RL78/G13, 78K0/Kx2

Migration Guide from 78K0 to RL78: Watch timer to Real-time clock

Introduction

This application note describes how to migrate the watch timer of the 78K0/Kx2 to the real-time clock of the RL78/G13.

Target Device

RL78/G13, 78K0/Kx2

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

Contents

1. Functions of Watch timer of 78K0/Kx2 and Real-time clock of RL78/G13

Table 1.1 shows the functions of the 78K0/Kx2 Watch timer and Table 1.2 shows the functions of the RL78/G13 Real-time clock.

Table 1.1 Functions of Watch timer

Function	Explanation
Watch timer	The watch timer generates an interrupt request signal at a specific time interval by using the peripheral hardware clock or subsystem clock.
Interval timer	The interval timer generates interrupt request signals (INTWTI) repeatedly at an interval of the preset count value.

Remark. Different products are provided with different functions. For details, refer to the appropriate user's manuals (hardware).

Table 1.2 Functions of Real-time clock

Function	Explanation
Real-time Clock	- The count of year, month, week, day, hour, minutes and second can be performed when the subsystem clock (f_{SUB} = 32.768 kHz) is selected as the operation clock. - When the low-speed oscillation clock (f_{IL} = 15 kHz) is selected, only the constant-period interrupt function is available.
Constant-period interrupt function	- The interrupt request signal is generated at a period of 0.5 seconds, 1 second, 1 minute, 1 hour, 1 day, or 1 month when the subsystem clock (f_{SUB} = 32.768 kHz) is selected as the operation clock. - The constant-period interrupt interval is calculated with the constant-period x (f_{SUB} / f_{IL}) when the low-speed oscillation clock (f_{IL} = 15 kHz) is selected as the operation clock.
Alarm interrupt function	The interrupt request signal is generated at the specified alarm day of the week, hour, and minute when the subsystem clock (f_{SUB} = 32.768 kHz) is selected as the operation clock.
Pin output function of 1 Hz	The 1-Hz pin output function is available when the subsystem clock (f_{SUB} = 32.768 kHz) is selected as the operation clock.

Remark. Different products are provided with different functions. For details, refer to the appropriate user's manuals (hardware).

When the watch timer of 78K0/Kx2 is operated an error up to $2^9 \times 1/f_W$ seconds occurs in the first interrupt request signal (INTWT). Subsequently, however, the interrupt request signal (INTWT) is generated at the specified intervals.

The RL78/G13 real-time clock generates an interrupt request signal at the specified interval after operation is enabled.

Table 1.3 shows the real-time clock functions corresponding to the watch timer.

Table 1.3 Correspondence between Functions

78K0/Kx2 Watch timer	RL78/G13 Real-time clock
Watch timer	Constant-period interrupt function
Interval timer	None (Note1)
-	Alarm interrupt function (Note2)
-	Pin output function of 1 Hz (Note3)

Note1. The 78K0/Kx2's interval timer function for the watch timer can be replaced by the RL78/G13's 12-bit interval timer or timer array units.

Note2. The 20- to 36-pin products have the constant-period interrupt function only, because these products have no subsystem clock. The constant-period interrupt interval when fIL is selected will be calculated with the constant-period (the value selected with RTCC0 register) × f_{SUB}/f_{IL}.

Note3. 40, 44, 48, 52, 64, 80, 100, and 128-pin products only.

Remark. Different products are provided with different functions. For details, refer to the appropriate user's manuals (hardware).

2. Differences between Watch timer and Real-time clock

2.1 Summary of Differences between Functions

Table 2.1 summarizes the differences between the functions of the watch timer of 78K0/Kx2 and real-time clock of RL78/G13.

Table 2.1 Summary of Differences between Functions

Item	78K0/Kx2 Watch timer	RL78/G13 Real-time Clock
Configuration	Counter 5-bit counter Prescaler 11-bit prescaler	Internal counter (16-bit) Each count registers - Second count register (SEC) - Minute count register (MIN) - Hour count register (HOUR) - Day count register (DAY) - Week count register (WEEK) - Month count register (MONTH) - Year count register (YEAR)
Count clock (Operating clock)	11-bit prescaler: f_W 5-bit counter: f_{WX}	f_{SUB}, f_{IL}
Enable supplying the clock to the Real-time Clock	None	Setting the RTCEN bit in the PER0 register to 1
Interrupt function	- Watch timer interrupt - Interval time interrupt	- Constant-period interrupt (Note) - Alarm interrupt
Interrupt occur cycle	$2^4/f_W$, $2^5/f_W$, $2^6/f_W$, $2^7/f_W$, $2^8/f_W$, $2^9/f_W$, $2^{10}/f_W$, $2^{11}/f_W$, $2^{13}/f_W$, $2^{14}/f_W$	0.5 s, 1s, 1minute, 1hour, 1day, 1month (f_{SUB} = 32.768 kHz)
Alarm interrupt	None	Yes
Starts count operation	Setting the WTM1 and WTM0 bits in the WTM register to 1	Setting the RTCE bit in the RTCC0 register to 1
Stops count operation	Setting the WTM1 and WTM0 bits in the WTM register to 0	Setting the RTCE bit in the RTCC0 register to 0
Counter value initialization timing	- When count operation stops - When an interrupt occurs	The second count register (SEC) is written.
1Hz output pin	None	RTC1HZ pin

Note. The count of year, month, week, day, hour, minutes and second can only be performed when a subsystem clock (f_{SUB} = 32.768 kHz) is selected as the operation clock of the real-time clock.When the low-speed oscillation clock (f_{IL} = 15 kHz) is selected, only the constant-period interrupt function is available. The 20- to 36-pin products have the constant-period interrupt function only, because these products have no subsystem clock. However, the constant-period interrupt interval when fIL is selected will be calculated with the constant-period (the value selected with RTCC0 register) × f_{SUB}/f_{IL}.

Remarks 1. f_W: Watch timer clock frequency ($f_{PRS}/2^7$ or f_{SUB})
f_{WX}: f_W or $f_W/2^9$

f_{PRS}: Peripheral hardware clock frequency

f_{SUB}: Subsystem clock frequency

f_{IL}: Low-speed on-chip oscillator clock

Remarks 2. Different products are provided with different functions. For details, refer to the appropriate user's manuals (hardware).

3. Sample Code for real-time clock

The sample code for the real-time clock is explained in the following application notes.

- RL78/G13 Real-Time Clock CC-RL (R01AN2590)

  The latest versions can be downloaded from the Renesas Electronics website.

4. Documents for Reference

User's Manual:

- RL78/G13 User's Manual: Hardware (R01UH0146)
- 78K0/Kx2 User's Manual: Hardware (R01UH0008)

  The latest versions can be downloaded from the Renesas Electronics website.

Technical Update/Technical News:

The latest information can be downloaded from the Renesas Electronics website.

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jun.07, 2019	-	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of 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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