User Manual

16

Flash Self-programming Library

FSL – T01

16 Bit Single-chip Microcontroller
RL78 Series

Renesas Electronics
www.renesas.com

R01US0016ED0101
May 27, 2011

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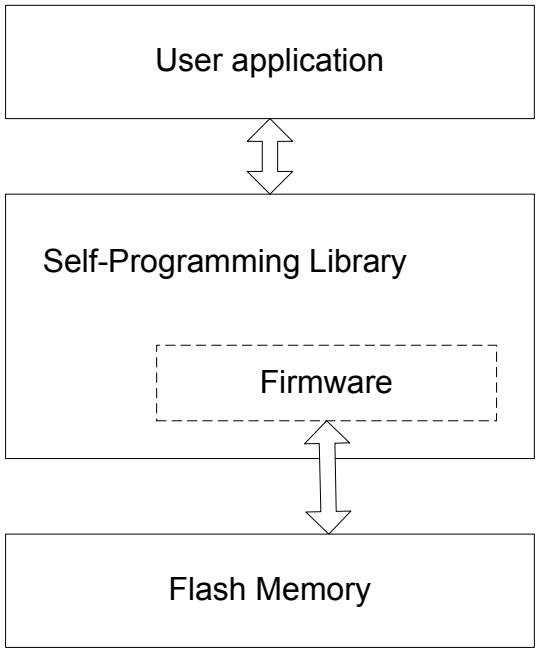
Chapter 1 Introduction

The RL78 products are equipped with an internal firmware, which allows rewriting of the flash memory without the use of an external programmer. In addition to this Renesas provides the so called Self-programming library. This library offers an easy-to-use interface to the internal firmware functionality. By calling the Self-programming library functions from user program, the contents of the flash memory can easily be rewritten in the field.

Figure 1-1 Flash Access



CAUTION

- The Self-programming library rewrites the contents of the flash memory by using the CPU, its registers and the internal RAM. Thus the user program cannot be executed while the Self-programming library is in process.
- Use of some RAM areas are prohibited when using the Self-programming. For detailed information please refer to the device Users Manual.

1.1 Naming convention

Certain terms, required for the description of the Flash Self-programming are long and too complicated for good readability of the document. Therefore, special names and abbreviations will be used in the course of this document to improve the readability.

Table 1-1 Used abbreviations and acronyms

Abbreviations / Acronyms	Description
Block	Smallest erasable unit
Code Flash	Embedded Flash where the application code is stored. For devices without Data Flash EEPROM emulation might be implemented on that flash in the so called data area.
Data Flash	Embedded Flash where mainly the data of the EEPROM emulation are stored. Beside that also code operation might be possible.
FSL	Flash Self-programming Library
Flash	“Flash EPROM” - Electrically erasable and programmable nonvolatile memory. The difference to ROM is, that this type of memory can be re-programmed several times.
RAM	“Random access memory” - volatile memory with random access
ROM	“Read only memory” - nonvolatile memory. The content of that memory can not be changed.
SCI	Status check internal mode
SCU	Status check user mode

Chapter 2 Programming Environment

This chapter describes the software environment which is used to rewrite flash memory by using the Self-programming library. For the hardware environment please refer to the device user manual.

2.1 Software Environment

The Self-programming library allocates its code inside the user area and consumes up to about 1300 bytes of the program memory. The self-programming library itself uses work area in form of entry RAM, application stack and so called data buffer for data exchange with the firmware. The following table lists the required software resources.

Table 2-1 Resource consumption

Item	Description
User RAM	Some RAM areas are prohibited. Please refer to the device users manual for detailed information.
Stack	56 bytes
Data buffer	5 - 256 bytes
Self-programming library	max. 1350 bytes **Note** Code size of the Self-programming library varies depending on their configuration.

CAUTION

- The Self-programming operation is not ensured if the user manipulates the above resources. Do not manipulate these resources during a Self-programming session.Use of some RAM areas are prohibited when using the Self-programming. For detailed information please refer to the device Users Manual.
- The user must release the above resources before calling the Self-programming library.

Table 2-2 Code size of the library depends on the user configuration

	Code size
Max. code size	1350 bytes
Max. code size (without GetInfo, SetInfo, FSL_ForceReset, FSL_PrepareExtFunctions, FSL_StandBy, FSL_WakeUp, FSL_CopySection and FSL_SwapBootCluster)	580 bytes
Max. code size (without GetInfo, SetInfo and FSL_SwapBootCluster) --> FSL_InvertBootFlag, FSL_ForceReset and FSL_GetBootFlag included	870 bytes

2.1.1 Data buffer

The data buffer is used for data-exchange between the firmware and the Self-programming library.

2.1.2 Location of segments

The following tables show the segment location for both execution modes.

Segments in status check internal mode (SCI)

Segment name	Segment location	Description
FSL_FCD	ROM	Segment will be used for the following functions: FSL_Init, FSL_Close, FSL_Open, FSL_PrepareFunctions, FSL_PrepareExtFunctions, FSL_ChangeInterruptTable, FSL_RestoreInterruptTable, FSL_GetVersionString
FSL_FECD	ROM	Segment will be used for the following functions: FSL_GetBlockEndAddr, FSL_GetFlashShieldWindow, FSL_GetSwapState, FSL_GetBootFlag and FSL_GetSecurityFlags
FSL_BCD	ROM	Must only be placed via linker file in case FSL_Erase, FSL_Write, FSL_IVerify or FSL_BlankCheck functions are used
FSL_BECD	ROM	Must only be placed via linker file in case FSL_SetXXX and FSL_InvertBootFlag functions are used
FSL_RCD	ROM/RAM	**Segment will be used for the following functions in case of execution from ROM:** FSL_ForceReset, FSL_SetXXXXFlag, FSL_StatusCheck, FSL_BlankCheck, FSL_Erase, FSL_IVerify, FSL_Write, FSL_SwapBootCluster, FSL_StandBy, FSL_WakeUp, FSL_SwapActiveBootCluster --- **The content of the FSL_RCD_ROM segment will be copied into this RAM segment via the FSL_CopySection(*1) function in case of execution from RAM.**
FSL_RCD_ROM (*1)	ROM	This segment is just a placeholder in ROM for the following functions. FSL_ForceReset, FSL_SetXXXXFlag, FSL_StatusCheck, FSL_BlankCheck, FSL_Erase, FSL_IVerify, FSL_Write, FSL_SwapBootCluster, FSL_StandBy, FSL_WakeUp, FSL_SwapActiveBootCluster This functions will be executed in the FSL_RCD segment in RAM after calling the FSL_CopySection(*1) function.

(*1) IAR Compiler only and only in case of FSL execution from RAM

Segments in status check user mode (SCU)

Segment name	Segment location	Description
FSL_FCD	ROM	Segment will be used for the following functions: FSL_Init, FSL_Close, FSL_Open, FSL_PrepareFunctions, FSL_PrepareExtFunctions, FSL_ChangeInterruptTable, FSL_RestoreInterruptTable, FSL_GetVersionString and FSL_CopySection
FSL_FECD	ROM	Segment will be used for the following functions: FSL_GetBlockEndAddr, FSL_GetFlashShieldWindow, FSL_GetSwapState, FSL_GetBootFlag and FSL_GetSecurityFlags
FSL_BCD	ROM	Must only be placed via linker file in case FSL_Erase, FSL_Write, FSL_IVerify or FSL_BlankCheck functions are used
FSL_BECD	ROM	Must only be placed via linker file in case FSL_SetXXX and FSL_InvertBootFlag functions are used
FSL_RCD	RAM	The content of the FSL_RCD_ROM segment will be copied into this RAM segment via the FSL_CopySection(*1) function.
FSL_RCD_ROM (*1)	ROM	This segment is just a placeholder in ROM for the following functions. FSL_ForceReset, FSL_SetXXXXFlag, FSL_StatusCheck, FSL_BlankCheck, FSL_Erase, FSL_IVerify, FSL_Write, FSL_SwapBootCluster, FSL_StandBy, FSL_WakeUp, FSL_SwapActiveBootCluster This functions will be executed in the FSL_RCD segment in RAM after calling the FSL_CopySection(*1) function.

(*1) IAR Compiler only

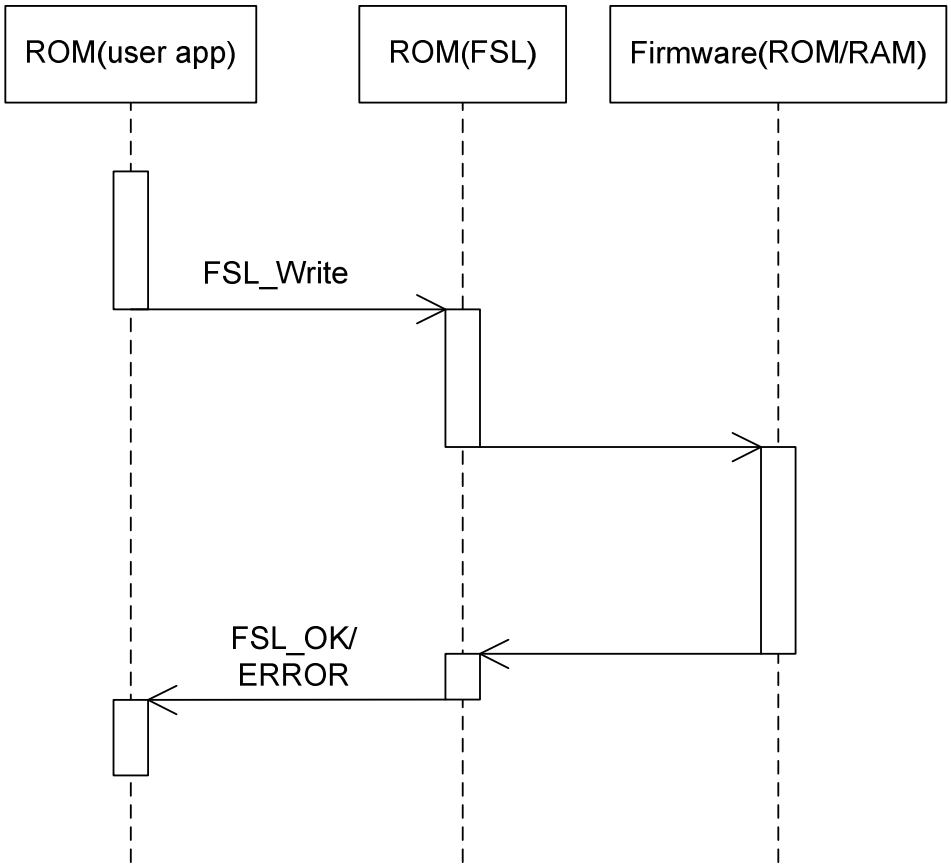
Chapter 3 Execution modes

Self-programming library can be executed in two different ways which will be described here.

3.1 Status check internal mode (from ROM or RAM)

This execution mode allows the user to execute FSL_XXX functions directly from ROM or RAM. The function returns only in case it is successfully finished or an error occurred. Means no status polling is required.

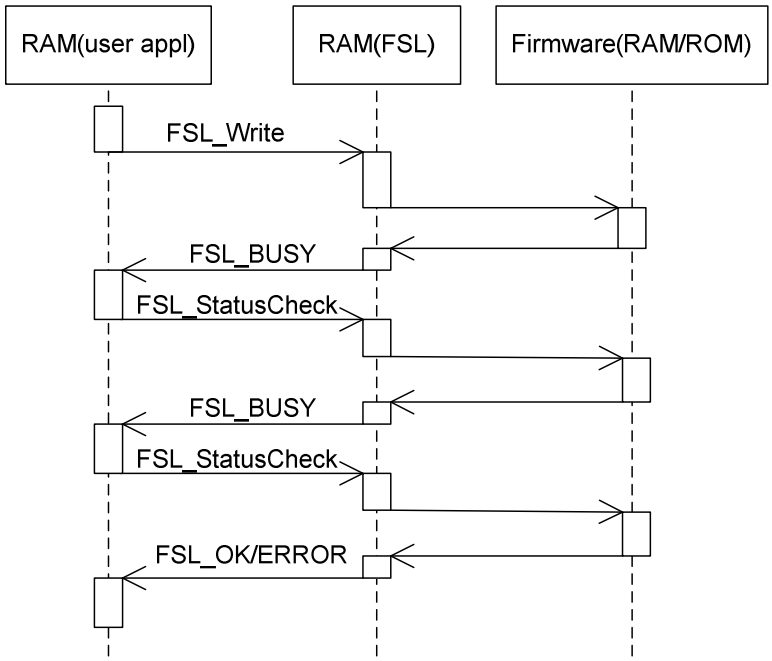
Figure 3-1 Status check internal mode sequence



3.2 Status check user mode (from RAM only)

This execution mode is designed for time critical systems. Means the called FSL_XXX functions return immediately after triggering/checking the hardware to the user for example to reset the watchdog. After that user has to call the FSL_StatusCheck command.

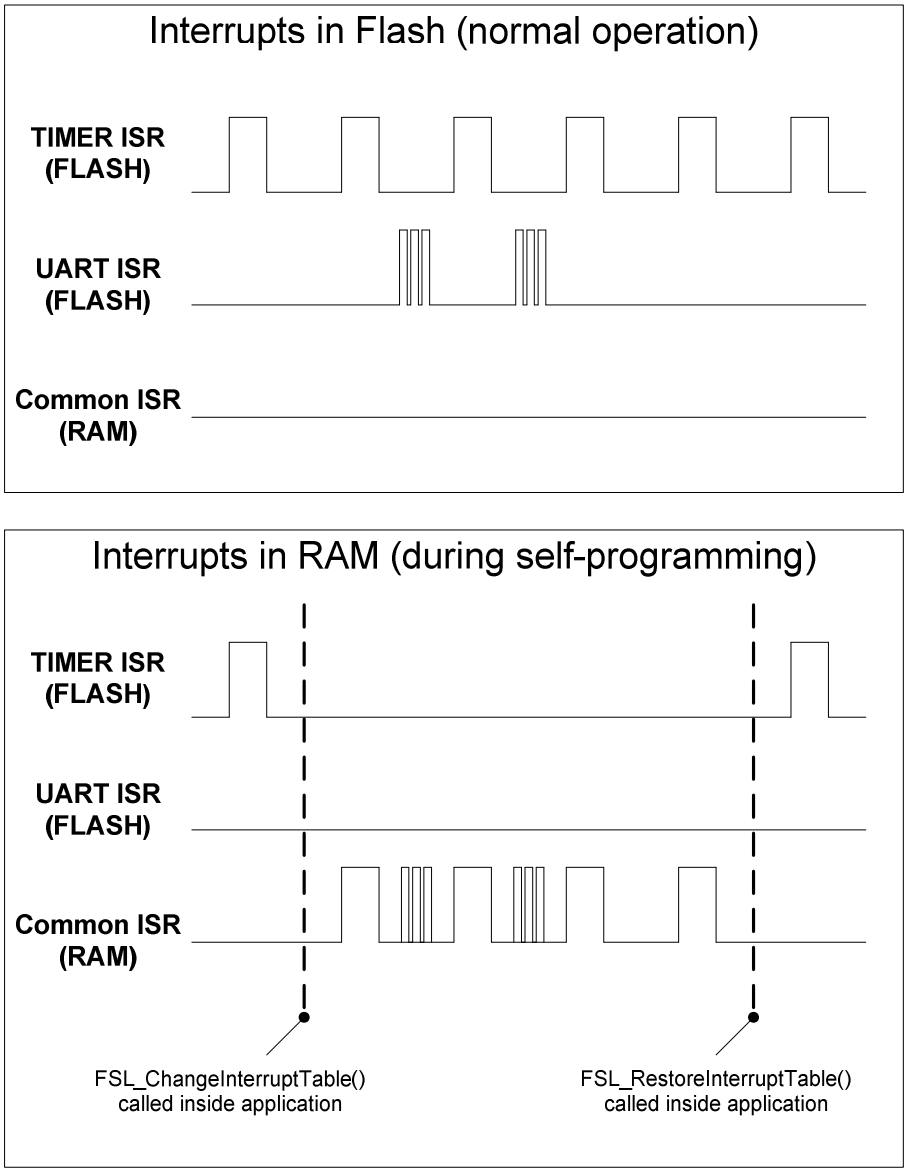
Figure 3-2 Status check user mode sequence



Chapter 4 Interrupt servicing

During execution of Self-programming functions the user cannot use the interrupt service routines located in flash. For that reason the library provides the functions FSL_ChangeInterruptTable and FSL_RestoreInterruptTable which allows the user to execute interrupts from RAM. Means one ISR is located in RAM and all occurred interrupts will be handled by this ISR inside of RAM. The following figure illustrates both scenarios where the interrupts are handled in ROM and in RAM.

Figure 4-1 Interrupts during normal operation and during Self-programming



As shown in the figure above (Interrupts in RAM) each interrupts will be handled in the RAM ISR. Means the user has to check in the RAM ISR which interrupt source generated the interrupt. This must be done by checking the Interrupt Request Flag Registers.

Note User has to take care that the request flag is cleared before leaving the ISR.

Chapter 5 Boot-swapping

During the re-programming of flash a permanent data loss may occur. This potential risk can be avoided by using the boot swap functionality.

Following events may cause the data loss

- temporary power failure
- externally generated reset

5.1 How to perform a boot-swap?

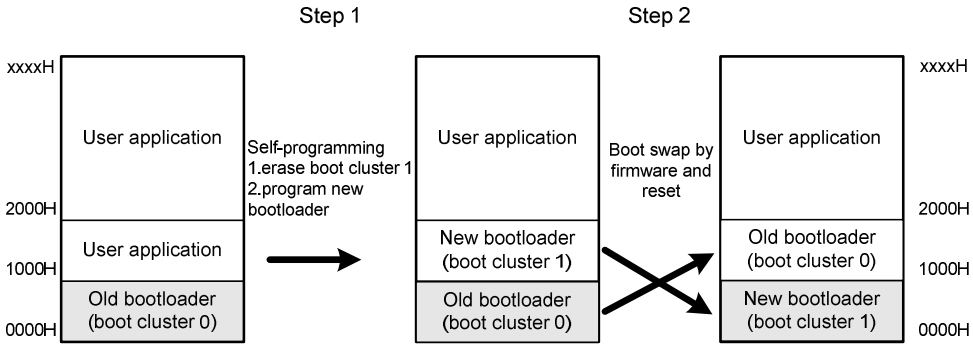
The FSL library provides a swap function (FSL_InvertBootFlag) which makes it possible to swap the boot cluster.

Before swapping, user program should write the new boot program into boot cluster 1. And then swap the two boot clusters and force a reset. The device will then be restarting from boot cluster 1.

As a result, even if a power failure occurs while the boot program area is being rewritten, the program runs correctly because after reset the circuit starts from boot cluster 1. After that, boot cluster 0 can be erased or written as required.

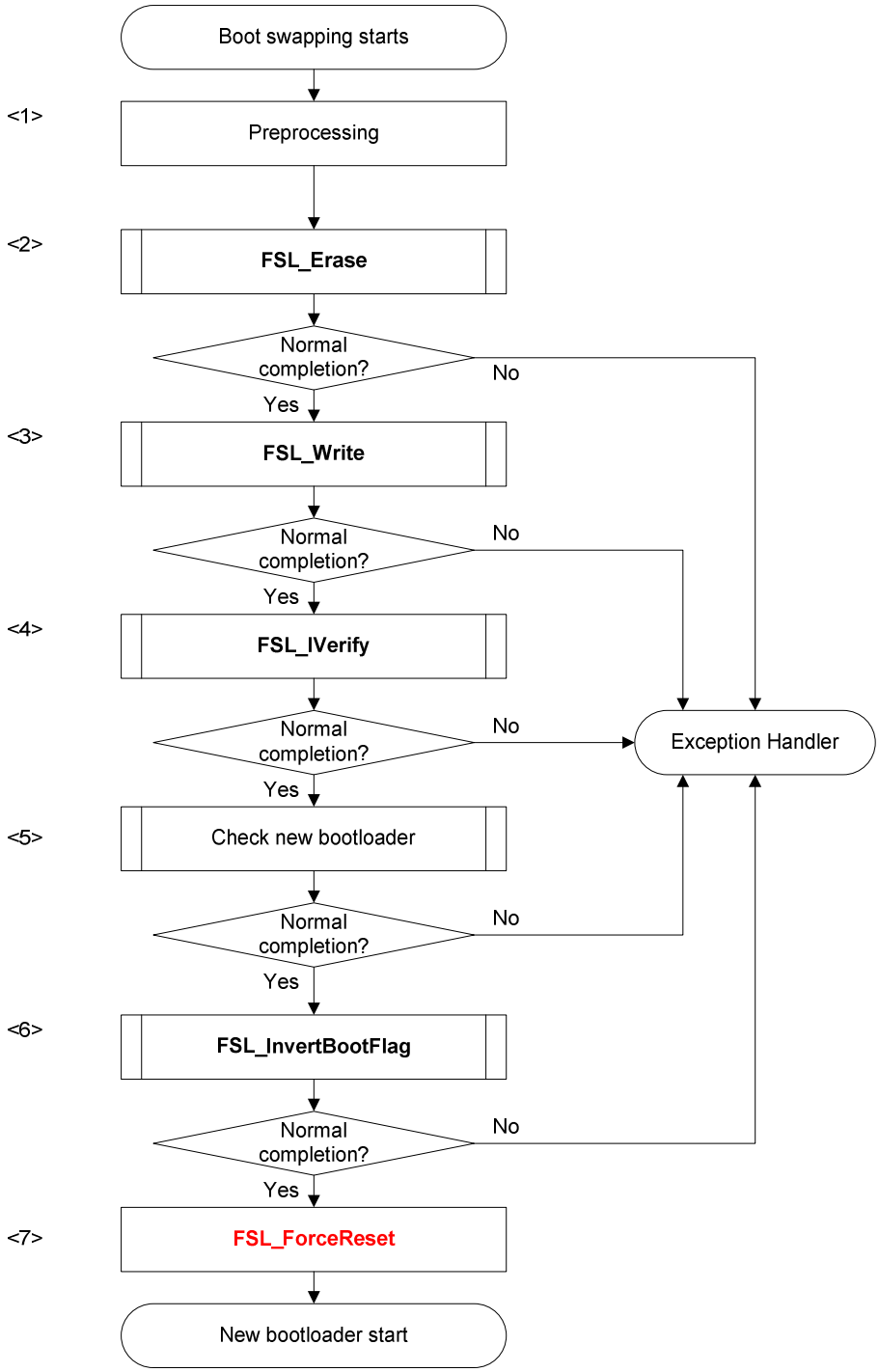
Note Boot cluster 0 (0000H to 0FFFH): Original boot program area
Boot cluster 1 (1000H to 1FFFH): Boot swap target area

Figure 5-1 Overview of swap procedure



Caution
• To rewrite the flash memory by using a programmer (such as the PG FP5) after boot swapping, please refer to the PG-FP5 users manual.
• After successful execution of the FSL_InvertBootFlag function it is not allowed to execute any FSL_Setxxx function till hardware reset occurred.

Figure 5-2 Flow of boot swapping



Caution FSL_ForceReset function generates a software reset (please refer to the device Users Manual for detailed information).

<1> Preprocessing

The following preprocess of boot swapping is performed.

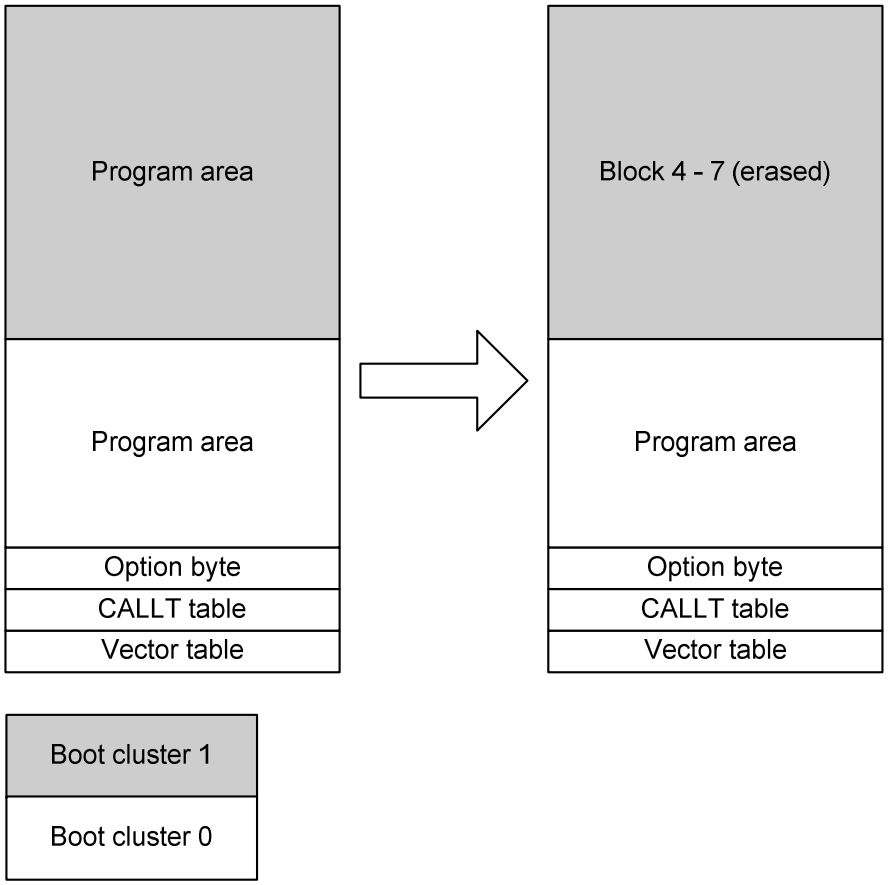
- Set up software environment
- Set up hardware environment
- Initialize entry RAM

<2> Erasing blocks 4 to 7

Call the erase function FSL_Erase to erase blocks 4 to 7.

Note The erase function erases only a block at a time. Call it once for each block.

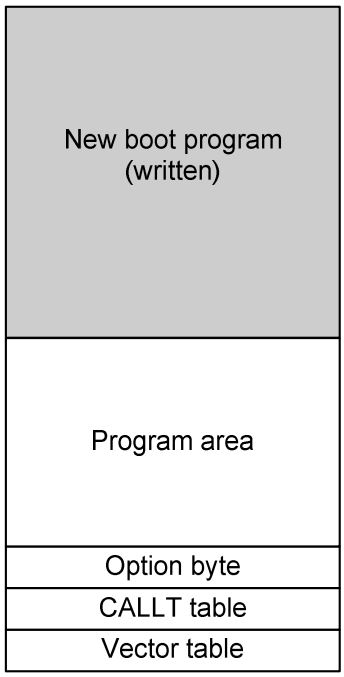
Figure 5-3 Erasing boot cluster 1



<3> Writing new program to boot cluster 1

Use the FSL_Write function to write the new bootloader.

Figure 5-4 Writing new program to boot cluster 1



<4> Verifying Blocks 4 to 7

Call the verify function FSL_IVerify to verify Blocks 4 to 7.

Note The internal verify function verifies only a block at a time. Call it once for each block.

<5> Checks the new bootloader

e.g. CRC check on the new bootloader.

<6> Setting of boot swap bit

Call the function FSL_InvertBootFlag. The inactive boot cluster with new bootloader becomes active after hardware reset.

<7> Force of reset

Call the FSL_ForceReset function. New bootloader is active after reset.

Chapter 6 User Interface (API)

6.1 Data types

This chapter describes all data definitions used and offered by the FSL.

6.1.1 Library specific simple type definitions

```
typedef unsigned char                   fsl_u08;
typedef unsigned int                    fsl_u16;
typedef unsigned long int               fsl_u32;
```

6.1.2 Structured type “fsl_descriptor_t”

This type defines structure of the FSL descriptor used for FSL_Init function.

Structure member name	Description
fsl_flash_voltage_u08	Setting for voltage mode: 0 = Full speed mode other = Wide voltage mode
fsl_frequency_u08	***Configured frequency (frequency >= 4MHz)*** Frequency must be rounded up as shown below: descr.fsl_frequency_u08 = 20 for 20000000Hz descr.fsl_frequency_u08 = 24 for 23100000Hz ***Configured frequency (frequency < 4MHz)*** In case the frequency is smaller than 4MHz the only supported physically frequencies are following: descr.fsl_frequency_u08 = 1 for 1000000Hz descr.fsl_frequency_u08 = 2 for 2000000Hz descr.fsl_frequency_u08 = 3 for 3000000Hz
fsl_auto_status_check_u08	Setting for execution mode: 0 = Status check user mode other = Status check internal mode

6.1.3 Structured type “fsl_write_t”

This type defines structure used for FSL_Write function.

Structure member name	Description
fsl_data_buffer_p_u08	Pointer to the data buffer where the data to be written is located.
fsl_destination_address_u32	Destination address: e.g. write.fsl_destination_address_u32 = 0x1000
fsl_word_count_u08	Number of words to be written (1 word = 4 bytes)

6.1.4 Structured type “fsl_getblockendaddr_t”

This type defines structure used for FSL_GetBlockEndAddr function.

Structure member name	Description
fsl_destination_address_u32	Destination address of the block end address info
fsl_block_u16	Block number the end-address is asked for

6.1.5 Structured type “fsl_fsw_t”

This type defines structure of the FSL descriptor used for FSL_SetFlashShieldWindow function.

Structure member name	Description
fsl_start_block_u16	Start block for the flash shield window
fsl_end_block_u16	End block for the flash shield window

6.2 Functions

This chapter describes all functions provided by the library.

6.2.1 Assembler interface

Following tables describes the parameter passing for the Renesas and IAR environment.

Table 6-1 Assembler interface for Renesas environment

Function	Register used for parameter passing	Register used as return value	Destroyed register after call
FSL_Init	AX(0-15)-C(16-23)	C	n/a
FSL_PrepareFunctions	n/a	n/a	n/a
FSL_PrepareExtFunctions	n/a	n/a	n/a
FSL_ChangeInterruptTable	AX(0-15)	n/a	n/a
FSL_RestoreInterruptTable	n/a	n/a	n/a
FSL_Open	n/a	n/a	n/a
FSL_Close	n/a	n/a	n/a
FSL_BlankCheck	AX(0-15)	C	n/a
FSL_Erase	AX(0-15)	C	n/a
FSL_IVerify	AX(0-15)	C	n/a
FSL_Write	AX(0-15)	C	n/a
FSL_GetSecurityFlags	AX(0-15)	C	n/a
FSL_GetBootFlag	AX(0-15)	C	n/a
FSL_GetSwapState	AX(0-15)	C	n/a
FSL_GetBlockEndAddr	AX(0-15)	C	n/a
FSL_GetFlashShieldWindow	AX(0-15)	C	n/a
FSL_SetBlockEraseProtectFlag	n/a	C	n/a
FSL_SetWriteProtectFlag	n/a	C	n/a
FSL_SetBootClusterProtectFlag	n/a	C	n/a
FSL_InvertBootFlag	n/a	C	n/a
FSL_SetFlashShieldWindow	AX(0-15)	C	n/a
FSL_SwapBootCluster	n/a	C	AX, C, ES, CS
FSL_SwapActiveBootCluster	n/a	C	n/a
FSL_ForceReset	n/a	n/a	n/a
FSL_StatusCheck	n/a	C	n/a
FSL_StandBy	n/a	C	n/a
FSL_WakeUp	n/a	C	n/a
FSL_GetVersionString	n/a	BC(0-15), DE(16-31)	n/a

Table 6-2 Assembler interface for IAR environment

Function	Register used for parameter passing	Register used as return value	Destroyed register after call
FSL_Init	Stack	A	n/a
FSL_PrepareFunctions	n/a	n/a	n/a
FSL_PrepareExtFunctions	n/a	n/a	n/a
FSL_ChangeInterruptTable	AX(0-15)	n/a	n/a
FSL_RestoreInterruptTable	n/a	n/a	n/a
FSL_Open	n/a	n/a	n/a
FSL_Close	n/a	n/a	n/a
FSL_BlankCheck	AX(0-15)	A	n/a
FSL_Erase	AX(0-15)	A	n/a
FSL_IVerify	AX(0-15)	A	n/a
FSL_Write	AX(0-15)	A	n/a
FSL_GetSecurityFlags	AX(0-15)	A	n/a
FSL_GetBootFlag	AX(0-15)	A	n/a
FSL_GetSwapState	AX(0-15)	A	n/a
FSL_GetBlockEndAddr	AX(0-15)	A	n/a
FSL_GetFlashShieldWindow	AX(0-15)	A	n/a
FSL_SetBlockEraseProtectFlag	n/a	A	n/a
FSL_SetWriteProtectFlag	n/a	A	n/a
FSL_SetBootClusterProtectFlag	n/a	A	n/a
FSL_InvertBootFlag	n/a	A	n/a
FSL_SetFlashShieldWindow	AX(0-15)	A	n/a
FSL_SwapBootCluster	n/a	A	AX, ES, CS
FSL_ForceReset	n/a	n/a	n/a
FSL_StatusCheck	n/a	A	n/a
FSL_StandBy	n/a	A	n/a
FSL_WakeUp	n/a	A	n/a
FSL_GetVersionString	n/a	HL(0-15), A(16-31)	n/a
FSL_CopySection	n/a	n/a	n/a

6.2.2 FSL_CopySection (IAR Compiler only)

This function copies all content of the segment FSL_RCD_ROM into the RAM segment FSL_RCD. This is necessary for Self-programming execution in status check user mode. Please refer to the chapter “Execution modes” and “Operation” for detailed explanation.

Caution: FSL_RCD segment size must be at least 10 bytes larger than the size of FSL_RCD_ROM segment when using FSL_CopySection.

C Language Interface (Renesas version)

Not supported

C Language Interface (IAR version)

```
__far_func void FSL_CopySection(void);
```

Pre-condition

None

Post-condition

Data are copied from ROM to RAM.

Argument

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
None		

Code example:

```
FSL_CopySection();
```

6.2.3 FSL_Init

This function initializes internal Self-programming environment. After initialization the start address of the data-buffer is registered for Self-programming.

C Language Interface (Renesas version)

```
fsl_u08  FSL_Init(__far fsl_descriptor_t* descriptor_pstr)
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_Init(const __far fsl_descriptor_t __far*
descriptor_pstr);
```

Pre-condition

Descriptor must be filled with valid values.
Internal high-speed oscillator is running.

Post-condition

FSL is initialized.

Argument

Argument	Type	Description
descriptor_pstr	fsl_descriptor_t* (far pointer)	This argument must be a pointer to the descriptor.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	FSL initialized
0x05 (FSL_ERR_PARAMETER)	fsl_u08	wrong parameter passed via descriptor or internal high-speed oscillator isn't started.

Code example:

```
fsl_u08             my_fsl_status;
fsl_descriptor_t    fsl_descr;

fsl_descr.fsl_flash_voltage_u08 = 0x00;
fsl_descr.fsl_frequency_u08 = 0x14;
fsl_descr.fsl_auto_status_check_u08 = 0x01;

my_fsl_status = FSL_Init((__far fsl_descriptor_t*)&fsl_descr);
if(my_fsl_status != FSL_OK) MyErrorHandler();
```

6.2.4 FSL_Open

This function opens the Self-programming session.

C Language Interface (Renesas version)

```
void  FSL_Open(void)
```

C Language Interface (IAR version)

```
__far_func void  FSL_Open(void)
```

Pre-condition

Library must be initialized via FSL_Init

Post-condition

None

Argument

Argument	Type	Description
none		

Return types/values

Argument	Type	Description
None		

Code example:

```
FSL_Open();
```

6.2.5 FSL_Close

This function closes the Self-programming session.

C Language Interface (Renesas version)

```
void  FSL_Close(void)
```

C Language Interface (IAR version)

```
__far_func void  FSL_Close(void)
```

Pre-condition

None

Post-condition

Self-programming cannot be performed.

Argument

Argument	Type	Description
none		

Return types/values

Argument	Type	Description
None		

Code example:

```
FSL_Close();
```

6.2.6 FSL_PrepareFunctions

This function activates a set (FSL_BlankCheck, FSL_Erase, FSL_Write, FSL_IVerify, FSL_StatusCheck, FSL_StandBy, FSL_WakeUp) of FSL functions which can be accessed by the user afterwards.

C Language Interface (Renesas version)

```
void  FSL_PrepareFunctions(void)
```

C Language Interface (IAR version)

```
__far_func void  FSL_PrepareFunctions(void)
```

Pre-condition

Library must be initialized via FSL_Init

Post-condition

Following functions can be used by user:
- FSL_BlankCheck
- FSL_Erase,
- FSL_Write,
- FSL_IVerify,
- FSL_StatusCheck,
- FSL_StandBy,
- FSL_WakeUp

Argument

Argument	Type	Description
none		

Return types/values

Argument	Type	Description
None		

Code example:

```
FSL_PrepareFunctions();
```

6.2.7 FSL_PrepareExtFunctions

This function activates a set of functions (FSL_SetXXXProtectFlag, FSL_InvertBootFlag, FSL_SetFlashShieldWinow, FSL_SwapBootCluster, FSL_SwapActiveBootCluster).

C Language Interface (Renesas version)

```
void  FSL_PrepareExtFunctions(void)
```

C Language Interface (IAR version)

```
__far_func void  FSL_PrepareExtFunctions(void)
```

Pre-condition

Library must be initialized via FSL_Init

Post-condition

Following functions can be used by user:
- FSL_SetXXXProtectFlag
- FSL_InvertBootFlag,
- FSL_SetFlashShieldWindow,
- FSL_SwapBootCluster,
- FSL_SwapActiveBootCluster (RENESAS Compiler only)

Argument

Argument	Type	Description
none		

Return types/values

Argument	Type	Description
None		

Code example:

```
FSL_PrepareExtFunctions();
```

6.2.8 FSL_ChangeInterruptTable

This function deactivates all interrupt vectors and configures only one common ISR located in RAM for all interrupts. Means each interrupt will be handled by only one ISR.

C Language Interface (Renesas version)

```
void FSL_ChangeInterruptTable(fsl_u16
 fsl_interrupt_destination_u16)
```

C Language Interface (IAR version)

```
__far_func void  FSL_ChangeInterruptTable(fsl_u16
fsl_interrupt_destination_u16)
```

Pre-condition

Library must be initialized via FSL_Init.
Common interrupt service routine must be copied into the RAM.

Post-condition

All Interrupts will be handled inside one ISR located in RAM.

Argument

Argument	Type	Description
fsl_interrupt_destination_u16	fsl_u16	The address of the common ISR located in RAM. **Note: The high address of the interrupt vector is fixed to 0x000F means the ISR is located in RAM.**

Return types/values

Argument	Type	Description
None		

Code example:

```
__interrupt void isr_RAM(void)
{
  ........
  if(TMIF01 == 1){
    ...
    TMIF01=0;
  }
  ........
}

void main(void)
{
  .....
  FSL_ChangeInterruptTable((fsl_u16)&isr_RAM);
  .....
  FSL_XXX(....);
  .....
  FSL_RestoreInterruptTable();
}
```

6.2.9 FSL_RestoreInterruptTable

This function restores the original interrupt vector table located in flash. Means each interrupt will be handled by its own ISR.

C Language Interface (Renesas version)

```
void FSL_RestoreInterruptTable(void)
```

C Language Interface (IAR version)

```
__far_func void  FSL_RestoreInterruptTable(void)
```

Pre-condition

Library must be initialized via FSL_Init.
Interrupt handling is changed by FSL_ChangeInterruptTable.

Post-condition

All Interrupts will be handled inside by its own ISR located in flash.

Argument

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
None		

Code example:

```
FSL_RestoreInterruptTable();
```

6.2.10 FSL_StatusCheck

This function is used by the application to proceed the execution of a command running in the background.

C Language Interface (Renesas version)

```
fsl_u08  FSL_StatusCheck(void)
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_StatusCheck(void)
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions and/or FSL_PrepareExtFunctions

Post-condition

Current status of the running command is returned to the caller.

Argument

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
0x00 (FSL_OK) (*1)	fsl_u08	Normal completion
0x1A (FSL_ERR_ERASE) (*1)		Erase error Block couldn't be erased.
0x1B (FSL_ERR_BLANKCHECK) (*1)		Blank check error Specified block is not blank
0x1B (FSL_ERR_IVERIFY) (*1)		Verify error Data inside the flash memory is not at a sufficient voltage level
0x1C (FSL_ERR_WRITE) (*1)		Write error Data couldn't be written to the specified address
0x1F (FSL_ERR_FLOW)		Possible errors: - Violates the precondition - FSL is suspending (*1)
0x30 (FSL_IDLE) (*1)		Driver is idle. No command is running.
0xFF (FSL_BUSY) (*1)		Command is running

(*1) For status check user mode only

Code example:

```
/* example for status check user mode */
fsl_u08             my_fsl_status;

my_fsl_status = FSL_Erase(0x0001);

while(my_fsl_status == FSL_BUSY)
{
  my_fsl_status = FSL_StatusCheck();
}

if(my_fsl_status != FSL_OK) MyErrorHandler();
```

6.2.11 FSL_StandBy

This function suspends a running flash command like FSL_Erase, FSL_Write etc.

Caution This function can be used in status check user mode only.

C Language Interface (Renesas version)

```
fsl_u08  FSL_StandBy(void);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_StandBy(void);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions and/or FSL_PrepareExtFunctions

Post-condition

All flash operations were stopped and the FSL is in StandBy mode.

Argument

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
0x00 (FSL_OK) (*1)	fsl_u08	Normal completion. FSL is suspended.
0x1A (FSL_ERR_ERASE) (*1)		Running erase is stopped with erase error. Block couldn't be erased. FSL is suspended.
0x1B (FSL_ERR_BLANKCHECK) (*1)		Running blank check is stopped with blank check error. Specified block is not blank (erase operation is not completed). FSL is suspended.
0x1B (FSL_ERR_IVERIFY) (*1)		Running verify is stopped with verify error. Data inside the flash memory is not at a sufficient voltage level. FSL is suspended.
0x1C (FSL_ERR_WRITE) (*1)		Running write is stopped with write error. Data couldn't be written to the specified address
0x1F (FSL_ERR_FLOW)		Possible errors: - Violates the precondition - FSL is already suspended (*1)
0x30 (FSL_IDLE) (*1)		Driver is idle. No command is running.
0x43 (FSL_SUSPEND) (*1)		Previous flash action is suspended.

(*1) For status check user mode only

Code example:

```
/* example for status check user mode */
fsl_u08             my_fsl_status;

my_fsl_status = FSL_Erase(0x0001);
.....
.....
my_fsl_status = FSL_StandBy();

if( (my_fsl_status == FSL_OK) || (my_fsl_status == FSL_SUSPEND))
{
  /* go into STOP mode if necessary*/
}
else
{
  MyErrorHandler();
}
```

6.2.12 FSL_WakeUp

This function resumes a previous suspended flash command(suspended by FSL_StandBy function).

Caution This function can be used in status check user mode only.

C Language Interface (Renesas version)

```
fsl_u08  FSL_WakeUp(void);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_WakeUp(void);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions

FSL must be suspended by FSL_StandBy function.

Post-condition

FSL is ready for use.

Argument

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
0x00 (FSL_OK) (*1)	fsl_u08	Normal completion. FSL is waked up and previous running command is successfully finished.
0x1A (FSL_ERR_ERASE) (*1)		FSL is waked up and previous running erase command is failed. Block couldn't be erased.
0x1F (FSL_ERR_FLOW)		Possible errors: - Violates the precondition - FSL is not suspended (*1)
0xFF (FSL_BUSY) (*1)		Previous flash action is resumed.

(*1) For status check user mode only

Code example:

```
/* example for status check user mode */
fsl_u08             my_fsl_status;

my_fsl_status = FSL_Erase(0x0001);
.....
.....
my_fsl_status = FSL_StandBy();
.....
.....
my_fsl_status = FSL_WakeUp();

if(my_fsl_status == FSL_BUSY)
{
  /* Continue calling FSL_StatusCheck for finishing the erase */
}
.....
```

6.2.13 FSL_BlankCheck

This function checks if a specified block is blank (erased).

C Language Interface (Renesas version)

```
fsl_u08  FSL_BlankCheck(fsl_u16 block_u16)
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_BlankCheck(fsl_u16 block_u16)
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions

Post-condition

In case of status check user mode:

- Blank check command is running

In case of status check internal mode:

- Blank check command is finished

Argument

Argument	Type	Description
block_u16	fsl_u16	Block number to be checked

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Specified block is blank (erased)
0x05 (FSL_ERR_PARAMETER)		Parameter error Specified block number is outside the allowed range
0x1B (FSL_ERR_BLANKCHECK)(*1)		Blank check error Specified block is not blank
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished(*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY) (*2)		- Command is running

(*1) For status check internal mode only

(*2) For status check user mode only

Code example:

```
/* example for status check internal mode */
fsl_u08             my_fsl_status;

my_fsl_status = FSL_BlankCheck(0x0001);
if(my_fsl_status != FSL_OK) MyErrorHandler();
```

6.2.14 FSL_IVerify

This function verifies (internal verification) a specified block.

Note - Because only one block is verified at a time, call this function once for each block.
- This internal verification is a function to check if the flash cell levels are such that the full data retention is ensured.
- It is different from a logical verification that just compares data.

C Language Interface (Renesas version)

```
fsl_u08  FSL_IVerify(fsl_u16 block_u16)
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_IVerify(fsl_u16 block_u16)
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions

Post-condition

In case of status check user:

- Internal verify command is running

In case of status check internal:

- Internal verify command is finished

Argument

Argument	Type	Description
block_u16	fsl_u16	Block number to be checked

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Specified block is blank (erased)
0x05 (FSL_ERR_PARAMETER)		Parameter error Specified block number is outside the allowed range
0x1B (FSL_ERR_IVERIFY) (*1)		Verify error Data inside the flash memory is not at a sufficient voltage level
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY)(*2)		- Command is running

(*1) For status check internal mode only

(*2) For status check user mode only

Code example:

```
/* example for status check internal mode */
fsl_u08             my_fsl_status;

my_fsl_status = FSL_IVerify(0x0001);
if(my_fsl_status != FSL_OK) MyErrorHandler();
```

6.2.15 FSL_Erase

This function erases a specified block.

Note Because only one block is erased at a time, call this function once for each block.

C Language Interface (Renesas version)

```
fsl_u08  FSL_Erase(fsl_u16 block_u16)
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_Erase(fsl_u16 block_u16)
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions

Post-condition

In case of status check user mode:

- Erase command is running

In case of status check internal mode:

- Erase command is finished

Argument

Argument	Type	Description
block_u16	fsl_u16	Block number to be checked

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Specified block is blank (erased)
0x10 (FSL_ERR_PROTECTION)		Specified block is included in the boot area and rewriting the boot area is disabled or block is outside the flash shield window.
0x05 (FSL_ERR_PARAMETER)		Parameter error Specified block number is outside the allowed range
0x1A (FSL_ERR_ERASE) (*1)		Erase error Block couldn't be erased.
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY)(*2)		- Command is running

(*1) For status check internal mode only
(*2) For status check user mode only

Code example:

```
/* example for status check internal mode */

fsl_u08             my_fsl_status;

my_fsl_status = FSL_Erase(0x0001);
if(my_fsl_status != FSL_OK) MyErrorHandler();
```

6.2.16 FSL_Write

This function writes the specified number of words (each word consists of 4 bytes) to a specified address.

Note - Set a RAM area as a data buffer, containing the data to be written and call this function.
- Data of up to 256 bytes (i.e. 64 words) can be written at one time.
- Call this function as many times as required to write data of more than 256 bytes.

Caution - After writing data, execute verification (internal verification) of the block including the range in which the data has been written. If verification is not executed, the written data is not guaranteed.
- It is not allowed to overwrite data in flash memory.
- Only blank flash cells can be used for the write.

C Language Interface (Renesas version)

```
fsl_u08  FSL_Write(__near fsl_write_t* write_pstr)
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_Write(__near fsl_write_t __near*
write_pstr)
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions

Data buffer must be filled with data to be written.

Post-condition

In case of status check user mode:

- Write command is running

In case of status check internal mode:

- Write command is finished

Argument (Renesas version)

Argument	Type	Description
write_pstr	__near fsl_write_t*	Pointer to the request structure containing necessary information for the write command.

Argument (IAR version)

Argument	Type	Description
write_pstr	__near fsl_write_t __near*	Pointer to the request structure containing necessary information for the write command.

Note - write_pstr.fsl_destination_address_u32 + (write_pstr.fsl_word_count_u08x4) must not straddle over the end address of a single block.

- write_pstr.fsl_destination_address_u32 must be a multiple of 4

- Most significant byte (MSB) of the write_pstr.fsl_destination_address_u32 has to be 0x00. In other words, only 0x00abcdef is a valid flash address.

- word_count*4 has to be less or equal than the size of data buffer. The firmware does not check this.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Specified block is blank (erased)
0x05 (FSL_ERR_PARAMETER)		Parameter error Specified address is outside the allowed range
0x10 (FSL_ERR_PROTECTION)		Protection error Specified address is inside of protected boot cluster or outside the flash shield window
0x1C (FSL_ERR_WRITE) (*1)		Write error Data couldn't be written to the specified address
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY)(*2)		- Command is running

(*1) For status check internal mode only

(*2) For status check user mode only

Code example (IAR version):

```
/* example for status check internal mode */

__near fsl_write_t   my_fsl_write_str;
fsl_u08              my_fsl_status;


my_fsl_write_str.fsl_data_buffer_p_u08 =
                  (__near fsl_u08 __near*)fsl_data_buffer_u08;
my_fsl_write_str.fsl_word_count_u08 = 0x01;
my_fsl_write_str.fsl_destination_address_u32 = 0x00001000;

my_fsl_status = FSL_Write((__near fsl_write_t __near*)
&my_fsl_write_str);
if(my_fsl_status != FSL_OK) MyErrorHandler();
```

Code example (Renesas version):

```
/* example for status check internal mode */

__near fsl_write_t   my_fsl_write_str;
fsl_u08              my_fsl_status;


my_fsl_write_str.fsl_data_buffer_p_u08 =
                  (__near fsl_u08 *)fsl_data_buffer_u08;
my_fsl_write_str.fsl_word_count_u08 = 0x01;
my_fsl_write_str.fsl_destination_address_u32 = 0x00001000;

my_fsl_status = FSL_Write((__near fsl_write_t*)
&my_fsl_write_str);
if(my_fsl_status != FSL_OK) MyErrorHandler();
```

6.2.17 FSL_GetSecurityFlags

This function reads the security (write-/erase-protection) information.

C Language Interface (Renesas version)

```
fsl_u08  FSL_GetSecurityFlags(fsl_u08 __near
*data_destination_pu08);
```

C Language Interface (IAR version)

```
___far_func fsl_u08  FSL_GetSecurityFlags(__near fsl_u08 __near*
data_destination_pu08)
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open

Post-condition

- None

Argument (Renesas version)

Argument	Type	Description
data_destination_pu08	__near fsl_u08 *	Pointer to the variable.

Argument (IAR version)

Argument	Type	Description
data_destination_pu08	__near fsl_u08 __near*	Pointer to the variable.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Security information is written to the variable
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*1) - Violates the precondition - FSL is suspending (*1)

(*1) For status check user mode only

Change in the destination address.

Security flag will be written in the destination address.

Meaning of each bit of security flag:

Bit 0: 1
Bit 1: Boot area overwrite protection (0: protected, 1: not protected)
Bit 2: Block erase protection (0: protected, 1: not protected)
Bit 3: 1
Bit 4: Write protection (0: protected, 1: not protected)
Bit 5: 1
Bit 6: 1
Bit 7: 1

Code example

```
/* get security informations                              */
my_status_u08 =
FSL_GetSecurityFlags( (fsl_u08*)&my_security_dest_u08);

if( my_status_u08 != 0x00 )
   my_error_handler();

if(my_security_dest_u08 & 0x0002)
{
  myPrintFkt("Boot area overwrite protection disabled!");
}
else{ myPrintFkt("Boot area overwrite protection enabled!");
```

6.2.18 FSL_GetBootFlag

This function reads the current value of the boot flag.

C Language Interface (Renesas version)

```
fsl_u08  FSL_GetBootFlag(fsl_u08 __near *data_destination_pu08);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_GetBootFlag(__near fsl_u08 __near*
data_destination_pu08);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open

Post-condition

- None

Argument (Renesas version)

Argument	Type	Description
data_destination_pu08	__near fsl_u08 *	Pointer to the valiable.

Argument (IAR version)

Argument	Type	Description
data_destination_pu08	__near fsl_u08 __near*	Pointer to the variable.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Security information is located in the passed variable
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*1) - Violates the precondition - FSL is suspending (*1)

(*1) For status check user mode only

Change in the destination address.
Boot flag will be written in the destination address.

00H: Boot area will be not swapped after reset
01H: Boot area will be swapped after reset

Code example

```
/* get boot-swap flag                                    */
my_status_u08= FSL_GetBootFlag((fsl_u08*)&my_bootflag_dest_u08);

if( my_status_u08 != 0x00 )
   my_error_handler();

if(my_bootflag_dest_u08){ myPrintFkt("Boot area is swapped!"); }
else{ myPrintFkt("Boot area is not swapped!"); }
```

6.2.19 FSL_GetSwapState

This function reads the current physical state of the boot clusters.

C Language Interface (Renesas version)

```
fsl_u08  FSL_GetBootFlag(fsl_u08 __near *data_destination_pu08);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_GetSwapState(__near fsl_u08 __near*
data_destination_pu08);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open

Post-condition

- None

Argument (Renesas version)

Argument	Type	Description
data_destination_pu08	__near fsl_u08 *	Pointer to the variable.

Argument (IAR version)

Argument	Type	Description
data_destination_pu08	__near fsl_u08 __near*	Pointer to the variable.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Security information is located in the passed variable
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*1) - Violates the precondition - FSL is suspending (*1)

(*1) For status check user mode only

Change in the destination address.
Boot flag will be written in the destination address.

00H: Boot cluster 0 starts with address 0x00000000
01H: Boot cluster 1 starts with address 0x00000000

Code example

```
/* get boot-swap flag                                    */
my_status_u08= FSL_GetSwapState((fsl_u08*)&my_bstate_dest_u08);

if( my_status_u08 != 0x00 )
   my_error_handler();

if(my_bstate_dest_u08){ myPrintFkt("Boot area is swapped!"); }
else{ myPrintFkt("Boot area is not swapped!"); }
```

6.2.20 FSL_GetBlockEndAddr

This function returns the end address of passed block.

Note This function may be used to secure the write function FSL_Write. If write operation exceeds the end address of a block, the written data is not guaranteed. Use this function to check whether the (write address + word number * 4) exceeds the end address of a block before calling the write function.

C Language Interface (Renesas version)

```
__far_func fsl_u08  FSL_GetBlockEndAddr(__near
fsl_getblockendaddr_t __near* getblockendaddr_pstr);
```

C Language Interface (IAR version)

```
fsl_u08  FSL_GetBlockEndAddr(__near fsl_getblockendaddr_t*
getblockendaddr_pstr);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open

Post-condition

- None

Argument (Renesas version)

Argument	Type	Description
getblockendaddr_pstr	__near fsl_getblockendaddr_t*	Pointer to the variable.

Argument (IAR version)

Argument	Type	Description
getblockendaddr_pstr	__near fsl_getblockendaddr_t __near*	Pointer to the variable.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Address information is located in the passed variable
0x05 (FSL_ERR_PARAMETER)		Wrong block number passed
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*1) - Violates the precondition - FSL is suspending (*1)

(*1) For status check user mode only

Change in the destination address.

Block end address will be written into the passed structure.

Code example

```
__near fsl_getblockendaddr_t      my_blk_str;

my_blk_str.fsl_block_u16 = 0x0001;
my_blk_str.fsl_destination_address_u32 = 0x00000000;
 /* get end adress of the block                          */
my_status_u08 = FSL_GetBlockEndAddr((fsl_getblockendaddr_t*)&
my_blk_str);

if( my_status_u08 != 0x00 )
   my_error_handler();

/* ##### ANALYSE my_blk_str.fsl_destination_address_u32 ##### */
```

6.2.21 FSL_GetFlashShieldWindow

This function reads the stored flash shield window. The flash shield window is a mechanism to protect the flash content against unwanted overwrite or erase defines. It can be reprogrammed by the application at any time by using the function FSL_SetFlashShieldWindow.

Example:
Flash shield window start block = 0x04
Flash shield window end block = 0x05

This configuration of the flash shield window prohibits the user to write e.g. into the block …..0x00, 0x01,0x02,0x03, 0x06…..0xFF

C Language Interface (Renesas version)

```
fsl_u08 FSL_GetFlashShieldWindow(__near fsl_fsw_t* getfsw_pstr);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_GetFlashShieldWindow(__near fsl_fsw_t
__near* getfsw_pstr);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open

Post-condition

- None

Argument (Renesas version)

Argument	Type	Description
getfsw_pstr	__near fsl_fsw_t*	Pointer to the variable.

Argument (IAR version)

Argument	Type	Description
getfsw_pstr	__near fsl_fsw_t __near*	Pointer to the variable.

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Flash shield window is located in the passed variable
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*1) - Violates the precondition - FSL is suspending (*1)

(*1) For status check user mode only

Change in the destination address.

Flash Shield Window information will be written into the passed structure.

Code example

```
__near fsl_fsw_t     my_fsw_info_str;

 /* get FSW info                                          */
my_status_u08 = FSL_GetFlashShieldWindow((fsl_fsw_t*)&
my_fsw_info_str);

if( my_status_u08 != 0x00 )
   my_error_handler();

/* ##### ANALYSE FSW stored in my_fsw_info_str ##### */
```

6.2.22 FSL_SetFlashShieldWindow

This function sets the new flash shield window. The flash shield window is a mechanism to protect the flash content against unwanted overwrite or erase defines.

Example:

Flash shield window start block = 0x04

Flash shield window end block = 0x05

This configuration of the flash shield window prohibits the user to write e.g. into the block …..0x00, 0x01,0x02, 0x03, 0x06…..0xFF

C Language Interface (Renesas version)

```
fsl_u08 FSL_SetFlashShieldWindow(__near fsl_fsw_t* setfsw_pstr);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_SetFlashShieldWindow(__near fsl_fsw_t
__near* setfsw_pstr);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions
4. FSL_PrepareExtFunctions

Post-condition

- None

Argument (Renesas version)

Argument	Type	Description
setfsw_pstr	__near fsl_fsw_t*	Information of the new shield window

Argument (IAR version)

Argument	Type	Description
setfsw_pstr	__near fsl_fsw_t __near*	Information of the new shield window

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion New Flash Shield Window is set
0x10 (FSL_ERR_PROTECTION)		Protection error.
0x1A (FSL_ERR_ERASE) (*1)		Erase error Block couldn't be erased.
0x1B (FSL_ERR_IVERIFY) (*1)		Verify error Data inside the flash memory is not at a sufficient voltage level
0x1C (FSL_ERR_WRITE) (*1)		Write error Data couldn't be written.
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY)(*2)		Command is running

(*1) For status check internal mode only

(*2) For status check user mode only

Code example

```
/* Example for status check internal mode only */
__near fsl_fsw_t     my_new_fsw_str;

my_new_fsw_str.fsl_start_block_u16 = 0x0000;
my_new_fsw_str.fsl_end_block_u16 = 0x0003;

/* set new fsw */
my_status_u08 = FSL_SetFlashShieldWindow((fsl_fsw_t*)
                                          &my_new_fsw_str);

if( my_status_u08 != 0x00 )
   my_error_handler();
```

6.2.23 FSL_SetXXX and FSL_InvertBootFlag

The Self-programming library has 4 functions for setting security bits. Each dedicated function sets a corresponding security flag.

These functions are listed below.

Function name	Outline
FSL_SetBlockEraseProtectFlag	Sets the block-erase-protection flag.
FSL_SetWriteProtectFlag	Sets the write-protection flag.
FSL_SetBootClusterProtectFlag	Sets the bootcluster-update-protection flag.
FSL_InvertBootFlag	Inverts the current value of the boot flag.

Caution **1. Boot-cluster protection cannot be reset by external programmer (e.g. PG-FP5).**

2. After successful execution of the FSL_InvertBootFlag function it is not allowed to execute any FSL_Setxxx function till hardware reset is occurred.

3. After RESET the other boot-cluster is activated. Please ensure a valid boot-loader inside the area, before calling the function.

4. Each security flag can be written by the application only once until next reset.

C Language Interface (Renesas version)

```
fsl_u08  FSL_SetBlockEraseProtectFlag(void);
fsl_u08  FSL_SetWriteProtectFlag(void);
fsl_u08  FSL_SetBootClusterProtectFlag(void);
fsl_u08  FSL_InvertBootFlag(void);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_SetBlockEraseProtectFlag(void);
__far_func fsl_u08  FSL_SetWriteProtectFlag(void);
__far_func fsl_u08  FSL_SetBootClusterProtectFlag(void);
__far_func fsl_u08  FSL_InvertBootFlag(void);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions
4. FSL_PrepareExtFunctions

Post-condition

- Security flag is set.

Argument (Renesas version)

Argument	Type	Description
None		

Argument (IAR version)

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion
0x10 (FSL_ERR_PROTECTION) (FSL_InvertBootFlag only)		Protection error.
0x1A (FSL_ERR_ERASE) (*1)		Erase error Block couldn't be erased.
0x1B (FSL_ERR_IVERIFY) (*1)		Verify error Data inside the flash memory is not at a sufficient voltage level
0x1C (FSL_ERR_WRITE) (*1)		Write error Data couldn't be written.
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY)(*2)		Command is running

(*1) For status check internal mode only

(*2) For status check user mode only

Code example

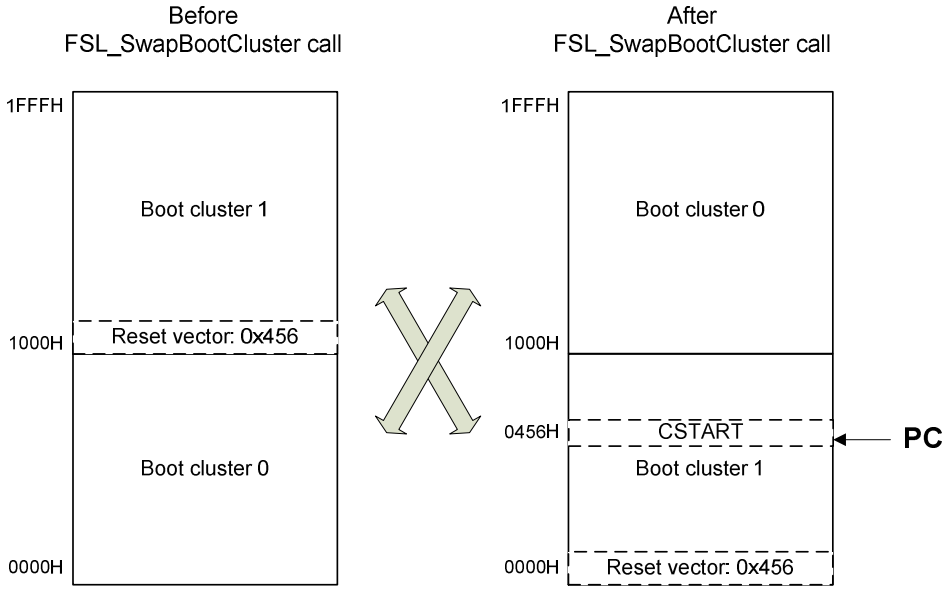
```
/* Example for status check internal mode only */
my_status_u08 = FSL_SetBlockEraseProtectFlag();

if( my_status_u08 != 0x00 )
   my_error_handler();
```

6.2.24 FSL_SwapBootCluster

This function performs the physical swap of the bootclusters (0 and 1) without touching the boot flag. After the physically swap the PC (program counter) will be set regarding the reset vector from the boot cluster 1.

Figure 6-1 Overview of swap procedure



Note 1. **After the execution of this function boot cluster 1 is located from the address 0x0000 to 0x0FFF and PSW.IE bit is cleared! After reset the boot clusters will be switched regarding the boot swap flag.**

2. **After successful execution of the FSL_InvertBootFlag function it is not allowed to execute any FSL_Setxxx function till reset is occurred.**

C Language Interface (Renesas version)

```
fsl_u08  FSL_SwapBootCluster(void);
```

C Language Interface (IAR version)

```
__far_func fsl_u08  FSL_SwapBootCluster(void);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions
4. FSL_PrepareExtFunctions

Post-condition

- Bootcluster 0 and 1 were swapped. Boot flag is not touched.

Argument (Renesas version)

Argument	Type	Description
None		

Argument (IAR version)

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
0x10 (FSL_ERR_PROTECTION)		Protection error.
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*1) - Violates the precondition - FSL is suspending (*1)

(*1) For status check user mode only

Code example

```
/* Example for status check internal mode only */
my_status_u08 = FSL_SwapBootCluster();

if( my_status_u08 != 0x00 )
   my_error_handler();
```

6.2.25 FSL_ForceReset

This function generates a software reset. For detailed information please refer to the device users manual.

C Language Interface (Renesas version)

```
void  FSL_ForceReset(void);
```

C Language Interface (IAR version)

```
__far_func void  FSL_ForceReset(void);
```

Pre-condition

None

Post-condition

None

Argument (Renesas version)

Argument	Type	Description
None		

Argument (IAR version)

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
None		

Code example

```
/* Generate a reset */
FSL_ForceReset();
```

6.2.26 FSL_GetVersionString

This function returns the pointer to the version string provided by the library.

C Language Interface (Renesas version)

```
fsl_u08 __far* FSL_GetVersionString(void);
```

C Language Interface (IAR version)

```
__far_func fsl_u08 __far* FSL_GetVersionString(void);
```

Pre-condition

None

Post-condition

None

Argument (Renesas version)

Argument	Type	Description
None		

Argument (IAR version)

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
Pointer to the version string	fsl_u08 __far*	This is the pointer to the version string.

Code example

```
fsl_u08 __far* my_pointer_version_str;

my_pointer_version_str = FSL_GetVersionString();
```

6.2.27 FSL_SwapActiveBootCluster (Renesas Compiler only)

This function inverts the current value of the boot and swaps the bootcluster 0 and 1 physically.

Caution **After execution of this function the boot clusters were swapped.**

C Language Interface (Renesas version)

```
fsl_u08  FSL_SwapActiveBootCluster(void);
```

Pre-condition

Library must be initialized and started via following sequence:

1. FSL_Init
2. FSL_Open
3. FSL_PrepareFunctions
4. FSL_PrepareExtFunctions

Post-condition

- Boot flag is inverted
- Bootcluster were swapped

Argument (Renesas version)

Argument	Type	Description
None		

Return types/values

Argument	Type	Description
0x00 (FSL_OK)	fsl_u08	Normal completion Boot flag is inverted and bootcluster were swapped
0x10 (FSL_ERR_PROTECTION)		Protection error.
0x1A (FSL_ERR_ERASE) (*1)		Erase error Block couldn't be erased.
0x1B (FSL_ERR_IVERIFY) (*1)		Verify error Data inside the flash memory is not at a sufficient voltage level
0x1C (FSL_ERR_WRITE) (*1)		Write error Data couldn't be written.
0x1F (FSL_ERR_FLOW)		Possible errors: - Last operation has not finished (*2) - Violates the precondition - FSL is suspending (*2)
0xFF (FSL_BUSY)(*2)		Command is running

(*1) For status check internal mode only

(*2) For status check user mode only

Code example

```
my_status_u08 = FSL_SwapActiveBootCluster();

if( my_status_u08 != 0x00 )
   my_error_handler();
```

Chapter 7 Operation

This chapter describes the operation of the libary as well as the integration.

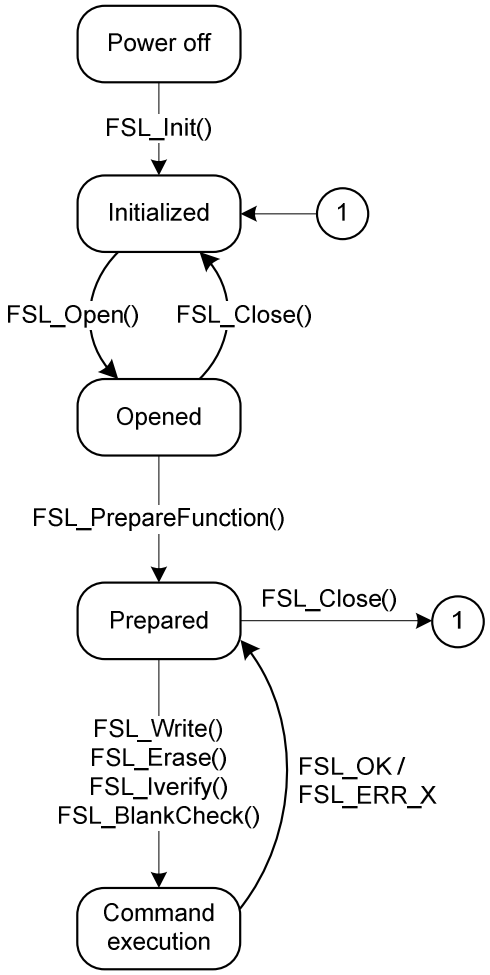
7.1 Basic workflow

To be able to use the FSL (execute commands) in a proper way the user has to follow a specific procedure. Following sub-chapters will help you to understand the different workflows.

7.1.1 FSL_Write, FSL_Erase ... in status check internal mode

The status check internal mode can be executed from ROM or RAM. The following figure illustrates the flash access flow.

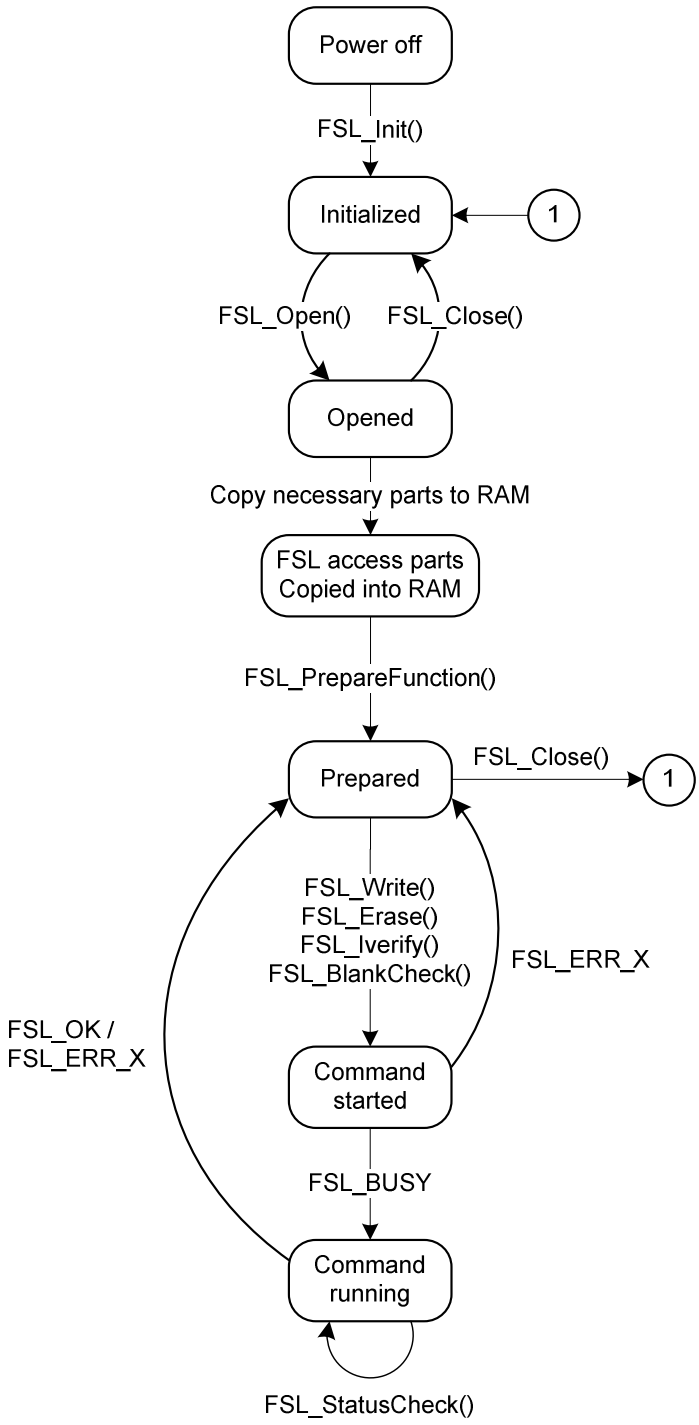
Figure 7-1 Status check internal mode (flash access)



7.1.2 FSL_Write, FSL_Erase ... in status check user mode

As shown in the figure below on status check mode the user has to copy the FSL parts into RAM before using them for status check.

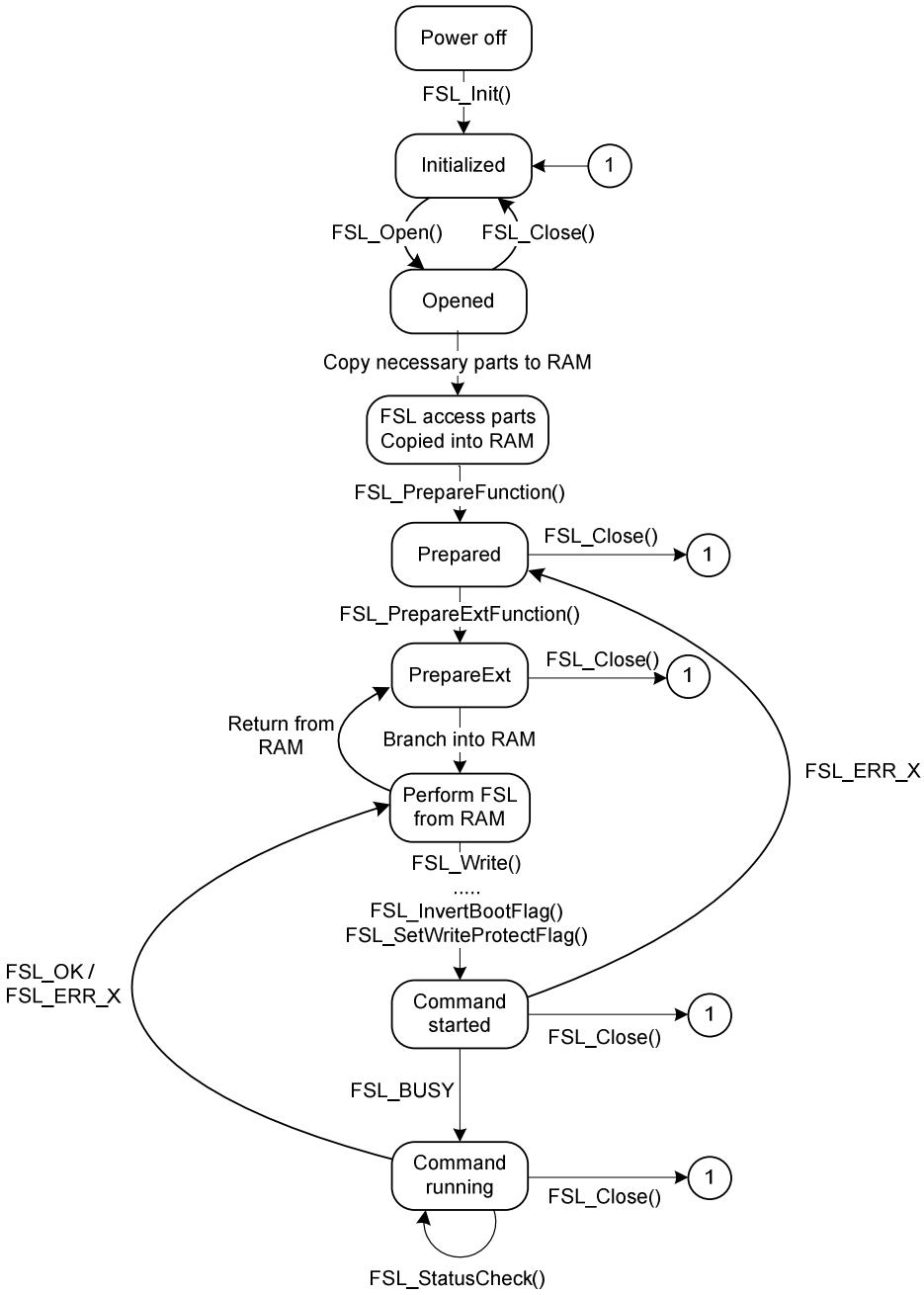
Figure 7-2 Status check user mode (flash access)



7.1.3 FSL_SetXXX, FSL_InvertBootFlag ... in status check user mode

The following figure illustrates the flow where the FSL_SetXXX functions are used. It is basically the same flow except that the FSL_PrepareExtFunction function must be called.

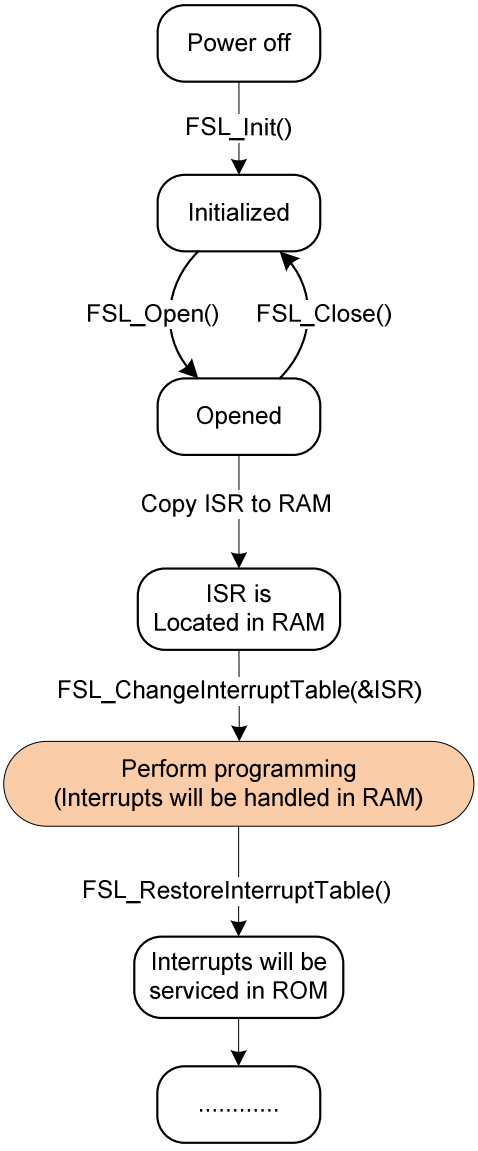
Figure 7-3 Status check user mode (flash access + security setting)



7.1.4 Interrupts during Self-programming

As described in the chapter “Interrupts servicing” the interrupts will always be handled in RAM during flash access. The following flow shows the general procedure on how to use interrupts.

Figure 7-4 Interrupts during Self-programming



7.2 Integration

- Copy all the files into your project subdirectory
- add all fsl*.* files into your project (workbench or make-file)
- adapt the *.XCL file due to your requirements (at least segments FSL_FCD, FSL_FECD, FSL_BCD, FSL_BECD, FSL_RCD and FSL_RCD_ROM(IAR only) should be defined). For detailed segment description please refer to chapter 2.1.2.
- re-compile the project

Chapter 8 Characteristics

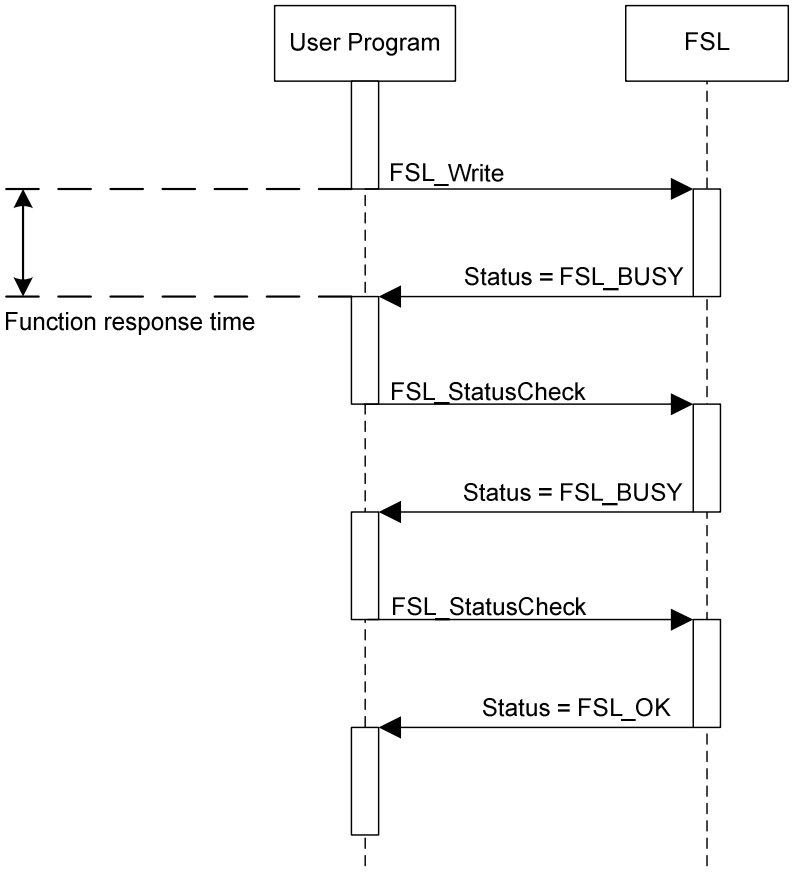
This chapter includes the timing information's of each function depending on the user configuration.

8.1 Function response time

8.1.1 Status check user mode

Please refer to the following figure for the function response time definition.

Figure 8-1 Function response time definition in case of SCU



Full speed mode

Function	Max
FSL_Init	4540/fclk
FSL_PrepareFunctions	2465/fclk
FSL_PrepareExtFunctions	1221/fclk
FSL_ChangeInterruptTable	253/fclk
FSL_RestoreInterruptTable	229/fclk
FSL_Open	10/fclk
FSL_Close	10/fclk
FSL_BlankCheck	2080/fclk + 30 us
FSL_Erase	2195/fclk + 30 us
FSL_IVerify	2099/fclk + 30 us
FSL_Write	2460/fclk + 30 us
FSL_GetSecurityFlags	331/fclk + 0 us
FSL_GetBootFlag	328/fclk + 0 us
FSL_GetSwapState	206/fclk + 0 us
FSL_GetBlockEndAddr	368/fclk + 0 us
FSL_GetFlashShieldWindow	307/fclk + 0 us
FSL_SetBlockEraseProtectFlag	2351/fclk + 30 us
FSL_SetWriteProtectFlag	2350/fclk + 30 us
FSL_SetBootClusterProtectFlag	2350/fclk + 30 us
FSL_InvertBootFlag	2345/fclk + 30 us
FSL_SetFlashShieldWindow	2168/fclk + 30 us
FSL_SwapBootCluster	431/fclk + 32 us
FSL_SwapActiveBootCluster	2328/fclk + 30 us
FSL_ForceReset	-
FSL_StatusCheck	1146/fclk + 50 us
FSL_StandBy	
(case: Erase)	935/fclk + 31 us
(case: except Erase) FSL_SetXXX are supported	140367/fclk + 513844 us
(case: except Erase) FSL_SetXXX are not supported	76101/fclk + 35952 us
FSL_WakeUp	
(case: suspended erase)	2144/fclk + 30 us
(case: except erase)	148/fclk + 0 us
FSL_GetVersionString	10/fclk

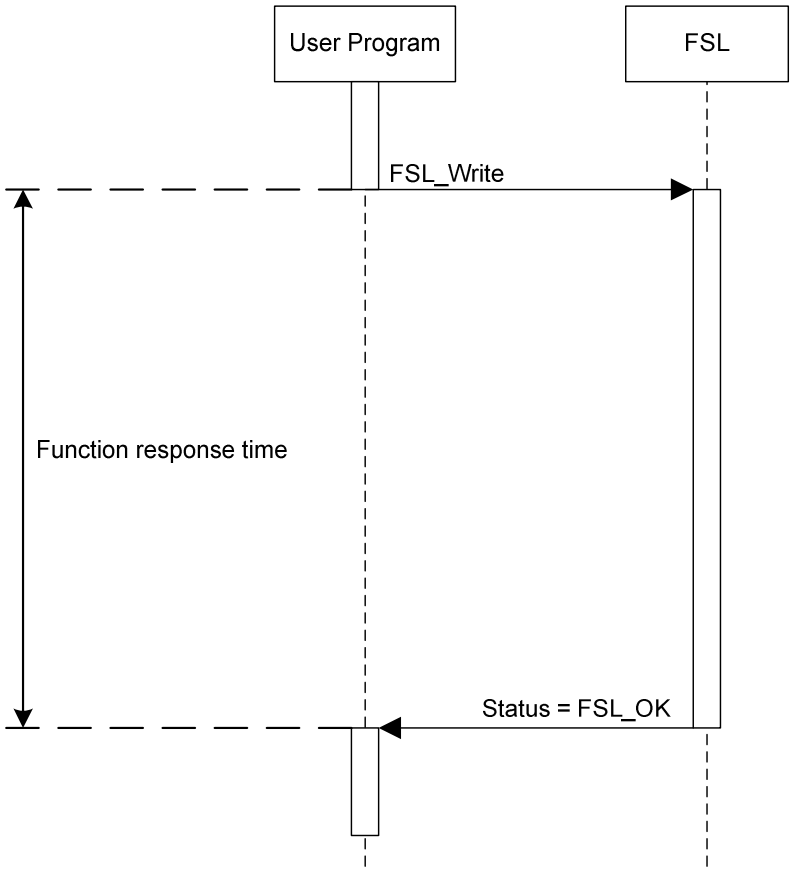
Wide voltage mode

Function	Max
FSL_Init	4540/fclk
FSL_PrepareFunctions	2465/fclk
FSL_PrepareExtFunctions	1221/fclk
FSL_ChangeInterruptTable	253/fclk
FSL_RestoreInterruptTable	229/fclk
FSL_Open	10/fclk
FSL_Close	10/fclk
FSL_BlankCheck	2079/fclk + 30 us
FSL_Erase	2195/fclk + 30 us
FSL_IVerify	2099/fclk + 30 us
FSL_Write	2460/fclk + 30 us
FSL_GetSecurityFlags	331/fclk + 0 us
FSL_GetBootFlag	328/fclk + 0 us
FSL_GetSwapState	206/fclk + 0 us
FSL_GetBlockEndAddr	368/fclk + 0 us
FSL_GetFlashShieldWindow	307/fclk + 0 us
FSL_SetBlockEraseProtectFlag	2351/fclk + 30 us
FSL_SetWriteProtectFlag	2350/fclk + 30 us
FSL_SetBootClusterProtectFlag	2350/fclk + 30 us
FSL_InvertBootFlag	2345/fclk + 30 us
FSL_SetFlashShieldWindow	2168/fclk + 30 us
FSL_SwapBootCluster	431/fclk + 32 us
FSL_SwapActiveBootCluster	2328/fclk + 30 us
FSL_ForceReset	-
FSL_StatusCheck	1146/fclk + 50 us
FSL_StandBy	
(case: Erase)	935/fclk + 44 us
(case: except Erase) FSL_SetXXX are supported	123274/fclk + 53833 us
(case: except Erase) FSL_SetXXX are not supported	73221/fclk + 69488 us
FSL_WakeUp	
(case: suspended erase)	2144/fclk + 30 us
(case: except erase)	148/fclk + 0 us
FSL_GetVersionString	10/fclk

8.1.2 Status check internal mode

Please refer to the following figure for the function response time definition in case of SCI.

Figure 8-2 Function response time definition in case of SCI



Full speed mode

Function	Min	Max
FSL_Init	4540/fclk	4540/fclk
FSL_PrepareFunctions	2465/fclk	2465/fclk
FSL_PrepareExtFunctions	1221/fclk	1221/fclk
FSL_ChangeInterruptTable	253/fclk	253/fclk
FSL_RestoreInterruptTable	229/fclk	229/fclk
FSL_Open	10/fclk	10/fclk
FSL_Close	10/fclk	10/fclk
FSL_BlankCheck	3313/fclk + 84 us	4844/fclk + 164us
FSL_Erase	4880/fclk + 163 us	73342/fclk + 255366 us
FSL_IVerify	10476/fclk + 1107 us	10476/fclk + 1107 us
FSL_Write	3129/fclk + 66 us +(595/fclk+60us)*W	3130/fclk + 66 us +(1153/fclk + 561us)*W
FSL_GetSecurityFlags	331/fclk + 0 us	331/fclk + 0 us
FSL_GetBootFlag	328/fclk + 0 us	328/fclk + 0 us
FSL_GetSwapState	206/fclk + 0 us	206/fclk + 0 us
FSL_GetBlockEndAddr	368/fclk + 0 us	368/fclk + 0 us
FSL_GetFlashShieldWindow	307/fclk + 0 us	307/fclk + 0 us
FSL_SetBlockEraseProtectFlag	1574/fclk+ 18us	140950/fclk+ 513830us
FSL_SetWriteProtectFlag	1573/fclk+ 18us	140949/fclk+ 513830us
FSL_SetBootClusterProtectFlag	1574/fclk+ 18us	140950/fclk+ 513830us
FSL_InvertBootFlag	1569/fclk+ 18us	140945/fclk+ 513830us
FSL_SetFlashShieldWindow	1385/fclk+ 18us	140768/fclk+ 513830us
FSL_SwapBootCluster	431/fclk+ 32us	431/fclk+ 32us
FSL_SwapActiveBootCluster	1950/fclk+ 50us	141326/fclk+ 513862us
FSL_ForceReset	n/a	n/a
FSL_StatusCheck	n/a	n/a
FSL_StandBy	n/a	n/a
FSL_WakeUp	n/a	n/a
FSL_GetVersionString	10/fclk	10/fclk

Wide voltage mode

Function	Min	Max
FSL_Init	4540/fclk	4540/fclk
FSL_PrepareFunctions	2465/fclk	2465/fclk
FSL_PrepareExtFunctions	1221/fclk	1221/fclk
FSL_ChangeInterruptTable	253/fclk	253/fclk
FSL_RestoreInterruptTable	229/fclk	229/fclk
FSL_Open	10/fclk	10/fclk
FSL_Close	10/fclk	10/fclk
FSL_BlankCheck	3309/fclk + 124us	4585/fclk + 401us
FSL_Erase	4678/fclk + 401 us	64471/fclk + 266193 us
FSL_IVerify	7661/fclk + 7534us	7661/fclk + 7534us
FSL_Write	3129/fclk + 66 us +(591/fclk+112us)*W	3130/fclk + 66us +(1108/fclk+1085us)*W
FSL_GetSecurityFlags	331/fclk + 0 us	331/fclk + 0 us
FSL_GetBootFlag	328/fclk + 0 us	328/fclk + 0 us
FSL_GetSwapState	206/fclk + 0 us	206/fclk + 0 us
FSL_GetBlockEndAddr	368/fclk + 0 us	368/fclk + 0 us
FSL_GetFlashShieldWindow	307/fclk + 0 us	307/fclk + 0 us
FSL_SetBlockEraseProtectFlag	1574/fclk+ 18us	123857/fclk+ 538032us
FSL_SetWriteProtectFlag	1573/fclk+ 18us	123856/fclk+ 538032us
FSL_SetBootClusterProtectFlag	1574/fclk+ 18us	123857/fclk+ 538032us
FSL_InvertBootFlag	1569/fclk+ 18us	123852/fclk+ 538032us
FSL_SetFlashShieldWindow	1385/fclk+ 18us	123675/fclk+ 538032us
FSL_SwapBootCluster	431/fclk+ 32us	431/fclk+ 32us
FSL_SwapActiveBootCluster	1950/fclk+ 50us	124233/fclk+ 538064us
FSL_ForceReset	n/a	n/a
FSL_StatusCheck	n/a	n/a
FSL_StandBy	n/a	n/a
FSL_WakeUp	n/a	n/a
FSL_GetVersionString	10/fclk	10/fclk

Chapter 9 General cautions

Following cautions must be considered before developing of an application.

- Library code and constants must be located completely in the same 64k flash page.
- All functions are not re-entrant. That means don't call FSL functions inside the ISRs while any FSL function is already running.
- Task switches, context changes and synchronization between FSL functions:

  All FSL functions depend on FSL global available information and are able to modify this. In order to avoid synchronization problems, it is necessary that at any time only one FSL function is executed. So, it is not allowed to start an FSL function, then switch to another task context and execute another FSL function while the last one has not finished.
- It is not possible to modify the Data Flash parallel to modification of the Code Flash
- It is not allowed to locate the data buffer over the 0xFFE20 address.
- The watchdog timer must be configured for period which is longer than the execution time of FSL_SetXXX and FSL_SwapBootCluster in case of using the status check internal mode.
- Some RAM areas are prohibited during execution of FSL library.
  Please refer to the device users manual for detailed information.
- FSL_RCD segment size must be at least 10 bytes larger than the size of FSL_RCD_ROM segment when using FSL_CopySection.
- Internal high-speed oscillator must be started before using of the FSL.
- In case of usage of RAM ISR:
  - It is not allowed to locate the RAM ISR over the 0xFFE20 address.
  - It is not allowed to access flash (read/write) during execution of RAM ISR.
  - User has to take care that the request flag is cleared before leaving the ISR

Flash Self-programming Library