CMOS 8–Bit Microcontrollers

TMP90PH44N/TMP90PH44F

1. Outline and Characteristics

The TMP90PH44 is a system evaluation LSI having a built-in One-Time PROM for (16K byte) for TMP90C844.

A programming and verification for the internal PROM is achieved by using a general EPROM programmer with an adapter socket.

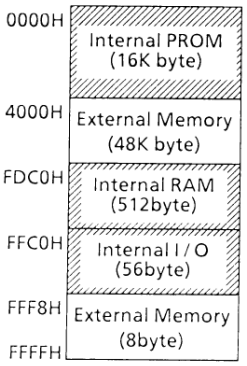
The function of this device is exactly the same as the TMP90C844 by programming to the internal PROM.

The different points between TMP90PH44 and TMP90C844 are the memory size (ROM/RAM).

The TMP90PH44N is in a Shrink Dual Inline Package. (SDIP64-P-750)

The TMP90PH44F is in a Quad Flat Package. (QFP64-P-1420A)

The following are the memory map of TMP90PH44 and TMP90C844.



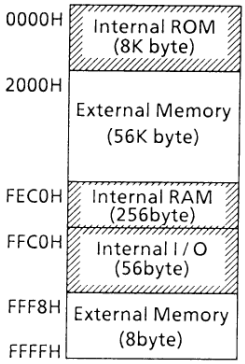


Figure 1.1. TMP90PH44 **Figure 1.2. TMP90C844**

Parts No.	ROM	RAM	Package	Adapter Socket No.
TMP90PH44N	OTP 16384 x 8bit	512 x 8bit	64-SDIP	BM1148 (Under Development)
TMP90PH44F			64-QFP	BM1149 (Under Development)

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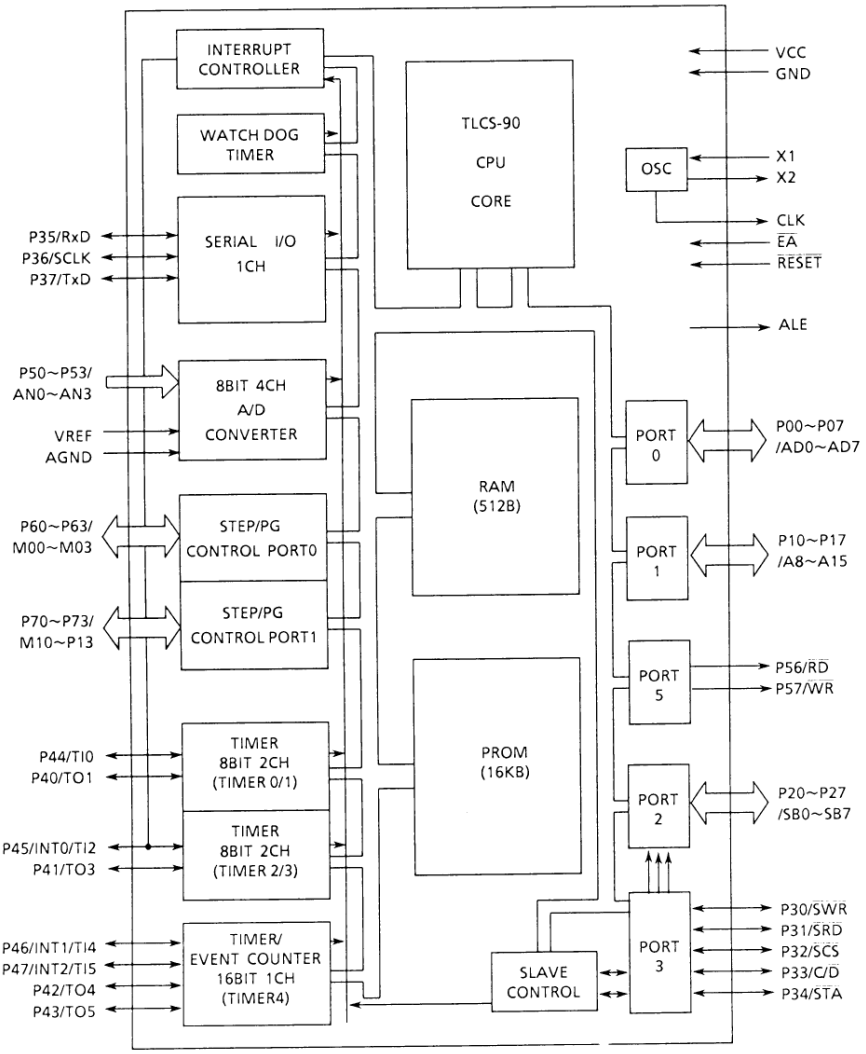


Figure 1. 3. TMP90PH44 Block Diagram

2. Pin Assignment and Functions

The TMP90PH44 pin assignment input/output pins name and functions are shown below.

2.1 Pin Assignment Diagram

The TMP90PH44N pin assignment are shown in Figure 2.1 (1).

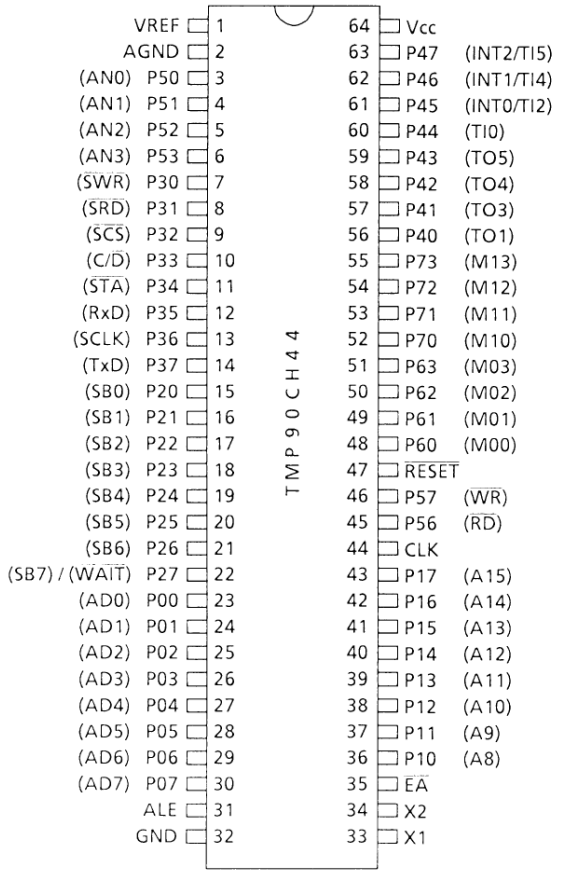


Figure 2.1 (1). Pin Assignment (Shrink DIP)

The TMP90PH44F pin assignment are shown in Figure 2.1 (2).

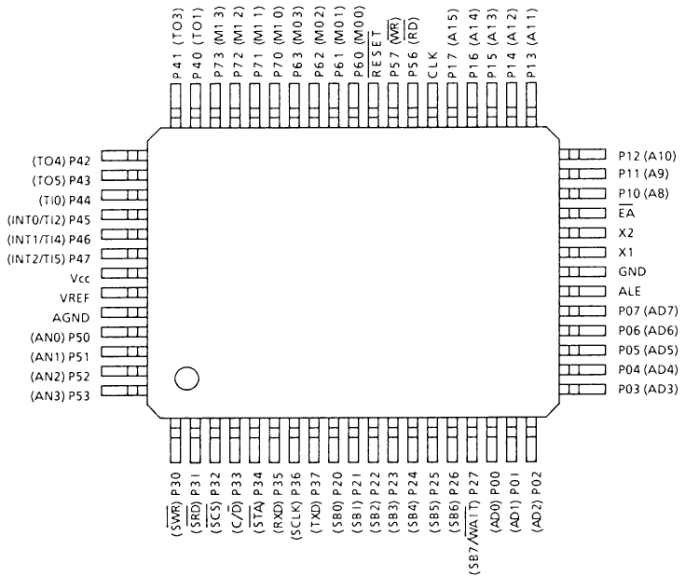


Figure 2.1 (2). Pin Assignment (Flat Package)

2.2 Pin Names and Functions

The TMP90PH44 has MCU mode and PROM mode.

(1) MCU Mode (The TMP90C844 and the TMP90PH44 are pin compatible).

Table 2.2 Pin Names and Functions (1/2)

Pin Name	No. of pins	I/O or tristate	Function
P00 ~ P07 /AD0 ~ AD7	8	I/O	Port 0: An 8-bit I/O port. Each bit can be set for input or output.
		/Tristate	Address/Data bus: Operates as an 8-bit bidirectional address bus or data bus when using external memory
P10 ~ P17 /A8 ~ A15	8	I/O	Port 1: An 8-bit I/O port. Each bit can be set for input or output.
		Output	Address bus:Operates as an address bus (upper 8 bits) when using external memory.
P20 ~ P27	8	I/O	Port 2: An 8-bit I/O port. Each bit can be set for input or output.
/SB0 ~ SB7	(8)		Slave bus: When used a s a slave processor, operates as the slave bue for the transfer data to and from the master processor.
/$\overline{\text{WAIT}}$	(1)	/Input	Wait: Used as an input pin when memory or perpheral LSIs with slow access times are controlled.
P30 ~ P37	8	I/O	Port 3: 8-bit I/O port which allows I/O selection on bit basis (with programmable pull-up resistor).
/SWR	(1)	/Input	Slave write: The strobe signal input to write data from the master processor.
/SRD	(1)	/Input	Slave read: The strobe signal used by the master processor to read data.
/SCS	(1)	/Input	Slave chip select: The chip select signal input from the master processor.
C/$\overline{\text{D}}$	(1)	Input	Command/data: The command/data select signal input from the master processor.
/$\overline{\text{STA}}$	(1)	/Output	Status output: Used to report the slave bus status to the master processor.
RxD	(1)	Input	Serial receive data
/SCLK	(1)	/I/O	Serial clock
/TxD	(1)	/Output	Serial transmit data
P40 ~ P47	8	I/O	Port 4: 8-bit I/O port which allows I/O section on bit basis (with programmable pull-up resistor).
/TO1, 3, 4, 5	(4)	/Output	Timer outputs 1, 3, 4, and 5: Output for timer 0, or timer 1, timer 2, timer 3 and timer 4 (2 lines).
/TI0, 2, 4, 5	(4)	/Input	Timer inputs 0, 2, 4, and 5: Input for timer 0, or timer 1, timer 2 and timer 4 (2 lines).
/INT0	(1)	/Input	Interrupt request terminal 0: Interrupt request pin 0: Level/rise edge programmable interrupt request pin
/INT1	(1)	/Input	Interrupt request terminal 1: Interrupt request pin 1: Rise/fall edge programmable interrupt request pin.
INT2	(1)	/Input	Interrupt request terminal 2: Interrupt request pin 2: Rise edge interrupt request pin.
P50 ~ P53 /AN0 ~ AN3	4	Input	Port 50 ~ 53: 1-bit output ports. Analog input: 4 analog inputs to A/D converter.
P56 /$\overline{\text{RD}}$	1	Output	Port 56: A 1-bit output port. Read: Strobe signal output for reading external memory.

Table 2.2 Pin Names and Functions (2/2)

Pin name	No. of pins	I/O or tristate	Function
P57 /$\overline{WR}$	1	Output	Port 57: A 1-bit output port. Write: Strobe signal output for writing external memory.
P60 ~ P63 /M00 ~ M03	4	I/O /Output	Port 6: 4-bit I/O port which allows I/O selection on bit basis. Stepping motor control port 0 or pattern generation port 0.
P70 ~ P73 /M10 ~ M13	4	I/O Output	Port 7: 4-bit I/O port which allows I/O selection on bit basis. Stepping motor control port 0 or pattern generation port 1.
ALE	1	Output	Address latch enable
CLK	1	Output	Clock output: Generates clock pulse at 1/4 frequency of clock oscillation. It is pulled up internally during resetting.
$\overline{EA}$	1	Input	External access: Connects with V_{CC} pin in the TMP90PH44 built ROM is used.
$\overline{RESET}$	1	Input	Reset: Initializes the TMP90PH44. (pull-up resistance is built-in).
X1, X2	2	I/O	Crystal oscillator connection pin
VREF	1	–	Input of reference voltage to A/D converter
AGND	1	–	GND pin for A/D converter
V_{CC}	1	–	Power supply (+5V +/- 10%)
GND	1	–	GND pin (0V)

(2) PROM Mode

Table 2.3

Pin Function Name	No. of pins	I/O	Function	Pin Name (MCU mode)
A7 ~ A0	8	Input	Program Memory Address Input	P73 ~ P70 P63 ~ P60
A13 ~ A8	6	Input		P15 ~ P10
A14	2	Input	Be fixed to “L” level ,	P16
A15				P17
D7 ~ D0	8	I/O	Data Input/Output	P07 ~ P00
$\overline{OE}$	1	Input	Output Enable Input	P26
$\overline{CE}$	1	Input	Chip Enable Input	P27
VPP	1	Power Supply	12.5V/5V (Programming Power Supply)	$\overline{EA}$
VCC	1	Power Supply	5V	VCC
VSS	1	Power Supply	0V	VSS
Pin Name	**No. of pins**	**I/O**	**Pin Setting**	
P20 ~ P27	8	Input	Be fixed to “L” level.	
P40 ~ P44	5	Input	Be fixed to “L or H” level.	
P45, P46	2	Input	Be fixed to “H” level.	
P47	1	Input	Be fixed to “L or H” level.	
P50 ~ P53 P30 ~ P37	4 8	Input	Be fixed to “L or H” level.	
VREF	1	–	Be fixed to “L” level.	
AGND	1	–	Be fixed to “L” level.	
$\overline{RESET}$	1	Input	Be fixed to “L” level.	
CLK	1	Input	Be fixed to “L” level.	
ALE	1	Output	Open	
X1	1	Input	Resonator connection pin	
X2	1	Output		

3. Operation

The TMP90PH44 is the OTP version of the TMP90C844 that is replaced an internal ROM from Mask ROM to EPROM.

The function of TMP90PH44 is exactly the same as that of TMP90C844 except the internal ROM/RAM size.

Refer to the TMP90C844 except the functions which are not described this section.

The following is an explanation of the hardware configuration and operation in the relation to the TMP90PH44.

The TMP90PH44 has an MCU mode and a PROM mode.

3.1 MCU Mode

(1) Mode Setting and Function

The MCU mode is set by opening the CLK pin (Output status).

In the MCU mode, the operation is the same as that of TMP90C844.

(2) Memory Map

Figure 1.1 and Figure 1.2 show the memory map of TMP90PH44 and TMP90C844.

Figure 3.1 shows the memory map of TMP90PH44, and the accessing area by the respective addressing mode.

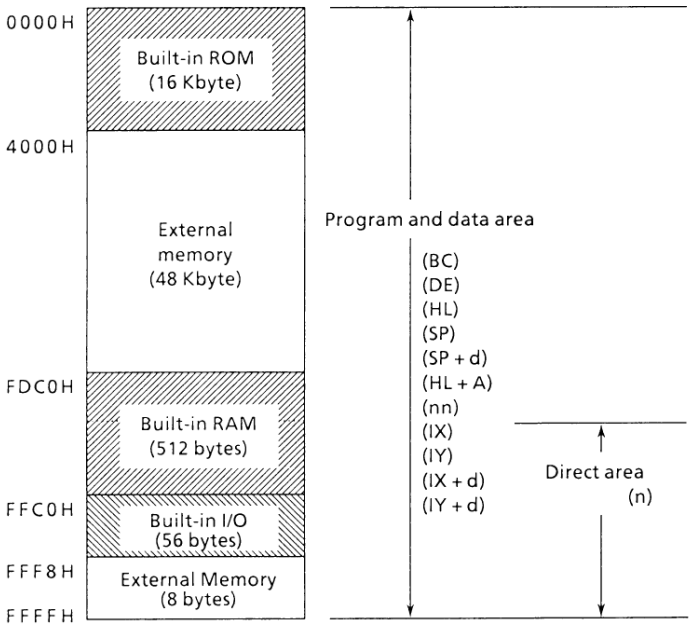


Figure 3.1. TMP90PH44 Memory Map

3.2 PROM Mode

(1) Mode Setting and Function

PROM mode is set by setting the $\overline{\text{RESET}}$ and CLK pins to the "L" level.

The programming and verification for the internal PROM is achieved by using a general EPROM programmer with the adaptor socket. The device selection (ROM Type) should be "27256" with following conditions.

size: 256K-bit (32K x 8-bit) VPP: 12.5V TPW: 1msec

Figure 3.2 shows the setting of pins in PROM mode.

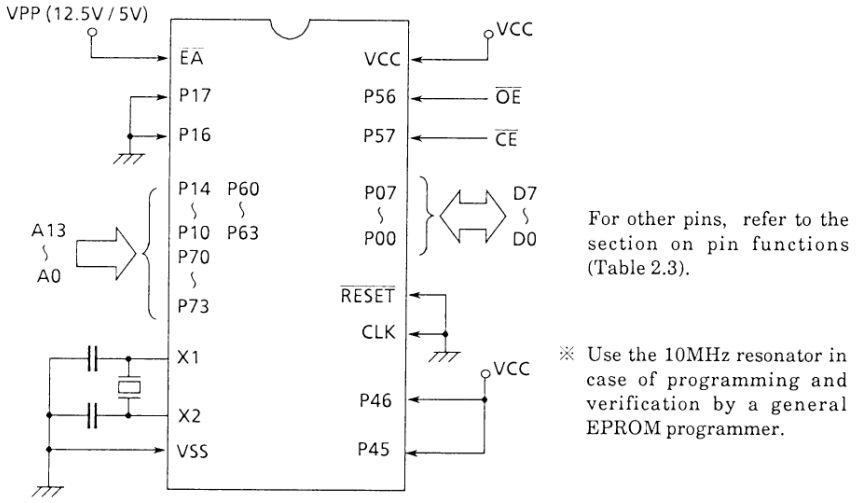


Figure 3.2. PROM Mode Pin Setting

(2) Programming Flow Chart

The programming mode is set by applying 12.5V (programming voltage) to the VPP pin when the following pins are set as follows,

(Vcc : 6.0V) *These conditions can be
($\overline{\text{RESET}}$): "L" level) obtained by using adaptor
(CLK) : "L" level) socket.

After the address and data have been fixed, a data on the Data Bus is programmed when the $\overline{\text{CE}}$ pin is set to "Low" (1ms plus is required).

General programming procedure of an EPROM programmer is as follows,

- Write a data to a specified address for 1ms.
- Verify the data. If the read-out data does not match the expected data, another writing is performed until the correct data is written (Max. 25 times).

After the correct data is written, an additional writing is performed by using three times longer programming pulse width (1ms x programming times), or using three times more programming pulse number. Then, verify the data and increment the address.

The verification for all data is done under the condition of Vpp = Vcc = 5V after all data were written.

Figure 3.3 shows the programming flow chart.

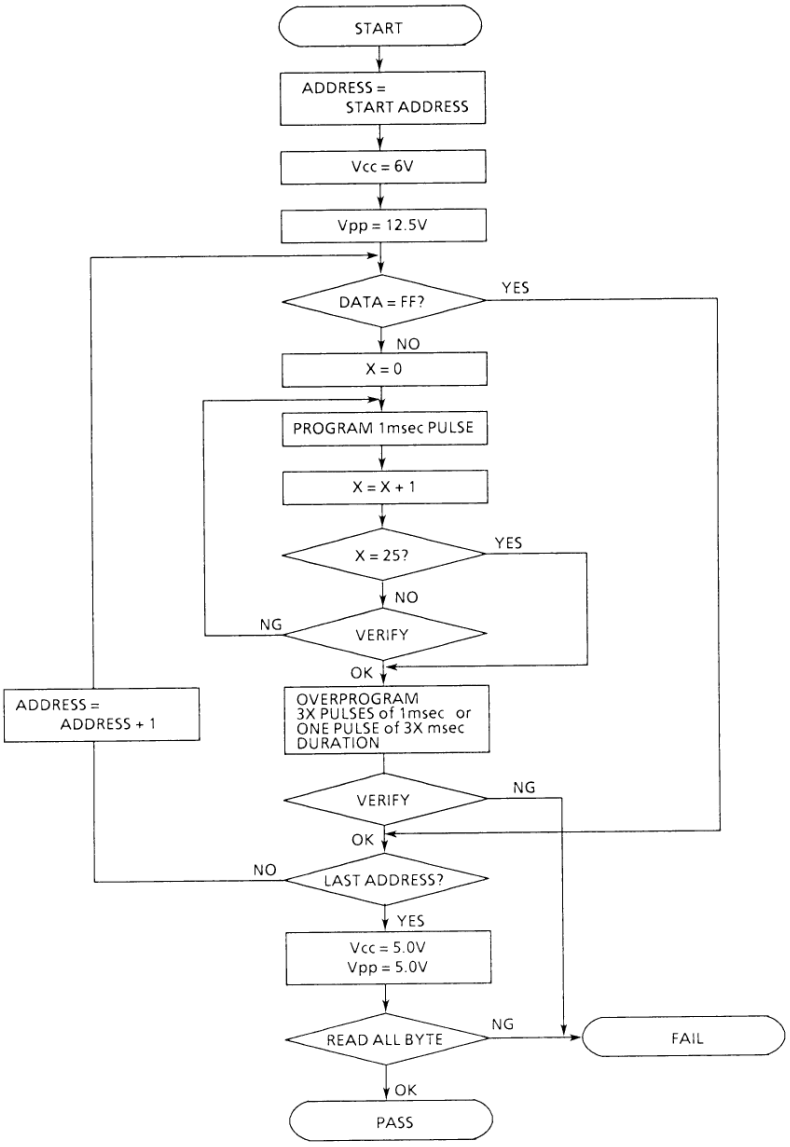


Figure 3.3. Flow Chart

4. Electrical Characteristics (Preliminary)

TMP90PH44N/TMP90PH44F

4.1 Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{CC}	Power supply voltage	-0.5 ~ + 7	V
V_{IN}	Input voltage	-0.5 ~ V_{CC} + 0.5	V
P_D	Power dissipation (Ta = 85°C)	F 500	mW
		N 600	
T_{SOLDER}	Soldering temperature (10s)	260	°C
T_{STG}	Storage temperature	-65 ~ 150	°C
T_{OPR}	Operating temperature	-40 ~ 85	°C

4.2 DC Characteristics

V_{CC} = 5V ± 10% TA = -20 ~ 70°C (1 ~ 16MHz)
Typical values are for TA = 25°C and Vcc = 5V.

Symbol	Parameter	Min	Max	Unit	Test Conditions
V_{IL}	Input Low Voltage (P0)	-0.3	0.8	V	–
V_{IL1}	P1, P2, P3, P4, P5, P6, P7	-0.3	$0.3V_{CC}$	V	–
V_{IL2}	$\overline{RESET}$, P45 (INT0)	-0.3	$0.25V_{CC}$	V	–
V_{IL3}	$\overline{EA}$	-0.3	0.3	V	–
V_{IL4}	X1	-0.3	$0.2V_{CC}$	V	–
V_{IH}	Input High Voltage (P0)	2.2	V_{CC} + 0.3	V	–
V_{IH1}	P1, P2, P3, P4, P5, P6, P7	$0.7V_{CC}$	V_{CC} + 0.3	V	–
V_{IH2}	$\overline{RESET}$, P45 (INT0)	$0.75V_{CC}$	V_{CC} + 0.3	V	–
V_{IH3}	$\overline{EA}$	V_{CC} - 0.3	V_{CC} + 0.3	V	–
V_{IH4}	X1	$0.8V_{CC}$	V_{CC} + 0.3	V	–
V_{OL}	Output Low Voltage	–	0.45	V	I_{OL} = 1.6mA
V_{OH} V_{OH1} V_{OH2}	Output High Voltage	2.4 $0.75V_{CC}$ $0.9V_{CC}$	–	V V V	I_{OH} = -400μA I_{OH} = -100μA I_{OH} = -20μA
I_{DAR}	Darlington Drive Current (8 I/O pins) (Note)	-1.0	-3.5	mA	V_{EXT} = 1.5V R_{EXT} = 1.1kΩ
I_{LI}	Input Leakage Current	0.02 (Typ)	±5	μA	0.0 ≤ Vin ≤ V_{CC}
I_{LO}	Output Leakage Current	0.05 (Typ)	±10	μA	0.2 ≤ Vin ≤ V_{CC} - 0.2
I_{CC}	Operating Current (RUN) Idle 1	35 (Typ) 1.5 (Typ)	50 5	mA mA	tosc = 16MHz
	STOP (TA = -20 ~ 70°C) STOP (TA = 0 ~ 50°C)	0.2 (Typ)	40 10	μA μA	0.2 ≤ Vin ≤ V_{CC} - 0.2
V_{STOP}	Power Down Voltage (@STOP)	2.0	6.0	V	$V_{IL2} = 0.2V_{CC}$, $V_{IH2} = 0.8V_{CC}$
R_{RST}	$\overline{RESET}$ Pull Up Register	50	150	KΩ	–
C_{IO}	Pin Capacitance	–	10	pF	testfreq = 1MHz
V_{TH}	Schmitt width $\overline{RESET}$, P45)	0.4	1.0 (Typ)	V	–

4.3 AC Characteristics

V_{CC} = 5V ± 10% TA = -20 ~ 70°C (1 ~ 16MHz)

Symbol	Parameter	Variable		12.5MHz Clock		16MHz Clock		Unit
		Min	Max	Min	Max	Min	Max	
t_{OSC}	Oscillation cycle (= x)	80	1000	80	–	62.5	–	ns
t_{CYC}	CLK Period	4x	4x	320	–	250	–	ns
t_{WH}	CLK High width	2x - 40	–	120	–	85	–	ns
t_{WL}	CLK Low width	2x - 40	–	120	–	85	–	ns
t_{AL}	A0 ~ 7 effective address→ALE fall	0.5x - 15	–	25	–	16	–	ns
t_{LA}	ALE fall →A0 ~ 7 hold	0.5x - 15	–	25	–	16	–	ns
t_{LL}	ALE Pulse width	x - 40	–	40	–	23	–	ns
t_{LC}	ALE fall $\overline{RD}/\overline{WR}$ fall	0.5x - 30	–	10	–	1	–	ns
t_{CL}	$\overline{RD}/\overline{WR}$ →ALE rise	0.5x - 20	–	20	–	11	–	ns
t_{ACL}	A0 ~ 7 effective address →$\overline{RD}/\overline{WR}$ fall	x - 25	–	55	–	38	–	ns
t_{ACH}	Upper effective address →$\overline{RD}/\overline{WR}$ fall	1.5x - 50	–	70	–	44	–	ns
t_{CA}	$\overline{RD}/\overline{WR}$ fall →Upper address hold	0.5x - 20	–	20	–	11	–	ns
t_{ADL}	A0 ~ 7 effective address →Effective data input	–	3.0x - 35	–	205	–	153	ns
t_{ADH}	Upper effective address →Effective data input	–	3.5x - 55	–	225	164	164	ns
t_{RD}	$\overline{RD}$ fall →Effective data input	–	2.0x - 50	–	110	–	75	ns
t_{RR}	$\overline{RD}$ Pulse width	2.0x - 40	–	120	–	85	–	ns
t_{HR}	$\overline{RD}$ rise →Data hold	0	–	0	–	0	–	ns
t_{RAE}	$\overline{RD}$ rise→ Address enable	x - 15	–	65	–	48	–	ns
t_{WW}	$\overline{WR}$ pulse width	2.0x - 40	–	120	–	85	–	ns
t_{DW}	Effective data→$\overline{WR}$ rise	2.0x - 50	–	110	–	75	–	ns
t_{WD}	$\overline{WR}$ rise→Effective data hold	0.5x - 10	–	30	–	21	–	ns
t_{ACKH}	Upper address→CLK fall	2.5x - 50	–	150	–	106	–	ns
t_{ACKL}	Lower address →CLK fall	2.0x - 50	–	110	–	75	–	ns
t_{CKHA}	CLK fall→Upper address hold	1.5x - 80	–	40	–	13	–	ns
t_{CCK}	$\overline{RD}/\overline{WR}$→CLK fall	x - 25	–	55	–	37	–	ns
t_{CKHC}	CLK fall→$\overline{RD}/\overline{WR}$ rise	x - 60	–	20	–	2	–	ns
t_{DCK}	Valid data CLK fall	x - 50	–	30	–	12	–	ns
t_{CWA}	$\overline{RD}/\overline{WR}$ fall→Valid $\overline{WAIT}$	–	x - 40	–	40	–	22	ns

4.4 A/D Conversion Characteristics

V_{CC} = 5V ± 10% TA = -020 ~ 70°C
f = 1 ~ 16MHz

Symbol	Parameter	Condition	Min	Max	Unit
V_{REF}	Analog reference voltage	Vcc - 1.5	Vcc	Vcc	V
A_{GND}	Analog reference voltage	Vss	Vss	Vss	
V_{AIN}	Analog input voltage range	Vss	–	Vcc	
IREF	Supply current for analog reference voltage	–	0.5	1.0	mA
Error (Quantize error of ±0.5 LSB not included)	Total error (TA = 25°C, Vcc = V_{REF} = 5.0V)	–	–	1.0	LSB
	Total error	–	–	2.5	

4.5 Zero-Cross Characteristics

V_{CC} = 5V ± 10% TA = -20 ~ 70°C
f = 1 ~ 16MHz

Symbol	Parameter	Condition	Min	Max	Unit
V_{ZX}	Zero-cross detection input	AC coupling C = 0.1μF	1	1.8	$V_{AC\ P-P}$
A_{ZX}	Zero-cross accuracy	50/60Hz sine wave	–	135	mV
F_{ZX}	Zero-cross detection input frequency	–	0.04	1	kHz

4.6 Timer/ Counter Input Clock (TI0, TI2, and TI4)

V_{CC} = 5V ± 10% TA = -20 ~ 70°C
f = 1 ~ 16MHz

Symbol	Parameter	Variable		12.5MHz Clock		16MHz Clock		Unit
		Min	Max	Min	Max	Min	Max	
t_{VCK}	Clock cycle	8x + 100	–	740	–	600	–	ns
t_{VCKL}	Low clock pulse width	4x + 40	–	360	–	290	–	ns
t_{VCKH}	High clock pulse width	4x + 40	–	360	–	290	–	ns

4.7 Interrupt Operation

V_{CC} = 5V ± 10% TA = -20 ~ 70°C
f = 1 ~ 16MHz

Symbol	Parameter	Variable		12.5MHz Clock		16MHz Clock		Unit
		Min	Max	Min	Max	Min	Max	
t_{INTAL}	INT0 Low level pulse width	4x	–	320	–	250	–	ns
t_{INTAH}	INT0 High level pulse width	4x	–	320	–	250	–	ns
t_{INTBL}	INT1, INT2 Low level pulse width	8x + 100	–	740	–	600	–	ns
t_{INTBH}	INT1, INT2 High level pulse width	8x + 100	–	740	–	600	–	ns

4.8 Serial Channel Timing-I/O Interface Mode
(1) SCLK Input Mode

V_{CC} = 5V ± 10% TA = -20 ~ 70°C
f = 1 ~ 16MHz

Symbol	Parameter	Variable		12.5MHz Clock		16MHz Clock		Unit
		Min	Max	Min	Max	Min	Max	
t_{SCY}	SCLK cycle	16x	–	1.28	–	1	–	μs
t_{OSS}	Output Data →rising edge of SCLK	t_{SCY} /2 - 5x - 50	–	190	–	137	–	ns
t_{OHS}	SCLK rising edge→output data hold	5x -100	–	300	–	212	–	ns
t_{HSR}	SCLK rising edge→input data hold	0	–	0	–	0	–	ns
t_{SRD}	SCLK rising edge→ effective data input	–	t_{SCY} - 5x - 50	–	780	–	587	ns

(2) SCLK Output Mode

Symbol	Parameter	Variable		12.5MHz Clock		16MHz Clock		Unit
		Min	Max	Min	Max	Min	Max	
t_{SCY}	SCLK cycle (programmable)	16x	8192x	1.28	655.4	1	512	μs
t_{OSS}	Output Data →rising edge of SCLK	t_{SCY} - 2x - 50	–	970	–	725	–	ns
t_{OHS}	SCLK rising edge→output data hold	2x - 80	–	80	–	45	–	ns
t_{HSR}	SCLK rising edge→input data hold	0	–	0	–	0	–	ns
t_{SRD}	SCLK rising edge→ effective data input	–	t_{SCY} - 2x - 150	–	970	–	725	ns

4.9 Slave Bus Interface Timing: $\overline{RD}$, $\overline{WR}$ Bus Mode

V_{CC} = 5V ± 10% TA = -20 ~ 70°C
f = 1 ~ 16MHz

Symbol	Parameter	Min	Max	Unit
T_{SAR}	C/$\overline{D}$ setup →$\overline{SRD}$ fall	20	–	ns
T_{HRA}	$\overline{SRD}$ rise→ $\overline{C}$/D hold	5	–	ns
T_{SCR}	$\overline{SCS}$ setup →$\overline{SRD}$ fall	0	–	ns
T_{HRC}	$\overline{SRD}$ rise →$\overline{SCS}$ hold	0	–	ns
T_{WRD}	$\overline{SRD}$ pulse width	120	–	ns
T_{ARD}	$\overline{SRD}$ fall →effective data output	–	80	ns
T_{VRB}	$\overline{SRD}$ rise →effective data hold	10	85	ns
T_{SAW}	C/$\overline{D}$ setup →$\overline{SWR}$ fall	20	–	ns
T_{HWA}	$\overline{SWR}$ rise →$\overline{C}$/D hold	5	–	ns
T_{SCW}	$\overline{SCR}$ setup →$\overline{SWR}$ fall	0	–	ns
T_{HWC}	$\overline{SWR}$ rise →$\overline{SCS}$ hold	0	–	ns
T_{WWR}	$\overline{SWR}$ pulse width	120	–	ns
T_{SBW}	effective data input →$\overline{SWR}$ rise	80	–	ns
T_{HWB}	$\overline{SWR}$ rise →effective data hold	10	–	ns

Slave Bus Interface Timing: $\overline{DS}$, R/$\overline{W}$ Bus Mode

Symbol	Parameter	Min	Max	Unit
T_{SAD}	C/$\overline{D}$ setup →$\overline{DS}$ fall	20	–	ns
T_{HDA}	$\overline{DS}$rise→ C/$\overline{D}$ hold	5	–	ns
T_{SCD}	$\overline{SCS}$ setup →$\overline{DS}$ fall	0	–	ns
T_{HDC}	$\overline{DS}$ rise →$\overline{SCS}$ hold	0	–	ns
T_{SAD}	$\overline{SCS}$ setup →$\overline{DS}$ fall	20	–	ns
T_{HDA}	$\overline{DS}$ rise →R/$\overline{W}$ hold	5	–	ns
T_{WDS}	$\overline{DS}$ pulse width	120	–	ns
T_{ADS}	$\overline{DS}$ fall →effective data output	–	80	ns
T_{VDB}	$\overline{DS}$ rise →effective data hold	10	85	ns
T_{SBD}	Effective data input → $\overline{DS}$ rise	80	–	ns
T_{HDB}	$\overline{DS}$ rise →effective data hold	10	–	ns

$\overline{STA}$ Change Timing

X = 1/fosc

Symbol	Parameter	Variable		16MHz Clock		Unit
		Min	Max	Min	Max	
t_{RPH}	$\overline{STA}$ fall after Output Buffer is read	–	2x + 50	–	175	ns
t_{WPH}	$\overline{STA}$ rise after Input Buffer is written	–	2x + 50	–	175	ns

4.10 Read Operation (PROM Mode)

DC Characteristic, AC Characteristic

TA = -40 ~ 85°C Vcc = 5V ± 10%

Symbol	Parameter	Condition	Min	Max	Unit
V_{PP}	V_{PP} Read Voltage	–	4.5	5.5	V
V_{IH1}	Input High Voltage (A0 ~ A15, $\overline{CE}$, $\overline{OE}$)	–	0.7 x V_{CC}	Vcc + 0.3	V
V_{IL1}	Input Low Voltage (A0 ~ A15, $\overline{CE}$, $\overline{OE}$)	–	-0.3	0. 3 x V_{CC}	V
t_{ACC}	Address to Output Delay	C_L = 50pF	–	2.25TCYC + α	ns

TCYC = 400ns (10MHz Clock)
α = 200ns

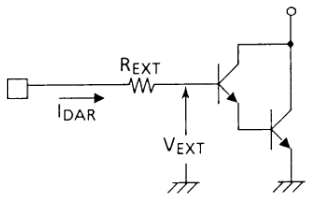
4.11 Programming Operation (PROM Mode)

DC Characteristic, AC Characteristic

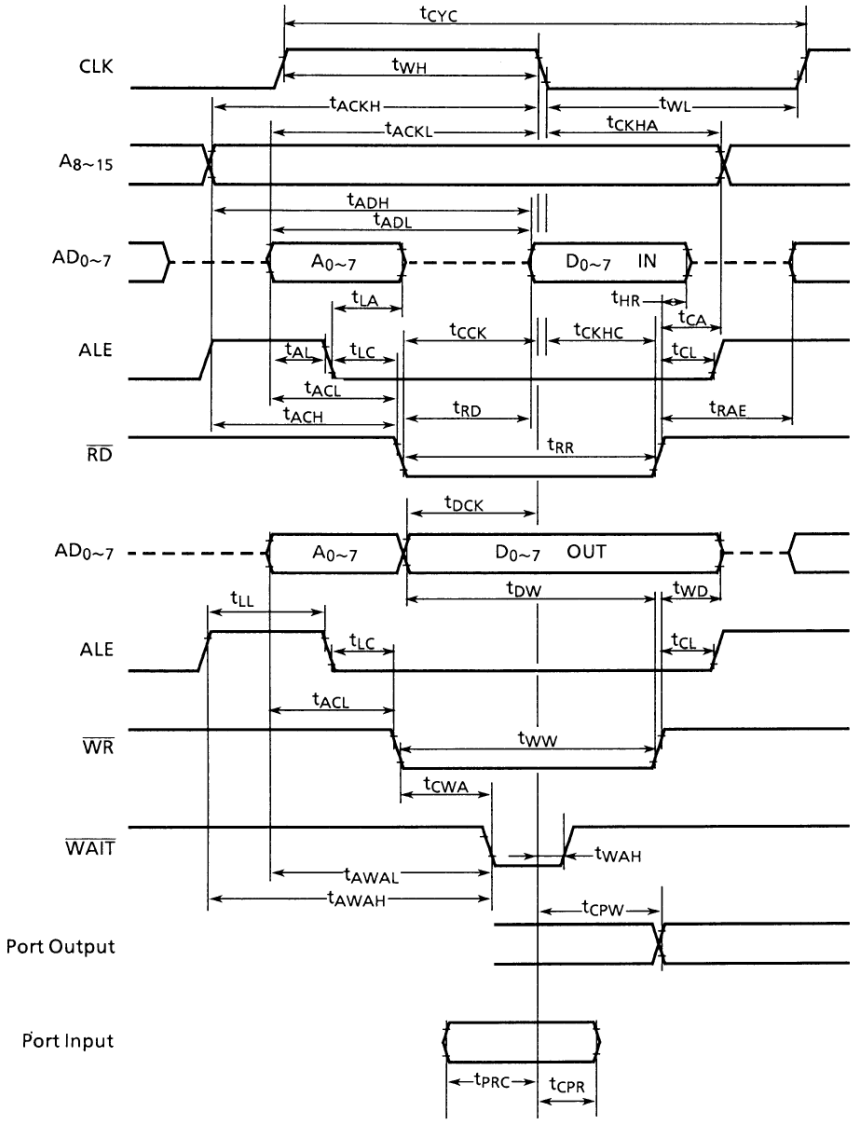
TA = 25 ± 5°C Vcc = 6V ± 0.25V

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{PP}	Programming Voltage	–	12.25	12.50	12.75	V
V_{IH}	Input High Voltage (D0 ~ D7)	–	0.2V_{CC} + 1.1		V_{CC} + 0.3	V
V_{IL}	Input Low Voltage (D0 ~ D7)	–	-0.3		0.2V_{CC} - 0.1	V
V_{IH1}	Input High Voltage (A0 ~ A15, $\overline{CE}$, $\overline{OE}$)	–	0.7V_{CC}		V_{CC} + 0.3	V
V_{IL1}	Input Low Voltage (A0 ~ A15, $\overline{CE}$, $\overline{OE}$)	–	-0.3		0.3V_{CC}	V
I_{CC}	V_{CC} Supply Current	f_{OSC} = 10MHz	–		50	mA
I_{PP}	V_{PP} Supply Current	V_{PP} = 13.00V	–		50	mA
t_{PW}	$\overline{CE}$ Programming Pulse Width	C_L = 50pF	0.95	1.00	1.05	ms

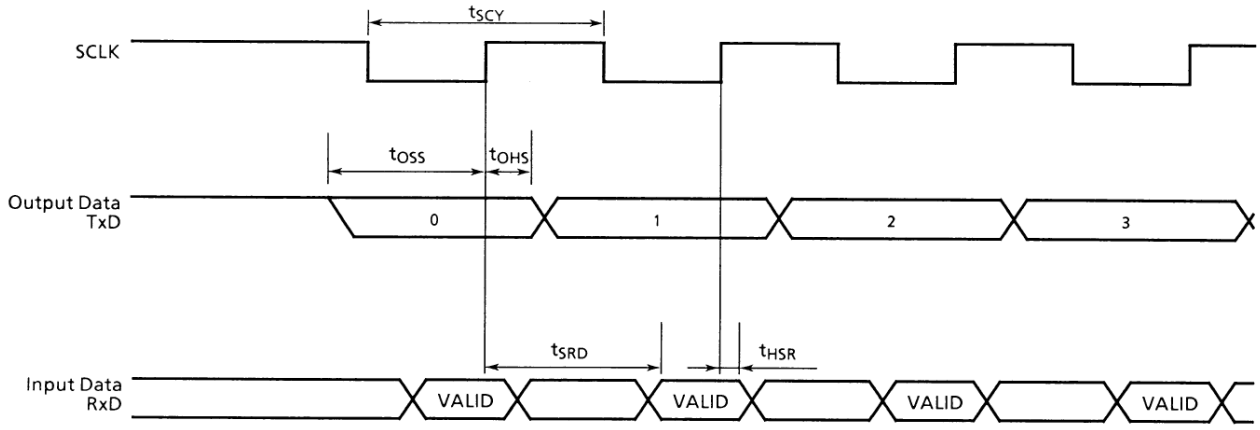
(Reference) Definition of I_{DAR}



4.12 Timing Chart

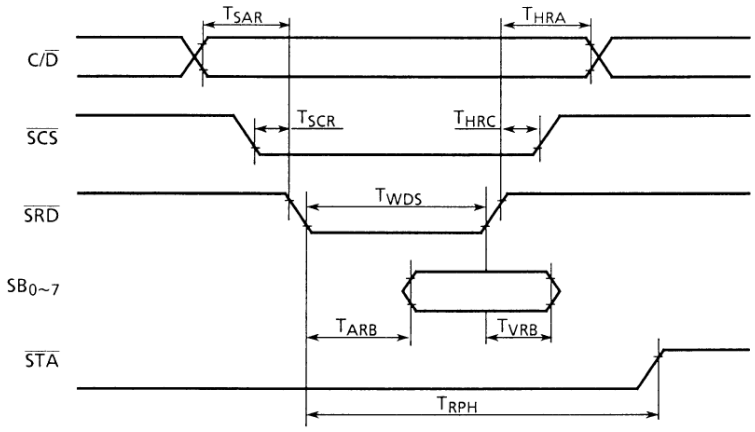


4.13 Timing Chart for I/O Interface Mode

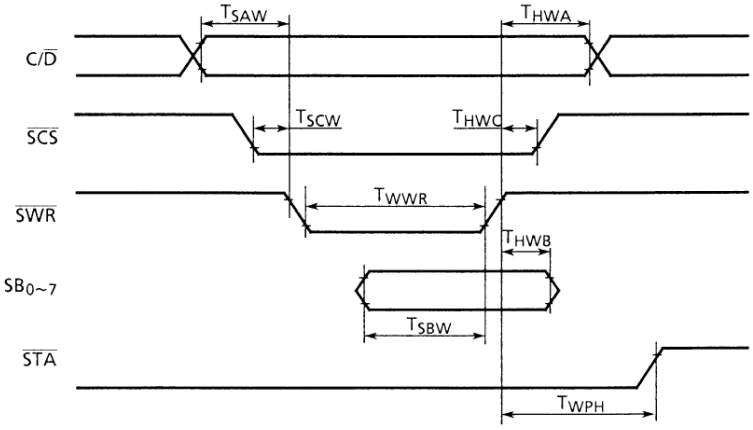


4.14 Timing Chart for Slave Bus Interface: $\overline{RD}$, $\overline{WR}$ Bus Mode

(1) Read Operation

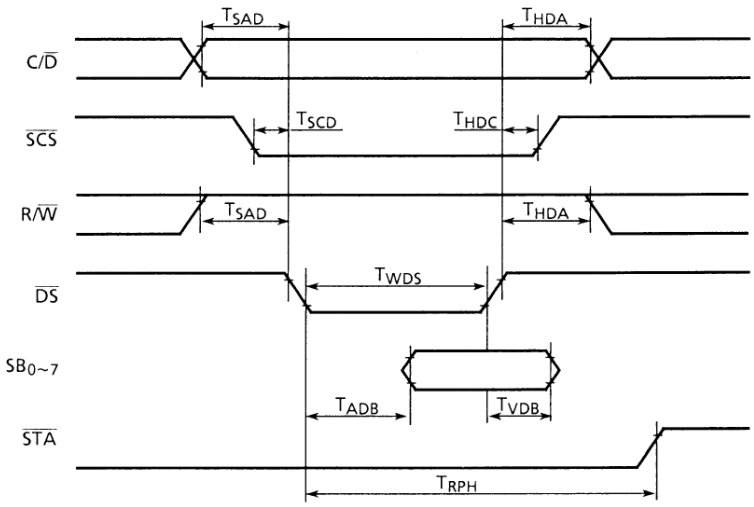


(2) Write Operation

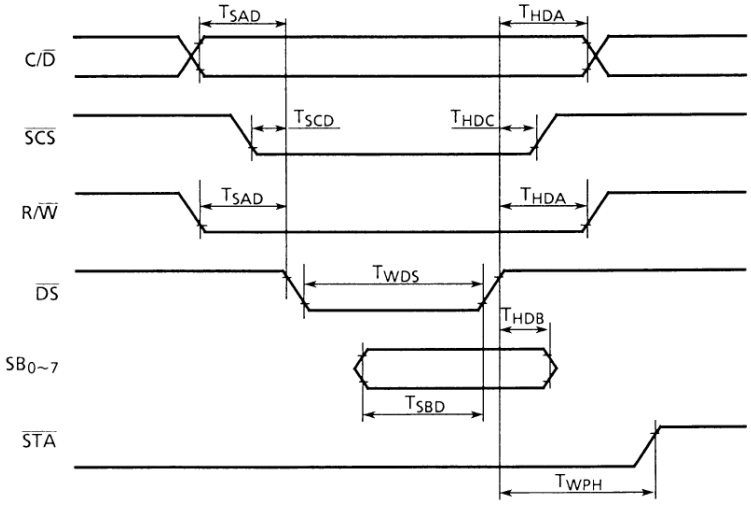


4.15 Timing Chart for Slave Bus Interface: $\overline{DS}$, R/$\overline{W}$ Bus Mode

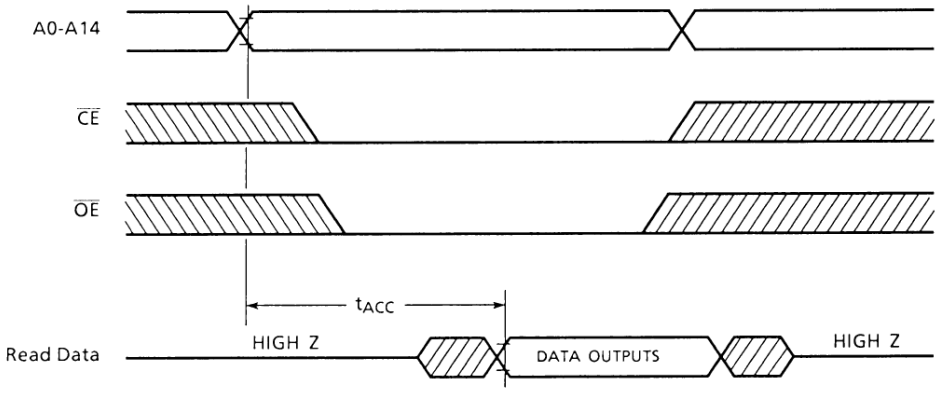
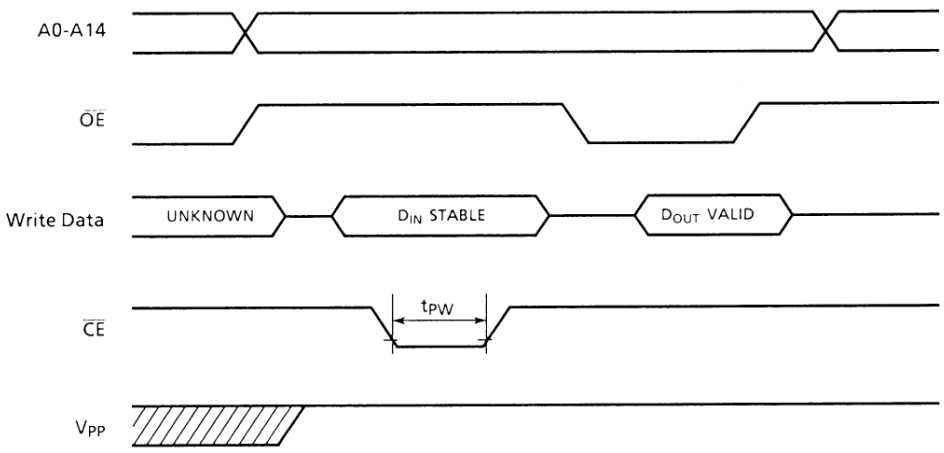
(1) Read Operation



(2) Write Operation



4.16 Read Operation Timing Chart (PROM Mode)



4.17 Programming Operation Timing Chart (PROM Mode)