Renesas Electronics America Inc - R5F51303ADFN#30 Datasheet

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"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	RX
Core Size	32-Bit Single-Core
Speed	32MHz
Connectivity	I²C, LINbus, SCI, SPI
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	68
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	8K x 8
RAM Size	10K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 17x12b; 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-LFQFP (12x12)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f51303adfn-30

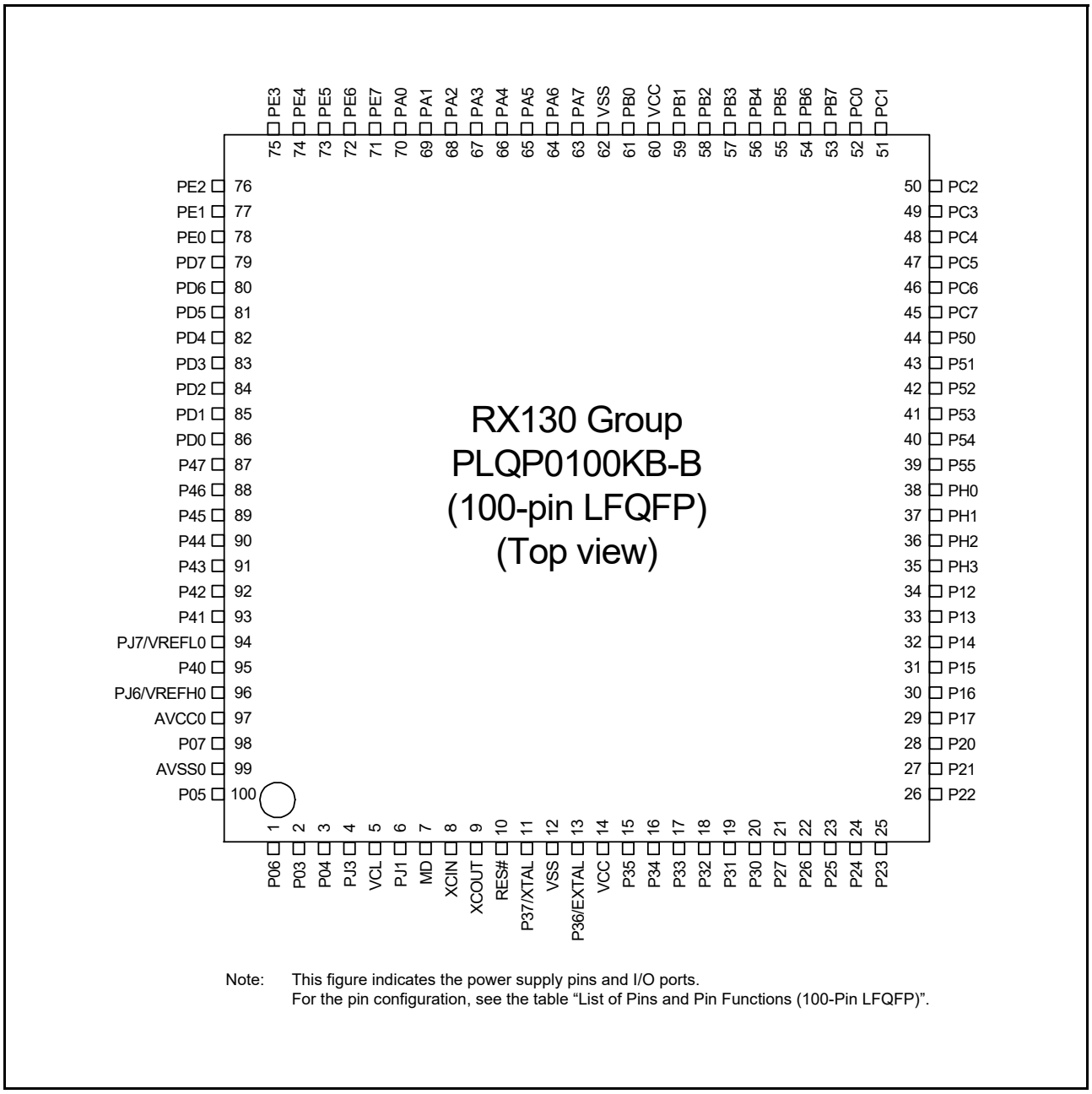
Table 1.3 List of Products (2/2)

Group	Part No.	Part No. (for Orders)	Package	ROM Capacity	RAM Capacity	E2 DataFlash	Operating Frequency (Max.)	Operating Temperature
RX130	R5F51308AGFP	R5F51308AGFP#30	PLQP0100KB-B	512 Kbytes	48 Kbytes	8 Kbytes	32 MHz	–40 to +105°C
	R5F51308AGFN	R5F51308AGFN#30	PLQP0080KB-B					
	R5F51308AGFM	R5F51308AGFM#30	PLQP0064KB-C					
	R5F51308AGFK	R5F51308AGFK#30	PLQP0064GA-A					
	R5F51308AGFL	R5F51308AGFL#30	PLQP0048KB-B					
	R5F51308AGNE	R5F51308AGNE#U0	PWQN0048KB-A					
	R5F51307AGFP	R5F51307AGFP#30	PLQP0100KB-B	384 Kbytes				
	R5F51307AGFN	R5F51307AGFN#30	PLQP0080KB-B					
	R5F51307AGFM	R5F51307AGFM#30	PLQP0064KB-C					
	R5F51307AGFK	R5F51307AGFK#30	PLQP0064GA-A					
	R5F51307AGFL	R5F51307AGFL#30	PLQP0048KB-B					
	R5F51307AGNE	R5F51307AGNE#U0	PWQN0048KB-A					
	R5F51306AGFP	R5F51306AGFP#30	PLQP0100KB-B	256 Kbytes	32 Kbytes			
	R5F51306AGFN	R5F51306AGFN#30	PLQP0080KB-B					
	R5F51306AGFM	R5F51306AGFM#30	PLQP0064KB-C					
	R5F51306AGFK	R5F51306AGFK#30	PLQP0064GA-A					
	R5F51306AGFL	R5F51306AGFL#30	PLQP0048KB-B					
	R5F51306AGNE	R5F51306AGNE#U0	PWQN0048KB-A					
	R5F51305AGFP	R5F51305AGFP#30	PLQP0100KB-B	128 Kbytes	16 Kbytes			
	R5F51305AGFN	R5F51305AGFN#30	PLQP0080KB-B					
	R5F51305AGFM	R5F51305AGFM#30	PLQP0064KB-C					
	R5F51305AGFK	R5F51305AGFK#30	PLQP0064GA-A					
	R5F51305AGFL	R5F51305AGFL#30	PLQP0048KB-B					
	R5F51305AGNE	R5F51305AGNE#U0	PWQN0048KB-A					
	R5F51303AGFN	R5F51303AGFN#30	PLQP0080KB-B	64 Kbytes	10 Kbytes			
	R5F51303AGFM	R5F51303AGFM#30	PLQP0064KB-C					
	R5F51303AGFK	R5F51303AGFK#30	PLQP0064GA-A					
	R5F51303AGFL	R5F51303AGFL#30	PLQP0048KB-B					
	R5F51303AGNE	R5F51303AGNE#U0	PWQN0048KB-A					

Note: The part numbers for orders above are used for products in mass production or under development when this manual is issued. Refer to the Renesas Electronics Corporation website for the latest part numbers.

1.5 Pin Assignments

Figure 1.3 to Figure 1.7 show the pin assignments. Table 1.5 to Table 1.8 show the lists of pins and pin functions.



Note: This figure indicates the power supply pins and I/O ports.
For the pin configuration, see the table “List of Pins and Pin Functions (100-Pin LFQFP)”.

Figure 1.3 Pin Assignments of the 100-Pin LFQFP

Table 1.5 List of Pins and Pin Functions (100-Pin LFQFP) (1/2)

Pin No.	Power Supply, Clock, System Control	I/O Port	Timers (MTU, TMR, POE)	Communications (SCIg, SCIh, RSPI, RIIC, REMC)	Touch sensing	Others
1		P06*1				
2		P03*1				DA0
3		P04*1				
4		PJ3	MTIOC3C	CTS6#/RTS6#/SS6#		
5	VCL					
6		PJ1	MTIOC3A			
7	MD					FINED
8	XCIN					
9	XCOUT					
10	RES#					
11	XTAL	P37				
12	VSS					
13	EXTAL	P36				
14	VCC					
15		P35				NMI
16		P34	MTIOC0A/TMCI3/POE2#	SCK6		IRQ4
17		P33	MTIOC0D/TMRI3/POE3#	RXD6/SMISO6/SSCL6		IRQ3
18		P32	MTIOC0C/TMO3	TXD6/SMOSI6/SSDA6	TS0	IRQ2/RTCOUT
19		P31	MTIOC4D/TMCI2	CTS1#/RTS1#/SS1#	TS1	IRQ1
20		P30	MTIOC4B/POE8#/TMRI3	RXD1/SMISO1/SSCL1	TS2	IRQ0
21		P27	MTIOC2B/TMCI3	SCK1	TS3	
22		P26	MTIOC2A/TMO1	TXD1/SMOSI1/SSDA1	TS4	
23		P25	MTIOC4C/MTCLKB			ADTRG0#
24		P24	MTIOC4A/MTCLKA/TMRI1			
25		P23	MTIOC3D/MTCLKD	CTS0#/RTS0#/SS0#		
26		P22	MTIOC3B/MTCLKC/TMO0	SCK0		
27		P21	MTIOC1B/TMCI0	RXD0/SMISO0/SSCL0		
28		P20	MTIOC1A/TMRI0	TXD0/SMOSI0/SSDA0		
29	(5V tolerant)	P17	MTIOC3A/MTIOC3B/TMO1/ POE8#	SCK1/MISOA/SDA		IRQ7
30	(5V tolerant)	P16	MTIOC3C/MTIOC3D/TMO2	TXD1/SMOSI1/SSDA1/MOSIA/SCL		IRQ6/RTCOUT/ ADTRG0#
31		P15	MTIOC0B/MTCLKB/TMCI2	RXD1/SMISO1/SSCL1	TS5	IRQ5
32		P14	MTIOC3A/MTCLKA/TMRI2	CTS1#/RTS1#/SS1#	TS6	IRQ4
33	(5V tolerant)	P13	MTIOC0B/TMO3	SDA		IRQ3
34	(5V tolerant)	P12	TMCI1	SCL		IRQ2
35		PH3	TMCI0		TS7	
36		PH2	TMRI0		TS8	IRQ1
37		PH1	TMO0		TS9	IRQ0
38		PH0			TS10	CACREF
39		P55	MTIOC4D/TMO3		TS11	
40		P54	MTIOC4B/TMCI1		TS12	
41		P53				
42		P52		PMC1		
43		P51		PMC0		
44		P50				
45		PC7	MTIOC3A/MTCLKB/TMO2	TXD8/SMOSI8/SSDA8/MISOA	TS13	CACREF
46		PC6	MTIOC3C/MTCLKA/TMCI2	RXD8/SMISO8/SSCL8/MOSIA	TS14	
47		PC5	MTIOC3B/MTCLKD/TMRI2	SCK8/RSPCKA	TS15	
48		PC4	MTIOC3D/MTCLKC/TMCI1/ POE0#	SCK5/CTS8#/RTS8#/SS8#/SSLA0	TSCAP	
49		PC3	MTIOC4D	TXD5/SMOSI5/SSDA5	TS16	
50		PC2	MTIOC4B	RXD5/SMISO5/SSCL5/SSLA3	TS17	
51		PC1	MTIOC3A	SCK5/SSLA2		
52		PC0	MTIOC3C	CTS5#/RTS5#/SS5#/SSLA1		

Table 1.6 List of Pins and Pin Functions (80-Pin LFQFP) (1/2)

Pin No.	Power Supply, Clock, System Control	I/O Port	Timers (MTU, TMR, POE)	Communications (SCIg, SCIh, RSPI, RIIC)	Touch sensing	Others
1		P06*1				
2		P03*1				DA0
3		P04*1				
4	VCL					
5		PJ1	MTIOC3A			
6	MD					FINED
7	XCIN					
8	XCOUT					
9	RES#					
10	XTAL	P37				
11	VSS					
12	EXTAL	P36				
13	VCC					
14		P35				NMI
15		P34	MTIOC0A/TMCI3/POE2#	SCK6		IRQ4
16		P32	MTIOC0C/TMO3	TXD6/SMOSI6/SSDA6	TS0	IRQ2/RTCOUT
17		P31	MTIOC4D/TMCI2	CTS1#/RTS1#/SS1#	TS1	IRQ1
18		P30	MTIOC4B/TMRI3/POE8#	RXD1/SMISO1/SSCL1	TS2	IRQ0
19		P27	MTIOC2B/TMCI3	SCK1	TS3	
20		P26	MTIOC2A/TMO1	TXD1/SMOSI1/SSDA1	TS4	
21		P21	MTIOC1B/TMCI0			
22		P20	MTIOC1A/TMRI0			
23	(5V tolerant)	P17	MTIOC3A/MTIOC3B/TMO1/ POE8#	SCK1/MISOA/SDA		IRQ7
24	(5V tolerant)	P16	MTIOC3C/MTIOC3D/TMO2	TXD1/SMOSI1/SSDA1/MOSIA/SCL		IRQ6/RTCOUT/ ADTRG0#
25		P15	MTIOC0B/MTCLKB/TMCI2	RXD1/SMISO1/SSCL1	TS5	IRQ5
26		P14	MTIOC3A/MTCLKA/TMRI2	CTS1#/RTS1#/SS1#	TS6	IRQ4
27	(5V tolerant)	P13	MTIOC0B/TMO3	SDA		IRQ3
28	(5V tolerant)	P12	TMCI1	SCL		IRQ2
29		PH3	TMCI0		TS7	
30		PH2	TMRI0		TS8	IRQ1
31		PH1	TMO0		TS9	IRQ0
32		PH0			TS10	CACREF
33		P55	MTIOC4D/TMO3		TS11	
34		P54	MTIOC4B/TMCI1		TS12	
35		PC7	MTIOC3A/TMO2/MTCLKB	MISOA	TS13	CACREF
36		PC6	MTIOC3C/MTCLKA/TMCI2	MOSIA	TS14	
37		PC5	MTIOC3B/MTCLKD/TMRI2	RSPCKA	TS15	
38		PC4	MTIOC3D/MTCLKC/TMCI1/ POE0#	SCK5/SSLA0	TSCAP	
39		PC3	MTIOC4D	TXD5/SMOSI5/SSDA5	TS16	
40		PC2	MTIOC4B	RXD5/SMISO5/SSCL5/SSLA3	TS17	
41		PB7/ PC1*2	MTIOC3B		TS18	
42		PB6/ PC0*2	MTIOC3D		TS19	
43		PB5	MTIOC2A/MTIOC1B/TMRI1/ POE1#		TS20	
44		PB4			TS21	
45		PB3	MTIOC0A/MTIOC4A/TMO0/ POE3#	SCK6	TS22	
46		PB2		CTS6#/RTS6#/SS6#	TS23	
47		PB1	MTIOC0C/MTIOC4C/TMCI0	TXD6/SMOSI6/SSDA6	TS24	IRQ4/CMPOB1
48	VCC					
49		PB0	MTIC5W	RXD6/SMISO6/SSCL6/RSPCKA	TS25	

3. Address Space

3.1 Address Space

This MCU has a 4-Gbyte address space, consisting of the range of addresses from 0000 0000h to FFFF FFFFh. That is, linear access to an address space of up to 4 Gbytes is possible, and this contains both program and data areas.
Figure 3.1 shows the memory maps.

4. I/O Registers

This section provides information on the on-chip I/O register addresses and bit configuration. The information is given as shown below. Notes on writing to registers are also given below.

(1) I/O register addresses (address order)

- Registers are listed from the lower allocation addresses.
- Registers are classified according to module symbols.
- Numbers of cycles for access indicate numbers of cycles of the given base clock.
- Among the internal I/O register area, addresses not listed in the list of registers are reserved. Reserved addresses must not be accessed. Do not access these addresses; otherwise, the operation when accessing these bits and subsequent operations cannot be guaranteed.

(2) Notes on writing to I/O registers

When writing to an I/O register, the CPU starts executing the subsequent instruction before completing I/O register write. This may cause the subsequent instruction to be executed before the post-update I/O register value is reflected on the operation.
As described in the following examples, special care is required for the cases in which the subsequent instruction must be executed after the post-update I/O register value is actually reflected.

[Examples of cases requiring special care]

- The subsequent instruction must be executed while an interrupt request is disabled with the IENj bit in IERn of the ICU (interrupt request enable bit) cleared to 0.
- A WAIT instruction is executed immediately after the preprocessing for causing a transition to the low power consumption state.

In the above cases, after writing to an I/O register, wait until the write operation is completed using the following procedure and then execute the subsequent instruction.

(a) Write to an I/O register.
(b) Read the value from the I/O register to a general register.
(c) Execute the operation using the value read.
(d) Execute the subsequent instruction.

[Instruction examples]

- Byte-size I/O registers

```
MOV.L  #SFR_ADDR, R1
MOV.B  #SFR_DATA, [R1]
CMP    [R1].UB, R1
;; Next process
```

- Word-size I/O registers

```
MOV.L  #SFR_ADDR, R1
MOV.W  #SFR_DATA, [R1]
CMP    [R1].W, R1
;; Next process
```

4.1 I/O Register Addresses (Address Order)

Table 4.1 List of I/O Registers (Address Order) (1 / 18)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access Cycles
0008 0000h	SYSTEM	Mode Monitor Register	MDMONR	16	16	3 ICLK
0008 0008h	SYSTEM	System Control Register 1	SYSCR1	16	16	3 ICLK
0008 000Ch	SYSTEM	Standby Control Register	SBYCR	16	16	3 ICLK
0008 0010h	SYSTEM	Module Stop Control Register A	MSTPCRA	32	32	3 ICLK
0008 0014h	SYSTEM	Module Stop Control Register B	MSTPCRB	32	32	3 ICLK
0008 0018h	SYSTEM	Module Stop Control Register C	MSTPCRC	32	32	3 ICLK
0008 001Ch	SYSTEM	Module Stop Control Register D	MSTPCRD	32	32	3 ICLK
0008 0020h	SYSTEM	System Clock Control Register	SCKCR	32	32	3 ICLK
0008 0026h	SYSTEM	System Clock Control Register 3	SCKCR3	16	16	3 ICLK
0008 0028h	SYSTEM	PLL Control Register	PLLCR	16	16	3 ICLK
0008 002Ah	SYSTEM	PLL Control Register 2	PLLCR2	8	8	3 ICLK
0008 0032h	SYSTEM	Main Clock Oscillator Control Register	MOSCCR	8	8	3 ICLK
0008 0033h	SYSTEM	Sub-Clock Oscillator Control Register	SOSCCR	8	8	3 ICLK
0008 0034h	SYSTEM	Low-Speed On-Chip Oscillator Control Register	LOCOCR	8	8	3 ICLK
0008 0035h	SYSTEM	IWDT-Dedicated On-Chip Oscillator Control Register	ILOCOCR	8	8	3 ICLK
0008 0036h	SYSTEM	High-Speed On-Chip Oscillator Control Register	HOCOCR	8	8	3 ICLK
0008 003Ch	SYSTEM	Oscillation Stabilization Flag Register	OSCOVFSR	8	8	3 ICLK
0008 003Dh	SYSTEM	High-Speed On-Chip Oscillator Forced Oscillation Control Register	HOFCR	8	8	3 ICLK
0008 003Eh	SYSTEM	CLKOUT Output Control Register	CKOCR	16	16	3 ICLK
0008 0040h	SYSTEM	Oscillation Stop Detection Control Register	OSTDCR	8	8	3 ICLK
0008 0041h	SYSTEM	Oscillation Stop Detection Status Register	OSTDSR	8	8	3 ICLK
0008 0060h	SYSTEM	Low-Speed On-Chip Oscillator Trimming Register	LOCOTRR	8	8	3 ICLK
0008 0064h	SYSTEM	IWDT-Dedicated On-Chip Oscillator Trimming Register	ILOCOTRR	8	8	3 ICLK
0008 0068h	SYSTEM	High-Speed On-Chip Oscillator Trimming Register 0	HOCOTRR0	8	8	3 ICLK
0008 00A0h	SYSTEM	Operating Power Control Register	OPCCR	8	8	3 ICLK
0008 00A1h	SYSTEM	Sleep Mode Return Clock Source Switching Register	RSTCKCR	8	8	3 ICLK
0008 00A2h	SYSTEM	Main Clock Oscillator Wait Control Register	MOSCWTCR	8	8	3 ICLK
0008 00AAh	SYSTEM	Sub Operating Power Control Register	SOPCCR	8	8	3 ICLK
0008 00B0h	LPT	Low-Power Timer Control Register 1	LPTCR1	8	8	3 ICLK
0008 00B1h	LPT	Low-Power Timer Control Register 2	LPTCR2	8	8	3 ICLK
0008 00B2h	LPT	Low-Power Timer Control Register 3	LPTCR3	8	8	3 ICLK
0008 00B4h	LPT	Low-Power Timer Cycle Setting Register	LPTPRD	16	16	3 ICLK
0008 00B8h	LPT	Low-Power Timer Compare Register 0	LPCMR0	16	16	3 ICLK
0008 00BCh	LPT	Low-Power Timer Standby Wakeup Enable Register	LPWUCR	16	16	3 ICLK
0008 00C0h	SYSTEM	Reset Status Register 2	RSTSR2	8	8	3 ICLK
0008 00C2h	SYSTEM	Software Reset Register	SWRR	16	16	3 ICLK
0008 00E0h	SYSTEM	Voltage Monitoring 1 Circuit Control Register 1	LVD1CR1	8	8	3 ICLK
0008 00E1h	SYSTEM	Voltage Monitoring 1 Circuit Status Register	LVD1SR	8	8	3 ICLK
0008 00E2h	SYSTEM	Voltage Monitoring 2 Circuit Control Register 1	LVD2CR1	8	8	3 ICLK
0008 00E3h	SYSTEM	Voltage Monitoring 2 Circuit Status Register	LVD2SR	8	8	3 ICLK
0008 03FEh	SYSTEM	Protect Register	PRCR	16	16	3 ICLK
0008 1300h	BSC	Bus Error Status Clear Register	BERCLR	8	8	2 ICLK
0008 1304h	BSC	Bus Error Monitoring Enable Register	BEREN	8	8	2 ICLK
0008 1308h	BSC	Bus Error Status Register 1	BERSR1	8	8	2 ICLK
0008 130Ah	BSC	Bus Error Status Register 2	BERSR2	16	16	2 ICLK
0008 1310h	BSC	Bus Priority Control Register	BUSPRI	16	16	2 ICLK
0008 2400h	DTC	DTC Control Register	DTCCR	8	8	2 ICLK
0008 2404h	DTC	DTC Vector Base Register	DTCVBR	32	32	2 ICLK
0008 2408h	DTC	DTC Address Mode Register	DTCADMOD	8	8	2 ICLK

Table 4.1 List of I/O Registers (Address Order) (4 / 18)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access Cycles
0008 838Dh	RSPI0	RSPI Slave Select Negation Delay Register	SSLND	8	8	2 or 3 PCLKB
0008 838Eh	RSPI0	RSPI Next-Access Delay Register	SPND	8	8	2 or 3 PCLKB
0008 838Fh	RSPI0	RSPI Control Register 2	SPCR2	8	8	2 or 3 PCLKB
0008 8390h	RSPI0	RSPI Command Register 0	SPCMD0	16	16	2 or 3 PCLKB
0008 8392h	RSPI0	RSPI Command Register 1	SPCMD1	16	16	2 or 3 PCLKB
0008 8394h	RSPI0	RSPI Command Register 2	SPCMD2	16	16	2 or 3 PCLKB
0008 8396h	RSPI0	RSPI Command Register 3	SPCMD3	16	16	2 or 3 PCLKB
0008 8398h	RSPI0	RSPI Command Register 4	SPCMD4	16	16	2 or 3 PCLKB
0008 839Ah	RSPI0	RSPI Command Register 5	SPCMD5	16	16	2 or 3 PCLKB
0008 839Ch	RSPI0	RSPI Command Register 6	SPCMD6	16	16	2 or 3 PCLKB
0008 839Eh	RSPI0	RSPI Command Register 7	SPCMD7	16	16	2 or 3 PCLKB
0008 8600h	MTU3	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8601h	MTU4	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8602h	MTU3	Timer Mode Register	TMDR	8	8	2 or 3 PCLKB
0008 8603h	MTU4	Timer Mode Register	TMDR	8	8	2 or 3 PCLKB
0008 8604h	MTU3	Timer I/O Control Register H	TIORH	8	8	2 or 3 PCLKB
0008 8605h	MTU3	Timer I/O Control Register L	TIORL	8	8	2 or 3 PCLKB
0008 8606h	MTU4	Timer I/O Control Register H	TIORH	8	8	2 or 3 PCLKB
0008 8607h	MTU4	Timer I/O Control Register L	TIORL	8	8	2 or 3 PCLKB
0008 8608h	MTU3	Timer Interrupt Enable Register	TIER	8	8	2 or 3 PCLKB
0008 8609h	MTU4	Timer Interrupt Enable Register	TIER	8	8	2 or 3 PCLKB
0008 860Ah	MTU	Timer Output Master Enable Registers	TOER	8	8	2 or 3 PCLKB
0008 860Dh	MTU	Timer Gate Control Registers	TGCR	8	8	2 or 3 PCLKB
0008 860Eh	MTU	Timer Output Control Register 1	TOCR1	8	8	2 or 3 PCLKB
0008 860Fh	MTU	Timer Output Control Register 2	TOCR2	8	8	2 or 3 PCLKB
0008 8610h	MTU3	Timer Counter	TCNT	16	16	2 or 3 PCLKB
0008 8612h	MTU4	Timer Counter	TCNT	16	16	2 or 3 PCLKB
0008 8614h	MTU	Timer Cycle Data Register	TCDR	16	16	2 or 3 PCLKB
0008 8616h	MTU	Timer Dead Time Data Register	TDDR	16	16	2 or 3 PCLKB
0008 8618h	MTU3	Timer General Register A	TGRA	16	16	2 or 3 PCLKB
0008 861Ah	MTU3	Timer General Register B	TGRB	16	16	2 or 3 PCLKB
0008 861Ch	MTU4	Timer General Register A	TGRA	16	16	2 or 3 PCLKB
0008 861Eh	MTU4	Timer General Register B	TGRB	16	16	2 or 3 PCLKB
0008 8620h	MTU	Timer Subcounter	TCNTS	16	16	2 or 3 PCLKB
0008 8622h	MTU	Timer Cycle Buffer Register	TCBR	16	16	2 or 3 PCLKB
0008 8624h	MTU3	Timer General Register C	TGRC	16	16	2 or 3 PCLKB
0008 8626h	MTU3	Timer General Register D	TGRD	16	16	2 or 3 PCLKB
0008 8628h	MTU4	Timer General Register C	TGRC	16	16	2 or 3 PCLKB
0008 862Ah	MTU4	Timer General Register D	TGRD	16	16	2 or 3 PCLKB
0008 862Ch	MTU3	Timer Status Register	TSR	8	8	2 or 3 PCLKB
0008 862Dh	MTU4	Timer Status Register	TSR	8	8	2 or 3 PCLKB
0008 8630h	MTU	Timer Interrupt Skipping Set Register	TITCR	8	8	2 or 3 PCLKB
0008 8631h	MTU	Timer Interrupt Skipping Counter	TITCNT	8	8	2 or 3 PCLKB
0008 8632h	MTU	Timer Buffer Transfer Set Register	TBTER	8	8	2 or 3 PCLKB
0008 8634h	MTU	Timer Dead Time Enable Register	TDER	8	8	2 or 3 PCLKB
0008 8636h	MTU	Timer Output Level Buffer Register	TOLBR	8	8	2 or 3 PCLKB
0008 8638h	MTU3	Timer Buffer Operation Transfer Mode Register	TBTM	8	8	2 or 3 PCLKB
0008 8639h	MTU4	Timer Buffer Operation Transfer Mode Register	TBTM	8	8	2 or 3 PCLKB
0008 8640h	MTU4	Timer A/D Converter Start Request Control Register	TADCR	16	16	2 or 3 PCLKB
0008 8644h	MTU4	Timer A/D Converter Start Request Cycle Set Register A	TADCORA	16	16	2 or 3 PCLKB
0008 8646h	MTU4	Timer A/D Converter Start Request Cycle Set Register B	TADCORB	16	16	2 or 3 PCLKB
0008 8648h	MTU4	Timer A/D Converter Start Request Cycle Set Buffer Register A	TADCOBRA	16	16	2 or 3 PCLKB

Table 4.1 List of I/O Registers (Address Order) (6 / 18)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access Cycles
0008 88A2h	MTU5	Timer General Register W	TGRW	16	16	2 or 3 PCLKB
0008 88A4h	MTU5	Timer Control Register W	TCRW	8	8	2 or 3 PCLKB
0008 88A6h	MTU5	Timer I/O Control Register W	TIORW	8	8	2 or 3 PCLKB
0008 88B2h	MTU5	Timer Interrupt Enable Register	TIER	8	8	2 or 3 PCLKB
0008 88B4h	MTU5	Timer Start Register	TSTR	8	8	2 or 3 PCLKB
0008 88B6h	MTU5	Timer Compare Match Clear Register	TCNTCMPCLR	8	8	2 or 3 PCLKB
0008 8900h	POE	Input Level Control/Status Register 1	ICSR1	16	8, 16	2 or 3 PCLKB
0008 8902h	POE	Output Level Control/Status Register 1	OCSR1	16	8, 16	2 or 3 PCLKB
0008 8908h	POE	Input Level Control/Status Register 2	ICSR2	16	8, 16	2 or 3 PCLKB
0008 890Ah	POE	Software Port Output Enable Register	SPOER	8	8	2 or 3 PCLKB
0008 890Bh	POE	Port Output Enable Control Register 1	POECR1	8	8	2 or 3 PCLKB
0008 890Ch	POE	Port Output Enable Control Register 2	POECR2	8	8	2 or 3 PCLKB
0008 890Eh	POE	Input Level Control/Status Register 3	ICSR3	16	8, 16	2 or 3 PCLKB
0008 9000h	S12AD	A/D Control Register	ADCSR	16	16	2 or 3 PCLKB
0008 9004h	S12AD	A/D Channel Select Register A0	ADANSA0	16	16	2 or 3 PCLKB
0008 9006h	S12AD	A/D Channel Select Register A1	ADANSA1	16	16	2 or 3 PCLKB
0008 9008h	S12AD	A/D-Converted Value Addition/Average Function Select Register 0	ADADS0	16	16	2 or 3 PCLKB
0008 900Ah	S12AD	A/D-Converted Value Addition/Average Function Select Register 1	ADADS1	16	16	2 or 3 PCLKB
0008 900Ch	S12AD	A/D-Converted Value Addition/Average Count Select Register	ADADC	8	8	2 or 3 PCLKB
0008 900Eh	S12AD	A/D Control Extended Register	ADCER	16	16	2 or 3 PCLKB
0008 9010h	S12AD	A/D Conversion Start Trigger Select Register	ADSTRGR	16	16	2 or 3 PCLKB
0008 9012h	S12AD	A/D Conversion Extended Input Control Register	ADEXICR	16	16	2 or 3 PCLKB
0008 9014h	S12AD	A/D Channel Select Register B0	ADANSB0	16	16	2 or 3 PCLKB
0008 9016h	S12AD	A/D Channel Select Register B1	ADANSB1	16	16	2 or 3 PCLKB
0008 9018h	S12AD	A/D Data Duplication Register	ADDBLDR	16	16	2 or 3 PCLKB
0008 901Ah	S12AD	A/D Temperature Sensor Data Register	ADTSDR	16	16	2 or 3 PCLKB
0008 901Ch	S12AD	A/D Internal Reference Voltage Data Register	ADOCDR	16	16	2 or 3 PCLKB
0008 901Eh	S12AD	A/D Self-Diagnosis Data Register	ADRD	16	16	2 or 3 PCLKB
0008 9020h	S12AD	A/D Data Register 0	ADDR0	16	16	2 or 3 PCLKB
0008 9022h	S12AD	A/D Data Register 1	ADDR1	16	16	2 or 3 PCLKB
0008 9024h	S12AD	A/D Data Register 2	ADDR2	16	16	2 or 3 PCLKB
0008 9026h	S12AD	A/D Data Register 3	ADDR3	16	16	2 or 3 PCLKB
0008 9028h	S12AD	A/D Data Register 4	ADDR4	16	16	2 or 3 PCLKB
0008 902Ah	S12AD	A/D Data Register 5	ADDR5	16	16	2 or 3 PCLKB
0008 902Ch	S12AD	A/D Data Register 6	ADDR6	16	16	2 or 3 PCLKB
0008 902Eh	S12AD	A/D Data Register 7	ADDR7	16	16	2 or 3 PCLKB
0008 9040h	S12AD	A/D Data Register 16	ADDR16	16	16	2 or 3 PCLKB
0008 9042h	S12AD	A/D Data Register 17	ADDR17	16	16	2 or 3 PCLKB
0008 9044h	S12AD	A/D Data Register 18	ADDR18	16	16	2 or 3 PCLKB
0008 9046h	S12AD	A/D Data Register 19	ADDR19	16	16	2 or 3 PCLKB
0008 9048h	S12AD	A/D Data Register 20	ADDR20	16	16	2 or 3 PCLKB
0008 904Ah	S12AD	A/D Data Register 21	ADDR21	16	16	2 or 3 PCLKB
0008 904Ch	S12AD	A/D Data Register 22	ADDR22	16	16	2 or 3 PCLKB
0008 904Eh	S12AD	A/D Data Register 23	ADDR23	16	16	2 or 3 PCLKB
0008 9050h	S12AD	A/D Data Register 24	ADDR24	16	16	2 or 3 PCLKB
0008 9052h	S12AD	A/D Data Register 25	ADDR25	16	16	2 or 3 PCLKB
0008 9054h	S12AD	A/D Data Register 26	ADDR26	16	16	2 or 3 PCLKB
0008 9056h	S12AD	A/D Data Register 27	ADDR27	16	16	2 or 3 PCLKB
0008 9058h	S12AD	A/D Data Register 28	ADDR28	16	16	2 or 3 PCLKB
0008 905Ah	S12AD	A/D Data Register 29	ADDR29	16	16	2 or 3 PCLKB
0008 905Ch	S12AD	A/D Data Register 30	ADDR30	16	16	2 or 3 PCLKB

Table 4.1 List of I/O Registers (Address Order) (9 / 18)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access Cycles
0008 A0A6h	SMCI5	Smart Card Mode Register	SCMR	8	8	2 or 3 PCLKB
0008 A0A7h	SCI5	Serial Extended Mode Register	SEMR	8	8	2 or 3 PCLKB
0008 A0A8h	SCI5	Noise Filter Setting Register	SNFR	8	8	2 or 3 PCLKB
0008 A0A9h	SCI5	I2C Mode Register 1	SIMR1	8	8	2 or 3 PCLKB
0008 A0AAh	SCI5	I2C Mode Register 2	SIMR2	8	8	2 or 3 PCLKB
0008 A0ABh	SCI5	I2C Mode Register 3	SIMR3	8	8	2 or 3 PCLKB
0008 A0ACh	SCI5	I2C Status Register	SISR	8	8	2 or 3 PCLKB
0008 A0ADh	SCI5	SPI Mode Register	SPMR	8	8	2 or 3 PCLKB
0008 A0AEh	SCI5	Transmit Data Register HL	TDRHL	16	16	2 or 3 PCLKB
0008 A0AEh	SCI5	Transmit Data Register H	TDRH	8	8	2 or 3 PCLKB
0008 A0AFh	SCI5	Transmit Data Register L	TDRL	8	8	2 or 3 PCLKB
0008 A0B0h	SCI5	Receive Data Register HL	RDRHL	16	16	2 or 3 PCLKB
0008 A0B0h	SCI5	Receive Data Register H	RDRH	8	8	2 or 3 PCLKB
0008 A0B1h	SCI5	Receive Data Register L	RDRL	8	8	2 or 3 PCLKB
0008 A0B2h	SCI5	Modulation Duty Register	MDDR	8	8	2 or 3 PCLKB
0008 A0C0h	SCI6	Serial Mode Register	SMR	8	8	2 or 3 PCLKB
0008 A0C1h	SCI6	Bit Rate Register	BRR	8	8	2 or 3 PCLKB
0008 A0C2h	SCI6	Serial Control Register	SCR	8	8	2 or 3 PCLKB
0008 A0C3h	SCI6	Transmit Data Register	TDR	8	8	2 or 3 PCLKB
0008 A0C4h	SCI6	Serial Status Register	SSR	8	8	2 or 3 PCLKB
0008 A0C5h	SCI6	Receive Data Register	RDR	8	8	2 or 3 PCLKB
0008 A0C6h	SMCI6	Smart Card Mode Register	SCMR	8	8	2 or 3 PCLKB
0008 A0C7h	SCI6	Serial Extended Mode Register	SEMR	8	8	2 or 3 PCLKB
0008 A0C8h	SCI6	Noise Filter Setting Register	SNFR	8	8	2 or 3 PCLKB
0008 A0C9h	SCI6	I2C Mode Register 1	SIMR1	8	8	2 or 3 PCLKB
0008 A0CAh	SCI6	I2C Mode Register 2	SIMR2	8	8	2 or 3 PCLKB
0008 A0CBh	SCI6	I2C Mode Register 3	SIMR3	8	8	2 or 3 PCLKB
0008 A0CCh	SCI6	I2C Status Register	SISR	8	8	2 or 3 PCLKB
0008 A0CDh	SCI6	SPI Mode Register	SPMR	8	8	2 or 3 PCLKB
0008 A0CEh	SCI6	Transmit Data Register HL	TDRHL	16	16	2 or 3 PCLKB
0008 A0CEh	SCI6	Transmit Data Register H	TDRH	8	8	2 or 3 PCLKB
0008 A0CFh	SCI6	Transmit Data Register L	TDRL	8	8	2 or 3 PCLKB
0008 A0D0h	SCI6	Receive Data Register HL	RDRHL	16	16	2 or 3 PCLKB
0008 A0D0h	SCI6	Receive Data Register H	RDRH	8	8	2 or 3 PCLKB
0008 A0D1h	SCI6	Receive Data Register L	RDRL	8	8	2 or 3 PCLKB
0008 A0D2h	SCI6	Modulation Duty Register	MDDR	8	8	2 or 3 PCLKB
0008 A100h	SCI8	Serial Mode Register	SMR	8	8	2 or 3 PCLKB
0008 A101h	SCI8	Bit Rate Register	BRR	8	8	2 or 3 PCLKB
0008 A102h	SCI8	Serial Control Register	SCR	8	8	2 or 3 PCLKB
0008 A103h	SCI8	Transmit Data Register	TDR	8	8	2 or 3 PCLKB
0008 A104h	SCI8	Serial Status Register	SSR	8	8	2 or 3 PCLKB
0008 A105h	SCI8	Receive Data Register	RDR	8	8	2 or 3 PCLKB
0008 A106h	SMCI8	Smart Card Mode Register	SCMR	8	8	2 or 3 PCLKB
0008 A107h	SCI8	Serial Extended Mode Register	SEMR	8	8	2 or 3 PCLKB
0008 A108h	SCI8	Noise Filter Setting Register	SNFR	8	8	2 or 3 PCLKB
0008 A109h	SCI8	I2C Mode Register 1	SIMR1	8	8	2 or 3 PCLKB
0008 A10Ah	SCI8	I2C Mode Register 2	SIMR2	8	8	2 or 3 PCLKB
0008 A10Bh	SCI8	I2C Mode Register 3	SIMR3	8	8	2 or 3 PCLKB
0008 A10Ch	SCI8	I2C Status Register	SISR	8	8	2 or 3 PCLKB
0008 A10Dh	SCI8	SPI Mode Register	SPMR	8	8	2 or 3 PCLKB
0008 A10Eh	SCI8	Transmit Data Register HL	TDRHL	16	16	2 or 3 PCLKB
0008 A10Eh	SCI8	Transmit Data Register H	TDRH	8	8	2 or 3 PCLKB

Table 4.1 List of I/O Registers (Address Order) (14 / 18)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access Cycles
0008 C147h	MPC	P07 Pin Function Control Register	P07PFS	8	8	2 or 3 PCLKB
0008 C14Ah	MPC	P12 Pin Function Control Register	P12PFS	8	8	2 or 3 PCLKB
0008 C14Bh	MPC	P13 Pin Function Control Register	P13PFS	8	8	2 or 3 PCLKB
0008 C14Ch	MPC	P14 Pin Function Control Register	P14PFS	8	8	2 or 3 PCLKB
0008 C14Dh	MPC	P15 Pin Function Control Register	P15PFS	8	8	2 or 3 PCLKB
0008 C14Eh	MPC	P16 Pin Function Control Register	P16PFS	8	8	2 or 3 PCLKB
0008 C14Fh	MPC	P17 Pin Function Control Register	P17PFS	8	8	2 or 3 PCLKB
0008 C150h	MPC	P20 Pin Function Control Register	P20PFS	8	8	2 or 3 PCLKB
0008 C151h	MPC	P21 Pin Function Control Register	P21PFS	8	8	2 or 3 PCLKB
0008 C152h	MPC	P22 Pin Function Control Register	P22PFS	8	8	2 or 3 PCLKB
0008 C153h	MPC	P23 Pin Function Control Register	P23PFS	8	8	2 or 3 PCLKB
0008 C154h	MPC	P24 Pin Function Control Register	P24PFS	8	8	2 or 3 PCLKB
0008 C155h	MPC	P25 Pin Function Control Register	P25PFS	8	8	2 or 3 PCLKB
0008 C156h	MPC	P26 Pin Function Control Register	P26PFS	8	8	2 or 3 PCLKB
0008 C157h	MPC	P27 Pin Function Control Register	P27PFS	8	8	2 or 3 PCLKB
0008 C158h	MPC	P30 Pin Function Control Register	P30PFS	8	8	2 or 3 PCLKB
0008 C159h	MPC	P31 Pin Function Control Register	P31PFS	8	8	2 or 3 PCLKB
0008 C15Ah	MPC	P32 Pin Function Control Register	P32PFS	8	8	2 or 3 PCLKB
0008 C15Bh	MPC	P33 Pin Function Control Register	P33PFS	8	8	2 or 3 PCLKB
0008 C15Ch	MPC	P34 Pin Function Control Register	P34PFS	8	8	2 or 3 PCLKB
0008 C160h	MPC	P40 Pin Function Control Register	P40PFS	8	8	2 or 3 PCLKB
0008 C161h	MPC	P41 Pin Function Control Register	P41PFS	8	8	2 or 3 PCLKB
0008 C162h	MPC	P42 Pin Function Control Register	P42PFS	8	8	2 or 3 PCLKB
0008 C163h	MPC	P43 Pin Function Control Register	P43PFS	8	8	2 or 3 PCLKB
0008 C164h	MPC	P44 Pin Function Control Register	P44PFS	8	8	2 or 3 PCLKB
0008 C165h	MPC	P45 Pin Function Control Register	P45PFS	8	8	2 or 3 PCLKB
0008 C166h	MPC	P46 Pin Function Control Register	P46PFS	8	8	2 or 3 PCLKB
0008 C167h	MPC	P47 Pin Function Control Register	P47PFS	8	8	2 or 3 PCLKB
0008 C169h	MPC	P51 Pin Function Control Register	P51PFS	8	8	2 or 3 PCLKB
0008 C16Ah	MPC	P52 Pin Function Control Register	P52PFS	8	8	2 or 3 PCLKB
0008 C16Ch	MPC	P54 Pin Function Control Register	P54PFS	8	8	2 or 3 PCLKB
0008 C16Dh	MPC	P55 Pin Function Control Register	P55PFS	8	8	2 or 3 PCLKB
0008 C190h	MPC	PA0 Pin Function Control Register	PA0PFS	8	8	2 or 3 PCLKB
0008 C191h	MPC	PA1 Pin Function Control Register	PA1PFS	8	8	2 or 3 PCLKB
0008 C192h	MPC	PA2 Pin Function Control Register	PA2PFS	8	8	2 or 3 PCLKB
0008 C193h	MPC	PA3 Pin Function Control Register	PA3PFS	8	8	2 or 3 PCLKB
0008 C194h	MPC	PA4 Pin Function Control Register	PA4PFS	8	8	2 or 3 PCLKB
0008 C195h	MPC	PA5 Pin Function Control Register	PA5PFS	8	8	2 or 3 PCLKB
0008 C196h	MPC	PA6 Pin Function Control Register	PA6PFS	8	8	2 or 3 PCLKB
0008 C197h	MPC	PA7 Pin Function Control Register	PA7PFS	8	8	2 or 3 PCLKB
0008 C198h	MPC	PB0 Pin Function Control Register	PB0PFS	8	8	2 or 3 PCLKB
0008 C199h	MPC	PB1 Pin Function Control Register	PB1PFS	8	8	2 or 3 PCLKB
0008 C19Ah	MPC	PB2 Pin Function Control Register	PB2PFS	8	8	2 or 3 PCLKB
0008 C19Bh	MPC	PB3 Pin Function Control Register	PB3PFS	8	8	2 or 3 PCLKB
0008 C19Ch	MPC	PB4 Pin Function Control Register	PB4PFS	8	8	2 or 3 PCLKB
0008 C19Dh	MPC	PB5 Pin Function Control Register	PB5PFS	8	8	2 or 3 PCLKB
0008 C19Eh	MPC	PB6 Pin Function Control Register	PB6PFS	8	8	2 or 3 PCLKB
0008 C19Fh	MPC	PB7 Pin Function Control Register	PB7PFS	8	8	2 or 3 PCLKB
0008 C1A0h	MPC	PC0 Pin Function Control Register	PC0PFS	8	8	2 or 3 PCLKB
0008 C1A1h	MPC	PC1 Pin Function Control Register	PC1PFS	8	8	2 or 3 PCLKB
0008 C1A2h	MPC	PC2 Pin Function Control Register	PC2PFS	8	8	2 or 3 PCLKB
0008 C1A3h	MPC	PC3 Pin Function Control Register	PC3PFS	8	8	2 or 3 PCLKB

Table 5.17 Permissible Output Currents (1)

Conditions: 1.8 V ≤ VCC = AVCC0 < 2.0 V, 2.0 V ≤ VCC ≤ 5.5 V, 2.0 V ≤ AVCC0 ≤ 5.5 V, VSS = AVSS0 = 0 V, Ta = –40 to +85°C

Item			Symbol	Max.	Unit
Permissible output low current (average value per pin)	Ports P03 to P07, Ports P40 to P47, Ports PJ6, PJ7		I_{OL}	4.0	mA
	Ports other than above	Normal output mode		4.0	
		High-drive output mode		8.0	
Permissible output low current (maximum value per pin)	Ports P03 to P07, Ports P40 to P47, Ports PJ6, PJ7			4.0	
	Ports other than above	Normal output mode		4.0	
		High-drive output mode		8.0	
Permissible output low current	Total of Ports P03 to P07, Ports P40 to P47, Ports PJ6, PJ7		ΣI_{OL}	40	
	Total of Ports P12 to P17, Ports P20 to P27, Ports P30 to P37, Ports PH2, PH3, Ports PJ1, PJ3			40	
	Total of Ports P50 to P55, Ports PB0 to PB7, Ports PC0 to PC7, Ports PH0, PH1			40	
	Total of Ports PA0 to PA7, Ports PD0 to PD7, Ports PE0 to PE7			40	
	Total of all output pins			80	
Permissible output high current (average value per pin)	Ports P03 to P07, Ports P40 to P47, Ports PJ6, PJ7		I_{OH}	–4.0	
	Ports other than above	Normal output mode		–4.0	
		High-drive output mode		–8.0	
Permissible output high current (maximum value per pin)	Ports P03 to P07, Ports P40 to P47, Ports PJ6, PJ7			–4.0	
	Ports other than above	Normal output mode		–4.0	
		High-drive output mode		–8.0	
Permissible output high current	Total of Ports P03 to P07, Ports P40 to P47, Ports PJ6, PJ7		ΣI_{OH}	–40	
	Total of Ports P12 to P17, Ports P20 to P27, Ports P30 to P37, Ports PH2, PH3, Ports PJ1, PJ3			–40	
	Total of Ports P50 to P55, Ports PB0 to PB7, Ports PC0 to PC7, Ports PH0, PH1			–40	
	Total of Ports PA0 to PA7, Ports PD0 to PD7, Ports PE0 to PE7			–40	
	Total of all output pins			–80	

Note: Do not exceed the permissible total supply current.

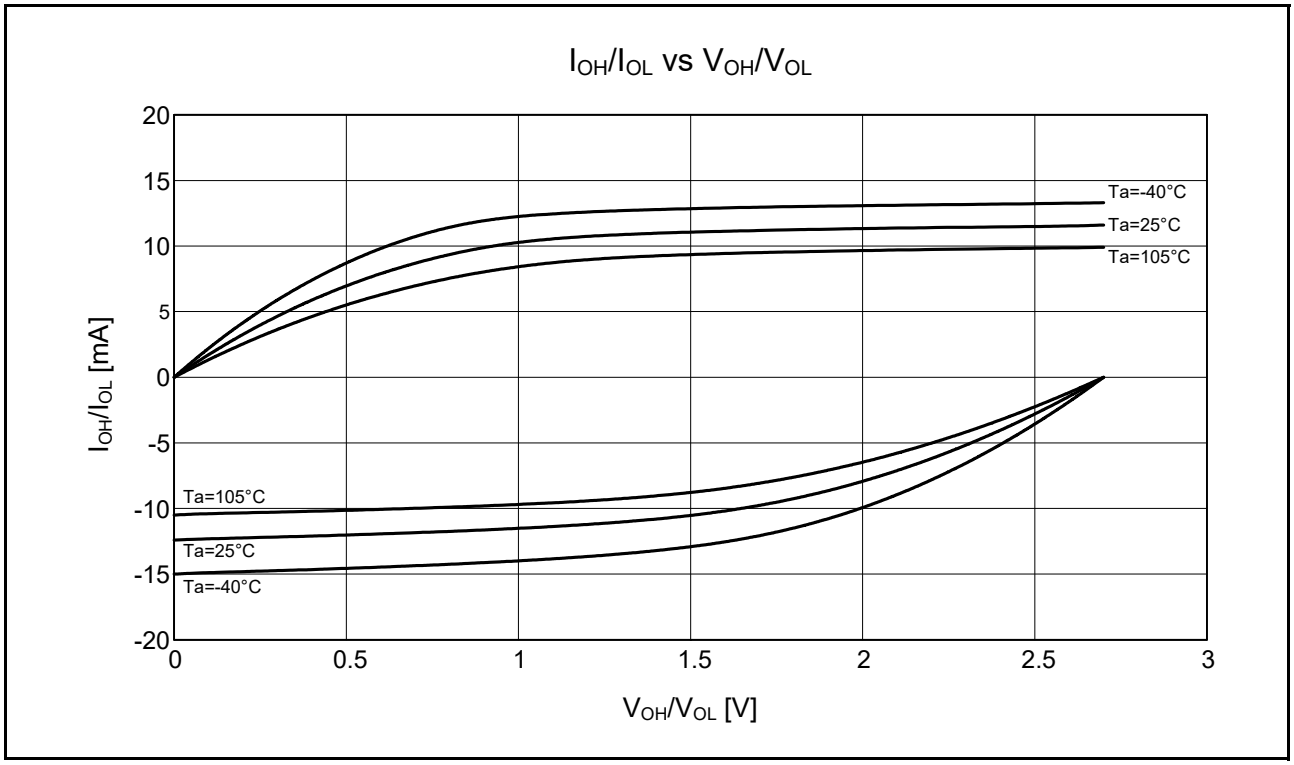


Figure 5.14 V_{OH}/V_{OL} and I_{OH}/I_{OL} Temperature Characteristics at VCC = 2.7 V When Normal Output is Selected (Reference Data)

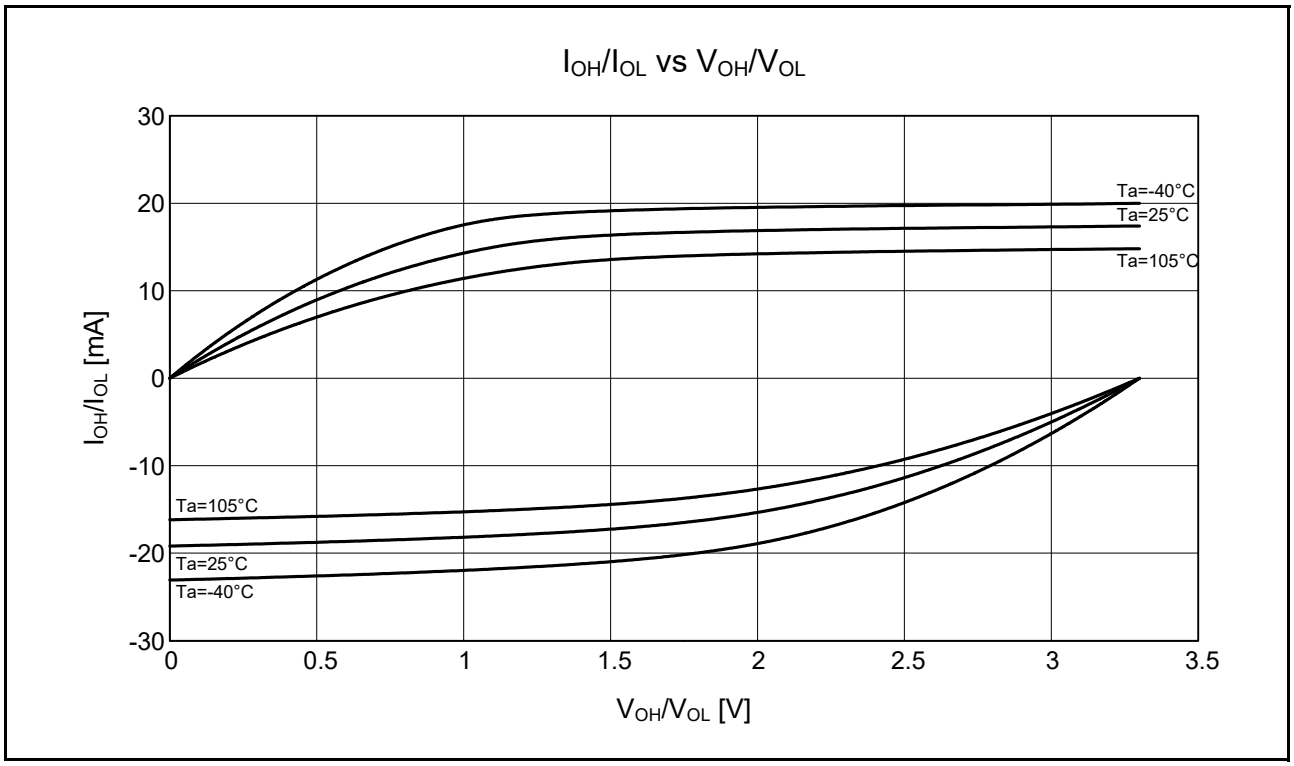


Figure 5.15 V_{OH}/V_{OL} and I_{OH}/I_{OL} Temperature Characteristics at VCC = 3.3 V When Normal Output is Selected (Reference Data)

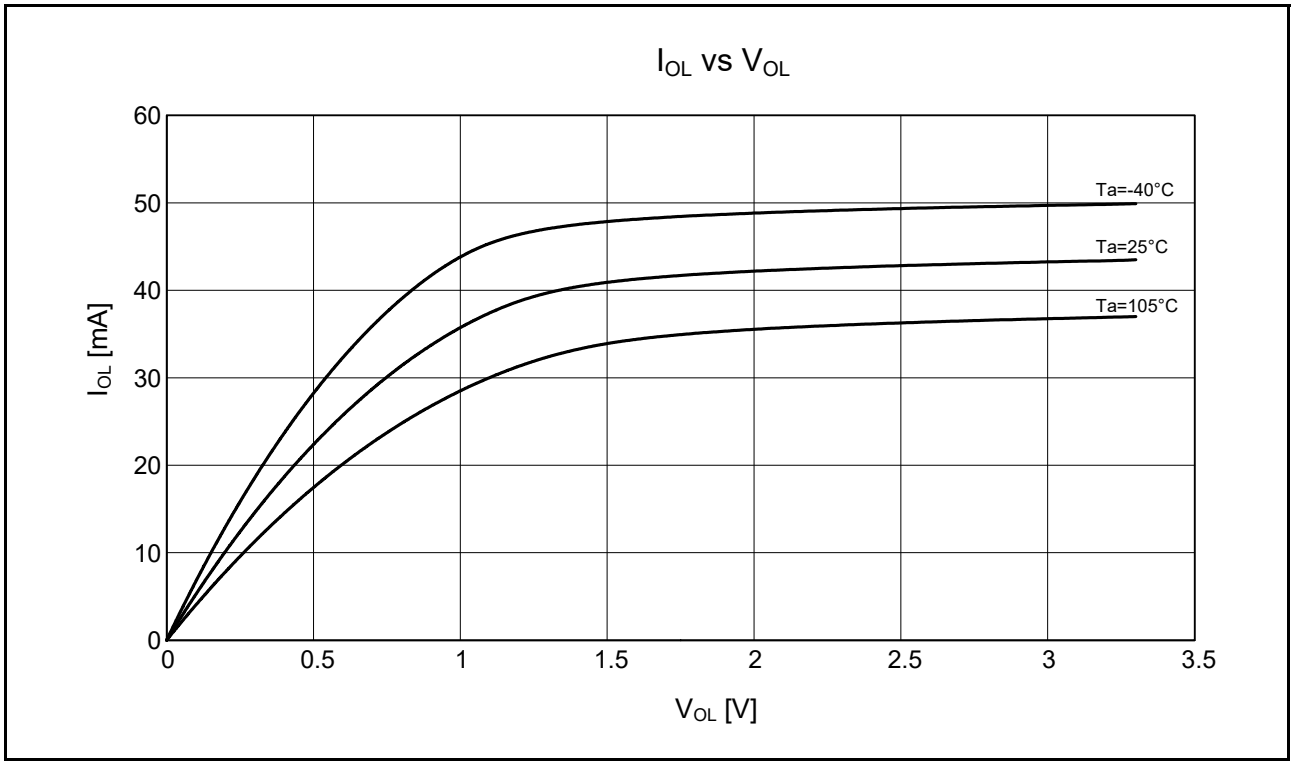


Figure 5.24 V_{OL} and I_{OL} Temperature Characteristics of RIIC Output Pin at VCC = 3.3 V (Reference Data)

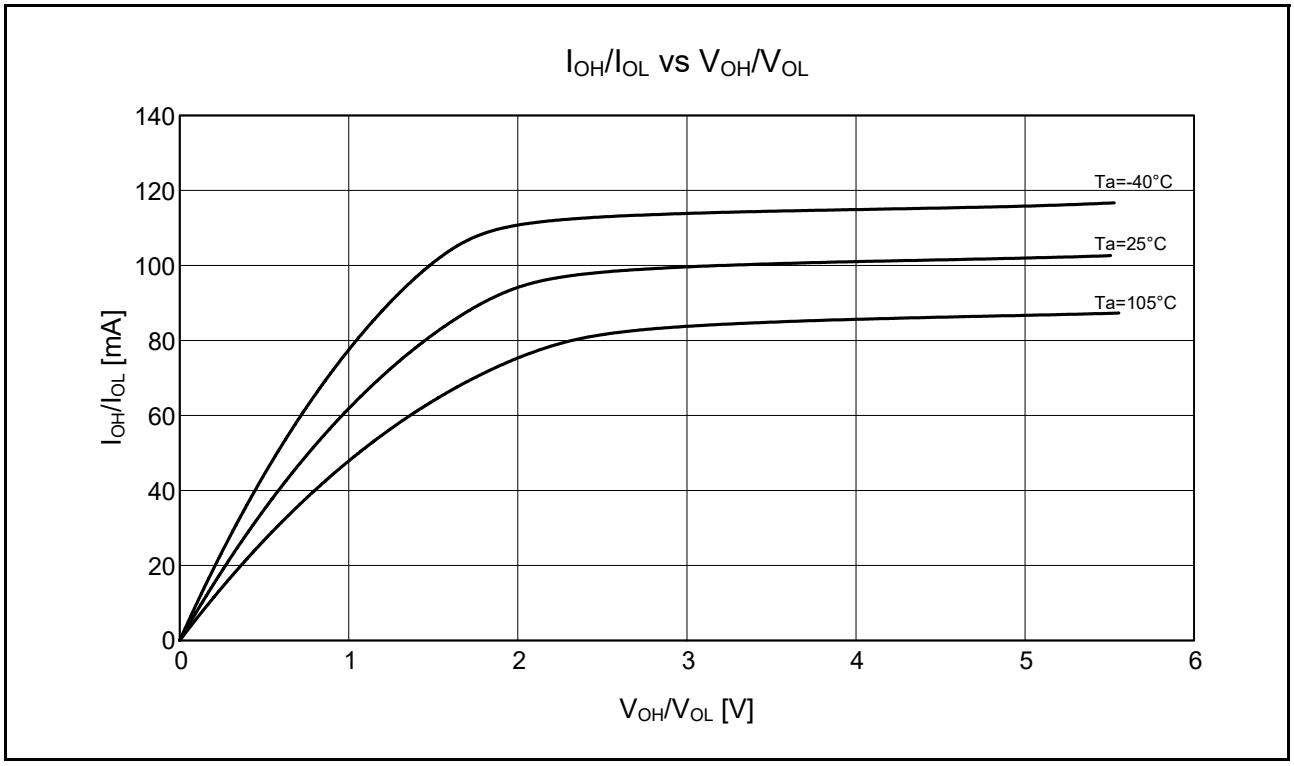


Figure 5.25 V_{OL} and I_{OL} Temperature Characteristics of RIIC Output Pin at VCC = 5.5 V (Reference Data)

Table 5.25 Clock Timing

Conditions: 1.8 V ≤ VCC = AVCC0 < 2.0 V, 2.0 V ≤ VCC ≤ 5.5 V, 2.0 V ≤ AVCC0 ≤ 5.5 V, VSS = AVSS0 = 0 V, Ta = –40 to +105°C

Item		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
EXTAL external clock input cycle time		t_{Xcyc}	50	—	—	ns	Figure 5.26
EXTAL external clock input high pulse width		t_{XH}	20	—	—	ns	
EXTAL external clock input low pulse width		t_{XL}	20	—	—	ns	
EXTAL external clock rise time		t_{Xr}	—	—	5	ns	
EXTAL external clock fall time		t_{Xf}	—	—	5	ns	
EXTAL external clock input wait time*1		t_{XWT}	0.5	—	—	μs	
Main clock oscillator oscillation frequency*2	2.4 ≤ VCC ≤ 5.5	f_{MAIN}	1	—	20	MHz	
	1.8 ≤ VCC < 2.4		1	—	8		
Main clock oscillation stabilization time (crystal)*2		$t_{MAINOSC}$	—	3	—	ms	Figure 5.27
Main clock oscillation stabilization time (ceramic resonator)*2		$t_{MAINOSC}$	—	50	—	μs	
LOCO clock oscillation frequency		f_{LOCO}	3.44	4.0	4.56	MHz	
LOCO clock oscillation stabilization time		t_{LOCO}	—	—	0.5	μs	Figure 5.28
IWDT-dedicated clock oscillation frequency		f_{ILOCO}	12.75	15	17.25	kHz	
IWDT-dedicated clock oscillation stabilization time		t_{ILOCO}	—	—	50	μs	Figure 5.29
HOCO clock oscillation frequency		f_{HOCO} (32 MHz)	31.52	32	32.48	MHz	T_a = –40 to + 85°C
			31.68	32	32.32		T_a = 0 to + 55°C
			31.36	32	32.64		T_a = –40 to +105°C
HOCO clock oscillation stabilization time		t_{HOCO}	—	—	30	μs	Figure 5.31
PLL input frequency*3		f_{PLLIN}	4	—	8	MHz	
PLL circuit oscillation frequency*3		f_{PLL}	24	—	32	MHz	
PLL clock oscillation stabilization time		t_{PLL}	—	—	50	μs	Figure 5.32
PLL free-running oscillation frequency		f_{PLLFR}	—	8	—	MHz	
Sub-clock oscillator oscillation frequency*5		f_{SUB}	—	32.768	—	kHz	
Sub-clock oscillation stabilization time*4		t_{SUBOSC}	—	0.5	—	s	Figure 5.33

Note 1. Time until the clock can be used after the main clock oscillator stop bit (MOSCCR.MOSTP) is set to 0 (operating).

Note 2. Reference values when an 8-MHz resonator is used.
When specifying the main clock oscillator stabilization time, set the MOSCWTCR register with a stabilization time value that is equal to or greater than the resonator-manufacturer-recommended value.
After changing the setting of the MOSCCR.MOSTP bit so that the main clock oscillator operates, read the OSCOVFSR.MOOVF flag to confirm that is has become 1, and then start using the main clock.

Note 3. The VCC range should be 2.4 to 5.5 V when the PLL is used.

Note 4. Reference value when a 32.768-kHz resonator is used.
After changing the setting of the SOSCCR.SOSTP bit or RCR3.RTCEN bit so that the sub-clock oscillator operates, only start using the sub-clock after the sub-clock oscillation stabilization wait time that is equal to or greater than the oscillator-manufacturer-recommended value has elapsed.

Note 5. Only 32.768-kHz can be used.

Table 5.33 Timing of On-Chip Peripheral Modules (1)

Conditions: 1.8 V ≤ VCC = AVCC0 < 2.0 V, 2.0 V ≤ VCC ≤ 5.5 V, 2.0 V ≤ AVCC0 ≤ 5.5 V, VSS = AVSS0 = 0 V, Ta = –40 to +105°C

Item			Symbol	Min.	Max.	Unit *1	Test Conditions
CLKOUT	CLKOUT pin output cycle*4	VCC = 2.7 V or above	t_{Ccyc}	62.5	—	ns	Figure 5.49
		VCC = 1.8 V or above		125			
	CLKOUT pin high pulse width*3	VCC = 2.7 V or above	t_{CH}	15	—	ns	
		VCC = 1.8 V or above		30			
	CLKOUT pin low pulse width*3	VCC = 2.7 V or above	t_{CL}	15	—	ns	
		VCC = 1.8 V or above		30			
	CLKOUT pin output rise time	VCC = 2.7 V or above	t_{Cr}	—	12	ns	
		VCC = 1.8 V or above			25		
	CLKOUT pin output fall time	VCC = 2.7 V or above	t_{Cf}	—	12	ns	
		VCC = 1.8 V or above			25		

Note 1. t_{Pcyc}: PCLK cycle
Note 2. t_{cac}: CAC count clock source cycle
Note 3. When the LOCO is selected as the clock output source (CKOCR.CKOSEL[3:0] bits = 0000b), set the clock output division ratio selection to divided by 2 (CKOCR.CKODIV[2:0] bits = 001b).
Note 4. When the XTAL external clock input or an oscillator is used with divided by 1 (CKOCR.CKOSEL[3:0] bits = 010b and CKOCR.CKODIV[2:0] bits = 000b) to output from CLKOUT, the above should be satisfied with an input duty cycle of 45 to 55%.

Table 5.40 A/D Conversion Characteristics (2)

Conditions: 2.4 V ≤ VCC ≤ 5.5 V, 2.4 V ≤ AVCC0 ≤ 5.5 V, 2.4 V ≤ VREFH0 ≤ AVCC0, Reference voltage = VREFH0, VSS = AVSS0 = VREFL0 = 0 V, T_a = –40 to +105°C

Item		Min.	Typ.	Max.	Unit	Test Conditions
Frequency		1	—	16	MHz	
Resolution		—	—	12	Bit	
Conversion time*1 (Operation at PCLKD = 16 MHz)	Permissible signal source impedance (Max.) = 1.3 kΩ	2.82	—	—	µs	High-precision channel ADCSR.ADHSC bit = 0 ADSSTRn = 0Dh
		4.5	—	—	µs	Normal-precision channel ADCSR.ADHSC bit = 0 ADSSTRn = 28h
Analog input capacitance	Cs	—	—	15	pF	Pin capacitance included
Analog input resistance	Rs	—	—	2.5	kΩ	
Analog input effective range		0	—	VREFH0	V	
Offset error		—	±0.5	±4.5	LSB	
Full-scale error		—	±0.75	±4.5	LSB	
Quantization error		—	±0.5	—	LSB	
Absolute accuracy		—	±1.25	±5.0	LSB	High-precision channel
				±8.0	LSB	Other than above
DNL differential nonlinearity error		—	±1.0	—	LSB	
INL integral nonlinearity error		—	±1.0	±4.5	LSB	

Note: The characteristics apply when no pin functions other than A/D converter input are used. Absolute accuracy includes quantization errors. Offset error, full-scale error, DNL differential nonlinearity error, and INL integral nonlinearity error do not include quantization errors.

Note 1. The conversion time is the sum of the sampling time and the comparison time. As the test conditions, the number of sampling states is indicated.

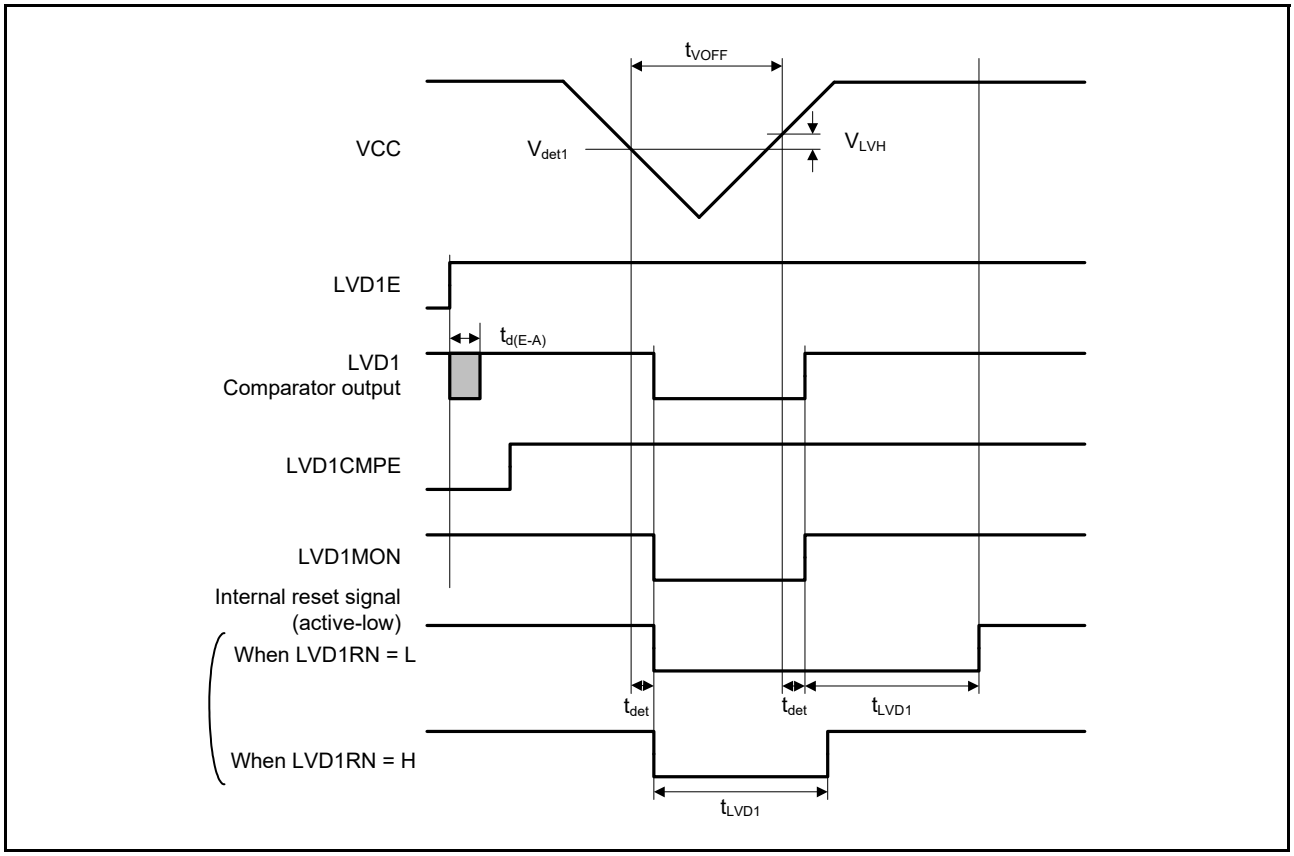


Figure 5.64 Voltage Detection Circuit Timing (V_{det1})

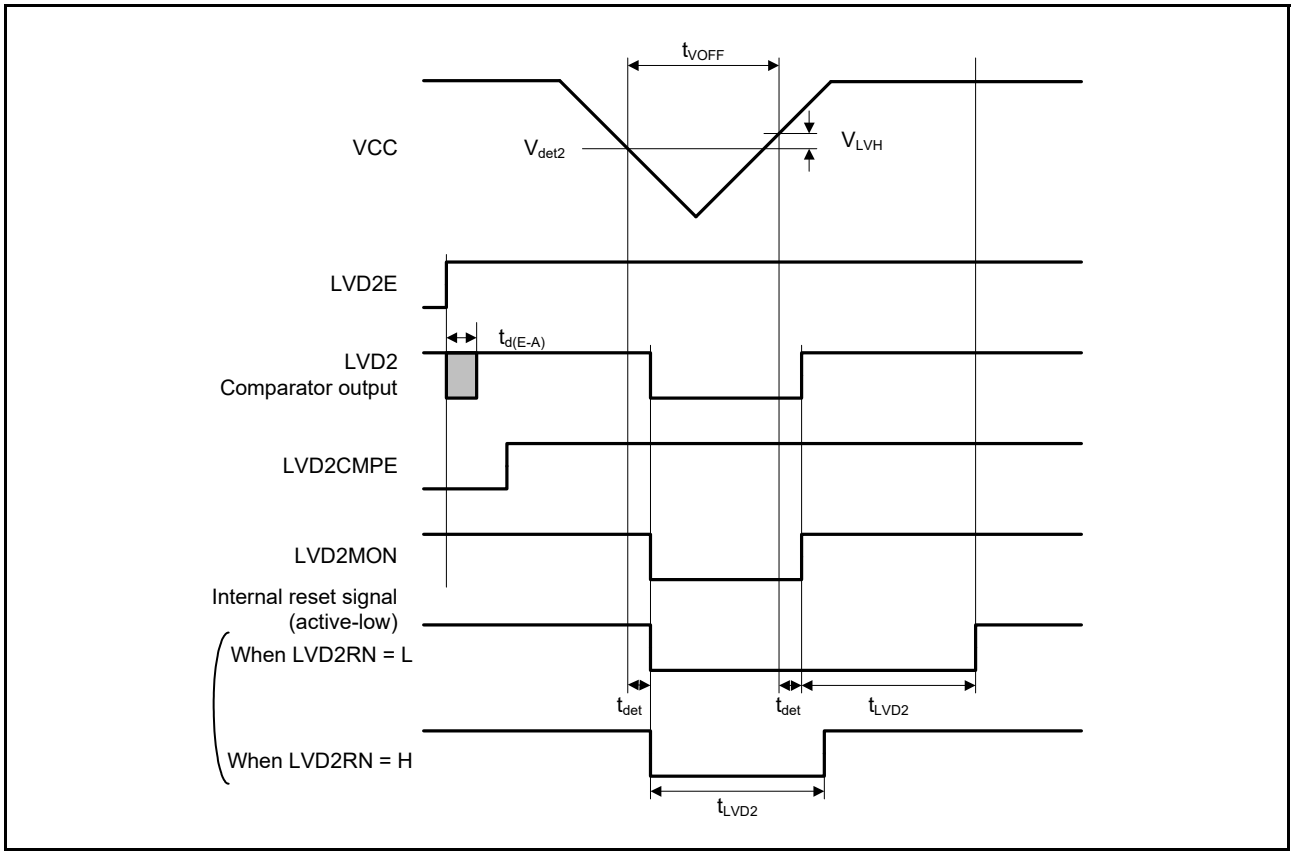


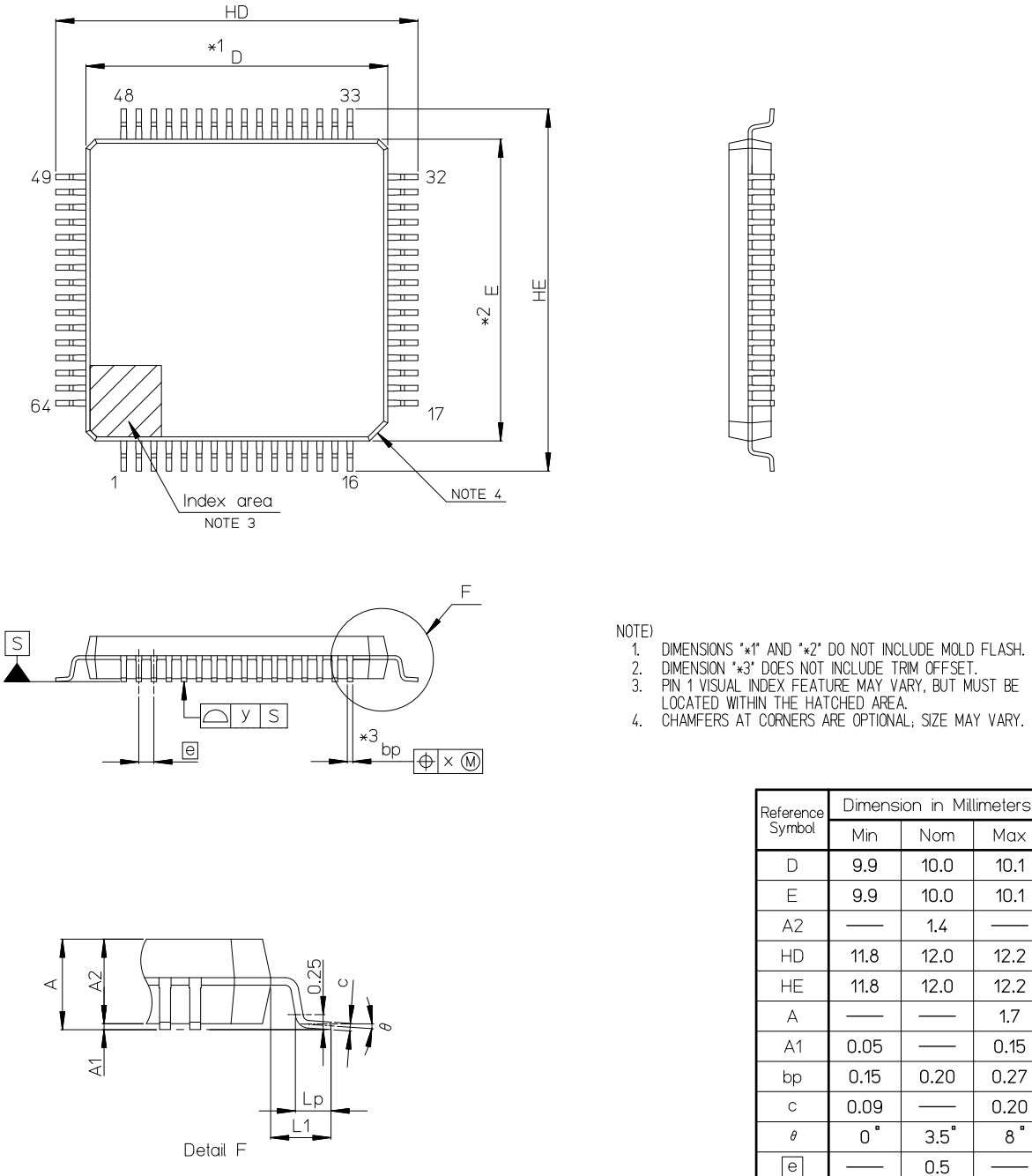
Figure 5.65 Voltage Detection Circuit Timing (V_{det2})

5.13 Usage Notes

5.13.1 Connecting VCL Capacitor and Bypass Capacitors

This MCU integrates an internal voltage-down circuit, which is used for lowering the power supply voltage in the internal MCU to adjust automatically to the optimum level. A 4.7-µF capacitor needs to be connected between this internal voltage-down power supply (VCL pin) and VSS pin. Figure 5.67 to Figure 5.70 shows how to connect external capacitors. Place an external capacitor close to the pins. Do not apply the power supply voltage to the VCL pin. Insert a multilayer ceramic capacitor as a bypass capacitor between each pair of the power supply pins. Implement a bypass capacitor to the MCU power supply pins as close as possible. Use a recommended value of 0.1 µF as the capacitance of the capacitors. For the capacitors related to crystal oscillation, see section 9, Clock Generation Circuit in the User's Manual: Hardware. For the capacitors related to analog modules, also see section 33, 12-Bit A/D Converter (S12ADE) in the User's Manual: Hardware.
For notes on designing the printed circuit board, see the descriptions of the application note "Hardware Design Guide" (R01AN1411EJ). The latest version can be downloaded from Renesas Electronics Website.

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-LFQFP64-10x10-0.50	PLQP0064KB-C	——	0.3g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.
3. PIN 1 VISUAL INDEX FEATURE MAY VARY, BUT MUST BE LOCATED WITHIN THE HATCHED AREA.
4. CHAMFERS AT CORNERS ARE OPTIONAL; SIZE MAY VARY.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	9.9	10.0	10.1
E	9.9	10.0	10.1
A2	——	1.4	——
HD	11.8	12.0	12.2
HE	11.8	12.0	12.2
A	——	——	1.7
A1	0.05	——	0.15
bp	0.15	0.20	0.27
c	0.09	——	0.20
θ	0°	3.5°	8°
e	——	0.5	——
x	——	——	0.08
y	——	——	0.08
Lp	0.45	0.6	0.75
L1	——	1.0	——

Figure D 64-Pin LFQFP (PLQP0064KB-C)