

RAJ240xxx Series

Specification of RSB_TOOL2 for Sample Code

Introduction

Renesas Smart Battery Tool 2 (And hereinafter, referred to “RSB_TOOL2” in this document) is a software tool to assist user in evaluating, developing, and optimizing battery management system basing on designed battery characteristics using Renesas battery management products.

This tool includes the following features.

- Registers full access
- Memory Access
- Single/Sequential Read/Write
- Initial Calibration
- Firmware Update

Note : This document is dedicated for RSB_TOOL2 (Rev6.30).

Target Device

RAJ240045 (2 - 4 cell)

RAJ240075 (2 -5 cell)

RAJ240080 (2 - 5 cell)

RAJ240090 (3 - 8 cell)

RAJ240100 (3 - 10 cell)

RAJ240055 (2 – 4 cell)

RAJ240057 (2 – 4 cell)

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1. Operating Environment

1.1 File contents

```
RSB_TOOL2
| Battcom.dll
| msbm2.ini
| RSB_TOOL2_Rev6.30.exe
| RSB_TOOL2.ini
|—DefaultFile
|   RAJ240xxx_sample_default.mot
|—UpdateFiles
|—SequenceFile
|   Ex.0_SoftwareReset.csv
|   Ex.1_ForcePowerDown.csv
|   Ex.2_WriteFlexibleData.csv
|—configuration
|—memory
|   RAJ240xxx_CS+_Sample _YYY_x.xx.bin
|—sbs
|   SBS_STD.bin
|   CS+_Sample _YYY_x.bin
```

1.2 System requirements

Operating System : Windows 10

Supporting Software : Microsoft .NET Framework 4.0 or Later, Visual C++ 2010 (or later) Library

1.3 Supported USB SMBus I/F Unit

The RSB_TOOL2 supports the following USB SMBus I/F.

1. RTK0EF0029Z00000BC
2. RTK0EF0029Z00001BJ
3. RTK0EF0029Z00001BM

1.4 Files

Table 1 shows the essential files for RSB_TOOL2. These files are preinstalled with the package.

Precaution Please do not delete these files.

It is necessary to place these files in the same folder with the software.

Table 1 Files Information

Name	Description
Battcom.dll	Dynamic link library for communicating to Renesas USB SMBus I/F.
msbm2.ini	Setting file of Battcom.dll.
RSB_TOOL2.ini	Setting file of this software.
configuration files	Configuration files that are used by this tool. These files have two formats(.bin and .csv). Please refer to Chapter エラー! 参照元が見つかりません。.
Sequence file	For generic function. Please refer to Chapter Smart Battery Data Communication3.1
RAJ240xxx_sample_default.mot	For factory default function. Please do not change it.

2. Settings

2.1 COM port setting

2.1.1 Initialize

During startup, RSB_TOOL2 will automatically check for the presence of USB SMBus I/F communication board. If the program fails to detect the USB SMBus I/F communication board, an error message stating "There is no communication board" will pop up.

Note: The RSB_TOOL2 program automatically search for COM Port address from 00 to 99. If Windows auto assigned USB SMBus I/F COM Port to three digit numbers, please modify it manually.

2.1.2 Updating COM Port address

Under the condition where RSB_TOOL2 COM Port setting does not match the Windows assigned COM Port address, the desired USB SMBus I/F connection address can be updated manually by

1. Click on "Setting" -> "Port" from the drop down menu
2. Select the desired Port address (example in Figure 1 shows COM5)
3. Click on "Update COM" button to update the tool's setting.
4. Click on "OK" button after completion.

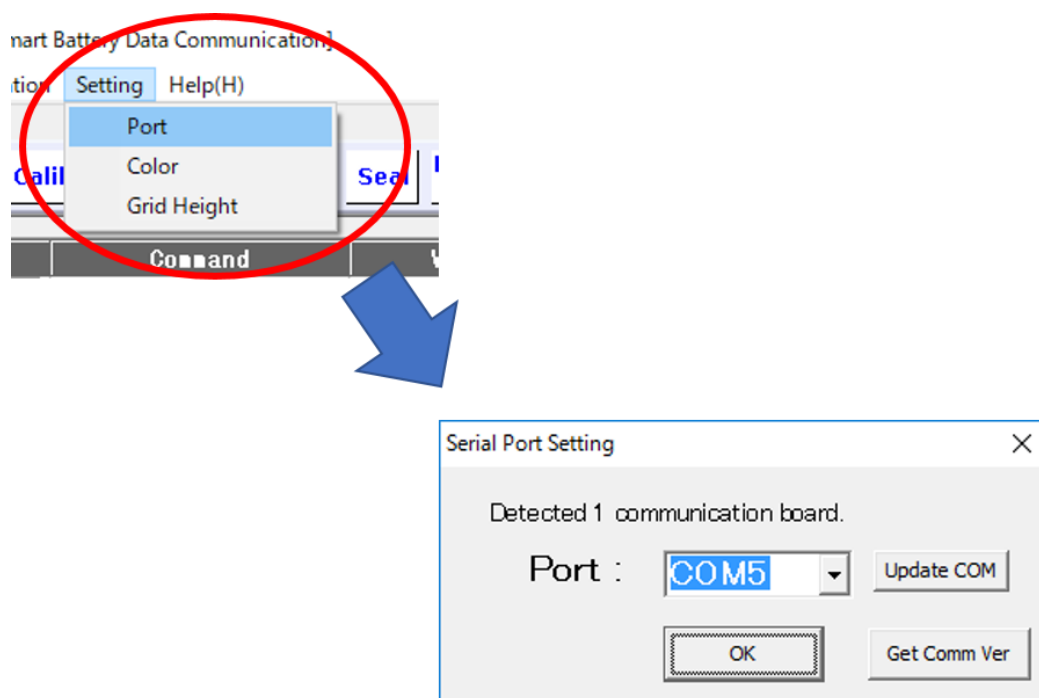


Figure 1 Port Setting

2.2 Color Selection

Some functions of RSB_TOOL2, bit color can be changed.

The color which is selected in this menu valid following function only.

- Status Detail (Smart Battery Data Communication)
- Control flag Bit configuration (Memory Access)

The bit color can be changed by

1. Click on "Setting" -> "Color" from the drop down menu.
2. Select the color.
3. Click on "OK" button after completion.

The default color can be changed in this dialog and it is saved to ini file. In this case, please check to "Save to ini file" checkbox.

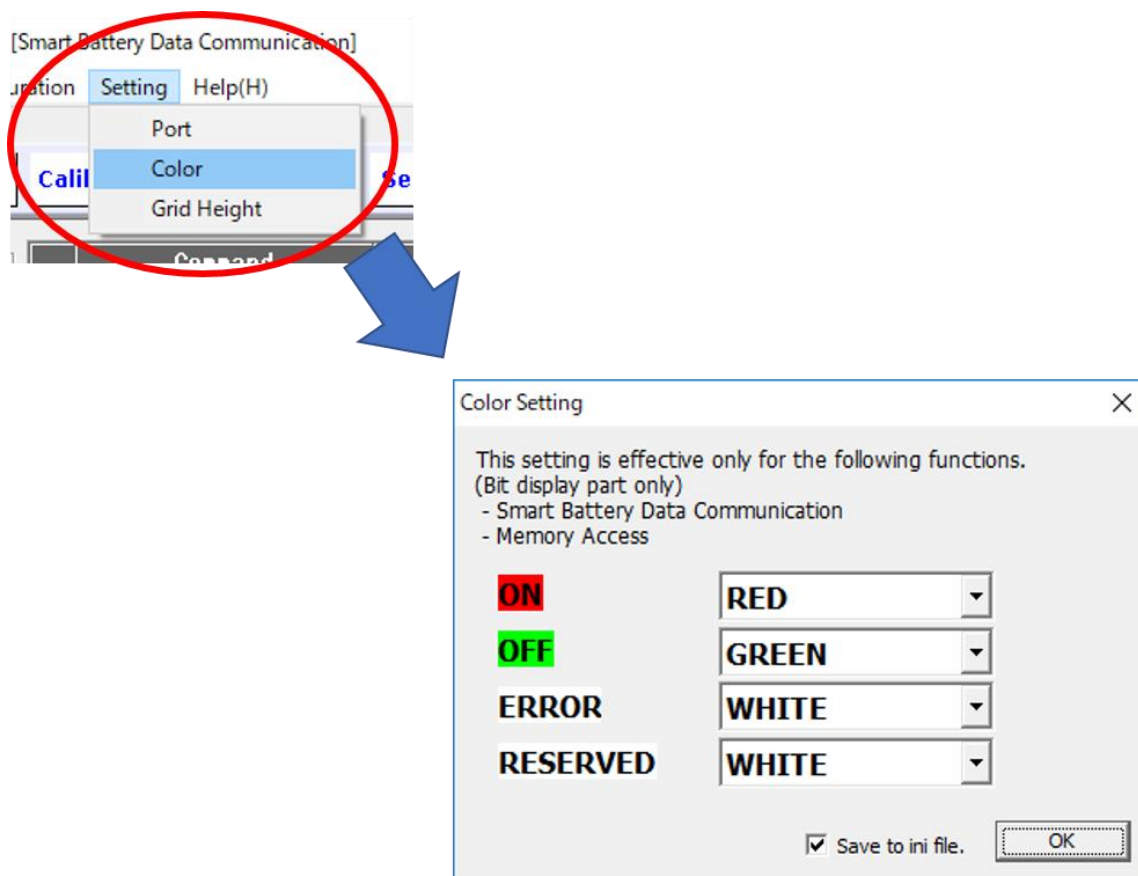


Figure 2 Color Setting

Note: The color which can be selected is definition color only in ini file. User can not add color definition. The selectable colors are as follows.

- RED
- GREEN
- WHITE
- GRAY
- BLUE
- YELLOW

2.3 Grid Height Setting

This tool uses grid design to display parameters, but this design may not be displayed properly depending on the usage environment. In this case, it can be adjusted using this function.

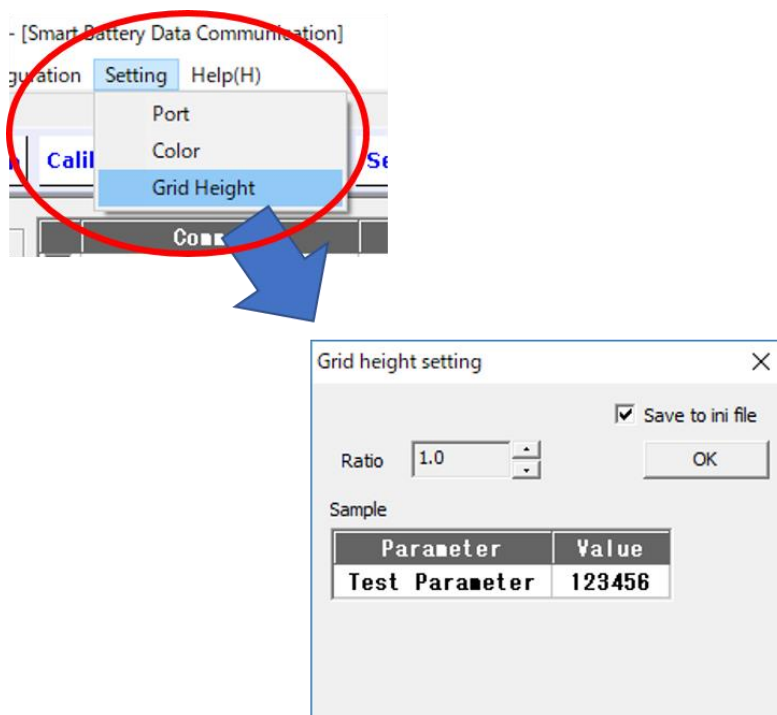


Figure 3 Grid Font Setting

When adjusting the grid height size, it can be adjusted using upper and lower buttons. By using this button, ratio is adjusted in 0.1 unit, and result is displayed sample grid that is placed under the dialog.

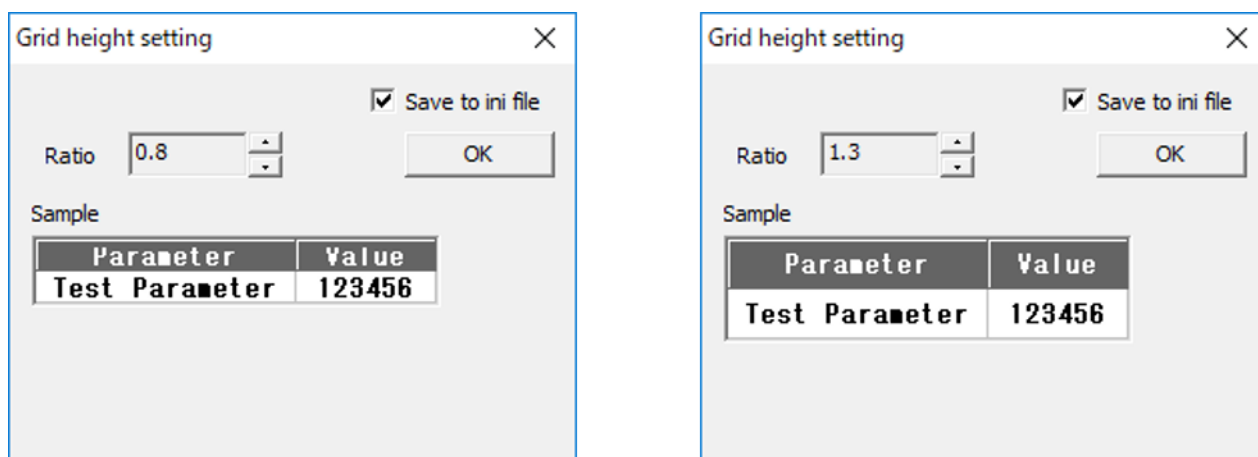


Figure 4 Adjust ratio

When the ratio is fixed, press the OK button at the end. If “Save to ini file” is checked, the ratio is saved to ini file (FONT_RATIO).

The update font will be used for new window. So, the window already exist does not be applied. The exist window should be restarted.

2.4 Configuration Selection

The RSB_TOOL2 contains configuration files. It is necessary to select the matching configuration file (during startup or can modify later by selecting from the drop down menu, "Configuration"→ "Select" (as shown in Figure 5 below). If configuration file that is created by user with .csv format is placed on the specified folder, it is displayed on the dialog bottom. Regarding to configuration file with .csv format, refer to CAPTER エラー! 参照元が見つかりません。 .

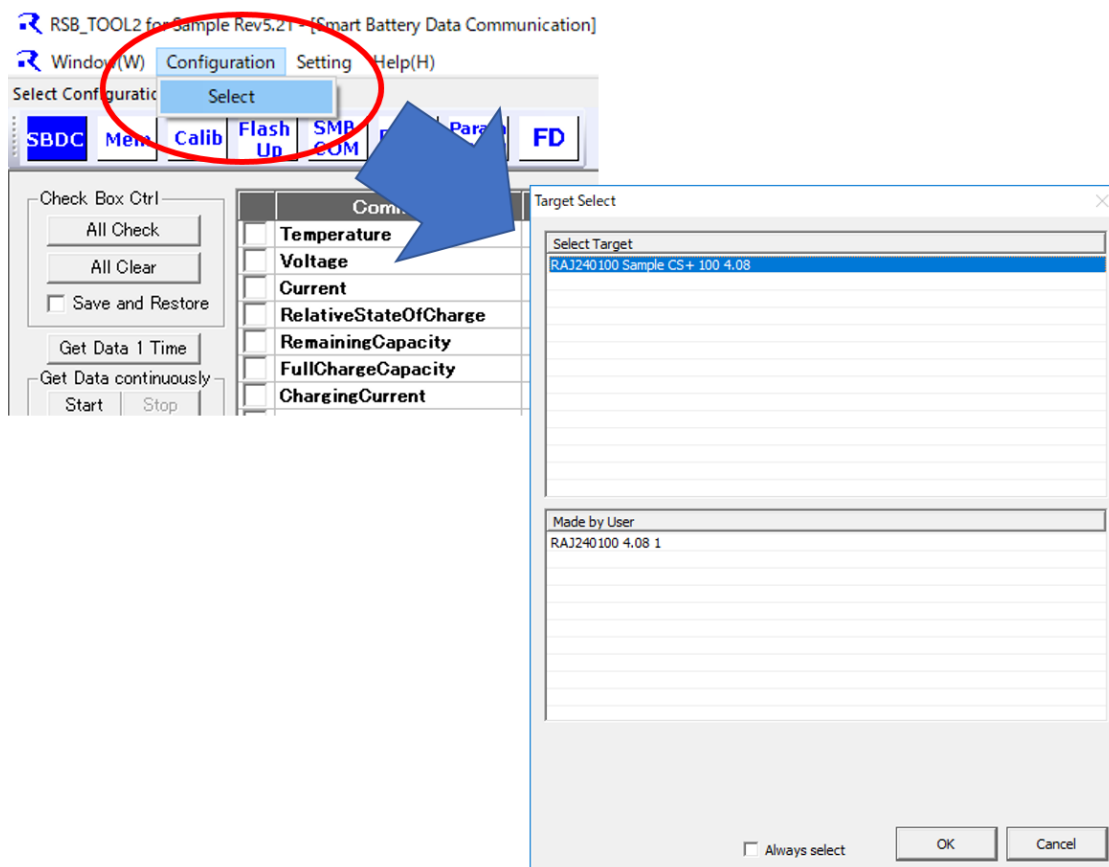


Figure 5 Selecting Configuration File

2.5 Current Information

The selected configuration information can be checked by clicking on “Help” -> “Current Information” from the drop down menu bar.

Note: For firmware that does not have any sub version, the information of the Sub Version as shown in Figure 6 will be blank.

The same information can also be viewed at the top right of the tool window as shown in Figure 6. The display format is the same as the CONFIG_SPECIFIC option that is defined in the .ini file. For more details, please refer to chapter 4.

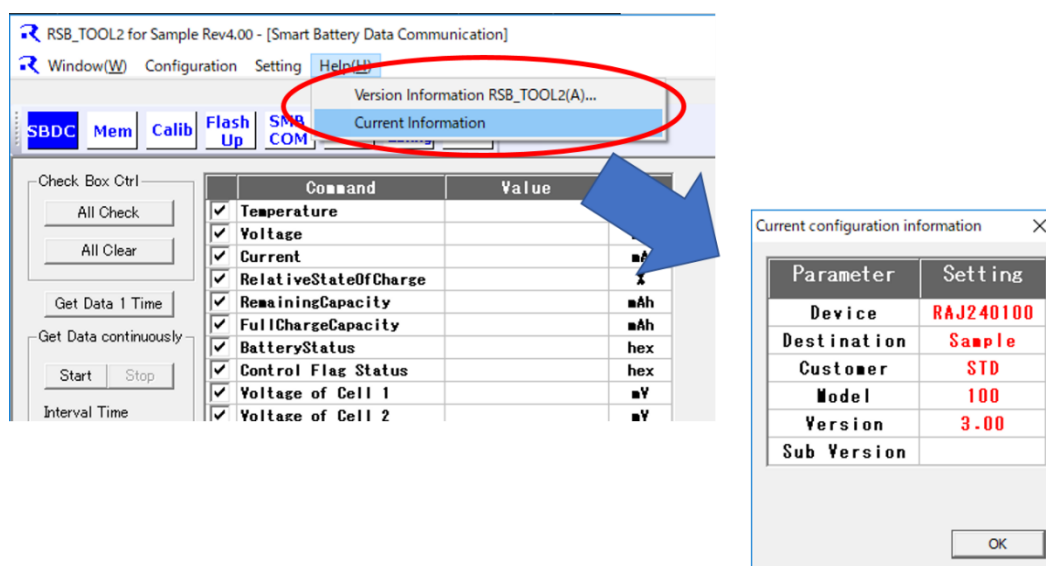


Figure 6 Current Information

And the configuration file name which is used for current configuration is displayed over the window. The displaying format is “sbs file / memory file”.

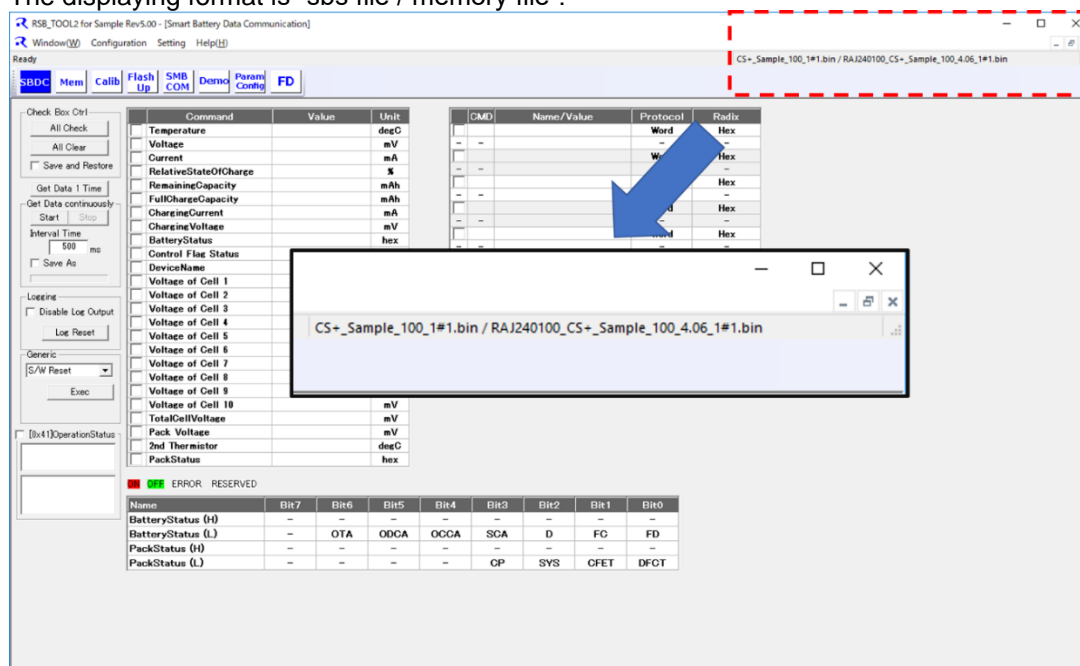


Figure 7 Current FGIC information quick view

3. Operations

3.1 Smart Battery Data Communication

This section explain the details of the Smart Battery data communication operation.

(1) Window

The GUI window shown in Figure 8 will be displayed when “Smart Battery Data Communication” from menu (“Window -> Smart Battery Data Communication”) or “SBDC” button is selected. If “DISP_CMD_NUM” option is enabled, the command number is displayed in front of Parameter name.

Note: Figure 8 shows an example of the GUI Window setting for RAJ240100. For other device setting, the items displayed will change accordingly.

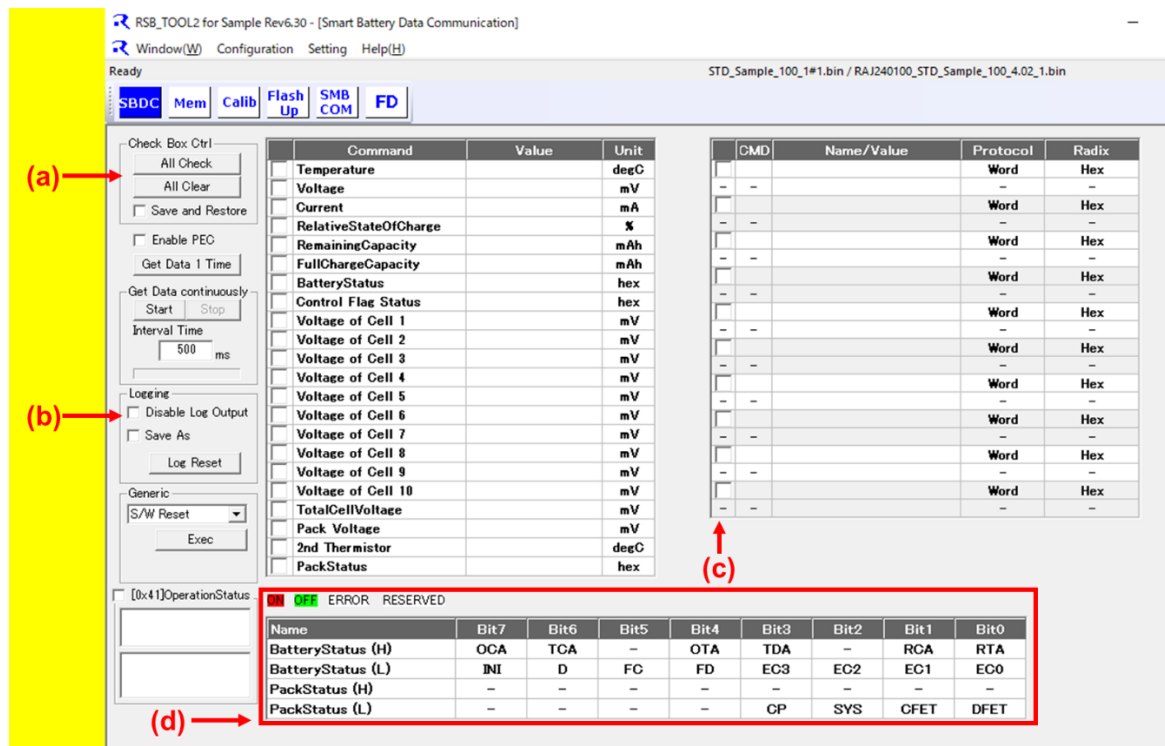


Figure 8 Smart Battery Data Communication

(a) Obtaining data from FGIC

To obtain data from the FGIC, the check box of the desired data need to be checked.

To ease operation, all standard command can be checked / cleared at the same time by using the “All Check” and “All Clear” button. If “Save and Restore” is checked when “All Clear” button was pushed, a status of checking is saved to internal data. And, if “Save and Restroe “ is checked when “All Check” button was pushed, the status of checking is restored by internal data.

(b) Data logging

The data obtained can be stored in log file with .CSV format. And with a file name automatically generated as SBLOGyyyymmddhhmmss.CSV. (SBLOG year month day hour minute sec.CSV)

The log file is created during the first time the data is read from the FGIC. Data of subsequent operation are added into the same file automatically ^{Note*}.

Note: There are 3 conditions where a new log file will be created.

- 1) Whenever the “Log Reset” button is press.
- 2) Restarting the RSB_TOOL2
- 3) When the log file fails to open, a new log file will automatically be generated with the default name.

Log file generation can be disabled by checking the “Disable Log output” check box.

The log file name can be renamed by checking the “Save As” check box. If this check box is checked, when the “Start” button or “Get Data 1 Time” button is pressed, a Save As Dialog will be shown. User will then required to key in the desire file name.

Note : Whenever the “Save As” check box is cleared after the file creation, the data will still be added to the same file that is created before the check box is cleared.

The log file is separated automatically specified size by ini file (Specifiable size is MegaByte unit.)

If you change the checking of target after starting continuous communication, the checked data will not be output, the unchecked data will be “-”.

(c) Additional command

Data from additional command can be retrieved by specifying the command here.

To enable this function, the user needs to specify “CMD”, “protocol”, and “radix” parameters. While the “Command Name” is optional.

Note : Whenever a minus sign is added to the command, the displayed value becomes a signed value.

	CMD	Name/Value	Protocol	Radix
<input checked="" type="checkbox"/>	A	Current	Word	Dec/Char
-	-	65332	-	-
<input checked="" type="checkbox"/>	-A	Current	Word	Dec/Char
-	-	-204	-	-
<input checked="" type="checkbox"/>	A-	Current	Word	Dec/Char
-	-	-204	-	-
<input type="checkbox"/>			Word	Hex
-	-		-	-

Figure 9 Extra command (signed value)

The extra command uses two rows for one command. Input the CMD, protocol and radix in the first row. The obtained value is displayed in the second row.

The extra command number is defined as “EXTENSION_NUM” option in .ini file. Half of the number in this option can be used because the extra command uses two rows for one command. If this value is upper than 20, this value is limited to 20.

Table 2 Extra command format

	Setting method	Specify	
CMD	Input to "CMD" column	Inputted command(Hexadecimal)	
Protocol	Select from Protocol combobox	Word	ReadWord protocol
		Block	ReadBlock protocol
Radix	Select from Radix combobox	Hex	hex
		Dec/Char	Decimal/Character
		Bit	Bit value ReadWord : Big endian ReadBlock : Byte order
		Hex(Block)	Hex(Reverse endian)
		Dec(Block)	Dec(Reverse endian)
		SDec(Block)	Signed Dec(Reverse endian)

If selected "Radix" includes "(Block)", the displaying format is changed by following rules.

Example

Recived data :

0	1	2	3
---	---	---	---

Display order :

Hex : 0 1 2 3

Hex(Block) : 3 2 1 0

Table 3 Display format

	CMD	Name/Value	Protocol	Radix
<input checked="" type="checkbox"/>	Command value	Command Name	Word or Block	Hex or Dec/Char or Bit
-	-	Obained value	-	-

	CMD	Name/Value	Protocol	Radix
<input checked="" type="checkbox"/>	30	AD value of Cell 1	Word	Hex
-	-	434b	-	-
<input checked="" type="checkbox"/>	30	AD value of Cell 2	Word	Hex
-	-	434b	-	-
<input type="checkbox"/>			Word	Hex
-	-		-	-
<input type="checkbox"/>			Word	Hex

Figure 10 Extra command

(d) Status Detail

Status details of the applicable commands are displayed.

The color specification follows "[Color Selection](#)" setting.

Color configuration change will be able to see after pushing "Get data 1 time" or "Start" button.

ON OFF ERROR RESERVED								
Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
BatteryStatus (H)	—	—	—	—	—	—	—	—
BatteryStatus (L)	—	OTA	ODCA	OCCA	SCA	D	FC	FD
PackStatus (H)	—	—	—	—	—	—	—	—
PackStatus (L)	—	—	—	—	CP	SYS	CFET	DFCT

Figure 11 Status Detail of Example

Figure 12 Status detail

And, displaying bit length can be changed by ini file option (DISP_16_BIT_LEN).

The default setting is 8 bit length. It can be able to change 16 bit length by ini file option.

ON OFF ERROR RESERVED

Name	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
BatteryStatus	—	—	—	—	—	—	—	—	—	OTA	ODCA	OCCA	SCA	D	FC	FD
PackStatus	—	—	—	—	—	—	—	—	—	—	—	—	CP	SYS	CFET	DFCT

Figure 13 16-bit mode

(2) Operation

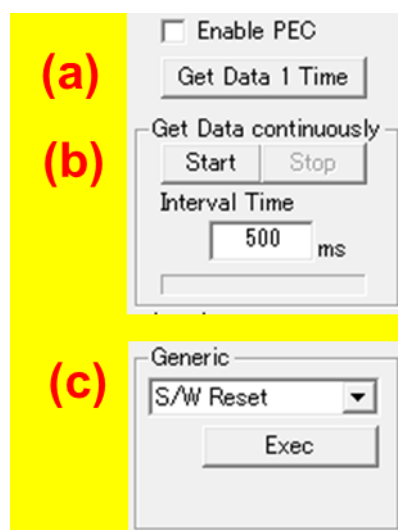


Figure 14 Smart Battery Data Communication operation

(a) Get data 1 time

By pressing the “Get Data 1 Time” button, RSB_TOOL2 will acquire data from the FGIC only for one time.

You can select to use PEC on each SMBus communication. If “Enable PEC” is checked, PEC is used. Otherwise, it isn’t used. This processing is applied on “Get data continuously”, too.

Some data will be displayed with the display format changed by the RSB_TOOL2.

Table 4 Display format

Parameter	Original Unit	Displaying Unit	formula
Temperature	0.1K	deg C	Displaying value = value / 10 – 273.0
Date	date (Compressed value)	date (YYYY/MM/DD)	Displaying value = Year/Month/Date Year = (value >> 9) + 1980 Month = (value >> 5) & 0x1F Day = value & 0x1F
	date+ (Compressed value)	date+ (YYYY/MM/DD)	Displaying value = Year/Month/Date Year = (value >> 9) + 2000 Month = (value >> 5) & 0x1F Day = value & 0x1F

(b) Get data continuously

By pressing the “Start” button, RSB_TOOL2 will read the data from the FGIC continuously with specified time interval. To stop data reading, press the “Stop” button.

To specify the time interval between data readings, key in the desire value (from 1 to 65535) in the “Interval Time” box, unit is in mili seconds (ms).

Note : There might have some delay due to operation time of Windows.

Precaution : If the “Interval Time” box is left empty, an error message will pop up when “Start” button is press.

(c) Generic function

This function can execute various writing commands. The executable command can be executed by defining the. in the csv file and placing them under the "SequenceFile" directory. The maximum number of csv files is 100.

Select the processing to be executed from the ComboBox and it is executed with the Exec button. The software reset function which is included default packages is defined as follows.

	A	B	C	D	E	F
1	* Renesas Electronics Corp. Sequence file for generic button.					
2						
3	FuncName	S/W Reset				
4						
5	Operation	CMD(hex) Radix		Data		
6	WriteWord	5D	Hex	5678		
7						

Figure 15 Sequence File (Ex. Software Reset)

The first line requires the description of this one sentence to indicate that it is an executable file.

In the third line, describe the function name in FuncName. The name written here will be displayed in the ComboBox on the GUI.

Describe the processing to be executed on line 6 and later. Up to 10 processes can be executed.

- Operation

Operation that can be described is as follows:

- WriteWord : Write the data described in "Data" with WriteWord protocol.
- WriteBlock : Write the data described in "Data" with WriteBlock protocol.
- Wait : Wait the time described in "Data" in msec.

- CMD(hex)

When "WriteWord" or "WriteBlock" is selected, write the command with Hex.

- Radix

Describe the radix of the data described in "Data". The valid radix is Hex and Dec only.

- Data

In the case of "WriteWord" or "WriteBlock", write the data to be written, if "Wait", write the wait time in msec.

If the specified protocol is "WriteBlock" and data length is odd, the data length is incremented by one.

When editing a Sequence file in Excel, set the data display format to String.

3.2 Memory Access

This function sets the “Fixed data”, Flexible data and “Calibration data” for the FGIC.

Note : Flexible data is enabled when using corresponded the configuration file.

Note : This function is not available while connecting with E1 emulator.

(1) Window

The following window will appear when “Memory Access” from the drop down menu (“Window->Memory Access”) or “Mem” button is selected.

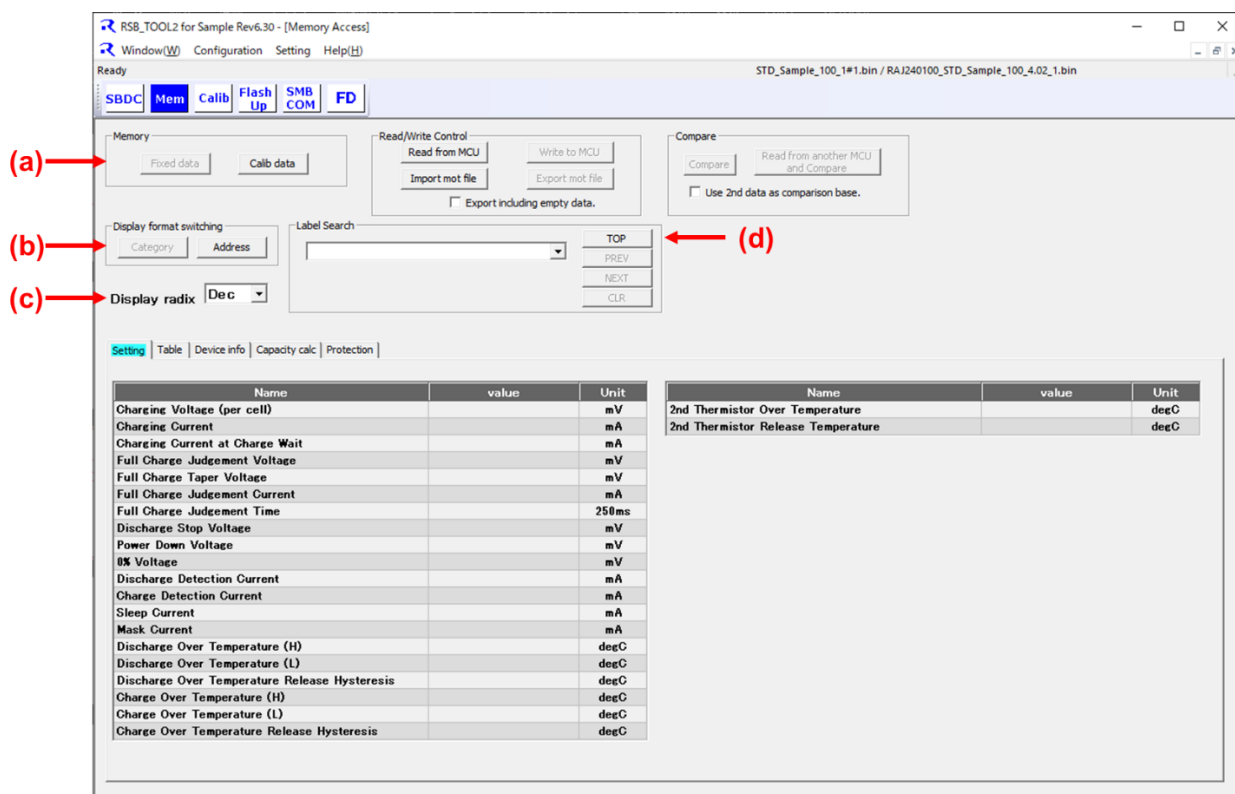


Figure 16 Memory Access

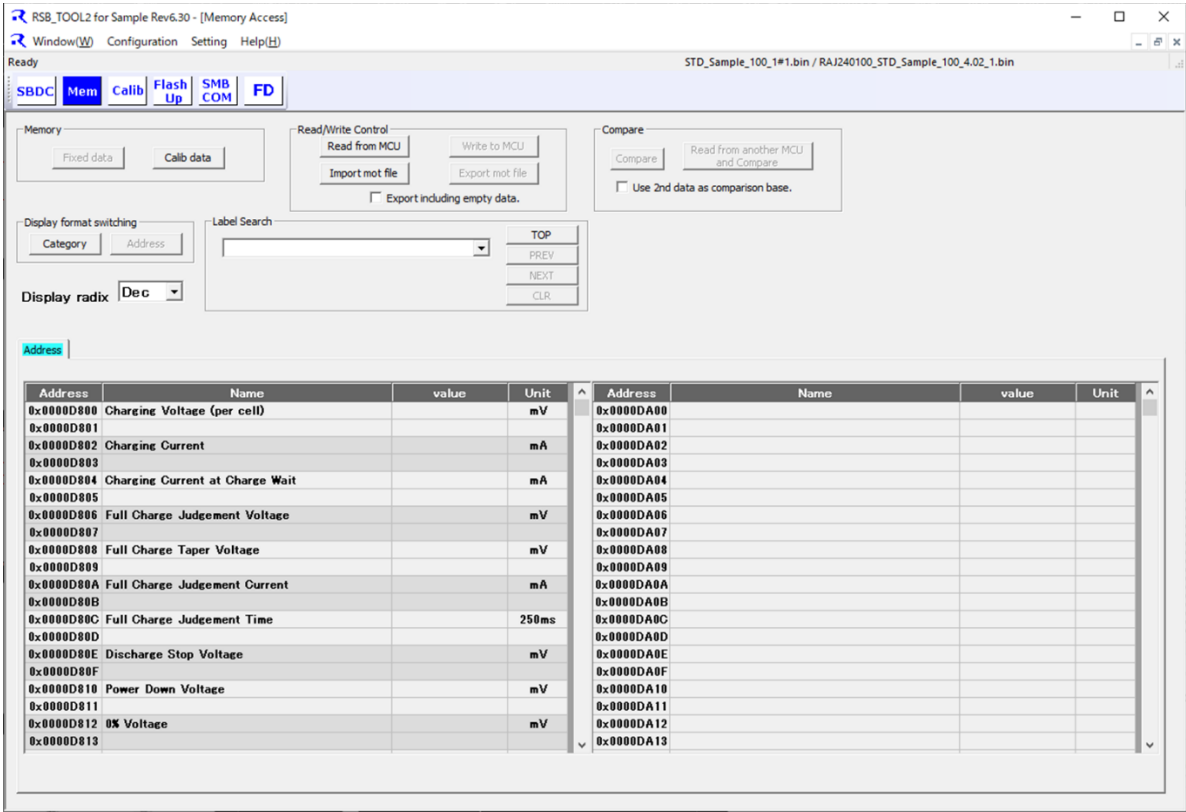


Figure 17 Memory Access (Address)

When using configuration file corresponding to “Flexible data”, a “Memory” selecting menu is changed to as following Figure.

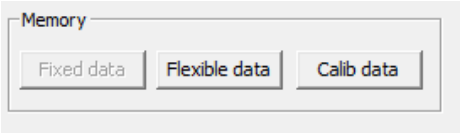


Figure 18 Memory Access + Flexible data

When using configuration file that is made by user (.csv format), the window is changed to as following Figure.

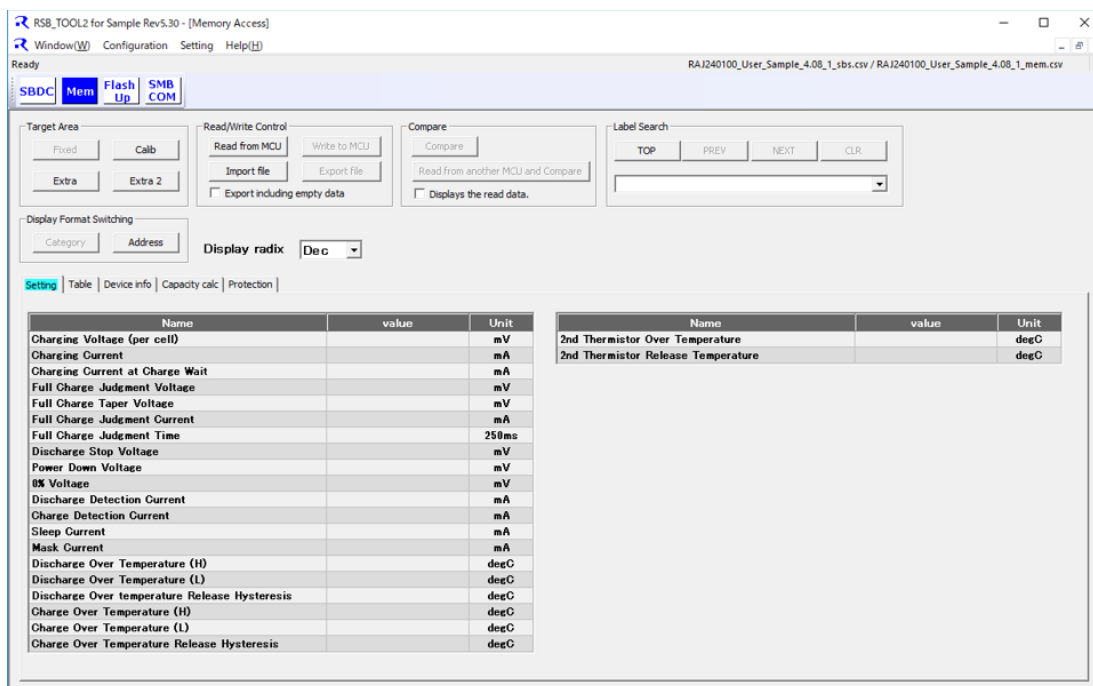


Figure 19 Memory Access (.csv format)

(a) Select displaying data

The data of the FGIC is divided into 4 types:

- 1) Fixed data : Battery characteristics, threshold for safety features, and device information.
- 2) Flexible data : Parameter of dynamic variable value.
- 3) Calibration data : Offset data obtain from calibration for accurate measurement
- 4) Extra / Extra 2 : Defined by User.

Note : If there is no parameter definition in Extra or Extra 2, the error message is displayed when pressed Extra or Extra 2 button.

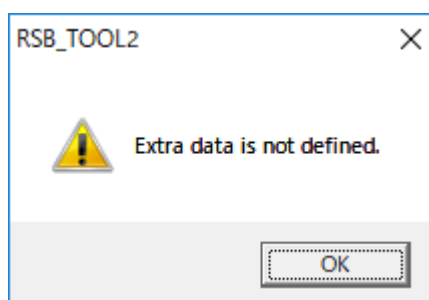


Figure 20 Error Message

(b) Select displaying format

This selection customized the data display format:

- 1) "Category" button : Data will be displayed in categorized format.
- 2) "Address" button : Data will be displayed in order based on address location

(c) Displaying digit

Each data can be displayed in Dec or Hex format. To change the display format, simply select the desire format from the drop-down selection.

- 1) When Dec is selected, all data will be displayed in decimal format

2) When Hex is selected, all data will be displayed in hexadecimal format

Note: Character-string data, date data and temperature data are display in its own format regardless of the selection.

(d) Label search

This function is used to search the desire data label within the data.

To search for the desire data label, key in part of the label name in the text box and press

“Top” button, and the first area that have the data name including the label will be displayed.

To move to the next/previous data, simply press the “NEXT”/“PREV” button.

Pressing the “CLR” button will clear the display.

(2) Operation

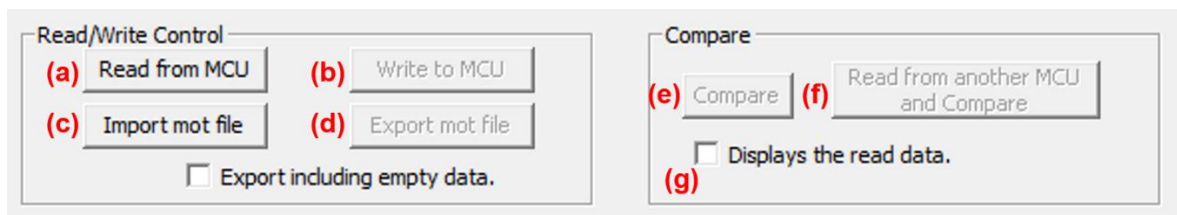


Figure 21 Memory Access Operation

(a) Read from MCU

This function reads control data from the targeted battery management system. When “Read from MCU” button is pressed, the Fixed data or Calibration data of the selected area will be read via USB SMBus I/F.

To perform data reading, the targeted battery management system needs to be in SMBus boot mode. If the targeted battery management system is not in SMBus boot mode, RSB_TOOL2 will send command to change SMBus into boot mode.

The RSB_TOOL2 will display each control data, when the read operation is completed.

Some data will be displayed with the display format changed by RSB_TOOL2.

Table 5 Display format

Parameter	Original Unit	Displaying Unit	formula
Temperature	0.1K	deg C	Displaying value = value / 10 – 237.0
	-128degC	deg C	Displaying value = value – 128
Date	Date (Compressed value)	Date (YYYY/MM/DD)	Year = (value >> 9) + 1980 Month = (value >> 5) & 0x1F Day = value & 0x1F
	date+ (Compressed value)	date+ (YYYY/MM/DD)	Year = (value >> 9) + 2000 Month = (value >> 5) & 0x1F Day = value & 0x1F
RemainingCapacity correct work	mA250ms	mAh	Displaying value = value / (60 * 60 * 4)

(b) Write to MCU

This function writes control data to the targeted battery management system.

By pressing "Write to MCU" button, each data of the selected area will be written to the target battery management system via USB SMBus I/F.

Note: At initial stage, this button cannot be selected (highlighted in grey). And only selectable after executing the "Read from MCU" or "Import mot file".

The RSB_TOOL2 will write the control data in the following steps.

- (1) Erase RAJ240xxx Fixed data block or Calibration data block of the selected area.
- (2) Write the control data of the selected area to RAJ240xxx.
- (3) Read the control data of the selected area from RAJ240xxx and verify it.

To perform data reading, the targeted battery management system needs to be in SMBus boot mode. If the targeted battery management system is not in SMBus boot mode, RSB_TOOL2 will send command to change SMBus into boot mode.

Upon completion, the RSB_TOOL2 will display the message window to show success or failure after completing the writing operation.

Regarding "Reserved" parameter, the value is changed depending on each memory area and write it. The write value as follows.

Table 6 Treatment of Reserved area.

Memory Area	Write value
Fixed data (padding data)	0x00
Fixed data (empty area)	0xFF
Calibration data	0xFF
Extra data (padding data)	0x00
Extra data (empty data)	0xFF
Extra 2 data (padding data)	0x00
Extra 2 data (empty data)	0xFF

(c) Import mot file

This function reads the control data from the designated file.

Supported file format are “.mot (Motorola S-record format)” and “.txt (Specified text format)”, and “.rff(Encrypted format)”.

Each extension is defined as follows.

Type	Extension
Text File	.txt
Fixed data	.fix
Flexible data	.flex
Calibration data	.own
Encrypted file	.rff
All File	.*

By pressing “Import mot file” button, a file selection window will appear. The listed extensions can be changed based on selected memory. When “Fixed data” has been selected, the listed extension is “fix”.

Each data of the selected area will be read from the selected file. If the RSB_TOOL2 encounter some errors (File does not exist, File format error, Data error, etc.), an error message will be displayed.

When .txt and .csv are imported, if there is not data defined by configuration file, it will be kept original value of internal buffer.

If the value is defined in the configuration file, but does not exist in the imported file, the background color is changed to Pink to notify User. In addition, when displaying format is Category, two Asterisk are added to the head of the tab name.

Setting	Table	**Device info	Capacity calc	Protection
Name			value	Unit
Series Number of Cell			3	–
Manufacturer Name			Renesas	str
Device Name			RAJ240055	str
Device Chemistry			Lion	str
SMBus Slave Address			22	–
Control flag			15	flag
New Param			65535	–

(d) Export mot file

This function saves the control data to a file.

Supported file formats are “. mot (Motorola S-record format)” and “.txt (Specified text format)” and “.rff(Encrypted format)”.

The defined extension is same as “Import mot file”.

When “Export mot file” button is pressed, a file selection window will appear.

The data from the selected area will be saved into the file.

If the RSB_TOOL2 detected an error, an operation failed window message will appear.

Nothing will be displayed if the operation succeeded.

When exporting to .txt format, the following information is added to the head of the file.

- I. Export time
- II. Device name
- III. Firmware version
- IV. Configuration file name of memory
- V. Output format

The output data in .txt format as follows.

Class, Category, Parameter Name, Value, Unit, Size, Address, Min, Max

If “Export including empty data” is checked, the exporting file includes all target block data even in target block data is empty. Otherwise, the exporting data does not include empty block.

(e) Compare

This function compares the data between data that is read from the MCU against the data that is read from .mot file.

When there are differences in the data, it will be highlighted in yellow.

(f) Read from another MCU and Compare

This function compares the data between the following 2 functions.

- 1) The data read using "Read from MCU" function.
- 2) The data read when this button is pressed.

Note: In short, when this button is pressed, the data obtained is stored in the buffer together with the data read using "Read from MCU" function, and compare the two sets of data.

(g) Displays the read data

When this check box is checked, during comparison the based data is replaced.
Further details of this function as below.

(1) Compare

- I. Import and display data using "Import .mot file" button.
- II. Press "Compare" button.
- III. Read data from FGIC internally.
- IV. Is there check?

(a) No

- 1) Compare the displayed data (= imported data) and the read data.

(b) Yes

- 1) Display the read data. (Display data is replaced.)
- 2) Compare the displayed data (= read data) and the imported data.

(2) Read from another MCU and Compare

- I. Read and display data using "Read from MCU" button.
- II. Change the communication target to other FGIC.
- III. Press "Read from another MCU and Compare" button.
- IV. Read data from FGIC internally.
- V. Is there check?

(a) No

- 1) Compare the displayed data and the read data.

(b) Yes

- 1) Display the read data. (Display data is replaced.)
- 2) Compare the displayed data and the read data.

(3) Control flag Bit configuration

Specific parameters can be displayed in bits (Ex. Control flag).

This function can be accessed by right-clicking the value which the user wants to display in bit format, and clicking on the pop-up menu (Disp Bit condition).

Name	value	Unit
CELL series number	6	-
ManufacturerName	Renesas	str
Device Name	RAJ240100	str
Device Chemistry	Lion	str
SMBus slave address	16	-
Control flag	A	-

Disp Bit condition

Figure 22 Disp Bit condition

By selecting “Disp Bit condition”, the bit detail window will pop up displaying the selected parameter (as shown in Figure 23 which use the Control Flag parameter as example). The background color determine the bit value. The color specification follows “[Color Selection](#)” setting.

Control flag	bit	7	6	5	4	3	2	1	0
MSB	-	-	-	-	-	-	-	-	-
LSB	-	-	-	Sysin Connection enable	InitCap table using	Initial Calibration 1Point mode	Cell balancing enable	2nd Thr enable	-

ON OFF RESERVED

Save

Figure 23 Bit detail

When clicking on the bit, the value of that bit can be changed from 1 to 0 or vice versa. After modifying the bit, simply click on the “Save” button to update the value.

Click

Control flag	bit	7	6	5	4	3	2	1	0
MSB	-	-	-	-	-	-	-	-	-
LSB	-	-	-	Sysin Connection enable	InitCap table using	Initial Calibration 1Point mode	Cell balancing enable	2nd Thr enable	-

ON OFF RESERVED

Save

Name	value	Unit
CELL series number	6	-
ManufacturerName	Renesas	str
Device Name	RAJ240100	str
Device Chemistry	Lion	str
SMBus slave address	16	-
Control flag	E	flag

Figure 24 Bit detail (After click)

At this stage, the modified parameters are only stored as temporary parameters. To update the FGIC, please click on “Write to MCU” button to complete update.

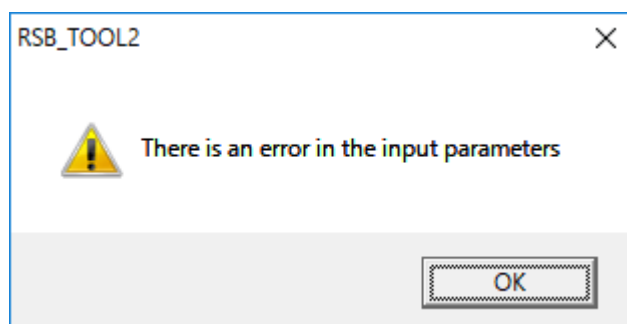
Note : When this operation is performed, "Reserved" bit becomes 0.

(4) Parameter check operation

This function checks range of inputting parameter when following timing.

- Push "Fixed data" / "Flexible data" / "Calibration data" button
- Push "Write to MCU" / "Export mot file" button
- Push "Category" / "Address" button
- Change displaying category (Category display only)

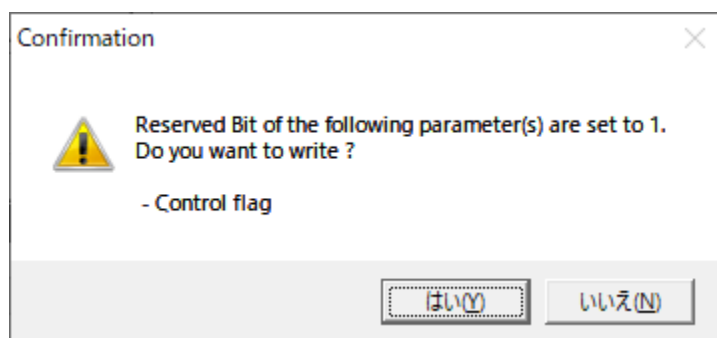
If there are range over parameters, the warning dialog is appeared, and background color of wrong parameter value becomes yellow. And the operation above is cancelled.



Setting	Table	Device info	Capacity calc	Protection
Name			value	Unit
Series Number of Cell			320	-
Manufacturer Name			Renesas	str
Device Name			RAJ240055	str
Device Chemistry			Lion	str
SMBus Slave Address			22	-
Control flag			11	flag
New Param			65535	-

In addition, for parameters such as those shown in (3), if Reserved bit is 1, a warning is displayed in a dialog box like the one below.

This process works when "Write to MCU" and "Export .mot file" are executed.



3.3 Initial Calibration

This function sends a command to execute the initial calibration function of the RAJ240xxx Sample Code.

Note : This function is not available while connecting with E1 emulator.

(1) Window

The following window will appear when the “Initial Calibration” from drop down menu (“Window -> Initial Calibration”) or “Calib” button is selected.

There are two types of Initial Calibration page

- 1) Individual cell calibration (Figure 25). Each cell to be calibrated individually (Cell1, Cell2, ...etc)
- 2) Simplified block calibration (Figure 26). Cell is calibrated in total (Cell1-Cell10 as total)

Note: The calibration method (1 and 2 above) can be change in the .ini file option (CALIB_ALL).

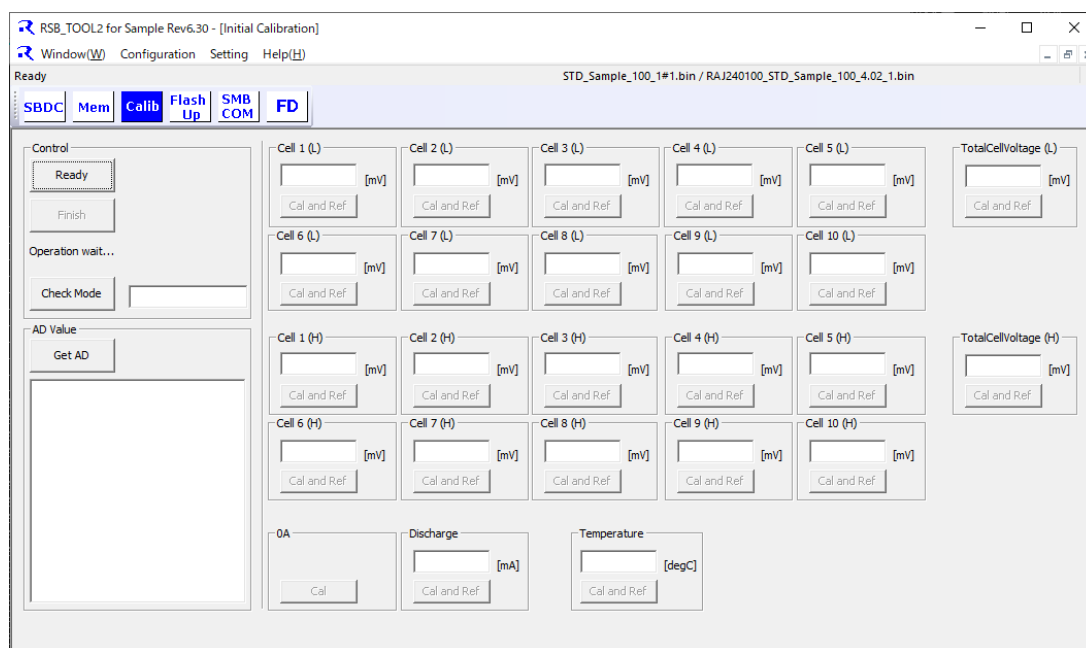


Figure 25 Initial Calibration (Individual Cell option)

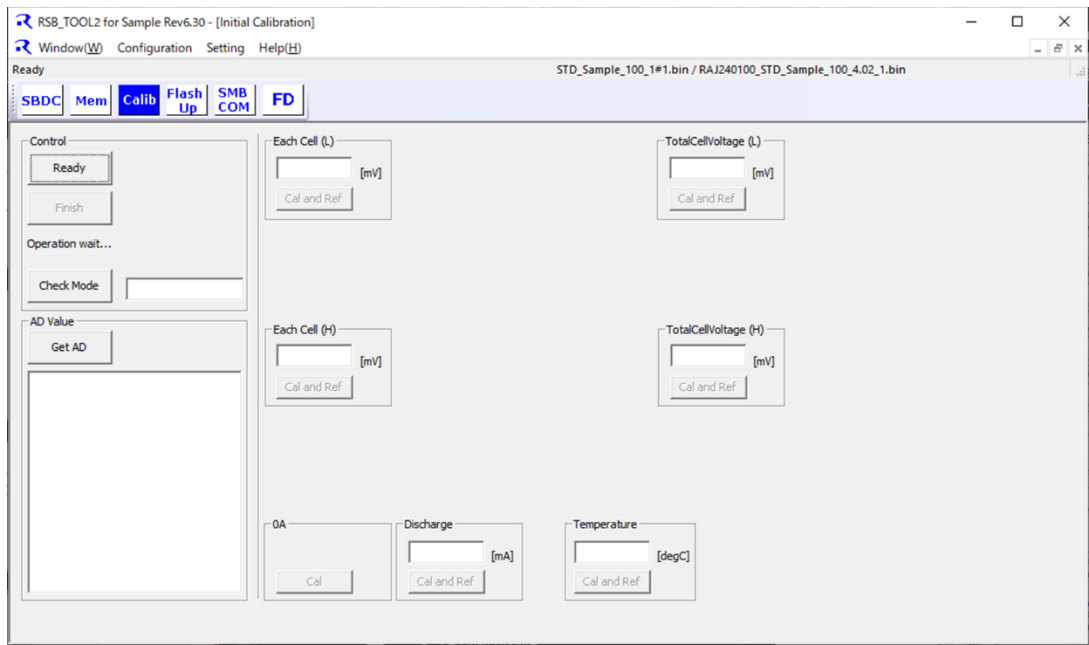


Figure 26 Initial Calibration (Simplified block option)

Figure 25 and Figure 26 show an example RSB_TOOL2 using “RAJ240090 or RAJ240100” configuration setting .
For other configuration, “TotalCellVoltage” will change to “PackVoltage”. (refer to Figure 27.)

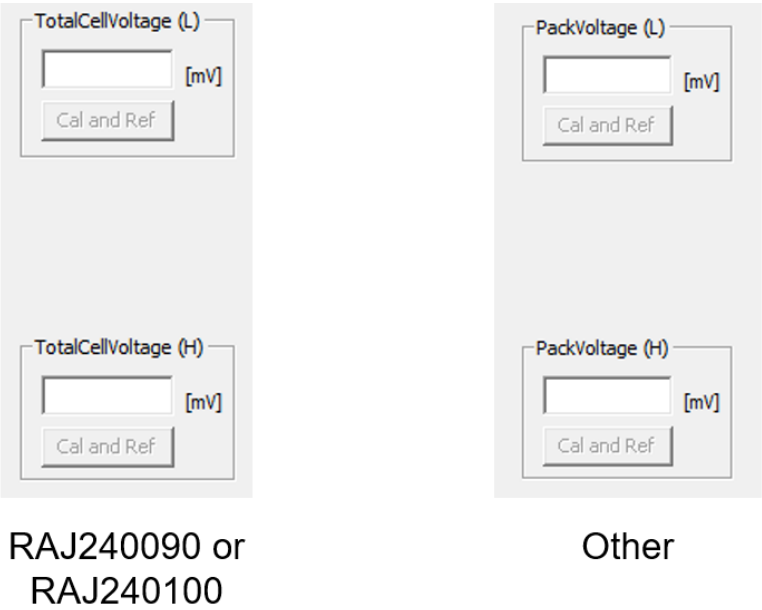
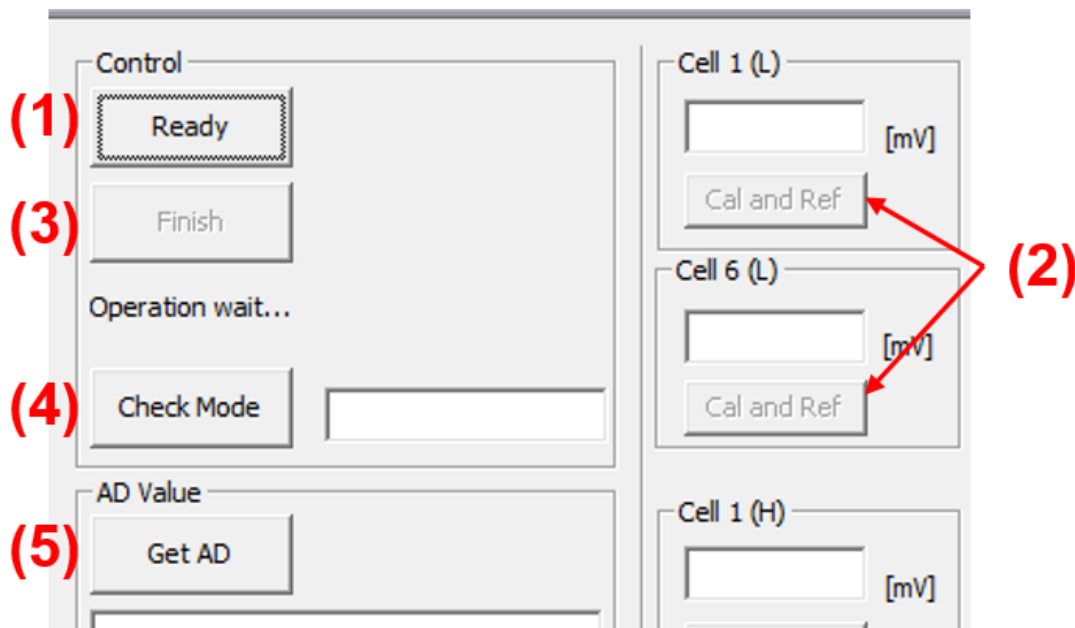


Figure 27 The difference between “RAJ240090 or RAJ240100” configuration and another IC configuration

(2) Operation



- (1) Click the “Ready” button to start calibration.

By pressing this button, RSB_TOOL2 will get the reference value from FGIC and displays it in the corresponding text box.

After that, the operation mode of the Sample Code will transit to “Initial Calibration mode”.

Upon completion, RSB_TOOL2 will enable reference value input and calibration push button (label “Cal and Ref”).

Detail operation after clicking the “Ready” button as below.

1. Checking the operating firmware. If the operating firmware is SMBus boot firmware, this tool will escape from SMBus boot firmware.
2. Read the series number.
3. Read the calibration mode (1 Point calibration mode or not).
4. Move to SMBus boot firmware.
5. Read Calibration data and display reference value.
6. Erase Calibration data.
7. Escape from SMBus boot firmware.
8. Confirm that firmware has transited to Initial Calibration mode.

(2) Cal and Ref

Change the reference value of voltage and current based on the actual applied voltage and current to the FGIC.

Change the reference value of temperature to the actual applied temperature.

If the calibration and reference value writing process has succeeded, a completion message will be displayed as shown in Figure 28.

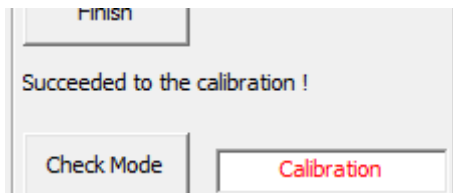


Figure 28 Success message

(3) If the calibration process is completed, click the “Finish” button.

After the “Finish” button is clicked, the tool will issue a software reset command and return the operation mode to normal mode.

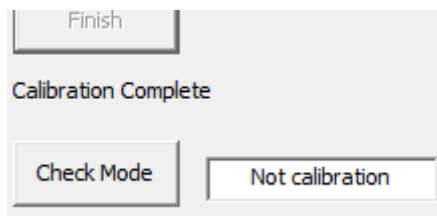


Figure 29 Initial calibration complete

- (4) Current operation mode can be checked by clicking on the “Check Mode” button.

When the operation mode is in Initial Calibration mode, the text box beside Check Mode will display as “Calibration”. Otherwise, it will displayed as “Not calibration”.



Figure 30 Check mode

- (5) Get AD

Press “Get AD” button to obtain each AD value.

Figure 31 shows an example when RAJ240090 or RAJ240100 setting is selected.

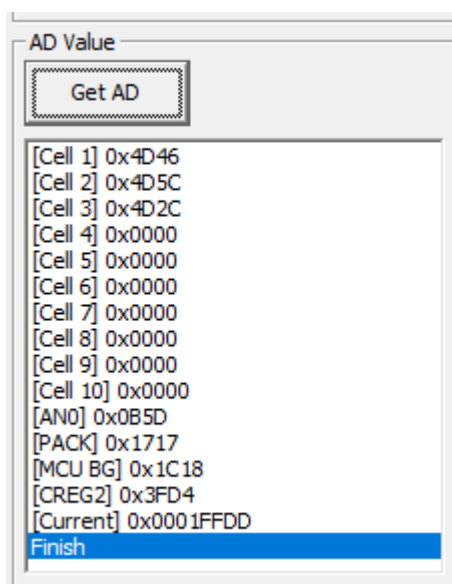


Figure 31 AD value

3.4 Flash Update

This is the update function for FGIC.

RSB_TOOL2 has two mode for Flash Update. The mode is determined by setting (EASY_FU) in the .ini file.

Note : Flexible data is enabled when using corresponded the configuration file.

Note : This function is not available while connecting with E1 emulator.

3.4.1 Normal

If EASY_FU is "0" or not defined in the .ini file, it starts up in Normal mode.

(1) Window

The following window will appear when the "Flash Update" from the drop down menu ("Window -> Flash Update") or "Flash Up" button is selected.

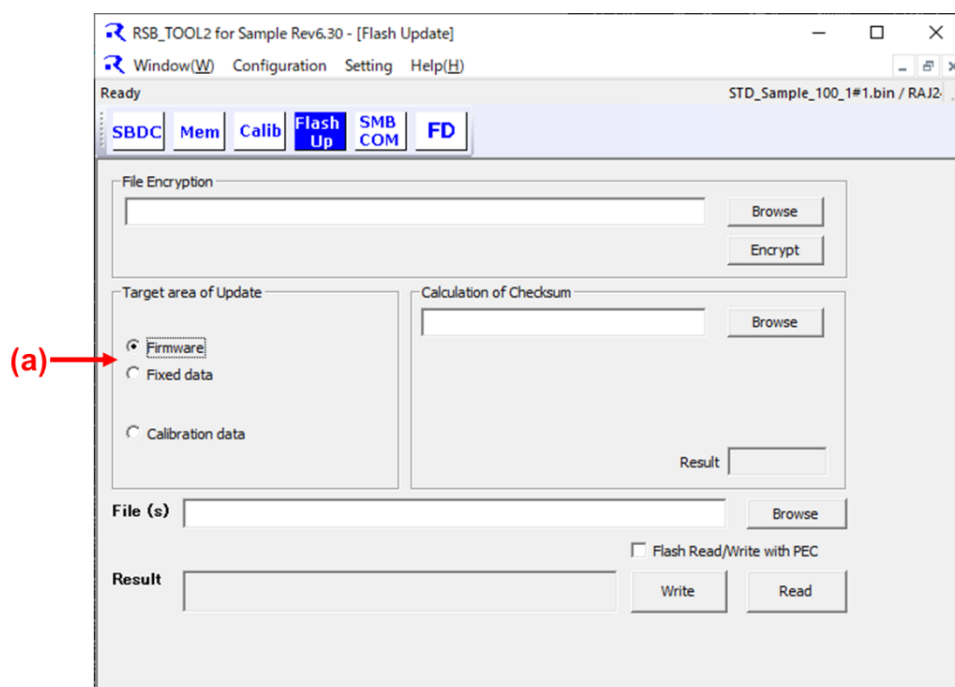


Figure 32 Flash Update

When using configuration file corresponding to “Flexible data”, the appeared window is changed to as following Figure.

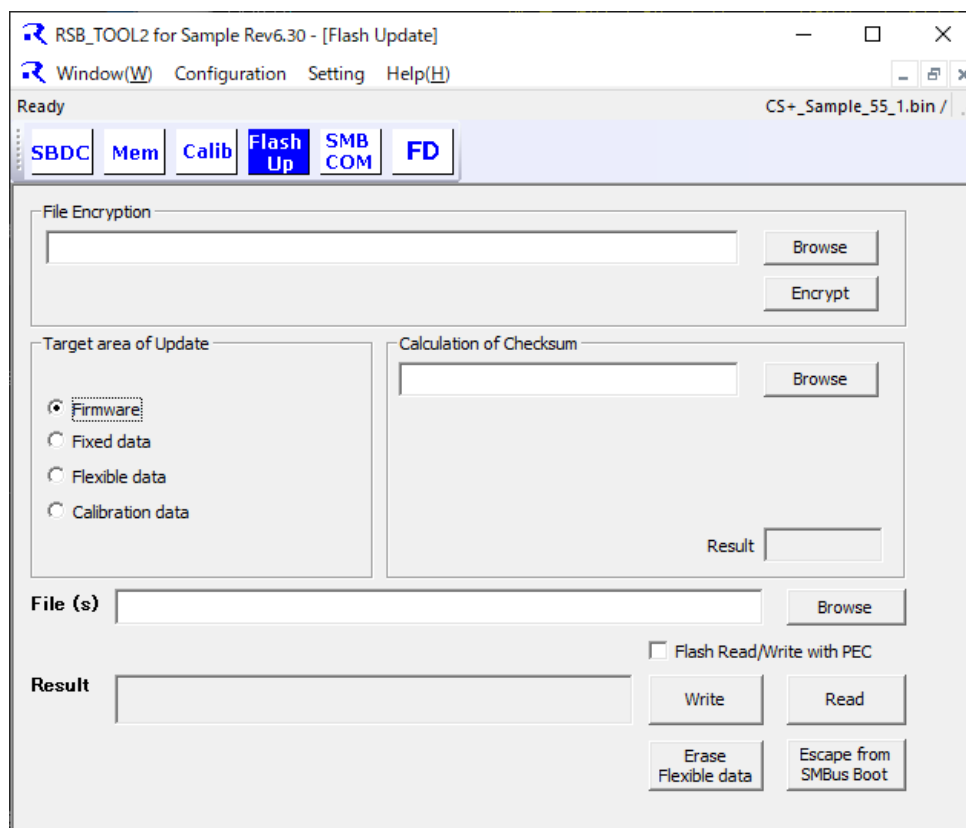


Figure 33 Flash Update + Flexible data

When using configuration file that is made by user(.csv format), the window is changed to as following Figure. But if Extra or Extra 2 data size is zero, applicable area is not shown.

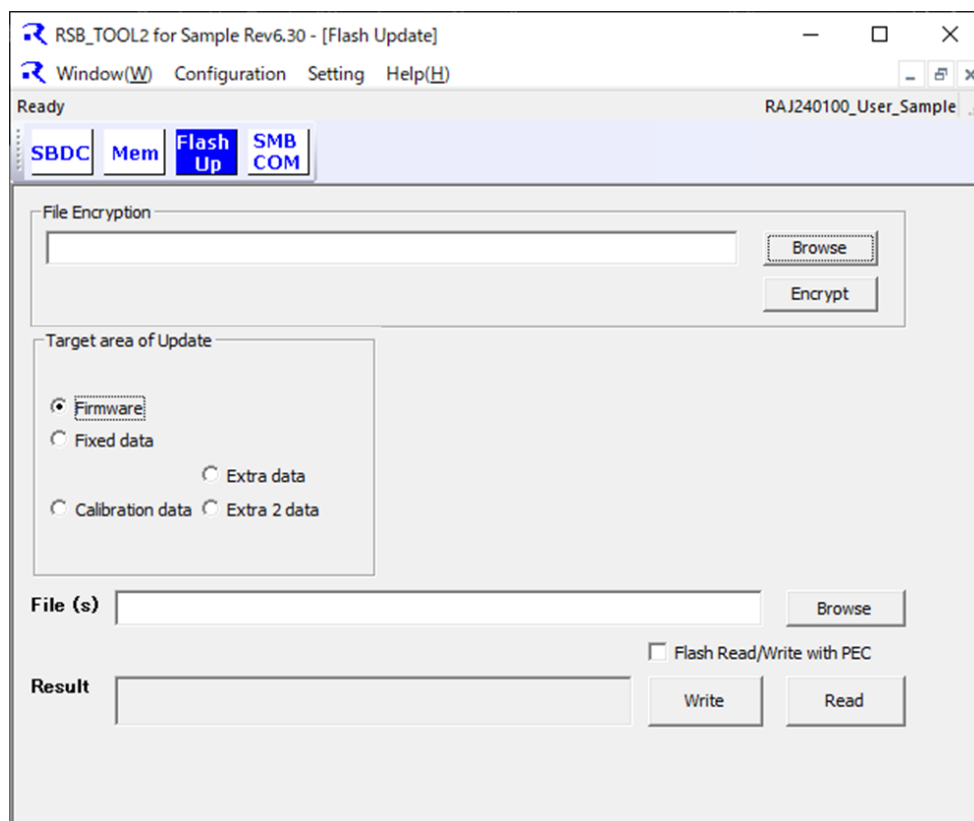


Figure 34 Flash Update (.csv format)

(a) Target area of update

Types of update that can be selected are shown below.

Table 7 Target area of Update

Type	Area of Update	Operation
Firmware	Firmware area.	Write
Fixed data	Fixed data area	Read / Write
Flexible data	Flexible data area	Read / Write
Calibration data	Calibration data area.	Read / Write
Extra data	Extra data area.	Read / Write
Extra 2 data	Extra 2 data area.	Read / Write

(2) Operation

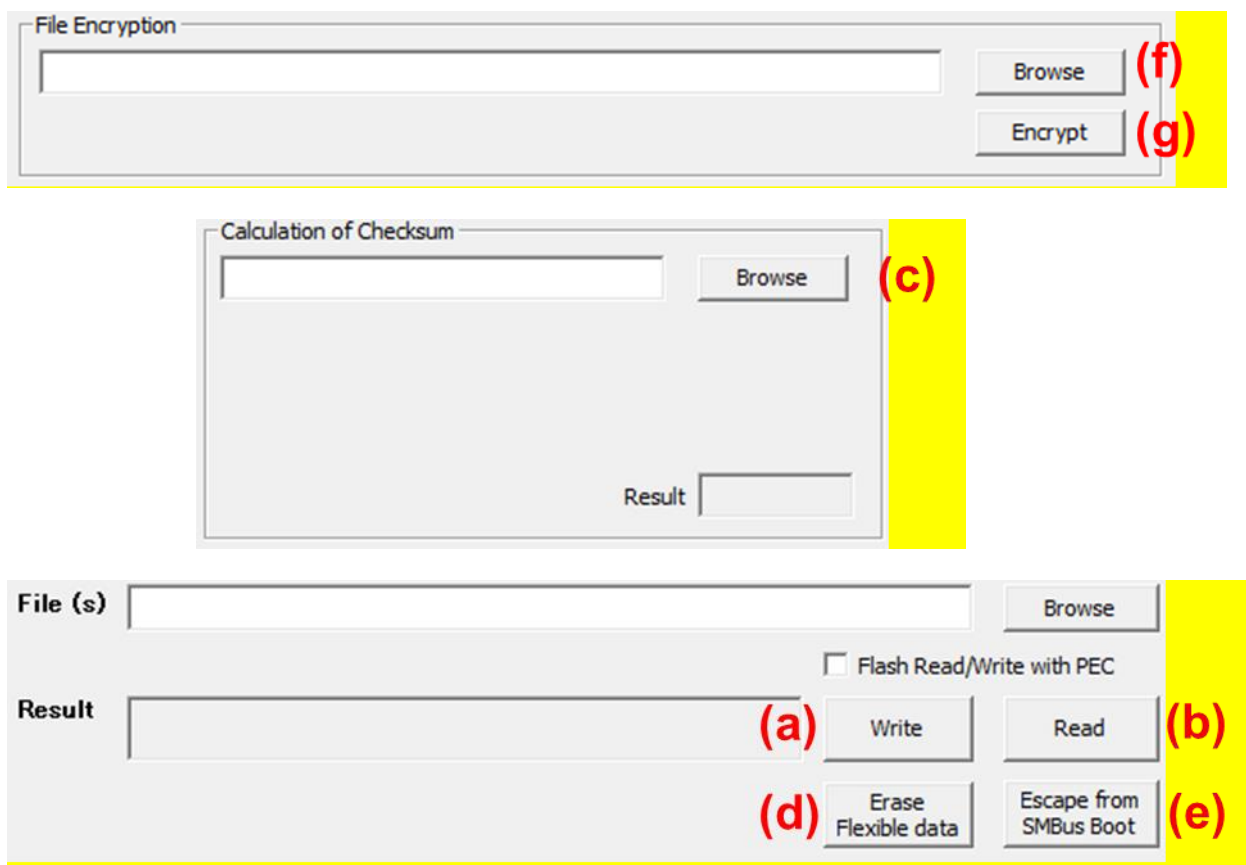


Figure 35 Flash Update Operation

(a) Write

The following is the flash update “Write” operation process.

1) Select target area

Select the following target area to update.

- a. Firmware
- b. Fixed data
- c. Flexible data
- d. Calibration data
- e. Extra data
- f. Extra 2 data

2) Select write data file

Select the desire .mot file name to write .

Click the “Browse” button to select the targeted file. The selected file name will be displayed in the file name edit box.

The file name can also be entered directly in the file name edit box without using the “Browse” option. In this case, enter the file name with the full directory path.

3) Executing Flash update

Click "Write" button to start the update process. Detail operations after clicking the "Write" button as shown below.

- a. Selected target area in process 2 is erased
- b. Write new target file
- c. Verify new target file

When the update completed, a message window will appears indicating a successful operation.

Note: If the file name not specified, an invalid file name is used, or the update operation has failed, the RSB_TOOL2 will displayed a corresponding message window.

When the write operation has failed, RSB_TOOL2 will automatically retry based on the .ini file option (UPDATE_RETRY).

(b) Read

The followings are the flash update “Read” operations.

1) Selecting target area

Select the following target area.

Fixed data / Flexible data / Calibration data / Extra data / Extra 2 data

Note: Error will occurs if other target area is selected.

2) Selecting save file

Select file with .mot extension to read the data.

Click the “Browse” button to select the desire file (only one file can be selected) from the file selection window. The file name will be displayed in the file name edit box.

The file name can also be entered directly into the file name edit box without using “Browse” option. In this case, enter the file name with full directory path.

3) Executing Flash read

Click on the “Read” button to start reading and RSB_TOOL2 will save the file in into .mot format.

Once completed, a message window will appears indicating a successful operation.

Note: If the file name is not specified, an invalid file name is used, or the read operation has failed, a corresponding error message window will be displayed.

(c) Browse (Checksum)

Select a file that is calculated a checksum using this button. The checksum is calculated adding data by WORD unit. The area to be calculated is specified CodeROM area (0x0000~0xDBFF). And if multiple area (Firmware, Fixed data) is included in selected file, this tool does not be calculated the checksum.

(d) Erase Flexible data

This function is enabled when using configuration file corresponded to Flexible data.

Erase Flexible data that placed in 0xF1000~0xF17FF.

When this button is pressed, a dialog that is asked to confirm erase or not. If Yes is pressed, the Flexible data will be erased.

(e) Escape from SMBus Boot

This function is enabled when using configuration file corresponded to Flexible data.

Escape from SMBus Boot F/W and move to User F/W.

(f) Browse (File Encryption)

Select a file that is encrypted using this button. The valid format is .mot format only, and it is enabled to select multiple files. The maximum file number is 5.

(g) Encrypt

Execute an encryption.

The extension that is encrypted file becomes to .rff and encrypted file can be used in following functions.

- Memory Access
 - Import mot file
- Flash Update

- Write
- Calculation of Checksum

3.4.2 Easy

If EASY_FU is "1" in the .ini file, it starts up in Easy mode.

(1) Window

The following window will appear when the "Flash Update" from the drop down menu ("Window - > Flash Update") or "Flash Up" button is selected.

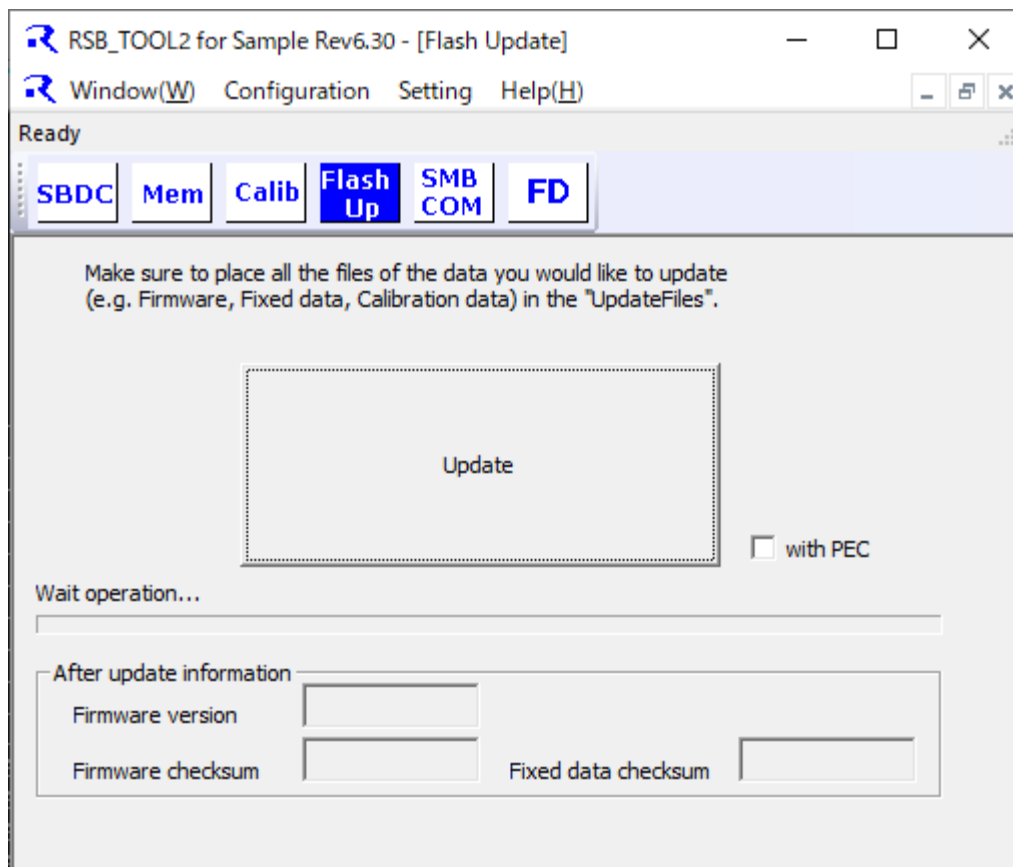
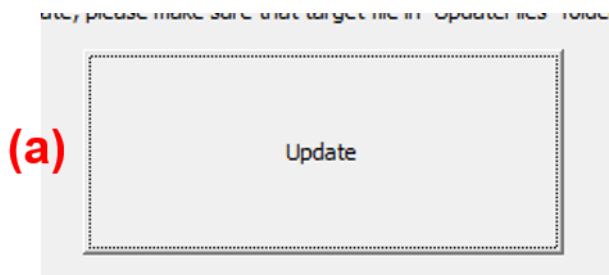


Figure 36 Flash Update (Easy)

(2) Operation

**Figure 37 Flash Update (Easy) operation**

This function updates firmware and parameter(Fixed data / Flexible data / Calibration data / Extra data / Extra 2 data) using placed in the specified directory. If there are files that be wanted to update, please place these files in "UpdateFiles" folder. The target folder can be changed by ini file option(EASY_FU_DIR). If option is not defined, "UpdateFiles" folder is used.

If update operation is completed properly, this function gets firmware version, firmware checksum, and Fixed data checksum, and display it.

(a) Update

This button executes update operation.

RSB TOOL2 supports .mot and .srec format.

And Table 8 shows the target area of Firmware, Fixed data, Flexible data, and Calibration data. Regarding to Extra data and Extra 2 data area, it is followed by user's definition.

Table 8 Target area and support block

Target Area	Support block
Firmware	00H-35H
Fixed data	36H
Flexible data	00H, 01H(Data Flash)
Calibcation data	02H (Data Flash)

3.5 SMBus Command

This is the functions of single/sequential Read/Write.

(1) Window

The following window will appear when “SMBus command” from the drop down menu (“Window -> SMBus command”) or “SMB COM” button is selected.

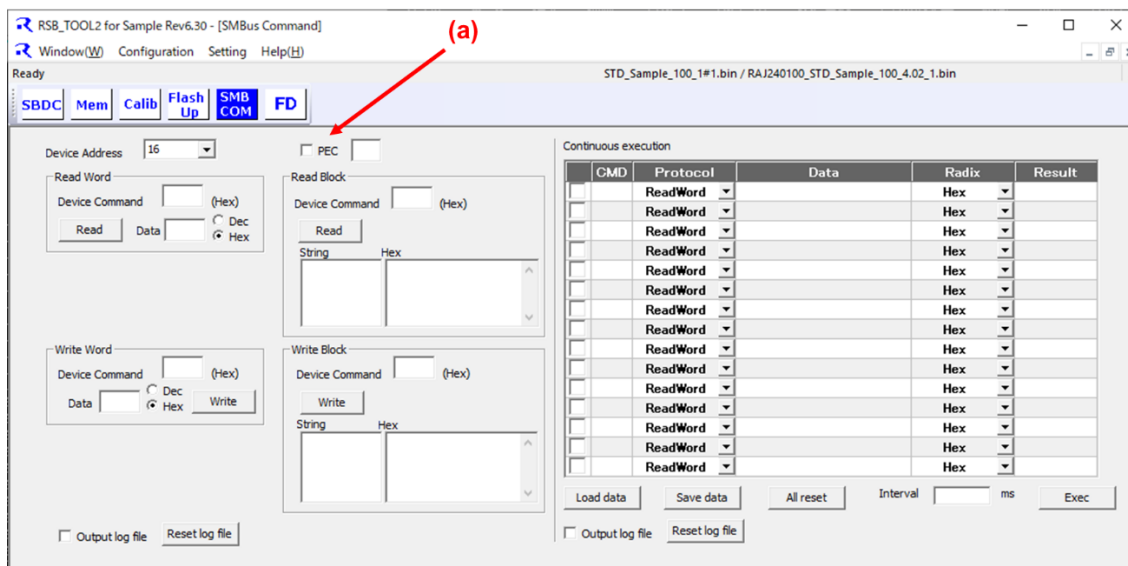


Figure 38 SMBus Command

(a) PEC setting

PEC can be enabled or disabled in SMBus communication. It is enabled when the check box is checked.

(2) Operation

(a) Read communication

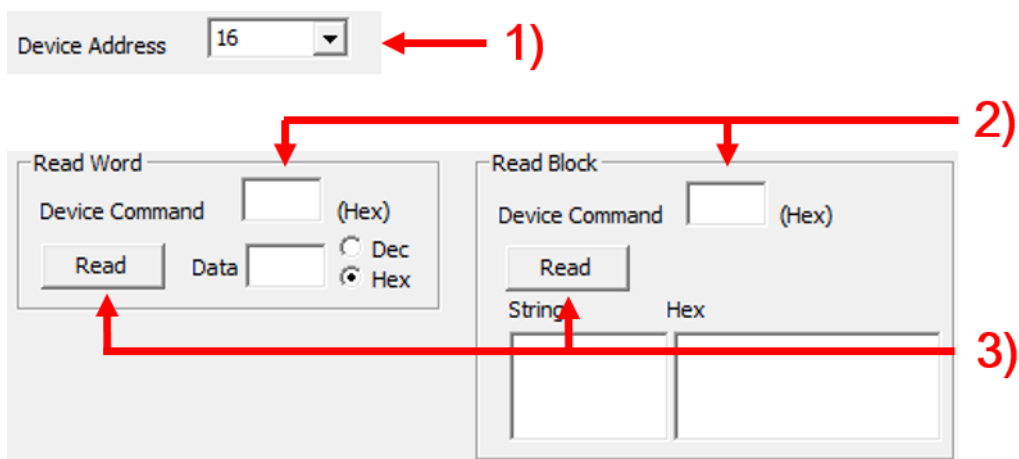


Figure 39 SMBus Command (Read)

Read communication can be used by pressing the “Read” button.
The procedure for read communication as follows.

1) Set the Slave Address.

Select or input the Slave Address in Device Address drop down menu.

2) Set the Command.

Input the Command in Device Command edit box.

3) Press the “Read” button.

If Succeed : The read data will be displayed.

If Fail : An error message will be displayed.

Note If the data is in Byte or Word protocol, it will be displayed in the Data edit box.

Note If the data is in Block protocol, it will be displayed in the String and Hex Data edit box. The String box content is displayed in ASCII characters, while the Hex box content is displayed in hexadecimal numbers.

Note PEC is displayed in the PEC box if PEC setting is enabled. Usually, the displayed font is in black color but it is in red if the PEC encountered error.

(b) Write communication

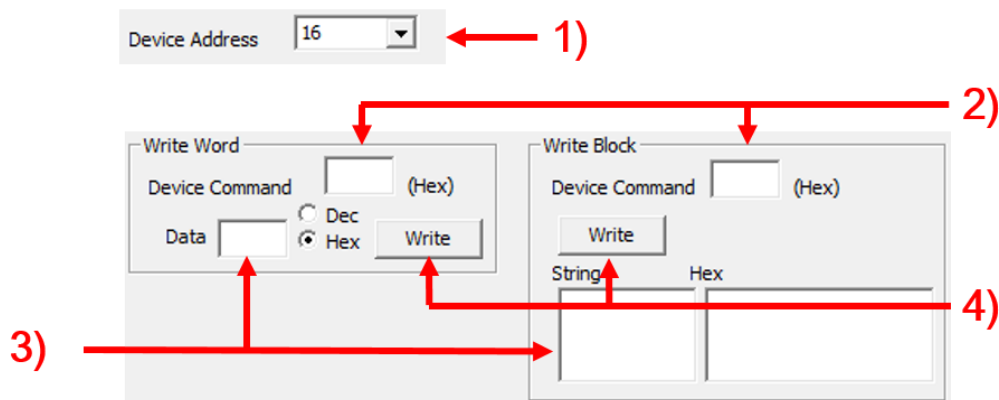


Figure 40 SMBus Command (Write)

Write communication can be used by pressing the “Write” button.
The procedure for write communication as follows.

1) Set the Slave Address.

Select or input the Slave Address in Device Address drop down menu.

2) Set the Command.

Input the Command in Device Command edit box.

3) Set the write data.

Input the write data.

If the data is in Byte or Word protocol, it should be input to Data edit box.

If the data is in Block protocol, it should be input to String (by ASCII character) or Hex (by hexadecimal number) edit box.

4) Press the “Write” button.

A message box indicating the write process has succeeded or failed will be displayed.
This message indicates result of the write communication only. It does not ensure the slave device has received the communication.

(c) Continuity communication

Continuous execution

	CMD	Protocol	Data	Radix	Result
<input checked="" type="checkbox"/>	41	ReadWord	0006	Hex	Success
<input checked="" type="checkbox"/>	9	ReadWord	17983	Dec/Char	Success
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-
<input type="checkbox"/>		ReadWord		Hex	-

Interval ms

↑ (a)
↑ (b)
↑ (c)
↑ (d)
↑ (e)

Figure 41 Continuity communication (Example)

Continuity communication can be executed by pressing the “Exec” button.

If the specified protocol is WriteBlock and the input data is not 2-byte aligned, 0 is added to the beginning of data at execution time.

The number of commands (= number of lines) that can be executed can be specified in the ini file options (EXEC_CONTINUOUS_COMM_NUM).

- (a) Load data
To load the saved data that was exported by “Save data” function.
- (b) Save data
To save the input data in .csv format.
- (c) All reset
To reset the displayed data/item.
- (d) Interval time
To specify time interval between commands.
- (e) Exec
To execute the commands in sequence.

Table 9 Continuity command format

	Setting method	Specify	
CMD	Input to "CMD" column	Inputted command(Hexadecimal)	
Protocol	Select from Protocol combo box	ReadWord	ReadWord protocol
		WriteBlock	ReadBlock protocol
		ReadBlock	ReadBlock protocol
		WriteBlock	WriteBlock protocol
Radix	Select from Radix combo box	Hex	hex
		Dec/Char	Decimal/Character
		Bit	Bit value (Valid in Read protocol only) ReadWord : Big enditan ReadBlock : Byte order
		Hex(Block)	Hex(Reverse endian)
		Dec(Block)	Dec(Reverse endian)
		SDec(Block)	Signed Dec(Reverse endian)
Result	None	Communication result	

(d) Log file

The data obtained can be stored in log file with .CSV format. If "Reset log file" button is pressed, a new log file will be created.

The log files name is generated as SMBLOG_@@@_YYYYMMDDHHMMSS.CSV
(SMBLOG_@@@_year month day hour minute sec.CSV)

@@@ symbols indicate as follows:

- ✧ Single communication : Single
- ✧ Continuous communication : Conti

Note: If read data (BlockRead Protocol) is in binary format, the log data may be incorrect.

3.6 Factory Default

This function resets the IC's status such as firmware, Fixed data, and Calibration data to the factory default.

Note : This function is not available while connecting with E1 emulator.

(1) Window

The following window will appear when “Reset to the Factory Default” from the drop down menu (“Window” -> “Reset to the Factory Default”) or “FD” button is selected.

Note: Figure 42 shows an example of the GUI window setting for RAJ240100 configuration.

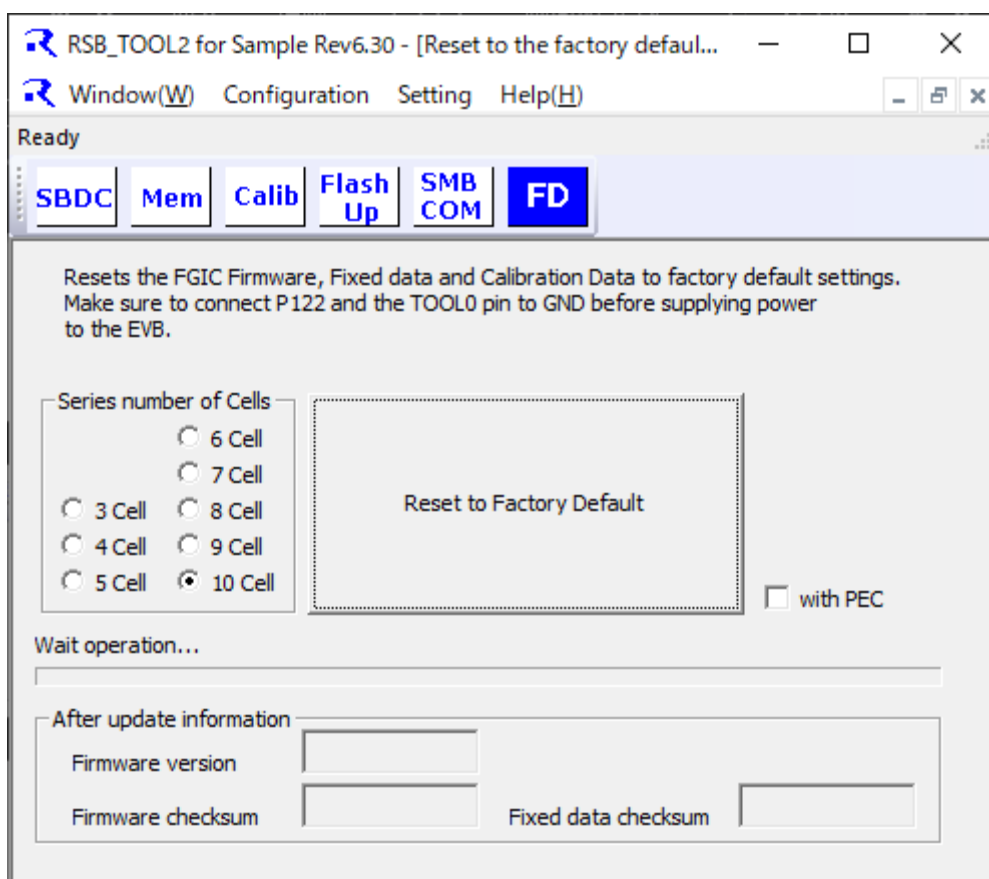


Figure 42 Factory Default

(2) Operation

**Figure 43 Factory Default operation**

- (a) Series number of Cell
First of all, please select "Series number of Cell" according to substrate's configuration.
- (b) Reset to the factory default
This button resets IC's status such as firmware, Fixed data, and Calibration data to the factory default. The file that is used in this operation is placed in "DefaultFile" folder name as "Device"_sample_default.mot. "Device" name is changed with depends on configuration file.
For example, RAJ240100_sample_default.mot.
If update operation is completed properly, this function gets firmware version, firmware checksum, and Fixed data checksum, and display it.

4. Configuration file

The RSB_TOOL2 has external configuration file which can be configured by using the tool itself. If the configuration file is updated, version number will be added behind the file name (updates are due to bug correction, etc). Example as follows.

(old file) RAJ240090_STD_Sample_None_1.00.bin

(new file) RAJ240090_STD_Sample_None_1.00#1.bin <- Updated configuration file.

4.1 Types of configuration file

There are two types of external configuration files, and each file must be placed correctly at designated location.

Details as follows.

1) SBS command files

Define SBS command that is used by Smart Battery Data Communication functions.

Location : \configuration\sbs\

2) Memory map files

Define memory map that is specified by firmware specification document.

Location : \configuration\memory\

5. Ini file setting

5.1 RSB_TOOL2.ini

The RSB_TOOL2 software operation settings can be changed by using "RSB_TOOL2.ini" setting file. The .ini setting file is optional, user do not have to prepare the file if they do not want to change the operation settings. The software will works on default setting if the .ini file could not be found.

Note: () in Table 10 below is the default value.

Table 10 ini file options

Section	Parameter	Outline	Value	Content
COMMON	REC_INI	Record setting in SBDC	0	No record
			(1)	Record setting
	CONFIG_SPECIFIC	RSB_TOOL2 can reflect specific configuration file.	0	No reflect (User select)
			*1	Reflect specific configuration file
	PORT	Specify COM Port.	Any (-)	
	DEVICE	Specify USB SMBus I/F PID(Product ID) and VID(Vendor ID). Use "@" to separate the PID and VID (PID@VID). If there is no @ mark, VID treated as Renesas.	Any (-)	Example PID : 023E VID : 045B 023E@045B
	CONFIG_SELECT_LOAD	Re-load configuration file when selecting configuration from menu.	(0)	No re-load
			1	Re-load
	UPDATE_RETRY	Retry count of the writing operation in the FlashUpdate function.	Any (1)	This is decimal value
	SLAVE_ADDRESS	Slave address of target device in Sample Code	Any (16)	This is hexadecimal value
	FONT_RATIO	Ratio of grid font.	(1.0)	This value is decimal value.
SELECT	LOG	Disable log output.	(0)	Disable log output
			1	Enable log output
	SBDC_LOG	If SMBus command function communicates when SBDC function is	0	Stop & not save to log file

		getting data continuously, RSB_TOOL2 will stop getting data continuously and save to log file in SBDC function.	(1)	Non-stop & save to log file
	TIMER	Interval timer in SBDC function	Any (500)	This is decimal value
	EXTENSION_NUM	Row number of extra commands in SBDC function.	~20 (20)	Decimal value
	DATA00~3F	Checkbox of getting target.	0 1	Not checked Checked
	EXTDATA00~xx*2	Checkbox of getting target for extra commands	0 1	Not checked Checked
	EXTNAME00~xx*2	Command Name of getting target for extra commands	Any	Display command name
	EXTCMD00~xx*2	Command number of extra commands	Any	Hexadecimal value
	EXTBLK00~xx*2	SMBus protocol of extra commands	0 1	ReadWord ReadBlock
	EXTHEX00~xx*2	Display radix of extra commands	0 1 2	Hex Dec or character Bit
	TEXT_CLR_R	Red text color element of SBDC.	0~255 (0)	Decimal value
	TEXT_CLR_G	Green text color element of SBDC.	0~255 (0)	Decimal value
	TEXT_CLR_B	Blue text color element of SBDC.	0~255 (0)	Decimal value
	BACK_CLR_R	Red background color element of SBDC.	0~255 (255)	Decimal value
	BACK_CLR_G	Green background color element of SBDC.	0~255 (255)	Decimal value
	BACK_CLR_B	Blue background color element of SBDC.	0~255 (255)	Decimal value
BIT_COLOR	COLOR_ON	Background color of on.	RED/ GREEN/ WHITE/	Selectable colors are only the colors
	COLOR_OFF	Background color of off.		

	COLOR_ERROR	Background color of error	GRAY/ BLUE/ YELLOW	defined here.
	COLOR_RESERVED	Background color of reserved.		
FRAME	SMBCOM	Displays SBDC function when RSB_TOOL2 is executed.	0	No display
			(1)	Display
	INITCALIB	Displays Initial Calibration function when RSB_TOOL2 is executed.	(0)	Not display
			1	Display
	SBDC	Displays SMBus command function when RSB_TOOL2 is executed.	(0)	Not display
			1	Display
OPTIONS	ABORT	If communication error count in SBDC function reach this value, stop obtaining data continuously. This option is invalid if the value is set to 0.	Any (3)	Decimal value
	CALIB_ALL	Using "Cell 1 – Cell 10" calibration or not.	0	Not used
			(1)	Using
	EASY_FU	Select the Flash Update function mode.	0	Normal
			(1)	Easy
	DISP_CMD_NUM	Display command number in front of parameter name or do not display.	(0)	Not display
			1	Display
	EASY_FU_DIR	This directory is used by Easy Update.	-	
	DISP_16_BIT_LEN	Using 16 bit length for bit display on SBDC	(0)	8 bit length
			1	16 bit length
	DIVIDE_FILE_SIZE	The size to divide the log file.	(10)	This value unit is MegaByte
	EXEC_CONTINUOUS_COMM_NUM	The number of commands to be executed continuously in SMBCOM function.	(15)	This value is decimal.

Note: To select specific configuration file automatically, file format need to be as follow.

RAJ240080_STD_Renesas_80_1.00

Note: The max value is half of the value defined by "EXTENSION_NUM". If "EXTENSION_NUM". When the value is an odd number, the value will be rounded down.

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jun.7 th .17	All	First release
2.00	Jun. 30 th .17	9	Added button that can be obtained the USB SMBus I/F version.
		19	Added Memory Access function.
3.00	Oct. 20 th '17	18, 19 27 – 32 33 – 35 36 – 41 43	Added enhancing operation in Memory Access function. Added logging function in SMBus Command function. Added Demonstration function. Added Parameter configuration assistant function. Updated "DEVICE" option.
3.10	Nov. 2 nd '17		Added RAJ240080 to the corresponding device.
	Nov. 22 th '17		Added RAJ240045 to the corresponding device.
3.20	Dec. 20 th '17		Added RAJ240075 to the corresponding device.
	Jan. 29 th '18	All	Modified the all description.
4.00	Mar. 30 th '18	19	Added "Export including empty data" operation.
		30 – 35	Added Flash Update Easy mode.
		53 – 54	Added Factory Default function.
		58	Added "EASY_FU" option.
		58	Changed the default value of "CALIB_ALL" option.
4.10	May. 18 th '18	6	Added the description for limitation of using E1 debugger.
		11	Added "Color Selection".
		19	Modified the description for "Color Selection"
		26 - 29	Modified the description for "Color Selection".
		45, 46	Added the checksum calculation function. Added the select cell number function to "Factory Default" function.
5.00	Mar. 18 th '19	8	Added "Grid Height Setting"
		12	Modified the current information display.
		12, 54	Added "DISP_CMD_NUM" option.
		13	Added "Save and Restore" function.
		14, 56	Added "DIVIDE_FILE_SIZE" option
		14	Added limitation about "EXTENSION_NUM".
		15, 42	Corresponded to Bit display format.
		15	Changed the display format of Status Detail.
		17	Added "Generic" function.
		34, 54	Added "EASY_FU_DIR" option.
5.10	Jun. 7 th '19	3, 4	Added "SequenceFile" information.
		12, 45	Added "Hex (Block)", "Dec(Block)", and "SDec(Block)" radix.
		16, 33	Corresponded to "Flexible data".
5.20	Jun. 28 th '19	25	Changed the condition of parameters that can be displayed in bit.
5.21	Jul. 24 th '19	8	Added Cancel button.
		15	Modified the specification for WriteBlock protocol.
		25	Added notes on editing Sequence file.
		44	Changed the process of Reserved Bit.
5.22	Sep 30 th '19	11	Modified the specification for WriteBlock protocol. Modified the description for log output.

Rev.	Date	Description	
		Page	Summary
5.30	Feb 18 th '20	4,8,18-18, 35-35,40, エラー! ブ ックマー クが定義 されてい ません。 14	Corresponded to configuration file that is created by User with specified .csv format. Added checkbox for PEC control.
5.31	Mar. 13 th '20	-	The specification has not changed. (Modified the code.)
5.40	Jun. 8 th '20	-	The specification has not changed. (Modified the code.)
6.00	Apr. 22 nd '21	-	The specification has not changed. (Modified the code.)
6.10	May. 12 th '21	-	The specification has not changed. (Modified the code.)
6.20	Jun. 24 th '21	-	The specification has not changed. (Modified the code.)
6.30	Jun. 22 nd '22	- - 10, 14 14 20 21 22 27 27 22, 23, 38 44, 49	Deleted Parameter configuration assistant and Demo function. Supported RAJ240055, RAJ240057 Modified the place of some controls. Added Table 4. Added Table 5 Added Table 6 Added the function to clearly display parameters that were not defined in the imported file. Added Parameter check operation. Added function that checks Reserved value in control flags. Added Encryption function. Added EXEC_CONTINUOUS_COMM_NUM option.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity.

Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

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.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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