

RX Family

R20AN0312EJ0106

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Sample code that uses TCP/IP for Embedded system M3S-T4-Tiny

Firmware Integration Technology

Introduction

This document explains the sample program of TCP/IP for Embedded system M3S-T4-Tiny (hereafter referred to as "T4 library").

T4 has sample programs for each CPU board included in [the Renesas Starter Kit](#), [the Gadget Renesas RX63N board](#), the 3rd Party board. This material explains how to setup CPU board, PC settings, Network connections to confirm correct sample program behavior.

We have prepared easily application for T4 Library (Web server, FTP server, DHCP client, DNS client).

Please refer to the following URL for the details.

<https://www.renesas.com/mw/t4>

Target Device

RX62N, RX63N, RX64M, RX71M, RX65N

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1. Structure of Application Note

Table 1 Structure of Application Note

name	Description
r20an0312ej0106-rx-t4.pdf	This document
readme_r22e.txt	Sample program Information
Workspace	
Sample program(sample)	
rx64m_rsk	Renesas Starter Kit+ for RX64M CPU Board: Sample program for Ethernet (Native T4 API) (e ² studio)(*1)
rx64m_rsk_socket (*3)	Renesas Starter Kit+ for RX64M CPU Board: Sample program for Ethernet (Socket API) (e ² studio)(*1)
rx62n_rsk	Renesas Starter Kit+ for RX62N CPU Board: Hokuto Denshi RX62N,RX621 group MCU board(*2): Sample program for Ethernet (e ² studio)(*1)
rx63n_rsk	Renesas Starter Kit+ for RX63N CPU Board: Sample program for Ethernet (e ² studio)(*1)
rx63n_gr_sakura	Gadget Renesas RX63N Board Sample program for Ethernet (e ² studio)(*1)
rx63n_hokuto	Hokuto Denshi RX63N group MCU board. Sample program for Ethernet (e ² studio)(*1)
rx71m_rsk	Renesas Starter Kit+ for RX71M CPU Board: Sample program for Ethernet (e ² studio)(*1)
rx65n_rsk	Renesas Starter Kit+ for RX65N CPU Board: Sample program for Ethernet (e ² studio)(*1)
Reference(reference)	
rx62n_rx63n_ether_driver	Sample driver for RX62N/RX63N Ethernet controller. Document No. R02AN0015JJ0100 (Document is written Japanese) Only RX62N.
Patch program(patch)	
ether_drv.zip	Patch file for Ether driver. In case, if user board does not connect ET_LINKSTA to PHY chip. Only RX62N. Check the configuration file of Ethernet Module(R01AN2009) for Other MCU's.

(*1) It is possible to convert e² studio project to CS+ project.

(*2) Please refer to the section 3.3. It is necessary to fix the sample program to confirm the behavior.

(*3) Socket API sample program is now stopping release in temporary at this revision 1.06. Next release will include this one.

2. Development Environment

Requirement items

When user develops, please choose newer version than below.

[Software]

- Integrated Development Environment
 - e² studio V5.2.0
 - CS+ V4.01.00
- C compiler
 - e² studio
 - Renesas RXC Toolchain V2.05.00
 - CS+
 - CC-RX V2.05.00

[Debug tools]

- E1 emulator

[Debugger software]

- e² studio
 - Renesas RX Debug Support Version: 4.0.0.201511231025
- CS+
 - Debugger Collection Plugin V3.02.00.00

[board]

Ethernet :

- Renesas Starter Kit+ for RX64M (type : [R0K50564MS100BE](#))
- Renesas Starter Kit+ for RX63N (type : [R0K50563NS100BE](#))
- Renesas Starter Kit+ for RX62N (type : [R0K5562N0S100BE](#))
- Renesas Starter Kit+ for RX71M (type : [R0K50571MS100BE](#))
- Renesas Starter Kit+ for RX65N (type : RTK5005651C01000BR)
- Hokuto Denshi RX62N,RX621 group MCU board (type: [HSBRX62N-A](#))
- Hokuto Denshi RX63N,RX631 group MCU board (type: [HSBRX63NB Series](#))
- Gadget Renesas RX63N Board (Type: [GR-SAKURA, GR-SAKURA-FULL](#))

The other equipment for confirm running sample program, please refer to the section.6

[Point of custom: Confirmation for Ethernet sample working]

(1) To confirm Renesas Starter Kit+ for RX62N CPU Board Ethernet sample, user needs change setting to remove/implement chip-resistor on board. This makes connection from PHY chip link status pins to RX62N ET_LINKSTA pin.

Renesas Starter Kit+ for RX62N CPU Board:

R93	->	remove
R91	->	implement

(2) To confirm Renesas Starter Kit+ for RX64M CPU Board and Renesas Starter Kit+ for RX71M CPU Board Ethernet sample, user needs change setting to remove/implement jumper on board. This makes connection from PHY chip ETHERNET1 pins to RX64M/RX71M pins.

Renesas Starter Kit+ for RX64M CPU Board:

J16	->	Shorted Pin 1 - 2
J18	->	Shorted Pin 1 - 2
J20	->	Shorted Pin 1 - 2

Renesas Starter Kit+ for RX71M CPU Board:

J16	->	Shorted Pin 1 - 2
J18	->	Shorted Pin 1 - 2
J20	->	Shorted Pin 1 - 2

(3) To confirm the sample program corresponding to the Gadget Renesas RX63N Board, please implement the 14 pin header to the JTAG interface to connect the E1 emulator.

3. Ethernet sample driver

Changes are following 4 points about Ethernet driver (R02AN0015) as RX62N application note.

3.1 Changing details of Ethernet sample driver

Correct 6 points like below.

[r_ether.c @ Line636] Please add the process for Link-On.

```
void R_ETHER_Callback_Link_On(void)
{
    /* Please add necessary processing when becoming Link up. */
    extern void callback_link_on(uint32_t channel);
    callback_link_on(0);
} /* End of function R_ETHER_Callback_Link_On() */
```

[r_ether.c @ Line650] Please add the process for Link-Off.

```
void R_ETHER_Callback_Link_Off(void)
{
    /* Please add necessary processing when becoming Link down. */
    extern void callback_link_off(uint32_t channel);
    callback_link_off(0);
} /* End of function R_ETHER_Callback_Link_Off() */
```

[r_ether.c @ Line784] Enable Ethernet interrupt

```
#if 1
    EDMAC.EESIPR.BIT.FRIP = 1;
    EDMAC.EESIPR.BIT.TCIP = 1;
#endif
```

[r_ether.c @ Line1088] Delete interrupt status flag and Call T4 interrupt handler

```
EDMAC.EESR.LONG = status_eesr; /* Clear EDMAC status bits */
lan_inthdr();
```

[r_ether_local.h @ Line39,Line41] Changing number of descriptor

```
/* The number of Rx descriptors. */
#define EMAC_NUM_RX_DESCRIPTOR (1)
/* The number of Tx descriptors. */
#define EMAC_NUM_TX_DESCRIPTOR (1)
```

[stacksct.h @ Line30] Change stack size

```
#pragma stacksize si=0x600
```

3.2 Ethernet sample driver patch program

ET_LINKSTA pin (RX62N, RX63N, RX64M, RX71M, RX65N) is multi-function pin. ET_LINKSTA can detect LAN cable state (LINK-ON/OFF).

The CPU board included in Renesas Starter Kit+ for RX64M connects ET_LINKSTA to PHY chip.

But the CPU board included in Renesas Starter Kit+ for RX62N or RX63N do not connect ET_LINKSTA to PHY chip. Therefore, user often does not connect ET_LINKSTA to PHY chip if user referred the circuit of Renesas Starter Kit.

Ethernet driver uses ET_LINKSTA pin as interrupt signal, and detects changing of LINK status.

<RX62N>

We prepared patch program that uses software-polling to detect LINK status for "no ET_LINKSTA connection to PHY chip board".

These patch program source code can be used to overwrite to same file name in Ethernet driver.

<Other>

Check the configuration file of Ethernet Module(R01AN2009).

3.3 Change points for Hokuto Denshi RX62N,RX621 group MCU board

Please use the Renesas Starter Kit+ for RX62N sample program to confirm this sample on the Hokuto Denshi RX62N,RX621 group MCU board. And RMII interface is used between RX62N and PHY chip. Please change the code as following.

[r_ether.h @ Line59] Change to the RMII interface setting

```
#define ETH_MODE_SEL          ETH_RMII_MODE
```

4. Environment for RX64M/RX63N/RX71M/RX65N sample program

Sample program projects for RX64M (rx64m_rsk_socket, or rx64m_rsk), RX63N(rx63n_rsk, rx63n_gr_sakura, rx63n_hokuto), RX71M(rx71m_rsk) and RX65N(rx65n_rsk) are built using FIT module plug-in function included in e² studio.

4.1 Using FIT Modules

This sample program use following FIT Modules.

- RX Family TCP/IP for Embedded system M3S-T4-Tiny Introduction Guide Firmware Integration Technology (R20AN0051)
RX Family Interface conversion module for Ethernet Driver and Embedded system M3S-T4-Tiny Firmware Integration Technology (R20AN0311)
- RX Family Ethernet Module Using Firmware Integration Technology (R01AN2009)
- RX Family System Timer Module Firmware Integration Technology (R20AN0431)
- RX Family CMT Module Using Firmware Integration Technology (R01AN1856)
- RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)

And, rx64m_rsk_socket project uses following FIT module in addition to the above.

- RX Family Embedded TCP/IP M3S-T4-Tiny Socket API Module Firmware Integration Technology (R20AN0296)

rx63n_hokuto and rx63n_gr_sakura project changed source code of the following FIT modules.

- RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)

Please refer to the document included each FIT modules when user needs more details information about each FIT modules.

4.2 Software Structure

Show software structure and FIT modules structure of sample program.

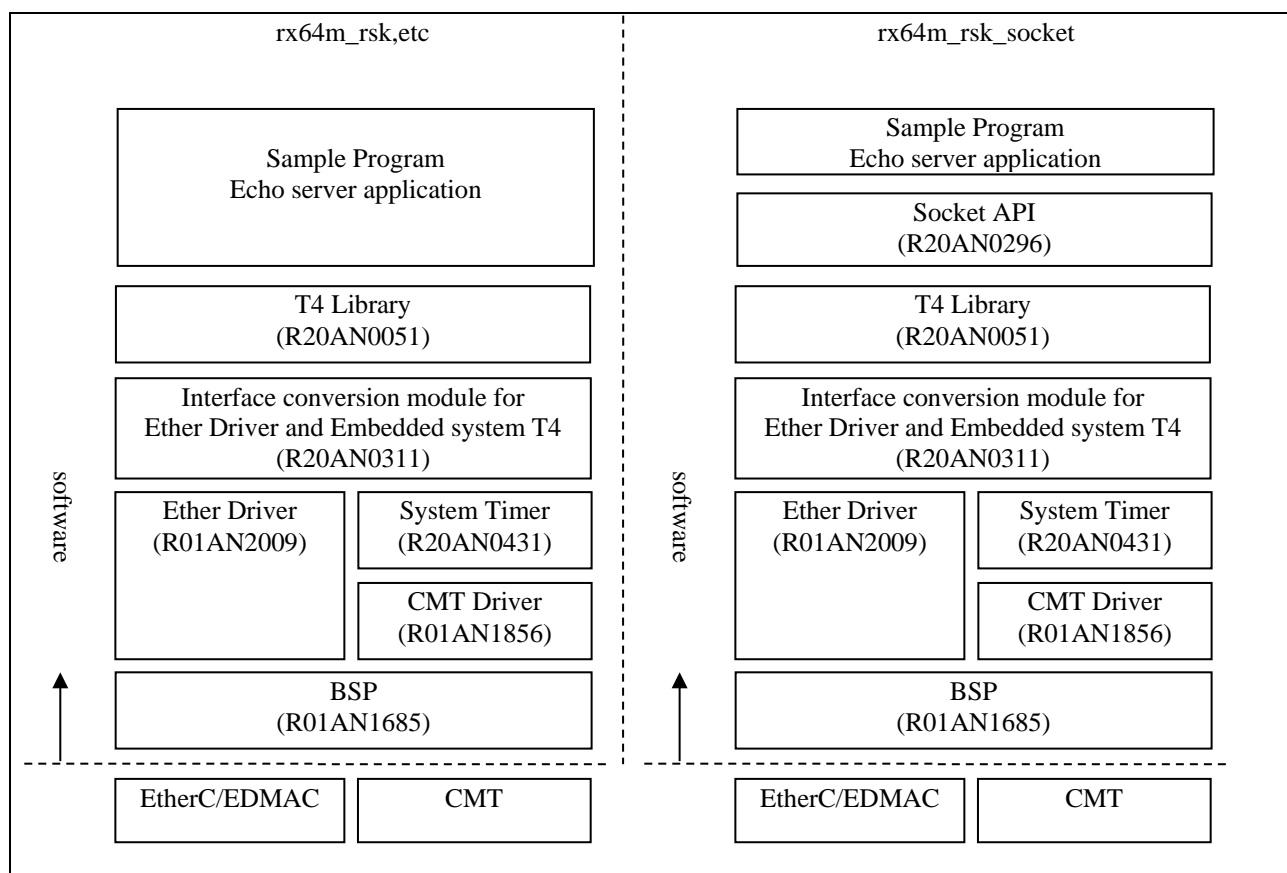


Figure 1 FIT modules structure of sample program

4.3 Scheme of link the Library file

In current e² studio version, user register the Library file (*.lib) to the Project Tree, this Library file can be seen in the Project Tree but this is not the target of building.

It needs to set the linker settings for T4 Library in manually after the plug-in T4 FIT module.

The followings are the sheme of link the Library file.

- Right click on the project name in "Project Explorer" window, And click "Renesas Tool Settings".
- In the status, selected "settings" in the "Property" dialog in the left side tree, After selecting "Linker" -> "Input", and click the "Add" icon.
- Click the "Workspace" in the "Add File path" dialog.
- Click "OK" in the "Select File" dialog with selecting r_t4_rx -> lib -> T4_Library_rxv1_ether_little.lib.
- Click "OK" in the "Add File path" dialog.
- Click "OK" in the "Property" dialog.

5. Method of converting e² studio to CS+ project

e² studio project can be converted to CS+ project to use *.rcpc file included in e² studio project. This section shows method of converting (in this example using sample program projects for RX64M).

- Start CS+ for CC, push the "GO" button in "e2 studio / CubeSuite / ...".
- Select "e² studio project file (*.rcpc) " and, open the *.rcpc file.
- "Project convert settings" window would open, and please select project in the project tree.
- Project settings on the right side of project tree, please select MCU "RX64M" -> "R5F564MLDxFC" and push the "OK" button. CS+ outputs the converted project.
- Please select "CC-RX" in the project tree.
- Please select "RXv2 architecture" in the "common option" tab -> "CPU" -> "command set architecture"
- echo_srv.c is registered in the each folders (project tree -> file -> src).
-> TCP-blocking, TCP none-blocking, UDP-blocking, UDP-nonblocking sample.
Please remove echo_srv.c from the project tree excluding you need to work.
- Build the project
- Please set the debug tools fitting for your environment. User can confirm working sample program after this.

6. Confirm sample program

6.1 How to confirm Ethernet sample program

(1) Setup Hardware connections

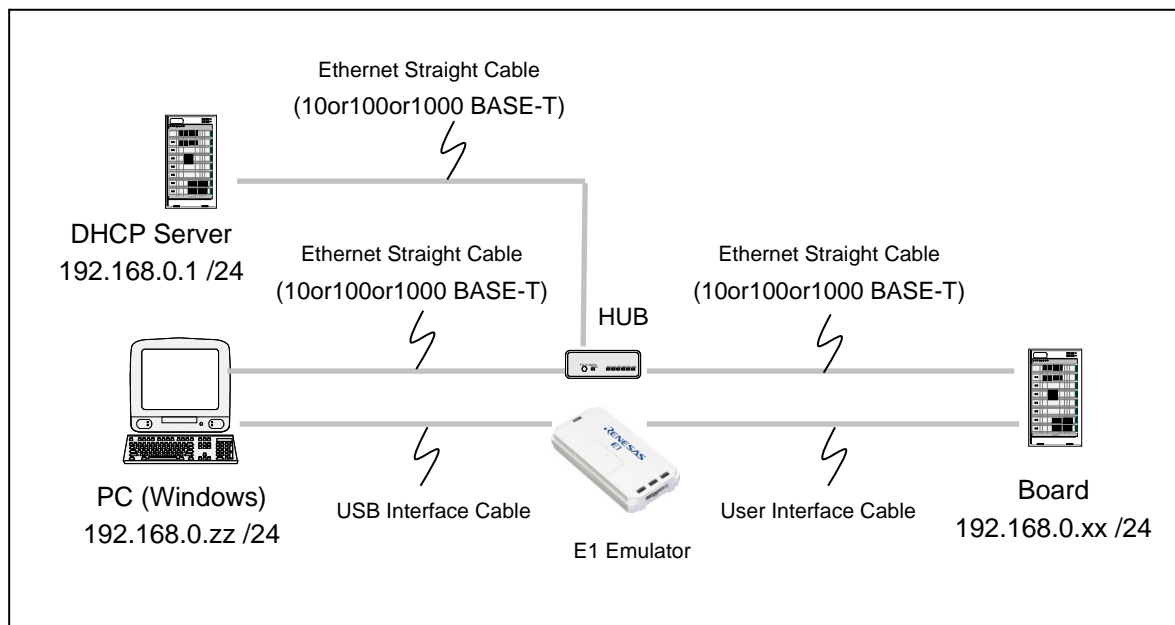


Figure 2 Ethernet sample program environment

We have confirmed using the Ethernet-switch product introduced in below.

- NETGEAR: GS108E

This Ethernet-switch has the function called “port mirroring function”, this function provides monitoring function for Ethernet. This Ethernet-switch can realize packet monitoring environment if user uses normally Ethernet-switch.

For example, please refer to the figure below, the board A transfers data to board B, normally Ethernet-switch filters packet and only outputs to the port connected to board B. If “port mirroring function” exists on Ethernet-switch, it copies data board B port and port mirroring port.

This function provides to monitor for peer-to-peer communication.

We recommend “Wireshark” for packet monitor. Please use “promiscuous mode” for peer-to-peer communication.

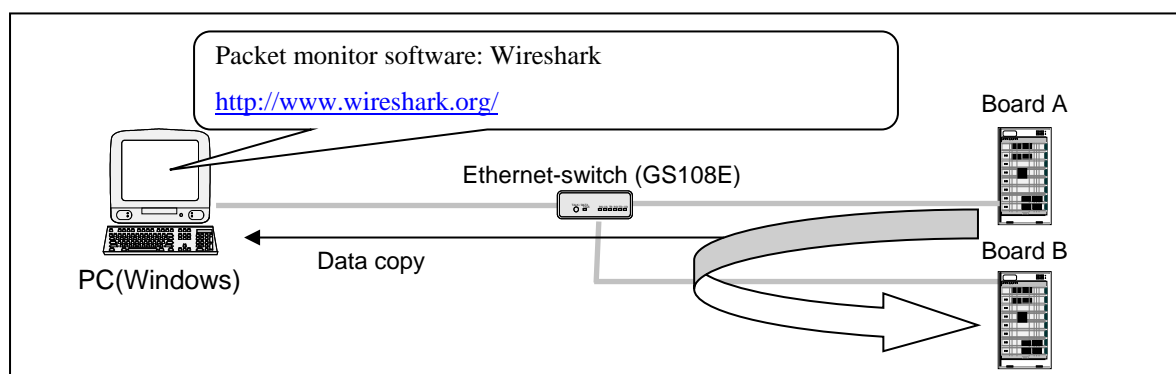


Figure 3 Ethernet sample program confirmation environment

(2) PC setting.

Windows 7:

Control Panel -> Network -> Adaptor setting -> Local Network Connection

Network Tab -> Internet Protocol Version 4 (TCP/IPv4) -> Property

Please select the “Auto IP address configuration” in following dialog.

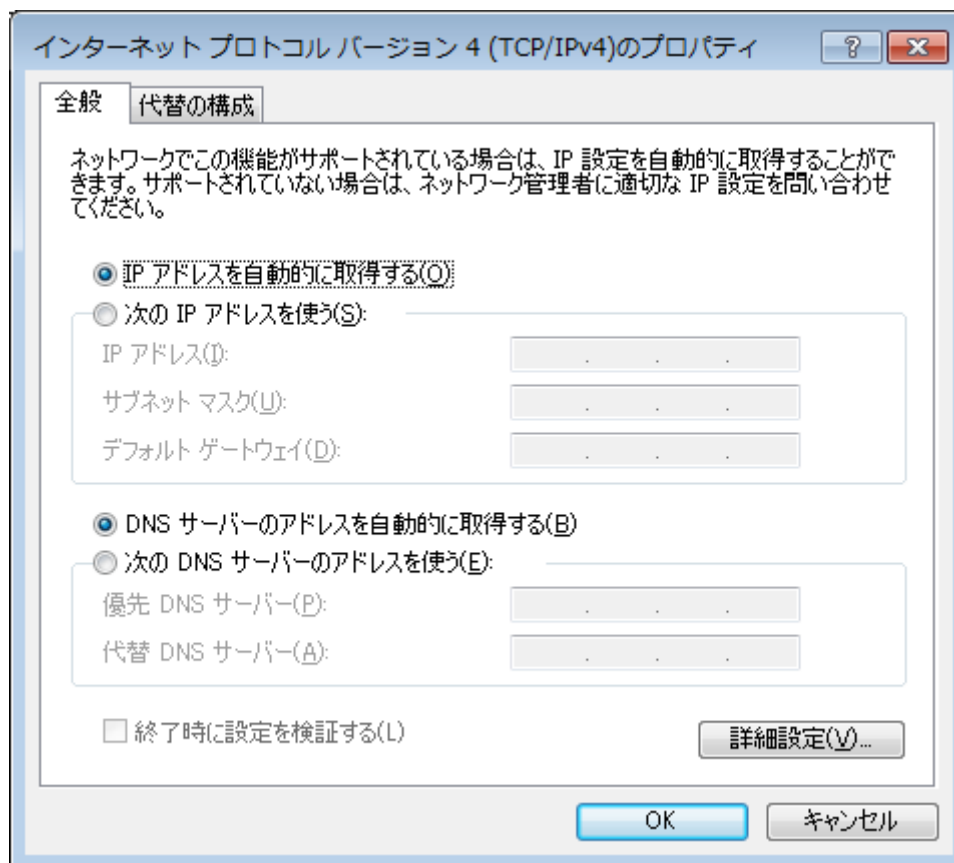



Figure 4 Internet Protocol Version 4 (TCP/IPv4) Property

After setting, please push OK button.

- (3) Start Sample program (sample folder)
- (4) From the [Project] menu, click the [Build Project].
- (5) Connect E1 Emulator, and from the [Run] menu, click the [Debug].
- (6) The program is run by clicking  button in the [Debug] view , or pressing [F8] key.

(7) Confirm IP Address for MCU

IP address will be allocated by DHCP server when sample program executes.

User can confirm the allocated IP address value using Renesas Debug Virtual Console on e2 studio.

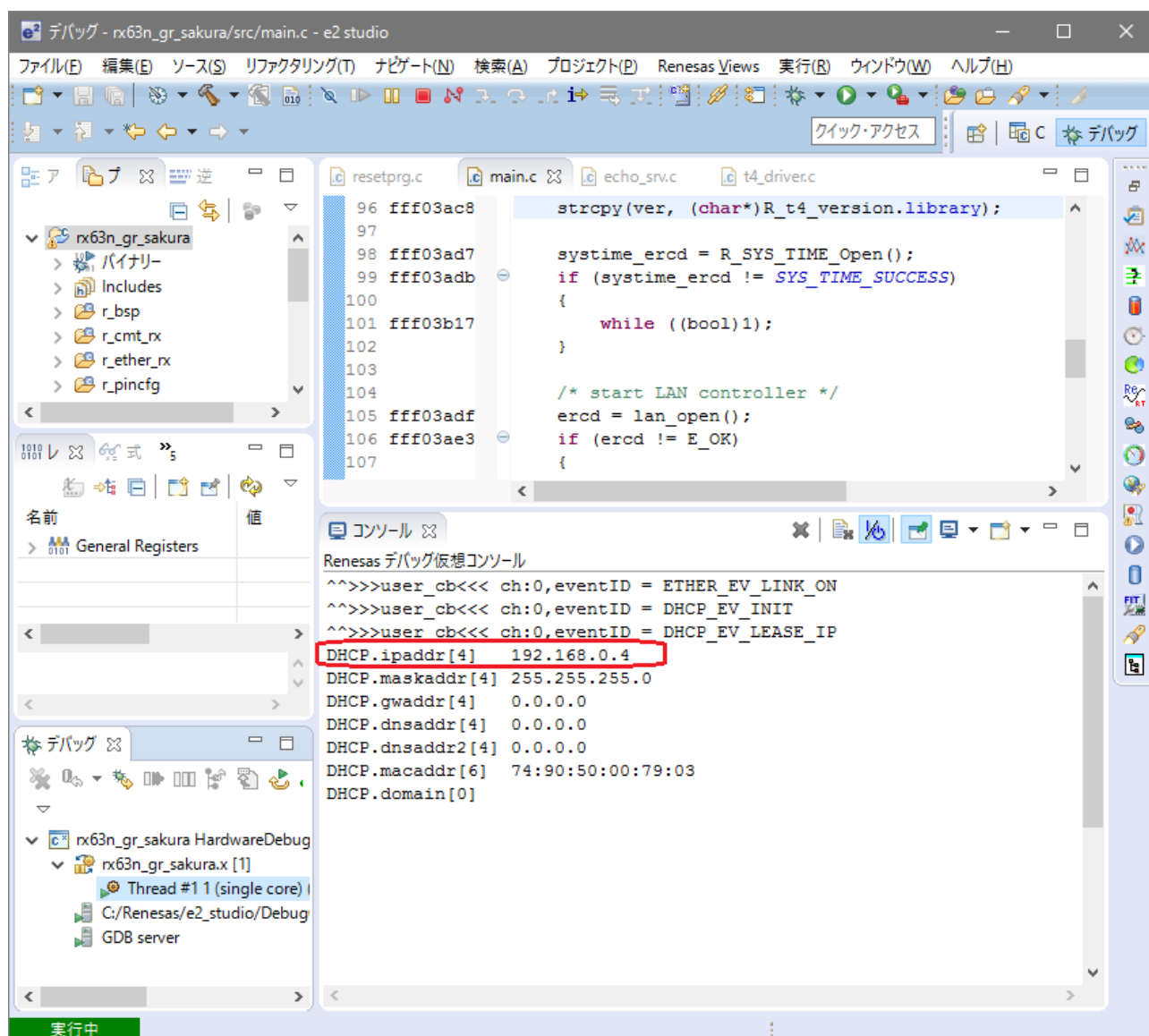
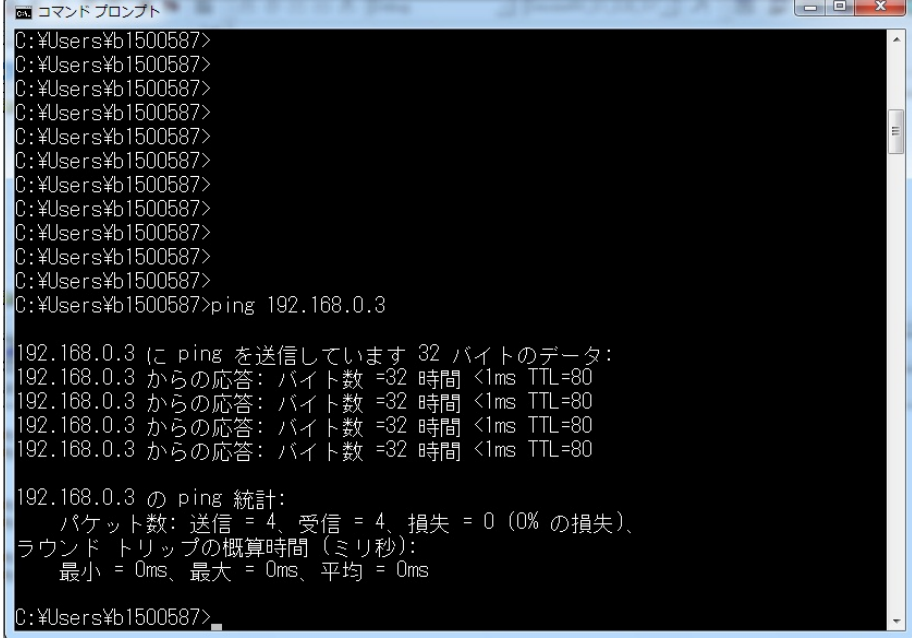


Figure 5 Example about Display of IP address

Figure 5: Example about display of IP Address shows IP address is 192.168.0.4 is allocated to MCU.

Please execute ipconfig in command prompt in order to confirm PC (Windows) IP address if need.

(8) Execute ping command to MCU in command prompt.



```
コマンドプロンプト
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>
C:\Users\b1500587>ping 192.168.0.3

192.168.0.3 に ping を送信しています 32 バイトのデータ:
192.168.0.3 からの応答: バイト数 =32 時間 <1ms TTL=80
192.168.0.3 からの応答: バイト数 =32 時間 <1ms TTL=80
192.168.0.3 からの応答: バイト数 =32 時間 <1ms TTL=80
192.168.0.3 からの応答: バイト数 =32 時間 <1ms TTL=80

192.168.0.3 の ping 統計:
    パケット数: 送信 = 4、受信 = 4、損失 = 0 (0% の損失)、
    ラウンド トリップの概算時間 (ミリ秒):
        最小 = 0ms、最大 = 0ms、平均 = 0ms
C:\Users\b1500587>
```

Figure 6 Example about Execution of ping

(9) Execute telnet in command prompt

Windows 7 needs availability to use telnet command.

Start -> Control Panel -> Program and Function

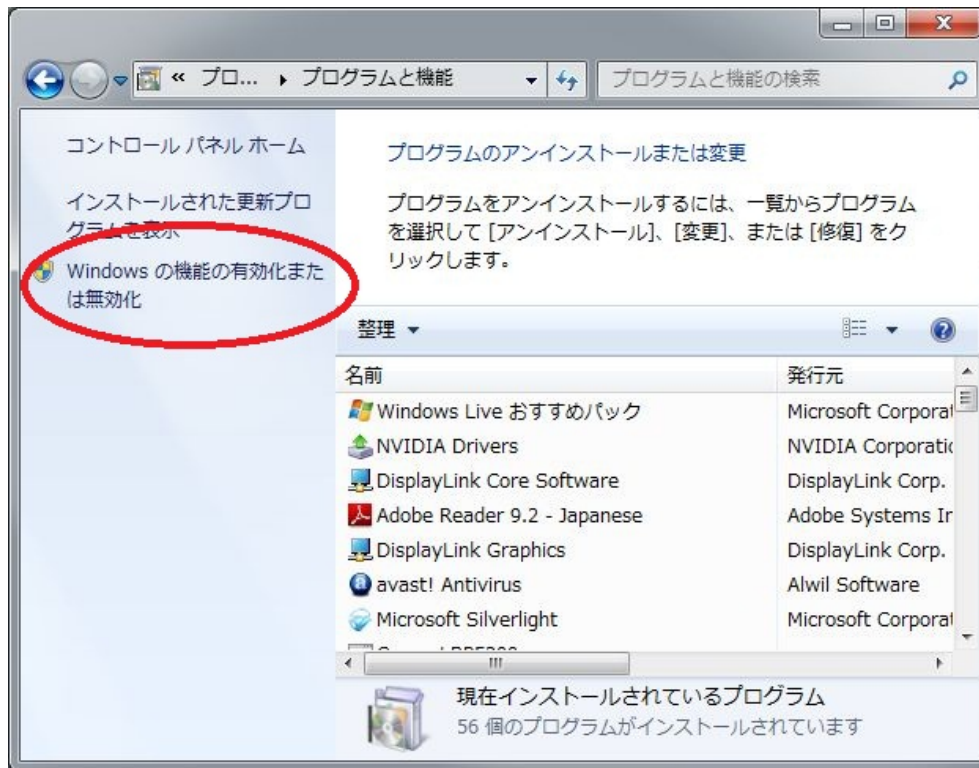


Figure 7 Program and Function

Please check Telnet client

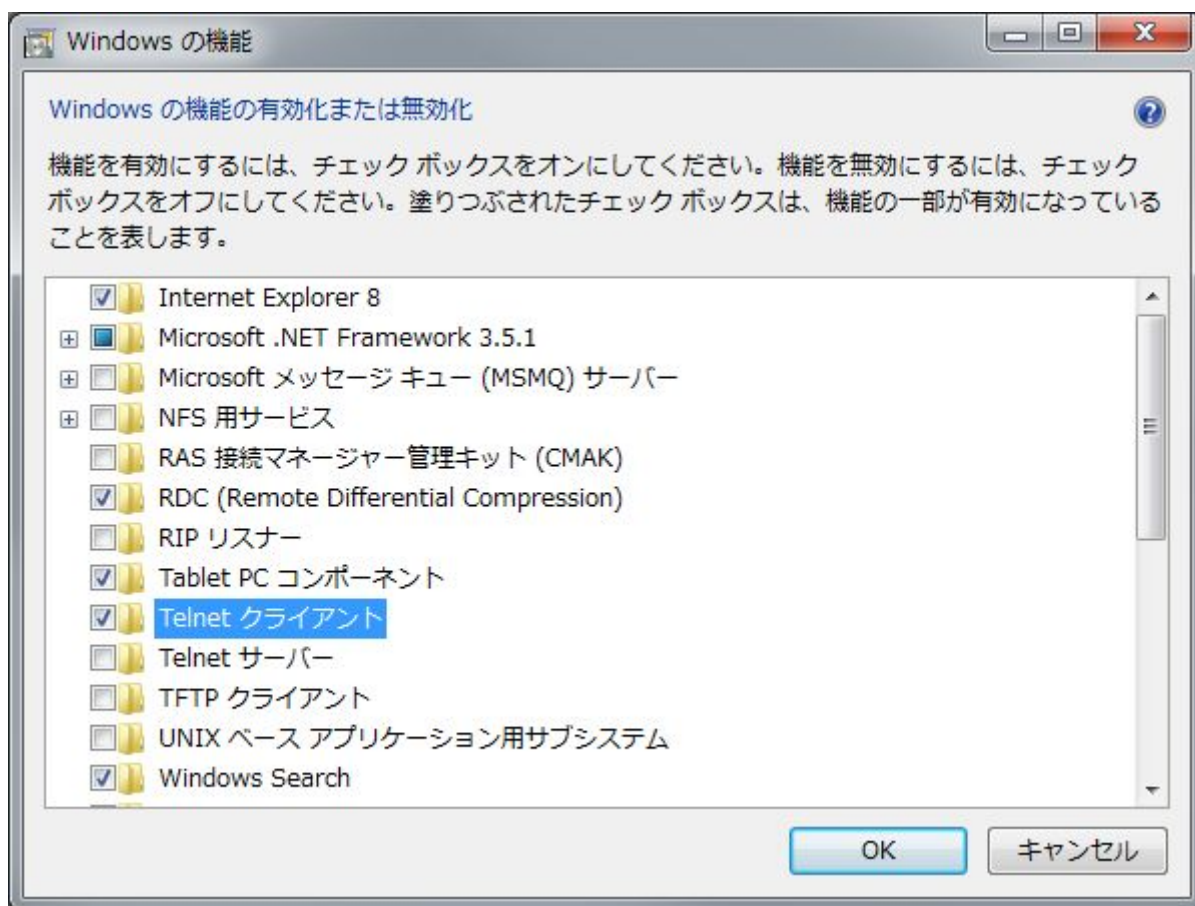


Figure 8 Telnet Client

Please input “telnet 192.168.0.xx 1024” in command prompt. (192.168.0.xx is the IP address allocated to MCU.)

Please input any keyboard input.

It is OK to confirm the data echo-back.

Please input Ctrl + “]” and next, input “quit[enter key]” makes disconnection.

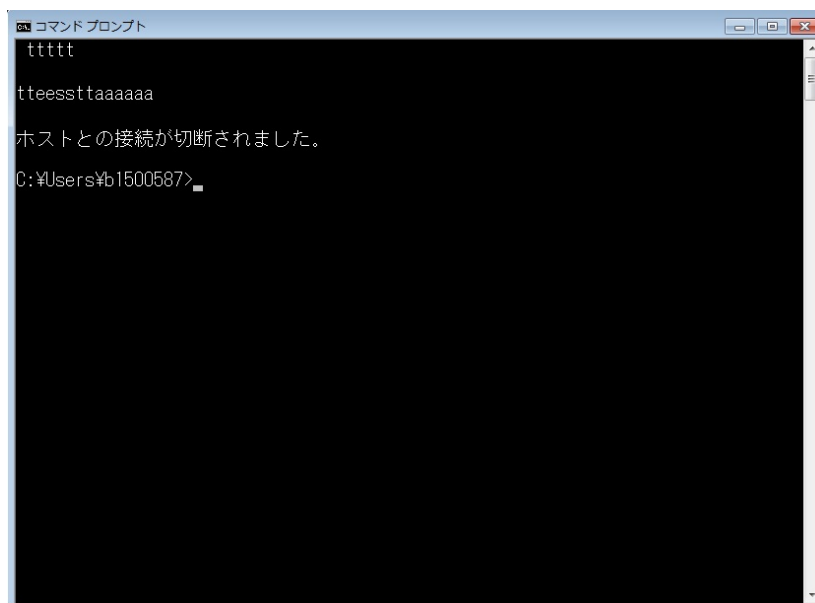


Figure 9 Disconnect

7. Notes

- (1) The sample program for little endian mode is only included.
- (2) The MAC address of the sample program is stored in `_myethaddr` variable of `config_tcpudp.c`.
Change an initial value of the `_myethaddr` (MAC address) variable if necessary according to the system.
- (3) If user uses RX62N, numbers of descriptors are defined in `r_ether_local.h`. If user needs changing number of Descriptors, please set the number in even at total of receive descriptor (`EMAC_NUM_RX_DESCRIPTOR`) and transmit descriptor (`EMAC_NUM_TX_DESCRIPTOR`).

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Revision History

Rev.	Date	Description	
		Page	Summary
1.06	Nov 30, 2016	3	Updated PDF name on table1.
		6	Updated 3.1 Changing details of Ethernet sample driver.
		8	Updated 4.1 Using FIT modules.
		9	Updated Figure1: FIT modules structure of sample program
		—	Changed: method of confirming IP address allocated to MCU and environment execution sample program in section 6.
1.05	Oct 01, 2016	—	Added sample program for RX71M and RX65N. Updated FIT Module's Changed at the timing of link-status detection in sample program of RX63N and RX64M.
1.04	Apr 15, 2016	—	Update with RX Family Interface conversion module for Ethernet Driver and Embedded system M3S-T4-Tiny Rev.1.04
		—	Update with RX Family Embedded TCP/IP M3S-T4-Tiny Socket API Module Rev.1.30
		4	Added note about the Gadget Renesas RX63N Board
		5	Added Section 3.3 Change points for Hokuto Denshi RX62N,RX621 group MCU board
		—	Update with TCP/IP for Embedded system M3S-T4-Tiny for the RX Family V.2.05 Release 00
1.03	Dec 01, 2015	—	Update with TCP/IP for Embedded system M3S-T4-Tiny for the RX Family V.2.05 Release 00
1.02	Aug 03, 2015	—	Update with TCP/IP for Embedded system M3S-T4-Tiny for the RX Family V.2.03 Release 00
1.01	Jul 01, 2014	—	Added Section 4.2 Software Structure Added Section 4.3 Scheme of link the Library file Changed Section No. Method of converting e ² studio to CubeSuite+ project to 4.4.
1.00	May 01, 2014	—	First edition issued

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. 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 LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

The state of the product is undefined at the moment when power is supplied.

- The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

- The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

- When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

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