RH850/U2B Group

R01AN6439EJ0110
Rev.1.10

OTA Operation Example by Double Map Mode

Summary

This application note summaries the OTA operation example for RH850/U2Bx by Double Map Mode. As the interface by the user program, the RS-CANFD is used. The internal code flash rewrite program is on the user mat.

Although the task examples and application examples described in this application note have been confirmed to operate, therefore be sure to confirm the operation before using them.

Application

This document is applicable for RH850/U2Bx.

[Note 1] Self-programing Function Activation, and Code Flash Memory Mapping

In this application note, enable the following setting on CS+ for performing OTA.

(1) Select “*****(Debag Tool)” from the project tree.

(2) Select the Tab of “Setting for Connection”.

(3) Set “Yes” to “Perform flash self programing” of “Flash”.

(4) Set “Map Mode” = “Single Map Mode” in “Memory”

(1) Contents

1. OTA Function for U2Bx Series

1.1 Map Mode

In U2Bx Series, there are two map modes: Single Map Mode and Double Map Mode.

1.1.1 Single Map Mode

In single map mode, perform the mapping switching for the programing before/after updating by using the address translation function by GCFU. Code flash can be used efficiently when partially updating the program. **Figure 1-1** shows the address translation by GCFU.

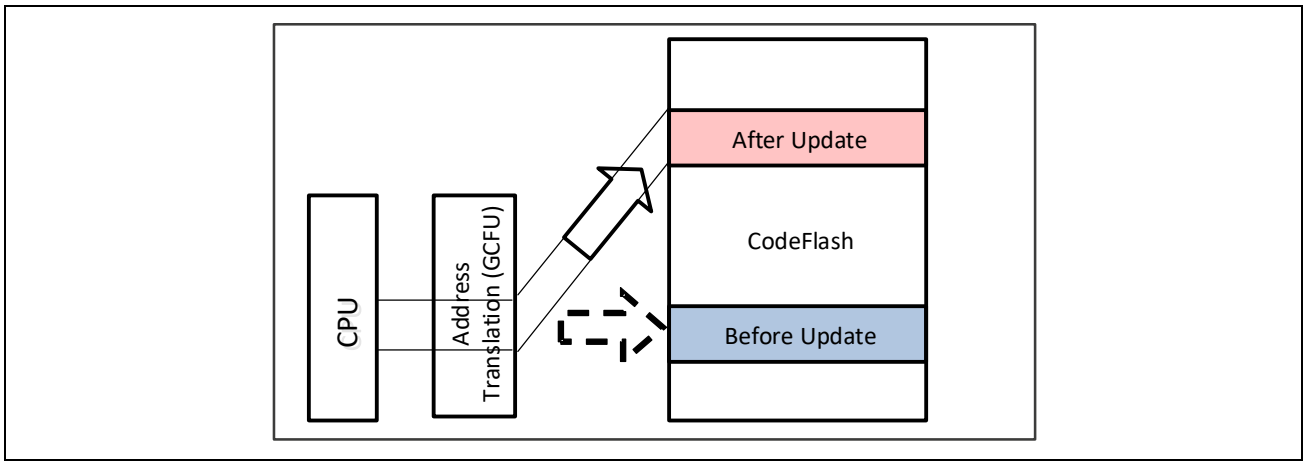

Figure 1-1 Address Translation by GCFU

1.1.2 Double Map Mode

Code flash area is separated as the two areas. Set one area as the Code Flash for system operation (front side) and the other area as the Code Flash for OTA update (back side), and switch the address assignment between the front side and the back side by setting the option byte. This map mode is suitable for OTA, which updates the entire program or programs stored in each bank within a cluster at once. The operation and the program updating are possible from all masters at the same logical address by full-duplexing. Figure 1-2 shows the bank swap by full-duplexing.

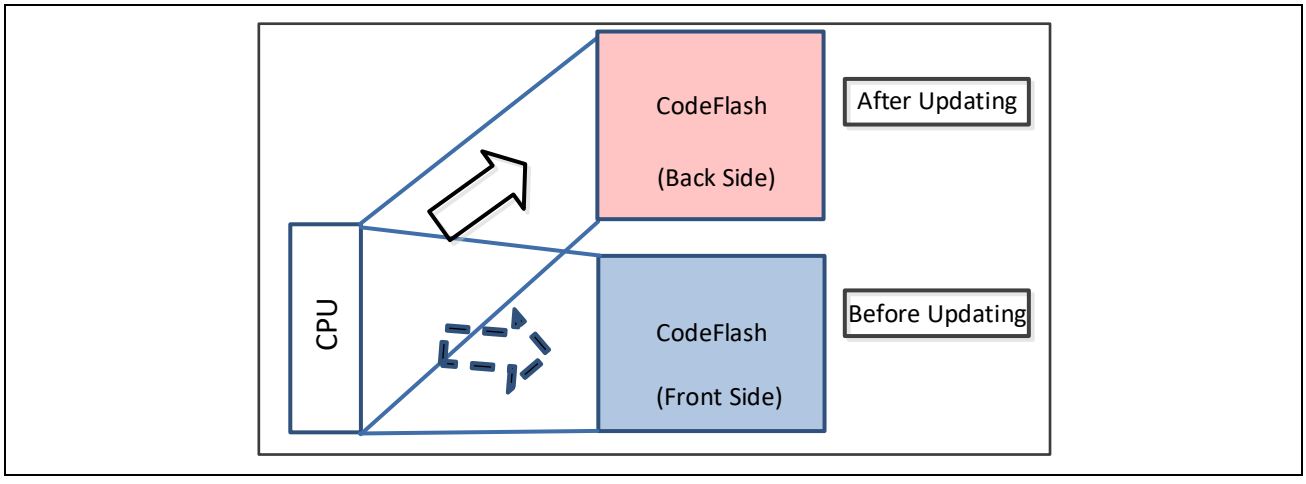

Figure 1-2 Full-duplexing by Bank Swap

2. OTA by Double Map Mode

In double map mode, the boot bank is decided by the option byte, therefore the bank determination is not necessary. Also, the program of the bank in back side is rewritten by the rewrite program of the stored bank in front side.

2.1 Write Operation

When booting from Bank A, rewrite the program of Bank B by the rewrite program of Bank A.

Figure 2-1 shows the write operation in the Bank A booting.

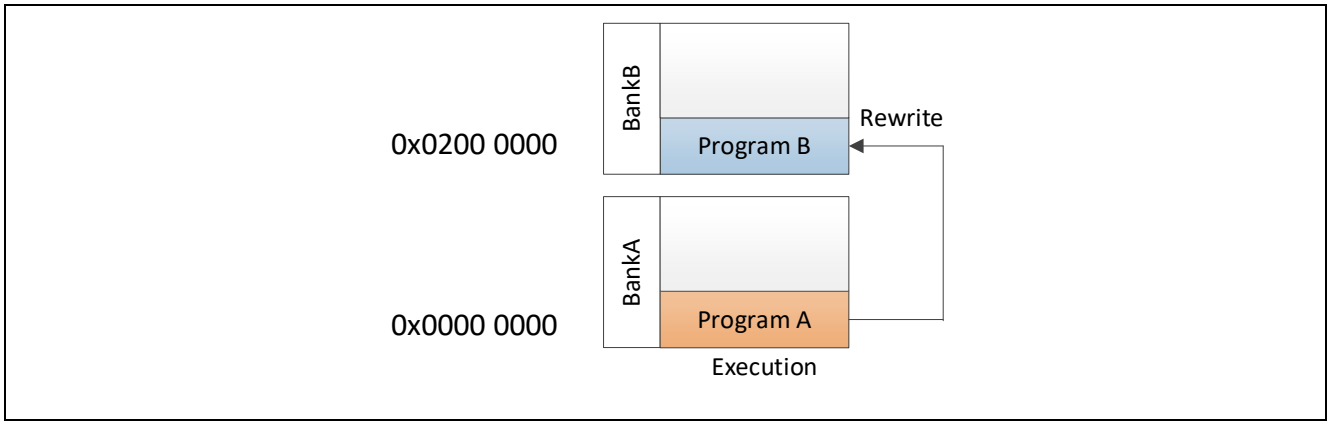

Figure 2-1 Write Operation in Bank A Booting

2.2 New Program Booting

Update the program of the bank in back side by the program in front side. Switch between the front side and the back side in bank swap setting by setting the option byte. Reflect new program after resetting. Figure 2-2 shows the bank swap setting.

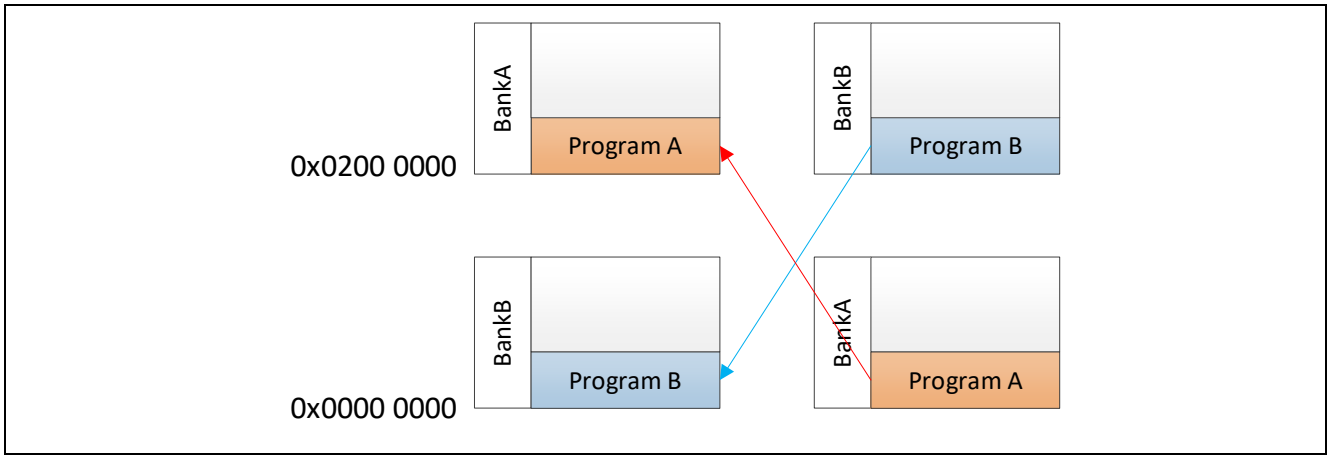

Figure 2-2 Bank Swap Setting

2.3 BGO Function

As the BGO (Background operation) function, U2Bx additionally support the data flash reading during programming/erasing of code flash. In addition, the extension of the suspend function improves the flexibility of interrupting and suspending in programing/erase processing. As the dual operation (simultaneous program/erase function), define the current specs newly, and support additionally for simultaneous programing/erase of Code Flash and Data Flash for ICU-M.

In this operation example, for realizing the concurrent programing/erasing that preferentially executes data flash erasing while erasing the code flash, program/erase suspend function is used. Figure 2-3 shows the flash memory related module configuration diagram.

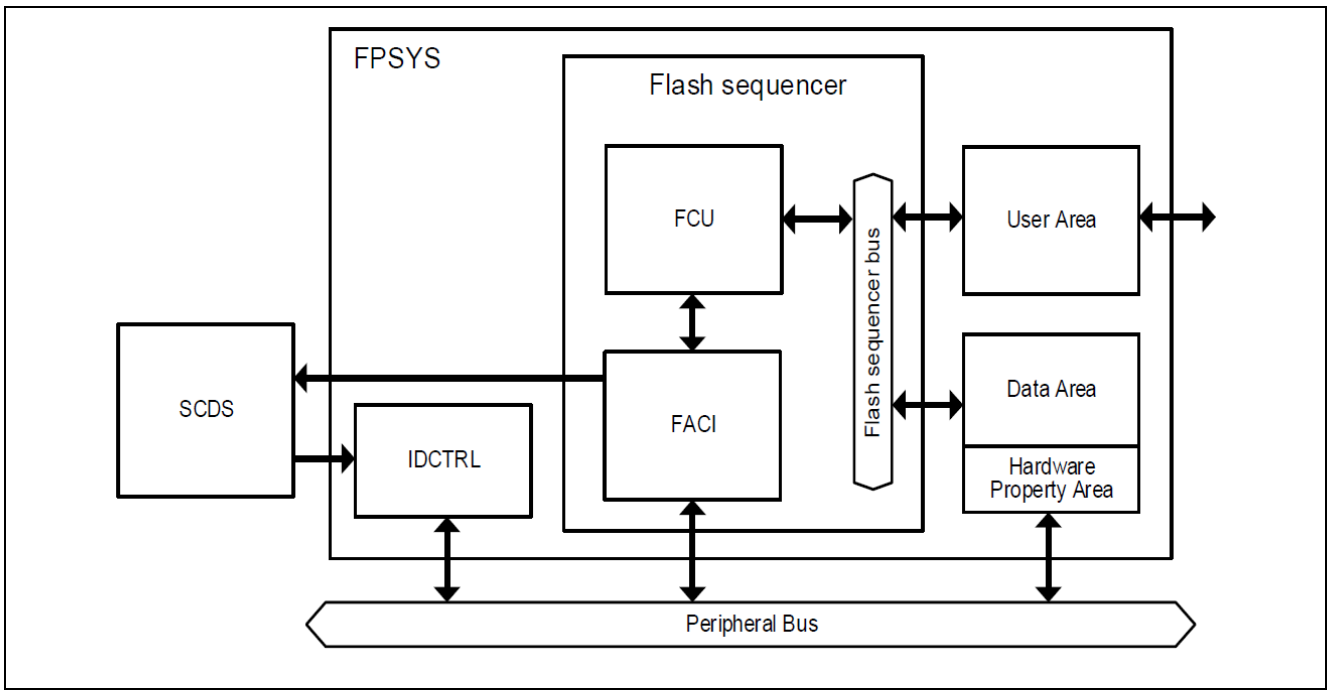

Figure 2-3 Memory Related Module Configuration Diagram

2.4 Suspend Function

2.4.1 Suspend/Interrupt of Program/Erase

Program (writing) between different macro (bank) is possible in erase suspending (before erase processing suspension).

Also, support the following two combinations, and if it is between different macros (banks), make it possible to suspend/interrupt of programing/erase in all combinations of programing/erase.

- Erase processing to different macro (Bank) in erase suspend period
- Programming/Erase processing to different macro (Bank) in program suspend period.

3. Specification

3.1 Entire Specification

- In this application note, the user mat is rewritten with OTA 2Bank configuration by double map mode. Table 3-1 shows the memory allocation.
- Rewrite area is performed for the bank different from the bank in which the program operates.
- Code flash memory mapping mode is double map mode. Operation mode is normal operation mode. Boot mat is user boot mode.
- RS-CANFD(ch1) is used as the data used for code flash writing, and stored to the internal RAM.
- The code flash rewrite target device uses RS-CANFD from the external device, and corresponding code flash rewrite processing is performed when receiving the specific ID and data. These combination of specific ID and data is called “CANFD Command” in this application note.
- After rewriting, change the option byte for changing the boot bank. Since the bank of the user boot mat is also switched, write the same boot program in the user boot mat in advance.

Figure 3-1 shows the system configuration diagram.

Table 3-1 Memory Allocation

Area	Physical Address	Block	Bank	Size	OTA Tartget
User boot mat	0x0800 0000 – 0x0800 FFFF	User boot area	BankA	64K bytes	Not target
	0x0A00 0000 – 0x0A00 FFFF		BankB	64K bytes	
User mat (Program A)	0x0000 0000 – 0x0001 7FFF	Block 0 to 5	BankA	96K bytes	Target
User mat (Program B)	0x0200 0000 – 0x0201 7FFF		BankB	96K bytes	

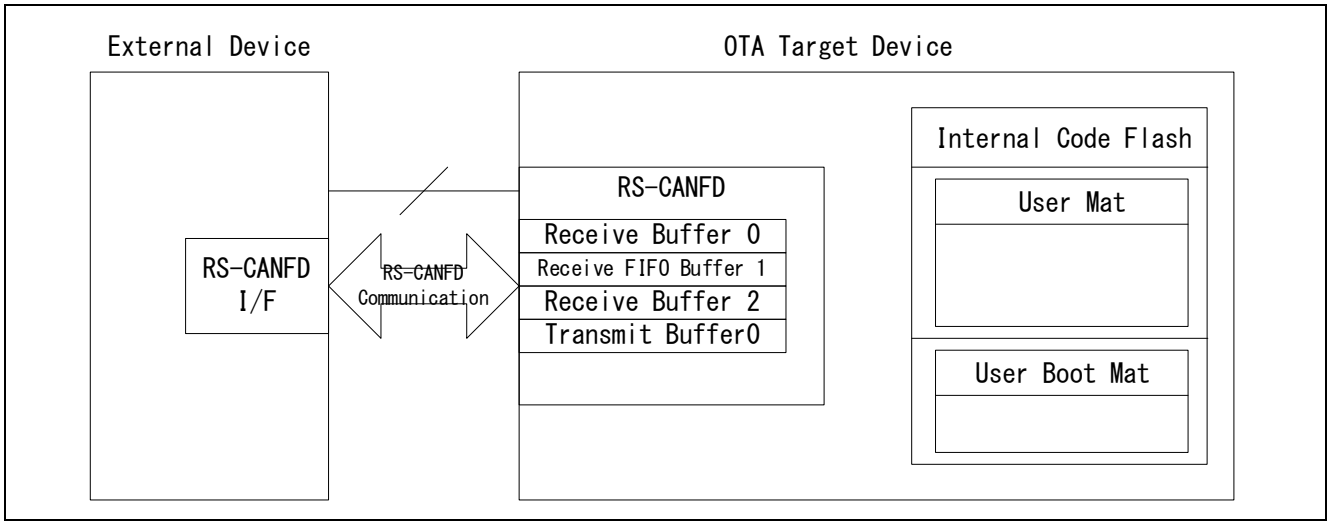

Figure 3-1 System Configuration Diagram

3.2 RS-CANFD Communication Specification

- Use channel 1.
- Set the communication speed the normal bit rate 1Mbps and the data bit rate 2Mbps.
- Set the communication frame to the CANFD frame.
- For storing each command transmitted from the external device, set the number of receive rules for channel 1 to “2”.

3.3 CANFD Command Specification

- Rewrite start command starts the code flash rewrite processing by transmitting the command from the external device to the code flash rewrite target device.
- Write data request command requests the write data by transmitting the command from the code flash rewrite target device to the external device.
- Write data download command transmits the write data from the external device to the code flash rewrite target device.
- Write end command completes the rewrite processing by transmitting the command from the code flash rewrite target device to the external device.

Table 3-2 shows the CANFD command specification.

Table 3-2 CANFD Command Specification

Buffer	Channel	Command Name	Transmission/Reception	Standard ID	Data Length	Data
0	1	Rewrite start command	Reception	H’100	1Byte	H’00
1	1	Write data download	Reception	H’110	64Byte	Download code flash write data download 512 bytes (64Byte x 8)
1	1	Write data request command	Transmission	H’111	1Byte	H’11
2	1	Write end command	Transmission	H’121	1Byte	H’22

3.4 Entire Sequences

Figure 3-2 to Figure 3-3 show the entire sequences.

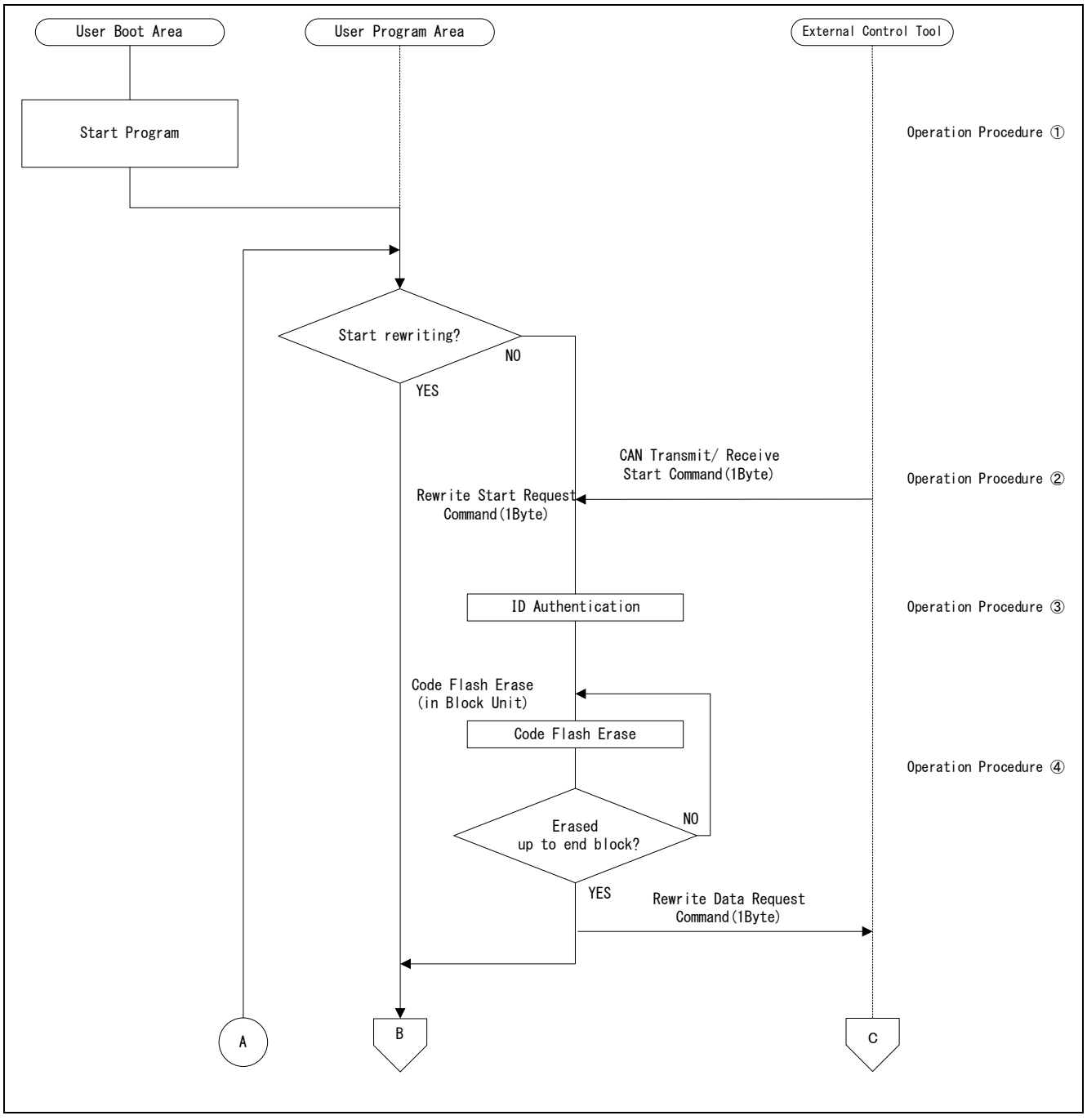

Figure 3-2 Entire Sequences Diagram (1)

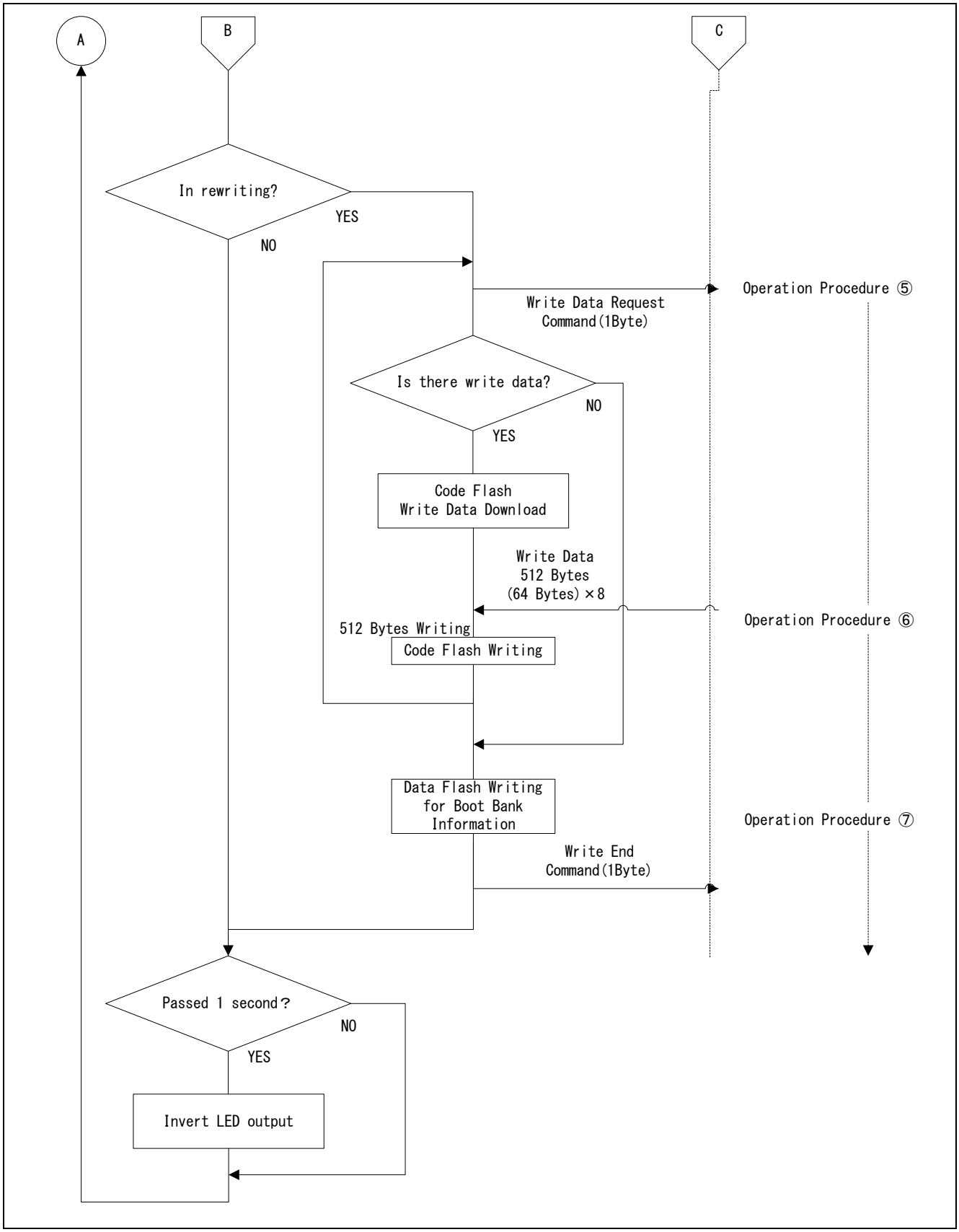

Figure 3-3 Entire Sequences Diagram (2)

3.5 Use Function

- CANFD Interface (RS-CANFD)
- FACI
- Pin

3.6 Operation Mode

In this application note, the operation mode for the microcomputer when rewriting code flash is performed on the user boot mode. In the user boot mode, the boot mat is the user boot mat.

Selection method for operation mode is set in the mode pin. Setting for the option byte is set by using Renesas Flash Programmer for RH850 family.

Table 3-3 shows the operation mode selection.

Table 3-3 Operation Mode Selection

Pin Setting Value			Option Byte Setting Value		Operation Mode	Boot Mat
MD1	MD0	TRST	STMSEL1	STMSEL0		
0	0	0	0	1	User boot mode	User boot mat

3.7 Memory Mapping

In this application note, the memory mapping when rewriting code flash is performed in single map mode. Table 3-4 shows the memory mapping selection.

Table 3-4 Memory Mapping Selection

Option Byte Setting Value		Memory Mapping
MAPMODE1	MAPMODE 0	
0	0	Double Map Mode

4. OTA Operation Example using External Device

4.1 Operation Procedure

Operation procedure ① to ⑦ is corresponds to “3.4 Entire Sequences”.

4.1.1 ① Program Booting

After starting the reset, boot the start program of the user boot mat, and jump to the user program of the user mat with initialization. Figure 4-1 shows the start program operation.

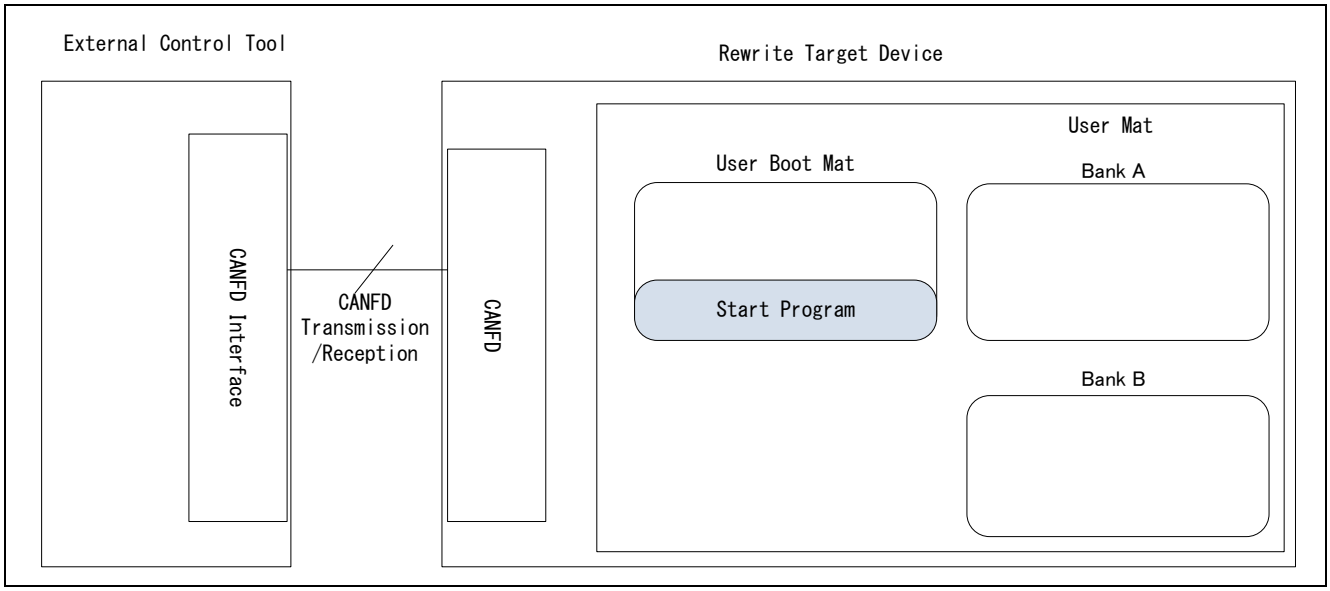

Figure 4-1 Startup Program Operation

Table 4-1 “main_pe0() Function”

Function Name	Overview
main_pe0()	Program starting. After switching the boot bank of the user mat, jump to user program.

Figure 4-1 shows “main_pe0() Function” flowchart.

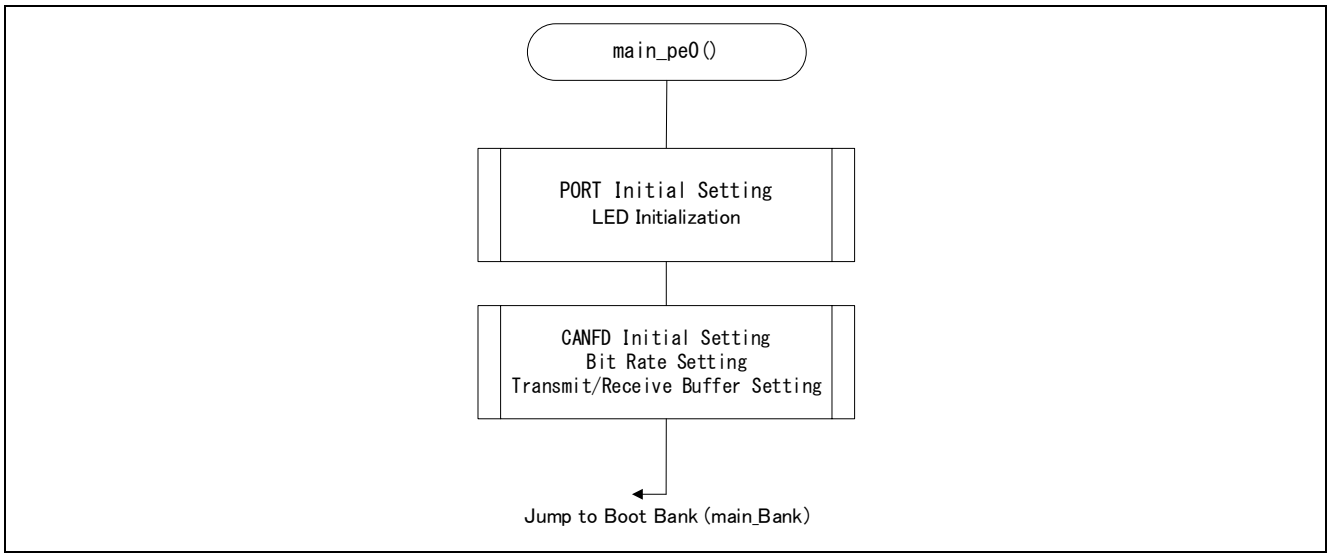

Figure 4-2 “main_pe0() Function” Flowchart

“Operation Procedure ①”

4.1.2 ② BGO Writing

By setting the code flash area to be written to a bank different from the startup bank, “Write Control Program” can be written to the code flash without transferring to RAM. When booting on Bank A, the code flash area of Bank B is rewritten by “Write Control Program” of Bank A.

In main routine, the user program constantly flickering LED is executed, and it executes OTA in parallel with the rewrite control program after receiving the rewrite start request command.

Figure 4-3 shows the code flash erase/write start operation.

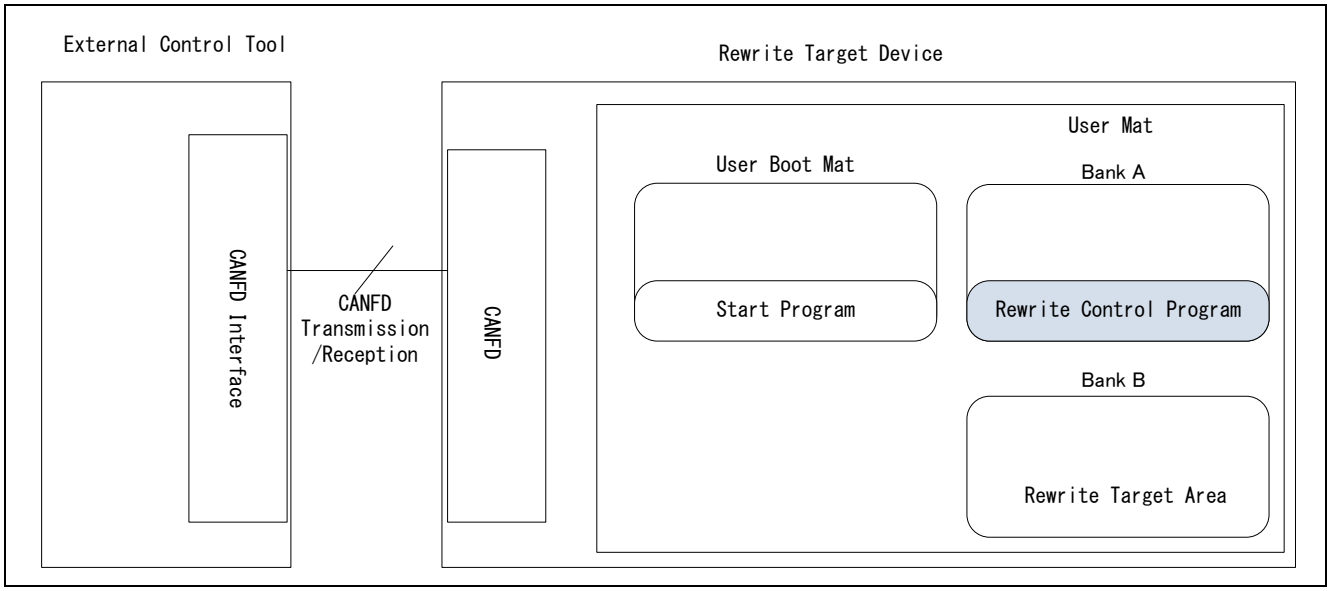

Figure 4-3 Code Flash Erase/Write Start Operation

Function Explanation

Table 4-2 “main_Bank () Function”

Function Name	Overview
main_Bank ()	Repeat LED flicking, and execute “Rewrite Control Program” after receiving rewrite start command.

Figure 4-4 shows “main_Bank ()” flowchart.

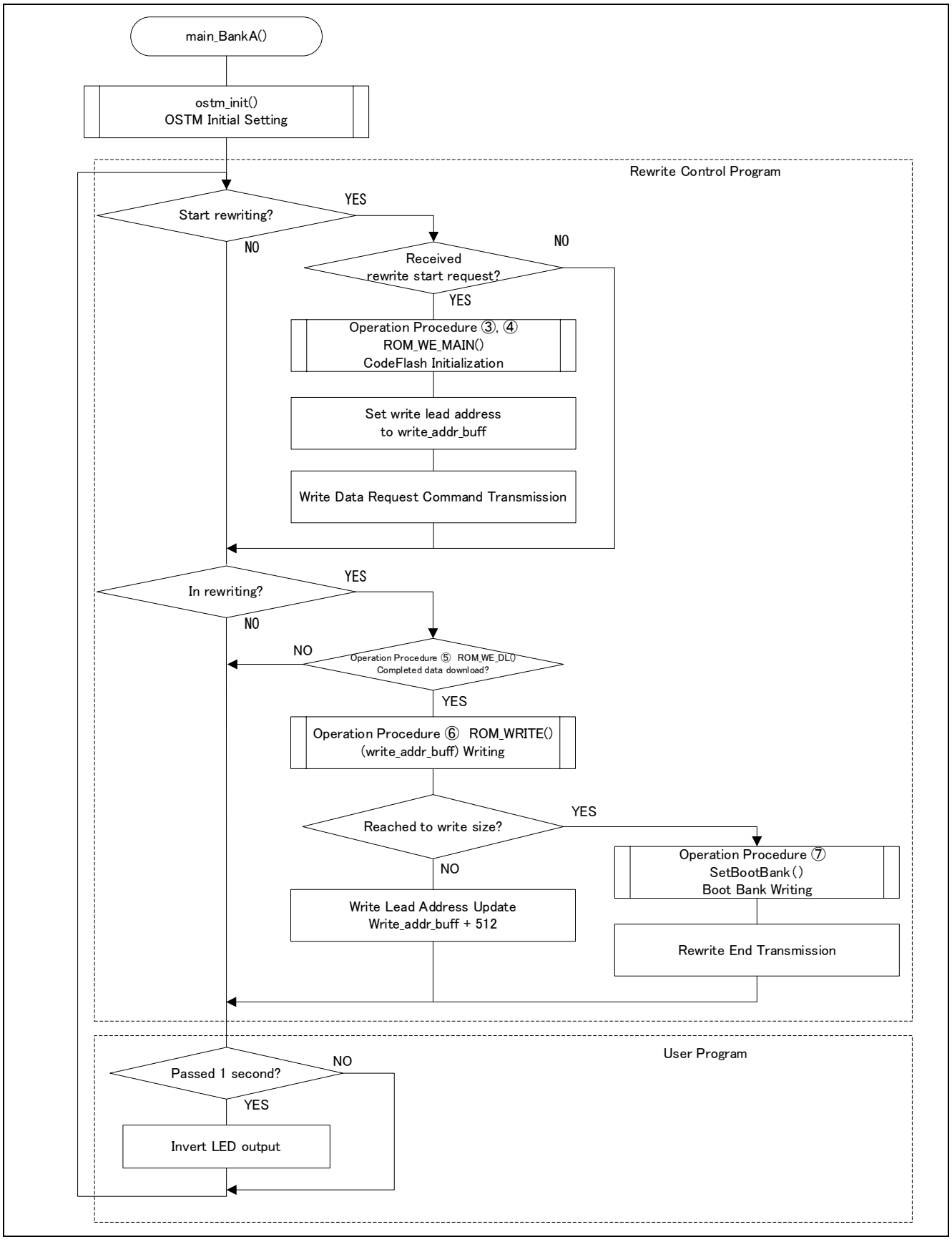

Figure 4-4 “main_Bank () Function” Flowchart

“Operation Procedure ②”

Function Explanation

Table 4-3 “Code Flash_WE_MAIN() Function”

Function Name	Overview
Code Flash_WE_MAIN()	Perform each function call of ID authentication, code flash erasing, code flash write data download, and code flash writing.

Figure 4-5 shows “Code Flash_WE_MAIN() Function” flowchart.

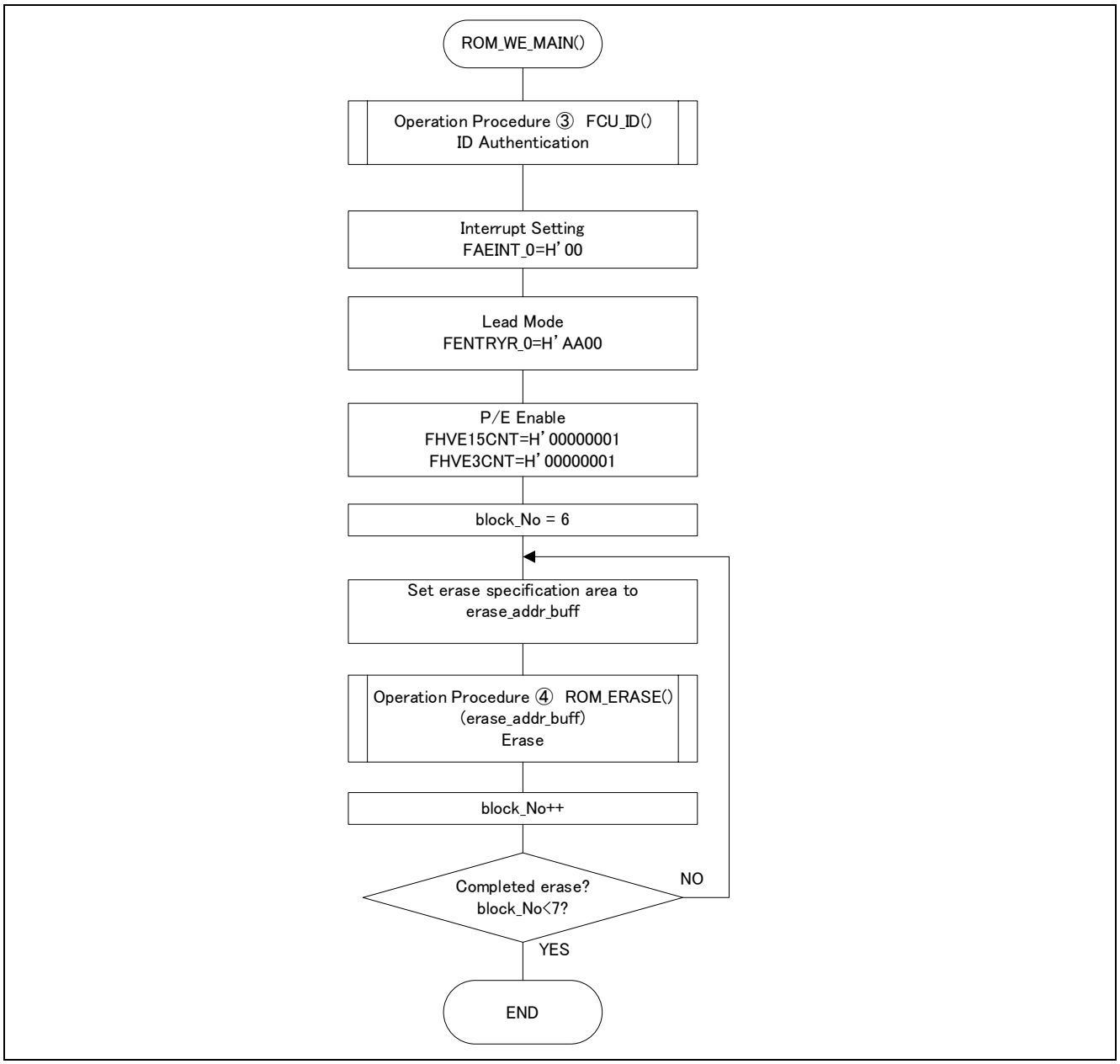

Figure 4-5 “Code Flash_WE_MAIN() Function” Flowchart

“Including Operation Procedure ③, ④”

4.1.3 ③ ID Authentication

Execute “ID Authentication Function” of “Rewrite Control Program”. ID authentication is executed by comparing the 256 bits ID preset in a special area of flash memory with the value of RHSIFIDIN 0 to 7.

In this application note, "0" for the first byte and "F" for other bytes are used as ID setting. Renesas Flash Programmer for RH850 family or the configuration setting command are used for changing ID setting.

Function Explanation

Table 4-4 “FCU_ID() Function”

Function Name	Overview
FCU_ID()	Execute comparison with ID set in the specific area of flash memory and ID authentication.

Figure 4-6 shows “FCU_ID() Function” flowchart.

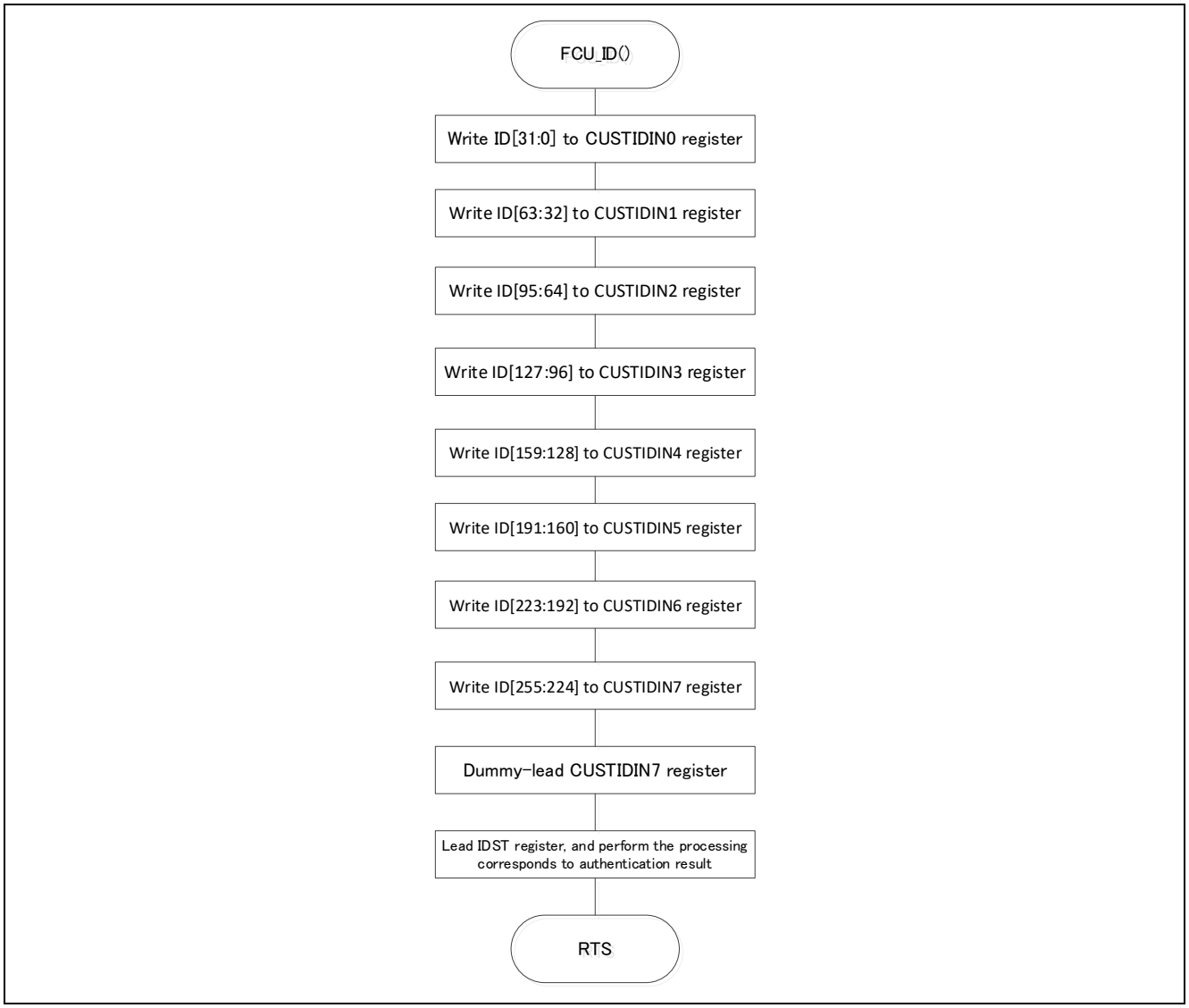

Figure 4-6 “FCU_ID() Function” Flowchart

“Operation Procedure ③”

4.1.4 ④ Code Flash Erase

After ID authentication, execute “Code Flash Erase Function” of “Rewrite Control Program”.

Issue block erase command to FACI command issue area, and erase the code flash rewrite specified area.

Function Explanation

Table 4-5 “Code Flash_ERASE() Function”

Function Name	Overview
Code Flash_ERASE()	Erase code flash rewrite specified area.

Figure 4-7 shows “Code Flash_ERASE()” flowchart.

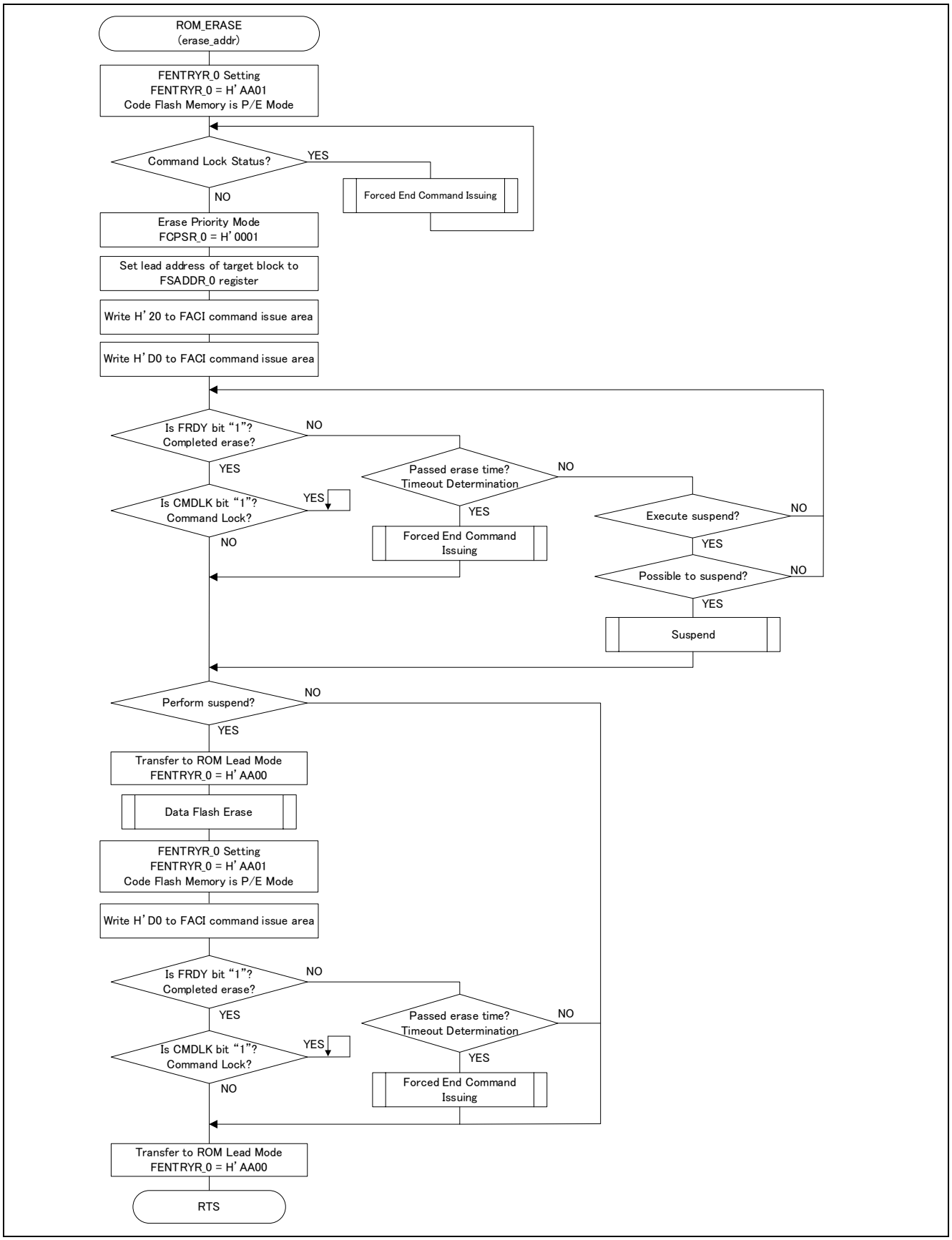

Figure 4-7 “Code Flash_ERASE() Function” Flowchart

“Operation Procedure ④”

Figure 4-8 shows “Code Flash_SUSP() Function” Flowchart.

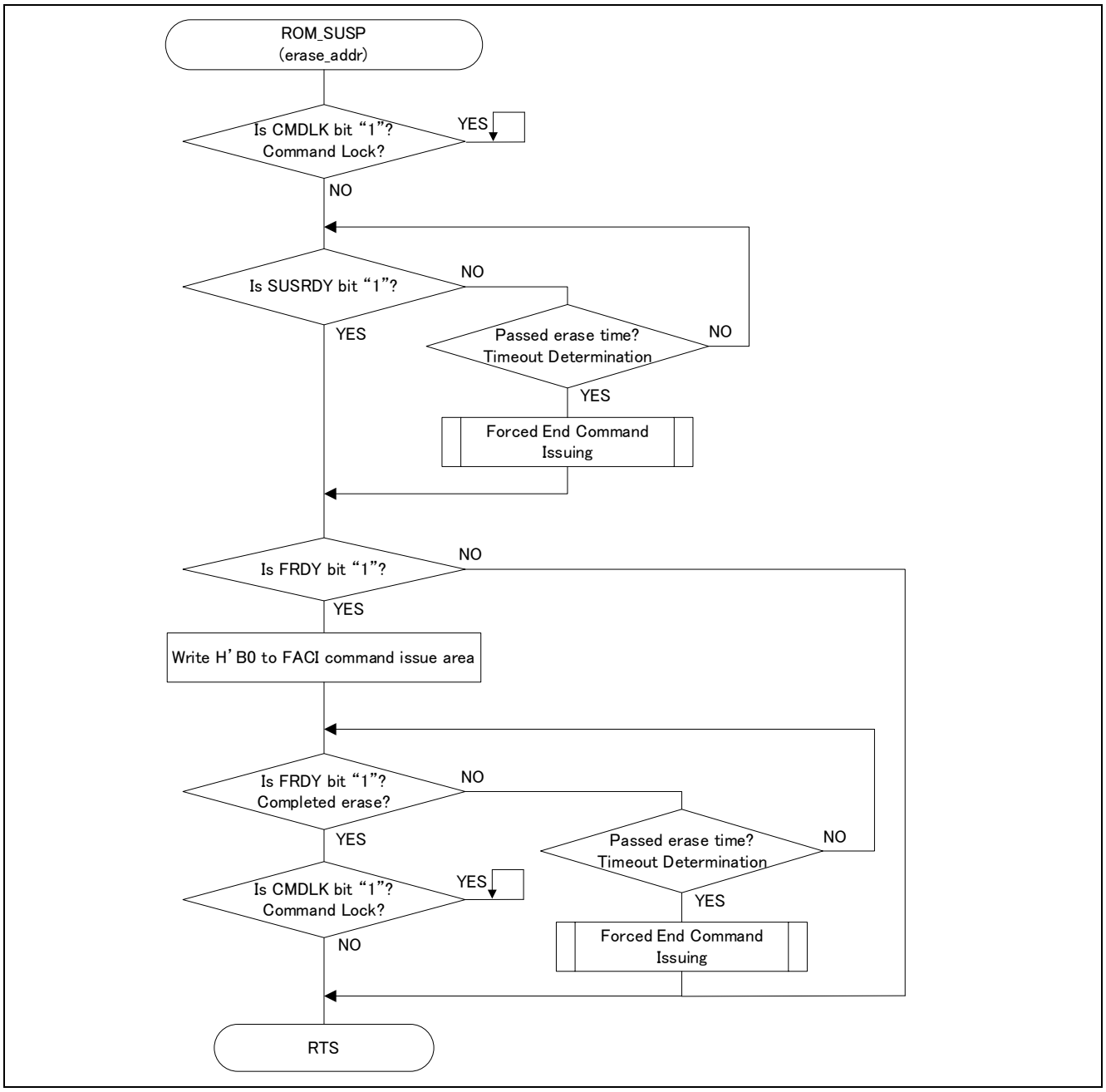

Figure 4-8 “Code Flash_SUSP() Function” Flowchart

4.1.5 ⑤ Code Flash Write Data Download

Execute “Code Flash Write Data Download Function”, and transmit the write data request command. The external device received the write data request command transmits the write data 512 bytes to the microcomputer by the write data download command. In “ Code Flash Write Data Download Function”, store the received write data to RAM.

Function Explanation

Table 4-6 “Code Flash_WE_DL() Function”

Function Name	Overview
Code Flash_WE_DL()	Download write data form external device.

Figure 4-9 shows “Code Flash_WE_DL() Function” flowchart.

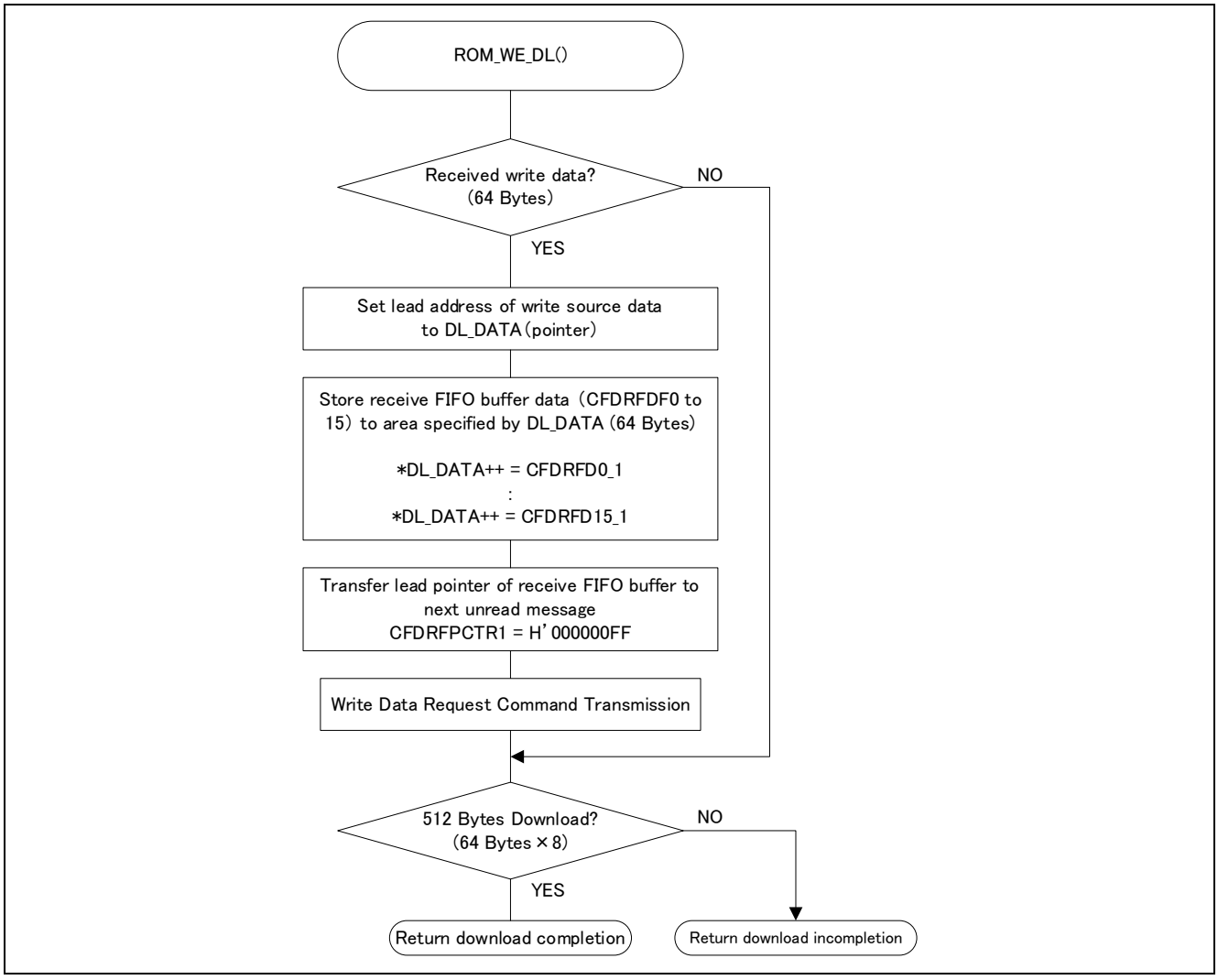

Figure 4-9 “Code Flash_WE_DL() Function” Flowchart

“Operation Procedure ⑤”

4.1.6 ⑥ Code Flash Writing

Write the write data received from the external device by CAN communication to code flash by using “Code Flash Write Function”.

Issue the program command to FACI command issue area, and write it to code flash rewrite specification area. When reaching the write size (96K bytes), terminate the flash rewriting.

Function Explanation

Table 4-7 “Code Flash_WRITE() Function”

Function Name	Overview
Code Flash_WRITE()	Write to code flash rewrite specified area (in 512 bytes unit).

Figure 4-10 shows “Code Flash_WRITE() Function” flowchart.

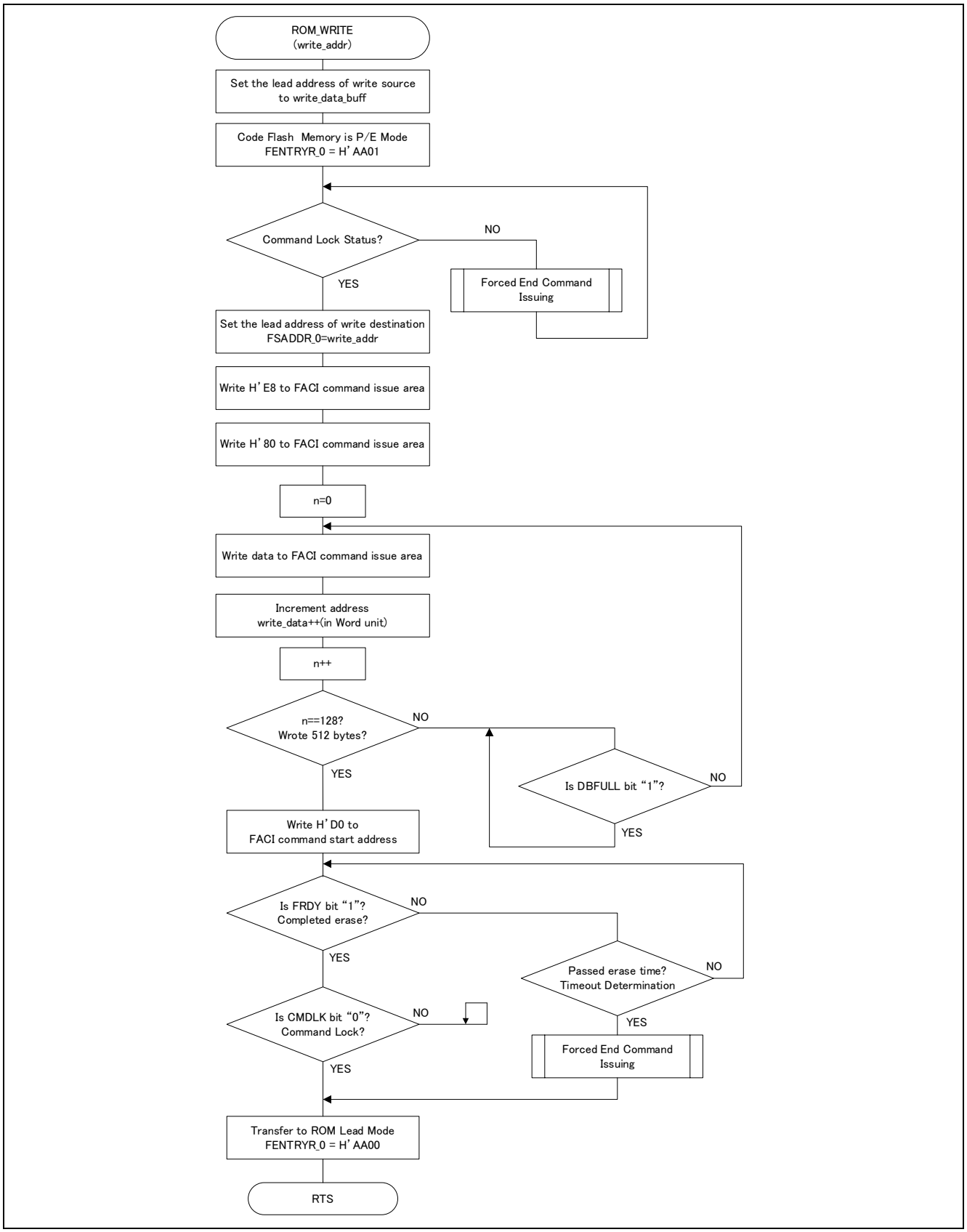

Figure 4-10 “Code Flash_WRITE() Function” Flowchart

“Operation Procedure ⑥”

4.1.7 ⑦ Option Byte Information Write Function

After completing the rewriting, write next boot bank information to the option byte.

Function Explanation

Table 4-8 “SetBootBank () Function”

Function Name	Overview
SetBootBank ()	Determine the next boot bank information, and write it to the option byte.

Figure 4-11 shows “SetBootBank () Function” Flowchart.

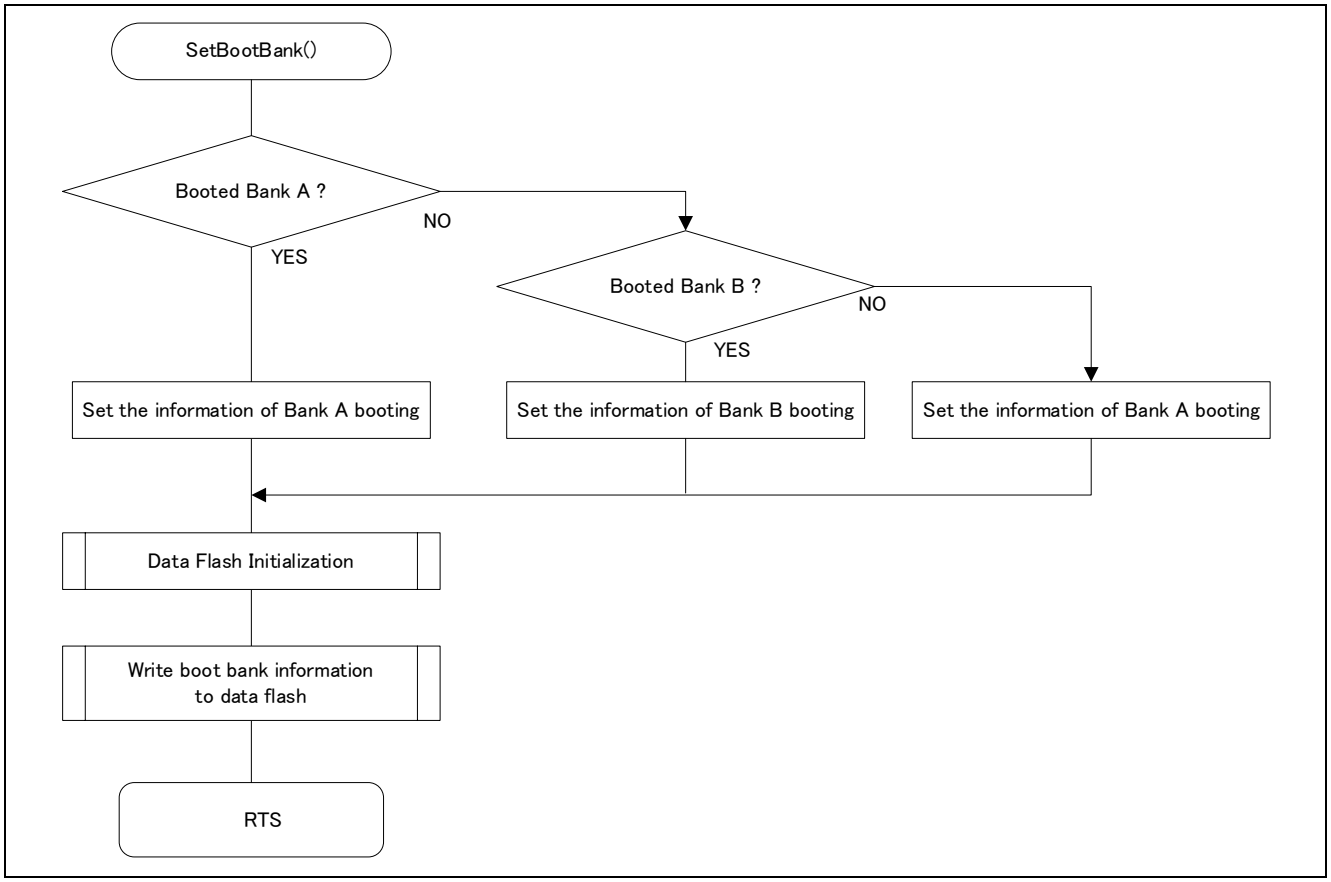

Figure 4-11 “SetBootBank () Function” Flowchart

“Operation Procedure ⑦”

5. Memory Allocation

5.1 Address Map

5.1.1 Address Allocation Diagram

Figure 5-1 shows the address allocation diagram.

Address	Section	
H'0000_0000	RESET	ROM (User Mat)
H'0000_0400	EIINTTBL	
	.rodata	
	.rosdata	
	.ROM.data	
	PE0.rodata	
	PE0.text	
	.secinfo	
	.syscall	
H'0001_4000	.Bank_textA	
	.Bank_text	
	.Bank_rosdata	
	.Bank_rodata	
H'0040_0000	PE1.rodata	
H'0800_0000	UBRESET	ROM (User Boot Mat)
	.text	
H'FDA0_0000	PE1.bss	RAM
	PE1.stack.bss	
H'FDC0_0000	PE0.bss	
	PE0.stack.bss	
	.data	
	.bss	
H'FE00_0000	CRAM0.bss	
H'FE08_0000	CRAM1.bss	
H'FE0A_0000	RRAM.bss	

Address	FCU,FACI
H'FF32_0000	OPBT Area

Figure 5-1 Address Allocation Diagram

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2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

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(Rev.5.0-1 October 2020)

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