M4K Group (1)

Application Note
Data Flash Emulation
(FLASH256-B)

Outlines

This application note is a reference material for developing products using the Code Flash memory as a Data Flash memory of M4K Group (1).
This document helps the user check operation of the product and develop its program.

Target sample program: CodeFlashE2PROMEmulation

Table of Contents

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1. Preface

This sample program controls the count of the write to the Code Flash memory region and others. It uses the Code Flash memory as a Data Flash memory.

The write count available is almost similar to that of an EEPROM device by changing the address variable and erasing per page.

2. Reference Document

1. Datasheet
   TMPM4K Group (1) datasheet Rev2.0 (Japanese edition)
2. Reference manual
   Flash Memory   Code Flash Memory: 256KB/128KB/96KB/64KB (FLASH256-B) Rev1.1 (Japanese edition)
3. Application note
   M4K Group (1) Application Note Startup (CMSIS System & Clock Configuration) Rev1.0
4. Other reference document
   TMPM4KxA Group Peripheral Driver User Manual (Doxygen) V1.0.4.0

3. Function to Use

IP	Channel	Port	Function/Operation mode
Flash Memory	—	—	Auto program

4. Target Device

The target devices of this application note are as follows;

TMPM4K4FYAUG	TMPM4K4FWAUG	TMPM4K4FUAUG	TMPM4K4FSAUG
TMPM4K4FYAFG	TMPM4K4FWAFG	TMPM4K4FUAFG	TMPM4K4FSAFG
TMPM4K2FYADUG	TMPM4K2FWADUG	TMPM4K2FUADUG	TMPM4K2FSADUG
TMPM4K1FYAUG	TMPM4K1FWAUG	TMPM4K1FUAUG	TMPM4K1FSAUG
			TMPM4K0FSADUG

* This sample program operates on the evaluation board of TMPM4K4FYAUG.

If other function than the TMPM4K4 one is checked, it is necessary that CMSIS Core related files (the startup file and I/O header file) should be changed properly.

Additionally, the name of microcontroller which is set to the project should be changed.

The BSP related file is dedicated to the evaluation board (TMPM4K4FYAUG). If other function than the TMPM4K4 one is checked, the BSP related file should be changed properly.

## 5. Operation Confirmation Condition

Used microcontroller   TMPM4K4FYAUG
Used board   TMPM4K4 evaluation board (Product of ESP-kikaku Co. Ltd.)
Integrated development environment   IAR Embedded Workbench for ARM 8.22.2
Integrated development environment   Arm® Keil® MDK Version 5.24.2.0
Sample program   v1.0.0

6. Sample Program

6.1. Structure Diagram of Sample Program

The structure diagram of the sample program is shown below.
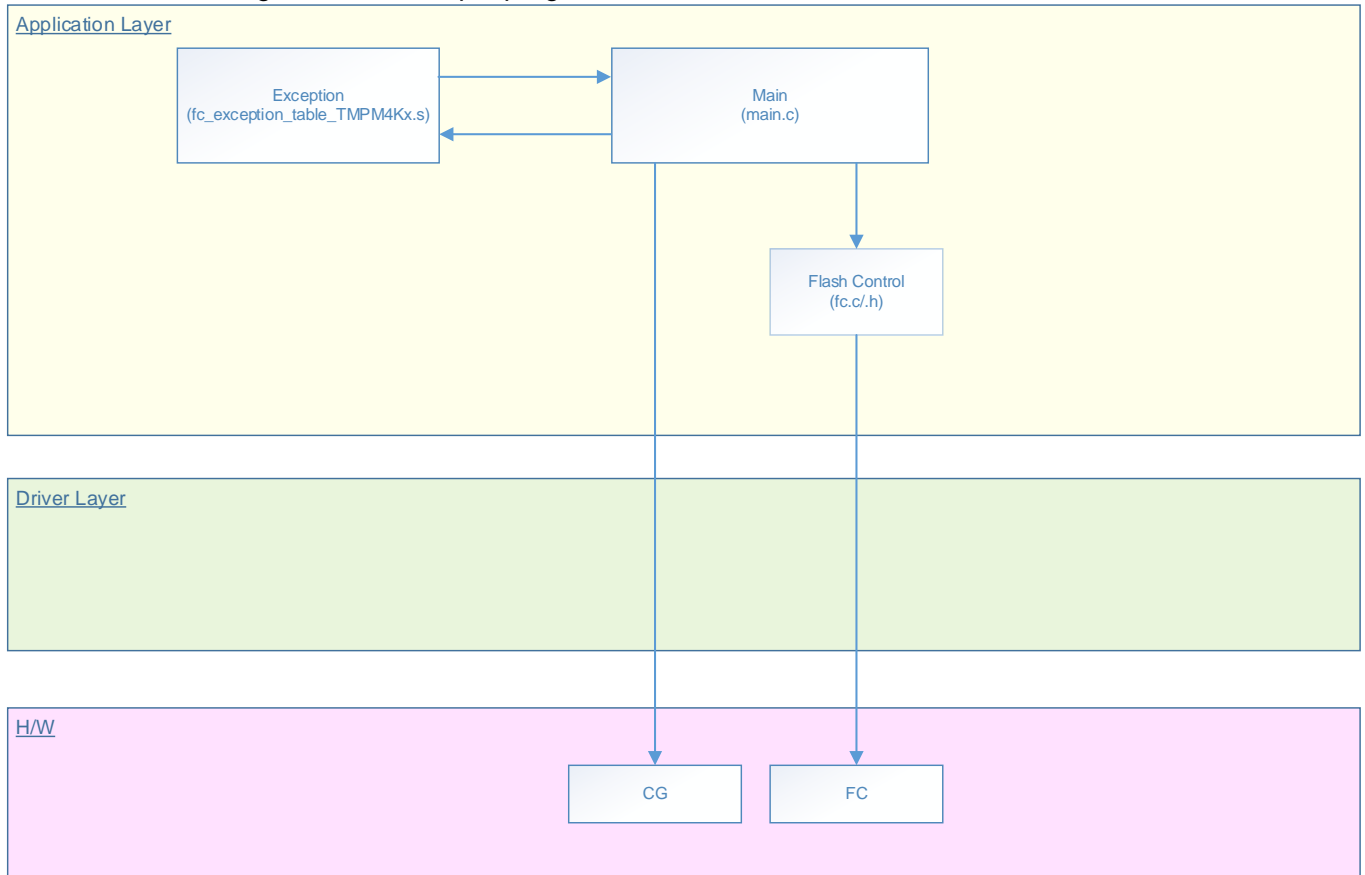
6.2. Parameter Setting

A user should set the following parameters.
Write start page of the Flash memory
Page count to be used (The page size is 4 KB.)
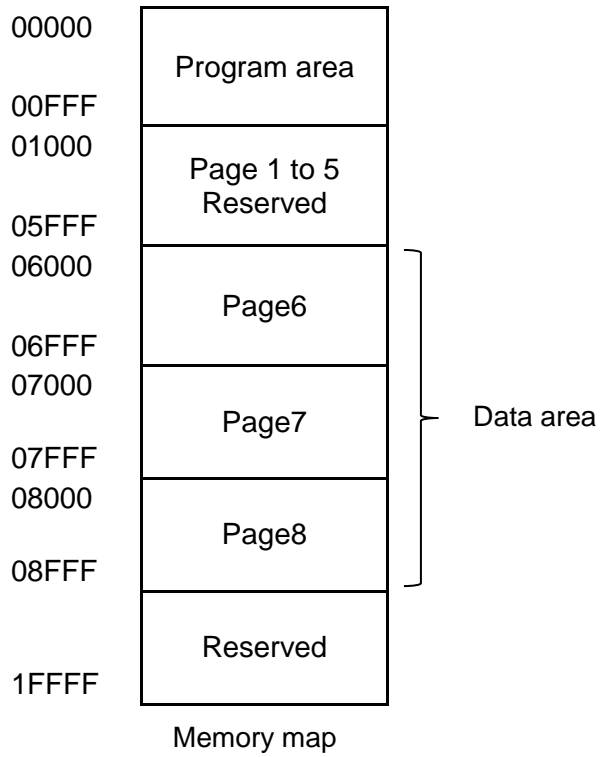Write data size (4079 bytes at maximum)
Storage address of the write data

6.3. Operation Example (When Using 128-KB Code Flash Memory)

Write start page = 0x06
Page count to be used (The page size is 4 KB.) = 3
Write data size = 100 bytes
Storage address of the write data = 0x2000xxxx0 (User Data)

The variables above can be modified using "cf_e2prom_emu_init_t init".

init.first_page = (fc_code_flash_page_number_t)FC_CODE_FLASH_PAGE6;
init.number_of_pages = (uint8_t)(FC_CODE_FLASH_PAGE8 - FC_CODE_FLASH_PAGE6+1);
init.data_size = (uint16_t)CF_E2ROM_EMU_DATA_SIZE;
init.data_address = user_data.user_data;

00000	Program area
00FFF	
01000	Page 1 to 5 Reserved
05FFF	
06000	Page6
06FFF	
07000	Page7
07FFF	
08000	Page8
08FFF	
	Reserved
1FFFF	

Data area

Memory map

The unit of a write is 16 bytes. When 100-byte data is written, the page should be divided into 36 Records by 112 bytes. In the extra 12-byte area, "0xFF" should be written to each byte of the first 11 bytes, and a written mark (0xA5) should be written to the last byte. When the write data size is a multiple of 16 bytes, a 16-byte area should be added to each Record and the written mark (0xA5) should be written to the last byte of the added area. The last 16 bytes in the page should be used as "Record D" to store the write count.

	00	10	20	30	40	50	60	70	80	90	A0	B0	C0	D0	E0	F0
06000	0							1							2	
06100	2				3					4						
06200	4			5				6								
06300	6	7				8						9				
06400	9				10					11						
06500	11			12				13								
06600	13		14			15										
06700	16				17				18							
06800	18			19				20								
06900	20		21			22										
06A00	22	23			24					25						
06B00	25			26				27								
06C00	27		28			29										
06D00	29		30			31										
06E00	32			33				34								
06F00	34			35				Reserved								D

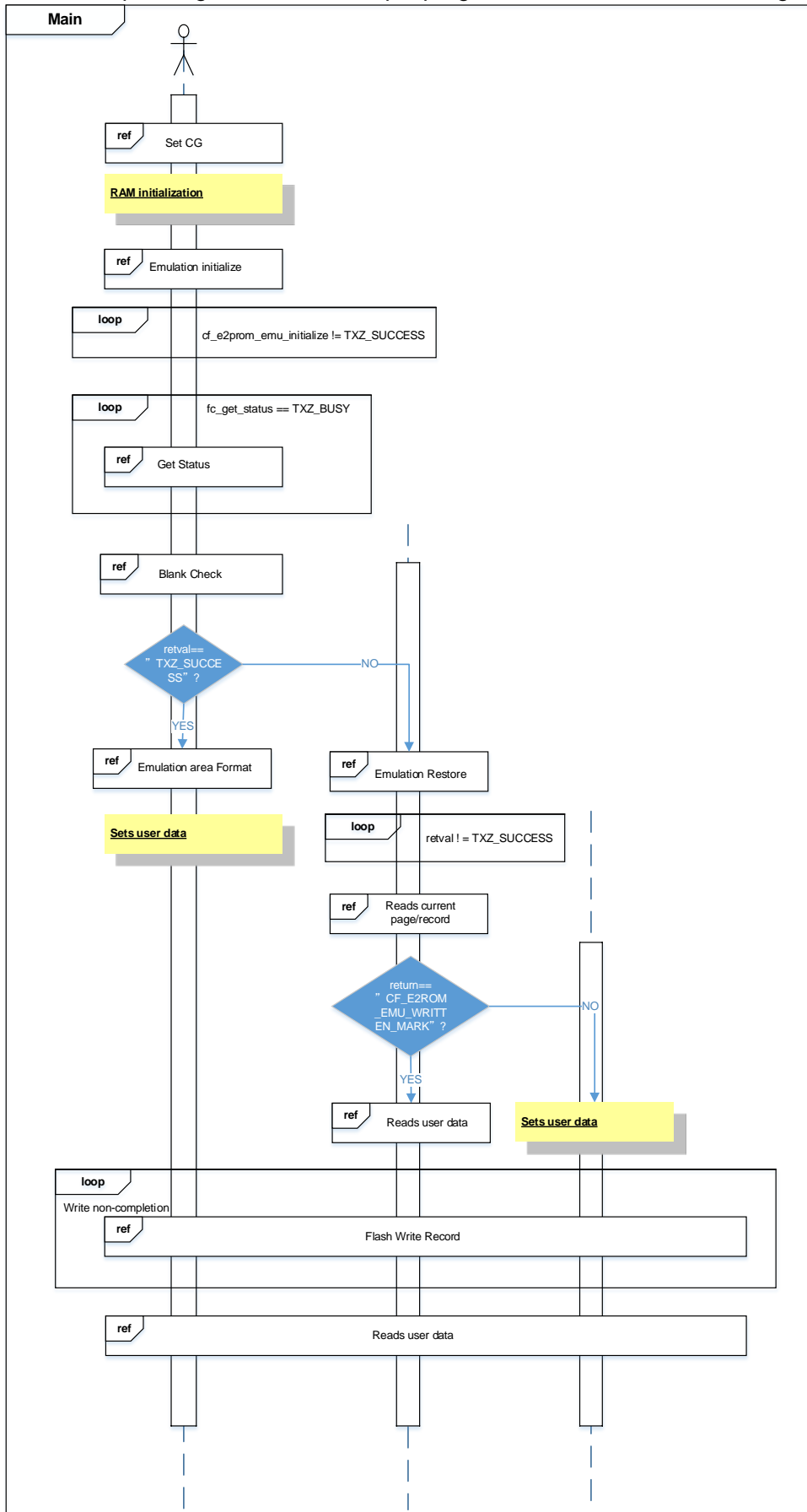Mapping in a page (in the case of Page 6)

6.3.1. Write Operation

Data is read in sequence from 0x20000000, and write the data from Record 0 in Page 6. After Record 35 in Page 6 is written, the write proceeds to the next page. After the write is done to Record 35 in Page 8, Page 6 is erased and data is written to Record 0 in Page 6. When multiple pages are set for write, the second write is done after all set pages are written and the first page is erased.
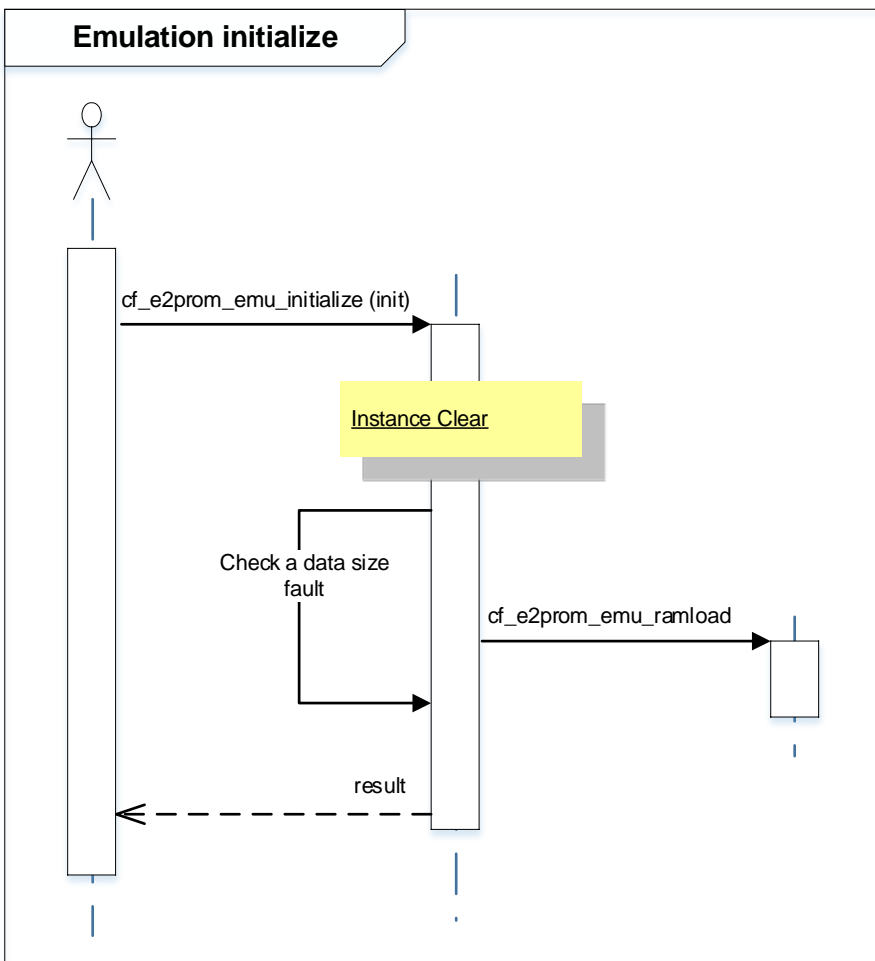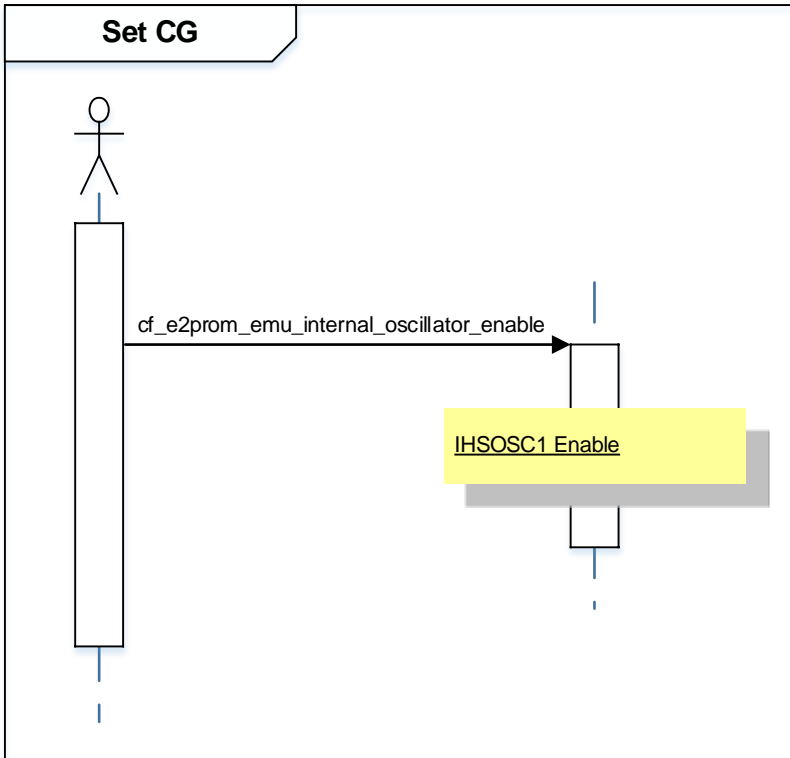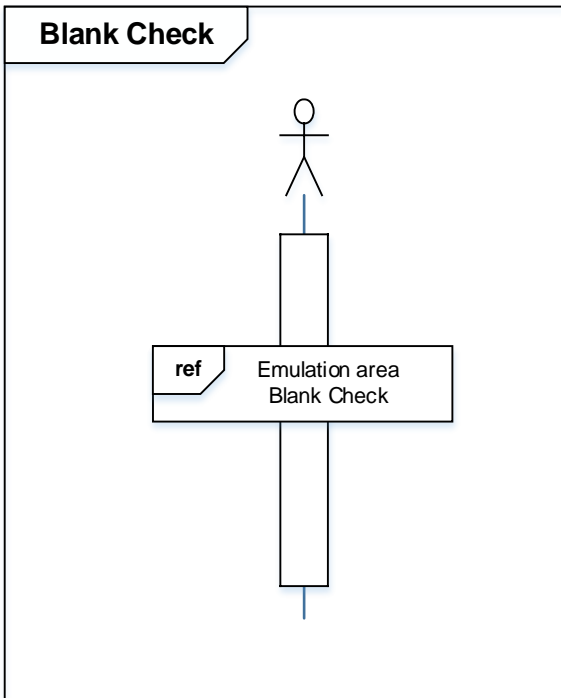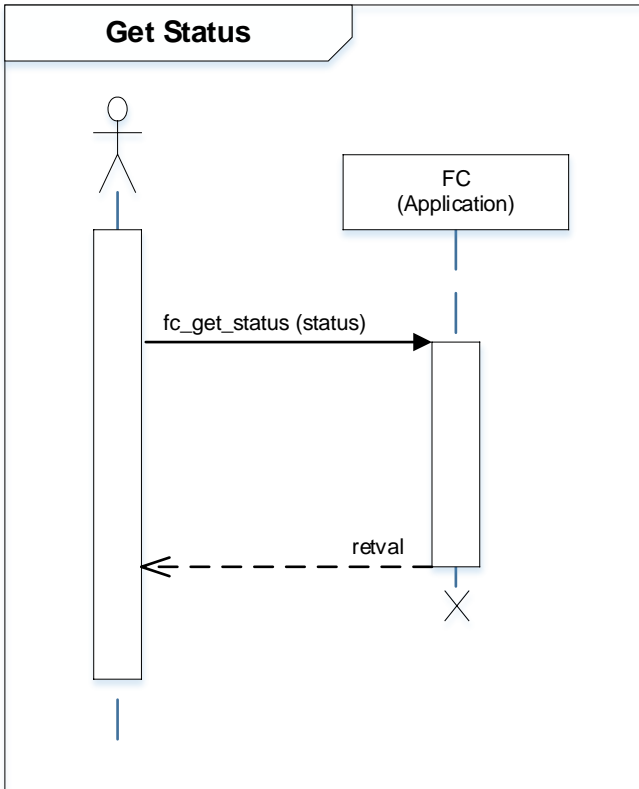
6.3.2. Control of Write Count

When the first write is done, 0x0000 is written to the last 4 bytes in "Record D". Before the second write is done, the data on the page is erased. Then, 0x0001 is written to the last 4 bytes in "Record D". The same operation is done to the other pages to control the write count. When the write control data "Record D" becomes 0x2710 (10000 times), no more erase is done.
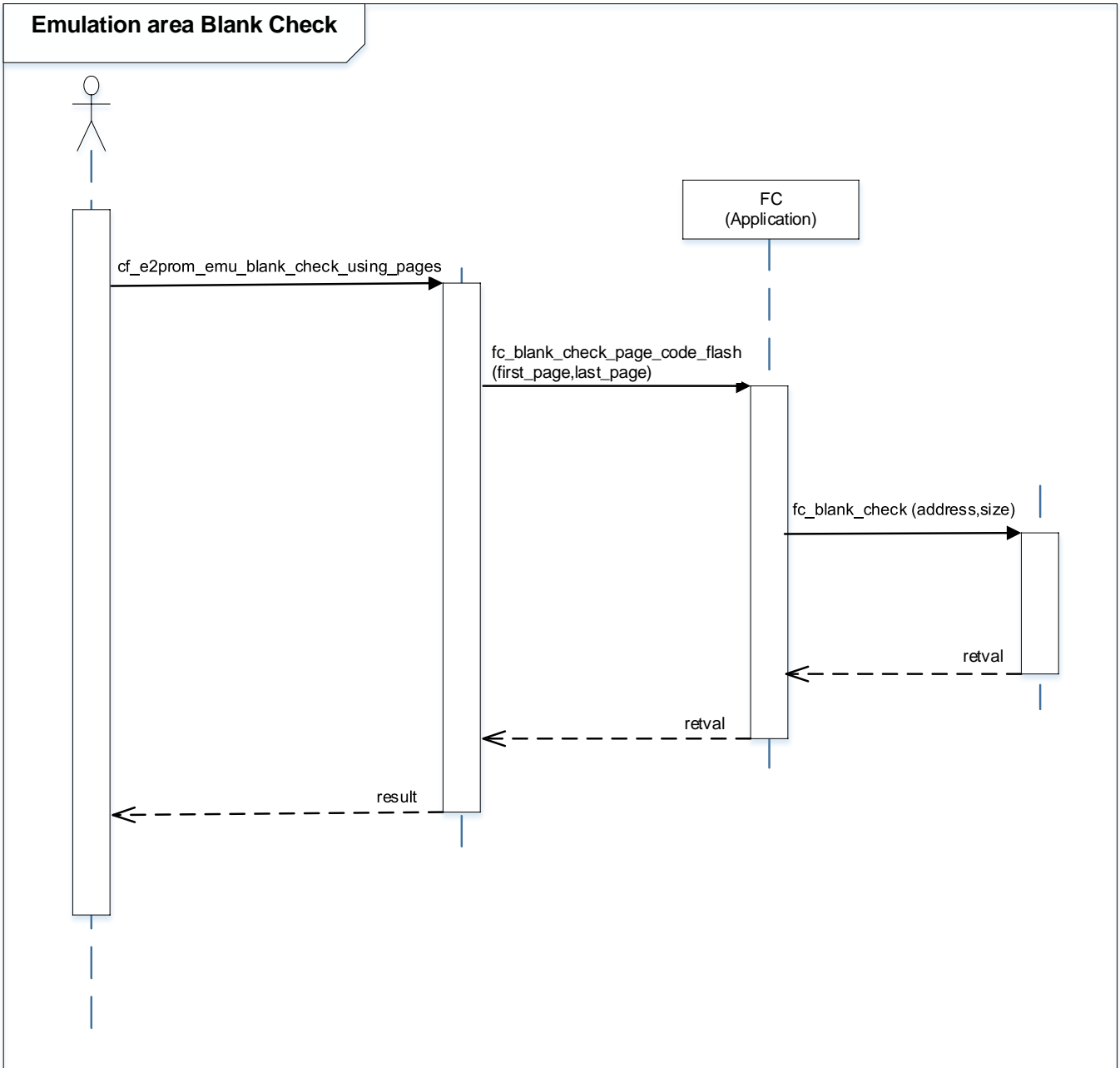
6.4. Operating Flow of Sample Program

The basic operating flows of the sample program are shown in the following;

Main

ref — Set CG

RAM initialization

ref — Emulation initialize

loop — cf_e2prom_emu_initialize != TXZ_SUCCESS

loop — fc_get_status == TXZ_BUSY

ref — Get Status

ref — Blank Check

retval==
" TXZ_SUCCE
SS" ?

NO

YES

ref — Emulation area Format

ref — Emulation Restore

Sets user data

loop — retval ! = TXZ_SUCCESS

ref — Reads current page/record

return==
" CF_E2ROM
_EMU_WRITT
EN_MARK" ?

NO

YES

ref — Reads user data

Sets user data

loop — Write non-completion

ref — Flash Write Record

ref — Reads user data

Set CG

cf_e2prom_emu_internal_oscillator_enable

IHSOSC1 Enable

Emulation initialize

cf_e2prom_emu_initialize (init)

Instance Clear

Check a data size fault

cf_e2prom_emu_ramload

result

Get Status

Blank Check

Emulation area Blank Check

Emulation area Format

Emulation Restore

cf_e2prom_emu_restore

ref Decides current page

ref Decides current record in the current page

result

Decides current page

first_page = last_page

cf_e2prom_emu_read_record_d (page)

*addr

Decides current record in the current page

cf_e2prom_emu_read_written_mark (page, record)

*addr

first_page = last_page

cf_e2prom_emu_read_written_mark (page, record)

*addr

Reads current page/record

cf_e2prom_emu_read_written_mark_current_record

cf_e2prom_emu_read_written_mark
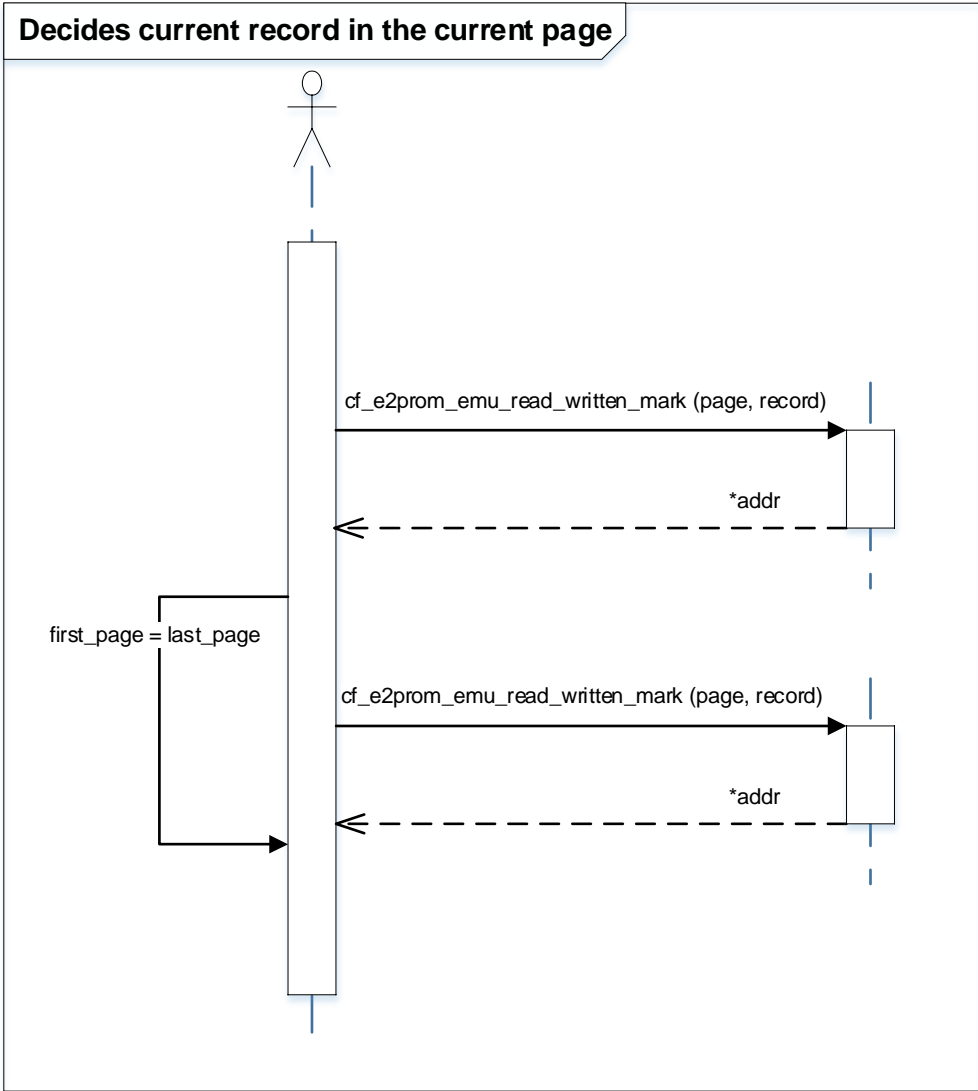(current_page, current_record)

*addr

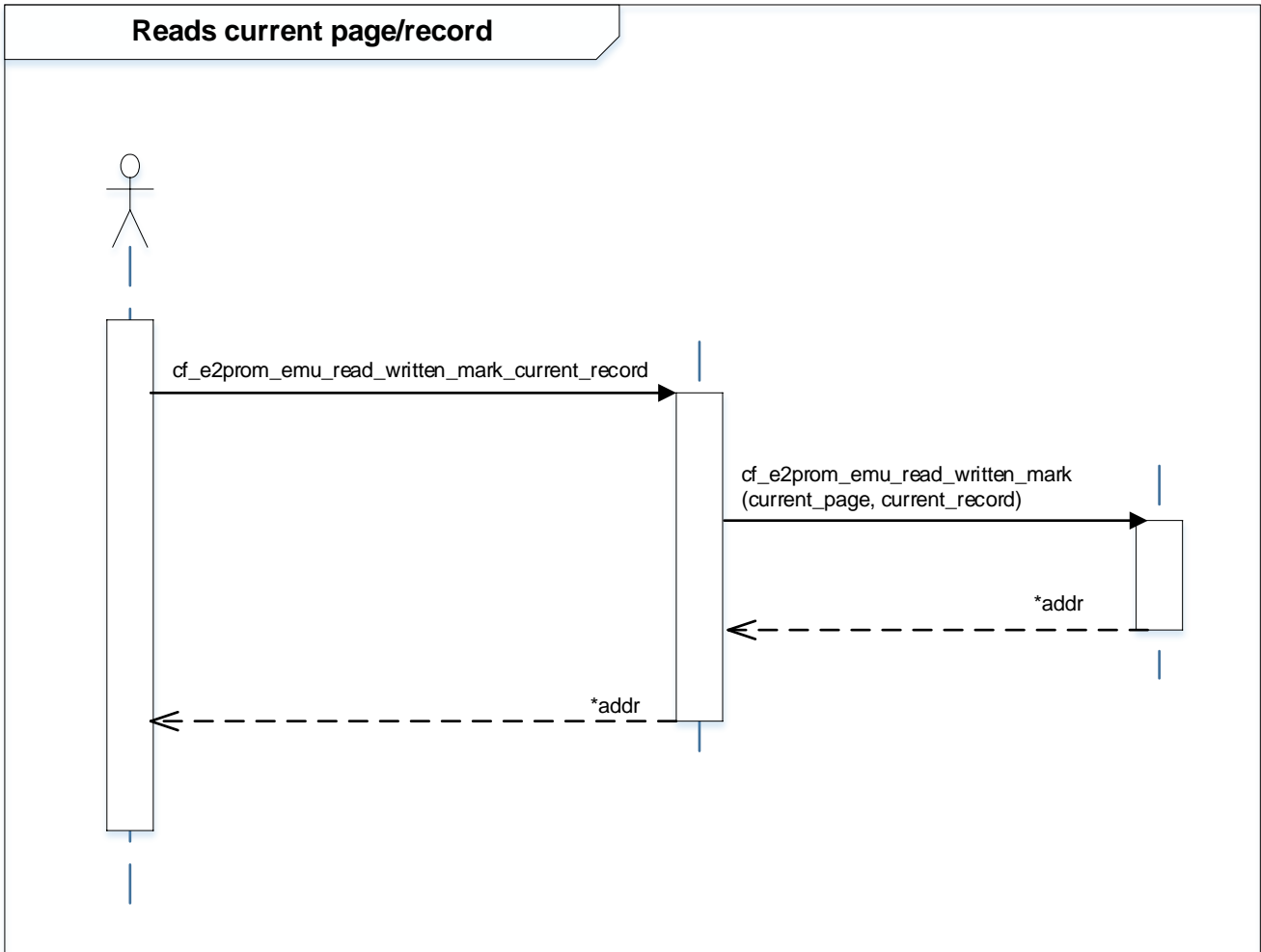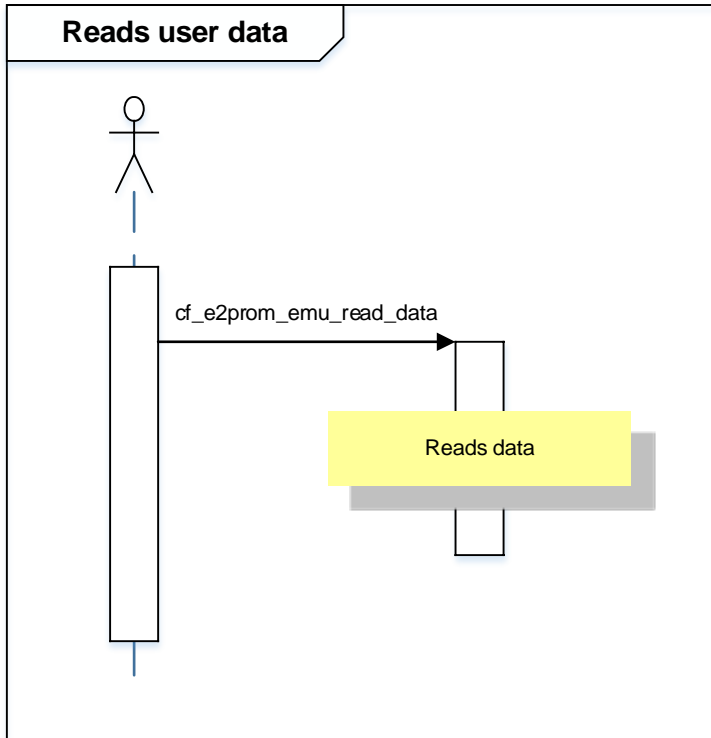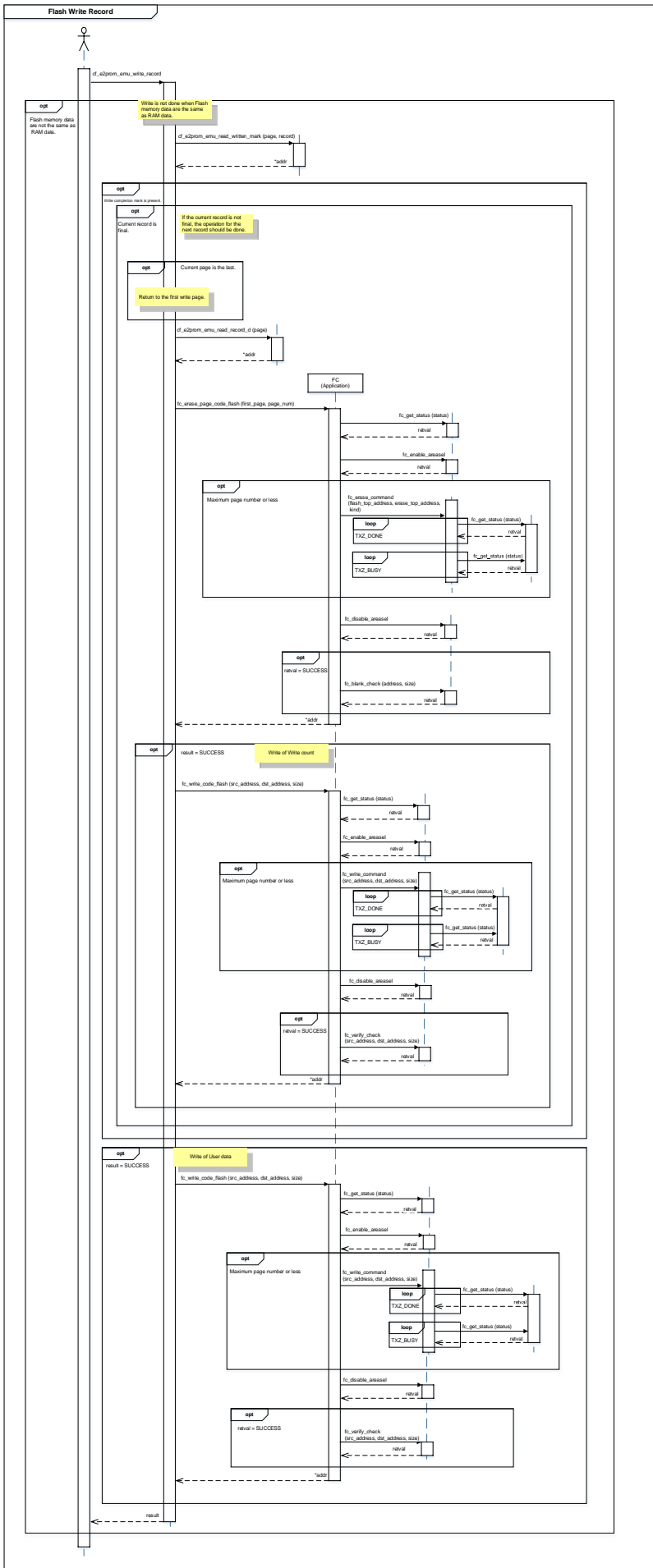*addr

Reads user data

cf_e2prom_emu_read_data

Reads data

7. Remarks

(1) If a User Data which should be written to a Record is the same as the User Data in the Code Flash memory, the write is not done.

(2) Operation while Code Flash memory is operating
When the program on the RAM is executed, a prepared vector table for the RAM is used. Any exceptions and interrupts are disabled. The vector table for the RAM receives the exception which cannot be disabled, and every process goes into an infinite loop.

(3) Failure of write or erase of Code Flash memory
This sample program does not retry when a failure occurs, but it returns the error information.
This program cannot control an unusable Record. When an error occurs, this function cannot be used.
If restoration is successful after the reset, the restored User Data can be read out to the User Data region.

(4) Operation after Reset
If restoration is successful after the reset, the EEPROM emulation function can be used. The restored User Data can be read out to the User Data region.

8. Points to Remember on Handling of Sample Programs

When using the sample program with other than "Operation Confirmation Condition" please check the operation sufficiently.

9. Revision History

Revision	Date	Description
1.0	2019-10-08	First release

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