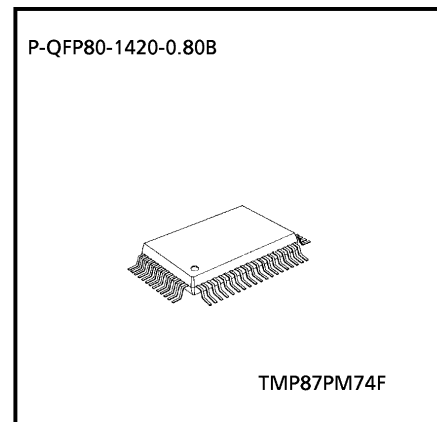


CMOS 8-Bit Microcontroller

TMP87PM74F

The 87PM74 is a One-Time PROM microcontroller with low-power 256 K bits (32 Kbytes) electrically programmable read only memory for the 87CH74A/M74A system evaluation. The 87PM74 is pin compatible with the 87CH74A/M74A. The operations possible with the 87CH74A/M74A can be performed by writing programs to PROM. The 87PM74 can write and verify in the same way as the TC57256AD using an adaptor socket BM11120 and an EPROM programmer.

Part No.	OTP	RAM	Package	Adaptor Socket
TMP87PM74F	32 K x 8-bit	1 K x 8-bit	P-QFP80-1420-0.80B	BM11120

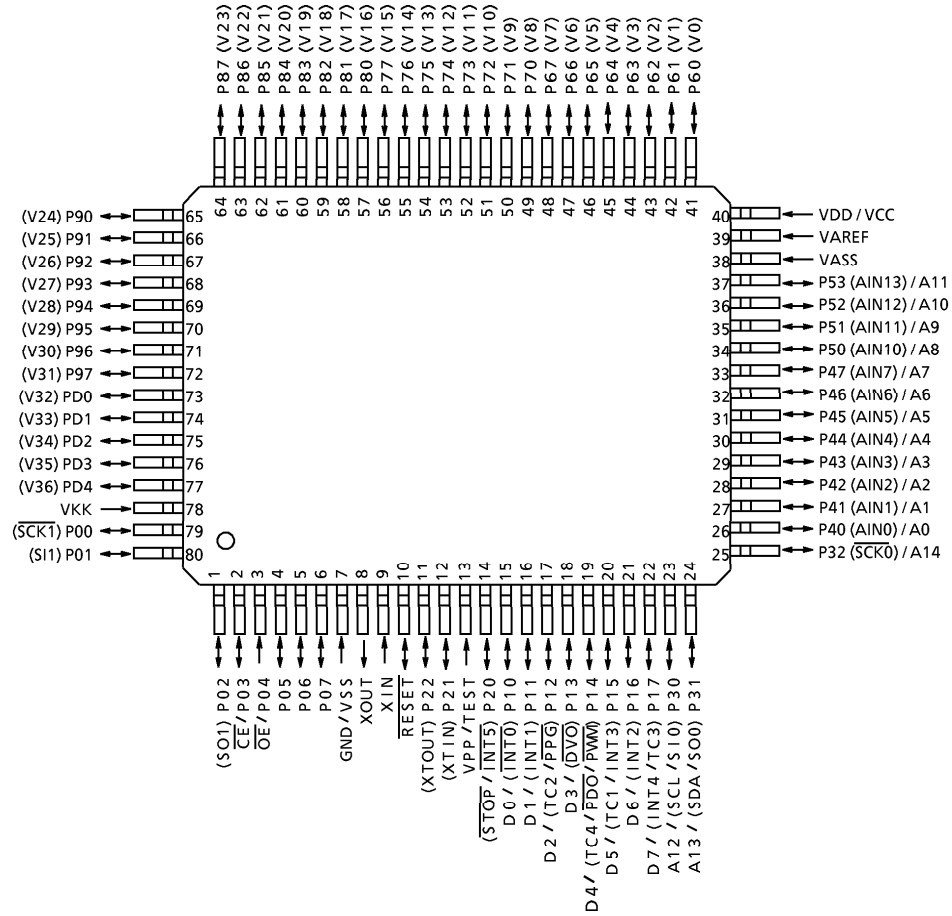


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Pin Assignments (Top View)

P-QFP80-1420-0.80B



Pin Function

The 87PM74 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PM74 is pin compatible with the 87CH74A/M74A (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input / Output	Functions	Pin Name (MCU mode)
A14 to A12	Input	PROM address inputs	P32 to P30
A11 to A8			P53 to P50
A7 to A0			P47 to P40
D7 to D0	I/O	PROM data input/outputs	P17 to P10
\overline{CE}	Input	Chip enable signal input (active low)	P03
\overline{OE}		Output enable signal input (active low)	P04
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	TEST
VCC		+ 5 V	VDD
GND		0 V	VSS
P05, P02, P01	I/O	PROM mode setting pin. Be fixed at high level.	
P21			
P07, P06, P00			
P22, P20			PROM mode setting pin. Be fixed at low level.
RESET			
XIN	Input	Connect an 8 MHz oscillator to stabilize the internal state.	
XOUT	Output		
PD4 to PD0	I/O	Open	
P97 to P90			
P87 to P80			
P77 to P70			
P67 to P60			
VKK	Power supply	0 V (GND)	
VAREF			
VASS			

Operational Description

The following explains the 87PM74 hardware configuration and operation. The configuration and functions of the 87PM74 are the same as those of the 87CH74A/M74A, except in that a one-time PROM is used instead of an on-chip mask ROM.

The 87PM74 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 87PM74 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 87CH74A/M74A (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The 87PM74 has a 32 K × 8-bit (addresses 8000_H to FFFF_H in the MCU mode, addresses 0000_H to 7FFF_H in the PROM mode) of program memory (OTP).

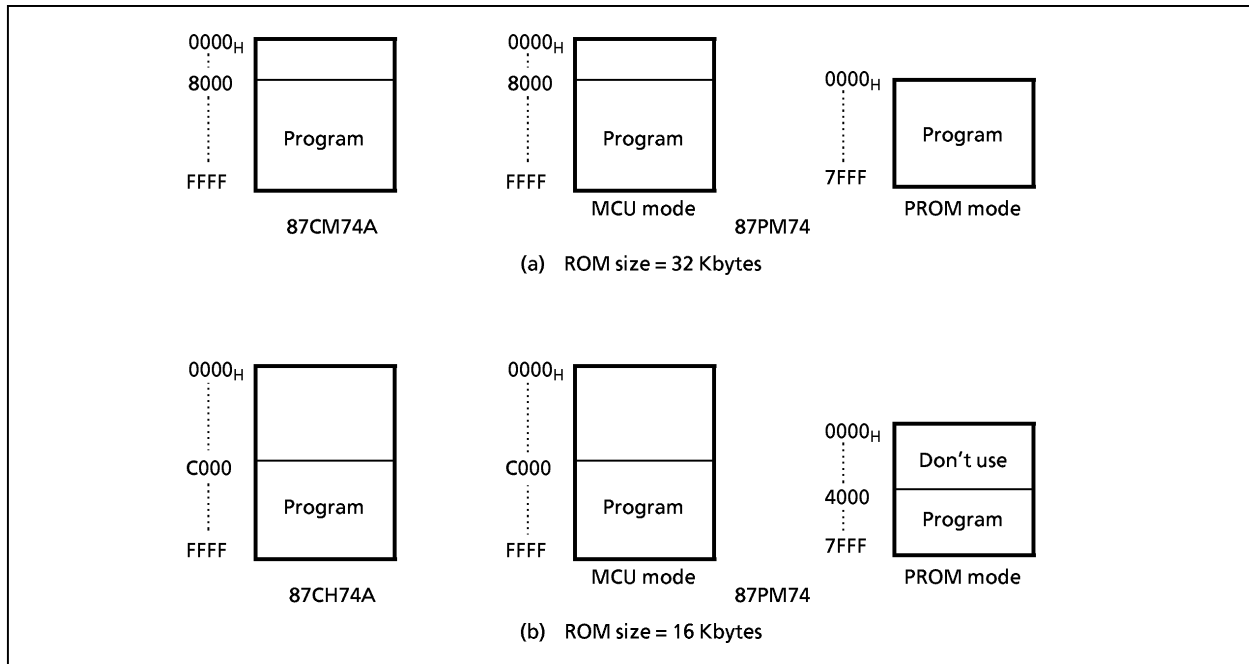


Figure 1-1. Program Memory Area

Note: Either write the data FF_H to the unused area or set the PROM programmer to access only the program storage area.

Electrical Characteristics

Absolute Maximum Ratings

 $(V_{SS} = 0\text{ V})$

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}	P2, P3, P4, P5, P6, XOUT, RESET	- 0.3 to $V_{DD} + 0.3$	V
	V_{OUT3}	Source open drain ports	$V_{DD} - 40$ to $V_{DD} + 0.3$	
Output Current (Per 1 pin)	I_{OUT1}	P15 to P17, P3, P4, P5	3.2	mA
	I_{OUT2}	P0, P10 to P14, P2	30	
	I_{OUT3}	P8, P9, PD	- 12	
	I_{OUT4}	P6, P7	- 25	
Output Current (Total)	ΣI_{OUT1}	P15 to P17, P3, P4, P5	60	mA
	ΣI_{OUT2}	P0, P10 to P14, P2	160	
	ΣI_{OUT3}	P6, P7, P8, P9, PD	- 200	
Power Dissipation [$T_{opr} = 25^\circ\text{C}$]	PD	Note 2	1200	mW
Soldering Temperature (time)	T_{sld}		260 (10 s)	$^\circ\text{C}$
Storage Temperature	T_{stg}		- 55 to 125	$^\circ\text{C}$
Operating Temperature	T_{opr}		- 30 to 70	$^\circ\text{C}$

Note 1: 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.

Note 2: Power Dissipation (PD); For PD, it is necessary to decrease 14.3 mW/ $^\circ\text{C}$.

Recommended Operating Conditions

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

Parameter	Symbol	Pins	Conditions	Min	Max	Unit	
Supply Voltage	V_{DD}		$f_c = 8\text{ MHz}$	NORMAL 1, 2 modes	4.5	5.5	V
				IDLE 1, 2 modes			
			$f_s = 32.768\text{ kHz}$	SLOW mode	2.7		
				SLEEP mode			
			STOP mode	2.0			
Output Voltage	V_{OUT3}	Source open drain ports		$V_{DD} - 38$	V_{DD}	V	
Input High Voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geq 4.5\text{ V}$	$V_{DD} \times 0.70$	V_{DD}	V	
	V_{IH2}	Hysteresis input		$V_{DD} \times 0.75$			
	V_{IH3}		$V_{DD} < 4.5\text{ V}$	$V_{DD} \times 0.90$			
Input Low Voltage	V_{IL1}	Except hysteresis input	$V_{DD} \geq 4.5\text{ V}$	0	$V_{DD} \times 0.30$	V	
	V_{IL2}	Hysteresis input			$V_{DD} \times 0.25$		
	V_{IL3}		$V_{DD} < 4.5\text{ V}$		$V_{DD} \times 0.10$		
Clock Frequency	f_c	XIN, XOUT	$V_{DD} = 4.5\text{ V to }5.5\text{ V}$	0.4	8.0	MHz	
			$V_{DD} = 2.7\text{ V to }5.5\text{ V}$		4.2		
	f_s	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 f_c : Supply voltage range is specified in NORMAL 1/2 mode and IDLE 1/2 mode.

D.C. Characteristics

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

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis input		–	0.9	–	V
Input Current	I_{IN1}	TEST	$V_{DD} = 5.5\text{ V}$ $V_{IN} = 5.5\text{ V} / 0\text{ V}$	–	–	± 2	μA
	I_{IN2}	Open drain ports, Tri-state ports					
	I_{IN3}	RESET, STOP					
	I_{IN4}	PD port (Note3)					
Input Resistance	R_{IN2}	RESET		100	220	450	$\text{k}\Omega$
Pull-down Resistance	R_K	Source open drain ports	$V_{DD} = 5.5\text{ V}, V_{KK} = -30\text{ V}$	50	80	110	$\text{k}\Omega$
Output Leakage Current	I_{LO1}	Sink open drain ports	$V_{DD} = 5.5\text{ V}, V_{OUT} = 5.5\text{ V}$	–	–	2	μA
	I_{LO2}	Source open drain ports	$V_{DD} = 5.5\text{ V}, V_{OUT} = -32\text{ V}$	–	–	-2	
	I_{LO3}	Tri-state ports	$V_{DD} = 5.5\text{ V}, V_{OUT} = 5.5\text{ V} / 0\text{ V}$	–	–	± 2	
Output High Voltage	V_{OH2}	Tri-state ports	$V_{DD} = 4.5\text{ V}, I_{OH} = -0.7\text{ mA}$	4.1	–	–	V
	V_{OH3}	P8, P9, PD	$V_{DD} = 4.5\text{ V}, I_{OH} = -8\text{ mA}$	2.4	–	–	
Output Low Voltage	V_{OL}	Except XOUT, P0, P10 to P14, P2	$V_{DD} = 4.5\text{ V}, I_{OL} = 1.6\text{ mA}$	–	–	0.4	V
Output Low Current	I_{OL3}	P0, P10 to P14, P2	$V_{DD} = 4.5\text{ V}, V_{OL} = 1.0\text{ V}$	–	20	–	mA
Output High Current	I_{OH}	P6, P7	$V_{DD} = 4.5\text{ V}, V_{OH} = 2.4\text{ V}$	–	-20	–	mA
Supply Current in NORMAL 1, 2 modes	I_{DD}		$V_{DD} = 5.5\text{ V}$ $f_c = 8\text{ MHz}$ $f_s = 32.768\text{ kHz}$ $V_{IN} = 5.3\text{ V} / 0.2\text{ V}$	–	12	18	mA
Supply Current in IDLE 1, 2 modes				–	6	9	
Supply Current in SLOW mode				–	30	60	μA
Supply Current in SLEEP mode				–	15	30	
Supply Current in STOP mode				$V_{DD} = 5.5\text{ V}$ $V_{IN} = 5.3\text{ V} / 0.2\text{ V}$	–	0.5	

Note 1: Typical values show those at $T_{opr} = 25^{\circ}\text{C}$, $V_{DD} = 5\text{ V}$.

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

 $(V_{SS} = 0\text{ V}, V_{DD} = 4.5\text{ to }6.0\text{ V}, T_{opr} = -30\text{ to }70^{\circ}\text{C})$

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}	$V_{AREF} - V_{ASS} \geq 2.5\text{ V}$	$V_{DD} - 1.5$	–	V_{DD}	V
	V_{ASS}		V_{SS}			
Analog Input Voltage	V_{AIN}		V_{ASS}	–	V_{AREF}	V
Analog Supply Current	I_{REF}	$V_{AREF} = 5.5\text{ V}, V_{ASS} = 0.0\text{ V}$	–	0.5	1.0	mA
Nonlinearity Error		$V_{DD} = 5.0\text{ V}, V_{SS} = 0.0\text{ V}$ $V_{AREF} = 5.000\text{ V}$ $V_{ASS} = 0.000\text{ V}$	–	–	± 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

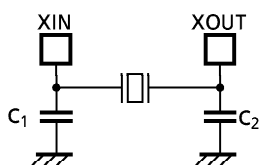
($V_{SS} = 0\text{ V}$, $V_{DD} = 4.5\text{ to }5.5\text{ V}$, $T_{opr} = -30\text{ to }70^\circ\text{C}$)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL1, 2 modes	0.5	-	10	μs
		In IDLE1, 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), $f_c = 8\text{ MHz}$	50	-	-	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input), $f_s = 32.768\text{ kHz}$	14.7	-	-	μs
Low Level Clock Pulse Width	t_{WSL}					

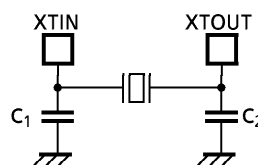
Recommended Oscillating Conditions

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

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	Crystal Oscillator	8 MHz	TOYOCOM	210B 8.0000	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

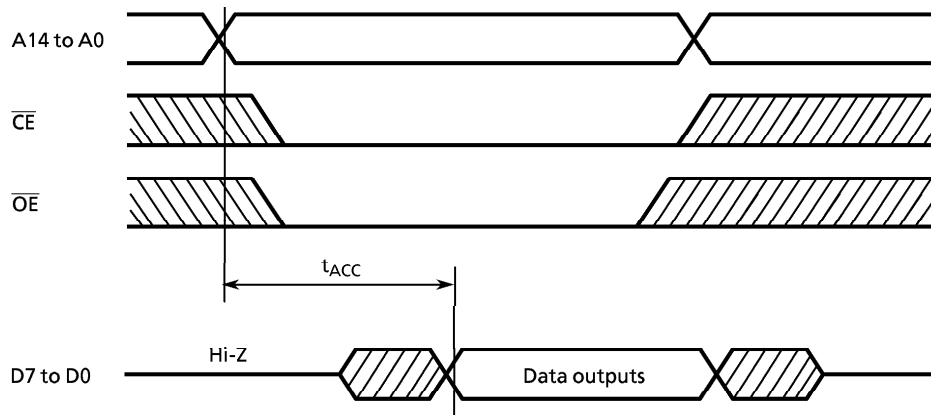
Note: An electrical shield by metal shield plate on the IC package should be recommend able in order to prevent the device from the high electric fieldstress applied for continuous reliable operation.

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

(1) Read Operation ($T_{opr} = -30\text{ to }70^\circ\text{C}$)

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}		$V_{CC} - 0.6\text{V}$	V_{CC}	$V_{CC} + 6.0$	
Address Access Time	t_{ACC}	$V_{CC} = 5.0 \pm 0.5\text{ V}$	–	$1.5\text{ t}_{cyc} + 300$	–	ns

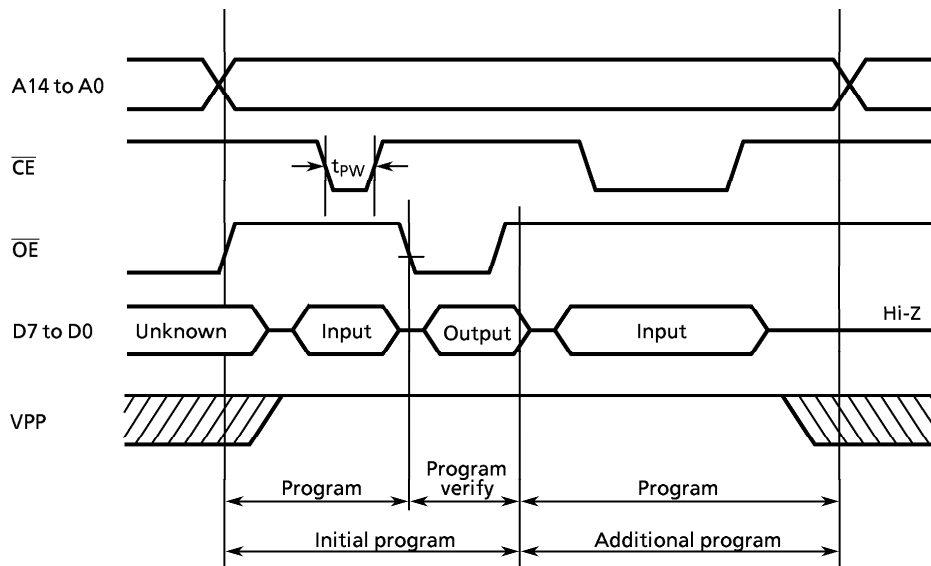
Note: $t_{cyc} = 500\text{ ns}$ at 8 MHz



Timing Waveforms of Read Operation

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

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
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}	$V_{CC} = 6.0\text{V} \pm 0.25\text{V}$ $V_{PP} = 12.5 \pm 0.25\text{V}$	0.95	1.0	1.05	ms

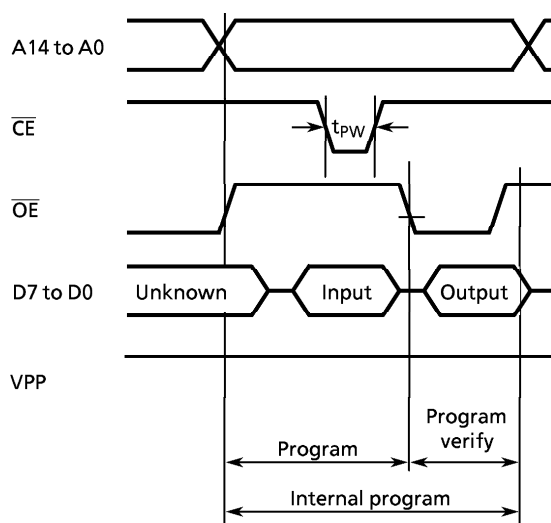


- Note1:** When V_{CC} power supply is turned on or after, V_{pp} must be increased. When V_{CC} power supply is turned off or before, V_{pp} must be decreased.
- Note2:** The device must not be set to the EPROM programmer or picked up from it under applying the program voltage ($12.75\text{V} \pm 0.5\text{V}$) to the V_{pp} pin as the device is damaged.
- Note3:** 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.

Timing Waveforms of programming Operation

(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



Note1: 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.

Note2: The device must not be set to the EPROM programmer or picked up from it under applying the program voltage ($12.75 \text{ V} \pm 0.25 \text{ V}$) to the V_{PP} pin as the device is damaged.