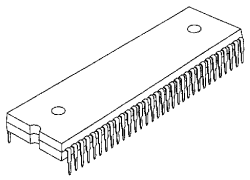
CMOS 8-Bit Microcontroller

TMP87PM14N/F

The 87PM14 is a One-Time PROM microcontroller with low-power 256 K bits (32 Kbytes) electrically programmable read only memory for the 87C814/CH14/CK14/CM14 system evaluation. The 87PM14 is pin compatible with the 87C814/CH14/CK14/CM14. The operations possible with the 87C814/CH14/CK14/CM14 can be performed by writing programs to PROM. The 87PM14 can write and verify in the same way as the TC27256 using an adaptor socket BM1198/BM1199 and an EPROM programmer.

Part No.	OTP	RAM	Package	Adaptor socket
TMP87PM14N	32K × 8-bit	1K × 8-bit	P-SDIP64-750-1.78	BM1198
TMP87PM14F			P-QFP64-1420-1.00A	BM1199

P-SDIP64-750-1.78



TMP87PM14N

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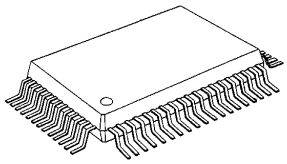

TMP87PM14F

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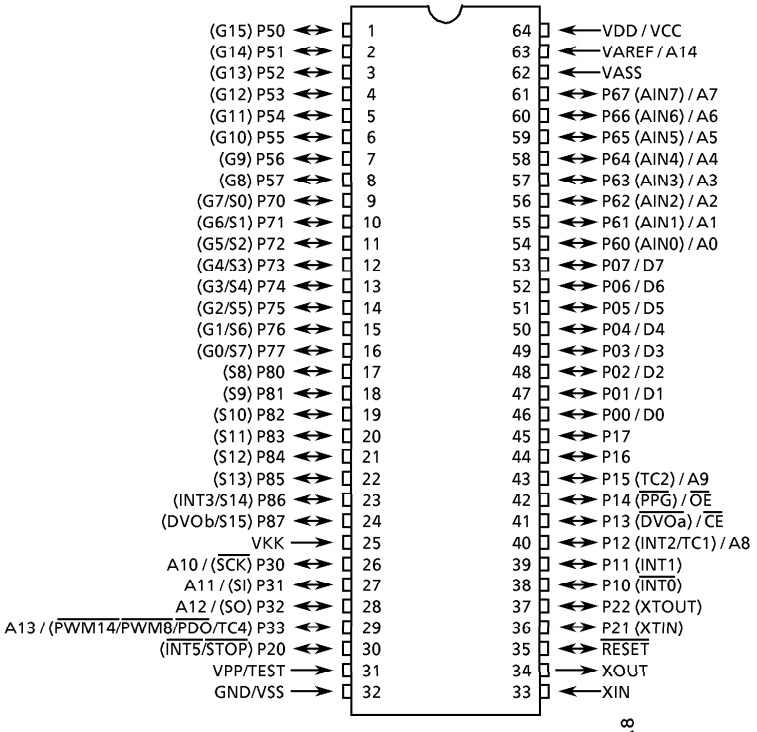
Pin Assignments (Top View)

P-SDIP64-750-1.78



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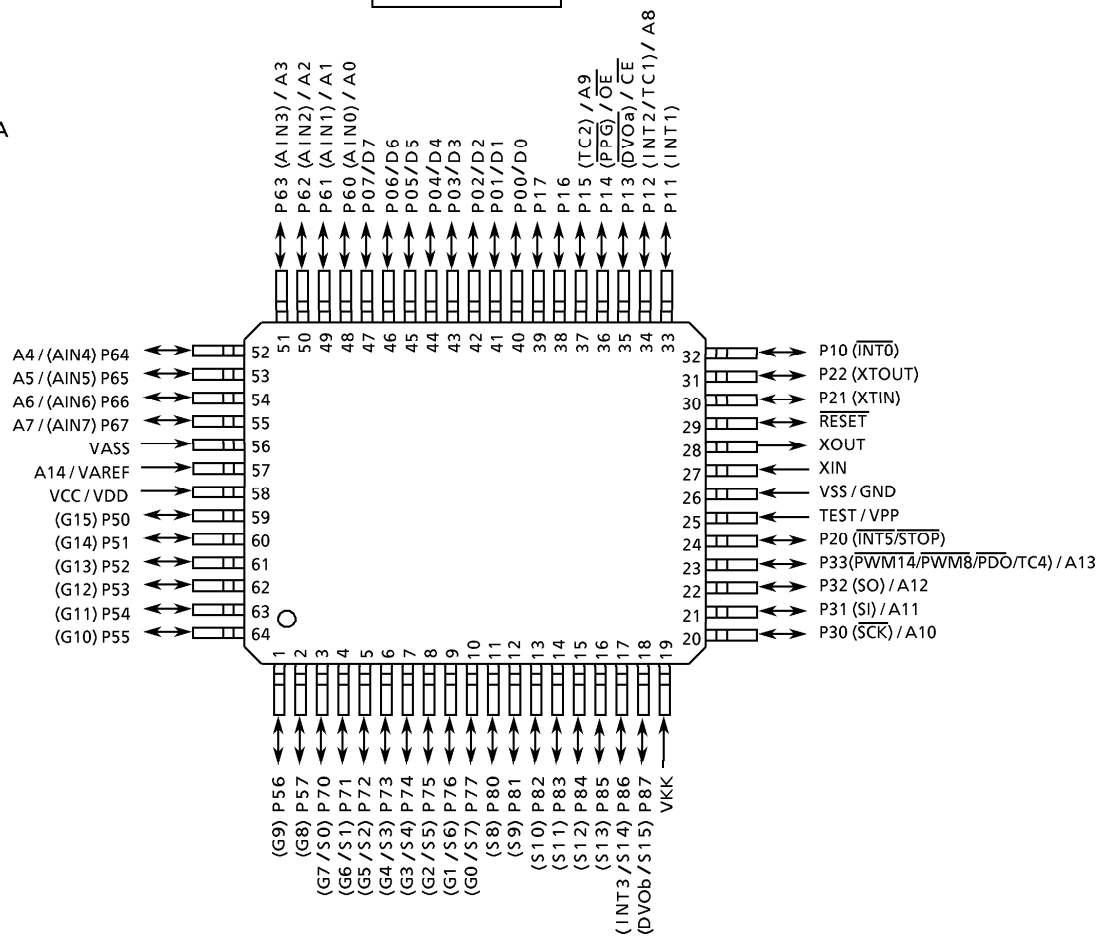


Pin Function

The 87PM14 has two modes two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PM14 is pin compatible with the 87C814/CH14/CK14/CM14 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input / Output	Functions	Pin Name (MCU mode)
A14	Input	PROM address inputs	VAREF
A13 to A10			P33 to P30
A9			P15
A8			P12
A7 to A0			P67 to P60
D7 to D0	I/O	PROM data input/outputs	P07 to P00
$\overline{CE}$	Input	Chip enable signal input (active low)	P13
$\overline{OE}$		Output enable signal input (active low)	P14
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	TEST
VCC		+ 5 V	VDD
GND		0 V	VSS
P11	I/O	PROM mode setting pin. Be fixed at high level.	
P21			
P87			
P10, P16, P17		PROM mode setting pin. Be fixed at low level.	
P22, P20			
$\overline{RESET}$			
XIN	Input	Connect an 8 MHz oscillator to stabilize the internal state.	
XOUT	output		
P57 to P50	I/O	Open	
P77 to P70			
P86 to P80			
VASS	Power supply	Open	
VKK	VFT Power supply	0 V (GND)	

OPERATIONAL DESCRIPTION

The following explains the 87PM14 hardware configuration and operation. The configuration and functions of the 87PM14 are the same as those of the 87C814/CH14/CK14/CM14, except in that a one-time PROM is used instead of an on-chip mask ROM.

The 87PM14 is placed in the *single-clock* mode during reset. To use the dual-clock mode, the low-frequency oscillator should be turned on by executing [SET (SYSCR2). XTEN] instruction at the beginning of the program.

1. OPERATING MODE

The 87PM14 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 87C814/CH14/CK14/CM14 (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

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}	P0, P1, P2, P3, P6, XOUT, $\overline{RESET}$	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	Source open drain ports	V_{DD} – 40 to V_{DD} + 0.3	
Output Current (Per 1 pin)	I_{OUT1}	P0, P1, P2, P3, P6	3.2	mA
	I_{OUT2}	P8	– 12	
	I_{OUT3}	P5, P7	– 25	
Output Current (Total)	ΣI_{OUT1}	P0, P1, P2, P3, P6	120	mA
	ΣI_{OUT2}	P5, P7, P8	– 120	
Power Dissipation [Topr = 25°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 = 8 MHz	NORMAL 1, 2 modes	4.5	5.5	V
				IDLE1, 2 modes			
			fs = 32.768 kHz	SLOW mode	2.7		
				SLEEP mode			
				STOP mode	2.0		
Output Voltage	V_{OUT2}	Source open drain ports			V_{DD} – 38	V_{DD}	V
Input High Voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geqq 4.5$ V		$V_{DD} \times 0.70$	V_{DD}	V
	V_{IH2}	Hysteresis input			$V_{DD} \times 0.75$		
	V_{IH3}		$V_{DD} < 4.5$ V		$V_{DD} \times 0.90$		
Input Low Voltage	V_{IL1}	Except hysteresis input	$V_{DD} \geqq 4.5$ V		0	$V_{DD} \times 0.30$	V
	V_{IL2}	Hysteresis input				$V_{DD} \times 0.25$	
	V_{IL3}		$V_{DD} < 4.5$ V			$V_{DD} \times 0.10$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 V to 5.5 V		0.4	8.0	MHz
	fs	XTIN, XTOUT			30.0	34.0	kHz

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: Supply voltage range is specified in NORMAL 1/2 mode and IDLE 1/2 mode.

D.C. Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis input		–	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, Tri-state ports					
	I_{IN3}	$\overline{RESET}$, $\overline{STOP}$					
Input Resistance	R_{IN1}	$\overline{RESET}$		100	220	450	kΩ
Pull-down Resistance	R_1	Source open drain ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	200	–	
	R_K		V_{DD} = 5.5 V, V_{KK} = – 30 V	–	80	–	
Output Leakage Current	I_{LO1}	Sink open drain ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	–	2	μA
	I_{LO2}	Source open drain ports	V_{DD} = 5.5 V, V_{OUT} = – 32 V	–	–	– 2	
	I_{LO3}	Tri-state ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V / 0 V	–	–	± 2	
Output High Voltage	V_{OH1}	Tri-state ports	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	V
	V_{OH2}	P8	V_{DD} = 4.5 V, I_{OH} = – 8 mA	2.4	–	–	
Output Low Voltage	V_{OL}	Except XOUT	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
Output High current	I_{OH}	P5, P7	V_{DD} = 4.5 V, V_{OH} = 2.4 V	–	– 20	–	mA
Supply Current in NORMAL 1, 2 modes	I_{DD}		V_{DD} = 5.5 V fc = 8 MHz	–	12	18	mA
Supply Current in IDLE 1, 2 modes			fs = 32.768 kHz V_{IN} = 5.3 V / 0.2 V	–	4.5	6	
Supply Current in SLOW mode			V_{DD} = 3.0 V fs = 32.768 kHz	–	30	60	μA
Supply Current in SLEEP mode			V_{IN} = 2.8 V / 0.2 V	–	15	30	
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 Topr = 25°C, V_{DD} = 5 V.

Note 2: Input Current I_{IN1}, I_{IN3}; The current through resistor is not included, when the input resistor (pull-up/pull-down) is contained.

A/D Conversion Characteristics

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

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}	$V_{AREF} - V_{ASS} \geqq 2.5$ V	V_{DD} – 1.5	—	V_{DD}	V
	V_{ASS}		V_{SS}	—	1.5	
Analog Input Voltage	V_{AIN}		V_{ASS}	—	V_{AREF}	V
Analog Supply Current	I_{REF}	V_{AREF} = 5.5 V, V_{ASS} = 0.0 V	—	0.5	1.0	mA
Nonlinearity Error		V_{DD} = 5.0 V, V_{SS} = 0.0 V V_{AREF} = 5.000 V V_{ASS} = 0.000 V	—	—	± 1	LSB
Zero Point Error			—	—	± 1	
Full Scale Error			—	—	± 1	
Total Error			—	—	± 2	

Note: Quantizing error is not contained in those errors.

A.C. Characteristics

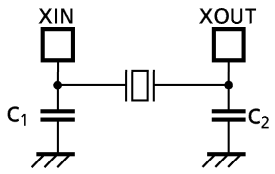
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL1, 2 modes	0.5	–	10	μs
		In IDLE 1, 2 modes				
		In SLOW mode	117.6	–	133.3	
		In SLEEP mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input), fc = 8 MHz	50	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input), fs = 32.768 kHz	14.7	–	–	μs
Low Level Clock Pulse Width	t_{WSL}					

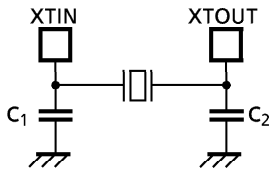
Recommended Oscillating Conditions

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

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator		Recommended Constant C_1	Recommended Constant 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		
Low-frequency Oscillation	Crystal Oscillator	32.768 kHz	NDK	MX-38T	15pF	15pF



(1) High-frequency Oscillation



(2) Low-frequency Oscillation

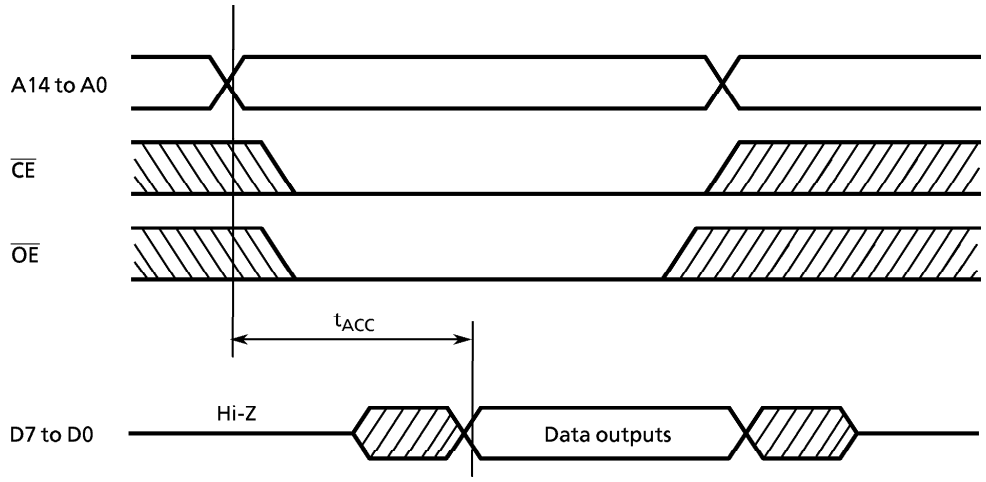
Note: An electrical shield by metal shied plate on the IC package should be recommend able in order to prevent the device from the high electric fieldstress applied for continuous reliable operation.

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

(1) Read Operation

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	5.0	5.25	V
Program Power Supply Voltage	V_{PP}					
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	1.5 tcyc + 300	–	ns

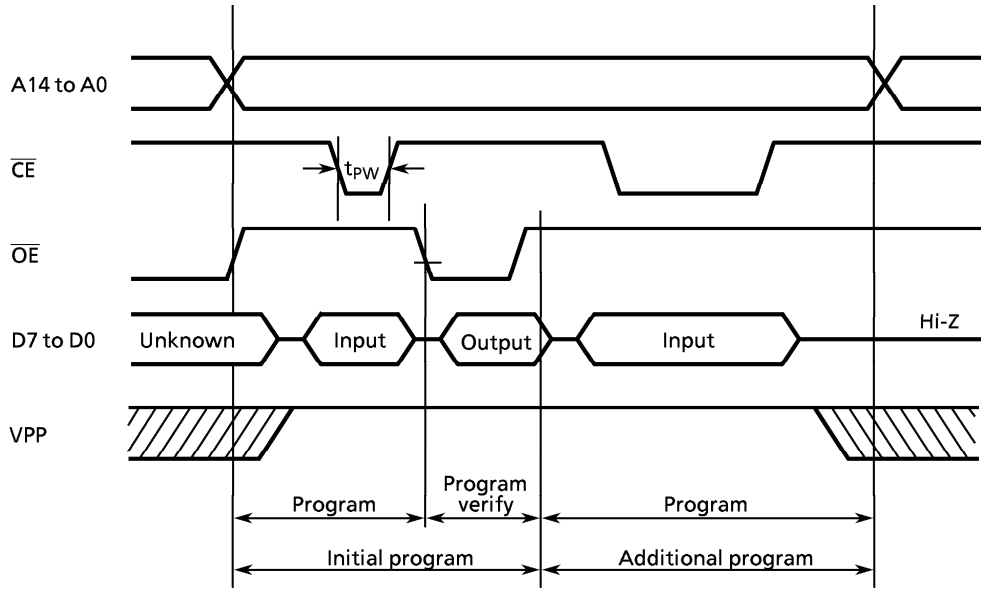
Note: tcyc = 500 ns at 8 MHz



Timing Waveforms of Read Operation

(2) Program Operation (High speed write mode-Ⅰ) (Topr = 25 ± 5°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 V	0.95	1.0	1.05	ms



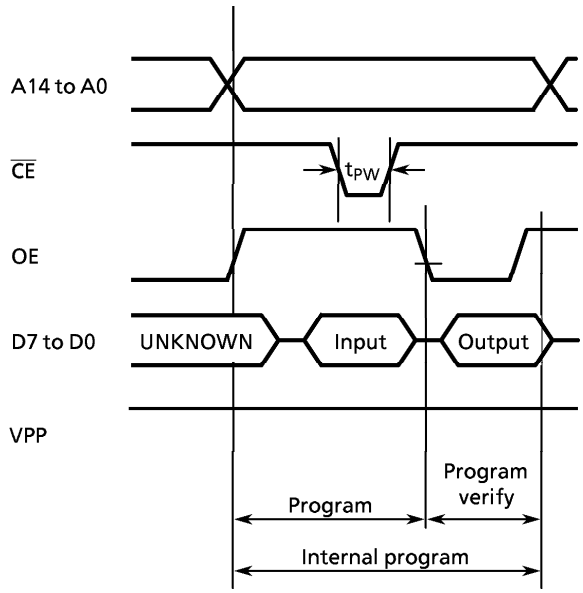
Note 1: When V_{cc} power supply is turned on or after, V_{pp} must be increased.
When V_{cc} power supply is turned off or before, V_{pp} must be decreased.

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

Timing Waveforms of Programming Operation

(3) Program Operation (High speed write mode - II) (Topr = 25 ± 5°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 V ± 0.25 V, V_{PP} = 12.75 V ± 0.25 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 V ± 0.5 V) to the V_{pp} pin as the device is damaged.