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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.

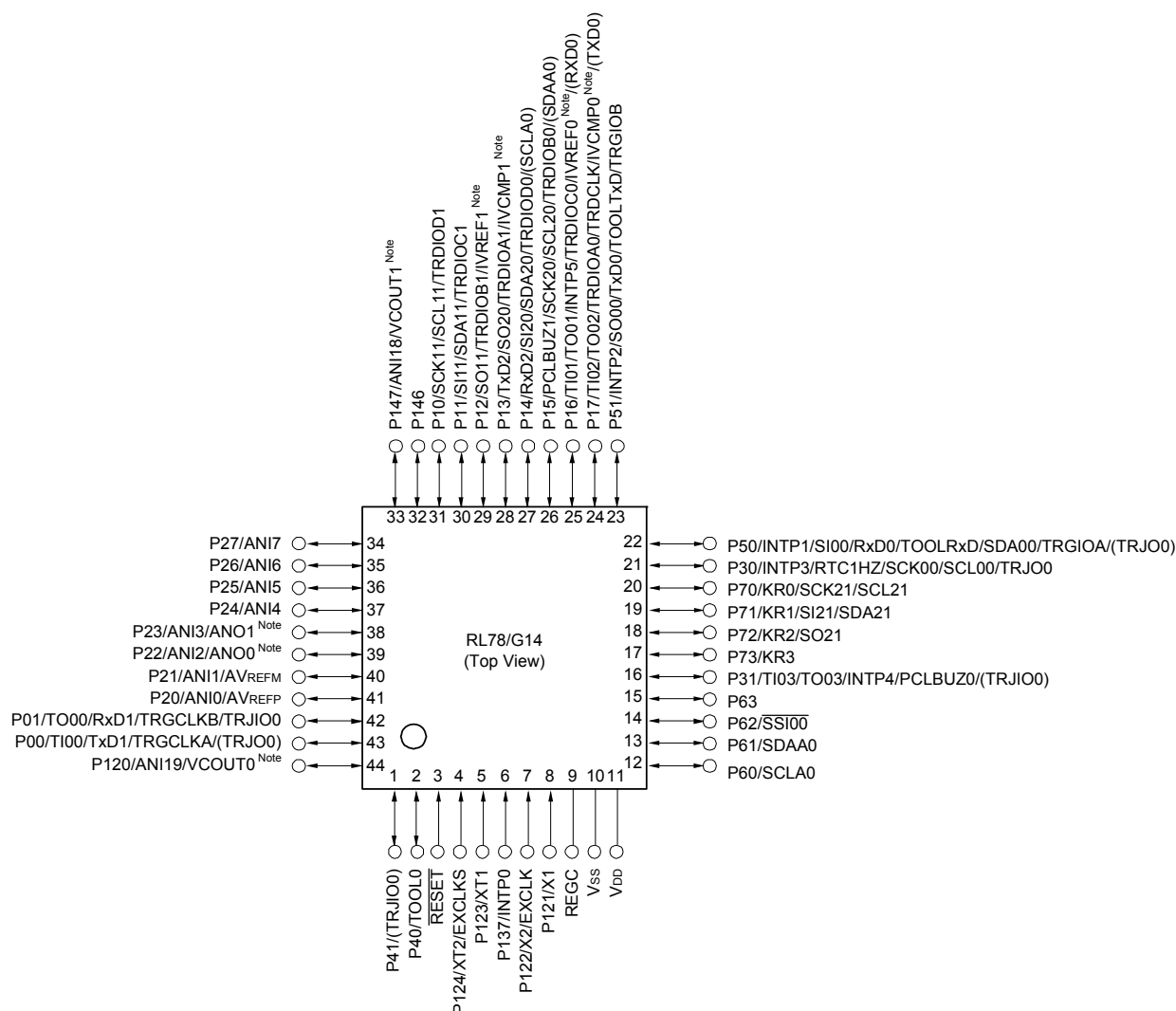
Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Active
Core Processor	RL78
Core Size	16-Bit
Speed	32MHz
Connectivity	CSI, I ² C, LINbus, UART/USART
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	34
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	1.6V ~ 5.5V
Data Converters	A/D 10x8/10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LFQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f104gcafb-50

1.3.5 44-pin products

- 44-pin plastic LQFP (10 × 10 mm, 0.8 mm pitch)



Note Mounted on the 96 KB or more code flash memory products.

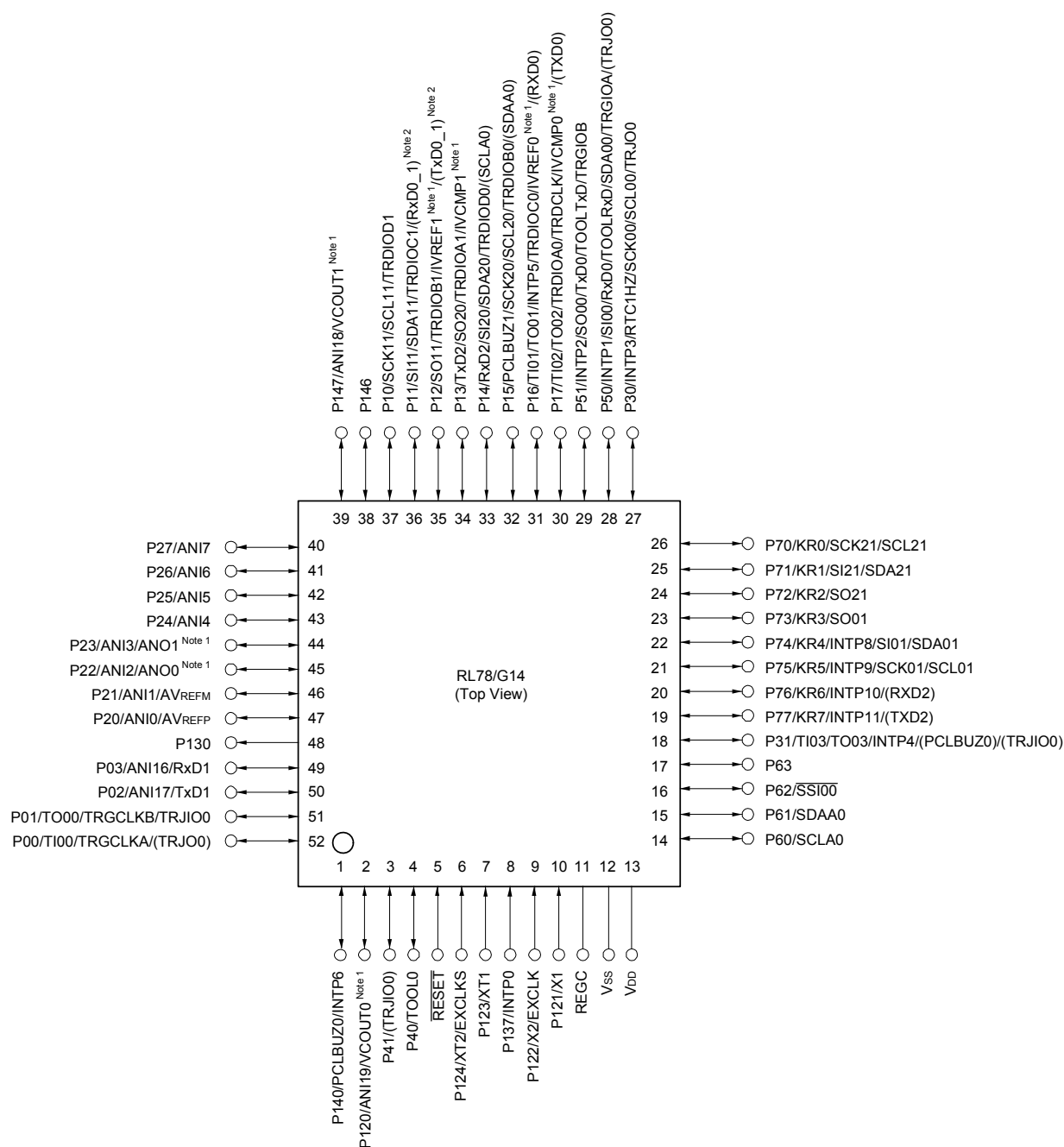
Caution Connect the REGC pin to Vss pin via a capacitor (0.47 to 1 μ F).

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 0, 1 (PIOR0, 1).

1.3.7 52-pin products

- 52-pin plastic LQFP (10 × 10 mm, 0.65 mm pitch)



Note 1. Mounted on the 96 KB or more code flash memory products.

Caution Connect the REGC pin to V_{SS} pin via a capacitor (0.47 to 1 μF).

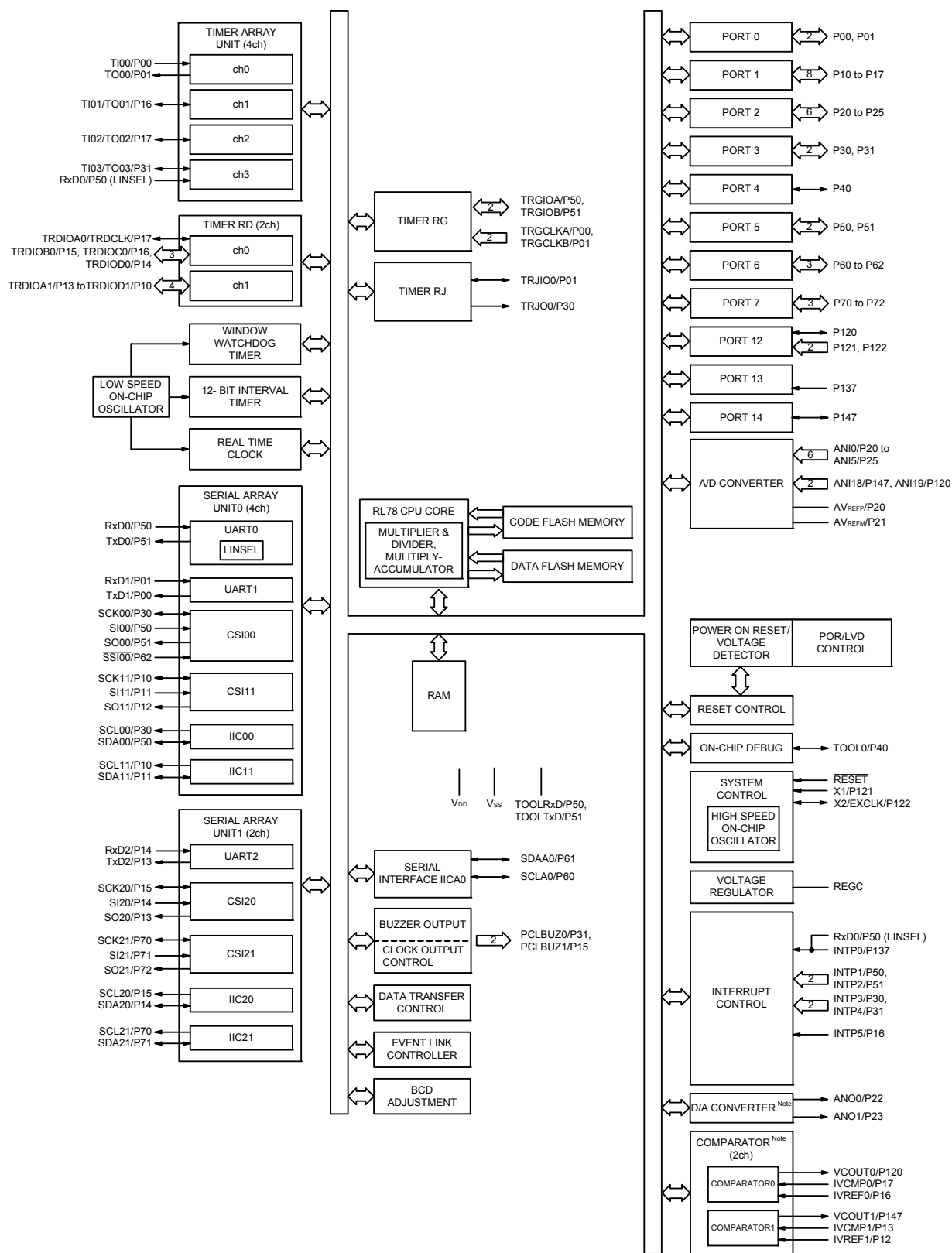
Remark 1. For pin identification, see 1.4 Pin Identification.

Remark 2. Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register 0, 1 (PIOR0, 1).

1.4 Pin Identification

ANI0 to ANI14,:	Analog input	RxD0 to RxD3:	Receive data
ANI16 to ANI20		SCK00, SCK01, SCK10,:	Serial clock input/output
ANO0, ANO1:	Analog output	SCK11, SCK20, SCK21,	
AVREFM:	A/D converter reference potential (– side) input	SCK30, SCK31	
AVREFP:	A/D converter reference potential (+ side) input	SCLA0, SCLA1,:	Serial clock input/output
EVDD0, EVDD1:	Power supply for port	SCL00, SCL01, SCL10, SCL11,:	Serial clock output
EVSS0, EVSS1:	Ground for port	SCL20, SCL21, SCL30,	
EXCLK:	External clock input (main system clock)	SCL31	
EXCLKS:	External clock input (subsystem clock)	SDAA0, SDAA1, SDA00,:	Serial data input/output
INTP0 to INTP11:	External interrupt input	SDA01, SDA10, SDA11,	
IVCMP0, IVCMP1:	Comparator input	SDA20, SDA21, SDA30,	
IVREF0, IVREF1:	Comparator reference input	SDA31	
KR0 to KR7:	Key return	SI00, SI01, SI10, SI11,:	Serial data input
P00 to P06:	Port 0	SI20, SI21, SI30, SI31	
P10 to P17:	Port 1	SO00, SO01, SO10,:	Serial data output
P20 to P27:	Port 2	SO11, SO20, SO21,	
P30, P31:	Port 3	SO30, SO31	
P40 to P47:	Port 4	$\overline{\text{SSI00}}$:	Serial interface chip select input
P50 to P57:	Port 5	TI00 to TI03,:	Timer input
P60 to P67:	Port 6	TI10 to TI13	
P70 to P77:	Port 7	TO00 to TO03,:	Timer output
P80 to P87:	Port 8	TO10 to TO13, TRJ00	
P100 to P102:	Port 10	TOOL0:	Data input/output for tool
P110, P111:	Port 11	TOOLRxD, TOOLTxD:	Data input/output for external device
P120 to P124:	Port 12	TRDCLK, TRGCLKA,:	Timer external input clock
P130, P137:	Port 13	TRGCLKB	
P140 to P147:	Port 14	TRDIOA0, TRDIOB0,:	Timer input/output
P150 to P156:	Port 15	TRDIOC0, TRDIOD0,	
PCLBUZ0, PCLBUZ1:	Programmable clock output/buzzer output	TRDIOA1, TRDIOB1,	
REGC:	Regulator capacitance	TRDIOC1, TRDIOD1,	
$\overline{\text{RESET}}$:	Reset	TRGIOA, TRGIOB, TRJIO0	
RTC1HZ:	Real-time clock correction clock (1 Hz) output	TxD0 to TxD3:	Transmit data
		VCOUT0, VCOUT1:	Comparator output
		VDD:	Power supply
		VSS:	Ground
		X1, X2:	Crystal oscillator (main system clock)
		XT1, XT2:	Crystal oscillator (subsystem clock)

1.5.3 36-pin products



Note Mounted on the 96 KB or more code flash memory products.

(TA = -40 to +85°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)

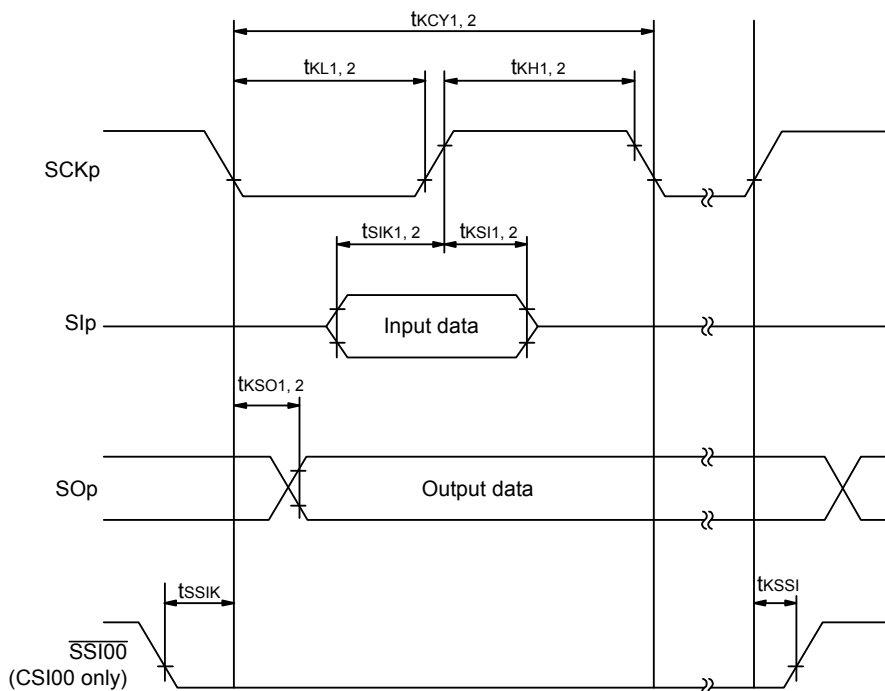
(4/5)

Items	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output voltage, high	VOH1	P00 to P06, P10 to P17, P30, P31, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P100 to P102, P110, P111, P120, P130, P140 to P147	4.0 V ≤ EVDD0 ≤ 5.5 V, IOH1 = -10.0 mA	EVDD0 - 1.5		V
			4.0 V ≤ EVDD0 ≤ 5.5 V, IOH1 = -3.0 mA	EVDD0 - 0.7		V
			1.8 V ≤ EVDD0 ≤ 5.5 V, IOH1 = -1.5 mA	EVDD0 - 0.5		V
			1.6 V ≤ EVDD0 < 1.8 V, IOH1 = -1.0 mA	EVDD0 - 0.5		V
	VOH2	P20 to P27, P150 to P156	1.6 V ≤ VDD ≤ 5.5 V, IOH2 = -100 μA	VDD - 0.5		V
Output voltage, low	VOL1	P00 to P06, P10 to P17, P30, P31, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P100 to P102, P110, P111, P120, P130, P140 to P147	4.0 V ≤ EVDD0 ≤ 5.5 V, IOL1 = 20.0 mA		1.3	V
			4.0 V ≤ EVDD0 ≤ 5.5 V, IOL1 = 8.5 mA		0.7	V
			2.7 V ≤ EVDD0 ≤ 5.5 V, IOL1 = 3.0 mA		0.6	V
			2.7 V ≤ EVDD0 ≤ 5.5 V, IOL1 = 1.5 mA		0.4	V
			1.8 V ≤ EVDD0 ≤ 5.5 V, IOL1 = 0.6 mA		0.4	V
			1.6 V ≤ EVDD0 ≤ 5.5 V, IOL1 = 0.3 mA		0.4	V
	VOL2	P20 to P27, P150 to P156	1.6 V ≤ VDD ≤ 5.5 V, IOL2 = 400 μA		0.4	V
	VOL3	P60 to P63	4.0 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 15.0 mA		2.0	V
			4.0 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 5.0 mA		0.4	V
			2.7 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 3.0 mA		0.4	V
			1.8 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 2.0 mA		0.4	V
			1.6 V ≤ EVDD0 ≤ 5.5 V, IOL3 = 1.0 mA		0.4	V

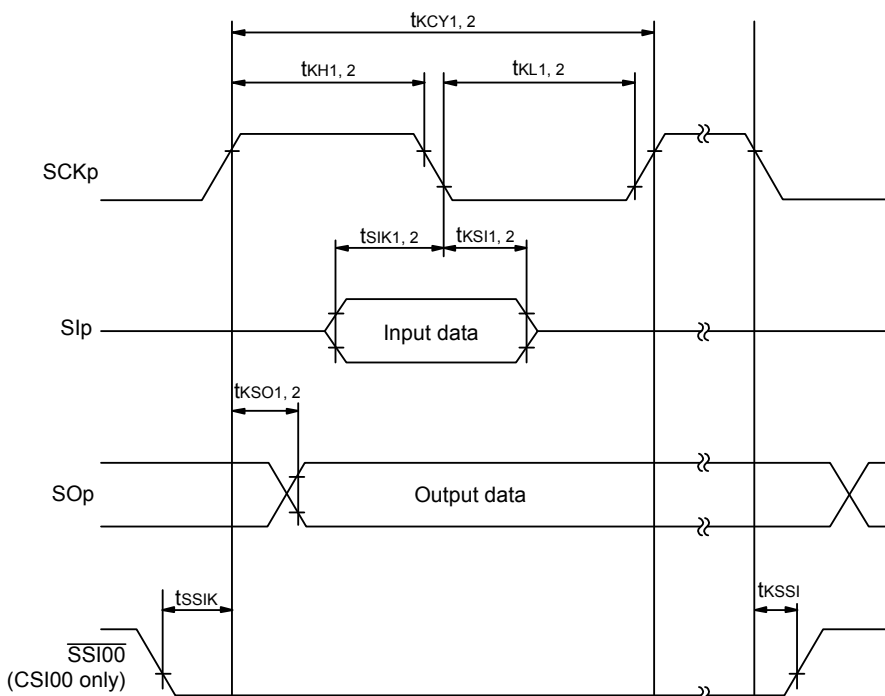
Caution P00, P02 to P04, P10, P11, P13 to P15, P17, P30, P43 to P45, P50 to P55, P71, P74, P80 to P82, P142 to P144 do not output high level in N-ch open-drain mode.

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

CSI mode serial transfer timing (during communication at same potential)
(When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.)



CSI mode serial transfer timing (during communication at same potential)
(When DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.)



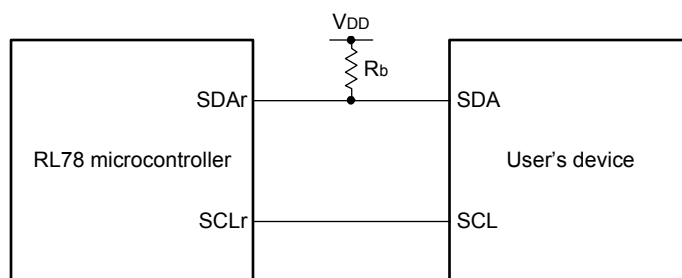
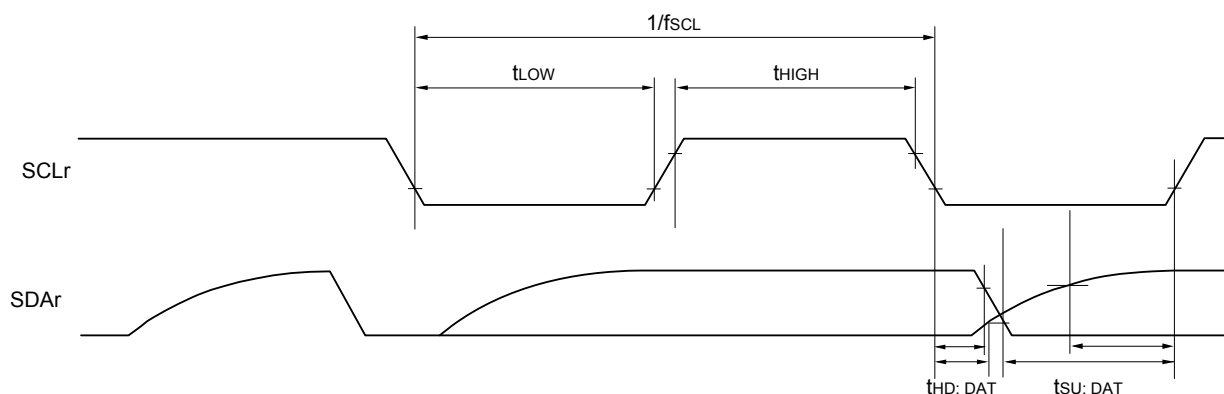
Remark 1. p: CSI number (p = 00, 01, 10, 11, 20, 21, 30, 31)

Remark 2. m: Unit number, n: Channel number (mn = 00 to 03, 10 to 13)

(5) During communication at same potential (simplified I²C mode)**(TA = -40 to +85°C, 1.6 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 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.	
SCLr clock frequency	f _{SCL}	2.7 V ≤ EVDD0 ≤ 5.5 V, Cb = 50 pF, Rb = 2.7 kΩ		1000 Note 1		400 Note 1		400 Note 1	kHz
		1.8 V ≤ EVDD0 ≤ 5.5 V, Cb = 100 pF, Rb = 3 kΩ		400 Note 1		400 Note 1		400 Note 1	kHz
		1.8 V ≤ EVDD0 < 2.7 V, Cb = 100 pF, Rb = 5 kΩ		300 Note 1		300 Note 1		300 Note 1	kHz
		1.7 V ≤ EVDD0 < 1.8 V, Cb = 100 pF, Rb = 5 kΩ		250 Note 1		250 Note 1		250 Note 1	kHz
		1.6 V ≤ EVDD0 < 1.8 V, Cb = 100 pF, Rb = 5 kΩ		—		250 Note 1		250 Note 1	kHz
Hold time when SCLr = "L"	t _{LOW}	2.7 V ≤ EVDD0 ≤ 5.5 V, Cb = 50 pF, Rb = 2.7 kΩ	475		1150		1150		ns
		1.8 V ≤ EVDD0 ≤ 5.5 V, Cb = 100 pF, Rb = 3 kΩ	1150		1150		1150		ns
		1.8 V ≤ EVDD0 < 2.7 V, Cb = 100 pF, Rb = 5 kΩ	1550		1550		1550		ns
		1.7 V ≤ EVDD0 < 1.8 V, Cb = 100 pF, Rb = 5 kΩ	1850		1850		1850		ns
		1.6 V ≤ EVDD0 < 1.8 V, Cb = 100 pF, Rb = 5 kΩ	—		1850		1850		ns
Hold time when SCLr = "H"	t _{HIGH}	2.7 V ≤ EVDD0 ≤ 5.5 V, Cb = 50 pF, Rb = 2.7 kΩ	475		1150		1150		ns
		1.8 V ≤ EVDD0 ≤ 5.5 V, Cb = 100 pF, Rb = 3 kΩ	1150		1150		1150		ns
		1.8 V ≤ EVDD0 < 2.7 V, Cb = 100 pF, Rb = 5 kΩ	1550		1550		1550		ns
		1.7 V ≤ EVDD0 < 1.8 V, Cb = 100 pF, Rb = 5 kΩ	1850		1850		1850		ns
		1.6 V ≤ EVDD0 < 1.8 V, Cb = 100 pF, Rb = 5 kΩ	—		1850		1850		ns

(Notes and Caution are listed on the next page, and Remarks are listed on the page after the next page.)

Simplified I²C mode connection diagram (during communication at same potential)**Simplified I²C mode serial transfer timing (during communication at same potential)**

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

Remark 2. r: IIC number (r = 00, 01, 10, 11, 20, 21, 30, 31), g: PIM number (g = 0, 1, 3 to 5, 14),
h: POM number (h = 0, 1, 3 to 5, 7, 14)

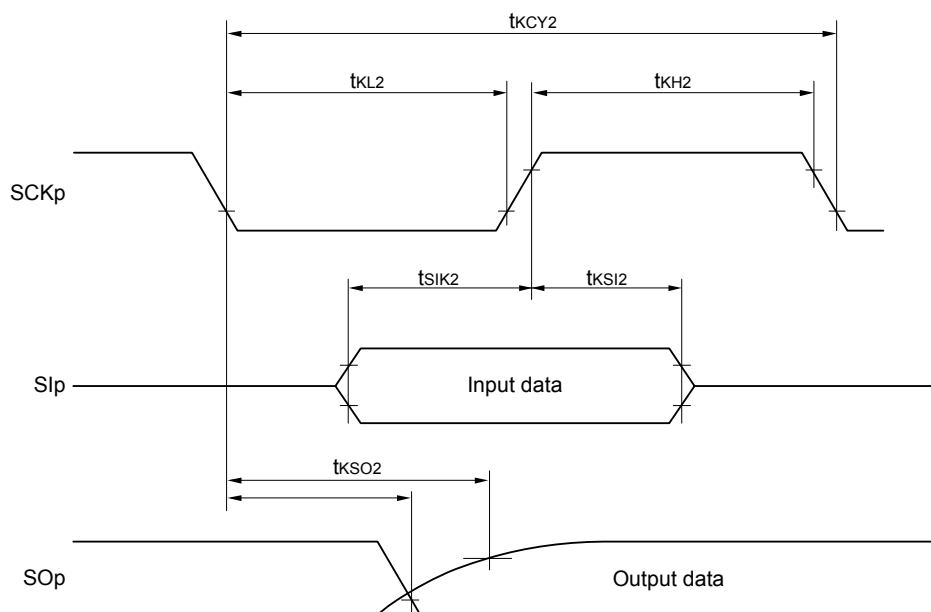
Remark 3. f_{MCK}: Serial array unit operation clock frequency
(Operation clock to be set by the CKSmn bit of serial mode register mn (SMRmn). m: Unit number (m = 0, 1),
n: Channel number (n = 0 to 3), mn = 00 to 03, 10 to 13)

(9) Communication at different potential (1.8 V, 2.5 V, 3 V) (CSI mode) (slave mode, SCKp... external clock input)**(TA = -40 to +85°C, 1.8 V ≤ EVDD0 = EVDD1 ≤ VDD ≤ 5.5 V, VSS = EVSS0 = EVSS1 = 0 V)**

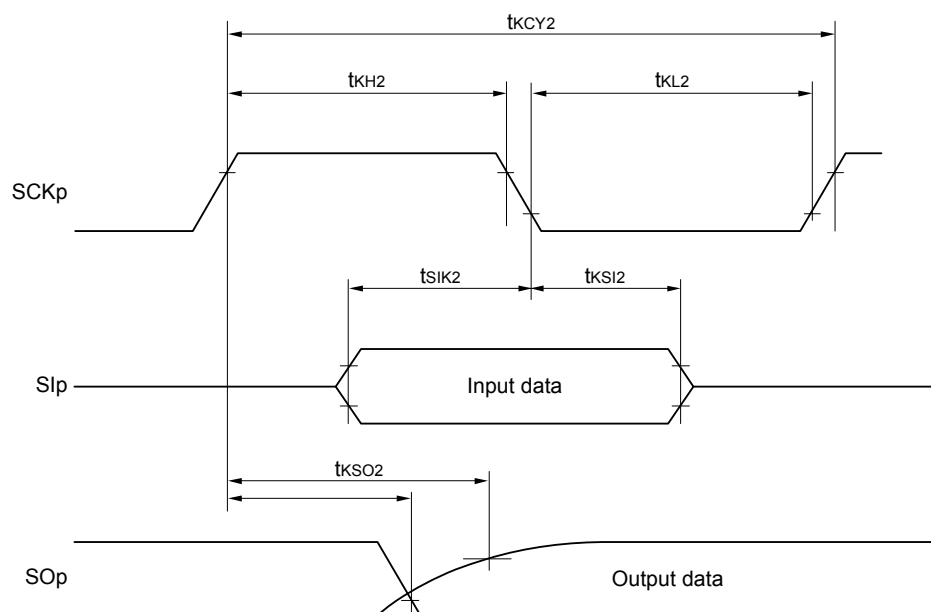
Parameter	Symbol	Conditions		HS (high-speed main) mode		LS (low-speed main) mode		LV (low-voltage main) mode		Unit
				MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
SCKp cycle time Note 1	tkCY2	4.0 V ≤ EVDD0 ≤ 5.5 V, 2.7 V ≤ Vb ≤ 4.0 V	24 MHz < fMCK	14/fMCK		—		—		ns
			20 MHz < fMCK ≤ 24 MHz	12/fMCK		—		—		ns
			8 MHz < fMCK ≤ 20 MHz	10/fMCK		—		—		ns
			4 MHz < fMCK ≤ 8 MHz	8/fMCK		16/fMCK		—		ns
			fMCK ≤ 4 MHz	6/fMCK		10/fMCK		10/fMCK		ns
		2.7 V ≤ EVDD0 < 4.0 V, 2.3 V ≤ Vb ≤ 2.7 V	24 MHz < fMCK	20/fMCK		—		—		ns
			20 MHz < fMCK ≤ 24 MHz	16/fMCK		—		—		ns
			16 MHz < fMCK ≤ 20 MHz	14/fMCK		—		—		ns
			8 MHz < fMCK ≤ 16 MHz	12/fMCK		—		—		ns
			4 MHz < fMCK ≤ 8 MHz	8/fMCK		16/fMCK		—		ns
			fMCK ≤ 4 MHz	6/fMCK		10/fMCK		10/fMCK		ns
		1.8 V ≤ EVDD0 < 3.3 V, 1.6 V ≤ Vb ≤ 2.0 V Note 2	24 MHz < fMCK	48/fMCK		—		—		ns
			20 MHz < fMCK ≤ 24 MHz	36/fMCK		—		—		ns
			16 MHz < fMCK ≤ 20 MHz	32/fMCK		—		—		ns
			8 MHz < fMCK ≤ 16 MHz	26/fMCK		—		—		ns
			4 MHz < fMCK ≤ 8 MHz	16/fMCK		16/fMCK		—		ns
			fMCK ≤ 4 MHz	10/fMCK		10/fMCK		10/fMCK		ns
SCKp high-/low-level width	tkH2, tkL2	4.0 V ≤ EVDD0 ≤ 5.5 V, 2.7 V ≤ Vb ≤ 4.0 V		tkCY2/2 - 12		tkCY2/2 - 50		tkCY2/2 - 50		ns
		2.7 V ≤ EVDD0 < 4.0 V, 2.3 V ≤ Vb ≤ 2.7 V		tkCY2/2 - 18		tkCY2/2 - 50		tkCY2/2 - 50		ns
		1.8 V ≤ EVDD0 < 3.3 V, 1.6 V ≤ Vb ≤ 2.0 V Note 2		tkCY2/2 - 50		tkCY2/2 - 50		tkCY2/2 - 50		ns
Slp setup time (to SCKp↑) Note 3	tsIK2	4.0 V ≤ EVDD0 ≤ 5.5 V, 2.7 V ≤ Vb ≤ 4.0 V		1/fMCK + 20		1/fMCK + 30		1/fMCK + 30		ns
		2.7 V ≤ EVDD0 < 4.0 V, 2.3 V ≤ Vb ≤ 2.7 V		1/fMCK + 20		1/fMCK + 30		1/fMCK + 30		ns
		1.8 V ≤ EVDD0 < 3.3 V, 1.6 V ≤ Vb ≤ 2.0 V Note 2		1/fMCK + 30		1/fMCK + 30		1/fMCK + 30		ns
Slp hold time (from SCKp↑) Note 4	tkSI2			1/fMCK + 31		1/fMCK + 31		1/fMCK + 31		ns
Delay time from SCKp↓ to SOp output Note 5	tkSO2	4.0 V ≤ EVDD0 ≤ 5.5 V, 2.7 V ≤ Vb ≤ 4.0 V, Cb = 30 pF, Rb = 1.4 kΩ			2/fMCK + 120		2/fMCK + 573		2/fMCK + 573	ns
		2.7 V ≤ EVDD0 < 4.0 V, 2.3 V ≤ Vb ≤ 2.7 V, Cb = 30 pF, Rb = 2.7 kΩ			2/fMCK + 214		2/fMCK + 573		2/fMCK + 573	ns
		1.8 V ≤ EVDD0 < 3.3 V, 1.6 V ≤ Vb ≤ 2.0 V Note 2, Cb = 30 pF, Rv = 5.5 kΩ			2/fMCK + 573		2/fMCK + 573		2/fMCK + 573	ns

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

CSI mode serial transfer timing (slave mode) (during communication at different potential)
(When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.)



CSI mode serial transfer timing (slave mode) (during communication at different potential)
(When DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.)



Remark 1. p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number (m = 0, 1), n: Channel number (n = 0 to 3),
g: PIM and POM number (g = 0, 1, 3 to 5, 14)

Remark 2. CSI01 of 48-, 52-, 64-pin products, and CSI11 and CSI21 cannot communicate at different potential. Use other CSI for communication at different potential.
Also, communication at different potential cannot be performed during clock synchronous serial communication with the slave select function.

(2) When reference voltage (+) = $AV_{REFP}/ANI0$ ($ADREFP1 = 0$, $ADREFP0 = 1$), reference voltage (-) = $AV_{REFM}/ANI1$ ($ADREFM = 1$), target pin: ANI16 to ANI20

(TA = -40 to +85°C, $1.6\text{ V} \leq EV_{DD0} \leq EV_{DD1} \leq V_{DD} \leq 5.5\text{ V}$, $1.6\text{ V} \leq AV_{REFP} \leq V_{DD} \leq 5.5\text{ V}$, $V_{SS} = EV_{SS0} = EV_{SS1} = 0\text{ V}$, Reference voltage (+) = AV_{REFP} , Reference voltage (-) = $AV_{REFM} = 0\text{ V}$)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Resolution	RES		8		10	bit
Overall error Note 1	AINL	10-bit resolution $EV_{DD0} \leq AV_{REFP} = V_{DD}$ Notes 3, 4	$1.8\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		±5.0	LSB
			$1.6\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ Note 5	1.2	±8.5	LSB
Conversion time	t_{CONV}	10-bit resolution Target ANI pin: ANI16 to ANI20	$3.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	2.125	39	μs
			$2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	3.1875	39	μs
			$1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	17	39	μs
			$1.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	57	95	μs
Zero-scale error Notes 1, 2	E_{ZS}	10-bit resolution $EV_{DD0} \leq AV_{REFP} = V_{DD}$ Notes 3, 4	$1.8\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		±0.35	%FSR
			$1.6\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ Note 5		±0.60	%FSR
Full-scale error Notes 1, 2	E_{FS}	10-bit resolution $EV_{DD0} \leq AV_{REFP} = V_{DD}$ Notes 3, 4	$1.8\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		±0.35	%FSR
			$1.6\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ Note 5		±0.60	%FSR
Integral linearity error Note 1	ILE	10-bit resolution $EV_{DD0} \leq AV_{REFP} = V_{DD}$ Notes 3, 4	$1.8\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		±3.5	LSB
			$1.6\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ Note 5		±6.0	LSB
Differential linearity error Note 1	DLE	10-bit resolution $EV_{DD0} \leq AV_{REFP} = V_{DD}$ Notes 3, 4	$1.8\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		±2.0	LSB
			$1.6\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ Note 5		±2.5	LSB
Analog input voltage	V_{AIN}	ANI16 to ANI20	0		AV_{REFP} and EV_{DD0}	V

Note 1. Excludes quantization error ($\pm 1/2$ LSB).

Note 2. This value is indicated as a ratio (%FSR) to the full-scale value.

Note 3. When $EV_{DD0} \leq AV_{REFP} \leq V_{DD}$, the MAX. values are as follows.

Overall error: Add ± 1.0 LSB to the MAX. value when $AV_{REFP} = V_{DD}$.

Zero-scale error/Full-scale error: Add $\pm 0.05\%$ FSR to the MAX. value when $AV_{REFP} = V_{DD}$.

Integral linearity error/ Differential linearity error: Add ± 0.5 LSB to the MAX. value when $AV_{REFP} = V_{DD}$.

Note 4. When $AV_{REFP} < EV_{DD0} \leq V_{DD}$, the MAX. values are as follows.

Overall error: Add ± 4.0 LSB to the MAX. value when $AV_{REFP} = V_{DD}$.

Zero-scale error/Full-scale error: Add $\pm 0.20\%$ FSR to the MAX. value when $AV_{REFP} = V_{DD}$.

Integral linearity error/ Differential linearity error: Add ± 2.0 LSB to the MAX. value when $AV_{REFP} = V_{DD}$.

Note 5. When the conversion time is set to 57 μs (min.) and 95 μs (max.).

- Note 1.** Total current flowing into VDD, EVDD0, and EVDD1, including the input leakage current flowing when the level of the input pin is fixed to VDD, EVDD0, and EVDD1, or VSS, EVSS0, and EVSS1. The values below the MAX. column include the peripheral operation current. However, not including the current flowing into the A/D converter, D/A converter, comparator, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors and the current flowing during data flash rewrite.
- Note 2.** When high-speed on-chip oscillator and subsystem clock are stopped.
- Note 3.** When high-speed system clock and subsystem clock are stopped.
- Note 4.** When high-speed on-chip oscillator and high-speed system clock are stopped. When AMPHS1 = 1 (Ultra-low power consumption oscillation). However, not including the current flowing into the 12-bit interval timer and watchdog timer.
- Note 5.** Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.
 HS (high-speed main) mode: $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}@1\text{ MHz to }32\text{ MHz}$
 $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}@1\text{ MHz to }16\text{ MHz}$

Remark 1. fMX: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

Remark 2. fHOCO: High-speed on-chip oscillator clock frequency (64 MHz max.)

Remark 3. fIH: High-speed on-chip oscillator clock frequency (32 MHz max.)

Remark 4. fSUB: Subsystem clock frequency (XT1 clock oscillation frequency)

Remark 5. Except subsystem clock operation, temperature condition of the TYP. value is TA = 25°C

- Note 5.** Current flowing only to the watchdog timer (including the operating current of the low-speed on-chip oscillator). The supply current of the RL78 microcontrollers is the sum of I_{DD1} , I_{DD2} or I_{DD3} and I_{WDT} when the watchdog timer is in operation.
- 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} when the A/D converter operates in an operation mode or the HALT mode.
- Note 7.** Current flowing only to the LVD circuit. The supply current of the RL78 microcontrollers is the sum of I_{DD1} , I_{DD2} or I_{DD3} and I_{LVD} when the LVD circuit is in operation.
- Note 8.** Current flowing during programming of the data flash.
- Note 9.** Current flowing during self-programming.
- Note 10.** For shift time to the SNOOZE mode, see **23.3.3 SNOOZE mode** in the RL78/G14 User's Manual.
- Note 11.** Current flowing only to the D/A converter. The supply current of the RL78 microcontrollers is the sum of I_{DD1} or I_{DD2} and I_{DAC} when the D/A converter operates in an operation mode or the HALT mode.
- Note 12.** Current flowing only to the comparator circuit. The supply current of the RL78 microcontrollers is the sum of I_{DD1} , I_{DD2} , or I_{DD3} and I_{CMP} when the comparator circuit is in operation.
- Note 13.** A comparator and D/A converter are provided in products with 96 KB or more code flash memory.

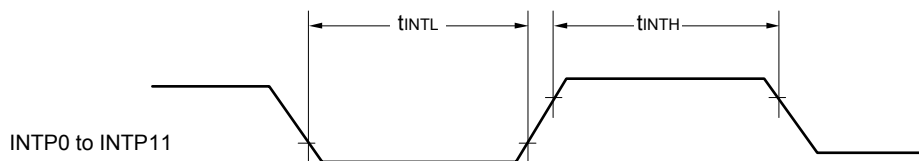
Remark 1. f_{IL} : Low-speed on-chip oscillator clock frequency

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

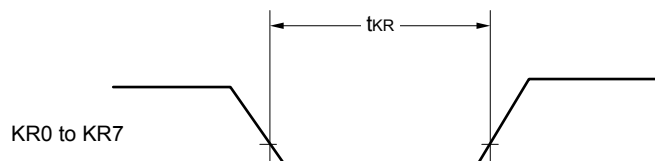
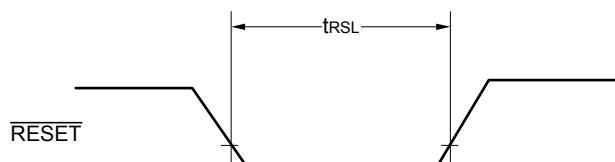
Remark 3. f_{CLK} : CPU/peripheral hardware clock frequency

Remark 4. Temperature condition of the TYP. value is $T_A = 25^{\circ}\text{C}$

Interrupt Request Input Timing



Key Interrupt Input Timing

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

(6) Communication at different potential (1.8 V, 2.5 V, 3 V) (CSI mode) (master mode, SCKp... internal clock output)**($T_A = -40$ to $+105^\circ\text{C}$, $2.4\text{ V} \leq \text{EVDD0} = \text{EVDD1} \leq \text{VDD} \leq 5.5\text{ V}$, $\text{VSS} = \text{EVSS0} = \text{EVSS1} = 0\text{ V}$)****(2/3)**

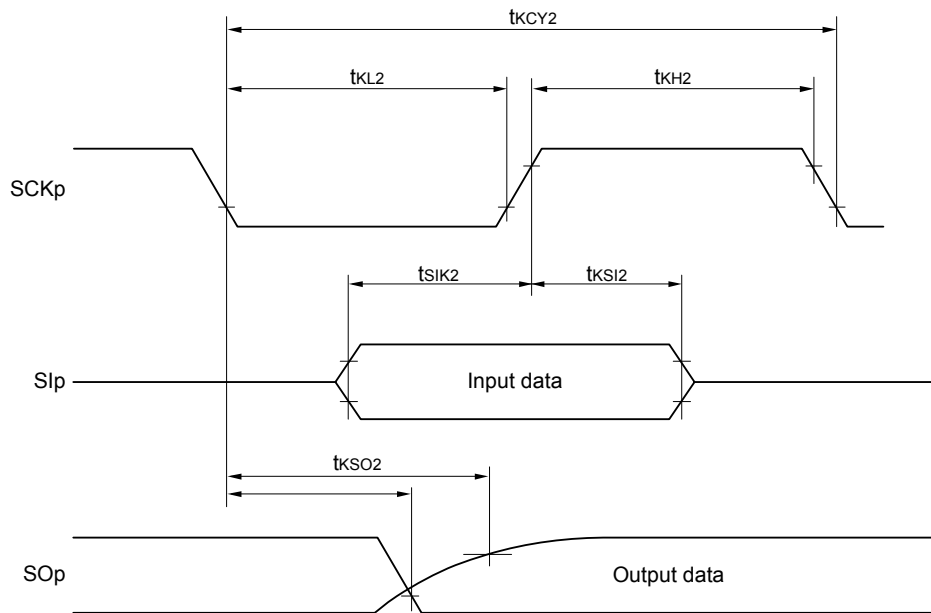
Parameter	Symbol	Conditions	HS (high-speed main) mode		Unit
			MIN.	MAX.	
Slp setup time (to SCKp $\uparrow$) ^{Note}	tsik1	$4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$, $2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 1.4\text{ k}\Omega$	162		ns
		$2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$, $2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 2.7\text{ k}\Omega$	354		ns
		$2.4\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$, $1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 5.5\text{ k}\Omega$	958		ns
Slp hold time (from SCKp $\uparrow$) ^{Note}	tkS11	$4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$, $2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 1.4\text{ k}\Omega$	38		ns
		$2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$, $2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 2.7\text{ k}\Omega$	38		ns
		$2.4\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$, $1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 5.5\text{ k}\Omega$	38		ns
Delay time from SCKp $\downarrow$ to SOp output ^{Note}	tkSO1	$4.0\text{ V} \leq \text{EVDD0} \leq 5.5\text{ V}$, $2.7\text{ V} \leq \text{Vb} \leq 4.0\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 1.4\text{ k}\Omega$		200	ns
		$2.7\text{ V} \leq \text{EVDD0} < 4.0\text{ V}$, $2.3\text{ V} \leq \text{Vb} \leq 2.7\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 2.7\text{ k}\Omega$		390	ns
		$2.4\text{ V} \leq \text{EVDD0} < 3.3\text{ V}$, $1.6\text{ V} \leq \text{Vb} \leq 2.0\text{ V}$, $\text{Cb} = 30\text{ pF}$, $\text{Rb} = 5.5\text{ k}\Omega$		966	ns

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

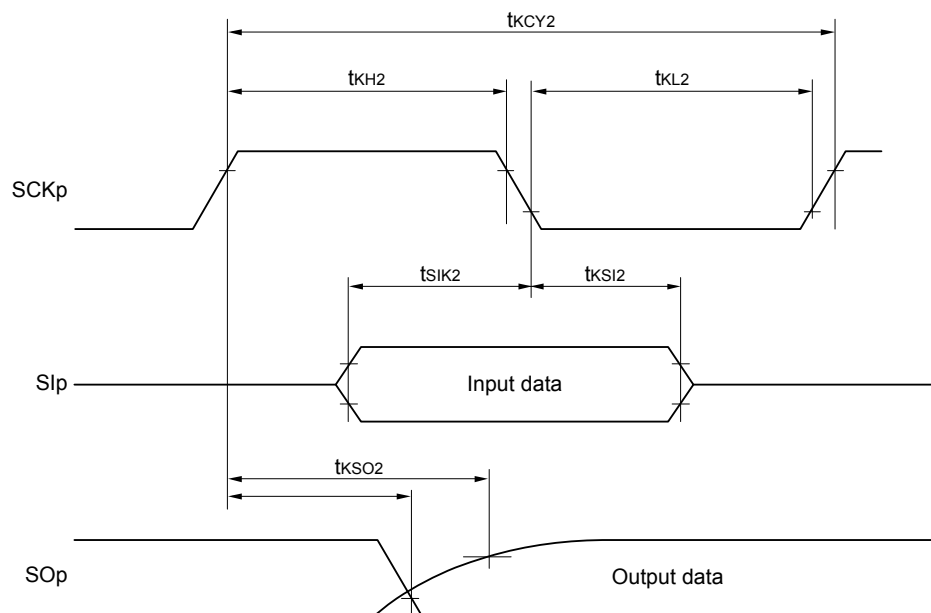
Caution Select the TTL input buffer for the Slp pin and the N-ch open drain output (VDD tolerance (for the 30- to 52-pin products)/ EVDD tolerance (for the 64- to 100-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V_{IH} and V_{IL} , see the DC characteristics with TTL input buffer selected.

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

CSI mode serial transfer timing (slave mode) (during communication at different potential)
(When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.)



CSI mode serial transfer timing (slave mode) (during communication at different potential)
(When DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.)



Remark 1. p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number (m = 0, 1), n: Channel number (n = 0 to 3),
g: PIM and POM number (g = 0, 1, 3 to 5, 14)

Remark 2. CSI01 of 48-, 52-, 64-pin products, and CSI11 and CSI21 cannot communicate at different potential. Use other CSI for communication at different potential.
Also, communication at different potential cannot be performed during clock synchronous serial communication with the slave select function.

3.6 Analog Characteristics

3.6.1 A/D converter characteristics

Classification of A/D converter characteristics

Reference Voltage	Reference voltage (+) = AV_{REFP} Reference voltage (-) = AV_{REFM}	Reference voltage (+) = V_{DD} Reference voltage (-) = V_{SS}	Reference voltage (+) = V_{BGR} Reference voltage (-) = AV_{REFM}
Input channel			
ANI0 to ANI14	Refer to 3.6.1 (1).	Refer to 3.6.1 (3).	Refer to 3.6.1 (4).
ANI16 to ANI20	Refer to 3.6.1 (2).		
Internal reference voltage Temperature sensor output voltage	Refer to 3.6.1 (1).		—

(1) When reference voltage (+) = $AV_{REFP}/ANI0$ ($ADREFP1 = 0$, $ADREFP0 = 1$), reference voltage (-) = $AV_{REFM}/ANI1$ ($ADREFM = 1$), target pin: ANI2 to ANI14, internal reference voltage, and temperature sensor output voltage

($T_A = -40$ to $+105^\circ\text{C}$, $2.4\text{ V} \leq AV_{REFP} \leq V_{DD} \leq 5.5\text{ V}$, $V_{SS} = 0\text{ V}$, Reference voltage (+) = AV_{REFP} ,
Reference voltage (-) = $AV_{REFM} = 0\text{ V}$)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Resolution	RES		8		10	bit
Overall error Note 1	AINL	10-bit resolution $AV_{REFP} = V_{DD}$ Note 3	$2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$	1.2	± 3.5	LSB
Conversion time	t_{CONV}	10-bit resolution Target pin: ANI2 to ANI14	$3.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	2.125	39	μs
			$2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	3.1875	39	μs
			$2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	17	39	μs
		10-bit resolution Target pin: Internal reference voltage, and temperature sensor output voltage (HS (high-speed main) mode)	$3.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	2.375	39	μs
			$2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	3.5625	39	μs
			$2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$	17	39	μs
Zero-scale error Notes 1, 2	E _{ZS}	10-bit resolution $AV_{REFP} = V_{DD}$ Note 3	$2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		± 0.25	%FSR
Full-scale error Notes 1, 2	E _{FS}	10-bit resolution $AV_{REFP} = V_{DD}$ Note 3	$2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		± 0.25	%FSR
Integral linearity error Note 1	ILE	10-bit resolution $AV_{REFP} = V_{DD}$ Note 3	$2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		± 2.5	LSB
Differential linearity error Note 1	DLE	10-bit resolution $AV_{REFP} = V_{DD}$ Note 3	$2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$		± 1.5	LSB
Analog input voltage	V_{AIN}	ANI2 to ANI14	0		AV_{REFP}	V
		Internal reference voltage output ($2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$, HS (high-speed main) mode)	V_{BGR} Note 4			V
		Temperature sensor output voltage ($2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$, HS (high-speed main) mode)	V_{TMPS25} Note 4			V

Note 1. Excludes quantization error ($\pm 1/2$ LSB).

Note 2. This value is indicated as a ratio (%FSR) to the full-scale value.

Note 3. When $AV_{REFP} < V_{DD}$, the MAX. values are as follows.

Overall error: Add ± 1.0 LSB to the MAX. value when $AV_{REFP} = V_{DD}$.

Zero-scale error/Full-scale error: Add $\pm 0.05\%$ FSR to the MAX. value when $AV_{REFP} = V_{DD}$.

Integral linearity error/ Differential linearity error: Add ± 0.5 LSB to the MAX. value when $AV_{REFP} = V_{DD}$.

Note 4. Refer to 3.6.2 Temperature sensor characteristics/internal reference voltage characteristic.

3.6.6 LVD circuit characteristics

(1) Reset Mode and Interrupt Mode

($T_A = -40$ to $+105^\circ\text{C}$, $V_{PDR} \leq V_{DD} \leq 5.5\text{ V}$, $V_{SS} = 0\text{ V}$)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Voltage detection threshold	Supply voltage level	VLVD0	Rising edge	3.90	4.06	4.22	V
			Falling edge	3.83	3.98	4.13	V
		VLVD1	Rising edge	3.60	3.75	3.90	V
			Falling edge	3.53	3.67	3.81	V
		VLVD2	Rising edge	3.01	3.13	3.25	V
			Falling edge	2.94	3.06	3.18	V
		VLVD3	Rising edge	2.90	3.02	3.14	V
			Falling edge	2.85	2.96	3.07	V
		VLVD4	Rising edge	2.81	2.92	3.03	V
			Falling edge	2.75	2.86	2.97	V
		VLVD5	Rising edge	2.70	2.81	2.92	V
			Falling edge	2.64	2.75	2.86	V
		VLVD6	Rising edge	2.61	2.71	2.81	V
			Falling edge	2.55	2.65	2.75	V
		VLVD7	Rising edge	2.51	2.61	2.71	V
			Falling edge	2.45	2.55	2.65	V
Minimum pulse width		tLW		300			μs
Detection delay time						300	μs

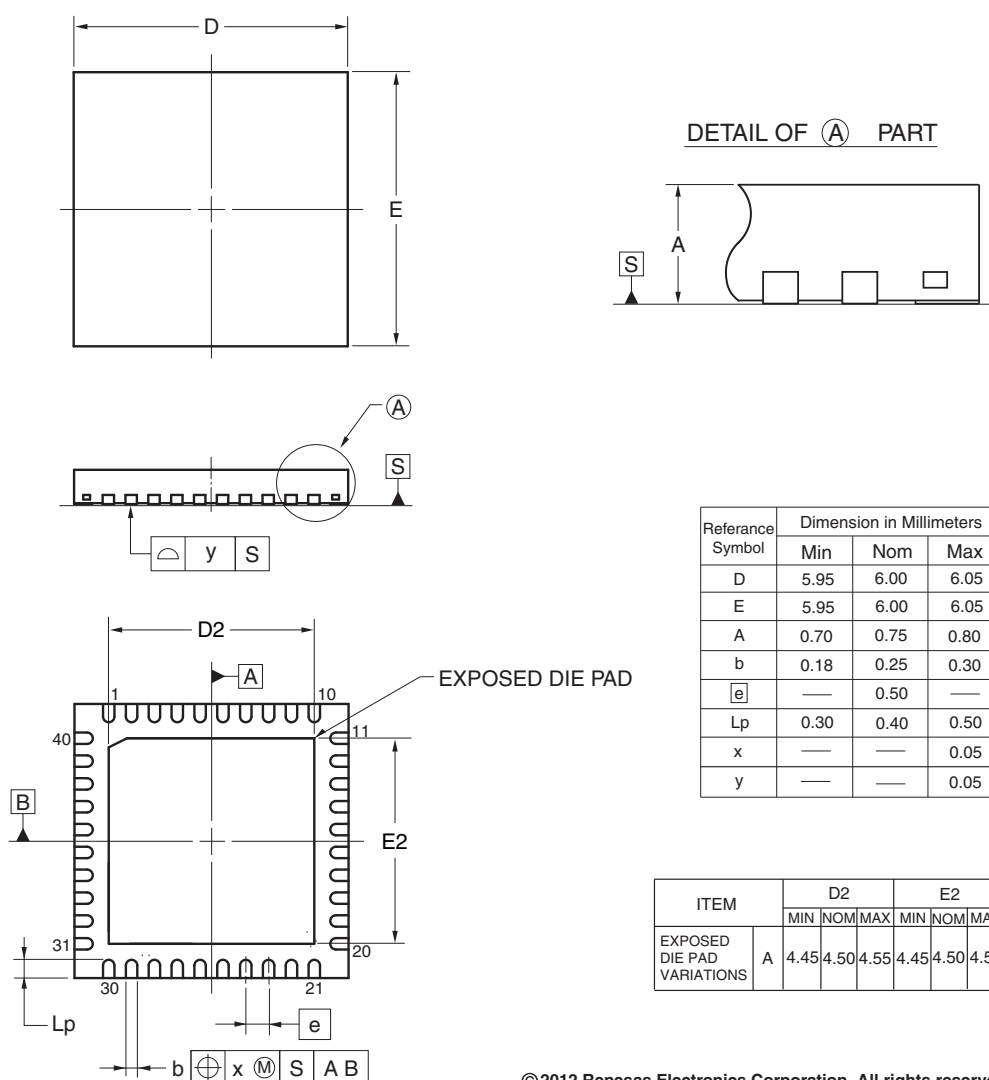
4.4 40-pin products

R5F104EAANA, R5F104ECANA, R5F104EDANA, R5F104EEANA, R5F104EFANA, R5F104EGANA, R5F104EHANA

R5F104EADNA, R5F104ECDNA, R5F104EDDNA, R5F104EEDNA, R5F104EFDNA, R5F104EGDNA, R5F104EHDNA

R5F104EAGNA, R5F104ECGNA, R5F104EDGNA, R5F104EEGNA, R5F104EFGNA, R5F104EGGNA, R5F104EHGNA

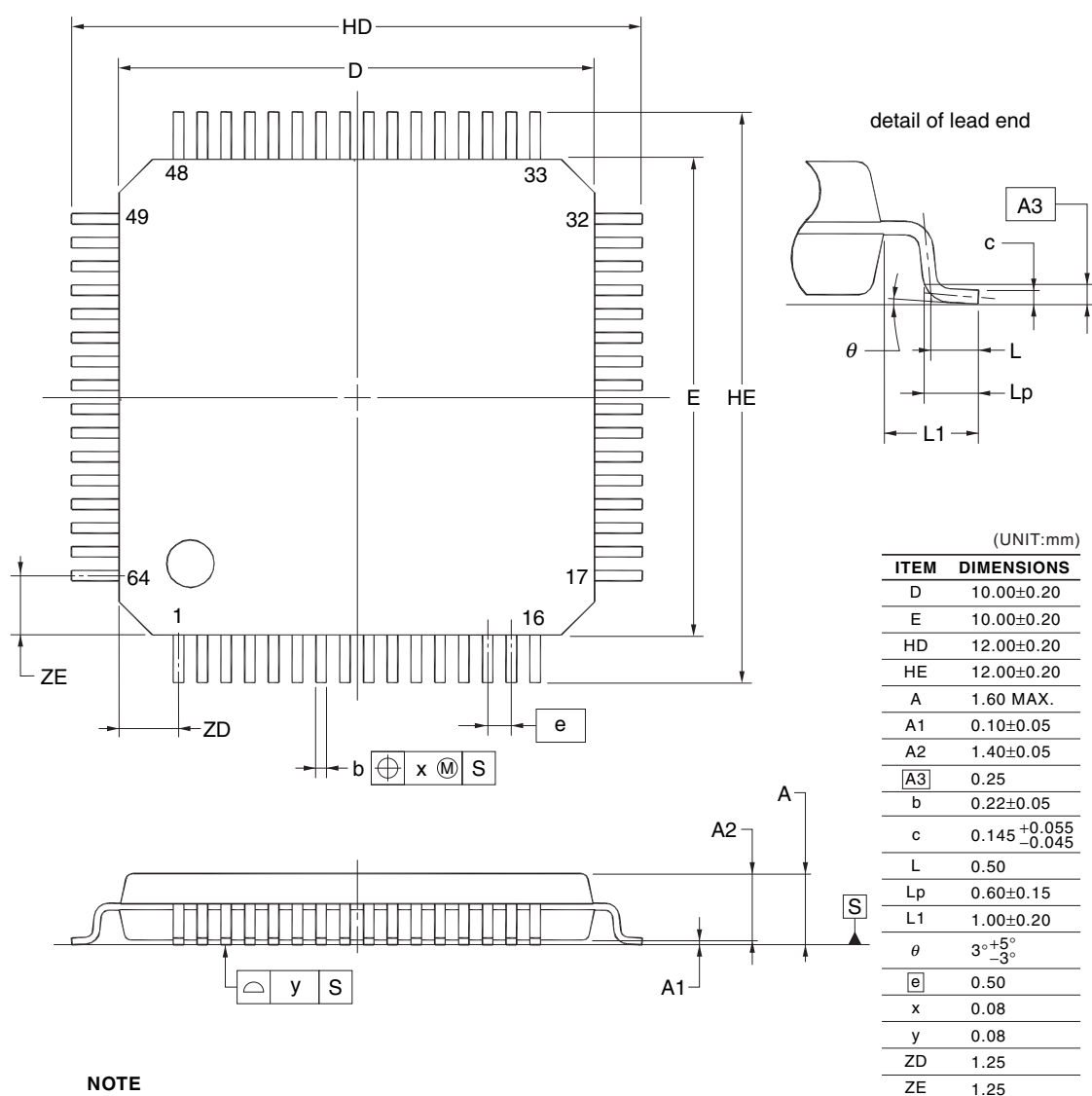
JEITA Package Code	RENESAS Code	Previous Code	MASS (TYP.) [g]
P-HWQFN40-6x6-0.50	PWQN0040KC-A	P40K8-50-4B4-4	0.09



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R5F104LCAFB, R5F104LDAFB, R5F104LEAFB, R5F104LFAFB, R5F104LGAFB, R5F104LHAFB,
 R5F104LJAFB
 R5F104LCDFB, R5F104LDDFB, R5F104LEDFB, R5F104LFDFB, R5F104LGDFB, R5F104LHDFB,
 R5F104LJDFB
 R5F104LCGFB, R5F104LDGFB, R5F104LEGFB, R5F104LFGFB, R5F104LGGFB, R5F104LHGFB,
 R5F104LJGFB

JEITA Package Code	RENESAS Code	Previous Code	MASS (TYP.) [g]
P-LFQFP64-10x10-0.50	PLQP0064KF-A	P64GB-50-UEU-2	0.35



NOTE

Each lead centerline is located within 0.08 mm of its true position at maximum material condition.