

RL78/G14, H8/3687 Group

R01AN1993EJ0100

Rev.1.00

Migration Guide from H8/3687 to RL78/G14: Timer RD

Mar.03,2014

Abstract

This document describes how to migrate from the H8/3687 Group timer Z to the RL78/G14 timer RD.

Target Devices

RL78/G14, H8/3687 Group

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

Contents

1.	Differences between Timer Z in the H8/3687 Group and Timer RD in RL78/G14	3
1.1	Assigned I/O Pins	4
2.	Register Compatibility	5
2.1	Changes in Registers	6
2.1.1	PER1 register (i = 0 or 1) (RL78/G14 Only)	6
2.1.2	TFCR Register and TRDFCR Register	6
2.1.3	TRDDFi Register (i = 0 or 1) (RL78/G14 Only)	7
2.1.4	TCRi Register and TRDCRi Register (i = 0 or 1)	8
2.1.5	PMR5 Register and TRDOER2 Register	8
2.1.6	TRDELC Register (RL78/G14 Only)	9
2.1.7	TSTR Register and TRDSTR Register	9
3.	Reference Documents	10

1. Differences between Timer Z in the H8/3687 Group and Timer RD in RL78/G14

Table 1.1 lists the differences between timer Z in the H8/3687 Group and timer RD in RL78/G14.

Table 1.1 Differences between Timer Z (H8/3687 Group) and Timer RD (RL78/G14)

Item	Timer Z in H8/3687 Group	Timer RD in RL78/G14
Count source	<ul style="list-style-type: none"> • ϕ • $\phi/2$ • $\phi/4$ • $\phi/8$ • FTIOA0 (TCLK) 	<ul style="list-style-type: none"> • fCLK • fCLK/2 • fCLK/4 • fCLK/8 • fCLK/32 • fHOCO • TRDCLK ^(Note 1)
Clock supply enable/disable	N/A	Available
Operating mode	<ul style="list-style-type: none"> • Timer mode • PWM mode (Reset synchronous, complementary PWM) 	<ul style="list-style-type: none"> • Timer mode • PWM mode (Reset synchronous, complementary PWM, PWM3)
Count stop at compare match	N/A	Available (Select either to stop or to continue at compare match with TRDGRA0/1)
Pulse output forced cutoff method	WKP4	INTP0, ELC0, or ELC1 ^(Note 2)
Pin used for pulse output forced cutoff	WKP4	INTP0
Pin state setting for pulse output forced cutoff	Set the registers PCR6 and PDR6 of the corresponding I/O port.	Set the TRDDFi register.
Pulse output forced cutoff cancel method	Set 0 to the master enable bit in the TOER register after inputting "H" to WKP4 pin.	Set 0 to the TRDSHUTS bit in the TRDOER2 register after inputting "H" to the INTP0 pin.
Timer Z/RD pins	P6_0 to P6_7 ^(Note 3)	P10 to P17 ^(Note 3)
Digital filter	N/A	Available
A/D trigger generation	Available ^(Note 4)	N/A ^(Note 5)
Event input from ELC	N/A	Available

i = 0 or 1

Notes

1. TRDCLK cannot be selected in the PWM3 mode.
2. The pulse output is cutoff during the low input period for forced cutoff from the INTP0 pin, but the pulse output is cutoff once by a single event input from the ELC for forced cutoff by the ELC event.
Setting procedures: (1) Set timer RD as the ELC event link destination. (2) Set bits ELCICEi (i = 0 or 1) and ELC0BEi (i = 0 or 1) in the TRDELIC register to 1.
3. See Table 1.2.
4. This function is valid only in the complementary PWM mode.
5. Using the event link controller enables to generate an A/D trigger.
The trigger is generated at peak in the complementary PWM mode.
 - Event source: Timer RD0 input capture A/compare match A
 - Event link destination: A/D converter
 The trigger is generated at trough in the complementary PWM mode.
 - Event source: Timer RD1 underflow
 - Event link destination: A/D converter

1.1 Assigned I/O Pins

Table 1.2 lists the assigned I/O pins to use in the timer Z in the H8/3687 Group and the timer RD in RL78/G14.

Table 1.2 I/O Pins in the H8/3687 Group and RL78/G14

Pin name	H8/3687 Group	Pin name	RL78/G14	I/O
FTIOA0/TCLK	P6_0	TRDIOA0/TRDCLK	P17	I/O
FTIOB0	P6_2	TRDIOB0	P15	I/O
FTIOC0	P6_1	TRDIOC0	P16	I/O
FTIOD0	P6_3	TRDIOD0	P14	I/O
FTIOA1	P6_4	TRDIOA1	P13	I/O
FTIOB1	P6_5	TRDIOB1	P12	I/O
FTIOC1	P6_6	TRDIOC1	P11	I/O
FTIOD1	P6_7	TRDIOD1	P10	I/O

2. Register Compatibility

Register compatibility between the H8/3687 Group and RL78/G14 is listed in **Table 2.1**.

Table 2.1 Register Compatibility

Item	H8/3687 Group	RL78/G14
Clock supply enable/disable	—	TRD0EN bit in the PER1 register
Timer RD synchronous	SYNC bit in the TMDR register	TRDSYNC bit in the TRDMR register
General register/buffer register select	BFki bit in the TMDR register	TRDBFki bit in the TRDMR register
Timer mode/PWM mode select	PWMBi bit in the TPMR register, PWMCi bit in the PWMDi register	Bits TRDPWMBi, TRDPWMCi, and TRDPWMDi in the TRDPMR register
PWM3 mode setting	—	PWM3 bit in the TRDFCR register
Count select at compare match with TRDGRAi	—	CSELi bit in the TRDSTR register
A/D trigger enable	ADTRG bit in the TFCR register	—
A/D trigger edge select	ADEG bit in the TFCR register	—
Pulse output forced cutoff signal input enable	WKP4 bit in the PMR5 register	TRDPTO bit in the TRDOER2 register
TRDIOj pin digital filter function enable	—	DFj bit in the TRDDFi register
Digital filter function clock select	—	DFCKi bit in the TRDDFi register
Count source select	Bits TPSC0 to TPSC2 in the TCRI register	Bits TCK0 to TCK2 in the TRDCRI register
Interrupt priority level select	—	<ul style="list-style-type: none"> • TRDPR0i bit in the PR02H register • TRDPR1i bit in the PR12H register
Interrupt request bit	Bits UDF ^(Note 1) , OVFi, and IMFj in the TSRi register	TRDIFI bit in the IF2H register
Interrupt enable/disable	Bits OVIE and IMIEj in the TIERi register	TRDMKi bit in the MK2H register
Forced cutoff flag	—	TRDSHUTS bit in the TRDOER2 register
TRDIOB pin pulse forced cutoff control	—	PENBi bit in the TRDDFi register
ELC event input i select for input capture	—	ELCICEi bit in the TRDELIC register
ELC event input i enable for pulse output forced cutoff	—	ELCOBEi bit in the TRDELIC register

—: No register is applicable.

i = 0 or 1

j = A, B, C, or D

k = C or D

Note

1. The TSR0 register has no UDF flag. Bit 5 in the TSR0 register is reserved. This bit is always read as 1.

2.1 Changes in Registers

2.1.1 PER1 register (i = 0 or 1) (RL78/G14 Only)

In RL78/G14, consumption power and noise can be reduced by setting the TRD0EN bit in the PER1 register to 0 for stopping clock supply. When using the timer RD, make sure to set the bit 4 (TRD0EN) to 1.

- PER1 (RL78/G14)

b7	b6	b5	b4	b3	b2	b1	b0
DACEN	TRGEN	CMPEN	TRD0EN	DTCEN	—	—	TRJ0EN

2.1.2 TFCR Register and TRDFCR Register

In the H8/3687 Group, whether to enable or disable an A/D trigger can be selected by setting the ADTRG bit in the TFCR register, and an A/D trigger edge can be selected by the ADEG bit in the TFCR register.

In RL78/G14, the timer RG cannot be used as an A/D conversion start trigger.

The PWM3 bit has been added to RL78/G14 for setting the PWM3 mode. However, the PWM3 mode cannot be used in the H8/3687 Group.

- TFCR (H8/3687 Group)

b7	b6	b5	b4	b3	b2	b1	b0
—	STCLK	ADEG	ADTRG	OLS1	OLS0	CMD1	CMD0

- TRDFCR (RL78/G14)

b7	b6	b5	b4	b3	b2	b1	b0
PWM3	STCLK	—	—	OLS1	OLS0	CMD1	CMD0

2.1.3 TRDDFi Register (i = 0 or 1) (RL78/G14 Only)

In RL78/G14, the digital filter function of the TRDIOj pin can be used. The bits DFj and DFCKi in the TRDDFi register are used to select whether to enable or disable the digital filter function and which clock should be used for the function. Table 2.2 lists the clocks for the digital filter function. In the H8/3687 Group, this function may not be used.

i = 0 or 1

j = A, B, C, or D

Table 2.2 Clocks for the Digital Filter Function

DFCK1	DFCK0	RL78/G14
0	0	f _{CLK} /32 ^(Note 1)
0	1	f _{CLK} /8 ^(Note 1)
1	0	f _{CLK} ^(Note 1)
1	1	Count source (Clock selected by bits TCK0 to TCK2 in the TRDCRi register)

i = 0 or 1

Note

- When FRQSEL4 in the user option byte (000C2H/010C2H) = 1, f_{CLK}/32, f_{CLK}/8, and f_{CLK} become f_{HOCO}/32, f_{HOCO}/8, and f_{HOCO} respectively.

In RL78/G14, the bits PENB0 and PENB1 are added for TRDIOB pin pulse forced cutoff control.

- TRDDFi (RL78/G14)

b7	b6	b5	b4	b3	b2	b1	b0
DFCK1	DFCK0	PENB1	PENB0	DFD	DFC	DFB	DFA

2.1.4 TCRI Register and TRDCRI Register (i = 0 or 1)

Count source which can be specified is different between the H8/3687 Group and RL78/G14. Table 2.3 lists the comparison of count sources.

Table 2.3 Comparison of Count Sources

TCK2	TCK1	TCK0	H8/3687 Group TCRI	RL78/G14 TRDCRI
0	0	0	ϕ	f _{CLK} , f _{HOCO}
0	0	1	$\phi/2$	f _{CLK} /2
0	1	0	$\phi/4$	f _{CLK} /4
0	1	1	$\phi/8$	f _{CLK} /8
1	0	0	FTIOA0 (TCLK) pin input	f _{CLK} /32
1	0	1		TRDCLK input ^(Note 1)
1	1	0		Do not set.
1	1	1		Do not set.

Note

1. This function cannot be selected in the PWM3 mode.

2.1.5 PMR5 Register and TRDOER2 Register

In the H8/3687 Group, pulse output forced cutoff signal input is enabled by setting the WKP4 bit in the PMR5 register to 1, while it is enabled in RL78/G14 by setting the TRDPTO bit in the TRDOER2 register to 1.

The TRDSHUTS bit has been added to RL78/G14 to indicate the forced cutoff. When the pulse output is forcibly cut off, the TRDSHUTS bit in the TRDOER2 register is set to 1. Such bit is not available in the H8/3687 Group.

- PMR5 (H8/3687 Group)

b7	b6	b5	b4	b3	b2	b1	b0
POF57	POF56	WP5	WKP4	WKP3	WKP2	WKP1	WKP0

- TRDOER2 (RL78/G14)

b7	b6	b5	b4	b3	b2	b1	b0
TRDPTO	—	—	—	—	—	—	TRDSHUTS

2.1.6 TRDEL C Register (RL78/G14 Only)

Bits ELCICE_i and ELCOBE_i have been added to RL78/G14 to select the ELC event input for the input capture, and to enable the ELC event for pulse output forced cutoff (*i* = 0 or 1).

- TRDEL C (RL78/G14)

b7	b6	b5	b4	b3	b2	b1	b0
—	—	ELCOBE1	ELCICE1	—	—	ELCOBE0	ELCICE0

2.1.7 TSTR Register and TRDSTR Register

The CSEL_i bit has been added to RL78/G14 to set count operation at compare match with the TRDGRA_i register (*i* = 0 or 1).

- TSTR (H8/3687 Group)

b7	b6	b5	b4	b3	b2	b1	b0
—	—	—	—	—	—	STR1	STR0

- TRDSTR (RL78/G14)

b7	b6	b5	b4	b3	b2	b1	b0
—	—	—	—	CSEL1	CSEL0	TSTART1	TSTART0

3. Reference Documents

RL78/G14 User's Manual: Hardware Rev. 2.00

H8/3687 Group Hardware Manual Rev.5.00

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.

Website and Support

Renesas Electronics Website

<http://www.renesas.com/>

Inquiries

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

REVISION HISTORY	RL78/G14, H8/3687 Group Application Note Migration Guide from H8/3687 to RL78/G14: Timer RD
---------------------	--

Rev.	Date of issue	Description	
		Page	Summary
1.00	Mar.3,2014	—	First edition issued

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

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 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 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.

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.



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.

2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited

1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.

7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, 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 Rd., Putuo District, Shanghai, China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited

Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.

13F, No. 363, Fu Shing North Road, Taipei, 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 906, 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 Korea Co., Ltd.

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