APPLICATION NOTE

RL78/G14, M16C/62P Group

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Migration Guide from M16C/62P to RL78/G14: Clock Generator

Abstract

This application note explains how to migrate from the clock generator of the M16C/62P Group to that of RL78/G14.

Target Devices

RL78/G14, M16C/62P 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 M16C/62P Group and RL78/G14

Table 1.1 and Table 1.2 show outlined specifications of the clock generators of the M16C/62P Group and RL78/G14. In addition, Table 1.3 describes differences in the clock generators.

Table 1.1 Outlined Specification of Clock Generator (M16C/62P Group)

Item	Main clock generation circuit	Sub clock generation circuit	On-chip oscillator	PLL frequency synthesizer
Application	• Clock source for CPU • Clock source for peripheral functions	• Clock source for CPU • Clock source for timers A and B	• Clock source for CPU • Clock source for peripheral functions • CPU and peripheral function clock sources when the main clock stops oscillating	• Clock source for CPU • Clock source for peripheral functions
Clock frequency	0 to 16 MHz	32.768 kHz	1 MHz (TPY.)	10 to 24 MHz
Connectable resonator	• Ceramic resonator • Crystal resonator	• Crystal resonator	—	—
Connection pin of resonator	XIN, XOUT	XCIN, XCOUT	—	—
Oscillation stop and restart function	Available	Available	Available	Available
Status after reset	Oscillating	Stopped	Stopped	Stopped
Other features	An externally generated clock can be input.	An externally generated clock can be input.	—	—

Table 1.2 Outlined Specification of Clock Generator (RL78/G14)

Item	Main system clock		Subsystem clock oscillator	Low-speed on-chip oscillator
	High-speed system clock oscillator	High-speed on-chip oscillator		
Application	• Clock source for CPU • Clock source for peripheral functions	• Clock source for CPU • Clock source for peripheral functions	• Clock source for CPU • Clock source for peripheral functions	• Watchdog timer • Real-time clock • 12-bit interval timer • Timer RJ
Clock frequency	1 to 20 MHz	64 MHz (TYP.) (Note 1)	32.768 kHz	15 kHz (TYP.)
Connectable resonator	• Ceramic resonator • Crystal resonator	—	Crystal resonator	—
Connection pin of resonator	X1, X2	—	XT1, XT2	—
Oscillation stop and restart function	Available			
Status after reset	Stopped	Oscillating	Stopped	Oscillating/stopped (Note 2)
Other features	An externally generated clock can be input.	—	An externally generated clock can be input.	—

Notes:

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

Table 1.3 Differences in the Clock Generators

Item	M16C/62P Group	RL78/G14
Oscillation accuracy of high-speed on-chip oscillator	No definition on 'high-speed' on-chip oscillator 1 MHz (TPY.) (-50 % to +100 %)	± 1 % (Note 1)
How to change oscillation frequency of high-speed on-chip oscillator	N/A	By setting the FRQSEL4 to FRQSEL0 bits of the user option byte (000C2H), following frequencies may be selected. • 64 MHz • 48 MHz • 32 MHz • 24 MHz • 16 MHz • 12 MHz • 8 MHz • 4 MHz • 1 MHz
Oscillation stabilization time of high-speed on-chip oscillator	Several ten μs	Reset: Included in the reset processing time Reset processing time: • When LVD is off: 417 μs (TYP.), 554 μs (MAX.) • When LVD is on: 690 μs (TYP.), 867 μs (MAX.) Other than reset: • When FRQSEL4 = 0: 18 μs to 65 μs • When FRQSEL4 = 1: 18 μs to 135 μs
Oscillation accuracy of low-speed on-chip oscillator	No definition on 'low-speed' on-chip oscillator 1 MHz (TPY.) (-50 % to +100 %)	± 15 %
CPU clock divider	Available	Available only in the high-speed on-chip oscillator
CPU clock after reset release	Main clock (divided by 8 mode)	High-speed on-chip oscillator
Oscillation mode selection function of subsystem clock	Available	Available

Note

1. Measurement conditions of V_{DD}: 1.8 V to 5.5 V, -20 to + 85 ˚C

1.1 Main Clock Generation Circuit

Clocks generated by the main clock generation circuit of the M16C/62P Group may be used as the clock source for the CPU clock and peripheral function clock. When using the main clock generation circuit, connect a crystal resonator or ceramic resonator between the XIN and XOUT pins. A clock generated externally can be also used by inputting it to the XIN pin. Table 1.4 lists the operating frequency and supply voltage (V_{CC}) of the main clock generation circuit. After reset, the main clock divided by 8 is selected for the CPU clock.

Table 1.4 Operating Frequency and Supply Voltage of the M16C/62P Group Main Clock Generation Circuit

Item	Operating frequency	Vcc
Main clock generation circuit	0 to 16 MHz	3.0 V ≤ Vcc ≤ 5.5 V
	0 to 16 MHz (Note1)	2.7 V ≤ Vcc < 3.0 V

Note 1: Operating frequency = 20 × Vcc - 44

Clocks generated by the high-speed system clock oscillator of RL78/G14 can be used as the clock source for the CPU clock and peripheral function clock. When using the high-speed system clock oscillator, connect a crystal resonator or ceramic resonator to the X1 and X2 pins. A clock generated externally may also be used by inputting it to the EXCLK pin. Table 1.5 shows a relationship between operating frequency and supply voltage (V_{DD}) of the RL78/G14 high-speed system clock oscillator.

Table 1.5 Operating Frequency and Supply Voltage of the RL78/G14 High-speed System Clock Oscillator

Item	Operating frequency	VDD
High-speed system clock oscillator	1 to 20 MHz	2.7 V ≤ VDD ≤ 5.5 V
	1 to 16 MHz	2.4 V ≤ VDD < 2.7 V
	1 to 8 MHz	1.8 V ≤ VDD < 2.4 V
	1 to 4 MHz	1.6 V ≤ VDD < 1.8 V

Figure 1.1 illustrates a comparison of operating frequencies of the main clock generation circuit of the M16C/62P Group and the high-speed system clock oscillator of RL78/G14.

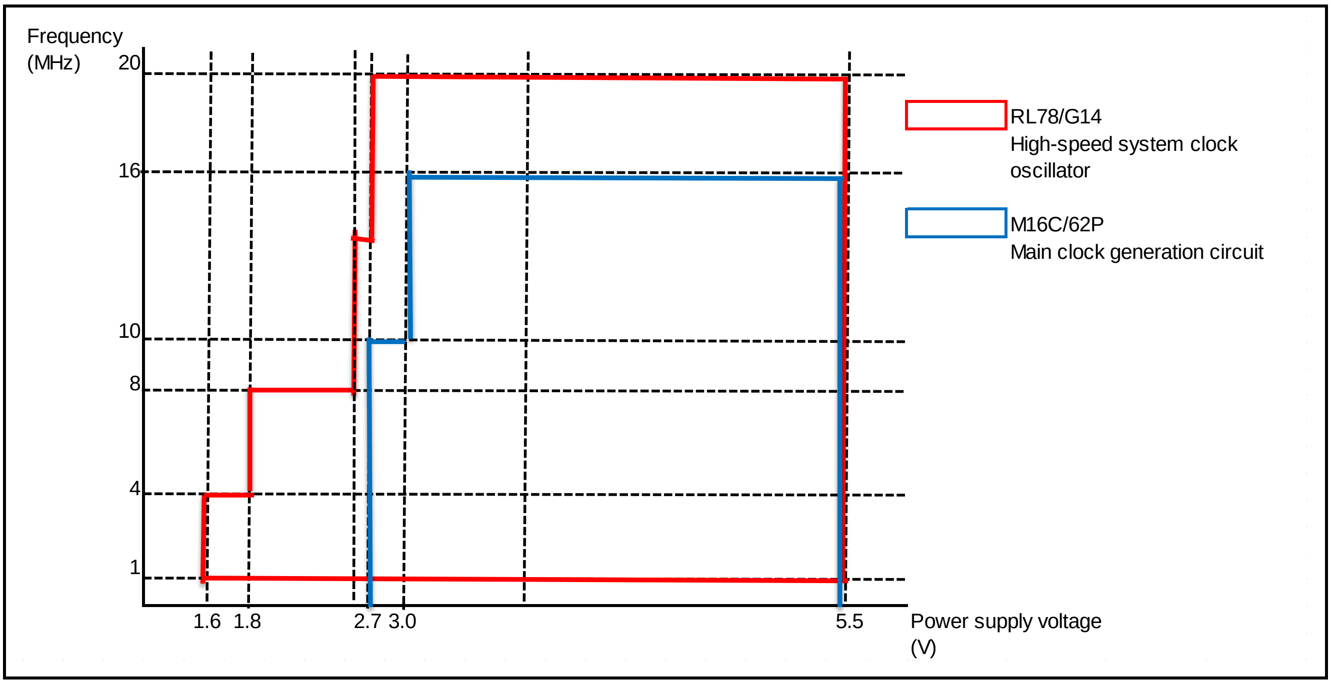

Figure 1.1 Comparison of Operating Frequencies of Main Clock Generation Circuit

1.2 High-speed On-chip Oscillator

As for the on-chip oscillator, the M16C/62P Group does not define it as either high-speed oscillator or low-speed oscillator. However, a clock, approximately 1MHz, is supplied by the on-chip oscillator. This clock can be used as the clock source for the CPU and peripheral function clocks. In addition, if the PM22 bit in the PM2 register is “1” (on-chip oscillator clock for the watchdog timer count source), this clock is used as the count source for the watchdog timer. Table 1.6 lists the operating frequency and supply voltage (V_{CC}) of the M16C/62P Group on-chip oscillator.

Table 1.6 Operating frequency and Supply Voltage of the M16C/62P Group On-chip Oscillator

Item	Operating frequency	VCC
On-chip oscillator	1 MHz (TYP.)	2.7 V ≤ VCC ≤ 5.5 V

Clocks generated by the high-speed on-chip oscillator of RL78/G14 can be used as the clock source for the CPU clock and peripheral function clock. The oscillation frequency can be selected from fHOCO = 64 MHz, 48 MHz, 32 MHz, 24 MHz, 16 MHz, 12 MHz, 8 MHz, 4 MHz or 1 MHz by setting the user option byte. When 64 MHz or 48 MHz is selected as fHOCO, fIH is set to 32 MHz or 24 MHz, respectively. When 32 MHz or less is selected as fHOCO, fIH is not divided and set to the same frequency as fHOCO. After a reset release, the high-speed on-chip oscillator clock is set as the CPU clock. Table 1.7 shows a relationship between the operating frequency and supply voltage (VDD) of the RL78/G14 high-speed on-chip oscillator

Table 1.7 Operating frequency and Supply Voltage of the RL78/G14 High-speed On-chip Oscillator

Item	Operating frequency	VDD
High-speed on-chip oscillator	1 to 64 MHz (TYP.)	1.6 V ≤ VDD ≤ 5.5 V

Figure 1.2 shows a comparison of operating frequency between the M16C/62P Group on-chip oscillator and RL78/G14 high-speed on-chip oscillator.

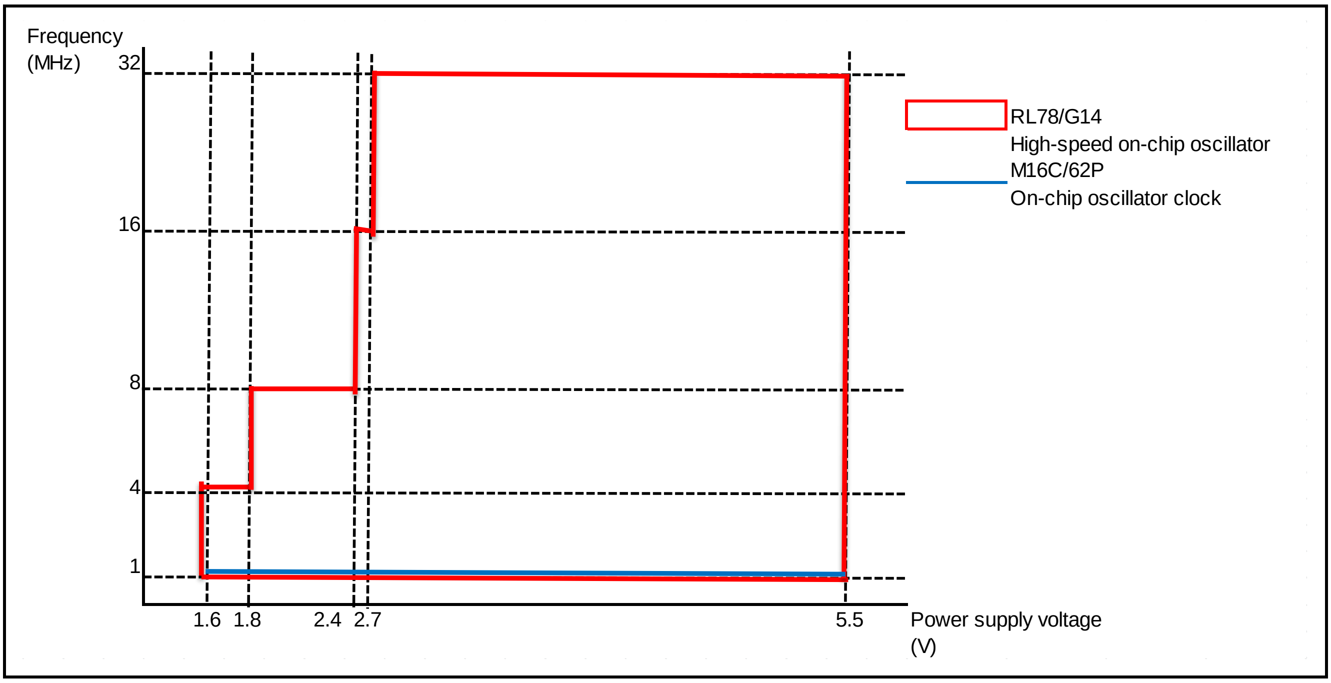

Figure 1.2 Comparison of Operating Frequencies of High-speed On-chip Oscillator

1.3 Sub Clock Generation Circuit

Clocks generated by the sub clock generation circuit of the M16C/62P Group may be used as the clock source for the CPU clock, as well as the timer A and timer B count sources. When using the sub clock generation circuit, connect a crystal resonator between the XCIN and XCOUT pins. A clock generated externally can be also used by inputting it to the XCIN pin. Table 1.8 lists the operating frequency and supply voltage (V_{CC}) of the sub clock generation circuit.

Table 1.8 Operating frequency and Supply Voltage of the M16C/62P Group Sub Clock Generation Circuit

Item	Operating frequency	VCC
Sub clock generation circuit	32.768 to 50 kHz	2.7 V ≤ VCC ≤ 5.5 V

Clocks generated by the XT1 oscillator of RL78/G14 can be used as the clock source for the CPU clock and peripheral function clock. Selecting the oscillation mode enables the XT1 oscillator to change consumption power and oscillation margin. When using the XT1 oscillator, connect a crystal resonator to the XT1 and XT2 pins. An external clock can be also used by inputting it to the EXCLKS pin. Table 1.9 shows a relationship between the operating frequency and supply voltage (VDD) of the RL78/G14 subsystem clock oscillator.

Table 1.9 Operating frequency and Supply Voltage of the RL78/G14Subsystem Clock Oscillator

Item	Operating frequency	VDD
Subsystem clock oscillator	32 to 35 kHz	1.6 V ≤ VDD ≤ 5.5 V

Figure 1.3 illustrates a comparison of operating frequencies of the sub clock generation circuit of the M16C/62P Group and the subsystem clock oscillator of RL78/G14.

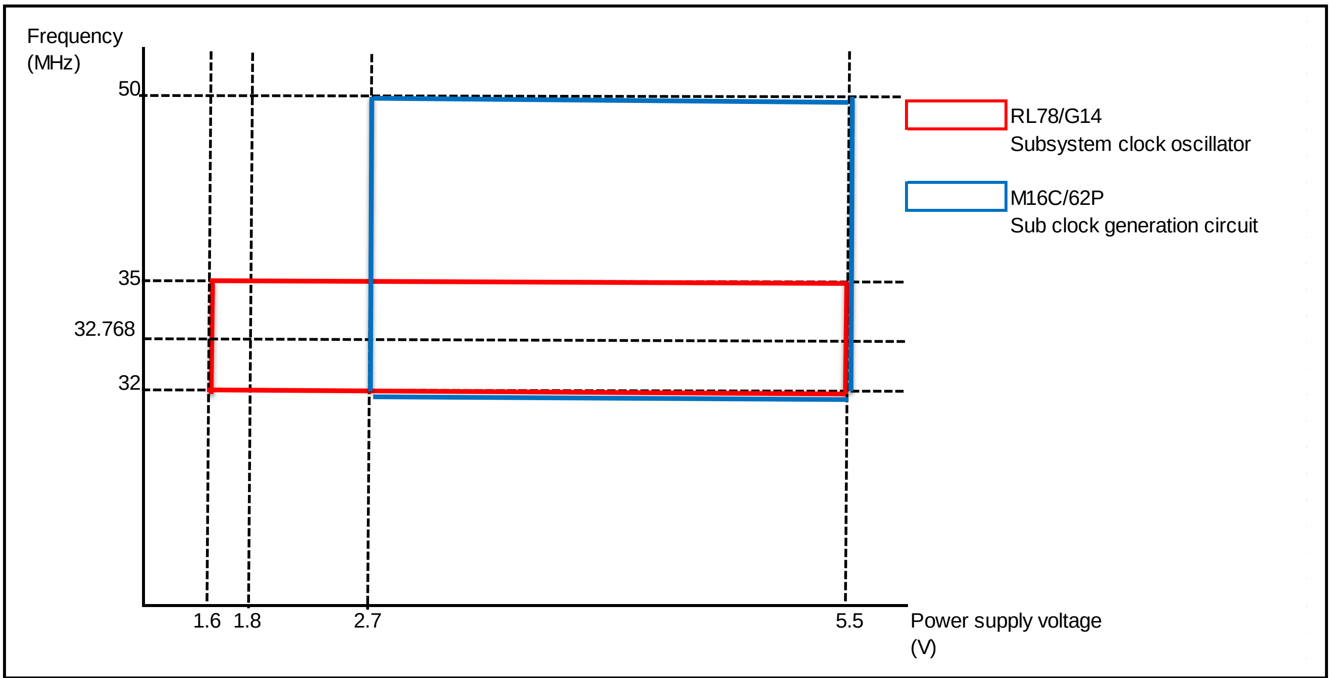

Figure 1.3 Comparison of Operating Frequencies of Sub Clock Generation Circuit

1.4 Low-speed On-chip Oscillator

As for the on-chip oscillator, the M16C/62P Group does not define it as either high-speed oscillator or low-speed oscillator. However, a 1-MHz (TYP.) clock is supplied by the on-chip oscillator. This clock can be used as the clock source for the CPU and peripheral function clocks. With a divider, a 31.25-kHz clock can be generated through division by 32.

Table 1.10 Operating frequency and Supply Voltage of the M16C/62P Group On-chip Oscillator

Item	Operating frequency	VCC
On-chip oscillator	1 MHz (TYP.)	2.7 V ≤ VCC ≤ 5.5 V

Clocks generated by the low-speed on-chip oscillator of RL78/G14 can be used as the clock source for the watchdog timer, real-time clock, 12-bit interval timer, and timer RJ. However, it may not be used as the CPU clock source. After reset release, this clock stops when the bit 4 (WDTON) of the option byte (000C0H) is set to 0 and it oscillates when the bit is 1. Table 1.11 shows a relationship between the operating frequency and supply voltage (VDD) of the RL78/G14 low-speed on-chip oscillator.

Table 1.11 Operating frequency and Supply Voltage of the RL78/G14 Low-speed On-chip Oscillator

Item	Operating frequency	VDD
Low-speed on-chip oscillator	15 kHz (TYP.)	1.6 V ≤ VDD ≤ 5.5 V

Figure 1.4 shows a comparison of operating frequencies of the M16C/62P Group on-chip oscillator (with frequency after the divider is used) and RL78/G14 low-speed on-chip oscillator.

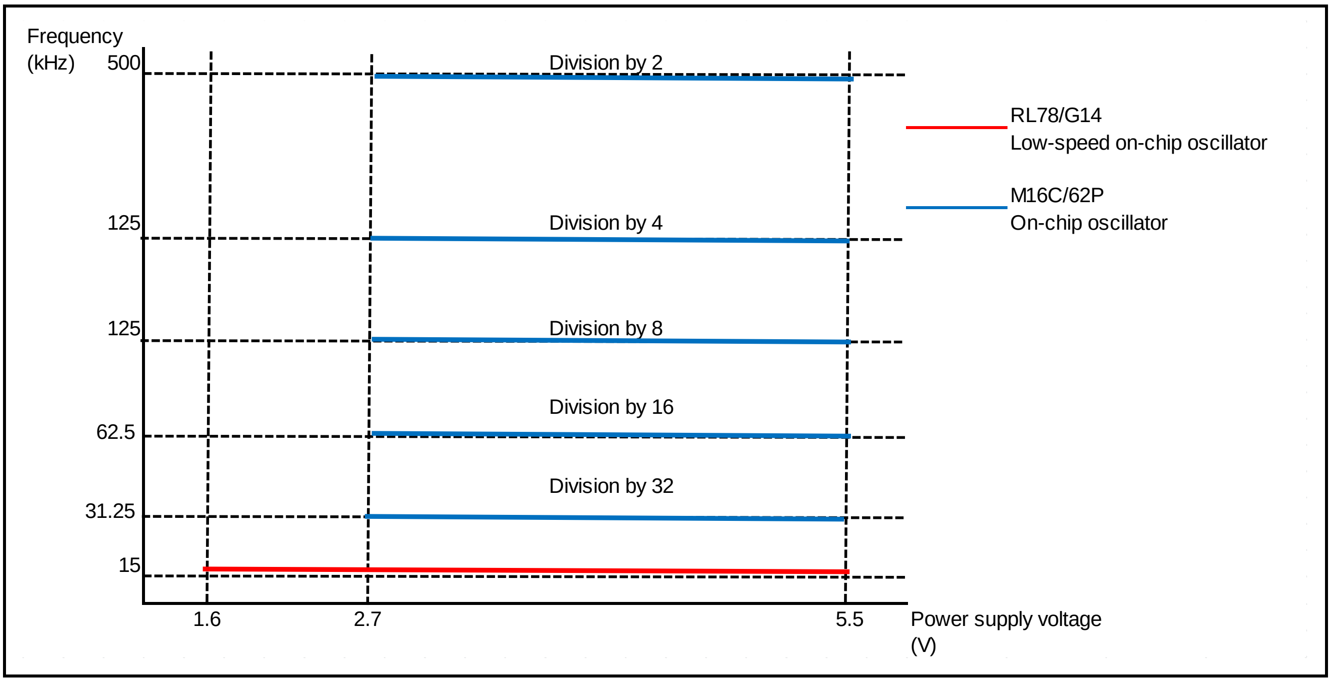

Figure 1.4 Comparison of Operating Frequencies of the Low-speed On-chip Oscillator

1.5 PLL Clock

The PLL clock is generated by PLL frequency synthesizer. This clock can be used as the clock source for the CPU and peripheral function clocks. After reset, the PLL frequency synthesizer is turned off. The PLL clock frequency is determined by the following equation.

PLL clock frequency = f(XIN) × (multiplying factor set by the PLC02 to PLC00 bits)
(However, PLL clock frequency is 10 MHz to 24 MHz.)

The PLC02 to PLC00 bits can be set only once after reset. Table 1.12 shows examples for setting PLL clock frequencies.

Table 1.12 Examples for Setting PLL Clock Frequencies

XIN (MHz)	PLC02	PLC01	PLC00	Multiplying Factor	PLL clock (MHz)
10	0	0	1	2	20
5	0	1	0	4	
3.33	0	1	1	6	
2.5	1	0	0	8	
12	0	0	1	2	24
6	0	1	0	4	
4	0	1	1	6	
3	1	0	0	8	

RL78/G14 does not have a PLL clock. Use the high-speed system clock XIN or high-speed on-chip oscillator clock.

Figure 1.5 illustrates operating frequency of the M16C/62P Group PLL clock.

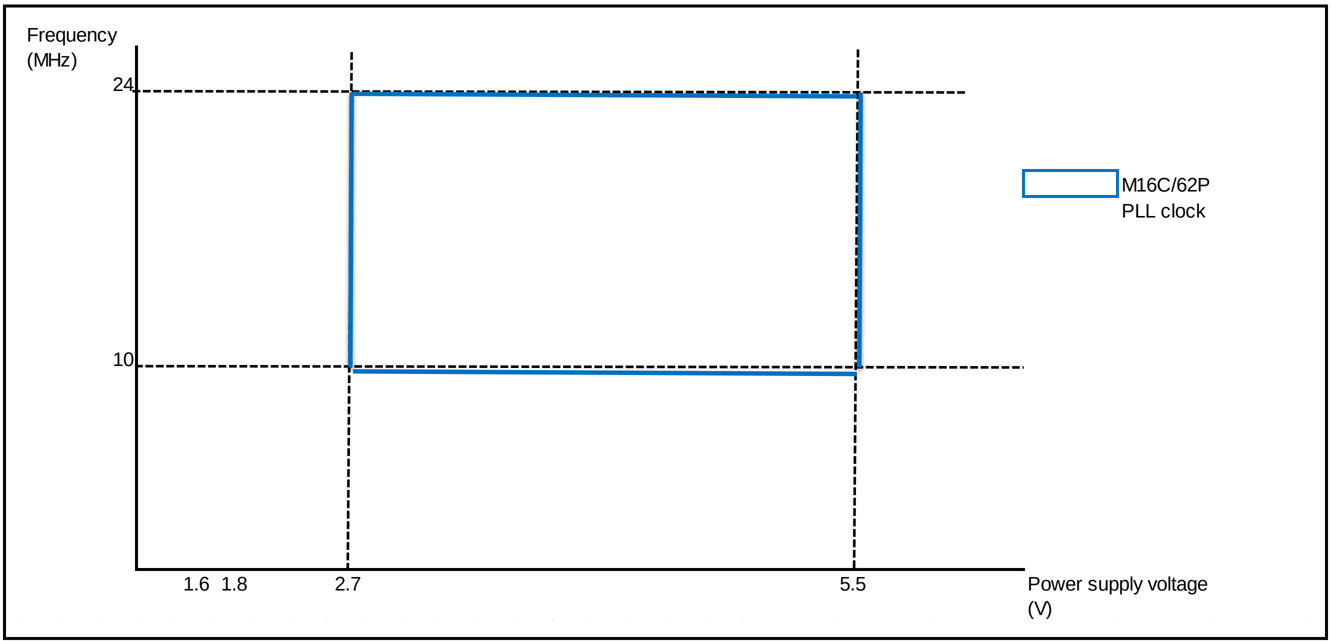

Figure 1.5 Operating Frequency of the M16C/62P Group PLL Clock

2. Terms

Terms for the M16C/62P Group and RL78/G14 are compared in Table 2.1.

Table 2.1 Comparison of Terms for the M16C/62P Group and RL78/G14

Item	M16C/62P Group	RL78/G14
Oscillator	Main clock generation circuit	High-speed system clock oscillator X1 oscillator
	On-chip oscillator	High-speed on-chip oscillator
	Sub clock generation circuit	Subsystem clock oscillator XT1 oscillator
	On-chip oscillator	Low-speed on-chip oscillator
Supply voltage	VCC	VDD

3. Reference Documents

RL78/G14 User's Manual: Hardware Rev. 2.00
M16C/62P Group Hardware ManualRev.2.41
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

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REVISION HISTORY	RL78/G14, M16C/62P Group Application Note Migration Guide from M16C/62P to RL78/G14: Clock Generator

Rev.	Date	Description	
		Page	Summary
1.00	Mar.6,2014	—	First edition issued

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.

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