RZ/T2M Group

ENCOUT sample program

Summary

This document describes the RZ/T2M ENCOUT sample program package. To use this sample program, please obtain “RZ/T2M Group Encoder I/F Configuration Library” release package (Rev.4.00 or later).

Functionality Checked Device

RSK+RZT2M Board (RTK9RZT2M0C00000BE)

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1. Package Contents

This package contains the following contents.

1.1 Software

- Source Code

No.	Name	Version number
1	RZ/T2M ENCOUT sample program	4.0

- Configuration Data

No.	Name	Version number
1	RZ/T2M ENCOUT Configuration Data	1.0
2	RZ/T2M ENCOUT PINMUX Data	1.0

1.2 Document

No.	Document name	Version	File name
1	RZ/T2M ENCOUT sample program Release Note	4.0	(j) r01an6416jj0400-rzt2m.pdf (e) r01an6416ej0400-rzt2m.pdf (this document)
2	RZ/T2M Group ENCOUT sample program Application Note	4.0	(j) r11an1058jj0400-rzt2m-encout.pdf (e) r11an1058ej0400-rzt2m-encout.pdf
3	RZ/T2M Group Encoder Divided-Output Module (ENCOUT) Application Note	1.0	(j) r01an6394jj0100-rzt2m_encout.pdf (e) r01an6394ej0100-rzt2m_encout.pdf

2. File Structure

The file structure and contents of this package are detailed below.

```
Top
 ├──r01an6416jj0400-rzt2m.pdf
 ├──r01an6416ej0400-rzt2m.pdf
 └──workspace
     ├──Software
     │    ├──iccarm
     │    │    └──RZ_T2_encout.zip          : RZ/T2M ENCOUT sample program set (IAR)
     │    └──gcc
     │         └──RZ_T2_encout.zip          : RZ/T2M ENCOUT sample program set (e2 studio)
     └──Documentation
          ├──r11an1058jj0400-rzt2m-encout.pdf
          ├──r11an1058ej0400-rzt2m-encout.pdf
          ├──r01an6394jj0100-rzt2m_encout.pdf
          └──r01an6394ej0100-rzt2m_encout.pdf
```

The file structure of the RZ_T2_encout.zip is shown below.

```
Top folder
 ├── configuration.xml                          : FSP Configuration Data
 ├── ( Build Tool Dependent Environment File )
 ├──  lib
 │     └── ecl
 │          ├── Config_Encout_v1.0_original.dat  : RZ/T2M ENCOUT Configuration Data
 │          └── RZT2_pinmux_v1.0.bin             : RZ/T2M ENCOUT Pin Configuration Data
 └── src
      ├── hal_entry.c                           : ENCOUT sample program
      ├── encout_main.c                         : ENCOUT sample program
      ├── encout_dat.asm                        : ENCOUT Linker setup file (only e2 studio)
      ├── siochar.c                             : SCI_UART sample program
      ├── siorw.c                               : SCI_UART sample program
      ├── sio_char.h                            : SCI_UART sample program
      └── drv
           ├── src
           │    └── r_encout_rzt2.c             : ENCOUT driver file
           └── inc
                ├──  iodefine_encout.h          : ENCOUT register definition file
                ├── r_encout_rzt2_config.h      : Configuration header file of ENCOUT driver file
                └── r_encout_rzt2_if.h          : APIs of ENCOUT driver file
```

3. About ENCOUT Sample Program

This section contains information necessary to use the complete set of ENCOUT sample program.

3.1 Software Information

3.1.1 Base OS

This sample program is OS-independent.

3.1.2 Memory Size

Memory size used by this sample program, ENCOUT driver, and configuration data is shown in following table. This table does not include memory size used by Encoder I/F Configuration Library, Flexible Software Package, or C language libraries of the compiler.

Items		Memory Size	
		EWARM [kBytes]	e² studio [kBytes]
ENCOUT driver	Code	0.8	0.7
	Data (with initial value)	0.0	0.0
	Data (without initial value)	0.0	0.0
	Constant Data	0.0	0.1
ENCOUT configuration data	Constant Data	8.4	8.4
Sample program	Code	1.8	2.0
	Data (with initial value)	0.0	0.0
	Data (without initial value)	0.0	0.0
	Constant Data	0.6	0.6

3.2 Hardware Information

3.2.1 Device

RZ/T2M

3.2.2 Target Board

(1) Board Name

RSK+RZT2M (RTK9RZT2M0C00000BE)

(2) Setting of the Target Board

The target board configuration is as follows.

SW4-1: ON

SW4-2: OFF

SW4-3: ON

SW4-4: ON

SW4-5: OFF

SW6-1: OFF

(3) Used Pins of the Target Board

Table 3.1 shows the pins used as the phase A, B and Z output ports, and their functions.

Table 3.1 Used pins and their function

Channel	Signal Name (Pin Name)	Pin Header	Input/Output	Description
ENCOUT0	POUTA0 (ENCIF2)	CN1 #3	Output	Phase A output pin
	POUTB0 (ENCIF3)	CN1 #4	Output	Phase B output pin
	POUTZ0 (ENCIF4)	CN1 #6	Output	Phase Z output pin
ENCOUT1	POUTA1 (ENCIF7)	CN1 #9	Output	Phase A output pin
	POUTB1 (ENCIF8)	CN1 #11	Output	Phase B output pin
	POUTZ1 (ENCIF9)	CN1 #12	Output	Phase Z output pin

3.3 Procedures on Development Environments

3.3.1 Preparation before Executing the Sample Program

In this sample program, communicates with the host PC. The USB connection terminal on the target board is CN16. The terminal software of the host PC is set as shown in the following table.

Function	Setting
Communication method	Asynchronous serial transmit / receive
Sending / receiving order	LSB first
Transfer rate	19200 bps
Character length	8 bits
Stop bit length	1 bit
Parity function	None
Hardware flow control	None

3.3.2 EWARM from IAR Systems

(1) Build Environment

IAR Embedded Workbench for Arm (EWARM) Version 9.60.3

RENESAS FSP Smart Configurator (FSP SC) 2025-12

RENESAS Flexible Software Package (FSP) for RZ v4.0.0

(2) Execution Environment ICE

IAR I-jet

(3) Build Procedure for Sample Programs

The build procedure for the sample program is as follows.

1 Copy the extracted source files to the desired location.
2 Copy the following files from “RZ/T2M Group Encoder I/F Configuration Library” under lib¥ecl in the same folder as the source files. (If the “lib¥ecl” folder already exists, overwrite it.) *1
lib¥ecl¥r_ecl_rzt2_iar.a
lib¥ecl¥r_ecl_rzt2_if.h
3 Activate EWARM.
4 Select [File] menu -> [Open Workspace].
5 Open the extracted source file RZ_T2_encout.eww.
6 Start the FSP Smart Configurator from the [Tools] menu of the EWARM IDE. *2

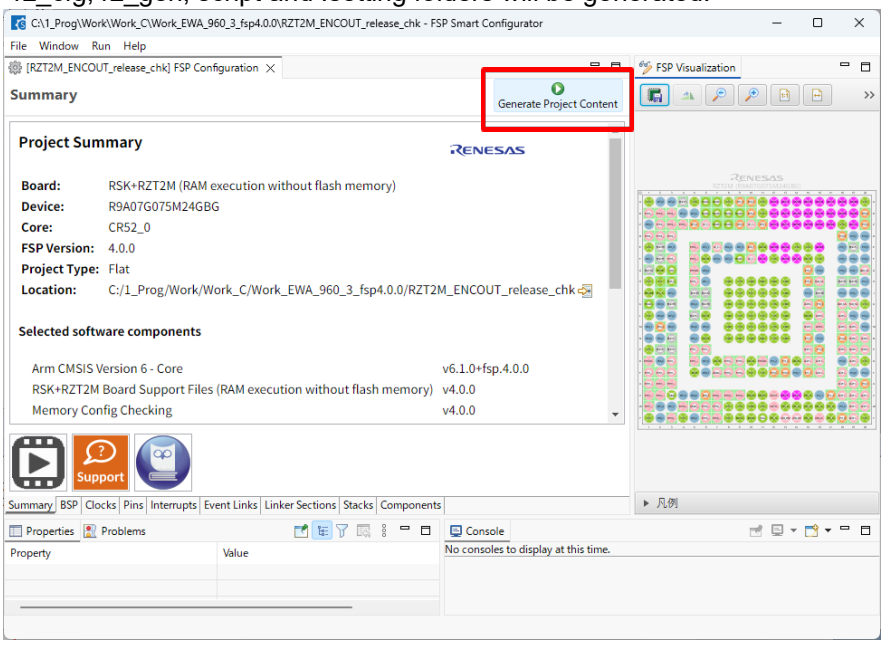
Note: 1. Please use Encoder I/F Configuration Library revision 4.00 or later.
2. The following procedure adds the activation of the FSP Smart Configurator to the [Tools] menu of the EWARM IDE. Select [Tools] menu -> [Tool Configuration] in the EWARM IDE. Select the [New] button, specify a table string in each field, and press [OK].

Field	String
Menu text	FSP Smart Configurator
Command	$RASC_EXE_PATH$
Argument	--compiler IAR configuration.xml
Initial directory	$PROJ_DIR$

String for the command is variable holding the path of the Smart Configurator execution file, rasc.exe.
If the path written as RASC_EXE_PATH in the buildinfo.ipcf file does not match with your rasc.exe installation path, please edit the buildinfo.ipcf to fit with your installation path.

You can also start the FSP Smart Configurator directly from the command prompt by specifying the folder where it is installed.

7 In the FSP Configuration pane of the Smart Configurator, click Generate Project Content. The rz, rz_cfg, rz_gen, script and .setting folders will be generated.



8 When project generation is complete, close the Smart Configurator.
9 Select [Rebuild ALL] from the [Project] menu of EWARM.
The file Debug\Exe\RZ_T2_encout.out is generated.

(4) Sample Program Execution Procedure

After executing the “build procedure”, connect the target board and debugger correctly, and perform the following operations.

1 Select [Project] menu -> [Download and Debug].
2 Select [Debug] menu -> [Execute].

3.3.3 e² studio from RENESAS

(1) Build Environment

RENESAS e² studio 2025-12

Toolchain version: GNU Arm Embedded 13.3.1.arm-13-24

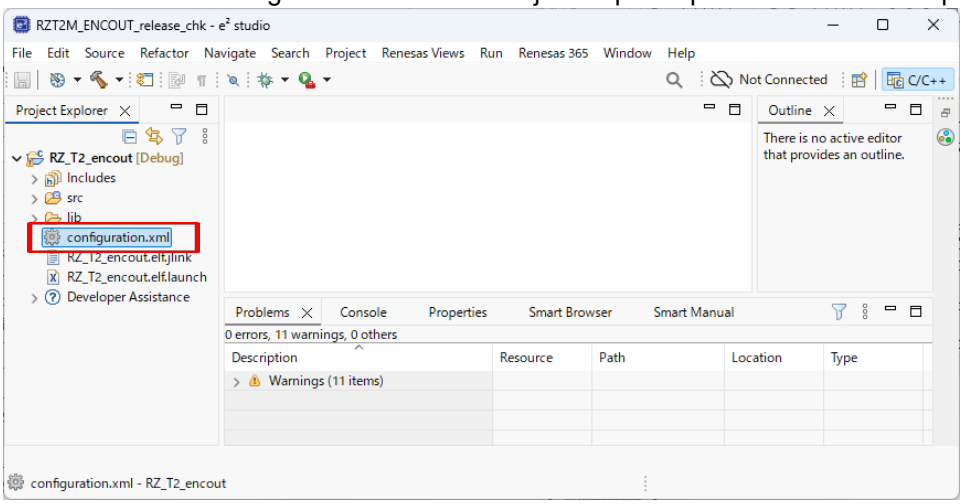
RENESAS Flexible Software Package (FSP) for RZ v4.0.0

(2) Execution Environment ICE

SEGGER J-Link™ v8.60

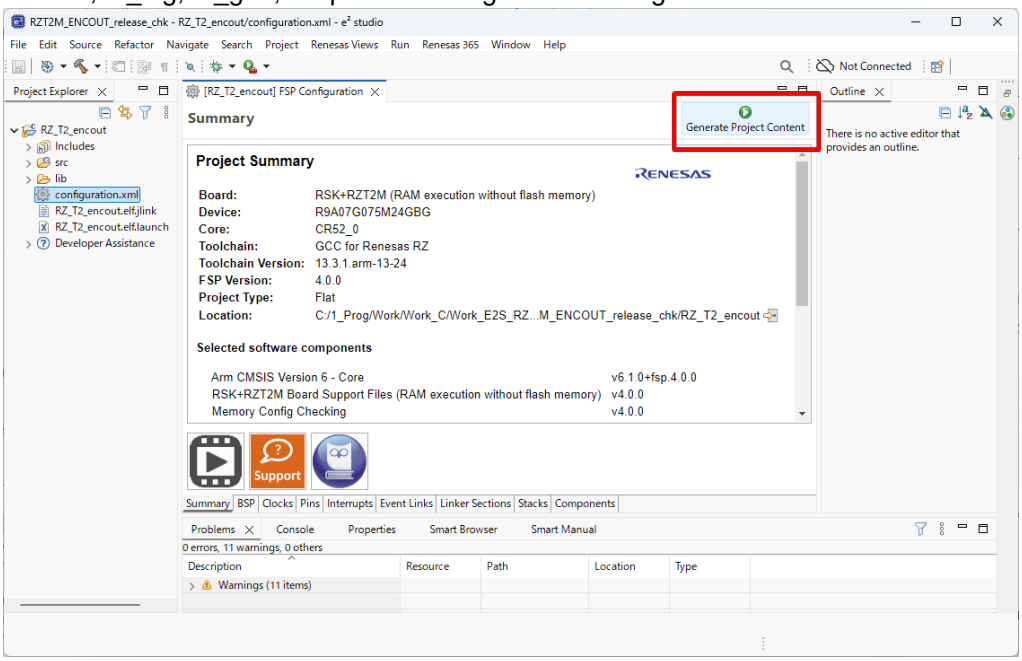
(3) Build Procedure for Sample Programs

1 The build procedure for the sample program is as follows.
2 Copy the following files in the "RZ/T2M Group Encoder I/F Configuration Library" to lib¥ecl in the same folder as the source file. (If the lib¥ecl folder already exists, overwrite it.) *1
lib¥ecl¥r_ecl_rzt2_gcc.a
lib¥ecl¥r_ecl_rzt2_if.h
3 After launching e² studio and moving to the workspace, click the [File] menu -> [Import] and select Existing project to workspace and click [Next].
4 On the project import screen, select the folder where the sample program was expanded as the root directory.
5 Select a project, check Copy Project to Workspace, and click [Finish].
6 Double-click the configuration.xml in the Project Explorer pane of e² studio to open it.



Note 1. Please use Encoder I/F Configuration Library revision 4.00 or later.

7 Click Generate Project Content in the FSP Configuration pane of e² studio.
The rz, rz_cfg, rz_gen, script and .settings folders are generated.



8 Select [Project] menu -> [Build All].
The Debug\RZ_T2_encout.elf file is generated.

(4) Execution Procedure of the Sample Program

After executing the "build procedure", connect the target board and debugger correctly, and perform the following operations.

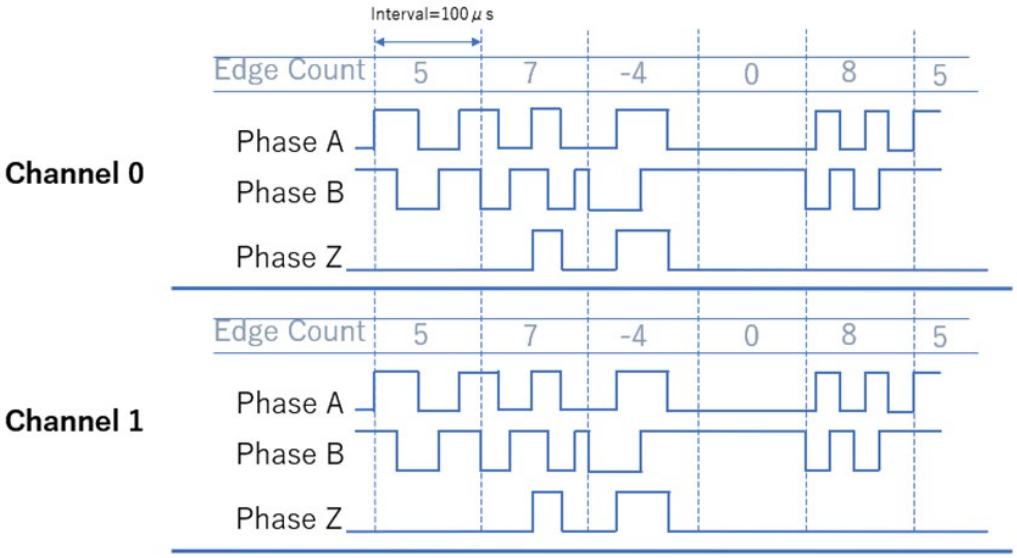
1 Select [Run] menu → [Debug As] → [Renesas GDB Hardware Debugging].
2 Click [Debug] to start downloading to internal RAM.
3 Click [Run] menu → [Resume] to run the sample program.

3.3.4 Execution Result

After executing the sample program, the following will be displayed on the terminal software.

```
ENCOUT sample program start
EC-Lib      Ver.4.0.0
ENCOUT drv  Ver.4.0
ENCOUT0 dat Ver.1.0
ENCOUT1 dat Ver.1.0
```

The following signals are output to the output port described in “3.2.2(3) Used Pins of the Target Board”.



Note: The channel 1 starts 50 μs (carrier cycle * 1/2) earlier than the channel 0.

Figure 3.1 ABZ phase output signal

3.3.5 Precautions for Creating Flash Boot Projects

When users want to create flash boot project (xSPI0 x1 boot mode) by using EWARM, change the alignment specification for the beginning of USER_DATA and USER_DATA block 2 (for .rodata) to a 32-byte boundary. The configuration data for the encoder interface is specified to be aligned to a 32-byte boundary. The change is to prevent misalignment between the data layout transferred to RAM and the data layout recognized by the program, even if such data is contained within .rodata.

The procedure for making changes is as follows.

Open the script/fsp_xspi0_boot.icf file and change the alignment specification at the beginning of USER_DATA and for USER_DATA block 2 (for .rodata) to a 32-byte boundary, as indicated by the bold red text in the figure below.

In RAM execution projects (RAM execution without flash memory), data transfer from ROM to RAM does not occur, so this setting is unnecessary.

```
/* Place the variables to be used in the user program (Programs other than SSBL). */
define block USER_DATA_RBLOCK with fixed order, alignment = 32
                { block USER_DATA_RBLOCK0 with alignment = 8 { section .data_init },
                  block USER_DATA_RBLOCK1 with alignment = 8 { section __DLIB_PERTHREAD_init },
                  block USER_DATA_RBLOCK2 with alignment = 32 { section .rodata_init },
                  block USER_DATA_RBLOCK3 with alignment = 8 { section .version_init }};

/* Allocate an address to copy the variables used in user program (Programs other than SSBL) to RAM. */
define block USER_DATA_WBLOCK with fixed order, alignment = 32
                { block USER_DATA_WBLOCK0 with alignment = 8 { section .data },
                  block USER_DATA_WBLOCK1 with alignment = 8 { section __DLIB_PERTHREAD },
                  block USER_DATA_WBLOCK2 with alignment = 32 { section .rodata },
                  block USER_DATA_WBLOCK3 with alignment = 8 { section .version }};
```

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	May.31.2022	-	First Edition issued
1.10	Jun. 30.2022	3	Chapter 1.1 Modify Version number of Source code
		3	Chapter 1.2 Modify File name
		4	Chapter 2 Modify the file structure and contents
		5	Table 3.1: Supports Flexible Software Package Version 1.0.0
		7	Modify 3.3.1 Chapter name
		7	Modify 3.3.2 Chapter name
		8	Modify Table 3.4
		-	Deleted 3.7.1 Memory size
1.20	May 31.2023	2, 5	Appended section 3.1.1 for memory size information.
		3, 4	Updated the release note version number.
		-	Remove unused folders of the zip sample program set.
1.30	Oct.6.2023	1, 7, 9	Append notes for the Encoder I/F Configuration Library revision.
		1, 4, 6	Updated the target board name.
		2, 3	Updated the source code, documents revisions and the document filenames.
			Revised to control GPT, ELC from FSP API.
			Updated the R_ENCOUT_GetVersion return value to “1.2”.
		3	Updated file structure. (Zip file name is changed. Removed RZ/T2M Pin Configuration data from zip file. Updated ENCOUT configuration data filenames.)
		5	Updated memory size information.
		6	Updated description of the CPU board setting.
		7 to 10	Updated build environment for FSP v1.3.0. Descriptions for development procedures.
		17, 18	Flowchart of the enc_main and timer interrupt function names are revised according to the code update.
		19	Description for the POSITION_MAX modification method is updated.
2.00	Jun 28.2024	1, 4, 6	Updated description of the board name.
		2, 3	Updated the source code, documents revisions and the document filenames.
			Updated the R_ENCOUT_GetVersion return value to “2.0”.
		5	Updated memory size information.
		7 to 10	Updated build environment for FSP v2.0.0. Figures are replaced.
3.00	Oct 17.2025	-	Separate operating environment and sample program specifications as application note.
		2, 3	Update revisions of the application note and the release note.
			Update sample program version to 3.0. (Support FSP v3.0.0.)
		4	Update memory size information.
		6 to 10	Update build environment for FSP v3.0.0. Figures are replaced.
4.00	Apr 03.2026	2, 3	Update revisions of the application note and the release note.
			Update sample program version to 4.0. (Support FSP v4.0.0.)
		4	Update memory size information.
		6 to 10	Update build environment for FSP v4.0.0. Figures are replaced.
		11	Add section 3.3.5 Precautions for Creating Flash Boot Project.

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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