

To our customers,

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## Old Company Name in Catalogs and Other Documents

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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## 1. Overview

The M32C/80 Group microcomputer is a single-chip control unit that utilizes high-performance silicon gate CMOS technology with the M32C/80 series CPU core. The M32C/80 Group is available in 100-pin plastic molded LQFP/QFP package.

With a 16-Mbyte address space, this microcomputer combines advanced instruction manipulation capabilities to process complex instructions by less bytes and execute instructions at higher speed.

It incorporates a multiplier and DMAC adequate for office automation, communication devices and industrial equipments and other high-speed processing applications.

The M32C/80 Group is ROMless device.  
Use the M32C/80 Group in microprocessor mode after reset.

### 1.1 Applications

Audio, cameras, office equipment, communications equipment, portable equipment, etc.

## 1.2 Performance Overview

Table 1.1 lists performance overview of the M32C/80 Group.

**Table 1.1 M32C/80 Group Performance**

Item		Performance
CPU	Basic Instructions	108 instructions
	Minimum Instruction Execution Time	31.3 ns ( f(BCLK)=32 MHz, Vcc1=4.2 to 5.5 V ) 41.7 ns ( f(BCLK)=24 MHz, Vcc1=3.0 to 5.5 V )
	Operating Mode	Single-chip mode, Memory expansion mode, Microprocessor mode
	Memory Space	16 Mbytes
	Memory Capacity	See Table 1.2
Peripheral function	I/O Port	47 I/O pins (when using 16-bit bus) and 1 input pin
	Multifunction Timer	Timer A: 16 bits x 5 channels, Timer B: 16 bits x 6 channels Three-phase motor control circuit
	Intelligent I/O Communication Function	2 channels
	Serial I/O	5 channels Clock synchronous serial I/O, Clock asynchronous serial I/O, IEBus <sup>(1)</sup> , I <sup>2</sup> C Bus <sup>(2)</sup>
	A/D Converter	10-bit A/D converter: 1 circuit, 10 channels
	D/A Converter	8 bits x 2 channels
	DMAC	4 channels
	DMAC II	Can be activated by all peripheral function interrupt sources Immediate transfer, operation and chain transfer function
	CRC Calculation Circuit	CRC-CCITT
	X/Y Converter	16 bits x 16 bits
	Watchdog Timer	15 bits x 1 channel (with prescaler)
	Interrupt	34 internal sources and 8 external sources, 5 software sources Interrupt priority level: 7
	Clock Generation Circuit	4 circuits Main Clock oscillation circuit (*), Sub clock oscillation circuit (*), On-chip oscillator, PLL frequency synthesizer (* )Equipped with a built-in feedback resistor
Oscillation Stop Detect Function	Main clock oscillation stop detect circuit	
Electrical Characteristics	Supply Voltage	Vcc1=4.2 to 5.5 V, Vcc2=3.0 to Vcc1 (f(BCLK)=32 MHz) Vcc1=3.0 to 5.5 V, Vcc2=3.0 to Vcc1 (f(BCLK)=24 MHz)
	Power Consumption	22 mA (Vcc1=Vcc2=5 V, f(BCLK)=32 MHz) 17 mA (Vcc1=Vcc2=3.3 V, f(BCLK)=24 MHz) 10 μA (Vcc1=Vcc2=3.3 V, f(BCLK)=32 kHz, in wait mode)
Operating Ambient Temperature		-20 to 85°C, -40 to 85°C(optional)
Package		100-pin plastic molded LQFP/QFP

NOTES:

1. IEBus is a trademark of NEC Electronics Corporation.
  2. I<sup>2</sup>C bus is a trademark of Koninklijke Philips Electronics N. V.
- All options are on a request basis.

### 1.3 Block Diagram

Figure 1.1 shows a block diagram of the M32C/80 Group microcomputer.

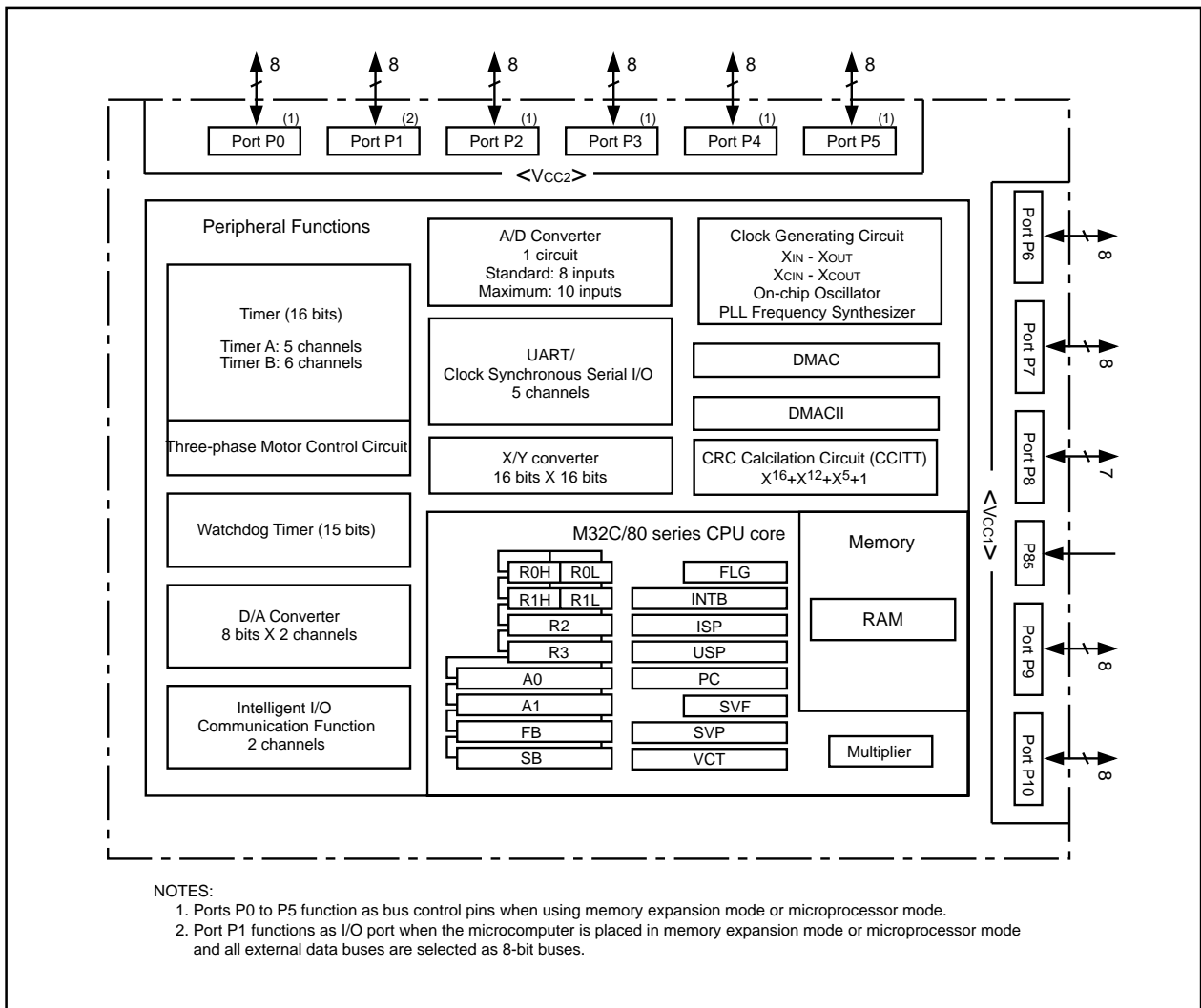


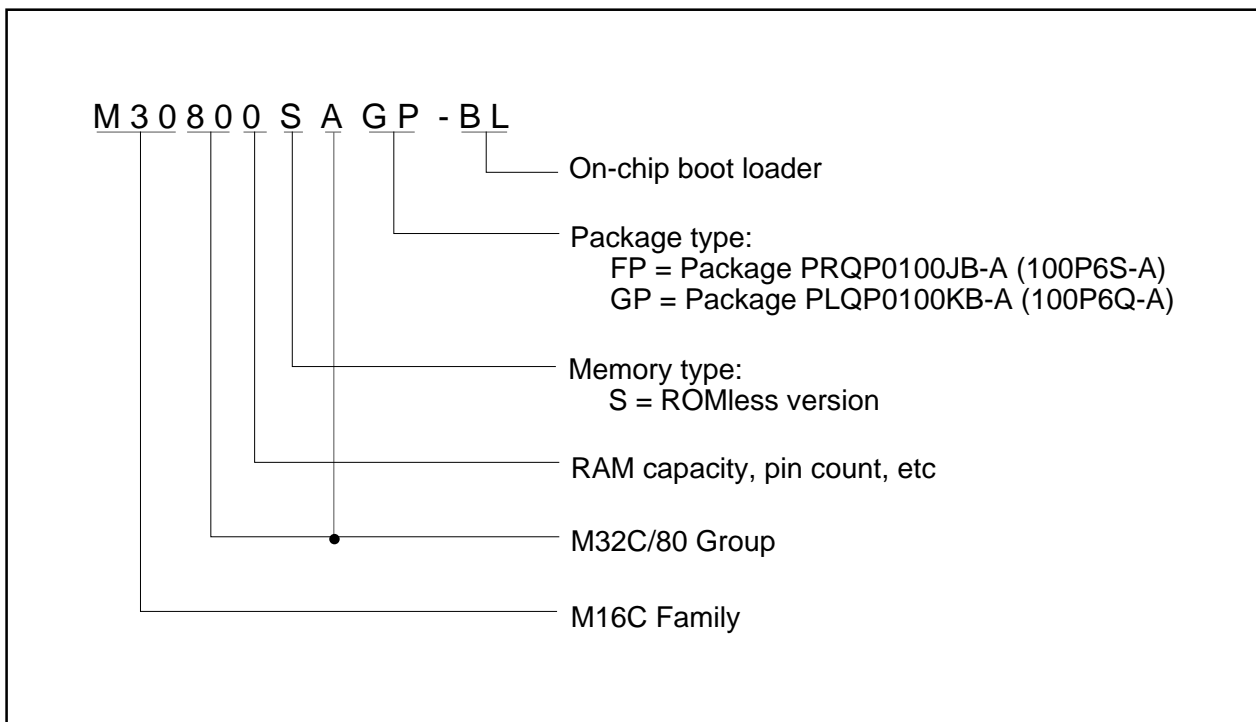
Figure 1.1 M32C/80 Group Block Diagram

### 1.4 Product Information

Table 1.2 lists the product information. Figure 1.2 shows the product numbering system.

**Table 1.2 M32C/80 Group** **As of November, 2005**

Type Number	Package Type	ROM Capacity	RAM Capacity	Remarks
M30800SAGP	PLQP0100KB-A (100P6Q-A)	—	8K	ROMless
M30800SAFP	PRQP0100JB-A (100P6S-A)			
M30800SAGP-BL	PLQP0100KB-A (100P6Q-A)			ROMless with on-chip boot loader
M30800SAFP-BL	PRQP0100JB-A (100P6S-A)			



**Figure 1.2 Product Numbering System**

### 1.5 Pin Assignment

Figures 1.3 and 1.4 show pin assignments (top view).

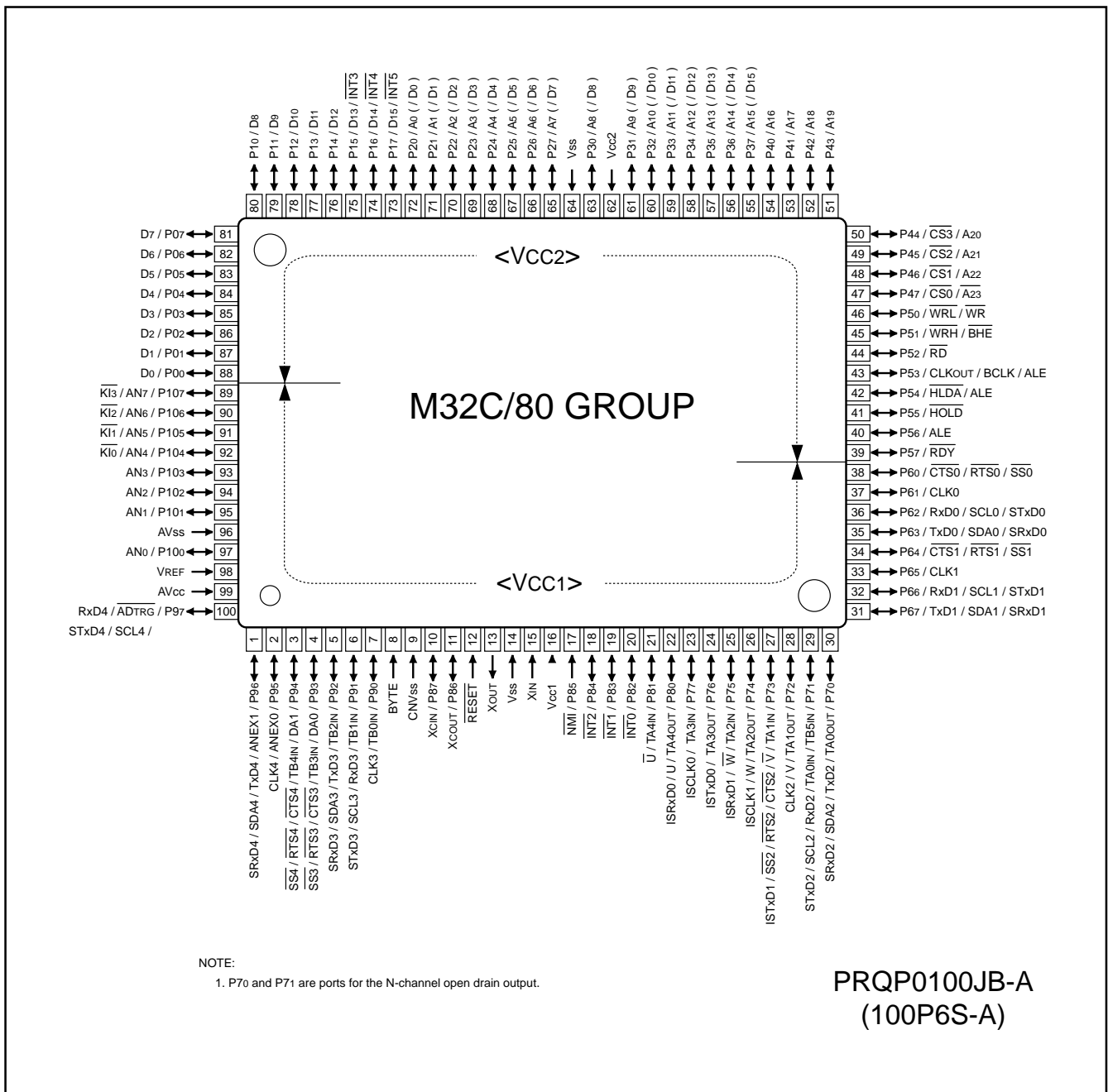


Figure 1.3 Pin Assignment

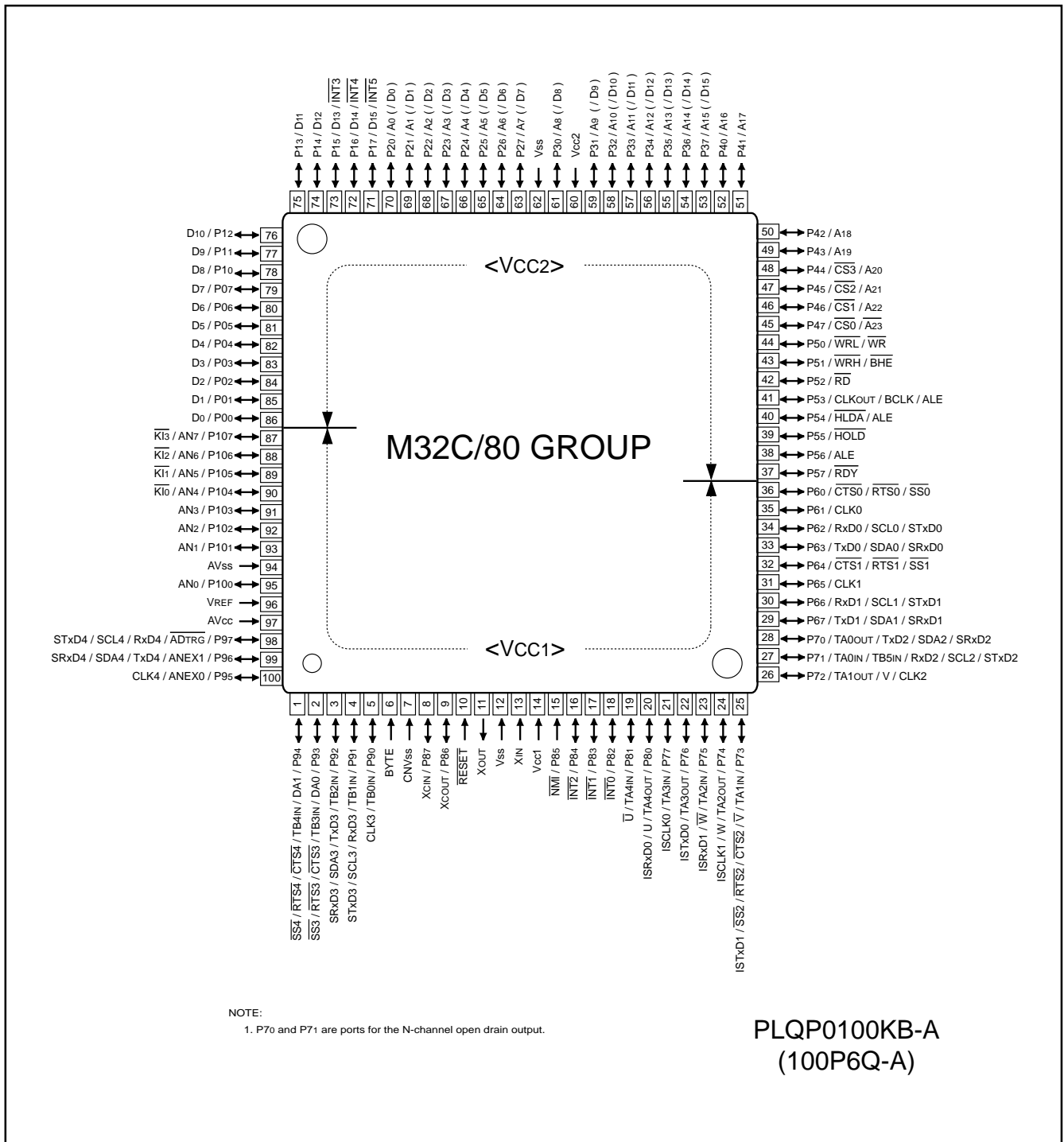


Figure 1.4 Pin Assignment



Table 1.3 Pin Characteristics

Package Pin No		Control pins	Port	Interrupt pins	Timer pins	UART pins	Analog pins	Bus control pins	Intelligent I/O pins
FP	GP								
1	99		P96			TxD4/SDA4/SRxD4	ANEX1		
2	100		P95			CLK4	ANEX0		
3	1		P94		TB4IN	CTS4/RTS4/SS4	DA1		
4	2		P93		TB3IN	CTS3/RTS3/SS3	DA0		
5	3		P92		TB2IN	TxD3/SDA3/SRxD3			
6	4		P91		TB1IN	RxD3/SCL3/STxD3			
7	5		P90		TB0IN	CLK3			
8	6	BYTE							
9	7	CNV <sub>SS</sub>							
10	8	XCIN	P87						
11	9	XCOUT	P86						
12	10	RESET							
13	11	XOUT							
14	12	V <sub>SS</sub>							
15	13	XIN							
16	14	V <sub>CC1</sub>							
17	15		P85	NMI					
18	16		P84	INT2					
19	17		P83	INT1					
20	18		P82	INT0					
21	19		P81		TA4IN/ $\bar{U}$				
22	20		P80		TA4OUT/U				ISRxD0
23	21		P77		TA3IN				ISCLK0
24	22		P76		TA3OUT				ISTxD0
25	23		P75		TA2IN/ $\bar{W}$				ISRxD1
26	24		P74		TA2OUT/W				ISCLK1
27	25		P73		TA1IN/ $\bar{V}$	CTS2/RTS2/SS2			ISTxD1
28	26		P72		TA1OUT/V	CLK2			
29	27		P71		TB5IN/TA0IN	RxD2/SCL2/STxD2			
30	28		P70		TA0OUT	TxD2/SDA2/SRxD2			
31	29		P67			TxD1/SDA1/SRxD1			
32	30		P66			RxD1/SCL1/STxD1			
33	31		P65			CLK1			
34	32		P64			CTS1/RTS1/SS1			
35	33		P63			TxD0/SDA0/SRxD0			
36	34		P62			RxD0/SCL0/STxD0			
37	35		P61			CLK0			
38	36		P60			CTS0/RTS0/SS0			
39	37		P57					RDY	
40	38		P56					ALE	
41	39		P55					HOLD	
42	40		P54					H $\bar{L}$ DA/ALE	
43	41		P53					CLKout/BCLK/ALE	
44	42		P52					RD	
45	43		P51					WRH/BHE	
46	44		P50					WRL/WR	
47	45		P47					CS0/A23	
48	46		P46					CS1/A22	
49	47		P45					CS2/A21	
50	48		P44					CS3/A20	

Table 1.3 Pin Characteristics (Continued)

Package pin No		Control pins	Port	Interrupt pins	Timer pins	UART pins	Analog pins	Bus control pins	Intelligent I/O pins
FP	GP								
51	49		P43					A19	
52	50		P42					A18	
53	51		P41					A17	
54	52		P40					A16	
55	53		P37					A15(/D15)	
56	54		P36					A14(/D14)	
57	55		P35					A13(/D13)	
58	56		P34					A12(/D12)	
59	57		P33					A11(/D11)	
60	58		P32					A10(/D10)	
61	59		P31					A9(/D9)	
62	60	VCC2							
63	61		P30					A8(/D8)	
64	62	VSS							
65	63		P27					A7(/D7)	
66	64		P26					A6(/D6)	
67	65		P25					A5(/D5)	
68	66		P24					A4(/D4)	
69	67		P23					A3(/D3)	
70	68		P22					A2(/D2)	
71	69		P21					A1(/D1)	
72	70		P20					A0(/D0)	
73	71		P17	$\overline{\text{INT5}}$				D15	
74	72		P16	$\overline{\text{INT4}}$				D14	
75	73		P15	$\overline{\text{INT3}}$				D13	
76	74		P14					D12	
77	75		P13					D11	
78	76		P12					D10	
79	77		P11					D9	
80	78		P10					D8	
81	79		P07					D7	
82	80		P06					D6	
83	81		P05					D5	
84	82		P04					D4	
85	83		P03					D3	
86	84		P02					D2	
87	85		P01					D1	
88	86		P00					D0	
89	87		P107	$\overline{\text{KI3}}$			AN7		
90	88		P106	$\overline{\text{KI2}}$			AN6		
91	89		P105	$\overline{\text{KI1}}$			AN5		
92	90		P104	$\overline{\text{KI0}}$			AN4		
93	91		P103				AN3		
94	92		P102				AN2		
95	93		P101				AN1		
96	94	AVSS							
97	95		P100				AN0		
98	96						VREF		
99	97	AVCC							
100	98		P97			RxD4/SCL4/STxD4	$\overline{\text{ADTRG}}$		

## 1.6 Pin Description

**Table 1.4 Pin Description**

Signal name	Pin name	I/O type	Supply voltage	Description
Power supply	VCC1, VCC2 VSS	I	-	Apply 3.0 to 5.5 V to both VCC1 and VCC2 pins. Apply 0 V to the VSS pin. $VCC1 \geq VCC2^{(1)}$
Analog power supply input	AVCC AVSS	I	VCC1	Supplies power for the A/D converter. Connect the AVCC pin to VCC1 and the AVSS pin to VSS
Reset input	RESET	I	VCC1	The microcomputer is in a reset state when "L" is applied to the RESET pin
CNVss	CNVss	I	VCC1	Connect this pin to VCC1
External data bus width select input	BYTE	I	VCC1	Switches the data bus in external memory space 3. The data bus is 16 bits long when the this pin is held "L" and 8 bits long when the this pin is held "H". Set it to either one.
Bus control pins	D0 to D7	I/O	VCC2	Inputs and outputs data (D0 to D7) while accessing an external memory space with separate bus
	D8 to D15	I/O	VCC2	Inputs and outputs data (D8 to D15) while accessing an external memory space with 16-bit separate bus
	A0 to A22	O	VCC2	Outputs address bits (A0 to A22)
	A23	O	VCC2	Outputs inversed address bit A23
	A0/D0 to A7/D7	I/O	VCC2	Inputs and outputs data (D0 to D7) and outputs 8 low-order address bits (A0 to A7) by time-sharing while accessing an external memory space with multiplexed bus
	A8/D8 to A15/D15	I/O	VCC2	Inputs and outputs data (D8 to D15) and outputs 8 middle-order address bits (A8 to A15) by time-sharing while accessing an external memory space with multiplexed bus
	CS0 to CS3	O	VCC2	Output CS0 to CS3 that are chip-select signals specifying an external space
	WRL/WR WRH/BHE RD	O	VCC2	Outputs WRL, WRH, (WR, BHE) and RD signals. WRL and WRH can be switched with WR and BHE by program <ul style="list-style-type: none"> <li>■ WRL, WRH and RD are selected: If external data bus is 16 bits wide, data is writtenn to an even address when WRL is held "L". Data is written to an odd address when WRH is held "L". Data is read when RD is held "L".</li> <li>■ WR, BHE and RD are selected Data is written to external memory space when WR is held "L". Data is read when RD is held "L". An odd address is accessed when BHE is held "L". Select WR, BHE and RD for an external 8-bit data bus</li> </ul>
	ALE	O	VCC2	ALE is a signal latching address
	HOLD	I	VCC2	The microcomputer is placed in a hold state while the HOLD pin is held "L"
HLDA	O	VCC2	Outputs an "L" siganl while the microcomputer is placed in a hold state	
RDY	I	VCC2	Bus is placed in a wait state while the RDY pin is held "L"	

I: Input    O: Output    I/O: Input and output

NOTE:

1. In this manual, hereafter, VCC refers to VCC1 unless otherwise noted.

**Table 1.4 Pin Description (Continued)**

Signal name	Pin name	I/O type	Supply voltage	Description
Main clock input	XIN	I	VCC1	I/O pins for the main clock generation circuit. Connect a ceramic resonator or crystal oscillator between XIN and XOUT. To apply external clock, input the clock from XIN and leave XOUT open
Main clock output	XOUT	O	VCC1	
Sub clock input	XCIN	I	VCC1	I/O pins for a sub clock oscillation circuit. Connect a crystal oscillator between XCIN and XCOUT. To apply external clock, input the clock from XCIN and leave XCOUT open
Sub clock output	XCOUT	O	VCC1	
BCLK output	BCLK	O	VCC2	Outputs BCLK signal
Clock output	CLKOUT	O	VCC2	Outputs clock having the same frequency as $f_c$ , $f_8$ , or $f_{32}$
INT interrupt input	INT0 to INT2	I	VCC1	Input pins for the $\overline{\text{INT}}$ interrupt
	INT3 to INT5		VCC2	
NMI interrupt input	NMI	I	VCC1	Input pin for the NMI interrupt
Key input interrupt	KI0 to KI3	I	VCC1	Input pins for the key input interrupt
Timer A	TA0OUT to TA4OUT	I/O	VCC1	I/O pins for the timer A0 to A4 (TA0OUT is a pin for the N-channel open drain output.)
	TA0IN to TA4IN		I	
Timer B	TB0IN to TB5IN	I	VCC1	Input pins for the timer B0 to B5
Three-phase motor control output	U, $\overline{\text{U}}$ , V, $\overline{\text{V}}$ , W, $\overline{\text{W}}$	O	VCC1	output pins for the three-phase motor control timer
Serial I/O	CTS0 to CTS4	I	VCC1	Input pins for data transmission control
	RTS0 to RTS4	O	VCC1	Output pins for data reception control
	CLK0 to CLK4	I/O	VCC1	Inputs and outputs the transfer clock
	RxD0 to RxD4	I	VCC1	Inputs serial data
	TxD0 to TxD4	O	VCC1	Outputs serial data (TxD2 is a pin for the N-channel open drain output.)
I <sup>2</sup> C mode	SDA0 to SDA4	I/O	VCC1	Inputs and outputs serial data (SDA2 is a pin for the N-channel open drain output.)
	SCL0 to SCL4		VCC1	Inputs and outputs the transfer clock (SCL2 is a pin for the N-channel open drain output.)
Serial I/O special function	STxD0 to STxD4	I	VCC1	Outputs serial data when slave mode is selected (SDA2 is a pin for the N-channel open drain output.)
	SRxD0 to SRxD4	I	VCC1	Inputs serial data when slave mode is selected
	SS0 to SS4	I	VCC1	Input pins to control serial I/O special function

I: Input    O: Output    I/O: Input and output

**Table 1.5 Pin Description (Continued)**

Signal name	Pin name	I/O type	Supply voltage	Description			
Reference voltage input	VREF	I	-	Applies reference voltage for the A/D converter and D/A converter			
A/D converter	AN <sub>0</sub> to AN <sub>7</sub>	I	VCC1	Analog input pins for the A/D converter			
	ADTRG	I	VCC1	Input pin for an external A/D trigger			
	ANEX0	I/O	VCC1	Extended analog input pin for the A/D converter and output pin in external op-amp connection mode			
	ANEX1	I	VCC1	Extended analog input pin for the A/D converter			
D/A converter	DA0, DA1	O	VCC1	Output pin for the D/A converter			
Intelligent I/O communication function	ISCLK0	I/O	VCC1	Inputs and outputs clock for the intelligent I/O communication function			
	ISCLK1						
	ISTxD0	O	VCC1	Outputs data for the intelligent I/O communication function			
	ISTxD1						
	ISRxD0	I	VCC1	Inputs data for the intelligent I/O communication function			
	ISRxD1						
I/O port	P0 <sub>0</sub> to P0 <sub>7</sub> <sup>(1)</sup> P1 <sub>0</sub> to P1 <sub>7</sub> <sup>(2)</sup> P2 <sub>0</sub> to P2 <sub>7</sub> <sup>(1)</sup> P3 <sub>0</sub> to P3 <sub>7</sub> <sup>(1)</sup> P4 <sub>0</sub> to P4 <sub>7</sub> <sup>(1)</sup> P5 <sub>0</sub> to P5 <sub>7</sub> <sup>(1)</sup>	I/O	VCC2	I/O ports for CMOS. Each port can be programmed for input or output under the control of the direction register. An input port can be set, by program, for a pull-up resistor available or for no pull-up resistor available in 4-bit units			
	P6 <sub>0</sub> to P6 <sub>7</sub> P7 <sub>0</sub> to P7 <sub>7</sub> P9 <sub>0</sub> to P9 <sub>7</sub> P10 <sub>0</sub> to P10 <sub>7</sub>				I/O	VCC1	I/O ports having equivalent functions to P0 (P7 <sub>0</sub> and P7 <sub>1</sub> are ports for the N-channel open drain output.)
	P8 <sub>0</sub> to P8 <sub>4</sub> , P8 <sub>6</sub> , P8 <sub>7</sub>						
	P8 <sub>5</sub>				I	VCC1	Shares a pin with NMI. NMI input state can be got by reading P8 <sub>5</sub>

I: Input    O: Output    I/O: Input and output

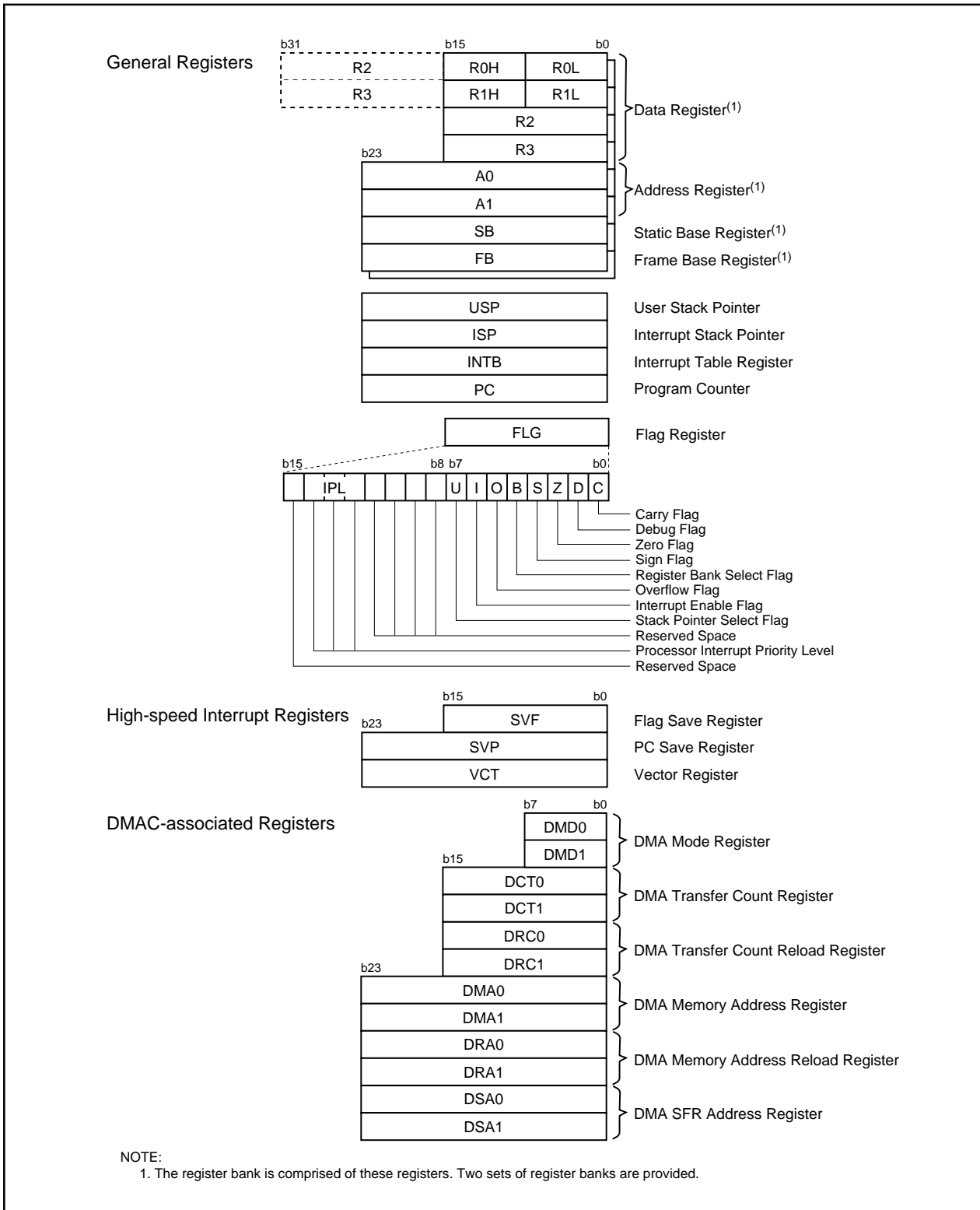
**NOTES:**

1. Ports P0 to P5 function as bus control pins when using memory expansion mode or microprocessor mode. They cannot be used as I/O ports.
2. Port P1 functions as I/O port when the microcomputer is placed in memory expansion mode or microprocessor mode and all external data buses are selected as 8-bit buses.

## 2. Central Processing Unit (CPU)

Figure 2.1 shows the CPU registers.

The register bank is comprised of 8 registers (R0, R1, R2, R3, A0, A1, SB and FB) out of 28 CPU registers. Two sets of register banks are provided.



**Figure 2.1 CPU Register**

## 2.1 General Registers

### 2.1.1 Data Registers (R0, R1, R2 and R3)

R0, R1, R2 and R3 are 16-bit registers for transfer, arithmetic and logic operations. R0 and R1 can be split into high-order bits (R0H) and low-order bits (R0L) to be used separately as 8-bit data registers. R0 can be combined with R2 to be used as a 32-bit data register (R2R0). The same applies to R1 and R3.

### 2.1.2 Address Registers (A0 and A1)

A0 and A1 are 24-bit registers for A0-/A1-indirect addressing, A0-/A1-relative addressing, transfer, arithmetic and logic operations.

### 2.1.3 Static Base Register (SB)

SB is a 24-bit register for SB-relative addressing.

### 2.1.4 Frame Base Register (FB)

FB is a 24-bit register for FB-relative addressing.

### 2.1.5 Program Counter (PC)

PC, 24 bits wide, indicates the address of an instruction to be executed.

### 2.1.6 Interrupt Table Register (INTB)

INTB is a 24-bit register indicating the starting address of an relocatable interrupt vector table.

### 2.1.7 User Stack Pointer (USP), Interrupt Stack Pointer (ISP)

The stack pointers (SP), USP and ISP, are 24 bits wide each. The U flag is used to switch between USP and ISP. Refer to **2.1.8 Flag Register (FLG)** for details on the U flag. Set USP and ISP to even addresses to execute an interrupt sequence efficiently.

### 2.1.8 Flag Register (FLG)

FLG is a 16-bit register indicating a CPU state.

#### 2.1.8.1 Carry Flag (C)

The C flag indicates whether carry or borrow has occurred after executing an instruction.

#### 2.1.8.2 Debug Flag (D)

The D flag is for debug only. Set to "0".

#### 2.1.8.3 Zero Flag (Z)

The Z flag is set to "1" when the value of zero is obtained from an arithmetic operation; otherwise "0".

#### 2.1.8.4 Sign Flag (S)

The S flag is set to "1" when a negative value is obtained from an arithmetic operation; otherwise "0".

### 2.1.8.5 Register Bank Select Flag (B)

The register bank 0 is selected when the B flag is set to "0". The register bank 1 is selected when this flag is set to "1".

### 2.1.8.6 Overflow Flag (O)

The O flag is set to "1" when the result of an arithmetic operation overflows; otherwise "0".

### 2.1.8.7 Interrupt Enable Flag (I)

The I flag enables a maskable interrupt.

Interrupt is disabled when the I flag is set to "0" and enabled when the I flag is set to "1". The I flag is set to "0" when an interrupt is acknowledged.

### 2.1.8.8 Stack Pointer Select Flag (U)

ISP is selected when the U flag is set to "0". USP is selected when this flag is set to "1".

The U flag is set to "0" when a hardware interrupt is acknowledged or the INT instruction of software interrupt numbers 0 to 31 is executed.

### 2.1.8.9 Processor Interrupt Priority Level (IPL)

IPL, 3 bits wide, assigns processor interrupt priority levels from level 0 to level 7.

If a requested interrupt has greater priority than IPL, the interrupt is enabled.

### 2.1.8.10 Reserved Space

When writing to a reserved space, set to "0". When reading, its content is indeterminate.

## 2.2 High-Speed Interrupt Registers

Registers associated with the high-speed interrupt are as follows:

- Flag save register (SVF)
- PC save register (SVP)
- Vector register (VCT)

## 2.3 DMAC-Associated Registers

Registers associated with DMAC are as follows:

- DMA mode register (DMD0, DMD1)
- DMA transfer count register (DCT0, DCT1)
- DMA transfer count reload register (DRC0, DRC1)
- DMA memory address register (DMA0, DMA1)
- DMA SFR address register (DSA0, DSA1)
- DMA memory address reload register (DRA0, DRA1)



### 3. Memory

Figure 3.1 shows a memory map of the M32C/80 Group.

The M32C/80 Group provides 16-Mbyte address space addressed from 000000<sub>16</sub> to FFFFFFF<sub>16</sub>.

The fixed interrupt vectors are allocated from address FFFFDC<sub>16</sub> to FFFFFFF<sub>16</sub>. It stores the starting address of each interrupt routine.

The internal RAM is allocated from address 000400<sub>16</sub> to higher. For example, a 8-Kbyte internal RAM is allocated from address 000400<sub>16</sub> to 0023FF<sub>16</sub>. Besides storing data, it becomes stacks when the subroutine is called or an interrupt is acknowledged.

SFRs, consisting of control registers for peripheral functions such as I/O port, A/D converter, serial I/O, timers, is allocated from address 000000<sub>16</sub> to 0003FF<sub>16</sub>. All blank spaces within SFRs are reserved and cannot be accessed by users.

The special page vector table is addressed from FFFE00<sub>16</sub> to FFFFDB<sub>16</sub>. It is used for the JMPS instruction and JSRS instruction. Refer to the Renesas publication **M32C/80 Series Software Manual** for details. In microprocessor mode, some spaces are reserved and cannot be accessed by users.

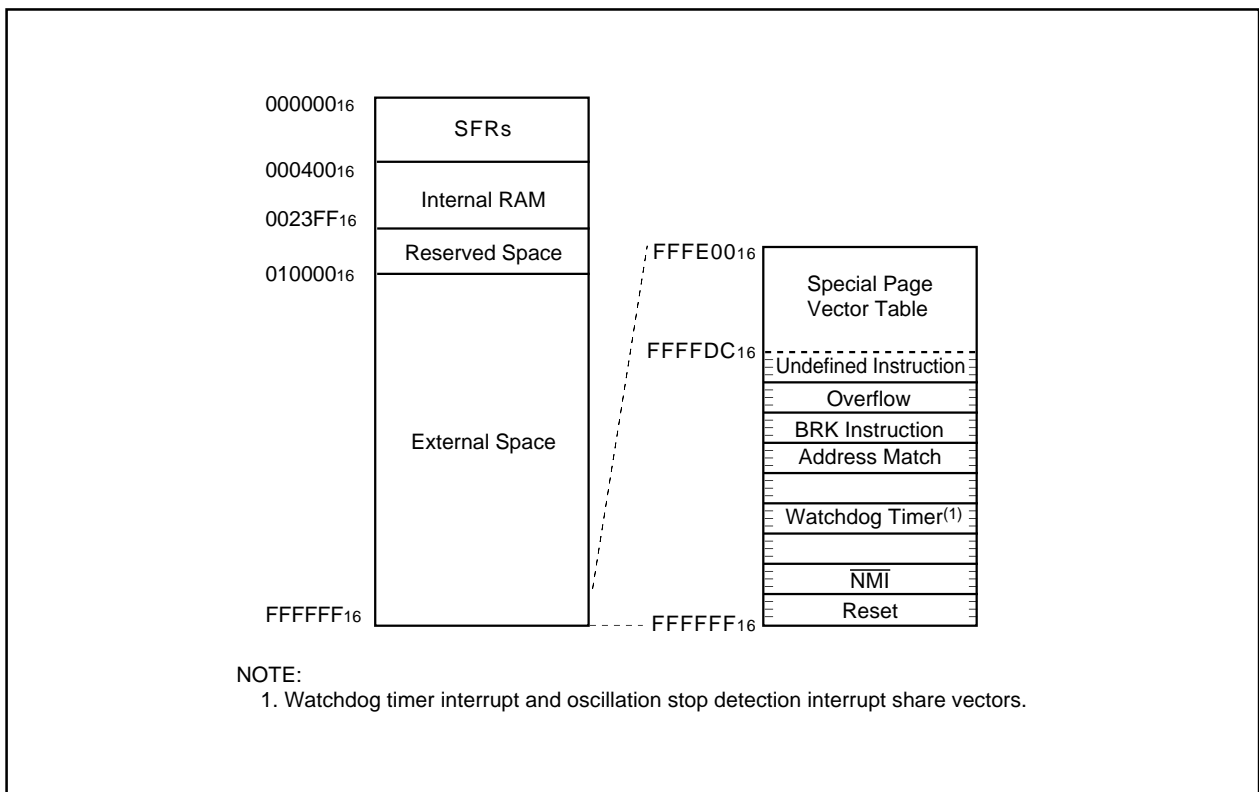


Figure 3.1 Memory Map

## 4. Special Function Registers (SFRs)

Address	Register	Symbol	Value after RESET
0000 <sub>16</sub>			
0001 <sub>16</sub>			
0002 <sub>16</sub>			
0003 <sub>16</sub>			
0004 <sub>16</sub>	Processor Mode Register <sup>(1)</sup>	PM0	0000 0011 <sub>2</sub> (CNVss pin ="H")
0005 <sub>16</sub>	Processor Mode Register 1	PM1	00 <sub>16</sub>
0006 <sub>16</sub>	System Clock Control Register 0	CM0	0000 1000 <sub>2</sub>
0007 <sub>16</sub>	System Clock Control Register 1	CM1	0010 0000 <sub>2</sub>
0008 <sub>16</sub>			
0009 <sub>16</sub>	Address Match Interrupt Enable Register	AIER	00 <sub>16</sub>
000A <sub>16</sub>	Protect Register	PRCR	XXXX 0000 <sub>2</sub>
000B <sub>16</sub>	External Data Bus Width Control Register	DS	XXXX 1000 <sub>2</sub> (BYTE pin ="L") XXXX 0000 <sub>2</sub> (BYTE pin ="H")
000C <sub>16</sub>	Main Clock Division Register	MCD	XXX0 1000 <sub>2</sub>
000D <sub>16</sub>	Oscillation Stop Detection Register	CM2	00 <sub>16</sub>
000E <sub>16</sub>	Watchdog Timer Start Register	WDTS	XX <sub>16</sub>
000F <sub>16</sub>	Watchdog Timer Control Register	WDC	000X XXXX <sub>2</sub>
0010 <sub>16</sub>			
0011 <sub>16</sub>	Address Match Interrupt Register 0	RMAD0	000000 <sub>16</sub>
0012 <sub>16</sub>			
0013 <sub>16</sub>	Processor Mode Register 2	PM2	00 <sub>16</sub>
0014 <sub>16</sub>			
0015 <sub>16</sub>	Address Match Interrupt Register 1	RMAD1	000000 <sub>16</sub>
0016 <sub>16</sub>			
0017 <sub>16</sub>			
0018 <sub>16</sub>			
0019 <sub>16</sub>	Address Match Interrupt Register 2	RMAD2	000000 <sub>16</sub>
001A <sub>16</sub>			
001B <sub>16</sub>			
001C <sub>16</sub>			
001D <sub>16</sub>	Address Match Interrupt Register 3	RMAD3	000000 <sub>16</sub>
001E <sub>16</sub>			
001F <sub>16</sub>			
0020 <sub>16</sub>			
0021 <sub>16</sub>			
0022 <sub>16</sub>			
0023 <sub>16</sub>			
0024 <sub>16</sub>			
0025 <sub>16</sub>			
0026 <sub>16</sub>	PLL Control Register 0	PLC0	0001 X010 <sub>2</sub>
0027 <sub>16</sub>	PLL Control Register 1	PLC1	000X 0000 <sub>2</sub>
0028 <sub>16</sub>			
0029 <sub>16</sub>	Address Match Interrupt Register 4	RMAD4	000000 <sub>16</sub>
002A <sub>16</sub>			
002B <sub>16</sub>			
002C <sub>16</sub>			
002D <sub>16</sub>	Address Match Interrupt Register 5	RMAD5	000000 <sub>16</sub>
002E <sub>16</sub>			
002F <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTE:

1. The PM01 and PM00 bits in the PM0 register maintain values set before reset, even after software reset or watchdog timer reset has been performed.

Address	Register	Symbol	Value after RESET
0030 <sub>16</sub>			
0031 <sub>16</sub>			
0032 <sub>16</sub>			
0033 <sub>16</sub>			
0034 <sub>16</sub>			
0035 <sub>16</sub>			
0036 <sub>16</sub>			
0037 <sub>16</sub>			
0038 <sub>16</sub> 0039 <sub>16</sub> 003A <sub>16</sub>	Address Match Interrupt Register 6	RMAD6	000000 <sub>16</sub>
003B <sub>16</sub>			
003C <sub>16</sub> 003D <sub>16</sub> 003E <sub>16</sub>	Address Match Interrupt Register 7	RMAD7	000000 <sub>16</sub>
003F <sub>16</sub>			
0040 <sub>16</sub>			
0041 <sub>16</sub>			
0042 <sub>16</sub>			
0043 <sub>16</sub>			
0044 <sub>16</sub>			
0045 <sub>16</sub>			
0046 <sub>16</sub>			
0047 <sub>16</sub>			
0048 <sub>16</sub>	External Space Wait Control Register 0	EWCR0	X0X0 0011 <sub>2</sub>
0049 <sub>16</sub>	External Space Wait Control Register 1	EWCR1	X0X0 0011 <sub>2</sub>
004A <sub>16</sub>	External Space Wait Control Register 2	EWCR2	X0X0 0011 <sub>2</sub>
004B <sub>16</sub>	External Space Wait Control Register 3	EWCR3	X0X0 0011 <sub>2</sub>
004C <sub>16</sub>			
004D <sub>16</sub>			
004E <sub>16</sub>			
004F <sub>16</sub>			
0050 <sub>16</sub>			
0051 <sub>16</sub>			
0052 <sub>16</sub>			
0053 <sub>16</sub>			
0054 <sub>16</sub>			
0055 <sub>16</sub>			
0056 <sub>16</sub>			
0057 <sub>16</sub>			
0058 <sub>16</sub>			
0059 <sub>16</sub>			
005A <sub>16</sub>			
005B <sub>16</sub>			
005C <sub>16</sub>			
005D <sub>16</sub>			
005E <sub>16</sub>			
005F <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0060 <sub>16</sub>			
0061 <sub>16</sub>			
0062 <sub>16</sub>			
0063 <sub>16</sub>			
0064 <sub>16</sub>			
0065 <sub>16</sub>			
0066 <sub>16</sub>			
0067 <sub>16</sub>			
0068 <sub>16</sub>	DMA0 Interrupt Control Register	DM0IC	XXXX X0002
0069 <sub>16</sub>	Timer B5 Interrupt Control Register	TB5IC	XXXX X0002
006A <sub>16</sub>	DMA2 Interrupt Control Register	DM2IC	XXXX X0002
006B <sub>16</sub>	UART2 Receive /ACK Interrupt Control Register	S2RIC	XXXX X0002
006C <sub>16</sub>	Timer A0 Interrupt Control Register	TA0IC	XXXX X0002
006D <sub>16</sub>	UART3 Receive /ACK Interrupt Control Register	S3RIC	XXXX X0002
006E <sub>16</sub>	Timer A2 Interrupt Control Register	TA2IC	XXXX X0002
006F <sub>16</sub>	UART4 Receive /ACK Interrupt Control Register	S4RIC	XXXX X0002
0070 <sub>16</sub>	Timer A4 Interrupt Control Register	TA4IC	XXXX X0002
0071 <sub>16</sub>	UART0/UART3 Bus Conflict Detect Interrupt Control Register	BCN0IC/BCN3IC	XXXX X0002
0072 <sub>16</sub>	UART0 Receive/ACK Interrupt Control Register	S0RIC	XXXX X0002
0073 <sub>16</sub>	A/D0 Conversion Interrupt Control Register	AD0IC	XXXX X0002
0074 <sub>16</sub>	UART1 Receive/ACK Interrupt Control Register	S1RIC	XXXX X0002
0075 <sub>16</sub>	Intelligent I/O Interrupt Control Register 0	IIO0IC	XXXX X0002
0076 <sub>16</sub>	Timer B1 Interrupt Control Register	TB1IC	XXXX X0002
0077 <sub>16</sub>	Intelligent I/O Interrupt Control Register 2	IIO2IC	XXXX X0002
0078 <sub>16</sub>	Timer B3 Interrupt Control Register	TB3IC	XXXX X0002
0079 <sub>16</sub>	Intelligent I/O Interrupt Control Register 4	IIO4IC	XXXX X0002
007A <sub>16</sub>	INT5 Interrupt Control Register	INT5IC	XX00 X0002
007B <sub>16</sub>			
007C <sub>16</sub>	INT3 Interrupt Control Register	INT3IC	XX00 X0002
007D <sub>16</sub>			
007E <sub>16</sub>	INT1 Interrupt Control Register	INT1IC	XX00 X0002
007F <sub>16</sub>			
0080 <sub>16</sub>			
0081 <sub>16</sub>			
0082 <sub>16</sub>			
0083 <sub>16</sub>			
0084 <sub>16</sub>			
0085 <sub>16</sub>			
0086 <sub>16</sub>			
0087 <sub>16</sub>			
0088 <sub>16</sub>	DMA1 Interrupt Control Register	DM1IC	XXXX X0002
0089 <sub>16</sub>	UART2 Transmit /NACK Interrupt Control Register	S2TIC	XXXX X0002
008A <sub>16</sub>	DMA3 Interrupt Control Register	DM3IC	XXXX X0002
008B <sub>16</sub>	UART3 Transmit /NACK Interrupt Control Register	S3TIC	XXXX X0002
008C <sub>16</sub>	Timer A1 Interrupt Control Register	TA1IC	XXXX X0002
008D <sub>16</sub>	UART4 Transmit /NACK Interrupt Control Register	S4TIC	XXXX X0002
008E <sub>16</sub>	Timer A3 Interrupt Control Register	TA3IC	XXXX X0002
008F <sub>16</sub>	UART2 Bus Conflict Detect Interrupt Control Register	BCN2IC	XXXX X0002

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0090 <sub>16</sub>	UART0 Transmit /NACK Interrupt Control Register	S0TIC	XXXX X0002
0091 <sub>16</sub>	UART1/UART4 Bus Conflict Detect Interrupt Control Register	BCN1IC/BCN4IC	XXXX X0002
0092 <sub>16</sub>	UART1 Transmit/NACK Interrupt Control Register	S1TIC	XXXX X0002
0093 <sub>16</sub>	Key Input Interrupt Control Register	KUPIC	XXXX X0002
0094 <sub>16</sub>	Timer B0 Interrupt Control Register	TB0IC	XXXX X0002
0095 <sub>16</sub>	Intelligent I/O Interrupt Control Register 1	IIO1IC	XXXX X0002
0096 <sub>16</sub>	Timer B2 Interrupt Control Register	TB2IC	XXXX X0002
0097 <sub>16</sub>	Intelligent I/O Interrupt Control Register 3	IIO3IC	XXXX X0002
0098 <sub>16</sub>	Timer B4 Interrupt Control Register	TB4IC	XXXX X0002
0099 <sub>16</sub>			
009A <sub>16</sub>	INT4 Interrupt Control Register	INT4IC	XX00 X0002
009B <sub>16</sub>			
009C <sub>16</sub>	INT2 Interrupt Control Register	INT2IC	XX00 X0002
009D <sub>16</sub>			
009E <sub>16</sub>	INT0 Interrupt Control Register	INT0IC	XX00 X0002
009F <sub>16</sub>	Exit Priority Control Register	RLVL	XXXX 00002
00A0 <sub>16</sub>	Interrupt Request Register 0	IIO0IR	0000 000X2
00A1 <sub>16</sub>	Interrupt Request Register 1	IIO1IR	0000 000X2
00A2 <sub>16</sub>	Interrupt Request Register 2	IIO2IR	0000 000X2
00A3 <sub>16</sub>	Interrupt Request Register 3	IIO3IR	0000 000X2
00A4 <sub>16</sub>	Interrupt Request Register 4	IIO4IR	0000 000X2
00A5 <sub>16</sub>			
00A6 <sub>16</sub>			
00A7 <sub>16</sub>			
00A8 <sub>16</sub>			
00A9 <sub>16</sub>			
00AA <sub>16</sub>			
00AB <sub>16</sub>			
00AC <sub>16</sub>			
00AD <sub>16</sub>			
00AE <sub>16</sub>			
00AF <sub>16</sub>			
00B0 <sub>16</sub>	Interrupt Enable Register 0	IIO0IE	00 <sub>16</sub>
00B1 <sub>16</sub>	Interrupt Enable Register 1	IIO1IE	00 <sub>16</sub>
00B2 <sub>16</sub>	Interrupt Enable Register 2	IIO2IE	00 <sub>16</sub>
00B3 <sub>16</sub>	Interrupt Enable Register 3	IIO3IE	00 <sub>16</sub>
00B4 <sub>16</sub>	Interrupt Enable Register 4	IIO4IE	00 <sub>16</sub>
00B5 <sub>16</sub>			
00B6 <sub>16</sub>			
00B7 <sub>16</sub>			
00B8 <sub>16</sub>			
00B9 <sub>16</sub>			
00BA <sub>16</sub>			
00BB <sub>16</sub>			
00BC <sub>16</sub>			
00BD <sub>16</sub>			
00BE <sub>16</sub>			
00BF <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
00C0 <sub>16</sub>			
00C1 <sub>16</sub>			
00C2 <sub>16</sub>			
00C3 <sub>16</sub>			
00C4 <sub>16</sub>			
00C5 <sub>16</sub>			
00C6 <sub>16</sub>			
00C7 <sub>16</sub>			
00C8 <sub>16</sub>			
00C9 <sub>16</sub>			
00CA <sub>16</sub>			
00CB <sub>16</sub>			
00CC <sub>16</sub>			
00CD <sub>16</sub>			
00CE <sub>16</sub>			
00CF <sub>16</sub>			
00D0 <sub>16</sub>			
00D1 <sub>16</sub>			
00D2 <sub>16</sub>			
00D3 <sub>16</sub>			
00D4 <sub>16</sub>			
00D5 <sub>16</sub>			
00D6 <sub>16</sub>			
00D7 <sub>16</sub>			
00D8 <sub>16</sub>			
00D9 <sub>16</sub>			
00DA <sub>16</sub>			
00DB <sub>16</sub>			
00DC <sub>16</sub>			
00DD <sub>16</sub>			
00DE <sub>16</sub>			
00DF <sub>16</sub>			
00E0 <sub>16</sub>			
00E1 <sub>16</sub>			
00E2 <sub>16</sub>			
00E3 <sub>16</sub>			
00E4 <sub>16</sub>			
00E5 <sub>16</sub>			
00E6 <sub>16</sub>			
00E7 <sub>16</sub>			
00E8 <sub>16</sub> 00E9 <sub>16</sub>	SI/O Receive Buffer Register 0	G0RB	XXXX XXXX <sub>2</sub> XXX0 XXXX <sub>2</sub>
00EA <sub>16</sub> 00EB <sub>16</sub>	Transmit Buffer/Receive Data Register 0	G0TB/G0DR	XX <sub>16</sub>
00EC <sub>16</sub>	Receive Input Register 0	G0RI	XX <sub>16</sub>
00ED <sub>16</sub>	SI/O Communication Mode Register 0	G0MR	00 <sub>16</sub>
00EE <sub>16</sub>	Transmit Output Register 0	G0TO	XX <sub>16</sub>
00EF <sub>16</sub>	SI/O Communication Control Register 0	G0CR	0000 X011 <sub>2</sub>

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
00F0 <sub>16</sub>	Data Compare Register 00	G0CMP0	XX <sub>16</sub>
00F1 <sub>16</sub>	Data Compare Register 01	G0CMP1	XX <sub>16</sub>
00F2 <sub>16</sub>	Data Compare Register 02	G0CMP2	XX <sub>16</sub>
00F3 <sub>16</sub>	Data Compare Register 03	G0CMP3	XX <sub>16</sub>
00F4 <sub>16</sub>	Data Mask Register 00	G0MSK0	XX <sub>16</sub>
00F5 <sub>16</sub>	Data Mask Register 01	G0MSK1	XX <sub>16</sub>
00F6 <sub>16</sub>	Communication Clock Select Register	CCS	XXXX 0000 <sub>2</sub>
00F7 <sub>16</sub>			
00F8 <sub>16</sub>	Receive CRC Code Register 0	G0RCRC	XX <sub>16</sub>
00F9 <sub>16</sub>			XX <sub>16</sub>
00FA <sub>16</sub>	Transmit CRC Code Register 0	G0TCRC	00 <sub>16</sub>
00FB <sub>16</sub>			00 <sub>16</sub>
00FC <sub>16</sub>	SI/O Expansion Mode Register 0	G0EMR	00 <sub>16</sub>
00FD <sub>16</sub>	SI/O Expansion Receive Control Register 0	G0ERC	00 <sub>16</sub>
00FE <sub>16</sub>	SI/O Special Communication Interrupt Detect Register 0	G0IRF	00 <sub>16</sub>
00FF <sub>16</sub>	SI/O Expansion Transmit Control Register 0	G0ETC	0000 0XXX <sub>2</sub>
0100 <sub>16</sub>			
0101 <sub>16</sub>			
0102 <sub>16</sub>			
0103 <sub>16</sub>			
0104 <sub>16</sub>			
0105 <sub>16</sub>			
0106 <sub>16</sub>			
0107 <sub>16</sub>			
0108 <sub>16</sub>			
0109 <sub>16</sub>			
010A <sub>16</sub>			
010B <sub>16</sub>			
010C <sub>16</sub>			
010D <sub>16</sub>			
010E <sub>16</sub>			
010F <sub>16</sub>			
0110 <sub>16</sub>			
0111 <sub>16</sub>			
0112 <sub>16</sub>			
0113 <sub>16</sub>			
0114 <sub>16</sub>			
0115 <sub>16</sub>			
0116 <sub>16</sub>			
0117 <sub>16</sub>			
0118 <sub>16</sub>			
0119 <sub>16</sub>			
011A <sub>16</sub>			
011B <sub>16</sub>			
011C <sub>16</sub>			
011D <sub>16</sub>			
011E <sub>16</sub>			
011F <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0120 <sub>16</sub>			
0121 <sub>16</sub>			
0122 <sub>16</sub>			
0123 <sub>16</sub>			
0124 <sub>16</sub>			
0125 <sub>16</sub>			
0126 <sub>16</sub>			
0127 <sub>16</sub>			
0128 <sub>16</sub> 0129 <sub>16</sub>	SI/O Receive Buffer Register 1	G1RB	XXXX XXXX <sub>2</sub> XXX0 XXXX <sub>2</sub>
012A <sub>16</sub> 012B <sub>16</sub>	Transmit Buffer/Receive Data Register 1	G1TB/G1DR	XX <sub>16</sub>
012C <sub>16</sub>	Receive Input Register 1	G1RI	XX <sub>16</sub>
012D <sub>16</sub>	SI/O Communication Mode Register 1	G1MR	00 <sub>16</sub>
012E <sub>16</sub>	Transmit Output Register 1	G1TO	XX <sub>16</sub>
012F <sub>16</sub>	SI/O Communication Control Register 1	G1CR	0000 X011 <sub>2</sub>
0130 <sub>16</sub>	Data Compare Register 10	G1CMP0	XX <sub>16</sub>
0131 <sub>16</sub>	Data Compare Register 11	G1CMP1	XX <sub>16</sub>
0132 <sub>16</sub>	Data Compare Register 12	G1CMP2	XX <sub>16</sub>
0133 <sub>16</sub>	Data Compare Register 13	G1CMP3	XX <sub>16</sub>
0134 <sub>16</sub>	Data Mask Register 10	G1MSK0	XX <sub>16</sub>
0135 <sub>16</sub>	Data Mask Register 11	G1MSK1	XX <sub>16</sub>
0136 <sub>16</sub>			
0137 <sub>16</sub>			
0138 <sub>16</sub> 0139 <sub>16</sub>	Receive CRC Code Register 1	G1RCRC	XX <sub>16</sub> XX <sub>16</sub>
013A <sub>16</sub> 013B <sub>16</sub>	Transmit CRC Code Register 1	G1TCRC	00 <sub>16</sub> 00 <sub>16</sub>
013C <sub>16</sub>	SI/O Expansion Mode Register 1	G1EMR	00 <sub>16</sub>
013D <sub>16</sub>	SI/O Expansion Receive Control Register 1	G1ERC	00 <sub>16</sub>
013E <sub>16</sub>	SI/O Special Communication Interrupt Detection Register 1	G1IRF	00 <sub>16</sub>
013F <sub>16</sub>	SI/O Expansion Transmit Control Register 1	G1ETC	0000 0XXX <sub>2</sub>
0140 <sub>16</sub>			
0141 <sub>16</sub>			
0142 <sub>16</sub>			
0143 <sub>16</sub>			
0144 <sub>16</sub>			
0145 <sub>16</sub>			
0146 <sub>16</sub>			
0147 <sub>16</sub>			
0148 <sub>16</sub>			
0149 <sub>16</sub>			
014A <sub>16</sub>			
014B <sub>16</sub>			
014C <sub>16</sub>			
014D <sub>16</sub> to 02AF <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.



Address	Register	Symbol	Value after RESET
02B1 <sub>16</sub>			
02B2 <sub>16</sub>			
02B3 <sub>16</sub>			
02B4 <sub>16</sub>			
02B5 <sub>16</sub>			
02B6 <sub>16</sub>			
02B7 <sub>16</sub>			
02B8 <sub>16</sub>			
02B9 <sub>16</sub>			
02BA <sub>16</sub>			
02BB <sub>16</sub>			
02BC <sub>16</sub>			
02BD <sub>16</sub>			
02BE <sub>16</sub>			
02BF <sub>16</sub>			
02C0 <sub>16</sub> 02C1 <sub>16</sub>	X0 Register Y0 Register	X0R,Y0R	XX <sub>16</sub> XX <sub>16</sub>
02C2 <sub>16</sub> 02C3 <sub>16</sub>	X1 Register Y1 Register	X1R,Y1R	XX <sub>16</sub> XX <sub>16</sub>
02C4 <sub>16</sub> 02C5 <sub>16</sub>	X2 Register Y2 Register	X2R,Y2R	XX <sub>16</sub> XX <sub>16</sub>
02C6 <sub>16</sub> 02C7 <sub>16</sub>	X3 Register Y3 Register	X3R,Y3R	XX <sub>16</sub> XX <sub>16</sub>
02C8 <sub>16</sub> 02C9 <sub>16</sub>	X4 Register Y4 Register	X4R,Y4R	XX <sub>16</sub> XX <sub>16</sub>
02CA <sub>16</sub> 02CB <sub>16</sub>	X5 Register Y5 Register	X5R,Y5R	XX <sub>16</sub> XX <sub>16</sub>
02CC <sub>16</sub> 02CD <sub>16</sub>	X6 Register Y6 Register	X6R,Y6R	XX <sub>16</sub> XX <sub>16</sub>
02CE <sub>16</sub> 02CF <sub>16</sub>	X7 Register Y7 Register	X7R,Y7R	XX <sub>16</sub> XX <sub>16</sub>
02D0 <sub>16</sub> 02D1 <sub>16</sub>	X8 Register Y8 Register	X8R,Y8R	XX <sub>16</sub> XX <sub>16</sub>
02D2 <sub>16</sub> 02D3 <sub>16</sub>	X9 Register Y9 Register	X9R,Y9R	XX <sub>16</sub> XX <sub>16</sub>
02D4 <sub>16</sub> 02D5 <sub>16</sub>	X10 Register Y10 Register	X10R,Y10R	XX <sub>16</sub> XX <sub>16</sub>
02D6 <sub>16</sub> 02D7 <sub>16</sub>	X11 Register Y11 Register	X11R,Y11R	XX <sub>16</sub> XX <sub>16</sub>
02D8 <sub>16</sub> 02D9 <sub>16</sub>	X12 Register Y12 Register	X12R,Y12R	XX <sub>16</sub> XX <sub>16</sub>
02DA <sub>16</sub> 02DB <sub>16</sub>	X13 Register Y13 Register	X13R,Y13R	XX <sub>16</sub> XX <sub>16</sub>
02DC <sub>16</sub> 02DD <sub>16</sub>	X14 Register Y14 Register	X14R,Y14R	XX <sub>16</sub> XX <sub>16</sub>
02DE <sub>16</sub> 02DF <sub>16</sub>	X15 Register Y15 Register	X15R,Y15R	XX <sub>16</sub> XX <sub>16</sub>

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
02E0 <sub>16</sub>	X/Y Control Register	XYC	XXXX XX00 <sub>2</sub>
02E1 <sub>16</sub>			
02E2 <sub>16</sub>			
02E3 <sub>16</sub>			
02E4 <sub>16</sub>	UART1 Special Mode Register 4	U1SMR4	00 <sub>16</sub>
02E5 <sub>16</sub>	UART1 Special Mode Register 3	U1SMR3	00 <sub>16</sub>
02E6 <sub>16</sub>	UART1 Special Mode Register 2	U1SMR2	00 <sub>16</sub>
02E7 <sub>16</sub>	UART1 Special Mode Register	U1SMR	00 <sub>16</sub>
02E8 <sub>16</sub>	UART1 Transmit/Receive Mode Register	U1MR	00 <sub>16</sub>
02E9 <sub>16</sub>	UART1 Bit Rate Register	U1BRG	XX <sub>16</sub>
02EA <sub>16</sub>	UART1 Transmit Buffer Register	U1TB	XX <sub>16</sub>
02EB <sub>16</sub>			XX <sub>16</sub>
02EC <sub>16</sub>	UART1 Transmit/Receive Control Register 0	U1C0	0000 1000 <sub>2</sub>
02ED <sub>16</sub>	UART1 Transmit/Receive Control Register 1	U1C1	0000 0010 <sub>2</sub>
02EE <sub>16</sub>	UART1 Receive Buffer Register	U1RB	XX <sub>16</sub>
02EF <sub>16</sub>			XX <sub>16</sub>
02F0 <sub>16</sub>			
02F1 <sub>16</sub>			
02F2 <sub>16</sub>			
02F3 <sub>16</sub>			
02F4 <sub>16</sub>	UART4 Special Mode Register 4	U4SMR4	00 <sub>16</sub>
02F5 <sub>16</sub>	UART4 Special Mode Register 3	U4SMR3	00 <sub>16</sub>
02F6 <sub>16</sub>	UART4 Special Mode Register 2	U4SMR2	00 <sub>16</sub>
02F7 <sub>16</sub>	UART4 Special Mode Register	U4SMR	00 <sub>16</sub>
02F8 <sub>16</sub>	UART4 Transmit/Receive Mode Register	U4MR	00 <sub>16</sub>
02F9 <sub>16</sub>	UART4 Bit Rate Register	U4BRG	XX <sub>16</sub>
02FA <sub>16</sub>	UART4 Transmit Buffer Register	U4TB	XX <sub>16</sub>
02FB <sub>16</sub>			XX <sub>16</sub>
02FC <sub>16</sub>	UART4 Transmit/Receive Control Register 0	U4C0	0000 1000 <sub>2</sub>
02FD <sub>16</sub>	UART4 Transmit/Receive Control Register 1	U4C1	0000 0010 <sub>2</sub>
02FE <sub>16</sub>	UART4 Receive Buffer Register	U4RB	XX <sub>16</sub>
02FF <sub>16</sub>			XX <sub>16</sub>
0300 <sub>16</sub>	Timer B3, B4, B5 Count Start Flag	TBSR	000X XXXX <sub>2</sub>
0301 <sub>16</sub>			
0302 <sub>16</sub>	Timer A1-1 Register	TA11	XX <sub>16</sub>
0303 <sub>16</sub>			XX <sub>16</sub>
0304 <sub>16</sub>	Timer A2-1 Register	TA21	XX <sub>16</sub>
0305 <sub>16</sub>			XX <sub>16</sub>
0306 <sub>16</sub>	Timer A4-1 Register	TA41	XX <sub>16</sub>
0307 <sub>16</sub>			XX <sub>16</sub>
0308 <sub>16</sub>	Three-Phase PWM Control Register 0	INVC0	00 <sub>16</sub>
0309 <sub>16</sub>	Three-Phase PWM Control Register 1	INVC1	00 <sub>16</sub>
030A <sub>16</sub>	Three-Phase Output Buffer Register 0	IDB0	XX11 1111 <sub>2</sub>
030B <sub>16</sub>	Three-Phase Output Buffer Register 1	IDB1	XX11 1111 <sub>2</sub>
030C <sub>16</sub>	Dead Time Timer	DTT	XX <sub>16</sub>
030D <sub>16</sub>	Timer B2 Interrupt Generation Frequency Set Counter	ICTB2	XX <sub>16</sub>
030E <sub>16</sub>			
030F <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0310 <sub>16</sub> 0311 <sub>16</sub>	Timer B3 Register	TB3	XX <sub>16</sub> XX <sub>16</sub>
0312 <sub>16</sub> 0313 <sub>16</sub>	Timer B4 Register	TB4	XX <sub>16</sub> XX <sub>16</sub>
0314 <sub>16</sub> 0315 <sub>16</sub>	Timer B5 Register	TB5	XX <sub>16</sub> XX <sub>16</sub>
0316 <sub>16</sub>			
0317 <sub>16</sub>			
0318 <sub>16</sub>			
0319 <sub>16</sub>			
031A <sub>16</sub>			
031B <sub>16</sub>	Timer B3 Mode Register	TB3MR	00XX 0000 <sub>2</sub>
031C <sub>16</sub>	Timer B4 Mode Register	TB4MR	00XX 0000 <sub>2</sub>
031D <sub>16</sub>	Timer B5 Mode Register	TB5MR	00XX 0000 <sub>2</sub>
031E <sub>16</sub>			
031F <sub>16</sub>	External Interrupt Request Source Select Register	IFSR	00 <sub>16</sub>
0320 <sub>16</sub>			
0321 <sub>16</sub>			
0322 <sub>16</sub>			
0323 <sub>16</sub>			
0324 <sub>16</sub>	UART3 Special Mode Register 4	U3SMR4	00 <sub>16</sub>
0325 <sub>16</sub>	UART3 Special Mode Register 3	U3SMR3	00 <sub>16</sub>
0326 <sub>16</sub>	UART3 Special Mode Register 2	U3SMR2	00 <sub>16</sub>
0327 <sub>16</sub>	UART3 Special Mode Register	U3SMR	00 <sub>16</sub>
0328 <sub>16</sub>	UART3 Transmit/Receive Mode Register	U3MR	00 <sub>16</sub>
0329 <sub>16</sub>	UART3 Bit Rate Register	U3BRG	XX <sub>16</sub>
032A <sub>16</sub> 032B <sub>16</sub>	UART3 Transmit Buffer Register	U3TB	XX <sub>16</sub> XX <sub>16</sub>
032C <sub>16</sub>	UART3 Transmit/Receive Control Register 0	U3C0	0000 1000 <sub>2</sub>
032D <sub>16</sub>	UART3 Transmit/Receive Control Register 1	U3C1	0000 0010 <sub>2</sub>
032E <sub>16</sub> 032F <sub>16</sub>	UART3 Receive Buffer Register	U3RB	XX <sub>16</sub> XX <sub>16</sub>
0330 <sub>16</sub>			
0331 <sub>16</sub>			
0332 <sub>16</sub>			
0333 <sub>16</sub>			
0334 <sub>16</sub>	UART2 Special Mode Register 4	U2SMR4	00 <sub>16</sub>
0335 <sub>16</sub>	UART2 Special Mode Register 3	U2SMR3	00 <sub>16</sub>
0336 <sub>16</sub>	UART2 Special Mode Register 2	U2SMR2	00 <sub>16</sub>
0337 <sub>16</sub>	UART2 Special Mode Register	U2SMR	00 <sub>16</sub>
0338 <sub>16</sub>	UART2 Transmit/Receive Mode Register	U2MR	00 <sub>16</sub>
0339 <sub>16</sub>	UART2 Bit Rate Register	U2BRG	XX <sub>16</sub>
033A <sub>16</sub> 033B <sub>16</sub>	UART2 Transmit Buffer Register	U2TB	XX <sub>16</sub> XX <sub>16</sub>
033C <sub>16</sub>	UART2 Transmit/Receive Control Register 0	U2C0	0000 1000 <sub>2</sub>
033D <sub>16</sub>	UART2 Transmit/Receive Control Register 1	U2C1	0000 0010 <sub>2</sub>
033E <sub>16</sub> 033F <sub>16</sub>	UART2 Receive Buffer Register	U2RB	XX <sub>16</sub> XX <sub>16</sub>

X: Indeterminate

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Address	Register	Symbol	Value after RESET
0340 <sub>16</sub>	Count Start Flag	TABSR	00 <sub>16</sub>
0341 <sub>16</sub>	Clock Prescaler Reset Flag	CPSRF	0XXX XXXX <sub>2</sub>
0342 <sub>16</sub>	One-Shot Start Flag	ONSF	00 <sub>16</sub>
0343 <sub>16</sub>	Trigger Select Register	TRGSR	00 <sub>16</sub>
0344 <sub>16</sub>	Up/Down Flag	UDF	00 <sub>16</sub>
0345 <sub>16</sub>			
0346 <sub>16</sub> 0347 <sub>16</sub>	Timer A0 Register	TA0	XX <sub>16</sub> XX <sub>16</sub>
0348 <sub>16</sub> 0349 <sub>16</sub>	Timer A1 Register	TA1	XX <sub>16</sub> XX <sub>16</sub>
034A <sub>16</sub> 034B <sub>16</sub>	Timer A2 Register	TA2	XX <sub>16</sub> XX <sub>16</sub>
034C <sub>16</sub> 034D <sub>16</sub>	Timer A3 Register	TA3	XX <sub>16</sub> XX <sub>16</sub>
034E <sub>16</sub> 034F <sub>16</sub>	Timer A4 Register	TA4	XX <sub>16</sub> XX <sub>16</sub>
0350 <sub>16</sub> 0351 <sub>16</sub>	Timer B0 Register	TB0	XX <sub>16</sub> XX <sub>16</sub>
0352 <sub>16</sub> 0353 <sub>16</sub>	Timer B1 Register	TB1	XX <sub>16</sub> XX <sub>16</sub>
0354 <sub>16</sub> 0355 <sub>16</sub>	Timer B2 Register	TB2	XX <sub>16</sub> XX <sub>16</sub>
0356 <sub>16</sub>	Timer A0 Mode Register	TA0MR	00 <sub>16</sub>
0357 <sub>16</sub>	Timer A1 Mode Register	TA1MR	00 <sub>16</sub>
0358 <sub>16</sub>	Timer A2 Mode Register	TA2MR	00 <sub>16</sub>
0359 <sub>16</sub>	Timer A3 Mode Register	TA3MR	00 <sub>16</sub>
035A <sub>16</sub>	Timer A4 Mode Register	TA4MR	00 <sub>16</sub>
035B <sub>16</sub>	Timer B0 Mode Register	TB0MR	00XX 0000 <sub>2</sub>
035C <sub>16</sub>	Timer B1 Mode Register	TB1MR	00XX 0000 <sub>2</sub>
035D <sub>16</sub>	Timer B2 Mode Register	TB2MR	00XX 0000 <sub>2</sub>
035E <sub>16</sub>	Timer B2 Special Mode Register	TB2SC	XXXX XXX0 <sub>2</sub>
035F <sub>16</sub>	Count Source Prescaler Register <sup>(1)</sup>	TCSPR	0XXX 0000 <sub>2</sub>
0360 <sub>16</sub>			
0361 <sub>16</sub>			
0362 <sub>16</sub>			
0363 <sub>16</sub>			
0364 <sub>16</sub>	UART0 Special Mode Register 4	U0SMR4	00 <sub>16</sub>
0365 <sub>16</sub>	UART0 Special Mode Register 3	U0SMR3	00 <sub>16</sub>
0366 <sub>16</sub>	UART0 Special Mode Register 2	U0SMR2	00 <sub>16</sub>
0367 <sub>16</sub>	UART0 Special Mode Register	U0SMR	00 <sub>16</sub>
0368 <sub>16</sub>	UART0 Transmit/Receive Mode Register	U0MR	00 <sub>16</sub>
0369 <sub>16</sub>	UART0 Bit Rate Register	U0BRG	XX <sub>16</sub>
036A <sub>16</sub> 036B <sub>16</sub>	UART0 Transmit Buffer Register	U0TB	XX <sub>16</sub> XX <sub>16</sub>
036C <sub>16</sub>	UART0 Transmit/Receive Control Register 0	U0C0	0000 1000 <sub>2</sub>
036D <sub>16</sub>	UART0 Transmit/Receive Control Register 1	U0C1	0000 0010 <sub>2</sub>
036E <sub>16</sub> 036F <sub>16</sub>	UART0 Receive Buffer Register	U0RB	XX <sub>16</sub> XX <sub>16</sub>

X: Indeterminate

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NOTE:

1. The TCSPR register maintains values set before reset, even after software reset or watchdog timer reset has been performed.

Address	Register	Symbol	Value after RESET
0370 <sub>16</sub>			
0371 <sub>16</sub>			
0372 <sub>16</sub>			
0373 <sub>16</sub>			
0374 <sub>16</sub>			
0375 <sub>16</sub>			
0376 <sub>16</sub>			
0377 <sub>16</sub>			
0378 <sub>16</sub>	DMA0 Request Source Select Register	DM0SL	0X00 0000 <sub>2</sub>
0379 <sub>16</sub>	DMA1 Request Source Select Register	DM1SL	0X00 0000 <sub>2</sub>
037A <sub>16</sub>	DMA2 Request Source Select Register	DM2SL	0X00 0000 <sub>2</sub>
037B <sub>16</sub>	DMA3 Request Source Select Register	DM3SL	0X00 0000 <sub>2</sub>
037C <sub>16</sub>	CRC Data Register	CRCD	XX <sub>16</sub>
037D <sub>16</sub>			XX <sub>16</sub>
037E <sub>16</sub>	CRC Input Register	CRCIN	XX <sub>16</sub>
037F <sub>16</sub>			
0380 <sub>16</sub>	A/D0 Register 0	AD00	XXXX XXXX <sub>2</sub>
0381 <sub>16</sub>			0000 0000 <sub>2</sub>
0382 <sub>16</sub>	A/D0 Register 1	AD01	XX <sub>16</sub>
0383 <sub>16</sub>			XX <sub>16</sub>
0384 <sub>16</sub>	A/D0 Register 2	AD02	XX <sub>16</sub>
0385 <sub>16</sub>			XX <sub>16</sub>
0386 <sub>16</sub>	A/D0 Register 3	AD03	XX <sub>16</sub>
0387 <sub>16</sub>			XX <sub>16</sub>
0388 <sub>16</sub>	A/D0 Register 4	AD04	XX <sub>16</sub>
0389 <sub>16</sub>			XX <sub>16</sub>
038A <sub>16</sub>	A/D0 Register 5	AD05	XX <sub>16</sub>
038B <sub>16</sub>			XX <sub>16</sub>
038C <sub>16</sub>	A/D0 Register 6	AD06	XX <sub>16</sub>
038D <sub>16</sub>			XX <sub>16</sub>
038E <sub>16</sub>	A/D0 Register 7	AD07	XX <sub>16</sub>
038F <sub>16</sub>			XX <sub>16</sub>
0390 <sub>16</sub>			
0391 <sub>16</sub>			
0392 <sub>16</sub>			
0393 <sub>16</sub>			
0394 <sub>16</sub>	A/D0 Control Register 2	AD0CON2	XX0X XXX0 <sub>2</sub>
0395 <sub>16</sub>	A/D0 Control Register 3	AD0CON3	XXXX X000 <sub>2</sub>
0396 <sub>16</sub>	A/D0 Control Register 0	AD0CON0	00 <sub>16</sub>
0397 <sub>16</sub>	A/D0 Control Register 1	AD0CON1	00 <sub>16</sub>
0398 <sub>16</sub>	D/A Register 0	DA0	XX <sub>16</sub>
0399 <sub>16</sub>			
039A <sub>16</sub>	D/A Register 1	DA1	XX <sub>16</sub>
039B <sub>16</sub>			
039C <sub>16</sub>	D/A Control Register	DACON	XXXX XX00 <sub>2</sub>
039D <sub>16</sub>			
039E <sub>16</sub>			
039F <sub>16</sub>			

X: Indeterminate

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Address	Register	Symbol	Value after RESET
03A0 <sub>16</sub>			
03A1 <sub>16</sub>			
03A2 <sub>16</sub>			
03A3 <sub>16</sub>			
03A4 <sub>16</sub>			
03A5 <sub>16</sub>			
03A6 <sub>16</sub>			
03A7 <sub>16</sub>	Function Select Register D1	PSD1	X0XX XX00 <sub>2</sub>
03A8 <sub>16</sub>			
03A9 <sub>16</sub>			
03AA <sub>16</sub>			
03AB <sub>16</sub>			
03AC <sub>16</sub>			
03AD <sub>16</sub>	Function Select Register C3	PSC3	X0XX XXXX <sub>2</sub>
03AE <sub>16</sub>			
03AF <sub>16</sub>	Function Select Register C	PSC	00X0 0000 <sub>2</sub>
03B0 <sub>16</sub>	Function Select Register A0	PS0	00 <sub>16</sub>
03B1 <sub>16</sub>	Function Select Register A1	PS1	00 <sub>16</sub>
03B2 <sub>16</sub>	Function Select Register B0	PSL0	00 <sub>16</sub>
03B3 <sub>16</sub>	Function Select Register B1	PSL1	00 <sub>16</sub>
03B4 <sub>16</sub>	Function Select Register A2	PS2	00X0 0000 <sub>2</sub>
03B5 <sub>16</sub>	Function Select Register A3	PS3	00 <sub>16</sub>
03B6 <sub>16</sub>	Function Select Register B2	PSL2	00X0 0000 <sub>2</sub>
03B7 <sub>16</sub>	Function Select Register B3	PSL3	00 <sub>16</sub>
03B8 <sub>16</sub>			
03B9 <sub>16</sub>			
03BA <sub>16</sub>			
03BB <sub>16</sub>			
03BC <sub>16</sub>			
03BD <sub>16</sub>			
03BE <sub>16</sub>			
03BF <sub>16</sub>			
03C0 <sub>16</sub>	Port P6 Register	P6	XX <sub>16</sub>
03C1 <sub>16</sub>	Port P7 Register	P7	XX <sub>16</sub>
03C2 <sub>16</sub>	Port P6 Direction Register	PD6	00 <sub>16</sub>
03C3 <sub>16</sub>	Port P7 Direction Register	PD7	00 <sub>16</sub>
03C4 <sub>16</sub>	Port P8 Register	P8	XX <sub>16</sub>
03C5 <sub>16</sub>	Port P9 Register	P9	XX <sub>16</sub>
03C6 <sub>16</sub>	Port P8 Direction Register	PD8	00X0 0000 <sub>2</sub>
03C7 <sub>16</sub>	Port P9 Direction Register	PD9	00 <sub>16</sub>
03C8 <sub>16</sub>	Port P10 Register	P10	XX <sub>16</sub>
03C9 <sub>16</sub>			
03CA <sub>16</sub>	Port P10 Direction Register	PD10	00 <sub>16</sub>
03CB <sub>16</sub>			
03CC <sub>16</sub>			
03CD <sub>16</sub>			
03CE <sub>16</sub>			
03CF <sub>16</sub>			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
03D0 <sub>16</sub>			
03D1 <sub>16</sub>			
03D2 <sub>16</sub>			
03D3 <sub>16</sub>			
03D4 <sub>16</sub>			
03D5 <sub>16</sub>			
03D6 <sub>16</sub>			
03D7 <sub>16</sub>			
03D8 <sub>16</sub>			
03D9 <sub>16</sub>			
03DA <sub>16</sub>	Pull-Up Control Register 2	PUR2	00 <sub>16</sub>
03DB <sub>16</sub>	Pull-Up Control Register 3	PUR3	00 <sub>16</sub>
03DC <sub>16</sub>			
03DD <sub>16</sub>			
03DE <sub>16</sub>			
03DF <sub>16</sub>			
03E0 <sub>16</sub>	Port P0 Register <sup>(1)</sup>	P0	XX <sub>16</sub>
03E1 <sub>16</sub>	Port P1 Register <sup>(1)</sup>	P1	XX <sub>16</sub>
03E2 <sub>16</sub>	Port P0 Direction Register <sup>(1)</sup>	PD0	00 <sub>16</sub>
03E3 <sub>16</sub>	Port P1 Direction Register <sup>(1)</sup>	PD1	00 <sub>16</sub>
03E4 <sub>16</sub>	Port P2 Register <sup>(1)</sup>	P2	XX <sub>16</sub>
03E5 <sub>16</sub>	Port P3 Register <sup>(1)</sup>	P3	XX <sub>16</sub>
03E6 <sub>16</sub>	Port P2 Direction Register <sup>(1)</sup>	PD2	00 <sub>16</sub>
03E7 <sub>16</sub>	Port P3 Direction Register <sup>(1)</sup>	PD3	00 <sub>16</sub>
03E8 <sub>16</sub>	Port P4 Register <sup>(1)</sup>	P4	XX <sub>16</sub>
03E9 <sub>16</sub>	Port P5 Register <sup>(1)</sup>	P5	XX <sub>16</sub>
03EA <sub>16</sub>	Port P4 Direction Register <sup>(1)</sup>	PD4	00 <sub>16</sub>
03EB <sub>16</sub>	Port P5 Direction Register <sup>(1)</sup>	PD5	00 <sub>16</sub>
03EC <sub>16</sub>			
03ED <sub>16</sub>			
03EE <sub>16</sub>			
03EF <sub>16</sub>			
03F0 <sub>16</sub>	Pull-up Control Register 0	PUR0	00 <sub>16</sub>
03F1 <sub>16</sub>	Pull-up Control Register 1	PUR1	XXXX 0000 <sub>2</sub>
03F2 <sub>16</sub>			
03F3 <sub>16</sub>			
03F4 <sub>16</sub>			
03F5 <sub>16</sub>			
03F6 <sub>16</sub>			
03F7 <sub>16</sub>			
03F8 <sub>16</sub>			
03F9 <sub>16</sub>			
03FA <sub>16</sub>			
03FB <sub>16</sub>			
03FC <sub>16</sub>			
03FD <sub>16</sub>			
03FE <sub>16</sub>			
03FF <sub>16</sub>	Port Control Register	PCR	XXXX XXX0 <sub>2</sub>

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTE:

1. Pins, functioning as bus control pins, cannot be selected as I/O ports.

## 5. Electrical Characteristics

**Table 5.1 Absolute Maximum Ratings**

Symbol	Parameter	Condition	Value	Unit
V <sub>CC1</sub> , V <sub>CC2</sub>	Supply Voltage	V <sub>CC1</sub> =AV <sub>CC</sub>	-0.3 to 6.0	V
V <sub>CC2</sub>	Supply Voltage	-	-0.3 to V <sub>CC1</sub>	V
AV <sub>CC</sub>	Analog Supply Voltage	V <sub>CC1</sub> =AV <sub>CC</sub>	-0.3 to 6.0	V
V <sub>I</sub>	Input Voltage	RESET, CNV <sub>SS</sub> , BYTE, P60-P67, P72-P77, P80-P87, P90-P97, P100-P107, V <sub>REF</sub> , X <sub>IN</sub>	-0.3 to V <sub>CC1</sub> +0.3	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57	-0.3 to V <sub>CC2</sub> +0.3	
		P70, P71	-0.3 to 6.0	
V <sub>O</sub>	Output Voltage	P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, X <sub>OUT</sub>	-0.3 to V <sub>CC1</sub> +0.3	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57	-0.3 to V <sub>CC2</sub> +0.3	
		P70, P71	-0.3 to 6.0	
P <sub>d</sub>	Power Dissipation	T <sub>opr</sub> =25° C	500	mW
T <sub>opr</sub>	Operating Ambient Temperature		-20 to 85/ -40 to 85 <sup>(1)</sup>	° C
T <sub>stg</sub>	Storage Temperature		-65 to 150	° C

**NOTE:**

1. Contact our sales office if temperature range of -40 to 85° C is required.



**Table 5.2 Recommended Operating Conditions**  
**(VCC1= VCC2=3.0V to 5.5V at Topr= -20 to 85°C unless otherwise specified)**

Symbol	Parameter	Standard			Unit
		Min.	Typ.	Max.	
VCC1, VCC2	Supply Voltage (VCC1 ≥ VCC2)	3.0	5.0	5.5	V
AVCC	Analog Supply Voltage		VCC1		V
VSS	Supply Voltage		0		V
AVSS	Analog Supply Voltage		0		V
VIH	Input High ("H") Voltage	P20-P27, P30-P37, P40-P47, P50-P57	0.8VCC2	VCC2	V
		P60-P67, P72-P77, P80-P87 <sup>(3)</sup> , P90-P97, P100-P107, XIN, RESET, CNVSS, BYTE	0.8VCC1	VCC1	
		P70, P71	0.8VCC1	6.0	
		P00-P07, P10-P17 (in single-chip mode)	0.8VCC2	VCC2	
		P00-P07, P10-P17 (in memory expansion mode and microprocessor mode)	0.5VCC2	VCC2	
VIL	Input Low ("L") Voltage	P20-P27, P30-P37, P40-P47, P50-P57	0	0.2VCC2	V
		P60-P67, P70-P77, P80-P87 <sup>(3)</sup> , P90-P97, P100-P107, XIN, RESET, CNVSS, BYTE	0	0.2VCC1	
		P00-P07, P10-P17 (in single-chip mode)	0	0.2VCC2	
		P00-P07, P10-P17 (in memory expansion mode and microprocessor mode)	0	0.16VCC2	
I <sub>OH(peak)</sub>	Peak Output High ("H") Current <sup>(2)</sup>	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107		-10.0	mA
I <sub>OH(avg)</sub>	Average Output High ("H") Current <sup>(1)</sup>	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107		-5.0	mA
I <sub>OL(peak)</sub>	Peak Output Low ("L") Current <sup>(2)</sup>	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107		10.0	mA
I <sub>OL(avg)</sub>	Average Output Low ("L") Current <sup>(1)</sup>	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107		5.0	mA

## NOTES:

- Typical values when average output current is 100 ms.
- Total I<sub>OL(peak)</sub> for P0, P1, P2, P86, P87, P9, and P10 must be 80 mA or less.  
 Total I<sub>OL(peak)</sub> for P3, P4, P5, P6, P7, and P80 to P84 must be 80 mA or less.  
 Total I<sub>OH(peak)</sub> for P0, P1, and P2 must be -40 mA or less.  
 Total I<sub>OH(peak)</sub> for P86, P87, P9, and P10 must be -40 mA or less.  
 Total I<sub>OH(peak)</sub> for P3, P4, and P5 must be -40 mA or less.  
 Total I<sub>OH(peak)</sub> for P6, P7, and P80 to P84 must be -40 mA or less.
- V<sub>IH</sub> and V<sub>IL</sub> reference for P87 applies when P87 is used as a programmable input port.  
 It does not apply when P87 is used as X<sub>CIN</sub>.

**Table 5.2 Recommended Operating Conditions (Continued)**  
**(V<sub>CC1</sub>=V<sub>CC2</sub>=3.0V to 5.5V at Topr=-20 to 85°C unless otherwise specified)**

Symbol	Parameter		Standard			Unit
			Min.	Typ.	Max.	
f(BCLK)	CPU Operation Frequency	V <sub>CC1</sub> =4.2 to 5.5 V	0		32	MHz
		V <sub>CC1</sub> =3.0 to 5.5 V	0		24	MHz
f(XIN)	Main Clock Input Frequency	V <sub>CC1</sub> =4.2 to 5.5 V	0		32	MHz
		V <sub>CC1</sub> =3.0 to 5.5 V	0		24	MHz
f(XCIN)	Sub Clock Frequency		32.768	50	kHz	
f(Ring)	On-chip Oscillator Frequency (Topr=25° C)		0.5	1	2	MHz
f(PLL)	PLL Clock Frequency	V <sub>CC1</sub> =4.2 to 5.5 V	10		32	MHz
		V <sub>CC1</sub> =3.0 to 5.5 V	10		24	MHz
tsu(PLL)	Wait Time to Stabilize PLL Frequency Synthesizer	V <sub>CC1</sub> =5.0 V			5	ms
		V <sub>CC1</sub> =3.3 V			10	ms

$V_{CC1}=V_{CC2}=5V$

**Table 5.3 Electrical Characteristics****( $V_{CC1}=V_{CC2}=4.2$  to  $5.5V$ ,  $V_{SS}=0V$  at  $T_{opr}=-20$  to  $85^{\circ}C$ ,  $f(BCLK)=32MHz$  unless otherwise specified)**

Symbol	Parameter		Condition	Standard			Unit	
				Min.	Typ.	Max.		
V <sub>OH</sub>	Output High ("H") Voltage	P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub>	I <sub>OH</sub> =-5mA	V <sub>CC2</sub> -2.0		V <sub>CC2</sub>	V	
		P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>2</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>4</sub> , P8 <sub>6</sub> , P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub>	I <sub>OH</sub> =-5mA	V <sub>CC1</sub> -2.0		V <sub>CC1</sub>		
		P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub>	I <sub>OH</sub> =-200μA	V <sub>CC2</sub> -0.3		V <sub>CC2</sub>	V	
		P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>2</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>4</sub> , P8 <sub>6</sub> , P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub>	I <sub>OH</sub> =-200μA	V <sub>CC1</sub> -0.3		V <sub>CC1</sub>		
		X <sub>OUT</sub>	I <sub>OH</sub> =-1mA	3.0		V <sub>CC1</sub>	V	
		X <sub>COUT</sub>	High Power	No load applied		2.5		V
		Low Power	No load applied		1.6			
V <sub>OL</sub>	Output Low ("L") Voltage	P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub> , P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>0</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>4</sub> , P8 <sub>6</sub> , P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub>	I <sub>OL</sub> =5mA			2.0	V	
		P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub> , P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>0</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>4</sub> , P8 <sub>6</sub> , P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub>	I <sub>OL</sub> =200μA			0.45	V	
		X <sub>OUT</sub>	I <sub>OL</sub> =1mA			2.0	V	
		X <sub>COUT</sub>	High Power	No load applied		0		V
			Low Power	No load applied		0		
V <sub>T+</sub> -V <sub>T-</sub>	Hysteresis	HOLD, RDY, TA0 <sub>IN</sub> -TA4 <sub>IN</sub> , TB0 <sub>IN</sub> -TB5 <sub>IN</sub> , INT0-INT5, AD <sub>TRG</sub> , CTS0-CTS4, CLK0-CLK4, TA0 <sub>OUT</sub> -TA4 <sub>OUT</sub> , NMI, K10-K13, RxD0-RxD4, SCL0-SCL4, SDA0-SDA4		0.2		1.0	V	
		RESET		0.2		1.8	V	
I <sub>IH</sub>	Input High ("H") Current	P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub> , P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>0</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub> , X <sub>IN</sub> , RESET, CNV <sub>SS</sub> , BYTE	V <sub>I</sub> =5V			5.0	μA	
I <sub>IL</sub>	Input Low ("L") Current	P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub> , P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>0</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub> , X <sub>IN</sub> , RESET, CNV <sub>SS</sub> , BYTE	V <sub>I</sub> =0V			-5.0	μA	
R <sub>PULLUP</sub>	Pull-up Resistance	P0 <sub>0</sub> -P0 <sub>7</sub> , P1 <sub>0</sub> -P1 <sub>7</sub> , P2 <sub>0</sub> -P2 <sub>7</sub> , P3 <sub>0</sub> -P3 <sub>7</sub> , P4 <sub>0</sub> -P4 <sub>7</sub> , P5 <sub>0</sub> -P5 <sub>7</sub> , P6 <sub>0</sub> -P6 <sub>7</sub> , P7 <sub>2</sub> -P7 <sub>7</sub> , P8 <sub>0</sub> -P8 <sub>4</sub> , P8 <sub>6</sub> , P8 <sub>7</sub> , P9 <sub>0</sub> -P9 <sub>7</sub> , P10 <sub>0</sub> -P10 <sub>7</sub>	V <sub>I</sub> =0V	20	40	167	kΩ	
R <sub>fXIN</sub>	Feedback Resistance	X <sub>IN</sub>			1.5		MΩ	
R <sub>fXCIN</sub>	Feedback Resistance	X <sub>CIN</sub>			15		MΩ	
V <sub>RAM</sub>	RAM Standby Voltage	In stop mode		2.0			V	
I <sub>CC</sub>	Power Supply Current	In single-chip mode, output pins are left open and other pins are connected to V <sub>SS</sub> .	f(BCLK)=32 MHz, Square wave, No division		22	60	mA	
			f(BCLK)=32 kHz, In wait mode, T <sub>opr</sub> =25° C		10		μA	
			While clock stops, T <sub>opr</sub> =25° C		0.8	5	μA	
			While clock stops, T <sub>opr</sub> =85° C			20	μA	

$$V_{CC1}=V_{CC2}=5V$$

**Table 5.4 A/D Conversion Characteristics ( $V_{CC1}=V_{CC2}=AV_{CC}=V_{REF}=4.2$  to  $5.5V$ ,  $V_{SS}=AV_{SS}=0V$  at  $T_{opr}=-20$  to  $85^{\circ}C$ ,  $f(BCLK) = 32MHz$  unless otherwise specified)**

Symbol	Parameter	Measurement Condition	Standard			Unit	
			Min.	Typ.	Max.		
-	Resolution	$V_{REF}=V_{CC1}$			10	Bits	
INL	Integral Nonlinearity Error	$V_{REF}=V_{CC1}=V_{CC2}=5V$	AN <sub>0</sub> to AN <sub>7</sub> , ANEX <sub>0</sub> , ANEX <sub>1</sub>			±3	LSB
							LSB
		External op-amp connection mode			±7	LSB	
DNL	Differential Nonlinearity Error				±1	LSB	
-	Offset Error				±3	LSB	
-	Gain Error				±3	LSB	
RLADDER	Resistor Ladder	$V_{REF}=V_{CC1}$	8		40	kΩ	
t <sub>CONV</sub>	10-bit Conversion Time <sup>(1, 2)</sup>		2.06			μs	
t <sub>CONV</sub>	8-bit Conversion Time <sup>(1, 2)</sup>		1.75			μs	
t <sub>SAMP</sub>	Sampling Time <sup>(1)</sup>		0.188			μs	
V <sub>REF</sub>	Reference Voltage		2		V <sub>CC1</sub>	V	
V <sub>IA</sub>	Analog Input Voltage		0		V <sub>REF</sub>	V	

## NOTES:

1. Divide  $f(X_{IN})$ , if exceeding 16 MHz, to keep  $\phi_{AD}$  frequency at 16 MHz or less.
2. With using the sample and hold function.

**Table 5.5 D/A Conversion Characteristics ( $V_{CC1}=V_{CC2}=V_{REF}=4.2$  to  $5.5V$ ,  $V_{SS}=AV_{SS}=0V$  at  $T_{opr}=-20$  to  $85^{\circ}C$ ,  $f(BCLK) = 32MHz$  unless otherwise specified)**

Symbol	Parameter	Measurement Condition	Standard			Unit
			Min.	Typ.	Max.	
-	Resolution				8	Bits
-	Absolute Accuracy				1.0	%
t <sub>SU</sub>	Setup Time				3	μs
R <sub>O</sub>	Output Resistance		4	10	20	kΩ
I <sub>VREF</sub>	Reference Power Supply Input Current	(Note 1)			1.5	mA

## NOTE:

1. Measurement when using one D/A converter. The DA<sub>i</sub> register (i=0, 1) of the D/A converter, not being used, is set to "00<sub>16</sub>". The resistor ladder in the A/D converter is excluded.  
I<sub>VREF</sub> flows even if the VCUT bit in the AD0CON1 register is set to "0" (no V<sub>REF</sub> connection).

$$V_{CC1}=V_{CC2}=5V$$

### Timing Requirements

( $V_{CC1}=V_{CC2}=4.2$  to  $5.5V$ ,  $V_{SS}=0V$  at  $T_{opr}=-20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.6 External Clock Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_c$	External Clock Input Cycle Time	31.25		ns
$t_{w(H)}$	External Clock Input High ("H") Width	13.75		ns
$t_{w(L)}$	External Clock Input Low ("L") Width	13.75		ns
$t_r$	External Clock Rise Time		5	ns
$t_f$	External Clock Fall Time		5	ns

**Table 5.7 Memory Expansion Mode and Microprocessor Mode**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{ac1(RD-DB)}$	Data Input Access Time (RD standard)		(Note 1)	ns
$t_{ac1(AD-DB)}$	Data Input Access Time (AD standard, CS standard)		(Note 1)	ns
$t_{ac2(RD-DB)}$	Data Input Access Time (RD standard, when accessing a space with the multiplexrd bus)		(Note 1)	ns
$t_{ac2(AD-DB)}$	Data Input Access Time (AD standard, when accessing a space with the multiplexed bus)		(Note 1)	ns
$t_{su(DB-BCLK)}$	Data Input Setup Time	26		ns
$t_{su(RDY-BCLK)}$	$\overline{RDY}$ Input Setup Time	26		ns
$t_{su(HOLD-BCLK)}$	$\overline{HOLD}$ Input Setup Time	30		ns
$t_{h(RD-DB)}$	Data Input Hold Time	0		ns
$t_{h(BCLK-RDY)}$	$\overline{RDY}$ Input Hold Time	0		ns
$t_{h(BCLK-HOLD)}$	$\overline{HOLD}$ Input Hold Time	0		ns
$t_{d(BCLK-HLDA)}$	$\overline{HLDA}$ Output Delay Time		25	ns

**NOTE:**

1. Values can be obtained from the following equations, according to BCLK frequency and external bus cycles. Insert a wait state or lower the operation frequency,  $f_{(BCLK)}$ , if the calculated value is negative.

$$t_{ac1(RD-DB)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, m=(bx2)+1)$$

$$t_{ac1(AD-DB)} = \frac{10^9 \times n}{f_{(BCLK)}} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, n=a+b)$$

$$t_{ac2(RD-DB)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, m=(bx2)-1)$$

$$t_{ac2(AD-DB)} = \frac{10^9 \times p}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, p=\{(a+b-1)x2\}+1)$$

$V_{CC1}=V_{CC2}=5V$

**Timing Requirements****( $V_{CC1}=V_{CC2}=4.2$  to  $5.5V$ ,  $V_{SS}=0V$  at  $T_{op}=-20$  to  $85^{\circ}C$  unless otherwise specified)****Table 5.8 Timer A Input (Count Source Input in Event Counter Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TA)}$	TAiIN Input Cycle Time	100		ns
$t_{w(TAH)}$	TAiIN Input High ("H") Width	40		ns
$t_{w(TAL)}$	TAiIN Input Low ("L") Width	40		ns

**Table 5.9 Timer A Input (Gate Input in Timer Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TA)}$	TAiIN Input Cycle Time	400		ns
$t_{w(TAH)}$	TAiIN Input High ("H") Width	200		ns
$t_{w(TAL)}$	TAiIN Input Low ("L") Width	200		ns

**Table 5.10 Timer A Input (External Trigger Input in One-Shot Timer Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TA)}$	TAiIN Input Cycle Time	200		ns
$t_{w(TAH)}$	TAiIN Input High ("H") Width	100		ns
$t_{w(TAL)}$	TAiIN Input Low ("L") Width	100		ns

**Table 5.11 Timer A Input (External Trigger Input in Pulse Width Modulation Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{w(TAH)}$	TAiIN Input High ("H") Width	100		ns
$t_{w(TAL)}$	TAiIN Input Low ("L") Width	100		ns

**Table 5.12 Timer A Input (Counter Increment/Decrement Input in Event Counter Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(UP)}$	TAiOUT Input Cycle Time	2000		ns
$t_{w(UPH)}$	TAiOUT Input High ("H") Width	1000		ns
$t_{w(UPL)}$	TAiOUT Input Low ("L") Width	1000		ns
$t_{su(UP-TIN)}$	TAiOUT Input Setup Time	400		ns
$t_{h(TIN-UP)}$	TAiOUT Input Hold Time	400		ns

$$V_{CC1}=V_{CC2}=5V$$

### Timing Requirements

( $V_{CC1} = V_{CC2} = 4.2$  to  $5.5V$ ,  $V_{SS} = 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.13 Timer B Input (Count Source Input in Event Counter Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time (counted on one edge)	100		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width (counted on one edge)	40		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width (counted on one edge)	40		ns
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time (counted on both edges)	200		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width (counted on both edges)	80		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width (counted on both edges)	80		ns

**Table 5.14 Timer B Input (Pulse Period Measurement Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time	400		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width	200		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width	200		ns

**Table 5.15 Timer B Input (Pulse Width Measurement Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time	400		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width	200		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width	200		ns

**Table 5.16 A/D Trigger Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(AD)}$	AD <sub>TRG</sub> Input Cycle Time (required for trigger)	1000		ns
$t_{w(ADL)}$	AD <sub>TRG</sub> Input Low ("L") Width	125		ns

**Table 5.17 Serial I/O**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(CK)}$	CLK <sub>i</sub> Input Cycle Time	200		ns
$t_{w(CKH)}$	CLK <sub>i</sub> Input High ("H") Width	100		ns
$t_{w(CKL)}$	CLK <sub>i</sub> Input Low ("L") Width	100		ns
$t_{d(C-Q)}$	TxD <sub>i</sub> Output Delay Time		80	ns
$t_{h(C-Q)}$	TxD <sub>i</sub> Hold Time	0		ns
$t_{su(D-C)}$	RxD <sub>i</sub> Input Setup Time	30		ns
$t_{h(C-Q)}$	RxD <sub>i</sub> Input Hold Time	90		ns

**Table 5.18 External Interrupt INT<sub>i</sub> Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{w(INH)}$	INT <sub>i</sub> Input High ("H") Width	250		ns
$t_{w(INL)}$	INT <sub>i</sub> Input Low ("L") Width	250		ns

$$V_{CC1}=V_{CC2}=5V$$

### Switching Characteristics

( $V_{CC1} = V_{CC2} = 4.2$  to  $5.5V$ ,  $V_{SS} = 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.19 Memory Expansion Mode and Microprocessor Mode  
(when accessing external memory space)**

Symbol	Parameter	Measurement Condition	Standard		Unit
			Min.	Max.	
$t_{d(BCLK-AD)}$	Address Output Delay Time	See Figure 5.1		18	ns
$t_{h(BCLK-AD)}$	Address Output Hold Time (BCLK standard)		-3		ns
$t_{h(RD-AD)}$	Address Output Hold Time (RD standard)		0		ns
$t_{h(WR-AD)}$	Address Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-CS)}$	Chip-Select Signal Output Delay Time			18	ns
$t_{h(BCLK-CS)}$	Chip-Select Signal Output Hold Time (BCLK standard)		-3		ns
$t_{h(RD-CS)}$	Chip-Select Signal Output Hold Time (RD standard)		0		ns
$t_{h(WR-CS)}$	Chip-Select Signal Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-RD)}$	RD Signal Output Delay Time			18	ns
$t_{h(BCLK-RD)}$	RD Signal Output Hold Time		-5		ns
$t_{d(BCLK-WR)}$	WR Signal Output Delay Time			18	ns
$t_{h(BCLK-WR)}$	WR Signal Output Hold Time		-5		ns
$t_{d(DB-WR)}$	Data Output Delay Time (WR standard)		(Note 2)		ns
$t_{h(WR-DB)}$	Data Output Hold Time (WR standard)		(Note 1)		ns
$t_{w(WR)}$	WR Output Width		(Note 2)		ns

#### NOTES:

1. Values can be obtained from the following equations, according to BCLK frequency.

$$t_{h(WR-DB)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(WR-AD)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(WR-CS)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

2. Values can be obtained from the following equations, according to BCLK frequency and external bus cycles.

$$t_{w(WR)} = \frac{10^9 \times n}{f_{(BCLK)} \times 2} - 15 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n=(bx2)-1)$$

$$t_{d(DB-WR)} = \frac{10^9 \times m}{f_{(BCLK)}} - 20 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, m= b)$$



$$V_{CC1}=V_{CC2}=5V$$

### Switching Characteristics

( $V_{CC} = 4.2$  to  $5.5V$ ,  $V_{SS} = 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.20 Memory Expansion Mode and Microprocessor Mode**  
(when accessing an external memory space with the multiplexed bus)

Symbol	Parameter	Measurement Condition	Standard		Unit
			Min.	Max.	
$t_{d(BCLK-AD)}$	Address Output Delay Time	See Figure 5.1		18	ns
$t_{h(BCLK-AD)}$	Address Output Hold Time (BCLK standard)		-3		ns
$t_{h(RD-AD)}$	Address Output Hold Time (RD standard)		(Note 1)		ns
$t_{h(WR-AD)}$	Address Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-CS)}$	Chip-Select Signal Output Delay Time			18	ns
$t_{h(BCLK-CS)}$	Chip-Select Signal Output Hold Time (BCLK standard)		-3		ns
$t_{h(RD-CS)}$	Chip-Select Signal Output Hold Time (RD standard)		(Note 1)		ns
$t_{h(WR-CS)}$	Chip-Select Signal Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-RD)}$	RD Signal Output Delay Time			18	ns
$t_{h(BCLK-RD)}$	RD Signal Output Hold Time		-5		ns
$t_{d(BCLK-WR)}$	WR Signal Output Delay Time			18	ns
$t_{h(BCLK-WR)}$	WR Signal Output Hold Time		-5		ns
$t_{d(DB-WR)}$	Data Output Delay Time (WR standard)		(Note 2)		ns
$t_{h(WR-DB)}$	Data Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-ALE)}$	ALE Signal Output Delay Time (BCLK standard)			18	ns
$t_{h(BCLK-ALE)}$	ALE Signal Output Hold Time (BCLK standard)		-5		ns
$t_{d(AD-ALE)}$	ALE Signal Output Delay Time (address standard)		(Note 3)		ns
$t_{h(ALE-AD)}$	ALE Signal Output Hold Time (address standard)		(Note 4)		ns
$t_{dZ(RD-AD)}$	Address Output Float Start Time			8	ns

#### NOTES:

1. Values can be obtained from the following equations, according to BCLK frequency.

$$t_{h(RD-AD)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(WR-AD)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(RD-CS)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(WR-CS)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(WR-DB)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

2. Values can be obtained from the following equations, according to BCLK frequency and external bus cycle.

$$t_{d(DB-WR)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 25 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, m = (bx2)-1)$$

3. Values can be obtained from the following equations, according to BCLK frequency and external bus cycle.

$$t_{d(AD-ALE)} = \frac{10^9 \times n}{f_{(BCLK)} \times 2} - 20 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n = a)$$

4. Values can be obtained from the following equations, according to BCLK frequency and external bus cycle.

$$t_{h(ALE-AD)} = \frac{10^9 \times n}{f_{(BCLK)} \times 2} - 10 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n = a)$$

$$V_{CC1}=V_{CC2}=5V$$

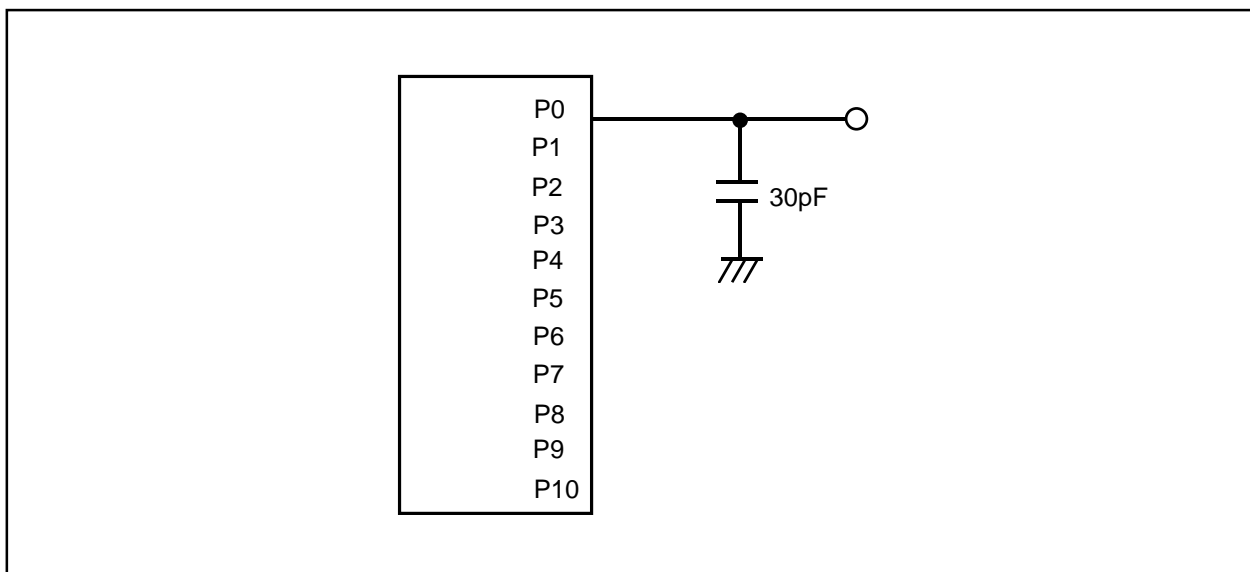


Figure 5.1 P0 to P10 Measurement Circuit

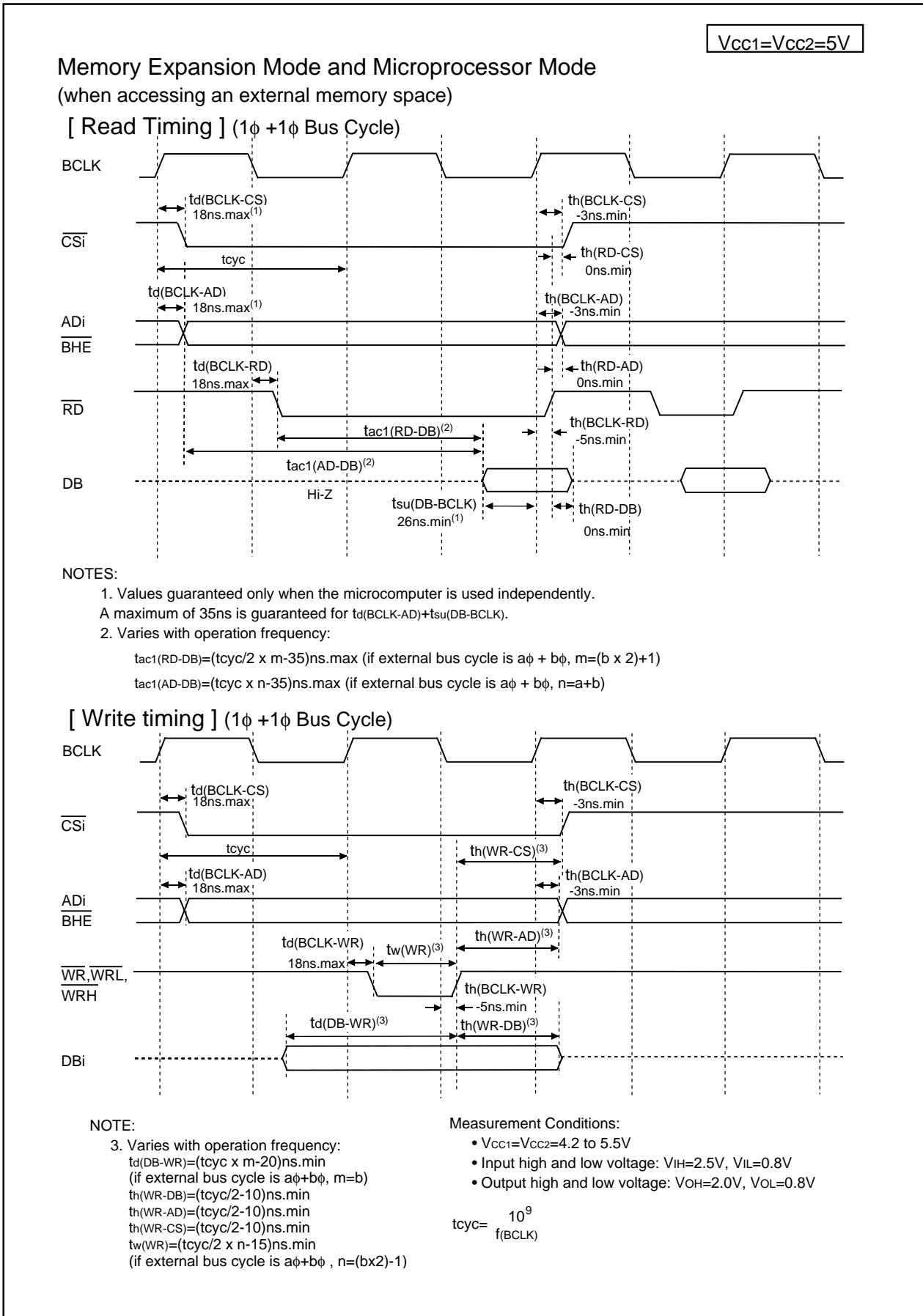
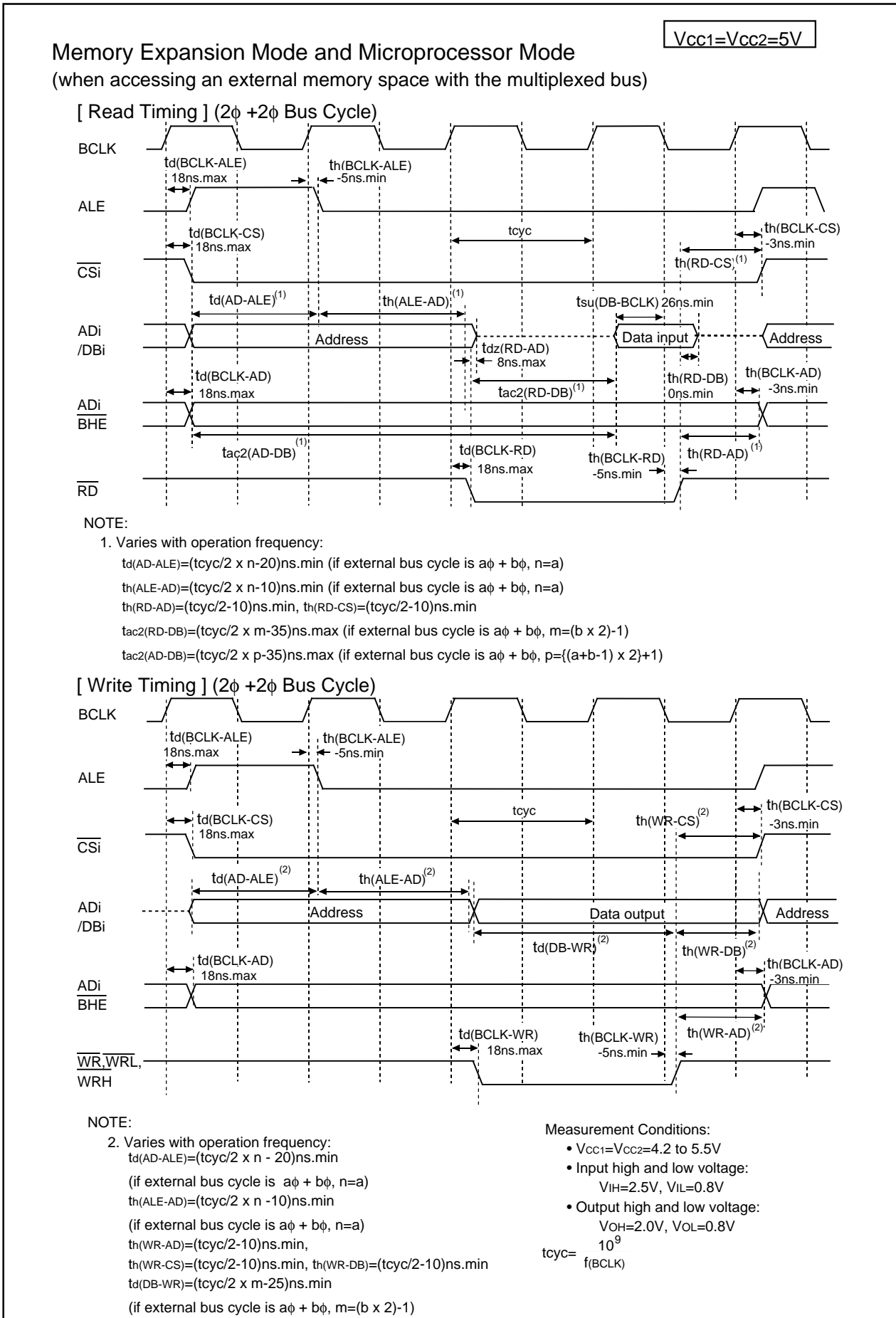


Figure 5.2 V<sub>CC1</sub>=V<sub>CC2</sub>=5V Timing Diagram (1)



**Figure 5.3 V<sub>CC1</sub>=V<sub>CC2</sub>=5V Timing Diagram (2)**

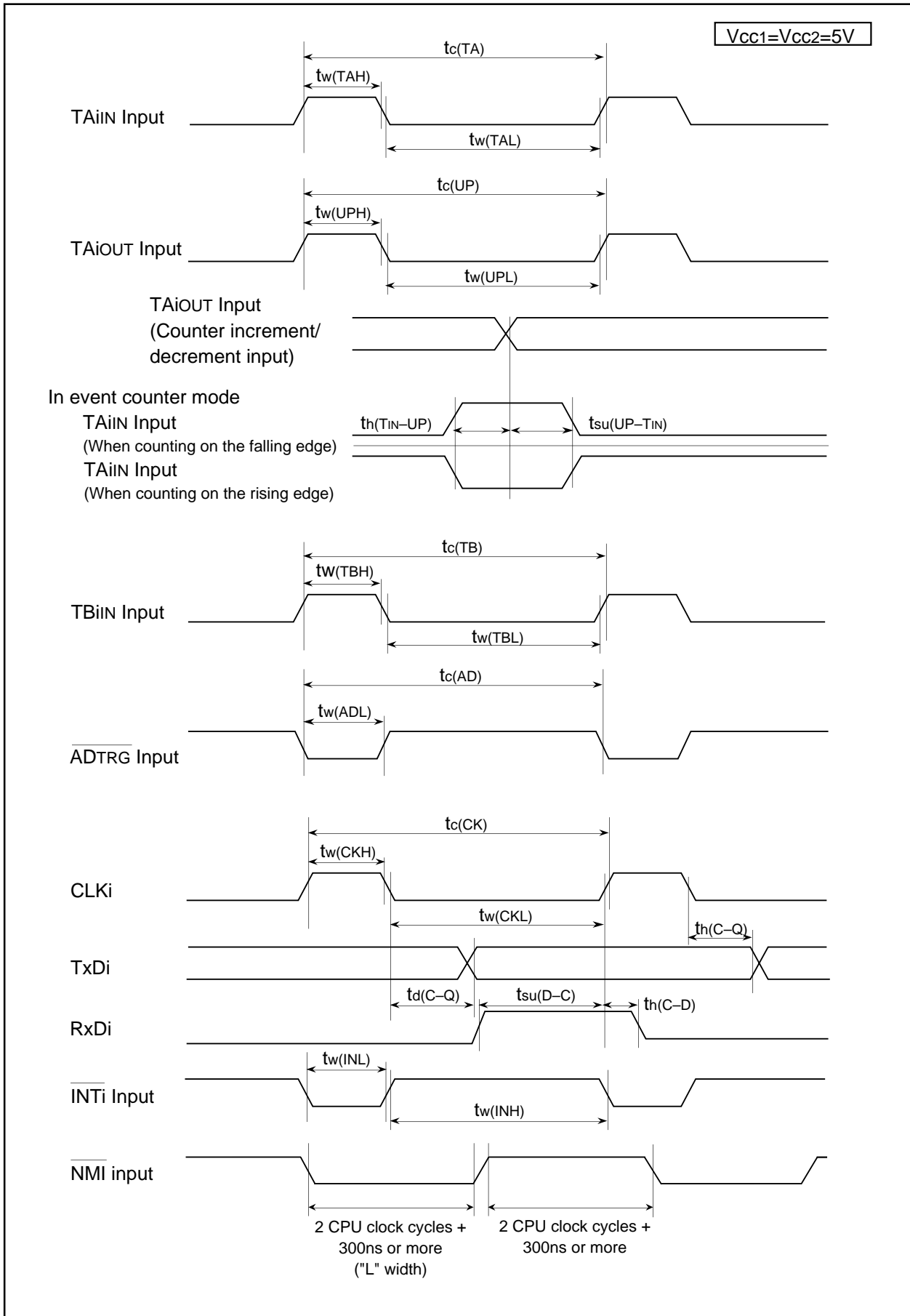


Figure 5.4 VCC1=VCC2=5V Timing Diagram (3)

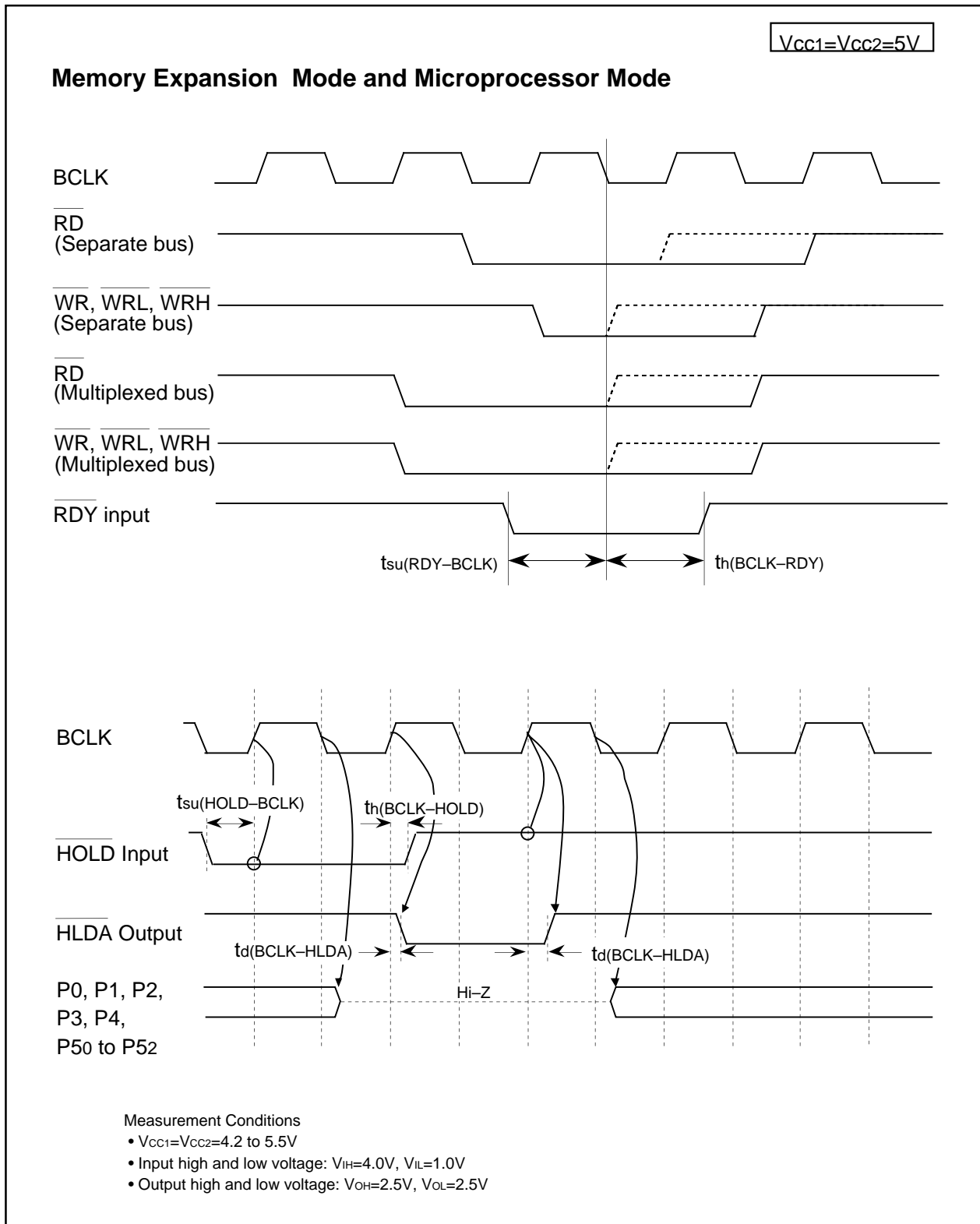


Figure 5.5  $V_{CC1}=V_{CC2}=5V$  Timing Diagram (4)

$$V_{CC1}=V_{CC2}=3.3V$$

**Table 5.21 Electrical Characteristics ( $V_{CC1}=V_{CC2}=3.0$  to  $3.6V$ ,  $V_{SS}=0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$ ,  
 $f(BCLK)=24MHz$  unless otherwise specified)**

Symbol	Parameter		Condition	Standard			Unit
				Min.	Typ.	Max.	
V <sub>OH</sub>	Output High ("H") Voltage	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57	I <sub>OH</sub> =-1mA	V <sub>CC2</sub> -0.6		V <sub>CC2</sub>	V
		P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107		V <sub>CC1</sub> -0.6		V <sub>CC1</sub>	V
	X <sub>OUT</sub>	I <sub>OH</sub> =-0.1mA	2.7		V <sub>CC1</sub>	V	
	X <sub>COUT</sub>	High Power	No load applied		2.5		V
		Low Power	No load applied		1.6		V
V <sub>OL</sub>	Output Low ("L") Voltage	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107	I <sub>OL</sub> =1mA			0.5	V
		X <sub>OUT</sub>	I <sub>OL</sub> =0.1mA			0.5	V
	X <sub>COUT</sub>	High Power	No load applied		0		V
		Low Power	No load applied		0		V
	V <sub>T+</sub> -V <sub>T-</sub>	Hysteresis	HOLD, RDY, TA0 <sub>IN</sub> -TA4 <sub>IN</sub> , TB0 <sub>IN</sub> -TB5 <sub>IN</sub> , INT0-INT5, AD <sub>TRG</sub> , CTS0-CTS4, CLK0-CLK4, TA0 <sub>OUT</sub> -TA4 <sub>OUT</sub> , NMI, KI0-KI3, RxD0-RxD4, SCL0-SCL4, SDA0-SDA4		0.2		1.0
RESET				0.2		1.8	V
I <sub>IH</sub>	Input High ("H") Current	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P87, P90-P97, P100-P107, X <sub>IN</sub> , RESET, CNV <sub>SS</sub> , BYTE	V <sub>I</sub> =3V			4.0	μA
I <sub>IL</sub>	Input Low ("L") Current	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P87, P90-P97, P100-P107, X <sub>IN</sub> , RESET, CNV <sub>SS</sub> , BYTE	V <sub>I</sub> =0V			-4.0	μA
R <sub>PULLUP</sub>	Pull-up Resistance	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107	V <sub>I</sub> =0V	40	70	500	kΩ
R <sub>fXIN</sub>	Feedback Resistance	X <sub>IN</sub>			3.0		MΩ
R <sub>fXCIN</sub>	Feedback Resistance	X <sub>CIN</sub>			30.0		MΩ
V <sub>RAM</sub>	RAM Standby Voltage	in stop mode		2.0			V
I <sub>CC</sub>	Power Supply Current	Measurement condition: In single-chip mode, output pins are left open and other pins are connected to V <sub>SS</sub> .	f(BCLK)=24 MHz, Square wave, No division		17	35	mA
			f(BCLK)=32 kHz, In wait mode, T <sub>opr</sub> =25° C		10		μA
			While clock stops, T <sub>opr</sub> =25° C		0.8	5	μA
			While clock stops, T <sub>opr</sub> =85° C			50	μA

$$V_{CC1}=V_{CC2}=3.3V$$

**Table 5.22 A/D Conversion Characteristics ( $V_{CC1}=V_{CC2}=AV_{CC}=V_{REF}=3.0$  to  $3.6V$ ,  $V_{SS}=AV_{SS}=0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$ ,  $f(BCLK) = 24MHz$  unless otherwise specified)**

Symbol	Parameter		Measurement Condition	Standard			Unit
				Min.	Typ.	Max.	
-	Resolution		$V_{REF}=V_{CC1}$			10	Bits
INL	Integral Nonlinearity Error	No S&H (8-bit)	$V_{CC1}=V_{CC2}=V_{REF}=3.3V$			$\pm 2$	LSB
DNL	Differential Nonlinearity Error	No S&H (8-bit)				$\pm 1$	LSB
-	Offset Error	No S&H (8-bit)				$\pm 2$	LSB
-	Gain Error	No S&H (8-bit)				$\pm 2$	LSB
RLADDER	Resistor Ladder		$V_{REF}=V_{CC1}$	8.0		40	k $\Omega$
tCONV	8-bit Conversion Time <sup>(1, 2)</sup>			6.1			$\mu s$
VREF	Reference Voltage			3.3		$V_{CC1}$	V
VIA	Analog Input Voltage			0		$V_{REF}$	V

S&amp;H: Sample and Hold

## NOTES:

1. Divide  $f(X_{IN})$ , if exceeding 10 MHz, to keep  $\phi AD$  frequency at 10 MHz or less.
2. S&H not available.

**Table 5.23 D/A Conversion Characteristics ( $V_{CC1}=V_{CC2}=V_{REF}=3.0$  to  $3.6V$ ,  $V_{SS}=AV_{SS}=0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$ ,  $f(BCLK) = 24MHz$  unless otherwise specified)**

Symbol	Parameter		Measurement Condition	Standard			Unit
				Min.	Typ.	Max.	
-	Resolution					8	Bits
-	Absolute Accuracy					1.0	%
tsu	Setup Time					3	$\mu s$
Ro	Output Resistance			4	10	20	k $\Omega$
I <sub>VREF</sub>	Reference Power Supply Input Current		(Note 1)			1.0	mA

## NOTE:

1. Measurement results when using one D/A converter. The DA<sub>i</sub> register (i=0, 1) of the D/A converter, not being used, is set to "00<sub>16</sub>". The resistor ladder in the A/D converter is excluded.  
I<sub>VREF</sub> flows even if the VCUT bit in the AD0CON1 register is set to "0" (no V<sub>REF</sub> connection).



$$V_{CC1}=V_{CC2}=3.3V$$

### Timing Requirements

( $V_{CC1}=V_{CC2}= 3.0$  to  $3.6V$ ,  $V_{SS} = 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.24 External Clock Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
t <sub>c</sub>	External Clock Input Cycle Time	41		ns
t <sub>w(H)</sub>	External Clock Input High ("H") Width	18		ns
t <sub>w(L)</sub>	External Clock Input Low ("L") Width	18		ns
t <sub>r</sub>	External Clock Rise Time		5	ns
t <sub>f</sub>	External Clock Fall Time		5	ns

**Table 5.25 Memory Expansion Mode and Microprocessor Mode**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
t <sub>ac1(RD-DB)</sub>	Data Input Access Time (RD standard)		(Note 1)	ns
t <sub>ac1(AD-DB)</sub>	Data Input Access Time (AD standard, CS standard)		(Note 1)	ns
t <sub>ac2(RD-DB)</sub>	Data Input Access Time (RD standard, when accessing a space with the multiplexed bus)		(Note 1)	ns
t <sub>ac2(AD-DB)</sub>	Data Input Access Time (AD standard, when accessing a space with the multiplexed bus)		(Note 1)	ns
t <sub>su(DB-BCLK)</sub>	Data Input Setup Time	30		ns
t <sub>su(RDY-BCLK)</sub>	$\overline{RDY}$ Input Setup Time	40		ns
t <sub>su(HOLD-BCLK)</sub>	HOLD Input Setup Time	60		ns
t <sub>h(RD-DB)</sub>	Data Input Hold Time	0		ns
t <sub>h(BCLK-RDY)</sub>	$\overline{RDY}$ Input Hold Time	0		ns
t <sub>h(BCLK-HOLD)</sub>	HOLD Input Hold Time	0		ns
t <sub>d(BCLK-HLDA)</sub>	HLDA Output Delay Time		25	ns

**NOTE:**

1. Values can be obtained from the following equations, according to BCLK frequency and external bus cycles. Insert a wait state or lower the operation frequency,  $f_{(BCLK)}$ , if the calculated value is negative.

$$t_{ac1(RD-DB)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, m=(bx2)+1)$$

$$t_{ac1(AD-DB)} = \frac{10^9 \times n}{f_{(BCLK)}} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, n=a+b)$$

$$t_{ac2(RD-DB)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, m=(bx2)-1)$$

$$t_{ac2(AD-DB)} = \frac{10^9 \times p}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, p=((a+b-1)x2)+1)$$

$$V_{CC1}=V_{CC2}=3.3V$$

### Timing Requirements

( $V_{CC1}=V_{CC2}= 3.0$  to  $3.6V$ ,  $V_{SS}= 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.26 Timer A Input (Count Source Input in Event Counter Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TA)}$	TAiIN Input Cycle Time	100		ns
$t_{W(TAH)}$	TAiIN Input High ("H") Width	40		ns
$t_{W(TAL)}$	TAiIN Input Low ("L") Width	40		ns

**Table 5.27 Timer A Input (Gate Input in Timer Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TA)}$	TAiIN Input Cycle Time	400		ns
$t_{W(TAH)}$	TAiIN Input High ("H") Width	200		ns
$t_{W(TAL)}$	TAiIN Input Low ("L") Width	200		ns

**Table 5.28 Timer A Input (External Trigger Input in One-Shot Timer Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TA)}$	TAiIN Input Cycle Time	200		ns
$t_{W(TAH)}$	TAiIN Input High ("H") Width	100		ns
$t_{W(TAL)}$	TAiIN Input Low ("L") Width	100		ns

**Table 5.29 Timer A Input (External Trigger Input in Pulse Width Modulation Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{W(TAH)}$	TAiIN Input High ("H") Width	100		ns
$t_{W(TAL)}$	TAiIN Input Low ("L") Width	100		ns

**Table 5.30 Timer A Input (Counter Increment/decrement Input in Event Counter Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(UP)}$	TAiOUT Input Cycle Time	2000		ns
$t_{W(UPH)}$	TAiOUT Input High ("H") Width	1000		ns
$t_{W(UPL)}$	TAiOUT Input Low ("L") Width	1000		ns
$t_{SU(UP-TIN)}$	TAiOUT Input Setup Time	400		ns
$t_{H(TIN-UP)}$	TAiOUT Input Hold Time	400		ns

$$V_{CC1}=V_{CC2}=3.3V$$

### Timing Requirements

( $V_{CC1}=V_{CC2}=3.0$  to  $3.6V$ ,  $V_{SS}=0V$  at  $T_{opr}=-20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.31 Timer B Input (Count Source Input in Event Counter Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time (counted on one edge)	100		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width (counted on one edge)	40		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width (counted on one edge)	40		ns
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time (counted on both edges)	200		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width (counted on both edges)	80		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width (counted on both edges)	80		ns

**Table 5.32 Timer B Input (Pulse Period Measurement Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time	400		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width	200		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width	200		ns

**Table 5.33 Timer B Input (Pulse Width Measurement Mode)**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(TB)}$	TB <sub>iIN</sub> Input Cycle Time	400		ns
$t_{w(TBH)}$	TB <sub>iIN</sub> Input High ("H") Width	200		ns
$t_{w(TBL)}$	TB <sub>iIN</sub> Input Low ("L") Width	200		ns

**Table 5.34 A/D Trigger Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(AD)}$	$\overline{AD}_{TRG}$ Input Cycle Time (required for trigger)	1000		ns
$t_{w(ADL)}$	$\overline{AD}_{TRG}$ Input Low ("L") Width	125		ns

**Table 5.35 Serial I/O**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(CK)}$	CLK <sub>i</sub> Input Cycle Time	200		ns
$t_{w(CKH)}$	CLK <sub>i</sub> Input High ("H") Width	100		ns
$t_{w(CKL)}$	CLK <sub>i</sub> Input Low ("L") Width	100		ns
$t_{d(C-Q)}$	TxD <sub>i</sub> Output Delay Time		80	ns
$t_{h(C-Q)}$	TxD <sub>i</sub> Hold Time	0		ns
$t_{su(D-C)}$	RxD <sub>i</sub> Input Setup Time	30		ns
$t_{h(C-Q)}$	RxD <sub>i</sub> Input Hold Time	90		ns

**Table 5.36 External Interrupt  $\overline{INT}_i$  Input**

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{w(INH)}$	$\overline{INT}_i$ Input High ("H") Width	250		ns
$t_{w(INL)}$	$\overline{INT}_i$ Input Low ("L") Width	250		ns

$$V_{CC1}=V_{CC2}=3.3V$$

### Switching Characteristics

( $V_{CC1}=V_{CC2}=3.0$  to  $3.6V$ ,  $V_{SS} = 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.37 Memory Expansion Mode and Microprocessor Mode  
(when accessing external memory space)**

Symbol	Parameter	Measurement Condition	Standard		Unit
			Min.	Max.	
$t_{d(BCLK-AD)}$	Address Output Delay Time	See Figure 5.1		18	ns
$t_{h(BCLK-AD)}$	Address Output Hold Time (BCLK standard)		0		ns
$t_{h(RD-AD)}$	Address Output Hold Time (RD standard)		0		ns
$t_{h(WR-AD)}$	Address Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-CS)}$	Chip-Select Signal Output Delay Time			18	ns
$t_{h(BCLK-CS)}$	Chip-Select Signal Output Hold Time (BCLK standard)		0		ns
$t_{h(RD-CS)}$	Chip-Select Signal Output Hold Time (RD standard)		0		ns
$t_{h(WR-CS)}$	Chip-Select Signal Output Hold Time (WR standard)		(Note 1)		ns
$t_{d(BCLK-RD)}$	RD Signal Output Delay Time			18	ns
$t_{h(BCLK-RD)}$	RD Signal Output Hold Time		-3		ns
$t_{d(BCLK-WR)}$	WR Signal Output Delay Time			18	ns
$t_{h(BCLK-WR)}$	WR Signal Output Hold Time		0		ns
$t_{d(DB-WR)}$	Data Output Delay Time (WR standard)		(Note 2)		ns
$t_{h(WR-DB)}$	Data Output Hold Time (WR standard)		(Note 1)		ns
$t_{w(WR)}$	WR Output Width		(Note 2)		ns

#### NOTES:

1. Values can be obtained from the following equations, according to BCLK frequency.

$$t_{h(WR-DB)} = \frac{10^9}{f_{(BCLK)} \times 2} - 20 \quad [ns]$$

$$t_{h(WR-AD)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

$$t_{h(WR-CS)} = \frac{10^9}{f_{(BCLK)} \times 2} - 10 \quad [ns]$$

2. Values can be obtained from the following equations, according to BCLK frequency and external bus cycles.

$$t_{w(WR)} = \frac{10^9 \times n}{f_{(BCLK)} \times 2} - 15 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n=(b \times 2)-1)$$

$$t_{d(DB-WR)} = \frac{10^9 \times m}{f_{(BCLK)}} - 20 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, m=b)$$

$$V_{CC1}=V_{CC2}=3.3V$$

### Switching Characteristics

( $V_{CC1} = V_{CC2} = 3.0$  to  $3.6V$ ,  $V_{SS} = 0V$  at  $T_{opr} = -20$  to  $85^{\circ}C$  unless otherwise specified)

**Table 5.38 Memory Expansion Mode and Microprocessor Mode**  
(when accessing an external memory space with the multiplexed bus)

Symbol	Parameter	Measurement Condition	Standard		Unit
			Min.	Max.	
td(BCLK-AD)	Address Output Delay Time	See Figure 5.1		18	ns
th(BCLK-AD)	Address Output Hold Time (BCLK standard)		0		ns
th(RD-AD)	Address Output Hold Time (RD standard)		(Note 1)		ns
th(WR-AD)	Address Output Hold Time (WR standard)		(Note 1)		ns
td(BCLK-CS)	Chip-Select Signal Output Delay Time			18	ns
th(BCLK-CS)	Chip-Select Signal Output Hold Time (BCLK standard)		0		ns
th(RD-CS)	Chip-Select Signal Output Hold Time (RD standard)		(Note 1)		ns
th(WR-CS)	Chip-Select Signal Output Hold Time (WR standard)		(Note 1)		ns
td(BCLK-RD)	RD Signal Output Delay Time			18	ns
th(BCLK-RD)	RD Signal Output Hold Time		-3		ns
td(BCLK-WR)	WR Signal Output Delay Time			18	ns
th(BCLK-WR)	WR Signal Output Hold Time		0		ns
td(DB-WR)	Data Output delay Time (WR standard)		(Note 2)		ns
th(WR-DB)	Data Output Hold Time (WR standard)		(Note 1)		ns
td(BCLK-ALE)	ALE Signal Output Delay Time (BCLK standard)			18	ns
th(BCLK-ALE)	ALE Signal Output Hold Time (BCLK standard)		-2		ns
td(AD-ALE)	ALE Signal Output Delay Time (address standard)		(Note 3)		ns
th(ALE-AD)	ALE Signal Output Hold Time (address standard)		(Note 4)		ns
tdz(RD-AD)	Address Output Float Start Time			8	ns

#### NOTES:

1. Values can be obtained by the following equations, according to BCLK frequency.

$$th(RD - AD) = \frac{10^9}{f(BCLK) \times 2} - 10 \quad [ns]$$

$$th(WR - AD) = \frac{10^9}{f(BCLK) \times 2} - 10 \quad [ns]$$

$$th(RD - CS) = \frac{10^9}{f(BCLK) \times 2} - 10 \quad [ns]$$

$$th(WR - CS) = \frac{10^9}{f(BCLK) \times 2} - 10 \quad [ns]$$

$$th(WR - DB) = \frac{10^9}{f(BCLK) \times 2} - 20 \quad [ns]$$

2. Values can be obtained by the following equations, according to BCLK frequency and external bus cycles.

$$td(DB - WR) = \frac{10^9 \times m}{f(BCLK) \times 2} - 25 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, m=(b+2)-1)$$

3. Values can be obtained by the following equations, according to BCLK frequency and external bus cycles.

$$td(AD - ALE) = \frac{10^9 \times n}{f(BCLK) \times 2} - 20 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n=a)$$

4. Values can be obtained by the following equations, according to BCLK frequency and external bus cycles.

$$th(ALE - AD) = \frac{10^9 \times n}{f(BCLK) \times 2} - 10 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n=a)$$

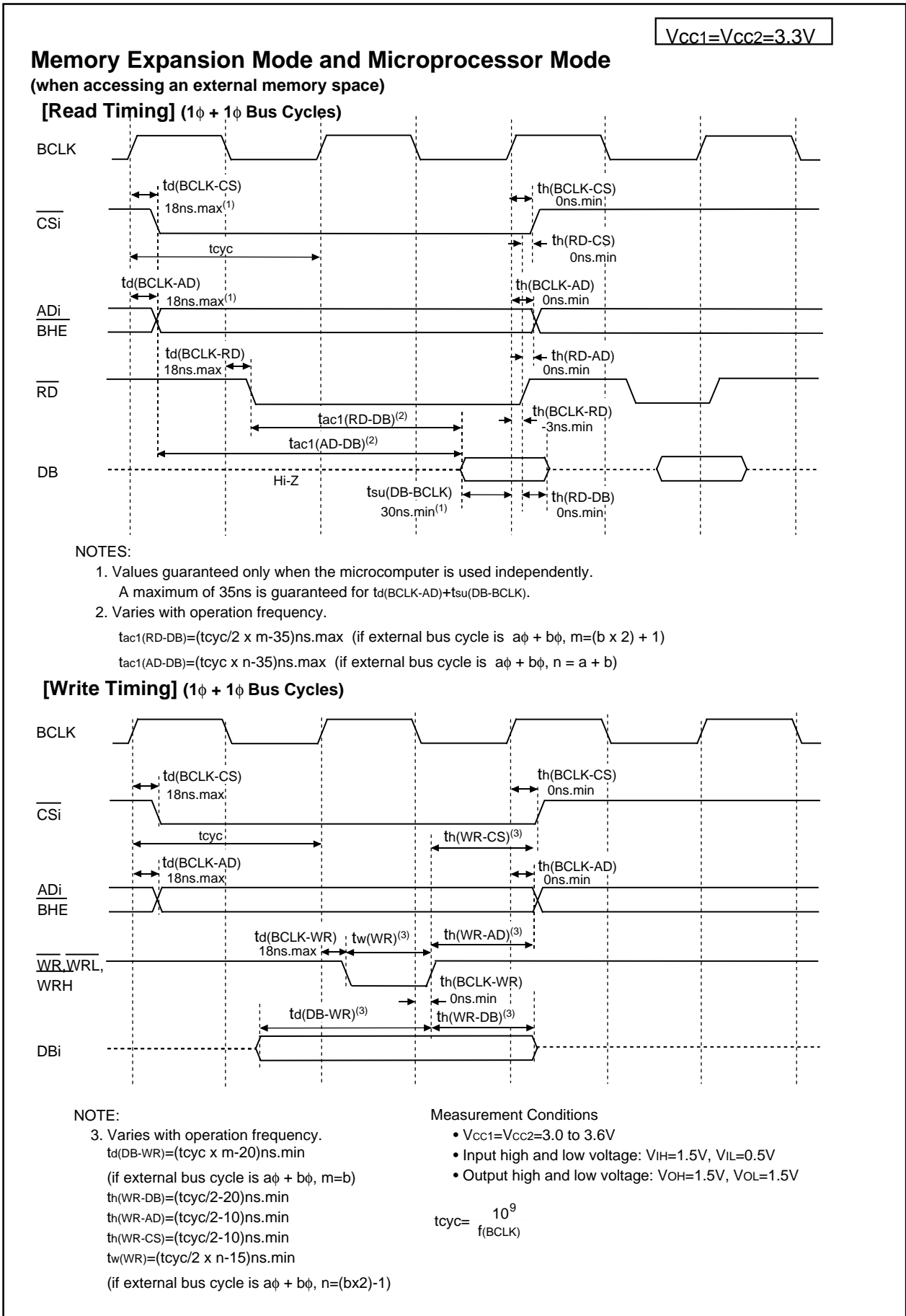


Figure 5.6  $V_{CC1}=V_{CC2}=3.3V$  Timing Diagram (1)

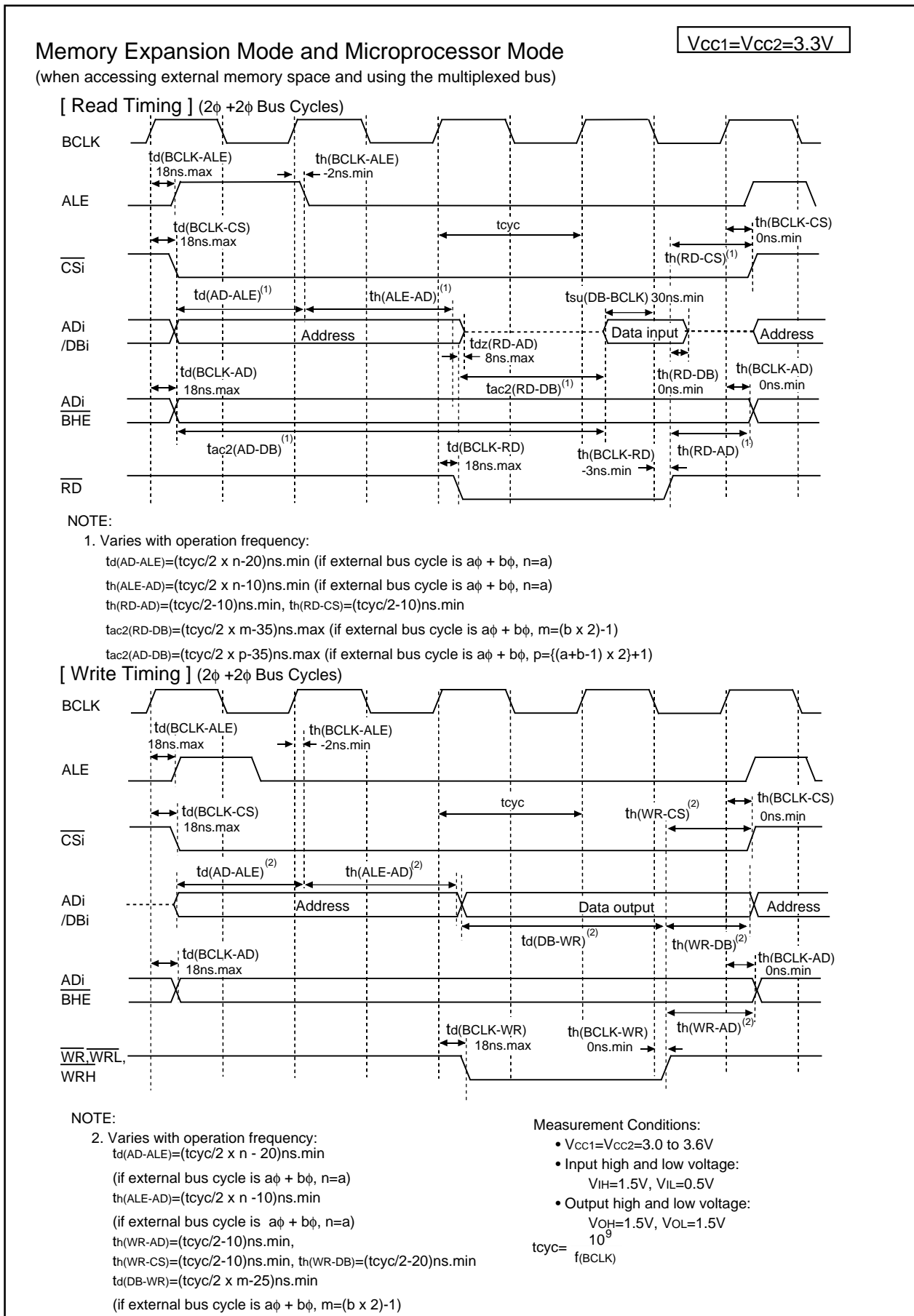


Figure 5.7 V<sub>CC1</sub>=V<sub>CC2</sub>=3.3V Timing Diagram (2)

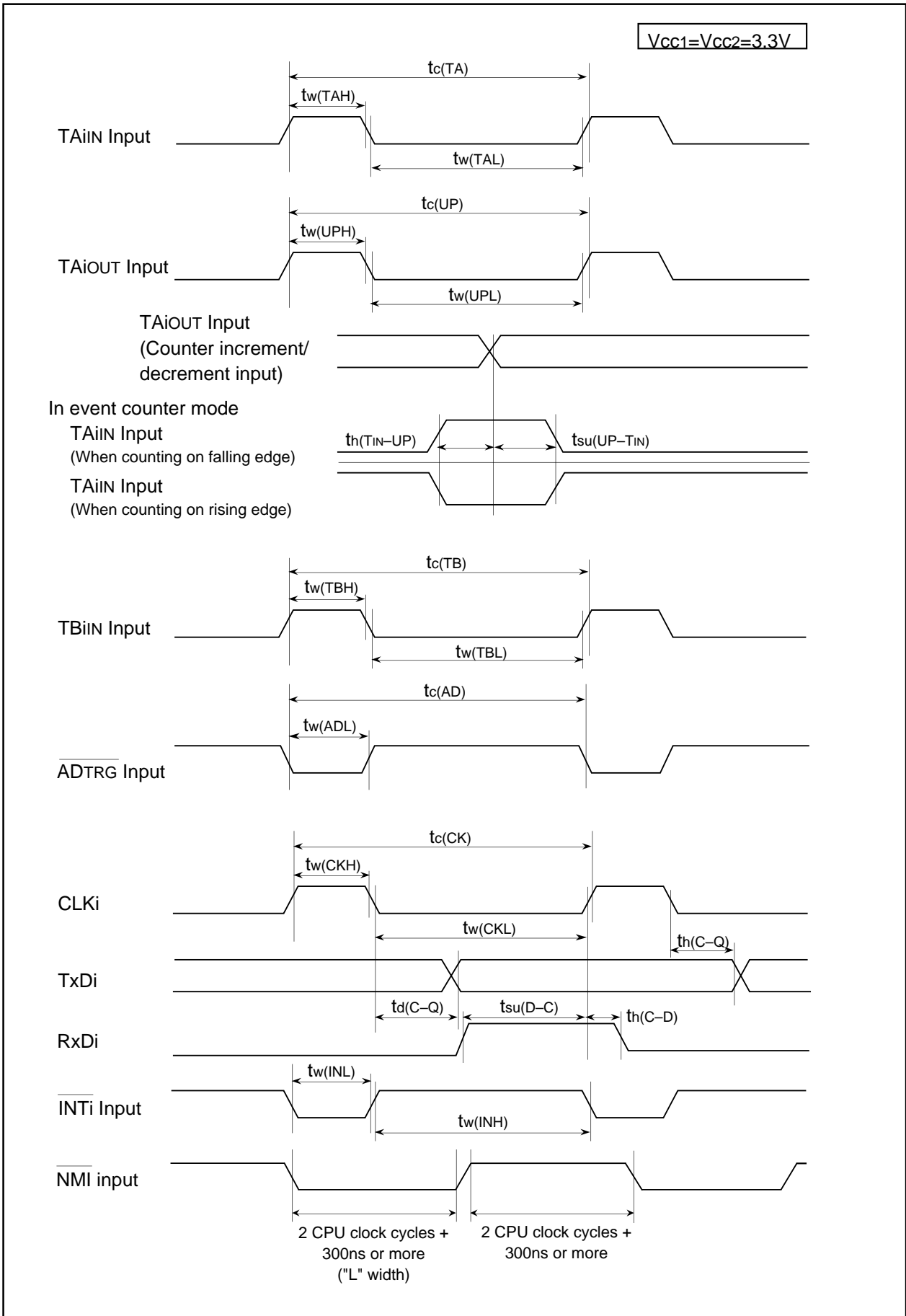
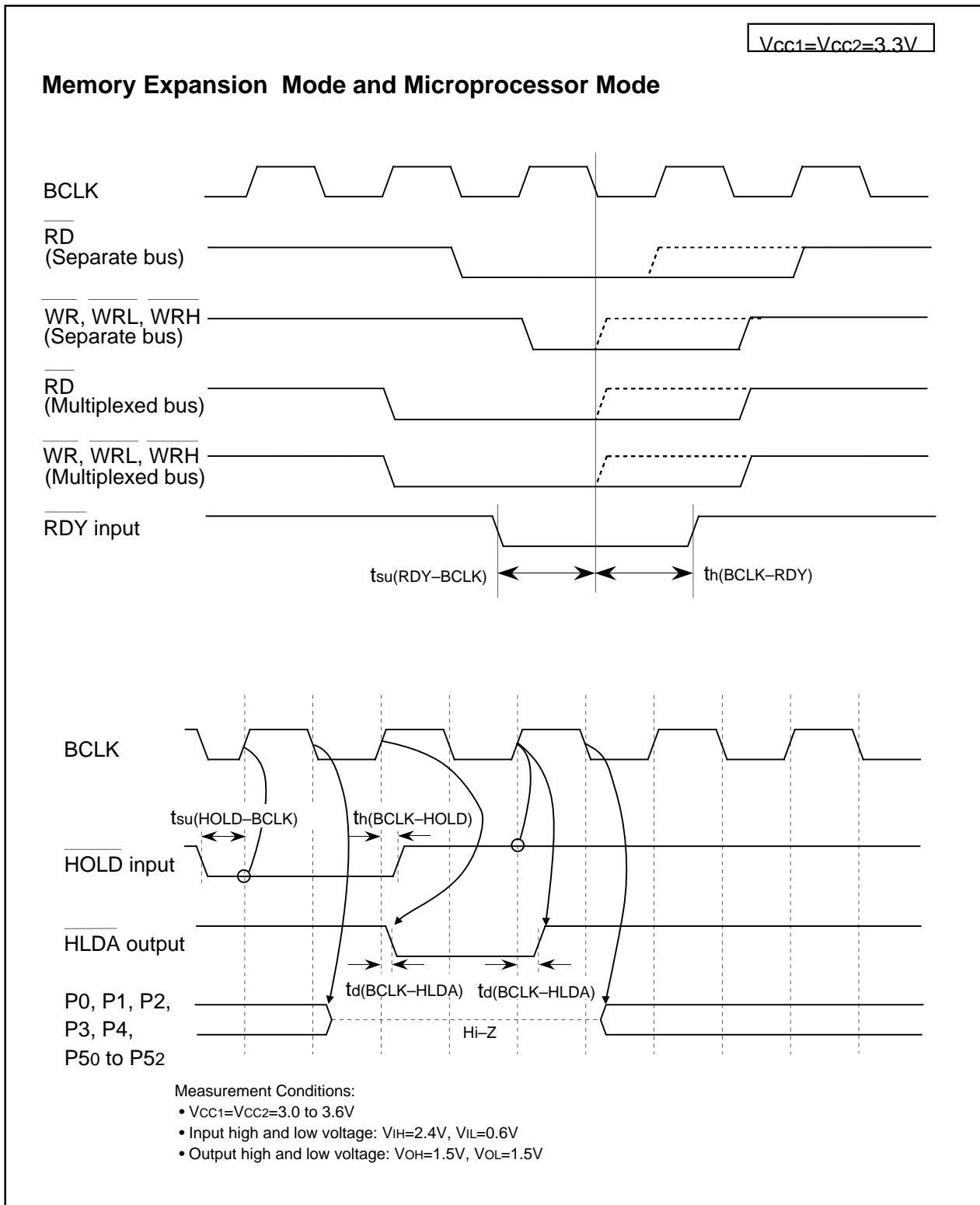


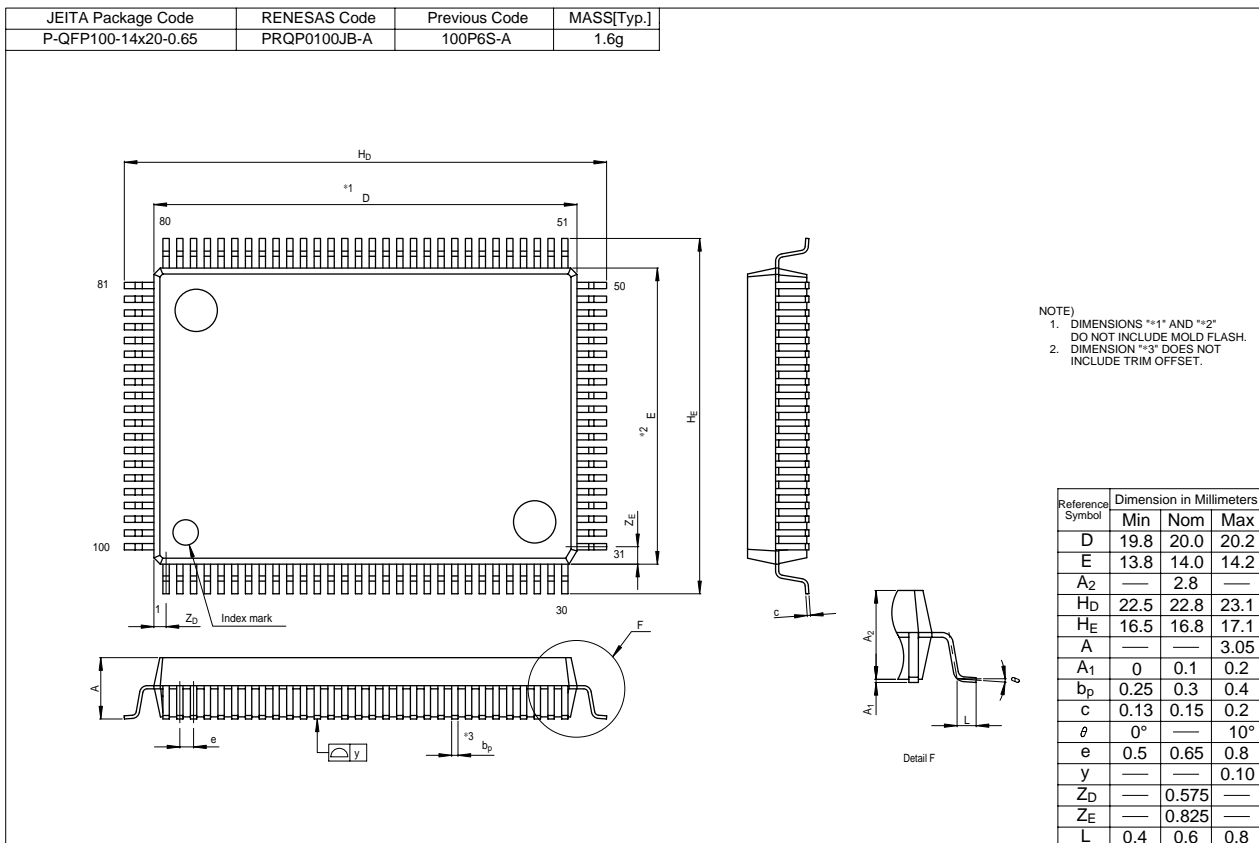
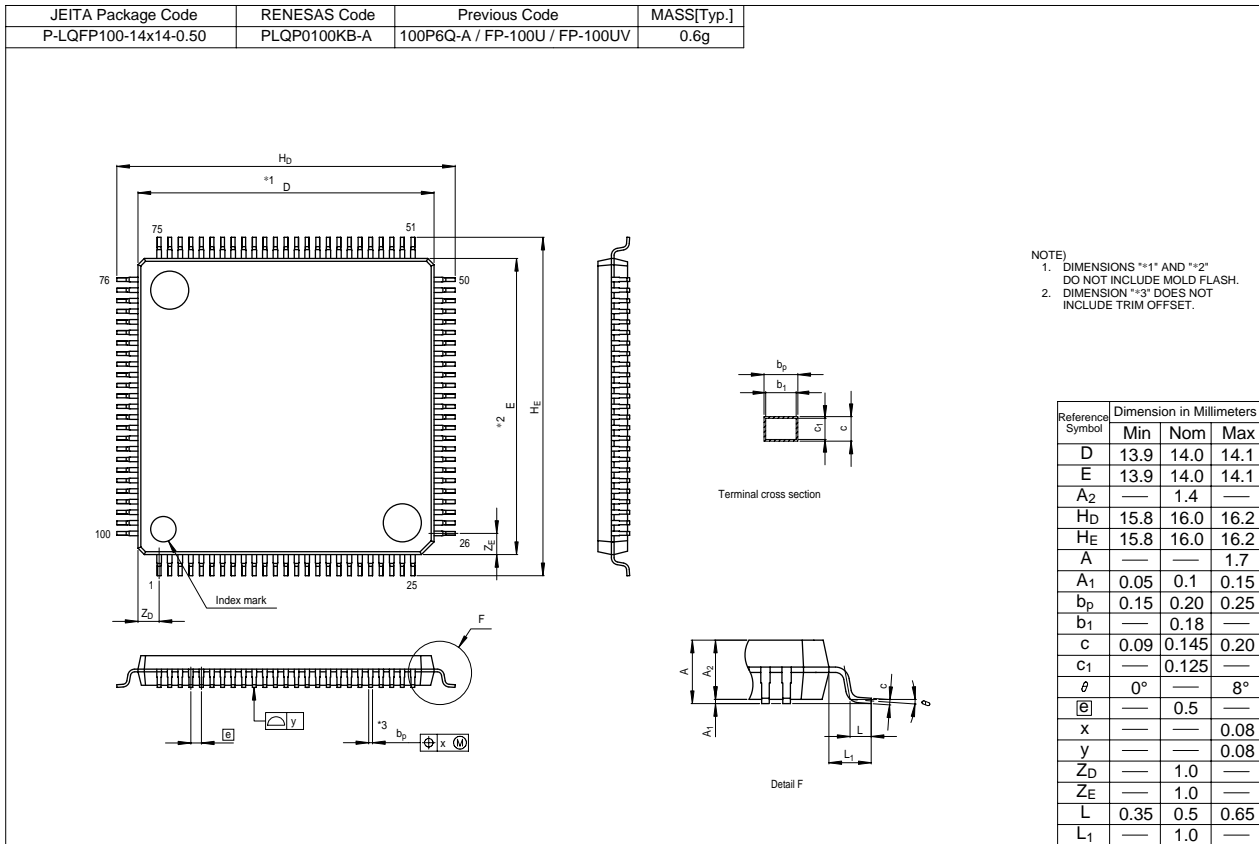
Figure 5.8  $V_{CC1}=V_{CC2}=3.3V$  Timing Diagram (3)





**Figure 5.9**  $V_{CC1}=V_{CC2}=3.3V$  Timing Diagram (4)

# Package Dimensions



REVISION HISTORY

M32C/80 Group Datasheet

Rev.	Date	Description																			
		Page	Summary																		
0.10	Sep., 02	–	New Document																		
0.11	Sep., 02	3	Table 1.1.1 "CAN" deleted																		
0.12	Nov., 02	3	Table 1.1.1 "4.2 to 5.5V" --> "3.0 to 5.5V" "3.0 to 3.6V (f(XIN)=20MHz without software wait)" deleted "26mA (f(XIN)=20MHz without software wait, Vcc=3.3V)" deleted																		
0.30	Aug., 02	–	<table border="0"> <tr> <td>1. Overview</td> <td>changed</td> </tr> <tr> <td>1.2 Performance Outline</td> <td>changed</td> </tr> <tr> <td>1.3 Block Diagram</td> <td>added</td> </tr> <tr> <td>1.5 Pin Assignments</td> <td>changed</td> </tr> <tr> <td>Table 1.3 Pin Characteristics for 100-Pin Package</td> <td>changed</td> </tr> <tr> <td>1.6 Pin Description</td> <td>added</td> </tr> <tr> <td>2. Central Processing Unit (CPU)</td> <td>added</td> </tr> <tr> <td>3. Memory</td> <td>added</td> </tr> <tr> <td>4. Special Function Registers (SFR)</td> <td>added</td> </tr> </table>	1. Overview	changed	1.2 Performance Outline	changed	1.3 Block Diagram	added	1.5 Pin Assignments	changed	Table 1.3 Pin Characteristics for 100-Pin Package	changed	1.6 Pin Description	added	2. Central Processing Unit (CPU)	added	3. Memory	added	4. Special Function Registers (SFR)	added
1. Overview	changed																				
1.2 Performance Outline	changed																				
1.3 Block Diagram	added																				
1.5 Pin Assignments	changed																				
Table 1.3 Pin Characteristics for 100-Pin Package	changed																				
1.6 Pin Description	added																				
2. Central Processing Unit (CPU)	added																				
3. Memory	added																				
4. Special Function Registers (SFR)	added																				
0.40	Jun., 04	All pages	Words standardized: On-chip oscillator, A/D converter and D/A converter																		
1.00	Nov., 04	2, 3	<b>Overview</b> <ul style="list-style-type: none"> <li>• <b>Table 1.1 and 1.2 M32C/80 Group Performance</b>                      "When using 16-bit bus" added to I/O ports                      "Option" deleted from Serial I/O, I<sup>2</sup>C bus, and IEBus                      "Voltage Detection Circuit" added                      Value added to "Power Consumption"                      "Flash Memory" added</li> </ul>																		
		4	• <b>1.3 Block Diagram</b> Description deleted																		
		5	• <b>Figure 1.2 ROM/RAM Capacity</b> deleted																		
		11	• <b>Table 1.3 M32C/85 Group</b> Note1 deleted • <b>Table 1.5 Pin Description</b> Note 1 added to I/O ports																		
		23	<b>Memory</b> <ul style="list-style-type: none"> <li>• Chapter Description modified</li> <li>• <b>Figure 3.1 Memory Map</b> modified</li> </ul>																		
		16-	<b>SFR</b> <ul style="list-style-type: none"> <li>• "X: Nothing is assigned" modified to "X: Indeterminate"</li> <li>• "?: Indeterminate" modified to "X: Indeterminate"</li> <li>• "Users cannot use any symbols with *" deleted</li> <li>• Register names, symbols, value after RESET of addresses 0017<sub>16</sub>, 001B<sub>16</sub>, 001F<sub>16</sub>, 002B<sub>16</sub>, 002F<sub>16</sub>, 004C<sub>16</sub>, and 004D<sub>16</sub> deleted</li> <li>• Value after RESET in the PM0 register revised</li> </ul>																		
		16	• Note 3 deleted																		
		29	• Note 1 added to addresses 03E0 <sub>16</sub> to 03EB <sub>16</sub>																		

REVISION HISTORY

M32C/80 Group Datasheet

Rev.	Date	Description	
		Page	Summary
		30-	<b>Electrical Characteristics</b> • This capter added
1.10	Nov., 05	All pages	Package code chnaged: 100P6Q-A to PLQP0100KB-A and 100P6S-A to PRQP0100JB-A
		1	<b>Overview</b> • Note that the M32C/80 Group is ROMless device added
		2	• <b>Table 1.1 M32C/80 Group Performance</b> Item "HDLC Data Processing" changed to "Intelligent I/O Communication Function"; item "Flash Memory" deleted
		3	• <b>Figure 1.1 M32C/80 Group Block Diagram</b> Notes 1 and 2 added
		9	• <b>Table 1.4 Pin Description</b> Supply voltage for analog power supply input modified "-" to "VCC1"; description for CNVSS changed; supply voltage for $\overline{\text{INT}}$ interrupt input modified; note for I/O ports added
		15	<b>Memory</b> • <b>Figure 3.1 Memory Map</b> Disgram changed; note added
		16	<b>Special Function Registers (SFRs)</b> • Note 2 deleted
		17	• Values after RESET in the RMAD6 and RMAD7 registers modified
		19	• Value after RESET in the RLVL register modified
		20	• Value after RESET in the GORB register modified
21	• Values after RESET in the G0EMR, G0ERC, and G0IRF registers modified		
26	• Value after RESET in the TCSPR register modified; note 1 added		
27, 28	• Register names, symbols, and value after RESET of addresses 039216 and 03AC16 deleted		
28	• Value after RESET in the PSC register modified		
30-	<b>Electrical Characteristics</b> • Ports P11 to P15 deleted		
32	• <b>Table 5.2 Recpmmeded Operating Conditions</b> f(BCLK) standard added		
33	• <b>Table 5.3 Electrical Characteristics</b> Max. standard for ICC modified		
34	• <b>Table 5.4 A/D Conversion Characteristics</b> AN0o to AN07 deleted from "INL" row		
35	• <b>Table 5.7 Memory Expansion Mode and Microprocessor Mode</b> Expressions on note 1 corrected		
41	• <b>Figure 5.2 Vcc1=Vcc2=5V Timing Diagram (1)</b> Expression for tcyc added; note 3 corrected		
42	• <b>Figure 5.3 Vcc1=Vcc2=5V Timing Diagram (2)</b> Expression for tcyc added; notes 1 and 2 corrected		
46	• <b>Table 5.22 A/D Conversion Characteristics</b> Min. standard for VREF modified		
47	• <b>Table 5.25 Memory Expansion Mode and Microprocessor Mode</b> Expres-sions on note 1 corrected		
52	• <b>Figure 5.6 Vcc1=Vcc2=3.3V Timing Diagram (1)</b> Expression for tcyc added; note 3 corrected		

REVISION HISTORY

M32C/80 Group Datasheet

Rev.	Date	Description	
		Page	Summary
		53	<ul style="list-style-type: none"> <li>• <b>Figure 5.7 Vcc1=Vcc2=3.3V Timing Diagram (2)</b> Expression for tcyc added; notes 1 and 2 corrected</li> </ul>

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