RL78/G14, H8/36109

Migration Guide from H8 to RL78: Clock Pulse Generators

Introduction

This application note describes how to migrate the Clock Pulse Generators of the H8/36109 to the Clock Generator of the RL78/G14 (100-pin package).

Target Device

RL78/G14, H8/36109

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 Clock Pulse Generators

Table 1.1 shows the functions of the Clock Pulse Generators in the H8/36109, and Table 1.2 shows the functions of the clock generator in the RL78/G14.

Table 1.1 Functions of H8/36109 Clock Pulse Generators

Function	Specification
System clock generating circuitry	You can choose either the on-chip oscillator clock or an external oscillator clock as the clock source. As the frequency of the on-chip oscillator clock, you can use your own software to select 40 MHz or 32 MHz. to supply external clock pulses, connect a crystal resonator or a ceramic resonator, or input external clock signals.
Subclock pulse generating circuitry	To supply clock signals to the subclock divider, connect a 32.768-kHz crystal resonator.

Table 1.2 Functions of RL78/G14 Clock Generator

Function	Specification
High-speed on-chip oscillator	The frequency at which to oscillate can be selected from among f_{HOCO} = 64, 48, 32, 24, 16, 12, 8, 6, 4, 3, 2, or 1MHz (TYP.) by using the option byte (000C2H). When 64 MHz or 48 MHz is selected as f_{HOCO}, f_{IH} is set to 32 MHz or 24 MHz, respectively. When 32 MHz or less is selected as f_{HOCO}, f_{IH} is not divided and set to the same frequency as f_{HOCO}. After a reset release, the CPU always starts operating with this high-speed on-chip oscillator clock. The frequency specified by using an option byte can be changed by using the high-speed on-chip oscillator frequency select register (HOCODIV).
X1 oscillator	This circuit oscillates a clock of f_X = 1 to 20 MHz by connecting a resonator to X1 pin and X2 pin.
External main system clock input	An external main system clock (f_{EX} = 1 to 20 MHz) can also be supplied from the EXCLK/X2/P122 pin.
Subsystem clock(Note)	This circuit oscillates a clock of f_{XT} = 32.768 kHz by connecting a 32.768 kHz resonator to XT1 and XT2 pins. An external subsystem clock (f_{EXS} = 32.768 kHz) can also be supplied from the EXCLKS/XT2 pin.
Low-speed on-chip oscillator	This circuit oscillates a clock of f_{IL} = 15 kHz (TYP.). The low-speed on-chip oscillator clock cannot be used as the CPU clock. Only the following peripheral hardware runs on the low-speed on-chip oscillator clock. - Watchdog timer - Real-time clock - 12-bit Interval timer - Timer RJ

Note. The RL78/G14 products with 40 or more pins are provided with a subsystem clock.

Figure 1.1 shows a block diagram of the Clock Pulse Generators in the H8/36109, and Figure 1.2 shows a block diagram of the clock generator in the RL78/G14.

After release from the reset state, the H8/36109 starts operating at On-chip oscillator, and the RL78/G14 starts operating at the frequency of the high-speed on-chip oscillator clock selected by the option byte.

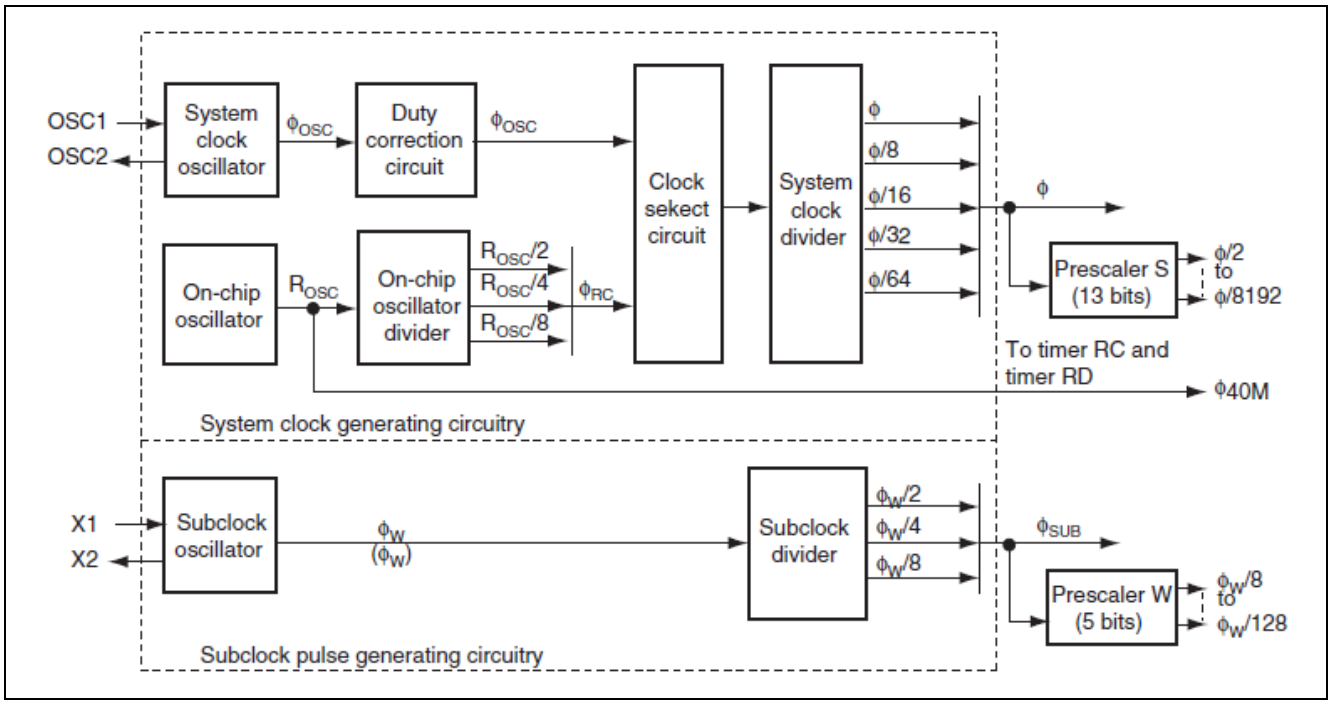

Figure 1.1 Block Diagram of Clock Pulse Generators (H8/36109)

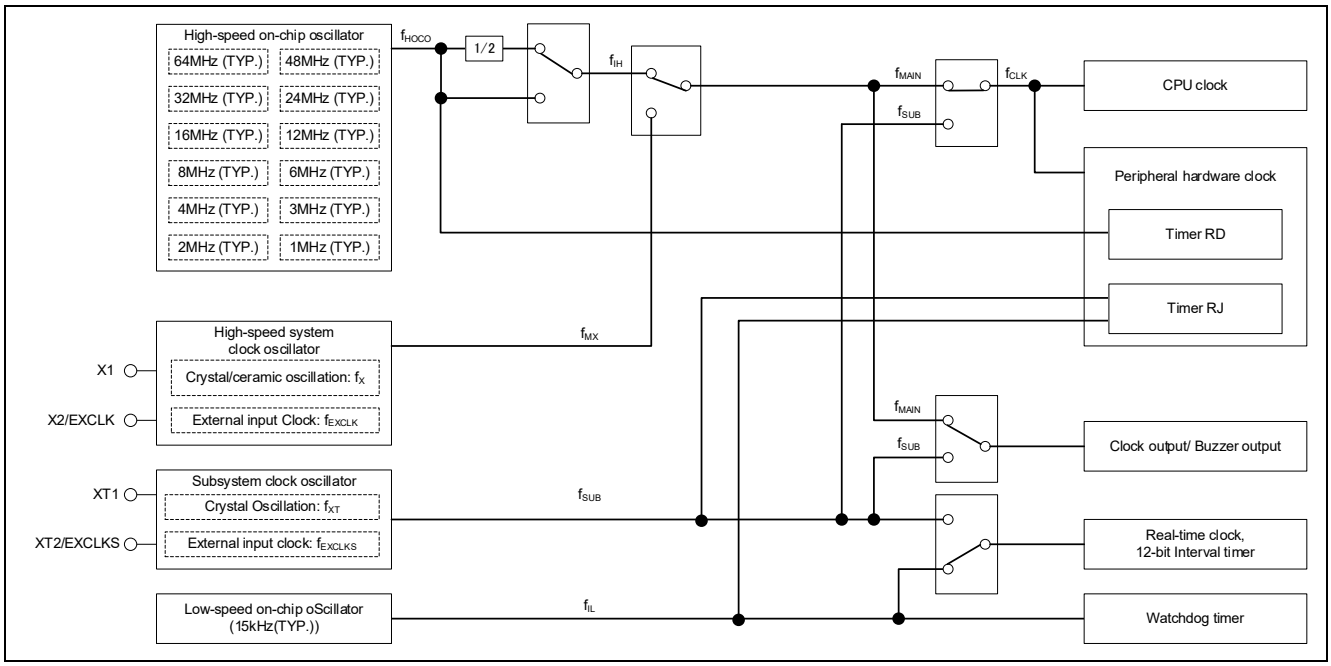

Figure 1.2 Block Diagram of Clock Generator (RL78/G13)

Table 1.3 shows the correspondence of frequency names between the Clock Pulse Generators of the H8/36109 and the RL78/G14.

Table 1.3 Correspondence of frequency name

H8/36109		RL78/G14	
Name	Symbol	Name	Symbol
System clock	φ (φ - φ/64)	CPU/peripheral hardware clock frequency	f_{CLK}
System clock oscillator	φOSC	X1 clock oscillation frequency	f_X
External clock input	OSC1	External main system clock frequency	f_{EX}
Subclock	$φ_{SUB}$ (φW/2 - φW/8)	XT1 clock oscillation frequency	f_{XT}
None	None	External subsystem clock frequency	f_{EXS}
On-chip oscillator divider	φRC (Rosc/2 - Rosc/8)	High-speed on-chip oscillator clock frequency (Max. 32 MHz) Note	f_{IH}
On-chip oscillator	Rosc (φ40M)	High-speed on-chip oscillator clock frequency (Max. 64 MHz)	f_{HOCO}
None	None	Main system clock frequency	f_{MAIN}
None	None	High-speed system clock frequency	f_{MX}
None	None	Subsystem clock frequency	f_{SUB}
None	None	Low-speed on-chip oscillator clock frequency	f_{IL}

Note. f_{IH} is controlled by hardware to be set to two frequency division of f_{HOCO} when f_{HOCO} is set to 64 MHz or 48 MHz, and the same clock frequency as f_{HOCO} when f_{HOCO} is set to 32 MHz or less. When supplying 64 MHz or 48 MHz to timer RD, set f_{CLK} to f_{IH}.

2. Differences in Function Overview

Table 2.1 summarizes the differences between the Clock Pulse Generators of the H8/36109 and the clock generator function of the RL78/G14.

Table 2.1 Differences

Item	H8/36109 Clock Pulse Generators	RL78/G14 Clock Generator
On-chip oscillator clock	40MHz, 32MHz	f_{HOCO} : Select from 64MHz, 48MHz (TYP.) f_{IH} : Select from 32MHz, 24MHz, 16MHz, 12MHz, 8MHz, 6MHz, 4MHz, 3MHz, 2MHz, 1MHz (TYP.)
Frequency trimming	Yes	Yes
Power Supply Select for On-Chip Oscillator	Yes	None
Division Ratio Select for On-Chip Oscillator	Yes (Rosc/2 - Rosc/8)	Yes (f_{IH}/2 - f_{IH}/32)
System clock oscillation frequency	4MHz - 20MHz	1MHz - 20MHz
Subclock oscillation frequency	32.768kHz	32.768kHz
Interrupt for switching the system clock	Yes	None

3. Register Compatibilities

Table 3.1 and Table 3.2 shows the compatibilities of the registers in the Clock Pulse Generators between the H8/36109 and the RL78/G14.

Table 3.1 Register Compatibilities (1/2)

Item	H8/36109	RL78/G14 (Note)
RC control register	RCCR register	None
On-Chip Oscillator Standby	RCCR register RCSTP bit	CSC register HIOSTOP bit
Frequency Select for On-Chip Oscillator	RCCR register FSEL bit	None
Power Supply Select for On-Chip Oscillator	RCCR register VCLSEL bit	None
Division Ratio Select for On-Chip Oscillator	RCCR register RCPSC1 bit, RCPSC0 bit	HOCODIV register HOCODIV2 - HOCODIV0 bit
RC Trimming Data Protect Register	RCTRMDPR register	None
Write Inhibit	RCTRMDPR register WRI bit	None
Protect Information Write Enable	RCTRMDPR register PRWE bit	None
Trimming Data Register Lock Down	RCTRMDPR register LOCKDW bit	None
Trimming Date Register Write Enable	RCTRMDPR register TRMDRWE bit	None
RC Trimming Data Register	RCTRMDR register	HIOTRM register
Clock Control/Status Register	CKCSR register	None
OSC Pin Function Select bit	CKCSR register PMRJ1 bit, PMRJ0 bit	CMC register EXCLK bit, OSCSEL bit
LSI Operating Clock Select	CKCSR register OSCSEL bit	CKC register MCM0 bit
Clock Switch Interrupt Enable	CKCSR register CKSWIE bit	None
Clock Switch Interrupt Request Flag	CKCSR register CKSWIF bit	None
LSI Operating Clock Status	CKCSR register CKSTA bit	CKC register MCS bit
Clock operation mode control register	None	CMC register
Subsystem clock pin operation mode	None	CMC register EXCLKS bit, OSCSELS bit
XT1 oscillator oscillation mode selection	None	CMC register AMPHS1 bit, AMPHS0 bit
Control of X1 clock oscillation frequency	None	CMC register AMPH bit

Note. The RL78/G14 products with 40 or more pins are provided with a subsystem clock.

Table 3.2 Register Compatibilities (2/2)

Item	H8/36109	RL78/G14(Note)
System clock control register	None	CKC register
Status of CPU/peripheral hardware clock (f_{CLK})	None	CKC register CLS bit
Selection of CPU/peripheral hardware clock (f_{CLK})	None	CKC register CSS bit
Status of Main system clock (f_{MAIN})	None	CKC register MCS bit
High-speed system clock operation control	None	CSC register MSTOP bit
Subsystem clock operation control	None	CSC register XTSTOP bit
Oscillation stabilization time counter status register	None	OSTC register
Oscillation stabilization time select register	None	OSTS register
Peripheral enable registers	None	PER1 register, PER0 register
Subsystem clock supply mode control register	None	OSMC register
Setting in STOP mode or HALT mode while subsystem clock is selected as CPU clock	None	OSMC register RTCLPC bit
Selection of operation clock for real-time clock, 12-bit interval timer, and timer RJ	None	OSMC register WUTMMCK0 bit

Note. The RL78/G14 products with 40 or more pins are provided with a subsystem clock.

4. Sample Code for Clock Generator

Sample codes for the clock generator are explained in the following application notes.

- RL78/G13 CPU Clock Changing and Standby Settings (C Language) CC-RL (R01AN3128)
- RL78/G13 CPU Clock Changing and Standby Settings (Assembly) CC-RL (R01AN2912)
- RL78/G13 High-speed On-chip Oscillator (HOCO) Clock Frequency Correction CC-RL (R01AN2833)

5. Documents for Reference

User's Manual:

- RL78/G14 User's Manual: Hardware (R01UH0186)
- H8/36109 Group User's Manual: Hardware (R01UH0294)

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	Aug.18, 2020	-	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.

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 or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving 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, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. 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 shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended 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; industrial robots; etc.
   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or 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 damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.
7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION (“Vulnerability Issues”). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, 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 and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall 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 shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
(Note2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/.