RL78/G14, R8C/36M Group

Migration Guide from R8C to RL78: Clock Generator

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Abstract

This document describes how to migrate from the R8C/36M Group clock generation circuit to the RL78/G14 clock generator.

Products

RL78/G14, R8C/36M 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 the R8C/36M Group and RL78/G14

Table 1.1 and Table 1.2 list the specification overview of the R8C/36M Group clock generation circuit and RL78/G14 clock generator.

Table 1.3 lists the differences between the R8C/36M Group clock generation circuit and RL78/G14 clock generator.

Table 1.1 Overview of the Clock Generation Circuit Specifications for the R8C/36M Group

Item	XIN Clock Oscillation Circuit	XCIN Clock Oscillation Circuit	On-chip Oscillator		Low-speed On-chip Oscillator for Watchdog Timer
			High-speed On-chip Oscillator	Low-speed On-chip Oscillator	
Applications	• CPU clock source • Peripheral function clock source		• CPU clock source • Peripheral function clock source • CPU and peripheral function clock source when XIN clock oscillation is stopped		• Watchdog timer clock source
Clock frequency	0 to 20 MHz	32.768 kHz	40 MHz (typ.) (1)	125 kHz (typ.)	125 kHz (typ.)
Applicable oscillator	• Ceramic resonator • Crystal oscillator	• Crystal oscillator	–	–	–
Oscillator connect pins	XIN, XOUT	XCIN, XCOUT	–	–	–
Oscillation stop, restart function	Applicable				
Oscillation status after reset	Stop	Stop	Stop	Oscillate	Stop, oscillate
Other	Externally-generated clock can be input	• Externally-generated clock can be input • On-chip feedback resistor Rf (connected or not connected selectable)	–	–	–

Note 1. The clock frequency is automatically set to a maximum of 20 MHz (typ.) by a divider when using the high-speed oscillator as a CPU clock source.

Table 1.2 Overview of the Clock Generator Specifications for the RL78/G14

Item	Main System Clock		Subsystem Clock Oscillator	Low-speed On-chip Oscillator
	High-speed System Clock Oscillator	High-speed On-chip Oscillator		
Applications	• CPU clock source • Peripheral function clock source	• CPU clock source • Peripheral function clock source	• CPU clock source • Peripheral function clock source	• Watchdog timer • Real-time clock • 12-bit interval timer • Timer RJ
Clock frequency	1 to 20 MHz	64 MHz (typ.) (1)	32.678 kHz	15 kHz (typ.)
Applicable oscillator	• Ceramic oscillator • Crystal resonator	–	• Crystal resonator	–
Oscillator connect pins	X1, X2	–	XT1, XT2	–
Oscillation stop and restart function	Applicable			
Oscillation status after reset	Stop	Oscillate	Stop	Oscillate, stop (2)
Other	Externally-generated clock can be input	–	Externally-generated clock can be input	–

Notes 1. When the oscillating frequency is specified as 48 MHz or 64 MHz, the selected clock divided-by-2 is supplied to the CPU clock.
2. This status can be set by the WDTON bit in the user option byte (000C0H).

Table 1.3 Differences in the Clock Generator

Item	R8C/36M Group	RL78/G14
High-speed on-chip oscillator accuracy	±1.5% (1)	±1% (2)
How to adjust the high-speed on-chip oscillator frequency	40 MHz: FRA1 = value after reset, FRA3 = value after reset 36.864 MHz: Transfer the value in the FRA4 register to the FRA1 register and the value in the FRA5 register to FRA3 register 32 MHz: Transfer the value in the FRA6 register to the FRA1 register and the value in the FRA7 register to the FRA3 register	The frequency of the high-speed on-chip oscillator can be selected from 64, 48, 32, 24, 16, 12, 8, 4 and 1 MHz by using FRQSEL0 to FRQSEL4 of the option byte (000C2H).
High-speed on-chip oscillator stabilization time	100 µs (typ.) 450 µs (max.)	Included in the reset processing time: • Reset processing time when LVD is off: 417 µs (typ.), 554 µs (max.) • Reset processing time when LVD is on: 690 µs (typ.), 867 µs (max.)
Low-speed on-chip oscillator accuracy	−52% to +100%	±15%
CPU clock divider	Available	Available only in the high-speed on-chip oscillator
CPU clock after reset release	Low-speed on-chip oscillator	High-speed on-chip oscillator
Subsystem clock oscillation mode select function	Not applicable	Applicable

Notes 1. Measuring conditions of V_{CC}: 1.8 to 5.5 V, −20°C ≤ T ≤ 85°C
2. Measuring conditions of V_{DD}: 1.8 to 5.5 V, −20°C to 85°C

1.1 XIN Clock Oscillation Circuit

Clocks generated by the R8C/36M Group XIN clock oscillation circuit can be used as the clock source for the CPU clock or the peripheral function clock. To use the XIN clock oscillation circuit, connect a crystal oscillator or ceramic resonator to pins XIN and XOUT. Also, an externally-generated clock can be input to the XOUT pin. Table 1.4 lists the relationship between the XIN clock operating frequency and the supply voltage (V_{CC}).

Table 1.4 Operating Frequency and Supply Voltage for the R8C/36M Group

Item	Operating Frequency	Vcc
XIN clock oscillation circuit	0 to 20 MHz	2.7 V ≤ V_{CC} ≤ 5.5 V
	0 to 5 MHz	1.8 V ≤ V_{CC} ≤ 2.7 V

Clocks generated by the RL78/G14 high-speed system clock oscillator can be used as the clock source for the CPU clock or the peripheral function clock. To use the high-speed system clock oscillator, connect a crystal resonator or ceramic oscillator to pins X1 and X2. An externally-generated clock can be input to the EXCLK pin. Table 1.5 lists the relationship between the high-speed system clock oscillator operating frequency and the supply voltage (V_{DD}).

Table 1.5 Operating Frequency and Supply Voltage for the RL78/G14

Item	Operating Frequency	V_{DD}
High-speed system clock oscillator	1 to 20 MHz	2.7 V ≤ V_{DD} ≤ 5.5 V
	1 to 8 MHz	1.8 V ≤ V_{DD} ≤ 2.7 V
	1 to 4 MHz	1.6 V ≤ V_{DD} ≤ 1.8 V

A comparison of the operating frequencies between the R8C/36M Group's XIN clock oscillation circuit and the RL78/G14 high-speed system clock oscillator is shown in Figure 1.1.

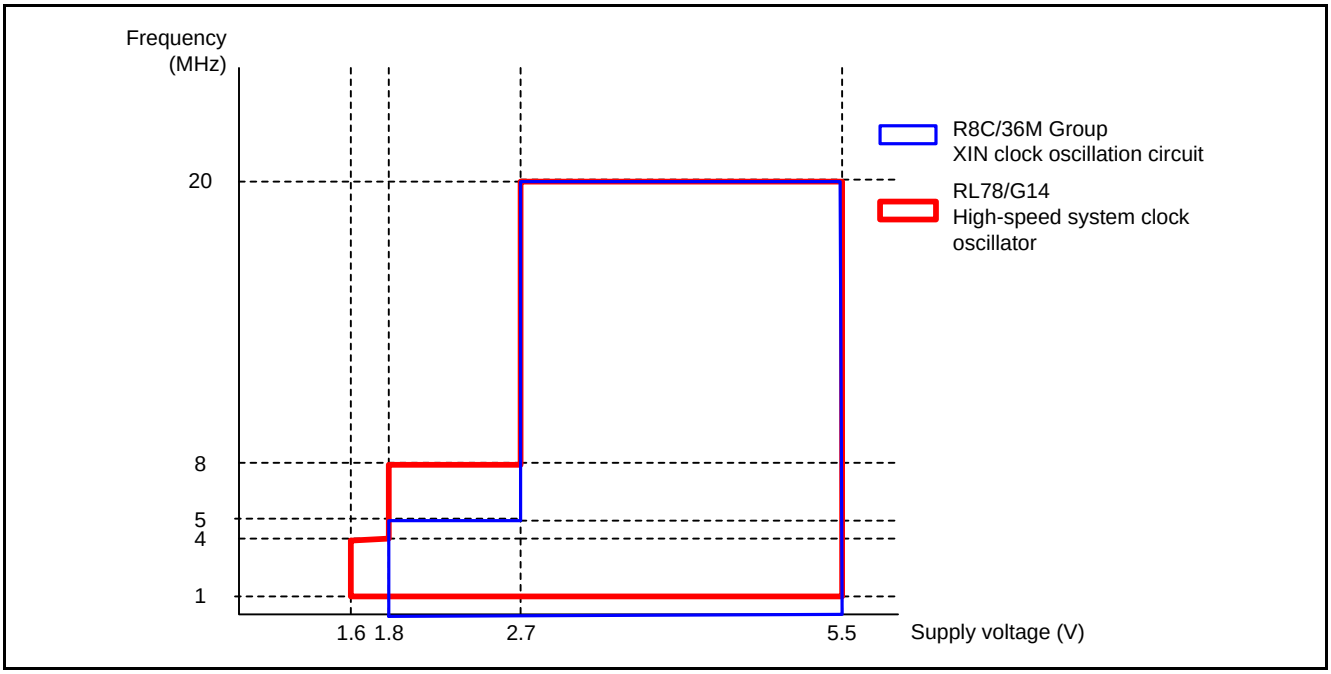

Figure 1.1 Comparison of Operating Frequencies between XIN Clock Oscillation Circuits

1.2 High-speed On-chip Oscillator

Clocks generated by the R8C/36M Group high-speed on-chip oscillator can be used as the clock source for the CPU clock, the peripheral function clock, fOCO, fOCO-F, fOCO40M, or fOCO128. The oscillating frequency can be specified as 40, 36.864, or 32 MHz by adjusting values in registers FRA1 and FRA3. Table 1.6 lists the relationship between the high-speed on-chip oscillator operating frequency and the supply voltage (V_{CC}).

Table 1.6 R8C/36M Group MCU Operating Frequency and Supply Voltage

Item	Operating Frequency	Vcc
High-speed on-chip oscillator	• 40 MHz (typ.) • 36.684 MHz (typ.) • 32 MHz (typ.)	1.8 V ≤ V_{CC} ≤ 5.5 V

Clocks generated by the RL78/G14 high-speed on-chip oscillator can be used as the clock source for the CPU clock or the peripheral function clock. The f_{HOCO} oscillating frequency can be specified as 64, 48, 32, 24, 16, 12, 8, 4, or 1 MHz by setting the user option byte. When f_{HOCO} is specified as 64 MHz or 48 MHz, f_{IH} is automatically set to 32 MHz or 24 MHz, respectively. When f_{HOCO} is specified as 32 MHz or below, f_{IH} is not divided and is set to the same frequency as f_{HOCO}. The high-speed on-chip oscillator clock is automatically set to the CPU clock after reset is released. Table 1.7 lists the relationship between the high-speed on-chip oscillator operating frequency and supply voltage (V_{DD}).

Table 1.7 Operating Frequency and Supply Voltage for the RL78/G14

Item	Operating Frequency	V_{DD}
High-speed on-chip oscillator	1, 4, 8, 12, 16, 24, 32, 48, 64 MHz (typ.)	1.6 V ≤ V_{DD} ≤ 5.5 V

A comparison of the operating frequencies between the R8C/36M Group's high-speed on-chip oscillator and the RL78/G14 high-speed on-chip oscillator is shown in Figure 1.2.

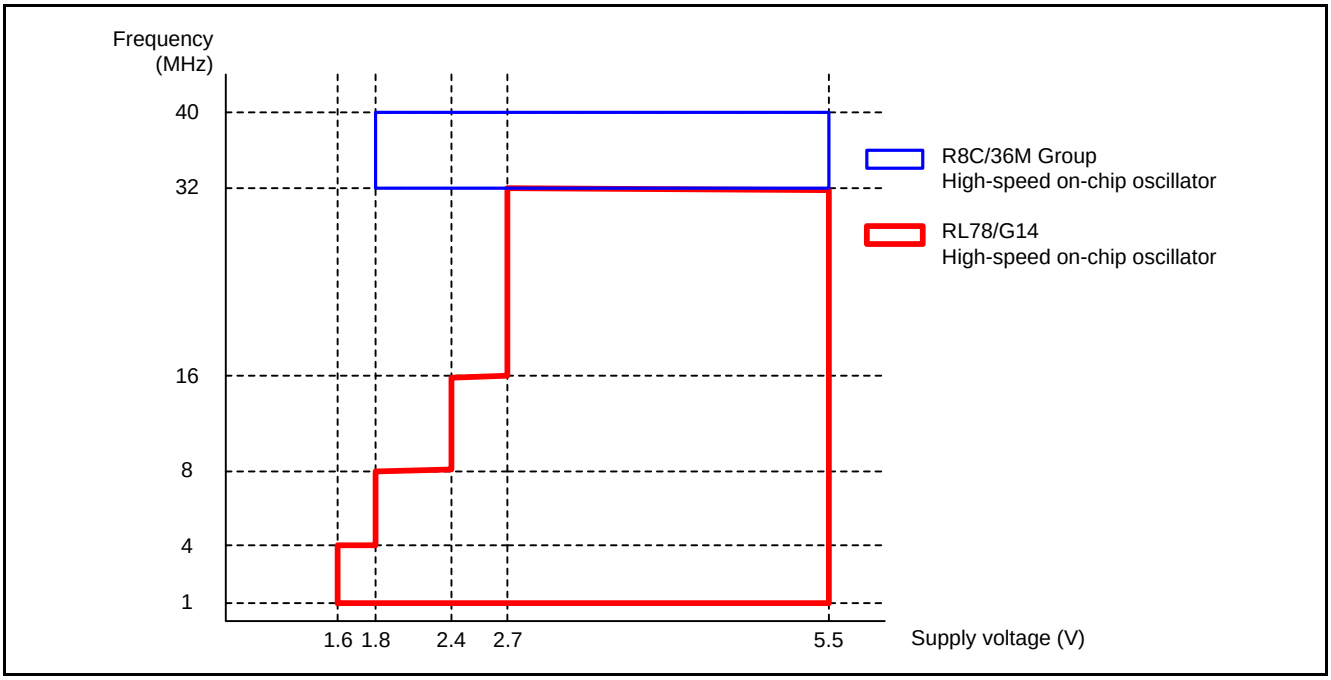

Figure 1.2 Comparison of Operating Frequencies between High-speed On-chip Oscillators

1.3 XCIN Clock Oscillation Circuit

Clocks generated by the R8C/36M Group XCIN clock oscillation circuit can be used as the clock source for the CPU clock or the peripheral function clock. To use the XCIN clock oscillation circuit, connect a crystal oscillator to pins XCIN and XCOUT. An externally-generated clock can be input to the XCIN pin. Table 1.8 lists the relationship between the XCIN clock oscillation circuit operating frequency and supply voltage (V_{CC}).

Table 1.8 Operating Frequency and Supply Voltage for the R8C/36M Group

Item	Operating Frequency	V_{CC}
XCIN clock oscillation circuit	32.768 to 50 kHz	1.8 V ≤ V_{CC} ≤ 5.5 V

Clocks generated by the RL78/G14 XT1 oscillator can be used as the clock source for the CPU clock or the peripheral function clock. The power consumption and oscillation margin for the XT1 oscillator can be adjusted by selecting the oscillation mode. To use the XT1 oscillator, connect a crystal resonator to pins XT1 and XT2. An externally-generated clock can be input to the EXCLKS pin. Table 1.9 lists the relationship between the subsystem clock oscillator operating frequency and the supply voltage (V_{DD}).

Table 1.9 Operating Frequency and Supply Voltage for the RL78/G14

Item	Operating Frequency	V_{DD}
Subsystem clock oscillator	32 to 35 kHz	1.6 V ≤ V_{DD} ≤ 5.5 V

A comparison of the operating frequencies between the R8C/36M Group's XCIN clock oscillation circuit and the RL78/G14 subsystem clock oscillator is shown in Figure 1.3.

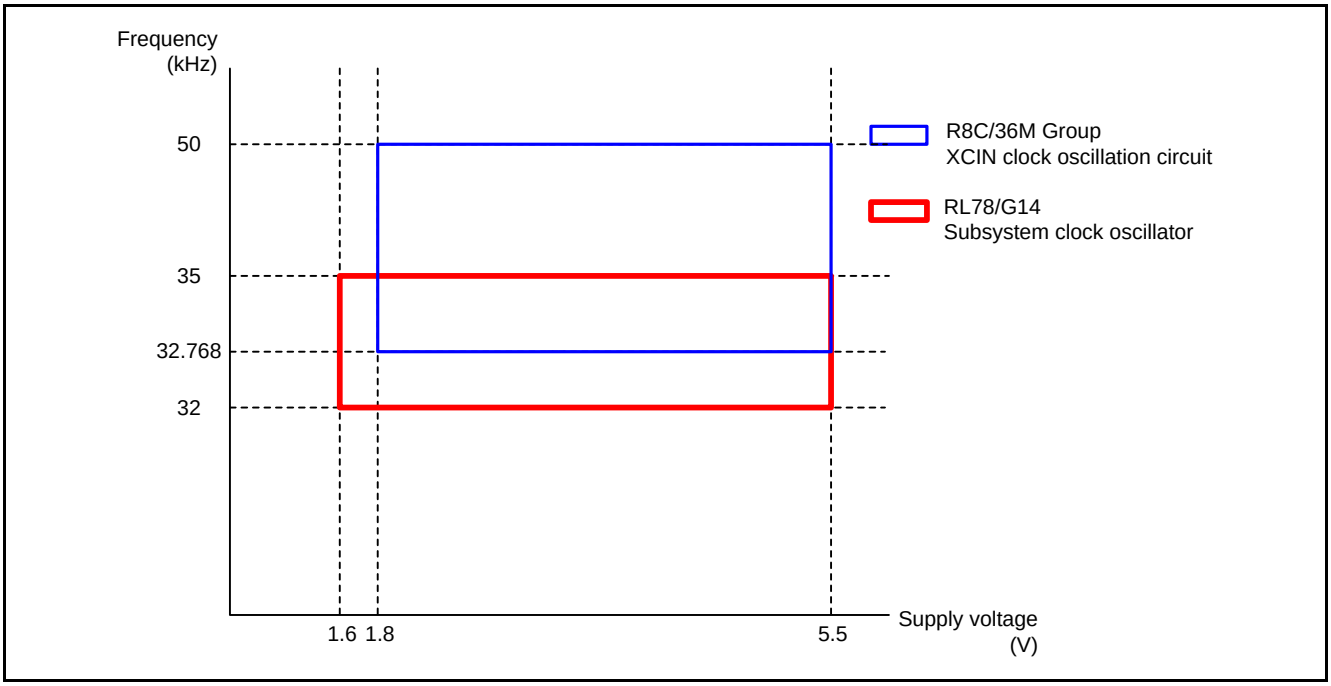

Figure 1.3 Comparison of Operating Frequencies between XCIN Clock Oscillation Circuits

1.4 Low-speed On-chip Oscillator

Clocks generated by the R8C/36M Group low-speed on-chip oscillator can be used as the clock source for the CPU clock, the peripheral function clock, fOCO, fOCO-S, or fOCO128. After a reset is released, clocks generated by the low-speed on-chip oscillator divided-by-1 (no division) are selected as the CPU clock. Table 1.10 lists the relationship between the low-speed on-chip oscillator operating frequency and the supply voltage (V_{CC}).

Table 1.10 Operating Frequency and Supply Voltage for the R8C/36M Group

Item	Operating Frequency	V_{CC}
Low-speed on-chip oscillator	125 kHz (typ.)	1.8 V ≤ V_{CC} ≤ 5.5 V

Clocks generated by the RL78/G14 low-speed on-chip oscillator can be used as the clock source for the watchdog timer, real-time clock, 12-bit interval timer, or timer RJ. It cannot be used as the clock source for the CPU clock. After a reset is released, the RL78/G14 low-speed on-chip oscillator stops when bit 4 (WDTON) in the option byte (000C0H) is 0, or oscillates when bit 4 in the option byte is 1. Table 1.11 lists the relationship between the low-speed on-chip oscillator operating frequency and the supply voltage (V_{DD}).

Table 1.11 Operating Frequency and Supply Voltage for the RL78/G14

Item	Operating Frequency	V_{DD}
Low-speed on-chip oscillator	15 kHz (typ.)	1.6 V ≤ V_{DD} ≤ 5.5 V

A comparison of the operating frequencies between the R8C/36M Group's low-speed on-chip oscillator and the RL78/G14 low-speed on-chip oscillator is shown in Figure 1.4.

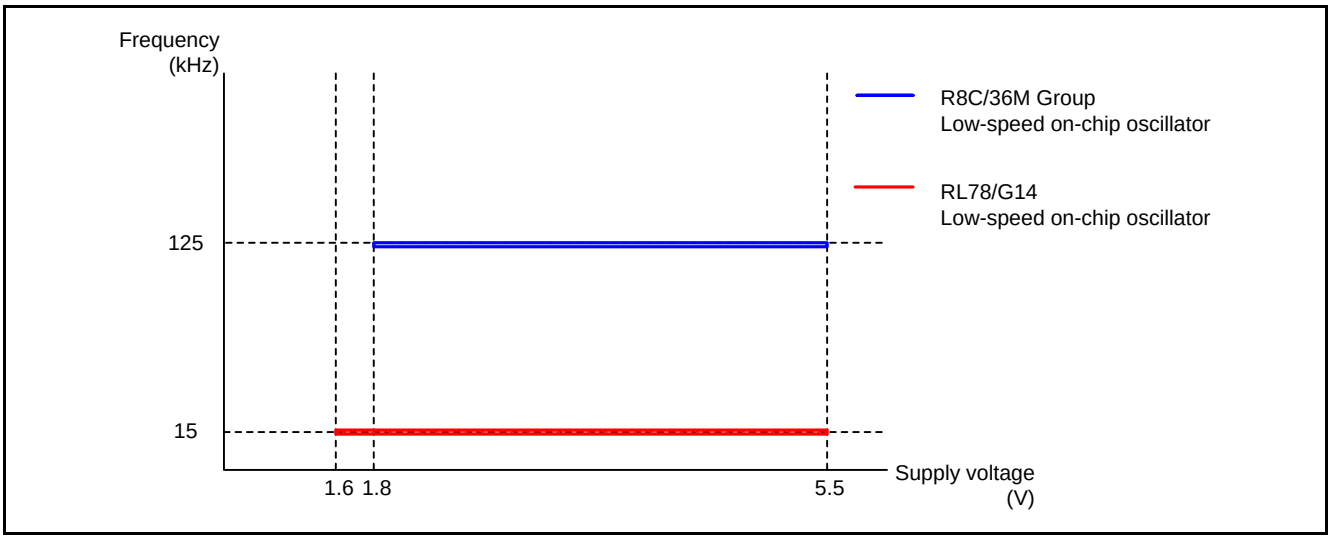

Figure 1.4 Comparison of Operating Frequencies between Low-speed On-chip Oscillators

2. Terms

Table 2.1 lists the comparison of terms between the R8C/36M Group and RL78/G14.

Table 2.1 Comparison of Terms between the R8C/36M Group and RL78/G14

Item	R8C/36M Group	RL78/G14
Oscillator	XIN clock oscillation circuit	High-speed system clock oscillator
	High-speed on-chip oscillator	High-speed on-chip oscillator
	XCIN clock oscillation circuit	XT1 oscillator
		Subsystem clock oscillator
	Low-speed on-chip oscillator	Low-speed on-chip oscillator
Peripheral function	Watchdog timer	Watchdog timer
Supply voltage	V_{CC}	V_{DD}

3. Reference Documents

User's Manual: Hardware
RL78/G14 User's Manual: Hardware Rev.1.00
R8C/36M Group User's Manual: Hardware Rev.1.01
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.

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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 manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord 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 one with a different type number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

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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 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

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.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

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