RL78/G1G

RL78/G14 Software Migration Guide

R01AN3396EJ0100
Rev.1.00
Jul. 27, 2016

Outline

This application note is a migration that explains how to modify RL78/G14 software for use as RL78/G1G software.

Target Device

RL78/G1G

Contents

1. RL78/G1G and RL78/G14 Functional Comparison

Tables 1.1 and 1.2 provide a functional comparison of RL78/G14 and RL78/G1G group MCUs. The RL78/G1G group has many functions compatible with the RL78/G14 group. RL78/G14 software can easily be used as RL78/G1G 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/G1G and RL78/G14 Functional Comparison (1/2)**

Item	RL78/G1G	RL78/G14
Pins	24 to 64 pins	30 to 100 pins
CPU architecture	RL78-S3 core	←
Memory	Code flash: 8K to 16KB Data flash: no Internal RAM: 1.5KB	Code flash: 16K to 512KB Data flash: 4KB, 8KB Internal RAM: 2.5K to 48KB
Clock generator	CPU operation frequency: 24MHz max. High-speed on-chip oscillator (select from 1MHz to 48MHz)	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	no	1 channel
Real-time clock	no	1 channel
12-bit interval timer	1 channel	←
Clock output/buzzer output controller	1 channel	←
Watchdog timer	1 channel	←
A/D converter	8 to 12 channels	8 to 20 channels
D/A converter	no	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/G1G and RL78/G14 Functional Comparison (2/2)**

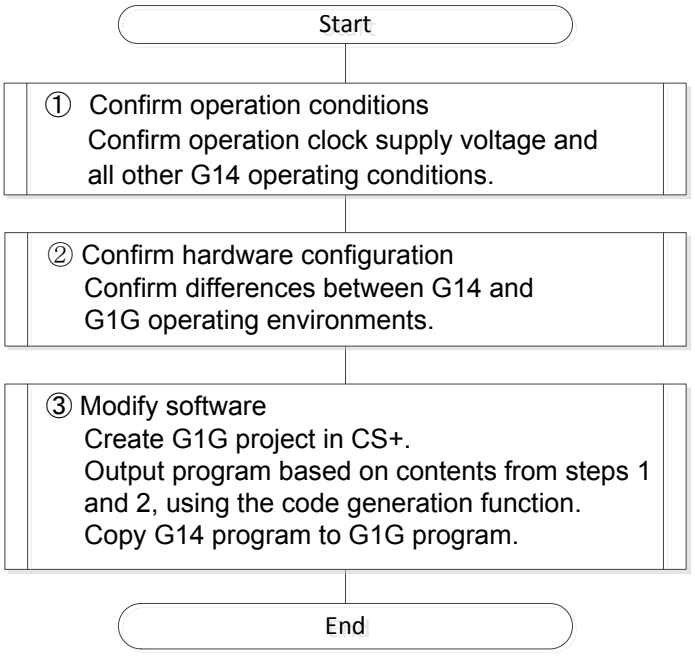
Item	RL78/G1G	RL78/G14
Serial array unit	CSI: 1 channel UART: 2 channels I2C: 1 channel	CSI: 3 to 8 channels UART: 3 to 4 channels I2C: 3 to 4 channels
Serial interface IICA	no	1 to 2 channels
DTC	no	31 to 39 sources
ELC	18 to 19 types	19 to 26 types
Others	Programmable gain amplifier (PGA)	-

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

2. Modification Steps

This section explains in detail how to modify G14 for G1G. 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 G1G program with the G14 program. RL78/G1G hardware is configured to support the RL78/G1G target board (YQB-R5F11EFA-TB) CPU board mounted on R5F11EFA.

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/G1G (R5F11EFAA) mounted on the G1G target board. The comparison should confirm that the contents of G14 can be used for RL78/G1G.

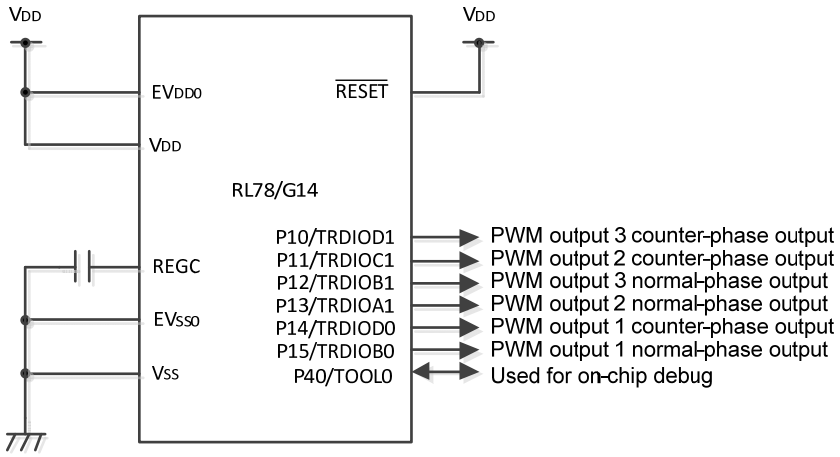
G14 Application Note: Table 2.1 Operation Confirmation Conditions

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

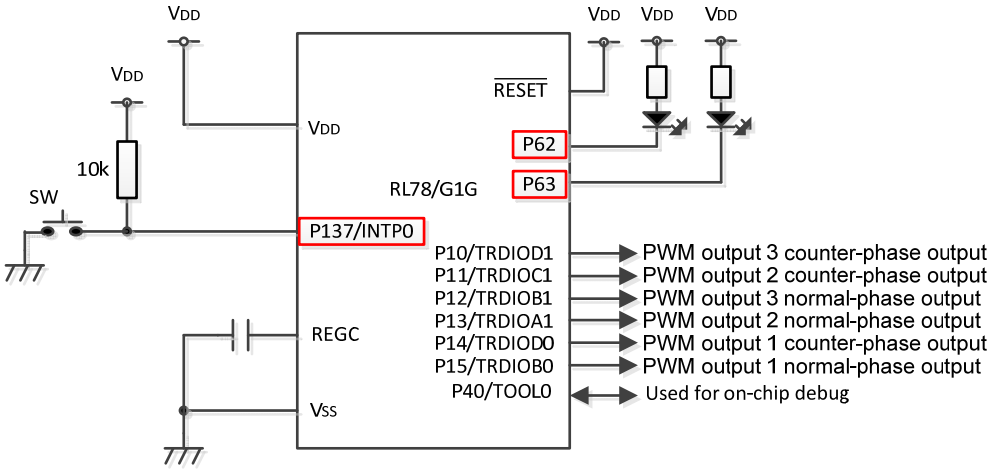
2.2 Hardware Configuration Confirmation

In this section, we compare the hardware configuration of the G1G target board (YQB-R5F11EFA-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 G1G 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 G1G 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



G1G Target Board Hardware Configuration

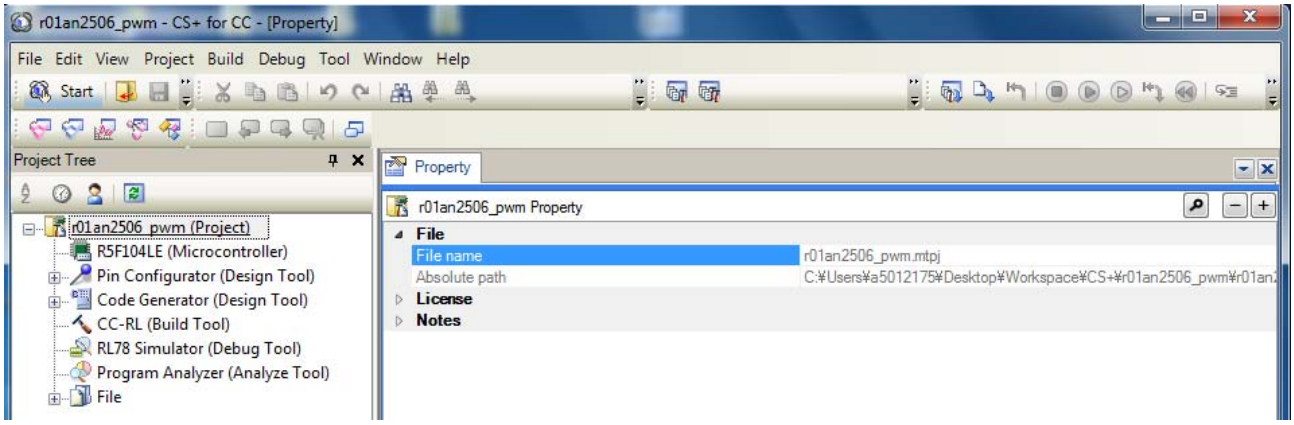
2.3 Software Implementation

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

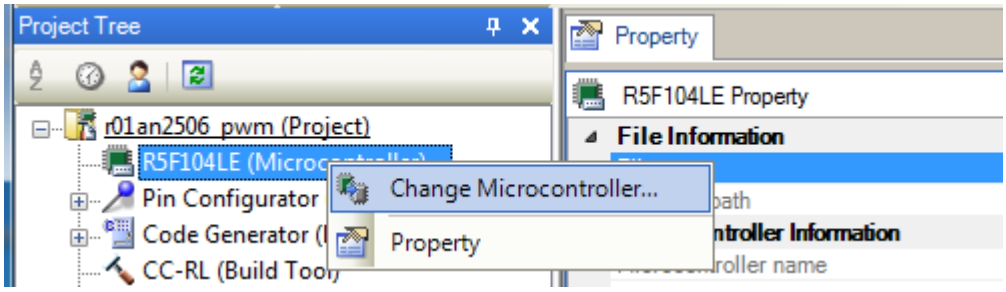
- Change the microcontroller in the existing project, or create a new project.
- Generate code (common/clock generator, port functions, timer RD, power supply circuit)
- Add user program (main, r_tmr_rd0_interrupt).

2.3.1 Change microcontroller

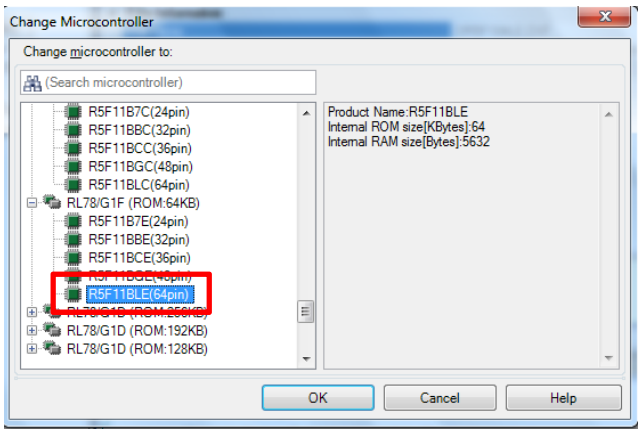
Open the r01an2506pwm project in CS+ for CC. When creating a new project, make sure you select the microcontroller.



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

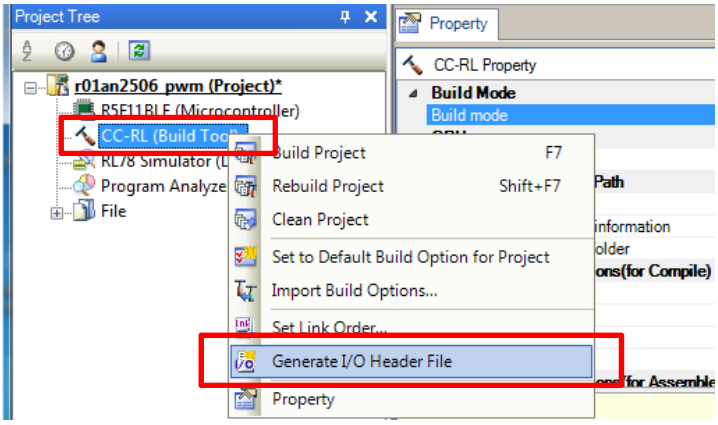


Select **R5F11EFA (44pin)** and press **OK**. This completes the sequence for changing the microcontroller.



2.3.2 Generate code

Next, update the I/O header file for RL78/G1G (R5F11E). Right click **CC-RL (build tool)** to execute **Generate I/O header file**.

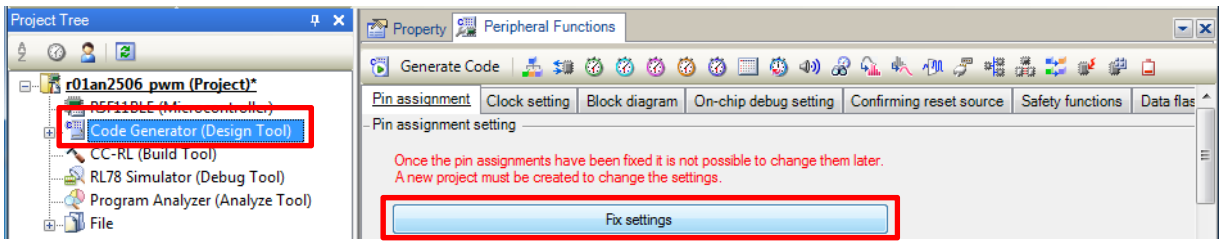


Now, create the source for each function setting using the code generator. Select **Code generation** and click **Peripheral functions**. Make sure to set the common/clock generator.

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**.

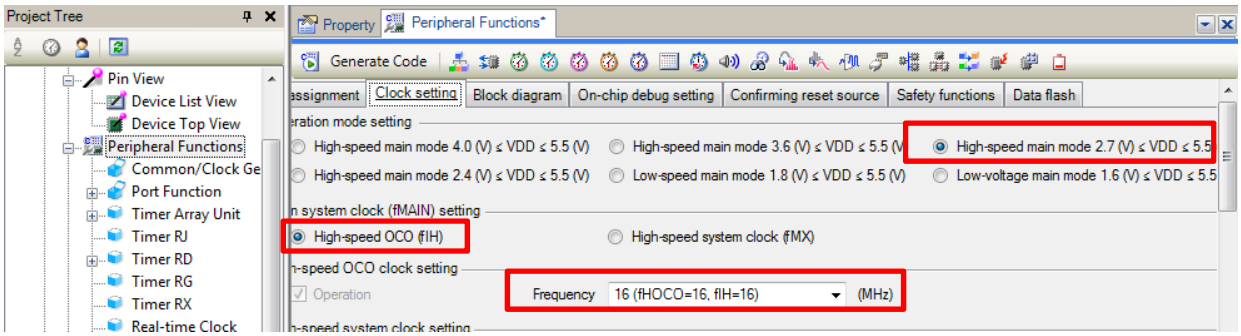
・Pin assignment

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



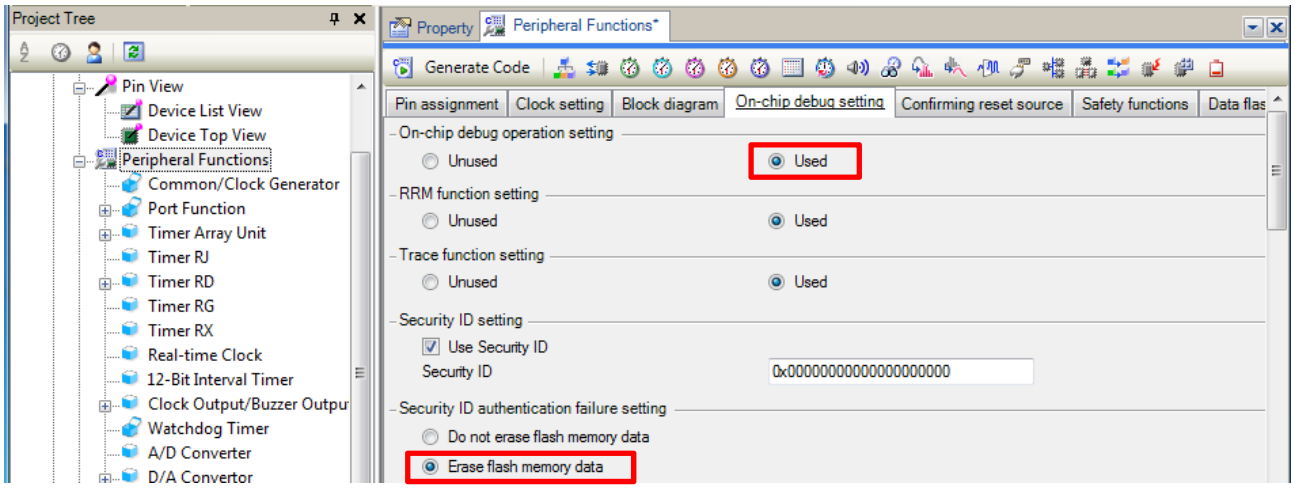
・Clock setting

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).

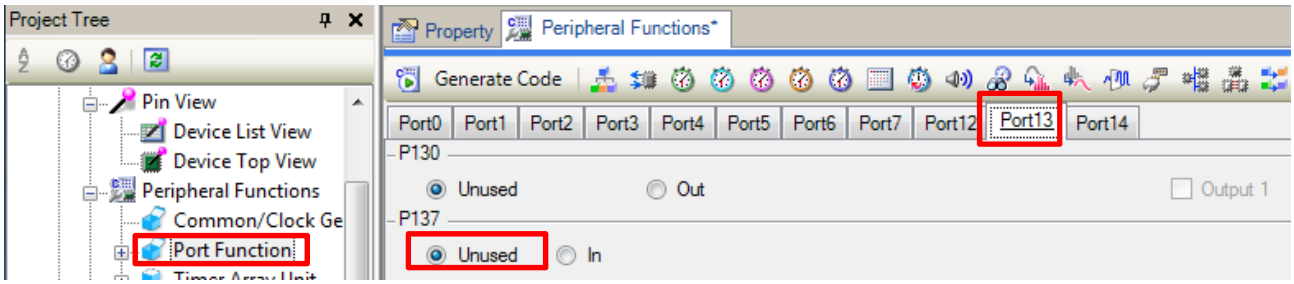
Set the peripheral functions next. Settings are executed based on the G14 Application Note peripheral functions and hardware. The following describes the **Port function setting**, **Timer RD** and **Power supply detection circuit**.

・Port function

First, confirm the hardware configuration on the G1G 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

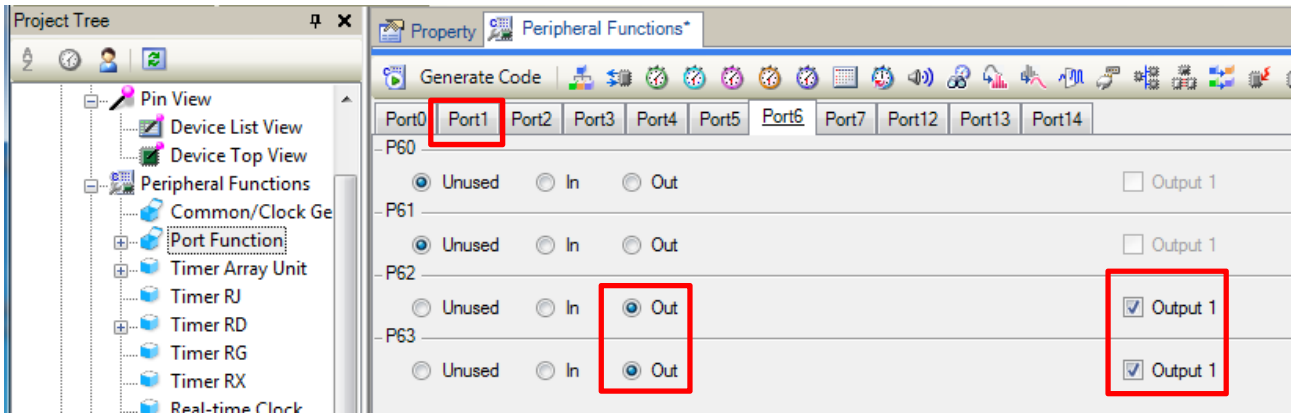
This is an input-only port. Because this is not used in the G14 Application Note, either **Unused** or **In** can be selected.



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

LED port control pins (P62, P64) settings

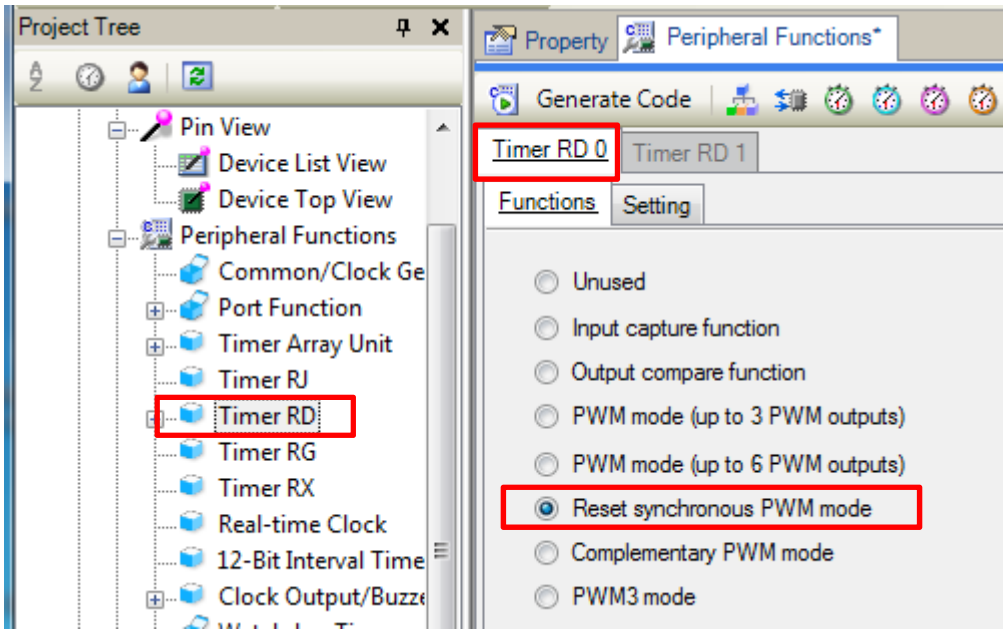
Because these are not used in the G14 Application Note, either **In** or **Out** can be selected. In the following example, **Out** and **Output 1** are selected to turn the LED off.



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**.

□PWM output setting

PWM period 200us

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

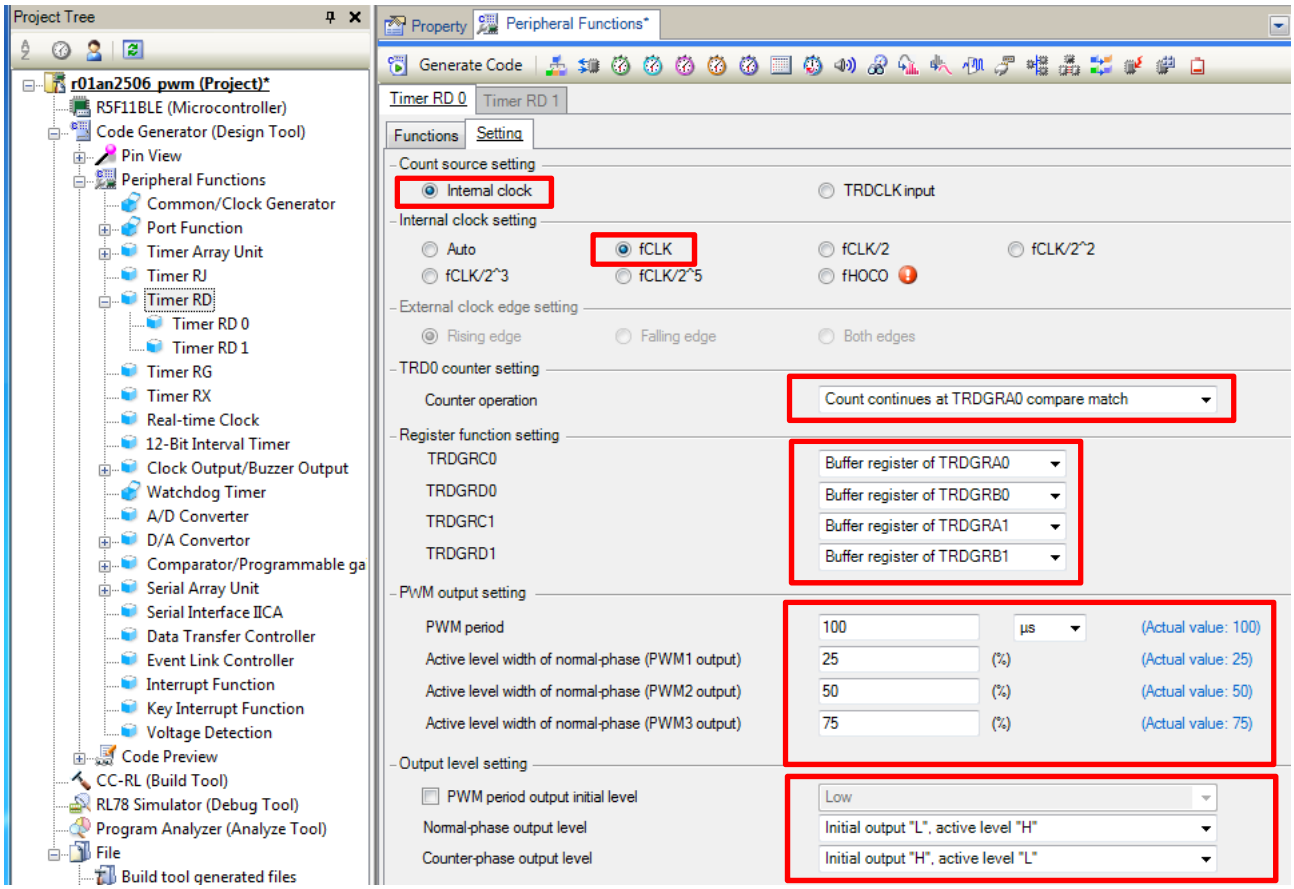
PWM2 output active level width: set to 50% (100us)

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"**

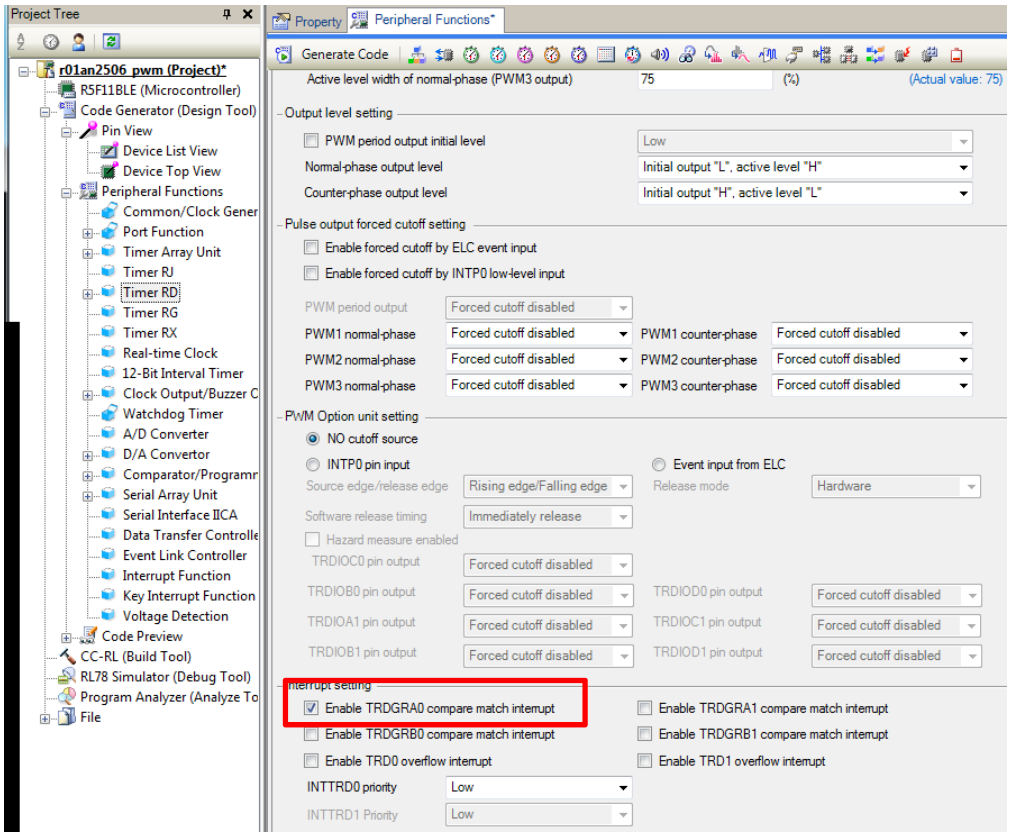


Continued on next page.

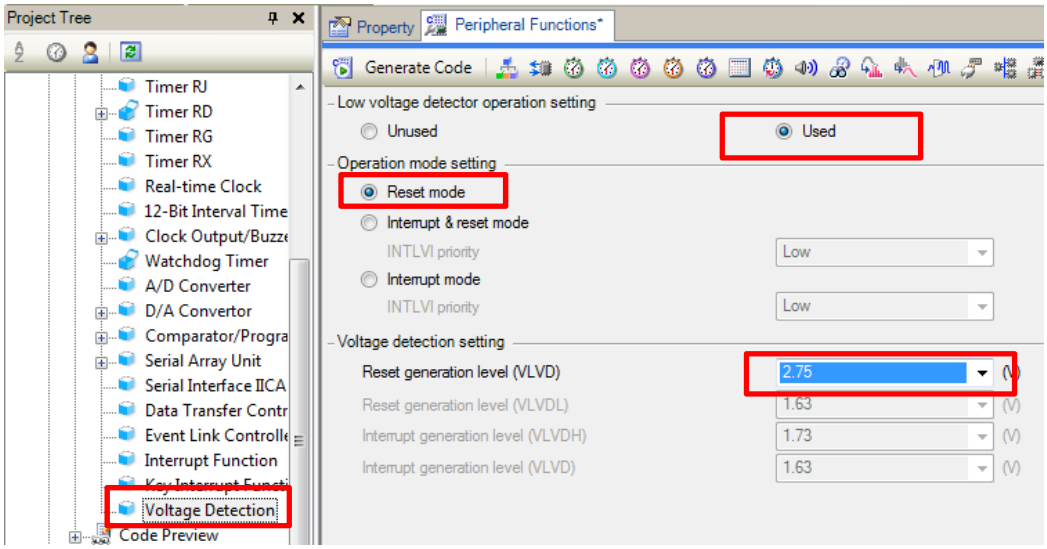
□Pulse output forced cutoff setting
This function is not used and does not need to be set.

□PWM option unit setting
This is an expansion unit for G1G. 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 G1G 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

G1G 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 G1G is changed to r_cg_main.c. The name of the R_TMR_RD0_Start() function is also changed to R_TMRD0_Start() in G1G. 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 G1G 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

G1G 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 G1G is changed to **r_cg_tmrd.c**.

This completes the sequence for replacing RL78/G1G software with RL78/G14 software.

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jul. 27, 2016	First edition issued.	

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1. Handling of Unused Pins

   Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

   ¾ 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.

   ¾ 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.

   ¾ 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.

   ¾ 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.

   ¾ 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.

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