RZ/T2M Group

Dual Encoder sample program

Summary

This document describes the RZ/T2M Dual Encoder sample program package. To use this sample program, please obtain “RZ/T2M Group Encoder I/F Configuration Library” release package (Rev.2.00 or later).

For A-format® communication protocol specifications and encoder specifications (RES-61QAP05, RES-61QAP06) , contact Nikon Corporation.

For EnDat 2.2 communication protocol specifications and encoder specifications (EQN1035), contact HEIDENHAIN GmbH.

Functionality Checked Device

RSK+RZT2M Board (RTK9RZT2M0C00000BE)

Contents

1. Package Contents

This package contains the following contents.

The Configuration Data included in this package supports up to 2 axes.

1.1 Software

- Source Code

No.	Name	Version number
1	RZ/T2M Dual Encoder sample program	2.0

- Configuration Data

No.	Name	Version number
1	RZ/T2M Encoder I/F Configuration Data (A-format)	1.0
2	RZ/T2M Encoder I/F Configuration Data (EnDat)	1.0
3	RZ/T2M Encoder I/F PINMUX Data	1.0

1.2 Document

No.	Document name	Version	File name
1	RZ/T2M Group Dual Encoder sample program Release Note	2.00	(j) r11an0696jj0200-rzt2m.pdf (e) r11an0696ej0200-rzt2m.pdf (this document)
2	RZ/T2M Group Dual Encoder sample program Application Note	2.00	(j) r11an0695jj0200-rzt2m-dual.pdf (e) r11an0695ej0200-rzt2m-dual.pdf
3	RZ/T2M Group A-format Interface Application Note	1.10	(j)r01an6313jj0110-rzt2m-a-format.pdf (e)r01an6313ej0110-rzt2m-a-format.pdf
4	RZ/T2M Group EnDat2.2 Interface Application Note	1.00	(j)r01an6409jj0100-rzt2m-endat.pdf (e)r01an6409ej0100-rzt2m-endat.pdf

2. File Structure

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

```
Top
├── r11an0696jj0200-rzt2m.pdf
├── r11an0696ej0200-rzt2m.pdf
└── workspace
    ├── Software
    │   ├── iccarm
    │   │   └── RZ_T2_dual.zip : RZ/T2M Dual Encoder sample program set (IAR)
    │   └── gcc
    │       └── RZ_T2_dual.zip : RZ/T2M Dual Encoder sample program set (e2 studio)
    └── Documents
        ├── r11an0695jj0200-rzt2m-dual.pdf
        ├── r11an0695ej0200-rzt2m-dual.pdf
        ├── r01an6313jj0110-rzt2m-a-format.pdf
        ├── r01an6313ej0110-rzt2m-a-format.pdf
        ├── r01an6409jj0100-rzt2m-endat.pdf
        └── r01an6409ej0100-rzt2m-endat.pdf
```

The file structure of the RZ_T2_dual.zip is shown below.

```
Top folder
├── configuration.xml                    : FSP Configuration Data
├── ( Build Tool Dependency Environment File )
├── lib
│   └── ecl
│       ├── Config_AFormat_v1.0.dat      : RZ/T2M A-format Configuration Data
│       ├── Config_Endat22_v1.0.dat      : RZ/T2M EnDat Configuration Data
│       └── RZT2_pinmux_v1.0.bin         : RZ/T2M Encoder I/F Pin Configuration Data
└── src
    ├── hal_entry.c                      : Dual Encoder sample program
    ├── dual_main.c                      : Dual Encoder sample program
    ├── enc_dat.asm                      : Encoder I/F 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
        ├── a_as
        │   ├── iodefine_a_as.h   : A_AS register definition file
        │   ├── r_a_as_rzt2.c             : A_AS driver file
        │   ├── r_a_as_rzt2_config.h      : A_AS driver file
        │   ├── r_a_as_rzt2_dat.h         : A_AS driver file
        │   ├── r_a_as_rzt2_if.h          : A_AS driver file
        │   ├── r_a_as_rzt2_private.h     : A_AS driver file
        │   └── a_format
        │       ├── r_a_format_rzt2.c             : A-format driver file
        │       ├── r_a_format_rzt2_config.h      : A-format driver file
        │       └── r_a_format_rzt2_private.h     : A-format driver file
        └── endat
            ├── iodefine_endat.h          : EnDat register definition file
            ├── r_endat_rzt2.c            : EnDat driver file
```

```
├── r_endat_rzt2_config.h     : EnDat driver file
├── r_endat_rzt2_dat.h        : EnDat driver file
└── r_endat_rzt2_if.h         : EnDat driver file
```

3. About Dual Encoder Sample Program

This section contains information necessary to use the complete set of Dual Encoder 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, A-format driver, EnDat 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]
A-format driver	Code	4.3	3.6
	Data (with initial value)	0.0	0.0
	Data (without initial value)	0.8	0.8
	Constant Data	0.1	0.1
EnDat driver	Code	4.3	3.3
	Data (with initial value)	0.0	0.0
	Data (without initial value)	0.1	0.1
	Constant Data	0.0	0.0
A-format configuration data *	Constant Data	63.1	63.1
EnDat configuration data *	Constant Data	108.6	108.6
Sample program	Code	6.8	7.2
	Data (with initial value)	0.2	0.0
	Data (without initial value)	1.8	1.8
	Constant Data	3.3	3.3

Note: Size of the Encoder I/F Pin Configuration Data, which is commonly used by A-format and EnDat, is counted in A-format configuration data.

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

The correspondence between the pin used as the encoder I/F and the pin header of the target board is as follows.

Channel	Port name (Function pin name)	Pin header	Input / Output	Description
A_AS0	SD0 (ENCIF0)	CN1 #1	Input	Data input pin
	CMND0 (ENCIF2)	CN1 #3	Output	Data output pin
	D_R0 (ENCIF3)	CN1 #4	Output	Drive / receive control pin
ENDAT_CH1	DATA_RC1 (ENCIF5)	CN1 #7	Input	Data input pin
	DATA_DV1 (ENCIF7)	CN1 #9	Output	Data output pin
	DE1 (ENCIF8)	CN1 #11	Output	Drive / receive control pin
	TCLK1 (ENCIF9)	CN1 #12	Output	Clock output pin

The correspondence with the pin header pins on the target board when the A-format and EnDat channels are swapped is as follows. How to swap channels is written in “4.15.11 Procedure of Channel Switching” of the RZ/T2M Group Dual Encoder Sample Program Application Note.

Channel	Port name (Function pin name)	Pin header	Input / Output	Description
A_AS1	SD1 (ENCIF5)	CN1 #7	Input	Data input pin
	CMND1 (ENCIF7)	CN1 #9	Output	Data output pin
	D_R1 (ENCIF8)	CN1 #11	Output	Drive / receive control pin
ENDAT_CH0	DATA_RC0 (ENCIF0)	CN1 #1	Input	Data input pin
	DATA_DV0 (ENCIF2)	CN1 #3	Output	Data output pin
	DE0 (ENCIF3)	CN1 #4	Output	Drive / receive control pin
	TCLK0 (ENCIF4)	CN1 #6	Output	Clock output pin

3.3 Procedures on Development Environments

3.3.1 Preparation before Executing the Sample Program

This sample program communicates with a 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 v9.50.1

RENESAS RZ/T2 Flexible Software Package v2.0.0

(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_dual.eww.
6. Start the FSP Smart Configurator from the [Tools] menu of the EWARM IDE. *2

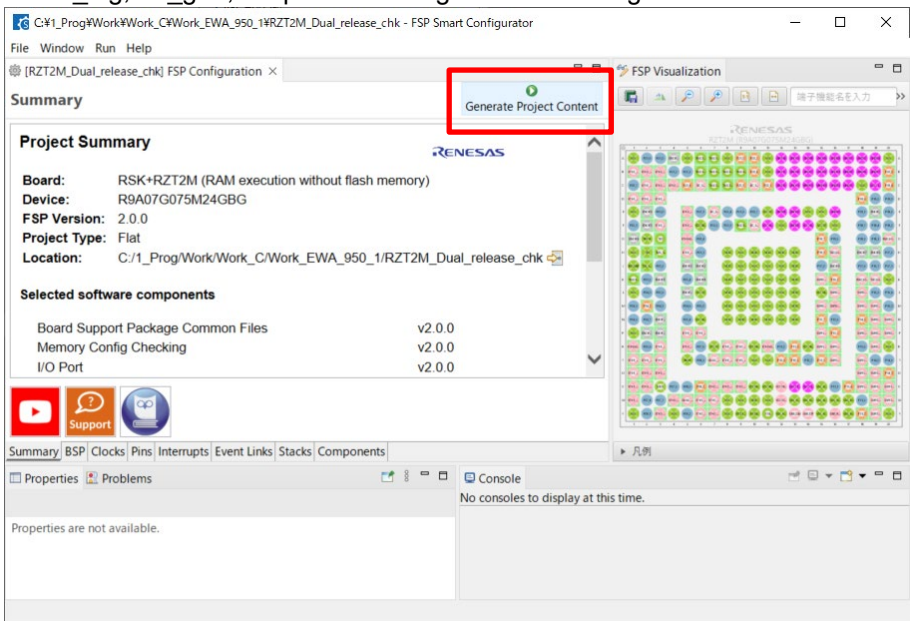
Note: 1. Please use Encoder I/F Configuration Library revision 2.00 or later.

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	RZ 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.
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 rzt, rzt_cfg, rzt_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_dual.out is generated.

(4) Sample Program Execution Procedure

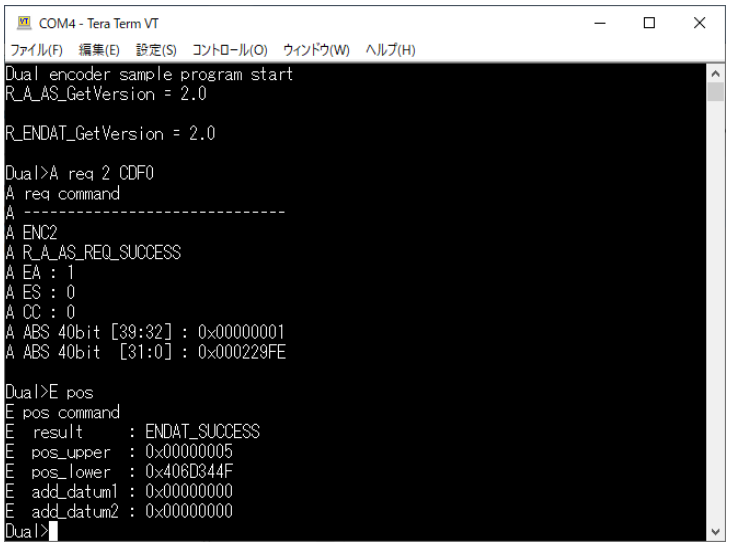
After executing the "build procedure", connect the target board and debugger correctly, and perform the following operations.

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

2 Select [Debug] menu -> [Execute].

(5) Execution Result of the Sample Program

Run the sample program and enter commands in the terminal software window. For commands, see 4.15.10 console commands in the RZ/T2M Group Dual Encoder Sample Program Application Note.



3.3.3 e² studio from RENESAS

(1) Build Environment

RENESAS e² studio 2024-01.1

GNU ARM Embedded Toolchain 12.2.1.arm-12-24

RENESAS RZ/T2 Flexible Software Package v2.0.0

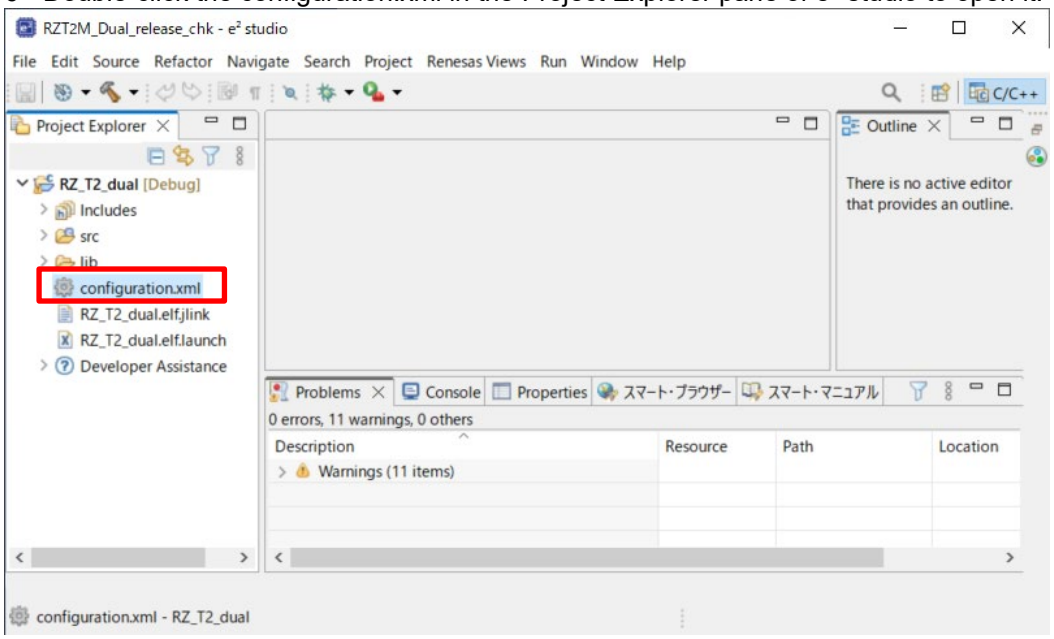
(2) Execution Environment ICE

SEGGER J-Link v7.94h

(3) Build Procedure of the Sample Program

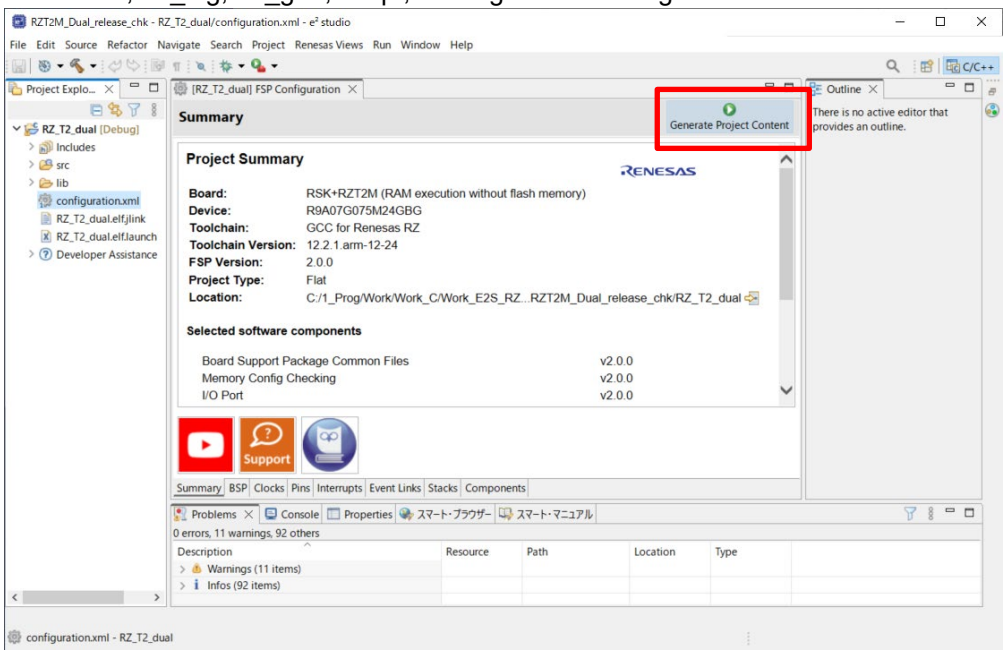
The procedure for building the sample program is as follows.

1. Copy the expanded source file to any location.
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 2.00 or later.

7 Click Generate Project Content in the FSP Configuration pane of e² studio.
The rzt, rzt_cfg, rzt_gen, script, .settings folders are generated.



8 Select [Project] menu -> [Build All]
The Debug\RZ_T2_dual.elf file is generated.

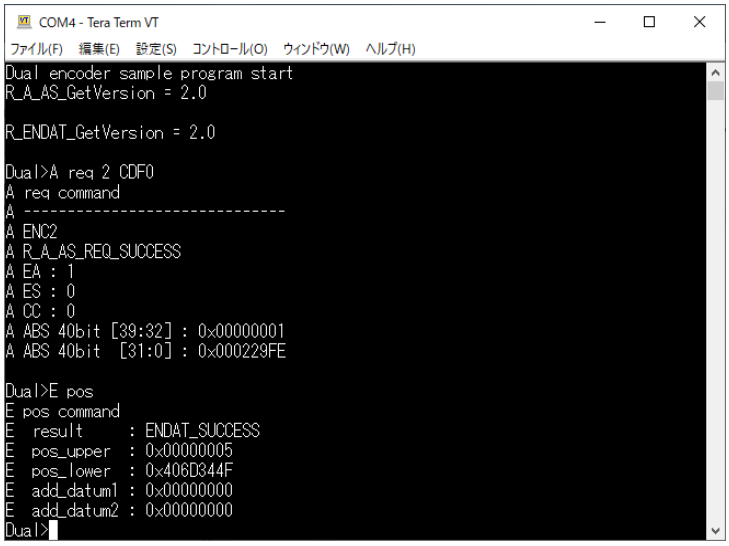
(4) Execution Procedure of the Sample Program

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.

(5) Execution Result of the Sample Program

Run the sample program and enter commands in the terminal software window. For commands, see 4.15.10 console commands in the RZ/T2M Group Dual Encoder Sample Program Application Note.



Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr.08.22	-	First Edition issued.
1.10	May 31.23	1, 4	Appended section 3.1.2 for memory size information.
		2, 3	Updated the release note version number.
1.20	Oct 6.23	1, 6, 8	Append notes for the Encoder I/F Configuration Library revision.
		1, 5	Updated the target board name.
		2, 3	Updated the source code and the release note version number.
		3	Updated file structure. (Removed RZ/T2M Pin Configuration data from zip file.)
		4	Updated memory size information.
		5	Updated description of the CPU board setting. (Description for the SW4-2 is changed. SW6-1 setting is added.)
		6 to 9	Updated build environment for FSP v1.3.0. Figures are replaced.
2.00	Jun 28.24	2, 3	Updated revisions of the application note and the release note.
			Updated sample program version to 2.0. (Supported FSP v2.0.0.)
		4	Updated memory size information.
		1, 5	Updated description of the board name.
		6 to 9	Updated build environment for FSP v2.0.0. Figures are replaced.

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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