

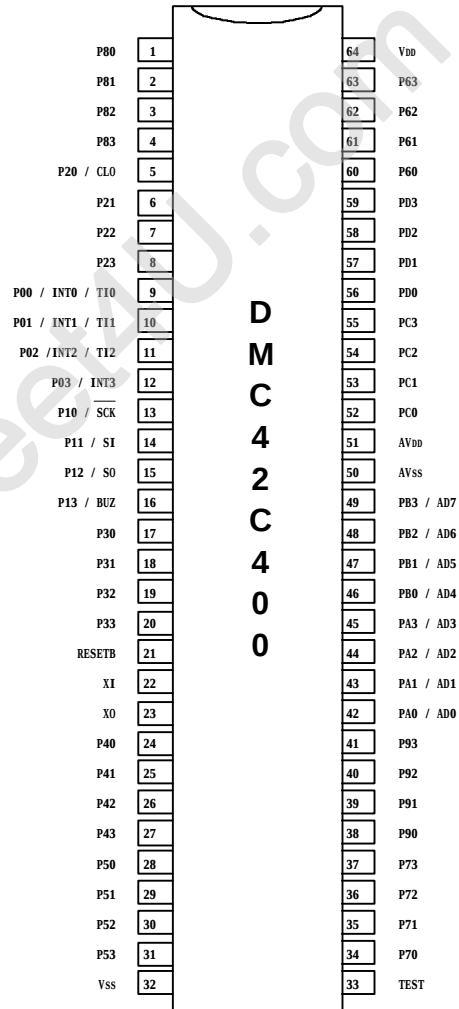
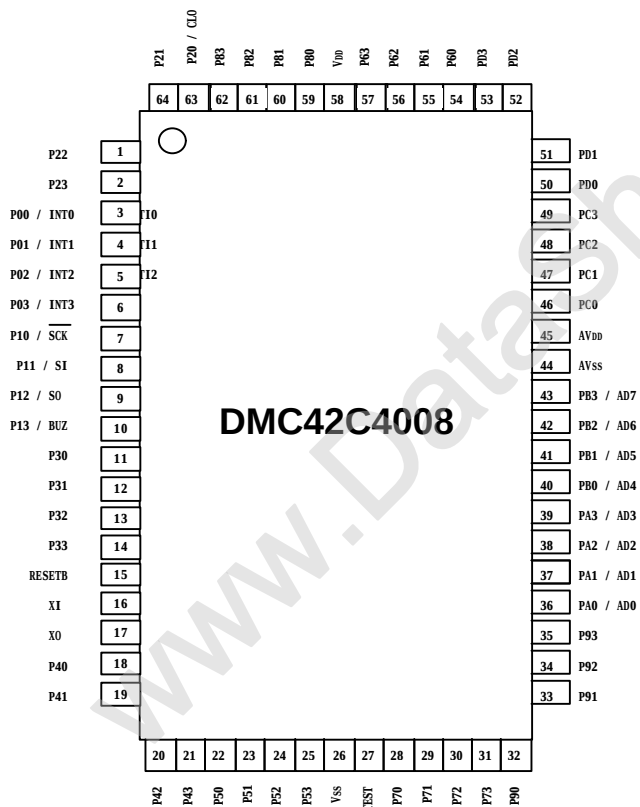
4Bit Single Chip Microcontroller

DMC42C4008

DESCRIPTION

The DMC42C4008 is a 4-bit single chip microcomputer having 8K bytes ROM and is designed with CMOS silicon gate technology. The DMC42C4008 includes peripherals such as various timers, A/D converter(8ch), serial communication interface(8bit), on-chip oscillator and clock circuit. It provides the hardware features, architectural enhancements and instructions which are necessary to make it a powerful and cost effective controller for applications requiring up to 64K bytes of programmable memory.

PIN CONFIGURATIONS



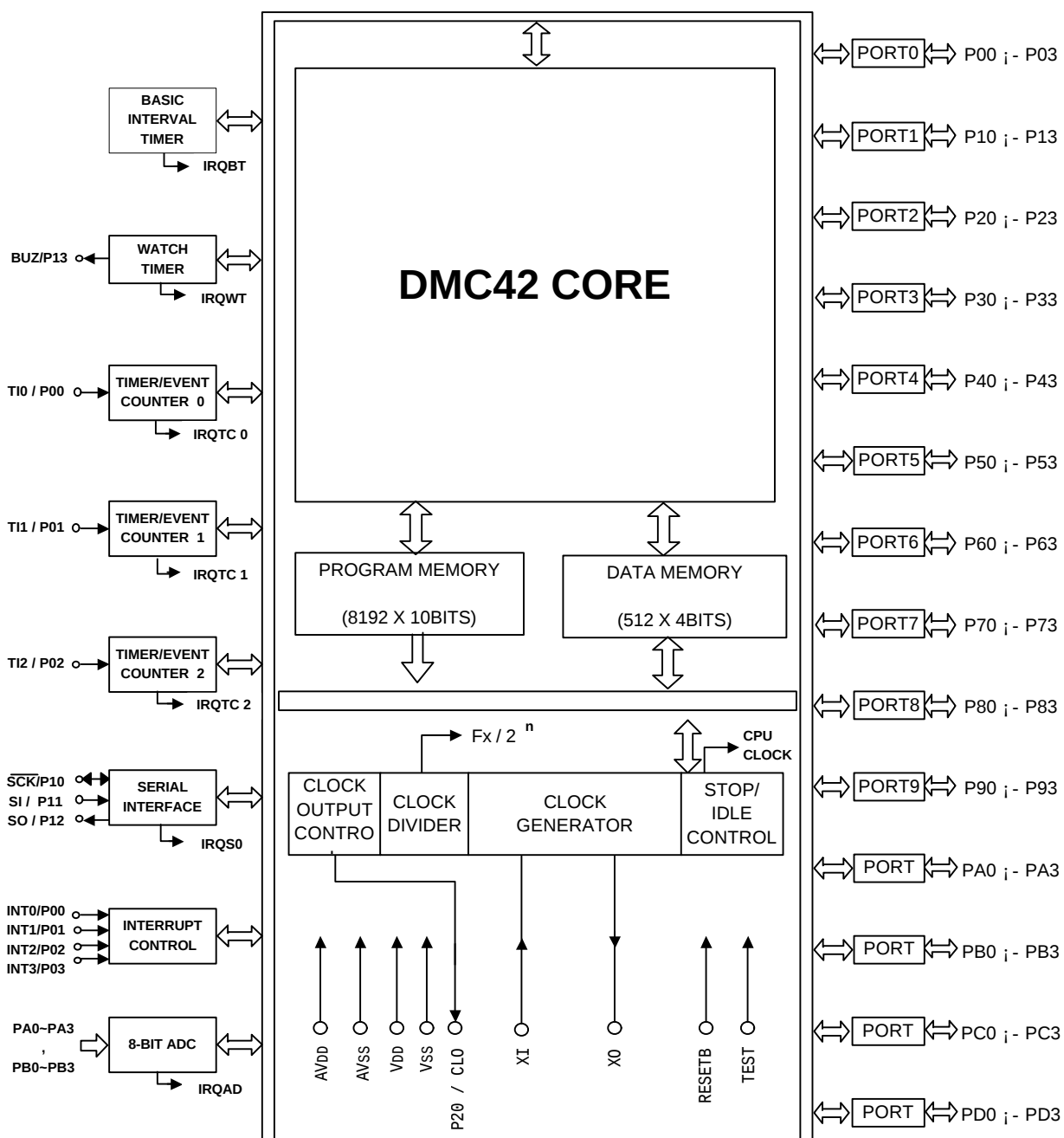
FEATURE

- Memory mapped I/O
- Program memory : 8192 x 10bits
- Data memory : 512 x 4bits
- Instructions
 - Various bit manipulation
 - 8-bit data operation
 - 7-bit relative branch
 - 1 byte absolute call
- Instruction cycle times
 - Main ($XI = 4.19\text{MHz}$)
 - . 15.3 μs ($XI/64 = 65.5\text{KHz}$)
 - . 1.91 μs ($XI/8 = 524.0\text{KHz}$)
 - . 0.95 μs ($XI/4 = 1.05\text{MHz}$)
- 4 Register Bank
- General register : 8 x 4-bit respectively
- Accumulator
 - Bit Accumulator (CY), 4 bit Accumulator (A),
8 bit Accumulator (XA)
- Multiple vectored interrupt source
 - External interrupt : 4
 - Internal interrupt : 7
- Watch timer
 - fast mode : 3.91 msec
 - normal mode : 0.5 sec
 - buzzer output : 1, 2, 4 KHz
- Basic interval timer
 - 8 kinds of period
 - Used stabilization wait timer to wake up Stop mode
- Three 8-bit timer / event counters
- 8-bit serial communication interface
 - External / Internal clock selection
 - Mode : Transmit ·Receive
Receive only
Clock continuous
- 8-bit A/D converter
 - 8-bit successive approximate type
 - 8 channels
 - Sample and hold
 - Conversion time : 17.1 μs at 4.19MHz
- Key scan
 - 4, 6, 8 Pins Selectable : Port 4, 5
 - Falling edge operation
- 56 I/O Ports
 - CMOS Ports : 40
 - N-channel open drain Ports : 16
 - Direct LED drive
 - Internal pull-up resistor (Mask option)
- Power saving mode
 - STOP : Main clock, CPU clock stop
 - STBY : Only CPU clock stop
Main clock operation
- Package : 64 QFP, 64 SDIP

APPLICATION

VTR, Audio, Telephone, Printer, Refrigerator
Fan Heater, Washing Machine

BLOCK DIAGRAM



PROGRAM MEMORY (ROM)

	CONTENTS
0000H	VECTOR ADDRESS AREA
001FH	
0020H	
005FH	ZERO-PAGE CALL AREA
0060H	
0060H	
1FFFH	8K Byte

VECTOR ADDRESS

	Prioty	INTERRUPT SUORCE	
0000H	0	RESET	Reset Signal
0002H	1	IRQBT	Basic Interval Timer
0004H	2	IRQ0	External interrupt 0
0006H	3	IRQ1	External interrupt 1
0008H	4	IRQTC0	Timer Event Counter 0
000AH	5	IRQTC1	Timer Event Counter 1
000CH	6	IRQ2	External interrupt 2
000EH	7	IRQTC2	Timer Event Counter 2
0010H	8	IRQ3	External interrupt 3
0012H	9	IRQS0	Serial I/O 0
0014H	10	IRQAD	8 bit ADC
0016H			
0018H	12	IRQWT	Watch Timer
001AH	13	IRQKS	Key Scan
001CH			
001EH	15	-	reserved

DATA MEMORY (RAM)

		DIRECT	INDIRECT			STACK	GENERAL REGISTER	
		m	@HL	@DE	@DL		RB=0	RB=1
BANK 0 (1K)	\$00 PAGE0 (256 Byte)	MB=0	MB=0	MP=0		SPS=0	RB=2	RB=4
	\$FF \$00 PAGE1 (256 Byte)							
	\$FF \$00 PAGE2 (256 Byte)							
	\$FF \$00 PAGE3 (256 Byte)							
	\$FF \$00 PAGE0 (256 Byte)	I/O MEMORY		MP=1		SPS=1		
	\$FF \$00 PAGE1 (256 Byte)							
	\$FF \$00 PAGE2 (256 Byte)							
	\$FF \$00 PAGE3 (256 Byte)							
	\$FF \$00 PAGE0 (256 Byte)	I/O MEMORY		MP=2		SPS=2		
	\$FF \$00 PAGE1 (256 Byte)							
	\$FF \$00 PAGE2 (256 Byte)							
	\$FF \$00 PAGE3 (256 Byte)							
	\$FF \$00 PAGE0 (256 Byte)	I/O MEMORY		MP=3				
	\$FF \$00 PAGE1 (256 Byte)							
	\$FF \$00 PAGE2 (256 Byte)							
	\$FF \$00 PAGE3 (256 Byte)							

; Usable

4Bit Single Chip Microcontroller

DMC42C4008

I/O ADDRESS MAP

ADDRESS	Hardware Module Name				R/W	Addressing Unit			REMARKS	INITIAL VALUE
	b3	b2	b1	b0		1 bit	4 bit	8bit		
318H	Stack pointer low (SPL)				R/W			O	Stack pointer low	E
319H	Stack pointer high (SPH)				R/W			O	stack pointer high	F
31AH	SP3	SP2	SP1	SP0	R/W			O	Stack Page Select Low (SPSL)	0
31BH	-	-	SP5	SP4	R/W			O	Stack Page Select High (SPSh)	0
31CH	AC		IS1	IS0	R/W	O	O	O	Psw low (PSWL)	0
31DH	CY	Z	OV	T					Psw high (PSWH)	0
320H	T/E counter mode register 0				W	320H.3		O	Clock source select. counter start (ch0)	00
321H	(TMOD0)									
322H	T/E counter register 0				R			O	readable count value (ch0)	00
323H	(TMCNT0)									
324H	T/E reference register 0				W			O	count reference register (ch0)	FF
325H	(TMREF0)									
326H	T/E counter mode register 1				W	326H.3		O	clock source select. counter start (ch1)	00
327H	(TMOD1)									
328H	T/E counter register 1				R			O	readable count value (ch1)	00
329H	(TMCNT1)									
32AH	T/E reference register 1				W			O	count reference register (ch1)	FF
32BH	(TMREF1)									
32CH	T/E counter mode register 2				W	32CH.3		O	clock source select. counter start (ch2)	00
32DH	(TMOD2)									
32EH	T/E counter register 2				R			O	readable count value (ch2)	00
32FH	(TMCNT2)									
330H	T/E reference register 2				W			O	count reference register (ch2)	FF
331H	(TMREF2)									
332H	Basic Timer mode register(BMOD)				R/W	332H.3	O		clock select, Bit start	0
334H	Basic interval timer count				R			O	readable count register	00
335H	register(BITCNT)									
336H	Watch timer mode register				R/W	336H.3		O	clock/buzzer select. bit3	00
337H	(WMOD)								readable	
386H	Adc8 mode register (ADCM8)				R/W	386H.3		O	analog input pin select. start & low 4bit readable	00
387H										
388H	Adc8 output latch (ADCOL8)				R			O	8bit conversion data	00
389H										
3A0H	Power control register (PCON)				R/W		O		system clock select, idle, stop mode	00
3A2H	Operating mode register (SCMOD)				R/W	O			main/sub system clock select	0
3A4H	Clock output mode register (CLOMD)				W		O		cpu clock output select, clock out EN/DIS	00
3A8H	Serial interface mode register0				W	3A8H.3		O	receive/transmit mode. clock select	00
3A9H	(SIOM0)									
3AAH	Serial interface buffer0				R/W				serial shift register 0	XX
3ABH	(SBUFF0)									
3ACH	Serial interface mode register1				W	3ACH.3		O	receive/transmit mode, clock select	00
3ADH	(SIOM1)									

4Bit Single Chip Microcontroller

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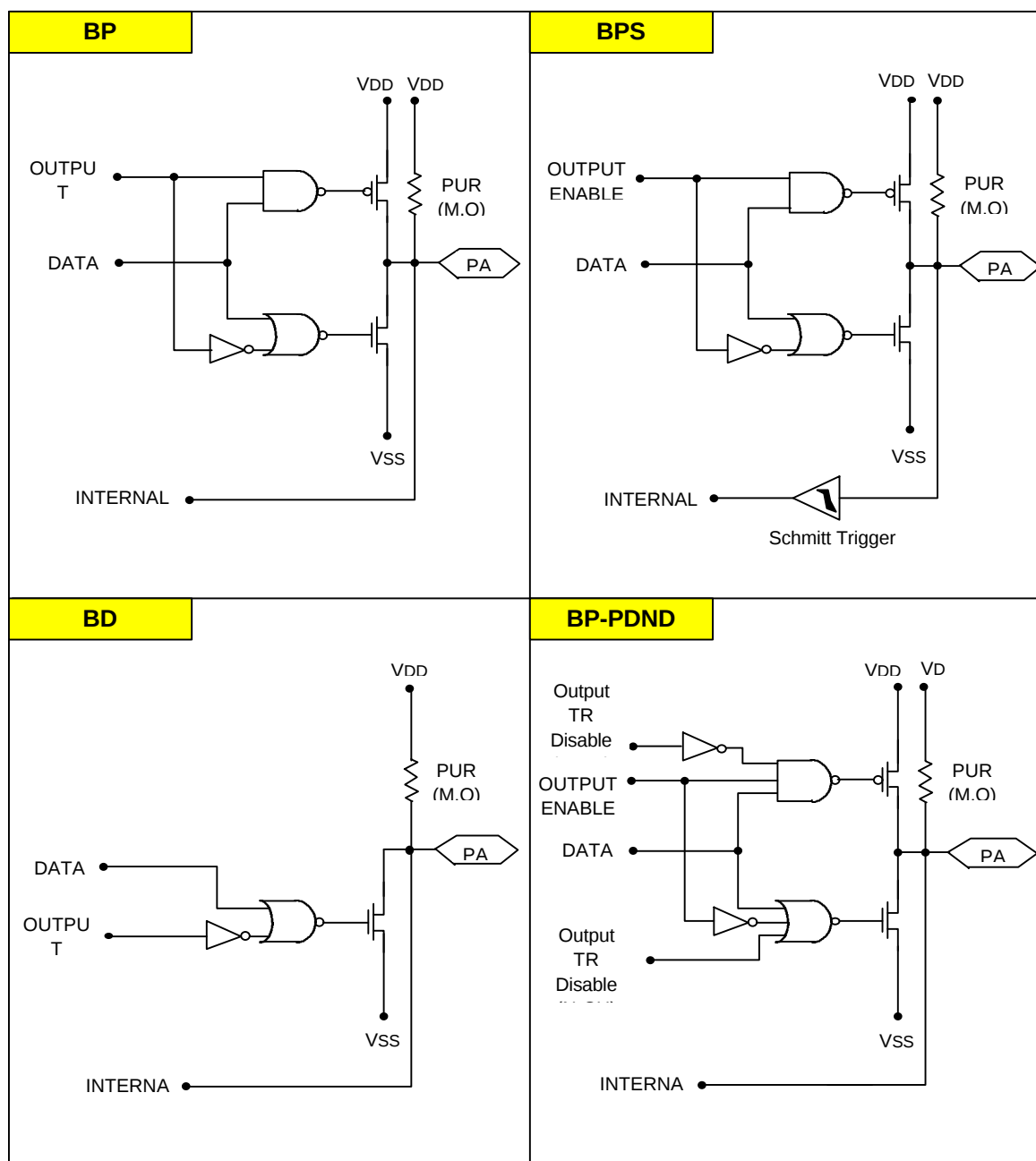
ADDRESS	Hardware Module Name				R/W	Addressing Unit			REMARKS	INITIAL VALUE
	b3	b2	b1	b0		1 bit	4 bit	8bit		
3AEH	Serial interface buffer1				R/W			O	serial shift register 1	00
3AFH	(SBUFF1)									
3B2H	Power on flag (PONF)				P/W	3B2H.0		O	power on reset flag	0
3C2H	IME				R/W	3C2H.3		O	Interrupt priority select, IME flag.	00
3C3H	IPSR3	IPSR2	IPSR1	IPSR0						
3C4H	External interrupt mode register0 (IMOD0)				W		O		external interrupt 0 edge detection	00
3C5H	External interrupt mode register1 (IMOD1)				W		O		external interrupt 1 edge detection	00
3C6H	External interrupt mode register2 (IMOD2)				W		O		external interrupt 2 edge detection	00
3C7H	External interrupt mode register3 (IMOD3)				W		O		external interrupt 3 edge detection	00
3D8H	IE2	IRQ2	IEBT	IRQBT	R/W	O	O		Interrupt EN/IRQ flag	0
3D9H	IEAD8	IRQAD8	IEWT	IRQWT	R/W	O	O		Interrupt EN/IRQ flag	0
3DAH			IES0	IRQS0	R/W	O	O		Interrupt EN/IRQ flag	0
3DBH	IETC1	IRQTC1	IETC0	IRQTC0	R/W	O	O		Interrupt EN/IRQ flag	0
3DCH	IE1	IRQ1	IE0	IRQ0	R/W	O	O		Interrupt EN/IRQ flag	0
3DDH	IETC2	IRQTC2	IES1	IRQS1	R/W	O	O		Interrupt EN/IRQ flag	0
3DEH			IE3	IRQ3	R/W	O	O		Interrupt EN/IRQ flag	0
3E0H	PW03	PW02	PW01	PW00	W			O	port 0, 1 mode register (PMGA)	00
3E1H	PW13	PW12	PW11	PW10						
3E2H	PW23	PW22	PW21	PW20	W			O	port 2, 3 mode register (PMGB)	00
3E3H	PW33	PW32	PW31	PW30						
3E4H	PW43	PW42	PW41	PW40	W			O	port 4, 5 mode register (PMGC)	00
3E5H	PW53	PW52	PW51	PW50						
3E6H	PW63	PW62	PW61	PW60	W			O	port 6, 7 mode register (PMGD)	00
3E7H	PW73	PW72	PW71	PW70						
3E8H	PW83	PW82	PW81	PW80	W			O	port 8, 9 mode register (PMGE)	00
3E9H	PW93	PW92	PW91	PW90						
3EAH	PWA3	PWA2	PWA1	PWA0	W			O	port a, b mode register (PMGF)	00
3EBH	PWB3	PWB2	PWB1	PWB0						
3ECH	PWC3	PWC2	PWC1	PWC0	W			O	port c, d mode register (PMGG)	00
3EDH	PWD3	PWD2	PWD1	PWD0						
3F0H	PORT0 (R0)				R/W	O	O		R0 Port Data Register	0
3F1H	PORT1 (R1)				R/W	O	O		R1 Port Data Register	0
3F2H	PORT2 (R2)				R/W	O	O		R2 Port Data Register	0
3F3H	PORT3 (R3)				R/W	O	O		R3 Port Data Register	0
3F4H	PORT4 (R4)				R/W	O	O	O	R4 Port Data Register	0
3F5H	PORT5 (R5)				R/W	O	O		R5 Port Data Register	0
3F6H	PORT6 (R6)				R/W	O	O		R6 Port Data Register	0
3F7H	PORT7 (R7)				R/W	O	O		R7 Port Data Register	0
3F8H	PORT8 (R8)				R/W	O	O		R8 Port Data Register	0
3F9H	PORT9 (R9)				R/W	O	O		R9 Port Data Register	0
3FAH	PORTA (RA)				R/W	O	O		RA Port Data Register	0
3FBH	PORTB (RB)				R/W	O	O		RB Port Data Register	0
3FCH	PORTC (RC)				R/W	O	O	O	RC Port Data Register	0
3FDH	PORTD (RD)				R/W	O	O		RD Port Data Register	0

PIN DESCRIPTION

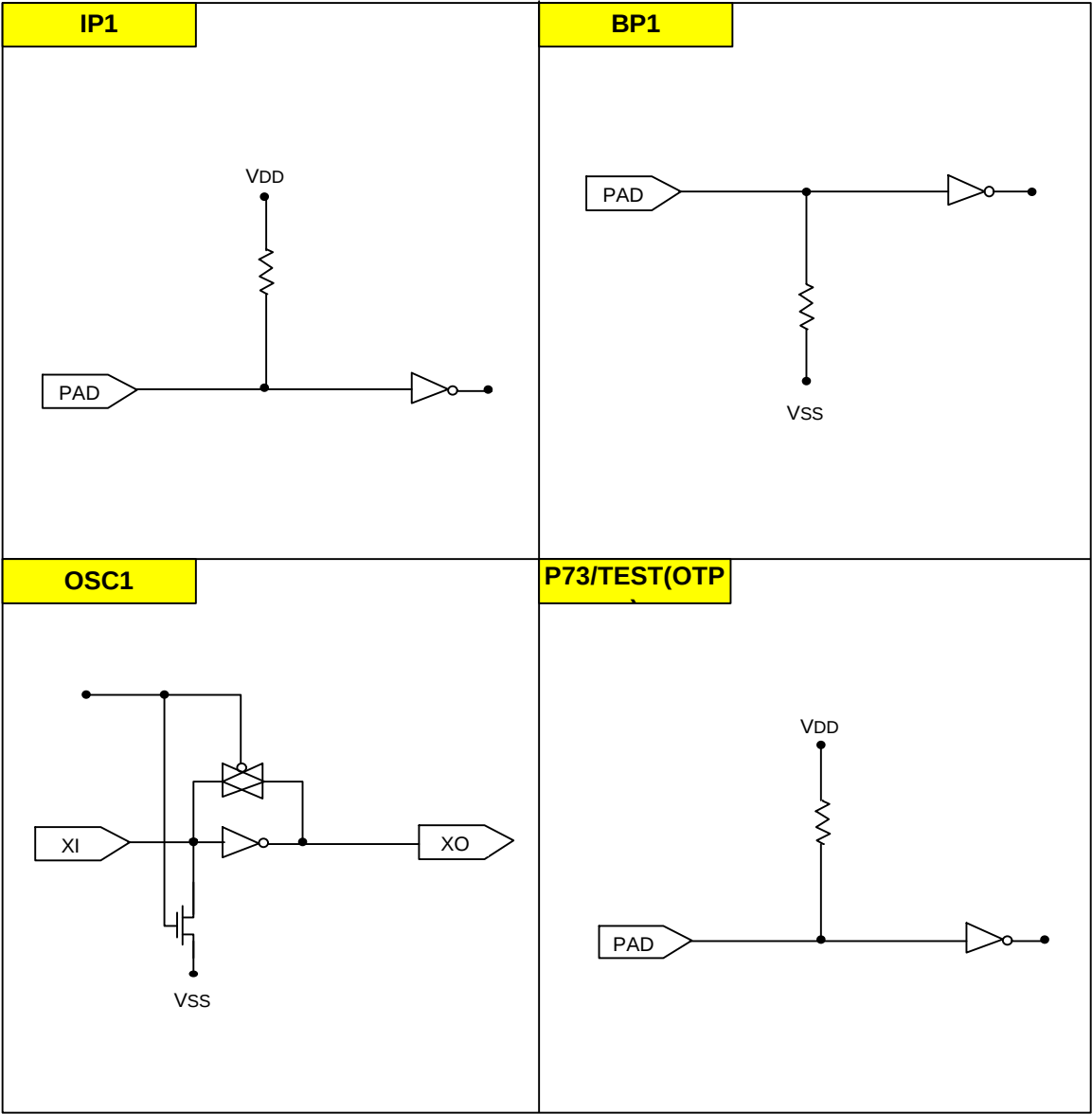
PIN SYMBOL	SHARED PIN	I/O	FUNCTION	RESET	PORT TYPE					
P00 P01 P02 P03	INT0/TI0 INT1/TI1 INT2/TI2 INT3	I/O	4-BIT I/O PORT PORT 0	INPUT	BPS					
P10 P11 P12 P13	SCK SI SO BUZ	I/O	4-BIT I/O PORT PORT 1		BPS					
P20 P21~ P23	CLO -	I/O	4-BIT I/O PORT PORT 2		BP					
P3 P4 P5 P6 P7 P8 P9	- - - - - - -	I/O	4-BIT I/O PORT. PORT3 4-BIT I/O PORT. PORT4 4-BIT I/O PORT. PORT5 4-BIT I/O PORT. PORT6 4-BIT I/O PORT. PORT7 4-BIT I/O PORT. PORT8 4-BIT I/O PORT. PORT9		BP BD BP-PDND BP					
PA PB PC PD	AD0~AD3 AD4~AD7 - -		4-BIT I/O PORT. PORTA 4-BIT I/O PORT. PORTB 4-BIT I/O PORT. PORTC 4-BIT I/O PORT. PORTD		BD					
INT0/TI0 INT1/TI1 INT2/TI2 INT3	P00 P01 P02 P03		I		External interrupt input port rising/falling edge detection Event pulse input port for the timer/event counters	BP				
SCK SI SO BUZ CLO	P10 P11 P12 P13 P20		I/O I O O O				Serial clock in/out port Serial data input port Serial data output port Buzzer output port Clock output port	BPS		
Key scan AD0~AD3 AD4~AD7	P4-P5 PA PB		I I						4, 6, 8, bits Key scan input selectable Analog input for the 8-bit A/D converter	BP
XI XO	-									
RESETB TEST AVDD, AVSS VDD, VSS	- - - -		I I 		Reset input pin Connect to Vss Power & ground for the A/D converter Power & ground	IP1 BP1 				

NOTE) P4, P5, PC, PD : 8-bit operation possible

I/O CIRCUITS



NOTE) PUR : Pull-Up Resistor
M.O : Mask Option



ABSOLUTE MAXIMUM RATINGS(T_A = 0°C to 70°C, V_{DD} = 5V ±10%, f_x = 4.19MHz)

PARAMETER	SYMBOL	CONDITION	RATING		UNIT
Supply Voltage	V _{DD}	-	-0.3 to +7.0		V
Input Voltage	V _I	All I/O ports	-0.3 to V _{DD} +0.3		V
Output Voltage	V _O	-	-0.3 to V _{DD} +0.3		V
Output Current High	I _{OH}	One I/O port active	-15		mA
		All I/O ports active	-30		
Output Current Low	I _{OL}	One I/O port active	Peak Value	+30	mA
		-	RMS Value	+15	
		Total value for ports P1, P2, P3, P8	Peak Value	+100	
			RMS Value	+60	
		Total value for ports P0, P4, P5, P6	Peak Value	+100	
			RMS Value	+60	
Operating Temperature	T _A	-	-40 to +85		°C
Storage Temperature	T _{stg}	-	-55 to +125		°C

* RMS values are calculated as $\text{peak value} \times \sqrt{\text{Duty}}$

* Exceeding beyond those listed values under "Absolute Maximum Ratings" may cause permanent damage to the device.

DC ELECTRICAL CHARACTERISTICS

(V_{SS} = 0, V_{DD} = 5V ±10%, T_A = 25°C, f_x = 4.19MHz)

PARAMETER	SYMBOL	TEST CONDITION			LIMIT			UNIT
					MIN.	TYP.	MAX.	
High Level Input Voltage	V _{IH}	Port 0 ~ Port D RESETB, XI			0.7V _{DD} 0.8V _{DD}	- -	V _{DD} V _{DD}	V
Low Level Input Voltage	V _{IL}	Port 0 ~ Port D (Excepted TEST/R73) RESETB, XI, TEST/R73			- -	- -	0.3V _{DD} 0.2V _{DD}	V
High Level Output Voltage	V _{OH}	All Ports Except Open	(I _{OH} = - 4mA)	0.85V _{DD}	-	-	V	
		Drain Ports	(I _{OH} = - 1mA)	0.95V _{DD}	-	-		
		(Port 4,5,C,D)	(I _{OH} = - 100uA)	0.99V _{DD}	-	-		
Low Level Output Voltage	V _{OL}	All Ports (I _{OL} = 10mA)		-	-	0.5	V	
		(I _{OL} = 4mA)		-	-	0.3		
		(I _{OL} = 400uA)		-	-	60	mV	
High Level Input Leakage Current	I _{IH}	All Pin Except XI, RESETB (V _{IN} = V _{DD})			- -	- 1.2	3 100	uA
Low Level Input Leakage Current	I _{IL}	All Pin Except RESETB, P73/TEST (V _{IN} = 0V)			- -	- -1.2	-3 -200	uA
Supply Current	I _{DD1}	Main Clock (XI) = 4.19MHz	Dynamic Mode	V _{DD} = 5V ±10%	-	-	10	mA
			Idle Mode		-	-	5	
	I _{DD2}	Main Clock (XI) = 2MHz	Dynamic Mode	V _{DD} = 3V ±10%	-	-	2	
			Idle Mode		-	-	1	

DC ELECTRICAL CHARACTERISTICS(V_{SS} = 0, V_{DD} = 5V ±10%, T_A = 25°C, f_X = 4.19MHz)

PARAMETER	SYMBOL	TEST			LIMIT			UNIT
		CONDITION			MIN.	TYP.	MAX.	
Supply Current	IDD3 (1)	Main Clock (XI) = 4.19MHz	Stop Mode	VDD = 5V ±10%	-	1	5	uA
				VDD = 3V ±10%	-	0.5	3	
Internal Pull-up Resistor (M.O)	RPU	All Ports VI or VO = 0V, VDD = 5V			-	-	40	Kohm
Pull-up Resistor	RL1	VI = 0V, VDD = 5V ±10% RESETB			20	-	60	
Pull-down Resistor	RL2	VI = 0V, VDD = 5V ±10% TEST			10	-	30	

NOTES) :

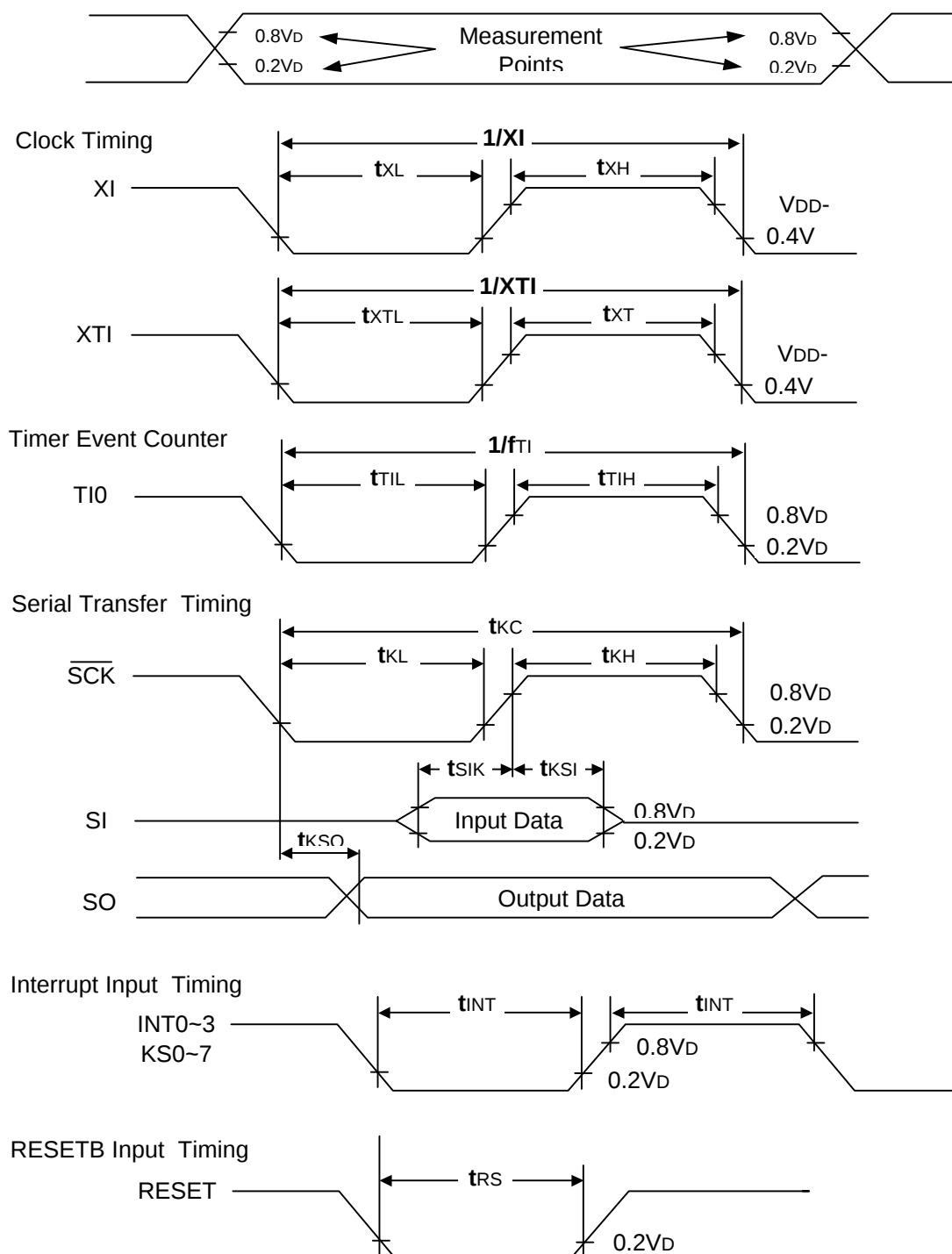
(1) Main system clock oscillation stops.

AC ELECTRICAL CHARACTERISTICS

(T_A = -40 to +85°C, V_{DD} = 2.7 to 6.0V)

PARAMETER	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Cycle Time	t _{cy}	V _{DD} = 4.5 to 6.0V		0.95	-	64	μS
		V _{DD} = 2.7 to 3.3V		3.8	-	64	μS
TI Input Frequency	f _{TI}	V _{DD} = 4.5 to 6.0V		0	-	1	MHz
		V _{DD} = 2.7 to 3.3V		0	-	275	KHz
TI Input High, Low Level Width	t _{TIH}	V _{DD} = 4.5 to 6.0V		0.48	-	-	μS
	t _{TIL}	V _{DD} = 2.7 to 3.3V		1.8	-	-	μS
SCK Cycle Time	t _{KCY}	V _{DD} = 4.5 to	Input	800	-	-	nS
			Output	950	-	-	nS
		V _{DD} = 2.7 to	Input	3200	-	-	nS
			Output	3800	-	-	nS
SCK High, Low Level Width	t _{KH}	V _{DD} = 4.5 to	Input	400	-	-	nS
			Output	t _{KCY} /2~50	-	-	nS
	t _{KL}	V _{DD} = 2.7 to	Input	1600	-	-	nS
			Output	t _{KCY} /2~15	-	-	nS
SI Set up Time to SCK High	t _{SIK}			100	-	-	nS
SI Hold Time to SCK High	t _{KSI}			400	-	-	nS
SCK to S0 Output Delay Time	t _{KSO}	V _{DD} = 4.5 to	Input	-	-	300	nS
			Output	-	-	250	nS
		V _{DD} = 2.7 to	Input	-	-	1000	nS
			Output	-	-	1000	nS
INT 0 ~ 4 Input Level High, Low	t _{INTH}			5	-	-	μS
	t _{INTL}			5	-	-	μS
RESETB Low Level	t _{RSL}			5	-	-	μS

AC Timing Measurement Points (Except XI and XTI)



RAM DATA RETENTION CHARACTERISTICS (in STOP Mode)

(TA = -40 to +85°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Data Retention Supply Voltage	VDDDR		2.0	-	6.0	V
Data Retention Supply Current	IDDDR	VDDDR = 2.0V	-	0.1	10	uA
Release Signal Set Time	tsREL		0	-	-	uS
Oscillation Stabilization Wait Time	tWAIT	When released by RESETB	-	2 ¹⁷ /fx	-	mS
		When released by interrupt Signal	-	NOTE 1)	-	mS

NOTE 1) Depends on the setting of the basic interval timer mode register.

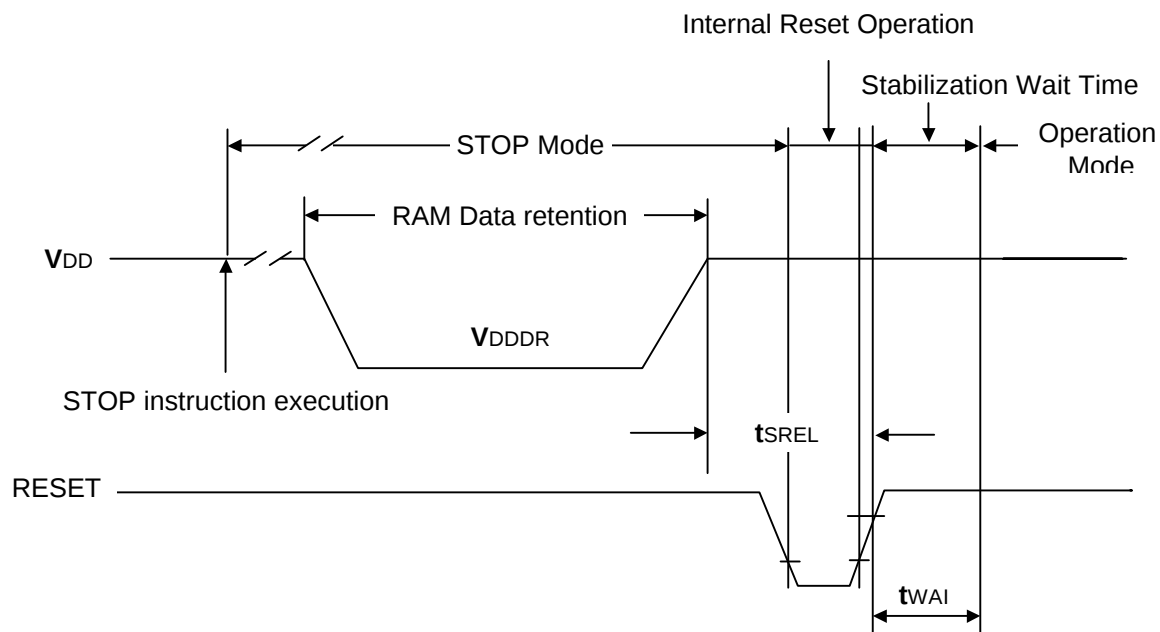
(refer to the table below)

(fx = 4.19MHz)

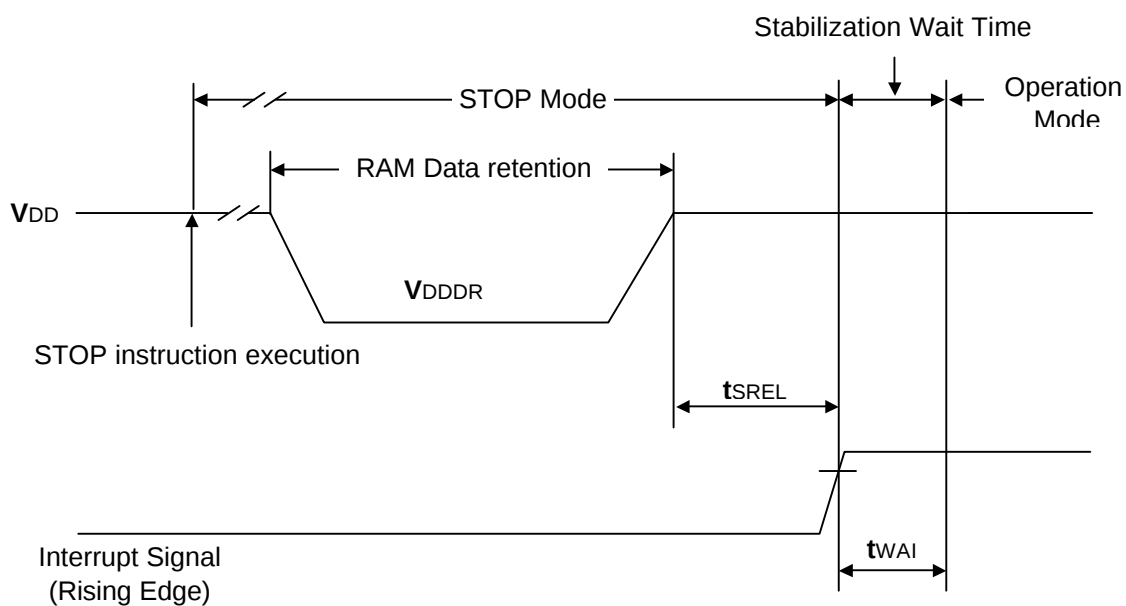
BMOD2	BMOD1	BMOD0	Oscillation Stabilization
0	0	0	2 ²⁰ /fx (Approximately 250ms)
0	1	1	2 ¹⁷ /fx (Approximately 31.3ms)
1	0	0	2 ¹⁵ /fx (Approximately 7.82ms)
1	0	1	2 ¹³ /fx (Approximately 1.95ms)

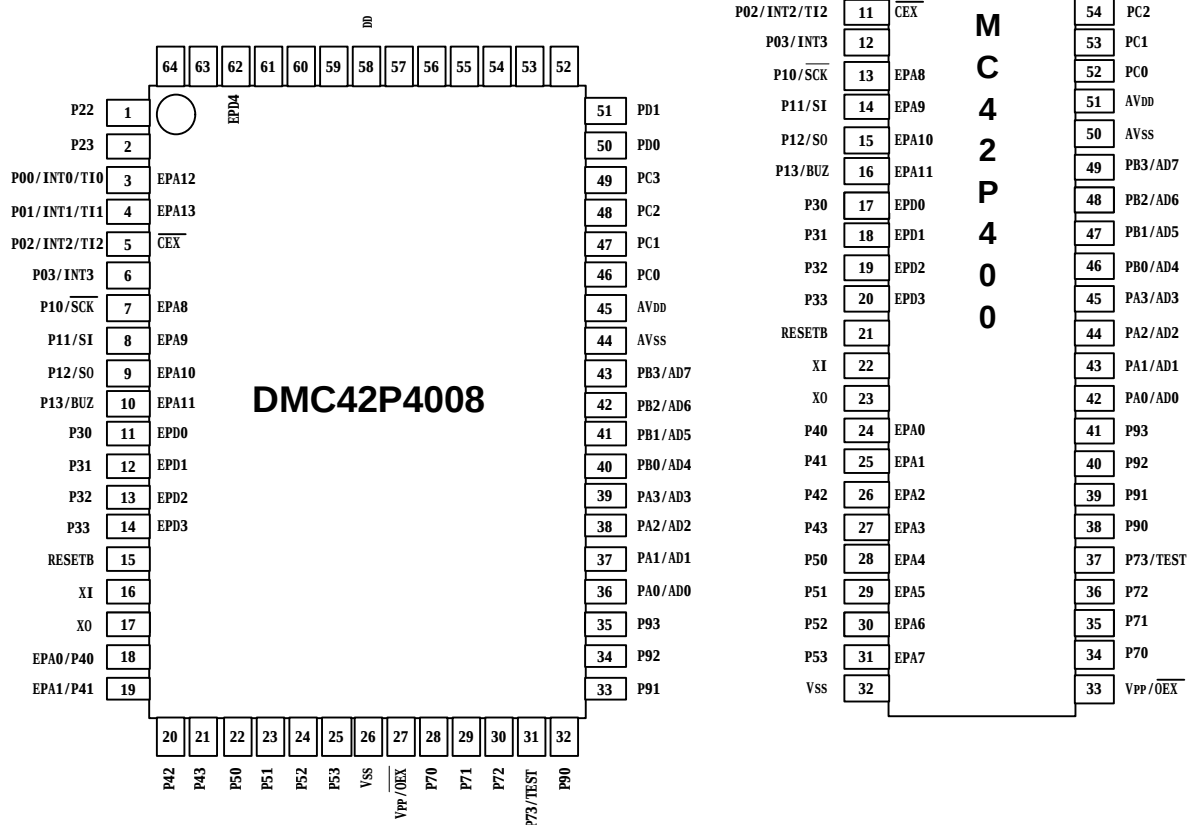
RAM DATA RETENTION TIMING

When STOP mode is released by RESETB input



When STOP mode is released by interrupt signal





DEVICE OPERATION

The operational modes of the DMC42P4008 are listed in Table 1.

A single 5V power supply is required in the read mode.

All inputs are TTL levels except for V_{PP} / $\overline{OEX}$.

$V_{PP} = 12.5 \pm 0.5V$

MODE \ PINS	$\overline{CEX}$	V_{PP} / $\overline{OEX}$	V_{DD}	OUTPU
READ	V_{IL}	V_{IL}	5.0V	DoUT
PROGRAM	V_{IL}	V_{PP}	6.0V	DiN
VERIFY	V_{IL}	V_{IL}	6.0V	DoUT
PROGRAM INHIBIT	V_{IH}	V_{PP}	6.0V	High Z

TABLE 1. Operating Modes

PIN NAME	MODE	
	EPROM MODE	USER MODE
TEST	V_{IL}	V_{IH}
RESETB	V_{IL}	

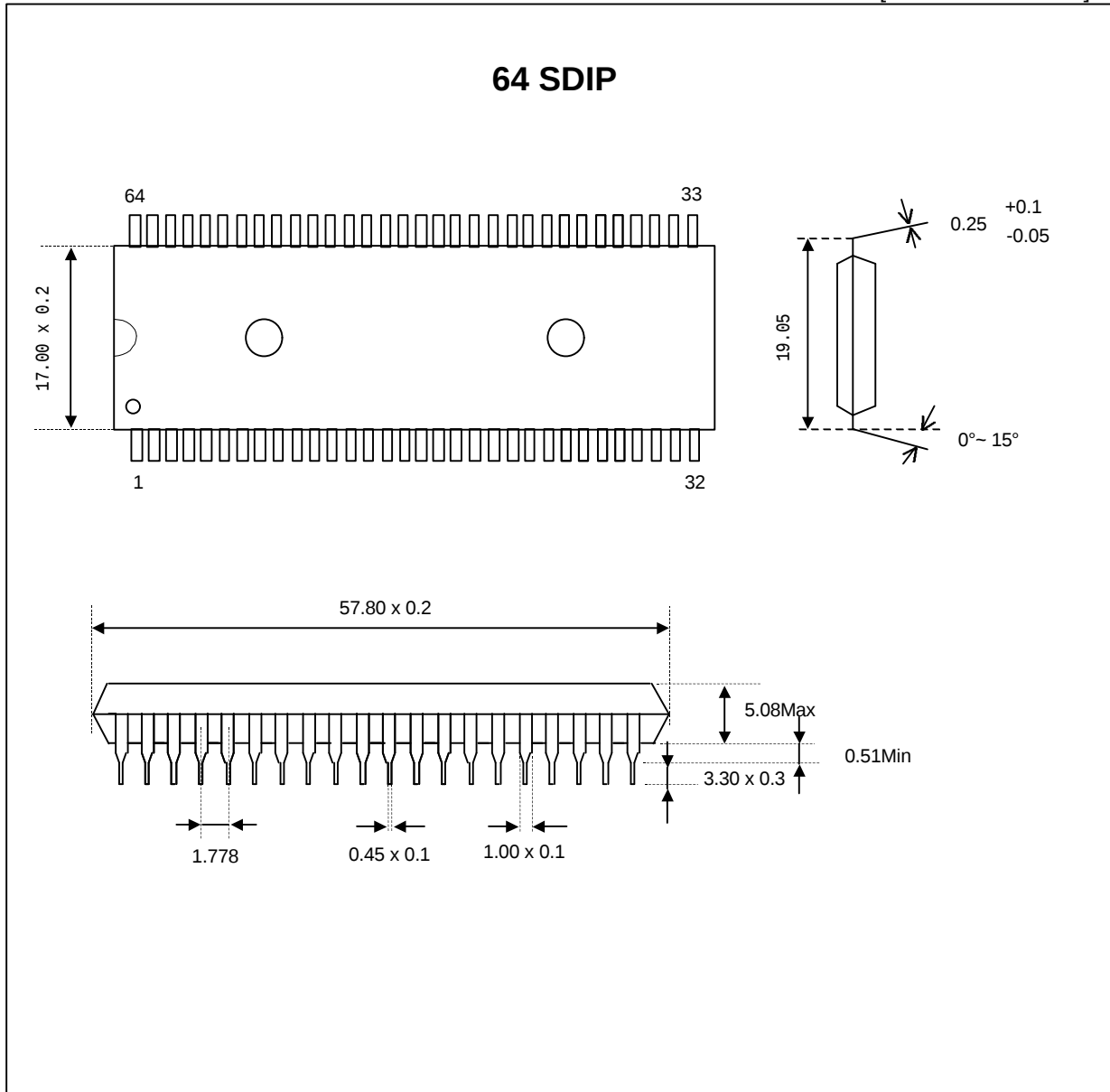
TABLE 2. The modes of DMC42P4008

DC PROGRAMMING CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	LIMIT		UNIT
			MIN.	MAX.	
Input Low Voltage	V_{IL}		-0.1	0.8	V
Input High Voltage	V_{IH}		2.0	V_{DD}	V
Output Low Voltage during Verify	V_{OL}	$I_{OL} = 2.1mA$	-	0.45	V
Output High Voltage during Verify	V_{OH}	$I_{OH} = -400\mu A$	2.4	-	V
Quick-pulse Programming	V_{PP}		12.5	13.0	V
Quick-pulse Programming	V_{DD}		6.0	6.5	V

PACKAGE DIMENSION

[UNIT : Millimeter]



PACKAGE DIMENSION

[UNIT : Millimeter]

