which makes it the easiest way to begin the development.
- **Standalone version** available for download from MCUXpresso Software and Tools. Recommended for customers using IAR Embedded Workbench, Keil MDK µVision, or Arm GCC.
- **Online version** available on MCUXpresso SDK Builder. Recommended to do a quick evaluation of the processor or use the tool without installation.

Each version of the product contains a specific *Quick Start Guide* document in the MCUXpresso IDE Config Tools installation folder. It can help start your work.

MCUXpresso IDE New Project Wizard

MCUXpresso IDE features a new project wizard. The wizard provides functionality for the user to create new projects from the installed SDKs (and from pre-installed part support). It offers user the flexibility to select and change multiple builds. The wizard also includes a library and provides source code options. The source code is organized as software components, categorized as drivers, utilities, and middleware.

To use the wizard, start the MCUXpresso IDE. This is located in the **QuickStart Panel** at the bottom left of the MCUXpresso IDE window. Select **New project**, as shown in *Figure 1*.

|

|

For more details and usage of new project wizard, see the *MCUXpresso_IDE_User_Guide.pdf* in the MCUXpresso IDE installation folder.

How to determine COM port

This section describes the steps necessary to determine the debug COM port number of your NXP hardware development platform.

1. **Linux**: The serial port can be determined by running the following command after the USB Serial is connected to the host:

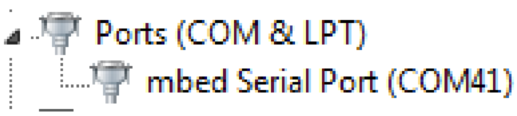
   ```
   $ dmesg | grep "ttyUSB"
                   [503175.307873] usb 3-12: cp210x converter now attached to ttyUSB0
                   [503175.309372] usb 3-12: cp210x converter now attached to ttyUSB1
   ```

   There are two ports: one is Cortex-A core debug console and the other is for Cortex M4.

2. **Windows**: To determine the COM port open Device Manager in the Windows operating system. Click on the **Start** menu and type **Device Manager** in the search bar.

3. In the Device Manager, expand the **Ports (COM & LPT)** section to view the available ports. The COM port names will be different for all the NXP boards.

   1. **OpenSDA – CMSIS-DAP/mbed/DAPLink** interface:

      |

|

```
2.  **OpenSDA – P&E Micro**:

    |![](../images/opensda_pe_micro.png "OpenSDA – P&E Micro")
```

|

```
3. **OpenSDA – J-Link**:

   |![](../images/opensda_jlink.png "OpenSDA – J-Link")
```

|

```
4. **P&E Micro OSJTAG**:

   |![](../images/pe_micro_osjtag.png "P&E Micro OSJTAG")
```

|

```
5. **MRB-KW01**:

   |![](../images/mrb_kw01.png "MRB-KW01")
```

|

Default debug interfaces

The MCUXpresso SDK supports various hardware platforms that come loaded with a variety of factory programmed debug interface configurations. *Table 1* lists the hardware platforms supported by the MCUXpresso SDK, their default debug interface, and any version information that helps differentiate a specific interface configuration.

Note: The *OpenSDA details* column is not applicable to LPC.

Hardware platform	Default interface	OpenSDA details
FRDM-KE17Z	CMSIS-DAP/mbed/DAPLink	OpenSDA v2.2

1.3 Getting Started with MCUXpresso SDK GitHub

1.3.1 Getting Started with MCUXpresso SDK Repository

Welcome to the **GitHub Repository SDK Guide**. This documentation provides instructions for setting up and working with the MCUXpresso SDK distributed in a **multi-repository model**. The SDK is distributed across multiple GitHub repositories and managed using the **Zephyr West** tool, enabling modular development and streamlined workflows.

Overview

The GitHub Repository SDK approach offers:

- **Modular Structure**: Multiple repositories for flexibility and scalability.
- **Zephyr West Integration**: Simplified repository management and synchronization.
- **Cross-Platform Support**: Designed for MCUXpresso SDK development environments.

Benefits of the Multi-Repository Approach

- **Scalability**: Easily add or update components without impacting the entire SDK.
- **Collaboration**: Enables distributed development across teams and repositories.

- **Version Control**: Independent versioning for components ensures better stability.
- **Automation**: Zephyr West simplifies dependency handling and repository synchronization.

Setup and Configuration

Follow these steps to prepare your development environment:

Development Tools Installation This guide explains how to install the essential tools for development with the MCUXpresso SDK.

Quick Start: Automated Installation (Recommended) The **MCUXpresso Installer** is the fastest way to get started. It automatically installs all the basic tools you need.

1. **Download the MCUXpresso Installer** from: Dependency-Installation
2. **Run the installer** and select **"MCUXpresso SDK Developer"** from the menu
3. **Click Install** and let it handle everything automatically

Manual Installation If you prefer to install tools manually or need specific versions, follow these steps:

Essential Tools

Git - Version Control **What it does**: Manages code versions and downloads SDK repositories from GitHub.

Installation:

- Visit git-scm.com
- Download for your operating system
- Run installer with default settings
- **Important**: Make sure "Add Git to PATH" is selected during installation

Setup:

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

Python - Scripting Environment **What it does**: Runs build scripts and SDK tools.

Installation:

- Install Python **3.10 or newer** from python.org
- **Important**: Check "Add Python to PATH" during installation

West - SDK Management Tool **What it does**: Manages SDK repositories and provides build commands. The west tool is developed by the Zephyr project for managing multiple repositories.

Installation:

```
pip install -U west
```

Minimum version: 1.2.0 or newer

Build System Tools

CMake - Build Configuration **What it does**: Configures how your projects are built.

Recommended version: 3.30.0 or newer

Installation:

- **Windows**: Download `.msi` installer from cmake.org/download
- **Linux**: Use package manager or download from cmake.org
- **macOS**: Use Homebrew (`brew install cmake`) or download from cmake.org

Ninja - Fast Build System **What it does**: Compiles your code quickly.

Minimum version: 1.12.1 or newer

Installation:

- **Windows**: Usually included, or download from ninja-build.org
- **Linux**: `sudo apt install ninja-build` or download binary
- **macOS**: `brew install ninja` or download binary

Ruby - IDE Project Generation (Optional) **What it does**: Generates project files for IDEs like IAR and Keil.

When needed: Only if you want to use traditional IDEs instead of VS Code.

Installation: Follow the Ruby environment setup guide

Compiler Toolchains Choose and install the compiler toolchain you want to use:

Toolchain	Best For	Download Link	Environment Variable
ARM GCC (Recommended)	Most users, free	ARM GNU Toolchain	ARMGCC_DIR
IAR EWARM	Professional development	IAR Systems	IAR_DIR
Keil MDK	ARM ecosystem	ARM Developer	MDK_DIR
ARM Compiler	Advanced optimization	ARM Developer	ARMCLANG_DIR

Setting Up Environment Variables After toolchain installation, set an environment variable so the build system locates it:

Windows:

```
# Example for ARM GCC installed in C:\armgcc
setx ARMGCC_DIR "C:\armgcc"
```

Linux/macOS:

```
# Add to ~/.bashrc or ~/.zshrc
export ARMGCC_DIR="/usr"  # or your installation path
```

Verify Your Installation After installation, verify everything works by opening a terminal/command prompt and running these commands:

```
# Check each tool - you should see version numbers
git --version
python --version
west --version
cmake --version
ninja --version
arm-none-eabi-gcc --version  # (if using ARM GCC)
```

Troubleshooting Installation Issues **"Command not found" errors**:

- The tool isn't in your system PATH
- **Solution**: Add the installation directory to your PATH environment variable

Python/pip issues:

- Try using `python3` and `pip3` instead of `python` and `pip`
- On Windows, run the Command Prompt as an Administrator

Slow downloads:

- Add timeout option: `pip install -U west --default-timeout=1000`
- Use alternative mirror: `pip install -U west -i https://pypi.tuna.tsinghua.edu.cn/simple`

GitHub Repository Setup This guide explains how to initialize your MCUXpresso SDK workspace from GitHub repositories using the west tool. The GitHub Repository SDK uses multiple repositories hosted on GitHub to provide modular, flexible development.

Prerequisites Verify the requirements:

System Requirements:

- Python 3.8 or later
- Git 2.25 or later
- CMake 3.20 or later
- Build tools for your target platform

Verification Commands:

```
python --version    # Should show 3.8+
git --version       # Should show 2.25+
cmake --version     # Should show 3.20+
west --version      # Should show west tool installation
```

Workspace Initialization The GitHub Repository SDK uses the Zephyr west tool to manage multiple repositories containing different SDK components.

Step 1: Initialize Workspace Create and initialize your SDK workspace from GitHub:

Get the latest SDK from main branch:

```
west init -m https://github.com/nxp-mcuxpresso/mcuxsdk-manifests.git mcuxpresso-sdk
```

Get SDK at specific revision:

```
west init -m https://github.com/nxp-mcuxpresso/mcuxsdk-manifests.git mcuxpresso-sdk --mr {revision}
```

Note: Replace `{revision}` *with the desired release tag, such as* `v25.09.00`

Step 2: Choose Your Repository Update Strategy Navigate to the SDK workspace:

```
cd mcuxpresso-sdk
```

The west tool manages multiple GitHub repositories containing different SDK components. You have two options for downloading:

Option A: Download All Repositories (Complete SDK) Download all SDK repositories for comprehensive development:

```
west update
```

This command downloads all the repositories defined in the manifest from GitHub. Initial download takes several minutes and requires ~7 GB of disk space.

Best for:

- Exploring the complete SDK
- Multi-board development projects
- Comprehensive middleware evaluation

Option B: Targeted Repository Download (Recommended) Download only repositories needed for your specific board or device to save time and disk space:

```
# For specific board development
west update_board --set board your_board_name

# For specific device family development
west update_board --set device your_device_name

# List available repositories before downloading
west update_board --set board your_board_name --list-repo
```

Best for:

- Single board development

- Faster setup and reduced disk usage
- Focused development workflows

Examples:

```
# Update only repositories for FRDM-MCXW23 board
west update_board --set board frdmmcxw23

# Update only repositories for MCXW23 device family
west update_board --set device mcxw23
```

Step 3: Verify Installation Confirm successful setup:

```
# Verify workspace structure
ls -la
# Should show: manifests/ and mcuxsdk/ directories

# Test build system
west list_project -p examples/demo_apps/hello_world
# Should display available build configurations
```

Advanced Repository Management The west extension command `update_board` provides advanced repository management capabilities for optimized workspace setup with GitHub repositories.

Board-Specific Setup Update only repositories required for a specific board:

```
# Update only repositories for specific board, e.g., frdmmcxw23
west update_board --set board frdmmcxw23

# List available repositories for the board before updating
west update_board --set board frdmmcxw23 --list-repo
```

Device-Specific Setup Update only repositories required for a specific device family:

```
# Update only repositories for specific device, e.g., MCXW235
west update_board --set device mcxw23

# List available repositories for the device family
west update_board --set device mcxw23 --list-repo
```

Custom Configuration For advanced users who want to create custom repository combinations:

```
# Use custom configuration file
west update_board --set custom path/to/custom-config.yml

# Generate custom configuration template
cp manifests/boards/custom.yml.template my-custom-config.yml
```

Benefits of Targeted Setup **Reduced Download Size**

- Download only components needed for your target board or device
- Significantly faster initial setup for focused development

- Typical reduction from 7 GB to 2GB

Optimized Workspace

- Cleaner workspace with relevant components only
- Reduced disk space usage
- Faster repository operations

Flexible Development

- Switch between different board configurations easily
- Maintain separate workspaces for different projects
- Include optional components as needed

Repository Information Before setting up your workspace, you can explore what repositories are available:

```
# Display repository information in console
west update_board --set board frdmmcxw23 --list-repo

# Export repository information to YAML file for reference
west update_board --set board frdmmcxw23 --list-repo -o board-repos.yml
```

This command lists all the available repositories with descriptions and outlines the included components in the workspace.

Package Generation (Optional) The `update_board` command can also generate ZIP packages for offline distribution:

```
# Generate board-specific SDK package
west update_board --set board frdmmcxw23 -o frdmmcxw23-sdk.zip
```

Note: Package generation is primarily intended for creating custom SDK distributions. For regular development, use the workspace update commands without the `-o` option.

Workspace Management

Updating Your Workspace Keep your SDK current with latest updates from GitHub:

For Complete SDK Workspace:

```
# Update manifest repository
cd manifests
git pull

# Update all component repositories
cd ..
west update
```

For Targeted Workspace:

```
# Update manifest repository
cd manifests
git pull

# Update board-specific repositories
cd ..
west update_board --set board your_board_name
```

Workspace Status Check workspace synchronization status:

```
# Show status of all repositories
west status

# Show detailed information about repositories
west list
```

Troubleshooting **Network Issues:**

- Use `west update --keep-descendants` for partial failures
- Configure Git credentials for private repositories
- Check firewall settings for Git protocol access

Permission Issues:

- Ensure write permissions in workspace directory
- Run commands without sudo/administrator privileges
- Verify Git SSH key configuration for authenticated access

Disk Space:

- Full SDK workspace requires approximately 7-8 GB
- Targeted workspace typically requires 1-2 GB
- Use board-specific setup to reduce workspace size

Repository Management Issues:

- Verify board/device names match available configurations
- Check that custom YAML files follow the correct template format
- Use `--list-repo` to verify available repositories before setup

Next Steps With your workspace initialized:

1. Review *Workspace Structure* to understand the layout
2. Build your first project with *First Build Guide*
3. Explore *Development Workflows MCUXPresso VSCode* or *Development Workflows Command Line* for the details on project setup and execution

For advanced repository management, see the west tool documentation.

Explore SDK Structure and Content

Learn about the organization of the SDK and its components:

SDK Architecture Overview The MCUXpresso SDK uses a modular architecture where software components are distributed across multiple repositories hosted on GitHub and managed through the west tool. This approach provides flexibility, maintainability, and enables selective component inclusion.

Repository Organization Based on the manifest structure, the SDK consists of four main repository categories:

Manifest Repository The manifest repo (mcuxsdk-manifests) contains the west.yml manifest file that tracks all other repositories in the SDK.

Base Repositories Recorded in submanifests/base.yml and loaded in the root west.yml manifest file. These are the foundational repositories that build the SDK:

- **Devices**: MCU-specific support packages
- **Examples**: Demonstration applications and code samples
- **Boards**: Board support packages

Middleware Repositories Recorded in the submanifests/middleware subdirectory, categorized according to functionality:

- **Connectivity**: Networking stacks, USB, and communication protocols
- **Security**: Cryptographic libraries and secure boot components
- **Wireless**: Bluetooth, IEEE 802.15.4, and other wireless protocols
- **Graphics**: Display drivers and UI frameworks
- **Audio**: Audio processing and voice recognition libraries
- **Machine Learning**: AI inference engines and neural network libraries
- **Safety**: IEC60730B safety libraries
- **Motor Control**: Motor control and real-time control libraries

Internal Repositories Recorded in submanifests/internal.yml and grouped into the "bifrost" group. These are only visible to NXP internal developers and hosted on NXP internal git servers.

Repository Hosting Public repositories are hosted on GitHub under these organizations:

- nxp-mcuxpresso
- NXP
- nxp-zephyr

Internal repositories are hosted on NXP's private Git infrastructure.

Benefits of This Architecture **Selective Integration**: Projects include only required components, reducing memory footprint and build complexity.

Independent Versioning: Each component maintains its own release cycle and version control.

Community Collaboration: Public repositories accept community contributions through standard Git workflows.

Scalable Maintenance: Component owners can update their repositories without affecting the entire SDK.

Workspace Management The west tool manages repository synchronization, version tracking, and workspace updates. All repositories are checked out under the mcuxsdk/ directory with their designated paths defined in the manifest files.

Workspace Structure After you initialize your SDK workspace, it creates a specific directory structure that organizes all SDK components. This structure is identical for both GitHub Repository SDK and Repository-Layout SDK Package.

Top-Level Organization

```
your-sdk-workspace/
   manifests/          # West manifest repository
   mcuxsdk/            # Main SDK content
```

The `mcuxsdk/` directory serves as your primary working directory and contains all the SDK components.

SDK Component Layout Based on the actual SDK structure, the main directories include:

Directory	Contents	Purpose
arch/	Architecture-specific files	ARM CMSIS, build configurations
cmake	Build system modules	CMake configuration and build rules
compo	Software components	Reusable software libraries and utilities
device	Device support packages	MCU-specific headers, startup code, linker scripts
drivers	Peripheral drivers	Hardware abstraction layer for MCU peripherals
examp	Sample applications	Demonstration code and reference implementations
middle	Optional software stacks	Networking, graphics, security, and other libraries
rtos/	Operating system support	FreeRTOS integration
scripts	Build and utility scripts	West extensions and development tools
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.	

Example Organization Examples follow a two-tier structure separating common code from board-specific implementations:

Common Example Files

```
examples/demo_apps/hello_world/
   CMakeLists.txt          # Build configuration
   example.yml             # Example metadata
   hello_world.c           # Application source code
   Kconfig                 # Configuration options
   readme.md               # General documentation
```

Board-Specific Files

```
examples/_boards/your_board/demo_apps/hello_world/
    app.h                       # Board specific application header
    example_board_readme.md     # Board specific documentation
    hardware_init.c             # Board specific hardware initialization
    pin_mux.c                   # Pin multiplexing configuration
    pin_mux.h                   # Pin multiplexing header definitions
    hello_world.bin             # Pre-built binary for quick testing
    hello_world.mex             # MCUXpresso Config Tools project file
    prj.conf                    # Board specific Kconfig configuration
    reconfig.cmake              # Board specific cmake configuration overrides
```

Device Support Structure Device support is organized hierarchically by MCU family:

```
devices/
    MCX/                    # MCU portfolio
        MCXW/               # MCU family
            MCXW235/        # Specific device
                MCXW235.h          # Device register definitions
                drivers/           # Device-specific drivers
                gcc/               # GNU toolchain files
                iar/               # IAR toolchain files
                mcuxpresso/        # MCUXpresso IDE files
                startup_MCXW235.c # Startup and vector table
                system_MCXW235.c  # System initialization
```

Middleware Organization Middleware components are categorized by functionality and maintained in separate repositories. Based on the manifest files, common middleware categories include:

- **Connectivity**: USB, TCP/IP, industrial protocols
- **Security**: Cryptographic libraries, secure boot
- **Wireless**: Bluetooth, IEEE 802.15.4, Wi-Fi
- **Graphics**: Display drivers, UI frameworks
- **Audio**: Processing libraries, voice recognition
- **Machine Learning**: Inference engines, neural networks
- **Safety**: IEC60730B safety libraries
- **Motor Control**: Motor control and real-time control libraries

Documentation Structure SDK documentation is distributed across multiple locations:

- `docs/` - Core SDK documentation and build infrastructure
- Component repositories - API documentation and integration guides
- Board directories - Hardware-specific setup instructions

For complete documentation, refer to the online documentation.

Understanding Example Structure Each example has **two README files**:

1. **General README:** examples/demo_apps/hello_world/readme.md
   - What the example does
   - General functionality description
   - Common usage information

2. **Board-Specific README:** examples/_boards/{board_name}/demo_apps/hello_world/example_board_readme.md
   - Board-specific setup instructions
   - Hardware connections required
   - Board-specific behavior notes

Tip: Always check both readme files - start with the general one, then read the board-specific one for detailed setup.

Development Workflows

Get started with building and running projects:

Building Your First Project This guide explains how to build and run your first SDK example project using the west build system. This applies to both GitHub Repository SDK and Repository-Layout SDK Package.

Prerequisites

- GitHub Repository SDK workspace initialized OR Repository-Layout SDK Package extracted
- Development board connected via USB
- Build tools installed per *Installation Guide*

Understanding Board Support Use the west extension to discover available examples for your board:

```
west list_project -p examples/demo_apps/hello_world
```

This shows all supported build configurations. You can filter by toolchain:

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

Basic Build Process

Simple Build Build the hello_world example with default settings:

```
west build -b your_board examples/demo_apps/hello_world
```

The default toolchain is armgcc, and the build system will select the first debug target as default if no config is specified.

Specifying Configuration

```
# Release build
west build -b your_board examples/demo_apps/hello_world --config release

# Debug build (default)
west build -b your_board examples/demo_apps/hello_world --config debug
```

Alternative Toolchains

```
# IAR toolchain
west build -b your_board examples/demo_apps/hello_world --toolchain iar

# Other toolchains as supported by the example
```

Multicore Applications For multicore devices, specify the core ID:

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

For multicore projects using sysbuild:

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

Flash an Application Flash the built application to your board:

```
west flash -r linkserver
```

Debug Start a debug session:

```
west debug -r linkserver
```

Common Build Options

Clean Build Force a complete rebuild:

```
west build -b your_board examples/demo_apps/hello_world -p always
```

Dry Run See the commands that get executed without running them:

```
west build -b your_board examples/demo_apps/hello_world --dry-run
```

Device Variants For boards supporting multiple device variants:

```
west build -b your_board examples/demo_apps/hello_world --device DEVICE_PART_NUMBER --config␣
↪release
```

Project Configuration

CMake Configuration Only Run configuration without building:

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

Interactive Configuration Launch the configuration GUI:

```
west build -t guiconfig
```

Troubleshooting

Build Failures Use pristine builds to resolve dependency issues:

```
west build -b your_board examples/demo_apps/hello_world -p always
```

Getting Help View the help information for west build:

```
west build -h
```

Check Supported Configurations To see available configuration options and board targets for an example, refer to the below command:

```
west list_project -p examples/demo_apps/hello_world
```

Next Steps

- Explore other examples in the SDK
- Learn about *Command Line Development* for advanced options
- Try *VS Code Development* for integrated development
- Refer *Workspace Structure* to understand the SDK layout

MCUXpresso for VS Code Development This guide covers using MCUXpresso for VS Code extension to build, debug, and develop SDK applications with an integrated development environment.

Prerequisites

- SDK workspace initialized (GitHub Repository SDK or Repository-Layout SDK Package)
- Development tools installed per *Installation Guide*
- Visual Studio Code installed
- MCUXpresso for VS Code extension installed

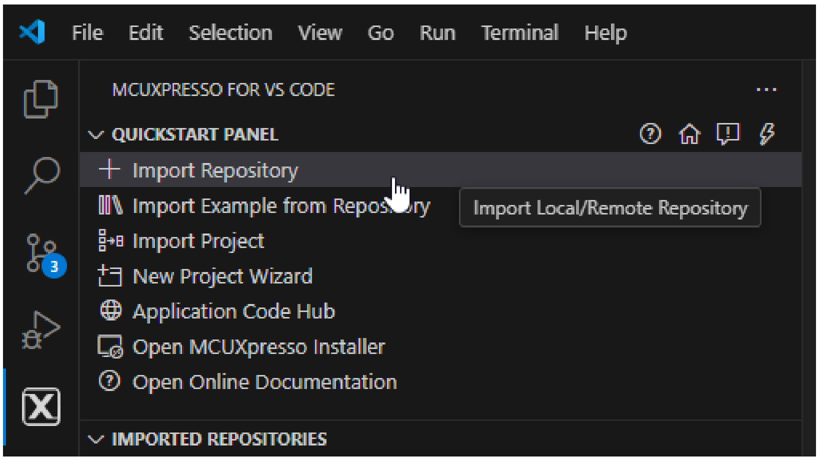
Extension Installation

Install MCUXpresso for VS Code The MCUXpresso for VS Code extension provides integrated development capabilities for MCUXpresso SDK projects. Refer to the MCUXpresso for VS Code Wiki for detailed installation and setup instructions.

SDK Import and Setup

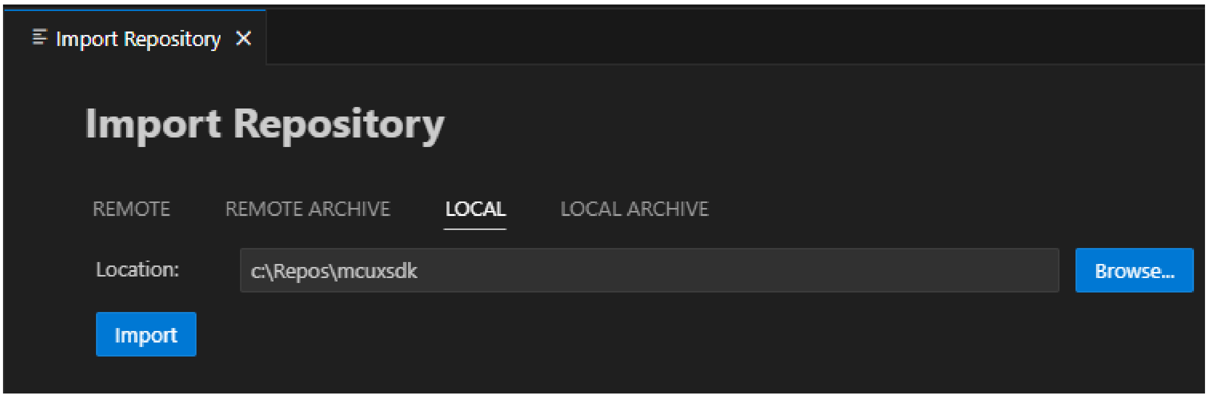
Import Methods The SDK can be imported in several ways. The MCUXpresso for VS Code extension supports both GitHub Repository SDK and Repository-Layout SDK Package distributions.

Import GitHub Repository SDK Click **Import Repository** from the **QUICKSTART PANEL**

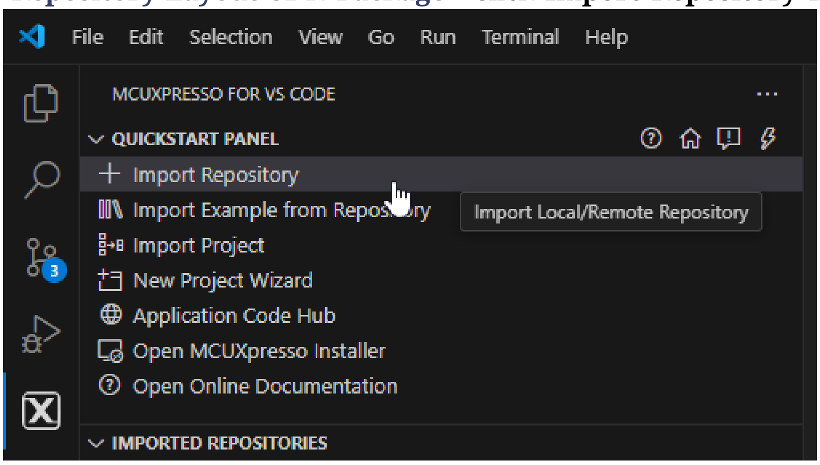


Note: You can import the SDK in several ways. Refer to MCUXpresso for VS Code Wiki for details.

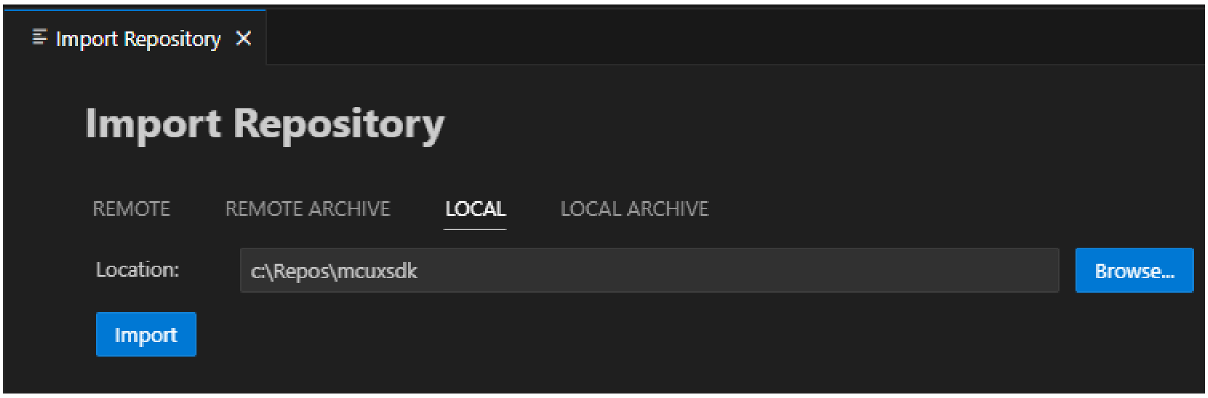
Select **Local** if you've already obtained the SDK according to *setting up the repo*. Select your location and click **Import**.



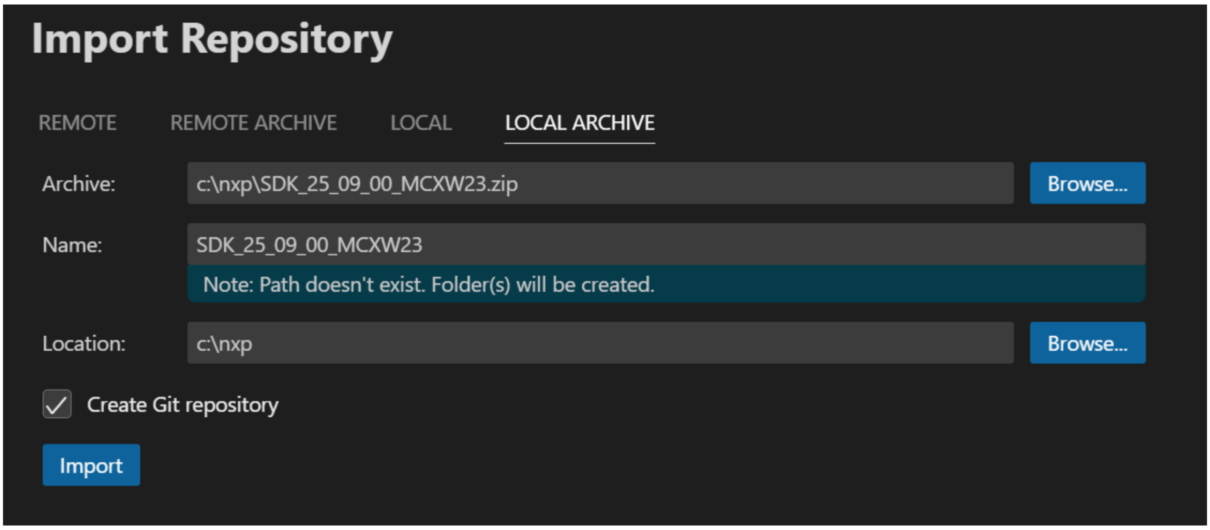
Import Repository-Layout SDK Package Click **Import Repository** from the **QUICKSTART PANEL**



Select **Local** if you've already unzipped the Repository-Layout SDK Package. Select your location and click **Import**.



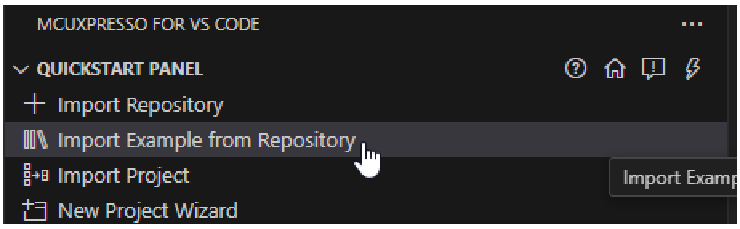
Else if the SDK is ZIP archive, select **Local Archive**, browse to the downloaded SDK ZIP file, fill the link of expect location, then click **Import**.



Building Example Applications

Import Example Project

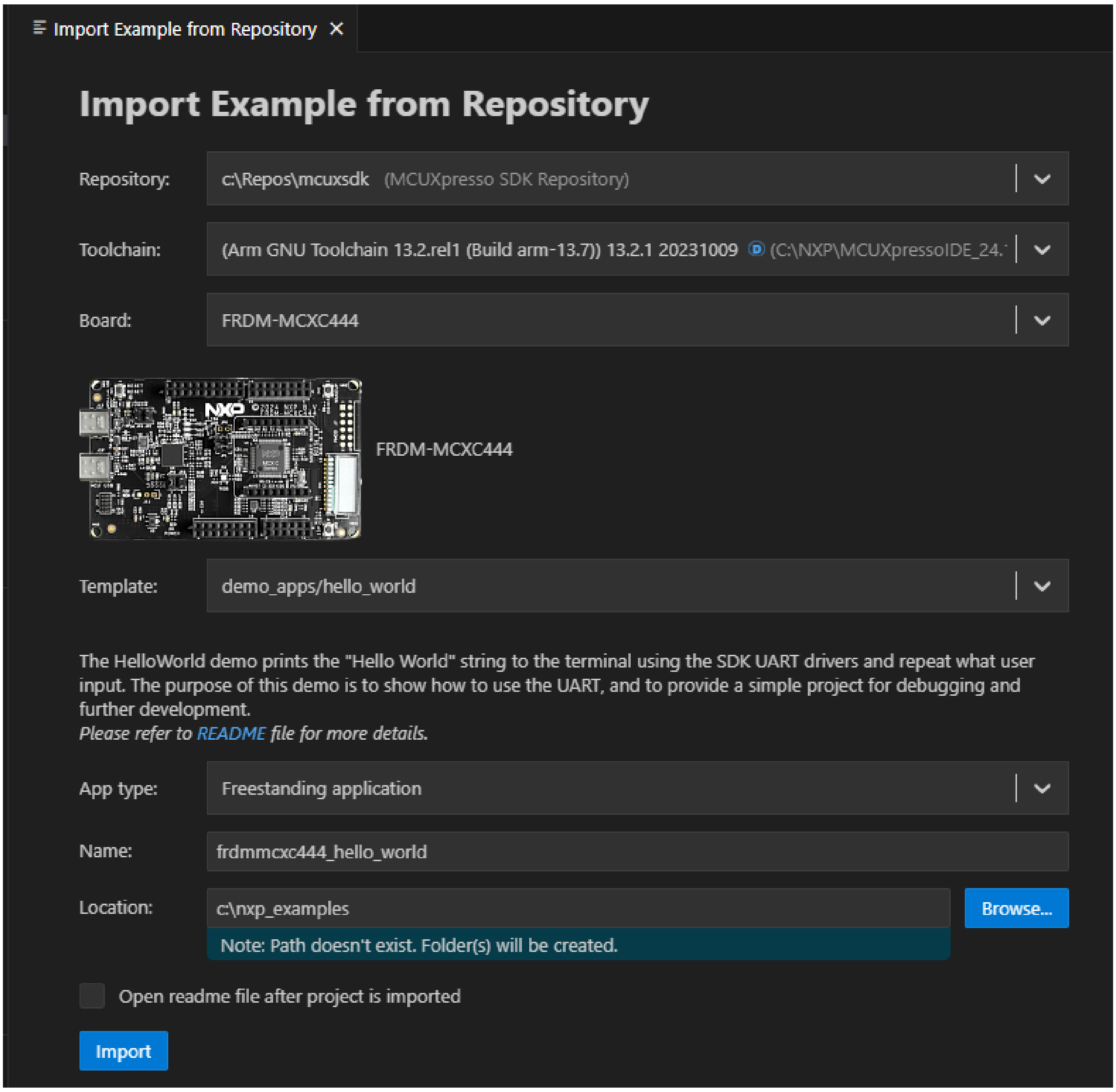
1. Click **Import Example from Repository** from the **QUICKSTART PANEL**



2. Configure project settings:
   - **MCUXpresso SDK**: Select your imported SDK
   - **Arm GNU Toolchain**: Choose toolchain
   - **Board**: Select your target development board
   - **Template**: Choose example category

- **Application**: Select specific example (e.g., hello_world)
- **App type**: Choose between Repository applications or Freestanding applications

3. Click **Import**



Application Types

Repository Applications:

- Located inside the MCUXpresso SDK
- Integrated with SDK workspace

Freestanding Applications:

- Imported to user-defined location
- Independent of SDK location

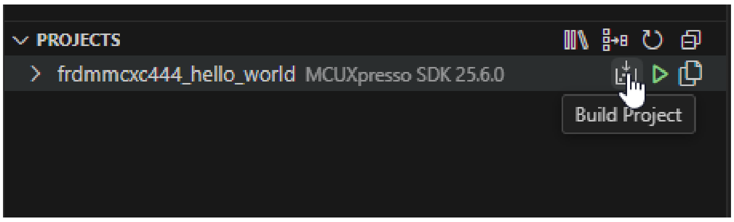
Trust Confirmation

VS Code will prompt you to confirm if the imported files are trusted. Click **Yes** to proceed.

Building Projects

Build Process

1. Navigate to **PROJECTS** view
2. Find your project
3. Click the **Build Project** icon

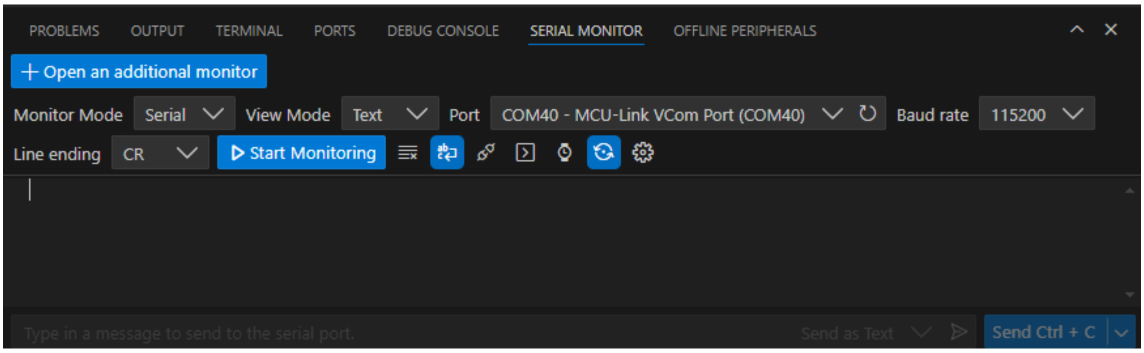


The integrated terminal will display build output at the bottom of the VS Code window.

Running and Debugging

Serial Monitor Setup

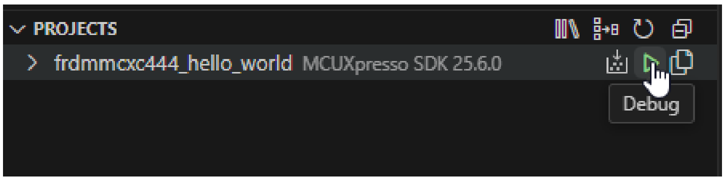
1. Open **Serial Monitor** from VS Code's integrated terminal



2. Configure serial settings:
   - **VCom Port**: Select port for your device
   - **Baud Rate**: Set to 115200

Debug Session

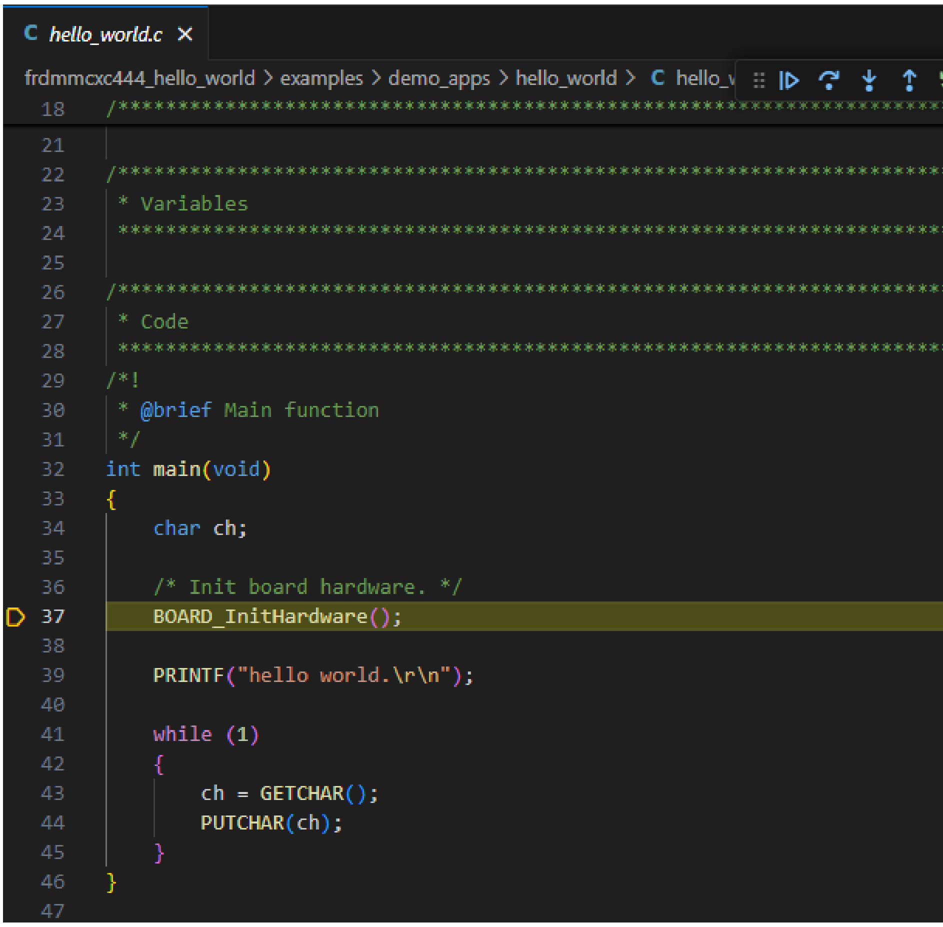
1. Navigate to **PROJECTS** view
2. Click the play button to initiate a debug session



The debug session will begin with debug controls initially at the top of the interface.

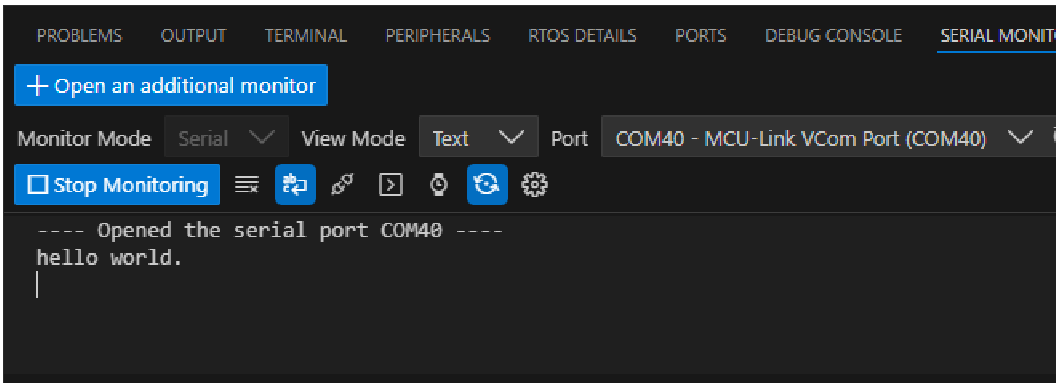
Debug Controls Use the debug controls to manage execution:

- **Continue**: Resume code execution
- **Step controls**: Navigate through code



- **Stop**: Terminate debug session

Monitor Output Observe application output in the **Serial Monitor** to verify correct operation.



Debug Probe Support For comprehensive information on debug probe support and configuration, refer to the MCUXpresso for VS Code Wiki DebugK section.

Project Configuration

Workspace Management The extension integrates with the MCUXpresso SDK workspace structure, providing access to:

- Example applications
- Board configurations

- Middleware components
- Build system integration

Multi-Project Support The PROJECTS view allows management of multiple imported projects within the same workspace.

Troubleshooting

Import Issues **SDK not detected:**

- Verify SDK workspace is properly initialized
- Ensure all required repositories are updated
- Check SDK manifest files are present

Project import failures:

- Confirm board support exists for selected example
- Verify toolchain installation
- Check example compatibility with selected board

Build Problems **Build failures:**

- Check integrated terminal for error messages
- Verify all dependencies are installed
- Ensure toolchain is properly configured

Debug Issues **Debug session fails:**

- Verify board connection via USB
- Check debug probe drivers are installed
- Confirm build completed successfully

Serial monitor problems:

- Verify correct VCom port selection
- Check baud rate configuration (115200)
- Ensure board drivers are installed

Integration with Command Line MCUXpresso for VS Code integrates with the underlying west build system, allowing seamless integration with command line workflows described in *Command Line Development*.

Advanced Features

Project Types The extension supports both repository-based and freestanding project types, providing flexibility in project organization and SDK integration.

Build System Integration The extension leverages the MCUXpresso SDK build system, providing access to all build configurations and options available through command line tools.

Next Steps

- Explore additional examples in the SDK
- Review *Command Line Development* for advanced build options
- Refer MCUXpresso for VS Code Wiki for detailed documentation
- Learn about *SDK Architecture* for better understanding of the development environment

Command Line Development This guide covers developing with the MCUXpresso SDK using command line tools and the west build system. This workflow applies to both GitHub Repository SDK and Repository-Layout SDK Package distributions.

Prerequisites

- GitHub Repository SDK workspace initialized OR Repository-Layout SDK Package extracted
- Development tools installed per *Installation Guide*
- Target board connected via USB

Understanding Board Support Use the west extension to discover available examples for your board:

```
west list_project -p examples/demo_apps/hello_world
```

This shows all supported build configurations. You can filter by toolchain:

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

Basic Build Commands

Standard Build Process Build with default settings (armgcc toolchain, first debug config):

```
west build -b your_board examples/demo_apps/hello_world
```

Specifying Build Configuration

```
# Release build
west build -b your_board examples/demo_apps/hello_world --config release

# Debug build with specific toolchain
west build -b your_board examples/demo_apps/hello_world --toolchain iar --config debug
```

Multicore Applications For multicore devices, specify the core ID:

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

For multicore projects using sysbuild:

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

Shield Support For boards with shields:

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

Advanced Build Options

Clean Builds Force a complete rebuild:

```
west build -b your_board examples/demo_apps/hello_world -p always
```

Dry Run See what commands would be executed:

```
west build -b your_board examples/demo_apps/hello_world --dry-run
```

Device Variants For boards supporting multiple device variants:

```
west build -b your_board examples/demo_apps/hello_world --device MK22F12810 --config release
```

Project Configuration

CMake Configuration Only Run configuration without building:

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

Interactive Configuration Launch the configuration GUI:

```
west build -t guiconfig
```

Flashing and Debugging

Flash Application Flash the built application to your board:

```
west flash -r linkserver
```

Debug Session Start a debugging session:

```
west debug -r linkserver
```

IDE Project Generation Generate IDE project files for traditional IDEs:

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

IDE project files are generated in `mcuxsdk/build/<toolchain>` folder.

Note: Ruby installation is required for IDE project generation. See *Installation Guide* for setup instructions.

Troubleshooting

Build Failures

Use pristine builds to resolve dependency issues:

```
west build -b your_board examples/demo_apps/hello_world -p always
```

Toolchain Issues

Verify environment variables are set correctly:

```
# Check ARM GCC
echo $ARMGCC_DIR
arm-none-eabi-gcc --version

# Check IAR (if using)
echo $IAR_DIR
```

Getting Help

Display help information:

```
west build -h
west flash -h
west debug -h
```

Check Supported Configurations

If unsure about supported options for an example:

```
west list_project -p examples/demo_apps/hello_world
```

Best Practices

Project Organization

- Keep custom projects outside the SDK tree
- Use version control for your application code
- Document any SDK modifications

Build Efficiency

- Use `-p always` for clean builds when troubleshooting
- Leverage `--dry-run` to understand build processes
- Use specific configs and toolchains to reduce build time

Development Workflow

1. Start with existing examples closest to your requirements
2. Copy and modify rather than building from scratch
3. Test with hello_world before moving to complex examples
4. Use configuration tools for pin muxing and clock setup

Next Steps

- Explore *VS Code Development* for integrated development experience
- Review *Workspace Structure* to understand SDK organization
- Refer build system documentation for advanced configurations

Using MCUXpresso Config Tools MCUXpresso Config tools provide a user-friendly way to configure hardware initialization of your projects. This guide explains the basic workflow with the MCUXpresso SDK west build system and the Config Tools.

Prerequisites

- GitHub Repository SDK workspace initialized OR Repository-Layout SDK Package extracted
- MCUXpresso Config Tools standalone installed (version 25.09 or above)
- MCUXpresso SDK Project that can be successfully built

Board Files MCUXpresso Config Tools generate source files for the board. These files include pin_mux.c/h and clock_config.c/h. The files contain initialization code functions that reflect the hardware configuration in the Config Tools. Within the SDK codebase, these files are specific for the board and either shared by multiple example projects or specific for one example. Open or import the configuration from the SDK project in the Config Tools and customize the settings to match the custom board or specific project use case and regenerate the code. See *User Guide for MCUXpresso Config Tools (Desktop)* (document GSMCUXCTUG) for details.

Note: When opening the configuration for SDK example projects, the board files may be shared across multiple examples. To ensure a separate copy of the board configuration files exists, create a freestanding project with copied board files.

Visual Studio Code To open the configuration in Visual Studio Code, use the context menu for the project to access Config Tools. See MCUXpresso Extension Documentation for details. Otherwise, use the manual workflow described in detail in the following section.

Manual Workflow Use the following steps:

1. Before using Config Tools, run the west command to get the project information for Config Tools from the SDK project files, for example:

   ```
   west cfg_project_info -b lpcxpresso55s69 ...mcuxsdk/examples/demo_apps/hello_world/ -Dcore_
   ↪id=cm33_core0
   ```

   This results in the creation of the project information json file that is searched by the config tools when the configuration is created. The parameters of the command should match the build parameters that will be used for the project.

2. Launch the MCUXpresso Config Tools and in the **Start development** wizard, select **Create a new configuration based on the existing IDE/Toolchain project**. Select the created "cfg_tools" subfolder as a project folder (for example: …mcuxsdk/examples/demo_apps/hello_world/cfg_tools/).

Updating the SDK West project **Note:** Updating project is supported with Config Tools V25.12 or newer only.

Changes in the Config tools generated source code modules may require adjustments to the toolchain project to ensure a successful build. These changes may mean, for example, adding the newly generated files, adding include paths, required drivers, or other SDK components. This section describes how to manually resolve the changes needed in the project within the toolchain projects based on the SDK project managed by the West tool.

After the configuration in the Config Tools is finished, write updated files to the disk using the 'Update Code' command. The written files include a json file with the required changes for the toolchain project.

To resolve the changes in the project in the terminal, launch the west command that updates the project. For example:

```
west cfg_resolve -b lpcxpresso55s69 ...mcuxsdk/examples/demo_apps/hello_world/ -Dcore_id=cm33_core0
```

This command updates the appropriate cmake and kconfig files to address the changes. After this, the application can be built.

Note: The cfg_resolve command supports additional arguments. Launch the *west cfg_resolve -h* command to get the list and description.

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.

- MCUXpresso IDE, Rev. 25.06.xx
- IAR Embedded Workbench for Arm, version is 9.70.2
- Keil MDK, version is 5.42a
- MCUXpresso for VS Code v25.12
- GCC Arm Embedded Toolchain 14.2.x

Supported development systems

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
FRDM-KE17Z	MKE13Z128VLF7, MKE13Z128VLH7, MKE13Z128VLL7, MKE13Z256VLF7, MKE13Z256VLH7, MKE13Z256VLL7, MKE17Z128VLF7, MKE17Z128VLH7, MKE17Z128VLL7, MKE17Z256VLF7, MKE17Z256VLH7, **MKE17Z256VLL7**, MKE12Z128VLF7, MKE12Z128VLH7, MKE12Z128VLL7, MKE12Z256VLF7, MKE12Z256VLH7, MKE12Z256VLL7

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.

MCU Boot MCU Boot (formerly KBOOT) NXP/Freescale proprietary loader

NXP Touch Library NXP Touch Library

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".

llhttp HTTP parser llhttp

FreeMASTER FreeMASTER communication driver for 32-bit platforms.

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.

Cannot add SDK components into FreeRTOS projects

It is not possible to add any SDK components into FreeRTOS project using the MCUXpresso IDE New Project wizard.

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

ACMP

[2.5.0]

- New Feature
  - Supported the plateforms which don't have continuous mode.

[2.4.0]

- New Feature
  - Supported the plateforms which don't have continuous mode.

[2.3.0]

- Improvements
  - Expose C0 register FILTER_CNT bitfield and FPR bitfield to the user.

[2.2.0]

- Improvements
  - Updated feature macros for roundrobin mode, window mode, filter mode, and 3V domain removes.

[2.1.0]

- New Feature
  - Supported the plateforms which don't have hysteresis mode.

[2.0.6]

- Bug Fixes
  - Fixed the wrong comments, the DAC value should range from 0 to 255.

[2.0.5]

- Bug Fixes
  - Fixed the out-of-bounds error of Coverity caused by missing an assert sentence to avoid the return value of ACMP_GetInstance() exceeding the array bounds.
  - Fixed the violations of MISRA C-2012 rules:
    * Rule 10.1, 14.4, 16.4, 17.7.

[2.0.4]

- Bug Fixes
  - Avoided changing w1c bit in ACMP_SetRoundRobinPreState().

[2.0.3]

- New Features
  - Added feature functions for usage of different power domains(1.8 V and 3 V). These functions are first enabled in ULP1. They are about:
    - ACMP_EnableLinkToDAC()
    - ACMP_SetDiscreteModeConfig()
    - ACMP_GetDefaultDiscreteModeConfig()

[2.0.2]

- Other Changes
  - Changed coding style of peripheral base address from "s_acmpBases" to "s_acmpBase".

[2.0.1]

- Bug Fixes
  - Fixed bug regarding the function "ACMP_SetRoundRobinConfig". It will not continue execution but returns directly after disabling round robin mode.

ADC12

[2.0.8]

- Bug Fixes
  - Fix build warning when FSL_SDK_DISABLE_DRIVER_CLOCK_CONTROL is defined as 1.

[2.0.7]

- Improvements
  - Change the method for judging the end of calibration. Previously, it was judged based on the COCO bit of the SC1 register. After the update, it is judged based on the CAL bit of the SC3 register. In some cases, SC1[COCO] was already set to 1 before calibration was performed, which caused calibration to fail.

[2.0.6]

- Improvements
  - Removed useless comments of ADC12_DoAutoCalibration() function.

[2.0.5]

- Bug Fixes
  - Fixed the violations of MISRA C-2012 rule 10.4.

[2.0.4]

- Bug Fixes
  - Fixed the violations of MISRA C-2012 rules:
    * Rule 4.7 10.1 10.3 10.4 10.8 12.2 16.4 17.7

[2.0.3]

- Improvements
  - Used conversion control feature macro instead of that in IO map.

[2.0.2]

- Bug Fixes
  - Set ADC clock frequency as half of the maximum value for calibration.

[2.0.1]

- New Features
  - Added a feature to control enablement of DMA.

[2.0.0]

- Initial version.

CLOCK

[2.0.0]

- Initial version.

COMMON

[2.6.3]

- New Features
  - Added bit mask inversion macros to avoid type promotion.
  - Added register operation macros.
- Improvements
  - Make function MSDK_EnableCpuCycleCounter compatible with CMSIS-5 and CMSIS-6.
- Bug Fixes
  - Fixed build issue of CMSIS PACK BSP example caused by CMSIS 6.1 issue.

[2.6.2]

- Bug Fixes
  - Fixed violations of MISRA C-2012 rule for implicit conversions in boolean contexts

[2.6.1]

- Improvements
  - Support Cortex M23.

[2.6.0]

- Bug Fixes
  - Fix CERT-C violations.

[2.5.0]

- New Features
  - Added new APIs InitCriticalSectionMeasurementContext, DisableGlobalIRQEx and EnableGlobalIRQEx so that user can measure the execution time of the protected sections.

[2.4.3]

- Improvements
  - Enable irqs that mount under irqsteer interrupt extender.

[2.4.2]

- Improvements
  - Add the macros to convert peripheral address to secure address or non-secure address.

[2.4.1]

- Improvements
  - Improve for the macro redefinition error when integrated with zephyr.

[2.4.0]

- New Features
  - Added EnableIRQWithPriority, IRQ_SetPriority, and IRQ_ClearPendingIRQ for ARM.
  - Added MSDK_EnableCpuCycleCounter, MSDK_GetCpuCycleCount for ARM.

[2.3.3]

- New Features
  - Added NETC into status group.

[2.3.2]

- Improvements
  - Make driver aarch64 compatible

[2.3.1]

- Bug Fixes
  - Fixed MAKE_VERSION overflow on 16-bit platforms.

[2.3.0]

- Improvements
  - Split the driver to common part and CPU architecture related part.

[2.2.10]

- Bug Fixes
  - Fixed the ATOMIC macros build error in cpp files.

[2.2.9]

- Bug Fixes
  - Fixed MISRA C-2012 issue, 5.6, 5.8, 8.4, 8.5, 8.6, 10.1, 10.4, 17.7, 21.3.
  - Fixed SDK_Malloc issue that not allocate memory with required size.

[2.2.8]

- Improvements
  - Included stddef.h header file for MDK tool chain.
- New Features:
  - Added atomic modification macros.

[2.2.7]

- Other Change
  - Added MECC status group definition.

[2.2.6]

- Other Change
  - Added more status group definition.
- Bug Fixes
  - Undef __VECTOR_TABLE to avoid duplicate definition in cmsis_clang.h

[2.2.5]

- Bug Fixes
  - Fixed MISRA C-2012 rule-15.5.

[2.2.4]

- Bug Fixes
  - Fixed MISRA C-2012 rule-10.4.

[2.2.3]

- New Features
  - Provided better accuracy of SDK_DelayAtLeastUs with DWT, use macro SDK_DELAY_USE_DWT to enable this feature.
  - Modified the Cortex-M7 delay count divisor based on latest tests on RT series boards, this setting lets result be closer to actual delay time.

[2.2.2]

- New Features
  - Added include RTE_Components.h for CMSIS pack RTE.

[2.2.1]

- Bug Fixes
  - Fixed violation of MISRA C-2012 Rule 3.1, 10.1, 10.3, 10.4, 11.6, 11.9.

[2.2.0]

- New Features
  - Moved SDK_DelayAtLeastUs function from clock driver to common driver.

[2.1.4]

- New Features
  - Added OTFAD into status group.

[2.1.3]

- Bug Fixes
  - MISRA C-2012 issue fixed.
    * Fixed the rule: rule-10.3.

[2.1.2]

- Improvements
  - Add SUPPRESS_FALL_THROUGH_WARNING() macro for the usage of suppressing fallthrough warning.

[2.1.1]

- Bug Fixes
  - Deleted and optimized repeated macro.

[2.1.0]

- New Features
  - Added IRQ operation for XCC toolchain.
  - Added group IDs for newly supported drivers.

[2.0.2]

- Bug Fixes
  - MISRA C-2012 issue fixed.
    * Fixed the rule: rule-10.4.

[2.0.1]

- Improvements
  - Removed the implementation of LPC8XX Enable/DisableDeepSleepIRQ() function.
  - Added new feature macro switch "FSL_FEATURE_HAS_NO_NONCACHEABLE_SECTION" for specific SoCs which have no noncacheable sections, that helps avoid an unnecessary complex in link file and the startup file.
  - Updated the align(x) to **attribute**(aligned(x)) to support MDK v6 armclang compiler.

[2.0.0]

- Initial version.

CRC

[2.1.0]

- Bug fix:
  - Choosing CRC clocks from CRC clock array according to instance instead of hardcoded value.

[2.0.5]

- Bug fix:
  - Fix CERT-C issue with boolean-to-unsigned integer conversion.

[2.0.4]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.0.3]

- Bug fix:
  - Fix MISRA issues.

[2.0.2]

- Bug fix:
  - Fix MISRA issues.

[2.0.1]

- Bug fix:
  - DATA and DATALL macro definition moved from header file to source file.

[2.0.0]

- Initial version.

DMAMUX

[2.1.3]

- Improvements
  - Wrap DMAMUX_GetInstance into FSL_SDK_DISABLE_DRIVER_CLOCK_CONTROL to avoid build issues.

[2.1.2]

- Bug Fixes
  - Add macro FSL_DMAMUX_CHANNEL_NUM to calculat correct DMAMUX channel number when input EDAM channel number.

[2.1.1]

- Improvements
  - Add macro FSL_FEATURE_DMAMUX_CHANNEL_NEEDS_ENDIAN_CONVERT and DMAMUX_CHANNEL_ENDIAN_CONVERTn do channel endian convert.

[2.1.0]

- Improvements
  - Modify the type of parameter source from uint32_t to int32_t in the DMAMUX_SetSource.

[2.0.5]

- Improvements
  - Added feature FSL_FEATURE_DMAMUX_CHCFG_REGISTER_WIDTH for the difference of CHCFG register width.

[2.0.4]

- Bug Fixes
  - Fixed violations of MISRA C-2012 rule 10.4.

[2.0.3]

- Bug Fixes
  - Fixed the issue for MISRA-2012 check.
    - Fixed rule 10.4 and rule 10.3.

[2.0.2]

- New Features
  - Added an always-on enable feature to a DMA channel for ULP1 DMAMUX support.

[2.0.1]

- Bug Fixes
  - Fixed the build warning issue by changing the type of parameter source from uint8_t to uint32_t when setting DMA request source in DMAMUX_SetSourceChange.

[2.0.0]

- Initial version.

EDMA

[2.4.7]

- Bug Fixes
  - Fixed coverity MSG issues with CERT INT31-C compliance.

[2.4.6]

- Bug Fixes
  - Fixed the EDMA header index retrieval error caused by done bit calculation mistake issue.

[2.4.5]

- Bug Fixes
  - Fixed memory convert would convert NULL as zero address issue.

[2.4.4]

- Bug Fixes
  - Fixed comments by replacing STCD with TCD
  - Fixed the TCD overwrite issue when submit transfer request in the callback if there is a active TCD in hardware.
  - Fixed violations of MISRA C-2012 rule 10.8,5.6.

[2.4.3]

- Improvements
  - Added FSL_FEATURE_MEMORY_HAS_ADDRESS_OFFSET to convert the address between system mapped address and dma quick access address.
- Bug Fixes
  - Fixed the wrong tcd done count calculated in first TCD interrupt for the non scatter gather case.

[2.4.2]

- Bug Fixes
  - Fixed the wrong tcd done count calculated in first TCD interrupt by correct the initial value of the header.
  - Fixed violations of MISRA C-2012 rule 10.3, 10.4.

[2.4.1]

- Bug Fixes
  - Added clear CITER and BITER registers in EDMA_AbortTransfer to make sure the TCD registers in a correct state for next calling of EDMA_SubmitTransfer.
  - Removed the clear DONE status for ESG not enabled case to aovid DONE bit cleared unexpectedly.

[2.4.0]

- Improvements
  - Added api EDMA_EnableContinuousChannelLinkMode to support continuous link mode.
  - Added apis EDMA_SetMajorOffsetConfig/EDMA_TcdSetMajorOffsetConfig to support major loop address offset feature.
  - Added api EDMA_EnableChannelMinorLoopMapping for minor loop offset feature.
  - Removed the reduntant IRQ Handler in edma driver.

[2.3.2]

- Improvements
  - Fixed HIS ccm issue in function EDMA_PrepareTransferConfig.
  - Fixed violations of MISRA C-2012 rule 11.6, 10.7, 10.3, 18.1.
- Bug Fixes
  - Added ACTIVE & BITER & CITER bitfields to determine the channel status to fixed the issue of the transfer request cannot submit by function EDMA_SubmitTransfer when channel is idle.

[2.3.1]

- Improvements
  - Added source/destination address alignment check.
  - Added driver IRQ handler support for multi DMA instance in one SOC.

[2.3.0]

- Improvements
  - Added new api EDMA_PrepareTransferConfig to allow different configurations of width and offset.
- Bug Fixes
  - Fixed violations of MISRA C-2012 rule 10.4, 10.1.
  - Fixed the Coverity issue regarding out-of-bounds write.

[2.2.0]

- Improvements
  - Added peripheral-to-peripheral support in EDMA driver.

[2.1.9]

- Bug Fixes
  - Fixed MISRA issue: Rule 10.7 and 10.8 in function EDMA_DisableChannelInterrupts and EDMA_SubmitTransfer.
  - Fixed MISRA issue: Rule 10.7 in function EDMA_EnableAsyncRequest.

[2.1.8]

- Bug Fixes
  - Fixed incorrect channel preemption base address used in EDMA_SetChannelPreemptionConfig API which causes incorrect configuration of the channel preemption register.

[2.1.7]

- Bug Fixes
  - Fixed incorrect transfer size setting.
    - Added 8 bytes transfer configuration and feature for RT series;
    - Added feature to support 16 bytes transfer for Kinetis.
  - Fixed the issue that EDMA_HandleIRQ would go to incorrect branch when TCD was not used and callback function not registered.

[2.1.6]

- Bug Fixes
  - Fixed KW3X MISRA Issue.
    - Rule 14.4, 10.8, 10.4, 10.7, 10.1, 10.3, 13.5, and 13.2.
- Improvements
  - Cleared the IRQ handler unavailable for specific platform with macro FSL_FEATURE_EDMA_MODULE_CHANNEL_IRQ_ENTRY_SHARED_OFFSET.

[2.1.5]

- Improvements
  - Improved EDMA IRQ handler to support half interrupt feature.

[2.1.4]

- Bug Fixes
  - Cleared enabled request, status during EDMA_Init for the case that EDMA is halted before reinitialization.

[2.1.3]

- Bug Fixes
  - Added clear DONE bit in IRQ handler to avoid overwrite TCD issue.
  - Optimized above solution for the case that transfer request occurs in callback.

[2.1.2]

- Improvements
  - Added interface to get next TCD address.
  - Added interface to get the unused TCD number.

[2.1.1]

- Improvements
  - Added documentation for eDMA data flow when scatter/gather is implemented for the EDMA_HandleIRQ API.
  - Updated and corrected some related comments in the EDMA_HandleIRQ API and edma_handle_t struct.

[2.1.0]

- Improvements
  - Changed the EDMA_GetRemainingBytes API into EDMA_GetRemainingMajorLoopCount due to eDMA IP limitation (see API comments/note for further details).

[2.0.5]

- Improvements
  - Added pubweak DriverIRQHandler for K32H844P (16 channels shared).

[2.0.4]

- Improvements
  - Added support for SoCs with multiple eDMA instances.
  - Added pubweak DriverIRQHandler for KL28T DMA1 and MCIMX7U5_M4.

[2.0.3]

- Bug Fixes
  - Fixed the incorrect pubweak IRQHandler name issue, which caused re-definition build errors when client set his/her own IRQHandler, by changing the 32-channel IRQHandler name to DriverIRQHandler.

[2.0.2]

- Bug Fixes
  - Fixed incorrect minorLoopBytes type definition in _edma_transfer_config struct, and defined minorLoopBytes as uint32_t instead of uint16_t.

[2.0.1]

- Bug Fixes
  - Fixed the eDMA callback issue (which did not check valid status) in EDMA_HandleIRQ API.

[2.0.0]

- Initial version.

EWM

[2.0.4]

- Bug Fixes
  - Fixed CERT INT31-C violations.

[2.0.3]

- Bug Fixes
  - Fixed violation of MISRA C-2012 rules: 10.1, 10.3.

[2.0.2]

- Bug Fixes
  - Fixed violation of MISRA C-2012 rules: 10.3, 10.4.

[2.0.1]

- Bug Fixes
  - Fixed the hard fault in EWM_Deinit.

[2.0.0]

- Initial version.

FLASH

[3.3.0]

- New Feature
  - Support for EEPROM Quick Write on devices with FTFC

[3.2.0]

- New Feature
  - Basic support for FTFC

[3.1.3]

- New Feature
  - Support 512KB flash for Kinetis E serials.

[3.1.2]

- Bug Fixes — Remove redundant comments.

[3.1.1]

- Bug Fixes — MISRA C-2012 issue fixed: rule 10.3

[3.1.0]

- New Feature
  - Support erase flash asynchronously.

[3.0.2]

- Bug Fixes — MISRA C-2012 issue fixed: rule 8.4, 17.7, 10.4, 16.1, 21.15, 11.3, 10.7 — building warning -Wnull-dereference on arm compiler v6

[3.0.1]

- New Features
  - Added support FlexNVM alias for (kw37/38/39).

[3.0.0]

- Improvements
  - Reorganized FTFx flash driver source file.
  - Extracted flash cache driver from FTFx driver.
  - Extracted flexnvm flash driver from FTFx driver.

[2.3.1]

- Bug Fixes
  - Unified Flash IFR design from K3.
  - New encoding rule for K3 flash size.

[2.3.0]

- New Features
  - Added support for device with LP flash (K3S/G).
  - Added flash prefetch speculation APIs.
- Improvements
  - Refined flash_cache_clear function.
  - Reorganized the member of flash_config_t struct.

[2.2.0]

- New Features
  - Supported FTFL device in FLASH_Swap API.
  - Supported various pflash start addresses.
  - Added support for KV58 in cache clear function.
  - Added support for device with secondary flash (KW40).
- Bug Fixes
  - Compiled execute-in-ram functions as PIC binary code for driver use.
  - Added missed flexram properties.
  - Fixed unaligned variable issue for execute-in-ram function code array.

[2.1.0]

- Improvements
  - Updated coding style to align with KSDK 2.0.
  - Different-alignment-size support for pflash and flexnvm.
  - Improved the implementation of execute-in-ram functions.

[2.0.0]

- Initial version

FLEXIO

[2.3.0]

- Improvements
  - Supported platforms which don't have DOZE mode control.
  - Added more pin control functions.

[2.2.3]

- Improvements
  - Adapter the FLEXIO driver to platforms which don't have system level interrupt controller, such as NVIC.

[2.2.2]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.2.1]

- Improvements
  - Added doxygen index parameter comment in FLEXIO_SetClockMode.

[2.2.0]

- New Features
  - Added new APIs to support FlexIO pin register.

[2.1.0]

- Improvements
  - Added API FLEXIO_SetClockMode to set flexio channel counter and source clock.

[2.0.4]

- Bug Fixes
  - Fixed MISRA 8.4 issues.

[2.0.3]

- Bug Fixes
  - Fixed MISRA 10.4 issues.

[2.0.2]

- Improvements
  - Split FLEXIO component which combines all flexio/flexio_uart/flexio_i2c/flexio_i2s drivers into several components: FlexIO component, flexio_uart component, flexio_i2c_master component, and flexio_i2s component.
- Bug Fixes
  - Fixed MISRA issues
    - Fixed rules 10.1, 10.3, 10.4, 10.7, 11.6, 11.9, 14.4, 17.7.

[2.0.1]

- Bug Fixes
  - Fixed the dozen mode configuration error in FLEXIO_Init API. For enableInDoze = true, the configuration should be 0; for enableInDoze = false, the configuration should be 1.

FLEXIO_I2C

[2.6.2]

- Improvements
  - Added timeout for while loop in FLEXIO_I2C_MasterTransferBlocking().
- Bug Fixes
  - Fixed build issues related to I2C_RETRY_TIMES.

[2.6.1]

- Bug Fixes
  - Fixed coverity issues

[2.6.0]

- Improvements
  - Supported platforms which don't have DOZE mode control.

[2.5.1]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.5.0]

- Improvements
  - Split some functions, fixed CCM problem in file fsl_flexio_i2c_master.c.

[2.4.0]

- Improvements
  - Added delay of 1 clock cycle in FLEXIO_I2C_MasterTransferRunStateMachine to ensure that bus would be idle before next transfer if master is nacked.
  - Fixed issue that the restart setup time is less than the time in I2C spec by adding delay of 1 clock cycle before restart signal.

[2.3.0]

- Improvements
  - Used 3 timers instead of 2 to support transfer which is more than 14 bytes in single transfer.
  - Improved FLEXIO_I2C_MasterTransferGetCount so that the API can check whether the transfer is still in progress.
- Bug Fixes
  - Fixed MISRA 10.4 issues.

[2.2.0]

- New Features
  - Added timeout mechanism when waiting certain state in transfer API.
  - Added an API for checking bus pin status.
- Bug Fixes
  - Fixed COVERITY issue of useless call in FLEXIO_I2C_MasterTransferRunStateMachine.
  - Fixed MISRA issues
    * Fixed rules 10.1, 10.3, 10.4, 10.7, 11.6, 11.9, 14.4, 17.7.
  - Added codes in FLEXIO_I2C_MasterTransferCreateHandle to clear pending NVIC IRQ, disable internal IRQs before enabling NVIC IRQ.
  - Modified code so that during master's nonblocking transfer the start and slave address are sent after interrupts being enabled, in order to avoid potential issue of sending the start and slave address twice.

[2.1.7]

- Bug Fixes
  - Fixed the issue that FLEXIO_I2C_MasterTransferBlocking did not wait for STOP bit sent.
  - Fixed COVERITY issue of useless call in FLEXIO_I2C_MasterTransferRunStateMachine.
  - Fixed the issue that I2C master did not check whether bus was busy before transfer.

[2.1.6]

- Bug Fixes
  - Fixed the issue that I2C Master transfer APIs(blocking/non-blocking) did not support the situation of master transfer with subaddress and transfer data size being zero, which means no data followed the subaddress.

[2.1.5]

- Improvements
  - Unified component full name to FLEXIO I2C Driver.

[2.1.4]

- Bug Fixes
  - The following modifications support FlexIO using multiple instances:
    - Removed FLEXIO_Reset API in module Init APIs.
    - Updated module Deinit APIs to reset the shifter/timer config instead of disabling module/clock.
    - Updated module Enable APIs to only support enable operation.

[2.1.3]

- Improvements
  - Changed the prototype of FLEXIO_I2C_MasterInit to return kStatus_Success if initialized successfully or to return kStatus_InvalidArgument if "(srcClock_Hz / masterConfig->baudRate_Bps) / 2 - 1" exceeds 0xFFU.

[2.1.2]

- Bug Fixes
  - Fixed the FLEXIO I2C issue where the master could not receive data from I2C slave in high baudrate.
  - Fixed the FLEXIO I2C issue where the master could not receive NAK when master sent non-existent addr.
  - Fixed the FLEXIO I2C issue where the master could not get transfer count successfully.
  - Fixed the FLEXIO I2C issue where the master could not receive data successfully when sending data first.
  - Fixed the Dozen mode configuration error in FLEXIO_I2C_MasterInit API. For enableInDoze = true, the configuration should be 0; for enableInDoze = false, the configuration should be 1.
  - Fixed the issue that FLEXIO_I2C_MasterTransferBlocking API called FLEXIO_I2C_MasterTransferCreateHandle, which lead to the s_flexioHandle/s_flexioIsr/s_flexioType variable being written. Then, if calling FLEXIO_I2C_MasterTransferBlocking API multiple times, the s_flexioHandle/s_flexioIsr/s_flexioType variable would not be written any more due to it being out of range. This lead to the following situation: NonBlocking transfer APIs could not work due to the fail of register IRQ.

[2.1.1]

- Bug Fixes
  - Implemented the FLEXIO_I2C_MasterTransferBlocking API which is defined in header file but has no implementation in the C file.

[2.1.0]

- New Features
  - Added Transfer prefix in transactional APIs.
  - Added transferSize in handle structure to record the transfer size.

FLEXIO_I2S

[2.2.2]

- Bug Fixes
  - Fixed violations of MISRA C-2012 rule 12.4.

[2.2.1]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.2.0]

- New Features
  - Added timeout mechanism when waiting certain state in transfer API.
- Bug Fixes
  - Fixed IAR Pa082 warnings.
  - Fixed violations of the MISRA C-2012 rules 10.4, 14.4, 11.8, 11.9, 10.1, 17.7, 11.6, 10.3, 10.7.

[2.1.6]

- Bug Fixes
  - Added reset flexio before flexio i2s init to make sure flexio status is normal.

[2.1.5]

- Bug Fixes
  - Fixed the issue that I2S driver used hard code for bitwidth setting.

[2.1.4]

- Improvements
  - Unified component's full name to FLEXIO I2S (DMA/EDMA) driver.

[2.1.3]

- Bug Fixes
  - The following modifications support FLEXIO using multiple instances:
    * Removed FLEXIO_Reset API in module Init APIs.
    * Updated module Deinit APIs to reset the shifter/timer config instead of disabling module/clock.
    * Updated module Enable APIs to only support enable operation.

[2.1.2]

- New Features
  - Added configure items for all pin polarity and data valid polarity.
  - Added default configure for pin polarity and data valid polarity.

[2.1.1]

- Bug Fixes
  - Fixed FlexIO I2S RX data read error and eDMA address error.
  - Fixed FlexIO I2S slave timer compare setting error.

[2.1.0]

- New Features
  - Added Transfer prefix in transactional APIs.
  - Added transferSize in handle structure to record the transfer size.

FLEXIO_I2S_EDMA

[2.1.9]

- Bug Fixes
  - Fixed violations of MISRA C-2012 rule 12.4.

[2.1.8]

- Improvements
  - Applied EDMA ERRATA 51327.

FLEXIO_SPI

[2.4.3]

- Improvements
  - Make SPI_RETRY_TIMES configurable by CONFIG_SPI_RETRY_TIMES.

[2.4.2]

- Bug Fixes
  - Fixed FLEXIO_SPI_MasterTransferBlocking and FLEXIO_SPI_MasterTransferNonBlocking issue in CS continuous mode, the CS might not be continuous.

[2.4.1]

- Bug Fixes
  - Fixed coverity issues

[2.4.0]

- Improvements
  - Supported platforms which don't have DOZE mode control.

[2.3.5]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.3.4]

- Bug Fixes
  - Fixed the txData from void * to const void * in transmit API

[2.3.3]

- Bugfixes
  - Fixed cs-continuous mode.

[2.3.2]

- Improvements
  - Changed FLEXIO_SPI_DUMMYDATA to 0x00.

[2.3.1]

- Bugfixes
  - Fixed IRQ SHIFTBUF overrun issue when one FLEXIO instance used as multiple SPIs.

[2.3.0]

- New Features
  - Supported FLEXIO_SPI slave transfer with continuous master CS signal and CPHA=0.
  - Supported FLEXIO_SPI master transfer with continuous CS signal.
  - Support 32 bit transfer width.
- Bug Fixes

- Fixed wrong timer compare configuration for dma/edma transfer.
- Fixed wrong byte order of rx data if transfer width is 16 bit, since the we use shifter buffer bit swapped/byte swapped register to read in received data, so the high byte should be read from the high bits of the register when MSB.

[2.2.1]

- Bug Fixes
  - Fixed bug in FLEXIO_SPI_MasterTransferAbortEDMA that when aborting EDMA transfer EDMA_AbortTransfer should be used rather than EDMA_StopTransfer.

[2.2.0]

- Improvements
  - Added timeout mechanism when waiting certain states in transfer driver.
- Bug Fixes
  - Fixed MISRA 10.4 issues.
  - Added codes in FLEXIO_SPI_MasterTransferCreateHandle and FLEXIO_SPI_SlaveTransferCreateHandle to clear pending NVIC IRQ before enabling NVIC IRQ, to fix issue of pending IRQ interfering the on-going process.

[2.1.3]

- Improvements
  - Unified component full name to FLEXIO SPI(DMA/EDMA) Driver.
- Bug Fixes
  - Fixed MISRA issues
    * Fixed rules 10.1, 10.3, 10.4, 10.7, 11.6, 11.9, 14.4, 17.7.

[2.1.2]

- Bug Fixes
  - The following modification support FlexIO using multiple instances:
    * Removed FLEXIO_Reset API in module Init APIs.
    * Updated module Deinit APIs to reset the shifter/timer config instead of disabling module/clock.
    * Updated module Enable APIs to only support enable operation.

[2.1.1]

- Bug Fixes
  - Fixed bug where FLEXIO SPI transfer data is in 16 bit per frame mode with eDMA.
  - Fixed bug when FLEXIO SPI works in eDMA and interrupt mode with 16-bit per frame and Lsbfirst.
  - Fixed the Dozen mode configuration error in FLEXIO_SPI_MasterInit/FLEXIO_SPI_SlaveInit API. For enableInDoze = true, the configuration should be 0; for enableInDoze = false, the configuration should be 1.

- Improvements
  - Added #ifndef/#endif to allow users to change the default TX value at compile time.

[2.1.0]

- New Features
  - Added Transfer prefix in transactional APIs.
  - Added transferSize in handle structure to record the transfer size.
- Bug Fixes
  - Fixed the error register address return for 16-bit data write in FLEXIO_SPI_GetTxDataRegisterAddress.
  - Provided independent IRQHandler/transfer APIs for Master and slave to fix the baudrate limit issue.

FLEXIO_UART

[2.6.4]

- Improvements
  - Make UART_RETRY_TIMES configurable by CONFIG_UART_RETRY_TIMES.

[2.6.3]

- Bug Fixes
  - Fixed coverity issues

[2.6.2]

- Bug Fixes
  - Fixed coverity issues

[2.6.1]

- Improvements
  - Improve baudrate calculation method, to support higher frequency FlexIO clock source.

[2.6.0]

- Improvements
  - Supported platforms which don't have DOZE mode control.

[2.5.1]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.5.0]

- Improvements
  - Added API FLEXIO_UART_FlushShifters to flush UART fifo.

[2.4.0]

- Improvements
  - Use separate data for TX and RX in flexio_uart_transfer_t.
- Bug Fixes
  - Fixed bug that when ring buffer is used, if some data is received in ring buffer first before calling FLEXIO_UART_TransferReceiveNonBlocking, the received data count returned by FLEXIO_UART_TransferGetReceiveCount is wrong.

[2.3.0]

- Improvements
  - Added check for baud rate's accuracy that returns kStatus_FLEXIO_UART_BaudrateNotSupport when the best achieved baud rate is not within 3% error of configured baud rate.
- Bug Fixes
  - Added codes in FLEXIO_UART_TransferCreateHandle to clear pending NVIC IRQ before enabling NVIC IRQ, to fix issue of pending IRQ interfering the on-going process.

[2.2.0]

- Improvements
  - Added timeout mechanism when waiting for certain states in transfer driver.
- Bug Fixes
  - Fixed MISRA 10.4 issues.

[2.1.6]

- Bug Fixes
  - Fixed IAR Pa082 warnings.
  - Fixed MISRA issues
    - Fixed rules 10.1, 10.3, 10.4, 10.7, 11.6, 11.9, 14.4, 17.7.

[2.1.5]

- Improvements
  - Triggered user callback after all the data in ringbuffer were received in FLEXIO_UART_TransferReceiveNonBlocking.

[2.1.4]

- Improvements
  - Unified component full name to FLEXIO UART(DMA/EDMA) Driver.

[2.1.3]

- Bug Fixes
  - The following modifications support FLEXIO using multiple instances:
    * Removed FLEXIO_Reset API in module Init APIs.
    * Updated module Deinit APIs to reset the shifter/timer configuration instead of disabling module and clock.
    * Updated module Enable APIs to only support enable operation.

[2.1.2]

- Bug Fixes
  - Fixed the transfer count calculation issue in FLEXIO_UART_TransferGetReceiveCount, FLEXIO_UART_TransferGetSendCount, FLEXIO_UART_TransferGetReceiveCountDMA, FLEXIO_UART_TransferGetSendCountDMA, FLEXIO_UART_TransferGetReceiveCountEDMA and FLEXIO_UART_TransferGetSendCountEDMA.
  - Fixed the Dozen mode configuration error in FLEXIO_UART_Init API. For enableInDoze = true, the configuration should be 0; for enableInDoze = false, the configuration should be 1.
  - Added code to report errors if the user sets a too-low-baudrate which FLEXIO cannot reach.
  - Disabled FLEXIO_UART receive interrupt instead of all NVICs when reading data from ring buffer. If ring buffer is used, receive nonblocking will disable all NVIC interrupts to protect the ring buffer. This had negative effects on other IPs using interrupt.

[2.1.1]

- Bug Fixes
  - Changed the API name FLEXIO_UART_StopRingBuffer to FLEXIO_UART_TransferStopRingBuffer to align with the definition in C file.

[2.1.0]

- New Features
  - Added Transfer prefix in transactional APIs.
  - Added txSize/rxSize in handle structure to record the transfer size.
- Bug Fixes
  - Added an error handle to handle the situation that data count is zero or data buffer is NULL.

FLEXIO_UART_EDMA

[2.3.1]

- Bug Fixes
  - Fixed violations of the MISRA C-2012 rules.

[2.3.0]

- Refer FLEXIO_UART driver change log to 2.3.0

FTM

[2.7.5]

- Bug Fixes
  - Corrected the bit shift calculation for fault input filter enable in FTM_SetupFaultInput().

[2.7.4]

- Bug Fixes
  - Fixed violations of the CERT INT31-C.
  - Fixed MISRA C-2012 issue: rule 10.1.

[2.7.3]

- Bug Fixes
  - Fixed violations of the CERT INT30-C INT31-C.

[2.7.2]

- Improvements
  - Add API FTM__ERRATA__010856 for ERR010856 workaround.

[2.7.1]

- Bug Fixes
  - Added function macro when accsee FLTCTRL register FSTATE bit to prevent access nonexistent register.
  - Added function macro to prevent access nonexistent FTM channel for API FTM_ConfigSinglePWM() and FTM_ConfigCombinePWM().

[2.7.0]

- Improvements
  - Support period dithering and edge dithering feature with new APIs:
    * FTM_SetPeriodDithering()
    * FTM_SetEdgeDithering()
  - Support get channel n output and input state feature with new APIs:
    * FTM_GetChannelOutputState()
    * FTM_GetChannelInputState()
  - Support configure deadtime for specific combined channel pair with new API:
    * FTM_SetPairDeadTime()

  - Support filter clock prescale, fault output state.
  - Support new APIs to configure PWM and Modified Combine PWM:
    * FTM_ConfigSinglePWM()
    * FTM_ConfigCombinePWM()
  - Support new API to configure channel software output control:
    * FTM_SetSoftwareOutputCtrl()
    * FTM_GetSoftwareOutputValue()
    * FTM_GetSoftwareOutputEnable()
  - Support new API to update FTM counter initial value, modulo value and chanle value:
    * FTM_SetInitialModuloValue()
    * FTM_SetChannelValue()

[2.6.1]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.6.0]

- Improvements
  - Added support to half and full cycle reload feature with new APIs:
    * FTM_SetLdok()
    * FTM_SetHalfCycPeriod()
    * FTM_LoadFreq()
- Bug Fixes
  - Set the HWRSTCNT and SWRSTCNT bits to optional at initialization.

[2.5.0]

- Improvements
  - Added FTM_CalculateCounterClkDiv to help calculates the counter clock prescaler.
  - Modify FTM_UpdatePwmDutycycle API to make it return pwm duty cycles status.
- Bug Fixes
  - Fixed TPM_SetupPwm can't configure 100% center align combined PWM issues.

[2.4.1]

- Bug Fixes
  - Added function macro to determine if FTM instance has only basic features, to prevent access to protected register bits.

[2.4.0]

- Improvements
  - Added CNTIN register initialization in FTM_SetTimerPeriod API.
  - Added a new API to read the captured value of a FTM channel configured in capture mode:
    * FTM_GetInputCaptureValue()

[2.3.0]

- Improvements
  - Added support of EdgeAligned/CenterAligned/Asymmetrical combine PWM mode in FTM_SetupPWM() and FTM_SetupPwmMode() APIs.
  - Remove kFTM_ComplementaryPwm from support PWM mode, and add new parameter "enableComplementary" in structure ftm_chnl_pwm_signal_param_t.
  - Rename FTM_SetupFault() API to FTM_SetupFaultInput() to avoid ambiguity.

[2.2.3]

- Bug Fixes
  - MISRA C-2012 issue fixed: rule 14.4 and 17.7.

[2.2.2]

- Bug Fixes
  - Fixed the issue that when FTM instance has only TPM features cannot be initialized by FTM_Init() function. By added function macro to assert FTM is TPM only instance.

[2.2.1]

- Bug Fixes
  - MISRA C-2012 issue fixed: rule 10.1, 10.3, 10.4, 10.6, 10.7 and 11.9.

[2.2.0]

- Bug Fixes
  - Fixed the issue of comparison between signed and unsigned integer expressions.
- Improvements
  - Added support of complementary mode in FTM_SetupPWM() and FTM_SetupPwmMode() APIs.
  - Added new parameter "enableDeadtime" in structure ftm_chnl_pwm_signal_param_t.

[2.1.1]

- Bug Fixes
  - Fixed COVERITY integer handing issue where the right operand of a left bit shift statement should not be a negative value. This appears in FTM_SetReloadPoints().

[2.1.0]

- Improvements
  - Added a new API FTM_SetupPwmMode() to allow the user to set the channel match value in units of timer ticks. New configure structure called ftm_chnl_pwm_config_param_t was added to configure the channel's PWM parameters. This API is similar with FTM_SetupPwm() API, but the new API will not set the timer period(MOD value), it will be useful for users to set the PWM parameters without changing the timer period.
- Bug Fixes
  - Added feature macro to enable/disable the external trigger source configuration.

[2.0.4]

- Improvements
  - Added a new API to enable DMA transfer:
    - FTM_EnableDmaTransfer()

[2.0.3]

- Bug Fixes
  - Updated the FTM driver to enable fault input after configuring polarity.

[2.0.2]

- Improvements
  - Added support to Quad Decoder feature with new APIs:
    - FTM_GetQuadDecoderFlags()
    - FTM_SetQuadDecoderModuloValue()
    - FTM_GetQuadDecoderCounterValue()
    - FTM_ClearQuadDecoderCounterValue()

[2.0.1]

- Bug Fixes
  - Updated the FTM driver to fix write to ELSA and ELSB bits.
  - FTM combine mode: set the COMBINE bit before writing to CnV register.

[2.0.0]

- Initial version.

GPIO

[2.8.4]

- Improvements
  - Make function GPIO_PortGetInterruptFlags and GPIO_PortClearInterruptFlags available for all variants, they are used for all pins flags in one GPIO port.

[2.8.3]

- Bug Fixes
  - Fixed violations of the MISRA C-2012 Rule 10.1, 5.7.

[2.8.2]

- Bug Fixes
  - Fixed COVERITY issue that GPIO_GetInstance could return clock array overflow values due to GPIO base and clock being out of sync.

[2.8.1]

- Bug Fixes
  - Fixed CERT INT31-C issues.

[2.8.0]

- Improvements
  - Add API GPIO_PortInit/GPIO_PortDeinit to set GPIO clock enable and releasing GPIO reset.

[2.8.0]

- Improvements
  - Add API GPIO_PortInit/GPIO_PortDeinit to set GPIO clock enable and releasing GPIO reset.
  - Remove support for API GPIO_GetPinsDMARequestFlags with GPIO_ISFR_COUNT <= 1.

[2.7.3]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.7.2]

- New Features
  - Support devices without PORT module.

[2.7.1]

- Bug Fixes
  - Fixed MISRA C-2012 rule 10.4 issues in GPIO_GpioGetInterruptChannelFlags() function and GPIO_GpioClearInterruptChannelFlags() function.

[2.7.0]

- New Features
  - Added API to support Interrupt select (IRQS) bitfield.

[2.6.0]

- New Features
  - Added API to get GPIO version information.
  - Added API to control a pin for general purpose input.
  - Added some APIs to control pin in secure and previliege status.

[2.5.3]

- Bug Fixes
  - Correct the feature macro typo: FSL_FEATURE_GPIO_HAS_NO_INDEP_OUTPUT_CONTORL.

[2.5.2]

- Improvements
  - Improved GPIO_PortSet/GPIO_PortClear/GPIO_PortToggle functions to support devices without Set/Clear/Toggle registers.

[2.5.1]

- Bug Fixes
  - Fixed wrong macro definition.
  - Fixed MISRA C-2012 rule issues in the FGPIO_CheckAttributeBytes() function.
  - Defined the new macro to separate the scene when the width of registers is different.
  - Removed some redundant macros.
- New Features
  - Added some APIs to get/clear the interrupt status flag when the port doesn't control pins' interrupt.

[2.4.1]

- Improvements
  - Improved GPIO_CheckAttributeBytes() function to support 8 bits width GACR register.

[2.4.0]

- Improvements
  - API interface added:
    * New APIs were added to configure the GPIO interrupt clear settings.

[2.3.2]

- Bug Fixes
  - Fixed the issue for MISRA-2012 check.
    * Fixed rule 3.1, 10.1, 8.6, 10.6, and 10.3.

[2.3.1]

- Improvements
  - Removed deprecated APIs.

[2.3.0]

- New Features
  - Updated the driver code to adapt the case of interrupt configurations in GPIO module. New APIs were added to configure the GPIO interrupt settings if the module has this feature on it.

[2.2.1]

- Improvements
  - API interface changes:
    * Refined naming of APIs while keeping all original APIs by marking them as deprecated. The original APIs will be removed in next release. The main change is updating APIs with prefix of _PinXXX() and _PortXXX.

[2.1.1]

- Improvements
  - API interface changes:
    * Added an API for the check attribute bytes.

[2.1.0]

- Improvements
  - API interface changes:
    * Added "pins" or "pin" to some APIs' names.
    * Renamed "_PinConfigure" to "GPIO_PinInit".

LPI2C

[2.6.4]

- Bug Fixes
  - Limited value of filtSda in LPI2C_MasterSetBaudRate().
  - Updated LPI2C_MasterStop() and LPI2C_MasterTransferBlocking() to send I2C STOP also in case of error.
  - Removed unused flag kLPI2C_TransferRepeatedStartFlag.

[2.6.3]

- Bug Fixes
  - Fixed static analysis identified issues.

[2.6.2]

- Improvements
  - Added timeout for while loop in LPI2C_TransferStateMachineSendCommand().

[2.6.1]

- Bug Fixes
  - Fixed coverity issues.

[2.6.0]

- New Feature
  - Added common IRQ handler entry LPI2C_DriverIRQHandler.

[2.5.7]

- Improvements
  - Added support for separated IRQ handlers.

[2.5.6]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.5.5]

- Bug Fixes
  - Fixed LPI2C_SlaveInit() - allow to disable SDA/SCL glitch filter.

[2.5.4]

- Bug Fixes
  - Fixed LPI2C_MasterTransferBlocking() - the return value was sometime affected by call of LPI2C_MasterStop().

[2.5.3]

- Improvements
  - Added handler for LPI2C7 and LPI2C8.

[2.5.2]

- Bug Fixes
  - Fixed ERR051119 to ignore the nak flag when IGNACK=1 in LPI2C_MasterCheckAndClearError.

[2.5.1]

- Bug Fixes
  - Added bus stop incase of bus stall in LPI2C_MasterTransferBlocking.
- Improvements
  - Release peripheral from reset if necessary in init function.

[2.5.0]

- New Features
  - Added new function LPI2C_SlaveEnableAckStall to enable or disable ACKSTALL.

[2.4.1]

- Improvements
  - Before master transfer with transactional APIs, enable master function while disable slave function and vise versa for slave transfer to avoid the one affecting the other.

[2.4.0]

- Improvements
  - Split some functions, fixed CCM problem in file fsl_lpi2c.c.
- Bug Fixes
  - Fixed bug in LPI2C_MasterInit that the MCFGR2's value set in LPI2C_MasterSetBaudRate may be overwritten by mistake.

[2.3.2]

- Improvements
  - Initialized the EDMA configuration structure in the LPI2C EDMA driver.

[2.3.1]

- Improvements
  - Updated LPI2C_GetCyclesForWidth to add the parameter of minimum cycle, because for master SDA/SCL filter, master bus idle/pin low timeout and slave SDA/SCL filter configuration, 0 means disabling the feature and cannot be used.
- Bug Fixes
  - Fixed bug in LPI2C_SlaveTransferHandleIRQ that when restart detect event happens the transfer structure should not be cleared.
  - Fixed bug in LPI2C_RunTransferStateMachine, that when only slave address is transferred or there is still data remaining in tx FIFO the last byte's nack cannot be ignored.
  - Fixed bug in slave filter doze enable, that when FILTDZ is set it means disable rather than enable.
  - Fixed bug in the usage of LPI2C_GetCyclesForWidth. First its return value cannot be used directly to configure the slave FILTSDA, FILTSCL, DATAVD or CLKHOLD, because the real cycle width for them should be FILTSDA+3, FILTSCL+3, FILTSCL+DATAVD+3 and CLKHOLD+3. Second when cycle period is not affected by the prescaler value, prescaler value should be passed as 0 rather than 1.
  - Fixed wrong default setting for LPI2C slave. If enabling the slave tx SCL stall, then the default clock hold time should be set to 250ns according to I2C spec for 100kHz standard mode baudrate.
  - Fixed bug that before pushing command to the tx FIFO the FIFO occupation should be checked first in case FIFO overflow.

[2.3.0]

- New Features
  - Supported reading more than 256 bytes of data in one transfer as master.
  - Added API LPI2C_GetInstance.
- Bug Fixes
  - Fixed bug in LPI2C_MasterTransferAbortEDMA, LPI2C_MasterTransferAbort and LPI2C_MasterTransferHandleIRQ that before sending stop signal whether master is active and whether stop signal has been sent should be checked, to make sure no FIFO error or bus error will be caused.
  - Fixed bug in LPI2C master EDMA transactional layer that the bus error cannot be caught and returned by user callback, by monitoring bus error events in interrupt handler.
  - Fixed bug in LPI2C_GetCyclesForWidth that the parameter used to calculate clock cycle should be 2^prescaler rather than prescaler.
  - Fixed bug in LPI2C_MasterInit that timeout value should be configured after baudrate, since the timeout calculation needs prescaler as parameter which is changed during baudrate configuration.
  - Fixed bug in LPI2C_MasterTransferHandleIRQ and LPI2C_RunTransferStateMachine that when master writes with no stop signal, need to first make sure no data remains in the tx FIFO before finishes the transfer.

[2.2.0]

- Bug Fixes

- Fixed issue that the SCL high time, start hold time and stop setup time do not meet I2C specification, by changing the configuration of data valid delay, setup hold delay, clock high and low parameters.
- MISRA C-2012 issue fixed.
  - Fixed rule 8.4, 13.5, 17.7, 20.8.

[2.1.12]

- Bug Fixes
  - Fixed MISRA advisory 15.5 issues.

[2.1.11]

- Bug Fixes
  - Fixed the bug that, during master non-blocking transfer, after the last byte is sent/received, the kLPI2C_MasterNackDetectFlag is expected, so master should not check and clear kLPI2C_MasterNackDetectFlag when remainingBytes is zero, in case FIFO is emptied when stop command has not been sent yet.
  - Fixed the bug that, during non-blocking transfer slave may nack master while master is busy filling tx FIFO, and NDF may not be handled properly.

[2.1.10]

- Bug Fixes
  - MISRA C-2012 issue fixed.
    - Fixed rule 10.3, 14.4, 15.5.
  - Fixed unaligned access issue in LPI2C_RunTransferStateMachine.
  - Fixed uninitialized variable issue in LPI2C_MasterTransferHandleIRQ.
  - Used linked TCD to disable tx and enable rx in read operation to fix the issue that for platform sharing the same DMA request with tx and rx, during LPI2C read operation if interrupt with higher priority happened exactly after command was sent and before tx disabled, potentially both tx and rx could trigger dma and cause trouble.
  - Fixed MISRA issues.
    - Fixed rules 10.1, 10.3, 10.4, 11.6, 11.9, 14.4, 17.7.
  - Fixed the waitTimes variable not re-assignment issue for each byte read.
- New Features
  - Added the IRQHandler for LPI2C5 and LPI2C6 instances.
- Improvements
  - Updated the LPI2C_WAIT_TIMEOUT macro to unified name I2C_RETRY_TIMES.

[2.1.9]

- Bug Fixes
  - Fixed Coverity issue of unchecked return value in I2C_RTOS_Transfer.
  - Fixed Coverity issue of operands did not affect the result in LPI2C_SlaveReceive and LPI2C_SlaveSend.

- Removed STOP signal wait when NAK detected.
- Cleared slave repeat start flag before transmission started in LPI2C_SlaveSend/LPI2C_SlaveReceive. The issue was that LPI2C_SlaveSend/LPI2C_SlaveReceive did not handle with the reserved repeat start flag. This caused the next slave to send a break, and the master was always in the receive data status, but could not receive data.

[2.1.8]

- Bug Fixes
  - Fixed the transfer issue with LPI2C_MasterTransferNonBlocking, kLPI2C_TransferNoStopFlag, with the wait transfer done through callback in a way of not doing a blocking transfer.
  - Fixed the issue that STOP signal did not appear in the bus when NAK event occurred.

[2.1.7]

- Bug Fixes
  - Cleared the stopflag before transmission started in LPI2C_SlaveSend/LPI2C_SlaveReceive. The issue was that LPI2C_SlaveSend/LPI2C_SlaveReceive did not handle with the reserved stop flag and caused the next slave to send a break, and the master always stayed in the receive data status but could not receive data.

[2.1.6]

- Bug Fixes
  - Fixed driver MISRA build error and C++ build error in LPI2C_MasterSend and LPI2C_SlaveSend.
  - Reset FIFO in LPI2C Master Transfer functions to avoid any byte still remaining in FIFO during last transfer.
  - Fixed the issue that LPI2C_MasterStop did not return the correct NAK status in the bus for second transfer to the non-existing slave address.

[2.1.5]

- Bug Fixes
  - Extended the Driver IRQ handler to support LPI2C4.
  - Changed to use ARRAY_SIZE(kLpi2cBases) instead of FEATURE COUNT to decide the array size for handle pointer array.

[2.1.4]

- Bug Fixes
  - Fixed the LPI2C_MasterTransferEDMA receive issue when LPI2C shared same request source with TX/RX DMA request. Previously, the API used scatter-gather method, which handled the command transfer first, then the linked TCD which was pre-set with the receive data transfer. The issue was that the TX DMA request and the RX DMA request were both enabled, so when the DMA finished the first command TCD transfer and handled the receive data TCD, the TX DMA request still happened due to empty TX FIFO. The result was that the RX DMA transfer would start without waiting on the expected RX DMA request.

- Fixed the issue by enabling IntMajor interrupt for the command TCD and checking if there was a linked TCD to disable the TX DMA request in LPI2C_MasterEDMACallback API.

[2.1.3]

- Improvements
  - Added LPI2C_WATI_TIMEOUT macro to allow the user to specify the timeout times for waiting flags in functional API and blocking transfer API.
  - Added LPI2C_MasterTransferBlocking API.

[2.1.2]

- Bug Fixes
  - In LPI2C_SlaveTransferHandleIRQ, reset the slave status to idle when stop flag was detected.

[2.1.1]

- Bug Fixes
  - Disabled the auto-stop feature in eDMA driver. Previously, the auto-stop feature was enabled at transfer when transferring with stop flag. Since transfer was without stop flag and the auto-stop feature was enabled, when starting a new transfer with stop flag, the stop flag would be sent before the new transfer started, causing unsuccesful sending of the start flag, so the transfer could not start.
  - Changed default slave configuration with address stall false.

[2.1.0]

- Improvements
  - API name changed:
    * LPI2C_MasterTransferCreateHandle -> LPI2C_MasterCreateHandle.
    * LPI2C_MasterTransferGetCount -> LPI2C_MasterGetTransferCount.
    * LPI2C_MasterTransferAbort -> LPI2C_MasterAbortTransfer.
    * LPI2C_MasterTransferHandleIRQ -> LPI2C_MasterHandleInterrupt.
    * LPI2C_SlaveTransferCreateHandle -> LPI2C_SlaveCreateHandle.
    * LPI2C_SlaveTransferGetCount -> LPI2C_SlaveGetTransferCount.
    * LPI2C_SlaveTransferAbort -> LPI2C_SlaveAbortTransfer.
    * LPI2C_SlaveTransferHandleIRQ -> LPI2C_SlaveHandleInterrupt.

[2.0.0]

- Initial version.

LPI2C_EDMA

[2.4.7]

- Bug Fixes
  - Fixed incorrect TX FIFO size (maxTxFifo) in LPI2C_MasterTransferEDMA() and LPI2C_MasterTransferEdmaHandleIRQ().

[2.4.6]

- Bug Fixes
  - Fixed static analysis identified issues.

[2.4.5]

- Improvements
  - Added condition to IRQ handler to check whether the interrupt is enabled - kLPI2C_MasterTxReadyFlag.

[2.4.4]

- Improvements
  - Added support for 2KB data transfer

[2.4.3]

- Improvements
  - Added support for separated IRQ handlers.

[2.4.2]

- Improvements
  - Add EDMA ext API to accommodate more types of EDMA.

[2.4.1]

- Refer LPI2C driver change log 2.0.0 to 2.4.1

LPIT

[2.1.3]

- Bug Fixes
  - Fixed doxygen generation warnings.

[2.1.2]

- Bug Fixes
  - Fix CERT INT31-C issues.

[2.1.1]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.1.0]

- Improvements
  - Add new function LPIT_SetTimerValue to set timeout period.

[2.0.2]

- Improvements
  - Improved LPIT_SetTimerPeriod implementation, configure timeout value with LPIT ticks minus 1 generate more correct interval.
  - Added timeout value configuration check for LPIT_SetTimerPeriod, at least input 3 ticks for calling LPIT_SetTimerPeriod.
- Bug Fixes
  - Fixed MISRA C-2012 rule 17.7 violations.

[2.0.1]

- Bug Fixes
  - MISRA C-2012 issue fixed.
    * Fixed rules, containing: rule-10.3, rule-14.4, rule-15.5.

[2.0.0]

- Initial version.

LPSPI

[2.7.4]

- Bug Fixes
  - Clear WIDTH bits from the TCR register before writing a new value in LPSPI_MasterTransferBlocking().

[2.7.3]

- Improvements
  - Added timeout for while loop in LPSPI_MasterTransferWriteAllTxData().
  - Make SPI_RETRY_TIMES configurable by CONFIG_SPI_RETRY_TIMES.

[2.7.2]

- Bug Fixes
  - Fixed coverity issues.

[2.7.1]

- Bug Fixes
  - Workaround for errata ERR050607
  - Workaround for errata ERR010655

[2.7.0]

- New Feature
  - Added common IRQ handler entry LPSPI_DriverIRQHandler.

[2.6.10]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.6.9]

- Bug Fixes
  - Fixed reading of TCR register
  - Workaround for errata ERR050606

[2.6.8]

- Bug Fixes
  - Fixed build error when SPI_RETRY_TIMES is defined to non-zero value.

[2.6.7]

- Bug Fixes
  - Fixed the txData from void * to const void * in transmit API _lpspi_master_handle and _lpspi_slave_handle.

[2.6.6]

- Bug Fixes
  - Added LPSPI register init in LPSPI_MasterInit incase of LPSPI register exist.

[2.6.5]

- Improvements
  - Introduced FSL_FEATURE_LPSPI_HAS_NO_PCSCFG and FSL_FEATURE_LPSPI_HAS_NO_MULTI_WIDTH for conditional compile.
  - Release peripheral from reset if necessary in init function.

[2.6.4]

- Bug Fixes
  - Added LPSPI6_DriverIRQHandler for LPSPI6 instance.

[2.6.3]

- Hot Fixes
  - Added macro switch in function LPSPI_Enable about ERRATA051472.

[2.6.2]

- Bug Fixes
  - Disabled lpspi before LPSPI_MasterSetBaudRate incase of LPSPI opened.

[2.6.1]

- Bug Fixes
  - Fixed return value while calling LPSPI_WaitTxFifoEmpty in function LPSPI_MasterTransferNonBlocking.

[2.6.0]

- Feature
  - Added the new feature of multi-IO SPI .

[2.5.3]

- Bug Fixes
  - Fixed 3-wire txmask of handle vaule reentrant issue.

[2.5.2]

- Bug Fixes
  - Workaround for errata ERR051588 by clearing FIFO after transmit underrun occurs.

[2.5.1]

- Bug Fixes
  - Workaround for errata ERR050456 by resetting the entire module using LPSPIn_CR[RST] bit.

[2.5.0]

- Bug Fixes
  - Workaround for errata ERR011097 to wait the TX FIFO to go empty when writing TCR register and TCR[TXMSK] value is 1.
  - Added API LPSPI_WaitTxFifoEmpty for wait the txfifo to go empty.

[2.4.7]

- Bug Fixes
  - Fixed bug that the SR[REF] would assert if software disabled or enabled the LPSPI module in LPSPI_Enable.

[2.4.6]

- Improvements
  - Moved the configuration of registers for the 3-wire lpspi mode to the LPSPI_MasterInit and LPSPI_SlaveInit function.

[2.4.5]

- Improvements
  - Improved LPSPI_MasterTransferBlocking send performance when frame size is 1-byte.

[2.4.4]

- Bug Fixes
  - Fixed LPSPI_MasterGetDefaultConfig incorrect default inter-transfer delay calculation.

[2.4.3]

- Bug Fixes
  - Fixed bug that the ISR response speed is too slow on some platforms, resulting in the first transmission of overflow, Set proper RX watermarks to reduce the ISR response times.

[2.4.2]

- Bug Fixes
  - Fixed bug that LPSPI_MasterTransferBlocking will modify the parameter txbuff and rxbuff pointer.

[2.4.1]

- Bug Fixes
  - Fixed bug that LPSPI_SlaveTransferNonBlocking can't detect RX error.

[2.4.0]

- Improvements
  - Split some functions, fixed CCM problem in file fsl_lpspi.c.

[2.3.1]

- Improvements
  - Initialized the EDMA configuration structure in the LPSPI EDMA driver.
- Bug Fixes
  - Fixed bug that function LPSPI_MasterTransferBlocking should return after the transfer complete flag is set to make sure the PCS is re-asserted.

[2.3.0]

- New Features
  - Supported the master configuration of sampling the input data using a delayed clock to improve slave setup time.

[2.2.1]

- Bug Fixes
  - Fixed bug in LPSPI_SetPCSContinous when disabling PCS continous mode.

[2.2.0]

- Bug Fixes
  - Fixed bug in 3-wire polling and interrupt transfer that the received data is not correct and the PCS continous mode is not working.

[2.1.0]

- Improvements
  - Improved LPSPI_SlaveTransferHandleIRQ to fill up TX FIFO instead of write one data to TX register which improves the slave transmit performance.
  - Added new functional APIs LPSPI_SelectTransferPCS and LPSPI_SetPCSContinous to support changing PCS selection and PCS continous mode.
- Bug Fixes
  - Fixed bug in non-blocking and EDMA transfer APIs that kStatus_InvalidArgument is returned if user configures 3-wire mode and full-duplex transfer at the same time, but transfer state is already set to kLPSPI_Busy by mistake causing following transfer can not start.
  - Fixed bug when LPSPI slave using EDMA way to transfer, tx should be masked when tx data is null, otherwise in 3-wire mode which tx/rx use the same pin, the received data will be interfered.

[2.0.5]

- Improvements
  - Added timeout mechanism when waiting certain states in transfer driver.
- Bug Fixes
  - Fixed the bug that LPSPI can not transfer large data using EDMA.
  - Fixed MISRA 17.7 issues.

- Fixed variable overflow issue introduced by MISRA fix.
- Fixed issue that rxFifoMaxBytes should be calculated according to transfer width rather than FIFO width.
- Fixed issue that completion flag was not cleared after transfer completed.

[2.0.4]

- Bug Fixes
  - Fixed in LPSPI_MasterTransferBlocking that master rxfifo may overflow in stall condition.
  - Eliminated IAR Pa082 warnings.
  - Fixed MISRA issues.
    - Fixed rules 10.1, 10.3, 10.4, 10.6, 11.9, 14.2, 14.4, 15.7, 17.7.

[2.0.3]

- Bug Fixes
  - Removed LPSPI_Reset from LPSPI_MasterInit and LPSPI_SlaveInit, because this API may glitch the slave select line. If needed, call this function manually.

[2.0.2]

- New Features
  - Added dummy data set up API to allow users to configure the dummy data to be transferred.
  - Enabled the 3-wire mode, SIN and SOUT pins can be configured as input/output pin.

[2.0.1]

- Bug Fixes
  - Fixed the bug that the clock source should be divided by the PRESCALE setting in LPSPI_MasterSetDelayTimes function.
  - Fixed the bug that LPSPI_MasterTransferBlocking function would hang in some corner cases.
- Optimization
  - Added #ifndef/#endif to allow user to change the default TX value at compile time.

[2.0.0]

- Initial version.

LPSPI_EDMA

[2.4.9]

- Improvements
  - Removed unused code from LPSPI_SeparateEdmaReadData().

[2.4.8]

- Improvements
  - Added timeout for while loop in EDMA_LpspiMasterCallback() and EDMA_LpspiSlaveCallback().

[2.4.7]

- Bug Fixes
  - Add macro LPSPI_ALIGN_TCD_SIZE_MASK to align an address to edma_tcd_t size.

[2.4.6]

- Improvements
  - Increased transmit FIFO watermark to ensure whole transmit FIFO will be used during data transfer.

[2.4.5]

- Bug Fixes
  - Fixed reading of TCR register
  - Workaround for errata ERR050606

[2.4.4]

- Improvements
  - Add EDMA ext API to accommodate more types of EDMA.

[2.4.3]

- Improvements
  - Supported 32K bytes transmit in DMA, improve the max datasize in LPSPI_MasterTransferEDMALite.

[2.4.2]

- Improvements
  - Added callback status in EDMA_LpspiMasterCallback and EDMA_LpspiSlaveCallback to check transferDone.

[2.4.1]

- Improvements
  - Add the TXMSK wait after TCR setting.

[2.4.0]

- Improvements
  - Separated LPSPI_MasterTransferEDMA functions to LPSPI_MasterTransferPrepareEDMA and LPSPI_MasterTransferEDMALite to optimize the process of transfer.

LPTMR

[2.2.1]

- Bug Fixes
  - Fix CERT INT31-C issues.

[2.2.0]

- Improvements
  - Updated lptmr_prescaler_clock_select_t, only define the valid options.

[2.1.1]

- Improvements
  - Updated the characters from "PTMR" to "LPTMR" in "FSL_FEATURE_PTMR_HAS_NO_PRESCALER_CLOCK_SOURCE_1_SUPPORT" feature definition.

[2.1.0]

- Improvements
  - Implement for some special devices' not supporting for all clock sources.
- Bug Fixes
  - Fixed issue when accessing CMR register.

[2.0.2]

- Bug Fixes
  - Fixed MISRA-2012 issues.
    - Rule 10.1.

[2.0.1]

- Improvements
  - Updated the LPTMR driver to support 32-bit CNR and CMR registers in some devices.

[2.0.0]

- Initial version.

LPUART

[2.10.0]

- New Feature
  - Added support to configure RTS watermark.

[2.9.4]

- Improvements
  - Merged duplicate code.

[2.9.3]

- Improvements
  - Added timeout for while loops in LPUART_Deinit().

[2.9.2]

- Bug Fixes
  - Fixed coverity issues.

[2.9.1]

- Bug Fixes
  - Fixed coverity issues.

[2.9.0]

- New Feature
  - Added support for swap TXD and RXD pins.
  - Added common IRQ handler entry LPUART_DriverIRQHandler.

[2.8.3]

- Improvements
  - Conditionally compile interrupt handling code to solve the problem of using this driver on CPU cores that do not support interrupts.

[2.8.2]

- Bug Fix
  - Fixed the bug that LPUART_TransferEnable16Bit controled by wrong feature macro.

[2.8.1]

- Bug Fixes
  - Fixed issue for MISRA-2012 check.
    * Fixed rule-5.3, rule-5.8, rule-10.4, rule-11.3, rule-11.8.

[2.8.0]

- Improvements
  - Added support of DATA register for 9bit or 10bit data transmit in write and read API. Such as: LPUART_WriteBlocking16bit, LPUART_ReadBlocking16bit, LPUART_TransferEnable16Bit LPUART_WriteNonBlocking16bit, LPUART_ReadNonBlocking16bit.

[2.7.7]

- Bug Fixes
  - Fixed the bug that baud rate calculation overflow when srcClock_Hz is 528MHz.

[2.7.6]

- Bug Fixes
  - Fixed LPUART_EnableInterrupts and LPUART_DisableInterrupts bug that blocks if the LPUART address doesn't support exclusive access.

[2.7.5]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.7.4]

- Improvements
  - Added support for atomic register accessing in LPUART_EnableInterrupts and LPUART_DisableInterrupts.

[2.7.3]

- Bug Fixes
  - Fixed violations of the MISRA C-2012 rules 15.7.

[2.7.2]

- Bug Fix
  - Fixed the bug that the OSR calculation error when lupart init and lpuart set baud rate.

[2.7.1]

- Improvements
  - Added support for LPUART_BASE_PTRS_NS in security mode in file fsl_lpuart.c.

[2.7.0]

- Improvements
  - Split some functions, fixed CCM problem in file fsl_lpuart.c.

[2.6.0]

- Bug Fixes
  - Fixed bug that when there are multiple lpuart instance, unable to support different ISR.

[2.5.3]

- Bug Fixes
  - Fixed comments by replacing unused status flags kLPUART_NoiseErrorInRxDataRegFlag and kLPUART_ParityErrorInRxDataRegFlag with kLPUART_NoiseErrorFlag and kLPUART_ParityErrorFlag.

[2.5.2]

- Bug Fixes
  - Fixed bug that when setting watermark for TX or RX FIFO, the value may exceed the maximum limit.
- Improvements
  - Added check in LPUART_TransferDMAHandleIRQ and LPUART_TransferEdmaHandleIRQ to ensure if user enables any interrupts other than transfer complete interrupt, the dma transfer is not terminated by mistake.

[2.5.1]

- Improvements
  - Use separate data for TX and RX in lpuart_transfer_t.
- Bug Fixes
  - Fixed bug that when ring buffer is used, if some data is received in ring buffer first before calling LPUART_TransferReceiveNonBlocking, the received data count returned by LPUART_TransferGetReceiveCount is wrong.

[2.5.0]

- Bug Fixes
  - Added missing interrupt enable masks kLPUART_Match1InterruptEnable and kLPUART_Match2InterruptEnable.
  - Fixed bug in LPUART_EnableInterrupts, LPUART_DisableInterrupts and LPUART_GetEnabledInterrupts that the BAUD[LBKDIE] bit field should be soc specific.
  - Fixed bug in LPUART_TransferHandleIRQ that idle line interrupt should be disabled when rx data size is zero.
  - Deleted unused status flags kLPUART_NoiseErrorInRxDataRegFlag and kLPUART_ParityErrorInRxDataRegFlag, since firstly their function are the same as kLPUART_NoiseErrorFlag and kLPUART_ParityErrorFlag, secondly to obtain them one data word must be read out thus interfering with the receiving process.
  - Fixed bug in LPUART_GetStatusFlags that the STAT[LBKDIF], STAT[MA1F] and STAT[MA2F] should be soc specific.
  - Fixed bug in LPUART_ClearStatusFlags that tx/rx FIFO is reset by mistake when clearing flags.

- Fixed bug in LPUART_TransferHandleIRQ that while clearing idle line flag the other bits should be masked in case other status bits be cleared by accident.
- Fixed bug of race condition during LPUART transfer using transactional APIs, by disabling and re-enabling the global interrupt before and after critical operations on interrupt enable register.
- Fixed DMA/eDMA transfer blocking issue by enabling tx idle interrupt after DMA/eDMA transmission finishes.

- New Features
  - Added APIs LPUART_GetRxFifoCount/LPUART_GetTxFifoCount to get rx/tx FIFO data count.
  - Added APIs LPUART_SetRxFifoWatermark/LPUART_SetTxFifoWatermark to set rx/tx FIFO water mark.

[2.4.1]

- Bug Fixes
  - Fixed MISRA advisory 17.7 issues.

[2.4.0]

- New Features
  - Added APIs to configure 9-bit data mode, set slave address and send address.

[2.3.1]

- Bug Fixes
  - Fixed MISRA advisory 15.5 issues.

[2.3.0]

- Improvements
  - Modified LPUART_TransferHandleIRQ so that txState will be set to idle only when all data has been sent out to bus.
  - Modified LPUART_TransferGetSendCount so that this API returns the real byte count that LPUART has sent out rather than the software buffer status.
  - Added timeout mechanism when waiting for certain states in transfer driver.

[2.2.8]

- Bug Fixes
  - Fixed issue for MISRA-2012 check.
    - Fixed rule-10.3, rule-14.4, rule-15.5.
  - Eliminated Pa082 warnings by assigning volatile variables to local variables and using local variables instead.
  - Fixed MISRA issues.
    - Fixed rules 10.1, 10.3, 10.4, 10.8, 14.4, 11.6, 17.7.
- Improvements

- Added check for kLPUART_TransmissionCompleteFlag in LPUART_WriteBlocking, LPUART_TransferHandleIRQ, LPUART_TransferSendDMACallback and LPUART_SendEDMACallback to ensure all the data would be sent out to bus.
- Rounded up the calculated sbr value in LPUART_SetBaudRate and LPUART_Init to achieve more acurate baudrate setting. Changed osr from uint32_t to uint8_t since osr's bigest value is 31.
- Modified LPUART_ReadBlocking so that if more than one receiver errors occur, all status flags will be cleared and the most severe error status will be returned.

[2.2.7]

- Bug Fixes
  - Fixed issue for MISRA-2012 check.
    - Fixed rule-12.1, rule-17.7, rule-14.4, rule-13.3, rule-14.4, rule-10.4, rule-10.8, rule-10.3, rule-10.7, rule-10.1, rule-11.6, rule-13.5, rule-11.3, rule-13.2, rule-8.3.

[2.2.6]

- Bug Fixes
  - Fixed the issue of register's being in repeated reading status while dealing with the IRQ routine.

[2.2.5]

- Bug Fixes
  - Do not set or clear the TIE/RIE bits when using LPUART_EnableTxDMA and LPUART_EnableRxDMA.

[2.2.4]

- Improvements
  - Added hardware flow control function support.
  - Added idle-line-detecting feature in LPUART_TransferNonBlocking function. If an idle line is detected, a callback is triggered with status kStatus_LPUART_IdleLineDetected returned. This feature may be useful when the received Bytes is less than the expected received data size. Before triggering the callback, data in the FIFO (if has FIFO) is read out, and no interrupt will be disabled, except for that the receive data size reaches 0.
  - Enabled the RX FIFO watermark function. With the idle-line-detecting feature enabled, users can set the watermark value to whatever you want (should be less than the RX FIFO size). Data is received and a callback will be triggered when data receive ends.

[2.2.3]

- Improvements
  - Changed parameter type in LPUART_RTOS_Init struct from rtos_lpuart_config to lpuart_rtos_config_t.
- Bug Fixes

    - Disabled LPUART receive interrupt instead of all NVICs when reading data from ring buffer. Otherwise when the ring buffer is used, receive nonblocking method will disable all NVICs to protect the ring buffer. This may has a negative effect on other IPs that are using the interrupt.

[2.2.2]

- Improvements
    - Added software reset feature support.
    - Added software reset API in LPUART_Init.

[2.2.1]

- Improvements
    - Added separate RX/TX IRQ number support.

[2.2.0]

- Improvements
    - Added support of 7 data bits and MSB.

[2.1.1]

- Improvements
    - Removed unnecessary check of event flags and assert in LPUART_RTOS_Receive.
    - Added code to always wait for RX event flag in LPUART_RTOS_Receive.

[2.1.0]

- Improvements
    - Update transactional APIs.

LPUART_EDMA

[2.4.0]

- Refer LPUART driver change log 2.1.0 to 2.4.0

MCM

[2.2.0]

- Improvements
    - Support platforms with less features.

[2.1.0]

- Others
  - Remove byteID from mcm_lmem_fault_attribute_t for document update.

[2.0.0]

- Initial version.

PMC

[2.0.4]

- Bug Fixes
  - Add validation before narrowing uint32_t to uint8_t conversions using assert
  - Replace direct boolean to integer casts with explicit ternary operators
  - Add INT31-C compliance comments for safe narrowing conversions
  - Apply fixes to PMC_ConfigureLowVoltDetect, PMC_ConfigureLowVoltWarning, and PMC_ConfigureBandgapBuffer functions

[2.0.3]

- Bug Fixes
  - Fixed the violation of MISRA C-2012 rule 11.3.

[2.0.2]

- Bug Fixes
  - Fixed the violations of MISRA 2012 rules:
    * Rule 10.3.

[2.0.1]

- Bug Fixes
  - Fixed MISRA issues.
    * Rule 10.8, Rule 10.3.

[2.0.0]

- Initial version.

PORT

[2.5.1]

- Bug Fixes
  - Fix CERT INT31-C issues.
  - Fixed the violations of MISRA C-2012 rules: 10.1.

[2.5.0]

- Bug Fixes
  - Correct the kPORT_MuxAsGpio for some platforms.

[2.4.1]

- Bug Fixes
  - Fixed the violations of MISRA C-2012 rules: 10.1, 10.8 and 14.4.

[2.4.0]

- New Features
  - Updated port_pin_config_t to support input buffer and input invert.

[2.3.0]

- New Features
  - Added new APIs for Electrical Fast Transient(EFT) detect.
  - Added new API to configure port voltage range.

[2.2.0]

- New Features
  - Added new api PORT_EnablePinDoubleDriveStrength.

[2.1.1]

- Bug Fixes
  - Fixed the violations of MISRA C-2012 rules: 10.1, 10.4，11.3，11.8, 14.4.

[2.1.0]

- New Features
  - Updated the driver code to adapt the case of the interrupt configurations in GPIO module. Will move the pin configuration APIs to GPIO module.

[2.0.2]

- Other Changes
  - Added feature guard macros in the driver.

[2.0.1]

- Other Changes
  - Added "const" in function parameter.
  - Updated some enumeration variables' names.

PWT

[2.0.2]

- Bug Fixes
  - Fixed CERT INT31-C violations.

[2.0.1]

- Bug Fixes
  - Fixed violations of MISRA C-2012 rules: 10.8, 10.3, 10.6.

[2.0.0]

- Initial version.

RCM

[2.0.5]

- Bug Fixes
  - Replace direct boolean to integer casts with explicit ternary operators for INT31-C compliance.
  - Add validation before narrowing uint32_t to uint8_t conversion using assert.
  - Add INT31-C compliance comments for safe type handling.
  - Apply fixes to RCM_ConfigureResetPinFilter and RCM_SetForceBootRomSource functions.

[2.0.4]

- Bug Fixes
  - Fixed violation of MISRA C-2012 rule 10.3

[2.0.3]

- Bug Fixes
  - Fixed violation of MISRA C-2012 rules.

[2.0.2]

- Bug Fixes
  - Fixed MISRA issue.
    * Rule 10.8, rule 10.1, rule 13.2, rule 3.1.

[2.0.1]

- Bug Fixes
  - Fixed kRCM_SourceSw bit shift issue.

[2.0.0]

- Initial version.

SIM

[2.2.0]

- Improvements
  - Added API to trigger TRGMUX.

[2.1.3]

- Improvements
  - Updated function SIM_GetUniqueId to support different register names.

[2.1.2]

- Bug Fixes
  - Fixed SIM_GetUniqueId bug that could not get UIDH.

[2.1.1]

- Bug Fixes
  - Fixed violations of the MISRA C-2012 rules 10.1, 10.4

[2.1.0]

- Improvements
  - Added new APIs: SIM_GetRfAddr() and SIM_EnableSystickClock().

[2.0.0]

- Initial version.

SMC

[2.0.8]

- Bug Fixes
  - Replace direct boolean to integer casts with explicit ternary operators for INT31-C compliance
  - Add validation before narrowing uint32_t to uint8_t conversion using assert
  - Add INT31-C compliance comments for safe type handling
  - Apply fixes to RCM_ConfigureResetPinFilter and RCM_SetForceBootRomSource functions

[2.0.7]

- Bug Fixes
  - Fixed MISRA-2012 issue 10.3.

[2.0.6]

- Bug Fixes
  - Fixed issue for MISRA-2012 check.
    * Fixed rule 10.3, rule 11.3.

[2.0.5]

- Bug Fixes
  - Fixed issue for MISRA-2012 check.
    * Fixed rule 15.7, rule 14.4, rule 10.3, rule 10.1, rule 10.4.

[2.0.4]

- Bug Fixes
  - When entering stop modes, used RAM function for the flash synchronization issue. Application should make sure that, the RW data of fsl_smc.c is located in memory region which is not powered off in stop modes.

[2.0.3]

- Improvements
  - Added APIs SMC_PreEnterStopModes, SMC_PreEnterWaitModes, SMC_PostExitWaitModes, and SMC_PostExitStopModes.

[2.0.2]

- Bug Fixes
  - Added DSB before WFI while ISB after WFI.
- Other Changes
  - Updated SMC_SetPowerModeVlpw implementation.

[2.0.1]

- Other Changes
  - Updated for KL8x.

[2.0.0]

- Initial version.

TRGMUX

[2.0.1]

- Bug Fixes
  - Fixed violations of the MISRA C-2012 rules 10.1, 10.3, 10.8.

[2.0.0]

- Initial version.

TSI_V5

[2.6.1]

- Improvements
  - The SHIELD register write was fixed to be rewritten.

[2.6.0]

- Improvements
  - Add API TSI_ShieldChannelConfig to config all TSI shield channels.

[2.5.0]

- Improvements
  - Add API TSI_EnableShieldChannels to enable/disable TSI shield channels.

[2.4.0]

- Bug Fixes
  - Fixed some elements in the array tsi_sensitivity_xdn_option_t does not match the S_XDN bits.

[2.3.0]

- Other Changes
  - Changed the TSI SINC cutoff divider number.

[2.2.0]

- Improvements
  - Extended enableShield items from tsi_selfCap_config_t structure to cover three shields in the ke17z series.
  - Added interface for getting instance from TSI base address and apply it for clock and IRQ enable/disable.

[2.1.2]

- Bug Fixes
  - Fixed the violations of MISRA C-2012 rules: 10.1, 10.8.

[2.1.1]

- Improvements
  - Improved the module's noise immunity in mutual cap mode by setting M_TRIM2[0] to 1 in TSI_MUL1 register.
- Bug Fixes
  - Fixed the violations of MISRA C-2012 rules:
    * Rule 10.1, 10.3, 10.4, 10.8, 12.2, 14.4, 17.7.

[2.1.0]

- Bug Fixes
  - Fixed incorrect TSI SSC clock calculation.

[2.0.1]

- Improvements
  - Added functions for M_TX_USED bitfield for ke16z only (Unused TX mutual pins can work as GPIO).

[2.0.0]

- Initial version.

WDOG32

[2.2.1]

- Bug Fixes
  - Fix CERT INT31-C that the bool value shall be converted to unsigned int 0 or 1 then passed to registers.
  - Fix MISRA 2012 20.3 vilation.

[2.2.0]

- Improvements
  - Added while loop timeout config value for WDOG32 reconfiguration and unlock sequence.
  - Change the return type of WDOG32_Init, WDOG32_Deinit and WDOG32_Unlock from void to status_t.

[2.1.0]

- Improvements
  - Release peripheral from reset if necessary in init function.

[2.0.4]

- Improvements
  - To ensure that the reconfiguration is inside 128 bus clocks unlock window, put all re-configuration APIs in quick access code section.

[2.0.3]

- Bug Fixes
  - Fixed the noncompliance issue of the reference document.
    - Waited until for new configuration to take effect by checking the RCS bit field.
    - Waited until for registers to be unlocked by checking the ULK bit field.
- Improvements
  - Added 128 bus clocks delay ensures a smooth transition before restarting the counter with the new configuration when there is no RCS status bit.

[2.0.2]

- Bug Fixes
  - MISRA C-2012 issue fixed.
    - Fixed rules, containing: rule-10.3, rule-14.4, rule-15.5.
  - Fixed the issue of the inseparable process interrupted by other interrupt source.
    - WDOG32_Refresh

[2.0.1]

- Bug Fixes
  - WDOG must be configured within its configuration time period.
    - Added WDOG32_Init API to quick access section.
    - Defined register variable in WDOG32_Init API.

[2.0.0]

- 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.

MKE17Z7

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 FreeMASTER

freemaster

1.7.2 FreeRTOS

FreeRTOS

Chapter 2

MKE17Z7

2.1 ACMP: Analog Comparator Driver

void ACMP_Init(CMP_Type *base, const *acmp_config_t* *config)

Initializes the ACMP.

The default configuration can be got by calling ACMP_GetDefaultConfig().

Parameters

- base – ACMP peripheral base address.
- config – Pointer to ACMP configuration structure.

void ACMP_Deinit(CMP_Type *base)

Deinitializes the ACMP.

Parameters

- base – ACMP peripheral base address.

void ACMP_GetDefaultConfig(*acmp_config_t* *config)

Gets the default configuration for ACMP.

This function initializes the user configuration structure to default value. The default value are:

Example:

```
config->enableHighSpeed = false;
config->enableInvertOutput = false;
config->useUnfilteredOutput = false;
config->enablePinOut = false;
config->enableHysteresisBothDirections = false;
config->hysteresisMode = kACMP_hysteresisMode0;
```

Parameters

- config – Pointer to ACMP configuration structure.

void ACMP_Enable(CMP_Type *base, bool enable)

Enables or disables the ACMP.

Parameters

- base – ACMP peripheral base address.
- enable – True to enable the ACMP.

void ACMP_EnableLinkToDAC(CMP_Type *base, bool enable)

Enables the link from CMP to DAC enable.

When this bit is set, the DAC enable/disable is controlled by the bit CMP_C0[EN] instead of CMP_C1[DACEN].

Parameters

- base – ACMP peripheral base address.
- enable – Enable the feature or not.

void ACMP_SetChannelConfig(CMP_Type *base, const *acmp_channel_config_t* *config)

Sets the channel configuration.

Note that the plus/minus mux's setting is only valid when the positive/negative port's input isn't from DAC but from channel mux.

Example:

```
acmp_channel_config_t configStruct = {0};
configStruct.positivePortInput = kACMP_PortInputFromDAC;
configStruct.negativePortInput = kACMP_PortInputFromMux;
configStruct.minusMuxInput = 1U;
ACMP_SetChannelConfig(CMP0, &configStruct);
```

Parameters

- base – ACMP peripheral base address.
- config – Pointer to channel configuration structure.

void ACMP_EnableDMA(CMP_Type *base, bool enable)

Enables or disables DMA.

Parameters

- base – ACMP peripheral base address.
- enable – True to enable DMA.

void ACMP_SetFilterConfig(CMP_Type *base, const *acmp_filter_config_t* *config)

Configures the filter.

The filter can be enabled when the filter count is bigger than 1, the filter period is greater than 0 and the sample clock is from divided bus clock or the filter is bigger than 1 and the sample clock is from external clock. Detailed usage can be got from the reference manual.

Example:

```
acmp_filter_config_t configStruct = {0};
configStruct.filterCount = 5U;
configStruct.filterPeriod = 200U;
configStruct.enableSample = false;
ACMP_SetFilterConfig(CMP0, &configStruct);
```

Parameters

- base – ACMP peripheral base address.
- config – Pointer to filter configuration structure.

void ACMP_SetDACConfig(CMP_Type *base, const *acmp_dac_config_t* *config)

Configures the internal DAC.

Example:

```
acmp_dac_config_t configStruct = {0};
configStruct.referenceVoltageSource = kACMP_VrefSourceVin1;
configStruct.DACValue = 20U;
configStruct.enableOutput = false;
configStruct.workMode = kACMP_DACWorkLowSpeedMode;
ACMP_SetDACConfig(CMP0, &configStruct);
```

Parameters

- base – ACMP peripheral base address.
- config – Pointer to DAC configuration structure. "NULL" is for disabling the feature.

void ACMP_EnableInterrupts(CMP_Type *base, uint32_t mask)

Enables interrupts.

Parameters

- base – ACMP peripheral base address.
- mask – Interrupts mask. See "_acmp_interrupt_enable".

void ACMP_DisableInterrupts(CMP_Type *base, uint32_t mask)

Disables interrupts.

Parameters

- base – ACMP peripheral base address.
- mask – Interrupts mask. See "_acmp_interrupt_enable".

uint32_t ACMP_GetStatusFlags(CMP_Type *base)

Gets status flags.

Parameters

- base – ACMP peripheral base address.

Returns

Status flags asserted mask. See "_acmp_status_flags".

void ACMP_ClearStatusFlags(CMP_Type *base, uint32_t mask)

Clears status flags.

Parameters

- base – ACMP peripheral base address.
- mask – Status flags mask. See "_acmp_status_flags".

void ACMP_SetDiscreteModeConfig(CMP_Type *base, const *acmp_discrete_mode_config_t* *config)

Configure the discrete mode.

Configure the discrete mode when supporting 3V domain with 1.8V core.

Parameters

- base – ACMP peripheral base address.
- config – Pointer to configuration structure. See "acmp_discrete_mode_config_t".

void ACMP_GetDefaultDiscreteModeConfig(*acmp_discrete_mode_config_t* *config)

Get the default configuration for discrete mode setting.

Parameters

- config – Pointer to configuration structure to be restored with the setting values.

FSL_ACMP_DRIVER_VERSION

ACMP driver version 2.5.0.

enum _acmp_interrupt_enable

Interrupt enable/disable mask.

Values:

enumerator kACMP_OutputRisingInterruptEnable

Enable the interrupt when comparator outputs rising.

enumerator kACMP_OutputFallingInterruptEnable

Enable the interrupt when comparator outputs falling.

enum _acmp_status_flags

Status flag mask.

Values:

enumerator kACMP_OutputRisingEventFlag

Rising-edge on compare output has occurred.

enumerator kACMP_OutputFallingEventFlag

Falling-edge on compare output has occurred.

enumerator kACMP_OutputAssertEventFlag

Return the current value of the analog comparator output.

enum _acmp_offset_mode

Comparator hard block offset control.

If OFFSET level is 1, then there is no hysteresis in the case of positive port input crossing negative port input in the positive direction (or negative port input crossing positive port input in the negative direction). Hysteresis still exists for positive port input crossing negative port input in the falling direction. If OFFSET level is 0, then the hysteresis selected by acmp_hysteresis_mode_t is valid for both directions.

Values:

enumerator kACMP_OffsetLevel0

The comparator hard block output has level 0 offset internally.

enumerator kACMP_OffsetLevel1

The comparator hard block output has level 1 offset internally.

enum _acmp_hysteresis_mode

Comparator hard block hysteresis control.

See chip data sheet to get the actual hysteresis value with each level.

Values:

enumerator kACMP_HysteresisLevel0

Offset is level 0 and Hysteresis is level 0.

enumerator kACMP_HysteresisLevel1

Offset is level 0 and Hysteresis is level 1.

enumerator kACMP_HysteresisLevel2

Offset is level 0 and Hysteresis is level 2.

enumerator kACMP_HysteresisLevel3
Offset is level 0 and Hysteresis is level 3.

enum _acmp_reference_voltage_source
CMP Voltage Reference source.

Values:

enumerator kACMP_VrefSourceVin1
Vin1 is selected as resistor ladder network supply reference Vin.

enumerator kACMP_VrefSourceVin2
Vin2 is selected as resistor ladder network supply reference Vin.

enum _acmp_port_input
Port input source.

Values:

enumerator kACMP_PortInputFromDAC
Port input from the 8-bit DAC output.

enumerator kACMP_PortInputFromMux
Port input from the analog 8-1 mux.

enum _acmp_dac_work_mode
Internal DAC's work mode.

Values:

enumerator kACMP_DACWorkLowSpeedMode
DAC is selected to work in low speed and low power mode.

enumerator kACMP_DACWorkHighSpeedMode
DAC is selected to work in high speed high power mode.

typedef enum *_acmp_offset_mode* acmp_offset_mode_t
Comparator hard block offset control.

If OFFSET level is 1, then there is no hysteresis in the case of positive port input crossing negative port input in the positive direction (or negative port input crossing positive port input in the negative direction). Hysteresis still exists for positive port input crossing negative port input in the falling direction. If OFFSET level is 0, then the hysteresis selected by acmp_hysteresis_mode_t is valid for both directions.

typedef enum *_acmp_hysteresis_mode* acmp_hysteresis_mode_t
Comparator hard block hysteresis control.

See chip data sheet to get the actual hysteresis value with each level.

typedef enum *_acmp_reference_voltage_source* acmp_reference_voltage_source_t
CMP Voltage Reference source.

typedef enum *_acmp_port_input* acmp_port_input_t
Port input source.

typedef enum *_acmp_dac_work_mode* acmp_dac_work_mode_t
Internal DAC's work mode.

typedef struct *_acmp_config* acmp_config_t
Configuration for ACMP.

typedef struct *_acmp_channel_config* acmp_channel_config_t
Configuration for channel.

The comparator's port can be input from channel mux or DAC. If port input is from channel mux, detailed channel number for the mux should be configured.

typedef struct *_acmp_filter_config* acmp_filter_config_t
Configuration for filter.

typedef struct *_acmp_dac_config* acmp_dac_config_t
Configuration for DAC.

typedef struct *_acmp_discrete_mode_config* acmp_discrete_mode_config_t
Configuration for discrete mode.

CMP_C0_CFx_MASK
The mask of status flags cleared by writing 1.

struct _acmp_config
#include <fsl_acmp.h> Configuration for ACMP.

Public Members

acmp_offset_mode_t offsetMode
Offset mode.

acmp_hysteresis_mode_t hysteresisMode
Hysteresis mode.

bool enableHighSpeed
Enable High Speed (HS) comparison mode.

bool enableInvertOutput
Enable inverted comparator output.

bool useUnfilteredOutput
Set compare output(COUT) to equal COUTA(true) or COUT(false).

bool enablePinOut
The comparator output is available on the associated pin.

struct _acmp_channel_config
#include <fsl_acmp.h> Configuration for channel.

The comparator's port can be input from channel mux or DAC. If port input is from channel mux, detailed channel number for the mux should be configured.

Public Members

acmp_port_input_t positivePortInput
Input source of the comparator's positive port.

uint32_t plusMuxInput
Plus mux input channel(0~7).

acmp_port_input_t negativePortInput
Input source of the comparator's negative port.

uint32_t minusMuxInput
Minus mux input channel(0~7).

struct _acmp_filter_config
#include <fsl_acmp.h> Configuration for filter.

Public Members

uint32_t filterCount
Filter Sample Count. Available range is 1-7, 0 would cause the filter disabled.

uint32_t filterPeriod
Filter Sample Period. The divider to bus clock. Available range is 0-255.

struct _acmp_dac_config
#include <fsl_acmp.h> Configuration for DAC.

Public Members

acmp_reference_voltage_source_t referenceVoltageSource
Supply voltage reference source.

uint32_t DACValue
Value for DAC Output Voltage. Available range is 0-255.

bool enableOutput
Enable the DAC output.

struct _acmp_discrete_mode_config
#include <fsl_acmp.h> Configuration for discrete mode.

Public Members

bool enablePositiveChannelDiscreteMode
Positive Channel Continuous Mode Enable. By default, the continuous mode is used.

bool enableNegativeChannelDiscreteMode
Negative Channel Continuous Mode Enable. By default, the continuous mode is used.

2.2 ADC12: Analog-to-Digital Converter

void ADC12_Init(ADC_Type *base, const *adc12_config_t* *config)
Initialize the ADC12 module.

Parameters

- base – ADC12 peripheral base address.
- config – Pointer to "adc12_config_t" structure.

void ADC12_Deinit(ADC_Type *base)
De-initialize the ADC12 module.

Parameters

- base – ADC12 peripheral base address.

void ADC12_GetDefaultConfig(*adc12_config_t* *config)

Gets an available pre-defined settings for converter's configuration.

This function initializes the converter configuration structure with an available settings. The default values are:

Example:

```
config->referenceVoltageSource = kADC12_ReferenceVoltageSourceVref;
config->clockSource = kADC12_ClockSourceAlt0;
config->clockDivider = kADC12_ClockDivider1;
config->resolution = kADC12_Resolution8Bit;
config->sampleClockCount = 12U;
config->enableContinuousConversion = false;
```

Parameters

- config – Pointer to "adc12_config_t" structure.

void ADC12_SetChannelConfig(ADC_Type *base, uint32_t channelGroup, const *adc12_channel_config_t* *config)

Configure the conversion channel.

This operation triggers the conversion in software trigger mode. In hardware trigger mode, this API configures the channel while the external trigger source helps to trigger the conversion.

Note that the "Channel Group" has a detailed description. To allow sequential conversions of the ADC to be triggered by internal peripherals, the ADC can have more than one group of status and control register, one for each conversion. The channel group parameter indicates which group of registers are used, channel group 0 is for Group A registers and channel group 1 is for Group B registers. The channel groups are used in a "ping-pong" approach to control the ADC operation. At any time, only one of the channel groups is actively controlling ADC conversions. Channel group 0 is used for both software and hardware trigger modes of operation. Channel groups 1 and greater indicate potentially multiple channel group registers for use only in hardware trigger mode. See the chip configuration information in the MCU reference manual about the number of SC1n registers (channel groups) specific to this device. None of the channel groups 1 or greater are used for software trigger operation and therefore writes to these channel groups do not initiate a new conversion. Updating channel group 0 while a different channel group is actively controlling a conversion is allowed and vice versa. Writing any of the channel group registers while that specific channel group is actively controlling a conversion aborts the current conversion.

Parameters

- base – ADC12 peripheral base address.
- channelGroup – Channel group index.
- config – Pointer to "adc12_channel_config_t" structure.

static inline uint32_t ADC12_GetChannelConversionValue(ADC_Type *base, uint32_t channelGroup)

Get the conversion value.

Parameters

- base – ADC12 peripheral base address.
- channelGroup – Channel group index.

Returns

Conversion value.

uint32_t ADC12_GetChannelStatusFlags(ADC_Type *base, uint32_t channelGroup)

Get the status flags of channel.

Parameters

- base – ADC12 peripheral base address.
- channelGroup – Channel group index.

Returns

Flags' mask if indicated flags are asserted. See to "_adc12_channel_status_flags".

status_t ADC12_DoAutoCalibration(ADC_Type *base)

Automate the hardware calibration.

This auto calibration helps to adjust the gain automatically according to the converter's working environment. Execute the calibration before conversion. Note that the software trigger should be used during calibration.

Parameters

- base – ADC12 peripheral base address.

Return values

- kStatus_Success – Calibration is done successfully.
- kStatus_Fail – Calibration is failed.

static inline void ADC12_SetOffsetValue(ADC_Type *base, uint32_t value)

Set the offset value for the conversion result.

This offset value takes effect on the conversion result. If the offset value is not zero, the conversion result is substracted by it.

Parameters

- base – ADC12 peripheral base address.
- value – Offset value.

static inline void ADC12_SetGainValue(ADC_Type *base, uint32_t value)

Set the gain value for the conversion result.

This gain value takes effect on the conversion result. If the gain value is not zero, the conversion result is amplified as it.

Parameters

- base – ADC12 peripheral base address.
- value – Gain value.

static inline void ADC12_EnableDMA(ADC_Type *base, bool enable)

Enable generating the DMA trigger when conversion is completed.

Parameters

- base – ADC12 peripheral base address.
- enable – Switcher of DMA feature. "true" means to enable, "false" means to disable.

static inline void ADC12_EnableHardwareTrigger(ADC_Type *base, bool enable)

Enable of disable the hardware trigger mode.

Parameters

- base – ADC12 peripheral base address.

- enable – Switcher of hardware trigger feature. "true" means to enable, "false" means not.

void ADC12_SetHardwareCompareConfig(ADC_Type *base, const *adc12_hardware_compare_config_t* *config)

Configure the hardware compare mode.

The hardware compare mode provides a way to process the conversion result automatically by hardware. Only the result in compare range is available. To compare the range, see "adc12_hardware_compare_mode_t", or the reference manual document for more detailed information.

Parameters

- base – ADC12 peripheral base address.
- config – Pointer to "adc12_hardware_compare_config_t" structure. Pass "NULL" to disable the feature.

void ADC12_SetHardwareAverage(ADC_Type *base, *adc12_hardware_average_mode_t* mode)

Set the hardware average mode.

Hardware average mode provides a way to process the conversion result automatically by hardware. The multiple conversion results are accumulated and averaged internally. This aids to get more accurate conversion result.

Parameters

- base – ADC12 peripheral base address.
- mode – Setting hardware average mode. See to "adc12_hardware_average_mode_t".

uint32_t ADC12_GetStatusFlags(ADC_Type *base)

Get the status flags of the converter.

Parameters

- base – ADC12 peripheral base address.

Returns

Flags' mask if indicated flags are asserted. See to "_adc12_status_flags".

enum _adc12_channel_status_flags

Channel status flags' mask.

Values:

enumerator kADC12_ChannelConversionCompletedFlag

Conversion done.

enum _adc12_status_flags

Converter status flags' mask.

Values:

enumerator kADC12_ActiveFlag

Converter is active.

enumerator kADC12_CalibrationFailedFlag

Calibration is failed.

enum _adc12_clock_divider

Clock divider for the converter.

Values:

enumerator kADC12_ClockDivider1
For divider 1 from the input clock to the module.

enumerator kADC12_ClockDivider2
For divider 2 from the input clock to the module.

enumerator kADC12_ClockDivider4
For divider 4 from the input clock to the module.

enumerator kADC12_ClockDivider8
For divider 8 from the input clock to the module.

enum _adc12_resolution
Converter's resolution.

Values:

enumerator kADC12_Resolution8Bit
8 bit resolution.

enumerator kADC12_Resolution12Bit
12 bit resolution.

enumerator kADC12_Resolution10Bit
10 bit resolution.

enum _adc12_clock_source
Conversion clock source.

Values:

enumerator kADC12_ClockSourceAlt0
Alternate clock 1 (ADC_ALTCLK1).

enumerator kADC12_ClockSourceAlt1
Alternate clock 2 (ADC_ALTCLK2).

enumerator kADC12_ClockSourceAlt2
Alternate clock 3 (ADC_ALTCLK3).

enumerator kADC12_ClockSourceAlt3
Alternate clock 4 (ADC_ALTCLK4).

enum _adc12_reference_voltage_source
Reference voltage source.

Values:

enumerator kADC12_ReferenceVoltageSourceVref
For external pins pair of VrefH and VrefL.

enumerator kADC12_ReferenceVoltageSourceValt
For alternate reference pair of ValtH and ValtL.

enum _adc12_hardware_average_mode
Hardware average mode.

Values:

enumerator kADC12_HardwareAverageCount4
For hardware average with 4 samples.

enumerator kADC12_HardwareAverageCount8
For hardware average with 8 samples.

enumerator kADC12_HardwareAverageCount16
For hardware average with 16 samples.

enumerator kADC12_HardwareAverageCount32
For hardware average with 32 samples.

enumerator kADC12_HardwareAverageDisabled
Disable the hardware average feature.

enum _adc12_hardware_compare_mode
Hardware compare mode.

Values:

enumerator kADC12_HardwareCompareMode0
x < value1.

enumerator kADC12_HardwareCompareMode1
x > value1.

enumerator kADC12_HardwareCompareMode2
if value1 <= value2, then x < value1 || x > value2; else, value1 > x > value2.

enumerator kADC12_HardwareCompareMode3
if value1 <= value2, then value1 <= x <= value2; else x >= value1 || x <= value2.

typedef enum *_adc12_clock_divider* adc12_clock_divider_t
Clock divider for the converter.

typedef enum *_adc12_resolution* adc12_resolution_t
Converter's resolution.

typedef enum *_adc12_clock_source* adc12_clock_source_t
Conversion clock source.

typedef enum *_adc12_reference_voltage_source* adc12_reference_voltage_source_t
Reference voltage source.

typedef enum *_adc12_hardware_average_mode* adc12_hardware_average_mode_t
Hardware average mode.

typedef enum *_adc12_hardware_compare_mode* adc12_hardware_compare_mode_t
Hardware compare mode.

typedef struct *_adc12_config* adc12_config_t
Converter configuration.

typedef struct *_adc12_hardware_compare_config* adc12_hardware_compare_config_t
Hardware compare configuration.

typedef struct *_adc12_channel_config* adc12_channel_config_t
Channel conversion configuration.

FSL_ADC12_DRIVER_VERSION
ADC12 driver version.

struct _adc12_config
#include <fsl_adc12.h> Converter configuration.

Public Members

adc12_reference_voltage_source_t referenceVoltageSource
    Select the reference voltage source.

adc12_clock_source_t clockSource
    Select the input clock source to converter.

adc12_clock_divider_t clockDivider
    Select the divider of input clock source.

adc12_resolution_t resolution
    Select the sample resolution mode.

uint32_t sampleClockCount
    Select the sample clock count. Add its value may improve the stability of the conversion result.

bool enableContinuousConversion
    Enable continuous conversion mode.

struct _adc12_hardware_compare_config
    #include <fsl_adc12.h> Hardware compare configuration.

Public Members

adc12_hardware_compare_mode_t hardwareCompareMode
    Select the hardware compare mode.

int16_t value1
    Setting value1 for hardware compare mode.

int16_t value2
    Setting value2 for hardware compare mode.

struct _adc12_channel_config
    #include <fsl_adc12.h> Channel conversion configuration.

Public Members

uint32_t channelNumber
    Setting the conversion channel number. The available range is 0-31. See channel connection information for each chip in Reference Manual document.

bool enableInterruptOnConversionCompleted
    Generate a interrupt request once the conversion is completed.

2.3 Clock Driver

enum _clock_name
    Clock name used to get clock frequency.

Values:

enumerator kCLOCK_CoreSysClk
    Core/system clock

enumerator kCLOCK_BusClk
Bus clock

enumerator kCLOCK_FlashClk
Flash clock

enumerator kCLOCK_ScgSysOscClk
SCG system OSC clock. (SYSOSC)

enumerator kCLOCK_ScgSircClk
SCG SIRC clock.

enumerator kCLOCK_ScgFircClk
SCG FIRC clock.

enumerator kCLOCK_ScgLpFllClk
SCG low power FLL clock. (LPFLL)

enumerator kCLOCK_ScgSysOscAsyncDiv2Clk
SOSCDIV2_CLK.

enumerator kCLOCK_ScgSircAsyncDiv2Clk
SIRCDIV2_CLK.

enumerator kCLOCK_ScgFircAsyncDiv2Clk
FIRCDIV2_CLK.

enumerator kCLOCK_ScgLpFllAsyncDiv2Clk
LPFLLDIV2_CLK.

enumerator kCLOCK_LpoClk
LPO clock

enumerator kCLOCK_ErClk
ERCLK. The external reference clock from SCG.

enum _clock_ip_src
Clock source for peripherals that support various clock selections.

Values:

enumerator kCLOCK_IpSrcNoneOrExt
Clock is off or external clock is used.

enumerator kCLOCK_IpSrcSysOscAsync
System Oscillator async clock.

enumerator kCLOCK_IpSrcSircAsync
Slow IRC async clock.

enumerator kCLOCK_IpSrcFircAsync
Fast IRC async clock.

enumerator kCLOCK_IpSrcLpFllAsync
LPFLL async clock.

enum _clock_ip_name
Peripheral clock name difinition used for clock gate, clock source and clock divider setting. It is defined as the corresponding register address.

Values:

enumerator kCLOCK_IpInvalid

enumerator kCLOCK_Dma0

enumerator kCLOCK_Flash0

enumerator kCLOCK_Dmamux0

enumerator kCLOCK_Lpspi0

enumerator kCLOCK_Crc0

enumerator kCLOCK_Lpit0

enumerator kCLOCK_Ftm0

enumerator kCLOCK_Ftm1

enumerator kCLOCK_Ftm2

enumerator kCLOCK_Adc0

enumerator kCLOCK_Lptmr0

enumerator kCLOCK_Tsi0

enumerator kCLOCK_Tsi1

enumerator kCLOCK_PortA

enumerator kCLOCK_PortB

enumerator kCLOCK_PortC

enumerator kCLOCK_PortD

enumerator kCLOCK_PortE

enumerator kCLOCK_Pwt0

enumerator kCLOCK_Flexio0

enumerator kCLOCK_RtcOsc0

enumerator kCLOCK_Ewm0

enumerator kCLOCK_FlexioTrig0

enumerator kCLOCK_FlexioTrig1

enumerator kCLOCK_Lpi2c0

enumerator kCLOCK_Lpuart0

enumerator kCLOCK_Lpuart1

enumerator kCLOCK_Lpuart2

enumerator kCLOCK_Cmp0

SCG status return codes.

Values:

enumerator kStatus_SCG_Busy

Clock is busy.

enumerator kStatus_SCG_InvalidSrc
Invalid source.

enum _scg_sys_clk
SCG system clock type.

Values:

enumerator kSCG_SysClkSlow
System slow clock.

enumerator kSCG_SysClkCore
Core clock.

enum _scg_sys_clk_src
SCG system clock source.

Values:

enumerator kSCG_SysClkSrcSysOsc
System OSC.

enumerator kSCG_SysClkSrcSirc
Slow IRC.

enumerator kSCG_SysClkSrcFirc
Fast IRC.

enumerator kSCG_SysClkSrcLpFll
Low power FLL.

enum _scg_sys_clk_div
SCG system clock divider value.

Values:

enumerator kSCG_SysClkDivBy1
Divided by 1.

enumerator kSCG_SysClkDivBy2
Divided by 2.

enumerator kSCG_SysClkDivBy3
Divided by 3.

enumerator kSCG_SysClkDivBy4
Divided by 4.

enumerator kSCG_SysClkDivBy5
Divided by 5.

enumerator kSCG_SysClkDivBy6
Divided by 6.

enumerator kSCG_SysClkDivBy7
Divided by 7.

enumerator kSCG_SysClkDivBy8
Divided by 8.

enumerator kSCG_SysClkDivBy9
Divided by 9.

enumerator kSCG_SysClkDivBy10
Divided by 10.

enumerator kSCG_SysClkDivBy11
Divided by 11.

enumerator kSCG_SysClkDivBy12
Divided by 12.

enumerator kSCG_SysClkDivBy13
Divided by 13.

enumerator kSCG_SysClkDivBy14
Divided by 14.

enumerator kSCG_SysClkDivBy15
Divided by 15.

enumerator kSCG_SysClkDivBy16
Divided by 16.

enum _clock_clkout_src
SCG clock out configuration (CLKOUTSEL).

Values:

enumerator kClockClkoutSelScgSlow
SCG slow clock.

enumerator kClockClkoutSelSysOsc
System OSC.

enumerator kClockClkoutSelSirc
Slow IRC.

enumerator kClockClkoutSelFirc
Fast IRC.

enumerator kClockClkoutSelLpFll
Low power FLL.

enum _scg_async_clk
SCG asynchronous clock type.

Values:

enumerator kSCG_AsyncDiv2Clk
The async clock by DIV2, e.g. SOSCDIV2_CLK, SIRCDIV2_CLK.

enum scg_async_clk_div
SCG asynchronous clock divider value.

Values:

enumerator kSCG_AsyncClkDisable
Clock output is disabled.

enumerator kSCG_AsyncClkDivBy1
Divided by 1.

enumerator kSCG_AsyncClkDivBy2
Divided by 2.

enumerator kSCG_AsyncClkDivBy4
Divided by 4.

enumerator kSCG_AsyncClkDivBy8
Divided by 8.

enumerator kSCG_AsyncClkDivBy16
Divided by 16.

enumerator kSCG_AsyncClkDivBy32
Divided by 32.

enumerator kSCG_AsyncClkDivBy64
Divided by 64.

enum _scg_sosc_monitor_mode
SCG system OSC monitor mode.

Values:

enumerator kSCG_SysOscMonitorDisable
Monitor disabled.

enumerator kSCG_SysOscMonitorInt
Interrupt when the system OSC error is detected.

enumerator kSCG_SysOscMonitorReset
Reset when the system OSC error is detected.

enum _scg_sosc_mode
OSC work mode.

Values:

enumerator kSCG_SysOscModeExt
Use external clock.

enumerator kSCG_SysOscModeOscLowPower
Oscillator low power.

enumerator kSCG_SysOscModeOscHighGain
Oscillator high gain.

OSC enable mode.

Values:

enumerator kSCG_SysOscEnable
Enable OSC clock.

enumerator kSCG_SysOscEnableInStop
Enable OSC in stop mode.

enumerator kSCG_SysOscEnableInLowPower
Enable OSC in low power mode.

enumerator kSCG_SysOscEnableErClk
Enable OSCERCLK.

enum _scg_sirc_range
SCG slow IRC clock frequency range.

Values:

enumerator kSCG_SircRangeLow
Slow IRC low range clock (2 MHz, 4 MHz for i.MX 7 ULP).

enumerator kSCG_SircRangeHigh
Slow IRC high range clock (8 MHz, 16 MHz for i.MX 7 ULP).

SIRC enable mode.

Values:

enumerator kSCG_SircEnable
Enable SIRC clock.

enumerator kSCG_SircEnableInStop
Enable SIRC in stop mode.

enumerator kSCG_SircEnableInLowPower
Enable SIRC in low power mode.

enum _scg_firc_trim_mode
SCG fast IRC trim mode.

Values:

enumerator kSCG_FircTrimNonUpdate
FIRC trim enable but not enable trim value update. In this mode, the trim value is fixed to the initialized value which is defined by trimCoar and trimFine in configure structure scg_firc_trim_config_t.

enumerator kSCG_FircTrimUpdate
FIRC trim enable and trim value update enable. In this mode, the trim value is auto update.

enum _scg_firc_trim_div
SCG fast IRC trim predivided value for system OSC.

Values:

enumerator kSCG_FircTrimDivBy1
Divided by 1.

enumerator kSCG_FircTrimDivBy128
Divided by 128.

enumerator kSCG_FircTrimDivBy256
Divided by 256.

enumerator kSCG_FircTrimDivBy512
Divided by 512.

enumerator kSCG_FircTrimDivBy1024
Divided by 1024.

enumerator kSCG_FircTrimDivBy2048
Divided by 2048.

enum _scg_firc_trim_src
SCG fast IRC trim source.

Values:

enumerator kSCG_FircTrimSrcSysOsc
System OSC.

enum _scg_firc_range
SCG fast IRC clock frequency range.

Values:

enumerator kSCG_FircRange48M
Fast IRC is trimmed to 48 MHz.

FIRC enable mode.

Values:

enumerator kSCG_FircEnable
Enable FIRC clock.

enumerator kSCG_FircEnableInStop
Enable FIRC in stop mode.

enumerator kSCG_FircEnableInLowPower
Enable FIRC in low power mode.

enumerator kSCG_FircDisableRegulator
Disable regulator.

LPFLL enable mode.

Values:

enumerator kSCG_LpFllEnable
Enable LPFLL clock.

enum _scg_lpfll_range
SCG LPFLL clock frequency range.

Values:

enumerator kSCG_LpFllRange48M
LPFLL is trimmed to 48MHz.

enumerator kSCG_LpFllRange72M
LPFLL is trimmed to 72MHz.

enum _scg_lpfll_trim_mode
SCG LPFLL trim mode.

Values:

enumerator kSCG_LpFllTrimNonUpdate
LPFLL trim is enabled but the trim value update is not enabled. In this mode, the trim value is fixed to the initialized value, which is defined by the Member variable trimValue in the structure scg_lpfll_trim_config_t.

enumerator kSCG_LpFllTrimUpdate
FIRC trim is enabled and trim value update is enabled. In this mode, the trim value is automatically updated.

enum _scg_lpfll_trim_src
SCG LPFLL trim source.

Values:

enumerator kSCG_LpFllTrimSrcSirc
SIRC.

enumerator kSCG_LpFllTrimSrcFirc
FIRC.

enumerator kSCG_LpFllTrimSrcSysOsc
System OSC.

enumerator kSCG_LpFllTrimSrcRtcOsc
RTC OSC (32.768 kHz).

enum _scg_lpfll_lock_mode
SCG LPFLL lock mode.

Values:

enumerator kSCG_LpFllLock1Lsb
Lock with 1 LSB.

enumerator kSCG_LpFllLock2Lsb
Lock with 2 LSB.

typedef enum *_clock_name* clock_name_t
Clock name used to get clock frequency.

typedef enum *_clock_ip_src* clock_ip_src_t
Clock source for peripherals that support various clock selections.

typedef enum *_clock_ip_name* clock_ip_name_t
Peripheral clock name difinition used for clock gate, clock source and clock divider setting. It is defined as the corresponding register address.

typedef enum *_scg_sys_clk* scg_sys_clk_t
SCG system clock type.

typedef enum *_scg_sys_clk_src* scg_sys_clk_src_t
SCG system clock source.

typedef enum *_scg_sys_clk_div* scg_sys_clk_div_t
SCG system clock divider value.

typedef struct *_scg_sys_clk_config* scg_sys_clk_config_t
SCG system clock configuration.

typedef enum *_clock_clkout_src* clock_clkout_src_t
SCG clock out configuration (CLKOUTSEL).

typedef enum *_scg_async_clk* scg_async_clk_t
SCG asynchronous clock type.

typedef enum *scg_async_clk_div* scg_async_clk_div_t
SCG asynchronous clock divider value.

typedef enum *_scg_sosc_monitor_mode* scg_sosc_monitor_mode_t
SCG system OSC monitor mode.

typedef enum *_scg_sosc_mode* scg_sosc_mode_t
OSC work mode.

typedef struct *_scg_sosc_config* scg_sosc_config_t
SCG system OSC configuration.

typedef enum *_scg_sirc_range* scg_sirc_range_t
SCG slow IRC clock frequency range.

typedef struct *_scg_sirc_config* scg_sirc_config_t
SCG slow IRC clock configuration.

typedef enum *_scg_firc_trim_mode* scg_firc_trim_mode_t
SCG fast IRC trim mode.

typedef enum *_scg_firc_trim_div* scg_firc_trim_div_t
SCG fast IRC trim predivided value for system OSC.

typedef enum *_scg_firc_trim_src* scg_firc_trim_src_t
SCG fast IRC trim source.

typedef struct *_scg_firc_trim_config* scg_firc_trim_config_t
SCG fast IRC clock trim configuration.

typedef enum *_scg_firc_range* scg_firc_range_t
SCG fast IRC clock frequency range.

typedef struct *_scg_firc_config_t* scg_firc_config_t
SCG fast IRC clock configuration.

typedef enum *_scg_lpfll_range* scg_lpfll_range_t
SCG LPFLL clock frequency range.

typedef enum *_scg_lpfll_trim_mode* scg_lpfll_trim_mode_t
SCG LPFLL trim mode.

typedef enum *_scg_lpfll_trim_src* scg_lpfll_trim_src_t
SCG LPFLL trim source.

typedef enum *_scg_lpfll_lock_mode* scg_lpfll_lock_mode_t
SCG LPFLL lock mode.

typedef struct *_scg_lpfll_trim_config* scg_lpfll_trim_config_t
SCG LPFLL clock trim configuration.

typedef struct *_scg_lpfll_config* scg_lpfll_config_t
SCG low power FLL configuration.

volatile uint32_t g_xtal0Freq
External XTAL0 (OSC0/SYSOSC) clock frequency.

The XTAL0/EXTAL0 (OSC0/SYSOSC) clock frequency in Hz. When the clock is set up, use the function CLOCK_SetXtal0Freq to set the value in the clock driver. For example, if XTAL0 is 8 MHz:

```
CLOCK_InitSysOsc(...);
CLOCK_SetXtal0Freq(80000000);
```

This is important for the multicore platforms where only one core needs to set up the OSC0/SYSOSC using CLOCK_InitSysOsc. All other cores need to call the CLOCK_SetXtal0Freq to get a valid clock frequency.

static inline void CLOCK_EnableClock(*clock_ip_name_t* name)
Enable the clock for specific IP.

Parameters

- name – Which clock to enable, see clock_ip_name_t.

static inline void CLOCK_DisableClock(*clock_ip_name_t* name)
Disable the clock for specific IP.

Parameters

- name – Which clock to disable, see clock_ip_name_t.

static inline void CLOCK_SetIpSrc(*clock_ip_name_t* name, *clock_ip_src_t* src)

Set the clock source for specific IP module.

Set the clock source for specific IP, not all modules need to set the clock source, should only use this function for the modules need source setting.

Parameters

- name – Which peripheral to check, see clock_ip_name_t.
- src – Clock source to set.

static inline void CLOCK_SetIpSrcDiv(*clock_ip_name_t* name, *clock_ip_src_t* src, uint16_t divValue, uint8_t fracValue)

Set the clock source and divider for specific IP module.

Set the clock source and divider for specific IP, not all modules need to set the clock source and divider, should only use this function for the modules need source and divider setting.

Divider output clock = Divider input clock x [(fracValue+1)/(divValue+1)]).

Parameters

- name – Which peripheral to check, see clock_ip_name_t.
- src – Clock source to set.
- divValue – The divider value.
- fracValue – The fraction multiply value.

uint32_t CLOCK_GetFreq(*clock_name_t* clockName)

Gets the clock frequency for a specific clock name.

This function checks the current clock configurations and then calculates the clock frequency for a specific clock name defined in clock_name_t.

Parameters

- clockName – Clock names defined in clock_name_t

Returns

Clock frequency value in hertz

uint32_t CLOCK_GetCoreSysClkFreq(void)

Get the core clock or system clock frequency.

Returns

Clock frequency in Hz.

uint32_t CLOCK_GetBusClkFreq(void)

Get the bus clock frequency.

Returns

Clock frequency in Hz.

uint32_t CLOCK_GetFlashClkFreq(void)

Get the flash clock frequency.

Returns

Clock frequency in Hz.

uint32_t CLOCK_GetErClkFreq(void)

Get the external reference clock frequency (ERCLK).

Returns

Clock frequency in Hz.

uint32_t CLOCK_GetIpFreq(*clock_ip_name_t* name)

Gets the clock frequency for a specific IP module.

This function gets the IP module clock frequency based on PCC registers. It is only used for the IP modules which could select clock source by PCC[PCS].

Parameters

- name – Which peripheral to get, see clock_ip_name_t.

Returns

Clock frequency value in hertz

FSL_CLOCK_DRIVER_VERSION

CLOCK driver version 2.0.0.

SDK_DEVICE_MAXIMUM_CPU_CLOCK_FREQUENCY

DMAMUX_CLOCKS

Clock ip name array for DMAMUX.

PORT_CLOCKS

Clock ip name array for PORT.

LPI2C_CLOCKS

Clock ip name array for LPI2C.

FLEXIO_CLOCKS

Clock ip name array for FLEXIO.

TSI_CLOCKS

Clock ip name array for TSI.

EDMA_CLOCKS

Clock ip name array for EDMA.

LPUART_CLOCKS

Clock ip name array for LPUART.

LPTMR_CLOCKS

Clock ip name array for LPTMR.

ADC12_CLOCKS

Clock ip name array for ADC12.

LPSPI_CLOCKS

Clock ip name array for LPSPI.

LPIT_CLOCKS

Clock ip name array for LPIT.

CRC_CLOCKS

Clock ip name array for CRC.

CMP_CLOCKS

Clock ip name array for CMP.

FLASH_CLOCKS

Clock ip name array for FLASH.

EWM_CLOCKS

Clock ip name array for EWM.

FTM_CLOCKS
Clock ip name array for FLEXTMR.

PWT_CLOCKS
Clock ip name array for PWT.

FLEXIOTRIG_CLOCKS
Clock ip name array for FLEXIO_TRIG0/1 Aync clock.

LPO_CLK_FREQ
LPO clock frequency.

kCLOCK_Osc0ErClk

CLOCK_GetOsc0ErClkFreq
For compatible with other MCG platforms.

uint32_t CLOCK_GetSysClkFreq(*scg_sys_clk_t* type)
Gets the SCG system clock frequency.

This function gets the SCG system clock frequency. These clocks are used for core, platform, external, and bus clock domains.

Parameters

- type – Which type of clock to get, core clock or slow clock.

Returns
Clock frequency.

static inline void CLOCK_SetVlprModeSysClkConfig(const *scg_sys_clk_config_t* *config)
Sets the system clock configuration for VLPR mode.

This function sets the system clock configuration for VLPR mode.

Parameters

- config – Pointer to the configuration.

static inline void CLOCK_SetRunModeSysClkConfig(const *scg_sys_clk_config_t* *config)
Sets the system clock configuration for RUN mode.

This function sets the system clock configuration for RUN mode.

Parameters

- config – Pointer to the configuration.

static inline void CLOCK_GetCurSysClkConfig(*scg_sys_clk_config_t* *config)
Gets the system clock configuration in the current power mode.

This function gets the system configuration in the current power mode.

Parameters

- config – Pointer to the configuration.

static inline void CLOCK_SetClkOutSel(*clock_clkout_src_t* setting)
Sets the clock out selection.

This function sets the clock out selection (CLKOUTSEL).

Parameters

- setting – The selection to set.

Returns
The current clock out selection.

status_t CLOCK_InitSysOsc(const *scg_sosc_config_t* *config)

Initializes the SCG system OSC.

This function enables the SCG system OSC clock according to the configuration.

Note: This function can't detect whether the system OSC has been enabled and used by an IP.

Parameters

- config – Pointer to the configuration structure.

Return values

- kStatus_Success – System OSC is initialized.
- kStatus_SCG_Busy – System OSC has been enabled and is used by the system clock.
- kStatus_ReadOnly – System OSC control register is locked.

status_t CLOCK_DeinitSysOsc(void)

De-initializes the SCG system OSC.

This function disables the SCG system OSC clock.

Note: This function can't detect whether the system OSC is used by an IP.

Return values

- kStatus_Success – System OSC is deinitialized.
- kStatus_SCG_Busy – System OSC is used by the system clock.
- kStatus_ReadOnly – System OSC control register is locked.

static inline void CLOCK_SetSysOscAsyncClkDiv(*scg_async_clk_t* asyncClk, *scg_async_clk_div_t* divider)

Set the asynchronous clock divider.

Note: There might be glitch when changing the asynchronous divider, so make sure the asynchronous clock is not used while changing divider.

Parameters

- asyncClk – Which asynchronous clock to configure.
- divider – The divider value to set.

uint32_t CLOCK_GetSysOscFreq(void)

Gets the SCG system OSC clock frequency (SYSOSC).

Returns

Clock frequency; If the clock is invalid, returns 0.

uint32_t CLOCK_GetSysOscAsyncFreq(*scg_async_clk_t* type)

Gets the SCG asynchronous clock frequency from the system OSC.

Parameters

- type – The asynchronous clock type.

Returns
Clock frequency; If the clock is invalid, returns 0.

static inline bool CLOCK_IsSysOscErr(void)

Checks whether the system OSC clock error occurs.

Returns
True if the error occurs, false if not.

static inline void CLOCK_ClearSysOscErr(void)

Clears the system OSC clock error.

static inline void CLOCK_SetSysOscMonitorMode(*scg_sosc_monitor_mode_t* mode)

Sets the system OSC monitor mode.

This function sets the system OSC monitor mode. The mode can be disabled, it can generate an interrupt when the error is disabled, or reset when the error is detected.

Parameters

- mode – Monitor mode to set.

static inline bool CLOCK_IsSysOscValid(void)

Checks whether the system OSC clock is valid.

Returns
True if clock is valid, false if not.

status_t CLOCK_InitSirc(const *scg_sirc_config_t* *config)

Initializes the SCG slow IRC clock.

This function enables the SCG slow IRC clock according to the configuration.

Note: This function can't detect whether the system OSC has been enabled and used by an IP.

Parameters

- config – Pointer to the configuration structure.

Return values

- kStatus_Success – SIRC is initialized.
- kStatus_SCG_Busy – SIRC has been enabled and is used by system clock.
- kStatus_ReadOnly – SIRC control register is locked.

status_t CLOCK_DeinitSirc(void)

De-initializes the SCG slow IRC.

This function disables the SCG slow IRC.

Note: This function can't detect whether the SIRC is used by an IP.

Return values

- kStatus_Success – SIRC is deinitialized.
- kStatus_SCG_Busy – SIRC is used by system clock.
- kStatus_ReadOnly – SIRC control register is locked.

static inline void CLOCK_SetSircAsyncClkDiv(*scg_async_clk_t* asyncClk, *scg_async_clk_div_t* divider)

Set the asynchronous clock divider.

Note: There might be glitch when changing the asynchronous divider, so make sure the asynchronous clock is not used while changing divider.

Parameters

- asyncClk – Which asynchronous clock to configure.
- divider – The divider value to set.

uint32_t CLOCK_GetSircFreq(void)

Gets the SCG SIRC clock frequency.

Returns

Clock frequency; If the clock is invalid, returns 0.

uint32_t CLOCK_GetSircAsyncFreq(*scg_async_clk_t* type)

Gets the SCG asynchronous clock frequency from the SIRC.

Parameters

- type – The asynchronous clock type.

Returns

Clock frequency; If the clock is invalid, returns 0.

static inline bool CLOCK_IsSircValid(void)

Checks whether the SIRC clock is valid.

Returns

True if clock is valid, false if not.

status_t CLOCK_InitFirc(const *scg_firc_config_t* *config)

Initializes the SCG fast IRC clock.

This function enables the SCG fast IRC clock according to the configuration.

Note: This function can't detect whether the FIRC has been enabled and used by an IP.

Parameters

- config – Pointer to the configuration structure.

Return values

- kStatus_Success – FIRC is initialized.
- kStatus_SCG_Busy – FIRC has been enabled and is used by the system clock.
- kStatus_ReadOnly – FIRC control register is locked.

status_t CLOCK_DeinitFirc(void)

De-initializes the SCG fast IRC.

This function disables the SCG fast IRC.

Note: This function can't detect whether the FIRC is used by an IP.

Return values

- kStatus_Success – FIRC is deinitialized.
- kStatus_SCG_Busy – FIRC is used by the system clock.
- kStatus_ReadOnly – FIRC control register is locked.

static inline void CLOCK_SetFircAsyncClkDiv(*scg_async_clk_t* asyncClk, *scg_async_clk_div_t* divider)

Set the asynchronous clock divider.

Note: There might be glitch when changing the asynchronous divider, so make sure the asynchronous clock is not used while changing divider.

Parameters

- asyncClk – Which asynchronous clock to configure.
- divider – The divider value to set.

uint32_t CLOCK_GetFircFreq(void)

Gets the SCG FIRC clock frequency.

Returns

Clock frequency; If the clock is invalid, returns 0.

uint32_t CLOCK_GetFircAsyncFreq(*scg_async_clk_t* type)

Gets the SCG asynchronous clock frequency from the FIRC.

Parameters

- type – The asynchronous clock type.

Returns

Clock frequency; If the clock is invalid, returns 0.

static inline bool CLOCK_IsFircValid(void)

Checks whether the FIRC clock is valid.

Returns

True if clock is valid, false if not.

status_t CLOCK_InitLpFll(const *scg_lpfll_config_t* *config)

Initializes the SCG LPFLL clock.

This function enables the SCG LPFLL clock according to the configuration.

Note: This function can't detect whether the LPFLL has been enabled and used by an IP.

Parameters

- config – Pointer to the configuration structure.

Return values

- kStatus_Success – LPFLL is initialized.
- kStatus_SCG_Busy – LPFLL has been enabled and is used by the system clock.
- kStatus_ReadOnly – LPFLL control register is locked.

status_t CLOCK_DeinitLpFll(void)

De-initializes the SCG LPFLL.

This function disables the SCG LPFLL.

Note: This function can't detect whether the LPFLL is used by an IP.

Return values

- kStatus_Success – LPFLL is deinitialized.
- kStatus_SCG_Busy – LPFLL is used by the system clock.
- kStatus_ReadOnly – LPFLL control register is locked.

static inline void CLOCK_SetLpFllAsyncClkDiv(*scg_async_clk_t* asyncClk, *scg_async_clk_div_t* divider)

Set the asynchronous clock divider.

Note: There might be glitch when changing the asynchronous divider, so make sure the asynchronous clock is not used while changing divider.

Parameters

- asyncClk – Which asynchronous clock to configure.
- divider – The divider value to set.

uint32_t CLOCK_GetLpFllFreq(void)

Gets the SCG LPFLL clock frequency.

Returns

Clock frequency in Hz; If the clock is invalid, returns 0.

uint32_t CLOCK_GetLpFllAsyncFreq(*scg_async_clk_t* type)

Gets the SCG asynchronous clock frequency from the LPFLL.

Parameters

- type – The asynchronous clock type.

Returns

Clock frequency in Hz; If the clock is invalid, returns 0.

static inline bool CLOCK_IsLpFllValid(void)

Checks whether the LPFLL clock is valid.

Returns

True if the clock is valid, false if not.

static inline void CLOCK_SetXtal0Freq(uint32_t freq)

Sets the XTAL0 frequency based on board settings.

Parameters

- freq – The XTAL0/EXTAL0 input clock frequency in Hz.

uint32_t divSlow

Slow clock divider, see scg_sys_clk_div_t.

uint32_t __pad0__

Reserved.

uint32_t __pad1__
Reserved.

uint32_t __pad2__
Reserved.

uint32_t divCore
Core clock divider, see scg_sys_clk_div_t.

uint32_t __pad3__
Reserved.

uint32_t src
System clock source, see scg_sys_clk_src_t.

uint32_t __pad4__
reserved.

uint32_t freq
System OSC frequency.

scg_sosc_monitor_mode_t monitorMode
Clock monitor mode selected.

uint8_t enableMode
Enable mode, OR'ed value of _scg_sosc_enable_mode.

scg_async_clk_div_t div2
SOSCDIV2 value.

scg_sosc_mode_t workMode
OSC work mode.

uint32_t enableMode
Enable mode, OR'ed value of _scg_sirc_enable_mode.

scg_async_clk_div_t div2
SIRCDIV2 value.

scg_sirc_range_t range
Slow IRC frequency range.

scg_firc_trim_mode_t trimMode
FIRC trim mode.

scg_firc_trim_src_t trimSrc
Trim source.

scg_firc_trim_div_t trimDiv
Trim predivided value for the system OSC.

uint8_t trimCoar
Trim coarse value; Irrelevant if trimMode is kSCG_FircTrimUpdate.

uint8_t trimFine
Trim fine value; Irrelevant if trimMode is kSCG_FircTrimUpdate.

uint32_t enableMode
Enable mode, OR'ed value of _scg_firc_enable_mode.

scg_async_clk_div_t div2
FIRCDIV2 value.

scg_firc_range_t range
: Fast IRC frequency range.

const *scg_firc_trim_config_t* *trimConfig
: Pointer to the FIRC trim configuration; set NULL to disable trim.

scg_lpfll_trim_mode_t trimMode
: Trim mode.

scg_lpfll_lock_mode_t lockMode
: Lock mode; Irrelevant if the trimMode is kSCG_LpFllTrimNonUpdate.

scg_lpfll_trim_src_t trimSrc
: Trim source.

uint8_t trimDiv
: Trim predivideds value, which can be 0 ~ 31. [Trim source frequency / (trimDiv + 1)] must be 2 MHz or 32768 Hz.

uint8_t trimValue
: Trim value; Irrelevant if trimMode is the kSCG_LpFllTrimUpdate.

uint8_t enableMode
: Enable mode, OR'ed value of _scg_lpfll_enable_mode

scg_async_clk_div_t div2
: LPFLLDIV2 value.

scg_lpfll_range_t range
: LPFLL frequency range.

const *scg_lpfll_trim_config_t* *trimConfig
: Trim configuration; set NULL to disable trim.

FSL_SDK_DISABLE_DRIVER_CLOCK_CONTROL
: Configure whether driver controls clock.

When set to 0, peripheral drivers will enable clock in initialize function and disable clock in de-initialize function. When set to 1, peripheral driver will not control the clock, application could control the clock out of the driver.

Note: All drivers share this feature switcher. If it is set to 1, application should handle clock enable and disable for all drivers.

struct _scg_sys_clk_config
: *#include <fsl_clock.h>* SCG system clock configuration.

struct _scg_sosc_config
: *#include <fsl_clock.h>* SCG system OSC configuration.

struct _scg_sirc_config
: *#include <fsl_clock.h>* SCG slow IRC clock configuration.

struct _scg_firc_trim_config
: *#include <fsl_clock.h>* SCG fast IRC clock trim configuration.

struct _scg_firc_config_t
: *#include <fsl_clock.h>* SCG fast IRC clock configuration.

struct _scg_lpfll_trim_config
: *#include <fsl_clock.h>* SCG LPFLL clock trim configuration.

struct _scg_lpfll_config
: *#include <fsl_clock.h>* SCG low power FLL configuration.

2.4 CRC: Cyclic Redundancy Check Driver

FSL_CRC_DRIVER_VERSION
: CRC driver version. Version 2.1.0.

  Current version: 2.1.0

  Change log:

  - Version 2.1.0
    - Choosing CRC clocks from CRC clock array according to instance instead of hard-coded value.
  - Version 2.0.5
    - Fix CERT-C issue with boolean-to-unsigned integer conversion.
  - Version 2.0.4
    - Release peripheral from reset if necessary in init function.
  - Version 2.0.3
    - Fix MISRA issues
  - Version 2.0.2
    - Fix MISRA issues
  - Version 2.0.1
    - move DATA and DATALL macro definition from header file to source file

enum _crc_bits
: CRC bit width.

  Values:

  enumerator kCrcBits16
  : Generate 16-bit CRC code

  enumerator kCrcBits32
  : Generate 32-bit CRC code

enum _crc_result
: CRC result type.

  Values:

  enumerator kCrcFinalChecksum
  : CRC data register read value is the final checksum. Reflect out and final xor protocol features are applied.

  enumerator kCrcIntermediateChecksum
  : CRC data register read value is intermediate checksum (raw value). Reflect out and final xor protocol feature are not applied. Intermediate checksum can be used as a seed for CRC_Init() to continue adding data to this checksum.

typedef enum *_crc_bits* crc_bits_t
: CRC bit width.

typedef enum *_crc_result* crc_result_t
CRC result type.

typedef struct *_crc_config* crc_config_t
CRC protocol configuration.

This structure holds the configuration for the CRC protocol.

void CRC_Init(CRC_Type *base, const *crc_config_t* *config)
Enables and configures the CRC peripheral module.

This function enables the clock gate in the SIM module for the CRC peripheral. It also configures the CRC module and starts a checksum computation by writing the seed.

Parameters

- base – CRC peripheral address.
- config – CRC module configuration structure.

void CRC_Deinit(CRC_Type *base)
Disables the CRC peripheral module.

This function disables the clock gate in the SIM module for the CRC peripheral.

Parameters

- base – CRC peripheral address.

void CRC_GetDefaultConfig(*crc_config_t* *config)
Loads default values to the CRC protocol configuration structure.

Loads default values to the CRC protocol configuration structure. The default values are as follows.

```
config->polynomial = 0x1021;
config->seed = 0xFFFF;
config->reflectIn = false;
config->reflectOut = false;
config->complementChecksum = false;
config->crcBits = kCrcBits16;
config->crcResult = kCrcFinalChecksum;
```

Parameters

- config – CRC protocol configuration structure.

void CRC_WriteData(CRC_Type *base, const uint8_t *data, size_t dataSize)
Writes data to the CRC module.

Writes input data buffer bytes to the CRC data register. The configured type of transpose is applied.

Parameters

- base – CRC peripheral address.
- data – Input data stream, MSByte in data[0].
- dataSize – Size in bytes of the input data buffer.

uint32_t CRC_Get32bitResult(CRC_Type *base)
Reads the 32-bit checksum from the CRC module.

Reads the CRC data register (either an intermediate or the final checksum). The configured type of transpose and complement is applied.

Parameters

- base – CRC peripheral address.

Returns
An intermediate or the final 32-bit checksum, after configured transpose and complement operations.

uint16_t CRC_Get16bitResult(CRC_Type *base)

Reads a 16-bit checksum from the CRC module.

Reads the CRC data register (either an intermediate or the final checksum). The configured type of transpose and complement is applied.

Parameters

- base – CRC peripheral address.

Returns
An intermediate or the final 16-bit checksum, after configured transpose and complement operations.

CRC_DRIVER_USE_CRC16_CCIT_FALSE_AS_DEFAULT

Default configuration structure filled by CRC_GetDefaultConfig(). Use CRC16-CCIT-FALSE as defeault.

struct _crc_config

#include <fsl_crc.h> CRC protocol configuration.

This structure holds the configuration for the CRC protocol.

Public Members

uint32_t polynomial

CRC Polynomial, MSBit first. Example polynomial: 0x1021 = 1_0000_0010_0001 = x^12+x^5+1

uint32_t seed

Starting checksum value

bool reflectIn

Reflect bits on input.

bool reflectOut

Reflect bits on output.

bool complementChecksum

True if the result shall be complement of the actual checksum.

crc_bits_t crcBits

Selects 16- or 32- bit CRC protocol.

crc_result_t crcResult

Selects final or intermediate checksum return from CRC_Get16bitResult() or CRC_Get32bitResult()

2.5 DMAMUX: Direct Memory Access Multiplexer Driver

void DMAMUX_Init(DMAMUX_Type *base)

Initializes the DMAMUX peripheral.

This function ungates the DMAMUX clock.

Parameters

- base – DMAMUX peripheral base address.

void DMAMUX_Deinit(DMAMUX_Type *base)

Deinitializes the DMAMUX peripheral.

This function gates the DMAMUX clock.

Parameters

- base – DMAMUX peripheral base address.

static inline void DMAMUX_EnableChannel(DMAMUX_Type *base, uint32_t channel)

Enables the DMAMUX channel.

This function enables the DMAMUX channel.

Parameters

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

static inline void DMAMUX_DisableChannel(DMAMUX_Type *base, uint32_t channel)

Disables the DMAMUX channel.

This function disables the DMAMUX channel.

Note: The user must disable the DMAMUX channel before configuring it.

Parameters

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

static inline void DMAMUX_SetSource(DMAMUX_Type *base, uint32_t channel, int32_t source)

Configures the DMAMUX channel source.

Parameters

- base – DMAMUX peripheral base address.
- channel – DMAMUX channel number.
- source – Channel source, which is used to trigger the DMA transfer.User need to use the dma_request_source_t type as the input parameter.

static inline void DMAMUX_EnablePeriodTrigger(DMAMUX_Type *base, uint32_t channel)

Enables the DMAMUX period trigger.

This function enables the DMAMUX period trigger feature.

Parameters

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

static inline void DMAMUX_DisablePeriodTrigger(DMAMUX_Type *base, uint32_t channel)

Disables the DMAMUX period trigger.

This function disables the DMAMUX period trigger.

Parameters

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

FSL_DMAMUX_DRIVER_VERSION
DMAMUX driver version 2.1.1.

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

void EDMA_Init(DMA_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(DMA_Type *base)
Deinitializes the eDMA peripheral.

This function gates the eDMA clock.

Parameters

- base – eDMA peripheral base address.

void EDMA_InstallTCD(DMA_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.

static inline void EDMA_EnableContinuousChannelLinkMode(DMA_Type *base, bool enable)
Enable/Disable continuous channel link mode.

Note: Do not use continuous link mode with a channel linking to itself if there is only one minor loop iteration per service request, for example, if the channel's NBYTES value is the same as either the source or destination size. The same data transfer profile can be achieved by simply increasing the NBYTES value, which provides more efficient, faster processing.

Parameters

- base – EDMA peripheral base address.
- enable – true is enable, false is disable.

static inline void EDMA_EnableMinorLoopMapping(DMA_Type *base, bool enable)

Enable/Disable minor loop mapping.

The TCDn.word2 is redefined to include individual enable fields, an offset field, and the NBYTES field.

Parameters

- base – EDMA peripheral base address.
- enable – true is enable, false is disable.

void EDMA_ResetChannel(DMA_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(DMA_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(DMA_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(DMA_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(DMA_Type *base, uint32_t channel, *edma_channel_link_type_t* linkType, 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.
- linkType – 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(DMA_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(DMA_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_EnableAsyncRequest(DMA_Type *base, uint32_t channel, bool enable)

Enables an async request for the eDMA transfer.

Parameters

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

static inline void EDMA_EnableAutoStopRequest(DMA_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(DMA_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(DMA_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(DMA_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_TcdReset(*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

- 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.

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.

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* linkType, 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

- tcd – Point to the TCD structure.
- linkType – 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.

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.

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.

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.

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.

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.

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.

static inline void EDMA_EnableChannelRequest(DMA_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(DMA_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(DMA_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(DMA_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(DMA_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(DMA_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(DMA_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, DMA_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).

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* transferType)

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.
- transferType – eDMA transfer type.

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.

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 2.4.7.

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 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_ChannelPriorityErrorFlag
Channel priority is not unique.

enumerator kEDMA_TransferCanceledFlag
Transfer cancelled

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

enum _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

_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.

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_interrupt_enable* edma_interrupt_enable_t
eDMA interrupt source

typedef enum *_edma_transfer_type* edma_transfer_type_t
eDMA transfer type

typedef struct *_edma_config* edma_config_t
eDMA global configuration structure.

typedef struct *_edma_transfer_config* edma_transfer_config_t
eDMA transfer configuration

This structure configures the source/destination transfer attribute.

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 struct *_edma_tcd* 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 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

DMA_DCHPRI_INDEX(channel)
Compute the offset unit from DCHPRI3.

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 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 enableRoundRobinArbitration

Enable (true) round robin channel arbitration method or fixed priority arbitration is used for channel selection

bool enableDebugMode

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

struct _edma_transfer_config

#include <fsl_edma.h> eDMA transfer configuration

This structure configures the source/destination transfer attribute.

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 applied to the current source address to form the next-state value as each source read is completed.

int16_t destOffset

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

uint32_t minorLoopBytes

Bytes to transfer in a minor loop

uint32_t majorLoopCounts

Major loop iteration count.

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_tcd
: *#include <fsl_edma.h>* 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.

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_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.

DMA_Type *base
    eDMA peripheral base address.

edma_tcd_t *tcdPool
    Pointer to memory stored TCDs.

uint8_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.

uint8_t flags
    The status of the current channel.

2.7 EWM: External Watchdog Monitor Driver

void EWM_Init(EWM_Type *base, const *ewm_config_t* *config)
    Initializes the EWM peripheral.

This function is used to initialize the EWM. After calling, the EWM runs immediately according to the configuration. Note that, except for the interrupt enable control bit, other control bits and registers are write once after a CPU reset. Modifying them more than once generates a bus transfer error.

This is an example.

```
ewm_config_t config;
EWM_GetDefaultConfig(&config);
config.compareHighValue = 0xAAU;
EWM_Init(ewm_base,&config);
```

Parameters

- base – EWM peripheral base address
- config – The configuration of the EWM

void EWM_Deinit(EWM_Type *base)
    Deinitializes the EWM peripheral.

This function is used to shut down the EWM.

Parameters

- base – EWM peripheral base address

void EWM_GetDefaultConfig(*ewm_config_t* *config)

Initializes the EWM configuration structure.

This function initializes the EWM configuration structure to default values. The default values are as follows.

```
ewmConfig->enableEwm = true;
ewmConfig->enableEwmInput = false;
ewmConfig->setInputAssertLogic = false;
ewmConfig->enableInterrupt = false;
ewmConfig->ewm_lpo_clock_source_t = kEWM_LpoClockSource0;
ewmConfig->prescaler = 0;
ewmConfig->compareLowValue = 0;
ewmConfig->compareHighValue = 0xFEU;
```

See also:

ewm_config_t

Parameters

- config – Pointer to the EWM configuration structure.

static inline void EWM_EnableInterrupts(EWM_Type *base, uint32_t mask)

Enables the EWM interrupt.

This function enables the EWM interrupt.

Parameters

- base – EWM peripheral base address
- mask – The interrupts to enable The parameter can be combination of the following source if defined
  - kEWM_InterruptEnable

static inline void EWM_DisableInterrupts(EWM_Type *base, uint32_t mask)

Disables the EWM interrupt.

This function enables the EWM interrupt.

Parameters

- base – EWM peripheral base address
- mask – The interrupts to disable The parameter can be combination of the following source if defined
  - kEWM_InterruptEnable

static inline uint32_t EWM_GetStatusFlags(EWM_Type *base)

Gets all status flags.

This function gets all status flags.

This is an example for getting the running flag.

```
uint32_t status;
status = EWM_GetStatusFlags(ewm_base) & kEWM_RunningFlag;
```

See also:

_ewm_status_flags_t

- True: a related status flag has been set.
- False: a related status flag is not set.

Parameters

- base – EWM peripheral base address

Returns
State of the status flag: asserted (true) or not-asserted (false).

void EWM_Refresh(EWM_Type *base)

Services the EWM.

This function resets the EWM counter to zero.

Parameters

- base – EWM peripheral base address

FSL_EWM_DRIVER_VERSION

EWM driver version 2.0.4.

enum _ewm_lpo_clock_source

Describes EWM clock source.

Values:

enumerator kEWM_LpoClockSource0

EWM clock sourced from lpo_clk[0]

enumerator kEWM_LpoClockSource1

EWM clock sourced from lpo_clk[1]

enumerator kEWM_LpoClockSource2

EWM clock sourced from lpo_clk[2]

enumerator kEWM_LpoClockSource3

EWM clock sourced from lpo_clk[3]

enum _ewm_interrupt_enable_t

EWM interrupt configuration structure with default settings all disabled.

This structure contains the settings for all of EWM interrupt configurations.

Values:

enumerator kEWM_InterruptEnable

Enable the EWM to generate an interrupt

enum _ewm_status_flags_t

EWM status flags.

This structure contains the constants for the EWM status flags for use in the EWM functions.

Values:

enumerator kEWM_RunningFlag

Running flag, set when EWM is enabled

typedef enum *_ewm_lpo_clock_source* ewm_lpo_clock_source_t

Describes EWM clock source.

typedef struct *_ewm_config* ewm_config_t

Data structure for EWM configuration.

This structure is used to configure the EWM.

struct _ewm_config

#include <fsl_ewm.h> Data structure for EWM configuration.

This structure is used to configure the EWM.

Public Members

bool enableEwm
Enable EWM module

bool enableEwmInput
Enable EWM_in input

bool setInputAssertLogic
EWM_in signal assertion state

bool enableInterrupt
Enable EWM interrupt

ewm_lpo_clock_source_t clockSource
Clock source select

uint8_t prescaler
Clock prescaler value

uint8_t compareLowValue
Compare low-register value

uint8_t compareHighValue
Compare high-register value

2.8 FGPIO Driver

void FGPIO_PinInit(FGPIO_Type *base, uint32_t pin, const *gpio_pin_config_t* *config)
Initializes a FGPIO pin used by the board.

To initialize the FGPIO driver, define a pin configuration, as either input or output, in the user file. Then, call the FGPIO_PinInit() function.

This is an example to define an input pin or an output pin configuration:

```
Define a digital input pin configuration,
gpio_pin_config_t config =
{
  kGPIO_DigitalInput,
  0,
}
Define a digital output pin configuration,
gpio_pin_config_t config =
{
  kGPIO_DigitalOutput,
  0,
}
```

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- pin – FGPIO port pin number
- config – FGPIO pin configuration pointer

static inline void FGPIO_PinWrite(FGPIO_Type *base, uint32_t pin, uint8_t output)
Sets the output level of the multiple FGPIO pins to the logic 1 or 0.

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- pin – FGPIO pin number
- output – FGPIOpin output logic level.
  - 0: corresponding pin output low-logic level.
  - 1: corresponding pin output high-logic level.

static inline void FGPIO_PortSet(FGPIO_Type *base, uint32_t mask)

Sets the output level of the multiple FGPIO pins to the logic 1.

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- mask – FGPIO pin number macro

static inline void FGPIO_PortClear(FGPIO_Type *base, uint32_t mask)

Sets the output level of the multiple FGPIO pins to the logic 0.

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- mask – FGPIO pin number macro

static inline void FGPIO_PortToggle(FGPIO_Type *base, uint32_t mask)

Reverses the current output logic of the multiple FGPIO pins.

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- mask – FGPIO pin number macro

static inline uint32_t FGPIO_PinRead(FGPIO_Type *base, uint32_t pin)

Reads the current input value of the FGPIO port.

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- pin – FGPIO pin number

Return values

FGPIO – port input value

- 0: corresponding pin input low-logic level.
- 1: corresponding pin input high-logic level.

uint32_t FGPIO_PortGetInterruptFlags(FGPIO_Type *base)

Reads the FGPIO port interrupt 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 – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)

Return values

The – current FGPIO port interrupt status flags, for example, 0x00010001 means the pin 0 and 17 have the interrupt.

void FGPIO_PortClearInterruptFlags(FGPIO_Type *base, uint32_t mask)

Clears the multiple FGPIO pin interrupt status flag.

Parameters

- base – FGPIO peripheral base pointer (FGPIOA, FGPIOB, FGPIOC, and so on.)
- mask – FGPIO pin number macro

2.9 C90TFS Flash Driver

2.10 FlexIO: FlexIO Driver

2.11 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.

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.

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 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.

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.

2.12 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

2.13 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

2.14 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.

FSL_FLEXIO_UART_EDMA_DRIVER_VERSION

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

2.15 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,
.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

FSL_FLEXIO_I2C_MASTER_DRIVER_VERSION

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.

2.16 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

2.17 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,
.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,
.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.

2.18 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,
.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 __unnamed40__

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.

2.19 ftfx adapter

2.20 Ftftx CACHE Driver

enum _ftfx_cache_ram_func_constants
Constants for execute-in-RAM flash function.

Values:

enumerator kFTFx_CACHE_RamFuncMaxSizeInWords
The maximum size of execute-in-RAM function.

typedef struct *_flash_prefetch_speculation_status* ftfx_prefetch_speculation_status_t
FTFx prefetch speculation status.

typedef struct *_ftfx_cache_config* ftfx_cache_config_t
FTFx cache driver state information.

An instance of this structure is allocated by the user of the flash driver and passed into each of the driver APIs.

status_t FTFx_CACHE_Init(*ftfx_cache_config_t* *config)
Initializes the global FTFx cache structure members.

This function checks and initializes the Flash module for the other FTFx cache APIs.

Parameters

- config – Pointer to the storage for the driver runtime state.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

status_t FTFx_CACHE_ClearCachePrefetchSpeculation(*ftfx_cache_config_t* *config, bool isPreProcess)

Process the cache/prefetch/speculation to the flash.

Parameters

- config – A pointer to the storage for the driver runtime state.
- isPreProcess – The possible option used to control flash cache/prefetch/speculation

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – Invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

status_t FTFx_CACHE_PflashSetPrefetchSpeculation(*ftfx_prefetch_speculation_status_t* *speculationStatus)

Sets the PFlash prefetch speculation to the intended speculation status.

Parameters

- speculationStatus – The expected protect status to set to the PFlash protection register. Each bit is

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidSpeculationOption – An invalid speculation option argument is provided.

status_t FTFx_CACHE_PflashGetPrefetchSpeculation(*ftfx_prefetch_speculation_status_t* *speculationStatus)

Gets the PFlash prefetch speculation status.

Parameters

- speculationStatus – Speculation status returned by the PFlash IP.

Return values

kStatus_FTFx_Success – API was executed successfully.

struct _flash_prefetch_speculation_status

#include <fsl_ftfx_cache.h> FTFx prefetch speculation status.

Public Members

bool instructionOff

Instruction speculation.

bool dataOff

Data speculation.

union function_bit_operation_ptr_t

#include <fsl_ftfx_cache.h>

Public Members

uint32_t commadAddr

void (*callFlashCommand)(volatile uint32_t *base, uint32_t bitMask, uint32_t bitShift, uint32_t bitValue)

struct _ftfx_cache_config

#include <fsl_ftfx_cache.h> FTFx cache driver state information.

An instance of this structure is allocated by the user of the flash driver and passed into each of the driver APIs.

Public Members

uint8_t flashMemoryIndex

0 - primary flash; 1 - secondary flash

function_bit_operation_ptr_t bitOperFuncAddr

An buffer point to the flash execute-in-RAM function.

2.21 ftfx controller

FTFx driver status codes.

Values:

enumerator kStatus_FTFx_Success

API is executed successfully

enumerator kStatus_FTFx_InvalidArgument

Invalid argument

enumerator kStatus_FTFx_SizeError

Error size

enumerator kStatus_FTFx_AlignmentError

Parameter is not aligned with the specified baseline

enumerator kStatus_FTFx_AddressError

Address is out of range

enumerator kStatus_FTFx_AccessError

Invalid instruction codes and out-of bound addresses

enumerator kStatus_FTFx_ProtectionViolation

The program/erase operation is requested to execute on protected areas

enumerator kStatus_FTFx_CommandFailure

Run-time error during command execution.

enumerator kStatus_FTFx_UnknownProperty

Unknown property.

enumerator kStatus_FTFx_EraseKeyError

API erase key is invalid.

enumerator kStatus_FTFx_RegionExecuteOnly
The current region is execute-only.

enumerator kStatus_FTFx_ExecuteInRamFunctionNotReady
Execute-in-RAM function is not available.

enumerator kStatus_FTFx_PartitionStatusUpdateFailure
Failed to update partition status.

enumerator kStatus_FTFx_SetFlexramAsEepromError
Failed to set FlexRAM as EEPROM.

enumerator kStatus_FTFx_RecoverFlexramAsRamError
Failed to recover FlexRAM as RAM.

enumerator kStatus_FTFx_SetFlexramAsRamError
Failed to set FlexRAM as RAM.

enumerator kStatus_FTFx_RecoverFlexramAsEepromError
Failed to recover FlexRAM as EEPROM.

enumerator kStatus_FTFx_CommandNotSupported
Flash API is not supported.

enumerator kStatus_FTFx_SwapSystemNotInUninitialized
Swap system is not in an uninitialzed state.

enumerator kStatus_FTFx_SwapIndicatorAddressError
The swap indicator address is invalid.

enumerator kStatus_FTFx_ReadOnlyProperty
The flash property is read-only.

enumerator kStatus_FTFx_InvalidPropertyValue
The flash property value is out of range.

enumerator kStatus_FTFx_InvalidSpeculationOption
The option of flash prefetch speculation is invalid.

enumerator kStatus_FTFx_CommandOperationInProgress
The option of flash command is processing.

enum _ftfx_driver_api_keys
Enumeration for FTFx driver API keys.

Note: The resulting value is built with a byte order such that the string being readable in expected order when viewed in a hex editor, if the value is treated as a 32-bit little endian value.

Values:

enumerator kFTFx_ApiEraseKey
Key value used to validate all FTFx erase APIs.

void FTFx_API_Init(*ftfx_config_t* *config)
Initializes the global flash properties structure members.

This function checks and initializes the Flash module for the other Flash APIs.

Parameters

- config – Pointer to the storage for the driver runtime state.

status_t FTFx_API_UpdateFlexnvmPartitionStatus(*ftfx_config_t* *config)

Updates FlexNVM memory partition status according to data flash 0 IFR.

This function updates FlexNVM memory partition status.

Parameters

- config – Pointer to the storage for the driver runtime state.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FTFx_CMD_Erase(*ftfx_config_t* *config, uint32_t start, uint32_t lengthInBytes, uint32_t key)

Erases the flash sectors encompassed by parameters passed into function.

This function erases the appropriate number of flash sectors based on the desired start address and length.

Parameters

- config – The pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be erased. The start address does not need to be sector-aligned but must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words) to be erased. Must be word-aligned.
- key – The value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – The parameter is not aligned with the specified baseline.
- kStatus_FTFx_AddressError – The address is out of range.
- kStatus_FTFx_EraseKeyError – The API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_EraseSectorNonBlocking(*ftfx_config_t* *config, uint32_t start, uint32_t key)

Erases the flash sectors encompassed by parameters passed into function.

This function erases one flash sector size based on the start address.

Parameters

- config – The pointer to the storage for the driver runtime state.

- start – The start address of the desired flash memory to be erased. The start address does not need to be sector-aligned but must be word-aligned.
- key – The value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – The parameter is not aligned with the specified baseline.
- kStatus_FTFx_AddressError – The address is out of range.
- kStatus_FTFx_EraseKeyError – The API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

status_t FTFx_CMD_EraseAll(*ftfx_config_t* *config, uint32_t key)

Erases entire flash.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FTFx_CMD_EraseAllUnsecure(*ftfx_config_t* *config, uint32_t key)

Erases the entire flash, including protected sectors.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FTFx_CMD_EraseAllExecuteOnlySegments(*ftfx_config_t* *config, uint32_t key)

Erases all program flash execute-only segments defined by the FXACC registers.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_Program(*ftfx_config_t* *config, uint32_t start, const uint8_t *src, uint32_t lengthInBytes)

Programs flash with data at locations passed in through parameters.

This function programs the flash memory with the desired data for a given flash area as determined by the start address and the length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- src – A pointer to the source buffer of data that is to be programmed into the flash.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with the specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.

- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_ProgramOnce(*ftfx_config_t* *config, uint32_t index, const uint8_t *src, uint32_t lengthInBytes)

Programs Program Once Field through parameters.

This function programs the Program Once Field with the desired data for a given flash area as determined by the index and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- index – The index indicating which area of the Program Once Field to be programmed.
- src – A pointer to the source buffer of data that is to be programmed into the Program Once Field.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_ProgramSection(*ftfx_config_t* *config, uint32_t start, const uint8_t *src, uint32_t lengthInBytes)

Programs flash with data at locations passed in through parameters via the Program Section command.

This function programs the flash memory with the desired data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- src – A pointer to the source buffer of data that is to be programmed into the flash.

- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_SetFlexramAsRamError – Failed to set flexram as RAM.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_RecoverFlexramAsEepromError – Failed to recover FlexRAM as EEPROM.

status_t FTFx_CMD_ProgramPartition(*ftfx_config_t* *config, *ftfx_partition_flexram_load_opt_t* option, uint32_t eepromDataSizeCode, uint32_t flexnvmPartitionCode, uint8_t CSEcKeySize, uint8_t CFE)

Prepares the FlexNVM block for use as data flash, EEPROM backup, or a combination of both and initializes the FlexRAM.

Parameters

- config – Pointer to storage for the driver runtime state.
- option – The option used to set FlexRAM load behavior during reset.
- eepromDataSizeCode – Determines the amount of FlexRAM used in each of the available EEPROM subsystems.
- flexnvmPartitionCode – Specifies how to split the FlexNVM block between data flash memory and EEPROM backup memory supporting EEPROM functions.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – Invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.

status_t FTFx_CMD_ReadOnce(*ftfx_config_t* *config, uint32_t index, uint8_t *dst, uint32_t lengthInBytes)

Reads the Program Once Field through parameters.

This function reads the read once feild with given index and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- index – The index indicating the area of program once field to be read.
- dst – A pointer to the destination buffer of data that is used to store data to be read.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_ReadResource(*ftfx_config_t* *config, uint32_t start, uint8_t *dst, uint32_t lengthInBytes, *ftfx_read_resource_opt_t* option)

Reads the resource with data at locations passed in through parameters.

This function reads the flash memory with the desired location for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- dst – A pointer to the destination buffer of data that is used to store data to be read.
- lengthInBytes – The length, given in bytes (not words or long-words), to be read. Must be word-aligned.
- option – The resource option which indicates which area should be read back.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with the specified baseline.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_VerifyErase(*ftfx_config_t* *config, uint32_t start, uint32_t lengthInBytes, *ftfx_margin_value_t* margin)

Verifies an erasure of the desired flash area at a specified margin level.

This function checks the appropriate number of flash sectors based on the desired start address and length to check whether the flash is erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be verified. The start address does not need to be sector-aligned but must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words), to be verified. Must be word-aligned.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_VerifyEraseAll(*ftfx_config_t* *config, *ftfx_margin_value_t* margin)

Verifies erasure of the entire flash at a specified margin level.

This function checks whether the flash is erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_VerifyEraseAllExecuteOnlySegments(*ftfx_config_t* *config, *ftfx_margin_value_t* margin)

Verifies whether the program flash execute-only segments have been erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_VerifyProgram(*ftfx_config_t* *config, uint32_t start, uint32_t lengthInBytes, const uint8_t *expectedData, *ftfx_margin_value_t* margin, uint32_t *failedAddress, uint32_t *failedData)

Verifies programming of the desired flash area at a specified margin level.

This function verifies the data programed in the flash memory using the Flash Program Check Command and compares it to the expected data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be verified. Must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words), to be verified. Must be word-aligned.
- expectedData – A pointer to the expected data that is to be verified against.
- margin – Read margin choice.
- failedAddress – A pointer to the returned failing address.
- failedData – A pointer to the returned failing data. Some derivatives do not include failed data as part of the FCCOBx registers. In this case, zeros are returned upon failure.

Return values

- kStatus_FTFx_Success – API was executed successfully.

- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_REG_GetSecurityState(*ftfx_config_t* *config, *ftfx_security_state_t* *state)

Returns the security state via the pointer passed into the function.

This function retrieves the current flash security status, including the security enabling state and the backdoor key enabling state.

Parameters

- config – A pointer to storage for the driver runtime state.
- state – A pointer to the value returned for the current security status code:

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

status_t FTFx_CMD_SecurityBypass(*ftfx_config_t* *config, const uint8_t *backdoorKey)

Allows users to bypass security with a backdoor key.

If the MCU is in secured state, this function unsecures the MCU by comparing the provided backdoor key with ones in the flash configuration field.

Parameters

- config – A pointer to the storage for the driver runtime state.
- backdoorKey – A pointer to the user buffer containing the backdoor key.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_SetFlexramFunction(*ftfx_config_t* *config, *ftfx_flexram_func_opt_t* option)

Sets the FlexRAM function command.

Parameters

- config – A pointer to the storage for the driver runtime state.
- option – The option used to set the work mode of FlexRAM.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FTFx_CMD_SwapControl(*ftfx_config_t* *config, uint32_t address, *ftfx_swap_control_opt_t* option, *ftfx_swap_state_config_t* *returnInfo)

Configures the Swap function or checks the swap state of the Flash module.

Parameters

- config – A pointer to the storage for the driver runtime state.
- address – Address used to configure the flash Swap function.
- option – The possible option used to configure Flash Swap function or check the flash Swap status
- returnInfo – A pointer to the data which is used to return the information of flash Swap.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_SwapIndicatorAddressError – Swap indicator address is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

enum _ftfx_partition_flexram_load_option

Enumeration for the FlexRAM load during reset option.

Values:

enumerator kFTFx_PartitionFlexramLoadOptLoadedWithValidEepromData

FlexRAM is loaded with valid EEPROM data during reset sequence.

enumerator kFTFx_PartitionFlexramLoadOptNotLoaded
FlexRAM is not loaded during reset sequence.

enum _ftfx_read_resource_opt
Enumeration for the two possible options of flash read resource command.

Values:

enumerator kFTFx_ResourceOptionFlashIfr
Select code for Program flash 0 IFR, Program flash swap 0 IFR, Data flash 0 IFR

enumerator kFTFx_ResourceOptionVersionId
Select code for the version ID

enum _ftfx_margin_value
Enumeration for supported FTFx margin levels.

Values:

enumerator kFTFx_MarginValueNormal
Use the 'normal' read level for 1s.

enumerator kFTFx_MarginValueUser
Apply the 'User' margin to the normal read-1 level.

enumerator kFTFx_MarginValueFactory
Apply the 'Factory' margin to the normal read-1 level.

enumerator kFTFx_MarginValueInvalid
Not real margin level, Used to determine the range of valid margin level.

enum _ftfx_security_state
Enumeration for the three possible FTFx security states.

Values:

enumerator kFTFx_SecurityStateNotSecure
Flash is not secure.

enumerator kFTFx_SecurityStateBackdoorEnabled
Flash backdoor is enabled.

enumerator kFTFx_SecurityStateBackdoorDisabled
Flash backdoor is disabled.

enum _ftfx_flexram_function_option
Enumeration for the two possilbe options of set FlexRAM function command.

Values:

enumerator kFTFx_FlexramFuncOptAvailableAsRam
An option used to make FlexRAM available as RAM

enumerator kFTFx_FlexramFuncOptEepromQuickWriteRecovery
An option used to complete interrupted EEPROM quick write process

enumerator kFTFx_FlexramFuncOptEepromQuickWriteStatus
An option used to make EEPROM quick write status query

enumerator kFTFx_FlexramFuncOptAvailableForEepromQuickWrite
An option used to make FlexRAM available for EEPROM in Quick Write mode

enumerator kFTFx_FlexramFuncOptAvailableForEeprom
An option used to make FlexRAM available for EEPROM

enum _flash_acceleration_ram_property
Enumeration for acceleration ram property.

Values:

enumerator kFLASH_AccelerationRamSize

enum _ftfx_swap_control_option
Enumeration for the possible options of Swap control commands.

Values:

enumerator kFTFx_SwapControlOptionIntializeSystem
An option used to initialize the Swap system

enumerator kFTFx_SwapControlOptionSetInUpdateState
An option used to set the Swap in an update state

enumerator kFTFx_SwapControlOptionSetInCompleteState
An option used to set the Swap in a complete state

enumerator kFTFx_SwapControlOptionReportStatus
An option used to report the Swap status

enumerator kFTFx_SwapControlOptionDisableSystem
An option used to disable the Swap status

enum _ftfx_swap_state
Enumeration for the possible flash Swap status.

Values:

enumerator kFTFx_SwapStateUninitialized
Flash Swap system is in an uninitialized state.

enumerator kFTFx_SwapStateReady
Flash Swap system is in a ready state.

enumerator kFTFx_SwapStateUpdate
Flash Swap system is in an update state.

enumerator kFTFx_SwapStateUpdateErased
Flash Swap system is in an updateErased state.

enumerator kFTFx_SwapStateComplete
Flash Swap system is in a complete state.

enumerator kFTFx_SwapStateDisabled
Flash Swap system is in a disabled state.

enum _ftfx_swap_block_status
Enumeration for the possible flash Swap block status.

Values:

enumerator kFTFx_SwapBlockStatusLowerHalfProgramBlocksAtZero
Swap block status is that lower half program block at zero.

enumerator kFTFx_SwapBlockStatusUpperHalfProgramBlocksAtZero
Swap block status is that upper half program block at zero.

enum _ftfx_memory_type
Enumeration for FTFx memory type.

Values:

enumerator kFTFx_MemTypePflash

enumerator kFTFx_MemTypeFlexnvm

typedef enum *_ftfx_partition_flexram_load_option* ftfx_partition_flexram_load_opt_t
Enumeration for the FlexRAM load during reset option.

typedef enum *_ftfx_read_resource_opt* ftfx_read_resource_opt_t
Enumeration for the two possible options of flash read resource command.

typedef enum *_ftfx_margin_value* ftfx_margin_value_t
Enumeration for supported FTFx margin levels.

typedef enum *_ftfx_security_state* ftfx_security_state_t
Enumeration for the three possible FTFx security states.

typedef enum *_ftfx_flexram_function_option* ftfx_flexram_func_opt_t
Enumeration for the two possilbe options of set FlexRAM function command.

typedef enum *_ftfx_swap_control_option* ftfx_swap_control_opt_t
Enumeration for the possible options of Swap control commands.

typedef enum *_ftfx_swap_state* ftfx_swap_state_t
Enumeration for the possible flash Swap status.

typedef enum *_ftfx_swap_block_status* ftfx_swap_block_status_t
Enumeration for the possible flash Swap block status.

typedef struct *_ftfx_swap_state_config* ftfx_swap_state_config_t
Flash Swap information.

typedef struct *_ftfx_special_mem* ftfx_spec_mem_t
ftfx special memory access information.

typedef struct *_ftfx_mem_descriptor* ftfx_mem_desc_t
Flash memory descriptor.

typedef struct *_ftfx_ops_config* ftfx_ops_config_t
Active FTFx information for the current operation.

typedef struct *_ftfx_ifr_descriptor* ftfx_ifr_desc_t
Flash IFR memory descriptor.

typedef struct *_ftfx_config* ftfx_config_t
Flash driver state information.

An instance of this structure is allocated by the user of the flash driver and passed into each of the driver APIs.

struct _ftfx_swap_state_config
#include <fsl_ftfx_controller.h> Flash Swap information.

Public Members

ftfx_swap_state_t flashSwapState
The current Swap system status.

ftfx_swap_block_status_t currentSwapBlockStatus
The current Swap block status.

ftfx_swap_block_status_t nextSwapBlockStatus
The next Swap block status.

struct _ftfx_special_mem
#include <fsl_ftfx_controller.h> ftfx special memory access information.

Public Members

uint32_t base
Base address of flash special memory.

uint32_t size
size of flash special memory.

uint32_t count
flash special memory count.

struct _ftfx_mem_descriptor
#include <fsl_ftfx_controller.h> Flash memory descriptor.

Public Members

uint32_t blockBase
A base address of the flash block

uint32_t aliasBlockBase
A base address of the alias flash block

uint32_t totalSize
The size of the flash block.

uint32_t sectorSize
The size in bytes of a sector of flash.

uint32_t blockCount
A number of flash blocks.

struct _ftfx_ops_config
#include <fsl_ftfx_controller.h> Active FTFx information for the current operation.

Public Members

uint32_t convertedAddress
A converted address for the current flash type.

struct _ftfx_ifr_descriptor
#include <fsl_ftfx_controller.h> Flash IFR memory descriptor.

union function_ptr_t
#include <fsl_ftfx_controller.h>

Public Members

uint32_t commadAddr

void (*callFlashCommand)(volatile uint8_t *FTMRx_fstat)

struct _ftfx_config
#include <fsl_ftfx_controller.h> Flash driver state information.

An instance of this structure is allocated by the user of the flash driver and passed into each of the driver APIs.

Public Members

uint32_t flexramBlockBase
    The base address of the FlexRAM/acceleration RAM

uint32_t flexramTotalSize
    The size of the FlexRAM/acceleration RAM

uint16_t eepromTotalSize
    The size of EEPROM area which was partitioned from FlexRAM

function_ptr_t runCmdFuncAddr
    An buffer point to the flash execute-in-RAM function.

struct ___unnamed11___

Public Members

uint8_t type
    Type of flash block.

uint8_t index
    Index of flash block.

struct feature

struct addrAligment

struct feature

struct resRange

Public Members

uint8_t versionIdStart
    Version ID start address

uint32_t pflashIfrStart
    Program Flash 0 IFR start address

uint32_t dflashIfrStart
    Data Flash 0 IFR start address

uint32_t pflashSwapIfrStart
    Program Flash Swap IFR start address

struct idxInfo

2.22 ftfx feature

FTFx_DRIVER_IS_FLASH_RESIDENT
    Flash driver location.

    Used for the flash resident application.

FTFx_DRIVER_IS_EXPORTED
    Flash Driver Export option.

    Used for the MCUXpresso SDK application.

FTFx_FLASH1_HAS_PROT_CONTROL
: Indicates whether the secondary flash has its own protection register in flash module.

FTFx_FLASH1_HAS_XACC_CONTROL
: Indicates whether the secondary flash has its own Execute-Only access register in flash module.

FTFx_DRIVER_HAS_FLASH1_SUPPORT
: Indicates whether the secondary flash is supported in the Flash driver.

FTFx_FLASH_COUNT

FTFx_FLASH1_IS_INDEPENDENT_BLOCK

2.23 Ftftx FLASH Driver

status_t FLASH_Init(*flash_config_t* *config)

Initializes the global flash properties structure members.

This function checks and initializes the Flash module for the other Flash APIs.

Parameters

- config – Pointer to the storage for the driver runtime state.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FLASH_Erase(*flash_config_t* *config, uint32_t start, uint32_t lengthInBytes, uint32_t key)

Erases the Dflash sectors encompassed by parameters passed into function.

This function erases the appropriate number of flash sectors based on the desired start address and length.

Parameters

- config – The pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be erased. The start address does not need to be sector-aligned but must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words) to be erased. Must be word-aligned.
- key – The value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully; the appropriate number of flash sectors based on the desired start address and length were erased successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – The parameter is not aligned with the specified baseline.

- kStatus_FTFx_AddressError – The address is out of range.
- kStatus_FTFx_EraseKeyError – The API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_EraseSectorNonBlocking(*flash_config_t* *config, uint32_t start, uint32_t key)

Erases the Dflash sectors encompassed by parameters passed into function.

This function erases one flash sector size based on the start address, and it is executed asynchronously.

NOTE: This function can only erase one flash sector at a time, and the other commands can be executed after the previous command has been completed.

Parameters

- config – The pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be erased. The start address does not need to be sector-aligned but must be word-aligned.
- key – The value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – The parameter is not aligned with the specified baseline.
- kStatus_FTFx_AddressError – The address is out of range.
- kStatus_FTFx_EraseKeyError – The API erase key is invalid.

status_t FLASH_EraseAll(*flash_config_t* *config, uint32_t key)

Erases entire flexnvm.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully; the all pflash and flexnvm were erased successfully, the swap and eeprom have been reset to unconfigured state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.

- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FLASH_EraseAllUnsecure(*flash_config_t* *config, uint32_t key)

Erases the entire flexnvm, including protected sectors.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully; the protected sectors of flash were reset to unprotected status.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FLASH_Program(*flash_config_t* *config, uint32_t start, uint8_t *src, uint32_t lengthInBytes)

Programs flash with data at locations passed in through parameters.

This function programs the flash memory with the desired data for a given flash area as determined by the start address and the length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- src – A pointer to the source buffer of data that is to be programmed into the flash.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desired data were programed successfully into flash based on desired start address and length.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

- kStatus_FTFx_AlignmentError – Parameter is not aligned with the specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_ProgramOnce(*flash_config_t* *config, uint32_t index, uint8_t *src, uint32_t lengthInBytes)

Program the Program-Once-Field through parameters.

This function Program the Program-once-feild with given index and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- index – The index indicating the area of program once field to be read.
- src – A pointer to the source buffer of data that is used to store data to be write.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; The index indicating the area of program once field was programed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_ProgramSection(*flash_config_t* *config, uint32_t start, uint8_t *src, uint32_t lengthInBytes)

Programs flash with data at locations passed in through parameters via the Program Section command.

This function programs the flash memory with the desired data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.

- src – A pointer to the source buffer of data that is to be programmed into the flash.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desired data have been programed successfully into flash based on start address and length.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_SetFlexramAsRamError – Failed to set flexram as RAM.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_RecoverFlexramAsEepromError – Failed to recover FlexRAM as EEPROM.

status_t FLASH_ReadResource(*flash_config_t* *config, uint32_t start, uint8_t *dst, uint32_t lengthInBytes, *ftfx_read_resource_opt_t* option)

Reads the resource with data at locations passed in through parameters.

This function reads the flash memory with the desired location for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- dst – A pointer to the destination buffer of data that is used to store data to be read.
- lengthInBytes – The length, given in bytes (not words or long-words), to be read. Must be word-aligned.
- option – The resource option which indicates which area should be read back.

Return values

- kStatus_FTFx_Success – API was executed successfully; the data have been read successfully from program flash IFR, data flash IFR space, and the Version ID field.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with the specified baseline.

- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_ReadOnce(*flash_config_t* *config, uint32_t index, uint8_t *dst, uint32_t lengthInBytes)

Reads the Program Once Field through parameters.

This function reads the read once feild with given index and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- index – The index indicating the area of program once field to be read.
- dst – A pointer to the destination buffer of data that is used to store data to be read.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; the data have been successfuly read form Program flash0 IFR map and Program Once field based on index and length.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_VerifyErase(*flash_config_t* *config, uint32_t start, uint32_t lengthInBytes, *ftfx_margin_value_t* margin)

Verifies an erasure of the desired flash area at a specified margin level.

This function checks the appropriate number of flash sectors based on the desired start address and length to check whether the flash is erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be verified. The start address does not need to be sector-aligned but must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words), to be verified. Must be word-aligned.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully; the specified FLASH region has been erased.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_VerifyEraseAll(*flash_config_t* *config, *ftfx_margin_value_t* margin)

Verifies erasure of the entire flash at a specified margin level.

This function checks whether the flash is erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully; all program flash and flexnvm were in erased state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_VerifyProgram(*flash_config_t* *config, uint32_t start, uint32_t lengthInBytes, const uint8_t *expectedData, *ftfx_margin_value_t* margin, uint32_t *failedAddress, uint32_t *failedData)

Verifies programming of the desired flash area at a specified margin level.

This function verifies the data programmed in the flash memory using the Flash Program Check Command and compares it to the expected data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be verified. Must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words), to be verified. Must be word-aligned.

- expectedData – A pointer to the expected data that is to be verified against.
- margin – Read margin choice.
- failedAddress – A pointer to the returned failing address.
- failedData – A pointer to the returned failing data. Some derivatives do not include failed data as part of the FCCOBx registers. In this case, zeros are returned upon failure.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desired data have been successfully programed into specified FLASH region.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_GetSecurityState(*flash_config_t* *config, *ftfx_security_state_t* *state)

Returns the security state via the pointer passed into the function.

This function retrieves the current flash security status, including the security enabling state and the backdoor key enabling state.

Parameters

- config – A pointer to storage for the driver runtime state.
- state – A pointer to the value returned for the current security status code:

Return values

- kStatus_FTFx_Success – API was executed successfully; the security state of flash was stored to state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

status_t FLASH_SecurityBypass(*flash_config_t* *config, const uint8_t *backdoorKey)

Allows users to bypass security with a backdoor key.

If the MCU is in secured state, this function unsecures the MCU by comparing the provided backdoor key with ones in the flash configuration field.

Parameters

- config – A pointer to the storage for the driver runtime state.
- backdoorKey – A pointer to the user buffer containing the backdoor key.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_SetFlexramFunction(*flash_config_t* *config, *ftfx_flexram_func_opt_t* option)

Sets the FlexRAM function command.

Parameters

- config – A pointer to the storage for the driver runtime state.
- option – The option used to set the work mode of FlexRAM.

Return values

- kStatus_FTFx_Success – API was executed successfully; the FlexRAM has been successfully configured as RAM or EEPROM.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLASH_Swap(*flash_config_t* *config, uint32_t address, bool isSetEnable)

Swaps the lower half flash with the higher half flash.

Parameters

- config – A pointer to the storage for the driver runtime state.
- address – Address used to configure the flash swap function
- isSetEnable – The possible option used to configure the Flash Swap function or check the flash Swap status.

Return values

- kStatus_FTFx_Success – API was executed successfully; the lower half flash and higher half flash have been swaped.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_SwapIndicatorAddressError – Swap indicator address is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.

- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_SwapSystemNotInUninitialized – Swap system is not in an uninitialized state.

status_t FLASH_IsProtected(*flash_config_t* *config, uint32_t start, uint32_t lengthInBytes, *flash_prot_state_t* *protection_state)

Returns the protection state of the desired flash area via the pointer passed into the function.

This function retrieves the current flash protect status for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be checked. Must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words) to be checked. Must be word-aligned.
- protection_state – A pointer to the value returned for the current protection status code for the desired flash area.

Return values

- kStatus_FTFx_Success – API was executed successfully; the protection state of specified FLASH region was stored to protection_state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – The address is out of range.

status_t FLASH_IsExecuteOnly(*flash_config_t* *config, uint32_t start, uint32_t lengthInBytes, *flash_xacc_state_t* *access_state)

Returns the access state of the desired flash area via the pointer passed into the function.

This function retrieves the current flash access status for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be checked. Must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words), to be checked. Must be word-aligned.
- access_state – A pointer to the value returned for the current access status code for the desired flash area.

Return values

- kStatus_FTFx_Success – API was executed successfully; the executeOnly state of specified FLASH region was stored to access_state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

- kStatus_FTFx_AlignmentError – The parameter is not aligned to the specified baseline.
- kStatus_FTFx_AddressError – The address is out of range.

status_t FLASH_PflashSetProtection(*flash_config_t* *config, *pflash_prot_status_t* *protectStatus)

Sets the PFlash Protection to the intended protection status.

Parameters

- config – A pointer to storage for the driver runtime state.
- protectStatus – The expected protect status to set to the PFlash protection register. Each bit is corresponding to protection of 1/32(64) of the total PFlash. The least significant bit is corresponding to the lowest address area of PFlash. The most significant bit is corresponding to the highest address area of PFlash. There are two possible cases as shown below: 0: this area is protected. 1: this area is unprotected.

Return values

- kStatus_FTFx_Success – API was executed successfully; the specified FLASH region is protected.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.

status_t FLASH_PflashGetProtection(*flash_config_t* *config, *pflash_prot_status_t* *protectStatus)

Gets the PFlash protection status.

Parameters

- config – A pointer to the storage for the driver runtime state.
- protectStatus – Protect status returned by the PFlash IP. Each bit is corresponding to the protection of 1/32(64) of the total PFlash. The least significant bit corresponds to the lowest address area of the PFlash. The most significant bit corresponds to the highest address area of PFlash. There are two possible cases as shown below: 0: this area is protected. 1: this area is unprotected.

Return values

- kStatus_FTFx_Success – API was executed successfully; the Protection state was stored to protectStatus;
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

status_t FLASH_GetProperty(*flash_config_t* *config, *flash_property_tag_t* whichProperty, uint32_t *value)

Returns the desired flash property.

Parameters

- config – A pointer to the storage for the driver runtime state.
- whichProperty – The desired property from the list of properties in enum flash_property_tag_t
- value – A pointer to the value returned for the desired flash property.

Return values

- kStatus_FTFx_Success – API was executed successfully; the flash property was stored to value.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

- kStatus_FTFx_UnknownProperty – An unknown property tag.

status_t FLASH_GetCommandState(void)

Get previous command status.

This function is used to obtain the execution status of the previous command.

Return values

- kStatus_FTFx_Success – The previous command is executed successfully.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

FSL_FLASH_DRIVER_VERSION

Flash driver version for SDK.

Version 3.3.0.

FSL_FLASH_DRIVER_VERSION_ROM

Flash driver version for ROM.

Version 3.0.0.

enum _flash_protection_state

Enumeration for the three possible flash protection levels.

Values:

enumerator kFLASH_ProtectionStateUnprotected

Flash region is not protected.

enumerator kFLASH_ProtectionStateProtected

Flash region is protected.

enumerator kFLASH_ProtectionStateMixed

Flash is mixed with protected and unprotected region.

enum _flash_execute_only_access_state

Enumeration for the three possible flash execute access levels.

Values:

enumerator kFLASH_AccessStateUnLimited

Flash region is unlimited.

enumerator kFLASH_AccessStateExecuteOnly

Flash region is execute only.

enumerator kFLASH_AccessStateMixed

Flash is mixed with unlimited and execute only region.

enum _flash_property_tag

Enumeration for various flash properties.

Values:

enumerator kFLASH_PropertyPflash0SectorSize
    Pflash sector size property.

enumerator kFLASH_PropertyPflash0TotalSize
    Pflash total size property.

enumerator kFLASH_PropertyPflash0BlockSize
    Pflash block size property.

enumerator kFLASH_PropertyPflash0BlockCount
    Pflash block count property.

enumerator kFLASH_PropertyPflash0BlockBaseAddr
    Pflash block base address property.

enumerator kFLASH_PropertyPflash0FacSupport
    Pflash fac support property.

enumerator kFLASH_PropertyPflash0AccessSegmentSize
    Pflash access segment size property.

enumerator kFLASH_PropertyPflash0AccessSegmentCount
    Pflash access segment count property.

enumerator kFLASH_PropertyPflash1SectorSize
    Pflash sector size property.

enumerator kFLASH_PropertyPflash1TotalSize
    Pflash total size property.

enumerator kFLASH_PropertyPflash1BlockSize
    Pflash block size property.

enumerator kFLASH_PropertyPflash1BlockCount
    Pflash block count property.

enumerator kFLASH_PropertyPflash1BlockBaseAddr
    Pflash block base address property.

enumerator kFLASH_PropertyPflash1FacSupport
    Pflash fac support property.

enumerator kFLASH_PropertyPflash1AccessSegmentSize
    Pflash access segment size property.

enumerator kFLASH_PropertyPflash1AccessSegmentCount
    Pflash access segment count property.

enumerator kFLASH_PropertyFlexRamBlockBaseAddr
    FlexRam block base address property.

enumerator kFLASH_PropertyFlexRamTotalSize
    FlexRam total size property.

typedef enum *_flash_protection_state* flash_prot_state_t
    Enumeration for the three possible flash protection levels.

typedef union *_pflash_protection_status* pflash_prot_status_t
    PFlash protection status.

typedef enum *_flash_execute_only_access_state* flash_xacc_state_t
    Enumeration for the three possible flash execute access levels.

typedef enum *_flash_property_tag* flash_property_tag_t
Enumeration for various flash properties.

typedef struct *_flash_config* flash_config_t
Flash driver state information.

An instance of this structure is allocated by the user of the flash driver and passed into each of the driver APIs.

kStatus_FLASH_Success

kFLASH_ApiEraseKey

union _pflash_protection_status
#include <fsl_ftfx_flash.h> PFlash protection status.

Public Members

uint32_t protl
PROT[31:0] .

uint32_t proth
PROT[63:32].

uint8_t protsl
PROTS[7:0] .

uint8_t protsh
PROTS[15:8] .

uint8_t reserved[2]

struct _flash_config
#include <fsl_ftfx_flash.h> Flash driver state information.

An instance of this structure is allocated by the user of the flash driver and passed into each of the driver APIs.

2.24 Ftftx FLEXNVM Driver

status_t FLEXNVM_Init(*flexnvm_config_t* *config)
Initializes the global flash properties structure members.

This function checks and initializes the Flash module for the other Flash APIs.

Parameters

- config – Pointer to the storage for the driver runtime state.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FLEXNVM_DflashErase(*flexnvm_config_t* *config, uint32_t start, uint32_t lengthInBytes, uint32_t key)

Erases the Dflash sectors encompassed by parameters passed into function.

This function erases the appropriate number of flash sectors based on the desired start address and length.

Parameters

- config – The pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be erased. The start address does not need to be sector-aligned but must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words) to be erased. Must be word-aligned.
- key – The value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully; the appropriate number of date flash sectors based on the desired start address and length were erased successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – The parameter is not aligned with the specified baseline.
- kStatus_FTFx_AddressError – The address is out of range.
- kStatus_FTFx_EraseKeyError – The API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_EraseAll(*flexnvm_config_t* *config, uint32_t key)

Erases entire flexnvm.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully; the entire flexnvm has been erased successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.

- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FLEXNVM_EraseAllUnsecure(*flexnvm_config_t* *config, uint32_t key)

Erases the entire flexnvm, including protected sectors.

Parameters

- config – Pointer to the storage for the driver runtime state.
- key – A value used to validate all flash erase APIs.

Return values

- kStatus_FTFx_Success – API was executed successfully; the flexnvm is not in securityi state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_EraseKeyError – API erase key is invalid.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_PartitionStatusUpdateFailure – Failed to update the partition status.

status_t FLEXNVM_DflashProgram(*flexnvm_config_t* *config, uint32_t start, uint8_t *src, uint32_t lengthInBytes)

Programs flash with data at locations passed in through parameters.

This function programs the flash memory with the desired data for a given flash area as determined by the start address and the length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- src – A pointer to the source buffer of data that is to be programmed into the flash.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desired date have been successfully programed into specified date flash region.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with the specified baseline.

- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_DflashProgramSection(*flexnvm_config_t* *config, uint32_t start, uint8_t *src, uint32_t lengthInBytes)

Programs flash with data at locations passed in through parameters via the Program Section command.

This function programs the flash memory with the desired data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- src – A pointer to the source buffer of data that is to be programmed into the flash.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desired date have been successfully programed into specified date flash area.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_SetFlexramAsRamError – Failed to set flexram as RAM.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.
- kStatus_FTFx_RecoverFlexramAsEepromError – Failed to recover FlexRAM as EEPROM.

status_t FLEXNVM_ProgramPartition(*flexnvm_config_t* *config, *ftfx_partition_flexram_load_opt_t* option, uint32_t eepromDataSizeCode, uint32_t flexnvmPartitionCode)

Prepares the FlexNVM block for use as data flash, EEPROM backup, or a combination of both and initializes the FlexRAM.

Parameters

- config – Pointer to storage for the driver runtime state.
- option – The option used to set FlexRAM load behavior during reset.
- eepromDataSizeCode – Determines the amount of FlexRAM used in each of the available EEPROM subsystems.
- flexnvmPartitionCode – Specifies how to split the FlexNVM block between data flash memory and EEPROM backup memory supporting EEPROM functions.

Return values

- kStatus_FTFx_Success – API was executed successfully; the FlexNVM block for use as data flash, EEPROM backup, or a combination of both have been Prepared.
- kStatus_FTFx_InvalidArgument – Invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.

status_t FLEXNVM_ProgramPartition_CSE(*flexnvm_config_t* *config, *ftfx_partition_flexram_load_opt_t* option, uint32_t eepromDataSizeCode, uint32_t flexnvmPartitionCode, uint8_t CSEcKeySize, uint8_t SFE)

Prepares the FlexNVM block for use as data flash, EEPROM backup, or a combination of both and initializes the FlexRAM. This is the CSE enabled version for IP's like FTFC.

Parameters

- config – Pointer to storage for the driver runtime state.
- option – The option used to set FlexRAM load behavior during reset.
- eepromDataSizeCode – Determines the amount of FlexRAM used in each of the available EEPROM subsystems.
- flexnvmPartitionCode – Specifies how to split the FlexNVM block between data flash memory and EEPROM backup memory supporting EEPROM functions.
- CSEcKeySize – CSEc/SHE key size, see RM for details and possible values
- SFE – Security Flag Extension (SFE), see RM for details and possible values

Return values

- kStatus_FTFx_Success – API was executed successfully; the FlexNVM block for use as data flash, EEPROM backup, or a combination of both have been Prepared.
- kStatus_FTFx_InvalidArgument – Invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.

- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.

status_t FLEXNVM_ReadResource(*flexnvm_config_t* *config, uint32_t start, uint8_t *dst, uint32_t lengthInBytes, *ftfx_read_resource_opt_t* option)

Reads the resource with data at locations passed in through parameters.

This function reads the flash memory with the desired location for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- dst – A pointer to the destination buffer of data that is used to store data to be read.
- lengthInBytes – The length, given in bytes (not words or long-words), to be read. Must be word-aligned.
- option – The resource option which indicates which area should be read back.

Return values

- kStatus_FTFx_Success – API was executed successfully; the data have been read successfully from program flash IFR, data flash IFR space, and the Version ID field
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with the specified baseline.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_DflashVerifyErase(*flexnvm_config_t* *config, uint32_t start, uint32_t lengthInBytes, *ftfx_margin_value_t* margin)

Verifies an erasure of the desired flash area at a specified margin level.

This function checks the appropriate number of flash sectors based on the desired start address and length to check whether the flash is erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be verified. The start address does not need to be sector-aligned but must be word-aligned.

- lengthInBytes – The length, given in bytes (not words or long-words), to be verified. Must be word-aligned.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully; the specified data flash region is in erased state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_VerifyEraseAll(*flexnvm_config_t* *config, *ftfx_margin_value_t* margin)

Verifies erasure of the entire flash at a specified margin level.

This function checks whether the flash is erased to the specified read margin level.

Parameters

- config – A pointer to the storage for the driver runtime state.
- margin – Read margin choice.

Return values

- kStatus_FTFx_Success – API was executed successfully; the entire flexnvm region is in erased state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_DflashVerifyProgram(*flexnvm_config_t* *config, uint32_t start, uint32_t lengthInBytes, const uint8_t *expectedData, *ftfx_margin_value_t* margin, uint32_t *failedAddress, uint32_t *failedData)

Verifies programming of the desired flash area at a specified margin level.

This function verifies the data programmed in the flash memory using the Flash Program Check Command and compares it to the expected data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be verified. Must be word-aligned.
- lengthInBytes – The length, given in bytes (not words or long-words), to be verified. Must be word-aligned.
- expectedData – A pointer to the expected data that is to be verified against.
- margin – Read margin choice.
- failedAddress – A pointer to the returned failing address.
- failedData – A pointer to the returned failing data. Some derivatives do not include failed data as part of the FCCOBx registers. In this case, zeros are returned upon failure.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desired data hve been programed successfully into specified data flash region.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AlignmentError – Parameter is not aligned with specified baseline.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_GetSecurityState(*flexnvm_config_t* *config, *ftfx_security_state_t* *state)

Returns the security state via the pointer passed into the function.

This function retrieves the current flash security status, including the security enabling state and the backdoor key enabling state.

Parameters

- config – A pointer to storage for the driver runtime state.
- state – A pointer to the value returned for the current security status code:

Return values

- kStatus_FTFx_Success – API was executed successfully; the security state of flexnvm was stored to state.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

status_t FLEXNVM_SecurityBypass(*flexnvm_config_t* *config, const uint8_t *backdoorKey)

Allows users to bypass security with a backdoor key.

If the MCU is in secured state, this function unsecures the MCU by comparing the provided backdoor key with ones in the flash configuration field.

Parameters

- config – A pointer to the storage for the driver runtime state.
- backdoorKey – A pointer to the user buffer containing the backdoor key.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_SetFlexramFunction(*flexnvm_config_t* *config, *ftfx_flexram_func_opt_t* option)

Sets the FlexRAM function command.

Parameters

- config – A pointer to the storage for the driver runtime state.
- option – The option used to set the work mode of FlexRAM.

Return values

- kStatus_FTFx_Success – API was executed successfully; the FlexRAM has been successfully configured as RAM or EEPROM
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_ExecuteInRamFunctionNotReady – Execute-in-RAM function is not available.
- kStatus_FTFx_AccessError – Invalid instruction codes and out-of bounds addresses.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_CommandFailure – Run-time error during the command execution.

status_t FLEXNVM_DflashSetProtection(*flexnvm_config_t* *config, uint8_t protectStatus)

Sets the DFlash protection to the intended protection status.

Parameters

- config – A pointer to the storage for the driver runtime state.
- protectStatus – The expected protect status to set to the DFlash protection register. Each bit corresponds to the protection of the 1/8 of the total DFlash. The least significant bit corresponds to the lowest address area of the DFlash. The most significant bit corresponds to the highest address area of the DFlash. There are two possible cases as shown below: 0: this area is protected. 1: this area is unprotected.

Return values

- kStatus_FTFx_Success – API was executed successfully; the specified DFlash region is protected.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_CommandNotSupported – Flash API is not supported.

- kStatus_FTFx_CommandFailure – Run-time error during command execution.

status_t FLEXNVM_DflashGetProtection(*flexnvm_config_t* *config, uint8_t *protectStatus)

Gets the DFlash protection status.

Parameters

- config – A pointer to the storage for the driver runtime state.
- protectStatus – DFlash Protect status returned by the PFlash IP. Each bit corresponds to the protection of the 1/8 of the total DFlash. The least significant bit corresponds to the lowest address area of the DFlash. The most significant bit corresponds to the highest address area of the DFlash, and so on. There are two possible cases as below: 0: this area is protected. 1: this area is unprotected.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_CommandNotSupported – Flash API is not supported.

status_t FLEXNVM_EepromSetProtection(*flexnvm_config_t* *config, uint8_t protectStatus)

Sets the EEPROM protection to the intended protection status.

Parameters

- config – A pointer to the storage for the driver runtime state.
- protectStatus – The expected protect status to set to the EEPROM protection register. Each bit corresponds to the protection of the 1/8 of the total EEPROM. The least significant bit corresponds to the lowest address area of the EEPROM. The most significant bit corresponds to the highest address area of EEPROM, and so on. There are two possible cases as shown below: 0: this area is protected. 1: this area is unprotected.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_CommandNotSupported – Flash API is not supported.
- kStatus_FTFx_CommandFailure – Run-time error during command execution.

status_t FLEXNVM_EepromGetProtection(*flexnvm_config_t* *config, uint8_t *protectStatus)

Gets the EEPROM protection status.

Parameters

- config – A pointer to the storage for the driver runtime state.
- protectStatus – DFlash Protect status returned by the PFlash IP. Each bit corresponds to the protection of the 1/8 of the total EEPROM. The least significant bit corresponds to the lowest address area of the EEPROM. The most significant bit corresponds to the highest address area of the EEPROM. There are two possible cases as below: 0: this area is protected. 1: this area is unprotected.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.

- kStatus_FTFx_CommandNotSupported – Flash API is not supported.

status_t FLEXNVM_GetProperty(*flexnvm_config_t* *config, *flexnvm_property_tag_t* whichProperty, uint32_t *value)

Returns the desired flexnvm property.

Parameters

- config – A pointer to the storage for the driver runtime state.
- whichProperty – The desired property from the list of properties in enum flexnvm_property_tag_t
- value – A pointer to the value returned for the desired flexnvm property.

Return values

- kStatus_FTFx_Success – API was executed successfully.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_UnknownProperty – An unknown property tag.

enum _flexnvm_property_tag

Enumeration for various flexnvm properties.

Values:

enumerator kFLEXNVM_PropertyDflashSectorSize

Dflash sector size property.

enumerator kFLEXNVM_PropertyDflashTotalSize

Dflash total size property.

enumerator kFLEXNVM_PropertyDflashBlockSize

Dflash block size property.

enumerator kFLEXNVM_PropertyDflashBlockCount

Dflash block count property.

enumerator kFLEXNVM_PropertyDflashBlockBaseAddr

Dflash block base address property.

enumerator kFLEXNVM_PropertyAliasDflashBlockBaseAddr

Dflash block base address Alias property.

enumerator kFLEXNVM_PropertyFlexRamBlockBaseAddr

FlexRam block base address property.

enumerator kFLEXNVM_PropertyFlexRamTotalSize

FlexRam total size property.

enumerator kFLEXNVM_PropertyEepromTotalSize

EEPROM total size property.

typedef enum *_flexnvm_property_tag* flexnvm_property_tag_t

Enumeration for various flexnvm properties.

typedef struct *_flexnvm_config* flexnvm_config_t

Flexnvm driver state information.

An instance of this structure is allocated by the user of the Flexnvm driver and passed into each of the driver APIs.

status_t FLEXNVM_EepromWrite(*flexnvm_config_t* *config, uint32_t start, uint8_t *src, uint32_t lengthInBytes)

Programs the EEPROM with data at locations passed in through parameters.

This function programs the emulated EEPROM with the desired data for a given flash area as determined by the start address and length.

Parameters

- config – A pointer to the storage for the driver runtime state.
- start – The start address of the desired flash memory to be programmed. Must be word-aligned.
- src – A pointer to the source buffer of data that is to be programmed into the flash.
- lengthInBytes – The length, given in bytes (not words or long-words), to be programmed. Must be word-aligned.

Return values

- kStatus_FTFx_Success – API was executed successfully; the desires data have been successfully programed into specified eeprom region.
- kStatus_FTFx_InvalidArgument – An invalid argument is provided.
- kStatus_FTFx_AddressError – Address is out of range.
- kStatus_FTFx_SetFlexramAsEepromError – Failed to set flexram as eeprom.
- kStatus_FTFx_ProtectionViolation – The program/erase operation is requested to execute on protected areas.
- kStatus_FTFx_RecoverFlexramAsRamError – Failed to recover the FlexRAM as RAM.

struct _flexnvm_config

#include <fsl_ftfx_flexnvm.h> Flexnvm driver state information.

An instance of this structure is allocated by the user of the Flexnvm driver and passed into each of the driver APIs.

2.25 ftfx utilities

ALIGN_DOWN(x, a)

Alignment(down) utility.

ALIGN_UP(x, a)

Alignment(up) utility.

MAKE_VERSION(major, minor, bugfix)

Constructs the version number for drivers.

MAKE_STATUS(group, code)

Constructs a status code value from a group and a code number.

FOUR_CHAR_CODE(a, b, c, d)

Constructs the four character code for the Flash driver API key.

B1P4(b)

bytes2word utility.

B1P3(b)

B1P2(b)

B1P1(b)

B2P3(b)

B2P2(b)

B2P1(b)

B3P2(b)

B3P1(b)

BYTE2WORD_1_3(x, y)

BYTE2WORD_2_2(x, y)

BYTE2WORD_3_1(x, y)

BYTE2WORD_1_1_2(x, y, z)

BYTE2WORD_1_2_1(x, y, z)

BYTE2WORD_2_1_1(x, y, z)

BYTE2WORD_1_1_1_1(x, y, z, w)

2.26 FTM: FlexTimer Driver

status_t FTM_Init(FTM_Type *base, const *ftm_config_t* *config)

Ungates the FTM clock and configures the peripheral for basic operation.

Note: This API should be called at the beginning of the application which is using the FTM driver. If the FTM instance has only TPM features, please use the TPM driver.

Parameters

- base – FTM peripheral base address
- config – Pointer to the user configuration structure.

Returns

kStatus_Success indicates success; Else indicates failure.

void FTM_Deinit(FTM_Type *base)

Gates the FTM clock.

Parameters

- base – FTM peripheral base address

void FTM_GetDefaultConfig(*ftm_config_t* *config)

Fills in the FTM configuration structure with the default settings.

The default values are:

```
config->prescale = kFTM_Prescale_Divide_1;
config->bdmMode = kFTM_BdmMode_0;
config->pwmSyncMode = kFTM_SoftwareTrigger;
config->reloadPoints = 0;
config->faultMode = kFTM_Fault_Disable;
config->faultFilterValue = 0;
config->deadTimePrescale = kFTM_Deadtime_Prescale_1;
config->deadTimeValue =  0;
config->extTriggers = 0;
config->chnlInitState = 0;
config->chnlPolarity = 0;
config->useGlobalTimeBase = false;
config->hwTriggerResetCount = false;
config->swTriggerResetCount = true;
```

Parameters

- config – Pointer to the user configuration structure.

static inline *ftm_clock_prescale_t* FTM_CalculateCounterClkDiv(FTM_Type *base, uint32_t counterPeriod_Hz, uint32_t srcClock_Hz)

brief Calculates the counter clock prescaler.

This function calculates the values for SC[PS] bit.

param base FTM peripheral base address param counterPeriod_Hz The desired frequency in Hz which corresponding to the time when the counter reaches the mod value param srcClock_Hz FTM counter clock in Hz

return Calculated clock prescaler value, see ftm_clock_prescale_t.

status_t FTM_SetupPwm(FTM_Type *base, const *ftm_chnl_pwm_signal_param_t* *chnlParams, uint8_t numOfChnls, *ftm_pwm_mode_t* mode, uint32_t pwmFreq_Hz, uint32_t srcClock_Hz)

Configures the PWM signal parameters.

Call this function to configure the PWM signal period, mode, duty cycle, and edge. Use this function to configure all FTM channels that are used to output a PWM signal.

Parameters

- base – FTM 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 ftm_pwm_mode_t
- pwmFreq_Hz – PWM signal frequency in Hz
- srcClock_Hz – FTM counter clock in Hz

Returns

kStatus_Success if the PWM setup was successful kStatus_Error on failure

status_t FTM_UpdatePwmDutycycle(FTM_Type *base, *ftm_chnl_t* chnlNumber, *ftm_pwm_mode_t* currentPwmMode, uint8_t dutyCyclePercent)

Updates the duty cycle of an active PWM signal.

Parameters

- base – FTM peripheral base address
- chnlNumber – The channel/channel pair number. In combined mode, this represents the channel pair number
- currentPwmMode – The current PWM mode set during PWM setup
- dutyCyclePercent – New PWM pulse width; The 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 update was successful kStatus_Error on failure

void FTM_UpdateChnlEdgeLevelSelect(FTM_Type *base, *ftm_chnl_t* chnlNumber, uint8_t level)

Updates the edge level selection for a channel.

Parameters

- base – FTM 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 Kinetis SoC reference manual for details about this field.

status_t FTM_SetupPwmMode(FTM_Type *base, const *ftm_chnl_pwm_config_param_t* *chnlParams, uint8_t numOfChnls, *ftm_pwm_mode_t* mode)

Configures the PWM mode parameters.

Call this function to configure the PWM signal mode, duty cycle in ticks, and edge. Use this function to configure all FTM channels that are used to output a PWM signal. Please note that: This API is similar with FTM_SetupPwm() API, but will not set the timer period, and this API will set channel match value in timer ticks, not period percent.

Parameters

- base – FTM 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 ftm_pwm_mode_t

Returns
kStatus_Success if the PWM setup was successful kStatus_Error on failure

void FTM_ConfigSinglePWM(FTM_Type *base, const *ftm_chnl_param_t* *chnlParams, *ftm_chnl_t* chnlNumber)

Configure FTM edge aligned PWM or center aligned PWM by each channel.

This function configure PWM signal by setting channel n value register. Need to invoke FTM_SetInitialModuloValue to configure FTM period.

Parameters

- base – FTM peripheral base address
- chnlParams – PWM configuration structure pointer.
- chnlPairNumber – Channel number.

void FTM_ConfigCombinePWM(FTM_Type *base, const *ftm_chnl_param_t* *chnlParams, *ftm_chnl_t* chnlPairNumber)

Configure FTM Combine PWM, Modified Combine PWM or Asymmetrical PWM by each channel pair.

This function configure PWM signal by setting channel n value register. Need to invoke FTM_SetInitialModuloValue to configure FTM period.

Parameters

- base – FTM peripheral base address
- chnlParams – PWM configuration structure pointer.
- chnlPairNumber – Channel pair number, options are 0, 1, 2, 3.

void FTM_SetupInputCapture(FTM_Type *base, *ftm_chnl_t* chnlNumber, *ftm_input_capture_edge_t* captureMode, uint32_t filterValue)

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 FTM counter is captured into the CnV register. The user has to read the CnV register separately to get this value. The filter function is disabled if the filterVal argument passed in is 0. The filter function is available only for channels 0, 1, 2, 3.

Parameters

- base – FTM peripheral base address
- chnlNumber – The channel number
- captureMode – Specifies which edge to capture
- filterValue – Filter value, specify 0 to disable filter. Available only for channels 0-3.

void FTM_SetupOutputCompare(FTM_Type *base, *ftm_chnl_t* chnlNumber, *ftm_output_compare_mode_t* compareMode, uint32_t compareValue)

Configures the FTM to generate timed pulses.

When the FTM 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 – FTM 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.

void FTM_SetupDualEdgeCapture(FTM_Type *base, *ftm_chnl_t* chnlPairNumber, const *ftm_dual_edge_capture_param_t* *edgeParam, uint32_t filterValue)

Configures the dual edge capture mode of the FTM.

This function sets up the dual edge capture mode on a channel pair. The capture edge for the channel pair and the capture mode (one-shot or continuous) is specified in the parameter argument. The filter function is disabled if the filterVal argument passed is zero. The filter function is available only on channels 0 and 2. The user has to read the channel CnV registers separately to get the capture values.

Parameters

- base – FTM peripheral base address
- chnlPairNumber – The FTM 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. Available only for channel pair 0 and 1.

void FTM_EnableInterrupts(FTM_Type *base, uint32_t mask)

Enables the selected FTM interrupts.

Parameters

- base – FTM peripheral base address
- mask – The interrupts to enable. This is a logical OR of members of the enumeration ftm_interrupt_enable_t

void FTM_DisableInterrupts(FTM_Type *base, uint32_t mask)

Disables the selected FTM interrupts.

Parameters

- base – FTM peripheral base address
- mask – The interrupts to enable. This is a logical OR of members of the enumeration ftm_interrupt_enable_t

uint32_t FTM_GetEnabledInterrupts(FTM_Type *base)

Gets the enabled FTM interrupts.

Parameters

- base – FTM peripheral base address

Returns

The enabled interrupts. This is the logical OR of members of the enumeration ftm_interrupt_enable_t

uint32_t FTM_GetInstance(FTM_Type *base)

Gets the instance from the base address.

Parameters

- base – FTM peripheral base address

Returns

The FTM instance

uint32_t FTM_GetStatusFlags(FTM_Type *base)

Gets the FTM status flags.

Parameters

- base – FTM peripheral base address

Returns

The status flags. This is the logical OR of members of the enumeration ftm_status_flags_t

void FTM_ClearStatusFlags(FTM_Type *base, uint32_t mask)

Clears the FTM status flags.

Parameters

- base – FTM peripheral base address
- mask – The status flags to clear. This is a logical OR of members of the enumeration ftm_status_flags_t

static inline void FTM_SetTimerPeriod(FTM_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 FTM module as a timer. Do not mix usage of this API with FTM'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 – FTM peripheral base address
- ticks – A timer period in units of ticks, which should be equal or greater than 1.

static inline void FTM_SetInitialModuloValue(FTM_Type *base, uint16_t initialValue, uint16_t moduloValue)

Set initial value and modulo value for FTM.

Parameters

- base – FTM peripheral base address
- initialValue – FTM counter initial value.
- moduloValue – FTM counter modulo value.

static inline uint32_t FTM_GetCurrentTimerCount(FTM_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 – FTM peripheral base address

Returns

The current counter value in ticks

static inline void FTM_SetChannelMatchValue(FTM_Type *base, *ftm_chnl_t* chnlNumber, uint16_t value)

Set channel match value for output.

Parameters

- base – FTM peripheral base address
- chnlNumber – Channel to set.
- value – Channel match value for output.

static inline uint32_t FTM_GetInputCaptureValue(FTM_Type *base, *ftm_chnl_t* chnlNumber)

Reads the captured value.

This function returns the captured value of a FTM channel configured in input capture or dual edge capture mode.

Note: Call the utility macros provided in the fsl_common.h to convert ticks to usec or msec.

Parameters

- base – FTM peripheral base address
- chnlNumber – Channel to be read

Returns

The captured FTM counter value of the input modes.

static inline void FTM_StartTimer(FTM_Type *base, *ftm_clock_source_t* clockSource)

Starts the FTM counter.

Parameters

- base – FTM peripheral base address
- clockSource – FTM clock source; After the clock source is set, the counter starts running.

static inline void FTM_StopTimer(FTM_Type *base)

Stops the FTM counter.

Parameters

- base – FTM peripheral base address

static inline uint32_t FTM_GetSoftwareOutputValue(FTM_Type *base)

Get channel software output status.

Parameters

- base – FTM peripheral base address

Returns

Status of channel software output, logical OR value of ftm_channel_index_t.

static inline uint32_t FTM_GetSoftwareOutputEnable(FTM_Type *base)

Get channel software enable status.

Parameters

- base – FTM peripheral base address

Returns

Status of channel software enable, logical OR value of ftm_channel_index_t.

static inline void FTM_SetSoftwareOutputCtrl(FTM_Type *base, uint32_t chnlEnable, uint32_t chnlValue)

Enables or disables the channel software output control and set channel software output value.

Parameters

- base – FTM peripheral base address
- chnlEnable – Channels to enable or disable software output control, logical OR of enumeration ftm_channel_index_t members.
- chnlValue – Channels output value, logical OR of enumeration ftm_channel_index_t members

static inline void FTM_SetSoftwareCtrlEnable(FTM_Type *base, *ftm_chnl_t* chnlNumber, bool value)

Enables or disables the channel software output control.

Parameters

- base – FTM peripheral base address
- chnlNumber – Channel to be enabled or disabled
- value – true: channel output is affected by software output control false: channel output is unaffected by software output control

static inline void FTM_SetSoftwareCtrlVal(FTM_Type *base, *ftm_chnl_t* chnlNumber, bool value)

Sets the channel software output control value.

Parameters

- base – FTM peripheral base address.
- chnlNumber – Channel to be configured
- value – true to set 1, false to set 0

static inline void FTM_SetFaultControlEnable(FTM_Type *base, *ftm_chnl_t* chnlPairNumber, bool value)

This function enables/disables the fault control in a channel pair.

Parameters

- base – FTM peripheral base address
- chnlPairNumber – The FTM channel pair number; options are 0, 1, 2, 3
- value – true: Enable fault control for this channel pair; false: No fault control

static inline void FTM_SetDeadTimeEnable(FTM_Type *base, *ftm_chnl_t* chnlPairNumber, bool value)

This function enables/disables the dead time insertion in a channel pair.

Parameters

- base – FTM peripheral base address
- chnlPairNumber – The FTM channel pair number; options are 0, 1, 2, 3
- value – true: Insert dead time in this channel pair; false: No dead time inserted

static inline void FTM_SetComplementaryEnable(FTM_Type *base, *ftm_chnl_t* chnlPairNumber, bool value)

This function enables/disables complementary mode in a channel pair.

Parameters

- base – FTM peripheral base address
- chnlPairNumber – The FTM channel pair number; options are 0, 1, 2, 3
- value – true: enable complementary mode; false: disable complementary mode

static inline void FTM_SetInvertEnable(FTM_Type *base, *ftm_chnl_t* chnlPairNumber, bool value)

This function enables/disables inverting control in a channel pair.

Parameters

- base – FTM peripheral base address
- chnlPairNumber – The FTM channel pair number; options are 0, 1, 2, 3
- value – true: enable inverting; false: disable inverting

void FTM_SetupQuadDecode(FTM_Type *base, const *ftm_phase_params_t* *phaseAParams, const *ftm_phase_params_t* *phaseBParams, *ftm_quad_decode_mode_t* quadMode)

Configures the parameters and activates the quadrature decoder mode.

Parameters

- base – FTM 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 FTM_SetQuadDecoderModuloValue(FTM_Type *base, uint32_t startValue, uint32_t overValue)

Sets the modulo values for Quad Decoder.

The modulo values configure the minimum and maximum values that the Quad decoder counter can reach. After the counter goes over, the counter value goes to the other side and decrease/increase again.

Parameters

- base – FTM peripheral base address.
- startValue – The low limit value for Quad Decoder counter.
- overValue – The high limit value for Quad Decoder counter.

static inline uint32_t FTM_GetQuadDecoderCounterValue(FTM_Type *base)

Gets the current Quad Decoder counter value.

Parameters

- base – FTM peripheral base address.

Returns

Current quad Decoder counter value.

static inline void FTM_ClearQuadDecoderCounterValue(FTM_Type *base)

Clears the current Quad Decoder counter value.

The counter is set as the initial value.

Parameters

- base – FTM peripheral base address.

FSL_FTM_DRIVER_VERSION

FTM driver version 2.7.5.

enum _ftm_chnl

List of FTM channels.

Note: Actual number of available channels is SoC dependent

Values:

enumerator kFTM_Chnl_0

FTM channel number 0

enumerator kFTM_Chnl_1

FTM channel number 1

enumerator kFTM_Chnl_2
FTM channel number 2

enumerator kFTM_Chnl_3
FTM channel number 3

enumerator kFTM_Chnl_4
FTM channel number 4

enumerator kFTM_Chnl_5
FTM channel number 5

enumerator kFTM_Chnl_6
FTM channel number 6

enumerator kFTM_Chnl_7
FTM channel number 7

enum _ftm_fault_input
List of FTM faults.

Values:

enumerator kFTM_Fault_0
FTM fault 0 input pin

enumerator kFTM_Fault_1
FTM fault 1 input pin

enumerator kFTM_Fault_2
FTM fault 2 input pin

enumerator kFTM_Fault_3
FTM fault 3 input pin

enum _ftm_pwm_mode
FTM PWM operation modes.

Values:

enumerator kFTM_EdgeAlignedPwm
Edge-aligned PWM

enumerator kFTM_CenterAlignedPwm
Center-aligned PWM

enumerator kFTM_EdgeAlignedCombinedPwm
Edge-aligned combined PWM

enumerator kFTM_CenterAlignedCombinedPwm
Center-aligned combined PWM

enumerator kFTM_ModifiedCombinedPwm
Modified combined PWM

enumerator kFTM_AsymmetricalCombinedPwm
Asymmetrical combined PWM

enum _ftm_pwm_level_select
FTM PWM output pulse mode: high-true, low-true or no output.

Note: kFTM_NoPwmSignal: ELSnB:ELSnA = 0:0 kFTM_LowTrue: ELSnB:ELSnA = 0:1 EPWM: Channel n output is forced low at counter overflow, forced high at channel n match.

CPWM: Channel n output is forced low at channel n match when counting down, and forced high at channel n match when counting up. Combined PWM: Channel n output is forced high at beginning of period and at channel n+1 match. It is forced low at the channel n match. kFTM_HighTrue: ELSnB:ELSnA = 1:0 EPWM: Channel n output is forced high at counter overflow, forced low at channel n match. CPWM: Channel n output is forced high at channel n match when counting down, and forced low at channel n match when counting up. Combined PWM: Channel n output is forced low at beginning of period and at channel n+1 match. It is forced high at the channel n match.

Values:

enumerator kFTM_NoPwmSignal

No PWM output on pin

enumerator kFTM_LowTrue

Low true pulses

enumerator kFTM_HighTrue

High true pulses

enum _ftm_output_compare_mode

FlexTimer output compare mode.

Values:

enumerator kFTM_NoOutputSignal

No channel output when counter reaches CnV

enumerator kFTM_ToggleOnMatch

Toggle output

enumerator kFTM_ClearOnMatch

Clear output

enumerator kFTM_SetOnMatch

Set output

enum _ftm_input_capture_edge

FlexTimer input capture edge.

Values:

enumerator kFTM_RisingEdge

Capture on rising edge only

enumerator kFTM_FallingEdge

Capture on falling edge only

enumerator kFTM_RiseAndFallEdge

Capture on rising or falling edge

enum _ftm_dual_edge_capture_mode

FlexTimer dual edge capture modes.

Values:

enumerator kFTM_OneShot

One-shot capture mode

enumerator kFTM_Continuous

Continuous capture mode

enum _ftm_quad_decode_mode
FlexTimer quadrature decode modes.

Values:

enumerator kFTM_QuadPhaseEncode
Phase A and Phase B encoding mode

enumerator kFTM_QuadCountAndDir
Count and direction encoding mode

enum _ftm_phase_polarity
FlexTimer quadrature phase polarities.

Values:

enumerator kFTM_QuadPhaseNormal
Phase input signal is not inverted

enumerator kFTM_QuadPhaseInvert
Phase input signal is inverted

enum _ftm_fault_output_state
FlexTimer pre-scaler factor for the dead time insertion.

Values:

enumerator kFTM_FaultOutput_PreDefined
FTM outputs will be placed into safe values when fault events in ongoing (defined by POL bits).

enumerator kFTM_FaultOutput_TriStated
FTM outputs will be tri-stated when fault event is ongoing.

enum _ftm_deadtime_prescale
FlexTimer pre-scaler factor for the dead time insertion.

Values:

enumerator kFTM_Deadtime_Prescale_1
Divide by 1

enumerator kFTM_Deadtime_Prescale_4
Divide by 4

enumerator kFTM_Deadtime_Prescale_16
Divide by 16

enum _ftm_clock_source
FlexTimer clock source selection.

Values:

enumerator kFTM_SystemClock
System clock selected

enumerator kFTM_FixedClock
Fixed frequency clock

enumerator kFTM_ExternalClock
External clock

enum _ftm_clock_prescale
FlexTimer pre-scaler factor selection for the clock source.

Values:

enumerator kFTM_Prescale_Divide_1
Divide by 1

enumerator kFTM_Prescale_Divide_2
Divide by 2

enumerator kFTM_Prescale_Divide_4
Divide by 4

enumerator kFTM_Prescale_Divide_8
Divide by 8

enumerator kFTM_Prescale_Divide_16
Divide by 16

enumerator kFTM_Prescale_Divide_32
Divide by 32

enumerator kFTM_Prescale_Divide_64
Divide by 64

enumerator kFTM_Prescale_Divide_128
Divide by 128

enum _ftm_filter_prescale
FlexTimer filter clock prescaler selection.

Values:

enumerator kFTM_Filter_Prescale_Divide_1
Divide by 1

enumerator kFTM_Filter_Prescale_Divide_2
Divide by 2

enumerator kFTM_Filter_Prescale_Divide_3
Divide by 3

enumerator kFTM_Filter_Prescale_Divide_4
Divide by 4

enumerator kFTM_Filter_Prescale_Divide_5
Divide by 5

enumerator kFTM_Filter_Prescale_Divide_6
Divide by 6

enumerator kFTM_Filter_Prescale_Divide_7
Divide by 7

enumerator kFTM_Filter_Prescale_Divide_8
Divide by 8

enumerator kFTM_Filter_Prescale_Divide_9
Divide by 9

enumerator kFTM_Filter_Prescale_Divide_10
Divide by 10

enumerator kFTM_Filter_Prescale_Divide_11
Divide by 11

enumerator kFTM_Filter_Prescale_Divide_12
Divide by 12

enumerator kFTM_Filter_Prescale_Divide_13
Divide by 13

enumerator kFTM_Filter_Prescale_Divide_14
Divide by 14

enumerator kFTM_Filter_Prescale_Divide_15
Divide by 15

enumerator kFTM_Filter_Prescale_Divide_16
Divide by 16

enum _ftm_bdm_mode
Options for the FlexTimer behaviour in BDM Mode.

Values:

enumerator kFTM_BdmMode_0
FTM counter stopped, CH(n)F bit can be set, FTM channels in functional mode, writes to MOD,CNTIN and C(n)V registers bypass the register buffers

enumerator kFTM_BdmMode_1
FTM counter stopped, CH(n)F bit is not set, FTM channels outputs are forced to their safe value , writes to MOD,CNTIN and C(n)V registers bypass the register buffers

enumerator kFTM_BdmMode_2
FTM counter stopped, CH(n)F bit is not set, FTM channels outputs are frozen when chip enters in BDM mode, writes to MOD,CNTIN and C(n)V registers bypass the register buffers

enumerator kFTM_BdmMode_3
FTM counter in functional mode, CH(n)F bit can be set, FTM channels in functional mode, writes to MOD,CNTIN and C(n)V registers is in fully functional mode

enum _ftm_fault_mode
Options for the FTM fault control mode.

Values:

enumerator kFTM_Fault_Disable
Fault control is disabled for all channels

enumerator kFTM_Fault_EvenChnls
Enabled for even channels only(0,2,4,6) with manual fault clearing

enumerator kFTM_Fault_AllChnlsMan
Enabled for all channels with manual fault clearing

enumerator kFTM_Fault_AllChnlsAuto
Enabled for all channels with automatic fault clearing

enum _ftm_external_trigger
FTM external trigger options.

Note: Actual available external trigger sources are SoC-specific

Values:

enumerator kFTM_Chnl0Trigger
Generate trigger when counter equals chnl 0 CnV reg

enumerator kFTM_Chnl1Trigger
Generate trigger when counter equals chnl 1 CnV reg

enumerator kFTM_Chnl2Trigger
Generate trigger when counter equals chnl 2 CnV reg

enumerator kFTM_Chnl3Trigger
Generate trigger when counter equals chnl 3 CnV reg

enumerator kFTM_Chnl4Trigger
Generate trigger when counter equals chnl 4 CnV reg

enumerator kFTM_Chnl5Trigger
Generate trigger when counter equals chnl 5 CnV reg

enumerator kFTM_Chnl6Trigger
Available on certain SoC's, generate trigger when counter equals chnl 6 CnV reg

enumerator kFTM_Chnl7Trigger
Available on certain SoC's, generate trigger when counter equals chnl 7 CnV reg

enumerator kFTM_InitTrigger
Generate Trigger when counter is updated with CNTIN

enumerator kFTM_ReloadInitTrigger
Available on certain SoC's, trigger on reload point

enum _ftm_pwm_sync_method
FlexTimer PWM sync options to update registers with buffer.

Values:

enumerator kFTM_SoftwareTrigger
Software triggers PWM sync

enumerator kFTM_HardwareTrigger_0
Hardware trigger 0 causes PWM sync

enumerator kFTM_HardwareTrigger_1
Hardware trigger 1 causes PWM sync

enumerator kFTM_HardwareTrigger_2
Hardware trigger 2 causes PWM sync

enum _ftm_reload_point
FTM options available as loading point for register reload.

Note: Actual available reload points are SoC-specific

Values:

enumerator kFTM_Chnl0Match
Channel 0 match included as a reload point

enumerator kFTM_Chnl1Match
Channel 1 match included as a reload point

enumerator kFTM_Chnl2Match
Channel 2 match included as a reload point

enumerator kFTM_Chnl3Match
Channel 3 match included as a reload point

enumerator kFTM_Chnl4Match
Channel 4 match included as a reload point

enumerator kFTM_Chnl5Match
Channel 5 match included as a reload point

enumerator kFTM_Chnl6Match
Channel 6 match included as a reload point

enumerator kFTM_Chnl7Match
Channel 7 match included as a reload point

enumerator kFTM_CntMax
Use in up-down count mode only, reload when counter reaches the maximum value

enumerator kFTM_CntMin
Use in up-down count mode only, reload when counter reaches the minimum value

enumerator kFTM_HalfCycMatch
Available on certain SoC's, half cycle match reload point

enum _ftm_interrupt_enable
List of FTM interrupts.

Note: Actual available interrupts are SoC-specific

Values:

enumerator kFTM_Chnl0InterruptEnable
Channel 0 interrupt

enumerator kFTM_Chnl1InterruptEnable
Channel 1 interrupt

enumerator kFTM_Chnl2InterruptEnable
Channel 2 interrupt

enumerator kFTM_Chnl3InterruptEnable
Channel 3 interrupt

enumerator kFTM_Chnl4InterruptEnable
Channel 4 interrupt

enumerator kFTM_Chnl5InterruptEnable
Channel 5 interrupt

enumerator kFTM_Chnl6InterruptEnable
Channel 6 interrupt

enumerator kFTM_Chnl7InterruptEnable
Channel 7 interrupt

enumerator kFTM_FaultInterruptEnable
Fault interrupt

enumerator kFTM_TimeOverflowInterruptEnable
Time overflow interrupt

enumerator kFTM_ReloadInterruptEnable
Reload interrupt; Available only on certain SoC's

enum _ftm_status_flags
List of FTM flags.

Note: Actual available flags are SoC-specific

Values:

enumerator kFTM_Chnl0Flag
Channel 0 Flag

enumerator kFTM_Chnl1Flag
Channel 1 Flag

enumerator kFTM_Chnl2Flag
Channel 2 Flag

enumerator kFTM_Chnl3Flag
Channel 3 Flag

enumerator kFTM_Chnl4Flag
Channel 4 Flag

enumerator kFTM_Chnl5Flag
Channel 5 Flag

enumerator kFTM_Chnl6Flag
Channel 6 Flag

enumerator kFTM_Chnl7Flag
Channel 7 Flag

enumerator kFTM_FaultFlag
Fault Flag

enumerator kFTM_TimeOverflowFlag
Time overflow Flag

enumerator kFTM_ChnlTriggerFlag
Channel trigger Flag

enumerator kFTM_ReloadFlag
Reload Flag; Available only on certain SoC's

enum _ftm_channel_index
List of FTM channel index used in logic OR.

Values:

enumerator kFTM_Chnl0_Mask
Channel 0 Mask

enumerator kFTM_Chnl1_Mask
Channel 1 Mask

enumerator kFTM_Chnl2_Mask
Channel 2 Mask

enumerator kFTM_Chnl3_Mask
Channel 3 Mask

enumerator kFTM_Chnl4_Mask
    Channel 4 Mask

enumerator kFTM_Chnl5_Mask
    Channel 5 Mask

enumerator kFTM_Chnl6_Mask
    Channel 6 Mask

enumerator kFTM_Chnl7_Mask
    Channel 7 Mask

typedef enum *_ftm_chnl* ftm_chnl_t
    List of FTM channels.

Note: Actual number of available channels is SoC dependent

typedef enum *_ftm_fault_input* ftm_fault_input_t
    List of FTM faults.

typedef enum *_ftm_pwm_mode* ftm_pwm_mode_t
    FTM PWM operation modes.

typedef enum *_ftm_pwm_level_select* ftm_pwm_level_select_t
    FTM PWM output pulse mode: high-true, low-true or no output.

Note: kFTM_NoPwmSignal: ELSnB:ELSnA = 0:0 kFTM_LowTrue: ELSnB:ELSnA = 0:1 EPWM: Channel n output is forced low at counter overflow, forced high at channel n match. CPWM: Channel n output is forced low at channel n match when counting down, and forced high at channel n match when counting up. Combined PWM: Channel n output is forced high at beginning of period and at channel n+1 match. It is forced low at the channel n match. kFTM_HighTrue: ELSnB:ELSnA = 1:0 EPWM: Channel n output is forced high at counter overflow, forced low at channel n match. CPWM: Channel n output is forced high at channel n match when counting down, and forced low at channel n match when counting up. Combined PWM: Channel n output is forced low at beginning of period and at channel n+1 match. It is forced high at the channel n match.

typedef struct *_ftm_chnl_pwm_signal_param* ftm_chnl_pwm_signal_param_t
    Options to configure a FTM channel's PWM signal.

typedef struct *_ftm_chnl_pwm_config_param* ftm_chnl_pwm_config_param_t
    Options to configure a FTM channel using precise setting.

typedef struct *_ftm_chnl_param* ftm_chnl_param_t
    General options to configure a FTM channel using precise setting.

typedef enum *_ftm_output_compare_mode* ftm_output_compare_mode_t
    FlexTimer output compare mode.

typedef enum *_ftm_input_capture_edge* ftm_input_capture_edge_t
    FlexTimer input capture edge.

typedef enum *_ftm_dual_edge_capture_mode* ftm_dual_edge_capture_mode_t
    FlexTimer dual edge capture modes.

typedef struct *_ftm_dual_edge_capture_param* ftm_dual_edge_capture_param_t
    FlexTimer dual edge capture parameters.

typedef enum *_ftm_quad_decode_mode* ftm_quad_decode_mode_t
FlexTimer quadrature decode modes.

typedef enum *_ftm_phase_polarity* ftm_phase_polarity_t
FlexTimer quadrature phase polarities.

typedef struct *_ftm_phase_param* ftm_phase_params_t
FlexTimer quadrature decode phase parameters.

typedef struct *_ftm_fault_param* ftm_fault_param_t
Structure is used to hold the parameters to configure a FTM fault.

typedef enum *_ftm_fault_output_state* ftm_fault_output_state_t
FlexTimer pre-scaler factor for the dead time insertion.

typedef enum *_ftm_deadtime_prescale* ftm_deadtime_prescale_t
FlexTimer pre-scaler factor for the dead time insertion.

typedef struct *_ftm_deadtime_param* ftm_deadtime_param_t
Options to configure FTM combined channel pair deadtime.

typedef enum *_ftm_clock_source* ftm_clock_source_t
FlexTimer clock source selection.

typedef enum *_ftm_clock_prescale* ftm_clock_prescale_t
FlexTimer pre-scaler factor selection for the clock source.

typedef enum *_ftm_filter_prescale* ftm_filter_prescale_t
FlexTimer filter clock prescaler selection.

typedef enum *_ftm_bdm_mode* ftm_bdm_mode_t
Options for the FlexTimer behaviour in BDM Mode.

typedef enum *_ftm_fault_mode* ftm_fault_mode_t
Options for the FTM fault control mode.

typedef enum *_ftm_external_trigger* ftm_external_trigger_t
FTM external trigger options.

Note: Actual available external trigger sources are SoC-specific

typedef enum *_ftm_pwm_sync_method* ftm_pwm_sync_method_t
FlexTimer PWM sync options to update registers with buffer.

typedef enum *_ftm_reload_point* ftm_reload_point_t
FTM options available as loading point for register reload.

Note: Actual available reload points are SoC-specific

typedef enum *_ftm_interrupt_enable* ftm_interrupt_enable_t
List of FTM interrupts.

Note: Actual available interrupts are SoC-specific typedef enum *_ftm_status_flags* ftm_status_flags_t

List of FTM flags.

Note: Actual available flags are SoC-specific

typedef enum *_ftm_channel_index* ftm_channel_index_t

List of FTM channel index used in logic OR.

typedef struct *_ftm_config* ftm_config_t

FTM configuration structure.

This structure holds the configuration settings for the FTM peripheral. To initialize this structure to reasonable defaults, call the FTM_GetDefaultConfig() function and pass a pointer to the configuration structure instance.

The configuration structure can be made constant so as to reside in flash.

void FTM_SetupFaultInput(FTM_Type *base, *ftm_fault_input_t* faultNumber, const *ftm_fault_param_t* *faultParams)

Sets up the working of the FTM fault inputs protection.

FTM can have up to 4 fault inputs. This function sets up fault parameters, fault level, and input filter.

Parameters

- base – FTM peripheral base address
- faultNumber – FTM fault to configure.
- faultParams – Parameters passed in to set up the fault

static inline void FTM_SetGlobalTimeBaseOutputEnable(FTM_Type *base, bool enable)

Enables or disables the FTM global time base signal generation to other FTMs.

Parameters

- base – FTM peripheral base address
- enable – true to enable, false to disable

static inline void FTM_SetOutputMask(FTM_Type *base, *ftm_chnl_t* chnlNumber, bool mask)

Sets the FTM peripheral timer channel output mask.

Parameters

- base – FTM peripheral base address
- chnlNumber – Channel to be configured
- mask – true: masked, channel is forced to its inactive state; false: unmasked

static inline void FTM_SetPwmOutputEnable(FTM_Type *base, *ftm_chnl_t* chnlNumber, bool value)

Allows users to enable an output on an FTM channel.

To enable the PWM channel output call this function with val=true. For input mode, call this function with val=false.

Parameters

- base – FTM peripheral base address
- chnlNumber – Channel to be configured
- value – true: enable output; false: output is disabled, used in input mode

static inline void FTM_SetSoftwareTrigger(FTM_Type *base, bool enable)

Enables or disables the FTM software trigger for PWM synchronization.

Parameters

- base – FTM peripheral base address
- enable – true: software trigger is selected, false: software trigger is not selected

static inline void FTM_SetWriteProtection(FTM_Type *base, bool enable)

Enables or disables the FTM write protection.

Parameters

- base – FTM peripheral base address
- enable – true: Write-protection is enabled, false: Write-protection is disabled

static inline void FTM_EnableDmaTransfer(FTM_Type *base, *ftm_chnl_t* chnlNumber, bool enable)

Enable DMA transfer or not.

Note: CHnIE bit needs to be set when calling this API. The channel DMA transfer request is generated and the channel interrupt is not generated if (CHnF = 1) when DMA and CHnIE bits are set.

Parameters

- base – FTM peripheral base address.
- chnlNumber – Channel to be configured
- enable – true to enable, false to disable

static inline void FTM_SetLdok(FTM_Type *base, bool value)

Enable the LDOK bit.

This function enables loading updated values.

Parameters

- base – FTM peripheral base address
- value – true: loading updated values is enabled; false: loading updated values is disabled.

static inline void FTM_SetHalfCycReloadMatchValue(FTM_Type *base, uint32_t ticks)

Sets the half cycle relade period in units of ticks.

This function can be callled to set the half-cycle reload value when half-cycle matching is enabled as a reload point. Note: Need enable kFTM_HalfCycMatch as reload point, and when this API call after FTM_StartTimer(), the new HCR value will not be active until next reload point (need call FTM_SetLdok to set LDOK) or register synchronization.

Parameters

- base – FTM peripheral base address
- ticks – A timer period in units of ticks, which should be equal or greater than 1.

static inline void FTM_SetLoadFreq(FTM_Type *base, uint32_t loadfreq)

Set load frequency value.

Parameters

- base – FTM peripheral base address.

- loadfreq – PWM reload frequency, range: 0 ~ 31.

static inline void FTM_SetPairDeadTime(FTM_Type *base, const *ftm_deadtime_param_t* *config, *ftm_chnl_t* chnlPairNumber)

brief Configure deadtime for specific combined channel pair.

param base FTM peripheral base address param config Pointer to the user configuration structure. param chnlPairNumber The FTM channel pair number; options are 0, 1, 2, 3

static inline void FTM_SetPeriodDithering(FTM_Type *base, uint16_t moduloValue, uint8_t fractionalValue)

Set PWM Period Dithering. For the PWM period dithering, the register MOD_MIRROR should be used instead of the register MOD.

Parameters

- base – FTM peripheral base address.
- moduloValue – FTM counter modulo value.
- fractionalValue – The modulo fractional value used in the PWM period dithering.

static inline void FTM_SetEdgeDithering(FTM_Type *base, *ftm_chnl_t* chnlNumber, uint16_t matchValue, uint8_t fractionalValue)

Set PWM Edge Dithering. For the PWM edge dithering, the register CnV_MIRROR should be used instead of the register CnV.

Parameters

- base – FTM peripheral base address.
- chnlNumber – The channel number.
- matchValue – FTM channel n match value.
- fractionalValue – The channel n match fractional value used in the PWM edge dithering.

static inline uint32_t FTM_GetChannelInputState(FTM_Type *base, *ftm_chnl_t* chnlNumber)

Get value of channel n input after the double-sampling or the filtering.

Parameters

- base – FTM peripheral base address.
- chnlNumber – The channel number.

Returns

Channel n input state, 0 or 1.

static inline uint32_t FTM_GetChannelOutputState(FTM_Type *base, *ftm_chnl_t* chnlNumber)

Get final value of the channel n output.

Parameters

- base – FTM peripheral base address.
- chnlNumber – The channel number.

Returns

Channel n output value, 0 or 1.

struct _ftm_chnl_pwm_signal_param

#include <fsl_ftm.h> Options to configure a FTM channel's PWM signal.

Public Members

ftm_chnl_t chnlNumber

The channel/channel pair number. In combined mode, this represents the channel pair number.

ftm_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 kFTM_AsymmetricalCombinedPwm mode to generate an asymmetrical PWM. Specifies the delay to the first edge in a PWM period. If unsure leave as 0; Should be specified as a percentage of the PWM period

bool enableComplementary

Used only in combined PWM mode. true: The combined channels output complementary signals; false: The combined channels output same signals;

bool enableDeadtime

Used only in combined PWM mode with enable complementary. true: The deadtime insertion in this pair of channels is enabled; false: The deadtime insertion in this pair of channels is disabled.

struct _ftm_chnl_pwm_config_param

#include <fsl_ftm.h> Options to configure a FTM channel using precise setting.

Public Members

ftm_chnl_t chnlNumber

The channel/channel pair number. In combined mode, this represents the channel pair number.

ftm_pwm_level_select_t level

PWM output active level select.

uint16_t dutyValue

PWM pulse width, the uint of this value is timer ticks.

uint16_t firstEdgeValue

Used only in kFTM_AsymmetricalCombinedPwm mode to generate an asymmetrical PWM. Specifies the delay to the first edge in a PWM period. If unsure leave as 0, uint of this value is timer ticks.

bool enableComplementary

Used only in combined PWM mode. true: The combined channels output complementary signals; false: The combined channels output same signals;

bool enableDeadtime

Used only in combined PWM mode with enable complementary. true: The deadtime insertion in this pair of channels is enabled; false: The deadtime insertion in this pair of channels is disabled.

struct _ftm_chnl_param

#include <fsl_ftm.h> General options to configure a FTM channel using precise setting.

Public Members

ftm_pwm_mode_t mode
PWM output mode.

ftm_pwm_level_select_t level
PWM output active level select.

uint16_t initialValue
FTM counter initial value.

uint16_t moduloValue
FTM counter modulo value.

uint16_t chnlValue
FTM channel n match value.

uint16_t combinedChnlValue
FTM combined channel n+1 match value, used only in (modified) combined PWM mode.

bool enableComplementary
Used only in combined PWM mode. true: The combined channels output complementary signals; false: The combined channels output same signals;

bool enableDeadtime
Used only in combined PWM mode with enable complementary. true: The deadtime insertion in this pair of channels is enabled; false: The deadtime insertion in this pair of channels is disabled.

bool enablePulseOutput
Used only in Edge-aligned PWM and Center-aligned PWM. true: If a match in channel occurs, a trigger pulse with one FTM input clock width is generated in the channel n; false: Channel outputs will generate normal PWM outputs without generating a pulse.

bool enableDithering
Enable fractional delay to achieve fine resolution on generated PWM signals. true: Enable dithering; false: Disable dithering.

uint8_t moduloFracValue
Modulo fractional value, used in Period Dithering.

uint8_t chnlFracValue
Channel n match fractional value, used in Edge Dithering.

uint8_t combinedChnlFracValue
Combined channel n+1 match fractional value, used in Edge Dithering. It is recommended to use only one PWM Edge Dithering (channel n PWM Edge Dithering or channel n+1 PWM Edge Dithering) at a time.

struct _ftm_dual_edge_capture_param
#include <fsl_ftm.h> FlexTimer dual edge capture parameters.

Public Members

ftm_dual_edge_capture_mode_t mode
Dual Edge Capture mode

ftm_input_capture_edge_t currChanEdgeMode
Input capture edge select for channel n

ftm_input_capture_edge_t nextChanEdgeMode
Input capture edge select for channel n+1

struct _ftm_phase_param
#include <fsl_ftm.h> FlexTimer quadrature decode phase parameters.

Public Members

bool enablePhaseFilter
True: enable phase filter; false: disable filter

uint32_t phaseFilterVal
Filter value, used only if phase filter is enabled

ftm_phase_polarity_t phasePolarity
Phase polarity

struct _ftm_fault_param
#include <fsl_ftm.h> Structure is used to hold the parameters to configure a FTM fault.

Public Members

bool enableFaultInput
True: Fault input is enabled; false: Fault input is disabled

bool faultLevel
True: Fault polarity is active low; in other words, '0' indicates a fault; False: Fault polarity is active high

bool useFaultFilter
True: Use the filtered fault signal; False: Use the direct path from fault input

struct _ftm_deadtime_param
#include <fsl_ftm.h> Options to configure FTM combined channel pair deadtime.

Public Members

ftm_deadtime_prescale_t deadTimePrescale
The dead time prescalar value

uint32_t deadTimeValue
The dead time value deadTimeValue's available range is 0-1023 when register has DT-VALEX, otherwise its available range is 0-63.

struct _ftm_config
#include <fsl_ftm.h> FTM configuration structure.

This structure holds the configuration settings for the FTM peripheral. To initialize this structure to reasonable defaults, call the FTM_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

ftm_clock_prescale_t prescale
FTM clock prescale value

ftm_filter_prescale_t filterPrescale
Clock prescaler used in FTM filters

ftm_bdm_mode_t bdmMode
FTM behavior in BDM mode

uint32_t pwmSyncMode
Synchronization methods to use to update buffered registers; Multiple update modes can be used by providing an OR'ed list of options available in enumeration ftm_pwm_sync_method_t.

uint32_t reloadPoints
FTM reload points; When using this, the PWM synchronization is not required. Multiple reload points can be used by providing an OR'ed list of options available in enumeration ftm_reload_point_t.

ftm_fault_mode_t faultMode
FTM fault control mode

uint8_t faultFilterValue
Fault input filter value

ftm_fault_output_state_t faultOutputState
Fault output state

ftm_deadtime_prescale_t deadTimePrescale
The dead time prescalar value

uint32_t deadTimeValue
The dead time value deadTimeValue's available range is 0-1023 when register has DTVALEX, otherwise its available range is 0-63.

uint32_t extTriggers
External triggers to enable. Multiple trigger sources can be enabled by providing an OR'ed list of options available in enumeration ftm_external_trigger_t.

uint8_t chnlInitState
Defines the initialization value of the channels in OUTINT register

uint8_t chnlPolarity
Defines the output polarity of the channels in POL register

bool useGlobalTimeBase
True: Use of an external global time base is enabled; False: disabled

bool swTriggerResetCount
FTM counter synchronization activated by software trigger, avtive when (syncMethod & FTM_SYNC_SWSYNC_MASK) != 0U

bool hwTriggerResetCount
FTM counter synchronization activated by hardware trigger, avtive when (syncMethod & (FTM_SYNC_TRIG0_MASK | FTM_SYNC_TRIG1_MASK | FTM_SYNC_TRIG2_MASK)) != 0U

2.27 GPIO: General-Purpose Input/Output Driver

FSL_GPIO_DRIVER_VERSION
GPIO driver version.

enum _gpio_pin_direction
GPIO direction definition.

Values:

enumerator kGPIO_DigitalInput
Set current pin as digital input

enumerator kGPIO_DigitalOutput
Set current pin as digital output

enum _gpio_checker_attribute
GPIO checker attribute.

Values:

enumerator kGPIO_UsernonsecureRWUsersecureRWPrivilegedsecureRW
User nonsecure:Read+Write; User Secure:Read+Write; Privileged Secure:Read+Write

enumerator kGPIO_UsernonsecureRUsersecureRWPrivilegedsecureRW
User nonsecure:Read; User Secure:Read+Write; Privileged Secure:Read+Write

enumerator kGPIO_UsernonsecureNUsersecureRWPrivilegedsecureRW
User nonsecure:None; User Secure:Read+Write; Privileged Secure:Read+Write

enumerator kGPIO_UsernonsecureRUsersecureRPrivilegedsecureRW
User nonsecure:Read; User Secure:Read; Privileged Secure:Read+Write

enumerator kGPIO_UsernonsecureNUsersecureRPrivilegedsecureRW
User nonsecure:None; User Secure:Read; Privileged Secure:Read+Write

enumerator kGPIO_UsernonsecureNUsersecureNPrivilegedsecureRW
User nonsecure:None; User Secure:None; Privileged Secure:Read+Write

enumerator kGPIO_UsernonsecureNUsersecureNPrivilegedsecureR
User nonsecure:None; User Secure:None; Privileged Secure:Read

enumerator kGPIO_UsernonsecureNUsersecureNPrivilegedsecureN
User nonsecure:None; User Secure:None; Privileged Secure:None

enumerator kGPIO_IgnoreAttributeCheck
Ignores the attribute check

typedef enum *_gpio_pin_direction* gpio_pin_direction_t
GPIO direction definition.

typedef enum *_gpio_checker_attribute* gpio_checker_attribute_t
GPIO checker attribute.

typedef struct *_gpio_pin_config* gpio_pin_config_t
The GPIO 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().

GPIO_FIT_REG(value)

struct _gpio_pin_config
#include <fsl_gpio.h> The GPIO 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

gpio_pin_direction_t pinDirection
GPIO direction, input or output

uint8_t outputLogic
Set a default output logic, which has no use in input

2.28 GPIO Driver

void GPIO_PortInit(GPIO_Type *base)
Initializes the GPIO peripheral.

This function ungates the GPIO clock.

Parameters

- base – GPIO peripheral base pointer.

void GPIO_PortDenit(GPIO_Type *base)
Denitializes the GPIO peripheral.

Parameters

- base – GPIO peripheral base pointer.

void GPIO_PinInit(GPIO_Type *base, uint32_t pin, const *gpio_pin_config_t* *config)
Initializes a GPIO pin used by the board.

To initialize the GPIO, define a pin configuration, as either input or output, in the user file. Then, call the GPIO_PinInit() function.

This is an example to define an input pin or an output pin configuration.

```
Define a digital input pin configuration,
gpio_pin_config_t config =
{
  kGPIO_DigitalInput,
  0,
}
Define a digital output pin configuration,
gpio_pin_config_t config =
{
  kGPIO_DigitalOutput,
  0,
}
```

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- pin – GPIO port pin number
- config – GPIO pin configuration pointer

static inline void GPIO_PinWrite(GPIO_Type *base, uint32_t pin, uint8_t output)
Sets the output level of the multiple GPIO pins to the logic 1 or 0.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- pin – GPIO pin number
- output – GPIO pin output logic level.

- 0: corresponding pin output low-logic level.
- 1: corresponding pin output high-logic level.

static inline void GPIO_PortSet(GPIO_Type *base, uint32_t mask)

Sets the output level of the multiple GPIO pins to the logic 1.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- mask – GPIO pin number macro

static inline void GPIO_PortClear(GPIO_Type *base, uint32_t mask)

Sets the output level of the multiple GPIO pins to the logic 0.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- mask – GPIO pin number macro

static inline void GPIO_PortToggle(GPIO_Type *base, uint32_t mask)

Reverses the current output logic of the multiple GPIO pins.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- mask – GPIO pin number macro

static inline uint32_t GPIO_PinRead(GPIO_Type *base, uint32_t pin)

Reads the current input value of the GPIO port.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- pin – GPIO pin number

Return values

GPIO – port input value

- 0: corresponding pin input low-logic level.
- 1: corresponding pin input high-logic level.

uint32_t GPIO_PortGetInterruptFlags(GPIO_Type *base)

Reads the GPIO port interrupt 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 – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)

Return values

The – current GPIO port interrupt status flag, for example, 0x00010001 means the pin 0 and 17 have the interrupt.

void GPIO_PortClearInterruptFlags(GPIO_Type *base, uint32_t mask)

Clears multiple GPIO pin interrupt status flags.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- mask – GPIO pin number macro

void GPIO_CheckAttributeBytes(GPIO_Type *base, *gpio_checker_attribute_t* attribute)

brief The GPIO module supports a device-specific number of data ports, organized as 32-bit words/8-bit Bytes. Each 32-bit/8-bit data port includes a GACR register, which defines the byte-level attributes required for a successful access to the GPIO programming model. If the GPIO module's GACR register organized as 32-bit words, the attribute controls for the 4 data bytes in the GACR follow a standard little endian data convention.

Parameters

- base – GPIO peripheral base pointer (GPIOA, GPIOB, GPIOC, and so on.)
- attribute – GPIO checker attribute

2.29 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.

MCUX_MASK_INVERT_8(mask)
    8-bit mask inversion.

MCUX_MASK_INVERT_16(mask)
    16-bit mask inversion.

MCUX_MASK_INVERT_32(mask)
    32-bit mask inversion for completeness.

MCUX_REG_WRITE8(reg, value)
    8-bit register write macro

MCUX_REG_WRITE16(reg, value)
    16-bit register write macro

MCUX_REG_WRITE32(reg, value)
    32-bit register write macro

MCUX_REG_READ8(reg)
    8-bit register read macro

MCUX_REG_READ16(reg)
    16-bit register read macro

MCUX_REG_READ32(reg)
    32-bit register read macro

MCUX_REG_BIT_SET8(reg, mask)
    8-bit register bit set macro

MCUX_REG_BIT_SET16(reg, mask)
    16-bit register bit set macro

MCUX_REG_BIT_SET32(reg, mask)
    32-bit register bit set macro

MCUX_REG_BIT_CLEAR8(reg, mask)
    8-bit register bit clear macro

MCUX_REG_BIT_CLEAR16(reg, mask)
    16-bit register bit clear macro

MCUX_REG_BIT_CLEAR32(reg, mask)
    32-bit register bit clear macro

MCUX_REG_BIT_GET8(reg, mask)
    8-bit register bit get macro

MCUX_REG_BIT_GET16(reg, mask)
    16-bit register bit get macro

MCUX_REG_BIT_GET32(reg, mask)
    32-bit register bit get macro

MCUX_REG_MODIFY8(reg, mask, value)
    32-bit register read-modify-write macro

MCUX_REG_MODIFY16(reg, mask, value)
    16-bit register read-modify-write macro

MCUX_REG_MODIFY32(reg, mask, value)
    32-bit register read-modify-write macro

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_ALIGN(var, alignbytes)
    Macro to define a variable with alignbytes alignment

SDK_SIZEALIGN(var, alignbytes)
    Macro to define a variable with L1 d-cache line size alignment

    Macro to define a variable with L2 cache line size alignment

    Macro to change a value to a given size aligned value (rounded up)

SDK_SIZEALIGN_UP(var, alignbytes)
    Macro to change a value to a given size aligned value (rounded up), the wrapper of SDK_SIZEALIGN

SDK_SIZEALIGN_DOWN(var, alignbytes)
    Macro to change a value to a given size aligned value (rounded down)

SDK_IS_ALIGNED(var, alignbytes)
    Macro to check if a value is aligned to a given size

AT_NONCACHEABLE_SECTION(var)
Define a variable *var*, and place it in non-cacheable section.

AT_NONCACHEABLE_SECTION_ALIGN(var, alignbytes)
Define a variable *var*, and place it in non-cacheable section, the start address of the variable is aligned to *alignbytes*.

AT_NONCACHEABLE_SECTION_INIT(var)
Define a variable *var* with initial value, and place it in non-cacheable section.

AT_NONCACHEABLE_SECTION_ALIGN_INIT(var, alignbytes)
Define a variable *var* with initial value, and place it in non-cacheable section, the start address of the variable is aligned to *alignbytes*.

AT_CACHE_LINE_SECTION(var)
Define a variable *var*, which is cache line size aligned and be placed in CacheLineData section.

AT_CACHE_LINE_SECTION_INIT(var)
Define a variable *var* with initial value, which is cache line size aligned and be placed in CacheLineData.init section.

AT_QUICKACCESS_SECTION_CODE(func)
Place function in a section which can be accessed quickly by core.

AT_QUICKACCESS_SECTION_DATA(var)
Place data in a section which can be accessed quickly by core.

AT_QUICKACCESS_SECTION_DATA_ALIGN(var, alignbytes)
Place data in a section which can be accessed quickly by core, and the variable address is set to align with *alignbytes*.

MCUX_RAMFUNC
Function attribute to place function in RAM. For example, to place function my_func in ram, use like:

```
MCUX_RAMFUNC my_func
```

RAMFUNCTION_SECTION_CODE(func)
Place function in ram.

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.

enumerator kStatusGroup_LPC_QSPI
Group number for LPC QSPI 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_HAS_DWT_CYCCNT
The chip supports DWT CYCCNT or not.

MSDK_INVALID_IRQ_HANDLER
Invalid IRQ handler address.

2.30 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 kLpi2cMasterIrqs[]

Array to map LPI2C instance number to IRQ number, used internally for LPI2C master interrupt and EDMA transactional APIs.

IRQn_Type const kLpi2cSlaveIrqs[]

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.

2.31 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_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.

2.32 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.

2.33 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;
```

(continues on next page)

(continued from previous page)

```
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.

2.34 LPIT: Low-Power Interrupt Timer

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.

FSL_LPIT_DRIVER_VERSION

Version 2.1.3

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.

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.

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.

LPIT_RESET_STATE_DELAY

Delay used in LPIT_Reset.

The macro value should be larger than 4 * core clock / LPIT peripheral clock.

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

2.35 LPSPI: Low Power Serial Peripheral Interface

2.36 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.

2.37 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

2.38 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:

enumerator kLPTMR_PrescalerClock_0
Prescaler/glitch filter clock 0 selected.

enumerator kLPTMR_PrescalerClock_1
Prescaler/glitch filter clock 1 selected.

enumerator kLPTMR_PrescalerClock_2
Prescaler/glitch filter clock 2 selected.

enumerator kLPTMR_PrescalerClock_3
Prescaler/glitch filter clock 3 selected.

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

2.39 LPUART: Low Power Universal Asynchronous Receiver/Transmitter Driver

2.40 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

status_t 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.

Return values

- kStatus_Success – Deinit is success.
- kStatus_LPUART_Timeout – Timeout during deinit.

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

uint8_t rtsWatermark
RTS watermark

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

bool swapTxdRxd
Swap TXD and RXD pins

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 ___unnamed23___

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 ___unnamed25___

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 __unnamed27__

Public Members

uint8_t *volatile rxData
: Address of remaining data to receive.

uint16_t *volatile rxData16
: Address of remaining data to receive.

union __unnamed29__

Public Members

uint8_t *rxRingBuffer
: Start address of the receiver ring buffer.

uint16_t *rxRingBuffer16
: Start address of the receiver ring buffer.

2.41 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

2.42 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.
- bufferfault – Structure to store the result.

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.
- lmemFault – Structure to store the result.

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.

2.43 PMC: Power Management Controller

static inline void PMC_GetVersionId(PMC_Type *base, *pmc_version_id_t* *versionId)

Gets the PMC version ID.

This function gets the PMC version ID, including major version number, minor version number, and a feature specification number.

Parameters

- base – PMC peripheral base address.
- versionId – Pointer to version ID structure.

void PMC_GetParam(PMC_Type *base, *pmc_param_t* *param)

Gets the PMC parameter.

This function gets the PMC parameter including the VLPO enable and the HVD enable.

Parameters

- base – PMC peripheral base address.
- param – Pointer to PMC param structure.

void PMC_ConfigureLowVoltDetect(PMC_Type *base, const *pmc_low_volt_detect_config_t* *config)

Configures the low-voltage detect setting.

This function configures the low-voltage detect setting, including the trip point voltage setting, enables or disables the interrupt, enables or disables the system reset.

Parameters

- base – PMC peripheral base address.
- config – Low-voltage detect configuration structure.

static inline bool PMC_GetLowVoltDetectFlag(PMC_Type *base)

Gets the Low-voltage Detect Flag status.

This function reads the current LVDF status. If it returns 1, a low-voltage event is detected.

Parameters

- base – PMC peripheral base address.

Returns
Current low-voltage detect flag

- true: Low-voltage detected
- false: Low-voltage not detected

static inline void PMC_ClearLowVoltDetectFlag(PMC_Type *base)

Acknowledges clearing the Low-voltage Detect flag.

This function acknowledges the low-voltage detection errors (write 1 to clear LVDF).

Parameters

- base – PMC peripheral base address.

void PMC_ConfigureLowVoltWarning(PMC_Type *base, const *pmc_low_volt_warning_config_t* *config)

Configures the low-voltage warning setting.

This function configures the low-voltage warning setting, including the trip point voltage setting and enabling or disabling the interrupt.

Parameters

- base – PMC peripheral base address.
- config – Low-voltage warning configuration structure.

static inline bool PMC_GetLowVoltWarningFlag(PMC_Type *base)

Gets the Low-voltage Warning Flag status.

This function polls the current LVWF status. When 1 is returned, it indicates a low-voltage warning event. LVWF is set when V Supply transitions below the trip point or after reset and V Supply is already below the V LVW.

Parameters

- base – PMC peripheral base address.

Returns
Current LVWF status

- true: Low-voltage Warning Flag is set.
- false: the Low-voltage Warning does not happen.

static inline void PMC_ClearLowVoltWarningFlag(PMC_Type *base)

Acknowledges the Low-voltage Warning flag.

This function acknowledges the low voltage warning errors (write 1 to clear LVWF).

Parameters

- base – PMC peripheral base address.

void PMC_ConfigureHighVoltDetect(PMC_Type *base, const *pmc_high_volt_detect_config_t* *config)

Configures the high-voltage detect setting.

This function configures the high-voltage detect setting, including the trip point voltage setting, enabling or disabling the interrupt, enabling or disabling the system reset.

Parameters

- base – PMC peripheral base address.
- config – High-voltage detect configuration structure.

static inline bool PMC_GetHighVoltDetectFlag(PMC_Type *base)

Gets the High-voltage Detect Flag status.

This function reads the current HVDF status. If it returns 1, a low voltage event is detected.

Parameters

- base – PMC peripheral base address.

Returns

Current high-voltage detect flag

- true: High-voltage detected
- false: High-voltage not detected

static inline void PMC_ClearHighVoltDetectFlag(PMC_Type *base)

Acknowledges clearing the High-voltage Detect flag.

This function acknowledges the high-voltage detection errors (write 1 to clear HVDF).

Parameters

- base – PMC peripheral base address.

void PMC_ConfigureBandgapBuffer(PMC_Type *base, const *pmc_bandgap_buffer_config_t* *config)

Configures the PMC bandgap.

This function configures the PMC bandgap, including the drive select and behavior in low-power mode.

Parameters

- base – PMC peripheral base address.
- config – Pointer to the configuration structure

static inline bool PMC_GetPeriphIOIsolationFlag(PMC_Type *base)

Gets the acknowledge Peripherals and I/O pads isolation flag.

This function reads the Acknowledge Isolation setting that indicates whether certain peripherals and the I/O pads are in a latched state as a result of having been in the VLLS mode.

Parameters

- base – PMC peripheral base address.
- base – Base address for current PMC instance.

Returns

ACK isolation 0 - Peripherals and I/O pads are in a normal run state. 1 - Certain peripherals and I/O pads are in an isolated and latched state.

static inline void PMC_ClearPeriphIOIsolationFlag(PMC_Type *base)

Acknowledges the isolation flag to Peripherals and I/O pads.

This function clears the ACK Isolation flag. Writing one to this setting when it is set releases the I/O pads and certain peripherals to their normal run mode state.

Parameters

- base – PMC peripheral base address.

static inline bool PMC_IsRegulatorInRunRegulation(PMC_Type *base)

Gets the regulator regulation status.

This function returns the regulator to run a regulation status. It provides the current status of the internal voltage regulator.

Parameters

- base – PMC peripheral base address.
- base – Base address for current PMC instance.

Returns

Regulation status 0 - Regulator is in a stop regulation or in transition to/from the regulation. 1 - Regulator is in a run regulation.

FSL_PMC_DRIVER_VERSION

PMC driver version.

Version 2.0.4.

enum _pmc_low_volt_detect_volt_select

Low-voltage Detect Voltage Select.

Values:

enumerator kPMC_LowVoltDetectLowTrip

Low-trip point selected (VLVD = VLVDL)

enumerator kPMC_LowVoltDetectHighTrip

High-trip point selected (VLVD = VLVDH)

enum _pmc_low_volt_warning_volt_select

Low-voltage Warning Voltage Select.

Values:

enumerator kPMC_LowVoltWarningLowTrip

Low-trip point selected (VLVW = VLVW1)

enumerator kPMC_LowVoltWarningMid1Trip

Mid 1 trip point selected (VLVW = VLVW2)

enumerator kPMC_LowVoltWarningMid2Trip

Mid 2 trip point selected (VLVW = VLVW3)

enumerator kPMC_LowVoltWarningHighTrip

High-trip point selected (VLVW = VLVW4)

enum _pmc_high_volt_detect_volt_select

High-voltage Detect Voltage Select.

Values:

enumerator kPMC_HighVoltDetectLowTrip

Low-trip point selected (VHVD = VHVDL)

enumerator kPMC_HighVoltDetectHighTrip

High-trip point selected (VHVD = VHVDH)

enum _pmc_bandgap_buffer_drive_select

Bandgap Buffer Drive Select.

Values:

enumerator kPMC_BandgapBufferDriveLow

Low-drive.

enumerator kPMC_BandgapBufferDriveHigh

High-drive.

enum _pmc_vlp_freq_option
VLPx Option.

Values:

enumerator kPMC_FreqRestrict
Frequency is restricted in VLPx mode.

enumerator kPMC_FreqUnrestrict
Frequency is unrestricted in VLPx mode.

typedef enum *_pmc_low_volt_detect_volt_select* pmc_low_volt_detect_volt_select_t
Low-voltage Detect Voltage Select.

typedef enum *_pmc_low_volt_warning_volt_select* pmc_low_volt_warning_volt_select_t
Low-voltage Warning Voltage Select.

typedef enum *_pmc_high_volt_detect_volt_select* pmc_high_volt_detect_volt_select_t
High-voltage Detect Voltage Select.

typedef enum *_pmc_bandgap_buffer_drive_select* pmc_bandgap_buffer_drive_select_t
Bandgap Buffer Drive Select.

typedef enum *_pmc_vlp_freq_option* pmc_vlp_freq_mode_t
VLPx Option.

typedef struct *_pmc_version_id* pmc_version_id_t
IP version ID definition.

typedef struct *_pmc_param* pmc_param_t
IP parameter definition.

typedef struct *_pmc_low_volt_detect_config* pmc_low_volt_detect_config_t
Low-voltage Detect Configuration Structure.

typedef struct *_pmc_low_volt_warning_config* pmc_low_volt_warning_config_t
Low-voltage Warning Configuration Structure.

typedef struct *_pmc_high_volt_detect_config* pmc_high_volt_detect_config_t
High-voltage Detect Configuration Structure.

typedef struct *_pmc_bandgap_buffer_config* pmc_bandgap_buffer_config_t
Bandgap Buffer configuration.

struct _pmc_version_id
#include <fsl_pmc.h> IP version ID definition.

Public Members

uint16_t feature
Feature Specification Number.

uint8_t minor
Minor version number.

uint8_t major
Major version number.

struct _pmc_param
#include <fsl_pmc.h> IP parameter definition.

Public Members

bool vlpoEnable
VLPO enable.

bool hvdEnable
HVD enable.

struct _pmc_low_volt_detect_config
#include <fsl_pmc.h> Low-voltage Detect Configuration Structure.

Public Members

bool enableInt
Enable interrupt when Low-voltage detect

bool enableReset
Enable system reset when Low-voltage detect

pmc_low_volt_detect_volt_select_t voltSelect
Low-voltage detect trip point voltage selection

struct _pmc_low_volt_warning_config
#include <fsl_pmc.h> Low-voltage Warning Configuration Structure.

Public Members

bool enableInt
Enable interrupt when low-voltage warning

pmc_low_volt_warning_volt_select_t voltSelect
Low-voltage warning trip point voltage selection

struct _pmc_high_volt_detect_config
#include <fsl_pmc.h> High-voltage Detect Configuration Structure.

Public Members

bool enableInt
Enable interrupt when high-voltage detect

bool enableReset
Enable system reset when high-voltage detect

pmc_high_volt_detect_volt_select_t voltSelect
High-voltage detect trip point voltage selection

struct _pmc_bandgap_buffer_config
#include <fsl_pmc.h> Bandgap Buffer configuration.

Public Members

bool enable
Enable bandgap buffer.

bool enableInLowPowerMode
Enable bandgap buffer in low-power mode.

pmc_bandgap_buffer_drive_select_t drive
Bandgap buffer drive select.

2.44 PORT: Port Control and Interrupts

static inline void PORT_SetPinConfig(PORT_Type *base, uint32_t pin, const *port_pin_config_t* *config)

Sets the port PCR register.

This is an example to define an input pin or output pin PCR configuration.

```
// Define a digital input pin PCR configuration
port_pin_config_t config = {
    kPORT_PullUp,
    kPORT_FastSlewRate,
    kPORT_PassiveFilterDisable,
    kPORT_OpenDrainDisable,
    kPORT_LowDriveStrength,
    kPORT_MuxAsGpio,
    kPORT_UnLockRegister,
};
```

Parameters

- base – PORT peripheral base pointer.
- pin – PORT pin number.
- config – PORT PCR register configuration structure.

static inline void PORT_SetMultiplePinsConfig(PORT_Type *base, uint32_t mask, const *port_pin_config_t* *config)

Sets the port PCR register for multiple pins.

This is an example to define input pins or output pins PCR configuration.

```
Define a digital input pin PCR configuration
port_pin_config_t config = {
    kPORT_PullUp ,
    kPORT_PullEnable,
    kPORT_FastSlewRate,
    kPORT_PassiveFilterDisable,
    kPORT_OpenDrainDisable,
    kPORT_LowDriveStrength,
    kPORT_MuxAsGpio,
    kPORT_UnlockRegister,
};
```

Parameters

- base – PORT peripheral base pointer.
- mask – PORT pin number macro.
- config – PORT PCR register configuration structure.

static inline void PORT_SetMultipleInterruptPinsConfig(PORT_Type *base, uint32_t mask, *port_interrupt_t* config)

Sets the port interrupt configuration in PCR register for multiple pins.

Parameters

- base – PORT peripheral base pointer.
- mask – PORT pin number macro.
- config – PORT pin interrupt configuration.
  - kPORT_InterruptOrDMADisabled: Interrupt/DMA request disabled.
  - kPORT_DMARisingEdge : DMA request on rising edge(if the DMA requests exit).
  - kPORT_DMAFallingEdge: DMA request on falling edge(if the DMA requests exit).
  - kPORT_DMAEitherEdge : DMA request on either edge(if the DMA requests exit).
  - kPORT_FlagRisingEdge : Flag sets on rising edge(if the Flag states exit).
  - kPORT_FlagFallingEdge : Flag sets on falling edge(if the Flag states exit).
  - kPORT_FlagEitherEdge : Flag sets on either edge(if the Flag states exit).
  - kPORT_InterruptLogicZero : Interrupt when logic zero.
  - kPORT_InterruptRisingEdge : Interrupt on rising edge.
  - kPORT_InterruptFallingEdge: Interrupt on falling edge.
  - kPORT_InterruptEitherEdge : Interrupt on either edge.
  - kPORT_InterruptLogicOne : Interrupt when logic one.
  - kPORT_ActiveHighTriggerOutputEnable : Enable active high-trigger output (if the trigger states exit).
  - kPORT_ActiveLowTriggerOutputEnable : Enable active low-trigger output (if the trigger states exit).

static inline void PORT_SetPinMux(PORT_Type *base, uint32_t pin, *port_mux_t* mux)

Configures the pin muxing.

Note: : This function is NOT recommended to use together with the PORT_SetPinsConfig, because the PORT_SetPinsConfig need to configure the pin mux anyway (Otherwise the pin mux is reset to zero : kPORT_PinDisabledOrAnalog). This function is recommended to use to reset the pin mux

Parameters

- base – PORT peripheral base pointer.
- pin – PORT pin number.
- mux – pin muxing slot selection.
  - kPORT_PinDisabledOrAnalog: Pin disabled or work in analog function.
  - kPORT_MuxAsGpio : Set as GPIO.
  - kPORT_MuxAlt2 : chip-specific.
  - kPORT_MuxAlt3 : chip-specific.
  - kPORT_MuxAlt4 : chip-specific.
  - kPORT_MuxAlt5 : chip-specific.
  - kPORT_MuxAlt6 : chip-specific.
  - kPORT_MuxAlt7 : chip-specific.

static inline void PORT_EnablePinsDigitalFilter(PORT_Type *base, uint32_t mask, bool enable)

Enables the digital filter in one port, each bit of the 32-bit register represents one pin.

Parameters

- base – PORT peripheral base pointer.
- mask – PORT pin number macro.
- enable – PORT digital filter configuration.

static inline void PORT_SetDigitalFilterConfig(PORT_Type *base, const *port_digital_filter_config_t* *config)

Sets the digital filter in one port, each bit of the 32-bit register represents one pin.

Parameters

- base – PORT peripheral base pointer.
- config – PORT digital filter configuration structure.

static inline void PORT_SetPinInterruptConfig(PORT_Type *base, uint32_t pin, *port_interrupt_t* config)

Configures the port pin interrupt/DMA request.

Parameters

- base – PORT peripheral base pointer.
- pin – PORT pin number.
- config – PORT pin interrupt configuration.
  - kPORT_InterruptOrDMADisabled: Interrupt/DMA request disabled.
  - kPORT_DMARisingEdge : DMA request on rising edge(if the DMA requests exit).
  - kPORT_DMAFallingEdge: DMA request on falling edge(if the DMA requests exit).
  - kPORT_DMAEitherEdge : DMA request on either edge(if the DMA requests exit).
  - kPORT_FlagRisingEdge : Flag sets on rising edge(if the Flag states exit).
  - kPORT_FlagFallingEdge : Flag sets on falling edge(if the Flag states exit).
  - kPORT_FlagEitherEdge : Flag sets on either edge(if the Flag states exit).
  - kPORT_InterruptLogicZero : Interrupt when logic zero.
  - kPORT_InterruptRisingEdge : Interrupt on rising edge.
  - kPORT_InterruptFallingEdge: Interrupt on falling edge.
  - kPORT_InterruptEitherEdge : Interrupt on either edge.
  - kPORT_InterruptLogicOne : Interrupt when logic one.
  - kPORT_ActiveHighTriggerOutputEnable : Enable active high-trigger output (if the trigger states exit).
  - kPORT_ActiveLowTriggerOutputEnable : Enable active low-trigger output (if the trigger states exit).

static inline void PORT_SetPinDriveStrength(PORT_Type *base, uint32_t pin, uint8_t strength)

Configures the port pin drive strength.

Parameters

- base – PORT peripheral base pointer.

- pin – PORT pin number.
- strength – PORT pin drive strength
  - kPORT_LowDriveStrength = 0U - Low-drive strength is configured.
  - kPORT_HighDriveStrength = 1U - High-drive strength is configured.

static inline uint32_t PORT_GetPinsInterruptFlags(PORT_Type *base)

Reads the whole port 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 – PORT peripheral base pointer.

Returns

Current port interrupt status flags, for example, 0x00010001 means the pin 0 and 16 have the interrupt.

static inline void PORT_ClearPinsInterruptFlags(PORT_Type *base, uint32_t mask)

Clears the multiple pin interrupt status flag.

Parameters

- base – PORT peripheral base pointer.
- mask – PORT pin number macro.

FSL_PORT_DRIVER_VERSION

PORT driver version.

enum _port_pull

Internal resistor pull feature selection.

Values:

enumerator kPORT_PullDisable

Internal pull-up/down resistor is disabled.

enumerator kPORT_PullDown

Internal pull-down resistor is enabled.

enumerator kPORT_PullUp

Internal pull-up resistor is enabled.

enum _port_slew_rate

Slew rate selection.

Values:

enumerator kPORT_FastSlewRate

Fast slew rate is configured.

enumerator kPORT_SlowSlewRate

Slow slew rate is configured.

enum _port_open_drain_enable

Open Drain feature enable/disable.

Values:

enumerator kPORT_OpenDrainDisable
Open drain output is disabled.

enumerator kPORT_OpenDrainEnable
Open drain output is enabled.

enum _port_passive_filter_enable
Passive filter feature enable/disable.

Values:

enumerator kPORT_PassiveFilterDisable
Passive input filter is disabled.

enumerator kPORT_PassiveFilterEnable
Passive input filter is enabled.

enum _port_drive_strength
Configures the drive strength.

Values:

enumerator kPORT_LowDriveStrength
Low-drive strength is configured.

enumerator kPORT_HighDriveStrength
High-drive strength is configured.

enum _port_lock_register
Unlock/lock the pin control register field[15:0].

Values:

enumerator kPORT_UnlockRegister
Pin Control Register fields [15:0] are not locked.

enumerator kPORT_LockRegister
Pin Control Register fields [15:0] are locked.

enum _port_mux
Pin mux selection.

Values:

enumerator kPORT_PinDisabledOrAnalog
Corresponding pin is disabled, but is used as an analog pin.

enumerator kPORT_MuxAsGpio
Corresponding pin is configured as GPIO.

enumerator kPORT_MuxAlt0
Chip-specific

enumerator kPORT_MuxAlt1
Chip-specific

enumerator kPORT_MuxAlt2
Chip-specific

enumerator kPORT_MuxAlt3
Chip-specific

enumerator kPORT_MuxAlt4
Chip-specific

enumerator kPORT_MuxAlt5
Chip-specific

enumerator kPORT_MuxAlt6
Chip-specific

enumerator kPORT_MuxAlt7
Chip-specific

enumerator kPORT_MuxAlt8
Chip-specific

enumerator kPORT_MuxAlt9
Chip-specific

enumerator kPORT_MuxAlt10
Chip-specific

enumerator kPORT_MuxAlt11
Chip-specific

enumerator kPORT_MuxAlt12
Chip-specific

enumerator kPORT_MuxAlt13
Chip-specific

enumerator kPORT_MuxAlt14
Chip-specific

enumerator kPORT_MuxAlt15
Chip-specific

enum _port_interrupt
Configures the interrupt generation condition.

Values:

enumerator kPORT_InterruptOrDMADisabled
Interrupt/DMA request is disabled.

enumerator kPORT_DMARisingEdge
DMA request on rising edge.

enumerator kPORT_DMAFallingEdge
DMA request on falling edge.

enumerator kPORT_DMAEitherEdge
DMA request on either edge.

enumerator kPORT_FlagRisingEdge
Flag sets on rising edge.

enumerator kPORT_FlagFallingEdge
Flag sets on falling edge.

enumerator kPORT_FlagEitherEdge
Flag sets on either edge.

enumerator kPORT_InterruptLogicZero
Interrupt when logic zero.

enumerator kPORT_InterruptRisingEdge
Interrupt on rising edge.

enumerator kPORT_InterruptFallingEdge
Interrupt on falling edge.

enumerator kPORT_InterruptEitherEdge
Interrupt on either edge.

enumerator kPORT_InterruptLogicOne
Interrupt when logic one.

enumerator kPORT_ActiveHighTriggerOutputEnable
Enable active high-trigger output.

enumerator kPORT_ActiveLowTriggerOutputEnable
Enable active low-trigger output.

enum _port_digital_filter_clock_source
Digital filter clock source selection.

Values:

enumerator kPORT_BusClock
Digital filters are clocked by the bus clock.

enumerator kPORT_LpoClock
Digital filters are clocked by the 1 kHz LPO clock.

typedef enum *_port_mux* port_mux_t
Pin mux selection.

typedef enum *_port_interrupt* port_interrupt_t
Configures the interrupt generation condition.

typedef enum *_port_digital_filter_clock_source* port_digital_filter_clock_source_t
Digital filter clock source selection.

typedef struct *_port_digital_filter_config* port_digital_filter_config_t
PORT digital filter feature configuration definition.

typedef struct *_port_pin_config* port_pin_config_t
PORT pin configuration structure.

FSL_COMPONENT_ID

struct _port_digital_filter_config
#include <fsl_port.h> PORT digital filter feature configuration definition.

Public Members

uint32_t digitalFilterWidth
Set digital filter width

port_digital_filter_clock_source_t clockSource
Set digital filter clockSource

struct _port_pin_config
#include <fsl_port.h> PORT pin configuration structure.

Public Members

uint16_t pullSelect
: No-pull/pull-down/pull-up select

uint16_t slewRate
: Fast/slow slew rate Configure

uint16_t passiveFilterEnable
: Passive filter enable/disable

uint16_t openDrainEnable
: Open drain enable/disable

uint16_t driveStrength
: Fast/slow drive strength configure

uint16_t lockRegister
: Lock/unlock the PCR field[15:0]

2.45 PWT: Pulse Width Timer

void PWT_Init(PWT_Type *base, const *pwt_config_t* *config)

Ungates the PWT clock and configures the peripheral for basic operation.

Note: This API should be called at the beginning of the application using the PWT driver.

Parameters

- base – PWT peripheral base address
- config – Pointer to the user configuration structure.

void PWT_Deinit(PWT_Type *base)

Gates the PWT clock.

Parameters

- base – PWT peripheral base address

void PWT_GetDefaultConfig(*pwt_config_t* *config)

Fills in the PWT configuration structure with the default settings.

The default values are:

```
config->clockSource = kPWT_BusClock;
config->prescale = kPWT_Prescale_Divide_1;
config->inputSelect = kPWT_InputPort_0;
config->enableFirstCounterLoad = false;
```

Parameters

- config – Pointer to the user configuration structure.

static inline void PWT_EnableInterrupts(PWT_Type *base, uint32_t mask)

Enables the selected PWT interrupts.

Parameters

- base – PWT peripheral base address

- mask – The interrupts to enable. This is a logical OR of members of the enumeration pwt_interrupt_enable_t

static inline void PWT_DisableInterrupts(PWT_Type *base, uint32_t mask)

Disables the selected PWT interrupts.

Parameters

- base – PWT peripheral base address
- mask – The interrupts to enable. This is a logical OR of members of the enumeration pwt_interrupt_enable_t

static inline uint32_t PWT_GetEnabledInterrupts(PWT_Type *base)

Gets the enabled PWT interrupts.

Parameters

- base – PWT peripheral base address

Returns

The enabled interrupts. This is the logical OR of members of the enumeration pwt_interrupt_enable_t

static inline uint32_t PWT_GetStatusFlags(PWT_Type *base)

Gets the PWT status flags.

Parameters

- base – PWT peripheral base address

Returns

The status flags. This is the logical OR of members of the enumeration pwt_status_flags_t

static inline void PWT_ClearStatusFlags(PWT_Type *base, uint32_t mask)

Clears the PWT status flags.

Parameters

- base – PWT peripheral base address
- mask – The status flags to clear. This is a logical OR of members of the enumeration pwt_status_flags_t

static inline void PWT_StartTimer(PWT_Type *base)

Starts the PWT counter.

Parameters

- base – PWT peripheral base address

static inline void PWT_StopTimer(PWT_Type *base)

Stops the PWT counter.

Parameters

- base – PWT peripheral base address

enum _pwt_clock_source

PWT clock source selection.

Values:

enumerator kPWT_BusClock

The Bus clock is used as the clock source of PWT counter

enumerator kPWT_AlternativeClock

Alternative clock is used as the clock source of PWT counter

enum _pwt_clock_prescale
PWT prescaler factor selection for clock source.

Values:

enumerator kPWT_Prescale_Divide_1
PWT clock divided by 1

enumerator kPWT_Prescale_Divide_2
PWT clock divided by 2

enumerator kPWT_Prescale_Divide_4
PWT clock divided by 4

enumerator kPWT_Prescale_Divide_8
PWT clock divided by 8

enumerator kPWT_Prescale_Divide_16
PWT clock divided by 16

enumerator kPWT_Prescale_Divide_32
PWT clock divided by 32

enumerator kPWT_Prescale_Divide_64
PWT clock divided by 64

enumerator kPWT_Prescale_Divide_128
PWT clock divided by 128

enum _pwt_input_select
PWT input port selection.

Values:

enumerator kPWT_InputPort_0
PWT input comes from PWTIN[0]

enumerator kPWT_InputPort_1
PWT input comes from PWTIN[1]

enumerator kPWT_InputPort_2
PWT input comes from PWTIN[2]

enumerator kPWT_InputPort_3
PWT input comes from PWTIN[3]

enum _pwt_interrupt_enable
List of PWT interrupts.

Values:

enumerator kPWT_PulseWidthReadyInterruptEnable
Pulse width data ready interrupt

enumerator kPWT_CounterOverflowInterruptEnable
Counter overflow interrupt

enum _pwt_status_flags
List of PWT flags.

Values:

enumerator kPWT_CounterOverflowFlag
Counter overflow flag

enumerator kPWT_PulseWidthValidFlag

Pulse width valid flag

typedef enum *_pwt_clock_source* pwt_clock_source_t

PWT clock source selection.

typedef enum *_pwt_clock_prescale* pwt_clock_prescale_t

PWT prescaler factor selection for clock source.

typedef enum *_pwt_input_select* pwt_input_select_t

PWT input port selection.

typedef struct *_pwt_config* pwt_config_t

PWT configuration structure.

This structure holds the configuration settings for the PWT peripheral. To initialize this structure to reasonable defaults, call the PWT_GetDefaultConfig() function and pass a pointer to the configuration structure instance.

The configuration structure can be made constant so as to reside in flash.

static inline uint16_t PWT_GetCurrentTimerCount(PWT_Type *base)

Reads the current counter value.

This function returns the timer counting value

Parameters

- base – PWT peripheral base address

Returns

Current 16-bit timer counter value

static inline uint16_t PWT_ReadPositivePulseWidth(PWT_Type *base)

Reads the positive pulse width.

This function reads the low and high registers and returns the 16-bit positive pulse width

Parameters

- base – PWT peripheral base address.

Returns

The 16-bit positive pulse width.

static inline uint16_t PWT_ReadNegativePulseWidth(PWT_Type *base)

Reads the negative pulse width.

This function reads the low and high registers and returns the 16-bit negative pulse width

Parameters

- base – PWT peripheral base address.

Returns

The 16-bit negative pulse width.

static inline void PWT_Reset(PWT_Type *base)

Performs a software reset on the PWT module.

Parameters

- base – PWT peripheral base address

FSL_PWT_DRIVER_VERSION

Version 2.0.2

struct _pwt_config

#include <fsl_pwt.h> PWT configuration structure.

This structure holds the configuration settings for the PWT peripheral. To initialize this structure to reasonable defaults, call the PWT_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

pwt_clock_source_t clockSource

Clock source for the counter

pwt_clock_prescale_t prescale

Pre-scaler to divide down the clock

pwt_input_select_t inputSelect

PWT Pulse input port selection

bool enableFirstCounterLoad

true: Load the first counter value to registers; false: Do not load first counter value

2.46 RCM: Reset Control Module Driver

static inline void RCM_GetVersionId(RCM_Type *base, *rcm_version_id_t* *versionId)

Gets the RCM version ID.

This function gets the RCM version ID including the major version number, the minor version number, and the feature specification number.

Parameters

- base – RCM peripheral base address.
- versionId – Pointer to the version ID structure.

static inline uint32_t RCM_GetResetSourceImplementedStatus(RCM_Type *base)

Gets the reset source implemented status.

This function gets the RCM parameter that indicates whether the corresponding reset source is implemented. Use source masks defined in the rcm_reset_source_t to get the desired source status.

This is an example.

```
uint32_t status;

To test whether the MCU is reset using Watchdog.
status = RCM_GetResetSourceImplementedStatus(RCM) & (kRCM_SourceWdog | kRCM_SourcePin);
```

Parameters

- base – RCM peripheral base address.

Returns

All reset source implemented status bit map.

static inline uint32_t RCM_GetPreviousResetSources(RCM_Type *base)

Gets the reset source status which caused a previous reset.

This function gets the current reset source status. Use source masks defined in the rcm_reset_source_t to get the desired source status.

This is an example.

```
uint32_t resetStatus;

To get all reset source statuses.
resetStatus = RCM_GetPreviousResetSources(RCM) & kRCM_SourceAll;

To test whether the MCU is reset using Watchdog.
resetStatus = RCM_GetPreviousResetSources(RCM) & kRCM_SourceWdog;

To test multiple reset sources.
resetStatus = RCM_GetPreviousResetSources(RCM) & (kRCM_SourceWdog | kRCM_SourcePin);
```

Parameters

- base – RCM peripheral base address.

Returns

All reset source status bit map.

static inline uint32_t RCM_GetStickyResetSources(RCM_Type *base)

Gets the sticky reset source status.

This function gets the current reset source status that has not been cleared by software for a specific source.

This is an example.

```
uint32_t resetStatus;

To get all reset source statuses.
resetStatus = RCM_GetStickyResetSources(RCM) & kRCM_SourceAll;

To test whether the MCU is reset using Watchdog.
resetStatus = RCM_GetStickyResetSources(RCM) & kRCM_SourceWdog;

To test multiple reset sources.
resetStatus = RCM_GetStickyResetSources(RCM) & (kRCM_SourceWdog | kRCM_SourcePin);
```

Parameters

- base – RCM peripheral base address.

Returns

All reset source status bit map.

static inline void RCM_ClearStickyResetSources(RCM_Type *base, uint32_t sourceMasks)

Clears the sticky reset source status.

This function clears the sticky system reset flags indicated by source masks.

This is an example.

```
Clears multiple reset sources.
RCM_ClearStickyResetSources(kRCM_SourceWdog | kRCM_SourcePin);
```

Parameters

- base – RCM peripheral base address.

- sourceMasks – reset source status bit map

void RCM_ConfigureResetPinFilter(RCM_Type *base, const *rcm_reset_pin_filter_config_t* *config)

Configures the reset pin filter.

This function sets the reset pin filter including the filter source, filter width, and so on.

Parameters

- base – RCM peripheral base address.
- config – Pointer to the configuration structure.

static inline bool RCM_GetEasyPortModePinStatus(RCM_Type *base)

Gets the EZP_MS_B pin assert status.

This function gets the easy port mode status (EZP_MS_B) pin assert status.

Parameters

- base – RCM peripheral base address.

Returns

status true - asserted, false - reasserted

static inline *rcm_boot_rom_config_t* RCM_GetBootRomSource(RCM_Type *base)

Gets the ROM boot source.

This function gets the ROM boot source during the last chip reset.

Parameters

- base – RCM peripheral base address.

Returns

The ROM boot source.

static inline void RCM_ClearBootRomSource(RCM_Type *base)

Clears the ROM boot source flag.

This function clears the ROM boot source flag.

Parameters

- base – Register base address of RCM

void RCM_SetForceBootRomSource(RCM_Type *base, *rcm_boot_rom_config_t* config)

Forces the boot from ROM.

This function forces booting from ROM during all subsequent system resets.

Parameters

- base – RCM peripheral base address.
- config – Boot configuration.

static inline void RCM_SetSystemResetInterruptConfig(RCM_Type *base, uint32_t intMask, *rcm_reset_delay_t* delay)

Sets the system reset interrupt configuration.

For a graceful shut down, the RCM supports delaying the assertion of the system reset for a period of time when the reset interrupt is generated. This function can be used to enable the interrupt and the delay period. The interrupts are passed in as bit mask. See rcm_int_t for details. For example, to delay a reset for 512 LPO cycles after the WDOG timeout or loss-of-clock occurs, configure as follows: RCM_SetSystemResetInterruptConfig(kRCM_IntWatchDog | kRCM_IntLossOfClk, kRCM_ResetDelay512Lpo);

Parameters

- base – RCM peripheral base address.
- intMask – Bit mask of the system reset interrupts to enable. See rcm_interrupt_enable_t for details.
- delay – Bit mask of the system reset interrupts to enable.

FSL_RCM_DRIVER_VERSION

RCM driver version 2.0.5.

enum _rcm_reset_source

System Reset Source Name definitions.

Values:

enumerator kRCM_SourceWakeup

Low-leakage wakeup reset

enumerator kRCM_SourceLvd

Low-voltage detect reset

enumerator kRCM_SourceLoc

Loss of clock reset

enumerator kRCM_SourceLol

Loss of lock reset

enumerator kRCM_SourceWdog

Watchdog reset

enumerator kRCM_SourcePin

External pin reset

enumerator kRCM_SourcePor

Power on reset

enumerator kRCM_SourceJtag

JTAG generated reset

enumerator kRCM_SourceLockup

Core lock up reset

enumerator kRCM_SourceSw

Software reset

enumerator kRCM_SourceMdmap

MDM-AP system reset

enumerator kRCM_SourceEzpt

EzPort reset

enumerator kRCM_SourceSackerr

Parameter could get all reset flags

enumerator kRCM_SourceAll

enum _rcm_run_wait_filter_mode

Reset pin filter select in Run and Wait modes.

Values:

enumerator kRCM_FilterDisable

All filtering disabled

enumerator kRCM_FilterBusClock
Bus clock filter enabled

enumerator kRCM_FilterLpoClock
LPO clock filter enabled

enum _rcm_boot_rom_config
Boot from ROM configuration.

Values:

enumerator kRCM_BootFlash
Boot from flash

enumerator kRCM_BootRomCfg0
Boot from boot ROM due to BOOTCFG0

enumerator kRCM_BootRomFopt
Boot from boot ROM due to FOPT[7]

enumerator kRCM_BootRomBoth
Boot from boot ROM due to both BOOTCFG0 and FOPT[7]

enum _rcm_reset_delay
Maximum delay time from interrupt asserts to system reset.

Values:

enumerator kRCM_ResetDelay8Lpo
Delay 8 LPO cycles.

enumerator kRCM_ResetDelay32Lpo
Delay 32 LPO cycles.

enumerator kRCM_ResetDelay128Lpo
Delay 128 LPO cycles.

enumerator kRCM_ResetDelay512Lpo
Delay 512 LPO cycles.

enum _rcm_interrupt_enable
System reset interrupt enable bit definitions.

Values:

enumerator kRCM_IntNone
No interrupt enabled.

enumerator kRCM_IntLossOfClk
Loss of clock interrupt.

enumerator kRCM_IntLossOfLock
Loss of lock interrupt.

enumerator kRCM_IntWatchDog
Watch dog interrupt.

enumerator kRCM_IntExternalPin
External pin interrupt.

enumerator kRCM_IntGlobal
Global interrupts.

enumerator kRCM_IntCoreLockup
Core lock up interrupt

enumerator kRCM_IntSoftware
software interrupt

enumerator kRCM_IntStopModeAckErr
Stop mode ACK error interrupt.

enumerator kRCM_IntCore1
Core 1 interrupt.

enumerator kRCM_IntAll
Enable all interrupts.

typedef enum *_rcm_reset_source* rcm_reset_source_t
System Reset Source Name definitions.

typedef enum *_rcm_run_wait_filter_mode* rcm_run_wait_filter_mode_t
Reset pin filter select in Run and Wait modes.

typedef enum *_rcm_boot_rom_config* rcm_boot_rom_config_t
Boot from ROM configuration.

typedef enum *_rcm_reset_delay* rcm_reset_delay_t
Maximum delay time from interrupt asserts to system reset.

typedef enum *_rcm_interrupt_enable* rcm_interrupt_enable_t
System reset interrupt enable bit definitions.

typedef struct *_rcm_version_id* rcm_version_id_t
IP version ID definition.

typedef struct *_rcm_reset_pin_filter_config* rcm_reset_pin_filter_config_t
Reset pin filter configuration.

struct _rcm_version_id
#include <fsl_rcm.h> IP version ID definition.

Public Members

uint16_t feature
Feature Specification Number.

uint8_t minor
Minor version number.

uint8_t major
Major version number.

struct _rcm_reset_pin_filter_config
#include <fsl_rcm.h> Reset pin filter configuration.

Public Members

bool enableFilterInStop
Reset pin filter select in stop mode.

rcm_run_wait_filter_mode_t filterInRunWait
Reset pin filter in run/wait mode.

uint8_t busClockFilterCount
Reset pin bus clock filter width.

2.47 SIM: System Integration Module Driver

FSL_SIM_DRIVER_VERSION
Driver version.

typedef struct *_sim_uid* sim_uid_t
Unique ID.

void SIM_GetUniqueId(*sim_uid_t* *uid)
Gets the unique identification register value.

Parameters

- uid – Pointer to the structure to save the UID value.

struct _sim_uid
#include <fsl_sim.h> Unique ID.

Public Members

uint32_t MH
UIDMH.

uint32_t ML
UIDML.

uint32_t L
UIDL.

2.48 SMC: System Mode Controller Driver

static inline void SMC_GetVersionId(SMC_Type *base, *smc_version_id_t* *versionId)
Gets the SMC version ID.

This function gets the SMC version ID, including major version number, minor version number, and feature specification number.

Parameters

- base – SMC peripheral base address.
- versionId – Pointer to the version ID structure.

void SMC_GetParam(SMC_Type *base, *smc_param_t* *param)
Gets the SMC parameter.

This function gets the SMC parameter including the enabled power mdoes.

Parameters

- base – SMC peripheral base address.
- param – Pointer to the SMC param structure.

static inline void SMC_SetPowerModeProtection(SMC_Type *base, uint8_t allowedModes)

Configures all power mode protection settings.

This function configures the power mode protection settings for supported power modes in the specified chip family. The available power modes are defined in the smc_power_mode_protection_t. This should be done at an early system level initialization stage. See the reference manual for details. This register can only write once after the power reset.

The allowed modes are passed as bit map. For example, to allow LLS and VLLS, use SMC_SetPowerModeProtection(kSMC_AllowPowerModeVlls | kSMC_AllowPowerModeVlps). To allow all modes, use SMC_SetPowerModeProtection(kSMC_AllowPowerModeAll).

Parameters

- base – SMC peripheral base address.
- allowedModes – Bitmap of the allowed power modes.

static inline *smc_power_state_t* SMC_GetPowerModeState(SMC_Type *base)

Gets the current power mode status.

This function returns the current power mode status. After the application switches the power mode, it should always check the status to check whether it runs into the specified mode or not. The application should check this mode before switching to a different mode. The system requires that only certain modes can switch to other specific modes. See the reference manual for details and the smc_power_state_t for information about the power status.

Parameters

- base – SMC peripheral base address.

Returns

Current power mode status.

void SMC_PreEnterStopModes(void)

Prepares to enter stop modes.

This function should be called before entering STOP/VLPS/LLS/VLLS modes.

void SMC_PostExitStopModes(void)

Recovers after wake up from stop modes.

This function should be called after wake up from STOP/VLPS/LLS/VLLS modes. It is used with SMC_PreEnterStopModes.

void SMC_PreEnterWaitModes(void)

Prepares to enter wait modes.

This function should be called before entering WAIT/VLPW modes.

void SMC_PostExitWaitModes(void)

Recovers after wake up from stop modes.

This function should be called after wake up from WAIT/VLPW modes. It is used with SMC_PreEnterWaitModes.

status_t SMC_SetPowerModeRun(SMC_Type *base)

Configures the system to RUN power mode.

Parameters

- base – SMC peripheral base address.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeHsrun(SMC_Type *base)

Configures the system to HSRUN power mode.

Parameters

- base – SMC peripheral base address.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeWait(SMC_Type *base)

Configures the system to WAIT power mode.

Parameters

- base – SMC peripheral base address.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeStop(SMC_Type *base, *smc_partial_stop_option_t* option)

Configures the system to Stop power mode.

Parameters

- base – SMC peripheral base address.
- option – Partial Stop mode option.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeVlpr(SMC_Type *base, bool wakeupMode)

Configures the system to VLPR power mode.

Parameters

- base – SMC peripheral base address.
- wakeupMode – Enter Normal Run mode if true, else stay in VLPR mode.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeVlpw(SMC_Type *base)

Configures the system to VLPW power mode.

Parameters

- base – SMC peripheral base address.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeVlps(SMC_Type *base)

Configures the system to VLPS power mode.

Parameters

- base – SMC peripheral base address.

Returns

SMC configuration error code.

status_t SMC_SetPowerModeLls(SMC_Type *base, const *smc_power_mode_lls_config_t* *config)

Configures the system to LLS power mode.

Parameters

- base – SMC peripheral base address.

- config – The LLS power mode configuration structure

Returns
SMC configuration error code.

status_t SMC_SetPowerModeVlls(SMC_Type *base, const *smc_power_mode_vlls_config_t* *config)
Configures the system to VLLS power mode.

Parameters
- base – SMC peripheral base address.
- config – The VLLS power mode configuration structure.

Returns
SMC configuration error code.

FSL_SMC_DRIVER_VERSION
SMC driver version.

enum _smc_power_mode_protection
Power Modes Protection.

Values:

enumerator kSMC_AllowPowerModeVlls
Allow Very-low-leakage Stop Mode.

enumerator kSMC_AllowPowerModeLls
Allow Low-leakage Stop Mode.

enumerator kSMC_AllowPowerModeVlp
Allow Very-Low-power Mode.

enumerator kSMC_AllowPowerModeHsrun
Allow High-speed Run mode.

enumerator kSMC_AllowPowerModeAll
Allow all power mode.

enum _smc_power_state
Power Modes in PMSTAT.

Values:

enumerator kSMC_PowerStateRun
0000_0001 - Current power mode is RUN

enumerator kSMC_PowerStateStop
0000_0010 - Current power mode is STOP

enumerator kSMC_PowerStateVlpr
0000_0100 - Current power mode is VLPR

enumerator kSMC_PowerStateVlpw
0000_1000 - Current power mode is VLPW

enumerator kSMC_PowerStateVlps
0001_0000 - Current power mode is VLPS

enumerator kSMC_PowerStateLls
0010_0000 - Current power mode is LLS

enumerator kSMC_PowerStateVlls
0100_0000 - Current power mode is VLLS

enumerator kSMC_PowerStateHsrun
1000_0000 - Current power mode is HSRUN

enum _smc_run_mode
Run mode definition.

Values:

enumerator kSMC_RunNormal
Normal RUN mode.

enumerator kSMC_RunVlpr
Very-low-power RUN mode.

enumerator kSMC_Hsrun
High-speed Run mode (HSRUN).

enum _smc_stop_mode
Stop mode definition.

Values:

enumerator kSMC_StopNormal
Normal STOP mode.

enumerator kSMC_StopVlps
Very-low-power STOP mode.

enumerator kSMC_StopLls
Low-leakage Stop mode.

enumerator kSMC_StopVlls
Very-low-leakage Stop mode.

enum _smc_stop_submode
VLLS/LLS stop sub mode definition.

Values:

enumerator kSMC_StopSub0
Stop submode 0, for VLLS0/LLS0.

enumerator kSMC_StopSub1
Stop submode 1, for VLLS1/LLS1.

enumerator kSMC_StopSub2
Stop submode 2, for VLLS2/LLS2.

enumerator kSMC_StopSub3
Stop submode 3, for VLLS3/LLS3.

enum _smc_partial_stop_mode
Partial STOP option.

Values:

enumerator kSMC_PartialStop
STOP - Normal Stop mode

enumerator kSMC_PartialStop1
Partial Stop with both system and bus clocks disabled

enumerator kSMC_PartialStop2
Partial Stop with system clock disabled and bus clock enabled

_smc_status, SMC configuration status.

Values:

enumerator kStatus_SMC_StopAbort
Entering Stop mode is abort

typedef enum *_smc_power_mode_protection* smc_power_mode_protection_t
Power Modes Protection.

typedef enum *_smc_power_state* smc_power_state_t
Power Modes in PMSTAT.

typedef enum *_smc_run_mode* smc_run_mode_t
Run mode definition.

typedef enum *_smc_stop_mode* smc_stop_mode_t
Stop mode definition.

typedef enum *_smc_stop_submode* smc_stop_submode_t
VLLS/LLS stop sub mode definition.

typedef enum *_smc_partial_stop_mode* smc_partial_stop_option_t
Partial STOP option.

typedef struct *_smc_version_id* smc_version_id_t
IP version ID definition.

typedef struct *_smc_param* smc_param_t
IP parameter definition.

typedef struct *_smc_power_mode_lls_config* smc_power_mode_lls_config_t
SMC Low-Leakage Stop power mode configuration.

typedef struct *_smc_power_mode_vlls_config* smc_power_mode_vlls_config_t
SMC Very Low-Leakage Stop power mode configuration.

struct _smc_version_id
#include <fsl_smc.h> IP version ID definition.

Public Members

uint16_t feature
Feature Specification Number.

uint8_t minor
Minor version number.

uint8_t major
Major version number.

struct _smc_param
#include <fsl_smc.h> IP parameter definition.

Public Members

bool hsrunEnable
HSRUN mode enable.

bool llsEnable
LLS mode enable.

bool lls2Enable
LLS2 mode enable.

bool vlls0Enable
VLLS0 mode enable.

struct _smc_power_mode_lls_config
#include <fsl_smc.h> SMC Low-Leakage Stop power mode configuration.

Public Members

smc_stop_submode_t subMode
Low-leakage Stop sub-mode

bool enableLpoClock
Enable LPO clock in LLS mode

struct _smc_power_mode_vlls_config
#include <fsl_smc.h> SMC Very Low-Leakage Stop power mode configuration.

Public Members

smc_stop_submode_t subMode
Very Low-leakage Stop sub-mode

bool enablePorDetectInVlls0
Enable Power on reset detect in VLLS mode

bool enableRam2InVlls2
Enable RAM2 power in VLLS2

bool enableLpoClock
Enable LPO clock in VLLS mode

2.49 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.

2.50 Tsi_v5_driver

enum _tsi_main_clock_selection

TSI main clock selection.

These constants set the tsi main clock.

Values:

enumerator kTSI_MainClockSlection_0
Set TSI main clock frequency to 20.72MHz

enumerator kTSI_MainClockSlection_1
Set TSI main clock frequency to 16.65MHz

enumerator kTSI_MainClockSlection_2
Set TSI main clock frequency to 13.87MHz

enumerator kTSI_MainClockSlection_3
Set TSI main clock frequency to 11.91MHz

enum _tsi_sensing_mode_selection
TSI sensing mode selection.

These constants set the tsi sensing mode.

Values:

enumerator kTSI_SensingModeSlection_Self
Set TSI sensing mode to self-cap mode

enumerator kTSI_SensingModeSlection_Mutual
Set TSI sensing mode to mutual-cap mode

enum _tsi_dvolt_option
TSI DVOLT settings.

These bits indicate the comparator vp, vm and dvolt voltage.

Values:

enumerator kTSI_DvoltOption_0
DVOLT value option 0, the value may differ on different platforms

enumerator kTSI_DvoltOption_1
DVOLT value option 1, the value may differ on different platforms

enumerator kTSI_DvoltOption_2
DVOLT value option 2, the value may differ on different platforms

enumerator kTSI_DvoltOption_3
DVOLT value option 3, the value may differ on different platforms

enum _tsi_sensitivity_xdn_option
TSI sensitivity ajustment (XDN option).

These constants define the tsi sensitivity ajustment in self-cap mode, when TSI_MODE[S_SEN] = 1.

Values:

enumerator kTSI_SensitivityXdnOption_0
Adjust sensitivity in self-cap mode, 1/16

enumerator kTSI_SensitivityXdnOption_1
Adjust sensitivity in self-cap mode, 1/8

enumerator kTSI_SensitivityXdnOption_2
Adjust sensitivity in self-cap mode, 1/4

enumerator kTSI_SensitivityXdnOption_3
Adjust sensitivity in self-cap mode, 1/2

enum _tsi_shield
TSI Shield setting (S_W_SHIELD option).

These constants define the shield pin used for HW shielding functionality. One or more shield pin can be selected. The involved bitfield is not fix can change from device to device (KE16Z7 and KE17Z7 support 3 shield pins, other KE serials only support 1 shield pin).

Values:

enumerator kTSI_shieldAllOff
No pin used

enumerator kTSI_shield0On
Shield 0 pin used

enumerator kTSI_shield1On
Shield 1 pin used

enumerator kTSI_shield1and0On
Shield 0,1 pins used

enumerator kTSI_shield2On
Shield 2 pin used

enumerator kTSI_shield2and0On
Shield 2,0 pins used

enumerator kTSI_shield2and1On
Shield 2,1 pins used

enumerator kTSI_shieldAllOn
Shield 2,1,0 pins used

enum _tsi_sensitivity_ctrim_option
TSI sensitivity ajustment (CTRIM option).

These constants define the tsi sensitivity ajustment in self-cap mode, when TSI_MODE[S_SEN] = 1.

Values:

enumerator kTSI_SensitivityCtrimOption_0
Adjust sensitivity in self-cap mode, 2.5p

enumerator kTSI_SensitivityCtrimOption_1
Adjust sensitivity in self-cap mode, 5.0p

enumerator kTSI_SensitivityCtrimOption_2
Adjust sensitivity in self-cap mode, 7.5p

enumerator kTSI_SensitivityCtrimOption_3
Adjust sensitivity in self-cap mode, 10.0p

enumerator kTSI_SensitivityCtrimOption_4
Adjust sensitivity in self-cap mode, 12.5p

enumerator kTSI_SensitivityCtrimOption_5
Adjust sensitivity in self-cap mode, 15.0p

enumerator kTSI_SensitivityCtrimOption_6
Adjust sensitivity in self-cap mode, 17.5p

enumerator kTSI_SensitivityCtrimOption_7
Adjust sensitivity in self-cap mode, 20.0p

enum _tsi_current_multiple_input
TSI current ajustment (Input current multiple).

These constants set the tsi input current multiple in self-cap mode.

Values:

enumerator kTSI_CurrentMultipleInputValue_0
Adjust input current multiple in self-cap mode, 1/8

enumerator kTSI_CurrentMultipleInputValue_1
Adjust input current multiple in self-cap mode, 1/4

enum _tsi_current_multiple_charge
TSI current ajustment (Charge/Discharge current multiple).

These constants set the tsi charge/discharge current multiple in self-cap mode.

Values:

enumerator kTSI_CurrentMultipleChargeValue_0
Adjust charge/discharge current multiple in self-cap mode, 1/16

enumerator kTSI_CurrentMultipleChargeValue_1
Adjust charge/discharge current multiple in self-cap mode, 1/8

enumerator kTSI_CurrentMultipleChargeValue_2
Adjust charge/discharge current multiple in self-cap mode, 1/4

enumerator kTSI_CurrentMultipleChargeValue_3
Adjust charge/discharge current multiple in self-cap mode, 1/2

enumerator kTSI_CurrentMultipleChargeValue_4
Adjust charge/discharge current multiple in self-cap mode, 1/1

enumerator kTSI_CurrentMultipleChargeValue_5
Adjust charge/discharge current multiple in self-cap mode, 2/1

enumerator kTSI_CurrentMultipleChargeValue_6
Adjust charge/discharge current multiple in self-cap mode, 4/1

enumerator kTSI_CurrentMultipleChargeValue_7
Adjust charge/discharge current multiple in self-cap mode, 8/1

enum _tsi_mutual_pre_current
TSI current used in vref generator.

These constants Choose the current used in vref generator.

Values:

enumerator kTSI_MutualPreCurrent_1uA
Vref generator current is 1uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_2uA
Vref generator current is 2uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_3uA
Vref generator current is 3uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_4uA
Vref generator current is 4uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_5uA
Vref generator current is 5uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_6uA
Vref generator current is 6uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_7uA
Vref generator current is 7uA, used in mutual-cap mode

enumerator kTSI_MutualPreCurrent_8uA
Vref generator current is 8uA, used in mutual-cap mode

enum _tsi_mutual_pre_resistor
TSI resistor used in pre-charge.

These constants Choose the resistor used in pre-charge.

Values:

enumerator kTSI_MutualPreResistor_1k
Vref generator resistor is 1k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_2k
Vref generator resistor is 2k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_3k
Vref generator resistor is 3k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_4k
Vref generator resistor is 4k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_5k
Vref generator resistor is 5k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_6k
Vref generator resistor is 6k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_7k
Vref generator resistor is 7k, used in mutual-cap mode

enumerator kTSI_MutualPreResistor_8k
Vref generator resistor is 8k, used in mutual-cap mode

enum _tsi_mutual_sense_resistor
TSI resistor used in I-sense generator.

These constants Choose the resistor used in I-sense generator.

Values:

enumerator kTSI_MutualSenseResistor_2k5
I-sense resistor is 2.5k , used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_5k
I-sense resistor is 5.0k , used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_7k5
I-sense resistor is 7.5k , used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_10k
I-sense resistor is 10.0k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_12k5
I-sense resistor is 12.5k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_15k
I-sense resistor is 15.0k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_17k5
I-sense resistor is 17.5k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_20k
I-sense resistor is 20.0k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_22k5
I-sense resistor is 22.5k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_25k
I-sense resistor is 25.0k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_27k5
I-sense resistor is 27.5k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_30k
I-sense resistor is 30.0k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_32k5
I-sense resistor is 32.5k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_35k
I-sense resistor is 35.0k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_37k5
I-sense resistor is 37.5k, used in mutual-cap mode

enumerator kTSI_MutualSenseResistor_40k
I-sense resistor is 40.0k, used in mutual-cap mode

enum _tsi_mutual_tx_channel
TSI TX channel selection in mutual-cap mode.

These constants Choose the TX channel used in mutual-cap mode.

Values:

enumerator kTSI_MutualTxChannel_0
Select channel 0 as tx0, used in mutual-cap mode

enumerator kTSI_MutualTxChannel_1
Select channel 1 as tx1, used in mutual-cap mode

enumerator kTSI_MutualTxChannel_2
Select channel 2 as tx2, used in mutual-cap mode

enumerator kTSI_MutualTxChannel_3
Select channel 3 as tx3, used in mutual-cap mode

enumerator kTSI_MutualTxChannel_4
Select channel 4 as tx4, used in mutual-cap mode

enumerator kTSI_MutualTxChannel_5
Select channel 5 as tx5, used in mutual-cap mode

enum _tsi_mutual_rx_channel
TSI RX channel selection in mutual-cap mode.

These constants Choose the RX channel used in mutual-cap mode.

Values:

enumerator kTSI_MutualRxChannel_6
Select channel 6 as rx6, used in mutual-cap mode

enumerator kTSI_MutualRxChannel_7
Select channel 7 as rx7, used in mutual-cap mode

enumerator kTSI_MutualRxChannel_8
Select channel 8 as rx8, used in mutual-cap mode

enumerator kTSI_MutualRxChannel_9
Select channel 9 as rx9, used in mutual-cap mode

enumerator kTSI_MutualRxChannel_10
Select channel 10 as rx10, used in mutual-cap mode

enumerator kTSI_MutualRxChannel_11
Select channel 11 as rx11, used in mutual-cap mode

enum _tsi_mutual_sense_boost_current
TSI sensitivity boost current settings.

These constants set the sensitivity boost current.

Values:

enumerator kTSI_MutualSenseBoostCurrent_0uA
Sensitivity boost current is 0uA , used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_2uA
Sensitivity boost current is 2uA , used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_4uA
Sensitivity boost current is 4uA , used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_6uA
Sensitivity boost current is 6uA , used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_8uA
Sensitivity boost current is 8uA , used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_10uA
Sensitivity boost current is 10uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_12uA
Sensitivity boost current is 12uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_14uA
Sensitivity boost current is 14uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_16uA
Sensitivity boost current is 16uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_18uA
Sensitivity boost current is 18uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_20uA
Sensitivity boost current is 20uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_22uA
Sensitivity boost current is 22uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_24uA
Sensitivity boost current is 24uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_26uA
Sensitivity boost current is 26uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_28uA
Sensitivity boost current is 28uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_30uA
Sensitivity boost current is 30uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_32uA
Sensitivity boost current is 32uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_34uA
Sensitivity boost current is 34uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_36uA
Sensitivity boost current is 36uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_38uA
Sensitivity boost current is 38uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_40uA
Sensitivity boost current is 40uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_42uA
Sensitivity boost current is 42uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_44uA
Sensitivity boost current is 44uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_46uA
Sensitivity boost current is 46uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_48uA
Sensitivity boost current is 48uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_50uA
Sensitivity boost current is 50uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_52uA
Sensitivity boost current is 52uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_54uA
Sensitivity boost current is 54uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_56uA
Sensitivity boost current is 56uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_58uA
Sensitivity boost current is 58uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_60uA
Sensitivity boost current is 60uA, used in mutual-cap mode

enumerator kTSI_MutualSenseBoostCurrent_62uA
Sensitivity boost current is 62uA, used in mutual-cap mode

enum _tsi_mutual_tx_drive_mode
TSI TX drive mode control.

These constants Choose the TX drive mode control setting.

Values:

enumerator kTSI_MutualTxDriveModeOption_0
TX drive mode is -5v ~ +5v, used in mutual-cap mode

enumerator kTSI_MutualTxDriveModeOption_1
TX drive mode is 0v ~ +5v, used in mutual-cap mode

enum _tsi_mutual_pmos_current_left
TSI Pmos current mirror selection on the left side.

These constants set the Pmos current mirror on the left side used in mutual-cap mode.

Values:

enumerator kTSI_MutualPmosCurrentMirrorLeft_4
Set Pmos current mirror left value as 4, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_8
Set Pmos current mirror left value as 8, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_12
Set Pmos current mirror left value as 12, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_16
Set Pmos current mirror left value as 16, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_20
Set Pmos current mirror left value as 20, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_24
Set Pmos current mirror left value as 24, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_28
Set Pmos current mirror left value as 28, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorLeft_32
Set Pmos current mirror left value as 32, used in mutual-cap mode

enum _tsi_mutual_pmos_current_right
TSI Pmos current mirror selection on the right side.

These constants set the Pmos current mirror on the right side used in mutual-cap mode.

Values:

enumerator kTSI_MutualPmosCurrentMirrorRight_1
Set Pmos current mirror right value as 1, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorRight_2
Set Pmos current mirror right value as 2, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorRight_3
Set Pmos current mirror right value as 3, used in mutual-cap mode

enumerator kTSI_MutualPmosCurrentMirrorRight_4
Set Pmos current mirror right value as 4, used in mutual-cap mode

enum _tsi_mutual_nmos_current
TSI Nmos current mirror selection.

These constants set the Nmos current mirror used in mutual-cap mode.

Values:

enumerator kTSI_MutualNmosCurrentMirror_1
Set Nmos current mirror value as 1, used in mutual-cap mode

enumerator kTSI_MutualNmosCurrentMirror_2
Set Nmos current mirror value as 2, used in mutual-cap mode

enumerator kTSI_MutualNmosCurrentMirror_3
Set Nmos current mirror value as 3, used in mutual-cap mode

enumerator kTSI_MutualNmosCurrentMirror_4
Set Nmos current mirror value as 4, used in mutual-cap mode

enum _tsi_sinc_cutoff_div
TSI SINC cutoff divider setting.

These bits set the SINC cutoff divider.

Values:

enumerator kTSI_SincCutoffDiv_1
Set SINC cutoff divider as 1

enumerator kTSI_SincCutoffDiv_2
Set SINC cutoff divider as 2

enumerator kTSI_SincCutoffDiv_4
Set SINC cutoff divider as 4

enumerator kTSI_SincCutoffDiv_8
Set SINC cutoff divider as 8

enumerator kTSI_SincCutoffDiv_16
Set SINC cutoff divider as 16

enumerator kTSI_SincCutoffDiv_32
Set SINC cutoff divider as 32

enumerator kTSI_SincCutoffDiv_64
Set SINC cutoff divider as 64

enumerator kTSI_SincCutoffDiv_128
Set SINC cutoff divider as 128

enum _tsi_sinc_filter_order
TSI SINC filter order setting.

These bits set the SINC filter order.

Values:

enumerator kTSI_SincFilterOrder_1
Use 1 order SINC filter

enumerator kTSI_SincFilterOrder_2
Use 1 order SINC filter

enum _tsi_sinc_decimation_value
TSI SINC decimation value setting.

These bits set the SINC decimation value.

Values:

enumerator kTSI_SincDecimationValue_1
The TSI_DATA[TSICH] bits is the counter value of 1 triger period.

enumerator kTSI_SincDecimationValue_2
The TSI_DATA[TSICH] bits is the counter value of 2 triger period.

enumerator kTSI_SincDecimationValue_3
The TSI_DATA[TSICH] bits is the counter value of 3 triger period.

enumerator kTSI_SincDecimationValue_4
The TSI_DATA[TSICH] bits is the counter value of 4 triger period.

enumerator kTSI_SincDecimationValue_5
The TSI_DATA[TSICH] bits is the counter value of 5 triger period.

enumerator kTSI_SincDecimationValue_6
The TSI_DATA[TSICH] bits is the counter value of 6 triger period.

enumerator kTSI_SincDecimationValue_7
The TSI_DATA[TSICH] bits is the counter value of 7 triger period.

enumerator kTSI_SincDecimationValue_8
The TSI_DATA[TSICH] bits is the counter value of 8 triger period.

enumerator kTSI_SincDecimationValue_9
The TSI_DATA[TSICH] bits is the counter value of 9 triger period.

enumerator kTSI_SincDecimationValue_10
The TSI_DATA[TSICH] bits is the counter value of 10 triger period.

enumerator kTSI_SincDecimationValue_11
The TSI_DATA[TSICH] bits is the counter value of 11 triger period.

enumerator kTSI_SincDecimationValue_12
The TSI_DATA[TSICH] bits is the counter value of 12 triger period.

enumerator kTSI_SincDecimationValue_13
The TSI_DATA[TSICH] bits is the counter value of 13 triger period.

enumerator kTSI_SincDecimationValue_14
The TSI_DATA[TSICH] bits is the counter value of 14 triger period.

enumerator kTSI_SincDecimationValue_15
The TSI_DATA[TSICH] bits is the counter value of 15 triger period.

enumerator kTSI_SincDecimationValue_16
The TSI_DATA[TSICH] bits is the counter value of 16 triger period.

enumerator kTSI_SincDecimationValue_17
The TSI_DATA[TSICH] bits is the counter value of 17 triger period.

enumerator kTSI_SincDecimationValue_18
The TSI_DATA[TSICH] bits is the counter value of 18 triger period.

enumerator kTSI_SincDecimationValue_19
The TSI_DATA[TSICH] bits is the counter value of 19 triger period.

enumerator kTSI_SincDecimationValue_20
The TSI_DATA[TSICH] bits is the counter value of 20 triger period.

enumerator kTSI_SincDecimationValue_21
The TSI_DATA[TSICH] bits is the counter value of 21 triger period.

enumerator kTSI_SincDecimationValue_22
The TSI_DATA[TSICH] bits is the counter value of 22 triger period.

enumerator kTSI_SincDecimationValue_23
The TSI_DATA[TSICH] bits is the counter value of 23 triger period.

enumerator kTSI_SincDecimationValue_24
The TSI_DATA[TSICH] bits is the counter value of 24 triger period.

enumerator kTSI_SincDecimationValue_25
The TSI_DATA[TSICH] bits is the counter value of 25 triger period.

enumerator kTSI_SincDecimationValue_26
The TSI_DATA[TSICH] bits is the counter value of 26 triger period.

enumerator kTSI_SincDecimationValue_27
The TSI_DATA[TSICH] bits is the counter value of 27 triger period.

enumerator kTSI_SincDecimationValue_28
The TSI_DATA[TSICH] bits is the counter value of 28 triger period.

enumerator kTSI_SincDecimationValue_29
The TSI_DATA[TSICH] bits is the counter value of 29 triger period.

enumerator kTSI_SincDecimationValue_30
The TSI_DATA[TSICH] bits is the counter value of 30 triger period.

enumerator kTSI_SincDecimationValue_31
The TSI_DATA[TSICH] bits is the counter value of 31 triger period.

enumerator kTSI_SincDecimationValue_32
The TSI_DATA[TSICH] bits is the counter value of 32 triger period.

enum _tsi_ssc_charge_num
TSI SSC output bit0's period setting(SSC0[CHARGE_NUM])

These bits set the SSC output bit0's period setting.

Values:

enumerator kTSI_SscChargeNumValue_1
The SSC output bit 0's period will be 1 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_2
The SSC output bit 0's period will be 2 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_3
The SSC output bit 0's period will be 3 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_4
The SSC output bit 0's period will be 4 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_5
The SSC output bit 0's period will be 5 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_6
The SSC output bit 0's period will be 6 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_7
The SSC output bit 0's period will be 7 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_8
The SSC output bit 0's period will be 8 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_9
The SSC output bit 0's period will be 9 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_10
The SSC output bit 0's period will be 10 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_11
The SSC output bit 0's period will be 11 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_12
The SSC output bit 0's period will be 12 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_13
The SSC output bit 0's period will be 13 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_14
The SSC output bit 0's period will be 14 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_15
The SSC output bit 0's period will be 15 clock cycle of system clock.

enumerator kTSI_SscChargeNumValue_16
The SSC output bit 0's period will be 16 clock cycle of system clock.

enum _tsi_ssc_nocharge_num
TSI SSC output bit1's period setting(SSC0[BASE_NOCHARGE_NUM])

These bits set the SSC output bit1's period setting.

Values:

enumerator kTSI_SscNoChargeNumValue_1
The SSC output bit 1's basic period will be 1 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_2
The SSC output bit 1's basic period will be 2 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_3
The SSC output bit 1's basic period will be 3 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_4
The SSC output bit 1's basic period will be 4 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_5
The SSC output bit 1's basic period will be 5 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_6
The SSC output bit 1's basic period will be 6 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_7
The SSC output bit 1's basic period will be 7 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_8
The SSC output bit 1's basic period will be 8 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_9
The SSC output bit 1's basic period will be 9 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_10
The SSC output bit 1's basic period will be 10 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_11
The SSC output bit 1's basic period will be 11 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_12
The SSC output bit 1's basic period will be 12 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_13
The SSC output bit 1's basic period will be 13 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_14
The SSC output bit 1's basic period will be 14 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_15
The SSC output bit 1's basic period will be 15 clock cycle of system clock.

enumerator kTSI_SscNoChargeNumValue_16
The SSC output bit 1's basic period will be 16 clock cycle of system clock.

enum _tsi_ssc_prbs_outsel
TSI SSC outsel choosing the length of the PRBS (Pseudo-RandomBinarySequence) method setting(SSC0[TSI_SSC0_PRBS_OUTSEL])

These bits set the SSC PRBS length.

Values:

enumerator kTSI_SscPrbsOutsel_2
The length of the PRBS is 2.

enumerator kTSI_SscPrbsOutsel_3
The length of the PRBS is 3.

enumerator kTSI_SscPrbsOutsel_4
The length of the PRBS is 4.

enumerator kTSI_SscPrbsOutsel_5
The length of the PRBS is 5.

enumerator kTSI_SscPrbsOutsel_6
The length of the PRBS is 6.

enumerator kTSI_SscPrbsOutsel_7
The length of the PRBS is 7.

enumerator kTSI_SscPrbsOutsel_8
The length of the PRBS is 8.

enumerator kTSI_SscPrbsOutsel_9
The length of the PRBS is 9.

enumerator kTSI_SscPrbsOutsel_10
The length of the PRBS is 10.

enumerator kTSI_SscPrbsOutsel_11
The length of the PRBS is 11.

enumerator kTSI_SscPrbsOutsel_12
The length of the PRBS is 12.

enumerator kTSI_SscPrbsOutsel_13
The length of the PRBS is 13.

enumerator kTSI_SscPrbsOutsel_14
The length of the PRBS is 14.

enumerator kTSI_SscPrbsOutsel_15
The length of the PRBS is 15.

enum _tsi_status_flags
TSI status flags.

Values:

enumerator kTSI_EndOfScanFlag
End-Of-Scan flag

enumerator kTSI_OutOfRangeFlag
Out-Of-Range flag

enum _tsi_interrupt_enable
TSI feature interrupt source.

Values:

enumerator kTSI_GlobalInterruptEnable
TSI module global interrupt

enumerator kTSI_OutOfRangeInterruptEnable
Out-Of-Range interrupt

enumerator kTSI_EndOfScanInterruptEnable
End-Of-Scan interrupt

enum _tsi_ssc_mode
TSI SSC mode selection.

These constants set the SSC mode.

Values:

enumerator kTSI_ssc_prbs_method
Using PRBS method generating SSC output bit.

enumerator kTSI_ssc_up_down_counter
Using up-down counter generating SSC output bit.

enumerator kTSI_ssc_disable
SSC function is disabled.

enum _tsi_ssc_prescaler
TSI main clock selection.

These constants set select the divider ratio for the clock used for generating the SSC output bit.

Values:

enumerator kTSI_ssc_div_by_1
Set SSC divider to 00000000 div1(2^0)

enumerator kTSI_ssc_div_by_2
Set SSC divider to 00000001 div2(2^1)

enumerator kTSI_ssc_div_by_4
Set SSC divider to 00000011 div4(2^2)

enumerator kTSI_ssc_div_by_8
Set SSC divider to 00000111 div8(2^3)

enumerator kTSI_ssc_div_by_16
Set SSC divider to 00001111 div16(2^4)

enumerator kTSI_ssc_div_by_32
Set SSC divider to 00011111 div32(2^5)

enumerator kTSI_ssc_div_by_64
Set SSC divider to 00111111 div64(2^6)

enumerator kTSI_ssc_div_by_128
Set SSC divider to 01111111 div128(2^7)

enumerator kTSI_ssc_div_by_256
Set SSC divider to 11111111 div256(2^8)

typedef enum *_tsi_main_clock_selection* tsi_main_clock_selection_t
TSI main clock selection.

These constants set the tsi main clock.

typedef enum *_tsi_sensing_mode_selection* tsi_sensing_mode_selection_t
TSI sensing mode selection.

These constants set the tsi sensing mode.

typedef enum *_tsi_dvolt_option* tsi_dvolt_option_t
TSI DVOLT settings.

These bits indicate the comparator vp, vm and dvolt voltage.

typedef enum *_tsi_sensitivity_xdn_option* tsi_sensitivity_xdn_option_t
TSI sensitivity ajustment (XDN option).

These constants define the tsi sensitivity ajustment in self-cap mode, when TSI_MODE[S_SEN] = 1.

typedef enum *_tsi_shield* tsi_shield_t
TSI Shield setting (S_W_SHIELD option).

These constants define the shield pin used for HW shielding functionality. One or more shield pin can be selected. The involved bitfield is not fix can change from device to device (KE16Z7 and KE17Z7 support 3 shield pins, other KE serials only support 1 shield pin).

typedef enum *_tsi_sensitivity_ctrim_option* tsi_sensitivity_ctrim_option_t
TSI sensitivity ajustment (CTRIM option).

These constants define the tsi sensitivity ajustment in self-cap mode, when TSI_MODE[S_SEN] = 1.

typedef enum *_tsi_current_multiple_input* tsi_current_multiple_input_t
TSI current ajustment (Input current multiple).

These constants set the tsi input current multiple in self-cap mode.

typedef enum *_tsi_current_multiple_charge* tsi_current_multiple_charge_t
TSI current ajustment (Charge/Discharge current multiple).

These constants set the tsi charge/discharge current multiple in self-cap mode.

typedef enum *_tsi_mutual_pre_current* tsi_mutual_pre_current_t
TSI current used in vref generator.

These constants Choose the current used in vref generator.

typedef enum *_tsi_mutual_pre_resistor* tsi_mutual_pre_resistor_t
TSI resistor used in pre-charge.

These constants Choose the resistor used in pre-charge.

typedef enum *_tsi_mutual_sense_resistor* tsi_mutual_sense_resistor_t
TSI resistor used in I-sense generator.

These constants Choose the resistor used in I-sense generator.

typedef enum *_tsi_mutual_tx_channel* tsi_mutual_tx_channel_t
TSI TX channel selection in mutual-cap mode.

These constants Choose the TX channel used in mutual-cap mode.

typedef enum *_tsi_mutual_rx_channel* tsi_mutual_rx_channel_t
TSI RX channel selection in mutual-cap mode.

These constants Choose the RX channel used in mutual-cap mode.

typedef enum *_tsi_mutual_sense_boost_current* tsi_mutual_sense_boost_current_t
TSI sensitivity boost current settings.

These constants set the sensitivity boost current.

typedef enum *_tsi_mutual_tx_drive_mode* tsi_mutual_tx_drive_mode_t
TSI TX drive mode control.

These constants Choose the TX drive mode control setting.

typedef enum *_tsi_mutual_pmos_current_left* tsi_mutual_pmos_current_left_t
TSI Pmos current mirror selection on the left side.

These constants set the Pmos current mirror on the left side used in mutual-cap mode.

typedef enum *_tsi_mutual_pmos_current_right* tsi_mutual_pmos_current_right_t
TSI Pmos current mirror selection on the right side.

These constants set the Pmos current mirror on the right side used in mutual-cap mode.

typedef enum *_tsi_mutual_nmos_current* tsi_mutual_nmos_current_t
TSI Nmos current mirror selection.

These constants set the Nmos current mirror used in mutual-cap mode.

typedef enum *_tsi_sinc_cutoff_div* tsi_sinc_cutoff_div_t
TSI SINC cutoff divider setting.

These bits set the SINC cutoff divider.

typedef enum *_tsi_sinc_filter_order* tsi_sinc_filter_order_t
TSI SINC filter order setting.

These bits set the SINC filter order.

typedef enum *_tsi_sinc_decimation_value* tsi_sinc_decimation_value_t
TSI SINC decimation value setting.

These bits set the SINC decimation value.

typedef enum *_tsi_ssc_charge_num* tsi_ssc_charge_num_t
TSI SSC output bit0's period setting(SSC0[CHARGE_NUM])

These bits set the SSC output bit0's period setting.

typedef enum *_tsi_ssc_nocharge_num* tsi_ssc_nocharge_num_t
TSI SSC output bit1's period setting(SSC0[BASE_NOCHARGE_NUM])

These bits set the SSC output bit1's period setting.

typedef enum *_tsi_ssc_prbs_outsel* tsi_ssc_prbs_outsel_t
TSI SSC outsel choosing the length of the PRBS (Pseudo-RandomBinarySequence) method setting(SSC0[TSI_SSC0_PRBS_OUTSEL])

These bits set the SSC PRBS length.

typedef enum *_tsi_status_flags* tsi_status_flags_t
TSI status flags.

typedef enum *_tsi_interrupt_enable* tsi_interrupt_enable_t
TSI feature interrupt source.

typedef enum *_tsi_ssc_mode* tsi_ssc_mode_t
TSI SSC mode selection.

These constants set the SSC mode.

typedef enum *_tsi_ssc_prescaler* tsi_ssc_prescaler_t
TSI main clock selection.

These constants set select the divider ratio for the clock used for generating the SSC output bit.

typedef struct *_tsi_calibration_data* tsi_calibration_data_t
TSI calibration data storage.

typedef struct *_tsi_common_config* tsi_common_config_t
TSI common configuration structure.

This structure contains the common settings for TSI self-cap or mutual-cap mode, configurations including the TSI module main clock, sensing mode, DVOLT options, SINC and SSC configurations.

typedef struct *_tsi_selfCap_config* tsi_selfCap_config_t
TSI configuration structure for self-cap mode.

This structure contains the settings for the most common TSI self-cap configurations including the TSI module charge currents, sensitivity configuration and so on.

typedef struct *_tsi_mutualCap_config* tsi_mutualCap_config_t
TSI configuration structure for mutual-cap mode.

This structure contains the settings for the most common TSI mutual-cap configurations including the TSI module generator settings, sensitivity related current settings and so on.

const *clock_ip_name_t* s_tsiClock[]

const IRQn_Type s_TsiIRQ[]

TSI_Type *const s_tsiBases[]

uint32_t TSI_GetInstance(TSI_Type *base)
Get the TSI instance from peripheral base address.

Parameters

- base – TSI peripheral base address.

Returns
TSI instance.

void TSI_InitSelfCapMode(TSI_Type *base, const *tsi_selfCap_config_t* *config)
Initialize hardware to Self-cap mode.

Initialize the peripheral to the targeted state specified by parameter config, such as sets sensitivity adjustment, current settings.

Parameters

- base – TSI peripheral base address.
- config – Pointer to TSI self-cap configuration structure.

Returns
none

void TSI_InitMutualCapMode(TSI_Type *base, const *tsi_mutualCap_config_t* *config)

Initialize hardware to Mutual-cap mode.

Initialize the peripheral to the targeted state specified by parameter config, such as sets Vref generator setting, sensitivity boost settings, Pmos/Nmos settings.

Parameters

- base – TSI peripheral base address.
- config – Pointer to TSI mutual-cap configuration structure.

Returns

none

void TSI_Deinit(TSI_Type *base)

De-initialize hardware.

De-initialize the peripheral to default state.

Parameters

- base – TSI peripheral base address.

Returns

none

void TSI_GetSelfCapModeDefaultConfig(*tsi_selfCap_config_t* *userConfig)

Get TSI self-cap mode user configure structure. This interface sets userConfig structure to a default value. The configuration structure only includes the settings for the whole TSI. The user configure is set to a value:

```
userConfig->commonConfig.mainClock      = kTSI_MainClockSlection_0;
userConfig->commonConfig.mode           = kTSI_SensingModeSlection_Self;
userConfig->commonConfig.dvolt          = kTSI_DvoltOption_2;
userConfig->commonConfig.cutoff         = kTSI_SincCutoffDiv_1;
userConfig->commonConfig.order          = kTSI_SincFilterOrder_1;
userConfig->commonConfig.decimation     = kTSI_SincDecimationValue_8;
userConfig->commonConfig.chargeNum      = kTSI_SscChargeNumValue_3;
userConfig->commonConfig.prbsOutsel     = kTSI_SscPrbsOutsel_2;
userConfig->commonConfig.noChargeNum    = kTSI_SscNoChargeNumValue_2;
userConfig->commonConfig.ssc_mode       = kTSI_ssc_prbs_method;
userConfig->commonConfig.ssc_prescaler = kTSI_ssc_div_by_1;
userConfig->enableSensitivity           = true;
userConfig->enableShield                = false;
userConfig->xdn                         = kTSI_SensitivityXdnOption_1;
userConfig->ctrim                       = kTSI_SensitivityCtrimOption_7;
userConfig->inputCurrent                = kTSI_CurrentMultipleInputValue_0;
userConfig->chargeCurrent               = kTSI_CurrentMultipleChargeValue_1;
```

Parameters

- userConfig – Pointer to TSI user configure structure.

void TSI_GetMutualCapModeDefaultConfig(*tsi_mutualCap_config_t* *userConfig)

Get TSI mutual-cap mode default user configure structure. This interface sets userConfig structure to a default value. The configuration structure only includes the settings for the whole TSI. The user configure is set to a value:

```
userConfig->commonConfig.mainClock      = kTSI_MainClockSlection_1;
userConfig->commonConfig.mode           = kTSI_SensingModeSlection_Mutual;
userConfig->commonConfig.dvolt          = kTSI_DvoltOption_0;
userConfig->commonConfig.cutoff         = kTSI_SincCutoffDiv_1;
userConfig->commonConfig.order          = kTSI_SincFilterOrder_1;
userConfig->commonConfig.decimation     = kTSI_SincDecimationValue_8;
```

(continues on next page)

(continued from previous page)

```
userConfig->commonConfig.chargeNum      = kTSI_SscChargeNumValue_4;
userConfig->commonConfig.prbsOutsel     = kTSI_SscPrbsOutsel_2;
userConfig->commonConfig.noChargeNum    = kTSI_SscNoChargeNumValue_5;
userConfig->commonConfig.ssc_mode       = kTSI_ssc_prbs_method;
userConfig->commonConfig.ssc_prescaler = kTSI_ssc_div_by_1;
userConfig->preCurrent                 = kTSI_MutualPreCurrent_4uA;
userConfig->preResistor                = kTSI_MutualPreResistor_4k;
userConfig->senseResistor              = kTSI_MutualSenseResistor_10k;
userConfig->boostCurrent               = kTSI_MutualSenseBoostCurrent_0uA;
userConfig->txDriveMode                = kTSI_MutualTxDriveModeOption_0;
userConfig->pmosLeftCurrent            = kTSI_MutualPmosCurrentMirrorLeft_32;
userConfig->pmosRightCurrent           = kTSI_MutualPmosCurrentMirrorRight_1;
userConfig->enableNmosMirror           = true;
userConfig->nmosCurrent                = kTSI_MutualNmosCurrentMirror_1;
```

Parameters

- userConfig – Pointer to TSI user configure structure.

void TSI_SelfCapCalibrate(TSI_Type *base, *tsi_calibration_data_t* *calBuff)

Hardware base counter value for calibration.

Calibrate the peripheral to fetch the initial counter value of the enabled channels. This API is mostly used at initial application setup, it shall be called after the TSI_Init API, then user can use the calibrated counter values to setup applications(such as to determine

under which counter value we can confirm a touch event occurs).

Note: This API is mainly used for self-cap mode;

Note: The calibration work in mutual-cap mode shall be done in applications due to different board layout.

Parameters

- base – TSI peripheral base address.
- calBuff – Data buffer that store the calibrated counter value.

Returns

none

void TSI_EnableInterrupts(TSI_Type *base, uint32_t mask)

Enables TSI interrupt requests.

Parameters

- base – TSI peripheral base address.
- mask – interrupt source The parameter can be combination of the following source if defined:
  - kTSI_GlobalInterruptEnable
  - kTSI_EndOfScanInterruptEnable
  - kTSI_OutOfRangeInterruptEnable

void TSI_DisableInterrupts(TSI_Type *base, uint32_t mask)

Disables TSI interrupt requests.

Parameters

- base – TSI peripheral base address.
- mask – interrupt source The parameter can be combination of the following source if defined:
  - kTSI_GlobalInterruptEnable
  - kTSI_EndOfScanInterruptEnable
  - kTSI_OutOfRangeInterruptEnable

static inline uint32_t TSI_GetStatusFlags(TSI_Type *base)

Get interrupt flag. This function get tsi interrupt flags.

Parameters

- base – TSI peripheral base address.

Returns

The mask of these status flags combination.

void TSI_ClearStatusFlags(TSI_Type *base, uint32_t mask)

Clear interrupt flag.

This function clear tsi interrupt flag, automatically cleared flags can not be cleared by this function.

Parameters

- base – TSI peripheral base address.
- mask – The status flags to clear.

static inline uint32_t TSI_GetScanTriggerMode(TSI_Type *base)

Get TSI scan trigger mode.

Parameters

- base – TSI peripheral base address.

Returns

Scan trigger mode.

static inline bool TSI_IsScanInProgress(TSI_Type *base)

Get scan in progress flag.

Parameters

- base – TSI peripheral base address.

Returns

True - scan is in progress. False - scan is not in progress.

static inline void TSI_EnableModule(TSI_Type *base, bool enable)

Enables the TSI Module or not.

Parameters

- base – TSI peripheral base address.
- enable – Choose whether to enable or disable module;
  - true Enable TSI module;
  - false Disable TSI module;

Returns
none.

static inline void TSI_EnableLowPower(TSI_Type *base, bool enable)
Sets the TSI low power STOP mode enable or not. This enables TSI module function in low power modes.

Parameters

- base – TSI peripheral base address.
- enable – Choose to enable or disable STOP mode.
  - true Enable module in STOP mode;
  - false Disable module in STOP mode;

Returns
none.

static inline void TSI_EnableHardwareTriggerScan(TSI_Type *base, bool enable)
Enable the hardware trigger scan or not.

Parameters

- base – TSI peripheral base address.
- enable – Choose to enable hardware trigger or software trigger scan.
  - true Enable hardware trigger scan;
  - false Enable software trigger scan;

Returns
none.

static inline void TSI_StartSoftwareTrigger(TSI_Type *base)
Start one sotware trigger measurement (trigger a new measurement).

Parameters

- base – TSI peripheral base address.

Returns
none.

static inline void TSI_SetSelfCapMeasuredChannel(TSI_Type *base, uint8_t channel)
Set the measured channel number for self-cap mode.

Note: This API can only be used in self-cap mode!

Parameters

- base – TSI peripheral base address.
- channel – Channel number 0 … 24.

Returns
none.

static inline uint8_t TSI_GetSelfCapMeasuredChannel(TSI_Type *base)
Get the current measured channel number, in self-cap mode.

Note: This API can only be used in self-cap mode!

Parameters

- base – TSI peripheral base address.

Returns
uint8_t Channel number 0 … 24.

static inline void TSI_EnableDmaTransfer(TSI_Type *base, bool enable)

Enable DMA transfer or not.

Parameters

- base – TSI peripheral base address.
- enable – Choose to enable DMA transfer or not.
  - true Enable DMA transfer;
  - false Disable DMA transfer;

Returns
none.

static inline void TSI_EnableEndOfScanDmaTransferOnly(TSI_Type *base, bool enable)

Decide whether to enable End of Scan DMA transfer request only.

Parameters

- base – TSI peripheral base address.
- enable – Choose whether to enable End of Scan DMA transfer request only.
  - true Enable End of Scan DMA transfer request only;
  - false Both End-of-Scan and Out-of-Range can generate DMA transfer request.

Returns
none.

static inline uint16_t TSI_GetCounter(TSI_Type *base)

Gets the conversion counter value.

Parameters

- base – TSI peripheral base address.

Returns
Accumulated scan counter value ticked by the reference clock.

static inline void TSI_SetLowThreshold(TSI_Type *base, uint16_t low_threshold)

Set the TSI wake-up channel low threshold.

Parameters

- base – TSI peripheral base address.
- low_threshold – Low counter threshold.

Returns
none.

static inline void TSI_SetHighThreshold(TSI_Type *base, uint16_t high_threshold)

Set the TSI wake-up channel high threshold.

Parameters

- base – TSI peripheral base address.
- high_threshold – High counter threshold.

Returns
none.

static inline void TSI_SetMainClock(TSI_Type *base, *tsi_main_clock_selection_t* mainClock)

Set the main clock of the TSI module.

Parameters

- base – TSI peripheral base address.
- mainClock – clock option value.

Returns
none.

static inline void TSI_SetSensingMode(TSI_Type *base, *tsi_sensing_mode_selection_t* mode)

Set the sensing mode of the TSI module.

Parameters

- base – TSI peripheral base address.
- mode – Mode value.

Returns
none.

static inline *tsi_sensing_mode_selection_t* TSI_GetSensingMode(TSI_Type *base)

Get the sensing mode of the TSI module.

Parameters

- base – TSI peripheral base address.

Returns
Currently selected sensing mode.

static inline void TSI_SetDvolt(TSI_Type *base, *tsi_dvolt_option_t* dvolt)

Set the DVOLT settings.

Parameters

- base – TSI peripheral base address.
- dvolt – The voltage rails.

Returns
none.

static inline void TSI_EnableNoiseCancellation(TSI_Type *base, bool enableCancellation)

Enable self-cap mode noise cancellation function or not.

Parameters

- base – TSI peripheral base address.
- enableCancellation – Choose whether to enable noise cancellation in self-cap mode
  - true Enable noise cancellation;
  - false Disable noise cancellation;

Returns
none.

static inline void TSI_SetMutualCapTxChannel(TSI_Type *base, *tsi_mutual_tx_channel_t* txChannel)

Set the mutual-cap mode TX channel.

Parameters

- base – TSI peripheral base address.
- txChannel – Mutual-cap mode TX channel number

Returns
none.

static inline *tsi_mutual_tx_channel_t* TSI_GetTxMutualCapMeasuredChannel(TSI_Type *base)

Get the current measured TX channel number, in mutual-cap mode.

Note: This API can only be used in mutual-cap mode!

Parameters

- base – TSI peripheral base address;

Returns
Tx Channel number 0 … 5;

static inline void TSI_SetMutualCapRxChannel(TSI_Type *base, *tsi_mutual_rx_channel_t* rxChannel)

Set the mutual-cap mode RX channel.

Parameters

- base – TSI peripheral base address.
- rxChannel – Mutual-cap mode RX channel number

Returns
none.

static inline *tsi_mutual_rx_channel_t* TSI_GetRxMutualCapMeasuredChannel(TSI_Type *base)

Get the current measured RX channel number, in mutual-cap mode.

Note: This API can only be used in mutual-cap mode!

Parameters

- base – TSI peripheral base address;

Returns
Rx Channel number 6 … 11;

static inline void TSI_SetSscMode(TSI_Type *base, *tsi_ssc_mode_t* mode)

Set the SSC clock mode of the TSI module.

Parameters

- base – TSI peripheral base address.
- mode – SSC mode option value.

Returns
none.

static inline void TSI_SetSscPrescaler(TSI_Type *base, *tsi_ssc_prescaler_t* prescaler)

Set the SSC prescaler of the TSI module.

Parameters

- base – TSI peripheral base address.
- prescaler – SSC prescaler option value.

Returns
none.

static inline void TSI_SetUsedTxChannel(TSI_Type *base, *tsi_mutual_tx_channel_t* txChannel)

Set used mutual-cap TX channel.

Parameters

- base – TSI peripheral base address.
- txChannel – Mutual-cap mode TX channel number

Returns
none.

static inline void TSI_ClearUsedTxChannel(TSI_Type *base, *tsi_mutual_tx_channel_t* txChannel)

Clear used mutual-cap TX channel.

Parameters

- base – TSI peripheral base address.
- txChannel – Mutual-cap mode TX channel number

Returns
none.

FSL_TSI_DRIVER_VERSION

TSI driver version.

ALL_FLAGS_MASK

TSI status flags macro collection.

struct _tsi_calibration_data

#include <fsl_tsi_v5.h> TSI calibration data storage.

Public Members

uint16_t calibratedData[1]

TSI calibration data storage buffer

struct _tsi_common_config

#include <fsl_tsi_v5.h> TSI common configuration structure.

This structure contains the common settings for TSI self-cap or mutual-cap mode, configurations including the TSI module main clock, sensing mode, DVOLT options, SINC and SSC configurations.

Public Members

tsi_main_clock_selection_t mainClock

Set main clock.

tsi_sensing_mode_selection_t mode

Choose sensing mode.

tsi_dvolt_option_t dvolt

DVOLT option value.

tsi_sinc_cutoff_div_t cutoff

Cutoff divider.

tsi_sinc_filter_order_t order
SINC filter order.

tsi_sinc_decimation_value_t decimation
SINC decimation value.

tsi_ssc_charge_num_t chargeNum
SSC High Width (t1), SSC output bit0's period setting.

tsi_ssc_prbs_outsel_t prbsOutsel
SSC High Random Width (t2), length of PRBS(Pseudo-RandomBinarySequence),SSC output bit2's period setting.

tsi_ssc_nocharge_num_t noChargeNum
SSC Low Width (t3), SSC output bit1's period setting.

tsi_ssc_mode_t ssc_mode
Clock mode selection (basic - from main clock by divider,advanced - using SSC(Switching Speed Clock) by three configurable intervals.

tsi_ssc_prescaler_t ssc_prescaler
Set clock divider for basic mode.

struct _tsi_selfCap_config
#include <fsl_tsi_v5.h> TSI configuration structure for self-cap mode.

This structure contains the settings for the most common TSI self-cap configurations including the TSI module charge currents, sensitivity configuration and so on.

Public Members

tsi_common_config_t commonConfig
Common settings.

bool enableSensitivity
Enable sensitivity boost of self-cap or not.

tsi_shield_t enableShield
Enable shield of self-cap mode or not.

tsi_sensitivity_xdn_option_t xdn
Sensitivity XDN option.

tsi_sensitivity_ctrim_option_t ctrim
Sensitivity CTRIM option.

tsi_current_multiple_input_t inputCurrent
Input current multiple.

tsi_current_multiple_charge_t chargeCurrent
Charge/Discharge current multiple.

struct _tsi_mutualCap_config
#include <fsl_tsi_v5.h> TSI configuration structure for mutual-cap mode.

This structure contains the settings for the most common TSI mutual-cap configurations including the TSI module generator settings, sensitivity related current settings and so on.

Public Members

tsi_common_config_t commonConfig
Common settings.

tsi_mutual_pre_current_t preCurrent
Vref generator current.

tsi_mutual_pre_resistor_t preResistor
Vref generator resistor.

tsi_mutual_sense_resistor_t senseResistor
I-sense generator resistor.

tsi_mutual_sense_boost_current_t boostCurrent
Sensitivity boost current setting.

tsi_mutual_tx_drive_mode_t txDriveMode
TX drive mode control setting.

tsi_mutual_pmos_current_left_t pmosLeftCurrent
Pmos current mirror on the left side.

tsi_mutual_pmos_current_right_t pmosRightCurrent
Pmos current mirror on the right side.

bool enableNmosMirror
Enable Nmos current mirror setting or not.

tsi_mutual_nmos_current_t nmosCurrent
Nmos current mirror setting.

2.51 WDOG32: 32-bit Watchdog Timer

void WDOG32_GetDefaultConfig(*wdog32_config_t* *config)

Initializes the WDOG32 configuration structure.

This function initializes the WDOG32 configuration structure to default values. The default values are:

```
wdog32Config->enableWdog32 = true;
wdog32Config->clockSource = kWDOG32_ClockSource1;
wdog32Config->prescaler = kWDOG32_ClockPrescalerDivide1;
wdog32Config->workMode.enableWait = true;
wdog32Config->workMode.enableStop = false;
wdog32Config->workMode.enableDebug = false;
wdog32Config->testMode = kWDOG32_TestModeDisabled;
wdog32Config->enableUpdate = true;
wdog32Config->enableInterrupt = false;
wdog32Config->enableWindowMode = false;
wdog32Config->windowValue = 0U;
wdog32Config->timeoutValue = 0xFFFFU;
```

See also:

wdog32_config_t

Parameters

- config – Pointer to the WDOG32 configuration structure.

status_t WDOG32_Init(WDOG_Type *base, const *wdog32_config_t* *config)

Initializes the WDOG32 module.

This function initializes the WDOG32. To reconfigure the WDOG32 without forcing a reset first, enableUpdate must be set to true in the configuration.

Example:

```
wdog32_config_t config;
WDOG32_GetDefaultConfig(&config);
config.timeoutValue = 0x7ffU;
config.enableUpdate = true;
WDOG32_Init(wdog_base,&config);
```

Note: If there is errata ERR010536 (FSL_FEATURE_WDOG_HAS_ERRATA_010536 defined as 1), then after calling this function, user need delay at least 4 LPO clock cycles before accessing other WDOG32 registers.

Parameters

- base – WDOG32 peripheral base address.
- config – The configuration of the WDOG32.

Return values

- kStatus_Success – The initialization was successful
- kStatus_Timeout – The initialization timed out

status_t WDOG32_Deinit(WDOG_Type *base)

De-initializes the WDOG32 module.

This function shuts down the WDOG32. Ensure that the WDOG_CS.UPDATE is 1, which means that the register update is enabled.

Parameters

- base – WDOG32 peripheral base address.

Return values

- kStatus_Success – The de-initialization was successful
- kStatus_Timeout – The de-initialization timed out

status_t WDOG32_Unlock(WDOG_Type *base)

Unlocks the WDOG32 register written.

This function unlocks the WDOG32 register written.

Before starting the unlock sequence and following the configuration, disable the global interrupts. Otherwise, an interrupt could effectively invalidate the unlock sequence and the WCT may expire. After the configuration finishes, re-enable the global interrupts.

Parameters

- base – WDOG32 peripheral base address

Return values

- kStatus_Success – The unlock sequence was successful
- kStatus_Timeout – The unlock sequence timed out

void WDOG32_Enable(WDOG_Type *base)

Enables the WDOG32 module.

This function writes a value into the WDOG_CS register to enable the WDOG32. The WDOG_CS register is a write-once register. Please check the enableUpdate is set to true for calling WDOG32_Init to do wdog initialize. Before call the re-configuration APIs, ensure that the WCT window is still open and this register has not been written in this WCT while the function is called.

Parameters

- base – WDOG32 peripheral base address.

void WDOG32_Disable(WDOG_Type *base)

Disables the WDOG32 module.

This function writes a value into the WDOG_CS register to disable the WDOG32. The WDOG_CS register is a write-once register. Please check the enableUpdate is set to true for calling WDOG32_Init to do wdog initialize. Before call the re-configuration APIs, ensure that the WCT window is still open and this register has not been written in this WCT while the function is called.

Parameters

- base – WDOG32 peripheral base address

void WDOG32_EnableInterrupts(WDOG_Type *base, uint32_t mask)

Enables the WDOG32 interrupt.

This function writes a value into the WDOG_CS register to enable the WDOG32 interrupt. The WDOG_CS register is a write-once register. Please check the enableUpdate is set to true for calling WDOG32_Init to do wdog initialize. Before call the re-configuration APIs, ensure that the WCT window is still open and this register has not been written in this WCT while the function is called.

Parameters

- base – WDOG32 peripheral base address.
- mask – The interrupts to enable. The parameter can be a combination of the following source if defined:
  - kWDOG32_InterruptEnable

void WDOG32_DisableInterrupts(WDOG_Type *base, uint32_t mask)

Disables the WDOG32 interrupt.

This function writes a value into the WDOG_CS register to disable the WDOG32 interrupt. The WDOG_CS register is a write-once register. Please check the enableUpdate is set to true for calling WDOG32_Init to do wdog initialize. Before call the re-configuration APIs, ensure that the WCT window is still open and this register has not been written in this WCT while the function is called.

Parameters

- base – WDOG32 peripheral base address.
- mask – The interrupts to disabled. The parameter can be a combination of the following source if defined:
  - kWDOG32_InterruptEnable

static inline uint32_t WDOG32_GetStatusFlags(WDOG_Type *base)

Gets the WDOG32 all status flags.

This function gets all status flags.

Example to get the running flag:

```
uint32_t status;
status = WDOG32_GetStatusFlags(wdog_base) & kWDOG32_RunningFlag;
```

See also:

_wdog32_status_flags_t

- true: related status flag has been set.
- false: related status flag is not set.

Parameters

- base – WDOG32 peripheral base address

Returns

State of the status flag: asserted (true) or not-asserted (false).

void WDOG32_ClearStatusFlags(WDOG_Type *base, uint32_t mask)

Clears the WDOG32 flag.

This function clears the WDOG32 status flag.

Example to clear an interrupt flag:

```
WDOG32_ClearStatusFlags(wdog_base,kWDOG32_InterruptFlag);
```

Parameters

- base – WDOG32 peripheral base address.
- mask – The status flags to clear. The parameter can be any combination of the following values:
  - kWDOG32_InterruptFlag

void WDOG32_SetTimeoutValue(WDOG_Type *base, uint16_t timeoutCount)

Sets the WDOG32 timeout value.

This function writes a timeout value into the WDOG_TOVAL register. The WDOG_TOVAL register is a write-once register. To ensure the reconfiguration fits the timing of WCT, unlock function will be called inline.

Parameters

- base – WDOG32 peripheral base address
- timeoutCount – WDOG32 timeout value, count of WDOG32 clock ticks.

void WDOG32_SetWindowValue(WDOG_Type *base, uint16_t windowValue)

Sets the WDOG32 window value.

This function writes a window value into the WDOG_WIN register. The WDOG_WIN register is a write-once register. Please check the enableUpdate is set to true for calling WDOG32_Init to do wdog initialize. Before call the re-configuration APIs, ensure that the WCT window is still open and this register has not been written in this WCT while the function is called.

Parameters

- base – WDOG32 peripheral base address.
- windowValue – WDOG32 window value.

static inline void WDOG32_Refresh(WDOG_Type *base)

Refreshes the WDOG32 timer.

This function feeds the WDOG32. This function should be called before the Watchdog timer is in timeout. Otherwise, a reset is asserted.

Parameters

- base – WDOG32 peripheral base address

static inline uint16_t WDOG32_GetCounterValue(WDOG_Type *base)

Gets the WDOG32 counter value.

This function gets the WDOG32 counter value.

Parameters

- base – WDOG32 peripheral base address.

Returns

Current WDOG32 counter value.

WDOG_FIRST_WORD_OF_UNLOCK

First word of unlock sequence

WDOG_SECOND_WORD_OF_UNLOCK

Second word of unlock sequence

WDOG_FIRST_WORD_OF_REFRESH

First word of refresh sequence

WDOG_SECOND_WORD_OF_REFRESH

Second word of refresh sequence

FSL_WDOG32_DRIVER_VERSION

WDOG32 driver version.

enum _wdog32_clock_source

Max loops to wait for WDOG32 unlock sequence complete.

This is the maximum number of loops to wait for the wdog32 unlock sequence to complete. If set to 0, it will wait indefinitely until the unlock sequence is complete.

Max loops to wait for WDOG32 reconfiguration complete.

This is the maximum number of loops to wait for the wdog32 reconfiguration to complete. If set to 0, it will wait indefinitely until the reconfiguration is complete.

Describes WDOG32 clock source.

Values:

enumerator kWDOG32_ClockSource0

Clock source 0

enumerator kWDOG32_ClockSource1

Clock source 1

enumerator kWDOG32_ClockSource2

Clock source 2

enumerator kWDOG32_ClockSource3

Clock source 3

enum _wdog32_clock_prescaler

Describes the selection of the clock prescaler.

Values:

enumerator kWDOG32_ClockPrescalerDivide1

Divided by 1

enumerator kWDOG32_ClockPrescalerDivide256
Divided by 256

enum _wdog32_test_mode
Describes WDOG32 test mode.

Values:

enumerator kWDOG32_TestModeDisabled
Test Mode disabled

enumerator kWDOG32_UserModeEnabled
User Mode enabled

enumerator kWDOG32_LowByteTest
Test Mode enabled, only low byte is used

enumerator kWDOG32_HighByteTest
Test Mode enabled, only high byte is used

enum _wdog32_interrupt_enable_t
WDOG32 interrupt configuration structure.

This structure contains the settings for all of the WDOG32 interrupt configurations.

Values:

enumerator kWDOG32_InterruptEnable
Interrupt is generated before forcing a reset

enum _wdog32_status_flags_t
WDOG32 status flags.

This structure contains the WDOG32 status flags for use in the WDOG32 functions.

Values:

enumerator kWDOG32_RunningFlag
Running flag, set when WDOG32 is enabled

enumerator kWDOG32_InterruptFlag
Interrupt flag, set when interrupt occurs

typedef enum *_wdog32_clock_source* wdog32_clock_source_t
Max loops to wait for WDOG32 unlock sequence complete.

This is the maximum number of loops to wait for the wdog32 unlock sequence to complete. If set to 0, it will wait indefinitely until the unlock sequence is complete.

Max loops to wait for WDOG32 reconfiguration complete.

This is the maximum number of loops to wait for the wdog32 reconfiguration to complete. If set to 0, it will wait indefinitely until the reconfiguration is complete.

Describes WDOG32 clock source.

typedef enum *_wdog32_clock_prescaler* wdog32_clock_prescaler_t
Describes the selection of the clock prescaler.

typedef struct *_wdog32_work_mode* wdog32_work_mode_t
Defines WDOG32 work mode.

typedef enum *_wdog32_test_mode* wdog32_test_mode_t
Describes WDOG32 test mode.

typedef struct *_wdog32_config* wdog32_config_t
    Describes WDOG32 configuration structure.

struct _wdog32_work_mode
    #include <fsl_wdog32.h> Defines WDOG32 work mode.

Public Members

bool enableWait
    Enables or disables WDOG32 in wait mode

bool enableStop
    Enables or disables WDOG32 in stop mode

bool enableDebug
    Enables or disables WDOG32 in debug mode

struct _wdog32_config
    #include <fsl_wdog32.h> Describes WDOG32 configuration structure.

Public Members

bool enableWdog32
    Enables or disables WDOG32

wdog32_clock_source_t clockSource
    Clock source select

wdog32_clock_prescaler_t prescaler
    Clock prescaler value

wdog32_work_mode_t workMode
    Configures WDOG32 work mode in debug stop and wait mode

wdog32_test_mode_t testMode
    Configures WDOG32 test mode

bool enableUpdate
    Update write-once register enable

bool enableInterrupt
    Enables or disables WDOG32 interrupt

bool enableWindowMode
    Enables or disables WDOG32 window mode

uint16_t windowValue
    Window value

uint16_t timeoutValue
    Timeout value

Chapter 3

Middleware

3.1 Motor Control

3.1.1 FreeMASTER

Communication Driver User Guide

Introduction

What is FreeMASTER? FreeMASTER is a PC-based application developed by NXP for NXP customers. It is a versatile tool usable as a real-time monitor, visualization tool, and a graphical control panel of embedded applications based on the NXP processing units.

This document describes the embedded-side software driver which implements an interface between the application and the host PC. The interface covers the following communication:

- **Serial** UART communication either over plain RS232 interface or more typically over a USB-to-Serial either external or built in a debugger probe.
- **USB** direct connection to target microcontroller
- **CAN bus**
- **TCP/IP network** wired or WiFi
- **Segger J-Link RTT**
- **JTAG** debug port communication
- …and all of the above also using a **Zephyr** generic drivers.

The driver also supports so-called "packet-driven BDM" interface which enables a protocol-based communication over a debugging port. The BDM stands for Background Debugging Module and its physical implementation is different on each platform. Some platforms leverage a semi-standard JTAG interface, other platforms provide a custom implementation called BDM. Regardless of the name, this debugging interface enables non-intrusive access to the memory space while the target CPU is running. For basic memory read and write operations, there is no communication driver required on the target when communicating with the host PC. Use this driver to get more advanced FreeMASTER protocol features over the BDM interface. The driver must be configured for the packet-driven BDM mode, in which the host PC uses the debugging interface to write serial command frames directly to the target memory buffer. The same method is then used to read response frames from that memory buffer.

Similar to "packet-driven BDM", the FreeMASTER also supports a communication over [J-Link RTT]((https://www.segger.com/products/debug-probes/j-link/technology/about-real-time-transfer/) interface defined by SEGGER Microcontroller GmbH for ARM CortexM-based microcontrollers. This method also uses JTAG physical interface and enables high-speed real time communication to run over the same channel as used for application debugging.

Driver version 3 This document describes version 3 of the FreeMASTER Communication Driver. This version features the implementation of the new Serial Protocol, which significantly extends the features and security of its predecessor. The new protocol internal number is v4 and its specification is available in the documentation accompanying the driver code.

Driver V3 is deployed to modern 32-bit MCU platforms first, so the portfolio of supported platforms is smaller than for the previous V2 versions. It is recommended to keep using the V2 driver for legacy platforms, such as S08, S12, ColdFire, or Power Architecture. Reach out to FreeMASTER community or to the local NXP representative with requests for more information or to port the V3 driver to legacy MCU devices.

Thanks to a layered approach, the new driver simplifies the porting of the driver to new UART, CAN or networking communication interfaces significantly. Users are encouraged to port the driver to more NXP MCU platforms and contribute the code back to NXP for integration into future releases. Existing code and low-level driver layers may be used as an example when porting to new targets.

Note: Using the FreeMASTER tool and FreeMASTER Communication Driver is only allowed in systems based on NXP microcontroller or microprocessor unit. Use with non-NXP MCU platforms is **not permitted** by the license terms.

Target platforms The driver implementation uses the following abstraction mechanisms which simplify driver porting and supporting new communication modules:

- **General CPU Platform** (see source code in the src/platforms directory). The code in this layer is only specific to native data type sizes and CPU architectures (for example; alignment-aware memory copy routines). This driver version brings two generic implementations of 32-bit platforms supporting both little-endian and big-endian architectures. There are also implementations customized for the 56F800E family of digital signal controllers and S12Z MCUs. **Zephyr** is treated as a specific CPU platform as it brings unified user configuration (Kconfig) and generic hardware device drivers. With Zephyr, the transport layer and low-level communication layers described below are configured automatically using Kconfig and Device Tree technologies.
- **Transport Communication Layer** - The Serial, CAN, Networking, PD-BDM, and other methods of transport logic are implemented as a driver layer called FMSTR_TRANSPORT with a uniform API. A support of the Network transport also extends single-client modes of operation which are native for Serial, USB and CAN by a concept of multiple client sessions.
- **Low-level Communication Driver** - Each type of transport further defines a low-level API used to access the physical communication module. For example, the Serial transport defines a character-oriented API implemented by different serial communication modules like UART, LPUART, USART, and also USB-CDC. Similarly, the CAN transport defines a message-oriented API implemented by the FlexCAN or MCAN modules. Moreover, there are multiple different implementations for the same kind of communication peripherals. The difference between the implementation is in the way the low-level hardware registers are accessed. The *mcuxsdk* folder contains implementations which use MCUXpresso SDK drivers. These drivers should be used in applications based on the NXP MCUXpresso SDK. The "ampsdk" drivers target automotive-specific MCUs and their respective SDKs. The "dreg" implementations use a plain C-language access to hardware register addresses which makes it a universal and the most portable solution. In this case, users are encouraged to add more drivers for other communication modules or other respective SDKs and contribute the code back to NXP for integration.

The low-level drivers defined for the Networking transport enable datagram-oriented UDP and stream TCP communication. This implementation is demonstrated using the lwIP software stack but shall be portable to other TCP/IP stacks. It may sound surprisingly, but also the Segger J-Link RTT communication driver is linked to the Networking transport (RTT is stream oriented communication handled similarly to TCP).

Replacing existing drivers For all supported platforms, the driver described in this document replaces the V2 implementation and also older driver implementations that were available separately for individual platforms (PC Master SCI drivers).

Clocks, pins, and peripheral initialization The FreeMASTER communication driver is only responsible for runtime processing of the communication and must be integrated with an user application code to function properly. The user application code is responsible for general initialization of clock sources, pin multiplexers, and peripheral registers related to the communication speed. Such initialization should be done before calling the FMSTR_Init function.

It is recommended to develop the user application using one of the Software Development Kits (SDKs) available from third parties or directly from NXP, such as MCUXpresso SDK, MCUXpresso IDE, and related tools. This approach simplifies the general configuration process significantly.

MCUXpresso SDK The MCUXpresso SDK is a software package provided by NXP which contains the device initialization code, linker files, and software drivers with example applications for the NXP family of MCUs. The MCUXpresso Config Tools may be used to generate the clock-setup and pin-multiplexer setup code suitable for the selected processor.

The MCUXpresso SDK also contains this FreeMASTER communication driver as a "middleware" component which may be downloaded along with the example applications from https://mcuxpresso.nxp.com/en/welcome.

MCUXpresso SDK on GitHub The FreeMASTER communication driver is also released as one of the middleware components of the MCUXpresso SDK on the GitHub. This release enables direct integration of the FreeMASTER source code Git repository into a target applications including Zephyr applications.

Related links:

- The official FreeMASTER middleware repository.
- Online version of this document

FreeMASTER in Zephyr The FreeMASTER middleware repository can be used with MCUXpresso SDK as well as a Zephyr module. Zephyr-specific samples which include examples of Kconfig and Device Tree configurations for Serial, USB and Network communications are available in separate repository. West manifest in this sample repository fetches the full Zephyr package including the FreeMASTER middleware repository used as a Zephyr module.

Example applications

MCUX SDK Example applications There are several example applications available for each supported MCU platform.

- **fmstr_uart** demonstrates a plain serial transmission, typically connecting to a computer's physical or virtual COM port. The typical transmission speed is 115200 bps.

- **fmstr_can** demonstrates CAN bus communication. This requires a suitable CAN interface connected to the computer and interconnected with the target MCU using a properly terminated CAN bus. The typical transmission speed is 500 kbps. A FreeMASTER-over-CAN communication plug-in must be used.
- **fmstr_usb_cdc** uses an on-chip USB controller to implement a CDC communication class. It is connected directly to a computer's USB port and creates a virtual COM port device. The typical transmission speed is above 1 Mbps.
- **fmstr_net** demonstrates the Network communication over UDP or TCP protocol. Existing examples use lwIP stack to implement the communication, but in general, it shall be possible to use any other TCP/IP stack to achieve the same functionality.
- **fmstr_wifi** is the fmstr_net application modified to use a WiFi network interface instead of a wired Ethernet connection.
- **fmstr_rtt** demonstrates the communication over SEGGER J-Link RTT interface. Both fmstr_net and fmstr_rtt examples require the FreeMASTER TCP/UDP communication plug-in to be used on the PC host side.
- **fmstr_eonce** uses the real-time data unit on the JTAG EOnCE module of the 56F800E family to implement pseudo-serial communication over the JTAG port. The typical transmission speed is around 10 kbps. This communication requires FreeMASTER JTAG/EOnCE communication plug-in.
- **fmstr_pdbdm** uses JTAG or BDM debugging interface to access the target RAM directly while the CPU is running. Note that such approach can be used with any MCU application, even without any special driver code. The computer reads from and writes into the RAM directly without CPU intervention. The Packet-Driven BDM (PD-BDM) communication uses the same memory access to exchange command and response frames. With PD-BDM, the FreeMASTER tool is able to go beyond basic memory read/write operations and accesses also advanced features like Recorder, TSA, or Pipes. The typical transmission speed is around 10 kbps. A PD-BDM communication plug-in must be used in FreeMASTER and configured properly for the selected debugging interface. Note that this communication cannot be used while a debugging interface is used by a debugger session.
- **fmstr_any** is a special example application which demonstrates how the NXP MCUXpresso Config Tools can be used to configure pins, clocks, peripherals, interrupts, and even the FreeMASTER "middleware" driver features in a graphical and user friendly way. The user can switch between the Serial, CAN, and other ways of communication and generate the required initialization code automatically.

Zephyr sample spplications Zephyr sample applications demonstrate Kconfig and Device Tree configuration which configure the FreeMASTER middleware module for a selected communication option (Serial, CAN, Network or RTT).

Refer to *readme.md* files in each sample directory for description of configuration options required to implement FreeMASTER connectivity.

Description

This section shows how to add the FreeMASTER Communication Driver into application and how to configure the connection to the FreeMASTER visualization tool.

Features The FreeMASTER driver implements the FreeMASTER protocol V4 and provides the following features which may be accessed using the FreeMASTER visualization tool:

- Read/write access to any memory location on the target.
- Optional password protection of the read, read/write, and read/write/flash access levels.

- Atomic bit manipulation on the target memory (bit-wise write access).
- Optimal size-aligned access to memory which is also suitable to access the peripheral register space.
- Oscilloscope access—real-time access to target variables. The sample rate may be limited by the communication speed.
- Recorder— access to the fast transient recorder running on the board as a part of the FreeMASTER driver. The sample rate is only limited by the MCU CPU speed. The length of the data recorded depends on the amount of available memory.
- Multiple instances of Oscilloscopes and Recorders without the limitation of maximum number of variables.
- Application commands—high-level message delivery from the PC to the application.
- TSA tables—describing the data types, variables, files, or hyperlinks exported by the target application. The TSA newly supports also non-memory mapped resources like external EEPROM or SD Card files.
- Pipes—enabling the buffered stream-oriented data exchange for a general-purpose terminal-like communication, diagnostic data streaming, or other data exchange.

The FreeMASTER driver features:

- Full FreeMASTER protocol V4 implementation with a new V4 style of CRC used.
- Layered approach supporting Serial, CAN, Network, PD-BDM, and other transports.
- Layered low-level Serial transport driver architecture enabling to select UART, LPUART, USART, and other physical implementations of serial interfaces, including USB-CDC.
- Layered low-level CAN transport driver architecture enabling to select FlexCAN, msCAN, MCAN, and other physical implementations of the CAN interface.
- Layered low-level Networking transport enabling to select TCP, UDP or J-Link RTT communication.
- TSA support to write-protect memory regions or individual variables and to deny the access to the unsafe memory.
- The pipe callback handlers are invoked whenever new data is available for reading from the pipe.
- Two Serial Single-Wire modes of operation are enabled. The “external” mode has the RX and TX shorted on-board. The “true” single-wire mode interconnects internally when the MCU or UART modules support it.

The following sections briefly describe all FreeMASTER features implemented by the driver. See the PC-based FreeMASTER User Manual for more details on how to use the features to monitor, tune, or control an embedded application.

Board Detection The FreeMASTER protocol V4 defines the standard set of configuration values which the host PC tool reads to identify the target and to access other target resources properly. The configuration includes the following parameters:

- Version of the driver and the version of the protocol implemented.
- MTU as the Maximum size of the Transmission Unit (for example; communication buffer size).
- Application name, description, and version strings.
- Application build date and time as a string.
- Target processor byte ordering (little/big endian).
- Protection level that requires password authentication.

- Number of the Recorder and Oscilloscope instances.
- RAM Base Address for optimized memory access commands.

Memory Read This basic feature enables the host PC to read any data memory location by specifying the address and size of the required memory area. The device response frame must be shorter than the MTU to fit into the outgoing communication buffer. To read a device memory of any size, the host uses the information retrieved during the Board Detection and splits the large-block request to multiple partial requests.

The driver uses size-aligned operations to read the target memory (for example; uses proper read-word instruction when an address is aligned to 4 bytes).

Memory Write Similarly to the Memory Read operation, the Memory Write feature enables to write to any RAM memory location on the target device. A single write command frame must be shorter than the MTU to fit into the target communication buffer. Larger requests must be split into smaller ones.

The driver uses size-aligned operations to write to the target memory (for example; uses proper write-word instruction when an address is aligned to 4 bytes).

Masked Memory Write To implement the write access to a single bit or a group of bits of target variables, the Masked Memory Write feature is available in the FreeMASTER protocol and it is supported by the driver using the Read-Modify-Write approach.

Be careful when writing to bit fields of volatile variables that are also modified in an application interrupt. The interrupt may be serviced in the middle of a read-modify-write operation and it may cause data corruption.

Oscilloscope The protocol and driver enables any number of variables to be read at once with a single request from the host. This feature is called Oscilloscope and the FreeMASTER tool uses it to display a real-time graph of variable values.

The driver can be configured to support any number of Oscilloscope instances and enable simultaneously running graphs to be displayed on the host computer screen.

Recorder The protocol enables the host to select target variables whose values are then periodically recorded into a dedicated on-board memory buffer. After such data sampling stops (either on a host request or by evaluating a threshold-crossing condition), the data buffer is downloaded to the host and displayed as a graph. The data sampling rate is not limited by the speed of the communication line, so it enables displaying the variable transitions in a very high resolution.

The driver can be configured to support multiple Recorder instances and enable multiple recorder graphs to be displayed on the host screen. Having multiple recorders also enables setting the recording point differently for each instance. For example; one instance may be recording data in a general timer interrupt while another instance may record at a specific control algorithm time in the PWM interrupt.

TSA With the TSA feature, data types and variables can be described directly in the application source code. Such information is later provided to the FreeMASTER tool which may use it instead of reading symbol data from the application ELF executable file.

The information is encoded as so-called TSA tables which become direct part of the application code. The TSA tables contain descriptors of variables that shall be visible to the host tool. The descriptors can describe the memory areas by specifying the address and size of the memory block or more conveniently using the C variable names directly. Different set of TSA descriptors can be used to encode information about the structure types, unions, enumerations, or arrays.

The driver also supports special types of TSA table entries to describe user resources like external EEPROM and SD Card files, memory-mapped files, virtual directories, web URL hyperlinks, and constant enumerations.

TSA Safety When the TSA is enabled in the application, the TSA Safety can be enabled and validate the memory accesses directly by the embedded-side driver. When the TSA Safety is turned on, any memory request received from the host is validated and accepted only if it belongs to a TSA-described object. The TSA entries can be declared as Read-Write or Read-Only so that the driver can actively deny the write access to the Read-Only objects.

Application commands The Application Commands are high-level messages that can be delivered from the PC Host to the embedded application for further processing. The embedded application can either poll the status, or be called back when a new Application Command arrives to be processed. After the embedded application acknowledges that the command is handled, the host receives the Result Code and reads the other return data from memory. Both the Application Commands and the Result Codes are specific to a given application and it is user's responsibility to define them. The FreeMASTER protocol and the FreeMASTER driver only implement the delivery channel and a set of API calls to enable the Application Command processing in general.

Pipes The Pipes enable buffered and stream-oriented data exchange between the PC Host and the target application. Any pipe can be written to and read from at both ends (either on the PC or the MCU). The data transmission is acknowledged using the special FreeMASTER protocol commands. It is guaranteed that the data bytes are delivered from the writer to the reader in a proper order and without losses.

Serial single-wire operation The MCU Serial Communication Driver natively supports normal dual-wire operation. Because the protocol is half-duplex only, the driver can also operate in two single-wire modes:

- "External" single-wire operation where the Receiver and Transmitter pins are shorted on the board. This mode is supported by default in the MCU driver because the Receiver and Transmitter units are enabled or disabled whenever needed. It is also easy to extend this operation for the RS485 communication.
- "True" single-wire mode which uses only a single pin and the direction switching is made by the UART module. This mode of operation must be enabled by defining the FMSTR_SERIAL_SINGLEWIRE configuration option.

Multi-session support With networking interface it is possible for multiple clients to access the target MCU simultaneously. Reading and writing of target memory is processed atomically so there is no risk of data corruption. The state-full resources such as Recorders or Oscilloscopes are locked to a client session upon first use and access is denied to other clients until lock is released..

Zephyr-specific

Dedicated communication task FreeMASTER communication may run isolated in a dedicated task. The task automates the FMSTR_Init and FMSTR_Poll calls together with periodic activities enabling the FreeMASTER UI to fetch information about tasks and CPU utilization. The task can be started automatically or manually, and it must be assigned a priority to be able to react on interrupts and other communication events. Refer to Zephyr FreeMASTER sample applications which all use this communication task.

Zephyr shell and logging over FreeMASTER pipe FreeMASTER implements a shell backend which may use FreeMASTER pipe as a I/O terminal and logging output. Refer to Zephyr FreeMASTER sample applications which all use this feature.

Automatic TSA tables TSA tables can be declared as "automatic" in Zephyr which make them automatically registered in the table list. This may be very useful when there are many TSA tables or when the tables are defined in different (often unrelated) libraries linked together. In this case user does not need to build a list of all tables manually.

Driver files The driver source files can be found in a top-level src folder, further divided into the sub-folders:

- ***src/platforms*** platform-specific folder—one folder exists for each supported processor platform (for example; 32-bit Little Endian platform). Each such folder contains a platform header file with data types and a code which implements the potentially platform-specific operations, such as aligned memory access.
- ***src/common*** folder—contains the common driver source files shared by the driver for all supported platforms. All the *.c* files must be added to the project, compiled, and linked together with the application.
  - *freemaster.h* - master driver header file, which declares the common data types, macros, and prototypes of the FreeMASTER driver API functions.
  - *freemaster_cfg.h.example* - this file can serve as an example of the FreeMASTER driver configuration file. Save this file into a project source code folder and rename it to *freemaster_cfg.h*. The FreeMASTER driver code includes this file to get the project-specific configuration options and to optimize the compilation of the driver.
  - *freemaster_defcfg.h* - defines the default values for each FreeMASTER configuration option if the option is not set in the *freemaster_cfg.h* file.
  - *freemaster_protocol.h* - defines the FreeMASTER protocol constants used internally by the driver.
  - *freemaster_protocol.c* - implements the FreeMASTER protocol decoder and handles the basic Get Configuration Value, Memory Read, and Memory Write commands.
  - *freemaster_rec.c* - handles the Recorder-specific commands and implements the Recorder sampling and triggering routines. When the Recorder is disabled by the FreeMASTER driver configuration file, this file only compiles to empty API functions.
  - *freemaster_scope.c* - handles the Oscilloscope-specific commands. If the Oscilloscope is disabled by the FreeMASTER driver configuration file, this file compiles as void.
  - *freemaster_pipes.c* - implements the Pipes functionality when the Pipes feature is enabled.
  - *freemaster_appcmd.c* - handles the communication commands used to deliver and execute the Application Commands within the context of the embedded application. When the Application Commands are disabled by the FreeMASTER driver configuration file, this file only compiles to empty API functions.

  - *freemaster_tsa.c* - handles the commands specific to the TSA feature. This feature enables the FreeMASTER host tool to obtain the TSA memory descriptors declared in the embedded application. If the TSA is disabled by the FreeMASTER driver configuration file, this file compiles as void.
  - *freemaster_tsa.h* - contains the declaration of the macros used to define the TSA memory descriptors. This file is indirectly included into the user application code (via *freemaster.h*).
  - *freemaster_sha.c* - implements the SHA-1 hash code used in the password authentication algorithm.
  - *freemaster_private.h* - contains the declarations of functions and data types used internally in the driver. It also contains the C pre-processor statements to perform the compile-time verification of the user configuration provided in the *freemaster_cfg.h* file.
  - *freemaster_serial.c* - implements the serial protocol logic including the CRC, FIFO queuing, and other communication-related operations. This code calls the functions of the low-level communication driver indirectly via a character-oriented API exported by the specific low-level driver.
  - *freemaster_serial.h* - defines the low-level character-oriented Serial API.
  - *freemaster_can.c* - implements the CAN protocol logic including the CAN message preparation, signalling using the first data byte in the CAN frame, and other communication-related operations. This code calls the functions of the low-level communication driver indirectly via a message-oriented API exported by the specific low-level driver.
  - *freemaster_can.h* - defines the low-level message-oriented CAN API.
  - *freemaster_net.c* - implements the Network protocol transport logic including multiple session management code.
  - *freemaster_net.h* - definitions related to the Network transport.
  - *freemaster_pdbdm.c* - implements the packet-driven BDM communication buffer and other communication-related operations.
  - *freemaster_utils.c* - aligned memory copy routines, circular buffer management and other utility functions
  - *freemaster_utils.h* - definitions related to utility code.
- ***src/drivers/[sdk]/serial*** - contains the code related to the serial communication implemented using one of the supported SDK frameworks.
  - *freemaster_serial_XXX.c* and *.h* - implement low-level access to the communication peripheral registers. Different files exist for the UART, LPUART, USART, and other kinds of Serial communication modules.
- ***src/drivers/[sdk]/can*** - contains the code related to the serial communication implemented using one of the supported SDK frameworks.
  - *freemaster_XXX.c* and *.h* - implement low-level access to the communication peripheral registers. Different files exist for the FlexCAN, msCAN, MCAN, and other kinds of CAN communication modules.
- ***src/drivers/[sdk]/network*** - contains low-level code adapting the FreeMASTER Network transport to an underlying TCP/IP or RTT stack.
  - *freemaster_net_lwip_tcp.c* and *_udp.c* - default networking implementation of TCP and UDP transports using lwIP stack.
  - *freemaster_net_segger_rtt.c* - implementation of network transport using Segger J-Link RTT interface

Driver configuration The driver is configured using a single header file (*freemaster_cfg.h*). Create this file and save it together with other project source files before compiling the driver code. All FreeMASTER driver source files include the *freemaster_cfg.h* file and use the macros defined here for the conditional and parameterized compilation. The C compiler must locate the configuration file when compiling the driver files. Typically, it can be achieved by putting this file into a folder where the other project-specific included files are stored.

As a starting point to create the configuration file, get the *freemaster_cfg.h.example* file, rename it to *freemaster_cfg.h*, and save it into the project area.

Note: It is NOT recommended to leave the *freemaster_cfg.h* file in the FreeMASTER driver source code folder. The configuration file must be placed at a project-specific location, so that it does not affect the other applications that use the same driver.

Configurable items This section describes the configuration options which can be defined in *freemaster_cfg.h*.

Interrupt modes

```
#define FMSTR_LONG_INTR    [0|1]
#define FMSTR_SHORT_INTR   [0|1]
#define FMSTR_POLL_DRIVEN [0|1]
```

Value Type boolean (0 or 1)

Description Exactly one of the three macros must be defined to non-zero. The others must be defined to zero or left undefined. The non-zero-defined constant selects the interrupt mode of the driver. See *Driver interrupt modes*.

- FMSTR_LONG_INTR — long interrupt mode
- FMSTR_SHORT_INTR — short interrupt mode
- FMSTR_POLL_DRIVEN — poll-driven mode

Note: Some options may not be supported by all communication interfaces. For example, the FMSTR_SHORT_INTR option is not supported by the USB_CDC interface.

Protocol transport

```
#define FMSTR_TRANSPORT [identifier]
```

Value Type Driver identifiers are structure instance names defined in FreeMASTER source code. Specify one of existing instances to make use of the protocol transport.

Description Use one of the pre-defined constants, as implemented by the FreeMASTER code. The current driver supports the following transports:

- **FMSTR_SERIAL** - serial communication protocol
- **FMSTR_CAN** - using CAN communication
- **FMSTR_PDBDM** - using packet-driven BDM communication
- **FMSTR_NET** - network communication using TCP or UDP protocol

Serial transport This section describes configuration parameters used when serial transport is used:

```
#define FMSTR_TRANSPORT FMSTR_SERIAL
```

FMSTR_SERIAL_DRV Select what low-level driver interface will be used when implementing the Serial communication.

```
#define FMSTR_SERIAL_DRV [identifier]
```

Value Type Driver identifiers are structure instance names defined in FreeMASTER drivers code. Specify one of existing serial driver instances.

Description When using MCUXpresso SDK, use one of the following constants (see */drivers/mcuxsdk/serial* implementation):

- **FMSTR_SERIAL_MCUX_UART** - UART driver
- **FMSTR_SERIAL_MCUX_LPUART** - LPUART driver
- **FMSTR_SERIAL_MCUX_USART** - USART driver
- **FMSTR_SERIAL_MCUX_MINIUSART** - miniUSART driver
- **FMSTR_SERIAL_MCUX_QSCI** - DSC QSCI driver
- **FMSTR_SERIAL_MCUX_USB** - USB/CDC class driver (also see code in the */support/mcuxsdk_usb* folder)
- **FMSTR_SERIAL_56F800E_EONCE** - DSC JTAG EOnCE driver

Other SDKs or BSPs may define custom low-level driver interface structure which may be used as FMSTR_SERIAL_DRV. For example:

- **FMSTR_SERIAL_DREG_UART** - demonstrates the low-level interface implemented without the MCUXpresso SDK and using direct access to peripheral registers.

FMSTR_SERIAL_BASE

```
#define FMSTR_SERIAL_BASE [address|symbol]
```

Value Type Optional address value (numeric or symbolic)

Description Specify the base address of the UART, LPUART, USART, or other serial peripheral module to be used for the communication. This value is not defined by default. User application should call `FMSTR_SetSerialBaseAddress()` to select the peripheral module.

FMSTR_COMM_BUFFER_SIZE

```
#define FMSTR_COMM_BUFFER_SIZE [number]
```

Value Type 0 or a value in range 32…255

Description Specify the size of the communication buffer to be allocated by the driver. Default value, which suits all driver features, is used when this option is defined as 0.

FMSTR_COMM_RQUEUE_SIZE

```
#define FMSTR_COMM_RQUEUE_SIZE [number]
```

Value Type Value in range 0…255

Description Specify the size of the FIFO receiver queue used to quickly receive and store characters in the FMSTR_SHORT_INTR interrupt mode.
The default value is 32 B.

FMSTR_SERIAL_SINGLEWIRE

```
#define FMSTR_SERIAL_SINGLEWIRE [0|1]
```

Value Type Boolean 0 or 1.

Description Set to non-zero to enable the "True" single-wire mode which uses a single MCU pin to communicate. The low-level driver enables the pin direction switching when the MCU peripheral supports it.

CAN Bus transport This section describes configuration parameters used when CAN transport is used:

```
#define FMSTR_TRANSPORT FMSTR_CAN
```

FMSTR_CAN_DRV Select what low-level driver interface will be used when implementing the CAN communication.

```
#define FMSTR_CAN_DRV [identifier]
```

Value Type Driver identifiers are structure instance names defined in FreeMASTER drivers code. Specify one of existing CAN driver instances.

Description When using MCUXpresso SDK, use one of the following constants (see */drivers/mcuxsdk/can implementation*):

- **FMSTR_CAN_MCUX_FLEXCAN** - FlexCAN driver
- **FMSTR_CAN_MCUX_MCAN** - MCAN driver
- **FMSTR_CAN_MCUX_MSCAN** - msCAN driver
- **FMSTR_CAN_MCUX_DSCFLEXCAN** - DSC FlexCAN driver
- **FMSTR_CAN_MCUX_DSCMSCAN** - DSC msCAN driver

Other SDKs or BSPs may define the custom low-level driver interface structure which may be used as FMSTR_CAN_DRV.

FMSTR_CAN_BASE

```
#define FMSTR_CAN_BASE [address|symbol]
```

Value Type Optional address value (numeric or symbolic)

Description Specify the base address of the FlexCAN, msCAN, or other CAN peripheral module to be used for the communication. This value is not defined by default. User application should call FMSTR_SetCanBaseAddress() to select the peripheral module.

FMSTR_CAN_CMDID

```
#define FMSTR_CAN_CMDID [number]
```

Value Type CAN identifier (11-bit or 29-bit number)

Description CAN message identifier used for FreeMASTER commands (direction from PC Host tool to target application). When declaring 29-bit identifier, combine the numeric value with FMSTR_CAN_EXTID bit. Default value is 0x7AA.

FMSTR_CAN_RSPID

```
#define FMSTR_CAN_RSPID [number]
```

Value Type CAN identifier (11-bit or 29-bit number)

Description CAN message identifier used for responding messages (direction from target application to PC Host tool). When declaring 29-bit identifier, combine the numeric value with FMSTR_CAN_EXTID bit. Note that both *CMDID* and *RSPID* values may be the same. Default value is 0x7AA.

FMSTR_FLEXCAN_TXMB

```
#define FMSTR_FLEXCAN_TXMB [number]
```

Value Type Number in range of 0..N where N is number of CAN message-buffers supported by HW module.

Description Only used when the FlexCAN low-level driver is used. Define the FlexCAN message buffer for CAN frame transmission. Default value is 0.

FMSTR_FLEXCAN_RXMB

```
#define FMSTR_FLEXCAN_RXMB [number]
```

Value Type Number in range of 0..N where N is number of CAN message-buffers supported by HW module.

Description Only used when the FlexCAN low-level driver is used. Define the FlexCAN message buffer for CAN frame reception. Note that the FreeMASTER driver may also operate with a common message buffer used by both TX and RX directions. Default value is 1.

Network transport This section describes configuration parameters used when Network transport is used:

```
#define FMSTR_TRANSPORT FMSTR_NET
```

FMSTR_NET_DRV Select network interface implementation.

```
#define FMSTR_NET_DRV [identifier]
```

Value Type Identifiers are structure instance names defined in FreeMASTER drivers code. Specify one of existing NET driver instances.

Description When using MCUXpresso SDK, use one of the following constants (see */drivers/mcuxsdk/network implementation*):

- **FMSTR_NET_LWIP_TCP** - TCP communication using lwIP stack
- **FMSTR_NET_LWIP_UDP** - UDP communication using lwIP stack
- **FMSTR_NET_SEGGER_RTT** - Communication using SEGGER J-Link RTT interface

Other SDKs or BSPs may define the custom networking interface which may be used as FMSTR_CAN_DRV.

Add another row below:

FMSTR_NET_PORT

```
#define FMSTR_NET_PORT [number]
```

Value Type TCP or UDP port number (short integer)

Description Specifies the server port number used by TCP or UDP protocols.

FMSTR_NET_BLOCKING_TIMEOUT

```
#define FMSTR_NET_BLOCKING_TIMEOUT [number]
```

Value Type Timeout as number of milliseconds

Description This value specifies a timeout in milliseconds for which the network socket operations may block the execution inside *FMSTR_Poll*. This may be set high (e.g. 250) when a dedicated RTOS task is used to handle FreeMASTER protocol polling. Set to a lower value when the polling task is also responsible for other operations. Set to 0 to attempt to use non-blocking socket operations.

FMSTR_NET_AUTODISCOVERY

```
#define FMSTR_NET_AUTODISCOVERY [0|1]
```

Value Type Boolean 0 or 1.

Description This option enables the FreeMASTER driver to use a separate UDP socket to broadcast auto-discovery messages to network. This helps the FreeMASTER tool to discover the target device address, port and protocol options.

Debugging options

FMSTR_DISABLE

```
#define FMSTR_DISABLE [0|1]
```

Value Type boolean (0 or 1)

Description Define as non-zero to disable all FreeMASTER features, exclude the driver code from build, and compile all its API functions empty. This may be useful to remove FreeMASTER without modifying any application source code. Default value is 0 (false).

FMSTR_DEBUG_TX

```
#define FMSTR_DEBUG_TX [0|1]
```

Value Type Boolean 0 or 1.

Description Define as non-zero to enable the driver to periodically transmit test frames out on the selected communication interface (SCI or CAN). With the debug transmission enabled, it is simpler to detect problems in the baudrate or other communication configuration settings.

The test frames are transmitted until the first valid command frame is received from the PC Host tool. The test frame is a valid error status frame, as defined by the protocol format. On the serial line, the test frame consists of three printable characters (+©W) which are easy to capture using the serial terminal tools.

This feature requires the FMSTR_Poll() function to be called periodically. Default value is 0 (false).

FMSTR_APPLICATION_STR

```
#define FMSTR_APPLICATION_STR
```

Value Type String.

Description Name of the application visible in FreeMASTER host application.

Memory access

FMSTR_USE_READMEM

```
#define FMSTR_USE_READMEM [0|1]
```

Value Type Boolean 0 or 1.

Description Define as non-zero to implement the Memory Read command and enable FreeMASTER to have read access to memory and variables. The access can be further restricted by using a TSA feature.
Default value is 1 (true).

FMSTR_USE_WRITEMEM

```
#define FMSTR_USE_WRITEMEM [0|1]
```

Value Type Boolean 0 or 1.

Description Define as non-zero to implement the Memory Write command.
The default value is 1 (true).

Oscilloscope options

FMSTR_USE_SCOPE

```
#define FMSTR_USE_SCOPE [number]
```

Value Type Integer number.

Description Number of Oscilloscope instances to be supported. Set to 0 to disable the Oscilloscope feature.
Default value is 0.

FMSTR_MAX_SCOPE_VARS

```
#define FMSTR_MAX_SCOPE_VARS [number]
```

Value Type Integer number larger than 2.

Description Number of variables to be supported by each Oscilloscope instance.
Default value is 8.

Recorder options

FMSTR_USE_RECORDER

```
#define FMSTR_USE_RECORDER [number]
```

Value Type Integer number.

Description Number of Recorder instances to be supported. Set to 0 to disable the Recorder feature.
Default value is 0.

FMSTR_REC_BUFF_SIZE

```
#define FMSTR_REC_BUFF_SIZE [number]
```

Value Type Integer number larger than 2.

Description Defines the size of the memory buffer used by the Recorder instance #0.
Default: not defined, user shall call 'FMSTR_RecorderCreate()" API function to specify this parameter in run time.

FMSTR_REC_TIMEBASE

```
#define FMSTR_REC_TIMEBASE [time specification]
```

Value Type Number (nanoseconds time).

Description Defines the base sampling rate in nanoseconds (sampling speed) Recorder instance #0.

Use one of the following macros:

- FMSTR_REC_BASE_SECONDS(x)
- FMSTR_REC_BASE_MILLISEC(x)
- FMSTR_REC_BASE_MICROSEC(x)
- FMSTR_REC_BASE_NANOSEC(x)

Default: not defined, user shall call 'FMSTR_RecorderCreate()" API function to specify this parameter in run time.

FMSTR_REC_FLOAT_TRIG

```
#define FMSTR_REC_FLOAT_TRIG [0|1]
```

Value Type Boolean 0 or 1.

Description Define as non-zero to implement the floating-point triggering. Be aware that floating-point triggering may grow the code size by linking the floating-point standard library.

Default value is 0 (false).

Application Commands options

FMSTR_USE_APPCMD

```
#define FMSTR_USE_APPCMD [0|1]
```

Value Type Boolean 0 or 1.

Description Define as non-zero to implement the Application Commands feature.
Default value is 0 (false).

FMSTR_APPCMD_BUFF_SIZE

```
#define FMSTR_APPCMD_BUFF_SIZE [size]
```

Value Type Numeric buffer size in range 1..255

Description The size of the Application Command data buffer allocated by the driver. The buffer stores the (optional) parameters of the Application Command which waits to be processed.

FMSTR_MAX_APPCMD_CALLS

```
#define FMSTR_MAX_APPCMD_CALLS [number]
```

Value Type Number in range 0..255

Description The number of different Application Commands that can be assigned a callback handler function using FMSTR_RegisterAppCmdCall(). Default value is 0.

TSA options

FMSTR_USE_TSA

```
#define FMSTR_USE_TSA [0|1]
```

Value Type Boolean 0 or 1.

Description Enable the FreeMASTER TSA feature to be used. With this option enabled, the TSA tables defined in the applications are made available to the FreeMASTER host tool.
Default value is 0 (false).

FMSTR_USE_TSA_SAFETY

```
#define FMSTR_USE_TSA_SAFETY [0|1]
```

Value Type Boolean 0 or 1.

Description Enable the memory access validation in the FreeMASTER driver. With this option, the host tool is not able to access the memory which is not described by at least one TSA descriptor. Also a write access is denied for objects defined as read-only in TSA tables.
Default value is 0 (false).

FMSTR_USE_TSA_INROM

```
#define FMSTR_USE_TSA_INROM [0|1]
```

Value Type Boolean 0 or 1.

Description Declare all TSA descriptors as *const*, which enables the linker to put the data into the flash memory. The actual result depends on linker settings or the linker commands used in the project.
Default value is 0 (false).

FMSTR_USE_TSA_DYNAMIC

```
#define FMSTR_USE_TSA_DYNAMIC [0|1]
```

Value Type Boolean 0 or 1.

Description Enable runtime-defined TSA entries to be added to the TSA table by the FMSTR_SetUpTsaBuff() and FMSTR_TsaAddVar() functions.
Default value is 0 (false).

Pipes options

FMSTR_USE_PIPES

```
#define FMSTR_USE_PIPES [0|1]
```

Value Type Boolean 0 or 1.

Description Enable the FreeMASTER Pipes feature to be used.
Default value is 0 (false).

FMSTR_MAX_PIPES_COUNT

```
#define FMSTR_MAX_PIPES_COUNT [number]
```

Value Type Number in range 1..63.

Description The number of simultaneous pipe connections to support.
The default value is 1.

Driver interrupt modes To implement the communication, the FreeMASTER driver handles the Serial or CAN module's receive and transmit requests. Use the *freemaster_cfg.h* configuration file to select whether the driver processes the communication automatically in the interrupt service routine handler or if it only polls the status of the module (typically during the application idle time).

This section describes each of the interrupt mode in more details.

Completely Interrupt-Driven operation Activated using:

```
#define FMSTR_LONG_INTR 1
```

In this mode, both the communication and the FreeMASTER protocol decoding is done in the *FMSTR_SerialIsr*, *FMSTR_CanIsr*, or other interrupt service routine. Because the protocol execution may be a lengthy task (especially with the TSA-Safety enabled) it is recommended to use this mode only if the interrupt prioritization scheme is possible in the application and the FreeMASTER interrupt is assigned to a lower (the lowest) priority.

In this mode, the application code must register its own interrupt handler for all interrupt vectors related to the selected communication interface and call the FMSTR_SerialIsr or FMSTR_CanIsr functions from that handler.

Mixed Interrupt and Polling Modes Activated using:

```
#define FMSTR_SHORT_INTR 1
```

In this mode, the communication processing time is split between the interrupt routine and the main application loop or task. The raw communication is handled by the *FMSTR_SerialIsr, FMSTR_CanIsr*, or other interrupt service routine, while the protocol decoding and execution is handled by the *FMSTR_Poll* routine. Call *FMSTR_Poll* during the idle time in the application main loop.

The interrupt processing in this mode is relatively fast and deterministic. Upon a serial-receive event, the received character is only placed into a FIFO-like queue and it is not further processed. Upon a CAN receive event, the received frame is stored into a receive buffer. When transmitting, the characters are fetched from the prepared transmit buffer.

In this mode, the application code must register its own interrupt handler for all interrupt vectors related to the selected communication interface and call the *FMSTR_SerialIsr* or *FMSTR_CanIsr* functions from that handler.

When the serial interface is used as the serial communication interface, ensure that the *FMSTR_Poll* function is called at least once per *N* character time periods. *N* is the length of the FreeMASTER FIFO queue (*FMSTR_COMM_RQUEUE_SIZE*) and the character time is the time needed to transmit or receive a single byte over the SCI line.

Completely Poll-driven

```
#define FMSTR_POLL_DRIVEN 1
```

In this mode, both the communication and the FreeMASTER protocol decoding are done in the *FMSTR_Poll* routine. No interrupts are needed and the *FMSTR_SerialIsr*, *FMSTR_CanIsr*, and similar handlers compile to an empty code.

When using this mode, ensure that the *FMSTR_Poll* function is called by the application at least once per the serial "character time" which is the time needed to transmit or receive a single character.

In the latter two modes (*FMSTR_SHORT_INTR* and *FMSTR_POLL_DRIVEN*), the protocol handling takes place in the FMSTR_Poll routine. An application interrupt can occur in the middle of the

Read Memory or Write Memory commands' execution and corrupt the variable being accessed by the FreeMASTER driver. In these two modes, some issues or glitches may occur when using FreeMASTER to visualize or monitor volatile variables modified in interrupt servicing code.

The same issue may appear even in the full interrupt mode (FMSTR_LONG_INTR), if volatile variables are modified in the interrupt code with a priority higher than the priority of the communication interrupt.

Data types Simple portability was one of the main requirements when writing the FreeMASTER driver. This is why the driver code uses the privately-declared data types and the vast majority of the platform-dependent code is separated in the platform-dependent source files. The data types used in the driver API are all defined in the platform-specific header file.

To prevent name conflicts with the symbols used in the application, all data types, macros, and functions have the FMSTR_ prefix. The only global variables used in the driver are the transport and low-level API structures exported from the driver-implementation layer to upper layers. Other than that, all private variables are declared as static and named using the fmstr_ prefix.

Communication interface initialization The FreeMASTER driver does not perform neither the initialization nor the configuration of the peripheral module that it uses to communicate. It is the application startup code responsibility to configure the communication module before the FreeMASTER driver is initialized by the FMSTR_Init call.

When the Serial communication module is used as the FreeMASTER communication interface, configure the UART receive and transmit pins, the serial communication baud rate, parity (no-parity), the character length (eight bits), and the number of stop bits (one) before initializing the FreeMASTER driver. For either the long or the short interrupt modes of the driver (see *Driver interrupt modes*), configure the interrupt controller and register an application-specific interrupt handler for all interrupt sources related to the selected serial peripheral module. Call the FMSTR_SerialIsr function from the application handler.

When a CAN module is used as the FreeMASTER communication interface, configure the CAN receive and transmit pins and the CAN module bit rate before initializing the FreeMASTER driver. For either the long or the short interrupt modes of the driver (see *Driver interrupt modes*), configure the interrupt controller and register an application-specific interrupt handler for all interrupt sources related to the selected CAN peripheral module. Call the FMSTR_CanIsr function from the application handler.

Note: It is not necessary to enable or unmask the serial nor the CAN interrupts before initializing the FreeMASTER driver. The driver enables or disables the interrupts and communication lines, as required during runtime.

FreeMASTER Recorder calls When using the FreeMASTER Recorder in the application (FMSTR_USE_RECORDER > 0), call the FMSTR_RecorderCreate function early after FMSTR_Init to set up each recorder instance to be used in the application. Then call the FMSTR_Recorder function periodically in the code where the data recording should occur. A typical place to call the Recorder routine is at the timer or PWM interrupts, but it can be anywhere else. The example applications provided together with the driver code call the FMSTR_Recorder in the main application loop.

In applications where FMSTR_Recorder is called periodically with a constant period, specify the period in the Recorder configuration structure before calling FMSTR_RecorderCreate. This setting enables the PC Host FreeMASTER tool to display the X-axis of the Recorder graph properly scaled for the time domain.

Driver usage Start using or evaluating FreeMASTER by opening some of the example applications available in the driver setup package.

Follow these steps to enable the basic FreeMASTER connectivity in the application:

- Make sure that all **.c* files of the FreeMASTER driver from the *src/common/platforms/[your_platform]* folder are a part of the project. See *Driver files* for more details.
- Configure the FreeMASTER driver by creating or editing the *freemaster_cfg.h* file and by saving it into the application project directory. See *Driver configuration* for more details.
- Include the *freemaster.h* file into any application source file that makes the FreeMASTER API calls.
- Initialize the Serial or CAN modules. Set the baud rate, parity, and other parameters of the communication. Do not enable the communication interrupts in the interrupt mask registers.
- For the FMSTR_LONG_INTR and FMSTR_SHORT_INTR modes, install the application-specific interrupt routine and call the FMSTR_SerialIsr or FMSTR_CanIsr functions from this handler.
- Call the FMSTR_Init function early on in the application initialization code.
- Call the FMSTR_RecorderCreate functions for each Recorder instance to enable the Recorder feature.
- In the main application loop, call the FMSTR_Poll API function periodically when the application is idle.
- For the FMSTR_SHORT_INTR and FMSTR_LONG_INTR modes, enable the interrupts globally so that the interrupts can be handled by the CPU.

Communication troubleshooting The most common problem that causes communication issues is a wrong baud rate setting or a wrong pin multiplexer setting of the target MCU. When a communication between the PC Host running FreeMASTER and the target MCU cannot be established, try enabling the FMSTR_DEBUG_TX option in the *freemaster_cfg.h* file and call the FMSTR_Poll function periodically in the main application task loop.

With this feature enabled, the FreeMASTER driver periodically transmits a test frame through the Serial or CAN lines. Use a logic analyzer or an oscilloscope to monitor the signals at the communication pins of the CPU device to examine whether the bit rate and signal polarity are configured properly.

Driver API

This section describes the driver Application Programmers' Interface (API) needed to initialize and use the FreeMASTER serial communication driver.

Control API There are three key functions to initialize and use the driver.

FMSTR_Init

Prototype

```
FMSTR_BOOL FMSTR_Init(void);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_protocol.c*

Description This function initializes the internal variables of the FreeMASTER driver and enables the communication interface. This function does not change the configuration of the selected communication module. The hardware module must be initialized before the *FMSTR_Init* function is called.

A call to this function must occur before calling any other FreeMASTER driver API functions.

FMSTR_Poll

Prototype

```
void FMSTR_Poll(void);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_protocol.c*

Description In the poll-driven or short interrupt modes, this function handles the protocol decoding and execution (see *Driver interrupt modes*). In the poll-driven mode, this function also handles the communication interface with the PC. Typically, the *FMSTR_Poll* function is called during the "idle" time in the main application task loop.

To prevent the receive data overflow (loss) on a serial interface, make sure that the FMSTR_Poll function is called at least once per the time calculated as:

*N * Tchar*

where:

- *N* is equal to the length of the receive FIFO queue (configured by the FMSTR_COMM_RQUEUE_SIZE macro). *N* is 1 for the poll-driven mode.
- *Tchar* is the character time, which is the time needed to transmit or receive a single byte over the SCI line.

Note: In the long interrupt mode, this function typically compiles as an empty function and can still be called. It is worthwhile to call this function regardless of the interrupt mode used in the application. This approach enables a convenient switching between the different interrupt modes only by changing the configuration macros in the *freemaster_cfg.h* file.

FMSTR_SerialIsr / FMSTR_CanIsr

Prototype

```
void FMSTR_SerialIsr(void);
void FMSTR_CanIsr(void);
```

- Declaration: *freemaster.h*
- Implementation: *hw-specific low-level driver C file*

Description This function contains the interrupt-processing code of the FreeMASTER driver. In long or short interrupt modes (see *Driver interrupt modes*), this function must be called from the application interrupt service routine registered for the communication interrupt vector. On platforms where the communication module uses multiple interrupt vectors, the application should register a handler for all vectors and call this function at each interrupt.

Note: In a poll-driven mode, this function is compiled as an empty function and does not have to be used.

Recorder API

FMSTR_RecorderCreate

Prototype

```
FMSTR_BOOL FMSTR_RecorderCreate(FMSTR_INDEX recIndex, FMSTR_REC_BUFF* buffCfg);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_rec.c*

Description This function registers a recorder instance and enables it to be used by the PC Host tool. Call this function for all recorder instances from 0 to the maximum number defined by the FMSTR_USE_RECORDER configuration option (minus one). An exception to this requirement is the recorder of instance *0* which may be automatically configured by FMSTR_Init when the *freemaster_cfg.h* configuration file defines the *FMSTR_REC_BUFF_SIZE* and *FMSTR_REC_TIMEBASE* options.

For more information, see *Configurable items*.

FMSTR_Recorder

Prototype

```
void FMSTR_Recorder(FMSTR_INDEX recIndex);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_rec.c*

Description This function takes a sample of the variables being recorded using the FreeMASTER Recorder instance *recIndex*. If the selected Recorder is not active when the *FMSTR_Recorder* function is being called, the function returns immediately. When the Recorder is active, the values of the variables being recorded are copied into the recorder buffer and the trigger conditions are evaluated.

If a trigger condition is satisfied, the Recorder enters the post-trigger mode, where it counts down the follow-up samples (number of *FMSTR_Recorder* function calls) and de-activates the Recorder when the required post-trigger samples are finished.

The *FMSTR_Recorder* function is typically called in the timer or PWM interrupt service routines. This function can also be called in the application main loop (for testing purposes).

FMSTR_RecorderTrigger

Prototype

```
void FMSTR_RecorderTrigger(FMSTR_INDEX recIndex);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_rec.c*

Description This function forces the Recorder trigger condition to happen, which causes the Recorder to be automatically deactivated after the post-trigger samples are sampled. Use this function in the application code for programmatic control over the Recorder triggering. This can be useful when a more complex triggering conditions need to be used.

Fast Recorder API The Fast Recorder feature is not available in the FreeMASTER driver version 3. This feature was heavily dependent on the target platform and it was only available for the 56F8xxxx DSCs.

TSA Tables When the TSA is enabled in the FreeMASTER driver configuration file (by setting the FMSTR_USE_TSA macro to a non-zero value), it defines the so-called TSA tables in the application. This section describes the macros that must to be used to define the TSA tables.

There can be any number of TSA tables spread across the application source files. There must be always exactly one TSA Table List defined, which informs the FreeMASTER driver about the active TSA tables.

When there is at least one TSA table and one TSA Table List defined in the application, the TSA information automatically appears in the FreeMASTER symbols list. The symbols can then be used to create FreeMASTER variables for visualization or control.

TSA table definition The TSA table describes the static or global variables together with their address, size, type, and access-protection information. If the TSA-described variables are of a structure type, the TSA table may also describe this type and provide an access to the individual structure members of the variable.

The TSA table definition begins with the FMSTR_TSA_TABLE_BEGIN macro with a *table_id* identifying the table. The *table_id* shall be a valid C-langiage symbol.

```
FMSTR_TSA_TABLE_BEGIN(table_id)
```

After this opening macro, the TSA descriptors are placed using these macros:

```
/* Adding variable descriptors */
FMSTR_TSA_RW_VAR(name, type)  /* read/write variable entry */
FMSTR_TSA_RO_VAR(name, type)  /* read-only variable entry */

/* Description of complex data types */
FMSTR_TSA_STRUCT(struct_name) /* structure or union type entry */
FMSTR_TSA_MEMBER(struct_name, member_name, type)  /* structure member entry */

/* Memory blocks */
FMSTR_TSA_RW_MEM(name, type, address, size) /* read/write memory block */
FMSTR_TSA_RO_MEM(name, type, address, size) /* read-only memory block */
```

The table is closed using the FMSTR_TSA_TABLE_END macro:

```
FMSTR_TSA_TABLE_END()
```

TSA descriptor parameters The TSA descriptor macros accept these parameters:

- *name* — variable name. The variable must be defined before the TSA descriptor references it.
- *type* — variable or member type. Only one of the pre-defined type constants may be used (see below).
- *struct_name* — structure type name. The type must be defined (typedef) before the TSA descriptor references it.

- *member_name* — structure member name.

Note: The structure member descriptors (FMSTR_TSA_MEMBER) must immediately follow the parent structure descriptor (FMSTR_TSA_STRUCT) in the table.

Note: To write-protect the variables in the FreeMASTER driver (FMSTR_TSA_RO_VAR), enable the TSA-Safety feature in the configuration file.

TSA variable types The table lists *type* identifiers which can be used in TSA descriptors:

Constant	Description
FMSTR_TSA_UINT*n*	Unsigned integer type of size *n* bits (n=8,16,32,64)
FMSTR_TSA_SINT*n*	Signed integer type of size *n* bits (n=8,16,32,64)
FMSTR_TSA_FRAC*n*	Fractional number of size *n* bits (n=16,32,64).
FMSTR_TSA_FRAC_Q(*m*,*n*)	Signed fractional number in general Q form (m+n+1 total bits)
FMSTR_TSA_FRAC_UQ(*m*,*n*)	Unsigned fractional number in general UQ form (m+n total bits)
FMSTR_TSA_FLOAT	4-byte standard IEEE floating-point type
FMSTR_TSA_DOUBLE	8-byte standard IEEE floating-point type
FMSTR_TSA_POINTER	Generic pointer type defined (platform-specific 16 or 32 bit)
FMSTR_TSA_USERTYPE(*name*)	Structure or union type declared with FMSTR_TSA_STRUCT record

TSA table list There shall be exactly one TSA Table List in the application. The list contains one entry for each TSA table defined anywhere in the application.

The TSA Table List begins with the FMSTR_TSA_TABLE_LIST_BEGIN macro and continues with the TSA table entries for each table.

```
FMSTR_TSA_TABLE_LIST_BEGIN()

FMSTR_TSA_TABLE(table_id)
FMSTR_TSA_TABLE(table_id2)
FMSTR_TSA_TABLE(table_id3)
...
```

The list is closed with the FMSTR_TSA_TABLE_LIST_END macro:

```
FMSTR_TSA_TABLE_LIST_END()
```

TSA Active Content entries FreeMASTER v2.0 and higher supports TSA Active Content, enabling the TSA tables to describe the memory-mapped files, virtual directories, and URL hyperlinks. FreeMASTER can access such objects similarly to accessing the files and folders on the local hard drive.

With this set of TSA entries, the FreeMASTER pages can be embedded directly into the target MCU flash and accessed by FreeMASTER directly over the communication line. The HTML-coded pages rendered inside the FreeMASTER window can access the TSA Active Content resources using a special URL referencing the *fmstr:* protocol.

This example provides an overview of the supported TSA Active Content entries:

```
FMSTR_TSA_TABLE_BEGIN(files_and_links)

/* Directory entry applies to all subsequent MEMFILE entries */
FMSTR_TSA_DIRECTORY("/text_files")      /* entering a new virtual directory */
```

(continues on next page)

(continued from previous page)

```
/* The readme.txt file will be accessible at the fmstr://text_files/readme.txt URL */
FMSTR_TSA_MEMFILE("readme.txt", readme_txt, sizeof(readme_txt)) /* memory-mapped file */

/* Files can also be specified with a full path so the DIRECTORY entry does not apply */
FMSTR_TSA_MEMFILE("/index.htm", index, sizeof(index))          /* memory-mapped file */
FMSTR_TSA_MEMFILE("/prj/demo.pmp", demo_pmp, sizeof(demo_pmp)) /* memory-mapped file */

/* Hyperlinks can point to a local MEMFILE object or to the Internet */
FMSTR_TSA_HREF("Board's Built-in Welcome Page", "/index.htm")
FMSTR_TSA_HREF("FreeMASTER Home Page", "http://www.nxp.com/freemaster")

/* Project file links simplify opening the projects from any URLs */
FMSTR_TSA_PROJECT("Demonstration Project (embedded)", "/prj/demo.pmp")
FMSTR_TSA_PROJECT("Full Project (online)", "http://mycompany.com/prj/demo.pmp")

FMSTR_TSA_TABLE_END()
```

TSA API

FMSTR_SetUpTsaBuff

Prototype

```
FMSTR_BOOL FMSTR_SetUpTsaBuff(FMSTR_ADDR buffAddr, FMSTR_SIZE buffSize);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_tsa.c*

Arguments

- *buffAddr* [in] - address of the memory buffer for the dynamic TSA table
- *buffSize* [in] - size of the memory buffer which determines the maximum number of TSA entries to be added in the runtime

Description This function must be used to assign the RAM memory buffer to the TSA subsystem when FMSTR_USE_TSA_DYNAMIC is enabled. The memory buffer is then used to store the TSA entries added dynamically to the runtime TSA table using the FMSTR_TsaAddVar function call. The runtime TSA table is processed by the FreeMASTER PC Host tool along with all static tables as soon as the communication port is open.

The size of the memory buffer determines the number of TSA entries that can be added dynamically. Depending on the MCU platform, one TSA entry takes either 8 or 16 bytes.

FMSTR_TsaAddVar

Prototype

```
FMSTR_BOOL FMSTR_TsaAddVar(FMSTR_TSATBL_STRPTR tsaName, FMSTR_TSATBL_STRPTR␣
↪tsaType,
        FMSTR_TSATBL_VOIDPTR varAddr, FMSTR_SIZE32 varSize,
        FMSTR_SIZE flags);
```

- Declaration: *freemaster.h*

- Implementation: *freemaster_tsa.c*

Arguments

- *tsaName* [in] - name of the object
- *tsaType* [in] - name of the object type
- *varAddr* [in] - address of the object
- *varSize* [in] - size of the object
- *flags* [in] - access flags; a combination of these values:
  - *FMSTR_TSA_INFO_RO_VAR* — read-only memory-mapped object (typically a variable)
  - *FMSTR_TSA_INFO_RW_VAR* — read/write memory-mapped object
  - *FMSTR_TSA_INFO_NON_VAR* — other entry, describing structure types, structure members, enumerations, and other types

Description This function can be called only when the dynamic TSA table is enabled by the FMSTR_USE_TSA_DYNAMIC configuration option and when the FMSTR_SetUpTsaBuff function call is made to assign the dynamic TSA table memory. This function adds an entry into the dynamic TSA table. It can be used to register a read-only or read/write memory object or describe an item of the user-defined type.

See *TSA table definition* for more details about the TSA table entries.

Application Commands API

FMSTR_GetAppCmd

Prototype

```
FMSTR_APPCMD_CODE FMSTR_GetAppCmd(void);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_appcmd.c*

Description This function can be used to detect if there is an Application Command waiting to be processed by the application. If no command is pending, this function returns the FMSTR_APPCMDRESULT_NOCMD constant. Otherwise, this function returns the code of the Application Command that must be processed. Use the FMSTR_AppCmdAck call to acknowledge the Application Command after it is processed and to return the appropriate result code to the host.

The FMSTR_GetAppCmd function does not report the commands for which a callback handler function exists. If the FMSTR_GetAppCmd function is called when a callback-registered command is pending (and before it is actually processed by the callback function), this function returns FMSTR_APPCMDRESULT_NOCMD.

FMSTR_GetAppCmdData

Prototype

```
FMSTR_APPCMD_PDATA FMSTR_GetAppCmdData(FMSTR_SIZE* dataLen);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_appcmd.c*

Arguments

- *dataLen* [out] - pointer to the variable that receives the length of the data available in the buffer. It can be NULL when this information is not needed.

Description This function can be used to retrieve the Application Command data when the application determines that an Application Command is pending (see *FMSTR_GetAppCmd*).

There is just a single buffer to hold the Application Command data (the buffer length is FMSTR_APPCMD_BUFF_SIZE bytes). If the data are to be used in the application after the command is processed by the FMSTR_AppCmdAck call, copy the data out to a private buffer.

FMSTR_AppCmdAck

Prototype

```
void FMSTR_AppCmdAck(FMSTR_APPCMD_RESULT resultCode);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_appcmd.c*

Arguments

- *resultCode* [in] - the result code which is to be returned to FreeMASTER

Description This function is used when the Application Command processing finishes in the application. The resultCode passed to this function is returned back to the host and the driver is re-initialized to expect the next Application Command.

After this function is called and before the next Application Command arrives, the return value of the FMSTR_GetAppCmd function is FMSTR_APPCMDRESULT_NOCMD.

FMSTR_AppCmdSetResponseData

Prototype

```
void FMSTR_AppCmdSetResponseData(FMSTR_ADDR resultDataAddr, FMSTR_SIZE resultDataLen);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_appcmd.c*

Arguments

- *resultDataAddr* [in] - pointer to the data buffer that is to be copied to the Application Command data buffer
- *resultDataLen* [in] - length of the data to be copied. It must not exceed the FMSTR_APPCMD_BUFF_SIZE value.

Description This function can be used before the Application Command processing finishes, when there are data to be returned back to the PC.

The response data buffer is copied into the Application Command data buffer, from where it is accessed when the host requires it. Do not use FMSTR_GetAppCmdData and the data buffer after FMSTR_AppCmdSetResponseData is called.

Note: The current version of FreeMASTER does not support the Application Command response data.

FMSTR_RegisterAppCmdCall

Prototype

```
FMSTR_BOOL FMSTR_RegisterAppCmdCall(FMSTR_APPCMD_CODE appCmdCode, FMSTR_
→PAPPCMDFUNC callbackFunc);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_appcmd.c*

Arguments

- *appCmdCode* [in] - the Application Command code for which the callback is to be registered
- *callbackFunc* [in] - pointer to the callback function that is to be registered. Use NULL to unregister a callback registered previously with this Application Command.

Return value This function returns a non-zero value when the callback function was successfully registered or unregistered. It can return zero when trying to register a callback function for more than FMSTR_MAX_APPCMD_CALLS different Application Commands.

Description This function can be used to register the given function as a callback handler for the Application Command. The Application Command is identified using single-byte code. The callback function is invoked automatically by the FreeMASTER driver when the protocol decoder obtains a request to get the application command result code.

The prototype of the callback function is

```
FMSTR_APPCMD_RESULT HandlerFunction(FMSTR_APPCMD_CODE nAppcmd,
        FMSTR_APPCMD_PDATA pData, FMSTR_SIZE nDataLen);
```

Where:

- *nAppcmd* -Application Command code
- *pData* —points to the Application Command data received (if any)
- *nDataLen* —information about the Application Command data length

The return value of the callback function is used as the Application Command Result Code and returned to FreeMASTER.

Note: The FMSTR_MAX_APPCMD_CALLS configuration macro defines how many different Application Commands may be handled by a callback function. When FMSTR_MAX_APPCMD_CALLS is undefined or defined as zero, the FMSTR_RegisterAppCmdCall function always fails.

Pipes API

FMSTR_PipeOpen

Prototype

```
FMSTR_HPIPE FMSTR_PipeOpen(FMSTR_PIPE_PORT pipePort, FMSTR_PPIPEFUNC pipeCallback,
↪
        FMSTR_ADDR pipeRxBuff, FMSTR_PIPE_SIZE pipeRxSize,
        FMSTR_ADDR pipeTxBuff, FMSTR_PIPE_SIZE pipeTxSize,
        FMSTR_U8 type, const FMSTR_CHAR *name);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_pipes.c*

Arguments

- *pipePort* [in] - port number that identifies the pipe for the client
- *pipeCallback* [in] - pointer to the callback function that is called whenever a pipe data status changes
- *pipeRxBuff* [in] - address of the receive memory buffer
- *pipeRxSize* [in] - size of the receive memory buffer
- *pipeTxBuff* [in] - address of the transmit memory buffer
- *pipeTxSize* [in] - size of the transmit memory buffer
- *type* [in] - a combination of FMSTR_PIPE_MODE_xxx and FMSTR_PIPE_SIZE_xxx constants describing primary pipe data format and usage. This type helps FreeMASTER decide how to access the pipe by default. Optional, use 0 when undetermined.
- *name* [in] - user name of the pipe port. This name is visible to the FreeMASTER user when creating the graphical pipe interface.

Description This function initializes a new pipe and makes it ready to accept or send the data to the PC Host client. The receive memory buffer is used to store the received data before they are read out by the FMSTR_PipeRead call. When this buffer gets full, the PC Host client denies the data transmission into this pipe until there is enough free space again. The transmit memory buffer is used to store the data transmitted by the application to the PC Host client using the FMSTR_PipeWrite call. The transmit buffer can get full when the PC Host is disconnected or when it is slow in receiving and reading out the pipe data.

The function returns the pipe handle which must be stored and used in the subsequent calls to manage the pipe object.

The callback function (if specified) is called whenever new data are received through the pipe and available for reading. This callback is also called when the data waiting in the transmit buffer are successfully pushed to the PC Host and the transmit buffer free space increases. The prototype of the callback function provided by the user application must be as follows. The *PipeHandler* name is only a placeholder and must be defined by the application.

```
void PipeHandler(FMSTR_HPIPE pipeHandle);
```

FMSTR_PipeClose

Prototype

```
void FMSTR_PipeClose(FMSTR_HPIPE pipeHandle);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_pipes.c*

Arguments

- *pipeHandle* [in] - pipe handle returned from the FMSTR_PipeOpen function call

Description This function de-initializes the pipe object. No data can be received or sent on the pipe after this call.

FMSTR_PipeWrite

Prototype

```
FMSTR_PIPE_SIZE FMSTR_PipeWrite(FMSTR_HPIPE pipeHandle, FMSTR_ADDR pipeData,
        FMSTR_PIPE_SIZE pipeDataLen, FMSTR_PIPE_SIZE writeGranularity);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_pipes.c*

Arguments

- *pipeHandle* [in] - pipe handle returned from the FMSTR_PipeOpen function call
- *pipeData* [in] - address of the data to be written
- *pipeDataLen* [in] - length of the data to be written
- *writeGranularity* [in] - size of the minimum unit of data which is to be written

Description This function puts the user-specified data into the pipe's transmit memory buffer and schedules it for transmission. This function returns the number of bytes that were successfully written into the buffer. This number may be smaller than the number of the requested bytes if there is not enough free space in the transmit buffer.

The *writeGranularity* argument can be used to split the data into smaller chunks, each of the size given by the *writeGranularity* value. The FMSTR_PipeWrite function writes as many data chunks as possible into the transmit buffer and does not attempt to write an incomplete chunk. This feature can prove to be useful to avoid the intermediate caching when writing an array of integer values or other multi-byte data items. When making the nGranularity value equal to the nLength value, all data are considered as one chunk which is either written successfully as a whole or not at all. The nGranularity value of 0 or 1 disables the data-chunk approach.

FMSTR_PipeRead

Prototype

```
FMSTR_PIPE_SIZE FMSTR_PipeRead(FMSTR_HPIPE pipeHandle, FMSTR_ADDR pipeData,
        FMSTR_PIPE_SIZE pipeDataLen, FMSTR_PIPE_SIZE readGranularity);
```

- Declaration: *freemaster.h*
- Implementation: *freemaster_pipes.c*

Arguments

- *pipeHandle* [in] - pipe handle returned from the FMSTR_PipeOpen function call
- *pipeData* [in] - address of the data buffer to be filled with the received data
- *pipeDataLen* [in] - length of the data to be read
- *readGranularity* [in] - size of the minimum unit of data which is to be read

Description This function copies the data received from the pipe from its receive buffer to the user buffer for further processing. The function returns the number of bytes that were successfully copied to the buffer. This number may be smaller than the number of the requested bytes if there is not enough data bytes available in the receive buffer.

The readGranularity argument can be used to copy the data in larger chunks in the same way as described in the FMSTR_PipeWrite function.

API data types This section describes the data types used in the FreeMASTER driver. The information provided here can be useful when modifying or porting the FreeMASTER Communication Driver to new NXP platforms.

Note: The licensing conditions prohibit use of FreeMASTER and the FreeMASTER Communication Driver with non-NXP MPU or MCU products.

Public common types The table below describes the public data types used in the FreeMASTER driver API calls. The data types are declared in the *freemaster.h* header file.

Type name	Description
FM-STR_ADDR	Data type used to hold the memory address. On most platforms, this is normally a C-pointer, but it may also be a pure integer type.
For example, this type is defined as long integer on the 56F8xxx platform where the 24-bit addresses must be supported, but the C-pointer may be only 16 bits wide in some compiler configurations.	
FM-STR_SIZE	Data type used to hold the memory block size.
It is required that this type is unsigned and at least 16 bits wide integer.	
FM-STR_BOOL	Data type used as a general boolean type.
This type is used only in zero/non-zero conditions in the driver code.	
FM-STR_APPCM…	Data type used to hold the Application Command code.
Generally, this is an unsigned 8-bit value.	
FM-STR_APPCM…	Data type used to create the Application Command data buffer.
Generally, this is an unsigned 8-bit value.	
FM-STR_APPCM…	Data type used to hold the Application Command result code.
Generally, this is an unsigned 8-bit value.	

Public TSA types The table describes the TSA-specific public data types. These types are declared in the *freemaster_tsa.h* header file, which is included in the user application indirectly by the *freemaster.h* file.

FMSTR_TSA_TII	Data type used to hold a descriptor index in the TSA table or a table index in the list of TSA tables.
By default, this is defined as FMSTR_SIZE.	
FMSTR_TSA_TS	Data type used to hold a memory block size, as used in the TSA descriptors.
By default, this is defined as FMSTR_SIZE.	

Public Pipes types The table describes the data types used by the FreeMASTER Pipes API:

FMSTR_HPIPE	Pipe handle that identifies the open-pipe object.
Generally, this is a pointer to a void type.	
FMSTR_PIPE_P(	Integer type required to hold at least 7 bits of data.
Generally, this is an unsigned 8-bit or 16-bit type.	
FMSTR_PIPE_SI	Integer type required to hold at least 16 bits of data.
This is used to store the data buffer sizes.	
FMSTR_PPIPEF	Pointer to the pipe handler function.
See *FMSTR_PipeOpen* for more details.	

Internal types The table describes the data types used internally by the FreeMASTER driver. The data types are declared in the platform-specific header file and they are not available in the application code.

FMSTR_U8	The smallest memory entity.
On the vast majority of platforms, this is an unsigned 8-bit integer.	
On the 56F8xx DSP platform, this is defined as an unsigned 16-bit integer.	
FMSTR_U16	Unsigned 16-bit integer.
FMSTR_U32	Unsigned 32-bit integer.
FMSTR_S8	Signed 8-bit integer.
FMSTR_S16	Signed 16-bit integer.
FMSTR_S32	Signed 32-bit integer.
FMSTR_FLOAT	4-byte standard IEEE floating-point type.
FMSTR_FLAGS	Data type forming a union with a structure of flag bit-fields.
FMSTR_SIZE8	Data type holding a general size value, at least 8 bits wide.
FMSTR_INDEX	General for-loop index. Must be signed, at least 16 bits wide.
FMSTR_BCHR	A single character in the communication buffer.
Typically, this is an 8-bit unsigned integer, except for the DSP platforms where it is a 16-bit integer.	
FMSTR_BPTR	A pointer to the communication buffer (an array of FMSTR_BCHR).

Document references

Links

- This document online: https://mcuxpresso.nxp.com/mcuxsdk/latest/html/middleware/freemaster/doc/index.html

- FreeMASTER tool home: www.nxp.com/freemaster
- FreeMASTER community area: community.nxp.com/community/freemaster
- FreeMASTER GitHub code repo: https://github.com/nxp-mcuxpresso/mcux-freemaster
- MCUXpresso SDK home: www.nxp.com/mcuxpresso
- MCUXpresso SDK builder: mcuxpresso.nxp.com/en

Documents

- *FreeMASTER Usage Serial Driver Implementation* (document AN4752)
- *Integrating FreeMASTER Time Debugging Tool With CodeWarrior For Microcontrollers v10.X Project* (document AN4771)
- *Flash Driver Library For MC56F847xx And MC56F827xx DSC Family* (document AN4860)

Revision history This Table summarizes the changes done to this document since the initial release.

Revision	Date	Description
1.0	03/2006	Limited initial release
2.0	09/2007	Updated for FreeMASTER version. New Freescale document template used.
2.1	12/2007	Added description of the new Fast Recorder feature and its API.
2.2	04/2010	Added support for MPC56xx platform, Added new API for use CAN interface.
2.3	04/2011	Added support for Kxx Kinetis platform and MQX operating system.
2.4	06/2011	Serial driver update, adds support for USB CDC interface.
2.5	08/2011	Added Packet Driven BDM interface.
2.7	12/2013	Added FLEXCAN32 interface, byte access and isr callback configuration option.
2.8	06/2014	Removed obsolete license text, see the software package content for up-to-date license.
2.9	03/2015	Update for driver version 1.8.2 and 1.9: FreeMASTER Pipes, TSA Active Content, LIN Transport Layer support, DEBUG-TX communication troubleshooting, Kinetis SDK support.
3.0	08/2016	Update for driver version 2.0: Added support for MPC56xx, MPC57xx, KEAxx and S32Kxx platforms. New NXP document template as well as new license agreement used. added MCAN interface. Folders structure at the installation destination was rearranged.
4.0	04/2019	Update for driver released as part of FreeMASTER v3.0 and MCUXpresso SDK 2.6. Updated to match new V4 serial communication protocol and new configuration options. This version of the document removes substantial portion of outdated information related to S08, S12, ColdFire, Power and other legacy platforms.
4.1	04/2020	Minor update for FreeMASTER driver included in MCUXpresso SDK 2.8.
4.2	09/2020	Added example applications description and information about the MCUXpresso Config Tools. Fixed the pipe-related API description.
4.3	10/2024	Added description of Network and Segger J-Link RTT interface configuration. Accompanying the MCUXpresso SDK version 24.12.00.
4.4	04/2025	Added Zephyr-specific information. Accompanying the MCUXpresso SDK version 25.06.00.

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 ChangeLog

FreeRTOS kernel Readme

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

4.1.4 corehttp

C language HTTP client library designed for embedded platforms.

4.1.5 corejson

JSON parser.

Readme

4.1.6 coremqtt

MQTT publish/subscribe messaging library.

4.1.7 corepkcs11

PKCS #11 key management library.

Readme

4.1.8 freertos-plus-tcp

Open source RTOS FreeRTOS Plus TCP.

Readme