RL78/G1F

RL78/G14 Software Migration Guide

R01AN2908EJ0110
Rev.1.10
Jul. 21, 2016

Outline

This application note is a migration that explains how to modify RL78/G14 software for use as RL78/G1F software.

Target Device

RL78/G1F

Contents

1. RL78/G1F and RL78/G14 Functional Comparison

Tables 1.1 and 1.2 provide a functional comparison of RL78/G14 and RL78/G1F group MCUs. The RL78/G1F group is upper-function compatible with the RL78/G14 group. RL78/G14 software can easily be used as RL78/G1F software by confirming pins used and availability of each function channel, making the changes required for only the parts that differ.

Table 1.1 **RL78/G1F and RL78/G14 Functional Comparison (1/2)**

Item	RL78/G1F	RL78/G14
Pins	24 to 64 pins	30 to 100 pins
CPU architecture	RL78-S3 core	←
Memory	Code flash: 32K to 64KB Data flash: 4KB Internal RAM: 5.5KB	Code flash: 16K to 512KB Data flash: 4KB, 8KB Internal RAM: 2.5K to 48KB
Clock generator	CPU operation frequency: 32MHz max. High-speed on-chip oscillator (select from 1MHz to 64MHz)	←
Timer array unit	4 channels x1 unit	4 channels x1 to x2 unit
Timer RJ	1 channel	←
Timer RD	2 channels	←
PWM option unit (Timer RD output cut-off option function)	yes	no
Timer RG	1 channel	←
Real-time clock	1 channel	←
12-bit interval timer	1 channel	←
Clock output/buzzer output controller	1 channel	←
Watchdog timer	1 channel	←
A/D converter	8 to 17 channels	8 to 20 channels
D/A converter	1 to 2 channels	0 to 2 channels
Comparator	2 channels *function expansion Selectable reference voltage: Internal reference voltage (256 variations) Internal reference voltage (1.45 V) External pin reference voltage	2 channels Select either internal reference voltage (1.45 V) or external input as the reference voltage.

Table 1.2 **RL78/G1F and RL78/G14 Functional Comparison (2/2)**

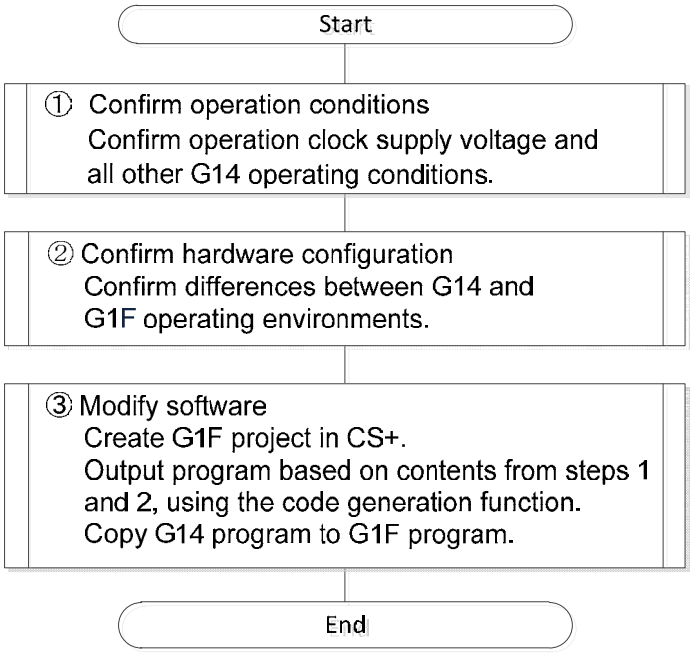
Item	RL78/G1F	RL78/G14
Serial array unit	CSI: 3 to 6 channels UART: 3 channels I2C: 3 to 6 channels	CSI: 3 to 8 channels UART: 3 to 4 channels I2C: 3 to 4 channels
Serial interface IICA	1 channel	1 to 2 channels
DTC	30 to 33 sources	31 to 39 sources
ELC	21 to 22 types	19 to 26 types
Others	Timer RX, Programmable gain amplifier (PGA), IrDA	-

Note: "← " indicates same function; "- " indicates not available

2. Modification Steps

This section explains in detail how to modify G14 for G1F. The following is the basic sequence.

Software Migration Steps



For a detailed example, refer to RL78/G14 Timer RD (Reset Synchronized PWM Mode) CC-RL (document R01AN2506EJ0100, referred to as RL78/G14 Application Note, herein). The Application Note explains how to modify the G1F program with the G14 program. RL78/G1F hardware is configured to support the RL78/G1F target board (YQB-R5F11BLE-TB) CPU board mounted on R5F11BLE.

2.1 Operation Confirmation Conditions

Confirm the items listed in Table 2.1 Operation Confirmation Conditions of the G14 Application Note and compare RL78/G14 (R5F104LEA) with RL78/G1F (R5F11BLEA) mounted on the G1F target board. The comparison should confirm that the contents of G14 can be used for RL78/G1F.

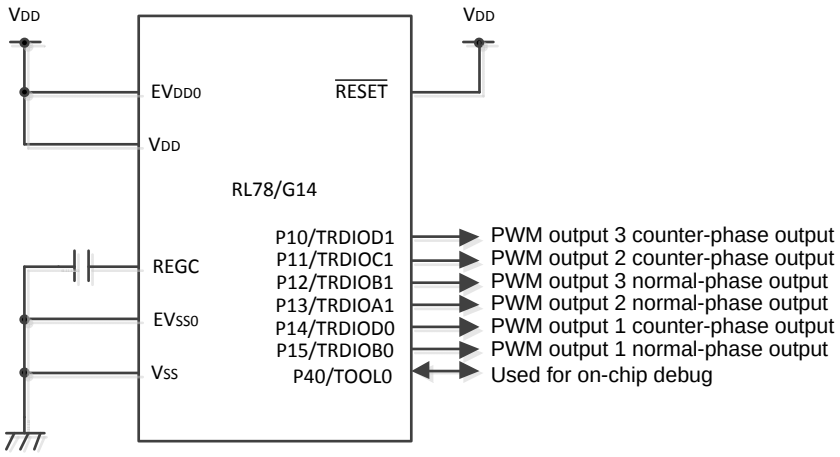
G14 Application Note: Table 2.1 Operation Confirmation Conditions

Item	Description
MCU used	RL78/G14 (R5F104LEA): 64-pin ROM 64KB, data flash 4KB, RAM 5.5KB
Operating frequency	High-speed internal oscillation clock (f_{HOCO}): 16 MHz (typical) CPU/peripheral hardware clock (f_{CLK}): 16 MHz
Operating voltage	5.0V (2.9 V to 5.5 V) LVD operation (V_{LVD}): 2.81 V at rising edge / 2.75 V at falling edge in rest mode

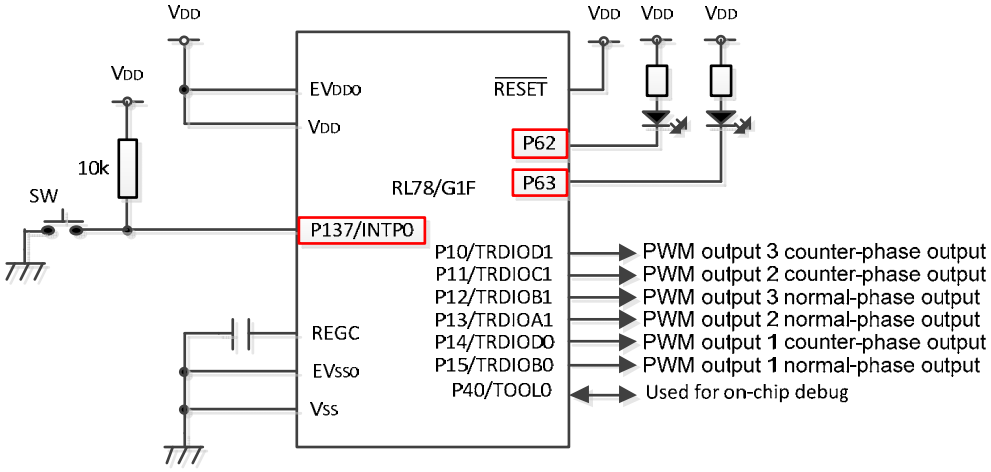
2.2 Hardware Configuration Confirmation

In this section, we compare the hardware configuration of the G1F target board (YQB-R5F11BLE-TB) and the details shown in Figure 3.1 Hardware Configuration in the G14 Application Note.

PWM output pins P10 to P15 can be used on the G1F target board in the same manner as described in the G14 Application Note. Even the pins settings can be diverted as is. Pins P137, P62, and P63 (not used in the G14 Application Note,) are connected to the G1F target board's switches (SW) or LEDs. The functions of these pins are not used, and are set as follows: P137 set to input, P62 and P63 set to H level output (LED off).



From G14 Application Note: Figure 3.1 Hardware Configuration



G1F Target Board Hardware Configuration

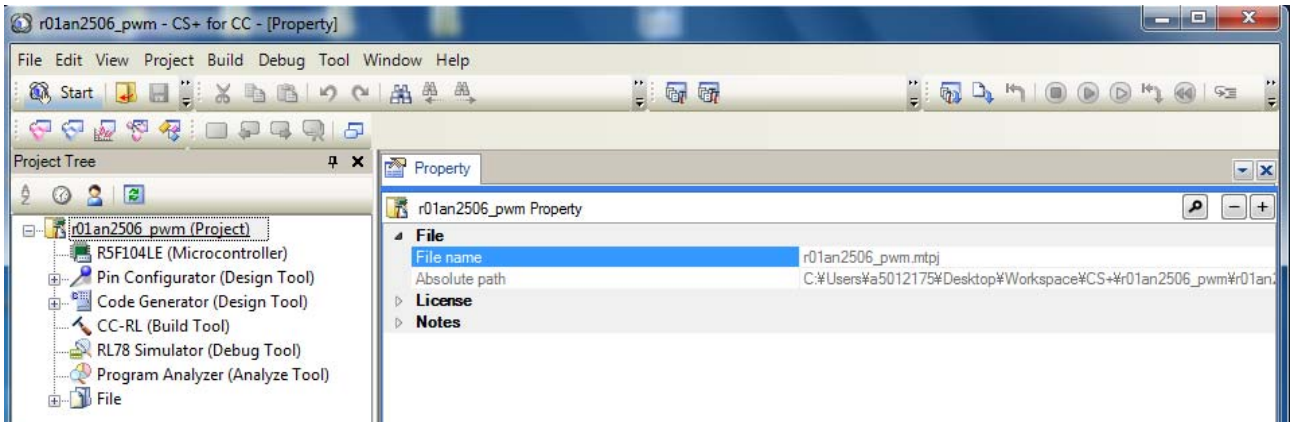
2.3 Software Implementation

The following steps must be taken to change the software in CS+.

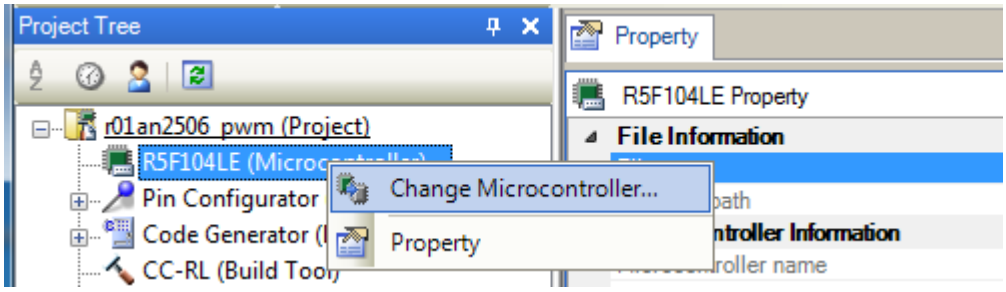
- Change the microcontroller in the existing project, or create a new project.
- Generate code (common/clock generator, port functions, timer RD, power supply circuit)
- Add user program (main, r_tmr_rd0_interrupt).

2.3.1 Change microcontroller

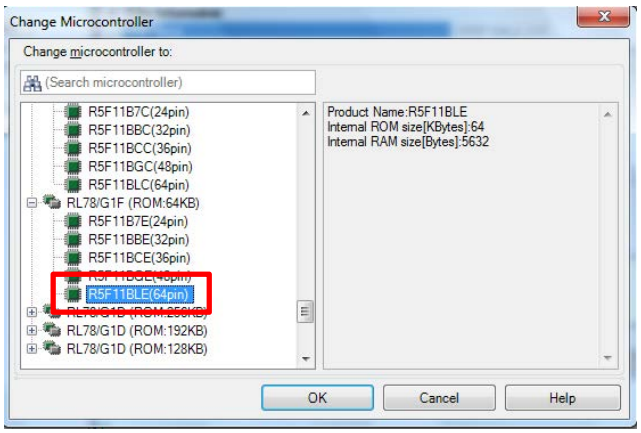
Open the r01an2506pwm project in CS+ for CC. When creating a new project, make sure you select the microcontroller.



Next, right click **R5F104LE microcontroller** in the project tree, and then **Change microcontroller**.

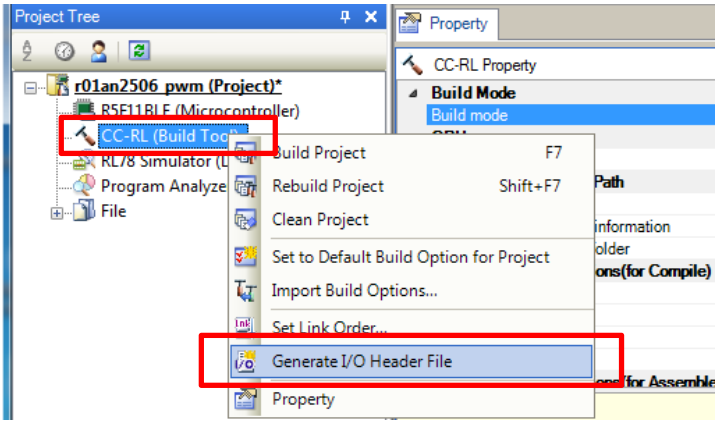


Select **R5F11BLE(64pin)** and press **OK**. This completes the sequence for changing the microcontroller.



2.3.2 Generate code

Next, update the I/O header file for RL78/G1F (R5F11B). Right click **CC-RL (build tool)** to execute **Generate I/O header file**.

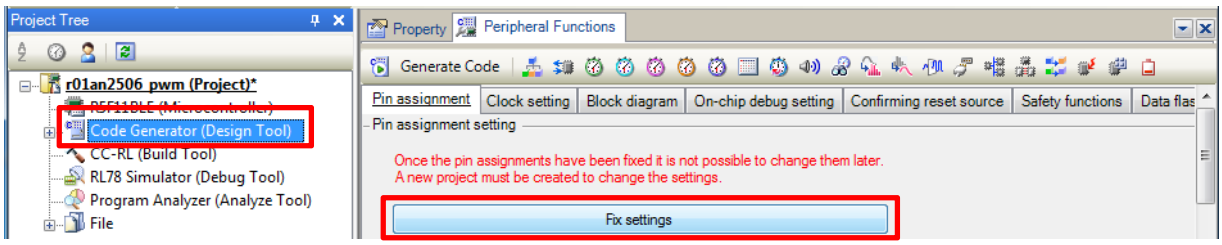


Now, create the source for each function setting using the code generator. Select **Code generation** and click **Peripheral functions**. Make sure to set the common/clock generator.

After completing the **Pin assignment**, set the following as necessary: **Clock setting**, **On-chip debug setting**, **Reset source confirmation**, **Safety function setting**, and **Data flash**.

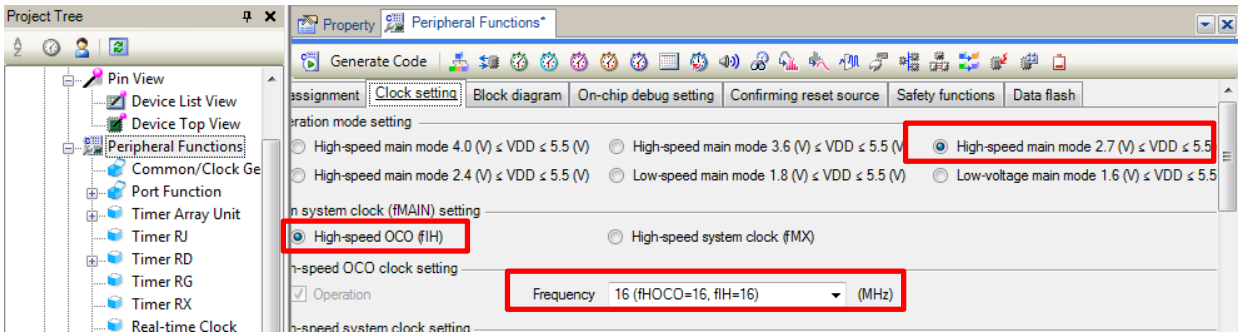
・Pin assignment

This register redirects the function pins. Since these won't be used here, press **Confirm** without changing the settings.



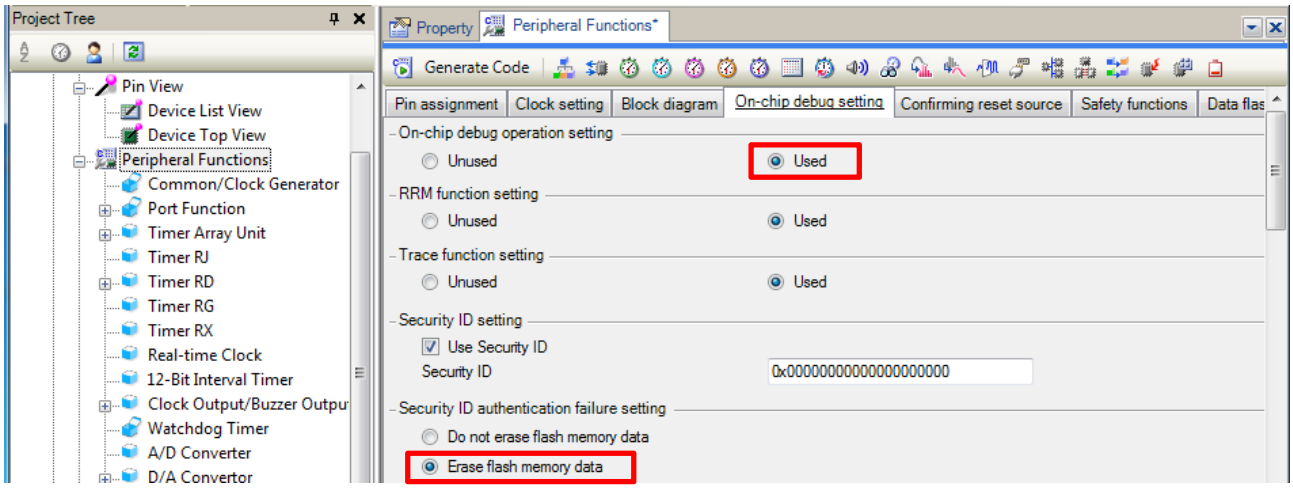
・Clock setting

The screen shown below is for setting the CPU operation clock. Based on the G14 Application Note, select **High-speed main mode** as the operation mode, **High-speed on-chip oscillator clock** as the main system clock, and **16 MHz** as the frequency.



・On-Chip debug setting

Either setting is acceptable. For this program, please keep the same setting as used in the G14 Application Note (**Use**).



・Reset source confirmation

Either setting is acceptable. Although not used in the G14 Application Note, setting this to **Used/Unused** enables the project to output a function that confirms the reset sources. (Setting not required).

・Safety function setting

Either setting is acceptable. This is not used in the G14 Application Note. (Setting not required).

・Data flash

Either setting is acceptable. The default setting is **access disabled**. Not used in the G14 Application Note. (Setting not required).

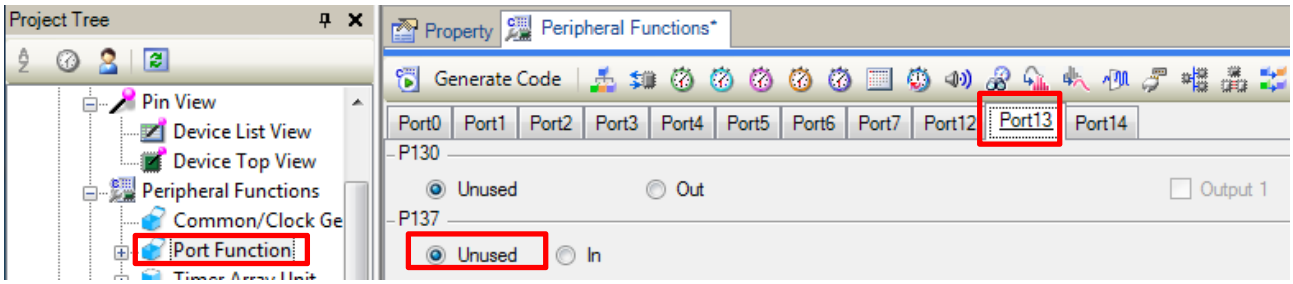
Set the peripheral functions next. Settings are executed based on the G14 Application Note peripheral functions and hardware. The following describes the **Port function setting**, **Timer RD** and **Power supply detection circuit**.

・Port function

First, confirm the hardware configuration on the G1F target board. You will find switch input and LED port control pins have been added to the G14 operation environment.

Switch input port (P137) setting

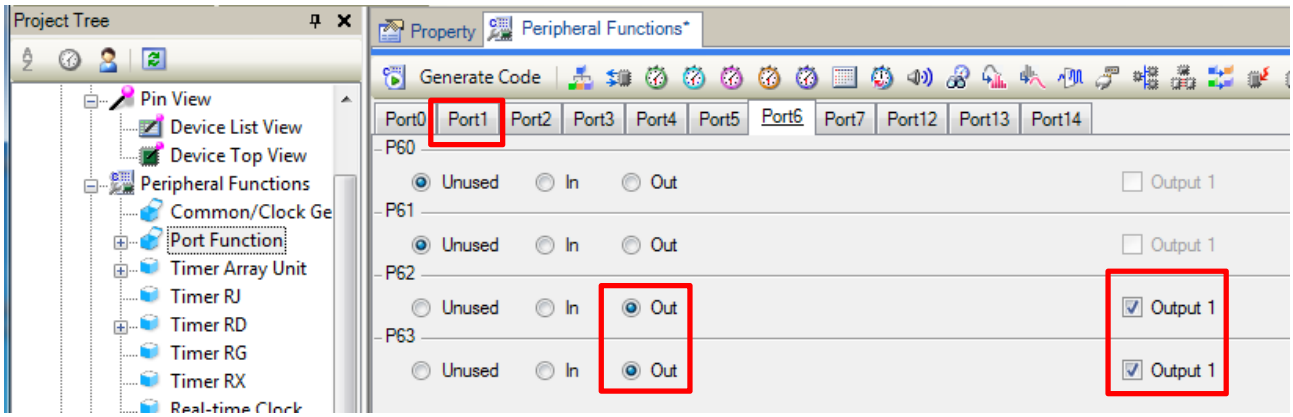
This is an input-only port. Because this is not used in the G14 Application Note, either **Unused** or **In** can be selected.



*Example shows **Do not used** selected.

LED port control pins (P62, P64) settings

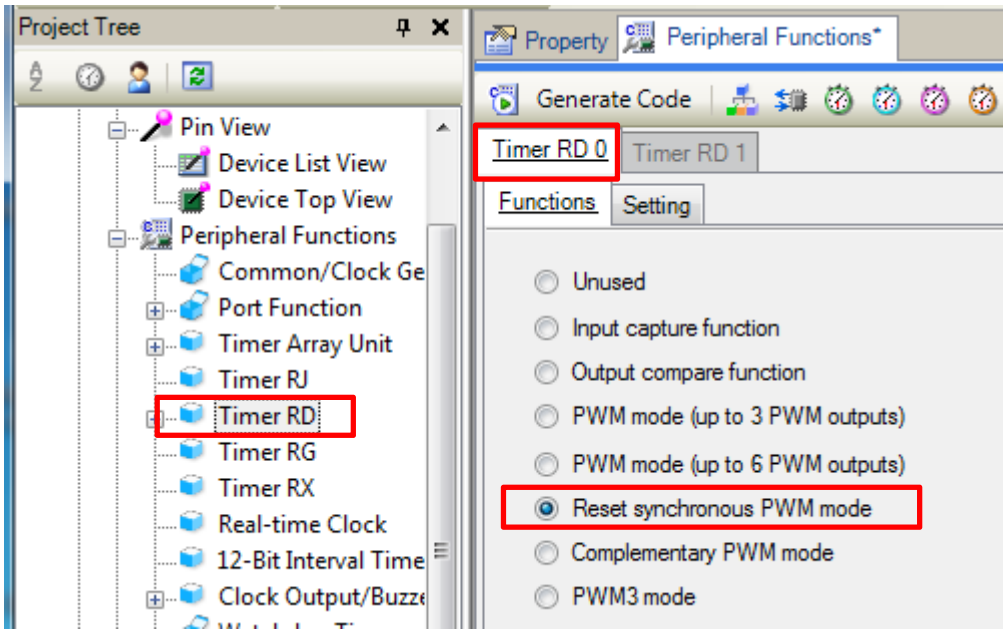
Because these are not used in the G14 Application Note, either **In** or **Out** can be selected. In the following example, **Out** and **Output 1** are selected to turn the LED off.



Note

The PWM output (P10 to P15) is set under the Timer RD tab.

・Timer RD
Select **Timer RD**, and then select **Reset synchronous PWM mode** under the **Timer RD0** tab.



Timer RD operation settings

Go to the **Setting tab** to set Timer RD specifications.

Count source setting/internal clock setting

This program uses the internal clock set to 16MHz.

TRD0 count setting

To continually output PWM, select **Count operation: Continue TRDGRA0 compare match**.

Register function setting

Select buffer operations for each DUTY setting register.

PWM output setting

PWM period 200us

PWM1 output active level width: set to 25% (50us)

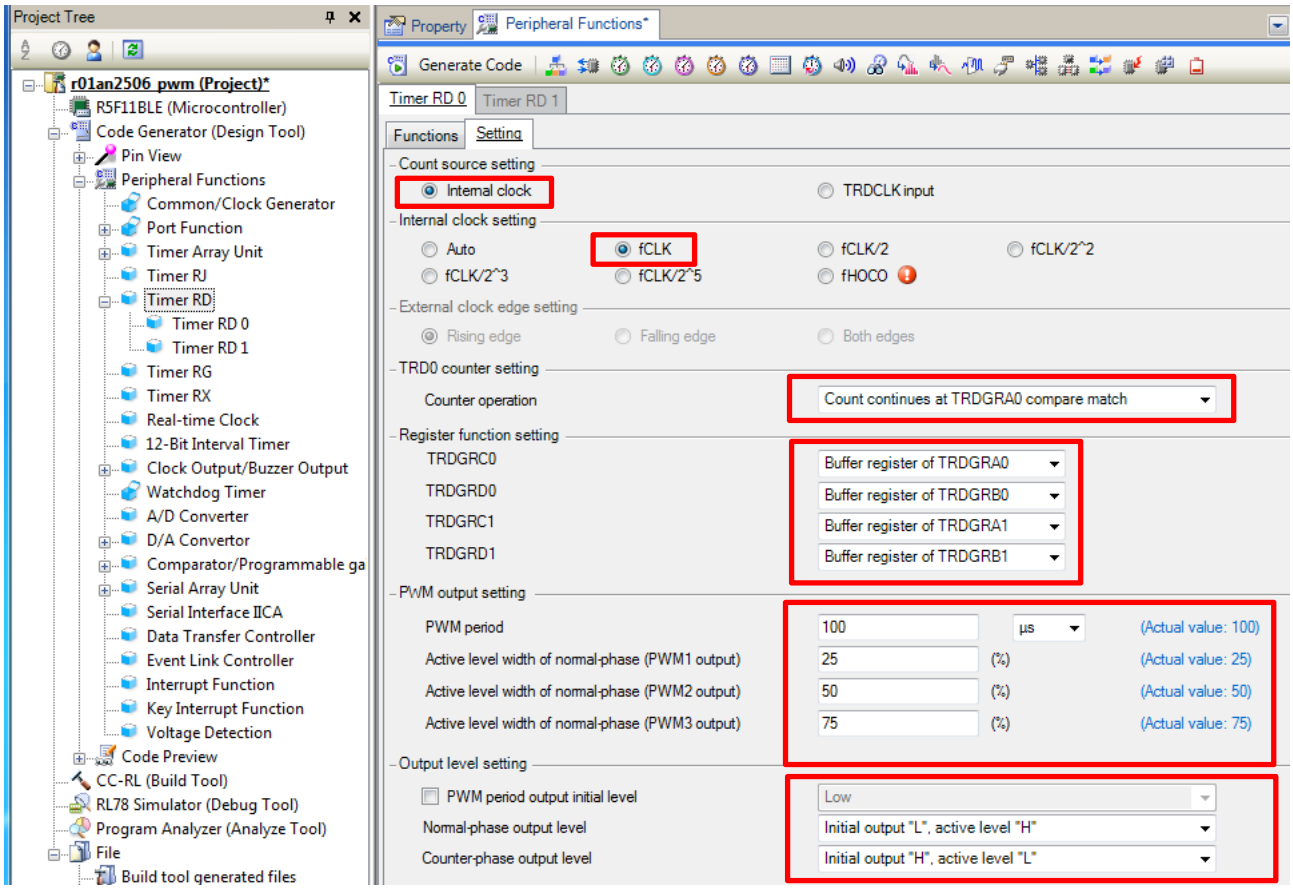
PWM2 output active level width: set to 50% (100us)

PWM3 output active level width: set to 75% (150us)

Output level setting

Inverted output level: set **Initial output "L", active level "H"**

Non-inverted output level: set **Initial output "H", active level "L"**

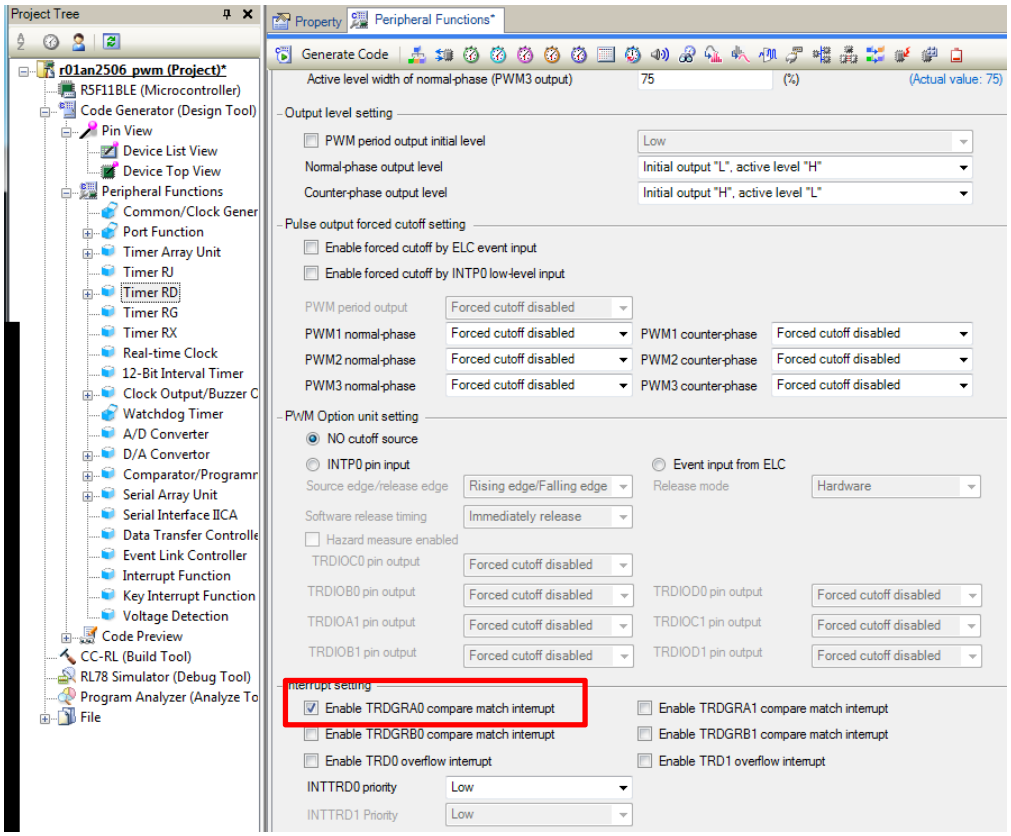


Continued on next page.

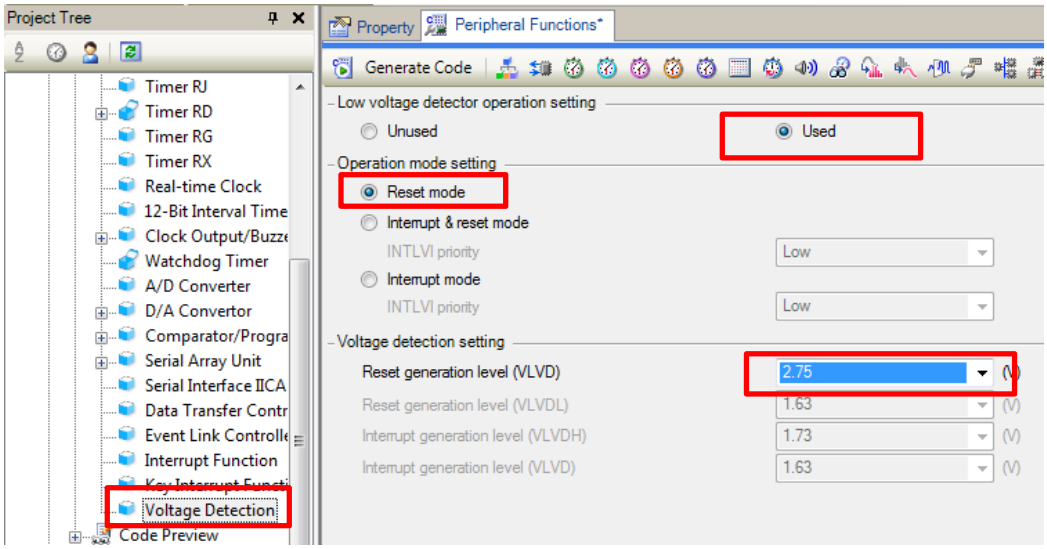
Pulse output forced cutoff setting
This function is not used and does not need to be set.

PWM option unit setting
This is an expansion unit for G1F. As it is not used for G14, it does not need to be set.

Interrupt setting
Set the interrupt source to be used as INTTRD0.
Select **Enable TRDCRA0 compare match interrupt** to use interrupts during the PWM period.
There is no priority specification for INTTRD0. The default is Level 3 (low priority level).



・Voltage detection circuit
Select **Reset mode** and **2.75 V** as the detection voltage (rising edge 2.75 V, falling edge 2.81 V)



2.3.3 Add User Program

Most of the functions used in the G14 Application Note were created with the code generation function. This section shows how to change the main program that includes the user processing and the interrupt program.

Change main program

The user program is added to the main routine generated with the code generator in the G14 Application Note. Copy the targeted program section into the G1F main program.

G14 Application Note main

```
/* Start user code for pragma. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */

/***********************************************************************
Global variables and functions
***********************************************************************/
/* Start user code for global. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */
void R_MAIN_UserInit(void);

/***********************************************************************
* Function Name: main
* Description  : This function implements main function.
* Arguments    : None
* Return Value : None
***********************************************************************/
void main(void)
{
    R_MAIN_UserInit();
    /* Start user code. Do not edit comment generated here */

    R_TMR_RD0_Start();

    while (1U)
    {
        ;
    }
    /* End user code. Do not edit comment generated here */
}

/***********************************************************************
* Function Name: R_MAIN_UserInit
* Description  : This function adds user code before implementing mai
* Arguments    : None
* Return Value : None
***********************************************************************/
void R_MAIN_UserInit(void)
{
    /* Start user code. Do not edit comment generated here */
    EI();
    /* End user code. Do not edit comment generated here */
}
```

Copy

G1F main

```
/***********************************************************************
/* Start user code for pragma. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */

/***********************************************************************
Global variables and functions
***********************************************************************/
/* Start user code for global. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */
void R_MAIN_UserInit(void);

/***********************************************************************
* Function Name: main
* Description  : This function implements main function.
* Arguments    : None
* Return Value : None
***********************************************************************/
void main(void)
{
    R_MAIN_UserInit();
    /* Start user code. Do not edit comment generated here */
    while (1U)
    {
        ;
    }
    /* End user code. Do not edit comment generated here */
}

/***********************************************************************
* Function Name: R_MAIN_UserInit
* Description  : This function adds user code before implementing main
* Arguments    : None
* Return Value : None
***********************************************************************/
void R_MAIN_UserInit(void)
{
    /* Start user code. Do not edit comment generated here */
    EI();
    /* End user code. Do not edit comment generated here */
}

/* Start user code for adding. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */
```

Caution The name of the file for the main program that generates code in G1F is changed to r_cg_main.c. The name of the R_TMR_RD0_Start() function is also changed to R_TMRD0_Start() in G1F. The user will need to change file names accordingly.

Change Timer RD interrupt program

The user program is added to the Timer RD interrupt program generated by the code generator in the G14 Application Note **r_cg_timer_user.c**. This section needs to be copied to the G1F program as well.

G14 Application Note r_tmr_rd0_interrupt

```
/***********************************************************************
* Function Name: r_tmr_rd0_interrupt
* Description  : This function is INTTRD0 interrupt service routine.
* Arguments    : None
* Return Value : None
***********************************************************************/
static void __near r_tmr_rd0_interrupt(void)
{
    /* Start user code. Do not edit comment generated here */
    volatile uint8_t trdsr_dummy = 0;

    trdsr_dummy = TRDSR0;
    TRDSR0 = (trdsr_dummy & 0x1E);  /* clear TRD0 each interrupt request
    /* End user code. Do not edit comment generated here */
}

/* Start user code for adding. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */
```

Copy

G1F r_tmr_rd0_interrupt

```
/***********************************************************************
* Function Name: r_tmrd0_interrupt
* Description  : None
* Arguments    : None
* Return Value : None
***********************************************************************/
static void __near r_tmrd0_interrupt(void)
{
    /* Start user code. Do not edit comment generated here */
    /* End user code. Do not edit comment generated here */
}

/* Start user code for adding. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */
[EOF]
```

*The name of the Timer RD interrupt program file generated by the code generator in G1F is changed to **r_cg_tmrd.c**.

This completes the sequence for replacing RL78/G1F software with RL78/G14 software.

Website and Support <website and support,ws>

Renesas Electronics Website

http://www.renesas.com/

Inquiries

http://www.renesas.com/contact/

All trademarks and registered trademarks are the property of their respective owners.

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb. 10, 2016	-	First edition issued.
1.10	Jul. 21, 2016	3	Modification of Table 1.2

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.

5. Differences between Products

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

   — The characteristics of Microprocessing unit or Microcontroller unit products 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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.
   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.
   Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

RENESAS

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HALII Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

© 2016 Renesas Electronics Corporation. All rights reserved.

Colophon 5.0