RL78/F13, F14

Porting Guide from R8C/3x to RL78/F13, F14

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Abstract

The RL78/F13, F14 products are the successors of the R8C/3x groups. This application note provides information on porting from R8C/3x products that you are currently using to the RL78/F13, F14 products that can replace the R8C/3x products. This application note also provides information on those functions of the RL78/F13, F14 products that can replace the functions of the R8C/3x products.

For details on each product, refer to the user's manual of the product.

Target Devices

The 80-pin, 64-pin, 48-pin, 32-pin, 30-pin, and 20-pin products shown below are the target devices. Note

- R8C/38W, 38X, 38Y, 38Z
- R8C/36W, 36X, 36Y, 36Z
- R8C/34W, 34X, 34Y, 34Z, R8C/34P, 34R
- R8C/33G, 33H
- R8C/32G, 32H
- RL78/F13, F14

Note: The 32-pin products of RL78/F13, F14 are QFN package.
There are no 20 pin product of RL78/F14 and 30 pin product of R8C/3x.

Contents

1. Product Memory/Package Comparison

The lineup of the R8C/3x products is shown in Table 1-1, broken down by the pin count, memory size, and CAN channel count of each product. Also, the lineup of the RL78/F13, F14 products that can replace the R8C/3x products is shown in Table 1-2 and Table 1-3.

1.1 R8C/3x Product Lineup

Table 1-1 R8C/38W, 38X, 38Y, 38Z Products and Replacement Products (RL78/F13, F14) (1)

Memory			80-pin products	
Code flash	Data flash	RAM	CAN：N/A	CAN：1 ch
128K	4KB	10K	R5F2138CY	R5F2138CW
	—		R5F2138CZ	R5F2138CX
96KB	4KB	8KB	R5F2138AY	R5F2138AW
	—		R5F2138AZ	R5F2138AX
64KB	4KB	6KB	R5F21388Y	R5F21388W
	—		R5F21388Z	R5F21388X
Replacement products			RL78/F13,F14	RL78/F13,F14

Table 1-1 R8C/36W, 36X, 36Y, 36Z Products and Replacement Products (RL78/F13, F14) (2)

Memory			64-pin products	
Code flash	Data flash	RAM	CAN：N/A	CAN：1 ch
128K	4KB	10K	R5F2136CY	R5F2136CW
	—		R5F2136CZ	R5F2136CX
96KB	4KB	8KB	R5F2136AY	R5F2136AW
	—		R5F2136AZ	R5F2136AX
64KB	4KB	6KB	R5F21368Y	R5F21368W
	—		R5F21368Z	R5F21368X
Replacement products			RL78/F13,F14	RL78/F13,F14

Table 1-1 R8C/34W, 34X, 34Y, 34Z Products, R8C/34P, 34R Products and Replacement Products (RL78/F13, F14) (3)

Memory			48-pin products	
Code flash	Data flash	RAM	CAN：N/A	CAN：1 ch
128K	4KB	10K	R5F2134CY	R5F2134CW
	—		R5F2134CZ	R5F2134CX
96KB	4KB	8KB	R5F2134AY	R5F2134AW
	—		R5F2134AZ	R5F2134AX
64KB	4KB	6KB	R5F21348Y	R5F21348W
	—		R5F21348Z	R5F21348X
48KB	4KB	4KB	R5F21347Y	R5F21347W
	—		R5F21347Z	R5F21347X
32KB	4KB	2.5KB	R5F21346Y R5F21346P	R5F21346W
	—		R5F21346Z R5F21346R	R5F21346X
16KB	4KB	1.5KB	R5F21344P	—
	—		R5F21344R	—
Replacement products			RL78/F13,F14	RL78/F13,F14

Table 1-1 R8C/33G, 33H Products and Replacement Products (RL78/F13) (4)

Memory			32-pin products	
Code flash	Data flash	RAM	CAN：N/A	CAN：1 ch
32KB	4KB	2.5KB	R5F21336G	—
	—		R5F21336H	—
16KB	4KB	1.5KB	R5F21334G	—
	—		R5F21334H	—
Replacement products			RL78/F13	—

Table 1-1 R8C/32G, 32H Products and Replacement Products (RL78/F13) (5)

Memory			20-pin products	
Code flash	Data flash	RAM	CAN：N/A	CAN：1 ch
32KB	4KB	2.5KB	R5F21326G	—
	—		R5F21326H	—
16KB	4KB	1.5KB	R5F21324G	—
	—		R5F21324H	—
Replacement products			RL78/F13	—

1.2 Replacement Product Lineup (RL78/F13, F14)

Table 1-2 Replacement Product Lineup (RL78/F13) (1)

Memory			80-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
128KB	4KB	8KB	R5F10AMG	R5F10BMG
96KB	4KB	6KB	R5F10AMF	R5F10BMF

Table 1-2 Replacement Product Lineup (RL78/F13) (2)

Memory			64-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
128KB	4KB	8KB	R5F10ALG	R5F10BLG
96KB	4KB	6KB	R5F10ALF	R5F10BLF

Table 1-2 Replacement Product Lineup (RL78/F13) (3)

Memory			48-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
128KB	4KB	8KB	R5F10AGG	R5F10BGG
96KB	4KB	6KB	R5F10AGF	R5F10BGF
64KB	4KB	4KB	R5F10AGE	R5F10BGE
48KB	4KB	3KB	R5F10AGD	R5F10BGD
32KB	4KB	2KB	R5F10AGC	R5F10BGC

Table 1-2 Replacement Product Lineup (RL78/F13) (4)

Memory			32-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
48KB	4KB	3KB	R5F10ABD	R5F10BBD
32KB	4KB	2KB	R5F10ABC	R5F10BBC

Table 1-2 Replacement Product Lineup (RL78/F13) (5)

Memory			30-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
48KB	4KB	3KB	R5F10AAD	R5F10BAD
32KB	4KB	2KB	R5F10AAC	R5F10BAC

Table 1-2 Replacement Product Lineup (RL78/F13) (6)

Memory			20-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
48KB	4KB	3KB	R5F10A6D	—
32KB	4KB	2KB	R5F10A6C	—

Table 1-3 Replacement Product Lineup (RL78/F14) (1)

Memory			80-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
128KB	8KB	10KB	—	R5F10PMG
96KB	4KB	8KB	—	R5F10PMF
64KB	4KB	6KB	—	R5F10PME

Table 1-3 Replacement Product Lineup (RL78/F14) (2)

Memory			64-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
128KB	8KB	10KB	—	R5F10PLG
96KB	4KB	8KB	—	R5F10PLF
64KB	4KB	6KB	—	R5F10PLE

Table 1-3Replacement Product Lineup (RL78/F14) (3)

Memory			64-pin products	
Code flash	Data flash	RAM	CAN: N/A	CAN：1 ch
128KB	8KB	10KB	—	R5F10PGG
96KB	4KB	8KB	—	R5F10PGF
64KB	4KB	6KB	—	R5F10PGE
48KB	4KB	4KB	—	R5F10PGD

Remark: Besides the products listed above, the RL78/F13, F14 products with different packages and memory size are also available. For details, refer to the User's Manual: Hardware of the applicable product.

2. Product Feature Comparison

Table 2-1 to Table 2-6 compare the features of the R8C/3x products with the counterparts of the RL78/F13, F14 products, broken down by their packages. Please use it as a reference when porting. For details on each feature, refer to the user's manual.

2.1 80-pin Products

Table 2-1 Feature Comparison between 80-pin Products of R8C/3x and RL78/F13, F14

Items	R8C/38x	RL78/F13 (R5F10AMx, R5F10BMx)	RL78/F14 (R5F10PMx)
CPU	R8C CPU core, 20 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)
Memory	Code flash: 128/96/64 KB Data flash: 4/- KB RAM: 10/8/6 KB	Code flash: 128/96/64 KB Data flash: 4 KB RAM: 8/6/4 KB	Code flash: 256/192/128/96/64 KB Data flash: 8/4 KB RAM: 20/16/10/8/6 KB
Voltage detection	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit
I/O ports	CMOS I/O: 75 Input only: 1	CMOS I/O: 68 Input only: 5 Output only: 1	CMOS I/O: 68 Input only : 5 Output only: 1
Clock	XIN, HOCO, LOCO	X1, PLL, HOCO, XT1, LOCO	X1, PLL, HOCO, XT1, LOCO
External interrupt inputs	$\overline{\text{INT}}$ × 5 ch, Key input × 4 ch Priority level: 7 levels	INTP × 12 ch, Key input × 8 ch Priority level: 4 levels	INTP × 14/12 ch, Key input × 8 ch Priority level: 4 levels
Watchdog timer	14-bit timer × 1 (with prescaler) (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)
DTC	1 unit	1 unit	1 unit

Items	R8C/38x	RL78/F13 (R5F10AMx, R5F10BMx)	RL78/F14 (R5F10PMx)
Timer	Timer RA0, RA1: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode) Timer RB: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode) Timer RC: 16bits (with 4 capture/compare) × 1 ch (Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output 1 pin)) Timer RD: 16bits (with 4 capture/compare) × 2 ch (Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode(PWM output 2 pins with fixed period)) Timer RE: 8bits × 1 ch (Output compare mode) Timer RF: 16bits × 1 ch (Input capture mode (input capture function), output compare mode (output compare function)) Timer RG: 16bits × 1ch (Timer mode (input capture function, output compare function), PWM mode (output 1 pin), phase counting mode (available automatic measurement for the counts of 2-phase encoder))	TAU: 16-bit timer (8 ch + 4 ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6 pins), Multiple PWM output(10 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch	TAU: 16-bit timer (8 ch × 2/ 8ch + 4ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(8/6 pins), Multiple PWM output(14/10 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch
Serial interface	UART0, 1: 2ch (Clock synchronous serial I/O mode, UART mode) UART2: 1ch (Clock synchronous serial I/O mode, UART mode, I^2C mode(I^2C-bus), IE mode(IEbus), Multiprocessor mode)	SAU: 2 units (CSI(SPI): 4 ch, Simplified I^2C: 4 ch, UART: 2 ch) Multi-master I^2C (IICA): 1 ch LIN/UART (RLIN3): 1 ch	SAU: 2 units (CSI(SPI): 4 ch, Simplified I^2C: 4 ch, UART: 2 ch) Multi-master I^2C (IICA): 1 ch LIN/UART (RLIN3): 2/1 ch
SSU	1 ch		
LIN module	UART0, 1, Timer RA0, RA1: 2 ch	RLIN3：1 ch UART0, TAU07, INTP0：1ch	RLIN3：2/1 ch UART0, TAU07, INTP0：1ch
CAN module	1/- ch	1/- ch	1 ch
A/D converter	10-bit resolution: 20 ch	10-bit resolution: 20 ch	10-bit resolution: 25/20 ch
Operating temperature	J-version: -40 to +85°C K-version: -40 to +125°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C
Package	80-pin LQFP	80-pin LQFP	80-pin LQFP

2.2 64-pin Products

Table 2-2 Feature Comparison between 64-pin Products of R8C/3x and RL78/F13, F14

Items	R8C/36x	RL78/F13 (R5F10ALx, R5F10BLx)	RL78/F14 (R5F10PLx)
CPU	R8C CPU core, 20 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)
Memory	Code flash: 128/96/64 KB Data flash: 4/- KB RAM: 10/8/6 KB	Code flash: 128/96/64/48/32 KB Data flash: 4 KB RAM: 8/6/4/3/2 KB	Code flash: 256/192/128/96/64 KB Data flash: 8/4 KB RAM: 20/16/10/8/6 KB
Voltage detection	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit
I/O ports	CMOS I/O: 59 Input only: 1	CMOS I/O: 52 Input only: 5 Output only: 1	CMOS I/O: 52 Input only : 5 Output only: 1
Clock	XIN, HOCO, LOCO	X1, PLL, HOCO, XT1, LOCO	X1, PLL, HOCO, XT1, LOCO
External interrupt inputs	$\overline{\text{INT}}$ × 5 ch, Key input × 4 ch Priority level: 7 levels	INTP × 13/12/8 ch, Key input × 8 ch Priority level: 4 levels	INTP × 13/12 ch, Key input × 8 ch Priority level: 4 levels
Watchdog timer	14-bit timer × 1 (with prescaler) (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)
DTC	1 unit	1 unit	1 unit
Timer	Timer RA0, RA1: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode) Timer RB: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode) Timer RC: 16bits (with 4 capture/compare) × 1 ch (Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output 1 pin)) Timer RD: 16bits (with 4 capture/compare) × 2 ch (Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode(PWM output 2 pins with fixed period)) Timer RE: 8bits × 1 ch (Output compare mode) Timer RF: 16bits × 1 ch (Input capture mode (input capture function), output compare mode (output compare function)) Timer RG: 16bits × 1ch (Timer mode (input capture function, output compare function), PWM mode (output 1 pin), phase counting mode (available automatic measurement for the counts of 2-phase encoder))	TAU: 16-bit timer (8 ch + 4 ch/8 ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6/4 pins), Multiple PWM output(10/7 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch	TAU: 16-bit timer (8 ch × 2/ 8ch + 4ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(8/6 pins), Multiple PWM output(14/10 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch

Items	R8C/36x	RL78/F13 (R5F10ALx, R5F10BLx)	RL78/F14 (R5F10PLx)
Serial interface	UART0, 1: 2ch (Clock synchronous serial I/O mode, UART mode) UART2: 1ch (Clock synchronous serial I/O mode, UART mode, I^2C mode(I^2C-bus), IE mode(IEbus), Multiprocessor mode)	SAU: 2 units (CSI(SPI): 4 ch, Simplified I^2C: 4 ch, UART: 2 ch) /1 unit (CSI(SPI): 2 ch, Simplified I^2C: 2 ch, UART: 1 ch) Multi-master I^2C (IICA): 1/- ch LIN/UART (RLIN3): 1 ch	SAU: 2 units (CSI(SPI): 4 ch, Simplified I^2C: 4 ch, UART: 2 ch) Multi-master I^2C (IICA): 1 ch LIN/UART (RLIN3): 2/1 ch
SSU	1 ch		
LIN module	UART0, 1, Timer RA0, RA1: 2 ch	RLIN3：1 ch UART0, TAU07, INTP0：1ch	RLIN3：2/1 ch UART0, TAU07, INTP0：1ch
CAN module	1/- ch	1/- ch	1 ch
A/D converter	10-bit resolution: 16 ch	10-bit resolution: 19/12 ch	10-bit resolution: 20/19 ch
Operating temperature	J-version: -40 to +85°C K-version: -40 to +125°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C
Package	64-pin LQFP	64-pin LQFP	64-pin LQFP

2.3 48-pin Products

Table 2-3 Feature Comparison between 48-pin Products of R8C/3x and RL78/F13, F14

Items	R8C/34x	RL78/F13 (R5F10AGx, R5F10BGx)	RL78/F14 (R5F10PGx)
CPU	R8C CPU core, 20 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)
Memory	Code flash: 128/96/64/48/32/16 KB Data flash: 4/- KB RAM: 10/8/6/4/2.5/1.5 KB	Code flash: 128/96/64/48/32/16 KB Data flash: 4 KB RAM: 8/6/4/3/2/1 KB	Code flash: 256/192/128/96/64/48 KB Data flash: 8/4 KB RAM: 20/16/10/8/6/4 KB
Voltage detection	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit
I/O ports	CMOS I/O: 43 Input only: 1	CMOS I/O: 38 Input only: 5 Output only: 1	CMOS I/O: 38 Input only : 5 Output only: 1
Clock	XIN, HOCO, LOCO	X1, PLL, HOCO, XT1, LOCO	X1, PLL, HOCO, XT1, LOCO
External interrupt inputs	$\overline{\text{INT}}$ × 5 ch, Key input × 4 ch Priority level: 7 levels	INTP × 10/8 ch, Key input × 8 ch Priority level: 4 levels	INTP × 10 ch, Key input × 8 ch Priority level: 4 levels
Watchdog timer	14-bit timer × 1 (with prescaler) (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)
DTC	1 unit	1 unit	1 unit
Timer	Timer RA: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode) Timer RB: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode) Timer RC: 16bits (with 4 capture/compare) × 1 ch (Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output 1 pin)) Timer RD: 16bits (with 4 capture/compare) × 2 ch (Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Timer RE: 8bits × 1 ch (Output compare mode)	TAU: 16-bit timer (8 ch + 4 ch/8 ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6/4 pins), Multiple PWM output(10/7 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch	TAU: 16-bit timer (8 ch × 2/ 8ch + 4ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(8/6 pins), Multiple PWM output(14/10 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch
Serial interface	UART0: 1ch (Clock synchronous serial I/O mode, UART mode) UART2: 1ch (Clock synchronous serial I/O mode, UART mode, I^2C mode(I^2C-bus), IE mode(IEbus), Multiprocessor mode)	SAU: 2 units (CSI(SPI): 4 ch, Simplified I^2C: 4 ch, UART: 2 ch) /1 unit (CSI(SPI): 2 ch, Simplified I^2C: 2 ch, UART: 1 ch) Multi-master I^2C (IICA): 1/- ch LIN/UART (RLIN3): 1 ch	SAU: 2 units (CSI(SPI): 4 ch, Simplified I^2C: 4 ch, UART: 2 ch) Multi-master I^2C (IICA): 1 ch LIN/UART (RLIN3): 2/1 ch
SSU	1 ch		
LIN module	UART0, Timer RA0: 1 ch	RLIN3 : 1 ch UART0, TAU07, INTP0 : 1ch	RLIN3 : 2/1 ch UART0, TAU07, INTP0 : 1ch
CAN module	1/- ch	1/- ch	1 ch
A/D converter	10-bit resolution: 12 ch	10-bit resolution: 15/12 ch	10-bit resolution: 18/15 ch
D/A converter	8-bit resolution: 2 ch	-	8-bit resolution: 1 ch
Comparator	2 ch	-	1 ch
Operating temperature	J-version: -40 to +85°C K-version:-40 to +125°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C
Package	48-pin LQFP	48-pin LQFP	48-pin LQFP

2.4 32-pin Products

There is no RL78/F13, F14 product of the same package as R8C/33x (32-pin product). Table 2-4 and Table 2-5 show the function comparison of each product when considering RL78/F13, F14 (30 pin products) or RL78/F13, F14 (32 pin products) as the transfer destination product.

Table 2-4 Feature Comparison between 32-pin Products of R8C/3x and RL78/F13, F14

Items	R8C/33x	RL78/F13 (R5F10ABx, R5F10BBx)	RL78/F14 (R5F10PBx)
CPU	R8C CPU core, 20 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)
Memory	Code flash: 32/16 KB Data flash: 4/- KB RAM: 2.5/1.5 KB	Code flash: 128/96/64/48/32/16 KB Data flash: 4 KB RAM: 8/6/4/3/2/1 KB	Code flash: 64/48 KB Data flash: 4 KB RAM: 6/4 KB
Voltage detection	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit
I/O ports	CMOS I/O: 27 Input only: 1	CMOS I/O: 25 Input only: 3 Output only: -	CMOS I/O: 25 Input only : 3 Output only: -
Clock	XIN, HOCO, LOCO	X1, PLL, HOCO, XT1, LOCO	X1, PLL, HOCO, XT1, LOCO
External interrupt inputs	$\overline{INT}$ × 3 ch, Key input × 4 ch Priority level: 7 levels	INTP × 6 ch, Key input × 6 ch Priority level: 4 levels	INTP × 6 ch, Key input × 6 ch Priority level: 4 levels
Watchdog timer	14-bit timer × 1 (with prescaler) (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)
DTC	1 unit	1 unit	1 unit
Timer	Timer RA: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode) Timer RB: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode) Timer RC: 16bits (with 4 capture/compare) × 1 ch (Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output 1 pin)) Timer RD: 16bits (with 4 capture/compare) × 2 ch (Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode(PWM output 2 pins with fixed period))	TAU: 16-bit timer (8 ch + 4 ch/8 ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6/4 pins), Multiple PWM output(10/7 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch	TAU: 16-bit timer (8ch + 4ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6 pins), Multiple PWM output(10 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch
Serial interface	UART0: 1ch (Clock synchronous serial I/O mode, UART mode) UART2: 1ch (Clock synchronous serial I/O mode, UART mode, I^2C mode(I^2C-bus), IE mode(IEbus), Multiprocessor mode)	SAU: 2 units (CSI(SPI): 3 ch, Simplified I^2C: 3 ch, UART: 2 ch) /1 unit (CSI(SPI): 2 ch, Simplified I^2C: 2 ch, UART: 1 ch) Multi-master I^2C (IICA): 1/- ch LIN/UART (RLIN3) : 1 ch	SAU: 2 units (CSI(SPI): 3 ch, Simplified I^2C: 3 ch, UART: 2 ch) Multi-master I^2C (IICA): 1 ch LIN/UART (RLIN3): 1 ch
SSU	1 ch		
LIN module	UART0, Timer RA0: 1 ch	RLIN3 : 1 ch UART0, TAU07, INTP0 : 1ch	RLIN3 : 1 ch UART0, TAU07, INTP0 : 1ch
CAN module	-	1/- ch	1 ch
A/D converter	10-bit resolution: 12 ch	10-bit resolution: 10/8 ch	10-bit resolution: 10 ch
D/A converter	8-bit resolution: 2 ch	-	8-bit resolution: 1 ch
Comparator	2 ch	-	1 ch
Operating temperature	J-version: -40 to +85°C K-version:-40 to +125°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C
Package	32-pin LQFP	32-pin VQFN	32-pin VQFN

Table 2-5 Feature Comparison between 32-pin Products of R8C/3x and 30-pin Products of RL78/F13, F14

Items	R8C/33x	RL78/F13 (R5F10AAx, R5F10BAx)	RL78/F14 (R5F10PAx)
CPU	R8C CPU core, 20 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)
Memory	Code flash: 32/16 KB Data flash: 4/- KB RAM: 2.5/1.5 KB	Code flash: 128/96/64/48/32/16 KB Data flash: 4 KB RAM: 8/6/4/3/2/1 KB	Code flash: 64/48 KB Data flash: 4 KB RAM: 6/4 KB
Voltage detection	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit
I/O ports	CMOS I/O: 27 Input only: 1	CMOS I/O: 23 Input only: 3 Output only: -	CMOS I/O: 23 Input only : 3 Output only: -
Clock	XIN, HOCO, LOCO	X1, PLL, HOCO, XT1, LOCO	X1, PLL, HOCO, XT1, LOCO
External interrupt inputs	$\overline{INT}$ × 3 ch, Key input × 4 ch Priority level: 7 levels	INTP × 6 ch, Key input × 8 ch Priority level: 4 levels	INTP × 6 ch, Key input × 8 ch Priority level: 4 levels
Watchdog timer	14-bit timer × 1 (with prescaler) (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)
DTC	1 unit	1 unit	1 unit
Timer	Timer RA: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode) Timer RB: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode) Timer RC: 16bits (with 4 capture/compare) × 1 ch (Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output 1 pin)) Timer RD: 16bits (with 4 capture/compare) × 2 ch (Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode(PWM output 2 pins with fixed period))	TAU: 16-bit timer (8 ch + 4 ch/8 ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6/4 pins), Multiple PWM output(10/7 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch	TAU: 16-bit timer (8ch + 4ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(6 pins), Multiple PWM output(10 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch
Serial interface	UART0: 1ch (Clock synchronous serial I/O mode, UART mode) UART2: 1ch (Clock synchronous serial I/O mode, UART mode, I^2C mode(I^2C-bus), IE mode(IEbus), Multiprocessor mode)	SAU: 2 units (CSI(SPI): 3 ch, Simplified I^2C: 3 ch, UART: 2 ch) /1 unit (CSI(SPI): 2 ch, Simplified I^2C: 2 ch, UART: 1 ch) Multi-master I^2C (IICA): 1/- ch LIN/UART (RLIN3) : 1 ch	SAU: 2 units (CSI(SPI): 3 ch, Simplified I^2C: 3 ch, UART: 2 ch) Multi-master I^2C (IICA): 1 ch LIN/UART (RLIN3): 1 ch
SSU	1 ch		
LIN module	UART0, Timer RA0: 1 ch	RLIN3 : 1 ch UART0, TAU07, INTP0 : 1ch	RLIN3 : 1 ch UART0, TAU07, INTP0 : 1ch
CAN module	-	1/- ch	1 ch
A/D converter	10-bit resolution: 12 ch	10-bit resolution: 12/10 ch	10-bit resolution: 12 ch
D/A converter	8-bit resolution: 2 ch	-	8-bit resolution: 1 ch
Comparator	2 ch	-	1 ch
Operating temperature	J-version: -40 to +85°C K-version:-40 to +125°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C
Package	32-pin LQFP	30-pin SSOP	30-pin SSOP

2.5 20-pin Products

Table 2-6 Feature Comparison between 20-pin Products of R8C/3x and RL78/F13

Items	R8C/32x	RL78/F13 (R5F10A6x)	RL78/F14
CPU	R8C CPU core, 20 MHz (Max.)	RL78 CPU core, 32 MHz (Max.) ● Grade L: 32 MHz (Max.) ● Grade K, Y: 24 MHz (Max.)	-
Memory	Code flash: 32/16 KB Data flash: 4/- KB RAM: 2.5/1.5 KB	Code flash: 64/48/32/16 KB Data flash: 4 KB RAM: 4/3/2/1 KB	-
Voltage detection	Power-on reset, Voltage detection circuit	Power-on reset, Voltage detection circuit	-
I/O ports	CMOS I/O: 15 Input only: 1	CMOS I/O: 13 Input only: 3 Output only: -	-
Clock	XIN, HOCO, LOCO	X1, PLL, HOCO, XT1, LOCO	-
External interrupt inputs	$\overline{\text{INT}}$ × 3 ch, Key input × 4 ch Priority level: 7 levels	INTP × 5 ch, Key input × 2 ch Priority level: 4 levels	-
Watchdog timer	14-bit timer × 1 (with prescaler) (Count source: Dedicated LOCO)	17-bit timer × 1 (Count source: Dedicated LOCO)	-
DTC	1 unit	1 unit	-
Timer	Timer RA: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), pulse output mode (output level inverted every period), event counter mode, pulse width measurement mode, pulse period measurement mode) Timer RB: 8bits (with 8-bit presclaer) × 1 ch (Timer mode (period timer), programmable waveform generation mode (PWM output), programmable one-shot generation mode, programmable wait one-shot generation mode) Timer RC: 16bits (with 4 capture/compare) × 1 ch (Timer mode (input capture function, output compare function), PWM mode (output 3 pins), PWM2 mode (PWM output 1 pin)) Timer RD: 16bits (with 4 capture/compare) × 2 ch (Timer mode (input capture function, output compare function), PWM mode (output 6 pins), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period))	TAU: 16-bit timer (8 ch + 4 ch) (Interval timer, Square wave output, External event counter, Divider function, Input pulse interval measurement, Measurement of high-/low-level width of input signal, Delay counter, One-shot pulse output, PWM output(4 pins), Multiple PWM output(7 pins)) Timer RJ: 16-bit timer × 1 ch (Timer mode, Pulse output mode, Event counter mode, Pulse width measurement mode, Pulse period measurement mode) Timer RD: 16-bit timer × 2 ch (Timer mode (input capture function, output compare function, PWM mode (output 6 pins)), reset synchronous PWM mode (output three-phase waveforms (6 pins), sawtooth wave modulation), complementary PWM mode (output three-phase waveforms (6 pins), triangular wave modulation), PWM3 mode (PWM output 2 pins with fixed period)) Real-time clock × 1 ch	-
Serial interface	UART0: 1ch (Clock synchronous serial I/O mode, UART mode) UART2: 1ch (Clock synchronous serial I/O mode, UART mode, I^2C mode(I^2C-bus), IE mode(IEbus), Multiprocessor mode)	SAU: 1 unit (CSI(SPI): 2 ch, Simplified I^2C: 2 ch, UART: 1 ch) Multi-master I^2C (IICA): - LIN/UART (RLIN3): 1 ch	-
SSU	1 ch		-
LIN module	UART0, Timer RA0: 1 ch	RLIN3：1 ch UART0, TAU07, INTP0：1ch	-
A/D converter	10-bit resolution: 4 ch	10-bit resolution: 4 ch	-
Comparator	2 ch	-	-
Operating temperature	J-version: -40 to +85°C K-version:-40 to +125°C	Grade L: -40 to +105°C Grade K: -40 to +125°C Grade Y: -40 to +150°C	-
Package	20-pin SSOP	20-pin SSOP	-

3. Product Pin Function Comparison

Table 3-1 compares the pin functions of the R8C/3x products with the counterparts of the RL78/F13, F14 products. Please use it as a reference when porting. For details on each pin function, refer to the user's manual.

Table 3-1 Pin Function Comparison between R8C/3x and RL78/F13, F14 (1)

R8C/3x			RL78/F13, F14		
Items	**Pins**	**I/O**	**Pins**	**I/O**	**Description of RL78/F13, F14 pins**
Power supply	VCC	I	V_{DD}, EV_{DD0}, EV_{DD1}	I	Positive power supply pins. Connect the pins to have V_{DD} = EV_{DD}.
	VSS	I	V_{SS}, EV_{SS0}, EV_{SS1}	I	Ground potential pins. Connect the pins to have V_{SS} = EV_{SS}.
	-	-	REGC	O	Regulator output stabilization capacitance connection pin for internal operation Note 1
Analog power supply	AVCC	I	V_{DD}, EV_{DD0}, EV_{DD1}	I	Power supply pins for analog input pins
	AVSS	I	V_{SS}, EV_{SS0}, EV_{SS1}	I	Ground potential pins for analog input pins
Reset input	$\overline{\text{RESET}}$	I	$\overline{\text{RESET}}$	I	External reset pin
Mode entry	MODE	I/O	TOOL0	I/O	Data I/O pin for a flash memory programmer/debugger
Main clock	XIN	I	X1	I	Resonator connection pin for the main system clock
	XOUT	I/O	X2/EXCLK	I/O	[X1 oscillation mode] Resonator connection pin for the main system clock (X2) [External clock input mode] External clock input pin for main system clock (EXCLK)
Sub Clock	-	-	XT1	I	Resonator connection pin for the subsystem clock
	-	-	XT2/EXCLKS	I/O	[XT1 oscillation mode] Resonator connection pin for the subsystem clock (XT2) [External clock input mode] External clock input pin for the subsystem clock (EXCLKS)
Clock output	-	-	PCLBUZ0	O	Clock/buzzer output pin
$\overline{\text{INT}}$ interrupt inputs	$\overline{\text{INT0}}$ to $\overline{\text{INT4}}$	I	INTP0 to INTP13	I	External interrupt request input pins
Key input interrupts	$\overline{\text{KI0}}$ to $\overline{\text{KI3}}$	I	KR0 to KR7	I	Key interrupt input pins
Timer RA0, RA1	TRAIO0, TRAIO1	I	TI00 to TI07, TI10 to TI17, TRJIO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	I	Timer input pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRAIO0, TRAIO1	O	TO00 to TO07, TO10 to TO17, TRJIO0, TRJO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	O	Timer output pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRAO0, TRAO1	O		O	
Timer RB	TRBO	O	TO00 to TO07, TO10 to TO17, TRJIO0, TRJO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	O	Timer output pins for TAU0, TAU1, Timer RJ, and Timer RD.
Timer RC	TRCIOA, TRCIOB, TRCIOC, TRCIOD	I	TI00 to TI07, TI10 to TI17, TRJIO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	I	Timer input pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRCIOA, TRCIOB, TRCIOC, TRCIOD	O	TO00 to TO07, TO10 to TO17, TRJIO0, TRJO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	O	Timer output pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRCCLK	I	TRDCLK0	I	External clock input pin for Timer RD.
	TRCTRG	I	-	-	Input pin for external trigger. Although the RL78/F13, F14 are not available, software trigger or the combination of INTPn and DTC can be used as alternative.
Timer RD	TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	I/O	TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	I/O	Timer input/output pins for Timer RD.
	TRDCLK	I	TRDCLK0	I	External clock input pin for Timer RD.
Timer RE	TREO	O	TO00 to TO07, TO10 to TO17, TRJIO0, TRJO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	O	Timer output pins for TAU0, TAU1, Timer RJ, and Timer RD.

Table 3-1 in Function Comparison between R8C/3x and RL78/F13, F14 (2)

R8C/3x			RL78/F13, F14		
Items	**Pins**	**I/O**	**Pins**	**I/O**	**Description of RL78/F13, F14 pins**
Timer RF	TRFO00, TRFO01, TRFO02, TRFO10, TRFO11, TRFO12	O	TO00 to TO07, TO10 to TO17, TRJIO0, TRJO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	O	Timer output pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRFI	I	TI00 to TI07, TI10 to TI17, TRJIO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	I	Timer input pins for TAU0, TAU1, Timer RJ, and Timer RD.
Timer RG	TRGIOA, TRGIOB	I	TI00 to TI07, TI10 to TI17, TRJIO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	I	Timer input pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRGIOA, TRGIOB	O	TO00 to TO07, TO10 to TO17, TRJIO0, TRJO0, TRDIOA0, TRDIOB0, TRDIOC0, TRDIOD0, TRDIOA1, TRDIOB1, TRDIOC1, TRDIOD1	O	Timer output pins for TAU0, TAU1, Timer RJ, and Timer RD.
	TRGCLKA, TRGCLKB	I	-	-	RL78/F13, F14 is no encoder counter function.
Real-time clock	-	-	RTC1HZ	O	Real-time clock correction clock (1 Hz) output pin.
Serial interface	CLK0, CLK1, CLK2	I/O	$\overline{SCK00}$, $\overline{SCK01}$, $\overline{SCK10}$, $\overline{SCK11}$,	I/O	Serial clock I/O pins of SAU0, 1
	RXD0, RXD1, RXD2	I	RXD0, RXD1, SI00, SI01, SI10, SI11, LRXD0, LRXD1	I	Serial data input pins of SAU0, 1, and RLIN3
	TXD0, TXD1, TXD2	O	TXD0, TXD1, SO00, SO01, SO10, SO11, LTXD0, LTXD1	O	Serial data output pins of SAU0, 1, and RLIN3
	$\overline{CTS2}$	I	$\overline{SSI00}$, $\overline{SSI01}$, $\overline{SSI10}$, $\overline{SSI11}$	I	Slave select input pins of SAU0, 1
	$\overline{RTS2}$	O	-	-	I/O ports can be used instead
	SCL2	I/O	SCL00, SCL01, SCL10, SCL11, SCLA0	I/O	Serial clock I/O pins of SAU0, 1, and IICA
	SDA2	I/O	SDA00, SDA01, SDA10, SDA11, SDAA0	I/O	Serial data I/O pins of SAU0, 1, and IICA
Synchronous Serial Communication Unit (SSU)	SSI	I/O	SI00, SI01, SI10, SI11	I	Serial data input pins of SAU0, 1
	$\overline{SCS}$	I/O	$\overline{SSI00}$, $\overline{SSI01}$, $\overline{SSI10}$, $\overline{SSI11}$	I	Slave select input pins of SAU0, 1
	SSCK	I/O	$\overline{SCK00}$, $\overline{SCK01}$, $\overline{SCK10}$, $\overline{SCK11}$	I/O	Serial clock I/O pins of SAU0, 1
	SSO	I/O	SO00, SO01, SO10, SO11	O	Serial data output pins of SAU0, 1
LIN module	RXD0, RXD1	I	LRXD0, LRXD1, RXD0	I	LIN serial data input pins
	TXD0, TXD1	O	LTXD0, LTXD1, TXD0	O	LIN serial data output pins
CAN Module	CRX0	I	CRXD0	I	CAN serial data input pin
	CTX0	O	CTXD0	O	CAN serial data output pin
A/D converter	VREF	I	AV_{REFP}	I	ADC reference voltage (+ side) input pin.
	-	-	AV_{REFM}	I	ADC reference voltage (- side) input pin.
	AN0 to AN19	I	ANI0 to ANI30	I	Analog input pins. * A/D conversion accuracy depends on the power supply for the analog input pins. V_{DD} system analog pins achieve higher accuracy Power supply for: ・ANI0 to ANI23 Note 2: V_{DD} ・ANI24 to ANI30: EV_{DD0}, EV_{DD1}
	$\overline{ADTRG}$	I	-	-	Combination of an external interrupt input to an INTPn pin and either DTC or ELC (provided only for the RL78/F14 product) can be used instead.(Software trigger when DTC selected/Hardware trigger when ELC selected)
D/A converter	DA0、DA1	O	ANO0	O	DAC output pin. (only RL78/F14)
Comparator	IVCMP1、IVCMP3	I	IVCMP00 to IVCMP03	I	Analog input pins for comparator. (only RL78/F14)
	IVREF1、IVREF3	I	IVREF0	I	reference voltage input pin for comparator. (only RL78/F14)
	-	-	VCOUT0	O	Comparator output pin. (only RL78/F14)
I/O ports	P0_0 to P0_7, P1_0 to P1_7, P2_0 to P2_7, P3_0 to P3_7, P4_3 to P4_7, P5_0 to P5_7, P6_0 to P6_7, P7_0 to P7_7, P8_0 to P8_7, P9_0 to P9_5	I/O	P00 to P03, P10 to P17, P30 to P34, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P107, P120, P125 to P127, P140, P150 to P157	I/O	Pins with IOH1/IOL1 specification Note 3: P00 to P03, P10 to P17, P30 to P32, P40 to P47,P50 to P57, P60 to P67, P70 to P77, P92 to P97 Note 4, P106, P107 P120, P125 to P127, P140, P150 to P157 Pins with IOH2/IOL2 specification Note 3: P33, P34, P80 to P87, P90 to P97 Note 4, P100 to P105
Input-only ports	P4_2	I	P121 to P124, P137	I	P121 to P124, P137 are input-only ports
Output-only port	-	-	P130	O	P130/RESOUT is an output-only port

Notes: 1. Connect the REGC pin to V_{SS} via a capacitor (0.47 µF to 1 µF).
2. When the ANI0 to ANI23 pins are used as both analog input pins and digital I/O ports, the analog channel numbers should be configured in sequential ascending order. See 4.1.5(1) for details.
3. The high-level output current (IOH1 or IOH2) and low-level output current (IOL1 or IOL2) vary from pin to pin. See 4.1.4(2) for details.
4. The high-level output current and low-level output current of P92 to P97, which are multiplexed with the analog input pin function, vary from product to product. See 4.1.4(2) for details.

4. Considerations

This chapter describes considerations that you need to take when porting from the R8C/3x products to the RL78/F13, F14 products.

4.1 Considerations When Porting to RL78/F13, F14

Make sure to refer to the user's manuals of the replacement products when porting from the R8C/3x products to the RL78/F13, F14 products. Customers are required to sufficiently evaluate their products on their system.

4.1.1 Development Tools

The table below provides information on the development tools for the RL78/F13, F14 products.

Table 4-1 Development Tools for RL78/F13, F14

Tools	Description
e^2 studio	Renesas integrated development environment
CS+	Renesas integrated development environment (for RH850, V850, RX, RL78, 78K0R, 78K0)
CC-RL	C compiler package for RL78 Family
CA78K0R	C compiler package for RL78 Family and 78K0 Family
E2 emulator	On-chip debugging emulator and flash programmer
E2 emulator lite	On-chip debugging emulator and flash programmer
E1 emulator	On-chip debugging emulator and flash programmer
IECUBE	Full-spec emulator
PG-FP6	Flash memory programmer
Code Generator Plug-in	Tool that can automatically generate control programs for peripheral modules (bundled with CS+ and e^2 studio)
Applilet	Standalone tool for automatically generating device driver programs for peripheral modules
Data flash library	Library for reprogramming data flash memories
Code flash library	Library for reprogramming code flash memories

Remark: Besides the tools listed above, different development tools manufactured by Renesas partners are also available. For more information, please visit Renesas Electronics website or contact their customer support.

4.1.2 Noise

In order to eliminate unwanted noise, placing bypass capacitors (approximately 0.1 μF) between the V_{DD} and V_{SS} pins, between the EV_{DD} and EV_{SS} pins is recommended. In addition, placing a capacitor (0.47 μF to 1 μF) between the REGC and V_{SS} pins is also recommended. Since the noise is affected by the board layout and software, customers are required to sufficiently evaluate the impact of the noise in their environments with their board layout and software.

4.1.3 Oscillator

Customers are required to consult the resonator manufacturer to determine the proper oscillation constant. In addition, customers are also required to sufficiently evaluate the oscillation in their environments.

4.1.4 I/O Ports

(1) Input-Only/Output-Only Ports

The RL78/F13, F14 products are provided with input-only ports (P121 to P124, P137) and an output-only port (P130). Care must be taken when assigning pin functions.

(2) Port Output Current

The output current of the I/O ports in the RL78/F13, F14 products varies from product to product and pin to pin. Care must be taken when assigning pin functions.

Table 4-2 Port Output Current of Each Product/Pin (Condition: V_{DD} = EV_{DD0} = EV_{DD1} = 4.0 V to 5.5 V)

Specification	Applicable pins		Port output current		
			Grade L	Grade K	Grade Y
IOH1/IOL1	P00 to P03, P10 to P17, P30 to P32, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P92 to P97 Note, P106, P107 P120, P125 to P127, P140, P150 to P157	Per pin	-5.0 mA/8.5 mA		
		Total of all pins	-50.0 mA/65.0 mA	-42.0 mA/65.0 mA	-32.0 mA/55.0 mA
IOH2/IOL2	P33, P34, P80 to P87, P90 to P97 Note, P100 to P105	Per pin	-0.1 mA/0.4 mA		
		Total of all pins	-2.0 mA/5.0 mA		

Note: The I/O buffer power supplies for P92 to P97 vary from product to product. The IOH1/IOL1 specification is applied to the pins whose power supply is EV_{DD0} or EV_{DD1} whereas the IOH2/IOL2 specification is applied to the pins whose power supply is V_{DD}. The table below shows the output current specifications applied to P92 to P97 of each product.

Table 4-3 Port Output Current Specifications Applied to P92 to P97

Products	Port output current specifications applied to P92 to P97
RL78/F14 (100-pin products)	IOH2/IOL2 (P92 to P97)
RL78/F14 (80-pin products)	Products with 128 KB to 256 KB of code flash: IOH2/IOL2 (P92 to P97) Products with 64 KB to 96 KB of code flash: IOH2/IOL2 (P92 to P95), IOH1/IOL1 (P96, P97)
RL78/F14 (64-pin products)	Products with 128 KB to 256 KB of code flash: IOH2/IOL2 (P92 to P96) Products with 64 KB to 96 KB of code flash: IOH2/IOL2 (P92 to P95), IOH1/IOL1 (P96)
RL78/F14 (48-pin products)	IOH2/IOL2 (P92)
RL78/F13 (CAN and LIN incorporated) (80-pin products)	IOH2/IOL2 (P92 to P95), IOH1/IOL1 (P96, P97)
RL78/F13 (CAN and LIN incorporated) (64-pin products)	IOH2/IOL2 (P92 to P95), IOH1/IOL1 (P96)
RL78/F13 (CAN and LIN incorporated) (48-pin products)	IOH2/IOL2 (P92)
RL78/F13 (LIN incorporated) (80-pin products)	IOH2/IOL2 (P92 to P95), IOH1/IOL1 (P96, P97)
RL78/F13 (LIN incorporated) (64-pin products)	Products with 96 KB to 128 KB of code flash: IOH2/IOL2 (P92 to P95), IOH1/IOL1 (P96) Products with 32 KB to 64 KB of code flash: IOH1/IOL1 (P92 to P96)
RL78/F13 (LIN incorporated) (48-pin products)	Products with 96 KB to 128 KB of code flash: IOH2/IOL2 (P92) Products with 16 KB to 64 KB of code flash: IOH1/IOL1 (P92)

4.1.5 A/D Conversion

(1) ANI0 to ANI23 Pin Configuration as Analog Input Pins

In order to use some or all of the ANI0 to ANI23 pins as analog input pins, the analog channel number should be configured in sequential ascending order by the ADPC register. For example, when the ANI0 and ANI2 pins need to be used as analog input pins, the ANI1 pin cannot be used as a digital I/O port.

(2) A/D Conversion Accuracy

The A/D conversion accuracy in the RL78/F13, F14 products depends on the pin and the power supply of the A/D converter. The analog input pins whose power supply is EV_{DD0}, EV_{DD1} (the ANI24 to ANI30 pins) have lower A/D conversion accuracy than the analog input pins whose power supply is V_{DD} (the ANI0 to ANI23 pins). For this reason, the ANI2 to ANI23 pins should be used as analog input pins and the AV_{REFP} and AV_{REFM} pins should be used as the reference voltage pins of the A/D converter to achieve higher conversion accuracy.

(3) A/D Conversion Result

The bit positions in the registers to which the A/D conversion results are written after the A/D conversion (10-bit A/D conversion) differ between the RL78/F13, F14 products and R8C/3x products. Care must be taken when using the A/D conversion result to calculate a voltage or make a comparison.

[R8C/3x] A/D Register (ADi)

b15						b8	b7	b0
0	0	0	0	0	0	Upper 2 bits	Lower 8 bits	

Remark: i= 0 to 7

[RL78/F13, F14] 10-Bit A/D Conversion Result Register (ADCR)

b15							b8	b7						b0
Upper 8 bits								Lower 2 bits	0	0	0	0	0	0

(4) Scan Mode

Although the scan mode in the RL78/F13, F14 products is the counterpart of the single sweep mode and repeat sweep mode in the R8C/3x products, the number of analog input channels to be converted differs between these products.

- R8C/3x: Selectable from 8 channels, 6 channels, 4 channels or 2 channels
- RL78/F13, F14: 4 sequential channels of ANI0 to ANI23

Each of the RL78/F13, F14 products is provided with only one A/D conversion result register. Therefore, the A/D conversion result register needs to be read each time a single channel is converted in the scan mode. As a side note, the DTC allows the conversion result to be stored in RAM without using the CPU.

4.1.6 Porting from R8C/33x products

There is no RL78/F13, F14 package equivalent to the R8C/33x package (32 pin LQFP). When porting from R8C/33x product to RL78/F13, F14 product, please consider package products of 30 pin SSOP, 32 pin-VQFN, 48 pin-LQFP.

5. References

The documents referenced in this application note are shown below. When referring to these documents, make sure to obtain the latest version of each document from Renesas Electronics website.

- RL78/ F13, F14 User's Manual: Hardware Rev. 2.10
- R8C/32G Group, R8C/32H Group User's Manual: Hardware Rev.1.10
- R8C/33G Group, R8C/33H Group User's Manual: Hardware Rev.1.10
- R8C/34P Group, R8C/34R Group User's Manual: Hardware Rev.1.10
- R8C/34W Group, R8C/34X Group, R8C/34Y Group, R8C/34Z Group User's Manual: Hardware Rev.1.10
- R8C/36W Group, R8C/36X Group, R8C/36Y Group, R8C/36Z Group User's Manual: Hardware Rev.1.10
- R8C/38W Group, R8C/38X Group, R8C/38Y Group, R8C/38Z Group User's Manual: Hardware Rev.1.10

Alongside the RL78/F13, F14 products described in this application note, the RH850 family Renesas 32-bit microcontrollers are worthy of consideration in terms of superior processing-performance (higher operation frequency) and many more peripheral functions in comparison with the R8C/3x products that you are currently using.

Website and Support

Renesas Electronics Website
http://www.renesas.com/

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
Rev.1.00	Oct. 19, 2018		First edition

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. 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 Microprocessing unit or Microcontroller unit products 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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