

1. Overview

The M32C/84 group (M32C/84, M32C/84T) microcomputer is a single-chip control unit that utilizes high-performance silicon gate CMOS technology with the M32C/80 series CPU core. The M32C/84 group (M32C/84, M32C/84T) is available in 144-pin and 100-pin plastic molded LQFP/QFP packages.

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.

1.1 Applications

Automobiles, audio, cameras, office equipment, communications equipment, portable equipment, etc.

1.2 Performance Outline

Tables 1.1 and 1.2 list performance outlines of the M32C/84 group (M32C/84, M32C/84T).

Table 1.1 M32C/84 Group (M32C/84, M32C/84T) Performance (144-Pin Package)

Characteristic		Performance	
		M32C/84	M32C/84T
CPU	Basic Instructions	108 instructions	
	Shortest Instruction Execution Time	31.3 ns (f(BCLK)=32 MHz, Vcc1=4.2 V to 5.5 V) 41.7 ns (f(BCLK)=24 MHz, Vcc1=3.0 V to 5.5 V)	31.3 ns (f(BCLK)=32 MHz, Vcc1=4.2 V to 5.5 V)
	Operation Mode	Single-chip mode, Memory expansion mode and Microprocessor mode	Single-chip mode
	Address Space	16 Mbytes	
	Memory Capacity	See Table 1.3	
Peripheral Function	I/O Port	123 I/O pins 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	Time measurement function or Waveform generating function: 16 bits x 8 channels Communication function (Clock synchronous serial I/O, Clock asynchronous serial I/O, HDLC data processing)	
	Serial I/O	5 Channels Clock synchronous serial I/O, Clock asynchronous serial I/O, IEBus ⁽¹⁾ , I ² C bus ⁽²⁾	
	CAN Module	1 channels Supporting CAN 2.0B specification	
	A/D Converter	10-bit A/D converter: 1 circuit, 34 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, Calculation transfer and Chain transfer functions	
	CRC Calculation Circuit	CRC-CCITT	
	XY Converter	16 bits x 16 bits	
	Watchdog Timer	15 bits x 1 channel (with prescaler)	
	Interrupt	38 internal and 8 external sources, 5 software sources Interrupt priority level: 7	
	Clock Generating Circuit	4 circuits Main clock oscillation circuit(*), Sub clock oscillation circuit(*), On-chip oscillator, PLL frequency synthesizer (*)Equipped with a built-in feedback resistor. Ceramic resonator or crystal oscillator must be connected externally	
	Oscillation Stop Detect Function	Main clock oscillation stop detect function	
	Supply Voltage Detect Circuit	Available (optional)	Not available
Electrical Characteristics	Supply Voltage	Vcc1=4.2 V to 5.5 V, Vcc2=3.0 V to Vcc1 (f(BCLK)=32 MHz) Vcc1=3.0 V to 5.5 V, Vcc2=3.0 V to Vcc1 (f(BCLK)=24 MHz)	Vcc1=Vcc2=4.2 V to 5.5 V, (f(BCLK)=32 MHz) ⁽³⁾
	Power Consumption	28 mA (Vcc1=Vcc2=5 V, f(BCLK)=32 MHz) 22 mA (Vcc1=Vcc2=3.3 V, f(BCLK)=24 MHz) 10μA (Vcc1=Vcc2=5 V, f(XCIN)=32 kHz, in wait mode)	28 mA (Vcc1=Vcc2=5 V, f(BCLK)=32 MHz) 10μA (Vcc1=Vcc2=5 V, f(XCIN)=32 kHz, in wait mode)
Flash Memory	Program/Erase Supply Voltage	3.3 V ± 0.3 V or 5.0 V ± 0.5 V	
	Program and Erase Endurance	100 cycles (all space)	
Operating Ambient Temperature		-20 to 85°C -40 to 85°C (optional)	-40 to 85°C (T version)
Package		144-pin plastic molded LQFP	

NOTES:

1. IEBus is a trademark of NEC Electronics Corporation.
 2. I²C bus is a trademark of Koninklijke Philips Electronics N. V.
 3. The supply voltage of M32C/84T (High-reliability version) must be Vcc1=Vcc2.
- All options are on a request basis.

Table 1.2 M32C/84 Group (M32C/84, M32C/84T) Performance (100-Pin Package)

Characteristic		Performance	
		M32C/84	M32C/84T
CPU	Basic Instructions	108 instructions	
	Shortest Instruction Execution Time	31.3 ns (f(BCLK)=32 MHz, Vcc1=4.2 V to 5.5 V) 41.7 ns (f(BCLK)=24 MHz, Vcc1=3.0 V to 5.5 V)	31.3 ns (f(BCLK)=32 MHz, Vcc1=4.2 V to 5.5 V)
	Operation Mode	Single-chip mode, Memory expansion mode and Microprocessor mode	Single-chip mode
	Address Space	16 Mbytes	
	Memory Capacity	See Table 1.3	
Peripheral Function	I/O Port	87 I/O pins 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	Time measurement function or Waveform generating function: 16 bits x 8 channels Communication function (Clock synchronous serial I/O, Clock asynchronous serial I/O, HDLC data processing)	
	Serial I/O	5 Channels Clock synchronous serial I/O, Clock asynchronous serial I/O, IEBus ⁽¹⁾ , I ² C bus ⁽²⁾	
	CAN Module	1 channels Supporting CAN 2.0B specification	
	A/D Converter	10-bit A/D converter: 1 circuit, 26 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, Calculation transfer and Chain transfer functions	
	CRC Calculation Circuit	CRC-CCITT	
	XY Converter	16 bits x 16 bits	
	Watchdog Timer	15 bits x 1 channel (with prescaler)	
	Interrupt	38 internal and 8 external sources, 5 software sources Interrupt priority level: 7	
	Clock Generating Circuit	4 circuits Main clock oscillation circuit(*), Sub clock oscillation circuit(*), On-chip oscillator, PLL frequency synthesizer (*)Equipped with a built-in feedback resistor. Ceramic resonator or crystal oscillator must be connected externally	
	Oscillation Stop Detect Function	Main clock oscillation stop detect function	
	Supply Voltage Detect Circuit	Available (optional)	Not available
Electrical Characteristics	Supply Voltage	Vcc1=4.2 V to 5.5 V, Vcc2=3.0 V to Vcc1 (f(BCLK)=32 MHz) Vcc1=3.0 V to 5.5 V, Vcc2=3.0 V to Vcc1 (f(BCLK)=24 MHz)	Vcc1=Vcc2=4.2 V to 5.5 V, (f(BCLK)=32 MHz) ⁽³⁾
	Power Consumption	28 mA (Vcc1=Vcc2=5 V, f(BCLK)=32 MHz) 22 mA (Vcc1=Vcc2=3.3 V, f(BCLK)=24 MHz) 10μA (Vcc1=Vcc2=5 V, f(XCIN)=32 kHz, wait mode)	28 mA (Vcc1=Vcc2=5 V, f(BCLK)=32 MHz) 10μA (Vcc1=Vcc2=5 V, f(XCIN)=32 kHz, wait mode)
Flash Memory	Program/Erase Supply Voltage	3.3 V ± 0.3 V or 5.0 V ± 0.5 V	
	Program and Erase Endurance	100 cycles (all space)	
Operating Ambient Temperature		-20 to 85°C -40 to 85°C (optional)	-40 to 85°C (T version)
Package		100-pin plastic molded LQFP/QFP	

NOTES:

1. IEBus is a trademark of NEC Electronics Corporation.
2. I²C bus is a trademark of Koninklijke Philips Electronics N. V.
3. The supply voltage of M32C/84T (High-reliability version) must be Vcc1=Vcc2.

All options are on a request basis.

1.3 Block Diagram

Figure 1.1 shows a block diagram of the M32C/84 group (M32C/84, M32C/84T) microcomputer.

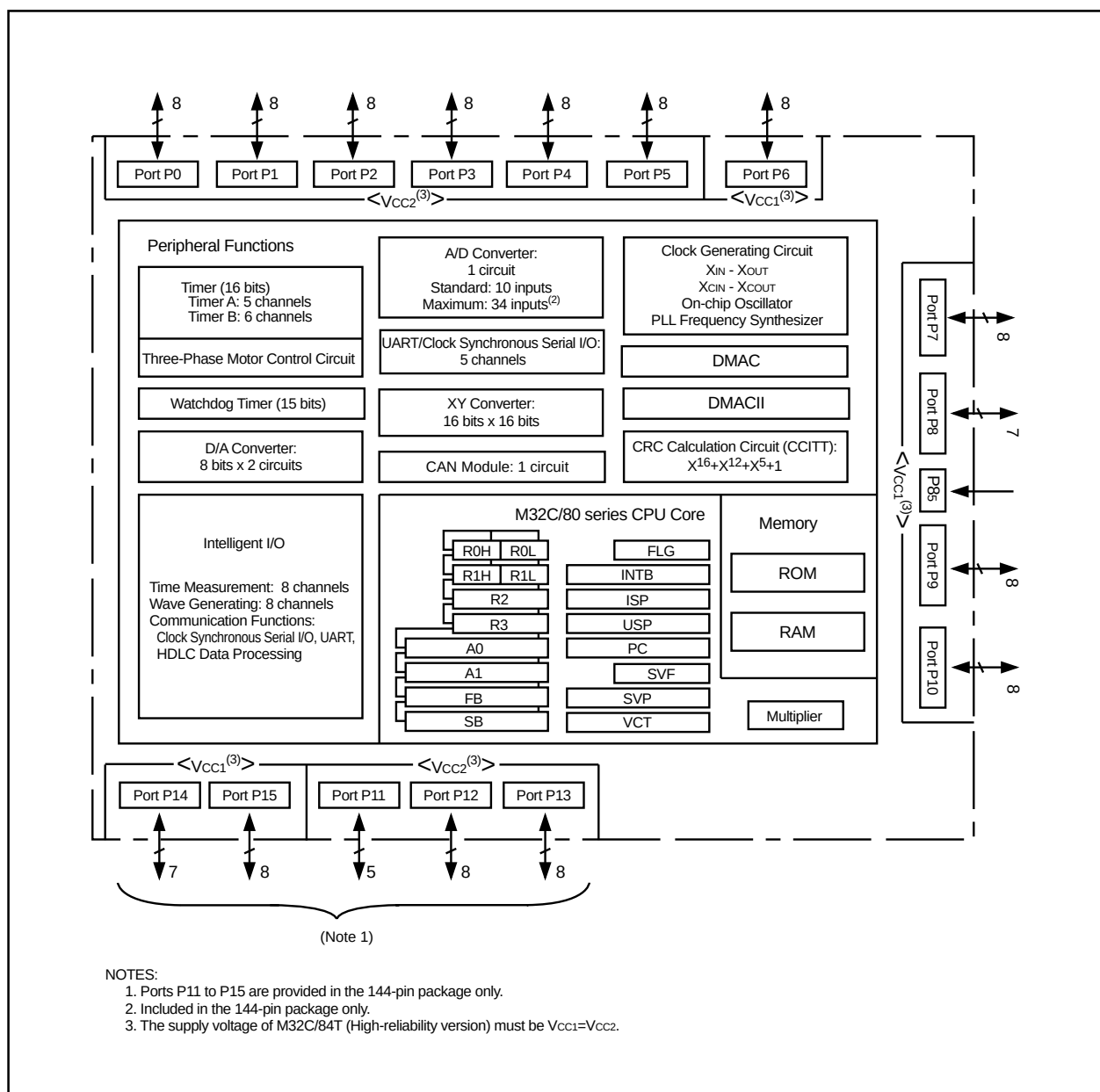


Figure 1.1 M32C/84 Group (M32C/84, M32C/84T) Block Diagram

1.4 Product Information

Table 1.3 lists product information. Figure 1.2 shows the product numbering system.

Table 1.3 M32C/84 Group (1) (M32C/84)

As of June, 2004

Type Number	ROM Capacity	RAM Capacity	Package Type	Remarks
M30845FJGP (D)	512K+4K	24K	144P6Q-A	Flash Memory
M30843FJGP (D)			100P6Q-A	
M30843FJFP (D)			100P6S-A	
M30845MW-XXXGP	320K	24K	144P6Q-A	Masked ROM
M30843MW-XXXGP			100P6Q-A	
M30843MW-XXXFP			100P6S-A	
M30842ME-XXXGP (P)	192K	16K	144P6Q-A	
M30840ME-XXXGP (P)			100P6Q-A	
M30840ME-XXXFP (P)			100P6S-A	
M30842MC-XXXGP (P)	128K	10K	144P6Q-A	
M30840MC-XXXGP (P)			100P6Q-A	
M30840MC-XXXFP (P)			100P6S-A	

(D): Under development (P): Planning

Table 1.3 M32C/84 Group (2) (T Version, M32C/84T)

As of June, 2004

Type Number	ROM Capacity	RAM Capacity	Package Type	Remarks	
M30845FJTGP (D)	512K+4K	24K	144P6Q-A	Flash Memory	T version (High-reliability 85°C version)
M30843FJTGP (D)			100P6Q-A		

(D): Under development

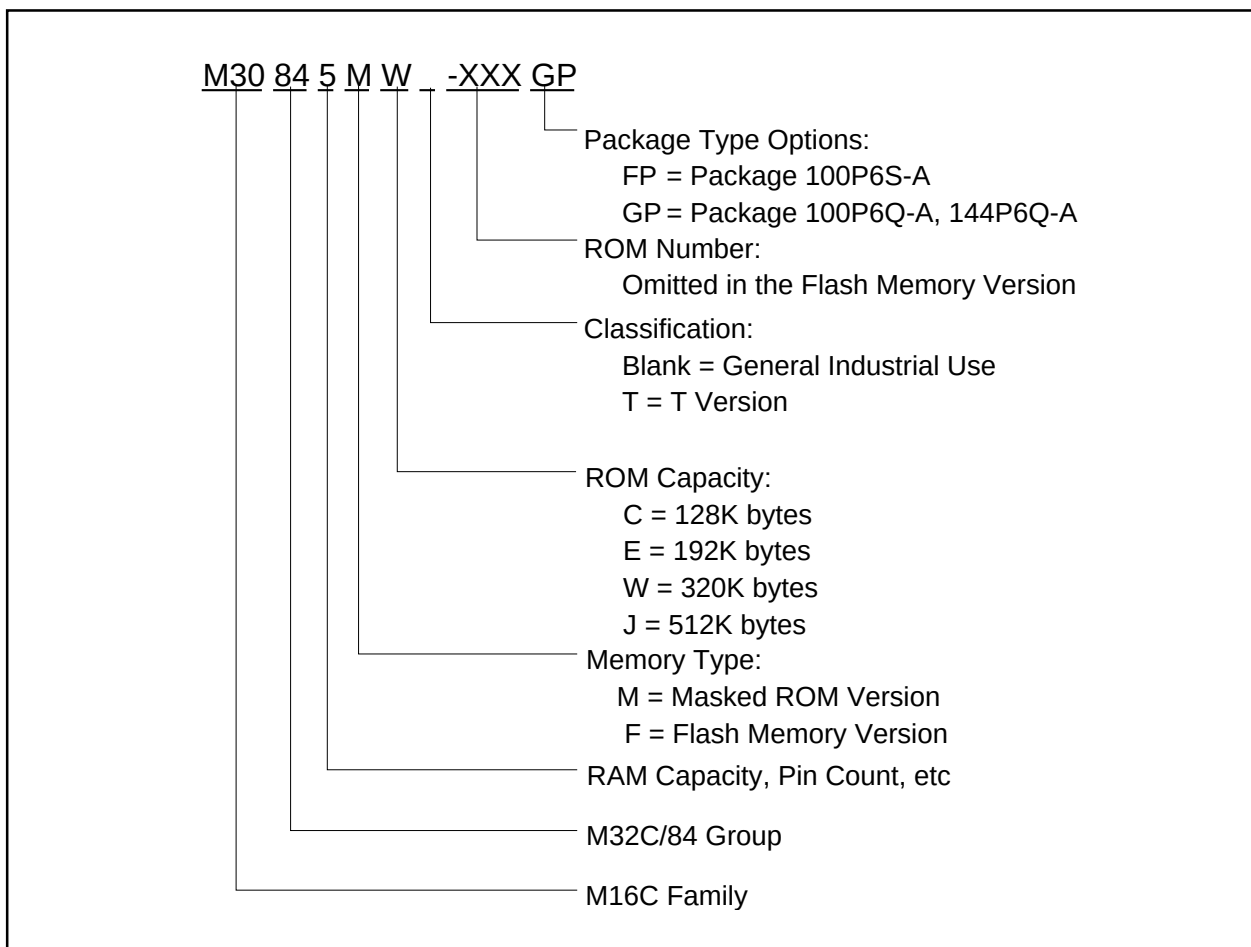


Figure 1.2 Product Numbering System

1.5 Pin Assignments and Descriptions

Figures 1.3 to 1.5 show pin assignments (top view).

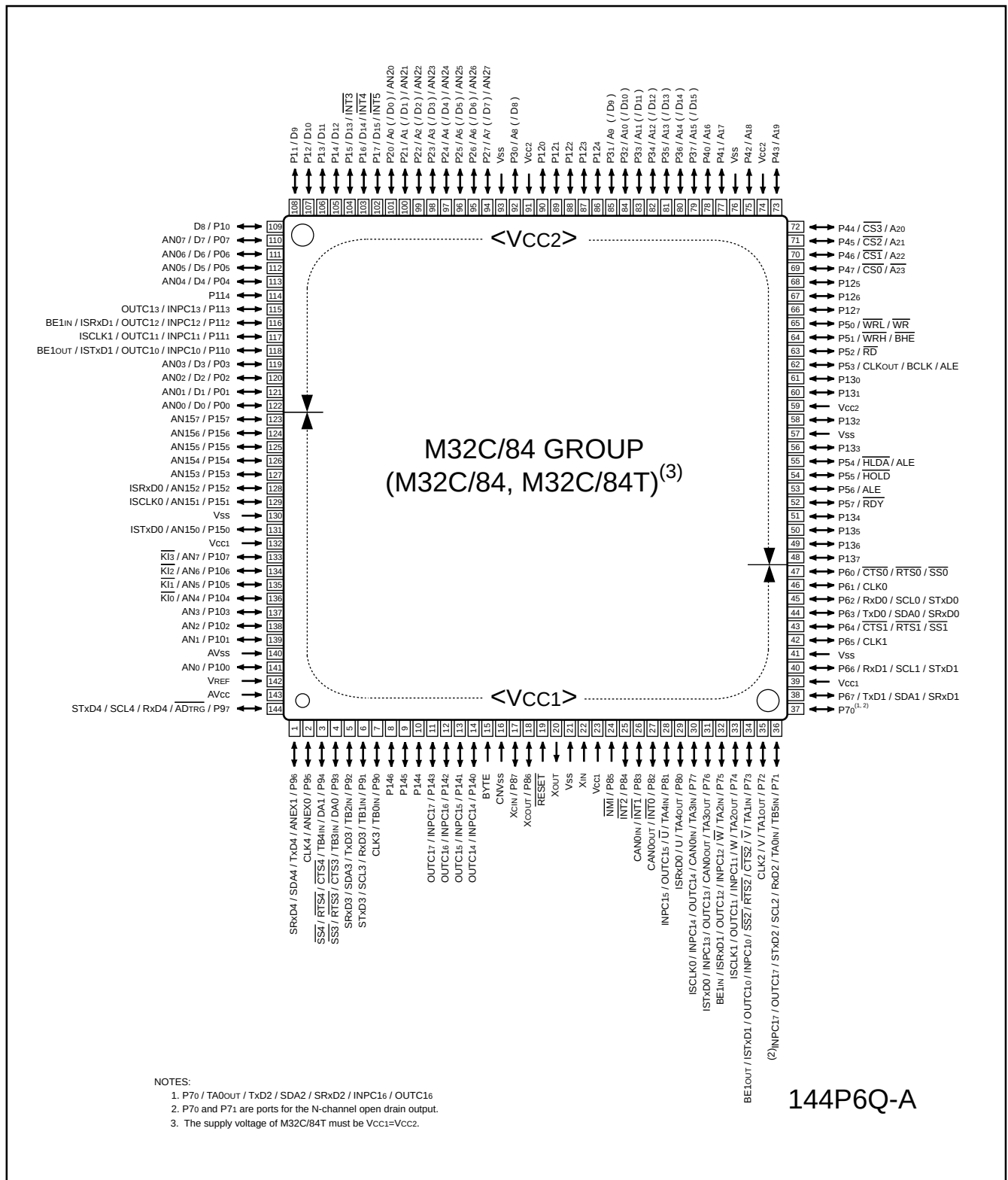


Figure 1.3 Pin Assignment for 144-Pin Package

Table 1.4 Pin Characteristics for 144-Pin Package

Pin No.	Control Pin	Port	Interrupt Pin	Timer Pin	UART/CAN Pin	Intelligent I/O Pin	Analog Pin	Bus Control Pin ⁽¹⁾
1		P96			TxD4/SDA4/SRx4D4		ANEX1	
2		P95			CLK4		ANEX0	
3		P94		TB4IN	CTS4/RTS4/SS4		DA1	
4		P93		TB3IN	CTS3/RTS3/SS3		DA0	
5		P92		TB2IN	TxD3/SDA3/SRx3D3			
6		P91		TB1IN	RxD3/SCL3/STxD3			
7		P90		TB0IN	CLK3			
8		P146						
9		P145						
10		P144						
11		P143				INPC17/OUTC17		
12		P142				INPC16/OUTC16		
13		P141				INPC15/OUTC15		
14		P140				INPC14/OUTC14		
15	BYTE							
16	CNVSS							
17	XcIN	P87						
18	XcOUT	P86						
19	RESET							
20	XOUT							
21	VSS							
22	XIN							
23	VCC1							
24		P85	NMI					
25		P84	INT2					
26		P83	INT1		CAN0IN			
27		P82	INT0		CAN0OUT			
28		P81		TA4IN/U		INPC15/OUTC15		
29		P80		TA4OUT/U		ISRxD0		
30		P77		TA3IN	CAN0IN	INPC14/OUTC14/ISCLK0		
31		P76		TA3OUT	CAN0OUT	INPC13/OUTC13/ISTxD0		
32		P75		TA2IN/W		INPC12/OUTC12/ISRxD1/BE1IN		
33		P74		TA2OUT/W		INPC11/OUTC11/ISCLK1		
34		P73		TA1IN/V	CTS2/RTS2/SS2	INPC10/OUTC10/ISTxD1/BE1OUT		
35		P72		TA1OUT/V	CLK2			
36		P71		TB5IN/TA0IN	RxD2/SCL2/STxD2	INPC17/OUTC17		
37		P70		TA0OUT	TxD2/SDA2/SRx2D2	INPC16/OUTC16		
38		P67			TxD1/SDA1/SRx1D1			
39	VCC1							
40		P66			RxD1/SCL1/STxD1			
41	VSS							
42		P65			CLK1			
43		P64			CTS1/RTS1/SS1			
44		P63			TxD0/SDA0/SRx0D0			
45		P62			RxD0/SCL0/STxD0			
46		P61			CLK0			
47		P60			CTS0/RTS0/SS0			
48		P137						

NOTES:

1. Bus control pins in M32C/84T cannot be used.

Table 1.4 Pin Characteristics for 144-Pin Package (Continued)

Pin No.	Control Pin	Port	Interrupt Pin	Timer Pin	UART/CAN Pin	Intelligent I/O Pin	Analog Pin	Bus Control Pin
49		P136						
50		P135						
51		P134						
52		P57						RDY
53		P56						ALE
54		P55						HOLD
55		P54						H LDA/ALE
56		P133						
57	Vss							
58		P132						
59	Vcc2							
60		P131						
61		P130						
62		P53						CLKOUT/BCLK/ALE
63		P52						RD
64		P51						WRH/BHE
65		P50						WRL/WR
66		P127						
67		P126						
68		P125						
69		P47						CS0/A23
70		P46						CS1/A22
71		P45						CS2/A21
72		P44						CS3/A20
73		P43						A19
74	Vcc2							
75		P42						A18
76	Vss							
77		P41						A17
78		P40						A16
79		P37						A15(/D15)
80		P36						A14(/D14)
81		P35						A13(/D13)
82		P34						A12(/D12)
83		P33						A11(/D11)
84		P32						A10(/D10)
85		P31						A9(/D9)
86		P124						
87		P123						
88		P122						
89		P121						
90		P120						
91	Vcc2							
92		P30						A8(/D8)
93	Vss							
94		P27					AN27	A7(/D7)
95		P26					AN26	A6(/D6)
96		P25					AN25	A5(/D5)

NOTES:

1. Bus control pins in M32C/84T cannot be used.

Table 1.4 Pin Characteristics for 144-Pin Package (Continued)

Pin No.	Control Pin	Port	Interrupt Pin	Timer Pin	UART/CAN Pin	Intelligent I/O Pin	Analog Pin	Bus Control Pin ⁽¹⁾
97		P24					AN24	A4(/D4)
98		P23					AN23	A3(/D3)
99		P22					AN22	A2(/D2)
100		P21					AN21	A1(/D1)
101		P20					AN20	A0(/D0)
102		P17	INT5					D15
103		P16	INT4					D14
104		P15	INT3					D13
105		P14						D12
106		P13						D11
107		P12						D10
108		P11						D9
109		P10						D8
110		P07					AN07	D7
111		P06					AN06	D6
112		P05					AN05	D5
113		P04					AN04	D4
114		P114						
115		P113				INPC13/OUTC13		
116		P112				INPC12/OUTC12/ISRxD1/BE1IN		
117		P111				INPC11/OUTC11/ISCLK1		
118		P110				INPC10/OUTC10/ISTxD1/BE1OUT		
119		P03					AN03	D3
120		P02					AN02	D2
121		P01					AN01	D1
122		P00					AN00	D0
123		P157					AN157	
124		P156					AN156	
125		P155					AN155	
126		P154					AN154	
127		P153					AN153	
128		P152				ISRxD0	AN152	
129		P151				ISCLK0	AN151	
130	VSS							
131		P150				ISTxD0	AN150	
132	VCC1							
133		P107	KI3				AN7	
134		P106	KI2				AN6	
135		P105	KI1				AN5	
136		P104	KI0				AN4	
137		P103					AN3	
138		P102					AN2	
139		P101					AN1	
140	AVSS							
141		P100					AN0	
142	VREF							
143	AVCC							
144		P97			RxD4/SCL4/STxD4		ADTRG	

NOTES:

1. Bus control pins in M32C/84T cannot be used.

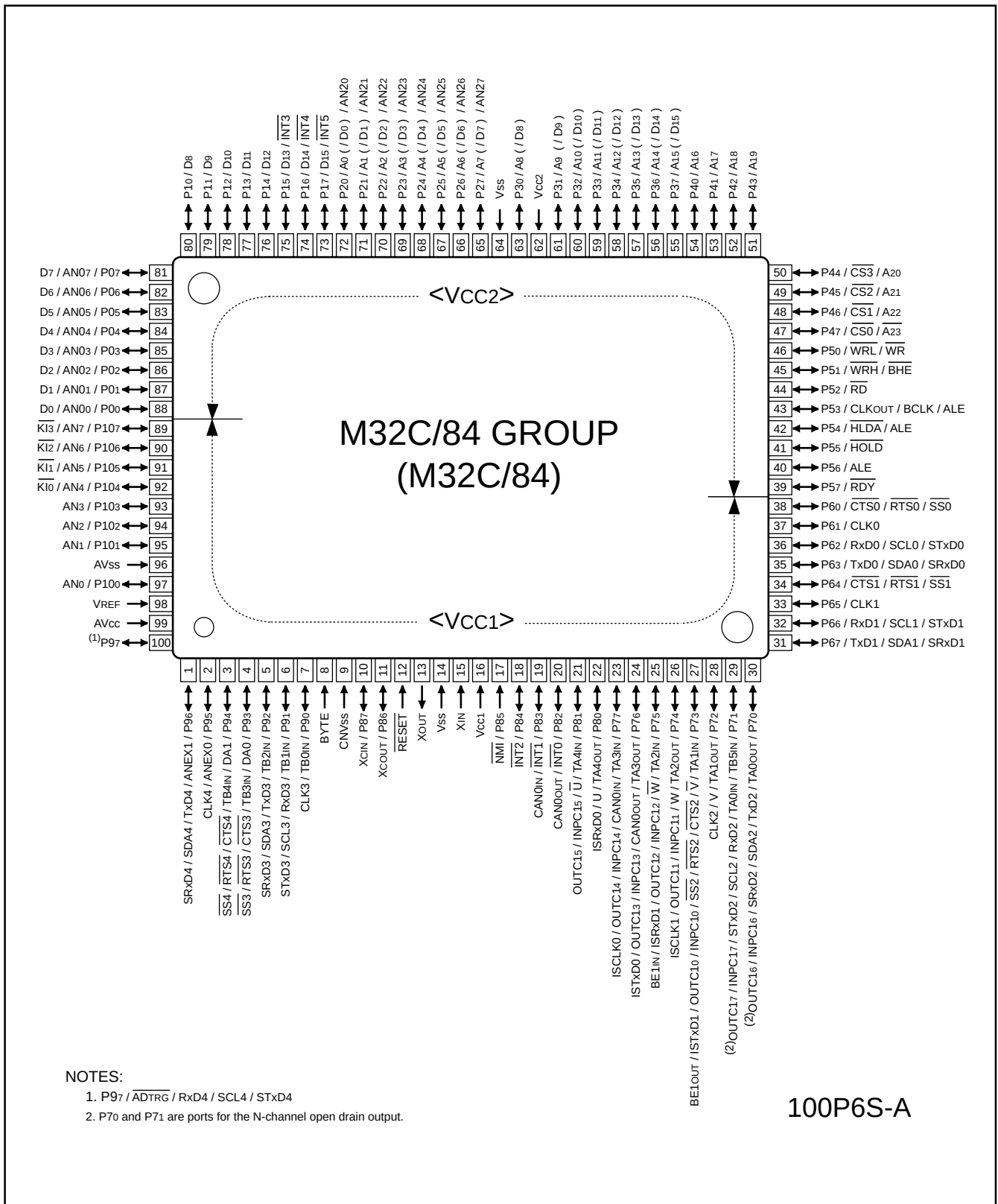


Figure 1.4 Pin Assignment for 100-Pin Package



Table 1.5 Pin Characteristics for 100-Pin Package

Package Pin No.		Control Pin	Port	Interrupt Pin	Timer Pin	UART/CAN Pin	Intelligent I/O Pin	Analog Pin	Bus Control Pin ⁽¹⁾
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	CNVSS							
10	8	X _{CIN}	P87						
11	9	X _{COU} T	P86						
12	10	RESET							
13	11	X _{OUT}							
14	12	V _{SS}							
15	13	X _{IN}							
16	14	V _{CC1}							
17	15		P85	NMI					
18	16		P84	INT2					
19	17		P83	INT1		CAN0IN			
20	18		P82	INT0		CAN0OUT			
21	19		P81		TA4IN/ $\bar{U}$		INPC15/OUTC15		
22	20		P80		TA4OUT/ $\bar{U}$		ISRxD0		
23	21		P77		TA3IN	CAN0IN	INPC14/OUTC14/ISCLK0		
24	22		P76		TA3OUT	CAN0OUT	INPC13/OUTC13/ISTxD0		
25	23		P75		TA2IN/ $\bar{W}$		INPC12/OUTC12/ISRxD1/BE1IN		
26	24		P74		TA2OUT/ $\bar{W}$		INPC11/OUTC11/ISCLK1		
27	25		P73		TA1IN/ $\bar{V}$	CTS2/RTS2/SS2	INPC10/OUTC10/ISTxD1/BE1OUT		
28	26		P72		TA1OUT/ $\bar{V}$	CLK2			
29	27		P71		TB5IN/TA0IN	RxD2/SCL2/STxD2	INPC17/OUTC17		
30	28		P70		TA0OUT	TxD2/SDA2/SRxD2	INPC16/OUTC16		
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						HLDA/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

NOTES:

1. Bus control pins in M32C/84T cannot be used.

Table 1.5 Pin Characteristics for 100-Pin Package (Continued)

Package Pin No.		Control Pin	Port	Interrupt Pin	Timer Pin	UART/CAN Pin	Intelligent I/O Pin	Analog Pin	Bus Control Pin
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					AN27	A7(/D7)
66	64		P26					AN26	A6(/D6)
67	65		P25					AN25	A5(/D5)
68	66		P24					AN24	A4(/D4)
69	67		P23					AN23	A3(/D3)
70	68		P22					AN22	A2(/D2)
71	69		P21					AN21	A1(/D1)
72	70		P20					AN20	A0(/D0)
73	71		P17	INT5					D15
74	72		P16	INT4					D14
75	73		P15	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					AN07	D7
82	80		P06					AN06	D6
83	81		P05					AN05	D5
84	82		P04					AN04	D4
85	83		P03					AN03	D3
86	84		P02					AN02	D2
87	85		P01					AN01	D1
88	86		P00					AN00	D0
89	87		P107	$\overline{\text{KI}}_3$				AN7	
90	88		P106	$\overline{\text{KI}}_2$				AN6	
91	89		P105	$\overline{\text{KI}}_1$				AN5	
92	90		P104	$\overline{\text{KI}}_0$				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		$\overline{\text{ADTRG}}$	

NOTES:

1. Bus control pins in M32C/84T cannot be used.

1.6 Pin Description

Table 1.6 Pin Description (100-Pin and 144-Pin Packages)

Classification	Symbol	I/O Type	Supply Voltage	Function
Power Supply	VCC1, VCC2 VSS	I I	–	Apply 3.0 to 5.5V to both VCC1 and VCC2 pins. Apply 0V to the VSS pin. $V_{CC1} \geq V_{CC2}$ ^(1, 2)
Analog Power Supply	AVCC AVSS	I	VCC1	Supplies power to the A/D converter and D/A 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	Switches processor mode. Connect the CNVSS pin to VSS to start up in single-chip mode or to VCC1 to start up in microprocessor mode
Input to Switch External Data Bus Width ⁽³⁾	BYTE	I	VCC1	Switches data bus width in external memory space 3. The data bus is 16 bits wide when the BYTE pin is held "L" and 8 bits wide when it is held "H". Set to either. Connect the BYTE pin to VSS to use the microcomputer in single-chip mode
Bus Control Pins ⁽³⁾	D0 to D7	I/O	VCC2	Inputs and outputs data (D0 to D7) while accessing an external memory space with the 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
	A ₂₃	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 the 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 16-bit multiplexed bus
	CS0 to CS3	O	VCC2	Outputs CS0 to CS3 that are chip-select signals specifying an external space
	WRL / $\overline{WR}$ WRH / $\overline{BHE}$ RD	O	VCC2	Outputs WRL, WRH, ($\overline{WR}$, $\overline{BHE}$) and RD signals. $\overline{WRL}$ and $\overline{WRH}$ can be switched with $\overline{WR}$ and $\overline{BHE}$ by program. ■ $\overline{WRL}$, $\overline{WRH}$ and RD selected: If external data bus is 16 bits wide, data is written to an even address in external memory space when $\overline{WRL}$ is held "L". Data is written to an odd address when $\overline{WRH}$ is held "L". Data is read when RD is held "L". ■ $\overline{WR}$, $\overline{BHE}$ and RD selected: Data is written to external memory space when $\overline{WR}$ is held "L". Data in an external memory space is read when RD is held "L". An odd address is accessed when $\overline{BHE}$ is held "L". Select $\overline{WR}$, $\overline{BHE}$ and RD for external 8-bit data bus.
	ALE	O	VCC2	ALE is a signal latching the 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" signal 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

NOTES:

1. VCC1 is hereinafter referred to as VCC unless otherwise noted.
2. Apply 4.2 to 5.5V to the VCC1 and VCC2 pins when using M32C/84T. $V_{CC1}=V_{CC2}$.
3. Bus control pins in M32C/84T cannot be used.

Table 1.6 Pin Description (100-Pin and 144-Pin Packages) (Continued)

Classification	Symbol	I/O Type	Supply Voltage	Function
Main Clock Input	XIN	I	VCC1	I/O pins for the main clock oscillation circuit. Connect a crystal oscillator between XIN and XOUT. To apply externally-generated clock, apply it to XIN and leave XOUT open.
Main Clock Output	XOUT	O	VCC1	
Sub Clock Input	XCIN	I	VCC1	I/O pins for the sub clock oscillation circuit. Connect a crystal oscillator between XCIN and Xcout. To apply externally-generated clock, apply it to XCIN and leave Xcout open.
Sub Clock Output	Xcout	O	VCC1	
BCLK Output ⁽¹⁾	BCLK	O	VCC2	Outputs BCLK signal
Clock Output	CLKOUT	O	VCC2	Outputs the clock having the same frequency as fc, f8 or f32
INT̄ Interrupt Input	INT0 to INT2	I	VCC1	Input pins for the INT̄ interrupt
	INT3 to INT5	I	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 timer A0 to A4 (TA0OUT is a pin for the N-channel open drain output.)
	TA0IN to TA4IN	I	VCC1	Input pins for timer A0 to A4
Timer B	TB0IN to TB5IN	I	VCC1	Input pins for timer B0 to B5
Three-phase Motor Control Timer Output	U, Ū, V, V̄, W, W̄	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 ² 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	I/O	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	O	VCC1	Outputs serial data when slave mode is selected (STxD2 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

NOTES:

1. Bus control pins in M32C/84T cannot be used.
2. Apply 4.2 to 5.5V to the VCC1 and VCC2 pins when using M32C/84T. VCC1 = VCC2.

Table 1.6 Pin Description (100-Pin and 144-Pin Packages) (Continued)

Classification	Symbol	I/O Type	Supply Voltage	Function
Reference Voltage Input	VREF	I	-	Supplies reference voltage to the A/D converter and D/A converter
A/D Converter	AN0 to AN7 AN00 to AN07 AN20 to AN27	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	INPC10 to INPC13	I	VCC1/VCC2 ⁽¹⁾	Input pins for the time measurement function
	INPC14 to INPC17	I	VCC1	
	OUTC10 to OUTC13	O	VCC1/VCC2 ⁽¹⁾	Output pins for the waveform generating function (OUTC16 and OUTC17 assigned to P70 and P71 are pins for the N-channel open drain output.)
	OUTC14 to OUTC17	O	VCC1	
	ISCLK0	I/O	VCC1	Inputs and outputs the clock for the intelligent I/O communication function
	ISCLK1	I/O	VCC1/VCC2 ⁽¹⁾	
	ISRXD0	I	VCC1	Inputs data for the intelligent I/O communication function
	ISRXD1	I	VCC1/VCC2 ⁽¹⁾	
	ISTXD0	O	VCC1	Outputs data for the intelligent I/O communication function
	ISTXD1	O	VCC1/VCC2 ⁽¹⁾	
	BE1IN	I	VCC1/VCC2 ⁽¹⁾	Inputs data for the intelligent I/O communication function
	BE1OUT	O	VCC1/VCC2 ⁽¹⁾	Outputs data for the intelligent I/O communication function
CAN	CAN0IN	I	VCC1	Input pin for the CAN communication function
	CAN0OUT	O	VCC1	Output pin for the CAN communication function
I/O Ports	P00 to P07 P10 to P17 P20 to P27 P30 to P37 P40 to P47 P50 to P57	I/O	VCC2	8-bit I/O ports in CMOS. Each port can be programmed to 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
	P60 to P67 P70 to P77 P90 to P97 P100 to P107	I/O	VCC1	8-bit I/O ports having equivalent functions to P0 (P70 and P71 are ports for the N-channel open drain output.)
	P80 to P84 P86, P87	I/O	VCC1	I/O ports having equivalent functions to P0
Input Port	P85	I	VCC1	Shares a pin with NMI. NMI input state can be got by reading P85

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

NOTES:

- VCC2 is not available in the 100-pin package. VCC1 only available.
- Apply 4.2 to 5.5V to the VCC1 and VCC2 pins when using M32C/84T. VCC1 = VCC2.

Table 1.6 Pin Description (144-Pin Package only) (Continued)

Classification	Symbol	I/O Type	Supply Voltage	Function
A/D Converter	AN150 to AN157	I	Vcc1	Analog input pins for the A/D converter
I/O Ports	P110 to P114	I/O	Vcc2	8-bit I/O ports having equivalent functions to P0
	P120 to P127			
	P130 to P137			
	P140 to P146	I/O	Vcc1	8-bit I/O ports having equivalent functions to P0
	P150 to P157			

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

NOTES:

1. Apply 4.2 to 5.5V to the Vcc1 and Vcc2 pins when using M32C/84T. Vcc1 = Vcc2.

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.

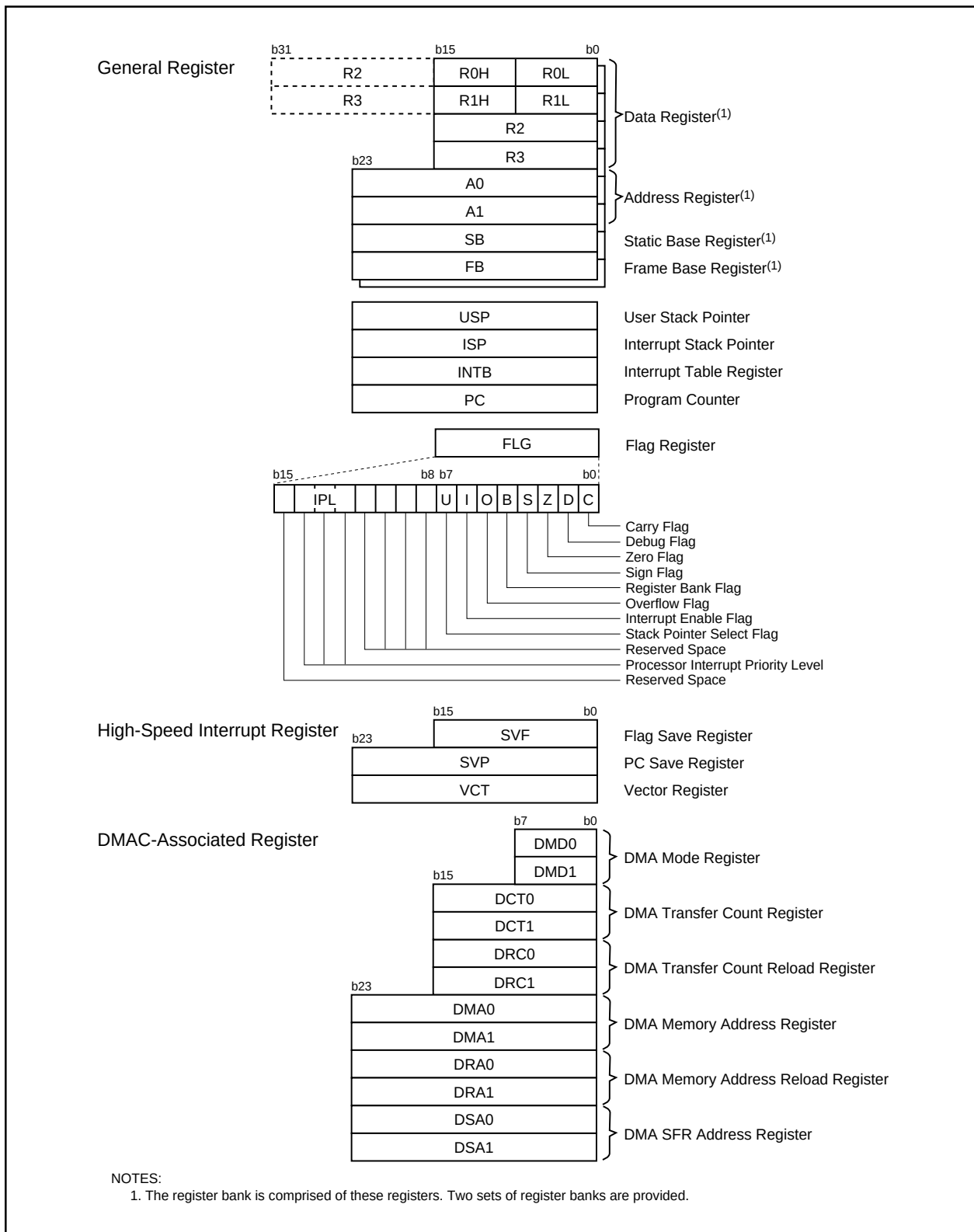


Figure 2.1 CPU Register

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/R1H) and low-order bits (R0L/R1L) 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 the next instruction to be executed.

2.1.6 Interrupt Table Register (INTB)

INTB is a 24-bit register indicating the starting address of a relocatable 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 calculation; 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 calculation; 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/84 group (M32C/84, M32C/84T).

The M32C/84 group (M32C/84, M32C/84T) provides 16-Mbyte address space from addresses 000000₁₆ to FFFFFFF₁₆.

The internal ROM is allocated lower addresses beginning with address FFFFFFF₁₆. For example, a 64-Kbyte internal ROM is allocated in addresses FF0000₁₆ to FFFFFFF₁₆.

The fixed interrupt vectors are allocated addresses FFFFDC₁₆ to FFFFFFF₁₆. It stores the starting address of each interrupt routine.

The internal RAM is allocated higher addresses beginning with address 000400₁₆. For example, a 10-Kbyte internal RAM is allocated addresses 000400₁₆ to 002BFF₁₆. Besides storing data, it becomes stacks when the subroutine is called or an interrupt is acknowledged.

SFR, consisting of control registers for peripheral functions such as I/O port, A/D conversion, serial I/O, and timers, is allocated addresses 000000₁₆ to 0003FF₁₆. All blank spaces within SFR are reserved space and cannot be accessed by users.

The special page vectors are allocated addresses FFFE00₁₆ to FFFFDB₁₆. It is used for the JMPS instruction and JSRS instruction. Refer to the Renesas publication **Software Manual** for details.

In memory expansion mode and microprocessor mode, some spaces are reserved and cannot be accessed by users.

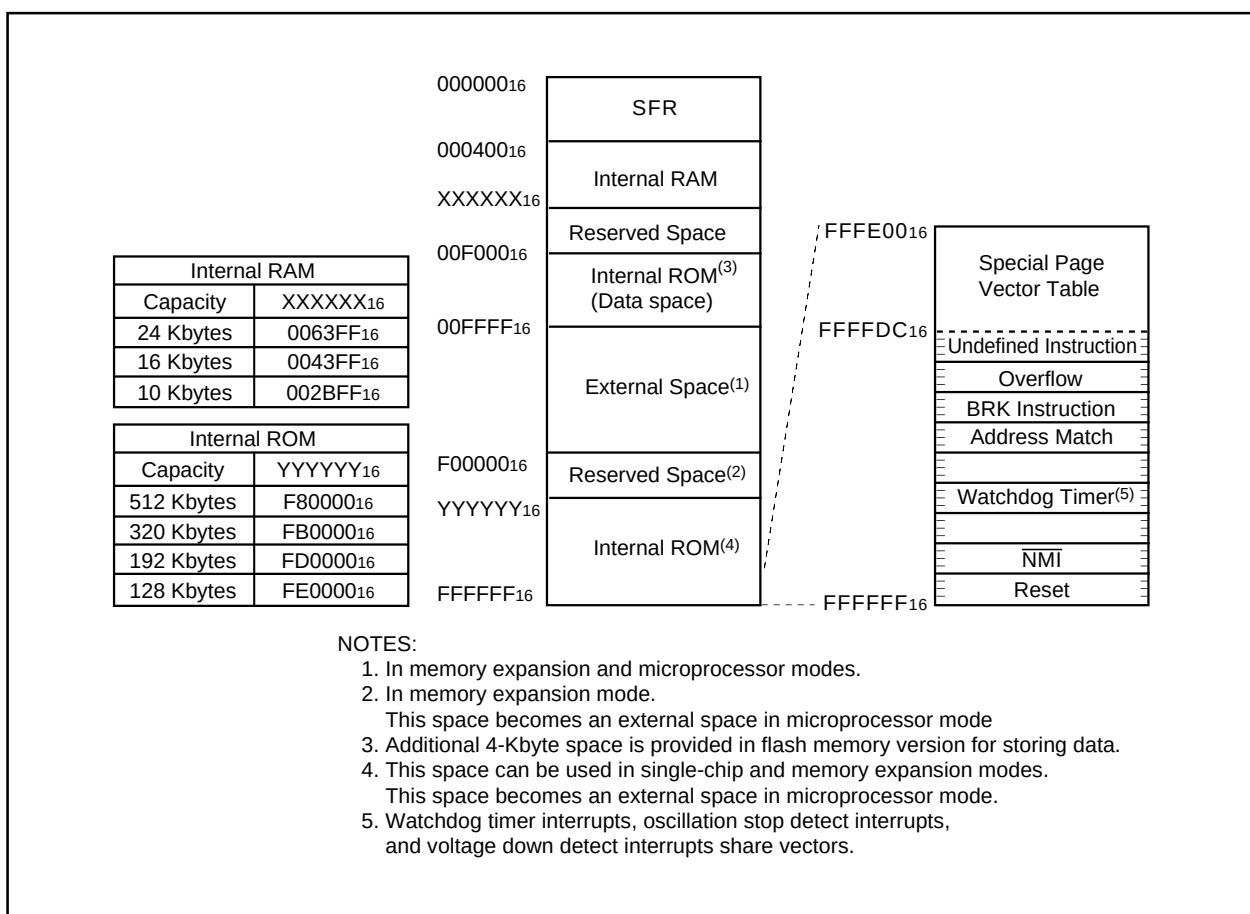


Figure 3.1 Memory Map

4. Special Function Registers (SFR)

Address	Register	Symbol	Value after RESET
0000 ₁₆			
0001 ₁₆			
0002 ₁₆			
0003 ₁₆			
0004 ₁₆	Processor Mode Register 0 ⁽¹⁾	PM0	1000 0000 ₂ (CNVss pin ="L") 0000 0011 ₂ (CNVss pin ="H")
0005 ₁₆	Processor Mode Register 1	PM1	00 ₁₆
0006 ₁₆	System Clock Control Register 0	CM0	0000 1000 ₂
0007 ₁₆	System Clock Control Register 1	CM1	0010 0000 ₂
0008 ₁₆			
0009 ₁₆	Address Match Interrupt Enable Register	AIER	00 ₁₆
000A ₁₆	Protect Register	PRCR	XXXX 0000 ₂
000B ₁₆	External Data Bus Width Control Register ⁽²⁾	DS	XXXX 1000 ₂ (BYTE pin ="L") XXXX 0000 ₂ (BYTE pin ="H")
000C ₁₆	Main Clock Division Register	MCD	XXX0 1000 ₂
000D ₁₆	Oscillation Stop Detection Register	CM2	00 ₁₆
000E ₁₆	Watchdog Timer Start Register	WDTs	XX ₁₆
000F ₁₆	Watchdog Timer Control Register	WDC	000X XXXX ₂
0010 ₁₆	Address Match Interrupt Register 0	RMAD0	000000 ₁₆
0011 ₁₆			
0012 ₁₆			
0013 ₁₆	Processor Mode Register 2	PM2	00 ₁₆
0014 ₁₆	Address Match Interrupt Register 1	RMAD1	000000 ₁₆
0015 ₁₆			
0016 ₁₆			
0017 ₁₆	Voltage Detection Register 2 ⁽²⁾	VCR2	00 ₁₆
0018 ₁₆	Address Match Interrupt Register 2	RMAD2	000000 ₁₆
0019 ₁₆			
001A ₁₆			
001B ₁₆	Voltage Detection Register 1 ⁽²⁾	VCR1	0000 1000 ₂
001C ₁₆	Address Match Interrupt Register 3	RMAD3	000000 ₁₆
001D ₁₆			
001E ₁₆			
001F ₁₆			
0020 ₁₆			
0021 ₁₆			
0022 ₁₆			
0023 ₁₆			
0024 ₁₆			
0025 ₁₆			
0026 ₁₆	PLL Control Register 0	PLC0	0001 X010 ₂
0027 ₁₆	PLL Control Register 1	PLC1	000X 0000 ₂
0028 ₁₆	Address Match Interrupt Register 4	RMAD4	000000 ₁₆
0029 ₁₆			
002A ₁₆			
002B ₁₆			
002C ₁₆	Address Match Interrupt Register 5	RMAD5	000000 ₁₆
002D ₁₆			
002E ₁₆			
002F ₁₆	Voltage Down Detection Interrupt Register ⁽²⁾	D4INT	00 ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTES:

1. The PM00 and PM01 bits in the PM1 register maintain values set before reset even if software reset or watchdog timer reset is performed.
2. These registers in M32C/84T cannot be used.

Address	Register	Symbol	Value after RESET
0030 ₁₆			
0031 ₁₆			
0032 ₁₆			
0033 ₁₆			
0034 ₁₆			
0035 ₁₆			
0036 ₁₆			
0037 ₁₆			
0038 ₁₆	Address Match Interrupt Register 6	RMAD6	000000 ₁₆
0039 ₁₆			
003A ₁₆			
003B ₁₆			
003C ₁₆	Address Match Interrupt Register 7	RMAD7	000000 ₁₆
003D ₁₆			
003E ₁₆			
003F ₁₆			
0040 ₁₆			
0041 ₁₆			
0042 ₁₆			
0043 ₁₆			
0044 ₁₆			
0045 ₁₆			
0046 ₁₆			
0047 ₁₆			
0048 ₁₆	External Space Wait Control Register 0 ⁽¹⁾	EWCR0	X0X0 0011 ₂
0049 ₁₆	External Space Wait Control Register 1 ⁽¹⁾	EWCR1	X0X0 0011 ₂
004A ₁₆	External Space Wait Control Register 2 ⁽¹⁾	EWCR2	X0X0 0011 ₂
004B ₁₆	External Space Wait Control Register 3 ⁽¹⁾	EWCR3	X0X0 0011 ₂
004C ₁₆			
004D ₁₆			
004E ₁₆			
004F ₁₆			
0050 ₁₆			
0051 ₁₆			
0052 ₁₆			
0053 ₁₆			
0054 ₁₆			
0055 ₁₆	Flash Memory Control Register 1	FMR1	0000 0101 ₂
0056 ₁₆			
0057 ₁₆	Flash Memory Control Register 0	FMR0	0000 0001 ₂ (Flash memory version) XXXX XXX0 ₂ (Masked ROM version)
0058 ₁₆			
0059 ₁₆			
005A ₁₆			
005B ₁₆			
005C ₁₆			
005D ₁₆			
005E ₁₆			
005F ₁₆			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTES:

1. These registers in M32C/84T cannot be used.

Address	Register	Symbol	Value after RESET
0060 ₁₆			
0061 ₁₆			
0062 ₁₆			
0063 ₁₆			
0064 ₁₆			
0065 ₁₆			
0066 ₁₆			
0067 ₁₆			
0068 ₁₆	DMA0 Interrupt Control Register	DM0IC	XXXX X000 ₂
0069 ₁₆	Timer B5 Interrupt Control Register	TB5IC	XXXX X000 ₂
006A ₁₆	DMA2 Interrupt Control Register	DM2IC	XXXX X000 ₂
006B ₁₆	UART2 Receive /ACK Interrupt Control Register	S2RIC	XXXX X000 ₂
006C ₁₆	Timer A0 Interrupt Control Register	TA0IC	XXXX X000 ₂
006D ₁₆	UART3 Receive /ACK Interrupt Control Register	S3RIC	XXXX X000 ₂
006E ₁₆	Timer A2 Interrupt Control Register	TA2IC	XXXX X000 ₂
006F ₁₆	UART4 Receive /ACK Interrupt Control Register	S4RIC	XXXX X000 ₂
0070 ₁₆	Timer A4 Interrupt Control Register	TA4IC	XXXX X000 ₂
0071 ₁₆	UART0/UART3 Bus Conflict Detect Interrupt Control Register	BCN0IC/BCN3IC	XXXX X000 ₂
0072 ₁₆	UART0 Receive/ACK Interrupt Control Register	S0RIC	XXXX X000 ₂
0073 ₁₆	A/D0 Conversion Interrupt Control Register	AD0IC	XXXX X000 ₂
0074 ₁₆	UART1 Receive/ACK Interrupt Control Register	S1RIC	XXXX X000 ₂
0075 ₁₆	Intelligent I/O Interrupt Control Register 0	IIO0IC	XXXX X000 ₂
0076 ₁₆	Timer B1 Interrupt Control Register	TB1IC	XXXX X000 ₂
0077 ₁₆	Intelligent I/O Interrupt Control Register 2	IIO2IC	XXXX X000 ₂
0078 ₁₆	Timer B3 Interrupt Control Register	TB3IC	XXXX X000 ₂
0079 ₁₆	Intelligent I/O Interrupt Control Register 4	IIO4IC	XXXX X000 ₂
007A ₁₆	INT5 Interrupt Control Register	INT5IC	XX00 X000 ₂
007B ₁₆			
007C ₁₆	INT3 Interrupt Control Register	INT3IC	XX00 X000 ₂
007D ₁₆	Intelligent I/O Interrupt Control Register 8	IIO8IC	XXXX X000 ₂
007E ₁₆	INT1 Interrupt Control Register	INT1IC	XX00 X000 ₂
007F ₁₆	Intelligent I/O Interrupt Control Register 10/ CAN Interrupt 1 Control Register	IIO10IC CAN1IC	XXXX X000 ₂
0080 ₁₆			
0081 ₁₆	CAN Interrupt 2 Control Register	CAN2IC	XXXX X000 ₂
0082 ₁₆			
0083 ₁₆			
0084 ₁₆			
0085 ₁₆			
0086 ₁₆			
0087 ₁₆			
0088 ₁₆	DMA1 Interrupt Control Register	DM1IC	XXXX X000 ₂
0089 ₁₆	UART2 Transmit /NACK Interrupt Control Register	S2TIC	XXXX X000 ₂
008A ₁₆	DMA3 Interrupt Control Register	DM3IC	XXXX X000 ₂
008B ₁₆	UART3 Transmit /NACK Interrupt Control Register	S3TIC	XXXX X000 ₂
008C ₁₆	Timer A1 Interrupt Control Register	TA1IC	XXXX X000 ₂
008D ₁₆	UART4 Transmit /NACK Interrupt Control Register	S4TIC	XXXX X000 ₂
008E ₁₆	Timer A3 Interrupt Control Register	TA3IC	XXXX X000 ₂
008F ₁₆	UART2 Bus Conflict Detect Interrupt Control Register	BCN2IC	XXXX X000 ₂

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0090 ₁₆	UART0 Transmit /NACK Interrupt Control Register	S0TIC	XXXX X000 ₂
0091 ₁₆	UART1/UART4 Bus Conflict Detect Interrupt Control Register	BCN1IC/BCN4IC	XXXX X000 ₂
0092 ₁₆	UART1 Transmit/NACK Interrupt Control Register	S1TIC	XXXX X000 ₂
0093 ₁₆	Key Input Interrupt Control Register	KUPIC	XXXX X000 ₂
0094 ₁₆	Timer B0 Interrupt Control Register	TB0IC	XXXX X000 ₂
0095 ₁₆	Intelligent I/O Interrupt Control Register 1	IIO1IC	XXXX X000 ₂
0096 ₁₆	Timer B2 Interrupt Control Register	TB2IC	XXXX X000 ₂
0097 ₁₆	Intelligent I/O Interrupt Control Register 3	IIO3IC	XXXX X000 ₂
0098 ₁₆	Timer B4 Interrupt Control Register	TB4IC	XXXX X000 ₂
0099 ₁₆			
009A ₁₆	INT4 Interrupt Control Register	INT4IC	XX00 X000 ₂
009B ₁₆			
009C ₁₆	INT2 Interrupt Control Register	INT2IC	XX00 X000 ₂
009D ₁₆	Intelligent I/O Interrupt Control Register 9/ CAN Interrupt 0 Control Register	IIO9IC CAN0IC	XXXX X000 ₂
009E ₁₆	INT0 Interrupt Control Register	INT0IC	XX00 X000 ₂
009F ₁₆	Exit Priority Control Register	RLVL	XXXX 0000 ₂
00A0 ₁₆	Interrupt Request Register 0	IIO0IR	0000 000X ₂
00A1 ₁₆	Interrupt Request Register 1	IIO1IR	0000 000X ₂
00A2 ₁₆	Interrupt Request Register 2	IIO2IR	0000 000X ₂
00A3 ₁₆	Interrupt Request Register 3	IIO3IR	0000 000X ₂
00A4 ₁₆	Interrupt Request Register 4	IIO4IR	0000 000X ₂
00A5 ₁₆			
00A6 ₁₆			
00A7 ₁₆			
00A8 ₁₆	Interrupt Request Register 8	IIO8IR	0000 000X ₂
00A9 ₁₆	Interrupt Request Register 9	IIO9IR	0000 000X ₂
00AA ₁₆	Interrupt Request Register 10	IIO10IR	0000 000X ₂
00AB ₁₆	Interrupt Request Register 11	IIO11IR	0000 000X ₂
00AC ₁₆			
00AD ₁₆			
00AE ₁₆			
00AF ₁₆			
00B0 ₁₆	Interrupt Enable Register 0	IIO0IE	00 ₁₆
00B1 ₁₆	Interrupt Enable Register 1	IIO1IE	00 ₁₆
00B2 ₁₆	Interrupt Enable Register 2	IIO2IE	00 ₁₆
00B3 ₁₆	Interrupt Enable Register 3	IIO3IE	00 ₁₆
00B4 ₁₆	Interrupt Enable Register 4	IIO4IE	00 ₁₆
00B5 ₁₆			
00B6 ₁₆			
00B7 ₁₆			
00B8 ₁₆	Interrupt Enable Register 8	IIO8IE	00 ₁₆
00B9 ₁₆	Interrupt Enable Register 9	IIO9IE	00 ₁₆
00BA ₁₆	Interrupt Enable Register 10	IIO10IE	00 ₁₆
00BB ₁₆	Interrupt Enable Register 11	IIO11IE	00 ₁₆
00BC ₁₆			
00BD ₁₆			
00BE ₁₆			
00BF ₁₆			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

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

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
00F0 ₁₆	Data Compare Register 00	G0CMP0	XX ₁₆
00F1 ₁₆	Data Compare Register 01	G0CMP1	XX ₁₆
00F2 ₁₆	Data Compare Register 02	G0CMP2	XX ₁₆
00F3 ₁₆	Data Compare Register 03	G0CMP3	XX ₁₆
00F4 ₁₆	Data Mask Register 00	G0MSK0	XX ₁₆
00F5 ₁₆	Data Mask Register 01	G0MSK1	XX ₁₆
00F6 ₁₆	Communication Clock Select Register	CCS	XXXX 0000 ₂
00F7 ₁₆			
00F8 ₁₆	Receive CRC Code Register 0	G0RCRC	XX ₁₆
00F9 ₁₆			XX ₁₆
00FA ₁₆	Transmit CRC Code Register 0	G0TCRC	00 ₁₆
00FB ₁₆			00 ₁₆
00FC ₁₆	SI/O Extended Mode Register 0	G0EMR	00 ₁₆
00FD ₁₆	SI/O Extended Receive Control Register 0	G0ERC	00 ₁₆
00FE ₁₆	SI/O Special Communication Interrupt Detect Register 0	G0IRF	00 ₁₆
00FF ₁₆	SI/O Extended Transmit Control Register 0	G0ETC	0000 0XXX ₂
0100 ₁₆	Time Measurement/Waveform Generating Register 10	G1TM0/G1PO0	XX ₁₆
0101 ₁₆			XX ₁₆
0102 ₁₆	Time Measurement/Waveform Generating Register 11	G1TM1/G1PO1	XX ₁₆
0103 ₁₆			XX ₁₆
0104 ₁₆	Time Measurement/Waveform Generating Register 12	G1TM2/G1PO2	XX ₁₆
0105 ₁₆			XX ₁₆
0106 ₁₆	Time Measurement/Waveform Generating Register 13	G1TM3/G1PO3	XX ₁₆
0107 ₁₆			XX ₁₆
0108 ₁₆	Time Measurement/Waveform Generating Register 14	G1TM4/G1PO4	XX ₁₆
0109 ₁₆			XX ₁₆
010A ₁₆	Time Measurement/Waveform Generating Register 15	G1TM5/G1PO5	XX ₁₆
010B ₁₆			XX ₁₆
010C ₁₆	Time Measurement/Waveform Generating Register 16	G1TM6/G1PO6	XX ₁₆
010D ₁₆			XX ₁₆
010E ₁₆	Time Measurement/Waveform Generating Register 17	G1TM7/G1PO7	XX ₁₆
010F ₁₆			XX ₁₆
0110 ₁₆	Waveform Generating Control Register 10	G1POCR0	0000 X000 ₂
0111 ₁₆	Waveform Generating Control Register 11	G1POCR1	0X00 X000 ₂
0112 ₁₆	Waveform Generating Control Register 12	G1POCR2	0X00 X000 ₂
0113 ₁₆	Waveform Generating Control Register 13	G1POCR3	0X00 X000 ₂
0114 ₁₆	Waveform Generating Control Register 14	G1POCR4	0X00 X000 ₂
0115 ₁₆	Waveform Generating Control Register 15	G1POCR5	0X00 X000 ₂
0116 ₁₆	Waveform Generating Control Register 16	G1POCR6	0X00 X000 ₂
0117 ₁₆	Waveform Generating Control Register 17	G1POCR7	0X00 X000 ₂
0118 ₁₆	Time Measurement Control Register 10	G1TMCR0	00 ₁₆
0119 ₁₆	Time Measurement Control Register 11	G1TMCR1	00 ₁₆
011A ₁₆	Time Measurement Control Register 12	G1TMCR2	00 ₁₆
011B ₁₆	Time Measurement Control Register 13	G1TMCR3	00 ₁₆
011C ₁₆	Time Measurement Control Register 14	G1TMCR4	00 ₁₆
011D ₁₆	Time Measurement Control Register 15	G1TMCR5	00 ₁₆
011E ₁₆	Time Measurement Control Register 16	G1TMCR6	00 ₁₆
011F ₁₆	Time Measurement Control Register 17	G1TMCR7	00 ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0120 ₁₆ 0121 ₁₆	Base Timer Register 1	G1BT	XX ₁₆ XX ₁₆
0122 ₁₆	Base Timer Control Register 10	G1BCR0	00 ₁₆
0123 ₁₆	Base Timer Control Register 11	G1BCR1	00 ₁₆
0124 ₁₆	Time Measurement Prescaler Register 16	G1TPR6	00 ₁₆
0125 ₁₆	Time Measurement Prescaler Register 17	G1TPR7	00 ₁₆
0126 ₁₆	Function Enable Register 1	G1FE	00 ₁₆
0127 ₁₆	Function Select Register 1	G1FS	00 ₁₆
0128 ₁₆ 0129 ₁₆	SI/O Receive Buffer Register 1	G1RB	XXXX XXXX ₂ XX00 XXXX ₂
012A ₁₆ 012B ₁₆	Transmit Buffer/Receive Data Register 1	G1TB/G1DR	XX ₁₆
012C ₁₆	Receive Input Register 1	G1RI	XX ₁₆
012D ₁₆	SI/O Communication Mode Register 1	G1MR	00 ₁₆
012E ₁₆	Transmit Output Register 1	G1TO	XX ₁₆
012F ₁₆	SI/O Communication Control Register 1	G1CR	0000 X011 ₂
0130 ₁₆	Data Compare Register 10	G1CMP0	XX ₁₆
0131 ₁₆	Data Compare Register 11	G1CMP1	XX ₁₆
0132 ₁₆	Data Compare Register 12	G1CMP2	XX ₁₆
0133 ₁₆	Data Compare Register 13	G1CMP3	XX ₁₆
0134 ₁₆	Data Mask Register 10	G1MSK0	XX ₁₆
0135 ₁₆	Data Mask Register 11	G1MSK1	XX ₁₆
0136 ₁₆			
0137 ₁₆			
0138 ₁₆ 0139 ₁₆	Receive CRC Code Register 1	G1RCRC	XX ₁₆ XX ₁₆
013A ₁₆ 013B ₁₆	Transmit CRC Code Register 1	G1TCRC	00 ₁₆ 00 ₁₆
013C ₁₆	SI/O Extended Mode Register 1	G1EMR	00 ₁₆
013D ₁₆	SI/O Extended Receive Control Register 1	G1ERC	00 ₁₆
013E ₁₆	SI/O Special Communication Interrupt Detect Register 1	G1IRF	00 ₁₆
013F ₁₆	SI/O Extended Transmit Control Register 1	G1ETC	0000 0XXX ₂
0140 ₁₆			
0141 ₁₆			
0142 ₁₆			
0143 ₁₆			
0144 ₁₆			
0145 ₁₆			
0146 ₁₆			
0147 ₁₆			
0148 ₁₆			
0149 ₁₆			
014A ₁₆			
014B ₁₆			
014C ₁₆			
014D ₁₆			
014E ₁₆			
014F ₁₆			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0150 ₁₆			
0151 ₁₆			
0152 ₁₆			
0153 ₁₆			
0154 ₁₆			
0155 ₁₆			
0156 ₁₆			
0157 ₁₆			
0158 ₁₆			
0159 ₁₆			
015A ₁₆			
015B ₁₆			
015C ₁₆			
015D ₁₆			
015E ₁₆			
015F ₁₆			
0160 ₁₆			
0161 ₁₆			
0162 ₁₆			
0163 ₁₆			
0164 ₁₆			
0165 ₁₆			
0166 ₁₆			
0167 ₁₆			
0168 ₁₆			
0169 ₁₆			
016A ₁₆			
016B ₁₆			
016C ₁₆			
016D ₁₆			
016E ₁₆			
016F ₁₆			
0170 ₁₆			
0171 ₁₆			
0172 ₁₆			
0173 ₁₆			
0174 ₁₆			
0175 ₁₆			
0176 ₁₆			
0177 ₁₆			
0178 ₁₆	Input Function Select Register	IPS	00 ₁₆
0179 ₁₆	Input Function Select Register A	IPSA	00 ₁₆
017A ₁₆			
017B ₁₆			
017C ₁₆			
017D ₁₆ to 01DF ₁₆			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
01E0 ₁₆	CAN0 Message Slot Buffer 0 Standard ID0	C0SLOT0_0	XX ₁₆
01E1 ₁₆	CAN0 Message Slot Buffer 0 Standard ID1	C0SLOT0_1	XX ₁₆
01E2 ₁₆	CAN0 Message Slot Buffer 0 Extended ID0	C0SLOT0_2	XX ₁₆
01E3 ₁₆	CAN0 Message Slot Buffer 0 Extended ID1	C0SLOT0_3	XX ₁₆
01E4 ₁₆	CAN0 Message Slot Buffer 0 Extended ID2	C0SLOT0_4	XX ₁₆
01E5 ₁₆	CAN0 Message Slot Buffer 0 Data Length Code	C0SLOT0_5	XX ₁₆
01E6 ₁₆	CAN0 Message Slot Buffer 0 Data 0	C0SLOT0_6	XX ₁₆
01E7 ₁₆	CAN0 Message Slot Buffer 0 Data 1	C0SLOT0_7	XX ₁₆
01E8 ₁₆	CAN0 Message Slot Buffer 0 Data 2	C0SLOT0_8	XX ₁₆
01E9 ₁₆	CAN0 Message Slot Buffer 0 Data 3	C0SLOT0_9	XX ₁₆
01EA ₁₆	CAN0 Message Slot Buffer 0 Data 4	C0SLOT0_10	XX ₁₆
01EB ₁₆	CAN0 Message Slot Buffer 0 Data 5	C0SLOT0_11	XX ₁₆
01EC ₁₆	CAN0 Message Slot Buffer 0 Data 6	C0SLOT0_12	XX ₁₆
01ED ₁₆	CAN0 Message Slot Buffer 0 Data 7	C0SLOT0_13	XX ₁₆
01EE ₁₆	CAN0 Message Slot Buffer 0 Time Stamp High-Order	C0SLOT0_14	XX ₁₆
01EF ₁₆	CAN0 Message Slot Buffer 0 Time Stamp Low-Order	C0SLOT0_15	XX ₁₆
01F0 ₁₆	CAN0 Message Slot Buffer 1 Standard ID0	C0SLOT1_0	XX ₁₆
01F1 ₁₆	CAN0 Message Slot Buffer 1 Standard ID1	C0SLOT1_1	XX ₁₆
01F2 ₁₆	CAN0 Message Slot Buffer 1 Extended ID0	C0SLOT1_2	XX ₁₆
01F3 ₁₆	CAN0 Message Slot Buffer 1 Extended ID1	C0SLOT1_3	XX ₁₆
01F4 ₁₆	CAN0 Message Slot Buffer 1 Extended ID2	C0SLOT1_4	XX ₁₆
01F5 ₁₆	CAN0 Message Slot Buffer 1 Data Length Code	C0SLOT1_5	XX ₁₆
01F6 ₁₆	CAN0 Message Slot Buffer 1 Data 0	C0SLOT1_6	XX ₁₆
01F7 ₁₆	CAN0 Message Slot Buffer 1 Data 1	C0SLOT1_7	XX ₁₆
01F8 ₁₆	CAN0 Message Slot Buffer 1 Data 2	C0SLOT1_8	XX ₁₆
01F9 ₁₆	CAN0 Message Slot Buffer 1 Data 3	C0SLOT1_9	XX ₁₆
01FA ₁₆	CAN0 Message Slot Buffer 1 Data 4	C0SLOT1_10	XX ₁₆
01FB ₁₆	CAN0 Message Slot Buffer 1 Data 5	C0SLOT1_11	XX ₁₆
01FC ₁₆	CAN0 Message Slot Buffer 1 Data 6	C0SLOT1_12	XX ₁₆
01FD ₁₆	CAN0 Message Slot Buffer 1 Data 7	C0SLOT1_13	XX ₁₆
01FE ₁₆	CAN0 Message Slot Buffer 1 Time Stamp High-Order	C0SLOT1_14	XX ₁₆
01FF ₁₆	CAN0 Message Slot Buffer 1 Time Stamp Low-Order	C0SLOT1_15	XX ₁₆
0200 ₁₆ 0201 ₁₆	CAN0 Control Register 0	C0CTRL0	XX01 0X01 ₂ ⁽¹⁾ XXXX 0000 ₂ ⁽¹⁾
0202 ₁₆ 0203 ₁₆	CAN0 Status Register	C0STR	0000 0000 ₂ ⁽¹⁾ X000 0X01 ₂ ⁽¹⁾
0204 ₁₆ 0205 ₁₆	CAN0 Extended ID Register	C0IDR	00 ₁₆ ⁽¹⁾ 00 ₁₆ ⁽¹⁾
0206 ₁₆ 0207 ₁₆	CAN0 Configuration Register	C0CONR	0000 XXXX ₂ ⁽¹⁾ 0000 0000 ₂ ⁽¹⁾
0208 ₁₆ 0209 ₁₆	CAN0 Time Stamp Register	C0TSR	00 ₁₆ ⁽¹⁾ 00 ₁₆ ⁽¹⁾
020A ₁₆	CAN0 Transmit Error Count Register	C0TEC	00 ₁₆ ⁽¹⁾
020B ₁₆	CAN0 Receive Error Count Register	C0REC	00 ₁₆ ⁽¹⁾
020C ₁₆ 020D ₁₆	CAN0 Slot Interrupt Status Register	C0SISTR	00 ₁₆ ⁽¹⁾ 00 ₁₆ ⁽¹⁾
020E ₁₆			
020F ₁₆			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTES:

1. Values are obtained by setting the SLEEP bit in the C0SLPR register to "1" (sleep mode exited) and supplying a clock to the CAN module after reset

Address	Register	Symbol	Value after RESET
0210 ₁₆	CAN0 Slot Interrupt Mask Register	C0SIMKR	00 ₁₆ ⁽²⁾
0211 ₁₆			00 ₁₆ ⁽²⁾
0212 ₁₆			
0213 ₁₆			
0214 ₁₆	CAN0 Error Interrupt Mask Register	C0EIMKR	XXXX X000 ₂ ⁽²⁾
0215 ₁₆	CAN0 Error Interrupt Status Register	C0EISTR	XXXX X000 ₂ ⁽²⁾
0216 ₁₆	CAN0 Error Cause Register	C0EFR	00 ₁₆ ⁽²⁾
0217 ₁₆	CAN0 Baud Rate Prescaler	C0BRP	0000 0001 ₂ ⁽²⁾
0218 ₁₆			
0219 ₁₆	CAN0 Mode Register	C0MDR	XXXX XX00 ₂ ⁽²⁾
021A ₁₆			
021B ₁₆			
021C ₁₆			
021D ₁₆			
021E ₁₆			
021F ₁₆			
0220 ₁₆	CAN0 Single Shot Control Register	C0SSCTLR	00 ₁₆ ⁽²⁾
0221 ₁₆			00 ₁₆ ⁽²⁾
0222 ₁₆			
0223 ₁₆			
0224 ₁₆	CAN0 Single Shot Status Register	C0SSSTR	00 ₁₆ ⁽²⁾
0225 ₁₆			00 ₁₆ ⁽²⁾
0226 ₁₆			
0227 ₁₆			
0228 ₁₆	CAN0 Global Mask Register Standard ID0	C0GMR0	XXX0 0000 ₂ ⁽²⁾
0229 ₁₆	CAN0 Global Mask Register Standard ID1	C0GMR1	XX00 0000 ₂ ⁽²⁾
022A ₁₆	CAN0 Global Mask Register Extended ID0	C0GMR2	XXXX 0000 ₂ ⁽²⁾
022B ₁₆	CAN0 Global Mask Register Extended ID1	C0GMR3	00 ₁₆ ⁽²⁾
022C ₁₆	CAN0 Global Mask Register Extended ID2	C0GMR4	XX00 0000 ₂ ⁽²⁾
022D ₁₆			
022E ₁₆			
022F ₁₆			
0230 ₁₆	CAN0 Message Slot 0 Control Register / CAN0 Local Mask Register A Standard ID0	C0MCTL0/ C0LMAR0	0000 0000 ₂ ⁽²⁾ XXX0 0000 ₂ ⁽²⁾
0231 ₁₆	CAN0 Message Slot 1 Control Register / CAN0 Local Mask Register A Standard ID1	C0MCTL1/ C0LMAR1	0000 0000 ₂ ⁽²⁾ XX00 0000 ₂ ⁽²⁾
0232 ₁₆	CAN0 Message Slot 2 Control Register / CAN0 Local Mask Register A Extended ID0	C0MCTL2/ C0LMAR2	0000 0000 ₂ ⁽²⁾ XXXX 0000 ₂ ⁽²⁾
0233 ₁₆	CAN0 Message Slot 3 Control Register / CAN0 local Mask Register A Extended ID1	C0MCTL3/ C0LMAR3	00 ₁₆ ⁽²⁾ 00 ₁₆ ⁽²⁾
0234 ₁₆	CAN0 Message Slot 4 Control Register / CAN0 Local Mask Register A Extended ID2	C0MCTL4/ C0LMAR4	0000 0000 ₂ ⁽²⁾ XX00 0000 ₂ ⁽²⁾
0235 ₁₆	CAN0 Message Slot 5 Control Register	C0MCTL5	00 ₁₆ ⁽²⁾
0236 ₁₆	CAN0 Message Slot 6 Control Register	C0MCTL6	00 ₁₆ ⁽²⁾
0237 ₁₆	CAN0 Message Slot 7 Control Register	C0MCTL7	00 ₁₆ ⁽²⁾
0238 ₁₆	CAN0 Message Slot 8 Control Register / CAN0 Local Mask Register B Standard ID0	C0MCTL8/ C0LMBR0	0000 0000 ₂ ⁽²⁾ XXX0 0000 ₂ ⁽²⁾

(Note 1)

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTES:

1. The BANKSEL bit in the C0CTLR1 register switches functions for addresses 0220₁₆ to 023F₁₆.
2. Values are obtained by setting the SLEEP bit in the C0SLPR register to "1" (sleep mode exited) and supplying a clock to the CAN module after reset.

Address	Register	Symbol	Value after RESET	
0239 ₁₆	CAN0 Message Slot 9 Control Register / CAN0 Local Mask Register B Standard ID1	C0MCTL9/ C0LMBR1	0000 0000 ₂ ⁽²⁾ XX00 0000 ₂ ⁽²⁾	↑ (Note 1) ↓
023A ₁₆	CAN0 Message Slot 10 Control Register / CAN0 Local Mask Register B Extended ID0	C0MCTL10/ C0LMBR2	0000 0000 ₂ ⁽²⁾ XXXX 0000 ₂ ⁽²⁾	
023B ₁₆	CAN0 Message Slot 11 Control Register / CAN0 Local Mask Register B Extended ID1	C0MCTL11/ C0LMBR3	00 ₁₆ ⁽²⁾ 00 ₁₆ ⁽²⁾	
023C ₁₆	CAN0 Message Slot 12 Control Register / CAN0 Local Mask Register B Extended ID2	C0MCTL12/ C0LMBR4	0000 0000 ₂ ⁽²⁾ XX00 0000 ₂ ⁽²⁾	
023D ₁₆	CAN0 Message Slot 13 Control Register	C0MCTL13	00 ₁₆ ⁽²⁾	
023E ₁₆	CAN0 Message Slot 14 Control Register	C0MCTL14	00 ₁₆ ⁽²⁾	
023F ₁₆	CAN0 Message Slot 15 Control Register	C0MCTL15	00 ₁₆ ⁽²⁾	
0240 ₁₆	CAN0 Slot Buffer Select Register	C0SBS	00 ₁₆ ⁽²⁾	
0241 ₁₆	CAN0 Control Register 1	C0CTLR1	X000 00XX ₂ ⁽²⁾	
0242 ₁₆	CAN0 Sleep Control Register	C0SLPR	XXXX XXX0 ₂	
0243 ₁₆				
0244 ₁₆	CAN0 Acceptance Filter Support Register	C0AFS	00 ₁₆ ⁽²⁾	
0245 ₁₆			01 ₁₆ ⁽²⁾	
0246 ₁₆				
0247 ₁₆				
0248 ₁₆				
0249 ₁₆				
024A ₁₆				
024B ₁₆				
024C ₁₆				
024D ₁₆				
024E ₁₆				
024F ₁₆				
0250 ₁₆				
0251 ₁₆				
0252 ₁₆				
0253 ₁₆				
0254 ₁₆				
0255 ₁₆				
0256 ₁₆				
0257 ₁₆				
0258 ₁₆				
0259 ₁₆				
025A ₁₆				
025B ₁₆				
025C ₁₆				
025D ₁₆ to 02BF ₁₆				

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTES:

1. The BANKSEL bit in the C0CTLR1 register switches functions for addresses 0220₁₆ to 023F₁₆.
2. Values are obtained by setting the SLEEP bit in the C0SLPR register to "1" (sleep mode exited) and supplying a clock to the CAN module after reset.

Address	Register	Symbol	Value after RESET
02C0 ₁₆ 02C1 ₁₆	X0 Register Y0 Register	X0R,Y0R	XX ₁₆ XX ₁₆
02C2 ₁₆ 02C3 ₁₆	X1 Register Y1 Register	X1R,Y1R	XX ₁₆ XX ₁₆
02C4 ₁₆ 02C5 ₁₆	X2 Register Y2 Register	X2R,Y2R	XX ₁₆ XX ₁₆
02C6 ₁₆ 02C7 ₁₆	X3 Register Y3 Register	X3R,Y3R	XX ₁₆ XX ₁₆
02C8 ₁₆ 02C9 ₁₆	X4 Register Y4 Register	X4R,Y4R	XX ₁₆ XX ₁₆
02CA ₁₆ 02CB ₁₆	X5 Register Y5 Register	X5R,Y5R	XX ₁₆ XX ₁₆
02CC ₁₆ 02CD ₁₆	X6 Register Y6 Register	X6R,Y6R	XX ₁₆ XX ₁₆
02CE ₁₆ 02CF ₁₆	X7 Register Y7 Register	X7R,Y7R	XX ₁₆ XX ₁₆
02D0 ₁₆ 02D1 ₁₆	X8 Register Y8 Register	X8R,Y8R	XX ₁₆ XX ₁₆
02D2 ₁₆ 02D3 ₁₆	X9 Register Y9 Register	X9R,Y9R	XX ₁₆ XX ₁₆
02D4 ₁₆ 02D5 ₁₆	X10 Register Y10 Register	X10R,Y10R	XX ₁₆ XX ₁₆
02D6 ₁₆ 02D7 ₁₆	X11 Register Y11 Register	X11R,Y11R	XX ₁₆ XX ₁₆
02D8 ₁₆ 02D9 ₁₆	X12 Register Y12 Register	X12R,Y12R	XX ₁₆ XX ₁₆
02DA ₁₆ 02DB ₁₆	X13 Register Y13 Register	X13R,Y13R	XX ₁₆ XX ₁₆
02DC ₁₆ 02DD ₁₆	X14 Register Y14 Register	X14R,Y14R	XX ₁₆ XX ₁₆
02DE ₁₆ 02DF ₁₆	X15 Register Y15 Register	X15R,Y15R	XX ₁₆ XX ₁₆
02E0 ₁₆	XY Control Register	XYC	XXXX XX00 ₂
02E1 ₁₆			
02E2 ₁₆			
02E3 ₁₆			
02E4 ₁₆	UART1 Special Mode Register 4	U1SMR4	00 ₁₆
02E5 ₁₆	UART1 Special Mode Register 3	U1SMR3	00 ₁₆
02E6 ₁₆	UART1 Special Mode Register 2	U1SMR2	00 ₁₆
02E7 ₁₆	UART1 Special Mode Register	U1SMR	00 ₁₆
02E8 ₁₆	UART1 Transmit/Receive Mode Register	U1MR	00 ₁₆
02E9 ₁₆	UART1 Baud Rate Register	U1BRG	XX ₁₆
02EA ₁₆ 02EB ₁₆	UART1 Transmit Buffer Register	U1TB	XX ₁₆ XX ₁₆
02EC ₁₆	UART1 Transmit/Receive Control Register 0	U1C0	0000 1000 ₂
02ED ₁₆	UART1 Transmit/Receive Control Register 1	U1C1	0000 0010 ₂
02EE ₁₆ 02EF ₁₆	UART1 Receive Buffer Register	U1RB	XX ₁₆ XX ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
02F0 ₁₆			
02F1 ₁₆			
02F2 ₁₆			
02F3 ₁₆			
02F4 ₁₆	UART4 Special Mode Register 4	U4SMR4	00 ₁₆
02F5 ₁₆	UART4 Special Mode Register 3	U4SMR3	00 ₁₆
02F6 ₁₆	UART4 Special Mode Register 2	U4SMR2	00 ₁₆
02F7 ₁₆	UART4 Special Mode Register	U4SMR	00 ₁₆
02F8 ₁₆	UART4 Transmit/Receive Mode Register	U4MR	00 ₁₆
02F9 ₁₆	UART4 Baud Rate Register	U4BRG	XX ₁₆
02FA ₁₆	UART4 Transmit Buffer Register	U4TB	XX ₁₆
02FB ₁₆			XX ₁₆
02FC ₁₆	UART4 Transmit/Receive Control Register 0	U4C0	0000 1000 ₂
02FD ₁₆	UART4 Transmit/Receive Control Register 1	U4C1	0000 0010 ₂
02FE ₁₆	UART4 Receive Buffer Register	U4RB	XX ₁₆
02FF ₁₆			XX ₁₆
0300 ₁₆	Timer B3, B4, B5 Count Start Flag	TBSR	000X XXXX ₂
0301 ₁₆			
0302 ₁₆	Timer A1-1 Register	TA11	XX ₁₆
0303 ₁₆			XX ₁₆
0304 ₁₆	Timer A2-1 Register	TA21	XX ₁₆
0305 ₁₆			XX ₁₆
0306 ₁₆	Timer A4-1 Register	TA41	XX ₁₆
0307 ₁₆			XX ₁₆
0308 ₁₆	Three-Phase PWM Control Register 0	INVC0	00 ₁₆
0309 ₁₆	Three-Phase PWM Control Register 1	INVC1	00 ₁₆
030A ₁₆	Three-Phase Output Buffer Register 0	IDB0	0011 1111 ₂
030B ₁₆	Three-Phase Output Buffer Register 1	IDB1	0011 1111 ₂
030C ₁₆	Dead Time Timer	DTT	XX ₁₆
030D ₁₆	Timer B2 Interrupt Generating Frequency Set Counter	ICTB2	XX ₁₆
030E ₁₆			
030F ₁₆			
0310 ₁₆	Timer B3 Register	TB3	XX ₁₆
0311 ₁₆			XX ₁₆
0312 ₁₆	Timer B4 Register	TB4	XX ₁₆
0313 ₁₆			XX ₁₆
0314 ₁₆	Timer B5 Register	TB5	XX ₁₆
0315 ₁₆			XX ₁₆
0316 ₁₆			
0317 ₁₆			
0318 ₁₆			
0319 ₁₆			
031A ₁₆			
031B ₁₆	Timer B3 Mode Register	TB3MR	00XX 0000 ₂
031C ₁₆	Timer B4 Mode Register	TB4MR	00XX 0000 ₂
031D ₁₆	Timer B5 Mode Register	TB5MR	00XX 0000 ₂
031E ₁₆			
031F ₁₆	External Interrupt Cause Select Register	IFSR	00 ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0320 ₁₆			
0321 ₁₆			
0322 ₁₆			
0323 ₁₆			
0324 ₁₆	UART3 Special Mode Register 4	U3SMR4	00 ₁₆
0325 ₁₆	UART3 Special Mode Register 3	U3SMR3	00 ₁₆
0326 ₁₆	UART3 Special Mode Register 2	U3SMR2	00 ₁₆
0327 ₁₆	UART3 Special Mode Register	U3SMR	00 ₁₆
0328 ₁₆	UART3 Transmit/Receive Mode Register	U3MR	00 ₁₆
0329 ₁₆	UART3 Baud Rate Register	U3BRG	XX ₁₆
032A ₁₆	UART3 Transmit Buffer Register	U3TB	XX ₁₆
032B ₁₆			XX ₁₆
032C ₁₆	UART3 Transmit/Receive Control Register 0	U3C0	0000 1000 ₂
032D ₁₆	UART3 Transmit/Receive Control Register 1	U3C1	0000 0010 ₂
032E ₁₆	UART3 Receive Buffer Register	U3RB	XX ₁₆
032F ₁₆			XX ₁₆
0330 ₁₆			
0331 ₁₆			
0332 ₁₆			
0333 ₁₆			
0334 ₁₆	UART2 Special Mode Register 4	U2SMR4	00 ₁₆
0335 ₁₆	UART2 Special Mode Register 3	U2SMR3	00 ₁₆
0336 ₁₆	UART2 Special Mode Register 2	U2SMR2	00 ₁₆
0337 ₁₆	UART2 Special Mode Register	U2SMR	00 ₁₆
0338 ₁₆	UART2 Transmit/Receive Mode Register	U2MR	00 ₁₆
0339 ₁₆	UART2 Baud Rate Register	U2BRG	XX ₁₆
033A ₁₆	UART2 Transmit Buffer Register	U2TB	XX ₁₆
033B ₁₆			XX ₁₆
033C ₁₆	UART2 Transmit/Receive Control Register 0	U2C0	0000 1000 ₂
033D ₁₆	UART2 Transmit/Receive Control Register 1	U2C1	0000 0010 ₂
033E ₁₆	UART2 Receive Buffer Register	U2RB	XX ₁₆
033F ₁₆			XX ₁₆
0340 ₁₆	Count Start Flag	TABSR	00 ₁₆
0341 ₁₆	Clock Prescaler Reset Flag	CPSRF	0XXX XXXX ₂
0342 ₁₆	One-Shot Start Flag	ONSF	00 ₁₆
0343 ₁₆	Trigger Select Register	TRGSR	00 ₁₆
0344 ₁₆	Up-Down Flag	UDF	00 ₁₆
0345 ₁₆			
0346 ₁₆	Timer A0 Register	TA0	XX ₁₆
0347 ₁₆			XX ₁₆
0348 ₁₆	Timer A1 Register	TA1	XX ₁₆
0349 ₁₆			XX ₁₆
034A ₁₆	Timer A2 Register	TA2	XX ₁₆
034B ₁₆			XX ₁₆
034C ₁₆	Timer A3 Register	TA3	XX ₁₆
034D ₁₆			XX ₁₆
034E ₁₆	Timer A4 Register	TA4	XX ₁₆
034F ₁₆			XX ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

Address	Register	Symbol	Value after RESET
0350 ₁₆ 0351 ₁₆	Timer B0 Register	TB0	XX ₁₆ XX ₁₆
0352 ₁₆ 0353 ₁₆	Timer B1 Register	TB1	XX ₁₆ XX ₁₆
0354 ₁₆ 0355 ₁₆	Timer B2 Register	TB2	XX ₁₆ XX ₁₆
0356 ₁₆	Timer A0 Mode Register	TA0MR	00 ₁₆
0357 ₁₆	Timer A1 Mode Register	TA1MR	00 ₁₆
0358 ₁₆	Timer A2 Mode Register	TA2MR	00 ₁₆
0359 ₁₆	Timer A3 Mode Register	TA3MR	00 ₁₆
035A ₁₆	Timer A4 Mode Register	TA4MR	00 ₁₆
035B ₁₆	Timer B0 Mode Register	TB0MR	00XX 0000 ₂
035C ₁₆	Timer B1 Mode Register	TB1MR	00XX 0000 ₂
035D ₁₆	Timer B2 Mode Register	TB2MR	00XX 0000 ₂
035E ₁₆	Timer B2 Special Mode Register	TB2SC	XXXX XXX0 ₂
035F ₁₆	Count Source Prescaler Register ⁽¹⁾	TCSPR	00 ₁₆
0360 ₁₆			
0361 ₁₆			
0362 ₁₆			
0363 ₁₆			
0364 ₁₆	UART0 Special Mode Register 4	U0SMR4	00 ₁₆
0365 ₁₆	UART0 Special Mode Register 3	U0SMR3	00 ₁₆
0366 ₁₆	UART0 Special Mode Register 2	U0SMR2	00 ₁₆
0367 ₁₆	UART0 Special Mode Register	U0SMR	00 ₁₆
0368 ₁₆	UART0 Transmit/Receive Mode Register	U0MR	00 ₁₆
0369 ₁₆	UART0 Baud Rate Register	U0BRG	XX ₁₆
036A ₁₆ 036B ₁₆	UART0 Transmit Buffer Register	U0TB	XX ₁₆ XX ₁₆
036C ₁₆	UART0 Transmit/Receive Control Register 0	U0C0	0000 1000 ₂
036D ₁₆	UART0 Transmit/Receive Control Register 1	U0C1	0000 0010 ₂
036E ₁₆ 036F ₁₆	UART0 Receive Buffer Register	U0RB	XX ₁₆ XX ₁₆
0370 ₁₆			
0371 ₁₆			
0372 ₁₆			
0373 ₁₆			
0374 ₁₆			
0375 ₁₆			
0376 ₁₆			
0377 ₁₆			
0378 ₁₆	DMA0 Factor Select Register	DM0SL	00 ₁₆
0379 ₁₆	DMA1 Factor Select Register	DM1SL	00 ₁₆
037A ₁₆	DMA2 Factor Select Register	DM2SL	00 ₁₆
037B ₁₆	DMA3 Factor Select Register	DM3SL	00 ₁₆
037C ₁₆ 037D ₁₆	CRC Data Register	CRCD	XX ₁₆ XX ₁₆
037E ₁₆ 037F ₁₆	CRC Input Register	CRCIN	XX ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

NOTES:

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
0380 ₁₆ 0381 ₁₆	A/D0 Register 0	AD00	XXXX XXXX ₂ 0000 0000 ₂
0382 ₁₆ 0383 ₁₆	A/D0 Register 1	AD01	XX ₁₆ XX ₁₆
0384 ₁₆ 0385 ₁₆	A/D0 Register 2	AD02	XX ₁₆ XX ₁₆
0386 ₁₆ 0387 ₁₆	A/D0 Register 3	AD03	XX ₁₆ XX ₁₆
0388 ₁₆ 0389 ₁₆	A/D0 Register 4	AD04	XX ₁₆ XX ₁₆
038A ₁₆ 038B ₁₆	A/D0 Register 5	AD05	XX ₁₆ XX ₁₆
038C ₁₆ 038D ₁₆	A/D0 Register 6	AD06	XX ₁₆ XX ₁₆
038E ₁₆ 038F ₁₆	A/D0 Register 7	AD07	XX ₁₆ XX ₁₆
0390 ₁₆			
0391 ₁₆			
0392 ₁₆ 0393 ₁₆	A/D0 Control Register 4	AD0CON4	XXXX 00XX ₂
0394 ₁₆	A/D0 Control Register 2	AD0CON2	XX0X X000 ₂
0395 ₁₆	A/D0 Control Register 3	AD0CON3	XXXX X000 ₂
0396 ₁₆	A/D0 Control Register 0	AD0CON0	00 ₁₆
0397 ₁₆	A/D0 Control Register 1	AD0CON1	00 ₁₆
0398 ₁₆ 0399 ₁₆	D/A Register 0	DA0	XX ₁₆
039A ₁₆ 039B ₁₆	D/A Register 1	DA1	XX ₁₆
039C ₁₆ 039D ₁₆	D/A Control Register	DACON	XXXX XX00 ₂
039E ₁₆			
039F ₁₆			

X: Indeterminate

Blank spaces are reserved. No access is allowed.

<144-pin Package>

Address	Register	Symbol	Value after RESET
03A0 ₁₆	Function Select Register A8	PS8	X000 0000 ₂
03A1 ₁₆	Function Select Register A9	PS9	00 ₁₆
03A2 ₁₆			
03A3 ₁₆			
03A4 ₁₆			
03A5 ₁₆			
03A6 ₁₆			
03A7 ₁₆	Function Select Register D1	PSD1	X0XX XX00 ₂
03A8 ₁₆			
03A9 ₁₆			
03AA ₁₆			
03AB ₁₆			
03AC ₁₆	Function Select Register C2	PSC2	XXXX X00X ₂
03AD ₁₆	Function Select Register C3	PSC3	X0XX XXXX ₂
03AE ₁₆			
03AF ₁₆	Function Select Register C	PSC	00X0 0000 ₂
03B0 ₁₆	Function Select Register A0	PS0	00 ₁₆
03B1 ₁₆	Function Select Register A1	PS1	00 ₁₆
03B2 ₁₆	Function Select Register B0	PSL0	00 ₁₆
03B3 ₁₆	Function Select Register B1	PSL1	00 ₁₆
03B4 ₁₆	Function Select Register A2	PS2	00X0 0000 ₂
03B5 ₁₆	Function Select Register A3	PS3	00 ₁₆
03B6 ₁₆	Function Select Register B2	PSL2	00X0 0000 ₂
03B7 ₁₆	Function Select Register B3	PSL3	00 ₁₆
03B8 ₁₆			
03B9 ₁₆	Function Select Register A5	PS5	XXX0 0000 ₂
03BA ₁₆			
03BB ₁₆			
03BC ₁₆			
03BD ₁₆			
03BE ₁₆			
03BF ₁₆			
03C0 ₁₆	Port P6 Register	P6	XX ₁₆
03C1 ₁₆	Port P7 Register	P7	XX ₁₆
03C2 ₁₆	Port P6 Direction Register	PD6	00 ₁₆
03C3 ₁₆	Port P7 Direction Register	PD7	00 ₁₆
03C4 ₁₆	Port P8 Register	P8	XX ₁₆
03C5 ₁₆	Port P9 Register	P9	XX ₁₆
03C6 ₁₆	Port P8 Direction Register	PD8	00X0 0000 ₂
03C7 ₁₆	Port P9 Direction Register	PD9	00 ₁₆
03C8 ₁₆	Port P10 Register	P10	XX ₁₆
03C9 ₁₆	Port P11 Register	P11	XX ₁₆
03CA ₁₆	Port P10 Direction Register	PD10	00 ₁₆
03CB ₁₆	Port P11 Direction Register	PD11	XXX0 0000 ₂
03CC ₁₆	Port P12 Register	P12	XX ₁₆
03CD ₁₆	Port P13 Register	P13	XX ₁₆
03CE ₁₆	Port P12 Direction Register	PD12	00 ₁₆
03CF ₁₆	Port P13 Direction Register	PD13	00 ₁₆

X: Indeterminate

Blank spaces are reserved. No access is allowed.

<144-pin Package>

Address	Register	Symbol	Value after RESET
03D0 ₁₆	Port P14 Register	P14	XX ₁₆
03D1 ₁₆	Port P15 Register	P15	XX ₁₆
03D2 ₁₆	Port P14 Direction Register	PD14	X000 0000 ₂
03D3 ₁₆	Port P15 Direction Register	PD15	00 ₁₆
03D4 ₁₆			
03D5 ₁₆			
03D6 ₁₆			
03D7 ₁₆			
03D8 ₁₆			
03D9 ₁₆			
03DA ₁₆	Pull-Up Control Register 2	PUR2	00 ₁₆
03DB ₁₆	Pull-Up Control Register 3	PUR3	00 ₁₆
03DC ₁₆	Pull-Up Control Register 4	PUR4	XXXX 0000 ₂
03DD ₁₆			
03DE ₁₆			
03DF ₁₆			
03E0 ₁₆	Port P0 Register	P0	XX ₁₆
03E1 ₁₆	Port P1 Register	P1	XX ₁₆
03E2 ₁₆	Port P0 Direction Register	PD0	00 ₁₆
03E3 ₁₆	Port P1 Direction Register	PD1	00 ₁₆
03E4 ₁₆	Port P2 Register	P2	XX ₁₆
03E5 ₁₆	Port P3 Register	P3	XX ₁₆
03E6 ₁₆	Port P2 Direction Register	PD2	00 ₁₆
03E7 ₁₆	Port P3 Direction Register	PD3	00 ₁₆
03E8 ₁₆	Port P4 Register	P4	XX ₁₆
03E9 ₁₆	Port P5 Register	P5	XX ₁₆
03EA ₁₆	Port P4 Direction Register	PD4	00 ₁₆
03EB ₁₆	Port P5 Direction Register	PD5	00 ₁₆
03EC ₁₆			
03ED ₁₆			
03EE ₁₆			
03EF ₁₆			
03F0 ₁₆	Pull-Up Control Register 0	PUR0	00 ₁₆
03F1 ₁₆	Pull-Up Control Register 1	PUR1	XXXX 0000 ₂
03F2 ₁₆			
03F3 ₁₆			
03F4 ₁₆			
03F5 ₁₆			
03F6 ₁₆			
03F7 ₁₆			
03F8 ₁₆			
03F9 ₁₆			
03FA ₁₆			
03FB ₁₆			
03FC ₁₆			
03FD ₁₆			
03FE ₁₆			
03FF ₁₆	Port Control Register	PCR	XXXX XXX0 ₂

X: Indeterminate

Blank spaces are reserved. No access is allowed.

<100-pin Package>

Address	Register	Symbol	Value after RESET
03A0 ₁₆			
03A1 ₁₆			
03A2 ₁₆			
03A3 ₁₆			
03A4 ₁₆			
03A5 ₁₆			
03A6 ₁₆			
03A7 ₁₆	Function Select Register D1	PSD1	X0XX XX00 ₂
03A8 ₁₆			
03A9 ₁₆			
03AA ₁₆			
03AB ₁₆			
03AC ₁₆	Function Select Register C2	PSC2	XXXX X00X ₂
03AD ₁₆	Function Select Register C3	PSC3	X0XX XXXX ₂
03AE ₁₆			
03AF ₁₆	Function Select Register C	PSC	0X00 0000 ₂
03B0 ₁₆	Function Select Register A0	PS0	00 ₁₆
03B1 ₁₆	Function Select Register A1	PS1	00 ₁₆
03B2 ₁₆	Function Select Register B0	PSL0	00 ₁₆
03B3 ₁₆	Function Select Register B1	PSL1	00 ₁₆
03B4 ₁₆	Function Select Register A2	PS2	00X0 0000 ₂
03B5 ₁₆	Function Select Register A3	PS3	00 ₁₆
03B6 ₁₆	Function Select Register B2	PSL2	00X0 0000 ₂
03B7 ₁₆	Function Select Register B3	PSL3	00 ₁₆
03B8 ₁₆			
03B9 ₁₆			
03BA ₁₆			
03BB ₁₆			
03BC ₁₆			
03BD ₁₆			
03BE ₁₆			
03BF ₁₆			
03C0 ₁₆	Port P6 Register	P6	XX ₁₆
03C1 ₁₆	Port P7 Register	P7	XX ₁₆
03C2 ₁₆	Port P6 Direction Register	PD6	00 ₁₆
03C3 ₁₆	Port P7 Direction Register	PD7	00 ₁₆
03C4 ₁₆	Port P8 Register	P8	XX ₁₆
03C5 ₁₆	Port P9 Register	P9	XX ₁₆
03C6 ₁₆	Port P8 Direction Register	PD8	00X0 0000 ₂
03C7 ₁₆	Port P9 Direction Register	PD9	00 ₁₆
03C8 ₁₆	Port P10 Register	P10	XX ₁₆
03C9 ₁₆			
03CA ₁₆	Port P10 Direction Register	PD10	00 ₁₆
03CB ₁₆	Set default value to "FF ₁₆ "		
03CC ₁₆			
03CD ₁₆			
03CE ₁₆	Set default value to "FF ₁₆ "		
03CF ₁₆	Set default value to "FF ₁₆ "		

X: Indeterminate

Blank spaces are reserved. No access is allowed.

<100-pin Package>

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

X: Indeterminate

Blank spaces are reserved. No access is allowed.

5. Electrical Characteristics

5.1 Electrical Characteristics (M32C/84)

Table 5.1 Absolute Maximum Ratings

Symbol	Parameter		Condition	Value	Unit
V _{CC1} , V _{CC2}	Supply Voltage		V _{CC1} =AV _{CC}	-0.3 to 6.0	V
V _{CC2}	Supply Voltage		-	-0.3 to V _{CC1}	V
AV _{CC}	Analog Supply Voltage		V _{CC1} =AV _{CC}	-0.3 to 6.0	V
V _I	Input Voltage	RESET, CNV _{SS} , BYTE, P60-P67, P72-P77, P80-P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾ , V _{REF} , X _{IN}		-0.3 to V _{CC1} +0.3	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽¹⁾		-0.3 to V _{CC2} +0.3	
		P70, P71		-0.3 to 6.0	
V _O	Output Voltage	P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾ , X _{OUT}		-0.3 to V _{CC1} +0.3	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽¹⁾		-0.3 to V _{CC2} +0.3	
P _d	Power Dissipation		T _{opr} =25° C	500	mW
T _{opr}	Operating Ambient Temperature	during CPU operation		-20 to 85/ -40 to 85 ⁽²⁾	° C
		during flash memory program and erase operation		0 to 60	
T _{stg}	Storage Temperature			-65 to 150	° C

NOTES:

1. P11 to P15 are provided in the 144-pin package only.
2. Contact Renesas Technology Sales Co., Ltd. if temperature range of -40 to 85° C is required.

Table 5.2 Recommended Operating Conditions**(V_{CC1}= V_{CC2}=3.0V to 5.5V at T_{opr}=– 20 to 85°C unless otherwise specified)**

Symbol	Parameter	Standard			Unit
		Min.	Typ.	Max.	
V _{CC1} , V _{CC2}	Supply Voltage (V _{CC1} ≥ V _{CC2})	3.0	5.0	5.5	V
AV _{CC}	Analog Supply Voltage		V _{CC1}		V
V _{SS}	Supply Voltage		0		V
AV _{SS}	Analog Supply Voltage		0		V

Table 5.2 Recommended Operating Conditions (Continued)
(V_{CC1}=V_{CC2}=3.0V to 5.5V at Topr=-20 to 85°C unless otherwise specified)

Symbol	Parameter	Accommodating Pins	Standard			Unit
			Min.	Typ.	Max.	
V _{IH}	Input High ("H") Voltage	P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽⁴⁾	0.8V _{CC2}		V _{CC2}	V
		P60-P67, P72-P77, P80-P87 ⁽³⁾ , P90-P97, P100-P107, P140-P146, P150-P157 ⁽⁴⁾ , X _{IN} , $\overline{\text{RESET}}$, CNV _{SS} , BYTE	0.8V _{CC1}		V _{CC1}	
		P70, P71	0.8V _{CC1}		6.0	
		P00-P07, P10-P17 (in single-chip mode)	0.8V _{CC2}		V _{CC2}	V
		P00-P07, P10-P17 (in memory expansion mode and microprocesor mode)	0.5V _{CC2}		V _{CC2}	V
V _{IL}	Input Low ("L") Voltage	P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽⁴⁾	0		0.2V _{CC2}	V
		P60-P67, P70-P77, P80-P87 ⁽³⁾ , P90-P97, P100-P107, P140-P146, P150-P157 ⁽⁴⁾ , X _{IN} , $\overline{\text{RESET}}$, CNV _{SS} , BYTE	0		0.2V _{CC1}	
		P00-P07, P10-P17 (in single-chip mode)	0		0.2V _{CC2}	V
		P00-P07, P10-P17 (in memory expansion mode and microprocesor mode)	0		0.16V _{CC2}	V
I _{OH(peak)}	Peak Output High ("H") Current ⁽²⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			-10.0	mA
I _{OH(avg)}	Average Output High ("H") Current ⁽¹⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			-5.0	mA
I _{OL(peak)}	Peak Output Low ("L") Current ⁽²⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			10.0	mA
I _{OL(avg)}	Average Output Low ("L") Current ⁽¹⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			5.0	mA

NOTES:

- Typical values when average output current is 100ms.
- Total I_{OL(peak)} for P0, P1, P2, P86, P87, P9, P10, P11, P14 and P15 must be 80mA or less.
 Total I_{OL(peak)} for P3, P4, P5, P6, P7, P80 to P84, P12 and P13 must be 80mA or less.
 Total I_{OH(peak)} for P0, P1, P2, and P11 must be -40mA or less.
 Total I_{OH(peak)} for P86, P87, P9, P10, P14 and P15 must be -40mA or less.
 Total I_{OH(peak)} for P3, P4, P5, P12 and P13 must be -40mA or less.
 Total I_{OH(peak)} for P6, P7, and P80 to P84 must be -40mA or less.
- V_{IH} and V_{IL} reference for P87 applies when P87 is used as a programmable input port.
 It does not apply when P87 is used as X_{CIN}.
- P11 to P15 are provided in the 144-pin package only.

Table 5.2 Recommended Operating Conditions (Continued)
(V_{CC1}=V_{CC2}=3.0V to 5.5V at T_{opr}=−20 to 85°C unless otherwise specified)

Symbol	Parameter		Standard			Unit
			Min.	Typ.	Max.	
f(X _{IN})	Main Clock Input Frequency	V _{CC1} =4.2 to 5.5V	0		32	MHz
		V _{CC1} =3.0 to 5.5V	0		24	MHz
f(X _{CIN})	Sub Clock Frequency			32.768	50	kHz
f(Ring)	On-chip Oscillator Frequency			1		MHz
f(PLL)	PLL Clock Frequency	V _{CC1} =4.2 to 5.5V	10		32	MHz
		V _{CC1} =3.0 to 5.5V	10		24	MHz
t _{SU(PLL)}	PLL Lock Time	V _{CC1} =5.0V			5	ms
		V _{CC1} =3.3V			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 $85^{\circ}C$, $f(X_{IN})=32MHz$ unless otherwise specified)

Symbol		Parameter		Condition	Standard			Unit	
					Min.	Typ.	Max.		
VOH	Output High ("H") Voltage	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137		IOH=-5mA	3.0		VCC2	V	
		P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾		IOH=-5mA	3.0		VCC1		
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137		IOH=-200μA	4.7		VCC2	V	
		P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107,P140-P146, P150-P157 ⁽¹⁾		IOH=-200μA	4.7		VCC1		
		XOUT		IOH=-1mA	3.0			V	
		XCOUT	High Power	No load applied		2.5		V	
			Low Power	No load applied		1.6			
VOL	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾		IOl=5mA			2.0	V	
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾		IOl=200μA			0.45	V	
		XOUT		IOl=1mA			2.0	V	
		XCOUT	High Power	No load applied		0		V	
			Low Power	No load applied		0			
		VT+-VT-	Hysteresis	HOLD, RDY, TA0IN-TA4IN, TB0IN-TB5IN, INT0-INT5, ADTRG, CTS0-CTS4, CLK0-CLK4, TA0OUT-TA4OUT, NMI, KI0-KI3, RxD0-RxD4, SCL0-SCL4, SDA0-SDA4			0.2		1.0
RESET					0.2		1.8	V	
IiH	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾ , XIN, RESET, CNVSS, BYTE		Vi=5V			5.0	μA	
IiL	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾ , XIN, RESET, CNVSS, BYTE		Vi=0V			-5.0	μA	
RPULLUP	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾		Vi=0V	Flash Memory	30	50	167	kΩ
					Masked ROM	20	40	167	kΩ
RfXIN	Feedback Resistance	XIN					1.5		MΩ
RfXCIN	Feedback Resistance	XCIN					10		MΩ
VRAM	RAM Standby Voltage	In stop mode				2.0			V
ICC	Power Supply Current	Measurement conditions: In single-chip mode, output pins are left open and other pins are connected to VSS.	f(XIN)=32 MHz, square wave, no division			28	45		mA
			f(XCIN)=32 kHz, in wait mode, Topr=25° C			10			μA
			Topr=25° C (while clock is stopped)			0.8	5		μA
			Topr=85° C (while clock is stopped)				50		μA

NOTES:

1. P11 to P15 are provided in the 144-pin package only.

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

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 $85^{\circ}C$, $f(X_{IN}) = 32MHz$ 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_0 to AN_7 , AN_{00} to AN_{07} , AN_{20} to AN_{27} , AN_{150} to AN_{157} , $ANEX0$, $ANEX1$			± 3	LSB
			External op-amp connection mode			± 7	LSB
							LSB
							LSB
DNL	Differential Nonlinearity Error					± 1	LSB
-	Offset Error					± 3	LSB
-	Gain Error					± 3	LSB
R_{LADDER}	Resistor Ladder	$V_{REF}=V_{CC1}$		8.00		40	$k\Omega$
t_{CONV}	10-bit Conversion Time ^(1, 2)			2.06			μs
t_{CONV}	8-bit Conversion Time ^(1, 2)			1.75			μs
t_{SAMP}	Sampling Time ⁽¹⁾			0.188			μs
V_{REF}	Reference Voltage			2.00		V_{CC1}	V
V_{IA}	Analog Input Voltage			0.00		V_{REF}	V

NOTES:

1. Divide $f(X_{IN})$, if exceeding 16 MHz, to keep ϕ_{AD} frequency at 16 MHz or less.
2. Sample and hold function available.

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 $85^{\circ}C$, $f(X_{IN}) = 32MHz$ unless otherwise specified)

Symbol	Parameter	Measurement Condition	Standard			Unit
			Min.	Typ.	Max.	
-	Resolution				8	Bits
-	Absolute Accuracy				1.0	%
t_{SU}	Setup Time				3	μs
R_o	Output Resistance		4	10	20	$k\Omega$
I_{VREF}	Reference Power Supply Input Current	(Note 1)			1.5	mA

NOTES:

1. Measurement when using one D/A converter. The DA_i register ($i=0, 1$) of the D/A converter, not being used, is set to "0016". The resistor ladder in the A/D converter is excluded.
 I_{VREF} flows even if the $VCUT$ bit in the $AD0CON1$ register is set to "0" (no V_{REF} connection).

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

Table 5.6 Flash Memory Version Electrical Characteristics⁽¹⁾

Symbol	Parameter		Standard			Unit
			Min.	Typ.	Max.	
-	Program and Erase Endurance ⁽³⁾		100			cycles
-	Word Program Time (V _{CC1} =5.0V, T _{opr} =25° C)			25	200	μs
-	Lock Bit Program Time			25	200	μs
-	Block Erase Time (V _{CC1} =5.0V, T _{opr} =25° C)	4-Kbyte Block		0.3	4	s
		8-Kbyte Block		0.3	4	s
		32-Kbyte Block		0.5	4	s
		64-Kbyte Block		0.8	4	s
-	All-Unlocked-Block Erase Time ⁽²⁾				4 x <i>n</i>	s
t _{PS}	Flash Memory Circuit Stabilization Wait Time				15	μs
-	Data Hold Time ⁽⁴⁾		10			years

NOTES:

1. Referenced to V_{CC1}=4.5 to 5.5V, 3.0 to 3.6V at T_{opr} = 0 to 60 ° C unless otherwise specified.
2. *n* denotes the number of block to be erased.
3. Number of program-erase cycles per block.
If Program and Erase Endurance is *n*/cycle (*n*≠100), each block can be erased and programmed *n*/cycles.
For example, if a 4-Kbyte block A is erased after programming a word data 2,048 times, each to a different address, this counts as one program and erase endurance. Data can not be programmed to the same address more than once without erasing the block. (Rewrite prohibited).
4. T_{opr} = -40 to 85 ° C

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

Table 5.7 Low Voltage Detect Circuit Electrical Characteristics ($V_{CC1}=V_{CC2}=3.0$ to $5.5V$, $V_{SS}=AV_{SS}=0V$ at $T_{opr}=-20$ to $85^{\circ}C$ unless otherwise specified)

Symbol	Parameter	Measurement Condition	Standard			Unit
			Min.	Typ.	Max.	
Vdet4	Voltage Down Detect Voltage ⁽¹⁾	$V_{CC1}=3.0$ to $5.5V$		3.8		V
Vdet3	Reset Space Detect Voltage ⁽¹⁾			3.0		V
Vdet3s	Low Voltage Reset Hold Voltage		2.0			V
Vdet3r	Low Voltage Reset Release Voltage ⁽²⁾			3.1		V

NOTES:

1. $V_{det4} > V_{det3}$
2. $V_{det3r} > V_{det3}$ is not guaranteed.

Table 5.8 Power Supply Timing

Symbol	Parameter	Measurement Condition	Standard			Unit
			Min.	Typ.	Max.	
td(P-R)	Wait Time for Stable Internal Supply Voltage when Power-on	$V_{CC1}=3.0$ to $5.5V$			2	ms
td(S-R)	Wait Time to Release Voltage Voltage Down Detect Reset	$V_{CC1}=V_{det3r}$ to $5.5V$		6 ⁽¹⁾	20	ms
td(E-A)	Start-up Time for Low Voltage Detect Circuit Operation	$V_{CC1}=3.0$ to $5.5V$			20	μs

NOTES:

1. $V_{CC1}=5V$

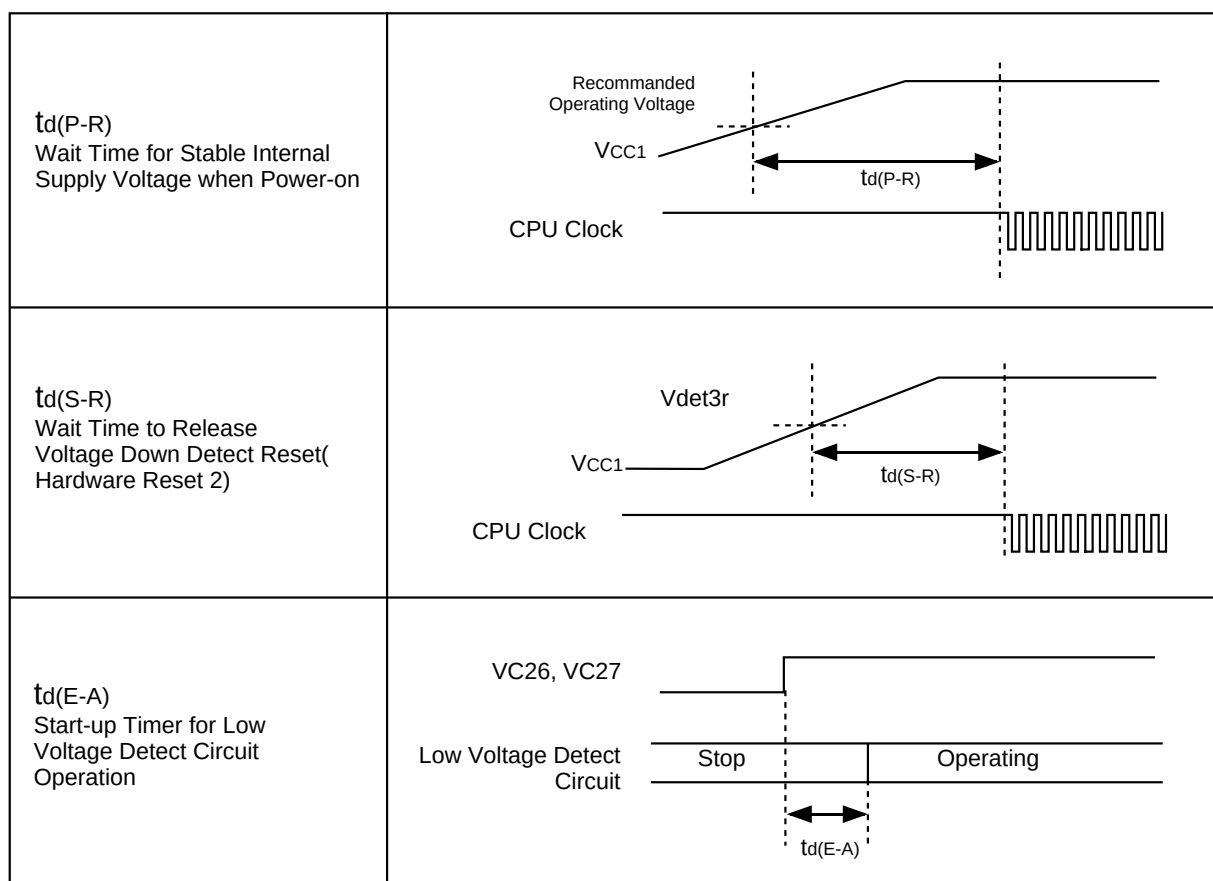


Figure 5.1 Power Supply Timing Diagram

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

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 5.9 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 5.10 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 multiplexed 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

NOTES:

- 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.

$$t_{ac1(RD-DB)} = t_{ac2(RD-DB)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, m=(bx2)+1)$$

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

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

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

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 5.11 Timer A Input (Count Source Input in Event Counter Mode)

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

Table 5.12 Timer A Input (Gate Input in Timer Mode)

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

Table 5.13 Timer A Input (External Trigger Input in One-Shot Timer Mode)

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

Table 5.14 Timer A Input (External Trigger Input in Pulse Width Modulation Mode)

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

Table 5.15 Timer A Input (Counter Increment/Decrement Input in Event Counter Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(UP)}$	TA _{IOU} T Input Cycle Time	2000		ns
$t_{W(UPH)}$	TA _{IOU} T Input High ("H") Width	1000		ns
$t_{W(UPL)}$	TA _{IOU} T Input Low ("L") Width	1000		ns
$t_{SU(UP-TIN)}$	TA _{IOU} T Input Setup Time	400		ns
$t_{H(TIN-UP)}$	TA _{IOU} T 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 5.16 Timer B Input (Count Source Input in Event Counter Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TB)}$	TBiN Input Cycle Time (counted on one edge)	100		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width (counted on one edge)	40		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width (counted on one edge)	40		ns
$t_{C(TB)}$	TBiN Input Cycle Time (counted on both edges)	200		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width (counted on both edges)	80		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width (counted on both edges)	80		ns

Table 5.17 Timer B Input (Pulse Period Measurement Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TB)}$	TBiN Input Cycle Time	400		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width	200		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width	200		ns

Table 5.18 Timer B Input (Pulse Width Measurement Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TB)}$	TBiN Input Cycle Time	400		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width	200		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width	200		ns

Table 5.19 A/D Trigger Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(AD)}$	$\overline{AD_{TRG}}$ Input Cycle Time (required for re-trigger)	1000		ns
$t_{W(ADL)}$	$\overline{AD_{TRG}}$ Input Low ("L") Width	125		ns

Table 5.20 Serial I/O

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(CLK)}$	CLKi Input Cycle Time	200		ns
$t_{W(CLKH)}$	CLKi Input High ("H") Width	100		ns
$t_{W(CLKL)}$	CLKi Input Low ("L") Width	100		ns
$t_{d(C-Q)}$	TxDi Output Delay Time		80	ns
$t_{h(C-Q)}$	TxDi Hold Time	0		ns
$t_{su(D-Q)}$	RxDi Input Setup Time	30		ns
$t_{h(C-Q)}$	RxDi Input Hold Time	90		ns

Table 5.21 External Interrupt $\overline{INTi}$ Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{W(INH)}$	$\overline{INTi}$ Input High ("H") Width	250		ns
$t_{W(INL)}$	$\overline{INTi}$ 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 5.22 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 5.2		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 5.23 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 5.2		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
$t_{h(DB-WR)}$	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)		-2		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.

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

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

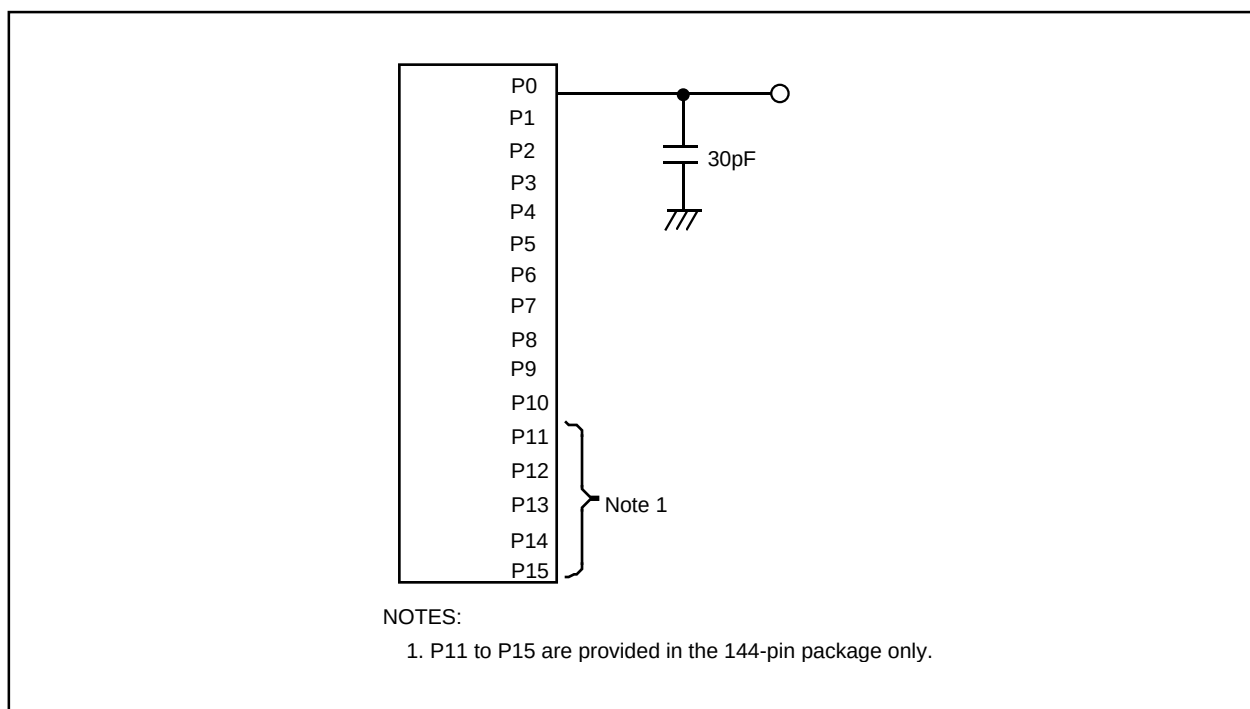
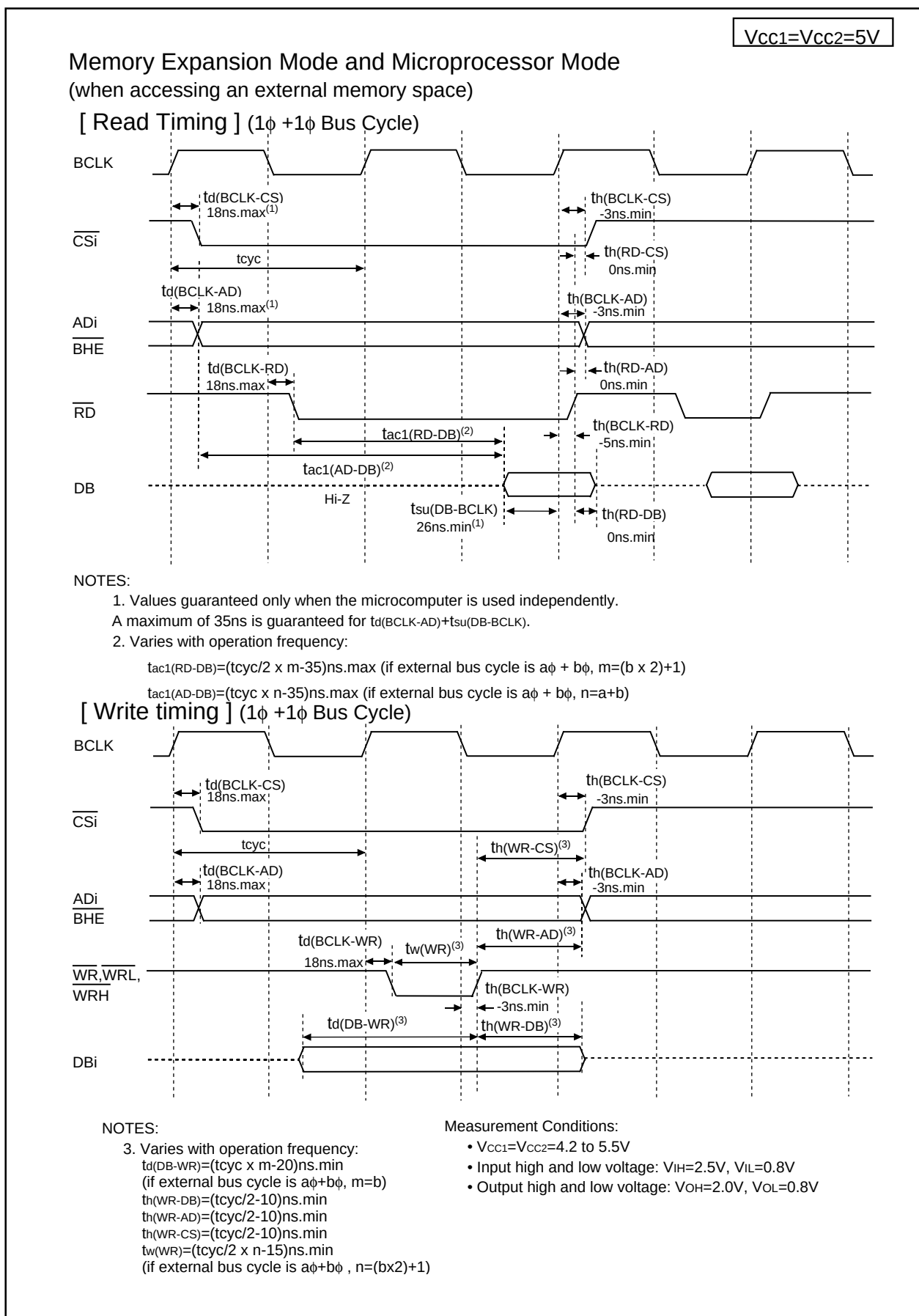
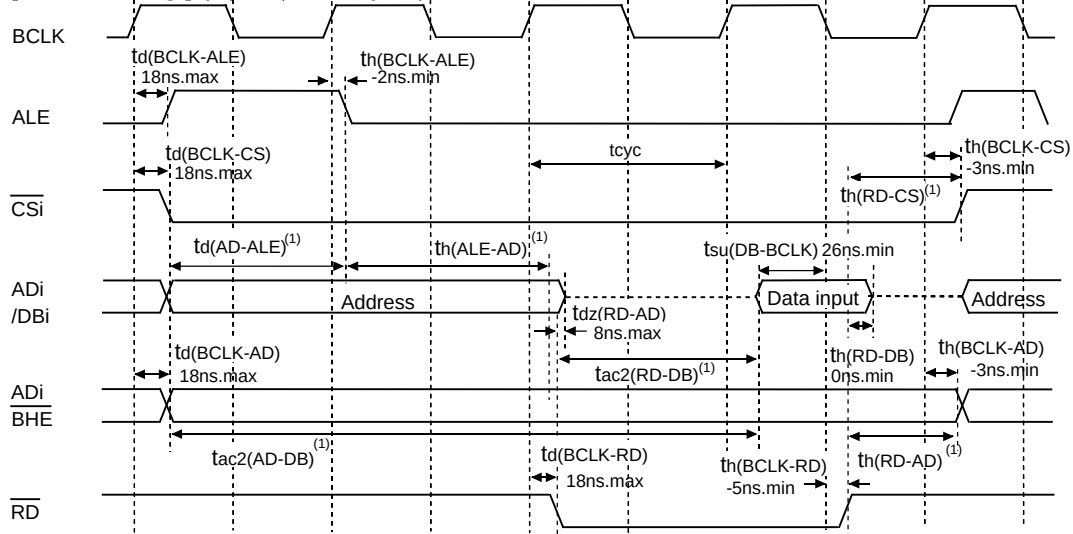


Figure 5.2 P0 to P15 Measurement Circuit

Figure 5.3 V_{CC1}=V_{CC2}=5V Timing Diagram (1)

Memory Expansion Mode and Microprocessor Mode

(when accessing an external memory space with the multiplexed bus)

 $V_{CC1}=V_{CC2}=5V$ [Read Timing] (2 ϕ + 2 ϕ Bus Cycle)

NOTES:

1. Varies with operation frequency:

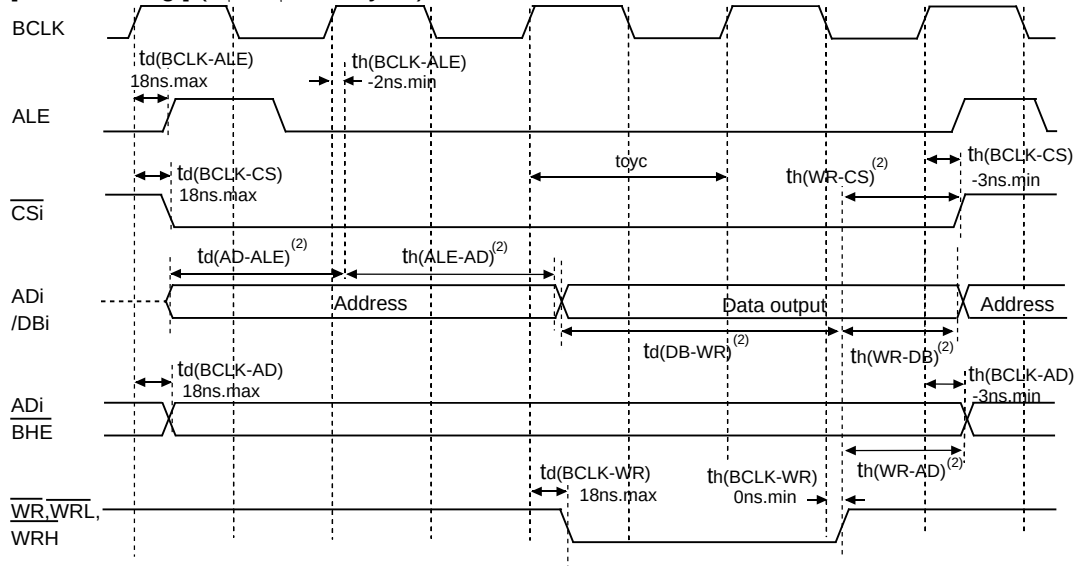
$$td(AD-ALE) = (tcyc/2 \times n - 20)ns.min \text{ (if external bus cycle is } a\phi + b\phi, n=a)$$

$$th(ALE-AD) = (tcyc \times n - 10)ns.min \text{ (if external bus cycle is } a\phi + b\phi, n=a)$$

$$th(RD-AD) = (tcyc/2 - 10)ns.min, th(RD-CS) = (tcyc/2 - 10)ns.min$$

$$tac2(RD-DB) = (tcyc/2 \times m - 35)ns.max \text{ (if external bus cycle is } a\phi + b\phi, m=(b \times 2)+1)$$

$$tac2(AD-DB) = (tcyc/2 \times p - 35)ns.max \text{ (if external bus cycle is } a\phi + b\phi, p=((a+b-1) \times 2)-1)$$

[Write Timing] (2 ϕ + 2 ϕ Bus Cycle)

NOTES:

2. Varies with operation frequency:

$$td(AD-ALE) = (tcyc/2 \times n - 20)ns.min$$

(if external bus cycle is $a\phi + b\phi, n=a$)

$$th(ALE-AD) = (tcyc \times n - 10)ns.min$$

(if external bus cycle is $a\phi + b\phi, n=a$)

$$th(WR-AD) = (tcyc/2 - 10)ns.min,$$

$$th(WR-CS) = (tcyc/2 - 10)ns.min, th(WR-DB) = (tcyc/2 - 10)ns.min$$

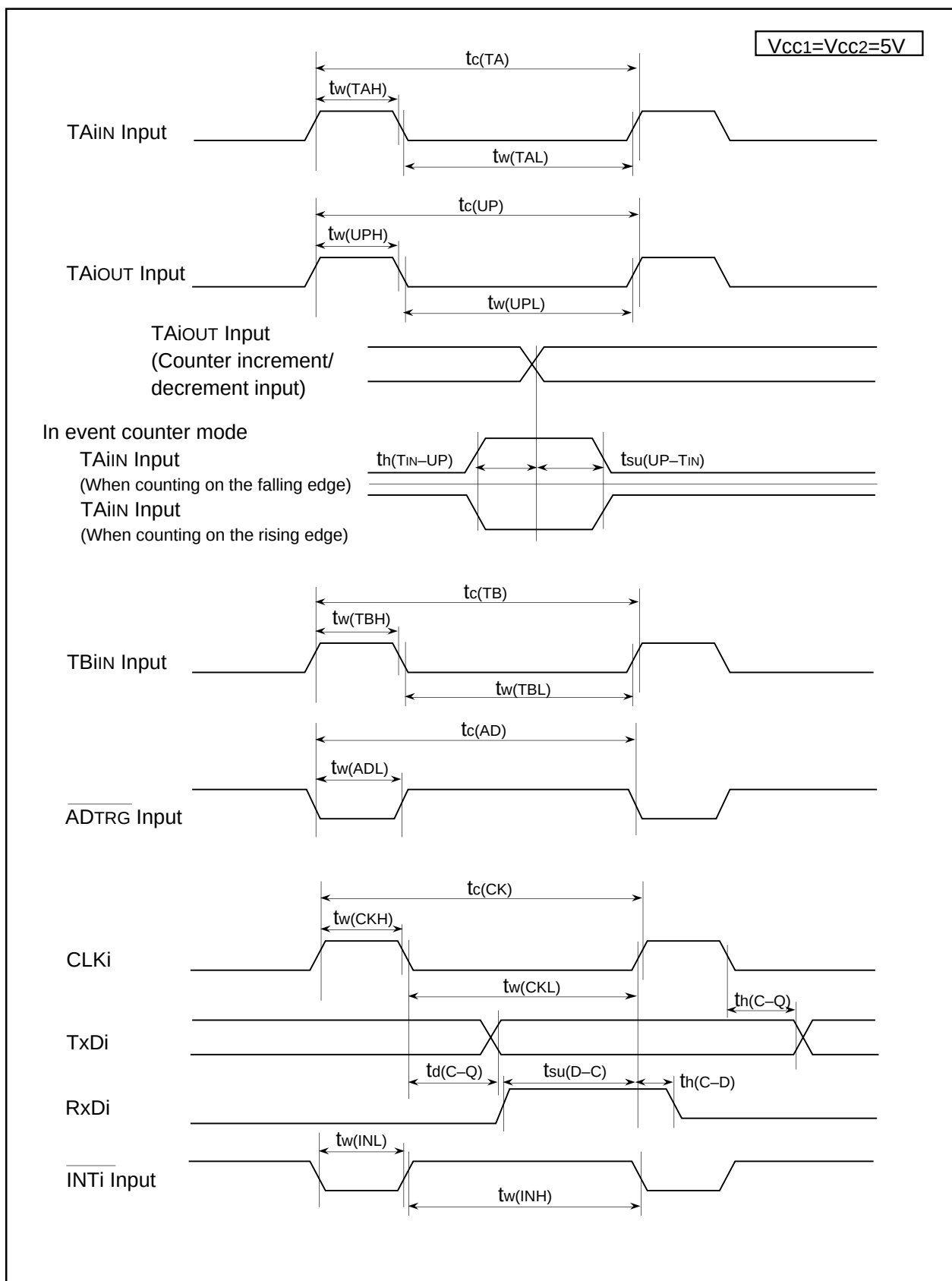
$$td(DB-WR) = (tcyc/2 \times m - 25)ns.min$$

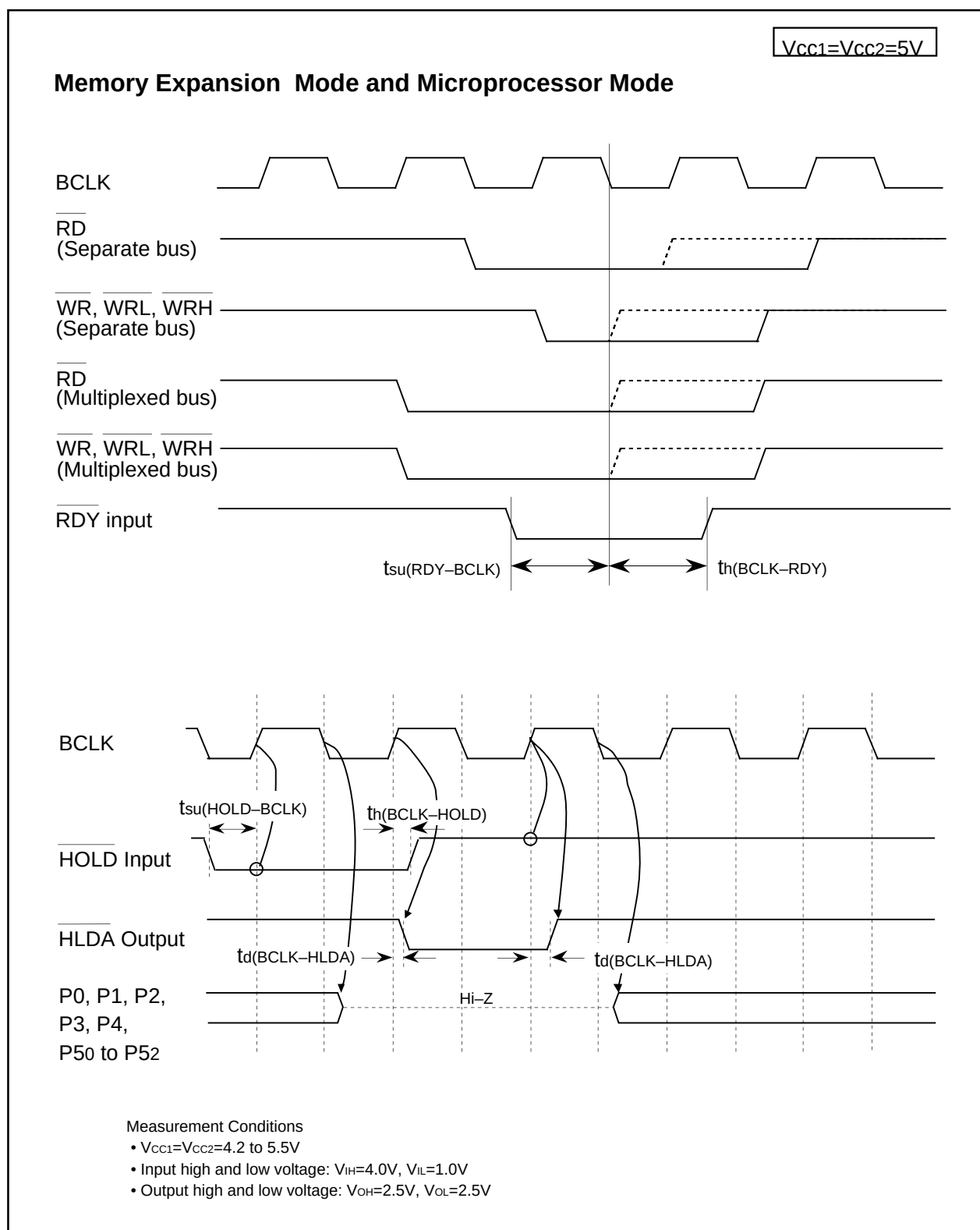
(if external bus cycle is $a\phi + b\phi, m=(b \times 2)+1$)

Measurement Conditions:

- $V_{CC1}=V_{CC2}=4.2$ to $5.5V$
- Input high and low voltage:
 $V_{IH}=2.5V, V_{IL}=0.8V$
- Output high and low voltage:
 $V_{OH}=2.0V, V_{OL}=0.8V$

Figure 5.4 $V_{CC1}=V_{CC2}=5V$ Timing Diagram (2)

Figure 5.5 $V_{CC1}=V_{CC2}=5V$ Timing Diagram (3)

Figure 5.6 $V_{CC1}=V_{CC2}=5V$ Timing Diagram (4)

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

Table 5.24 Electrical Characteristics

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

Symbol	Parameter		Condition	Standard			Unit	
				Min.	Typ.	Max.		
VOH	Output High ("H") Voltage	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137	IOH=-1mA	2.7		VCC2	V	
		P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾		2.7		VCC1	V	
		XOUT	IOH=-0.1mA	2.7		VCC1	V	
		XCOUT	High Power	No load applied		2.5		V
			Low Power	No load applied		1.6		V
VOL	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾	IOL=1mA			0.5	V	
		XOUT	IOL=0.1mA			0.5	V	
		XCOUT	High Power	No load applied		0		V
			Low Power	No load applied		0		V
VT+-VT-	Hysteresis	HOLD, RDY, TA0IN-TA4IN, TB0IN-TB5IN, INT0-INT5, ADTRG, CTS0-CTS4, CLK0-CLK4, TA0OUT-TA4OUT, NMI, KI0-KI3, RxD0-RxD4, SCL0-SCL4, SDA0-SDA4		0.2		1.0	V	
		RESET		0.2		1.8	V	
IiH	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾ , XIN, RESET, CNVSS, BYTE	Vi=3V			4.0	μA	
IiL	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾ , XIN, RESET, CNVSS, BYTE	Vi=0V			-4.0	μA	
RPULLUP	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾	Vi=0V	Flash Memory	66	120	500	kΩ
				Masked ROM	40	70	500	kΩ
RfXIN	Feedback Resistance	XIN			3.0		MΩ	
RfXCIN	Feedback Resistance	XCIN			20.0		MΩ	
VRAM	RAM Standby Voltage	in stop mode		2.0			V	
ICC	Power Supply Current	Measurement condition: In single-chip mode, output pins are left open and other pins are connected to VSS.	f(XIN)=24 MHz, square wave, no division		22	35	mA	
			f(XCIN)=32 kHz, in wait mode, Topr=25° C		10		μA	
			Topr=25° C when the clock stops		0.8	5	μA	
			Topr=85° C when the clock stops			50	μA	

NOTES:

1. P11 to P15 are provided in the 144-pin package only.

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

Table 5.25 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 $85^{\circ}C$, $f(X_{IN}) = 24MHz$ 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 function (8-bit)	$V_{CC1}=V_{CC2}=V_{REF}=3.3V$			± 2	LSB
DNL	Differential Nonlinearity Error	No S&H function (8-bit)				± 1	LSB
-	Offset Error	No S&H function (8-bit)				± 2	LSB
-	Gain Error	No S&H function (8-bit)				± 2	LSB
RLADDER	Resistor Ladder		$V_{REF}=V_{CC1}$	8		40	k Ω
tCONV	8-bit Conversion Time ^(1, 2)			6.1			μs
VREF	Reference Voltage			3.0		V_{CC1}	V
VIA	Analog Input Voltage			0		V_{REF}	V

S&H: Sample and Hold

NOTES:

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

Table 5.26 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 $85^{\circ}C$, $f(X_{IN}) = 24MHz$ unless otherwise specified)

Symbol	Parameter	Measurement Condition	Standard			Unit
			Min.	Typ.	Max.	
-	Resolution				8	Bits
-	Absolute Accuracy				1.0	%
tsu	Setup Time				3	μs
Ro	Output Resistance		4	10	20	k Ω
IvREF	Reference Power Supply Input Current	(Note 1)			1.0	mA

NOTES:

1. Measurement results when using one D/A converter. The DAI register ($i=0, 1$) of the D/A converter, not being used, is set to "00₁₆". The resistor ladder in the A/D converter is excluded.
IvREF flows even if the VCUT bit in the AD0CON1 register is set to "0" (no VREF 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 5.27 External Clock Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
t_c	External Clock Input Cycle Time	41		ns
$t_{w(H)}$	External Clock Input High ("H") Width	18		ns
$t_{w(L)}$	External Clock Input Low ("L") Width	18		ns
t_r	External Clock Rise Time		5	ns
t_f	External Clock Fall Time		5	ns

Table 5.28 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 multiplexed 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	30		ns
$t_{su(RDY-BCLK)}$	RDY Input Setup Time	40		ns
$t_{su(HOLD-BCLK)}$	HOLD Input Setup Time	60		ns
$t_{h(RD-DB)}$	Data Input Hold Time	0		ns
$t_{h(BCLK-RDY)}$	RDY Input Hold Time	0		ns
$t_{h(BCLK-HOLD)}$	HOLD Input Hold Time	0		ns
$t_{d(BCLK-HLDA)}$	HLDA Output Delay Time		25	ns

NOTES:

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.

$$t_{ac1(RD-DB)} = t_{ac2(RD-DB)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 35 \quad [\text{ns}] \text{ (if external bus cycle is } a\phi + b\phi, m = (b \times 2) + 1)$$

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

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

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

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 5.29 Timer A Input (Count Source Input in Event Counter Mode)

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

Table 5.30 Timer A Input (Gate Input in Timer Mode)

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

Table 5.31 Timer A Input (External Trigger Input in One-Shot Timer Mode)

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

Table 5.32 Timer A Input (External Trigger Input in Pulse Width Modulation Mode)

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

Table 5.33 Timer A Input (Counter Increment/decrement Input in Event Counter Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(UP)}$	TA _{IOU} Input Cycle Time	2000		ns
$t_{w(UPH)}$	TA _{IOU} Input High ("H") Width	1000		ns
$t_{w(UPL)}$	TA _{IOU} Input Low ("L") Width	1000		ns
$t_{su(UP-TIN)}$	TA _{IOU} Input Setup Time	400		ns
$t_{h(TIN-UP)}$	TA _{IOU} 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 5.34 Timer B Input (Count Source Input in Event Counter Mode)

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

Table 5.35 Timer B Input (Pulse Period Measurement Mode)

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

Table 5.36 Timer B Input (Pulse Width Measurement Mode)

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

Table 5.37 A/D Trigger Input

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

Table 5.38 Serial I/O

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{c(CLK)}$	CLKi Input Cycle Time	200		ns
$t_{w(CLKH)}$	CLKi Input High ("H") Width	100		ns
$t_{w(CLKL)}$	CLKi Input Low ("L") Width	100		ns
$t_{d(CQ)}$	TxDi Output Delay Time		80	ns
$t_{h(CQ)}$	TxDi Hold Time	0		ns
$t_{su(DQ)}$	RxDi Input Setup Time	30		ns
$t_{h(CQ)}$	RxDi Input Hold Time	90		ns

Table 5.39 External Interrupt $\overline{INTi}$ Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{w(INH)}$	$\overline{INTi}$ Input High ("H") Width	250		ns
$t_{w(INL)}$	$\overline{INTi}$ 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 5.40 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 5.2		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.

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

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

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

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 5.41 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 5.2		18	ns
$t_{h(BCLK-AD)}$	Address Output Hold Time (BCLK standard)		0		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)		0		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
$t_{h(BCLK-AD)}$	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
$t_{d(BCLK-ALE)}$	ALE Signal Output Delay Time (BCLK standard)			18	ns
$t_{h(BCLK-ALE)}$	ALE Signal Output Hold Time (BCLK standard)		-2		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 by the following equations, according to BCLK frequency.

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

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

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

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

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

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

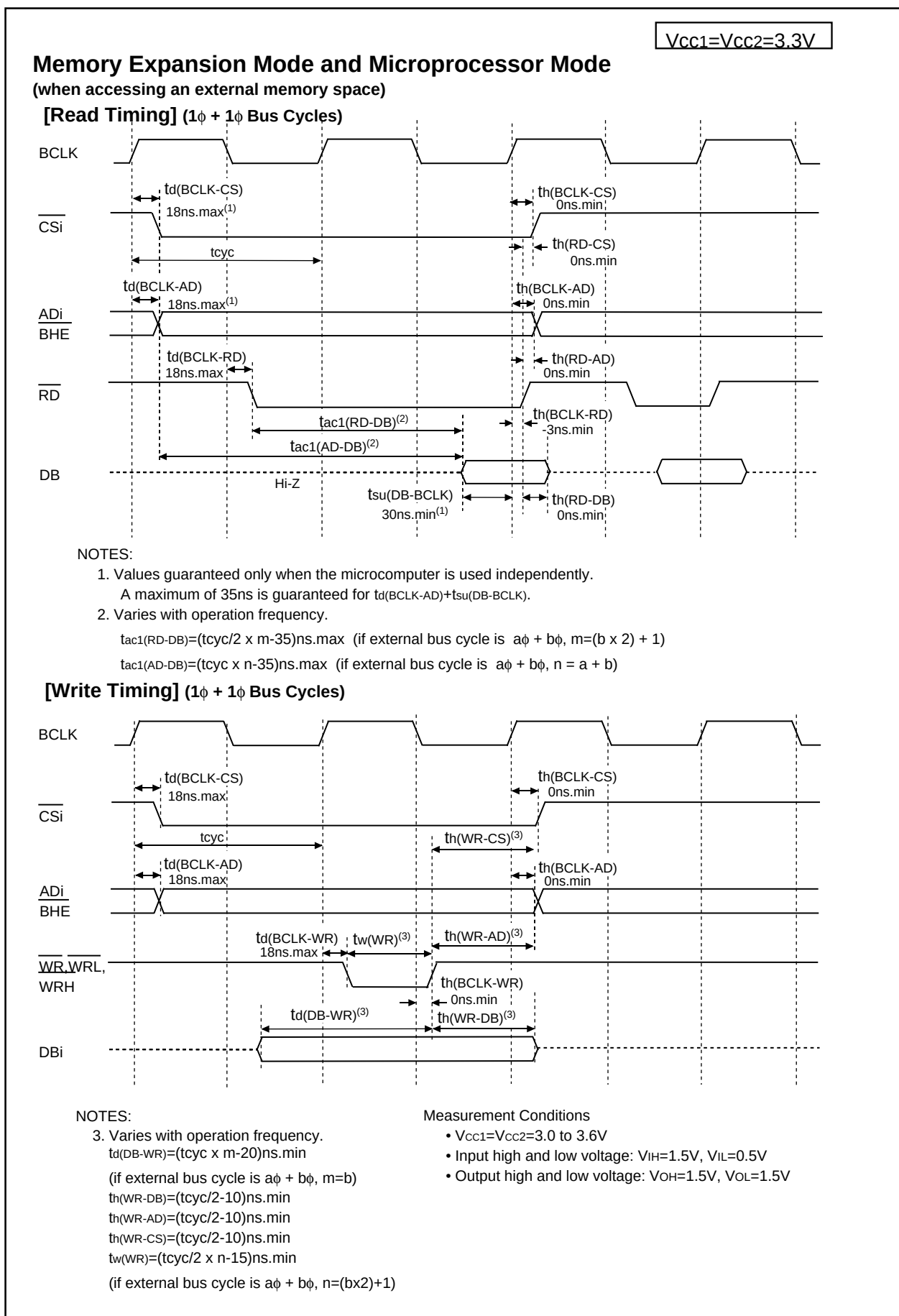
$$t_{d(DB-WR)} = \frac{10^9 \times m}{f_{(BCLK)} \times 2} - 25 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, m=(b+2)-1)$$

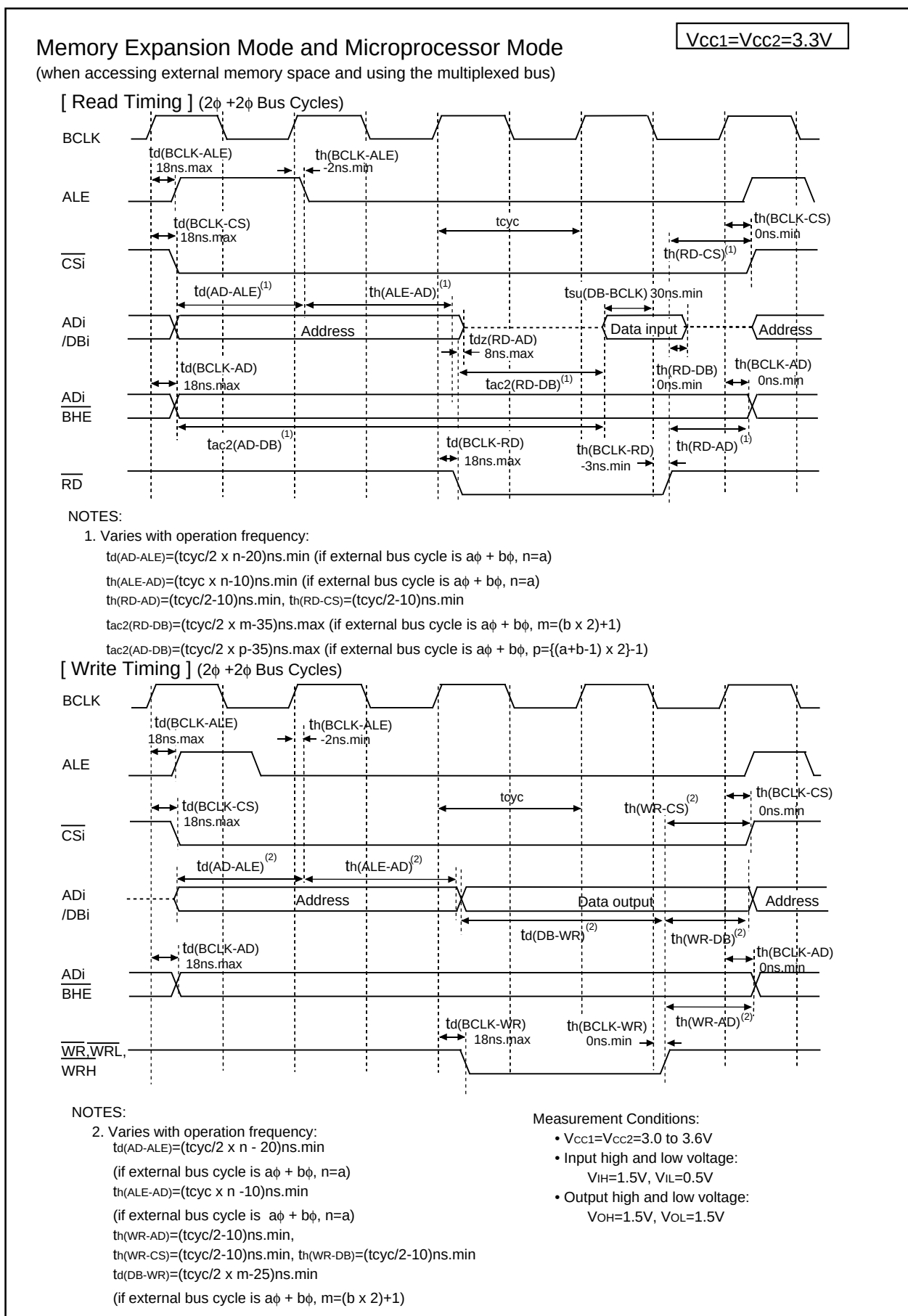
3. Values can be obtained by the following equations, according to BCLK frequency and external bus cycles.

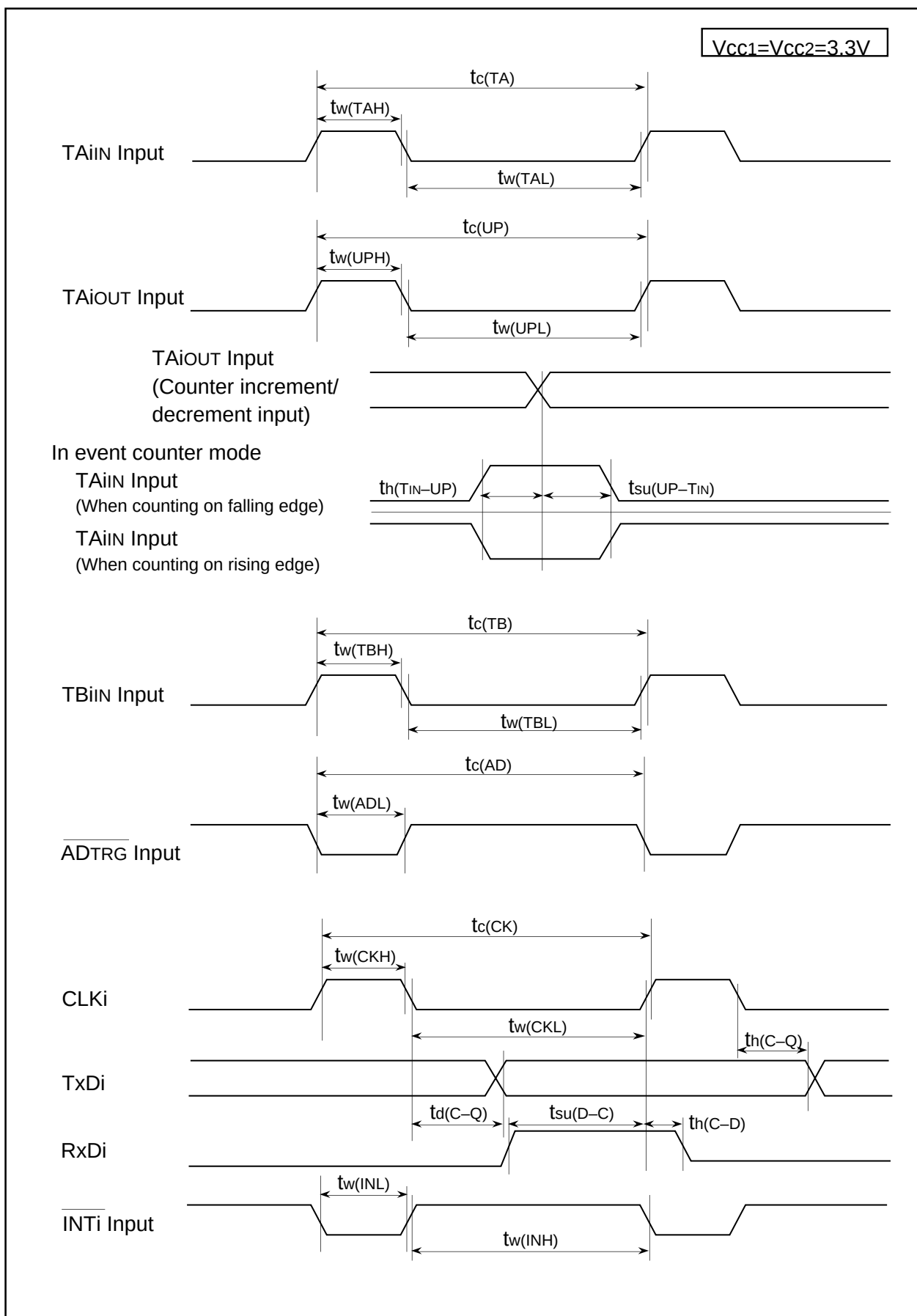
$$t_{d(AD-ALE)} = \frac{10^9 \times n}{f_{(BCLK)} \times 2} - 20 \quad [ns] \quad (\text{if external bus cycle is } a\phi + b\phi, n=a)$$

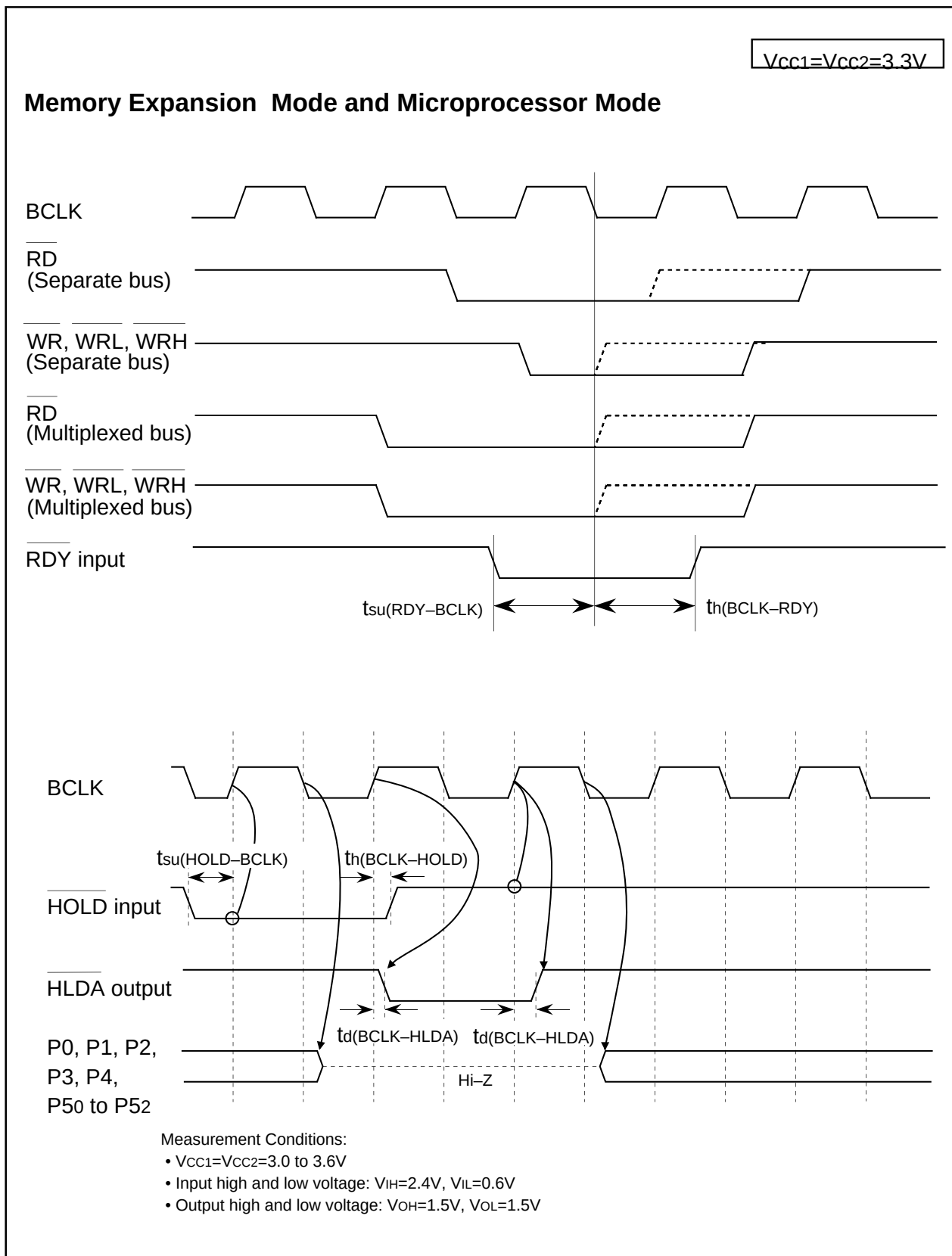
4. Values can be obtained by the following equations, according to BCLK frequency and external bus cycles.

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

Figure 5.7 V_{CC1}=V_{CC2}=3.3V Timing Diagram (1)

Figure 5.8 $V_{CC1}=V_{CC2}=3.3V$ Timing Diagram (2)

Figure 5.9 $V_{CC1}=V_{CC2}=3.3V$ Timing Diagram (3)

Figure 5.10 $V_{CC1}=V_{CC2}=3.3V$ Timing Diagram (4)

5.2 Electrical Characteristics (M32C/84T)

Table 5.42 Absolute Maximum Ratings

Symbol	Parameter		Condition	Value	Unit
V _{CC1} , V _{CC2}	Supply Voltage		V _{CC1} =V _{CC2} =AV _{CC}	-0.3 to 6.0	V
AV _{CC}	Analog Supply Voltage		V _{CC1} =V _{CC2} =AV _{CC}	-0.3 to 6.0	V
V _I	Input Voltage	RESET, CNV _{SS} , BYTE, P60-P67, P72-P77, P80-P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾ , V _{REF} , X _{IN}		-0.3 to V _{CC1} +0.3	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽¹⁾		-0.3 to V _{CC2} +0.3	
		P70, P71		-0.3 to 6.0	
V _O	Output Voltage	P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾ , X _{OUT}		-0.3 to V _{CC1} +0.3	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽¹⁾		-0.3 to V _{CC2} +0.3	
P _d	Power Dissipation		T _{opr} =25° C	500	mW
T _{opr}	Operating Ambient Temperature	during CPU operation	T version	-40 to 85	° C
		during flash memory program and erase operation		0 to 60	
T _{stg}	Storage Temperature			-65 to 150	° C

NOTES:

1. P11 to P15 are provided in the 144-pin package only.

Table 5.43 Recommended Operating Conditions

(Vcc1=Vcc2=4.2 to 5.5V, Vss=0V at Topr= -40 to 85°C (T version) unless otherwise specified)

Symbol	Parameter	Standard			Unit
		Min.	Typ.	Max.	
Vcc1, Vcc2	Supply Voltage (Vcc1=Vcc2)	4.2	5.0	5.5	V
AVcc	Analog Supply Voltage		Vcc1		V
Vss	Supply Voltage		0		V
AVss	Analog Supply Voltage		0		V

Table 5.43 Recommended Operating Conditions (Continued)
(V_{CC1}=V_{CC2}=4.2 to 5.5V, V_{SS}=0V at Topr = -40 to 85°C (T version) unless otherwise specified)

Symbol	Parameter	Accommodating Pins	Standard			Unit
			Min.	Typ.	Max.	
V _{IH}	Input High ("H") Voltage	P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽⁴⁾	0.8V _{CC2}		V _{CC2}	V
		P60-P67, P72-P77, P80-P87 ⁽³⁾ , P90-P97, P100-P107, P140-P146, P150-P157 ⁽⁴⁾ , X _{IN} , RESET, CNV _{SS} , BYTE	0.8V _{CC1}		V _{CC1}	
		P70, P71	0.8V _{CC1}		6.0	
		P00-P07, P10-P17	0.8V _{CC2}		V _{CC2}	V
V _{IL}	Input Low ("L") Voltage	P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137 ⁽⁴⁾	0		0.2V _{CC2}	V
		P60-P67, P70-P77, P80-P87 ⁽³⁾ , P90-P97, P100-P107, P140-P146, P150-P157 ⁽⁴⁾ , X _{IN} , RESET, CNV _{SS} , BYTE			0.2V _{CC1}	
		P00-P07, P10-P17	0		0.2V _{CC2}	V
I _{OH(peak)}	Peak Output High ("H") Current ⁽²⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			-10.0	mA
I _{OH(avg)}	Average Output High ("H") Current ⁽¹⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			-5.0	mA
I _{OL(peak)}	Peak Output Low ("L") Current ⁽²⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			10.0	mA
I _{OL(avg)}	Average Output Low ("L") Current ⁽¹⁾	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽⁴⁾			5.0	mA

NOTES:

1. Typical values when average output current is 100ms.
2. Total I_{OL(peak)} for P0, P1, P2, P86, P87, P9, P10, P11, P14 and P15 must be 80mA or less.
Total I_{OL(peak)} for P3, P4, P5, P6, P7, P80 to P84, P12 and P13 must be 80mA or less.
Total I_{OH(peak)} for P0, P1, P2, and P11 must be -40mA or less.
Total I_{OH(peak)} for P86, P87, P9, P10, P14 and P15 must be -40mA or less.
Total I_{OH(peak)} for P3, P4, P5, P12 and P13 must be -40mA or less.
Total I_{OH(peak)} for P6, P7, and P80 to P84 must be -40mA or less.
3. V_{IH} and V_{IL} reference for P87 applies when P87 is used as a programmable input port.
It does not apply when P87 is used as X_{CIN}.
4. P11 to P15 are provided in the 144-pin package only.

Table 5.43 Recommended Operating Conditions (Continued)
(V_{CC1}=V_{CC2}=4.2 to 5.5V, V_{SS}=0V at T_{opr} = -40 to 85°C (T version) unless otherwise specified)

Symbol	Parameter		Standard			Unit
			Min.	Typ.	Max.	
f(X _{IN})	Main Clock Input Frequency	V _{CC1} =4.2 to 5.5V	0		32	MHz
f(X _{CIN})	Sub Clock Frequency			32.768	50	kHz
f(Ring)	On-chip Oscillator Frequency			1		MHz
f(PLL)	PLL Clock Frequency	V _{CC1} =4.2 to 5.5V	10		32	MHz
t _{SU(PLL)}	PLL Lock Time	V _{CC1} =5.0V			5	ms

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

Table 5.44 Electrical Characteristics

($V_{CC1}=V_{CC2}=4.2$ to $5.5V$, $V_{SS}=0V$ at $T_{opr} = -40$ to $85^{\circ}C$ (T version),
 $f(X_{IN})=32MHz$ unless otherwise specified)

Symbol	Parameter		Measurement Condition	Standard			Unit
				Min.	Typ.	Max.	
V _{OH}	Output High ("H") Voltage	P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137	I _{OH} =-5mA	3.0		V _{CC2}	V
		P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾	I _{OH} =-5mA	3.0		V _{CC1}	
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P110-P114, P120-P127, P130-P137	I _{OH} =-200μA	4.7		V _{CC2}	V
		P60-P67, P72-P77, P80-P84, P86, P87, P90-P97, P100-P107, P140-P146, P150-P157 ⁽¹⁾	I _{OH} =-200μA	4.7		V _{CC1}	
		X _{OUT}	I _{OH} =-1mA	3.0			V
		X _{COUT}	High Power		2.5		V
			Low Power		1.6		
V _{OL}	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾	I _{OL} =5mA			2.0	V
		P00-P07, P10-P17, P20-P27, P30-P37, P40-P47, P50-P57, P60-P67, P70-P77, P80-P84, P86, P87, P90-P97, P100-P107, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾	I _{OL} =200μA			0.45	V
		X _{OUT}	I _{OL} =1mA			2.0	V
		X _{COUT}	High Power		0		V
			Low Power		0		
V _{T+} -V _{T-}	Hysteresis	HOLD, RDY, TA0IN-TA4IN, TB0IN-TB5IN, INT0-INT5, ADTRG, CTS0-CTS4, CLK0-CLK4, TA0OUT-TA4OUT, NMI, KI0-KI3, RxD0-RxD4, SCL0-SCL4, SDA0-SDA4		0.2		1.0	V
		RESET		0.2		1.8	V
I _{IH}	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾ , X _{IN} , RESET, CNV _{SS} , BYTE	V _I =5V			5.0	μA
I _{IL}	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾ , X _{IN} , RESET, CNV _{SS} , BYTE	V _I =0V			-5.0	μA
R _{PULLUP}	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, P110-P114, P120-P127, P130-P137, P140-P146, P150-P157 ⁽¹⁾	V _I =0V Flash Memory	30	50	167	kΩ
			Masked ROM	20	40	167	kΩ
R _{fXIN}	Feedback Resistance	X _{IN}			1.5		MΩ
R _{fXCIN}	Feedback Resistance	X _{CIN}			10		MΩ
V _{RAM}	RAM Standby Voltage	in stop mode		2.0			V
I _{CC}	Power Supply Current	Measurement conditions: In single-chip mode, output pins are left open and other pins are connected to V _{SS} .	f(X _{IN})=32 MHz, square wave, no division		28	50	mA
			f(X _{CIN})=32 kHz, in wait mode, T _{opr} =25° C		10		μA
			T _{opr} =25° C (while clock is stopped)		0.8	5	μA
			T _{opr} =85° C (while clock is stopped)			50	μA

NOTES:

1. P11 to P15 are provided in the 144-pin package only.

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

Table 5.45 A/D Conversion Characteristics ($V_{CC1}=V_{CC2}=4.2$ to $5.5V$, $V_{SS}=0V$ at $T_{opr}= -40$ to $85^{\circ}C$ (T version), $f(X_{IN})=32MHz$ 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 ₀ to AN ₇ , AN ₀ to AN ₇ , AN ₂₀ to AN ₂₇ , AN ₁₅₀ to AN ₁₅₇ , AN _{EX0} , AN _{EX1}			±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	$V_{REF}=V_{CC1}$	8.00		40	kΩ
t _{CONV}	10-bit Conversion Time ^(1, 2)		2.06			μs
t _{CONV}	8-bit Conversion Time ^(1, 2)		1.75			μs
t _{SAMP}	Sampling Time ⁽¹⁾		0.188			μs
V _{REF}	Reference Voltage		2.00		V _{CC1}	V
V _{IA}	Analog Input Voltage		0.00		V _{REF}	V

NOTES:

1. Divide $f(X_{IN})$, if exceeding 16 MHz, to keep ϕ_{AD} frequency at 16 MHz or less.
2. Sample and Hold function is available.

Table 5.46 D/A Conversion Characteristics ($V_{CC1}=V_{CC2}=4.2$ to $5.5V$, $V_{SS}=0V$ at $T_{opr}= -40$ to $85^{\circ}C$ (T version), $f(X_{IN})=32MHz$ unless otherwise specified)

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

NOTES:

1. Measurement when using one D/A converter. The DA_i register (i=0, 1) of the D/A converter, not being used, is set to "00₁₆". The resistor ladder in the A/D converter is excluded.
I_{VREF} flows even if the VCUT bit in the AD0CON1 register is set to "0" (no V_{REF} connection).

VCC1=VCC2=5V

Table 5.47 Flash Memory Version Electrical Characteristics⁽¹⁾

Symbol	Parameter		Standard			Unit
			Min.	Typ.	Max.	
-	Program and Erase Endurance ⁽³⁾		100			cycles
-	Word Program Time (V _{CC1} =5.0V,Topr=25° C)			25	200	μs
-	Lock Bit Program Time			25	200	μs
-	Block Erase Time (V _{CC1} =5.0V,Topr=25° C)	4-Kbyte Block		0.3	4	s
		8-Kbyte Block		0.3	4	s
		32-Kbyte Block		0.5	4	s
		64-Kbyte Block		0.8	4	s
-	All-Unlocked-Block Erase Time ⁽²⁾				4 x <i>n</i>	s
t _{PS}	Flash Memory Circuit Stabilization Wait Time				15	μs
-	Data Hold Time ⁽⁴⁾		10			years

NOTES:

1. Referenced to VCC1=4.5 to 5.5V, 3.0 to 3.6V at Topr = 0 to 60 ° C unless otherwise specified.
2. *n* denotes the number of block to be erased.
3. Number of program-erase cycles per block.
If Program and Erase Endurance is *n* cycle (*n*=100), each block can be erased and programmed *n* cycles.
For example, if a 4-Kbyte block A is erased after programming a word data 2,048 times, each to a different address, this counts as one program and erase endurance. Data can not be programmed to the same address more than once without erasing the block. (Rewrite prohibited).
4. Topr = -40 to 85 ° C

VCC1=VCC2=5V

Table 5.48 Power Supply Timing

Symbol	Parameter	Measurement Condition	Standard			Unit
			Min.	Typ.	Max.	
td(P-R)	Wait Time for Stable Internal Supply Voltage when Power-on	VCC1=3.0 to 5.5V			2	ms

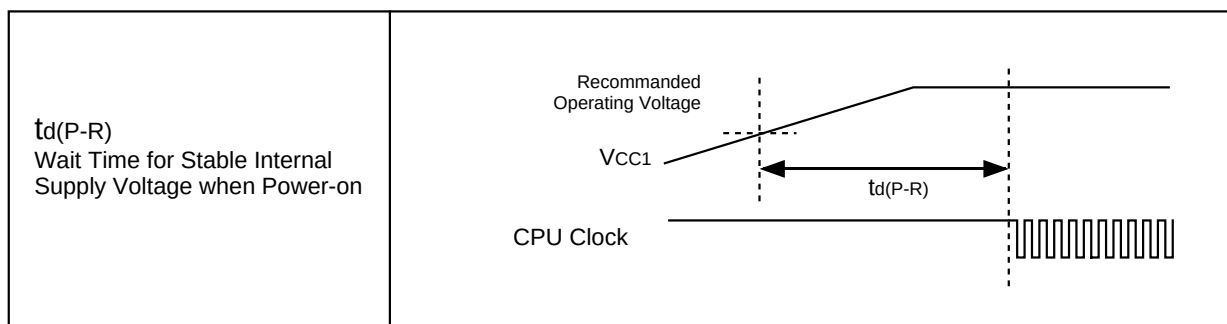


Figure 5.11 Power Supply Timing Diagram

VCC1=VCC2=5V

Timing Requirements

(VCC1=VCC2=4.2 to 5.5V, VSS=0V at Topr= -40 to 85°C (T version) unless otherwise specified)

Table 5.49 External Clock Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
tc	External Clock Input Cycle Time	31.25		ns
tw(H)	External Clock Input High ("H") Width	13.75		ns
tw(L)	External Clock Input Low ("L") Width	13.75		ns
tr	External Clock Rise Time		5	ns
tf	External Clock Fall Time		5	ns

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

Timing Requirements

($V_{CC1}=V_{CC2}=4.2$ to $5.5V$, $V_{SS}=0V$ at $T_{opr}=-40$ to $85^{\circ}C$ (T version) unless otherwise specified)

Table 5.50 Timer A Input (Count Source Input in Event Counter Mode)

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

Table 5.51 Timer A Input (Gate Input in Timer Mode)

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

Table 5.52 Timer A Input (External Trigger Input in One-Shot Timer Mode)

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

Table 5.53 Timer A Input (External Trigger Input in Pulse Width Modulation Mode)

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

Table 5.54 Timer A Input (Counter Increment/Decrement Input in Event Counter Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(UP)}$	TA _{IOU} Input Cycle Time	2000		ns
$t_{W(UPH)}$	TA _{IOU} Input High ("H") Width	1000		ns
$t_{W(UPL)}$	TA _{IOU} Input Low ("L") Width	1000		ns
$t_{SU(UP-TIN)}$	TA _{IOU} Input Setup Time	400		ns
$t_{H(TIN-UP)}$	TA _{IOU} 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 $T_{opr} = -40$ to $85^{\circ}C$ (T version) unless otherwise specified)

Table 5.55 Timer B Input (Count Source Input in Event Counter Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TB)}$	TBiN Input Cycle Time (counted on one edge)	100		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width (counted on one edge)	40		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width (counted on one edge)	40		ns
$t_{C(TB)}$	TBiN Input Cycle Time (counted on both edges)	200		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width (counted on both edges)	80		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width (counted on both edges)	80		ns

Table 5.56 Timer B Input (Pulse Period Measurement Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TB)}$	TBiN Input Cycle Time	400		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width	200		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width	200		ns

Table 5.57 Timer B Input (Pulse Width Measurement Mode)

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(TB)}$	TBiN Input Cycle Time	400		ns
$t_{W(TBH)}$	TBiN Input High ("H") Width	200		ns
$t_{W(TBL)}$	TBiN Input Low ("L") Width	200		ns

Table 5.58 A/D Trigger Input

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(AD)}$	$\overline{AD_{TRG}}$ Input Cycle Time (required for re-trigger)	1000		ns
$t_{W(ADL)}$	$\overline{AD_{TRG}}$ Input Low ("L") Pulse Width	125		ns

Table 5.59 Serial I/O

Symbol	Parameter	Standard		Unit
		Min.	Max.	
$t_{C(CLK)}$	CLKi Input Cycle Time	200		ns
$t_{W(CLKH)}$	CLKi Input High ("H") Width	100		ns
$t_{W(CLKL)}$	CLKi Input Low ("L") Width	100		ns
$t_{d(C-Q)}$	TxDi Output Delay Time		80	ns
$t_{h(C-Q)}$	TxDi Hold Time	0		ns
$t_{su(D-Q)}$	RxDi Input Setup Time	30		ns
$t_{h(C-Q)}$	RxDi Input Hold Time	90		ns

Table 5.60 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

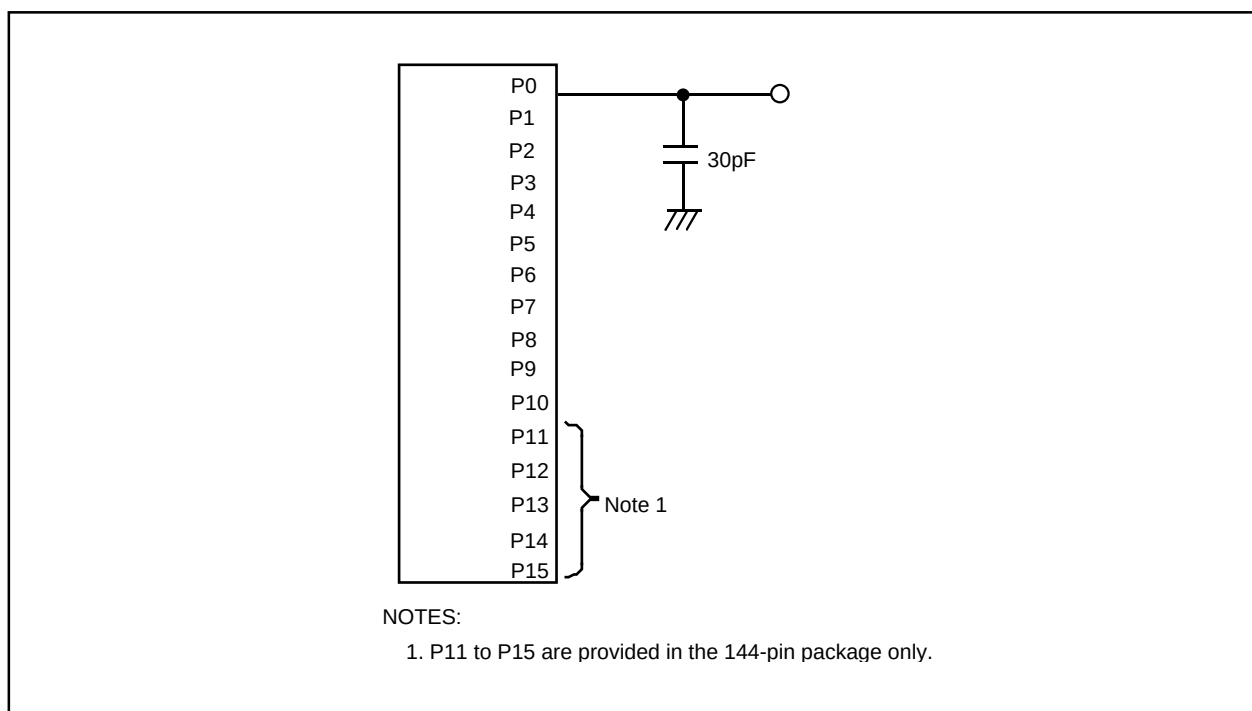


Figure 5.12 P0 to P15 Measurement Circuit

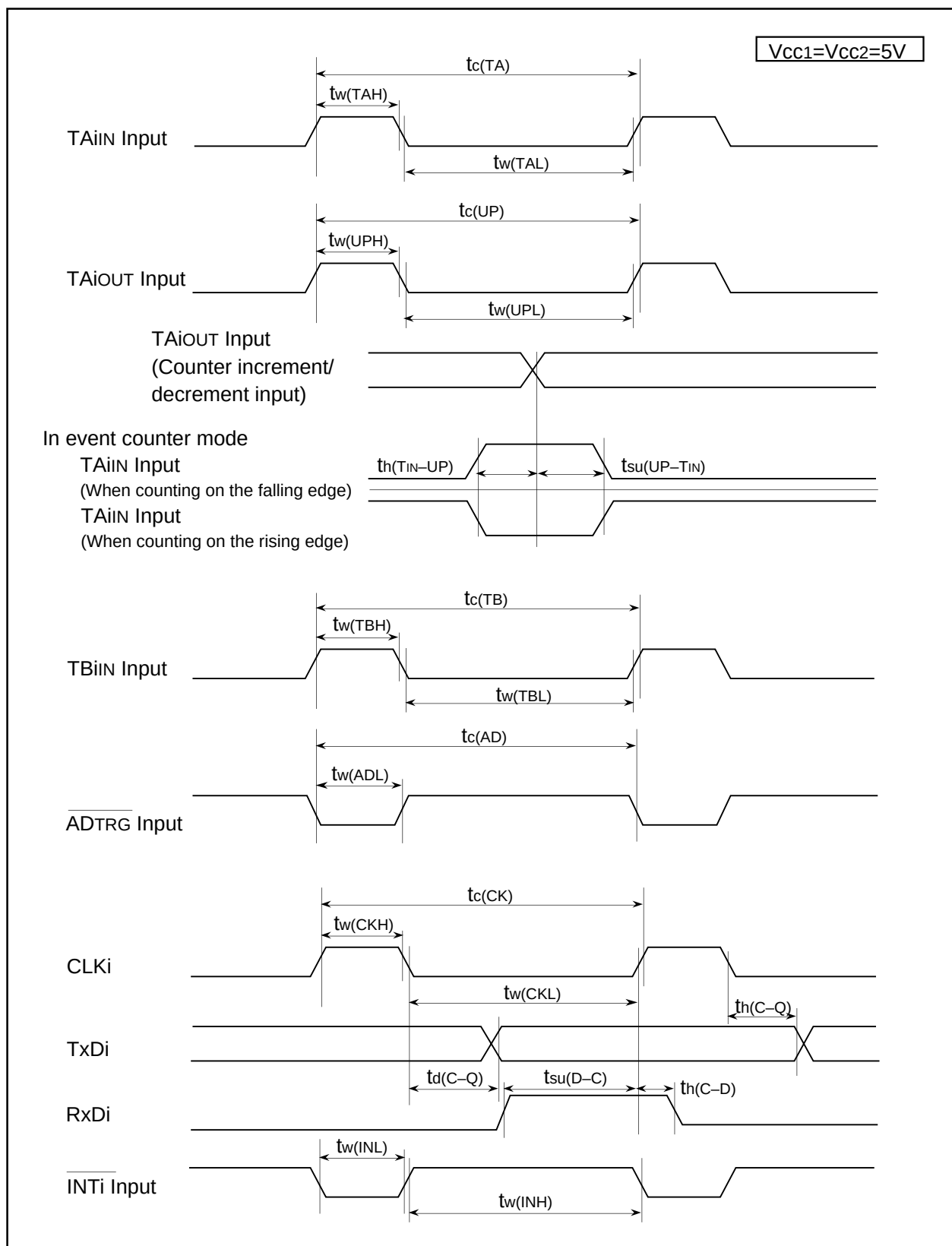


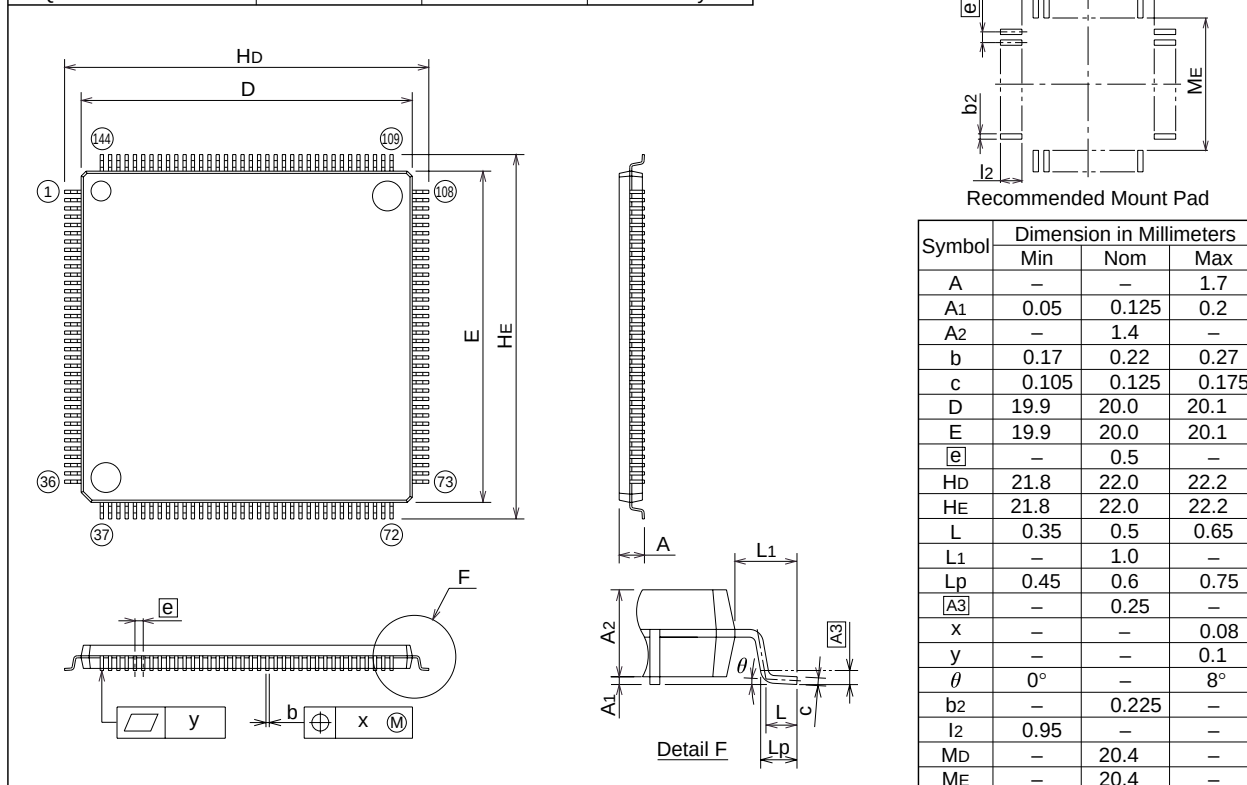
Figure 5.13 Vcc1=Vcc2=5V Timing Diagram

Package Dimensions

144P6Q-A Recommended

Plastic 144pin 20X20mm body LQFP

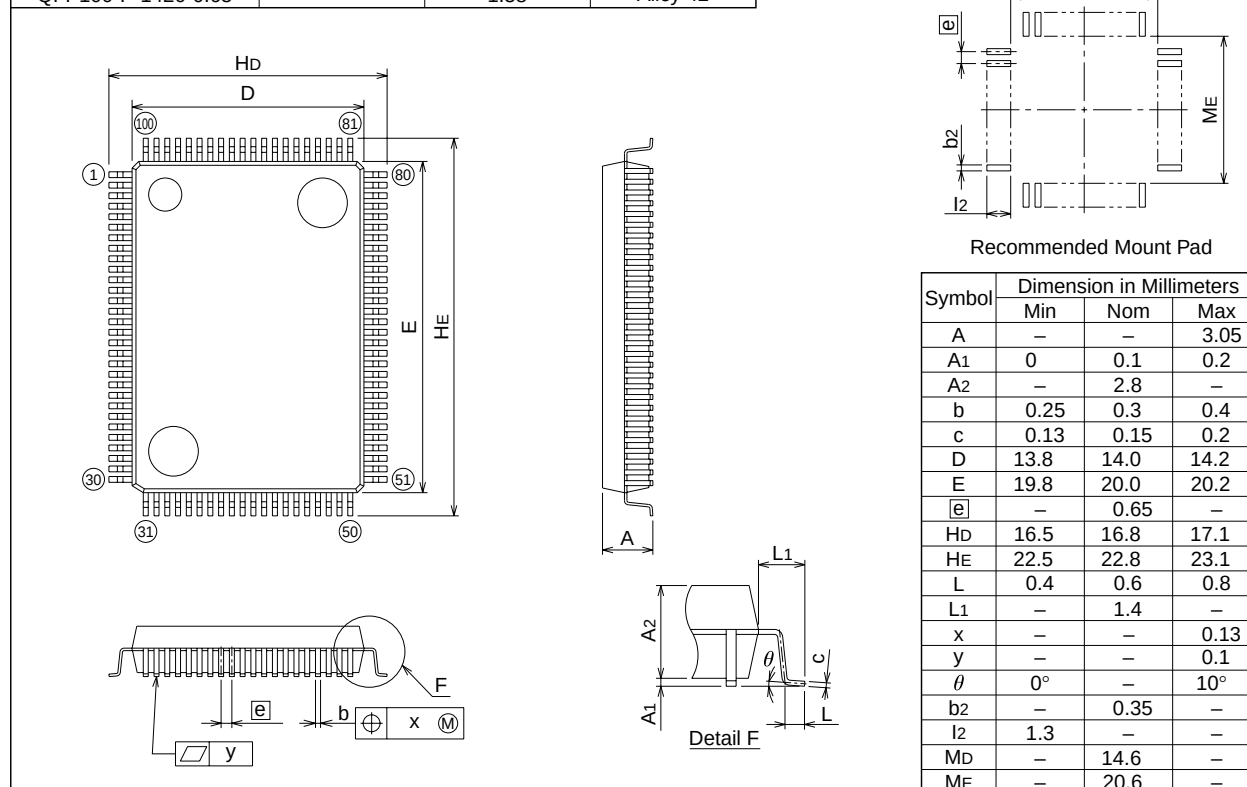
EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
LQFP144-P-2020-0.50	—	1.23	Cu Alloy



100P6S-A Recommended

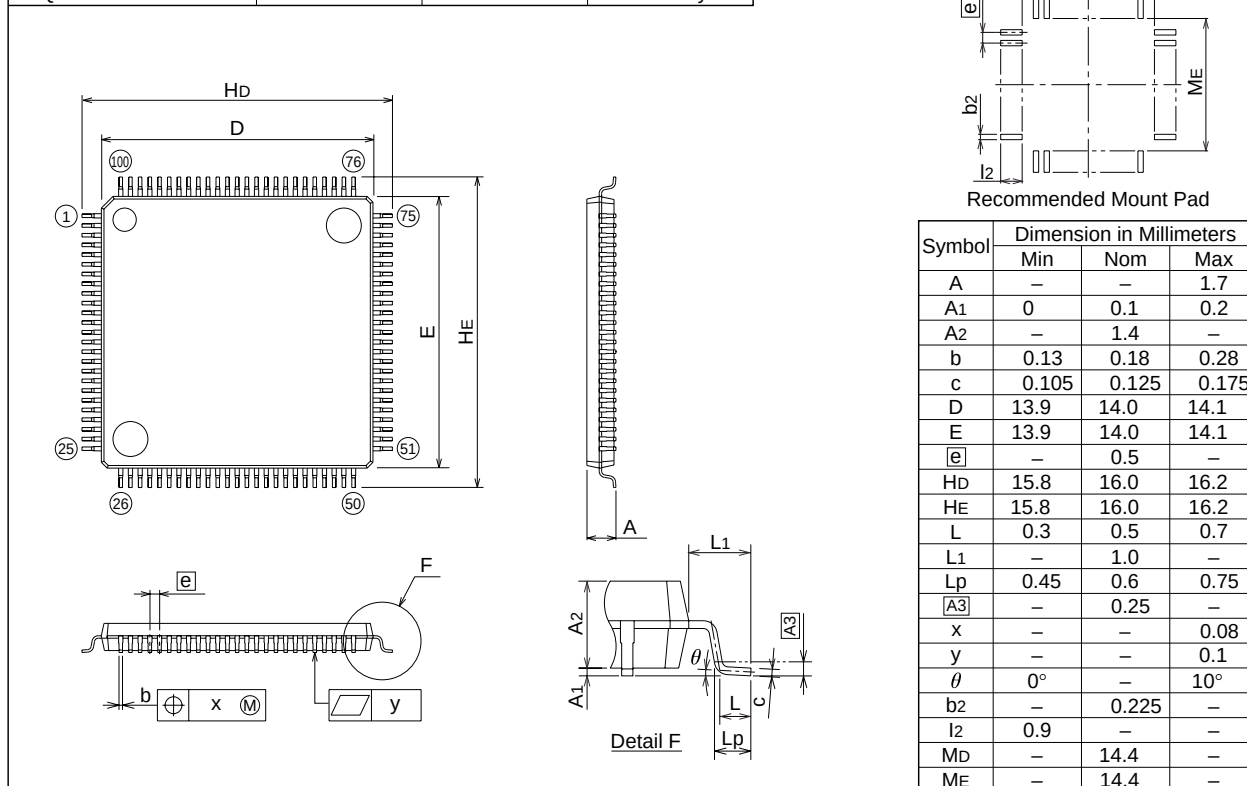
Plastic 100pin 14X20mm body QFP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
QFP100-P-1420-0.65	—	1.58	Alloy 42



100P6Q-A Recommended**Plastic 100pin 14X14mm body LQFP**

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
LQFP100-P-1414-0.50	—	0.63	Cu Alloy



REVISION HISTORY	M32C/84 Group (M32C/84, M32C/84T) Data Sheet
------------------	--

Rev.	Date	Description	
		Page	Summary
0.40	Sep. 30, 2003	—	New Document
0.50	Feb. 05, 2004	2, 3	Overview • Table 1.1 and Table 1.2 M32C/84 Group Performance Values for Shortest Instruction Execution Time and Power Consumption” modified
		5	• Figure 1.2 ROM/RAM Capacity Products added
		6	• Table 1.3 M32C/84 Group Products added
		6	• Figure 1.3 Product Numbering System 128-Kbytes added to ROM capacity Memory
0.50	Feb. 05, 2004	23	• Figure 3.1 Memory Map Diagram modified; products added
		24	SFR • “Values after RESET” for the PM1, PM2, D4INT, G0IRF, G1IRF, IDB0 to IDB1, TA0MR to TA4MR, TCSPR, DM0SL to DM3SL registers revised • The IPSA register added to address 0179 ₁₆ • NOTES added to the PM0 and TCSPR register
		44	Electrical Characteristics • Newly added
0.51	Feb. 09, 2004		Electrical Characteristics
		50	• Table 5.6 Flash Memory Version Electrical Characteristics Note 4 revised
		57	• Figure 5.2 Vcc1=Vcc2=5V Timing Diagram (1) Notes 1 and 2 revised
		68	• Figure 5.3 Vcc1=Vcc2=5V Timing Diagram (2) Notes 1, 2, and 3 revised
		68	• Figure 5.6 Vcc1=Vcc2=3.3V Timing Diagram (1) Notes 1, 2, and 3 revised
0.51	Feb. 09, 2004	69	• Figure 5.7 Vcc1=Vcc2=3.3V Timing Diagram (2) Notes 1 and 2 revised
0.52	Mar.12, 2004		Overview
		2, 3	• Table 1.1 and 1.2 M32C/84 Group Performance Values for Power Consumption modified
		48	Electrical Characteristics • Table 5.3 Electrical Characteristics Maximum values for Power Supply Current modified
		50	• Table 5.6 Flash Memory Version Electrical Characteristics Note 1. 100-cycle Products (D3, D5, U3, U5) deleted; Note 4 modified
0.52	Mar.12, 2004		• Table 5.7 Flash Memory Version Program and Erase Voltage and Read Operation Voltage Characteristics (at Topr=0 to 60°C) deleted
		61	• Table 5.22 Electrical Characteristics Maximum values for Power Supply Consumption modified and standard values when “Topr=85°C while clock is stopped” deleted

REVISION HISTORY	M32C/84 Group (M32C/84, M32C/84T) Data Sheet
------------------	--

Rev.	Date	Description	
		Page	Summary
1.00	Jun.01, 2004	-	M32C/84T (High-reliability version) added
		All Pages	Words standardized: On-chip oscillator, A/D converter and D/A converter
			Overview
		1	• 1.1 Applications Automobiles added
		2, 3	• Table 1.1 and Table 1.2 M32C/84 Group (M32C/84, M32C/84T) Performance M32C/84T added; note 3 added
		4	• Figure 1.1 M32C/84 Group (M32C/84, M32C/84T) Block Diagram Note 3 added
		5	• 1.4 Product Information Description modified
		6	• Figure 1.2 ROM/RAM Capacity figure modified
		6	• Table 1.3 M32C/84 Group M32C/84T added
		6	• Figure 1.3 Product Numbering System M32C/84T added
		7	• Figure 1.4 Pin Assignment for 144-Pin Package Note 3 added
		12	• Figure 1.6 Pin Assignment for 100-Pin Package Note 5 added
		8 to 10	• Table 1.5 Pin Characteristics for 144-Pin Package Note 1 added
		13, 14	• Table 1.6 Pin Characteristics for 100-Pin Package Note 1 added
		15 to 18	• Table 1.7 Pin Description Notes added
			Memory
		22	• Figure 3.1 Memory Map Tables of internal ROM/internal RAM modified; note 2 modified; notes 4 and 5 added
			SFR
		23	• Note 2 added
		24	• PWCR0 and PWCR1 registers deleted
			• “Values after RESET” of the masked ROM version added to the FMR0 register
			• Note 1 added
			Electrical Characteristics
		44	• Table 5.2 Recommended Operating Conditions f_{ripple} , $V_{p-p(\text{ripple})}$, V_{CC} , SV_{CC} and note 1 deleted
		47	• Table 5.3 Electrical Characteristics R_{PULLUP} value for the masked ROM version added
		48	• Table 5.4 A/D Conversion Characteristics t_{SMP} value modified; note 1 added
		50	• Table 5.7 Low Voltage Detect Circuit Electrical Characteristics added
			• Table 5.8 Power Supply Timing added
			• Figure 5.1 Power Supply Timing Diagram added
		55	• Table 5.23 Memory Expansion Mode and Microprocessor Mode $t_{h(BCLK-ALE)}$ value modified
		61	• Table 5.24 Electrical Characteristics R_{PULLUP} value for the masked ROM version added
		62	• Table 5.25 A/D Conversion Characteristics t_{CONV} value modified

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors.
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.



RENESAS SALES OFFICES

<http://www.renesas.com>

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500 Fax: <1> (408) 382-7501

Renesas Technology Europe Limited.
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, United Kingdom
Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

Renesas Technology Europe GmbH
Dornacher Str. 3, D-85622 Feldkirchen, Germany
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

Renesas Technology Hong Kong Ltd.
7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2375-6836

Renesas Technology Taiwan Co., Ltd.
FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology (Shanghai) Co., Ltd.
26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

Renesas Technology Singapore Pte. Ltd.
1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001