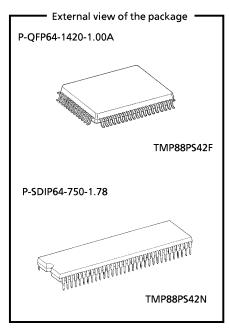
CMOS 8-Bit Microcontroller

TMP88PS42N/F

The TMP88PS42 is a high-speed, high-function 8-bit single-chip microcomputer incorporating 64-Kbyte onetime PROM. This microcomputer is pin compatible with the TMP88CS42, the mask ROM product. Once a program is written into its internal PROM, this microcomputer operates the same way as the TMP88CS42. By using an adapter socket, the TMP88PS42 can be programmed and verified with a general-purpose PROM programmer in the same way as for the TC571000D/AD.

Product No.	ROM	RAM	Package	Adapter Socket
TMP88PS42F	CA Klaustaa	2 K . 120 hutaa	P-QFP64-1420-1.00A	BM11200
TMP88PS42N	64 Kbytes	2 K + 128 bytes	P-SDIP64-750-1.78	BM11199



030519EBP1

The information contained herein is subject to change without notice.

The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.

TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress.

It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in

- It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.

 In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..

 The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, and instruments all types of transportation instruments traffic signal instruments. transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's
- The products described in this document are subject to the foreign exchange and foreign trade laws.

TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and

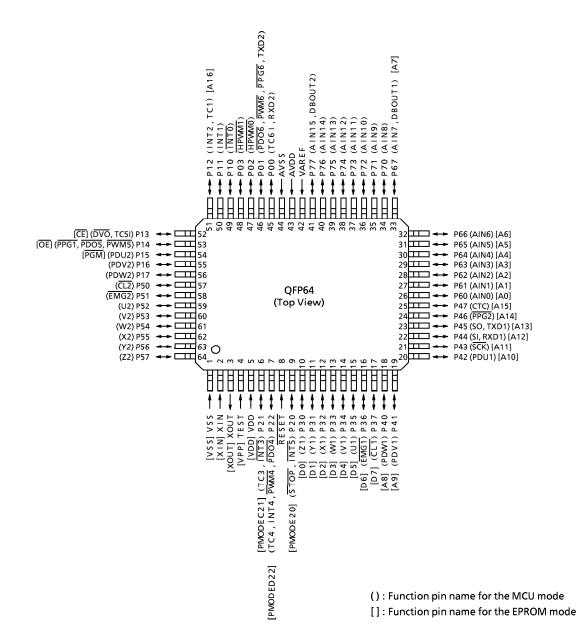
sold, under any law and regulations.

For a discussion of how the reliability of microcontrollers can be predicted, please refer to Section 1.3 of the chapter entitled Quality and Reliability Assurance/Handling Precautions.

88PS42-1 2003-06-03

Pin Assignment (Top View)

P-QFP64-1420-1.00A



88PS42-2 2003-06-03

Pin Assignment (Top View)

P-SDIP64-750-1.78

```
(U2) P52 → □
                                                           64 □ → P51 (EMG2)
                                                           63 □ → P50 (CL2)
                            (V2) P53 🔫
                                                          62 P17 (PDW2)
                            (W2) P54 → ☐
                             (X2) P55 → □
                                                           61 □ → P16 (PDV2)
                                                           60 □ → P15 (PDU2) [PGM]
                             (Y2) P56 → □
                             (Z2) P57 → □
                                                          59 → P14 (PDO5, PWM5, PPG1) [OE]
                                                          58 → P13 (TC51, DVO) [CE]
                            [vss] vss ---
                                                          57 □ → P12 (INT2, TC1) [A16]
                            [XIN] XIN → □ 8
                                                          56 □ ← → P11 (INT1)
                        [XOUT] XOUT ← ☐ 9
                                                           55 □ → P10 (INTO)
                           [VPP] TEST → ☐ 10
                                                          54 □ → P03 (HPWM1)
                          [VDD] VDD → ☐ 11
                                                           53 □ → P02 (HPWM0)
            [PMODEC21] (TC3, INT3) P21 → □ 12
                                                          52 → P01 (PDO6, PWM6, PPG6, TXD2)
51 → P00 (TC6I, RXD2)
[PMODED22] (TC4, INT4, PWM4, PDO4) P22 → ☐ 13
                              RESET → 14
                                                          50 - AVSS
49 - AVDD
            [PMODE20] ($TOP, |NT5) P20 → □ 15
                                                SDIP64
                         [D0] (Z1) P30 → ☐ 16
                                                          48 ☐── VAREF
                         [D1] (Y1) P31 ←→ ☐ 17
                                                          47 □ → P77 (AIN15, DBOUT2)
                         [D2] (X1) P32 → □ 18
                        [D3] (W1) P33 → □ 19
                                                          46 P76 (AIN14)
                                                          45 P75 (AIN13)
                         [D4] (V1) P34 -- 20
                                                          44 P74 (AIN12)
43 P73 (AIN11)
                         [D5] (U1) P35 +- [ 21
                      [D6] (EMG1) P36 → □ 22
                                                          42 P72 (AIN10)
                        [D7] (CL1) P37 → □ 23
                      [A8] (PDW1) P40 → □ 24
                                                          41 □ → P71 (AIN9)
                      [A9] (PDV1) P41 -- 25
                                                          40 P70 (AIN8)
                                                          39 ☐ → P67 (AIN7, DBOUT1) [A7]
                     [A10] (PDU1) P42 -- 26
                       [A11] (SCK) P43 → ☐ 27
                                                          38 □ → P66 (AIN6) [A6]
                                                          37 P65 (AIN5) [A5]
                   [A12] (RXD1, SI) P44 -- 28
                                                          36 P64 (AIN4) [A4]
35 P63 (AIN3) [A3]
                  [A13] (TXD1, SO) P45 ← □ 29
                     [A14] (PPG2) P46 → ☐ 30
                       [A15] (CTC) P47 - 31
                                                          34 P62 (AIN2) [A2]
                       [A0] (AIN0) P60 → ☐ 32
                                                          33 □ → P61 (AIN1) [A1]
```

- (): Function pin name for the MCU mode
- []: Function pin name for the EPROM mode

Pin Functions

The TMP88PS42 has MCU and PROM modes.

(1) MCU mode

Pin compatible with the TMP88CS42 (always makes sure the TEST pin is fixed low).

(2) PROM mode

Pin Name (during PROM Mode)	I/O	Functions	Pin Name (during MCU Mode)		
A16			P12		
A15 to A8	Input	Program memory address input	P47 to P40		
A7 to A0			P67 to P60		
D7 to D0	Input/output	Program memory data input/output	P37 to P30		
CE		Chip enable signal input	P13		
ŌĒ	Input	Output enable signal input	P14		
PGM		Program mode signal input	P15		
VPP		+ 12.75 V/5 V (Programming power supply)	TEST		
V _{DD}	Power supply	+ 6.25 V/5 V	VDD		
GND		0 V	VSS		
P03 to P00					
P17 to P16					
P57 to P50		Leave these pins open.			
P77 to P70					
P21		PROM mode setup pins. Fix these pins high.			
P11 to P10	Input/output				
P22, P20		PROM mode setup pins. Fix these pins low.			
RESET					
XIN					
XOUT		Attach a resonator (20 MHz) to these pins for self-	oscillation.		
AVDD		5 V			
VAREF	Power supply				
VASS					

Functional Description

The TMP88PS42 is a one-time PROM version of the TMP88CS42 with its internal mask ROM replaced with one-time PROM. All other configurations and functions are the same as those of the TMP88CS42. (TMP88CS42 RAM size is 2 K + 128 bytes.) Immediately after a reset, the TMP88PS42 is in single-clock mode.

1. Operation Modes

The TMP88PS42 has MCU and PROM modes.

1.1 MCU Mode

The microcomputer is placed in MCU mode by fixing the TEST and VPP pins low.

In this mode, the microcomputer operates the same way as the TMP88CS42 (because the TEST and VPP pins do not have internal pulldown resistors, they cannot be left open while in use).

1.1.1 Program Memory

The TMP88PS42 contains a 64-Kbyte one-time PROM (located at addresses 04000 to 13EFF_H or addresses FFF00 to FFFFF_H during MCU mode and addresses 00000 to 0FFFF_H during PROM mode). When using this microcomputer for the purpose of evaluating the system constructed with the TMP88CS42, write a program into the program storage area shown in Figure 1-1.

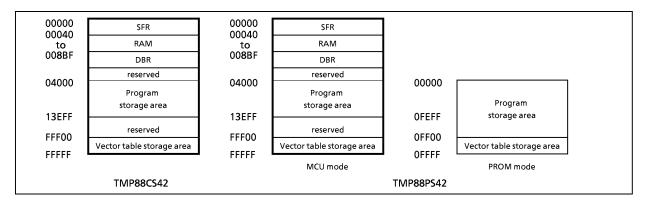


Figure 1-1. Program Storage Area

Note: Fill the unused area with data FF_H, or set up the general-purpose PROM programmer so that only the program storage area will be accessed.

1.1.2 Data Memory

The TMP88PS42 contains 2 K + 128-byte data memory (static RAM).

1.1.3 Input/Output Circuits of the Pins

(1) Control pins

The control pins are the same as those of the TMP88CS42, except that the TEST pin does not have an internal pulldown resistor.

(2) Input/output ports

The input/output circuits of the TMP88PS42 input/output ports are the same as those of the TMP88CS42.

1.2 PROM Mode

The microcomputer is placed in PROM mode by setting the RESET pin, ports P11 and P10, and ports P22 to P20 as shown in Figure 1-2. In this mode, a program can be written into the microcomputer and verified for by using a general-purpose PROM programmer.

Note: The microcomputer can be programmed in fast programming mode (because settings vary with each PROM programmer used, consult the user's manual of your PROM programmer). Because the TMP88PS42 does not have the electric signature function, set the ROM type of your PROM programmer to be the TC571000D/AD or equivalent.

When using one of the adapter sockets supported by Toshiba, set the switch to the N position.

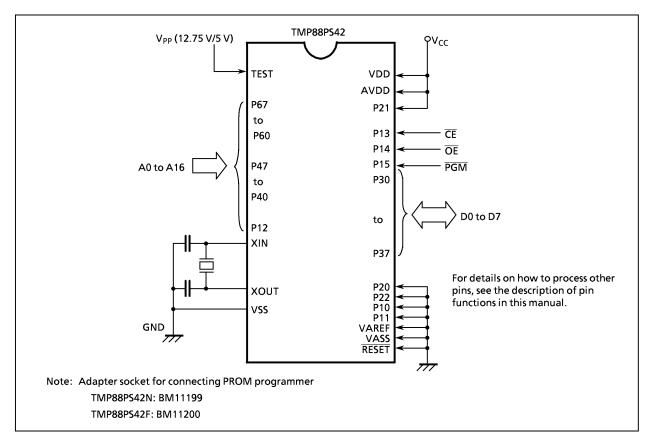


Figure 1-2. Setting Up PROM Mode

1.2.1 Programming Flowchart (Fast programming mode)

Fast programming mode is entered into by applying a programming voltage of $V_{PP} = 12.75 \text{ V}$ while $V_{CC} = 6.25 \text{ V}$. After setting the valid address and input data, apply a 0.1 ms programming (one-shot) pulse to the \overline{PGM} input, and the data is written into the PROM. Verify whether data has been written into the PROM and if not written into correctly, apply a 0.1 ms programming pulse again. Repeat this (up to 25 times) until data is written into correctly. When data has been written to the set address correctly, proceed to write the next address and input data. When all data has been programmed in this way, set $V_{CC} = VPP = 5 \text{ V}$ and verify all addresses.

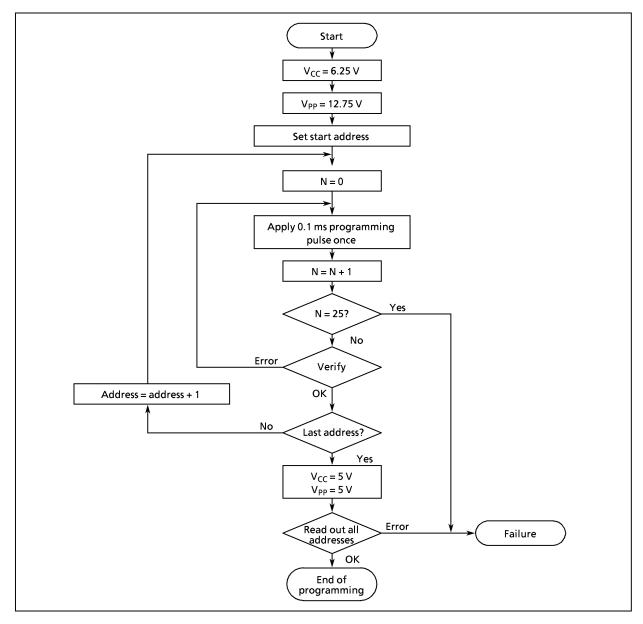


Figure 1-3. Programming Flowchart

1.2.2 Method of Programming Using a General-purpose PROM Programmer and Toshiba Adapter Socket

(1) Preparing the adapter

BM11199: Provided for use with the TMP88PS42N. BM11200: Provided for use with the TMP88PS42F.

(2) Setting up the adapter

Set the switch (SW1) to the N position.

- (3) Setting up the PROM programmer
 - i) Set the PROM type for the TC571000D/AD.
 Programming voltage: 12.75 V (fast programming mode)
 - ii) Transfer data (or copy) (Note 1).

 The EPROM of this microcomputer exists in an area at addresses 00000 to 0FFFF_H. Therefore, data must be transferred (copied) to the addresses at which the program can be written to in PROM mode. For the relationship between program storage areas in MCU and PROM modes, refer to Figure 1-1, "Program Storage Area."
 - iii) Set the write addresses (Note 1).

Start address: 00000H End address: 0FFFFH

(4) Programming

Write data to the PROM and verify the programmed data following the PROM programmer operation procedure.

- Note 1: For details on how to set, consult the user's manual of your PROM programmer. Make sure the data set in unused address areas all are FF_H.
- Note 2: When setting the MCU into the adapter or the adapter into the PROM programmer, make sure the No. 1 pin positions on both sides are matched. If erroneously set in the opposite direction, the MCU, adapter, or PROM programmer may be damaged.
- Note 3: This microcomputer does not support electric signature mode. Therefore, if the PROM programmer is used in electric signature mode, the device may be damaged because a voltage of 12 V±0.5 V is applied to the No. 9 address pin (A9). Please do not use electric signature mode.

88PS42-8 2003-06-03

Electrical Characteristics

Absolute Maximum Ratings

 $(V_{SS} = 0V)$

Parameter	Symbol	Pin	Standard	Unit	Remark
Power Supply Voltage	V_{DD}		– 0.3 to 6.5		
Program Voltage	V_{PP}	TEST/VPP	- 0.3 to 13.0	v	
Input Voltage	V_{IN}		-0.3 to $V_{DD} + 0.3$		
Output Voltage	V _{OUT}		-0.3 to $V_{DD} + 0.3$		
	I _{OH}	P0, 1, 3, 4, 5, 6, 7	- 1.8		
Output Current	I _{OL1}	P0, 1, 2, 6, 7	3.2		
	I _{OL2}	P3, P4, P5	30		
	Σ I _{OUT1}	P0, 1, 2, 6, 7	60		Total of all ports except large- current ports
	Σ I _{OUT2}	Р3	60	mA	Total of 8 pins of large-current ports P30 to 7
Mean Output Current	Σ I _{OUT3}	P4	60		Total of 8 pins of large-current ports P40 to 7
	ΣI _{OUT4}	P5	60		Total of 8 pins of large-current ports P50 to 7
D D: : ::	20	TMP88PS42N	600	101	SDIP
Power Dissipation	PD	TMP88PS42F	350	mW	QFP
Operating Temperature	Topr		- 40 to 85		
Soldering Temperature (time)	Tsld		260 (10 s)	°C	
Storage Temperature	Tstg		– 55 to 125		

Note: The Absolute Maximum Ratings stipulate the standards, any parameter of which cannot be exceeded even in an instant. If the device is used under conditions exceeding the Absolute Maximum Ratings, it may break down or degrade, causing injury due to rupture or burning. Therefore, always make sure the Absolute Maximum Ratings will not be exceeded when designing your application equipment.

Recommended Operating Conditions

$$(V_{SS} = 0 \text{ V}, \text{ Topr} = -40 \text{ to } 85^{\circ}\text{C})$$

Parameter	Symbol	Pin	Condition		Min	Max	Unit
Power Supply Voltage	V _{DD}		fc = 20 MHz NORMAL/IDLE/ STOP		4.5	5.5	
History I amed to must	V _{IH1}	Normal (P6, P7)	V _{DD} ≧ 4.5 V		V _{DD} × 0.70		
High Level Input	V _{IH2}	Hysteresis (P0, P1, P2, P3, P4, P5, RESET)			V _{DD} × 0.75	V _{DD}	V
I am I am al la mont	V _{IL1}				V _{DD} × 0.30		
Low Level Input Voltage	V _{IL2}	Hysteresis (P0, P1, P2, P3, P4, P5, RESET)	$V_{DD} \ge 4.5 V$		0	V _{DD} × 0.25	
Clock Frequency	fc	XIN, XOUT	V _{DD} = 4	4.5 V to 5.5 V	8	20	MHz

Note: The Recommended Operating Conditions show the conditions under which we recommend the device be used in order for it to operate normally while maintaining its quality. If the device is used outside the range of Recommended Operating Conditions (power supply voltage, operating temperature range, or AC/DC rated values), it may operate erratically. Therefore, when designing your application equipment, always make sure its intended working conditions will not exceed the range of Recommended Operating Conditions.

88PS42-9 2003-06-03

DC Characteristics

 $(V_{SS} = 0 \text{ V}, \text{ Topr} = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Pin	Condition	Min	Тур.	Max	Unit
Input Current	I _{IN1} I _{IN2} I _{IN3}	TEST Sink open drain, Tri-state RESET, STOP	V _{DD} = 5.5 V V _{IN} = 5.5 V/0 V	_	_	± 2	μΑ
Input Resistance	R _{IN}	RESET		90	220	510	kΩ
Output Leakage Current	I _{LO}	Sink open drain, Tri-state	$V_{DD} = 5.5 \text{ V}, V_{IN} = 5.5 \text{ V}/0 \text{ V}$	_	_	± 2	μΑ
High Level Output Voltage	V _{OH}	Tri-state port	$V_{DD} = 4.5 \text{ V}, I_{OH} = -0.7 \text{ mA}$	4.1	_	_	V
Lavel aval Output Current	I _{OL1}	P0, 1, 2, 6, 7	$V_{DD} = 4.5 \text{ V}, V_{OL} = 0.4 \text{ V}$	1.6	-	-	
Low Level Output Current	I _{OL2}	P3, P5, P4	$V_{DD} = 4.5 \text{ V}, V_{OL} = 1.0 \text{ V}$	_	20	-	^
Power Supply Current	I _{DDO}		V _{DD} = 5.5 V, V _{IN} = 5.3 V/0.2 V	_	18	25	mA
	I _{DDL}			_	16	23	
	I _{DDH}		fc = 20 MHz	_	2	100	μΑ

AD Conversion Characteristics

(Topr = $-40 \text{ to } 85^{\circ}\text{C}$)

Parameter	C. mala al	Pin	Min	T	М	Unit	
Parameter	Symbol	Pin	IVIIII	Тур.	8 bits	10 bits	Unit
Analog Reference Voltage	VA _{REF}	$V_{SS} = 0 V$, $V_{DD} = AV_{DD}$	V _{DD} – 1.0	-	V	OD	
Analog Input Voltage Range	VA _{IN}		V _{ASS}	-	VA	REF	V
Analog Reference Power Supply Current	I _{REF}	$V_{DD} = AV_{DD} = VA_{REF} = 5.0 V$ $V_{SS} = AV_{SS} = 0 V$	-	0.5	1.	.0	mA
Nonlinearity Error		V 5VV 0V	_	_	± 1	± 2	
Zero Error		$V_{DD} = 5 \text{ V}, V_{SS} = 0 \text{ V}$	_	-	± 1	± 2] ,,,,
Full Scale Error		$- AV_{DD} = VA_{REF} = 5 V$ $- AV_{SS} = 0 V$	-	_	± 1	± 2	LSB
Overall Error			_	-	± 2	± 4	1

AC Characteristics

 $(V_{SS} = 0 \text{ V}, V_{DD} = 4.5 \text{ to } 5.5 \text{ V}, Topr = -40 \text{ to } 85^{\circ}\text{C})$

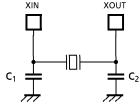
Parameter	Symbol	Pin	Min	Тур.	Max	Unit
	4	During NORMAL mode	0.2		0.5	
Machine Cycle Time	tcy	During IDLE mode	0.2	_		μ s
High Level Clock Pulse Width	t _{WCH}	When operating with external		_		
Low Level Clock Pulse Width	t _{WCL}	clock (XIN input) fc = 20 MHz	-	25	-	ns

Recommended Oscillation Conditions

 $(V_{SS} = 0 \text{ V}, V_{DD} = 4.5 \text{ to } 5.5 \text{ V}, Topr = -40 \text{ to } 85^{\circ}\text{C})$

Doromotor Doromotor	Barranta	Oscillation	B	Recommended Constant		
Parameter Resonator Fr		Frequency	Recommended Resonator	C ₁	C ₂	
High-frequency oscillation	Ceramic resonator	16 MHz	CSTLS16MOX51-B0 made by Murata Mfg. Co.	(5 pF)	(5 pF)	
		20 MHz	CSTLS20MOX51-B0 made by Murata Mfg. Co.	(5 pF)	(5 pF)	

(C1, C2 built-in type)



High-frequency oscillation

- Note 1: When using the device in places exposed to high electric fields as in cathode-ray tubes, we recommend electrically shielding the package in order to maintain the device in normal working condition.
- Note 2: These product numbers and the corresponding specifications are subject to change. For up-to-date information, please refer to the following URL: http://www.murata.co.jp/search/index.html

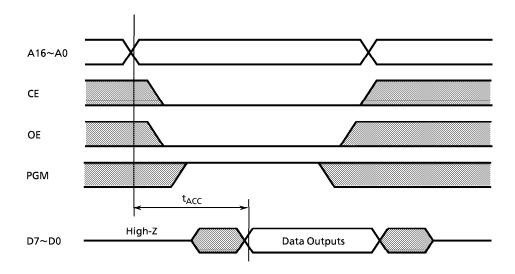
DC/AC Characteristics (PROM mode)

 $(V_{SS} = 0 \text{ V, Topr} = 25 \pm 5^{\circ}\text{C})$

(1) Read Operation

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
Input High Voltage	V _{IH4}		V _{CC} × 0.7	-	V _{CC}	
Input Low Voltage	V _{IL4}		0	-	V _{CC} × 0.12	\ _V
Power Supply Voltage	V _{CC}		4.75	5.0	5.25	\
Program Power Supply Voltage	V_{PP}		4.73	3.0	3.23	
Address Access Time	t _{ACC}	V _{CC} = 5.0 ± 0.25 V	_	1.5tcyc + 300	-	ns

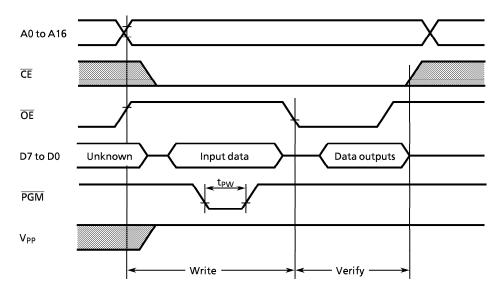
Note: tcyc = 200 ns at 20 MHz



(2) High-Speed Programming Operation (Topr = $25 \pm 5^{\circ}$ C)

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
Input High Voltage	V _{IH4}		V _{CC} × 0.7	-	V _{CC}	
Input Low Voltage	V _{IL4}		0	-	V _{CC} × 0.12	v
Power Supply Voltage	V _{CC}		6.0	6.25	6.5	\ \ \
Program Power Supply Voltage	V _{PP}		12.5	12.75	13.0	
Initial Program Pulse Width	t _{PW}	V _{CC} = 6.0 V	0.095	0.1	0.105	ms

High-speed program



Note 1: The power supply of V_{PP} (12.75 V) must be set power-on at the same time or the later time for a power supply of V_{CC} and must be clear power-on at the same time or early time for a power supply of V_{CC} .

Note 2: The pulling up/down device on the condition of $V_{PP} = 12.75 \text{ V } \pm 0.25 \text{ V}$ causes a damage for the device. Do not pull up/down at programming.

Note 3: Use the recommended adapter and mode (See 1.2.2 (1) and 1.2.2 (3) i.).

Using other than the above condition may cause the trouble of the writting.