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What is "Embedded - Microcontrollers"?

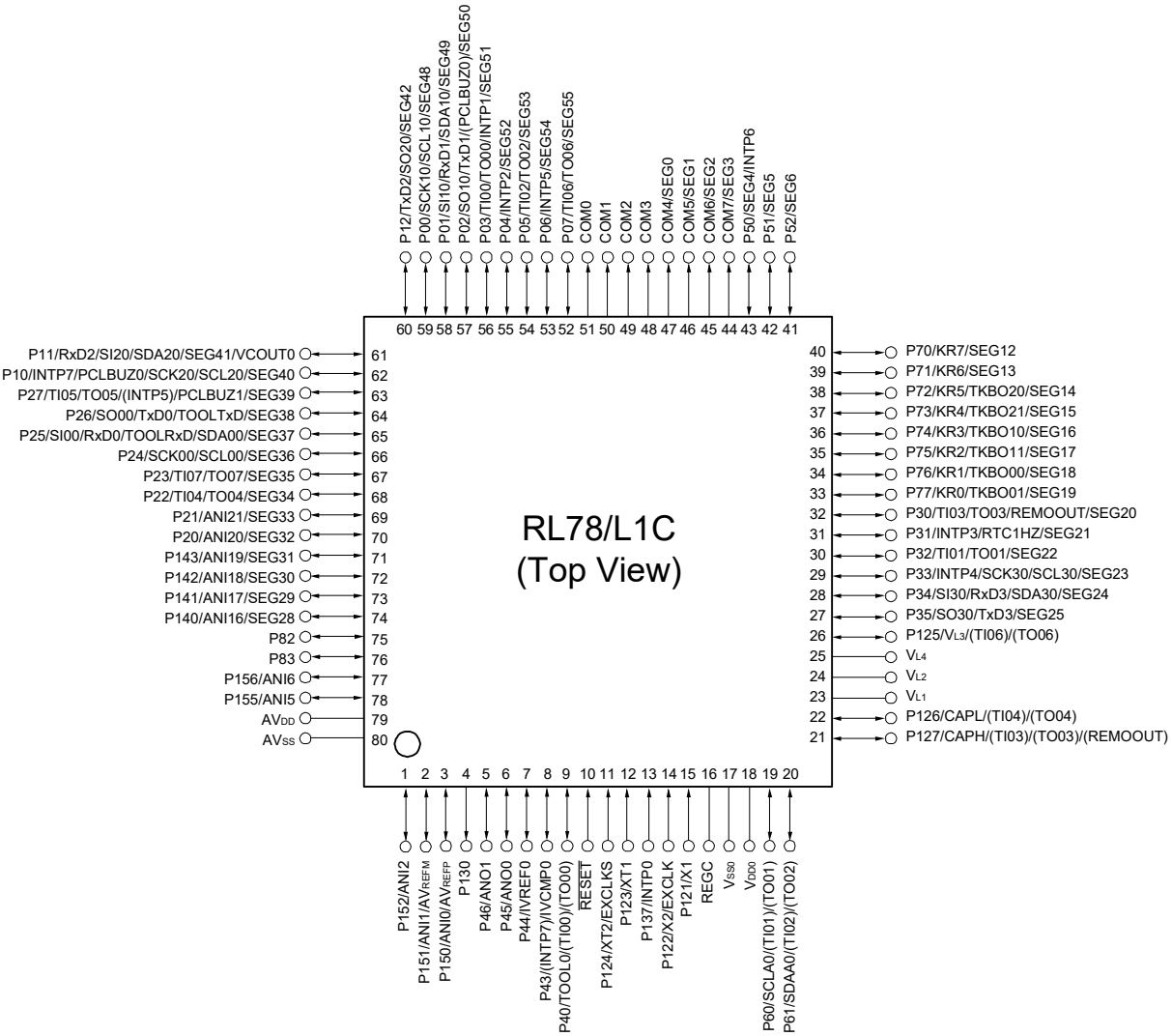
"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	RL78
Core Size	16-Bit
Speed	24MHz
Connectivity	CSI, I²C, LINbus, UART/USART, USB
Peripherals	LCD, LVD, POR, PWM, WDT
Number of I/O	51
Program Memory Size	96KB (96K x 8)
Program Memory Type	FLASH
EEPROM Size	8K x 8
RAM Size	10K x 8
Voltage - Supply (Vcc/Vdd)	1.6V ~ 3.6V
Data Converters	A/D 9x8/12b; D/A 2x8b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	80-LQFP
Supplier Device Package	80-LQFP (12x12)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f110mfafb-30

1.3.2 80-pin products (without USB)

• 80-pin plastic LFQFP (fine pitch) (12 × 12 mm, 0.5 mm pitch)



Caution Connect the REGC pin to Vss pin via a capacitor (0.47 to 1 µF).

Remark 1. For pin identification, see **1.4 Pin Identification**.

Remark 2. Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR).

Note 1. Current flowing to V_{DD}.

Note 2. When high speed on-chip oscillator and high-speed system clock are stopped.

Note 3. Current flowing only to the real-time clock 2 (excluding the operating current of the low-speed on-chip oscillator and the XT1 oscillator). The supply current of the RL78 microcontrollers is the sum of the values of either I_{DD1} or I_{DD2}, and I_{RTC}, when the real-time clock 2 operates in operation mode or HALT mode. When the low-speed on-chip oscillator is selected, I_{FIL} should be added. I_{DD2} subsystem clock operation includes the operational current of the real-time clock 2.

Note 4. Current flowing only to the 12-bit interval timer (excluding the operating current of the low-speed on-chip oscillator and the XT1 oscillator). The supply current of the RL78 microcontrollers is the sum of the values of either I_{DD1} or I_{DD2}, and I_{TMKA}, when the 12-bit interval timer operates in operation mode or HALT mode. When the low-speed on-chip oscillator is selected, I_{FIL} should be added. I_{DD2} subsystem clock operation includes the operational current of the 12-bit interval timer.

Note 5. Current flowing only to the watchdog timer (including the operating current of the low-speed on-chip oscillator). The current value of the RL78 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{WDT} when the watchdog timer operates in STOP mode.

Note 6. Current flowing only to the A/D converter. The supply current of the RL78 microcontrollers is the sum of I_{DD1} or I_{DD2} and I_{ADC}, I_{AVREF}, I_{ADREF} when the A/D converter operates in an operation mode or the HALT mode.

Note 7. Current flowing to the AV_{DD}.

Note 8. Current flowing from the reference voltage source of A/D converter.

Note 9. Operation current flowing to the internal reference voltage.

Note 10. Current flowing to the AV_{REFP}.

Note 11. Current flowing only to the D/A converter. The current value of the RL78 microcontrollers is the sum of I_{DD1} or I_{DD2} and I_{DA} when the D/A converter operates in an operation mode or the HALT mode.

Note 12. Current flowing only to the comparator circuit. The current value of the RL78 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{CMP} when the comparator circuit operates in the Operating, HALT or STOP mode.

Note 13. Current flowing only to the LVD circuit. The current value of the RL78 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{LVI} when the LVD circuit operates in the Operating, HALT or STOP mode.

Note 14. Current flowing only during self-programming.

Note 15. Current flowing only during data flash rewrite.

Note 16. For shift time to the SNOOZE mode, see **23.3.3 SNOOZE mode** in the RL78/L1C User's Manual.

Note 17. Current flowing only to the LCD controller/driver (V_{DD} pin). The current value of the RL78 microcontrollers is the sum of the LCD operating current (I_{LCD1}, I_{LCD2} or I_{LCD3}) to the supply current (I_{DD1}, or I_{DD2}) when the LCD controller/driver operates in an operation mode or HALT mode. Not including the current that flows through the LCD panel.

Note 18. Not including the current that flows through the external divider resistor divider resistor.

Note 19. Current flowing to the UV_{BUS}.

Note 20. Including the operating current when f_{PLL} = 48 MHz.

Note 21. Including the current supplied from the pull-up resistor of the UDP pin to the pull-down resistor of the host device, in addition to the current consumed by this MCU during the suspended state.

Remark 1. f_{IL}: Low-speed on-chip oscillator clock frequency

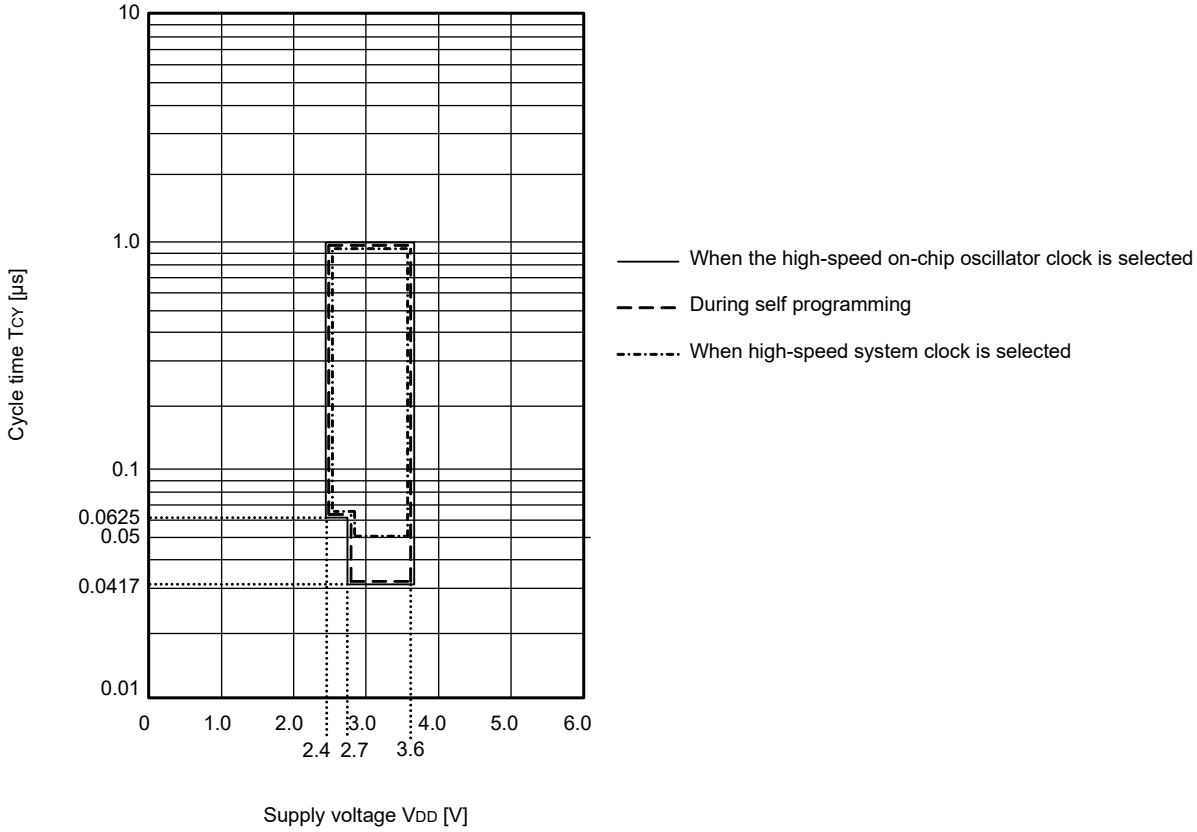
Remark 2. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)

Remark 3. f_{CLK}: CPU/peripheral hardware clock frequency

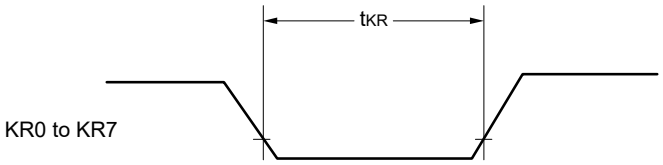
Remark 4. Temperature condition of the TYP. value is T_A = 25°C

Minimum Instruction Execution Time during Main System Clock Operation

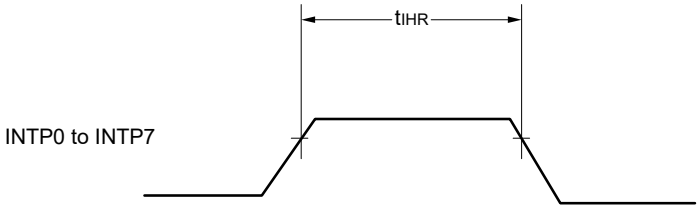
T_{CY} vs V_{DD} (HS (high-speed main) mode)



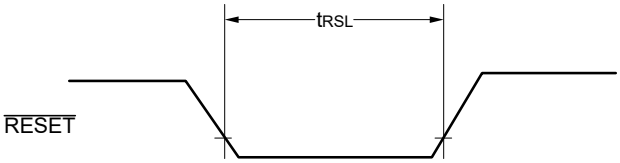
Key Interrupt Input Timing



Timer KB2 Input Timing



$\overline{\text{RESET}}$ Input Timing



(9) Communication at different potential (1.8 V, 2.5 V) (CSI mode) (slave mode, SCKp... external clock input)

(T_A = -40 to +85°C, 1.8 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions		HS (high-speed main) Mode		LS (low-speed main) Mode		LV (low-voltage main) Mode		Unit
				MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
SCKp cycle time Note 1	t_{KCY2}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V	20 MHz < f_{MCK} ≤ 24 MHz	16/f_{MCK}		—		—		ns
			16 MHz < f_{MCK} ≤ 20 MHz	14/f_{MCK}		—		—		ns
			8 MHz < f_{MCK} ≤ 16 MHz	12/f_{MCK}		—		—		ns
			4 MHz < f_{MCK} ≤ 8 MHz	8/f_{MCK}		16/f_{MCK}		—		ns
			f_{MCK} ≤ 4 MHz	6/f_{MCK}		10/f_{MCK}		10/f_{MCK}		ns
		1.8 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 2	20 MHz < f_{MCK} ≤ 24 MHz	36/f_{MCK}		—		—		ns
			16 MHz < f_{MCK} ≤ 20 MHz	32/f_{MCK}		—		—		ns
			8 MHz < f_{MCK} ≤ 16 MHz	26/f_{MCK}		—		—		ns
			4 MHz < f_{MCK} ≤ 8 MHz	16/f_{MCK}		16/f_{MCK}		—		ns
			f_{MCK} ≤ 4 MHz	10/f_{MCK}		10/f_{MCK}		10/f_{MCK}		ns
SCKp high-/low-level width	t_{KH2}, t_{KL2}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V		t_{KCY2}/2 - 18		t_{KCY2}/2 - 50		t_{KCY2}/2 - 50		ns
		1.8 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 2		t_{KCY2}/2 - 50		t_{KCY2}/2 - 50		t_{KCY2}/2 - 50		ns
SIp setup time (to SCKp↑) Note 3	t_{SIK2}	2.7 V ≤ V_{DD} ≤ 3.6 V		1/f_{MCK} + 20		1/f_{MCK} + 30		1/f_{MCK} + 30		ns
		1.8 V ≤ V_{DD} < 3.3 V		1/f_{MCK} + 30		1/f_{MCK} + 30		1/f_{MCK} + 30		ns
SIp hold time (from SCKp↑) Note 4	t_{KSI2}			1/f_{MCK} + 31		1/f_{MCK} + 31		1/f_{MCK} + 31		ns
Delay time from SCKp↓ to SOp output Note 5	t_{KSO2}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V C_b = 30 pF, R_b = 2.7 kΩ			2/f_{MCK} + 214		2/f_{MCK} + 573		2/f_{MCK} + 573	ns
		1.8 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 2 C_b = 30 pF, R_b = 5.5 kΩ			2/f_{MCK} + 573		2/f_{MCK} + 573		2/f_{MCK} + 573	ns

Note 1. Transfer rate in the SNOOZE mode: MAX. 1 Mbps

Note 2. Use it with V_{DD} ≥ V_b.

Note 3. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The SIp setup time becomes "to SCKp↓" when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

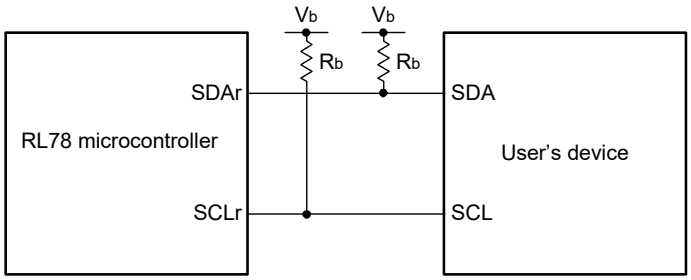
Note 4. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The SIp hold time becomes "from SCKp↓" when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

Note 5. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The delay time to SOp output becomes "from SCKp↑" when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

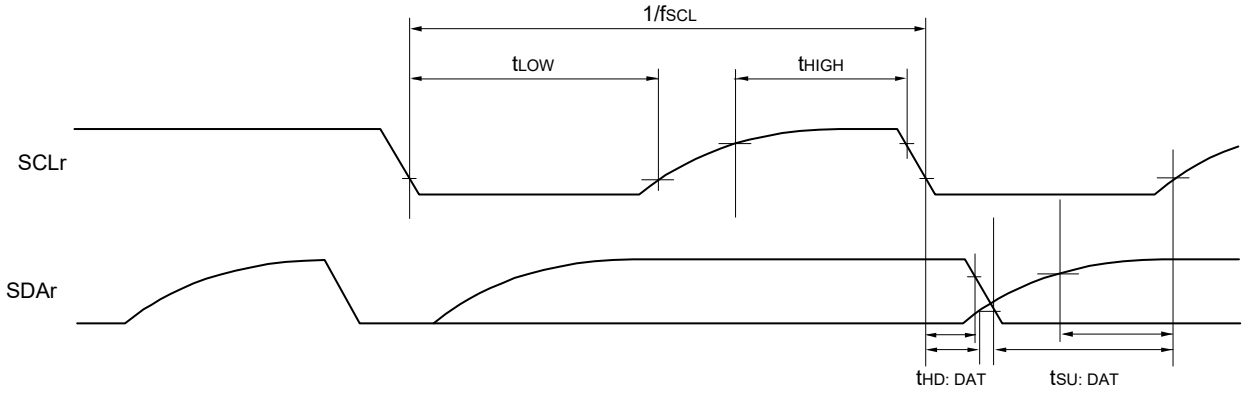
Caution Select the TTL input buffer for the SIp pin and SCKp pin and the N-ch open drain output (V_{DD} tolerance) mode for the SOp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V_{IH} and V_{IL}, see the DC characteristics with TTL input buffer selected.

(**Remarks** are listed on the next page.)

Simplified I²C mode connection diagram (during communication at different potential)



Simplified I²C mode serial transfer timing (during communication at different potential)



Remark 1. R_b[Ω]: Communication line (SDAr, SCLr) pull-up resistance, C_b[F]: Communication line (SDAr, SCLr) load capacitance, V_b[V]: Communication line voltage

Remark 2. r: IIC number (r = 00, 10, 20, 30), g: PIM, POM number (g = 0 to 3)

Remark 3. f_{MCK}: Serial array unit operation clock frequency
(Operation clock to be set by the CKSmn bit of serial mode register mn (SMRmn). m: Unit number (m = 0, 1), n: Channel number (n = 0, 2), mn = 00, 02, 10, 12)

(2) I^2C fast mode

(T_A = -40 to +85°C, 1.8 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions		HS (high-speed main) Mode		LS (low-speed main) Mode		LV (low-voltage main) Mode		Unit
				MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
SCLA0 clock frequency	f_{SCL}	Fast mode: f_{CLK} ≥ 3.5 MHz	2.7 V ≤ V_{DD} ≤ 3.6 V	0	400	0	400	0	400	kHz
			1.8 V ≤ V_{DD} ≤ 3.6 V	0	400	0	400	0	400	kHz
Setup time of restart condition	$t_{SU: STA}$	2.7 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
Hold time Note 1	$t_{HD: STA}$	2.7 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
Hold time when SCLA0 = "L"	t_{LOW}	2.7 V ≤ V_{DD} ≤ 3.6 V		1.3		1.3		1.3		μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		1.3		1.3		1.3		μs
Hold time when SCLA0 = "H"	t_{HIGH}	2.7 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
Data setup time (reception)	$t_{SU: DAT}$	2.7 V ≤ V_{DD} ≤ 3.6 V		100		100		100		ns
		1.8 V ≤ V_{DD} ≤ 3.6 V		100		100		100		ns
Data hold time (transmission) Note 2	$t_{HD: DAT}$	2.7 V ≤ V_{DD} ≤ 3.6 V		0	0.9	0	0.9	0	0.9	μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		0	0.9	0	0.9	0	0.9	μs
Setup time of stop condition	$t_{SU: STO}$	2.7 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		0.6		0.6		0.6		μs
Bus-free time	t_{BUF}	2.7 V ≤ V_{DD} ≤ 3.6 V		1.3		1.3		1.3		μs
		1.8 V ≤ V_{DD} ≤ 3.6 V		1.3		1.3		1.3		μs

Note 1. The first clock pulse is generated after this period when the start/restart condition is detected.

Note 2. The maximum value (MAX.) of $t_{HD: DAT}$ is during normal transfer and a wait state is inserted in the ACK (acknowledge) timing.

Remark The maximum value of C_b (communication line capacitance) and the value of R_b (communication line pull-up resistor) at that time in each mode are as follows.
Fast mode: C_b = 320 pF, R_b = 1.1 kΩ

(2) When reference voltage (+) = AV_{REFP}/ANI0 (ADREFP1 = 0, ADREFP0 = 1), reference voltage (-) = AV_{REFM}/ANI1 (ADREFM = 1), conversion target: ANI2 to ANI6

(T_A = -40 to +85°C, 1.6 V ≤ AV_{REFP} ≤ AV_{DD} = V_{DD} ≤ 3.6 V, V_{SS} = 0 V, AV_{SS} = 0 V, Reference voltage (+) = AV_{REFP}, Reference voltage (-) = AV_{REFM} = 0 V)

Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Resolution	RES		2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	8		12	bit
			1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	8		10 Note 1	
			1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	8 Note 2			
Overall error Note 3	AINL	12-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±6.0	LSB
		10-bit resolution	1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±5.0	
		8-bit resolution	1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±2.5	
Conversion time	t_{CONV}	ADTYP = 0, 12-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	3.375			µs
		ADTYP = 0, 10-bit resolution Note 1	1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	6.75			
		ADTYP = 0, 8-bit resolution Note 2	1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	13.5			
		ADTYP = 1, 8-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	2.5625			
			1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	5.125			
			1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V	10.25			
Zero-scale error Note 3	E_{ZS}	12-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±4.5	LSB
		10-bit resolution	1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±4.5	
		8-bit resolution	1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±2.0	
Full-scale error Note 3	E_{FS}	12-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±4.5	LSB
		10-bit resolution	1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±4.5	
		8-bit resolution	1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±2.0	
Integral linearity error Note 3	ILE	12-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±2.0	LSB
		10-bit resolution	1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±1.5	
		8-bit resolution	1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±1.0	
Differential linearity error Note 3	DLE	12-bit resolution	2.4 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±1.5	LSB
		10-bit resolution	1.8 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±1.5	
		8-bit resolution	1.6 V ≤ AV_{REFP} ≤ AV_{DD} ≤ 3.6 V			±1.0	
Analog input voltage	V_{AIN}			0		AV_{REFP}	V

Note 1. Cannot be used for lower 2 bit of ADCR register

Note 2. Cannot be used for lower 4 bit of ADCR register

Note 3. Excludes quantization error (±1/2 LSB).

Caution Always use AV_{DD} pin with the same potential as the V_{DD} pin.

(6) When reference voltage (+) = Internal reference voltage (1.45 V) (ADREFP1 = 1, ADREFP0 = 0), reference voltage (-) = AVSS (ADREFM = 0), conversion target: ANI0 to ANI6, ANI16 to ANI21

(T_A = -40 to +85°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, 1.6 V ≤ V_{DD}, 1.6 V ≤ AV_{DD} = V_{DD}, V_{SS} = 0 V, AV_{SS} = 0 V, Reference voltage (+) = internal reference voltage, Reference voltage (-) = AV_{SS} = 0 V, HS (high-speed main) mode)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Resolution	RES			8		bit
Conversion time	tCONV	8-bit resolution	16			µs
Zero-scale error Note	EZS	8-bit resolution			±4.0	LSB
Integral linearity error Note	ILE	8-bit resolution			±2.0	LSB
Differential linearity error Note	DLE	8-bit resolution			±2.5	LSB
Reference voltage (+)	$AV_{REF(+)}$	= Internal reference voltage (V_{BGR})	1.38	1.45	1.5	V
Analog input voltage	VAIN		0		V_{BGR}	V

Note Excludes quantization error (±1/2 LSB).

Caution Always use AV_{DD} pin with the same potential as the V_{DD} pin.

2.6.2 Temperature sensor, internal reference voltage output characteristics

(T_A = -40 to +85°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V (HS (high-speed main) mode))

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Temperature sensor output voltage	V_{TMPS25}	Setting ADS register = 80H, T_A = +25°C		1.05		V
Internal reference voltage	V_{BGR}	Setting ADS register = 81H	1.38	1.45	1.5	V
Temperature coefficient	F_{VTMPS}	Temperature sensor output voltage that depends on the temperature		-3.6		mV/°C
Operation stabilization wait time	tAMP		10			µs

2.6.3 D/A converter characteristics

(T_A = -40 to +85°C, 1.6 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

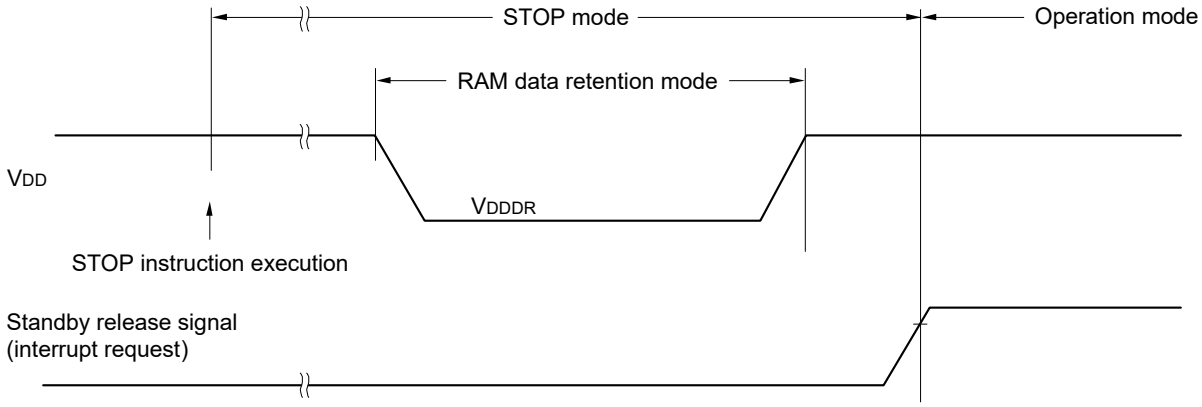
Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Resolution	RES					8	bit
Overall error	AINL	Rload = 4 MΩ	1.8 V ≤ V_{DD} ≤ 3.6 V			±2.5	LSB
		Rload = 8 MΩ	1.8 V ≤ V_{DD} ≤ 3.6 V			±2.5	LSB
Settling time	tSET	Cload = 20 pF	2.7 V ≤ V_{DD} ≤ 3.6 V			3	µs
			1.6 V ≤ V_{DD} < 2.7 V			6	µs

2.9 RAM Data Retention Characteristics

(T_A = -40 to +85°C, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Data retention supply voltage	V_{DDDR}		1.46 Note		3.6	V

Note This depends on the POR detection voltage. For a falling voltage, data in RAM are retained until the voltage reaches the level that triggers a POR reset but not once it reaches the level at which a POR reset is generated.



2.10 Flash Memory Programming Characteristics

(T_A = -40 to +85°C, 1.8 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
CPU/peripheral hardware clock frequency	f_{CLK}	2.4 V ≤ V_{DD} ≤ 3.6 V	1		24	MHz
Number of code flash rewrites Notes 1, 2, 3	C_{erwr}	Retained for 20 years T_A = 85°C	1,000			Times
Number of data flash rewrites Notes 1, 2, 3		Retained for 1 year T_A = 25°C		1,000,000		
		Retained for 5 years T_A = 85°C	100,000			
		Retained for 20 years T_A = 85°C	10,000			

Note 1. 1 erase + 1 write after the erase is regarded as 1 rewrite. The retaining years are until next rewrite after the rewrite.

Note 2. When using flash memory programmer and Renesas Electronics self programming library

Note 3. These are the characteristics of the flash memory and the results obtained from reliability testing by Renesas Electronics Corporation.

2.11 Dedicated Flash Memory Programmer Communication (UART)

(T_A = -40 to +85°C, 1.8 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Transfer rate		During serial programming	115,200		1,000,000	bps

3.1 Absolute Maximum Ratings

Absolute Maximum Ratings (T_A = 25°C) **(1/3)**

Parameter	Symbols	Conditions	Ratings	Unit
Supply voltage	V_{DD}		-0.5 to + 6.5	V
	UV_{BUS}		-0.5 to + 6.5	V
	AV_{DD}	$AV_{DD} \leq V_{DD}$	-0.5 to + 4.6	V
REGC pin input voltage	V_{IREGC}	REGC	-0.3 to + 2.8 and -0.3 to V_{DD} + 0.3 Note 1	V
U_{REGC} pin input voltage	V_{IUREGC}	U_{REGC}	-0.3 to UV_{BUS} + 0.3 Note 2	V
Input voltage	V_{I1}	P00 to P07, P10 to P17, P20 to P27, P30 to P37, P40 to P46, P50 to P57, P70 to P77, P80 to P83, P125 to P127, P137, P140 to P143, EXCLK, EXCLKS, $\overline{\text{RESET}}$	-0.3 to V_{DD} + 0.3 Note 3	V
	V_{I2}	P60, P61 (N-ch open-drain)	-0.3 to + 6.5	V
	V_{I3}	UDP, UDM	-0.3 to + 6.5	V
	V_{I4}	P150 to P156	-0.3 to AV_{DD} + 0.3 Note 4	V
Output voltage	V_{O1}	P00 to P07, P10 to P17, P20 to P27, P30 to P37, P40 to P46, P50 to P57, P60, P61, P70 to P77, P80 to P83, P125 to P127, P130, P140 to P143	-0.3 to V_{DD} + 0.3 Note 3	V
	V_{O2}	P150 to P156	-0.3 to AV_{DD} + 0.3 Note 3	V
	V_{O3}	UDP, UDM	-0.3 to + 3.8	V
Analog input voltage	V_{AI1}	ANI16 to ANI21	-0.3 to V_{DD} + 0.3 and $AV_{REF(+)}$ + 0.3 Notes 3, 5	V
	V_{AI2}	ANI0 to ANI6	-0.3 to AV_{DD} + 0.3 and $AV_{REF(+)}$ + 0.3 Notes 3, 5	V

Note 1. Connect the REGC pin to V_{SS} via a capacitor (0.47 to 1 μF). This value regulates the absolute maximum rating of the REGC pin. Do not use this pin with voltage applied to it.

Note 2. Connect the U_{REGC} pin to Vss via a capacitor (0.33 μF). This value regulates the absolute maximum rating of the U_{REGC} pin. Do not use this pin with voltage applied to it.

Note 3. Must be 6.5 V or lower.

Note 4. Must be 4.6 V or lower.

Note 5. Do not exceed $AV_{REF(+)}$ + 0.3 V in case of A/D conversion target pin.

Caution **Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.**

Remark 1. Unless specified otherwise, the characteristics of alternate-function pins are the same as those of the port pins.

Remark 2. $AV_{REF(+)}$: + side reference voltage of the A/D converter.

Remark 3. V_{SS}: Reference voltage

(T_A = -40 to +105°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V) (2/2)

Parameter	Symbol	Conditions				MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD2} Note 2	HALT mode	HS (high-speed main) mode Note 7	f_{HOCO} = 48 MHz Note 4, f_{IH} = 24 MHz Note 4	V_{DD} = 3.6 V		0.77	3.4	mA
					V_{DD} = 3.0 V		0.77	3.4	
				f_{HOCO} = 24 MHz Note 4, f_{IH} = 24 MHz Note 4	V_{DD} = 3.6 V		0.55	2.7	
					V_{DD} = 3.0 V		0.55	2.7	
				f_{HOCO} = 16 MHz Note 4, f_{IH} = 16 MHz Note 4	V_{DD} = 3.6 V		0.48	1.9	
					V_{DD} = 3.0 V		0.47	1.9	
			HS (high-speed main) mode Note 7	f_{MX} = 20 MHz Note 3, V_{DD} = 3.6 V	Square wave input		0.35	2.10	mA
					Resonator connection		0.51	2.20	
				f_{MX} = 20 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.34	2.10	
					Resonator connection		0.51	2.20	
				f_{MX} = 16 MHz Note 3, V_{DD} = 3.6 V	Square wave input		0.30	1.25	
					Resonator connection		0.45	1.41	
				f_{MX} = 16 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.29	1.23	
					Resonator connection		0.45	1.41	
				f_{MX} = 10 MHz Note 3, V_{DD} = 3.6 V	Square wave input		0.23	1.10	
					Resonator connection		0.30	1.20	
				f_{MX} = 10 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.22	1.10	
					Resonator connection		0.30	1.20	
			HS (High-speed main) mode (PLL operation)	f_{MX} = 48 MHz, f_{CLK} = 24 MHz Note 3	V_{DD} = 3.6 V		0.99	2.93	mA
					V_{DD} = 3.0 V		0.99	2.92	
				f_{MX} = 48 MHz, f_{CLK} = 12 MHz Note 3	V_{DD} = 3.6 V		0.89	2.51	
					V_{DD} = 3.0 V		0.89	2.50	
				f_{MX} = 48 MHz, f_{CLK} = 6 MHz Note 3	V_{DD} = 3.6 V		0.84	2.30	
					V_{DD} = 3.0 V		0.84	2.29	
			Subsystem clock operation	f_{SUB} = 32.768 kHz Note 5 T_A = -40°C	Square wave input		0.32	0.61	μA
					Resonator connection		0.51	0.80	
				f_{SUB} = 32.768 kHz Note 5 T_A = +25°C	Square wave input		0.41	0.74	
					Resonator connection		0.62	0.91	
				f_{SUB} = 32.768 kHz Note 5 T_A = +50°C	Square wave input		0.52	2.30	
					Resonator connection		0.75	2.49	
				f_{SUB} = 32.768 kHz Note 5 T_A = +70°C	Square wave input		0.82	4.03	
					Resonator connection		1.08	4.22	
				f_{SUB} = 32.768 kHz Note 5 T_A = +85°C	Square wave input		1.38	8.04	
					Resonator connection		1.62	8.23	
				f_{SUB} = 32.768 kHz Note 5 T_A = +105°C	Square wave input		3.29	41.00	
					Resonator connection		3.63	41.00	
	I_{DD3} Note 6	STOP mode Note 8	T_A = -40°C				0.18	0.52	μA
			T_A = +25°C				0.25	0.52	
			T_A = +50°C				0.34	2.21	
			T_A = +70°C				0.64	3.94	
			T_A = +85°C				1.18	7.95	
			T_A = +105°C				2.92	40.00	

(**Notes** and **Remarks** are listed on the next page.)

(T_A = -40 to +105°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions				MIN.	TYP.	MAX.	Unit
Low-speed on-chip oscillator operating current	I_{FIL} Note 1						0.20		μA
RTC2 operating current	I_{RTC} Notes 1, 3						0.02		μA
12-bit interval timer operating current	I_{TMKA} Notes 1, 2, 4						0.02		μA
Watchdog timer operating current	I_{WDT} Notes 1, 2, 5	f_{IL} = 15 kHz					0.22		μA
A/D converter operating current	I_{ADC} Notes 6, 7	AV_{DD} = 3.0 V, when conversion at maximum speed					422	720	μA
$AV_{REF(+)}$ current	I_{AVREF} Note 8	AV_{DD} = 3.0 V, ADREFP1 = 0, ADREFP0 = 0 Note 7					14.0	25.0	μA
		AV_{REFP} = 3.0 V, ADREFP1 = 0, ADREFP0 = 1 Note 10					14.0	25.0	
		ADREFP1 = 1, ADREFP0 = 0 Note 1					14.0	25.0	
A/D converter reference voltage current	I_{ADREF} Notes 1, 9	V_{DD} = 3.0 V					75.0		μA
Temperature sensor operating current	I_{TMPS} Note 1						78		μA
D/A converter operating current	I_{DAC} Notes 1, 11	Per D/A converter channel					0.53	1.5	mA
Comparator operating current	I_{CMP} Notes 1, 12	V_{DD} = 3.6 V, Regulator output voltage = 2.1 V	Window mode				12.5		μA
			Comparator high-speed mode				4.5		μA
			Comparator low-speed mode				1.2		μA
LVD operating current	I_{LVD} Notes 1, 13						0.06		μA
Self-programming operating current	I_{FSP} Notes 1, 14						2.50	12.20	mA
BGO operating current	I_{BGO} Notes 1, 15						1.68	12.20	mA
SNOOZE operating current	I_{SNOZ} Note 1	ADC operation	The mode is performed Note 16				0.34	1.10	mA
			The A/D conversion operations are performed, Low voltage mode, AV_{REFP} = V_{DD} = 3.0 V				0.53	2.04	
		CSI/UART operation					0.70	1.54	mA
LCD operating current	I_{LCD1} Notes 17, 18	External resistance division method	f_{LCD} = f_{SUB} LCD clock = 128 Hz	1/3 bias 4-time slice	V_{DD} = 3.6 V, V_{L4} = 3.6 V		0.14		μA
	I_{LCD2} Note 17	Internal voltage boosting method	f_{LCD} = f_{SUB} LCD clock = 128 Hz	1/3 bias 4-time slice	V_{DD} = 3.0 V, V_{L4} = 3.0 V (VLCD = 04H)		0.61		μA
	I_{LCD3} Note 17	Capacitor split method	f_{LCD} = f_{SUB} LCD clock = 128 Hz	1/3 bias 4-time slice	V_{DD} = 3.0 V, V_{L4} = 3.0 V		0.12		μA
USB current Note 19	I_{USB} Note 20	Operating current during USB communication					4.88		mA
	I_{USB} Note 21	Operating current in the USB suspended state					0.04		mA

(**Notes** and **Remarks** are listed on the next page.)

Note 1. Current flowing to V_{DD}.

Note 2. When high speed on-chip oscillator and high-speed system clock are stopped.

Note 3. Current flowing only to the real-time clock 2 (excluding the operating current of the low-speed on-chip oscillator and the XT1 oscillator). The supply current of the RL78 microcontrollers is the sum of the values of either I_{DD1} or I_{DD2}, and I_{RTC}, when the real-time clock 2 operates in operation mode or HALT mode. When the low-speed on-chip oscillator is selected, I_{FIL} should be added. I_{DD2} subsystem clock operation includes the operational current of the real-time clock 2.

Note 4. Current flowing only to the 12-bit interval timer (excluding the operating current of the low-speed on-chip oscillator and the XT1 oscillator). The supply current of the RL78 microcontrollers is the sum of the values of either I_{DD1} or I_{DD2}, and I_{TMKA}, when the 12-bit interval timer operates in operation mode or HALT mode. When the low-speed on-chip oscillator is selected, I_{FIL} should be added. I_{DD2} subsystem clock operation includes the operational current of the 12-bit interval timer.

Note 5. Current flowing only to the watchdog timer (including the operating current of the low-speed on-chip oscillator). The current value of the RL78 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{WDT} when the watchdog timer operates in STOP mode.

Note 6. Current flowing only to the A/D converter. The supply current of the RL78 microcontrollers is the sum of I_{DD1} or I_{DD2} and I_{ADC}, I_{AVREF}, I_{ADREF} when the A/D converter operates in an operation mode or the HALT mode.

Note 7. Current flowing to the AV_{DD}.

Note 8. Current flowing from the reference voltage source of A/D converter.

Note 9. Operation current flowing to the internal reference voltage.

Note 10. Current flowing to the AV_{REFP}.

Note 11. Current flowing only to the D/A converter. The current value of the RL78 microcontrollers is the sum of I_{DD1} or I_{DD2} and I_{DA} when the D/A converter operates in an operation mode or the HALT mode.

Note 12. Current flowing only to the comparator circuit. The current value of the RL78 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{CMP} when the comparator circuit operates in the Operating, HALT or STOP mode.

Note 13. Current flowing only to the LVD circuit. The current value of the RL78 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{LVI} when the LVD circuit operates in the Operating, HALT or STOP mode.

Note 14. Current flowing only during self-programming.

Note 15. Current flowing only during data flash rewrite.

Note 16. For shift time to the SNOOZE mode, see **23.3.3 SNOOZE mode** in the RL78/L1C User's Manual..

Note 17. Current flowing only to the LCD controller/driver (V_{DD} pin). The current value of the RL78 microcontrollers is the sum of the LCD operating current (I_{LCD1}, I_{LCD2} or I_{LCD3}) to the supply current (I_{DD1}, or I_{DD2}) when the LCD controller/driver operates in an operation mode or HALT mode. Not including the current that flows through the LCD panel.

Note 18. Not including the current that flows through the external divider resistor divider resistor.

Note 19. Current flowing to the UV_{BUS}.

Note 20. Including the operating current when f_{PLL} = 48 MHz.

Note 21. Including the current supplied from the pull-up resistor of the UDP pin to the pull-down resistor of the host device, in addition to the current consumed by this MCU during the suspended state.

Remark 1. f_{IL}: Low-speed on-chip oscillator clock frequency

Remark 2. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)

Remark 3. f_{CLK}: CPU/peripheral hardware clock frequency

Remark 4. Temperature condition of the TYP. value is T_A = 25°C

(4) During communication at same potential (simplified I²C mode)

(T_A = -40 to +105°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

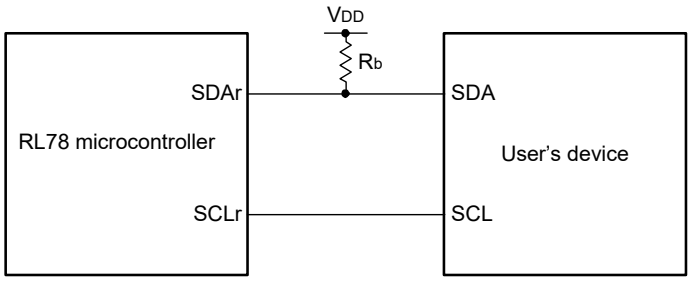
Parameter	Symbol	Conditions	HS (high-speed main) Mode		Unit
			MIN.	MAX.	
SCLr clock frequency	f_{SCL}	2.7 V ≤ V_{DD} ≤ 3.6 V, C_b = 50 pF, R_b = 2.7 kΩ		400 Note 1	kHz
		2.4 V ≤ V_{DD} ≤ 3.6 V, C_b = 100 pF, R_b = 3 kΩ		100 Note 1	kHz
Hold time when SCLr = "L"	t_{LOW}	2.7 V ≤ V_{DD} ≤ 3.6 V, C_b = 50 pF, R_b = 2.7 kΩ	1200		ns
		2.4 V ≤ V_{DD} ≤ 3.6 V, C_b = 100 pF, R_b = 3 kΩ	4600		ns
Hold time when SCLr = "H"	t_{HIGH}	2.7 V ≤ V_{DD} ≤ 3.6 V, C_b = 50 pF, R_b = 2.7 kΩ	1200		ns
		2.4 V ≤ V_{DD} ≤ 3.6 V, C_b = 100 pF, R_b = 3 kΩ	4600		ns
Data setup time (reception)	$t_{SU: DAT}$	2.7 V ≤ V_{DD} ≤ 3.6 V, C_b = 50 pF, R_b = 2.7 kΩ	1/f_{MCK} + 200 Note 2		ns
		2.4 V ≤ V_{DD} ≤ 3.6 V, C_b = 100 pF, R_b = 3 kΩ	1/f_{MCK} + 580 Note 2		ns
Data hold time (transmission)	$t_{HD: DAT}$	2.7 V ≤ V_{DD} ≤ 3.6 V, C_b = 50 pF, R_b = 2.7 kΩ	0	770	ns
		2.4 V ≤ V_{DD} ≤ 3.6 V, C_b = 100 pF, R_b = 3 kΩ	0	1420	ns

Note 1. The value must be equal to or less than f_{MCK}/4.

Note 2. Set the f_{MCK} value to keep the hold time of SCLr = "L" and SCLr = "H".

Caution Select the normal input buffer and the N-ch open drain output (V_{DD} tolerance) mode for the SDAr pin and the normal output mode for the SCLr pin by using port input mode register g (PIMg) and port output mode register h (POMh).

Simplified I²C mode connection diagram (during communication at same potential)



(6) Communication at different potential (1.8 V, 2.5 V) (CSI mode) (master mode, SCKp... internal clock output)

(T_A = -40 to +105°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V) (2/2)

Parameter	Symbol	Conditions	HS (high-speed main) Mode		Unit
			MIN.	MAX.	
SIp setup time (to SCKp↑) Note 1	t_{SIK1}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V, C_b = 30 pF, R_b = 2.7 kΩ	354		ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 3, C_b = 30 pF, R_b = 5.5 kΩ	958		ns
SIp hold time (from SCKp↑) Note 1	t_{KSI1}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V, C_b = 30 pF, R_b = 2.7 kΩ	38		ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 3, C_b = 30 pF, R_b = 5.5 kΩ	38		ns
Delay time from SCKp↓ to SOp output Note 1	t_{KSO1}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V, C_b = 30 pF, R_b = 2.7 kΩ		390	ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 3, C_b = 30 pF, R_b = 5.5 kΩ		966	ns
SIp setup time (to SCKp↓) Note 2	t_{SIK1}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V, C_b = 30 pF, R_b = 2.7 kΩ	88		ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 3, C_b = 30 pF, R_b = 5.5 kΩ	220		ns
SIp hold time (from SCKp↓) Note 2	t_{KSI1}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V, C_b = 30 pF, R_b = 2.7 kΩ	38		ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 3, C_b = 30 pF, R_b = 5.5 kΩ	38		ns
Delay time from SCKp↑ to SOp output Note 2	t_{KSO1}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V, C_b = 30 pF, R_b = 2.7 kΩ		50	ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 3, C_b = 30 pF, R_b = 5.5 kΩ		50	ns

Note 1. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.

Note 2. When DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

Note 3. Use it with V_{DD} ≥ V_b.

Caution Select the TTL input buffer for the SIp pin and the N-ch open drain output (V_{DD} tolerance) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V_{IH} and V_{IL}, see the DC characteristics with TTL input buffer selected.

(**Remarks** are listed on the next page.)

(7) Communication at different potential (1.8 V, 2.5 V) (CSI mode) (slave mode, SCKp... external clock input)

(T_A = -40 to +105°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions		HS (high-speed main) Mode		Unit
				MIN.	MAX.	
SCKp cycle time Note 1	t_{KCY2}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V	20 MHz < f_{MCK} ≤ 24 MHz	32/f_{MCK}		ns
			16 MHz < f_{MCK} ≤ 20 MHz	28/f_{MCK}		ns
			8 MHz < f_{MCK} ≤ 16 MHz	24/f_{MCK}		ns
			4 MHz < f_{MCK} ≤ 8 MHz	16/f_{MCK}		ns
			f_{MCK} ≤ 4 MHz	12/f_{MCK}		ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 2	20 MHz < f_{MCK} ≤ 24 MHz	72/f_{MCK}		ns
			16 MHz < f_{MCK} ≤ 20 MHz	64/f_{MCK}		ns
			8 MHz < f_{MCK} ≤ 16 MHz	52/f_{MCK}		ns
			4 MHz < f_{MCK} ≤ 8 MHz	32/f_{MCK}		ns
			f_{MCK} ≤ 4 MHz	20/f_{MCK}		ns
SCKp high-/low-level width	t_{KH2}, t_{KL2}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V		t_{KCY2}/2 - 36		ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 2		t_{KCY2}/2 - 100		ns
SIp setup time (to SCKp↑) Note 3	t_{SIK2}	2.7 V ≤ V_{DD} ≤ 3.6 V		1/f_{MCK} + 40		ns
		2.4 V ≤ V_{DD} < 3.3 V		1/f_{MCK} + 60		ns
SIp hold time (from SCKp↑) Note 4	t_{KSI2}			1/f_{MCK} + 62		ns
Delay time from SCKp↓ to SOp output Note 5	t_{KSO2}	2.7 V ≤ V_{DD} ≤ 3.6 V, 2.3 V ≤ V_b ≤ 2.7 V C_b = 30 pF, R_b = 2.7 kΩ			2/f_{MCK} + 428	ns
		2.4 V ≤ V_{DD} < 3.3 V, 1.6 V ≤ V_b ≤ 2.0 V Note 2 C_b = 30 pF, R_b = 5.5 kΩ			2/f_{MCK} + 1146	ns

Note 1. Transfer rate in the SNOOZE mode: MAX. 1 Mbps

Note 2. Use it with $V_{DD} \geq V_b$.

Note 3. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The SIp setup time becomes “to SCKp↓” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

Note 4. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The SIp hold time becomes “from SCKp↓” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

Note 5. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The delay time to SOp output becomes “from SCKp↑” when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

Caution Select the TTL input buffer for the SIp pin and SCKp pin and the N-ch open drain output (V_{DD} tolerance) mode for the SOp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V_{IH} and V_{IL}, see the DC characteristics with TTL input buffer selected.

(**Remarks** are listed on the next page.)

3.8 LCD Characteristics

3.8.1 Resistance division method

(1) Static display mode

(T_A = -40 to +105°C, V_{L4} (MIN.) ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
LCD drive voltage	V_{L4}		2.0		V_{DD}	V

(2) 1/2 bias method, 1/4 bias method

(T_A = -40 to +105°C, V_{L4} (MIN.) ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
LCD drive voltage	V_{L4}		2.7		V_{DD}	V

(3) 1/3 bias method

(T_A = -40 to +105°C, V_{L4} (MIN.) ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

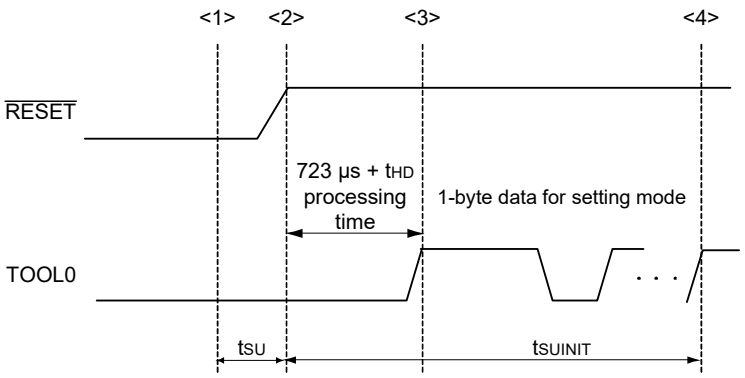
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
LCD drive voltage	V_{L4}		2.5		V_{DD}	V

3.12 Timing of Entry to Flash Memory Programming Modes

(T_A = -40 to +105°C, 2.4 V ≤ V_{DD} ≤ 3.6 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
How long from when an external reset ends until the initial communication settings are specified	t_{SUINIT}	POR and LVD reset must end before the external reset ends.			100	ms
How long from when the TOOL0 pin is placed at the low level until an external reset ends	t_{SU}	POR and LVD reset must end before the external reset ends.	10			μs
Time to hold the TOOL0 pin at the low level after an external reset is released (excluding the processing time of the firmware to control the flash memory)	t_{HD}	POR and LVD reset must end before the external reset ends.	1			ms

<R>



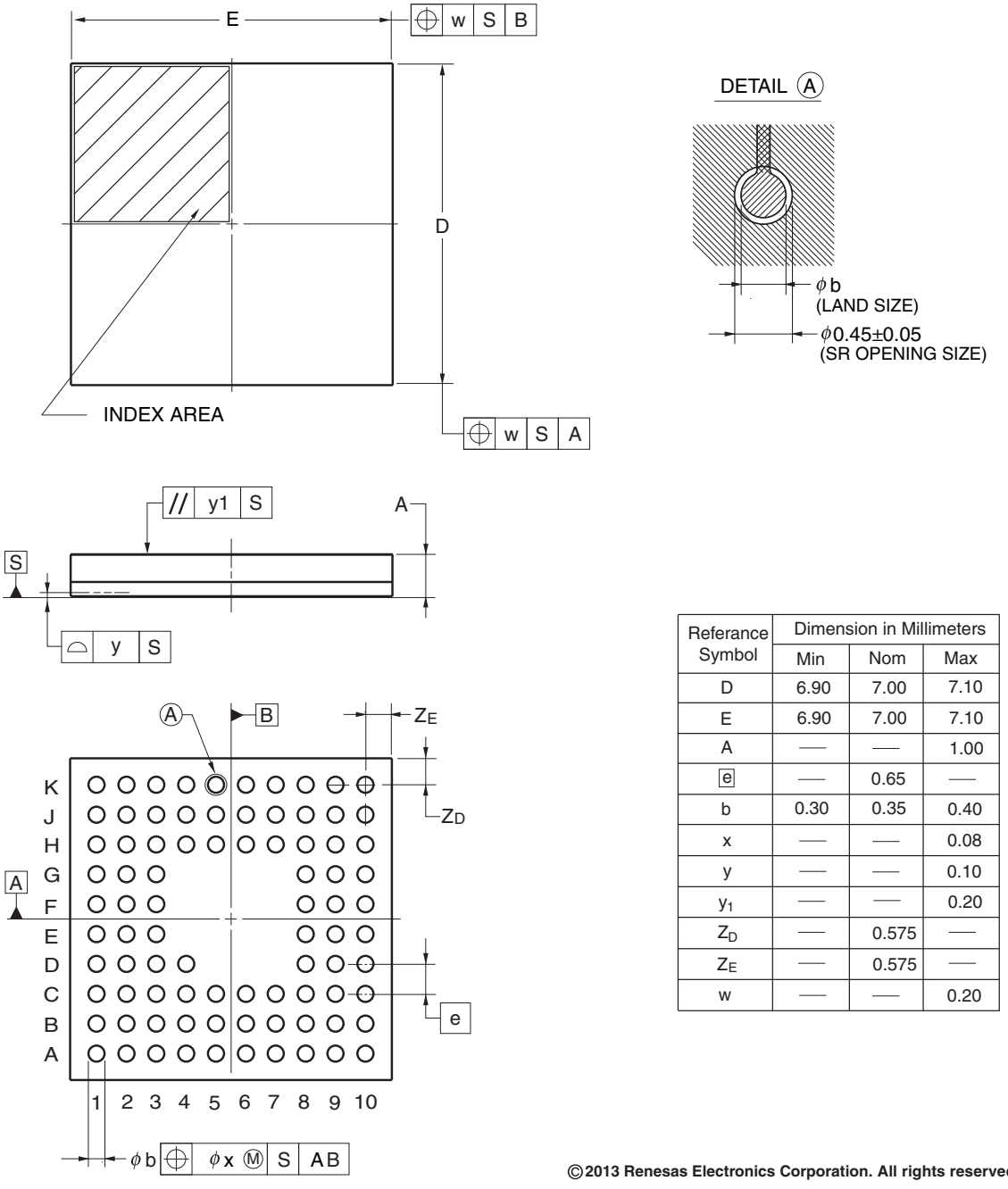
<1> The low level is input to the TOOL0 pin.
<2> The external reset ends (POR and LVD reset must end before the external reset ends.).
<3> The TOOL0 pin is set to the high level.
<4> Setting of the flash memory programming mode by UART reception and complete the baud rate setting.

Remark t_{SUINIT}: The segment shows that it is necessary to finish specifying the initial communication settings within 100 ms from when the resets end.
t_{SU}: How long from when the TOOL0 pin is placed at the low level until a external reset ends
t_{HD}: How long to keep the TOOL0 pin at the low level from when the external and internal resets end (except soft processing time)

4.2 85-pin products

R5F110NEALA, R5F110NFALA, R5F110NGALA, R5F110NHALA, R5F110NJALA
R5F111NEALA, R5F111NFALA, R5F111NGALA, R5F111NHALA, R5F111NJALA
R5F110NEGLA, R5F110NFGLA, R5F110NGGLA, R5F110NHGLA, R5F110NJGLA
R5F111NEGLA, R5F111NFGLA, R5F111NGGLA, R5F111NHGLA, R5F111NJGLA

JEITA Package code	RENESAS code	Previous code	MASS(TYP.)[g]
P-VFLGA85-7x7-0.65	PVLG0085JA-A	P85FC-65-BN4	0.1



Referance Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	6.90	7.00	7.10
E	6.90	7.00	7.10
A	—	—	1.00
e	—	0.65	—
b	0.30	0.35	0.40
x	—	—	0.08
y	—	—	0.10
y_1	—	—	0.20
Z_D	—	0.575	—
Z_E	—	0.575	—
w	—	—	0.20