RX72M Group

Communications Board CANopen (Slave) Startup Manual

Introduction

This is a quick start guide to running CANopen® communications on the RX72M communications board for evaluating industrial networks.

Target Device

- RX72M Group

Sample Program

This sample program uses the evaluation version of the CANopen stack produced by one of our partners, M2M craft Co., Ltd. The stack's major communications specifications are as follows.

- Communications protocol: Compliant with CANopen CiA 301 v4.2
- Supports the conformance test tool v3.0.3.8

For purchase of the official version of the stack and the specifications of the sample program, contact M2M craft Co., Ltd.

M2M craft Co., Ltd. Web site: http://m2mcraft.co.jp/

[Restrictions]

The evaluation version of the CANopen stack consists of library files which were built with the functional limitations as listed below. This version is only made available for purposes of evaluation.

- The numbers of communications services and types are fixed.
- The number of objects that can be registered in the object dictionary has a limit of 15.
- The evaluation stack automatically stops running after 60 minutes. Re-starting the program requires resetting the device.

Please note that the evaluation stack cannot be used in commercial products. Purchasing the official version of the CANopen stack is required if it is to be used in a commercial product.

Contents

1. Operating Environment

The sample program covered in this manual runs in the environment below.

Table 1.1   Operating Environment

Item	Description
Board	RX72M communications board TS-TCS07298 from Tessera Technology
CPU	RX CPU (RXv3)
Operating frequency	CPU clock (CPUCLK): 240 MHz
Operating voltage	3.3 V
Operating modes	Single chip mode

Device requirements	R5F572MNDDBD
	
	• Code flash memory
	  Capacity: 4 Mbytes
	  ROM cache: 8 Kbytes
	
	• Data flash memory
	  Capacity: 32 Kbytes
	
	• RAM/extended RAM
	  Capacity: 512 Kbytes / 512 Kbytes

Communications protocol	CANopen
Integrated development environment	e^2 studio (V7.5.0 or later) with the CC-RX compiler (V3.01.00)
Emulator (ICE)	Renesas E2 Lite

2.   Setting up and Connecting the Evaluation Board

For detailed information on the board, refer to the *RX72M Group Communications Board Hardware Manual*.
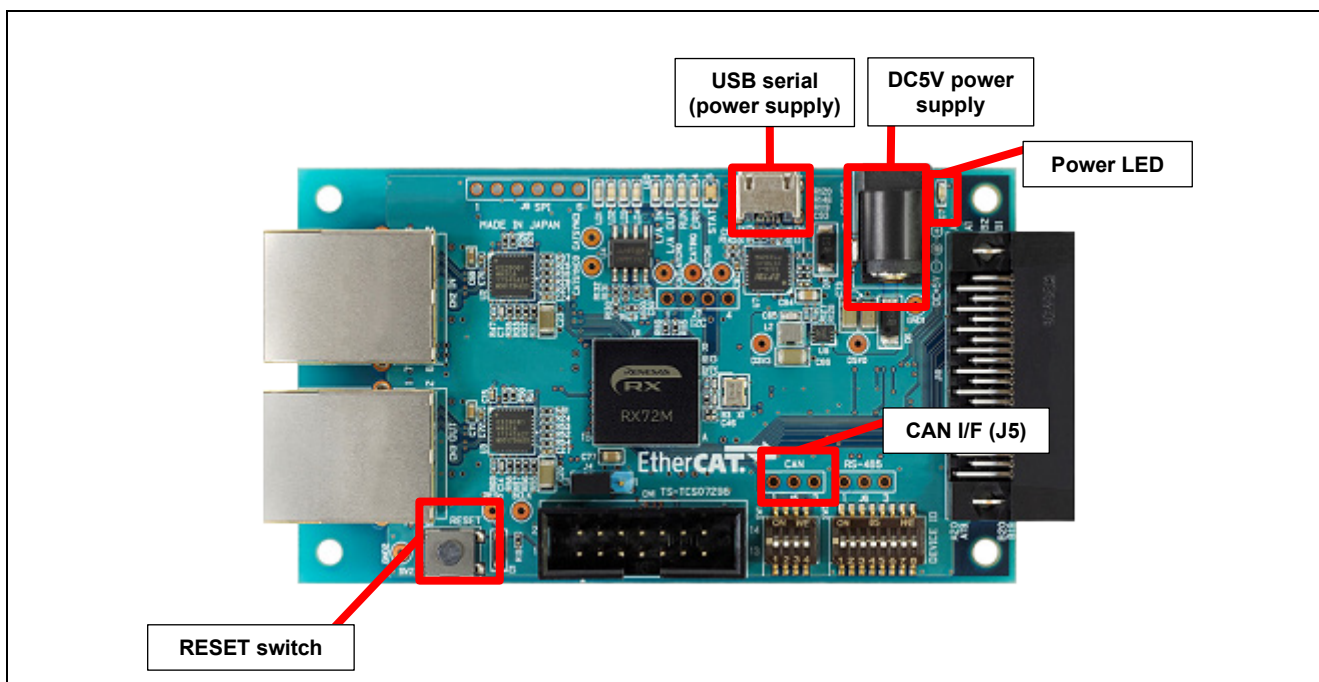

Figure 2.1   Configuration of the RX72M Communications Board

Table 2.1   CAN Interface (J5)

Pin Number	I/O	Signal Name
1	I/O	CANH
2	I/O	CANL
3	—	GND

2.1   Setting up the Board

Before supplying power to the board, set up jumpers and connect the cables. In addition, make settings for the JTAG configuration mode. This mode is normally used with a short circuit between jumper pins 2 and 3.

For the detailed locations of the related parts, refer to the *RX72M Communications Board Hardware Manual*.

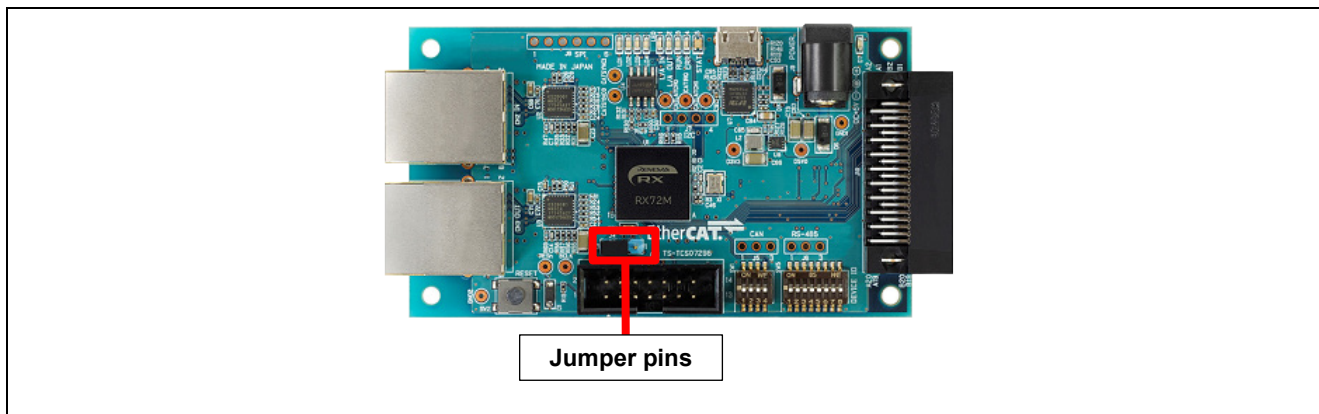
Figure 2.2   Setting up Jumper Pins

2.2   Selecting the Power Source

Power to the RX72M can be supplied from a 5-V DC power source or through the USB port. Use whichever is suitable for the configuration of your operating environment.
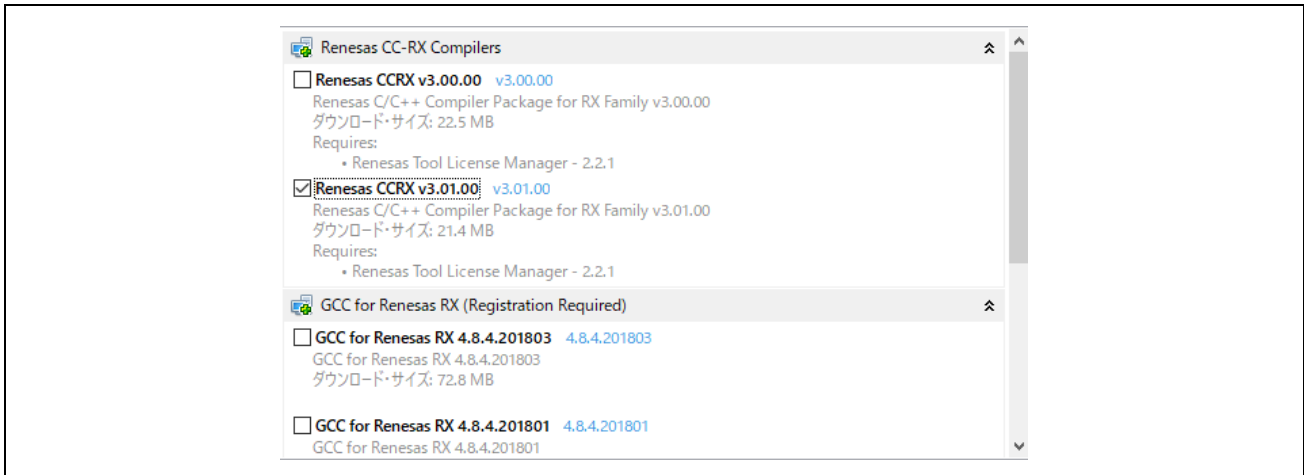
3.   Installing the e^2 studio

Download the e^2 studio for RX72M (V7.5.0 or later) from the Web site below.

https://www.renesas.com/e2studio_download

3.1   Installing the CC-RX Compiler V3.01.00

The compiler selection dialog box appears while installing the e^2 studio. Click [Renesas CCRX v3.01.00] and select [Next]. CC-RX V3.01.00 Compiler for RX72M will be installed with the e^2 studio.
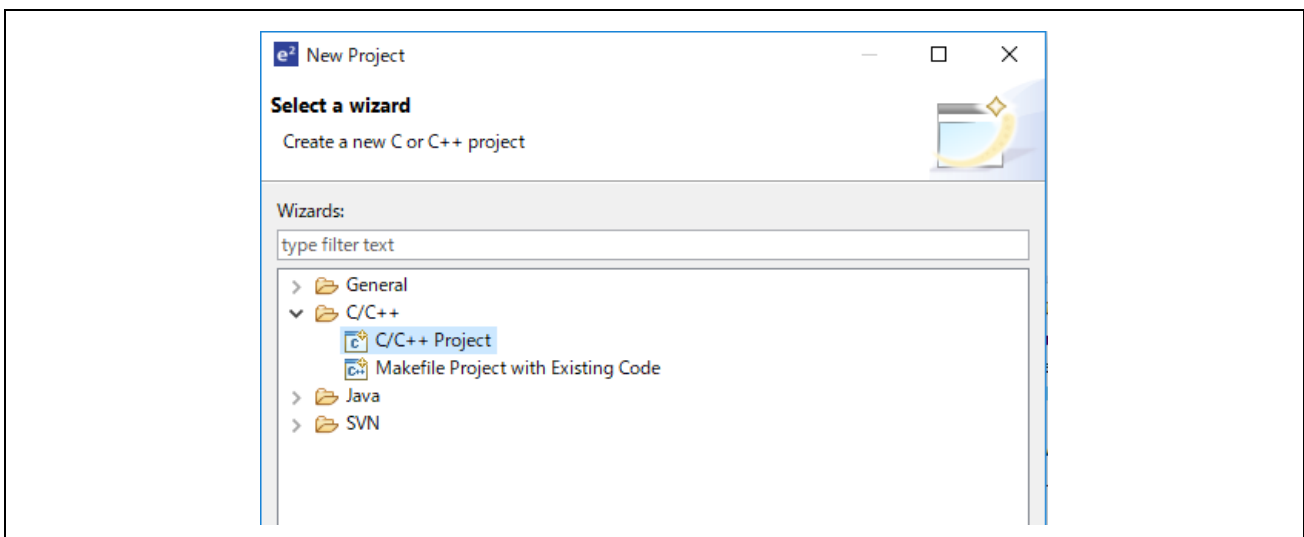

To start the e^2 studio, execute "e2studio.exe" in the following installation folder.

e2_studio_rx72m\eclipse

3.2   How to check the registered Compiler

(1) Start the e^2 studio.

(2) Select [File] → [New] → [C/C++Project] → [Next].

(3) In the [Templates for New C/C++ Project] dialog box, select [Renesas RX] → [Renesas CC-RX C/C++ Executable Project] → [Next].
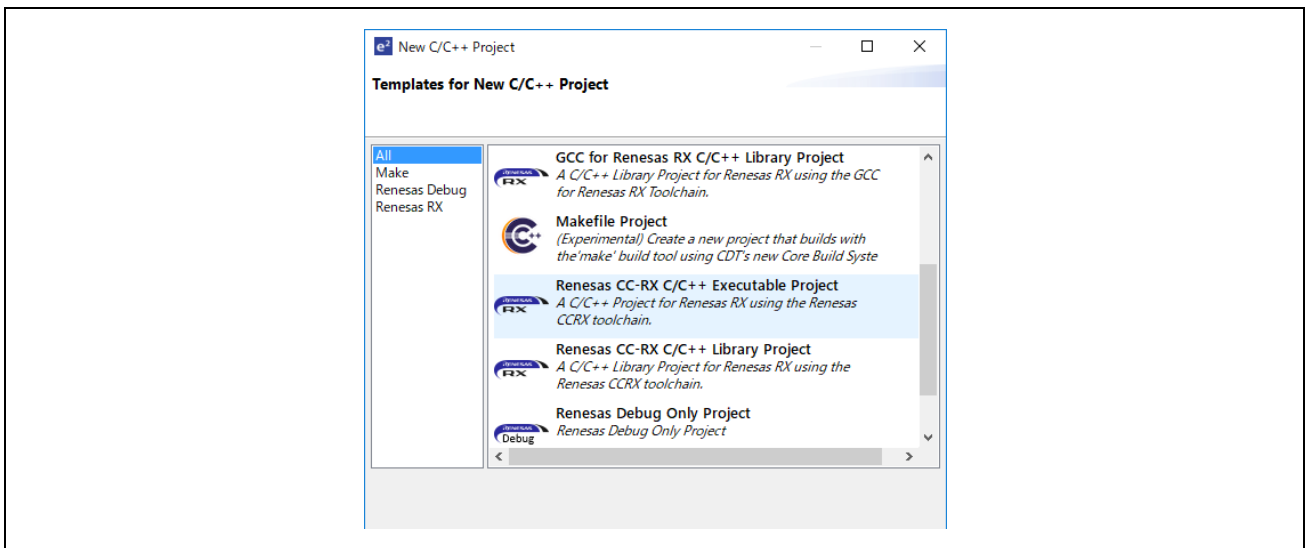
(4) In the [New Renesas CC-RX C/C++ Executable Project] dialog box, enter a desired project name and select [Next].

(5) In the [Select toolchain, device & debug settings] dialog box, select [Manage Toolchains...] under [Toolchain Settings].

(6) In the [Renesas Toolchain Management] dialog box, the registration was successful if "v3.01.00" has been added under "Renesas CCRX".
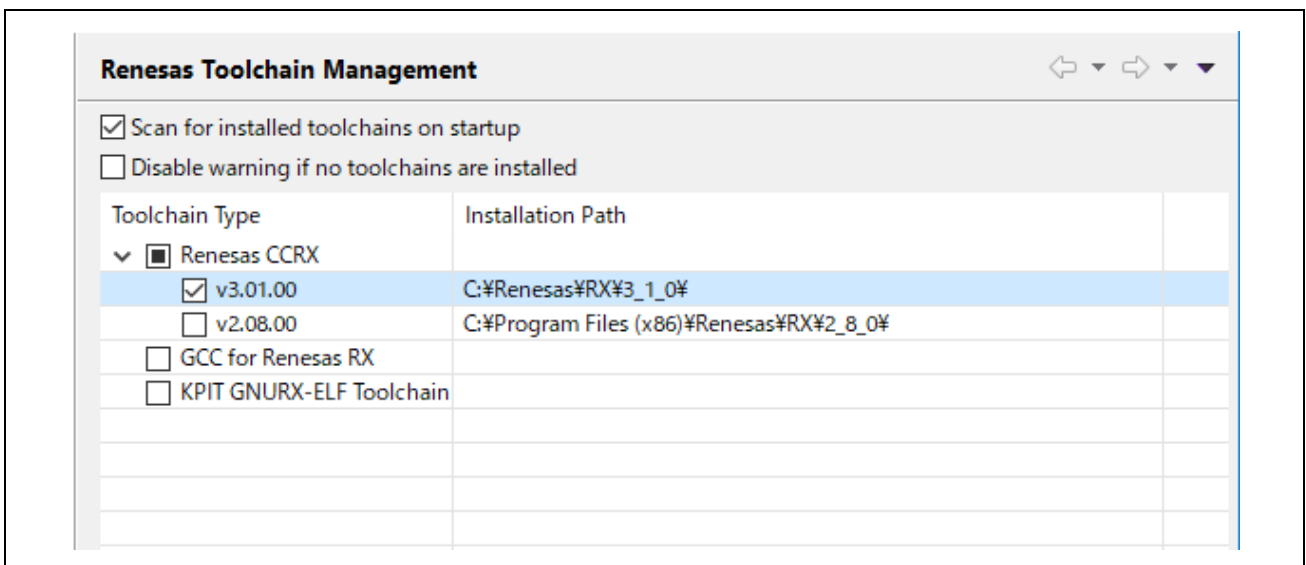
4. Connections

(1) Connect the CAN interface to the CAN bus.

(2) Connect the E2 Emulator Lite to the JTAG connector on the communications board with the user interface cable.

(3) Connect the E2 Emulator Lite to a USB port of the PC you are using. The "ACT" LED on the E2 Emulator Lite starts to blink.

(4) The "Found new hardware" wizard appears. Follow the procedure described below to install the driver. Installation on a PC running Windows™ 7, 8, or 8.1 requires logging in with a user name that has administrator rights.

     Windows™ 7/8/8.1:   A notice appears on the Windows taskbar when the installation is finished.

     Windows™ 10:   A button for device configuration appears on the Windows taskbar and installation is automatic.

(5) Supply power to the communications board from a 5-V DC power source or through the USB port.

5.   Importing a Sample Project to the e² studio

(1) Select [File] → [Import].

(2) In the [Select] dialog box, select [General] → [Existing Projects into Workspace] and select [Next].
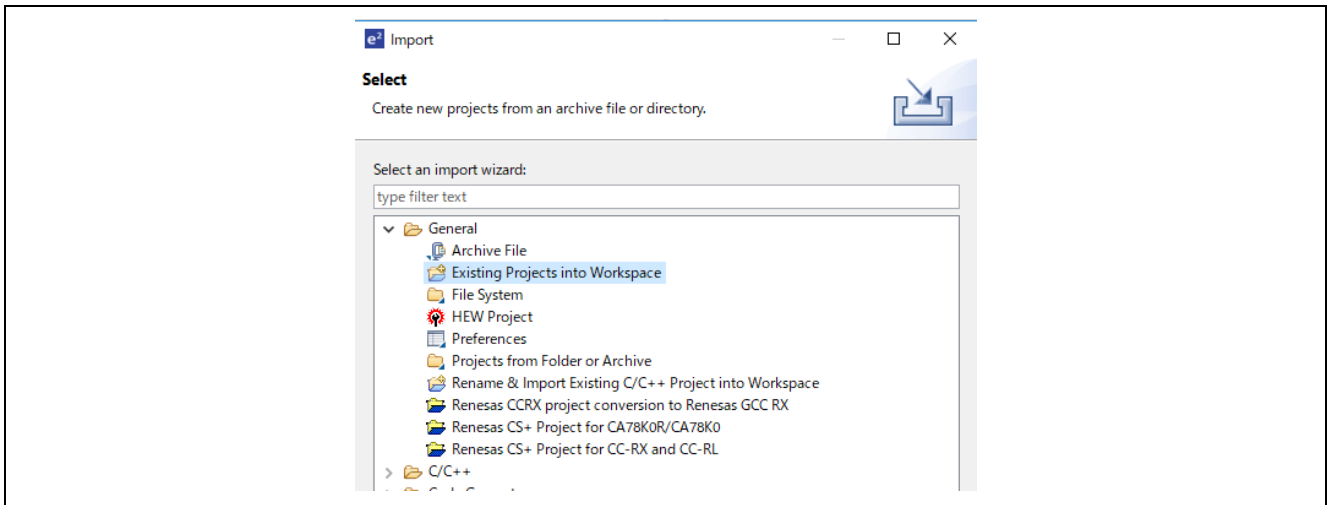
(3) In the [Import Projects] dialog box, check the "Select archive file:" button, then select [Browse...].

(4) Select "RX72M_CoSlave.zip" as a sample project file for the communications board, and select [Open].
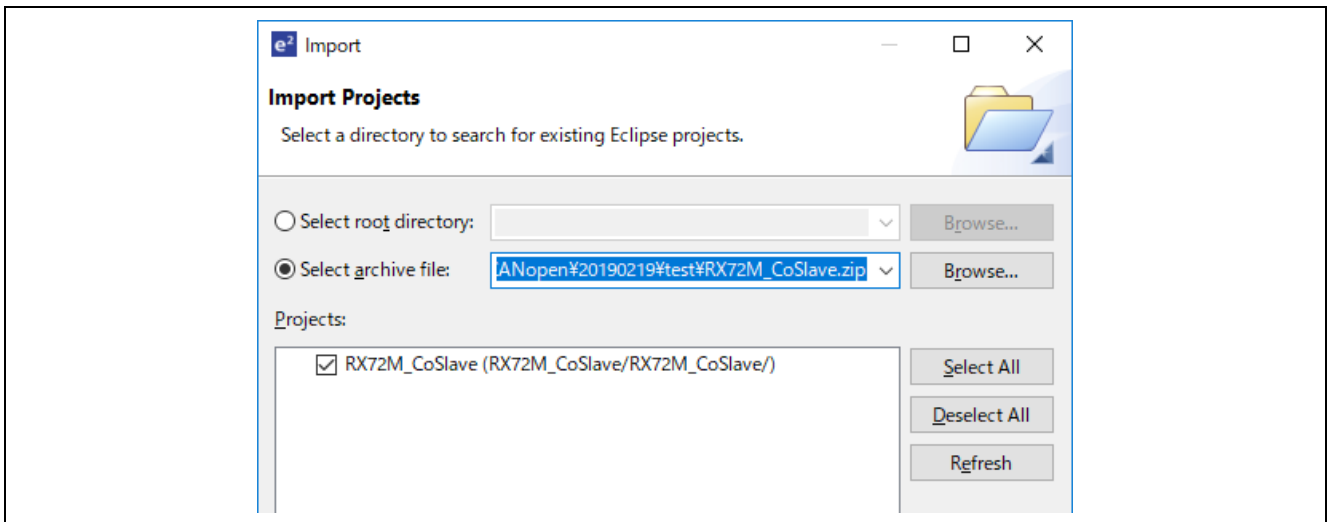
Check "RX72M_CoSlave(RX72M_CoSlave/RX72M_CoSlave/)" under the "Projects" label and select [Next]. The project will be imported into the workspace.

6. Programming and Debugging

(1) Select the "RX72M_CoSlave " project in the Project Explorer view. Select the arrow next to the build button (hammer icon) and select [HardwareDebug] from the drop-down menu.
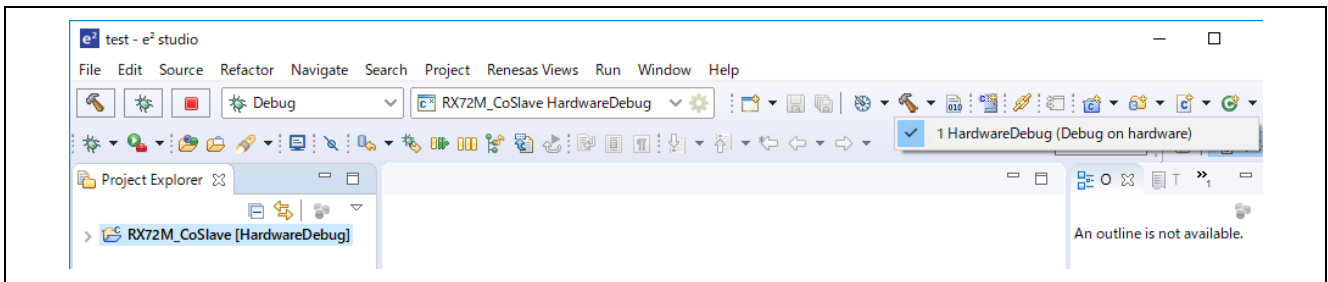
(2) e² studio will build the project. After the build is completed, select the arrow next to the debug button (bug icon). You can start debugging by selecting [Debug Configurations...].
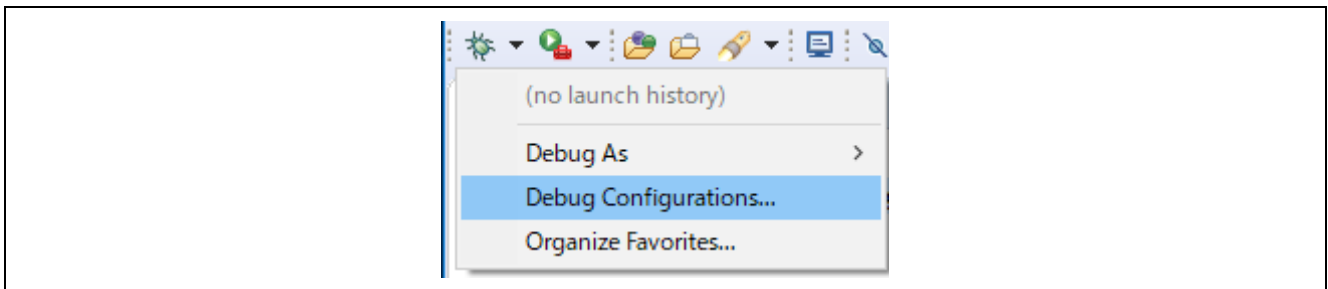
(3) Select the file "RX72M_CoSlave HardwareDebug" and download the program to the target device. Click on the [Debug] button to start debugging.
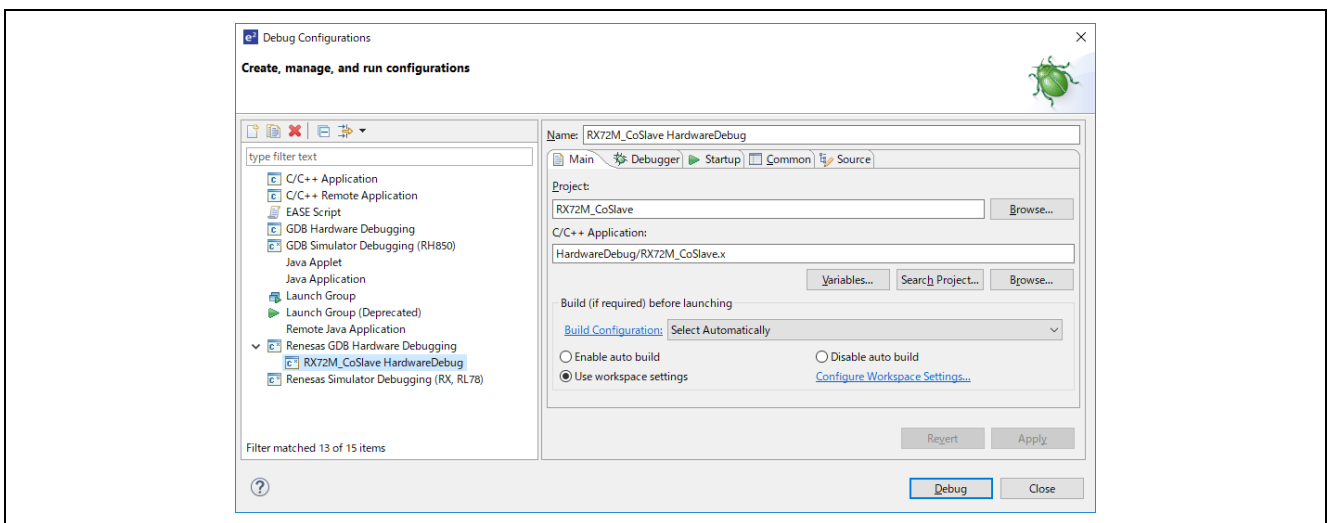
(4) If a firewall warning is displayed for "e2-server-gdb.exe", check the checkbox for [Private networks, such as my home or work network] and select [Allow access].

(5) The User Account Control (UAC) dialog box may appear. Enter the administrator's password and select [Yes].

(6) If the Confirm Perspective Switch dialog box appears prompting you to switch the perspective, check the checkbox for [Remember my decision] and select [Yes].

(7) The green "ACT" LED on the E2 Lite debugger will be continuously lit.

(8) After downloading the code, select the [Resume] button to run the code. The code will break at the address where the main function starts. Select the [Resume] button again to continue to run the code.

7. Appendix

7.1 Verifying Operation of the Sample Project

Operation of the sample project can be verified as follows.

7.1.1 Configuration of Connections

Note 1.   If you want to change the node ID of the RX72M communications board, modify the sample program. For how to modify the node ID, see section 7.1.4, Changing the Node ID of the RX72M Communications Board (as a CANopen Slave).
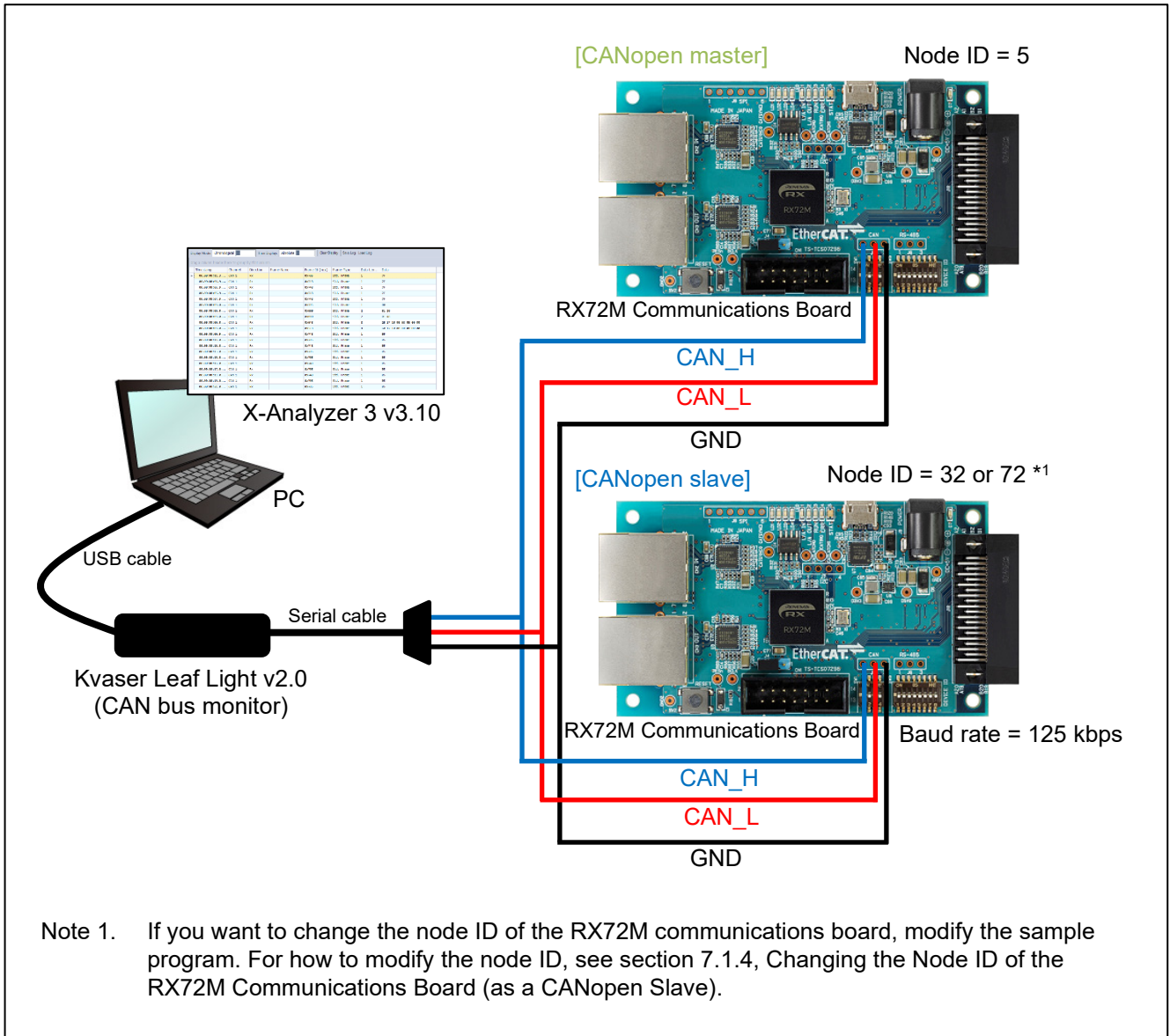
Figure 7.1   Configuration of Connections

Table 7.1   List of Devices

Item	Description
CANopen slave device	RX72M communications board (with this sample program already written to it) TS-TCS02796 (Tessera Technology)
CANopen master device[1]	RX72M communications board TS-TCS02796 (Tessera Technology)
CAN bus monitor	Kvaser Leaf Light v2.0 (Kvaser)[2]
PC software	X-Analyzer 3 v3.10 (Warwick Control Technologies)[2]

Notes: 1. Download the CANopen master program for CANopen master devices from the Renesas Electronics website.

2. For how to obtain the device and PC software and related support information, contact the respective manufacturers.

7.1.2　Overview of CANopen Master Operations

After the device is reset and started, operations of the CANopen master are as follows.

— It sends an NMT (network management) message "Start" to node ID 32 (= 0x20) or 72 (= 0x48) to request a change of state to "Operational".

— It sends an SDO (service data object) write request to node ID 72 to request a change of the heartbeat time to 3000 ms.

After that, it monitors to check if the required changes have been correctly made.

A flowchart is given below.
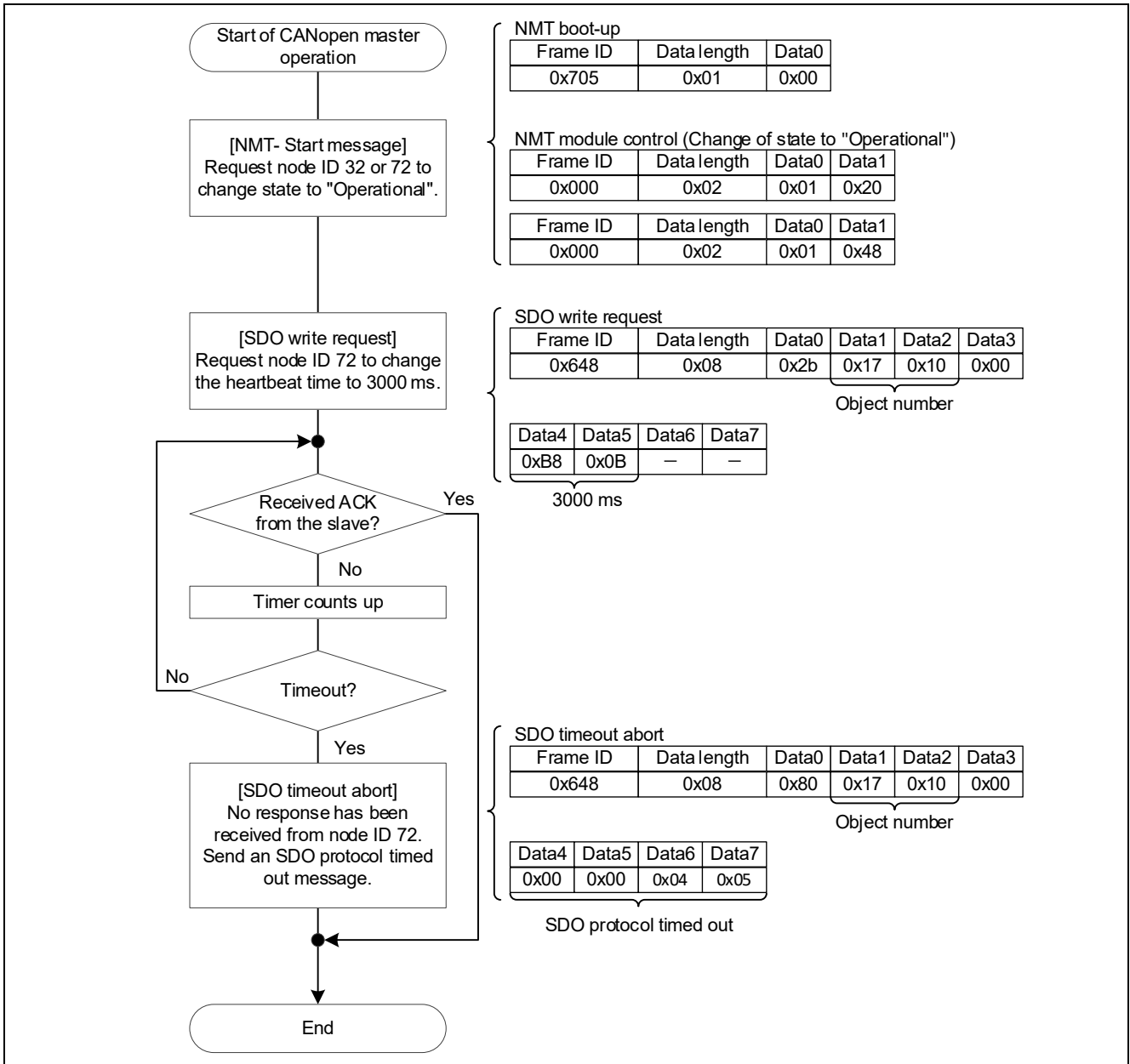
Figure 7.2　　Flowchart of CANopen Master Operations

7.1.3   Verifying the Results of Operations

7.1.3.1   The RX72M Communications Board as Node ID 32

The results of communications with the CANopen master device by the RX72M communications board as node ID 32 are shown below.
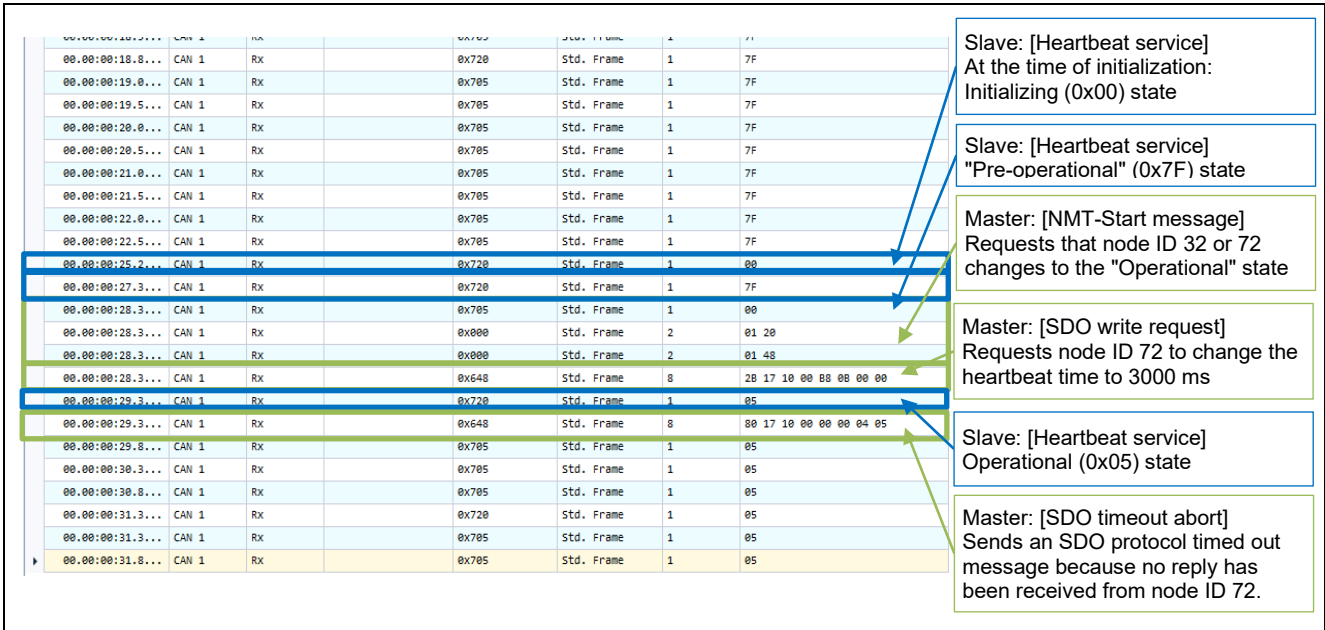
Figure 7.3   Results of Monitoring the X-Analyzer 3

7.1.3.2   The RX72M Communications Board as Node ID 72

The results of communications with the CANopen master device by the RX72M communications board as node ID 72 are shown below.

Figure 7.4   Results of Monitoring the X-Analyzer 3

7.1.4 Changing the Node ID of the RX72M Communications Board

To change the node ID assigned to the RX72M communications board, rewrite the value for "#define NODE_ID" in the main.c file of this sample program. After changing the node ID, be sure to rebuild the program before writing it to the board.

```
/* header of standard C - libraries */

#include <string.h>
#include <stdio.h>
#include <stdlib.h>

#define DEF_HW_PART
#include <cal_conf.h>        /* !!! first file to include for all CANopen */
#ifdef CONFIG_CPU_FAMILY_LINUX
# include <unistd.h>
# include <time.h>
#endif

#include <co_acces.h>
#include <co_sdo.h>
#include <co_pdo.h>
#include <co_drv.h>
#include <co_lme.h>
#include <co_nmt.h>
#include <co_init.h>

/* examples.h is part of the CANopen driver
 * and contains also the macros
 * PRINTF() for printf()
 * PUTCHAR() for putchar()
 * FFLUSH() for fflush()
 */
#include <examples.h>

#include "objects.h"              /* object dictionary */

/* constant definitions
------------------------------------------------------------
#define NODE_ID       32        /* ID of local node */
```
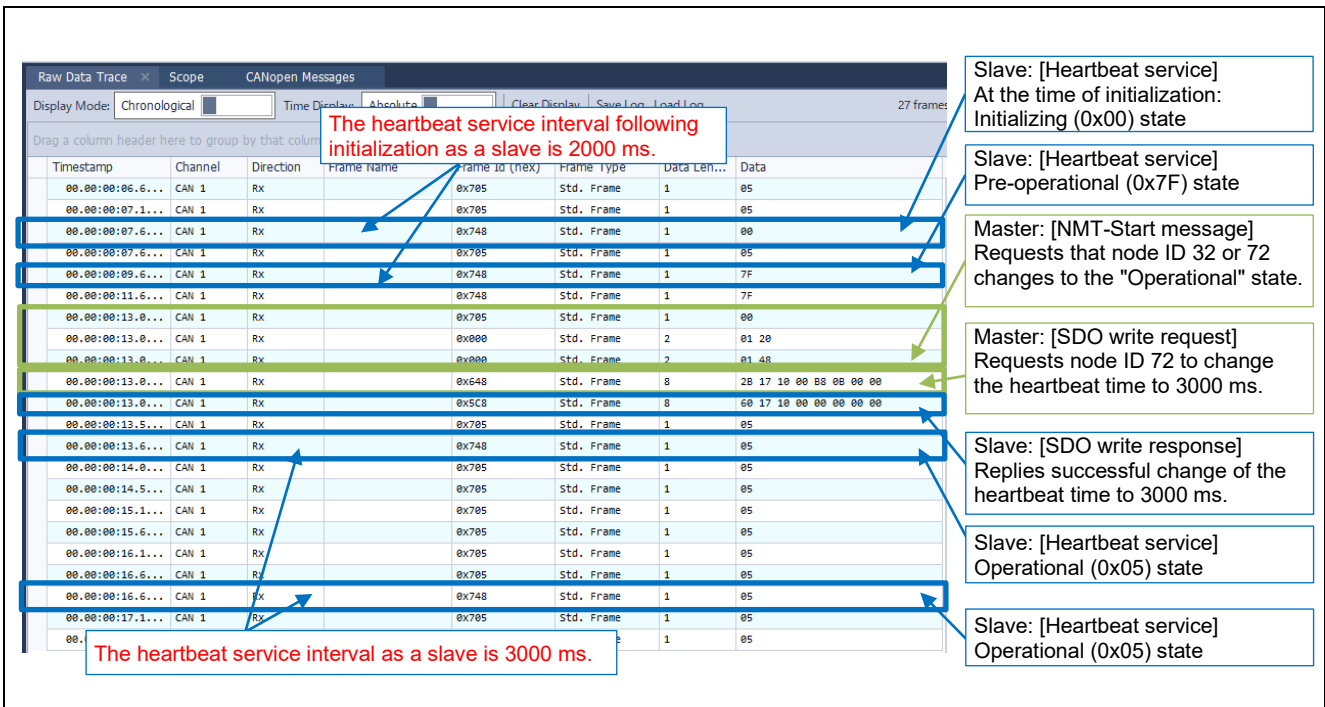
To change node ID 32 to node ID 72, change the value to 72.

```
/* For the example exists two variants of a macro to print
 * out return values of CANopen system functions.
 * First for small embedded systems, which only puts a '0' (error free)
 * or '1'.
 * Second for systems with a large console capable of printing text.
 */
#ifdef NO_PRINTF_S
# define PRINTRET(s, e) do {                                      \
                if ((e) == 0) { PUTCHAR('0'); }                   \
                else { PUTCHAR('1'); err = CO_TRUE; }             \
                } while(0);
#else
# define PRINTRET(s, e) do {                                      \
                PRINTF(s, e);                                     \
                if((e) != 0) err = CO_TRUE;                       \
                } while(0);
#endif
```

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Aug. 2, 2019	-	First edition issued
1.01	Jan. 31, 2020	-	Changed the name of the development partner

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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.).

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

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(Rev.4.0-1 November 2017)

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