

CMOS 8-Bit Microcontroller

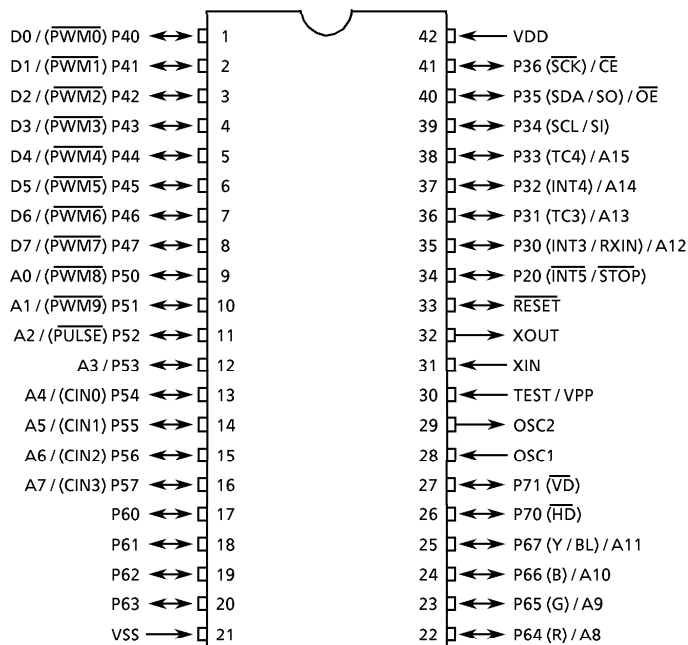
TMP87PM36N

The 87PM36 is a One-Time PROM microcontroller with low-power 287.5 Kbits (a 32 Kbytes program memory and a 128 characters OSD font memory) electrically programmable read only memory for the 87CM36 system evaluation. The 87PM36 is pin compatible with the 87CM36. The operations possible with the 87CM36 can be performed by writing programs and OSD character data to PROM. The 87PM36 can write and verify in the same way as the TC57256AD using an adaptor socket BM1183A and an EPROM programmer.

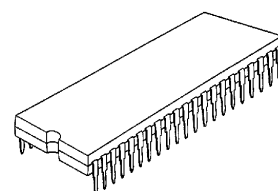
Part No.	OTP	RAM	Package	Adaptor Socket
TMP87PM36N	32 Kbytes + 14 × 18 × 128 bits	1 Kbytes	SDIP42-P-600-1.78	BM1183A

Pin Assignments (Top View)

SDIP42-P-600-1.78



SDIP42-P-600-1.78



TMP87PM36N

980910EBP1

- 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.
- TOSHIBA is continually working to improve the quality and the 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 observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product 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 products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- 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.
- The information contained herein is subject to change without notice.



Purchase of TOSHIBA I²C components conveys a license under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specification as defined by Philips.

Pin Function

The 87PM36 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PM36 is pin compatible with the 87CM36 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin Name (MCU mode)
A15 to A12	Input	PROM address inputs	P33 to P30
A11 to A8			P67 to P64
A7 to A0			P57 to P50
D7 to D0	I/O	PROM data input/outputs	P47 to P40
$\overline{\text{CE}}$	Input	Chip enable signal input (active low)	P36
$\overline{\text{OE}}$		Output enable signal input (active low)	P35
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	TEST
VCC		+ 5 V	VDD
GND		0V	VSS
P36	I/O	Pull-up with resistance for input processing	
P61		PROM mode setting pin. Be fixed at high level.	
P70			
P20		PROM mode setting pin. Be fixed at low level.	
P63, P62, P60			
P71			
$\overline{\text{RESET}}$			
XIN	Input	Connect an 8 MHz oscillator to stabilize the internal state.	
XOUT	Output		
OSC1	Input	Non connection	
OSC2	Output		

Operational Description

The following explains the 87PM36 hardware configuration and operation. The configuration and functions of the 87PM36 are the same as those of the 87CM36, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. Operating Mode

The 87PM36 has two modes: MCU and PROM.

1.1 MCU mode

The MCU mode is activated by fixing the TEST / VPP pin at low level.

In the MCU mode, operation is the same as with the 87CM36 (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program memory and OSD character font memory

The 87PM36 has a 32 Kbytes of program memory and a 14 × 18 × 128 bits of OSD character font memory.

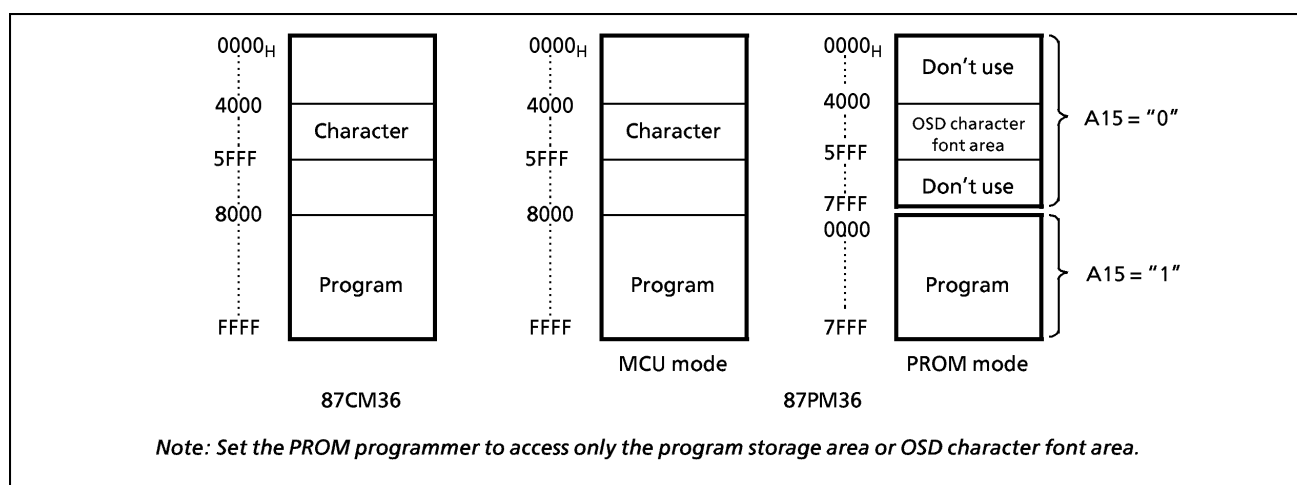


Figure 1-1. Program Memory Area

1.1.2 Data memory

The 87PM36 has an on-chip 1 Kbytes data memory (static RAM).

1.1.3 Input/output circuitry

(1) Control pins

The control pins of the 87PM36 are the same as those of the 87CM36 except that the TEST pin has no built-in pull-down resistance.

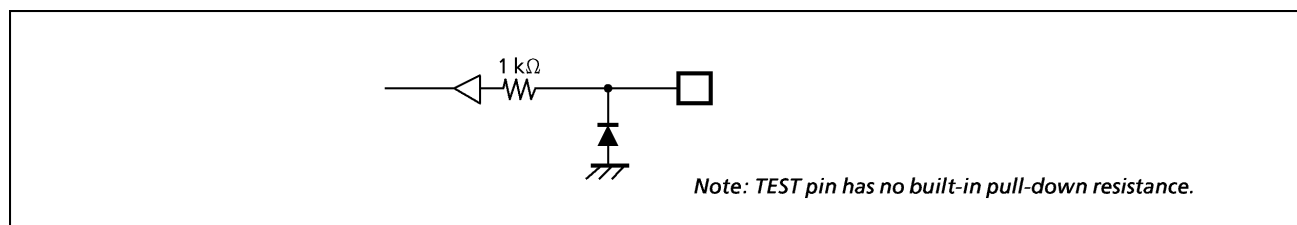


Figure 1-2. TEST Pin

(2) I/O ports

The I/O circuitries of 87PM36 I/O ports are the same as those of the 87CM36.

Electrical Characteristics

Absolute Maximum Ratings

(V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V _{DD}		– 0.3 to 6.5	V
Program Voltage	V _{PP}	TEST / VPP	– 0.3 to 13.0	V
Input Voltage	V _{IN}		– 0.3 to V _{DD} + 0.3	V
Output Voltage	V _{OUT1}		– 0.3 to V _{DD} + 0.3	V
Output Current (Per 1 pin)	I _{OUT1}	Ports P2, P3, P4, P5, P64 to P67, P7	3.2	mA
	I _{OUT2}	Ports P60 to P63	30	
Output Current (Total)	Σ I _{OUT1}	Ports P2, P3, P4, P5, P64 to P67, P7	120	mA
	Σ I _{OUT2}	Ports P60 to P63	120	
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 30 to 70	°C

Note: The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Any one of the ratings must not be exceeded. If any absolute maximum rating is exceeded, a device may break down or its performance may be degraded, causing it to catch fire or explode resulting in injury to the user. Thus, when designing products which include this device, ensure that no absolute maximum rating value will ever be exceeded.

Recommended Operating Conditions

(V_{SS} = 0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Max	Unit
Supply Voltage	V _{DD}		fc = 8MHz	4.5	5.5	V
			NORMAL mode			
			IDLE mode	2.0		
Input High Voltage	V _{IH1}	Except hysteresis input		V _{DD} × 0.70	V _{DD}	V
	V _{IH2}	Hysteresis input		V _{DD} × 0.75		
Input Low Voltage	V _{IL1}	Except hysteresis input		0	V _{DD} × 0.30	V
	V _{IL2}	Hysteresis input			V _{DD} × 0.25	
Clock Frequency	fc	XIN, XOUT	V _{DD} = 4.5 to 5.5 V	4.0	8.0	MHz
	f _{OSC}	OSC1, OSC2	Normal frequency mode (FORS = 0, V _{DD} = 4.5 to 5.5 V)	4.0	f _{OSC} ≤ f _C × 1.2 ≤ 8.0	
			Double frequency mode (FORS = 1, V _{DD} = 4.5 to 5.5 V)	2.0	f _{OSC} ≤ f _C × 0.6 ≤ 4.0	

Note 1: The recommended operating conditions for a device are operating conditions under which it can be guaranteed that the device will operate as specified. If the device is used under operating conditions other than the recommended operating conditions (supply voltage, operating temperature range, specified AC/DC values etc.), malfunction may occur. Thus, when designing products which include this device, ensure that the recommended operating conditions for the device are always adhered to.

Note 2: Clock frequency fc ; The condition of supply voltage range is the value in NORMAL and IDLE modes.

D.C. Characteristics

(V_{SS} = 0 V, T_{opr} = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V _{HS}	Hysteresis inputs		–	0.9	–	V
Input Current	I _{IN1}	TEST	V _{DD} = 5.5 V, V _{IN} = 5.5 V / 0 V	–	–	± 2	μA
	I _{IN2}	Open drain ports	V _{DD} = 5.5 V, V _{IN} = 5.5 V	–	–	2	
	I _{IN3}	Tri-state ports	V _{DD} = 5.5 V, V _{IN} = 5.5 V / 0 V	–	–	± 2	
	I _{IN4}	RESET, STOP	V _{DD} = 5.5 V, V _{IN} = 5.5 V / 0 V	–	–	± 2	
Input Resistance	R _{IN2}	RESET		100	220	450	kΩ
Output Leakage Current	I _{LO1}	Sink open drain ports	V _{DD} = 5.5 V, V _{OUT} = 5.5 V	–	–	2	μA
	I _{LO2}	Tri-state ports	V _{DD} = 5.5 V, V _{OUT} = 5.5 V / 0 V	–	–	± 2	
Output High Voltage	V _{OH2}	Tri-state port	V _{DD} = 4.5 V, I _{OH} = – 0.7 mA	4.1	–	–	V
Output Low Voltage	V _{OL}	Except XOUT, OSC2 and ports P60 to P63	V _{DD} = 4.5 V, I _{OL} = 1.6 mA	–	–	0.4	V
Output Low Current	I _{OL3}	Ports P60 to P63	V _{DD} = 4.5 V, V _{OL} = 1.0 V	–	20	–	mA
Supply Current in NORMAL mode	I _{DD}		V _{DD} = 5.5 V f _c = 8 MHz V _{IN} = 5.3 V / 0.2 V	–	10	16	mA
Supply Current in IDLE mode				–	6	8	mA
Supply Current in STOP mode			V _{DD} = 5.5 V V _{IN} = 5.3 V / 0.2 V	–	0.5	10	μA

Note 1 : Typical values show those at T_{opr} = 25°C, V_{DD} = 5 V.

Note 2 : Input Current I_{IN4}; The current through pull-up resistor is not included.

Note 3 : Typical current consumption during A/D conversion is 1.2mA.

A/D Conversion Characteristics

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, T_{opr} = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Analog Input Voltage Range	V _{AIN}	CIN3 to CIN0		V _{SS}	–	V _{DD}	V
Conversion Error			V _{DD} = 5.0 V	–	–	± 1.5	LSB

A.C. Characteristics

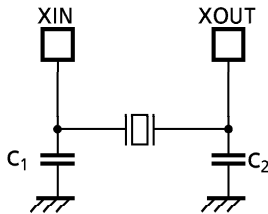
($V_{SS} = 0\text{ V}$, $V_{DD} = 4.5\text{ to }5.5\text{ V}$, $T_{opr} = -30\text{ to }70^{\circ}\text{C}$)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL mode	0.5	–	1.0	μs
		In IDLE mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input), $f_c = 8\text{ MHz}$	50	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					

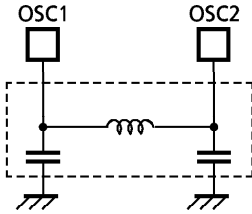
Recommended Oscillating Conditions

($V_{SS} = 0\text{ V}$, $V_{DD} = 4.5\text{ to }5.5\text{ V}$, $T_{opr} = -30\text{ to }70^{\circ}\text{C}$)

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator	Recommended Constant	
				C_1	C_2
High-frequency Oscillation	Ceramic Resonator	8 MHz	KYOCERA KBR8.0M	30pF	30pF
		4 MHz	KYOCERA KBR4.0MS		
			MURATA CSA4.00MG		
	Crystal Oscillator	8 MHz	TOYOCOM 210B 8.0000	20pF	20pF
		4 MHz	TOYOCOM 204B 4.0000		
OSD	LC Resonator	8 MHz	TOKO A285TNIS-11695	–	–
		7 MHz	TOKO TBEKSES-30375FBY		



(1) High-frequency Oscillation



(2) LC Resonator for OSD

Note : On our OSD circuit, the horizontal display start position is determined by counting the clock from LC oscillator. So, the unstable start of oscillation after the rising edge of Horizontal Sync. Signal will cause the OSD distortion.

Generally, smaller C and larger L make clearer wave form at the beginning of oscillation.
We recommend that the value of LC oscillator should be equal and bigger than $33\mu\text{H}$.

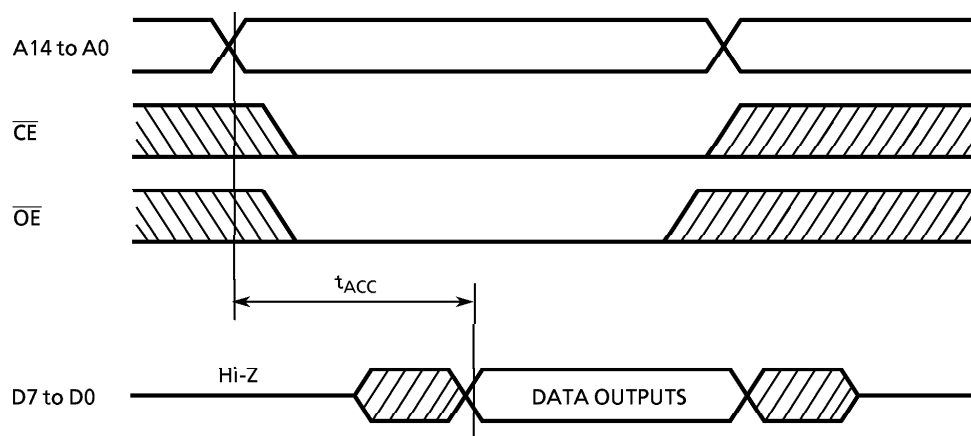
Note : To keep reliable operation, shield the device electrically with the metal plate on its package mold surface against the high electric field, for example, by CRT (Cathode Ray Tube).

D.C./A.C. Characteristics (PROM mode)	($V_{SS} = 0\text{ V}$)
---------------------------------------	---------------------------

(1) Read Operation ($T_a = 25 \pm 5^\circ\text{C}$)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		4.75	5.00	5.25	V
Program Power Supply Voltage	V_{PP}		$V_{CC} - 0.6$	V_{CC}	$V_{CC} + 0.6$	
Address Access Time	t_{ACC}	$V_{CC} = 5.0 \pm 0.25\text{ V}$	–	$1.5\text{ }t_{cyc} + 300$	–	ns

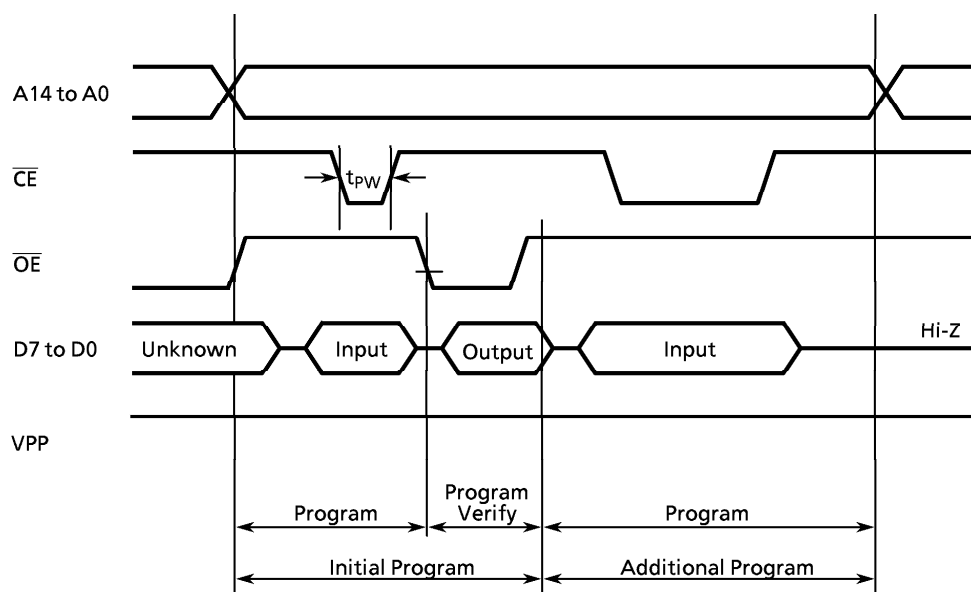
Note : $t_{cyc} = 500\text{ ns}$ at 8 MHz



Timing Waveforms of Read operation

(2) High-Speed Programming Operation (High speed write mode- I) ($T_a = 25 \pm 5^\circ\text{C}$)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		5.75	6.0	6.25	V
Program Power Supply Voltage	V_{PP}		12.0	12.5	13.0	V
Initial Program Pulse Width	t_{PW}	$V_{CC} = 6.0 \pm 0.25\text{ V}$, $V_{PP} = 12.5 \pm 0.25\text{ V}$	0.95	1.0	1.05	ms



Timing Waveforms of Programming Operation

Note 1: When V_{CC} power supply is turned on or after, V_{PP} must be increased.

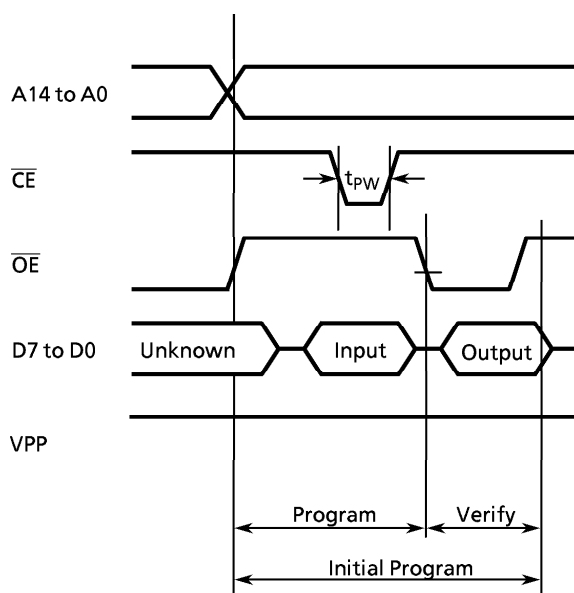
When V_{CC} power supply is turned off or before, V_{PP} must be increased.

Note 2: The device must not be set to the EPROM programmer or picked up from it under applying the program voltage ($12.5\text{ V} \pm 0.5\text{ V} = V$) to the V_{PP} pin as the device is damaged.

Note 3: Be sure to execute the recommended programming mode with the recommended programming adaptor. If a mode or an adaptor except the above, the misoperation sometimes occurs.

(3) PROGRAM OPERATION (High speed write mode - II) ($T_{opr} = 25 \pm 5^{\circ}\text{C}$)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Supply Voltage	V_{CC}		6.00	6.25	6.50	V
Program Supply Voltage	V_{PP}		12.50	12.75	13.0	V
Initial Program Pulse Width	t_{PW}	$V_{CC} = 6.25 \text{ V} \pm 0.25 \text{ V}$, $V_{PP} = 12.75 \text{ V} \pm 0.25 \text{ V}$	0.095	0.1	0.105	ms



Note 1: When V_{CC} power supply is turned on or after, V_{PP} must be increased.

When V_{CC} power supply is turned off or before, V_{PP} must be decreased.

Note 2: The device must not be set to the EPROM programmer or picked up from it under applying the program voltage ($12.75 \text{ V} \pm 0.5 \text{ V}$) to the V_{PP} pin as the device is damaged.

Note 3: Be sure to execute the recommended programing mode with the recommended programing adaptor. If a mode or an adaptor except the above, the misoperation sometimes occurs.

