78K0, 78K0R, RL78 and V850 Devices

Flash Protection and Security Setting Guide

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Introduction

This application note provides a state-of-the-art protection of the Flash contents against a fraudulent readout of the flash contents of the 78K0, 78K0R, RL78 and V850 devices and a guide to security settings of aforementioned Renesas Electronics embedded flash Microcontrollers (MCUs). The application note first explains which protection features are provided in different access modes and afterward guides through how to achieve a specific protection level by setting security option. For specific device security settings, reference the microcontroller's user manual, HEX Consolidation Utility user manual, PG-FP5 user manual and self-programming library application note for additional details.

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1. Protection Features

The protection of the Flash contents is achieved by implementing a whole range of features. There are different channels to access the Flash which needs to be considered independently:

- ♦ Flash Programming Interface, or the so called ‘Serial Programming Mode
- ♦ Debugging Interface
- ♦ Self-programming Mode
- ♦ Normal operation mode with instruction and data fetch from the flash

The protection of each of the access types is described independently as those protection features are quite independent of each other.

1.1 Flash Programming Interface

The Flash Programming Interface is active in the so called ‘Serial Programming Mode’ which allows the user to write to the internal flash memory of a virgin device or to reprogram a previously written device using an external programming tool. Those tools are either offered by Renesas Electronics, for example PG-FP5, or by 3rd parties. As this is a generic interface which could also be misused for read-out attacks, special care is taken to offer a proper protection of this interface. The following protection flags are available:

- − Chip Erase, where applicable
- − Block Erase
- − Program
- − Read, where applicable
- − Boot block cluster reprogramming

The disabling of those programming interface functions will have the following effects:

1. Chip Erase

The disabling of this function will prevent any erasure of the internal device flash by a flash programmer. Neither single blocks nor the entire flash can be erased. Thus it is not possible to update the stored memory contents with a flash programmer. As the self-programming operation is not influenced by this setting, it is possible to erase the flash memory in self-programming mode, and perform an application update. Please note that this function does not increase the protection against a read-out of the flash contents. This option should only be set if any reprogramming of the device with a flash programmer should be prevented.

2. Block Erase

By disabling the block erase, it is not possible to erase single or multiple blocks of the flash memory. When block erase is disabled, only chip erase is possible. The disabling of the block erase ensures that it is only possible to erase the complete flash memory by chip erase if it is applicable. This ensures that no data remain in the device when performing an application update. Malicious software, which would be downloaded into the device with a flash programmer, will not be able to find remains of the old application. For some devices, it is impossible to erase the device after disabling block erase when chip erase function is not supported on that particular device.

3. Program Note

By disabling program it is not possible to write any further data into the Flash memory. This feature prevents that a non-written area of the Flash is misused to store malicious software or to overwrite already written Flash areas with invalid data to cause software misbehavior.

4. Read

Devices which offer a read command, also offer a flag to disable this command.

5. Boot block cluster reprogramming

The disabling of this function will prevent any erasure of the internal device flash by a flash programmer and any erasure of the boot blocks by self-programming. Thus, the boot blocks will behave like as read only memory (ROM) after activating this function.

Abovementioned security functions are also expressed as security flags such as Chip erase disable flag, Block erase disable flag, Write disable flag, Read disable flag, and Boot block cluster rewrite disable flag. Though different description among in documents, they are the same protection features. Section 2 will explain how to set these features for various protection levels.

Note: For flash programming in this document, program and write are interchangeable jargons and so do the same as reprogram and rewrite.

1.2 Implementation of flags

All above mentioned flags have no influence on the self-programming operations except Boot block cluster reprogramming. Even if the flags are set, all operation can be performed in the self-programming mode. Self-programming, nevertheless, cannot erase boot blocks when Boot block cluster reprogramming function is set. Example: When setting the block erase disable flag, single blocks cannot be erased via an external flash programming tool, but it is still possible to erase a single block, or a set of blocks, in the self-programming mode. The flags are implemented in such a way that the communication protocol rejects any command which is prohibited by the flags. Furthermore, the programming hardware itself is also configured by the flags in such a way that any operation which is prohibited by the flags is not possible.

1.3 Recommendation for usage of flags

Out of those flags, the ‘Block Erase’, ‘Program’, and ‘Read’ flags are considered to be sufficient for an effective read-out protection. The ‘Chip Erase’ and ‘Boot block cluster reprogramming’ disable prevents a reprogramming in serial mode completely and should therefore be used with care.

1.4 Debugging Interface

For the debugging interface a 10 bytes password can be chosen which needs to be transmitted before the debugging interface can be used. For 32-bit device, V850 series, by setting the uppermost bit of this password to ‘0’ it is possible to disable the interface completely. For 8-bit and 16-bit devices, On-chip debug option byte setting will determine whether debug operation is enable or disable. This option byte setting can also be set for additional protection to erase flash content in case of authentication fail.

1.5 Self-programming

The basic idea of self-programming is to write data, which are already available in the RAM of the device, to the Flash memory. Thus, the application needs the ability to receive those data from the outside. In order to provide the greatest flexibility, there is no limitation on the communication channel to receive those data. Consequently, it is not possible to provide a dedicated protection of those channels by Renesas Electronics, but partial protection can be done by Boot block cluster reprogramming and Flash Shield Window, which is explained in section 2.4. By setting Boot block cluster reprogramming function and/or Flash Shield Window, self-programming cannot reprogram specified flash memory area. It is up to the application program to ensure that those communication channels are not misused to gain an unwanted access to the flash and its contents.

1.6 Normal operation mode

During normal operation mode no data which have been fetched from the internal memory can be observed from the outside. As some application offer diagnostic functions, it needs to be ensured that those diagnostic functions are properly protected against a misuse.

1.7 Considerations when using Flash protection flags

- **Potential influence on the Bootswap function of V850 devices**
  The programming interface offers a single function to set the security flags. For V850 this command includes also a block number which is used either for the Boot cluster protection or for the Bootswap function. As this block number needs to be transmitted and as the original value of a blank device, which is 0xFF, is not possible, the activation of any security flag necessarily modifies the block number of the Bootswap function.

1.8 Low Pin Count device flash protection

For RL78 low pin count 8-bit microcontroller such as RL78/G10, there has neither security flag nor self-programming functionality. This device can be checked blank only when shipped from factory. Once programmed the device, it can be erased and programmed by executing with single command – program after erase on entire flash memory. Thus, individual or a group of blocks erase and program are impossible. Since there is no security flag in this device, you cannot prohibit the device for reprogramming. Read and verify commands are not supported as well.

2. Security Option

Using Renesas Electronics dedicated flash programmer PG-FP5 or third party programmer, application code in flash memory is secured by different levels of protection features. The security settings can also be set by self-programming and the explanation of detail setting using self-programming library will be described in respective *User Manual*. Using HEX Consolidation Utility software (HCU), the security settings can be merged with application code to single file and later utilized for factory programming. This section will explain on how to set these protections and their results of individual and combination of the setting. The following section will explain in detail on security option.

- ♦ Definition of Terms
- ♦ Security Settings
- ♦ Protection configuration settings

2.1 Definition of Terms

– Application code
Application code is an HEX file (i.e. program file) which is programmed without security option data into embedded flash memory.

– [Erase] command
The Erase command erases the flash memory in the target device. The erase command performs in two Operation modes: Chip mode and Block mode (refer to Figure 1[b]).The command erases all blocks in Chip mode and erases defined blocks only in Block mode.

– [Program] command
The Program command transmits the memory contents (program files) in the PG-FP5 valid programming area to the target device and writes the programs to the embedded flash memory.

– [Read] command
The Read command loads data on the embedded flash memory in the target device and saves it as a file. The read data can be saved in the Intel HEX format or Motorola HEX format

– [Security] command
The Security command sets the security functions (security settings) for the target device.

– [Get Security settings] command
The Get Security Settings command reads the setting of the security functions from the target device and displays the result in the PG-FP5 GUI.

– ESF file
ESF file (customized setup file) contains the programming environment settings specific to the user environment. This ESF file is generated by PG-FP5 programmer and not compatible to SET file generated by former programmer, PG-FP4.

– HCUHEX file
An HCUHEX file is created by HEX Consolidation Utility software for merging HEX files and option data.

Note: The commands inside the closed bracket “[ ]” are executable by PG-FP5 programmer. This command symbol will be used throughout this document.

2.2 Security Settings

Renesas Electronics microcontroller has five security functions and Flash Shield Window in embedded flash memory for protection. The following are description of each security and flash shield window function.

I. Security function

1. **Disable Chip Erase** [Note 1]
This security setting can prohibit erase command in Chip Operation mode (chip erase command) if it is applicable. Checked Disable Chip Erase box in Figure 3 [a], which selects as checked option, activates Chip erase disable flag and can prohibit erasing entire embedded flash memory.

2. **Disable Block Erase**
This security setting can prohibit erase command in Block Operation mode (Block erase command). Checked Disable Block Erase box in Figure 4[a], which selects as checked option, activates Block erase disable flag and

can prohibit erasing flash block via Programming Interface, but it does not affect on block erase by self-programming.

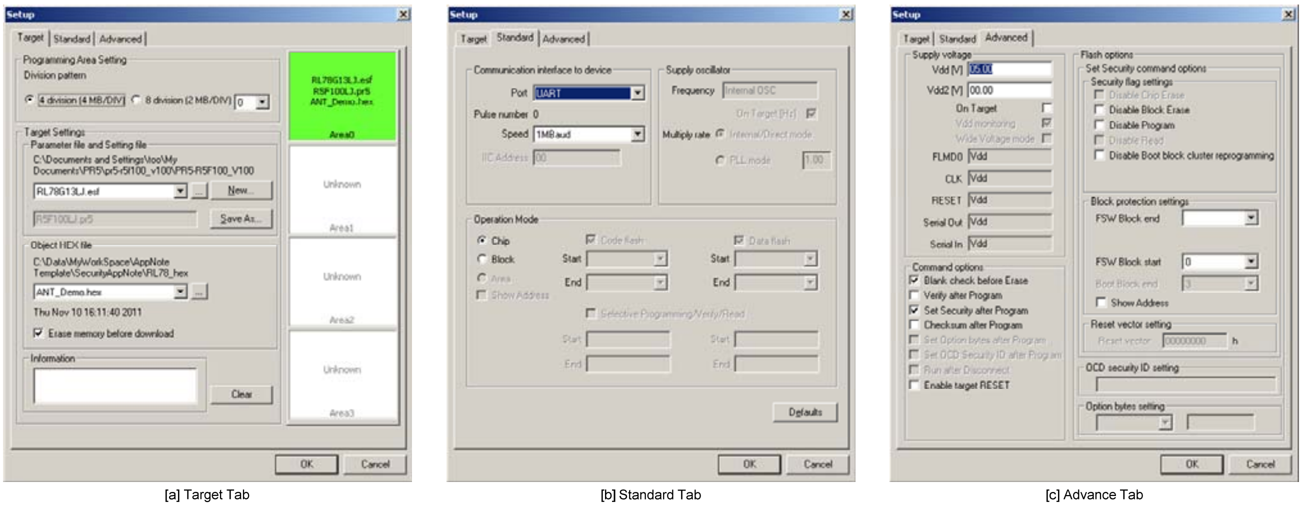
3. **Disable Program**
   This security setting can prohibit program command. Checked Disable Program box in Figure 4[a], which selects as checked option, activates Program disable flag and can prohibit program command, but it allows reprogramming by self-programming.

4. **Disable Read** Note 2
   This security setting can prohibit read command via Programming Interface. Checked Disable Read box in Figure 4[a], which selects as checked option, activates Read disable flag and can prohibit reading data from embedded flash memory via Programming Interface.

5. **Disable Boot block cluster reprogramming**
   This security setting can prohibit program command to boot blocks. Checked Disable Boot block cluster reprogramming box in Figure 4[a], which selects as checked option, activates Boot block cluster rewrite disable flag and can prohibit writing boot blocks. After setting this security function, self-programming can erase and write individual block except boot blocks.

Note 1 and 2:

Disable Chip Erase and Disable Read setting are only accessible on supported device. If the device does not support these features, Disable Chip Erase and Disable Read check boxes will dim in setup dialog box. Refer to specific device's User Manual for a detailed description. For example, Figure 1 [c] shows these circumstances in Security flag setting group box.



[a] Target Tab

Programming Area Setting
Division pattern
● 4 division (4 MB/DIV) ○ 8 division (2 MB/DIV) 0

Target Settings
Parameter file and Setting file
C:\Documents and Settings\too\My Documents\PR5\pr5-r5f100_v100\PR5-R5F100_V100
RL78G13LJ.esf
R5F100LJ.pr5

Object HEX file
C:\Data\MyWorkSpace\AppNote Template\SecurityAppNote\RL78_hex
ANT_Demo.hex
Thu Nov 10 16:11:40 2011
☑ Erase memory before download

Information

Area0: RL78G13LJ.esf, R5F100LJ.pr5, ANT_Demo.hex
Area1: Unknown
Area2: Unknown
Area3: Unknown

[b] Standard Tab

Communication interface to device
Port: UART
Pulse number: 0
Speed: 1MBaud
IIC Address: 00

Supply oscillator
Frequency: Internal OSC
On Target [Hz] ☑
Multiply rate ● Internal/Direct mode
○ PLL mode 1.00

Operation Mode
● Chip
○ Block
○ Area
□ Show Address
☑ Code flash Start End
☑ Data flash Start End
□ Selective Programming/Verify/Read
Start End
Start End

[c] Advance Tab

Supply voltage
Vdd [V]: 05.00
Vdd2 [V]: 00.00
On Target □
Vdd monitoring ☑
Wide Voltage mode □
FLMD0: Vdd
CLK: Vdd
RESET: Vdd
Serial Out: Vdd
Serial In: Vdd

Command options
☑ Blank check before Erase
□ Verify after Program
☑ Set Security after Program
□ Checksum after Program
□ Set Option bytes after Program
□ Set OCD Security ID after Program
□ Run after Disconnect
□ Enable target RESET

Flash options
Set Security command options
Security flag settings
□ Disable Chip Erase
□ Disable Block Erase
□ Disable Program
□ Disable Read
□ Disable Boot block cluster reprogramming

Block protection settings
FSW Block end:
FSW Block start: 0
Boot Block end: 3
□ Show Address

Reset vector setting
Reset vector: 00000000 h

OCD security ID setting

Option bytes setting

Figure 1 PG-FP5 Setup Windows

II. Flash shield window function

Flash shield window function can prevent writing and erasing flash memory area out of specified range in self-programming. The window, however, does not limit to Programming Interface command. The flash shield window range can be set or changed via start block and end block of flash memory either under Block protection area form programmer GUI (as shown in Figure 1[c], Block protection setting group box) or in self-programming mode. The relationship between flash shield window function and Programming Interface commands is shown in Table 1. This function can only be available on supported device.

Table 1. Relationship between flash shield window function and Commands

Programming Conditions	Flash shield window range	Command	
		Block Erase	Program
Self-programming	Specify window range by self-programming library function	Enable block erase within specified flash shield window range	Enable program within specified flash shield window range
Programming Interface	Specify window range under	No effect on specified	No effect on specified

	Block protection area in programmer GUI	flash shield window range	flash shield window range

Note: Block protection area is only accessible on supported device. If the device does not support this feature, the FS Block end and FS Block start check boxes will dim in Block protection area.

2.3 Protection configuration settings

Each security setting has different protection levels and one or more settings can be activated by selecting checked options in parallel to facilitate security functions. After selecting checked option to Disable Chip Erase box, the application code is impossible to update via Programming Interface; it is possible to write by self-programming, however. The effects of Programming Interface commands and self-programming by security setting are shown in Table 3, Table 4, and Table 5 respectively. Protection level, Interface commands and self-programming related to Security settings will be described in the following sections.

2.4 Security protection level

Basically, protection level can be set as irreversible or reversible setting. Once set to protection level to irreversible setting, the security setting cannot be changed to its original state. In contrast, protection level reversible setting can be possible to alter all security settings to default state by executing chip erase command or security release command whichever supported by device. [Erase] command in Chip operation mode by PG-FP5 programming interface can alter all security settings to unchecked condition. The security protection level settings are shown in Table 2.

Table 2. Security protection level with Chip Erase function

Security Setting	Description	Protection Level Setting
Disable Chip Erase (if applicable)	Impossible to erase chip after setting checked option	Irreversible
Disable Boot block cluster reprogramming	Impossible to erase chip after setting checked option	Irreversible
Disable Program	Impossible to program after setting checked option	Reversible
Disable Block Erase	Impossible to erase block after setting checked option	Reversible
Disable Read (if applicable)	Impossible to read after setting checked option	Reversible

Note: It is only possible to restore the security setting to default state if all blocks are erased at once by [Erase] command in Chip operation mode.

2.5 Relationship between security settings and Programming Interface command

Depending on security setting, programmer cannot execute any one or more of the Programming Interface commands. For example, by using the device that supports all security flag setting shown in Figure 4[a] and checking to Disable Program and Disable Block Erase boxes, programmer can execute [Erase] command and [Read] command only. If you also check to Disable Read box in previous setting, programmer can execute only [Erase] command. Any combination of security settings can be set for different protection levels. The relationship between security settings and Programming Interface commands with Chip Erase function is shown in Table 3, and the relationship without Chip Erase function is shown in Table 4. Block erase function is used for erasing all blocks when [Erase] command is used in PG-FP5 programmer if there is no chip erase function. The programmer cannot support [Read] command to 8-bit and 16-bit MCU such as 78K0, 78K0R, and RL78 device because read function is not applicable to those devices. Thus, Security setting for Disable Read is conditionally applicable in Table 3 and Table 4. For specific relationship between security settings and Programming Interface commands, refer to respective device's *User Manual* for additional details.

Table 3. Relationship of security settings and Programming Interface commands with Chip Erase function

Security setting	Programming Interface command			
	Chip erase	**Block erase**	**Program**	**Read**
Disable Chip erase	Impossible	Impossible	Possible	Possible
Disable Block erase	Possible	Impossible	Possible	Possible
Disable Program	Possible	Impossible	Impossible	Possible
Disable Read (if applicable)	Possible	Possible	Possible	Impossible
Disable Boot block cluster reprogramming	Impossible	Possible [Note1]	Possible [Note1]	Possible

Table 4. Relationship of security settings and Programming Interface commands without Chip Erase function

Security setting	Programming Interface command			
	Chip erase	**Block erase**	**Program**	**Read**
Disable Chip erase	▨	▨	▨	▨
Disable Block erase	▨	Impossible	Possible [Note2]	Possible
Disable Program	▨	Possible	Impossible	Possible
Disable Read (if applicable)	▨	Possible	Possible	Impossible
Disable Boot block cluster reprogramming	▨	Possible [Note1]	Possible [Note1]	Possible

Note1: All blocks other than boot blocks.

Note2: Only for blank blocks after disabling Block erase setting.

Impossible	: Impossible to execute Programming Interface command after setting checked option
Possible	: Possible to execute Programming Interface command after setting checked option

2.6 Effect of security setting on self-programming functions

All security settings do not affect on self-programming except Disable Boot block cluster reprogramming function. Selecting checked option to Disable Boot block cluster reprogramming function prohibits erasing boot blocks so that neither chip erase command nor self-programming can erase the boot blocks. Disable Block erase function, nevertheless, does not affect on blocks except boot blocks for both Programming Interface and self-programming. If you select block option button inside Operation mode group box in Figure 1 [b], checking Disable Boot block cluster reprogramming function will not affect on erasing blocks except boot blocks by Programming Interface. If the device has not supported Chip Erase function (see Figure 1 [c], dimmed Disable Chip Erase check box), the same configuration, checking Disable Boot block cluster reprogramming function as abovementioned, will not affect on erasing individual block except boot blocks by self-programming. Refer to the respective device self-programming library User Manual for detailed description.

Table 5. Relationship between security settings and self-programming

Security setting	Self-programming function
Disable Chip erase (if applicable)	No effect on self-programming functions after setting checked option
Disable Block erase	
Disable Program	
Disable Read (if applicable)	
Disable Boot block cluster reprogramming	Effect on block erase and write functions to boot block clusters after setting checked option.

3. Setting security option

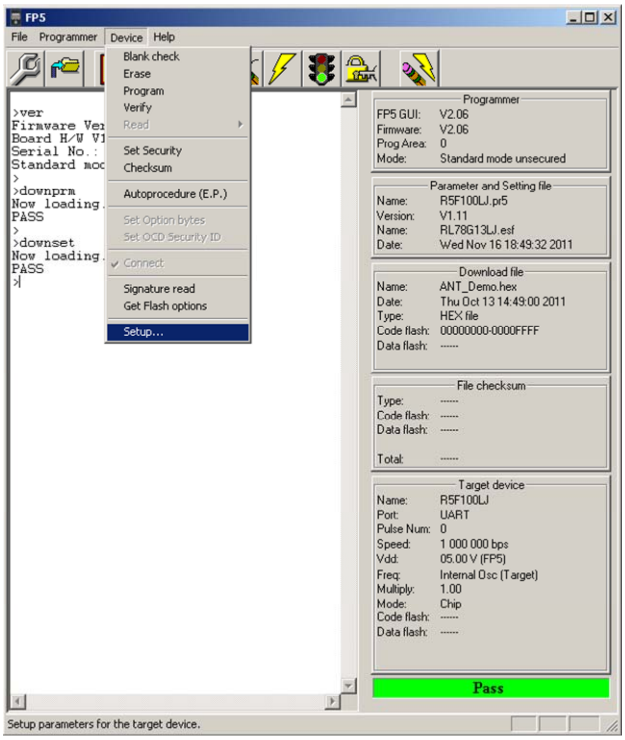
The security settings can be set in three ways – Programming Interface, HEX Consolidation Utility software and self-programming. Programming Interface can set security option using on-board or off-board programming. HEX Consolidation Utility software, on the other hand, allows setting security option in edit mode for factory programming and self-programming can set by self-programming library when device is executing application code. If HEX Consolidation Utility software cannot support the device, manual security setting will be processed with printed form known as Option Release Form. Sample Option form is shown in Appendix B. The form is only available on regional support up on request and contact regional representative for availability. In case of online File Transfer System is available in that region, use online instead of printed form. For example, the online system can be available at https://romcode.renesas.eu/rcts/ for Europe region.

3.1 Setting security option by Programming Interface

PG-FP5 programmer allows you to set the security option and program application code. To set security option, select setup command under Device pull-down menu from Main window as shown in Figure 2. Setup Dialog box will prompt for setting option data as shown in Figure 1 [a], [b] and [c]. Select Advanced Tab for selecting Security flag settings – refer to Figure 3[a]. Checked appropriate option buttons in Security flag settings group box will activate the respective security functions. The setting will be saved in ESF file after clicking OK button and back to Main Window. Either executing security command under Device pull-down menu or clicking security icon will program the option data to embedded flash memory.

Since option data is set differently from Application code, it cannot be written by Program command. Alternatively, executing Program command does not program the Security flag settings. Security command, however, will execute automatically after executing Program command if select checked option to “Security after Program” in Command options, which shown in Figure 4[a].

When the HCU object HEX file is loaded for programming to PG-FP5 as shown in Figure 3 [b], the security setting cannot be configurable by user. All the check boxes in Security flag setting group box will be dimmed to prevent checking the boxes. This circumstance of loading with HCU object HEX file shows in Figure 4 [b] for Security flag setting.



```
>ver
Firmware Ver
Board H/W V1
Serial No.:
Standard moc
>
>downprm
Now loading.
PASS
>
>downset
Now loading.
PASS
>|
```

Programmer
FP5 GUI: V2.06
Firmware: V2.06
Prog Area: 0
Mode: Standard mode unsecured

Parameter and Setting file
Name: R5F100LJ.pr5
Version: V1.11
Name: RL78G13LJ.esf
Date: Wed Nov 16 18:49:32 2011

Download file
Name: ANT_Demo.hex
Date: Thu Oct 13 14:49:00 2011
Type: HEX file
Code flash: 00000000-0000FFFF
Data flash: ------

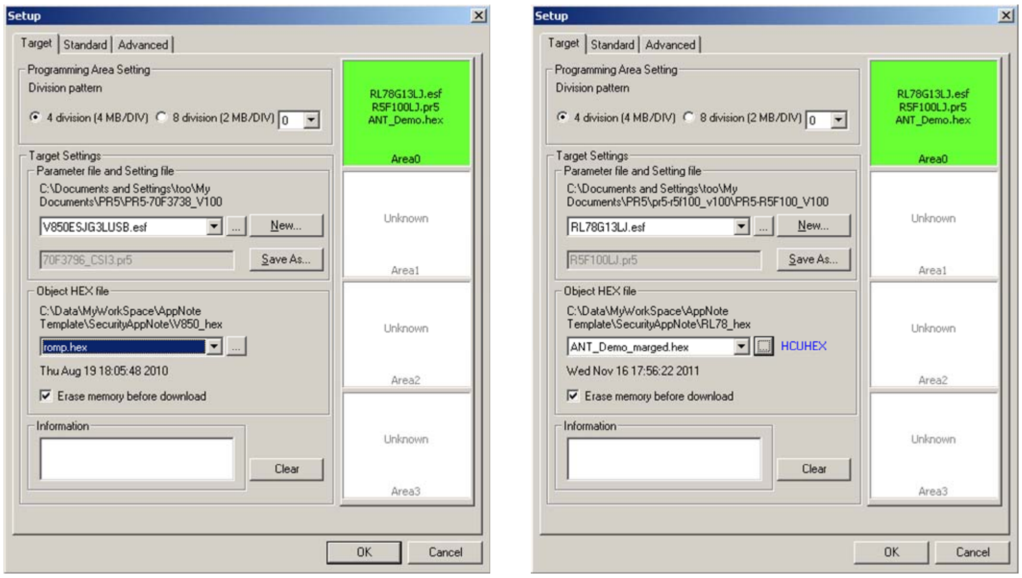
File checksum
Type: ------
Code flash: ------
Data flash: ------
Total: ------

Target device
Name: R5F100LJ
Port: UART
Pulse Num: 0
Speed: 1 000 000 bps
Vdd: 05.00 V (FP5)
Freq: Internal Osc (Target)
Multiply: 1.00
Mode: Chip
Code flash: ------
Data flash: ------

Pass

Setup parameters for the target device.

Figure 2 Main Window



Setup

Target | Standard | Advanced

Programming Area Setting
Division pattern
● 4 division (4 MB/DIV) ○ 8 division (2 MB/DIV) 0

Target Settings
Parameter file and Setting file
C:\Documents and Settings\too\My Documents\PR5\PR5-70F3738_V100
V850ESJG3LUSB.esf
70F3796_CSI3.pr5

Object HEX file
C:\Data\MyWorkSpace\AppNote Template\SecurityAppNote\V850_hex
romp.hex
Thu Aug 19 18:05:48 2010
☑ Erase memory before download

Area0: RL78G13LJ.esf R5F100LJ.pr5 ANT_Demo.hex
Area1: Unknown
Area2: Unknown
Area3: Unknown

[a] Load with object HEX file

Setup

Target | Standard | Advanced

Programming Area Setting
Division pattern
● 4 division (4 MB/DIV) ○ 8 division (2 MB/DIV) 0

Target Settings
Parameter file and Setting file
C:\Documents and Settings\too\My Documents\PR5\pr5-r5f100_v100\PR5-R5F100_V100
RL78G13LJ.esf
R5F100LJ.pr5

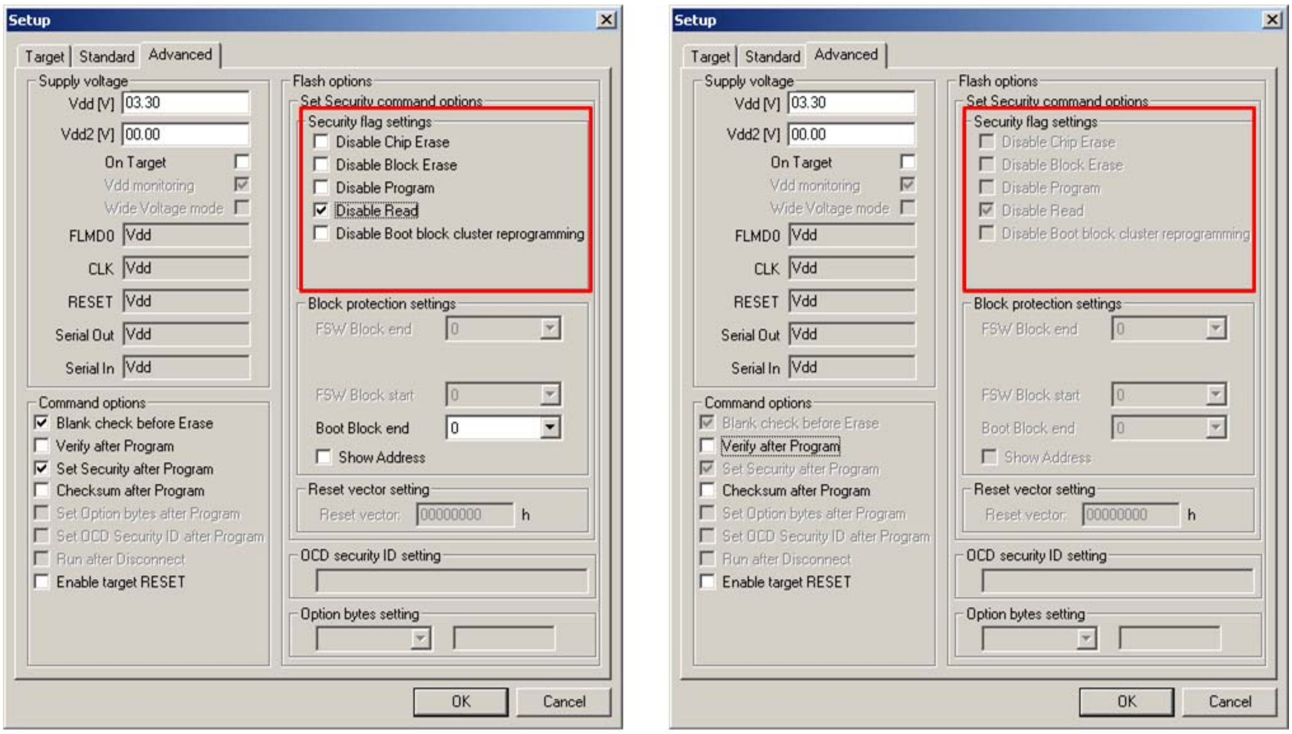
Object HEX file
C:\Data\MyWorkSpace\AppNote Template\SecurityAppNote\RL78_hex
ANT_Demo_marged.hex HCUHEX
Wed Nov 16 17:56:22 2011
☑ Erase memory before download

Area0: RL78G13LJ.esf R5F100LJ.pr5 ANT_Demo.hex
Area1: Unknown
Area2: Unknown
Area3: Unknown

[b] Load with HCU object HEX file

Figure 3 Device Setup Dialog Box

For retrieving security option from target device, select Get Security Settings command under Device pull-down menu and Setup dialog box will prompt with programmed Security flag settings. In this dialog box, clicking OK button will store up-loaded option data to ESF file and revise the previous setting. Refer to PG-FP5 *User Manual* for a more detailed description.



Setup

Target | Standard | Advanced

Supply voltage
Vdd [V] 03.30
Vdd2 [V] 00.00
On Target □
Vdd monitoring ☑
Wide Voltage mode □
FLMD0 Vdd
CLK Vdd
RESET Vdd
Serial Out Vdd
Serial In Vdd

Command options
☑ Blank check before Erase
□ Verify after Program
☑ Set Security after Program
□ Checksum after Program
□ Set Option bytes after Program
□ Set OCD Security ID after Program
□ Run after Disconnect
□ Enable target RESET

Flash options
Set Security command options
Security flag settings
□ Disable Chip Erase
□ Disable Block Erase
□ Disable Program
☑ Disable Read
□ Disable Boot block cluster reprogramming

Block protection settings
FSW Block end 0
FSW Block start 0
Boot Block end 0
□ Show Address

Reset vector setting
Reset vector 00000000 h

OCD security ID setting

Option bytes setting

[a] Load with object HEX file

Setup

Target | Standard | Advanced

Supply voltage
Vdd [V] 03.30
Vdd2 [V] 00.00
On Target □
Vdd monitoring ☑
Wide Voltage mode □
FLMD0 Vdd
CLK Vdd
RESET Vdd
Serial Out Vdd
Serial In Vdd

Command options
☑ Blank check before Erase
□ Verify after Program
☑ Set Security after Program
□ Checksum after Program
□ Set Option bytes after Program
□ Set OCD Security ID after Program
□ Run after Disconnect
□ Enable target RESET

Flash options
Set Security command options
Security flag settings
□ Disable Chip Erase
□ Disable Block Erase
□ Disable Program
☑ Disable Read
□ Disable Boot block cluster reprogramming

Block protection settings
FSW Block end 0
FSW Block start 0
Boot Block end 0
□ Show Address

Reset vector setting
Reset vector 00000000 h

OCD security ID setting

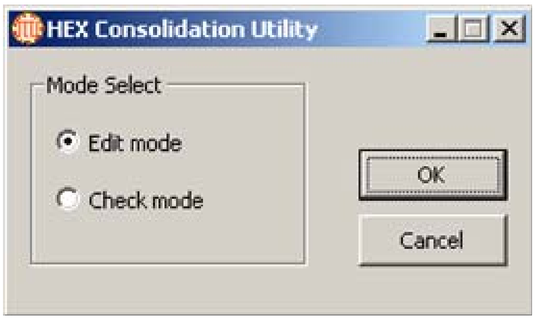
Option bytes setting

[b] Load with HCU object file

Figure 4 Security flag settings from target device

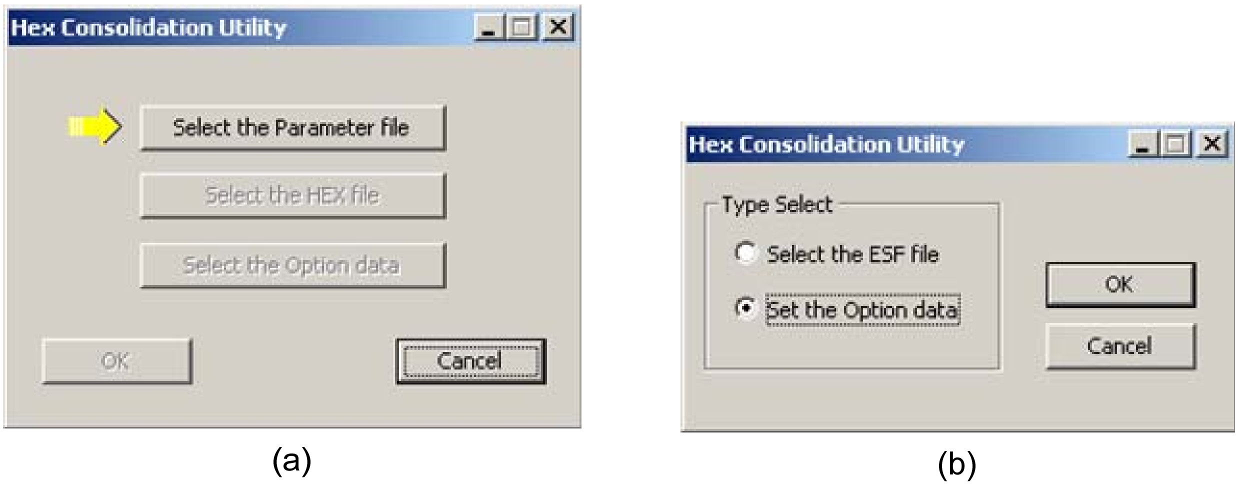
3.2 Setting security by HEX consolidation utility

HEX Consolidation Utility software (HCU) is a program that combines application code and option data into single HCUHEX file. This program has two modes: Edit mode and Check mode (see Figure 5). Edit mode allows you to set security option, and Check mode can review the setting. To set security option, first, run HCU program and select Edit mode from HCU Main selection box and then click OK button. Second selection box (see Figure 6[a]) will prompt for selecting parameter meter file, hex file and option data. After selecting parameter file and hex file, clicking third selection button “Select Option data”, will prompt a message box shown in Figure 6[b] for option data selection. Select Set Option data and click OK button. The Option data dialog box will open to set security option. Checked respective boxes in Security flag settings, shown in Figure 7, will activate the respective security functions. Depend on the selected device, only supported flag can be checked in Security flag setting group box. The option buttons which are not supported security flags in this group box will dimed. In the Figure 7, Disable Chip Erase and Disable Read are not supported in this case. Finally, click OK buttons to generate consolidated HCUHEX file and ready for programming. After consolidating application code and option data, the HCUHEX file is needed to verify with PG-FP5 or MINICUBE2® by programming to the selected device. Refer to the HEX Consolidation Utility software *User Manual* for more details.



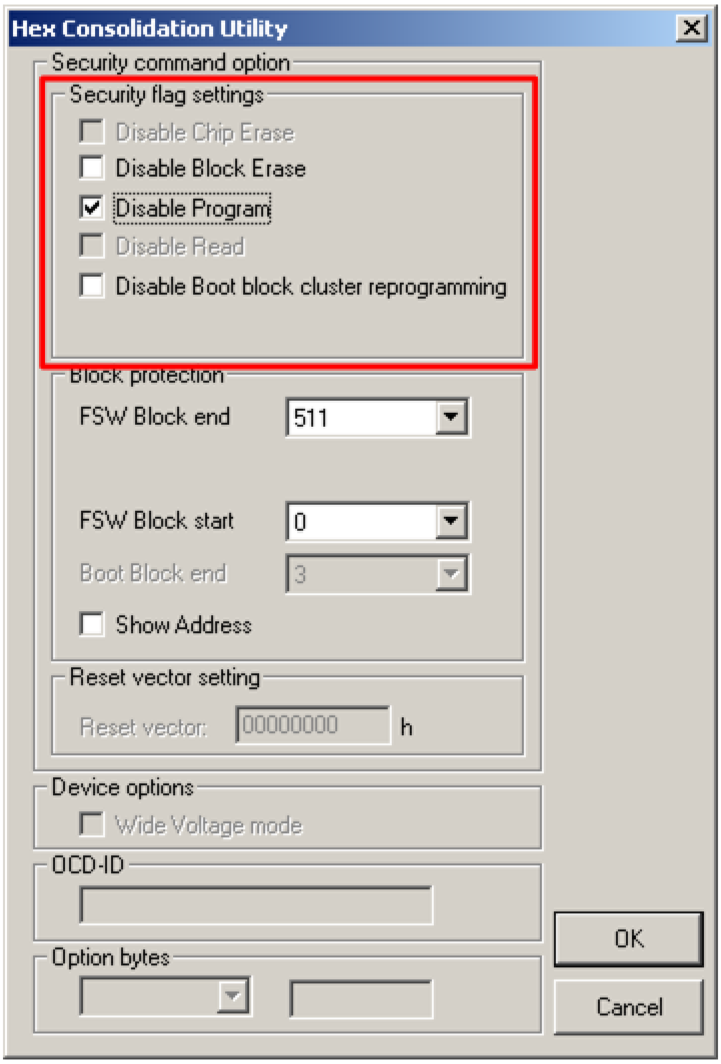
● Edit mode
○ Check mode

Figure 5 HCU Main selection box


Hex Consolidation Utility
Select the Parameter file
Select the HEX file
Select the Option data
OK
Cancel
(a)
Hex Consolidation Utility
Type Select
OK
Cancel
(b)

○ Select the ESF file
● Set the Option data

Figure 6 HCU selection box



Hex Consolidation Utility

Security command option

Security flag settings

- □ Disable Chip Erase
- □ Disable Block Erase
- ☑ Disable Program
- □ Disable Read
- □ Disable Boot block cluster reprogramming

Block protection

FSW Block end: 511

FSW Block start: 0

Boot Block end: 3

□ Show Address

Reset vector setting

Reset vector: 00000000 h

Device options

□ Wide Voltage mode

OCD-ID

Option bytes

Figure 7 HCU Option data dialog box

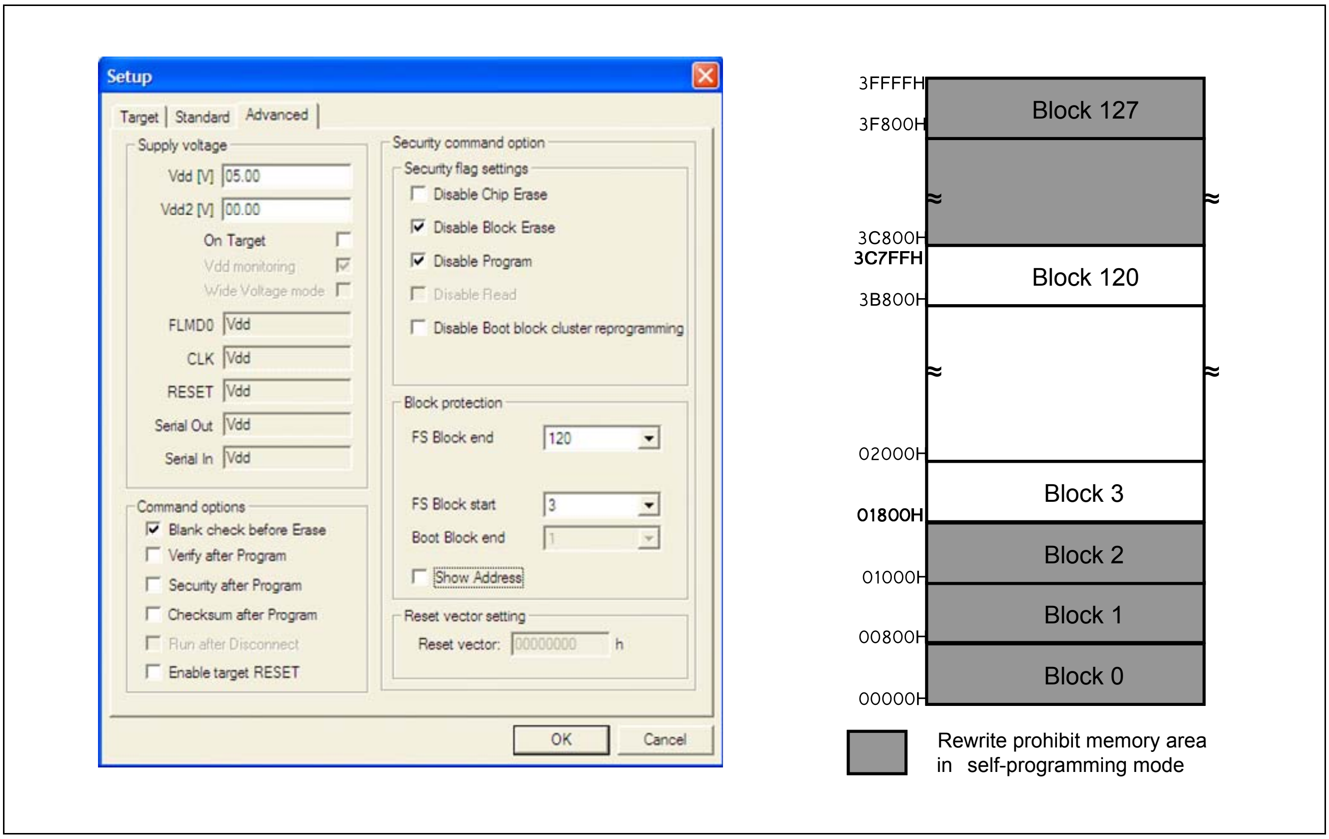
3.3 Setting security settings by self-programming

In self-programming mode, security option can be set by self-programming library. Using specific library function calls, individual security function can be activated, but it cannot be reversed by the library. Refer to self flash programming library *User Manual* for a more detailed description.

Appendix A

Setting security option by Option Release Form

For factory programming, if HEX Consolidation Utility software does not support to an intended device, manual entry will be used for setting security option. In this case, Renesas Electronics will issue an Option Release Form for each Application code. A sample Option Release Form is shown Appendix B. Follow the specific instructions on provided Option Release Form for accuracy. For option data setting, the sample form has a couple of groups list from 002 to 005 for Security flag settings and from 007 to 022 for Block protection. Mark with "01" for unchecked option or "02" for checked option in the appropriate bracket to deactivate or activate the security functions respectively.



Setup

Target | Standard | Advanced

Supply voltage
Vdd [V] 05.00
Vdd2 [V] 00.00
On Target □
Vdd monitoring ☑
Wide Voltage mode □
FLMD0 Vdd
CLK Vdd
RESET Vdd
Serial Out Vdd
Serial In Vdd

Command options
☑ Blank check before Erase
□ Verify after Program
□ Security after Program
□ Checksum after Program
□ Run after Disconnect
□ Enable target RESET

Security command option
Security flag settings
□ Disable Chip Erase
☑ Disable Block Erase
☑ Disable Program
□ Disable Read
□ Disable Boot block cluster reprogramming

Block protection
FS Block end 120
FS Block start 3
Boot Block end 1
□ Show Address

Reset vector setting
Reset vector: 00000000 h

Figure 8 Example of the option data settings in PG-FP5 and its Flash Shield Window memory map

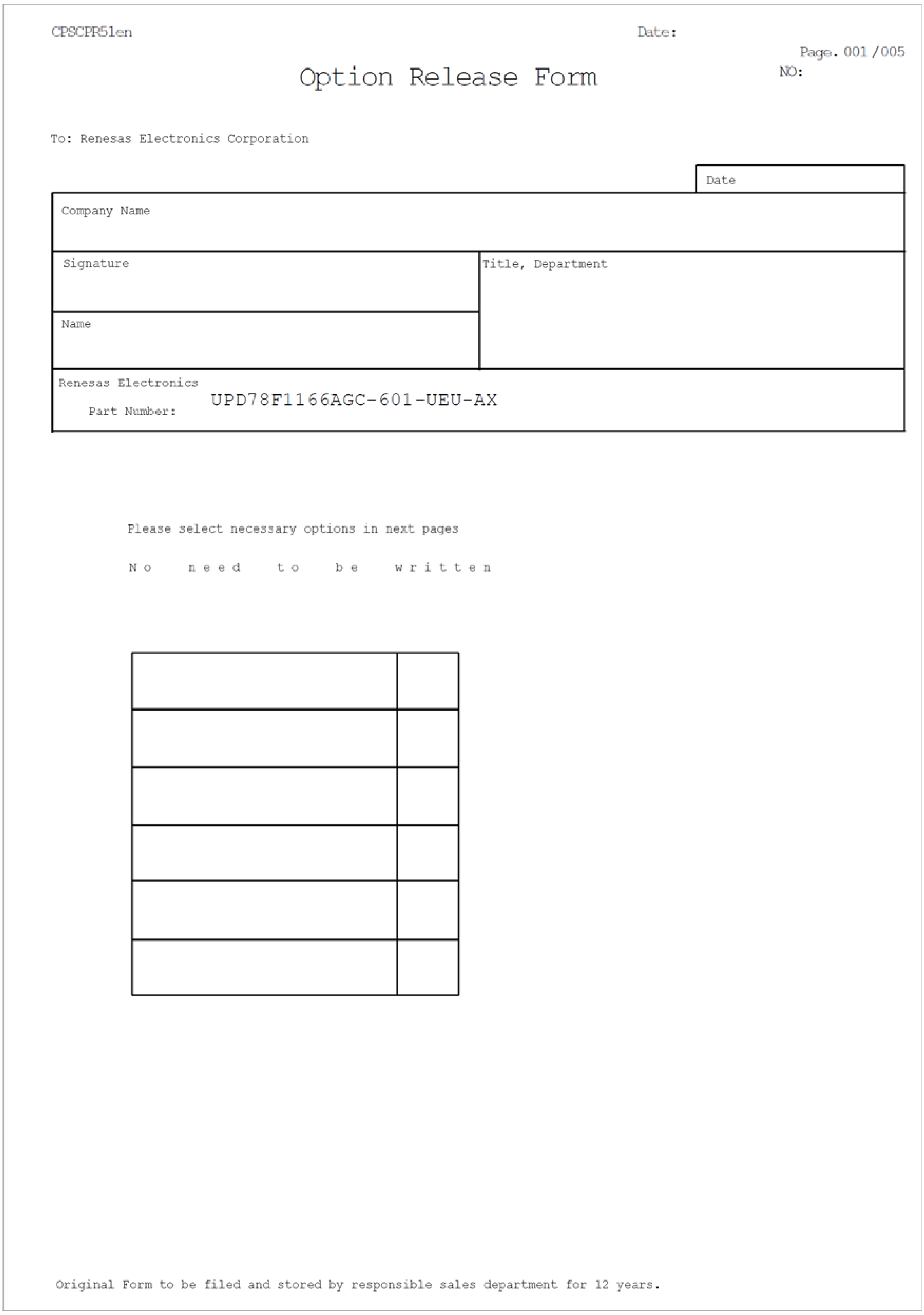
In the Option Release Form, flash shield block start and end values are expressed in binary format for selecting block number. Set bit to one with writing "01" or reset bit to zero with writing "02" in respective bracket. As a sample demonstration, option data setting in PG-FP5 setup is shown in Figure 8, and its related setting to Option Release form is listed in **Table 6** . In this example, the Security flag settings permit Disable Boot block cluster reprogramming and Disable Chip erase command via Programming Interface. The Flash Shield Window setting also allows you to rewrite flash memory from 1800H (start address of block 3) to 3C7FFH (end address of block 120) in self-programming mode.

Table 6. Example of relationship between PG-FP5 setup and Option Release Form setting

PG-FP5		Option Release Form									
Disable Boot block cluster reprogramming	unchecked	**002**	Disabling rewriting boot cluster 0 flag	**[01]**	enabled boot block cluster 0 rewriting						
Disable Block erase	checked	**003**	Disabling block erase flag	**[02]**	disabled block erase						
Disable Chip erase	unchecked	**004**	Disabling batch erase flag	**[01]**	enabled batch erase “chip erase”						
Disable Program	checked	**005**	Disabling write flag	**[02]**	disabled write						
Disable Read											
FS Block start	3	**007-014**	Flash Shield Window start block (binary)	**(007) Bit-7**	**(008) Bit-6**	**(009) Bit-5**	**(010) Bit-4**	**(011) Bit-3**	**(012) Bit-2**	**(013) Bit-1**	**(014) Bit-0**
				[02]	**[02]**	**[02]**	**[02]**	**[02]**	**[02]**	**[01]**	**[01]**
FS Block end	120	**015-022**	Flash Shield Window start block (binary)	**(015) Bit-7**	**(016) Bit-6**	**(017) Bit-5**	**(018) Bit-4**	**(019) Bit-3**	**(020) Bit-2**	**(021) Bit-1**	**(022) Bit-0**
				[02]	**[01]**	**[01]**	**[01]**	**[01]**	**[02]**	**[02]**	**[02]**
Boot Block end											

Appendix B

Sample Option Release Form



CPSCPR51en

Date:

Page. 001 / 005

NO:

Option Release Form

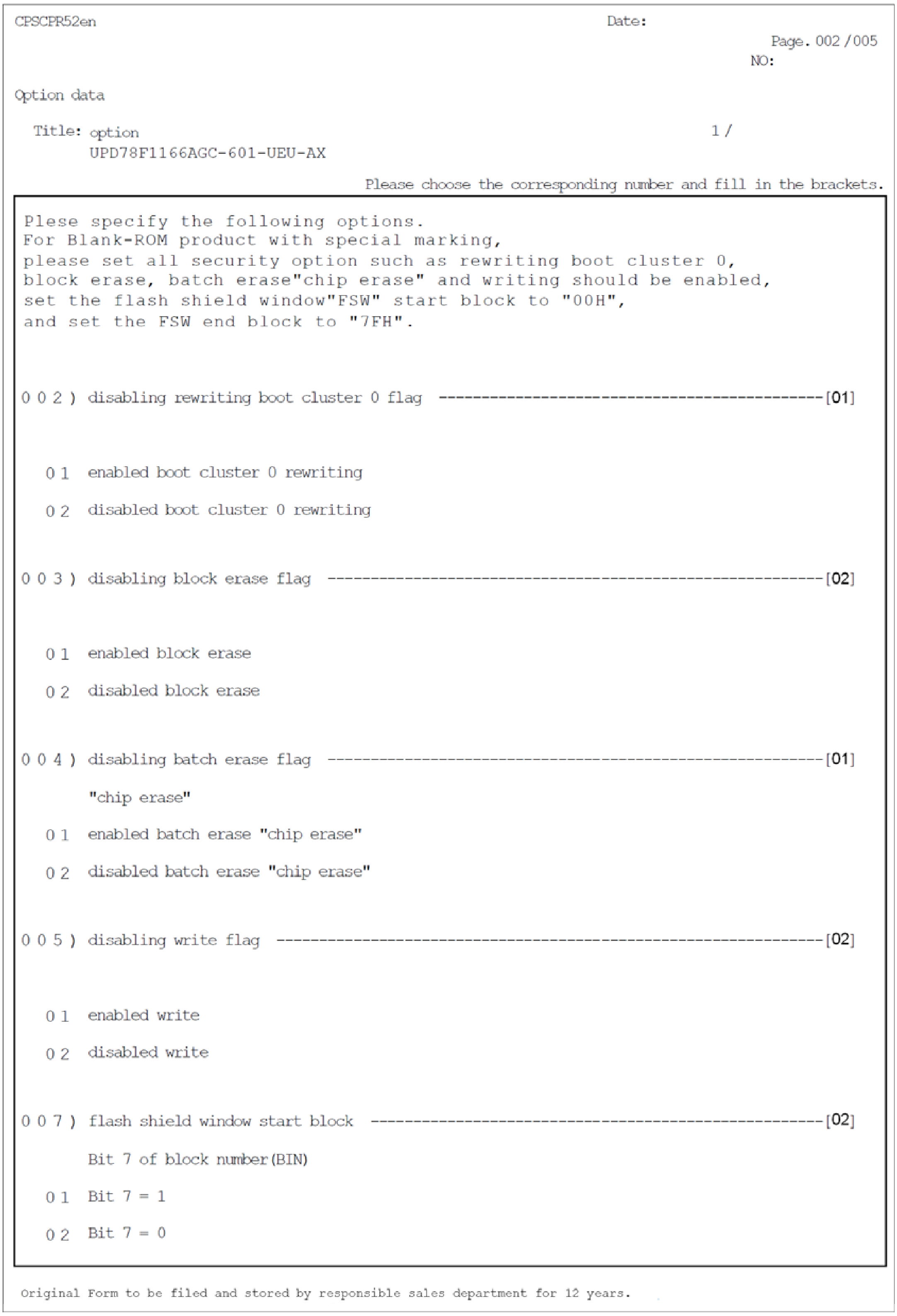
To: Renesas Electronics Corporation

	Date
Company Name	
Signature	Title, Department
Name	
Renesas Electronics Part Number:	UPD78F1166AGC-601-UEU-AX

Please select necessary options in next pages

No need to be written

Original Form to be filed and stored by responsible sales department for 12 years.



CPSCPR52en Date:

Page. 002 / 005

NO:

Option data

Title: option 1 /

UPD78F1166AGC-601-UEU-AX

Please choose the corresponding number and fill in the brackets.

Plese specify the following options.
For Blank-ROM product with special marking,
please set all security option such as rewriting boot cluster 0,
block erase, batch erase"chip erase" and writing should be enabled,
set the flash shield window"FSW" start block to "00H",
and set the FSW end block to "7FH".

0 0 2) disabling rewriting boot cluster 0 flag --[01]

0 1 enabled boot cluster 0 rewriting

0 2 disabled boot cluster 0 rewriting

0 0 3) disabling block erase flag --[02]

0 1 enabled block erase

0 2 disabled block erase

0 0 4) disabling batch erase flag --[01]

"chip erase"

0 1 enabled batch erase "chip erase"

0 2 disabled batch erase "chip erase"

0 0 5) disabling write flag --[02]

0 1 enabled write

0 2 disabled write

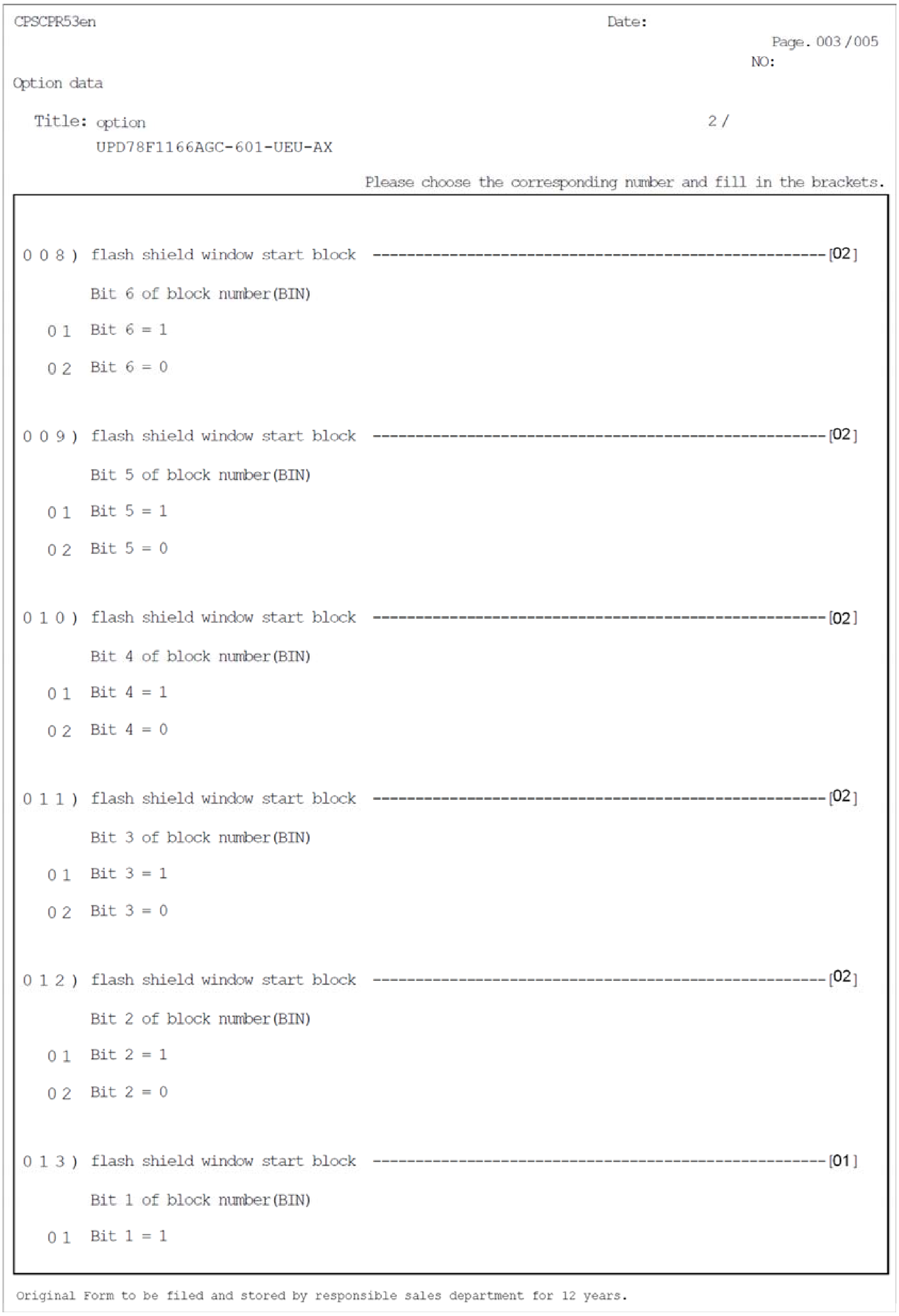
0 0 7) flash shield window start block --[02]

Bit 7 of block number(BIN)

0 1 Bit 7 = 1

0 2 Bit 7 = 0

Original Form to be filed and stored by responsible sales department for 12 years.



CPSCPR53en Date:

Page. 003 / 005

NO:

Option data

Title: option 2 /

UPD78F1166AGC-601-UEU-AX

Please choose the corresponding number and fill in the brackets.

0 0 8) flash shield window start block -- [02]

Bit 6 of block number(BIN)

0 1 Bit 6 = 1

0 2 Bit 6 = 0

0 0 9) flash shield window start block -- [02]

Bit 5 of block number(BIN)

0 1 Bit 5 = 1

0 2 Bit 5 = 0

0 1 0) flash shield window start block -- [02]

Bit 4 of block number(BIN)

0 1 Bit 4 = 1

0 2 Bit 4 = 0

0 1 1) flash shield window start block -- [02]

Bit 3 of block number(BIN)

0 1 Bit 3 = 1

0 2 Bit 3 = 0

0 1 2) flash shield window start block -- [02]

Bit 2 of block number(BIN)

0 1 Bit 2 = 1

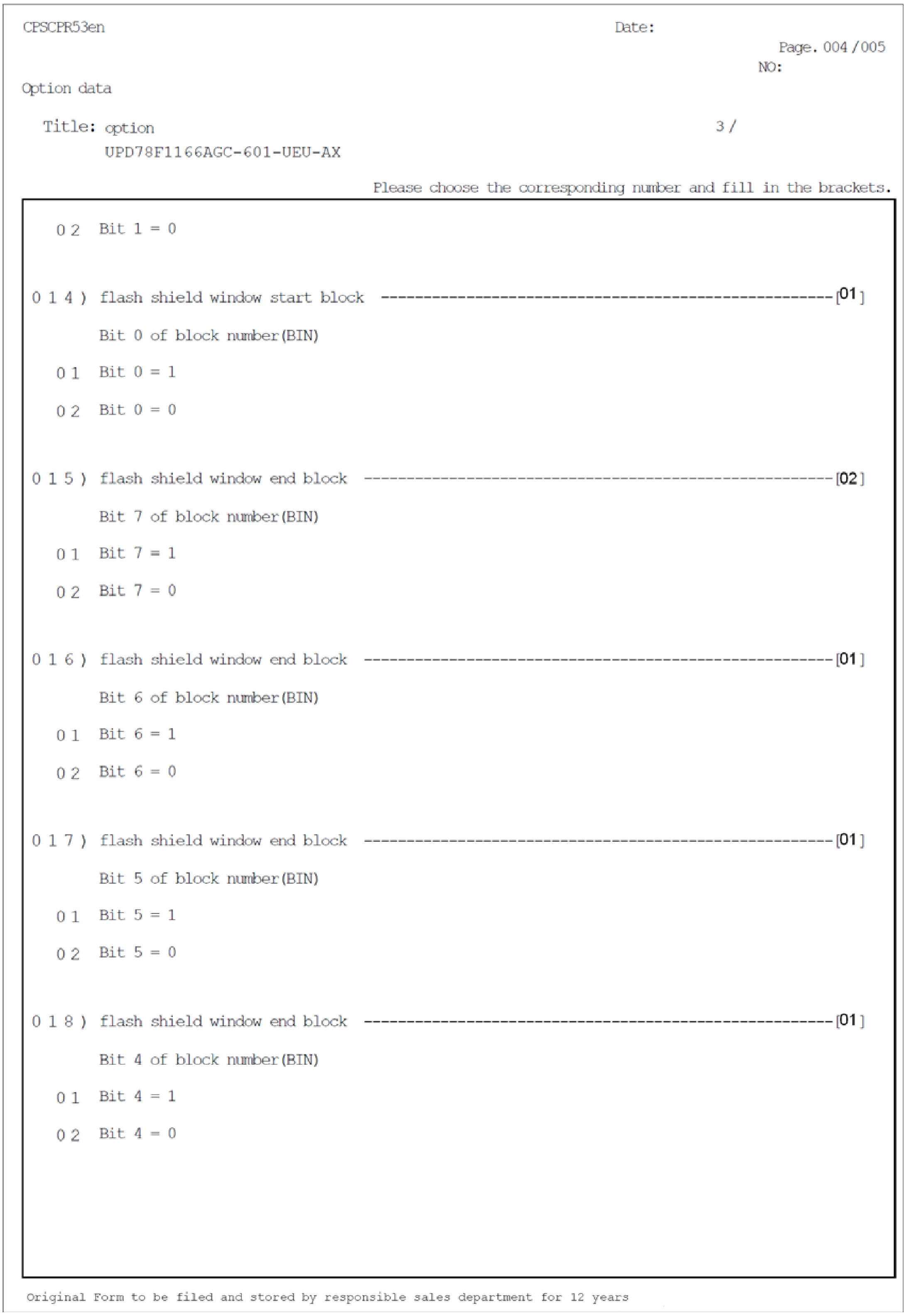
0 2 Bit 2 = 0

0 1 3) flash shield window start block -- [01]

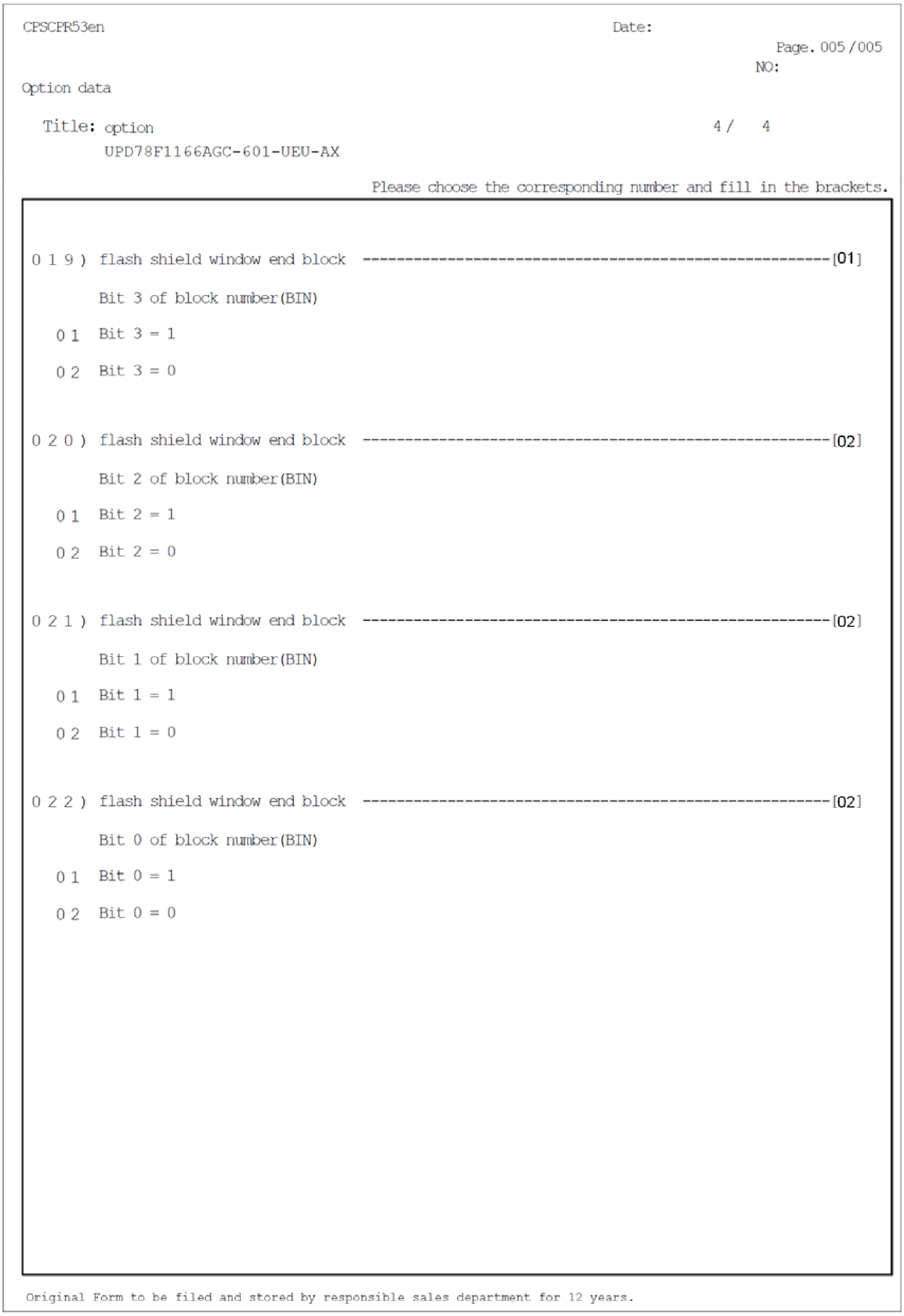
Bit 1 of block number(BIN)

0 1 Bit 1 = 1

Original Form to be filed and stored by responsible sales department for 12 years.



```
CPSCPR53en                                              Date:
                                                                  Page. 004 /005
                                                                 NO:
Option data

  Title: option                                               3 /
         UPD78F1166AGC-601-UEU-AX

                          Please choose the corresponding number and fill in the brackets.

   0 2  Bit 1 = 0

 0 1 4 ) flash shield window start block ------------------------------------------------[01]
        Bit 0 of block number(BIN)
   0 1  Bit 0 = 1
   0 2  Bit 0 = 0

 0 1 5 ) flash shield window end block --------------------------------------------------[02]
        Bit 7 of block number(BIN)
   0 1  Bit 7 = 1
   0 2  Bit 7 = 0

 0 1 6 ) flash shield window end block --------------------------------------------------[01]
        Bit 6 of block number(BIN)
   0 1  Bit 6 = 1
   0 2  Bit 6 = 0

 0 1 7 ) flash shield window end block --------------------------------------------------[01]
        Bit 5 of block number(BIN)
   0 1  Bit 5 = 1
   0 2  Bit 5 = 0

 0 1 8 ) flash shield window end block --------------------------------------------------[01]
        Bit 4 of block number(BIN)
   0 1  Bit 4 = 1
   0 2  Bit 4 = 0

 Original Form to be filed and stored by responsible sales department for 12 years
```



CPSCPR53en Date:

Page. 005 / 005

NO:

Option data

Title: option 4 / 4

UPD78F1166AGC-601-UEU-AX

Please choose the corresponding number and fill in the brackets.

019) flash shield window end block --[01]

Bit 3 of block number(BIN)

01 Bit 3 = 1

02 Bit 3 = 0

020) flash shield window end block --[02]

Bit 2 of block number(BIN)

01 Bit 2 = 1

02 Bit 2 = 0

021) flash shield window end block --[02]

Bit 1 of block number(BIN)

01 Bit 1 = 1

02 Bit 1 = 0

022) flash shield window end block --[02]

Bit 0 of block number(BIN)

01 Bit 0 = 1

02 Bit 0 = 0

Original Form to be filed and stored by responsible sales department for 12 years.

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Revision Record

		Description	
Rev.	Date	Page	Summary
1.01	March 31, 2012	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.
2. Processing at Power-on
   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.
3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.
4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.
5. Differences between Products
   Before changing from one product to another, i.e. to one with a different type number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

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