

RX Family

RX Driver Package Ver.1.10

R01AN3345EJ0100 Rev.1.00 July 15, 2016

APPLICATION NOTE

Introduction

This document is the RX Family RX Driver Package User's Manual, version 1.10.

This User's Manual describes basic structures, features and usage of RX Driver Package applications, and about the sample application program using the FIT modules included in this package.

Target Device

RX110 Group (Renesas Starter Kit for RX110)

RX111 Group (Renesas Starter Kit for RX111)

RX113 Group (Renesas Starter Kit for RX113)

RX130 Group (Renesas Starter Kit for RX130)

RX210 Group (Renesas Starter Kit for RX210) RX230 Group (Renesas Starter Kit for RX230)

- RX231 Group (Renesas Starter Kit for RX231)
- RX23T Group (Renesas Starter Kit for RX23T)
- RX24T Group (Renesas Starter Kit for RX24T)
- RX24T Group (Renesas Starter Kit for RX24T)
- RX63N Group (Renesas Starter Kit for RX63N)
- RX64M Group (Renesas Starter Kit+ for RX64M)
- RX71M Group (Renesas Starter Kit+ for RX71M)

When using this application note with your product, careful evaluation is recommended.

And when using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Related Documents

- RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685EU)
- Firmware Integration Technology User's Manual (R01AN1833EU)
- RX Family Adding Firmware Integration Technology Modules to Projects (R01AN1723EU)
- RX Family Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826EJ)
- The User's Manual provided with the RX Driver Package Application.



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1. Overview

1.1 Applicability

This User's Manual applies to the RX Family RX Driver Package, version 1.10.

1.2 Operating Environment

This package runs under the operating environment described below.

Table 1-1 Operating Environment (RX110)

Microcontroller	RX110 Group
Evaluation board	Renesas Starter Kit for RX110
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-2 Operating Environment (RX111)

Microcontroller	RX111 Group
Evaluation board	Renesas Starter Kit for RX111
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-3 Operating Environment (RX113)

Microcontroller	RX113 Group
Evaluation board	Renesas Starter Kit for RX113
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-4 Operating Environment (RX130)

Microcontroller	RX130 Group
Evaluation board	Renesas Starter Kit for RX130
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-5 Operating Environment (RX230)

Microcontroller	RX230 Group
Evaluation board	Renesas Starter Kit for RX230
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20



Table 1-6 Operating Environment (RX230)

Microcontroller	RX230 Group
Evaluation board	Renesas Starter Kit for RX230
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-7 Operating Environment (RX231)

Microcontroller	RX231 Group
Evaluation board	Renesas Starter Kit for RX231
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-8 Operating Environment (RX23T)

Microcontroller	RX23T Group
Evaluation board	Renesas Starter Kit for RX23T
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-9 Operating Environment (RX24T)

Microcontroller	RX24T Group
Evaluation board	Renesas Starter Kit for RX24T
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-10 Operating Environment (RX63N)

Microcontroller	RX63N Group
Evaluation board	Renesas Starter Kit for RX63N
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20

Table 1-11 Operating Environment (RX64M)

Microcontroller	RX64M Group
Evaluation board	Renesas Starter Kit+ for RX64M
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20



Table 1-12	Operating Environment (RX71M)
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Microcontroller	RX71M Group
Evaluation board	Renesas Starter Kit+ for RX71M
Integrated development environment (IDE)	e ² studio, V4.0.2 or later
Cross tools	RX Family C/C++ Compiler Package V2.03.00 or later
Emulator	E1, E20



2. About RX Driver Package

The RX Driver Package is a software platform (framework) that combines the following modules to be required for development in a single package. Since the package contains multiple modules, you can start developing immediately without having to obtain each module separately.

- Board Support Package (BSP) module
- FIT peripheral function modules (free version)
- FIT middleware modules (free version)
- FIT interface modules

You can develop the user application layer with ease by using the Sample Application Program (RX Driver Package Application) which utilizes the RX Driver Package.

2.1 System Structure

The figure below shows the system structure of the RX Driver Package.

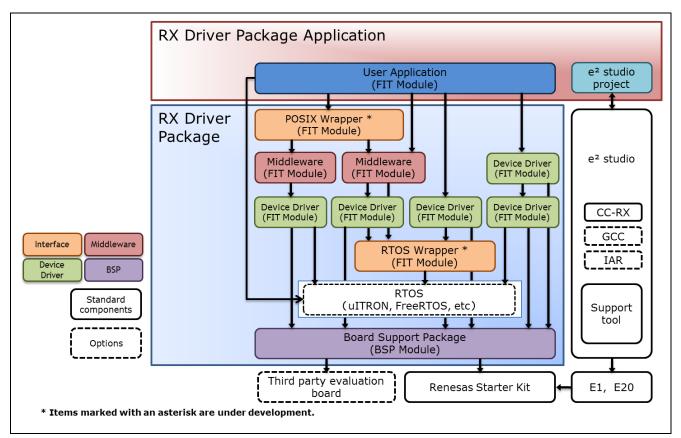


Figure 2-1 System Structure



2.2 RX Driver Package Features

The RX Driver Package has the following features.

(a) Select necessary modules and start developing immediately the application program

You can easily build a system simply by selecting the modules you need from the package. After that, all you have to do is develop the application program.

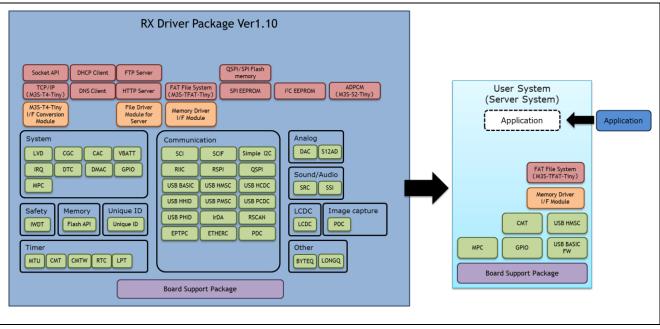


Figure 2-2 An example of system build

(b) Free to use

All the modules included in the RX Driver Package can be used free of charge. Free versions of middleware modules such as TCP/IP and file system are included.

(c) Can upgrade to paid versions of modules

The free versions of modules in the RX Driver Package can be replaced with commercial (paid) versions. By using a commercial (paid) version, all the functionality of the module will be available, as well as support about a commercial version.

(d) Check operation including user application

The RX Driver Package Application is provided as a sample user application that uses the RX Driver Package. The RX Driver Package Application consists of programs for operating each module in the RX Driver Package, and the project files for building the programs. It enables you to start checking the operation of your user application immediately.



3. Structure of the RX Family RX Driver Package

3.1 Folder Structure

The folder structure used in this package is shown below.

When the ZIP file for this package is downloaded from the Renesas web site and decompressed, a folder of the same name will be present and it will contain a **FITModules** folder, a **reference_documents** folder, and this document.

The **FITModules** folder contains the FIT modules for the modules shown in Table 3-1, Table 3-2, Table 3-3 (as ZIP files and XML files).

The reference_documents folder contains the documentation for using this package in various development

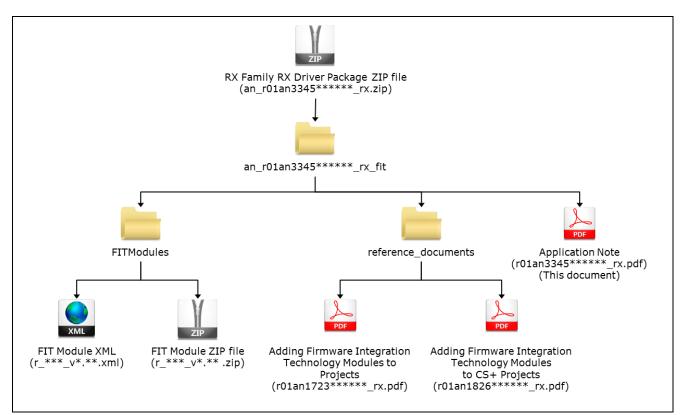


Figure 3-1 Folder Structure of the RX Family RX Driver Package



3.2 Module Structure

The figure below shows the types and structure of the FIT modules included in this package.

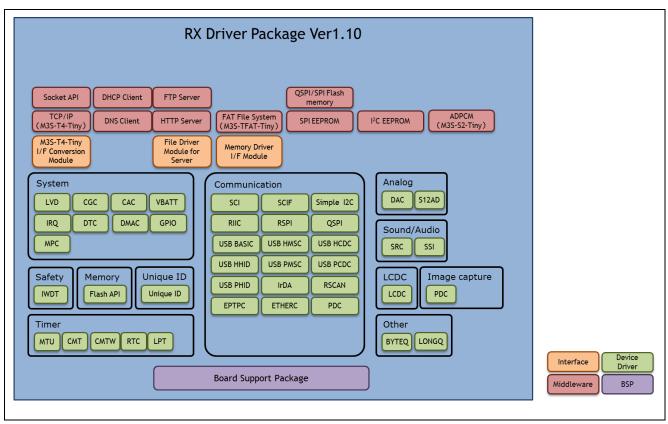


Figure 3-2 RX Family RX Driver Package FIT Module Structure



3.3 FIT Modules

The table below lists the FIT modules included in this package.

(1) Board Support Package (BSP)

Table 3-1 Board Support Package (BSP)

Module	FIT Module Name	Rev
Board Support Package (BSP)	r_bsp	3.31

(2) Device Driver

Table 3-2 Device Driver

Module	FIT Module Name	Rev
Voltage Detection Circuit (LVD)	r_lvd_rx	1.50
Clock Generation Circuit (CGC)	r_cgc_rx100	1.31
Clock Frequency Accuracy Measurement Circuit (CAC)	r_cac_rx	1.10
Battery Backup (VBATT)	r_vbatt_rx	1.01
Interrupt Controller (IRQ)	r_irq_rx	1.90
Data Transfer Controller (DTC)	r_dtc_rx	2.04
DMA Controller (DMAC)	r_dmaca_rx	1.03
I/O Ports (GPIO)	r_gpio_rx	2.00
Multi-Function Pin Controller (MPC)	r_mpc_rx	2.00
Multi-pulse Timer Unit (MTU2a)	r_mtu_rx	1.20
Compare Match Timer (CMT)	r_cmt_rx	2.90
Compare Match Timer W (CMTW)	r_cmtw_rx	1.10
Real-Time Clock (RTC)	r_rtc_rx	2.41
Low Power Timer (LPT)	r_lpt_rx	1.00
Independent Watchdog Timer (IWDT)	r_iwdt_rx	1.51
Serial Communications Interface (SCI: Asynchronous/Clock Synchronous)	r_sci_rx	1.70
Serial Communications Interface with FIFO (SCIF: Asynchronous/Clock Synchronous)	r_scif_rx	1.10
Serial Communications Interface with FIFO (SCIF: Device Driver for Serial Memory Control)	r_scifa_smstr_rx	1.08
Serial Communications Interface (SCI: Simple I ² C Bus)	r_sci_iic_rx	1.90
Serial Peripheral Interface (RSPI: Device Driver for Serial Memory Control)	r_rspi_smstr_rx	1.11
Quad Serial Peripheral Interface (QSPI: Device Driver for Serial Memory Control)	r_qspi_smstr_rx	1.08
USB Basic Firmware	r_usb_basic	1.11
USB Host Mass Storage Class	r_usb_hmsc	1.11
USB Host Communication Device Class	r_usb_hcdc	1.11
USB Host Human Interface Device Class	r_usb_hhid	1.11
USB Peripheral Mass Storage Class	r_usb_pmsc	1.11
USB Peripheral Communications Device Class	r_usb_pcdc	1.11
USB Peripheral Human Interface Device Class	r_usb_phid	1.11
USB Basic Firmware mini	r_usb_basic_mini	1.02
USB Host Mass Storage Class mini	r_usb_hmsc_mini	1.02
USB Host Communication Device Class mini	r_usb_hcdc_mini	1.02



USB Host Human Interface Device Class mini r_usb_hhid USB Peripheral Mass Storage Class mini r_usb_pms USB Peripheral Communications Device Class mini r_usb_pcd USB Peripheral Human Interface Device Class mini r_usb_pcd IrDA Interface (IrDA) r_irda_sci_ CAN Module (CAN) r_can_rx	
USB Peripheral Communications Device Class mini r_usb_pcd USB Peripheral Human Interface Device Class mini r_usb_phic IrDA Interface (IrDA) r_irda_sci_	
USB Peripheral Human Interface Device Class mini r_usb_phic IrDA Interface (IrDA) r_irda_sci_	sc_mini 1.02
IrDA Interface (IrDA) r_irda_sci_	c_mini 1.02
	d_mini 1.02
	_rx 1.01
	2.02
CAN Module (RSCAN) r_rscan_rx	1.00
PTP Module for the Ethernet Controller (EPTPC) r_ptp_rx	1.11
EPTPC Light Module r_ptp_light	_rx 1.10
Ethernet controller (ETHERC) r_ether_rx	1.10
Parallel Data Capture Unit (PDC) r_pdc_rx	1.03
12-Bit A/D Converter (S12AD) r_s12ad_rx	x 2.11
D/A Converter (DAC) r_dac_rx	2.80
Flash Memory (Flash API) r_flash_rx	1.63
Sampling Rate Converter (SRC) r_src_api_	rx 1.11
Serial Sound Interface (SSI) r_ssi_api_i	rx 1.20
LCD Controller/Driver (LCDC) r_lcdc_rx	1.00
Unique ID Read r_uid_rx	1.00
Byte Queue Buffer (Data Management) r_byteq	1.60
Long Queue Buffer (Data Management) r_longq	1.60



Table 3-3 Middleware/Interface Module

FIT Module Name	Rev
r_t4_rx	2.05
r_t4_driver_rx	1.04
r_socket_rx	1.30
r_t4_dhcp_client_rx	1.03
r_t4_dns_client_rx	1.02
r_t4_ftp_server_rx	1.03
r_t4_http_server_rx	1.04
r_t4_file_driver_rx	1.01
r_s2_rx	3.03
r_tfat_rx	3.02
r_tfat_driver_rx	1.02
r_eeprom_sci_iic_rx	1.30
r_eeprom_riic_rx	1.40
r_eeprom_spi	2.33
r_flash_spi	2.33
	r_t4_rx r_t4_driver_rx r_socket_rx r_t4_dhcp_client_rx r_t4_dhcp_client_rx r_t4_ftp_server_rx r_t4_ftp_server_rx r_t4_file_driver_rx r_s2_rx r_tfat_rx r_tfat_driver_rx r_eeprom_sci_iic_rx r_eeprom_spi

Iote: This package includes the M3S-T4-Tiny (TCP/IP protocol stack library) of evaluation version. For the commercial version, please go to the below URL.

https://www.renesas.com/en-us/products/software-tools/software-os-middleware-driver/communicationsoftware/m3s-t4-tiny.html

https://www.renesas.com/pt-br/products/software-tools/software-os-middleware-driver/communicationsoftware/m3s-t4-tiny.html

https://www.renesas.com/en-eu/products/software-tools/software-os-middleware-driver/communication-software/m3s-t4-tiny.html

https://www.renesas.com/ja-jp/products/software-tools/software-os-middleware-driver/communication-software/m3s-t4-tiny.html

https://www.renesas.com/en-sg/products/software-tools/software-os-middleware-driver/communication-software/m3s-t4-tiny.html

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https://www.renesas.com/ko-kr/products/software-tools/software-os-middleware-driver/communication-software/m3s-t4-tiny.html

https://www.renesas.com/zh-tw/products/software-tools/software-os-middleware-driver/communication-software/m3s-t4-tiny.html



4. Usage Procedures

The RX Driver Package allows programs to be easily constructed by using the FIT plugin included in e^2 studio. The remainder of this section presents a simple usage example using e^2 studio. To use CS+, see the document "RX Family Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826EJ)" included in this package.

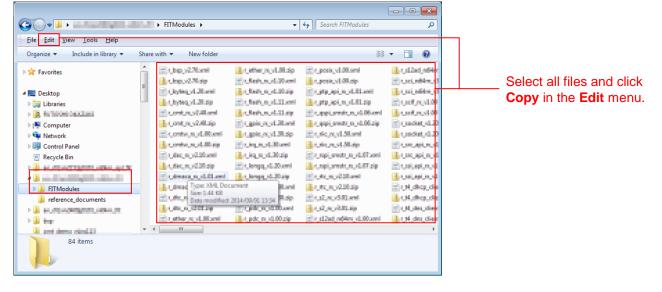
4.1 Environment Used

The RX231 is used as the target microcontroller and the Renesas Starter Kit RX231 is used as the target board. If a different environment is used, replace the specifics used in the example with the ones for that environment as you read.

4.2 Install RX Driver Package in e² studio

Install the FIT modules in the RX Driver Package into e² studio.

- 1. Decompress the downloaded file an_r01an3345ej****_rx.zip into an arbitrary directory.
- 2. Open the folder that was decompressed and open the FITModules folder in that folder.
- 3. Select all the files in the **FITModules** folder and click **Copy** in the **Edit** menu.





- 4. Open the e² studio install folder (Usually, this will be c:/Renesas/e2_studio.) and open the **FITModules** folder in that folder.
- 5. Click **Paste** on the **Edit** menu.

The e² studio **FITModules** folder will be copied to the FIT modules.

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Open the **FITModules** folder and click **Paste** on the **Edit** menu. The folder will be copied.

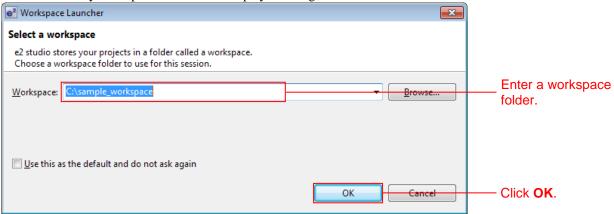
4.3 Application Creation

In this section, create a simple application that drives an LED.

4.3.1 Create a Workspace and a Project

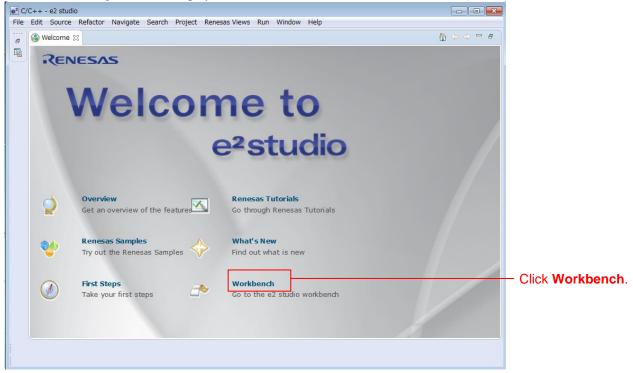
First, create a new workspace and a new project.

- 1. Start e^2 studio.
- 2. Enter an arbitrary workspace folder in the displayed dialog box and click **OK**.





3. When the following window is displayed, click **Workbench**.



4. When the workbench has started, select New from the File menu and click C Project.

e² C	/C++ - e2 studio						
File	Edit Source Refactor	Navigate Search I	roje	ct Run Window Help			
	New	Alt+Shift+N ►	C	Renesas FIT Module		9	
	Open File		C.	C Project			Click here.
	Close Close All	Ctrl+W Ctrl+Shift+W	8 8 1	C++ Project Makefile Project with Existing Code Project			
R.	Save Save As Save All Revert	Ctrl+S Ctrl+Shift+S		Convert to a C/C++ Project (Adds C Source Folder Folder Source File	C/C++ Nature)		
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è Z	Switch Workspace Restart Import Export	•					
	Properties	Alt+Enter					
	Exit		1				
_			-				



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5. Enter the project name. For the project type, click **Sample Project** under **Executable** (**Renesas**). For the tool chain, click **Renesas RXC Toolchain**. After making these settings, click **Next**.

e ² C Project		
C Project		
Create C project of selected type		
1.5 51		
		Enterthe
Project name: led_sample		Enter the
Use default location		project na
Location: C:\sample_workspace\led	sample Browse	
Create Directory for Pro	ject	
Project type:	Toolchains:	
Executable (Renesas)	KPIT GNUARM-RZ-EABI Toolchain	
Sample Project	KPIT GNURL78 ELF Toolchain	Click here
Static Library (Renesas)	KPIT GNURX-ELF Toolchain	
Sample Project	KPIT GNUSH-ELF Toolchain	
Debug-Only Project	Renesas RXC Toolchain	
Executable	Renesas SHC Toolchain	
Executable (IAR)		
Shared Library		
Static Library		
V800 Standalone Executable (Green		
V800 Standalone Static Library (Gree		
V800 ThreadX Executable (Green Hil	is)	
Makefile project		
< III	•	
Show project types and toolchains	s only if they are supported on the platform	
(?) < <u>B</u> ack	Next > Finish Cancel	
· <u>D</u> ack		

6. Select the target. Click the "..." button under **Target Selection** and select **R5F52318AxFP**. After making these settings, click **Next**.

e ² C Project	
e2 studio - Project Generation Select Target Specific Settings	
Toolchain Version : v2.01.00 Debug Hardware: E1 Data endian : Little-endian data Select Target: Select Configurations: V Hardware Debug : Debug using hardware Debug using Simulator : Debug using simulator Release (no debug) : Project without any debug information	Click here and select R5F52318AxFF
Build configurations will be created in the project only for the selected debug mode options, however by default the project will be built for the active configuration i.e., first configuration selected from group. Based on the device selection you made (RK500) the debug hardware (E1) and debug target (RSF56107VxFP),debug configuration will be automatically created for you.	
Image: Second	Click here.



8.

Set the check box of "Use FIT module" and click Next here.

ode Generator and FIT Settings				
Use Peripheral code Generator				
Use FIT module Downloa	d FIT modules			——— Set the check b
interfaces, A/D converters, DMA of programming interfaces (APIs) ar Conventionally, the information "(with user application" etc; has in application. With FIT, there are no function drivers and middleware v migrating between RX microcontr	controllers, etc.) based on setti nd are not limited to initializatio CMCU initial settings", "How too many cases varied by sample o ules for this information, so eac which support FIT have a comm	ngs entered via a graphical us in of peripheral functions. define a target board", "File co code, so changes needed to be h sample code can be embed	or MCU peripheral functions (clocks er interface (GUI). Functions are p onfiguration", "Names of functions", a made to sample code when emb ded into a user application with ea ations. This makes it easy to port	rovided as application "Common interface edding into a user se. Also, the peripheral
	Middlewar	e FIT		
CG	RTOS			
Device Driver	Device	Driver (BSP)		
	MCU			
ply click Next here.				
studio - Project Generation				
tudio - Project Generation				
tudio - Project Generation lect Additional CPU Options	Nearest			
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9. Simply click **Next** here.

e2 studio - Project Generation		
Global Options Settings		
Patch code generation	None •	
Fast interrupt vector register:	None	
ROM:	None	
RAM:	None 👻	
Address (H'):	0000000	
Address Register:	None	

10. Simply click **Finish** here.

e ² C Project		
e2 studio - Project Gene Standard Header Files	ration 📄	
Library configuration:	C(C99) *	
Select Header Files:		
√ runtime	: Runtime routines (Checked and disabled by default)	
ctype.h	: Character classification routines	
math.h	: Mathematical/trigonometric operations(double-precision)	
mathf.h	: Mathematical/trigonometric operations(single-precision)	
stdarg.h	: Variable argument functions	
✓ stdio.h	: Input/Output	
✓ stdlib.h	: General purpose library features	
✓ string.h	: String handling operations	
ios(EC++)	: Input/Output Streams	
new(EC++)	: Memory allocation and deallocation routines	
complex(EC++)	: Complex number operations	
<pre>string(EC++)</pre>	: String manipulation operations	
complex.h(C99)	: Performs complex number calculation	
fenv.h(C99)	: Sets floating point environment	
inttypes.h(C99)	: Converts integer type format	
wchar.h(C99)	: Performs wide character	
wctype.h(C99)	: Performs wide character conversion	
	Select All Deselect All	
?	< Back Next > Finish Cancel	Click hei



RX Family

11.Click **OK**. The project will be generated.

Summary		83		
Project Summary:				
PROJECT GENERAT PROJECT NAME : PROJECT DIRECTORY : CPU SERIES : CPU TYPE : TOOLCHAIN NAME : TOOLCHAIN VERSION : GENERATION FILES :	TOR led_sample C:\WorkSpace\RDP\led_sample Renesas RXC Toolchain	*		
C:\WorkSpace\RDP\led_san	nple\src\led_sample.c	Ŧ		
Click OK to generate the pro	ject or Cancel to abort.			
	OK Cance		Click here	Э



4.3.2 Install the FIT Modules with the FIT Plugin.

Install the required modules with the FIT plugin into the created project.

Here, install the BSP module (r_bsp) and the compare match timer driver (r_cmt_rx).

C/C++ - e2 studio							, 🖻 🗙
File Edit Source Refactor Navigate Search Project	Renesas Views Run Wind	low Help					
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🎦 Project Explorer 💥 📄 😫 🗢 🗖	Code Generator	•			- 0	E Outline 🛛 🛞 Make Ta	0
Eled_sample [HardwareDebug]	Debug		1	Click b			
	e2 solution toolkit	FIT Configurator		 Click h 	ere.	An outline is not available.	
	Partner OS	Continuization Assistant					
	Renesas OS	Smart Browser Smart Manual					
		Smart Manual	1				
	🖲 Problems 💥 🔎 Tasks	🖳 Console 🔲 Properties 🔋 Memo	v Usage 🖪 Stack	k Analysis 🚇 Smart Bro	WSPr		~
	0 items		,,- [u]				_
	Description	Resource	Path	Location	Туре		
😂 led_sample							
						CAPS /9	4:45 PM
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1. In the Renesas Views menu, select e2 solution toolkit and click FIT Configurator.

2. In the **FIT Configurator** tab,

Select the created project with **Project to Add FIT Module** to. Next, select **RX231** under **Group** and select **RSKRX231** from **Target Board**. Next, click **r_cmt_rx** in the module list and click **Add Module** >>.

C/C++ - ez studio					
File Edit Source Refactor Navigate	Search Project Rene	sas Views – R	tun Window Help		
📬 🕶 📙 💩 📥 🗎 🗞 💌 🚵 🗎 🗞	. 🕤 🖉 🐨 🔂 •	· 63 • 6	▼ ♂ ▼ ☆ ▼ ○ ▼ ∿ ▼ ≫ <i>A</i> ▼ 目 目 加 ▼ 和 ▼ ⊕ ▼ ⊕ ▼ → ▼		Quick Access
Project Explorer 😫 📃 🗖					ine 🕱 🛞 Make Target 🛛 🗖 🗖
E 😫 ⊽ ⊳ 🐸 led_sample [HardwareDebug]					ne is not available.
	👔 Problems 🧔 Tas	sks 📮 Con:	sole 🔲 Properties 🔋 Memory Usage 🐚 Stack Analysis 🛞 Smart Browser 🌠 FIT Configurator 🛙		🐻 Generate Code 🛛 🗖 🗖
	Name of the projec	t to add FIT n	nodules: led_sample		•
	Target Board	s	Advanced Filters Select the target board.		Select the proje
	Modules	Version	Description		Modules Version
	r_bsp	3.00	Board Support Packages.	=	
	r_byteq	1.50	Byte-based circular buffer library.		
	r cmtw rx	1.10	CMTW Driver		
	r_cmt_rx	2.60	Simple CMT driver for creating timer tick.		 Select this iten
	r_dac_rx	2.50	Digital-to-Analog Converter driver		
	r_dmaca_rx	1.03	DMACA driver		
	r_dtc_rx	2.03	DTC driver		
	r_eeprom_spi	2.32	Renesas R1EX25xxx series Serial EEPROM control software RX Driver Package		
	r athar rv	1.02	Ethernet Driver	*	
	Add Module >>				Kernove Module Click
		_			
	Details				
	Dependency: r_b				*
	This module crea	ates a timer ti	ck using a CMT channel based on a frequency input by the user.		
					*



3. In the **Console** tab,

The **r_bsp** having a dependency with **r_cmt_rx** is also added at a time. Note Click **FIT Configurator** again.

Note: Additional FIT driver specifies the adaptable "r_bsp" version.

If the "r_bsp" versions specified and added mismatch according to the time of FIT driver release,

Warning (W0000001) is output on the console screen.

If the "r_bsp" version added is the one specified or later, Warning can be ignored, as the new "r_bsp" version is backward compatible.

💽 Problems 🧔 Tasks 📮 Console 🛛 🥅 Properties 🔋 Memory Usage 🍡 Sta	ack Analysis 👒 Smart Browser 🌉 *FIT Configurator 🛛 🔒 🔝 🛛 💌 🖃 💌 🗖 🕶 🗖
FIT Configurator Console	
M0000001: The following dependencies have been added for the following	
r_cmt_rx: r_bsp version(s) 2.90	Click here.
W0000001: The following dependencies versions are mismatched:	
r_cmt_rx: r_bsp version(s) 2.90	This is an example of CMT driver specifying the BSP ver. 2.90.
	If the r_bsp added is ver. 2.9 or later, ignore this warning because of backward compatible.

4. Check **r_bsp** and **r_cmt_rx** are added in **Selected Modules**. The mark **o** on **r_cmt_rx** indicates occurrence of the Warning explained in the above 3.

Modules Version Description				
Modules Version Description			Modules	Version
r_bsp 3.00 Board Support Packad	ges.	Ξ	r_bsp	3.00
byteq 1.50 Byte-based circular b	-		p r_cmt_rx	2.60
_cmtw_rx 1.10 CMTW Driver	-			_
_cmt_rx 2.60 Simple CMT driver fo	r creating timer tick.			
dac_rx 2.50 Digital-to-Analog Co	nverter driver		Check	here.
dmaca_rx 1.03 DMACA driver				
_dtc_rx 2.03 DTC driver				
_eeprom_spi 2.32 Renesas R1EX25xxx se	ries Serial EEPROM control software RX Driver Package			
ether rv 102 Ethernet Driver		*		
dd Module >>			<< Remove Mod	lule

Then, click Generate Code.



RX Family

5. Click **OK** with changing anything.

 FIT Generation - Summary 	8
Following modules will be installed: r_bsp r_cmt_rx	*
Following include paths will be added to project setting: /\${ProjName}/r_bsp /\${ProjName}/r_config /\${ProjName}/r_cmt_rx /\${ProjName}/r_cmt_rx	
Click OK to continue, Cancel to go back	Ŧ
ОК	ncel



4.3.3 Create an LED Driving Program

Create a program that toggles the LED0 on/off state every 0.5 seconds using the compare match timer.

Open the file src/(the project name).c and modify it as shown below.

src/(the project name).c

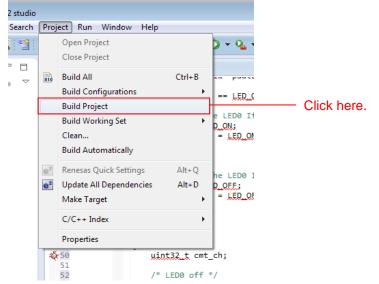
```
#include "platform.h"
#include "r cmt rx if.h"
/* LED Currently status */
uint32 t ledstatus = LED OFF;
void call_back(void *pdata)
{
 if (ledstatus == LED OFF)
 {
    /* Turn ON the LEDO If the status is LED_OFF */
  LEDO = LED ON;
  ledstatus = LED_ON;
 }
 else
 {
   /* Turn OFF the LEDO If the status is LED ON */
  LEDO = LED OFF;
  ledstatus = LED_OFF;
 }
}
void main(void)
{
 uint32 t cmt ch;
 /* LED0 off */
 LEDO =LED OFF;
 /* Create of 0.5 second(2Hz) cyclic timer. */
 R CMT CreatePeriodic(2, &call back, &cmt ch);
 while(1);
}
```



4.3.4 Build and Try Running the Program

Build the program just created and verify that it runs.

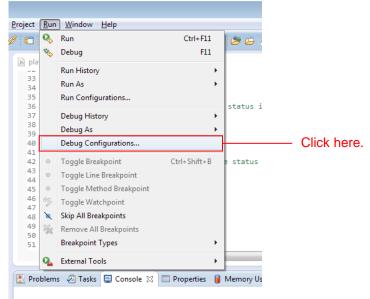
1. Click **Build Project** on the **Project** menu.



2. When the build completes, the following will be displayed in **Console** view.

Problems Tasks Console Cons

3. Click **Debug Build** on the **Run** menu.





4. Click *d* under the **Renesas GDB Hardware Debugging and c**lick **led_sample HardwareDebug**. Click the **Debugger** tab and click **Connection Setting**.

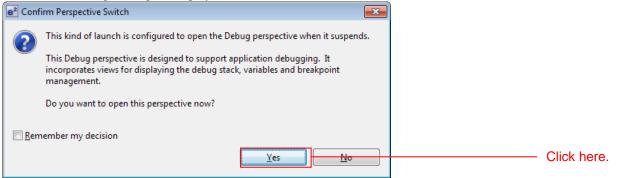
Modify **EXTAL Frequency** to be **8.0000** and change **Provide Power from Emulator** to **No** *. When these changes have been made, click **Debug**.

Note : This is setting when using an external power supply. When supplying power from the emulator, select Yes.

e ² Debug Configurations			×
Create, manage, and run configurations	s	the second se	
		1	
📑 🗎 🗶 🖃 🎲 🕶	Name: led_sample HardwareDebug		
type filter text	📄 Main 🏇 Debugger 🌗 Startup 🧤 Source		
c [®] Debug-only	Main se bebugger in startup of source		-
GDB Hardware Debugging	Debug hardware: E1 Target	Device	Click here.
C ² GDB Simulator Debugging (SH, RL78			Click here.
GHS Local C/C++ Launch	GDB Settings Connection Settings Debug To	10.00	
🐉 Renesas GDB Hardware Attach		oi Settings	
Renesas GDB Hardware Debugging	⊿ Clock	EVTAL	
Ied_sample HardwareDebug	Main Clock Source	EXTAL	Modify to be
Renesas Simulator Debugging (RX o	Extal Frequency[MHz]		
	Permit Clock Source Change On Writing	Inte Yes 👻	8.0000 .
	Connection with Target Board Emulator	(4.11)	
		(Auto)	
	Connection Type	JTag 👻	
	JTag Clock Frequency[MHz]	16.5 -	
	Fine Baud Rate[Mbps]	2.00 -	
	Hot Plug	No 👻	
	⊿ Power		NAL PERIOD AND
	Power Target From The Emulator (MAX		Modify to be No .
	Supply Voltage	3.3V	
	▲ CPU Operating Mode		
	Register Setting	Single Chip 👻	
	Mode pin	Single-chip mode 👻	
	⊿ Communication Mode		
	Mode	Debug Mode 👻	
	Execute The User Program After Ending	The I No 🔻 👻	
4			
Filter matched 9 of 13 items		Apply Revert	
Filter matched 9 of 13 Items			
?		Debug Close	Click here.



5. When the following message is displayed, click **Yes**.



6. When the load module download completes, a **Debug** perspective opens.

e ^a Debug - led_sample/r_bsp/board/rskn64m/resetprg.c - e2 studio			
<u>Eile Edit Source Refactor Navigate Search Project Run Window H</u> elp			
C1 ▼ 16 Δ 16 ▼ ¶ + ¶ ¶ Ø 12 16 ▼ Q ▼ Q ▼ 10 ■ M 2. 10 14 元	र 🙋 😝 🖋 📲 🍂 🖢	$[\bullet, \{5, \bullet, 4\}] \to [\bullet, 4]$	■ Quick Access 腔 I 職 C/C++ 体 Debug
Bebug S Bebugsing] Bebugsing] Bebugsing] Bebugsing] Bebugsing Bebugsing Bebugsing Bebugsing Bebugsing Signal: SIGTRAP:Trace/breakpoint trap) EnverON_Reset_PC() at resetping.cl222 0xffc017e8 Bougsing GOB server	00- Variables 23 00 Break		lules % Expressions @ Eventpoints 📰 10 Registers 🤗 🗆
<pre> platform.h @ led_sample. @ resetpric E3 for end this initialization is complete, the user's main() funct</pre>	*****	ld not return.	P ⊟ J ^a _Z R X ² ● ₩ U _h c lib.h
Console ﷺ	d6-902dd,902e6-902ed,90	2f6-902fd,90306-9030d,90	■ ¥ 🔆 🛼 🚮 🖅 🗗 🖬 🖉 マ 😁 マ
<pre>monitor set_io_access_width,RN,1,99366-9936d,99376-9937d,99386-9938d,99396-9938d,9938d,9938</pre>	76-9127d,91286-9128d,91	296-9129d,912a6-912ad,9	12b6-912bd,912c6-912cd,912d6-912dd,912e6-912ed,91
			A contract of the second se

7. Click **Restart** on the toolbar. The program will be executed and a break will occur at the start of the main function.

Bebug - led_sample/r_bsp/board/rskrx64m/resetprg.c	- e2 studio	
<u>File Edit Source Refactor Navigate Search Providente Search</u>	ject <u>R</u> un <u>W</u> indow <u>H</u> elp	
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🏇 Debug 🔀	🍇 🔩 🕶 🇞 🍓 🕹 🗱 🛛 i>	
▲ C [™] led_sample HardwareDebug [Renesas GDB Hard	ware Debugging]	
a 🎲 led_sample.x		
a 🎲 Thread [1] 1 (No thread info available) (S	uspended : Signal : SIGTRAP:Trace/breakpoint trap]	
PowerON_Reset_PC() at resetprg.c:12	2 0xffc017e8	
📕 gdb		
📓 GDB server		
h platform.h c led_sample.c c resetprg.c	23	

8. After the break at the start of the main function, click **Restart** on the tool bar again. The project will be run and the program will iterate toggling LED0 with a period of 0.5 seconds.



4.3.5 For location of the API information of each FIT module

For the API information of FIT module embedded in the project, refer to the **doc** folder of each FIT module folder.



5. RX Driver Package Application

5.1 RX Driver Package Application Structure

The RX Driver Package Application is a sample application program provided so that users can use the RX Driver Package easily. The RX Driver Package Application consists of an application program that operates using device drivers and middleware included in the RX Driver Package and a project file for building that application. This allows users to start evaluation quickly.

RX Driver Package Application
Sample application program Project file

Figure 5-1 RX Driver Package Application Structure

Renesas plans to release a variety of types of this RX Driver Package Application in the future, such as system programs that operate using a combination of multiple drivers and middleware and evaluation programs for independent modules from the RX Driver Package.

For information of the latest RX Driver Package Application, refer to the "Products Supporting RX Driver Package Application" shown in the following URL.

http://www.renesas.com/products/mpumcu/rx/child/fit.jsp

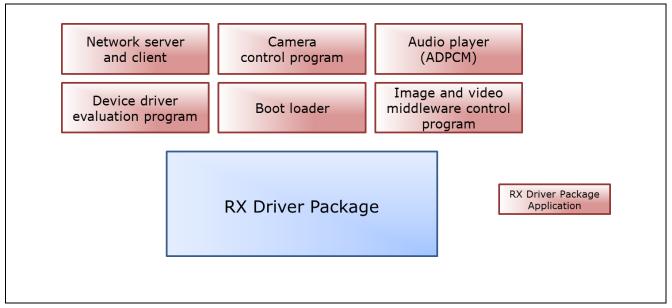


Figure 5-2 Types of RX Driver Package Application



6. Supplement

6.1 Commercial Version of Middleware and Drivers Supporting FIT

A list of the commercial version (paid) Middleware and Drivers for RX family is shown below.

For the information of the latest commercial version (paid) Middleware and Drivers, refer to the page of the Middleware and Drivers.

Commercial Version of	URL	FIT
Middleware and Drivers		Compliant
TCP/IP for Embedding	https://www.renesas.com/en-us/products/software-tools/software-os-	Available
M3S-T4-Tiny	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/pt-br/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/en-eu/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/ja-jp/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/en-sg/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/en-in/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/ko-kr/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	
	https://www.renesas.com/zh-tw/products/software-tools/software-os-	
	middleware-driver/communication-software/m3s-t4-tiny.html	



6.2 Differences from previous RDP for RX600/RX700 Series

After the release of RX64M/RX71M Group RX Driver Package Ver.1.02 (R01AN2606EJ), RX130/RX230/EX231/RX23T/RX24T Group were released, and many Firmware Integration Technology (FIT) modules have been updated.

Differences from RX64M/RX71M Group RX Driver Package Ver.1.02 (R01AN2606EJ0104) are shown in Table 6-2, Table 6-3 and Table 6-4.

The meaning of the terms shown in differences columns are as follows:

"N/A"	Does not support RX64M/RX71M Group.
"Same"	Supports RX64M/RX71M Group, and includes the same module as previous.
"Updated"	Supports RX64M/RX71M Group, and includes updated modules.
	Updated contents differ depending on the driver used. Check with the driver's
	document.
"Added"	Supports RX64M/RX71M Group; the modules added this time.

(1) Board Support Package (BSP)

Table 6-2 Board Support Package (BSP)

Module	Update Information	Rev
Board Support Package (BSP)	Updated	3.31

(2) Device Driver

Table 6-3 Device Driver

Module	Update Information	Rev
Voltage Detection Circuit (LVD)	N/A	1.50
Clock Generation Circuit (CGC)	N/A	1.31
Clock Frequency Accuracy Measurement Circuit (CAC)	N/A	1.10
Battery Backup (VBATT)	N/A	1.01
Interrupt Controller (IRQ)	Updated	1.90
Data Transfer Controller (DTC)	Updated	2.04
DMA Controller (DMAC)	Same	1.03
I/O Ports (GPIO)	Updated	2.00
Multi-Function Pin Controller (MPC)	Updated	2.00
Multi-pulse Timer Unit (MTU2a)	N/A	1.20
Compare Match Timer (CMT)	Updated	2.90
Compare Match Timer W (CMTW)	Same	1.10
Real-Time Clock (RTC)	Updated	2.41
Low Power Timer (LPT)	N/A	1.00
Independent Watchdog Timer (IWDT)	N/A	1.51
Serial Communications Interface (SCI: Asynchronous/Clock Synchronous)	Same	1.70
Serial Communications Interface with FIFO (SCIF: Asynchronous/Clock Synchronous)	Same	1.10
Serial Communications Interface with FIFO (SCIF: Device Driver for Serial Memory Control)	Same	1.08
Serial Communications Interface (SCI: Simple I2C Bus)	Updated	1.90
Serial Peripheral Interface (RSPI: Device Driver for Serial Memory Control)	Updated	1.11
Quad Serial Peripheral Interface (QSPI: Device Driver for Serial Memory Control)	Same	1.08



Module	Update Information	Rev
USB Basic Firmware	Updated	1.11
USB Host Mass Storage Class	Updated	1.11
USB Host Communication Device Class	Updated	1.11
USB Host Human Interface Device Class	Updated	1.11
USB Peripheral Mass Storage Class	Updated	1.11
USB Peripheral Communications Device Class	Updated	1.11
USB Peripheral Human Interface Device Class	Added	1.11
USB Basic Firmware mini	N/A	1.02
USB Host Mass Storage Class mini	N/A	1.02
USB Host Communication Device Class mini	N/A	1.02
USB Host Human Interface Device Class mini	N/A	1.02
USB Peripheral Mass Storage Class mini	N/A	1.02
USB Peripheral Communications Device Class mini	N/A	1.02
USB Peripheral Human Interface Device Class mini	N/A	1.02
IrDA Interface (IrDA)	N/A	1.01
CAN Module (CAN)	Added	2.02
CAN Module (RSCAN)	N/A	1.00
PTP Module for the Ethernet Controller (EPTPC)	Same	1.11
EPTPC Light Module	Same	1.10
Ethernet controller (ETHERC)	Updated	1.10
Parallel Data Capture Unit (PDC)	Updated	1.03
12-Bit A/D Converter (S12AD)	Updated	2.11
D/A Converter (DAC)	Updated	2.80
Flash Memory (Flash API)	Updated	1.63
Sampling Rate Converter (SRC)	Updated	1.11
Serial Sound Interface (SSI)	Updated	1.20
LCD Controller/Driver (LCDC)	N/A	1.00
Unique ID Read	N/A	1.00
Byte Queue Buffer (Data Management)	Updated	1.60
Long Queue Buffer (Data Management)	Updated	1.60



(3) Middleware/Interface Module

Table 6-4 Middleware/Interface Module

Module	Update Information	Rev
TCP/IP M3S-T4-Tiny for Embedding	Updated	2.05
Interface conversion module for Ethernet Driver and Embedded system M3S-T4-Tiny	Updated	1.04
Embedded TCP/IP M3S-T4-Tiny Socket API Module	Updated	1.30
DHCP client using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.03
DNS client using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.02
FTP server using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.03
Web server using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.04
File driver for FTP server and Web server Module	Same	1.01
Sound playback system and compression system (original ADPCM codec)	Same	3.03
M3S-TFAT-Tiny (FAT file system)	Same	3.02
M3S-TFAT-Tiny Memory Driver Interface Module	Same	1.02
Simple I2C Module for EEPROM Access	N/A	1.30
I2C Bus Interface (RIIC) Module for EEPROM Access	N/A	1.40
SPI Serial EEPROM Module	Updated	2.33
SPI Serial Flash memory Module	Same	2.33



Update

6.3 Differences from previous RDP for RX100/RX200 Series

After the release of RX110/RX111/RX113/RX130/RX230/RX231/RX23T/RX24T Group RX Driver Package Ver.1.03 (R01AN3233EJ0103), FIT modules have been updated.

Differences from RX110/RX111/RX113/RX130/RX230/RX231/RX23T/RX24T Group RX Driver Package Ver.1.03 (R01AN3233EJ0103) are shown in the Table 6-5, Table 6-6 and Table 6-7. The meaning of the terms shown in differences columns are as follows:

"N/A"	Does not support RX110/RX111/RX113/RX130/RX230/RX231/RX23T/RX24T Group
"Same"	Supports RX110/RX111/RX113/RX130/RX230/RX231/RX23T/RX24T Group, and includes the same module as previous.
"Updated"	Supports RX110/RX111/RX113/RX130/RX230/RX231/RX23T/RX24T Group, and includes updated modules.
	Updated contents differ depending on the driver used. Check with the driver's document.
"Added"	Supports RX110/RX111/RX113/RX130/RX230/RX231/RX23T/RX24T Group; the modules added this time.

(1) Board Support Package (BSP)

Table 6-5 Board Support Package (BSP)

Module	Update Information	Rev
Board Support Package (BSP)	Updated	3.31

(2) Device Driver

Table 6-6 Device Driver

Module

module	Information	Nev
Voltage Detection Circuit (LVD)	Same	1.50
Clock Generation Circuit (CGC)	Same	1.31
Clock Frequency Accuracy Measurement Circuit (CAC)	Same	1.10
Battery Backup (VBATT)	Same	1.01
Interrupt Controller (IRQ)	Updated	1.90
Data Transfer Controller (DTC)	Updated	2.04
DMA Controller (DMAC)	Same	1.03
I/O Ports (GPIO)	Same	2.00
Multi-Function Pin Controller (MPC)	Same	2.00
Multi-pulse Timer Unit (MTU2a)	Same	1.20
Compare Match Timer (CMT)	Same	2.90
Compare Match Timer W (CMTW)	N/A	1.10
Real-Time Clock (RTC)	Same	2.41
Low Power Timer (LPT)	Same	1.00
Independent Watchdog Timer (IWDT)	Same	1.51
Serial Communications Interface (SCI: Asynchronous/Clock Synchronous)	Same	1.70
Serial Communications Interface with FIFO (SCIF: Asynchronous/Clock Synchronous)	N/A	1.10
Serial Communications Interface with FIFO (SCIF: Device Driver for Serial Memory Control)	N/A	1.08



Rev

Module	Update Information	Rev
Serial Communications Interface (SCI: Simple I2C Bus)	Same	1.90
Serial Peripheral Interface (RSPI: Device Driver for Serial Memory Control)	Updated	1.11
Quad Serial Peripheral Interface (QSPI: Device Driver for Serial Memory Control)	N/A	1.08
USB Basic Firmware	N/A	1.11
USB Host Mass Storage Class	N/A	1.11
USB Host Communication Device Class	N/A	1.11
USB Host Human Interface Device Class	N/A	1.11
USB Peripheral Mass Storage Class	N/A	1.11
USB Peripheral Communications Device Class	N/A	1.11
USB Peripheral Human Interface Device Class	N/A	1.11
USB Basic Firmware mini	Same	1.02
USB Host Mass Storage Class mini	Same	1.02
USB Host Communication Device Class mini	Same	1.02
USB Host Human Interface Device Class mini	Same	1.02
USB Peripheral Mass Storage Class mini	Same	1.02
USB Peripheral Communications Device Class mini	Same	1.02
USB Peripheral Human Interface Device Class mini	Same	1.02
IrDA Interface (IrDA)	Same	1.01
CAN Module (CAN)	N/A	2.02
CAN Module (RSCAN)	Same	1.00
PTP Module for the Ethernet Controller (EPTPC)	N/A	1.11
EPTPC Light Module	N/A	1.10
Ethernet controller (ETHERC)	N/A	1.10
Parallel Data Capture Unit (PDC)	N/A	1.03
12-Bit A/D Converter (S12AD)	Same	2.11
D/A Converter (DAC)	Same	2.80
Flash Memory (Flash API)	Updated	1.63
Sampling Rate Converter (SRC)	N/A	1.11
Serial Sound Interface (SSI)	Updated	1.20
LCD Controller/Driver (LCDC)	Same	1.00
Unique ID Read	Same	1.00
Byte Queue Buffer (Data Management)	Same	1.60
Long Queue Buffer (Data Management)	Same	1.60

RX Family



(3) Middleware/Interface Module

Table 6-7 Middleware/Interface Module

Module	Update Information	Rev
TCP/IP M3S-T4-Tiny for Embedding	Updated	2.05
Interface conversion module for Ethernet Driver and Embedded system M3S-T4-Tiny	Updated	1.04
Embedded TCP/IP M3S-T4-Tiny Socket API Module	Updated	1.30
DHCP client using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.03
DNS client using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.02
FTP server using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.03
Web server using the embedded TCP/IP M3S-T4-Tiny Module	Same	1.04
File driver for FTP server and Web server Module	Same	1.01
Sound playback system and compression system (original ADPCM codec)	Same	3.03
M3S-TFAT-Tiny (FAT file system)	Same	3.02
M3S-TFAT-Tiny Memory Driver Interface Module	Same	1.02
Simple I2C Module for EEPROM Access	N/A	1.30
I2C Bus Interface (RIIC) Module for EEPROM Access	N/A	1.40
SPI Serial EEPROM Module	Updated	2.33
SPI Serial Flash memory Module	Same	2.33



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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	July 15, 2016	-	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU 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 accord 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 shootthrough 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.

5. Differences between Products

Before changing from one product to another, i.e. to a product with a different type number, confirm that the change will not lead to problems.

— The characteristics of an MPU or MCU in the same group but having a different part number may differ in terms of the 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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