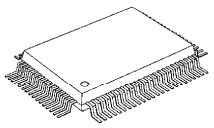
CMOS 8-Bit Microcontroller

TMP87PM70F

The 87PM70 is a One-Time PROM microcontroller with low-power 256 K bits (32 Kbytes) electrically programmable read only memory for the 87CH70B/CM70B system evaluation. The 87PM70 is pin compatible with the 87CH70B/CM70B. The operations possible with the 87CH70B/CM70B can be performed by writing programs to PROM. The 87PM70 can write and verify in the same way as the TC57256AD using an adaptor socket BM1150 and an EPROM programmer.

Part No.	OTP	RAM	Package	Adapter Socket
TMP87PM70F	32 K × 8-bit	512 × 8-bit	P-QFP80-1420-0.80B	BM1150B

P-QFP80-1420-0.80B



TMP87PM70F

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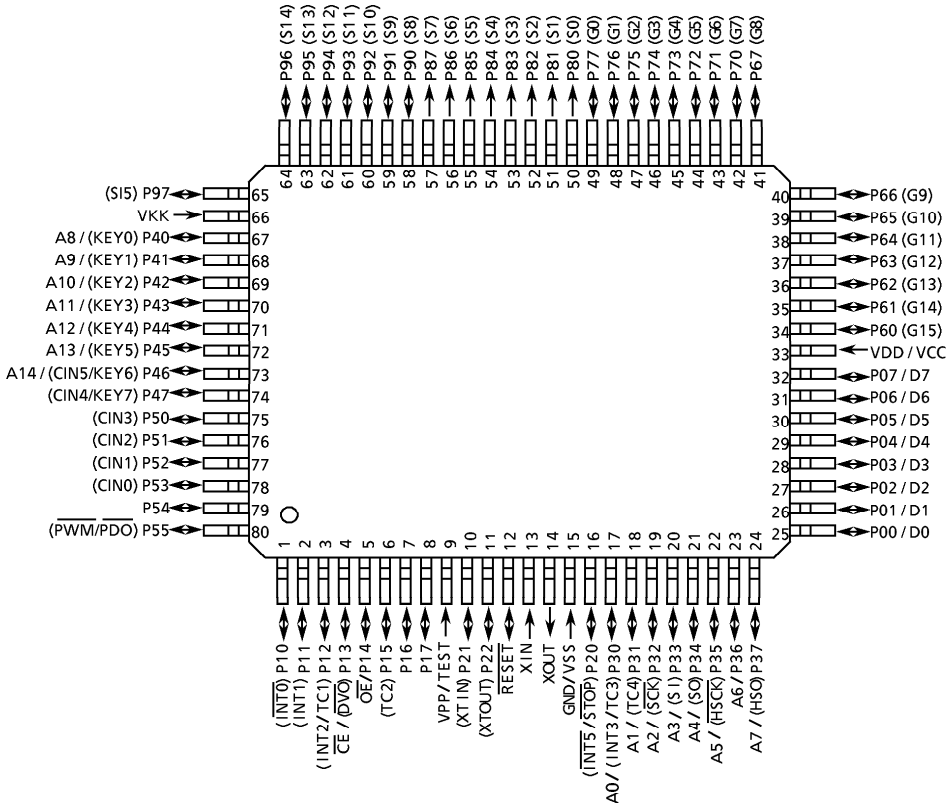
Pin Assignments (Top View)

P-QFP80-1420-0.80B



Pin Function

The 87PM70 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PM70 is pin compatible with the 87CH70B/CM70B (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input / Output	Functions	Pin Name (MCU mode)
A14 to A8	Input	PROM address inputs	P46 to P40
A7 to A0			P37 to P30
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
P55 to P50	I/O	Pull-down with resistance for input processing	
P11		PROM mode setting pin. Be fixed at high level.	
P21			
P47			
P17 to P15		PROM mode setting pin. Be fixed at low level.	
P12, P10			
P22, P20			
$\overline{RESET}$			
XIN	Input	Connect an 8 MHz oscillator to stabilize the internal state.	
XOUT	Output		
VKK	VFT power supply	GND	
P97 to P90	I/O	Open	
P87 to P80	Output		
P77 to P70	I/O		
P67 to P60			

OPERATIONAL DESCRIPTION

The following explains the 87PM70 hardware configuration and operation. The configuration and functions of the 87PM70 are the same as those of the 87CH70B/CM70B, except in that a one-time PROM is used instead of an on-chip mask ROM.

The 87PM70 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 87PM70 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 87CH70B/CM70B (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The 87PM70 has a 32K × 8-bit (addresses 8000_H-$FFFF_H$ in the MCU mode, addresses 0000_H-$7FFF_H$ in the PROM mode) of program memory (OTP).

To use the 87PM70 as the system evaluation for the 87CH70B/M70B, the program should be written to the program memory area as shown in Figure 1-1.

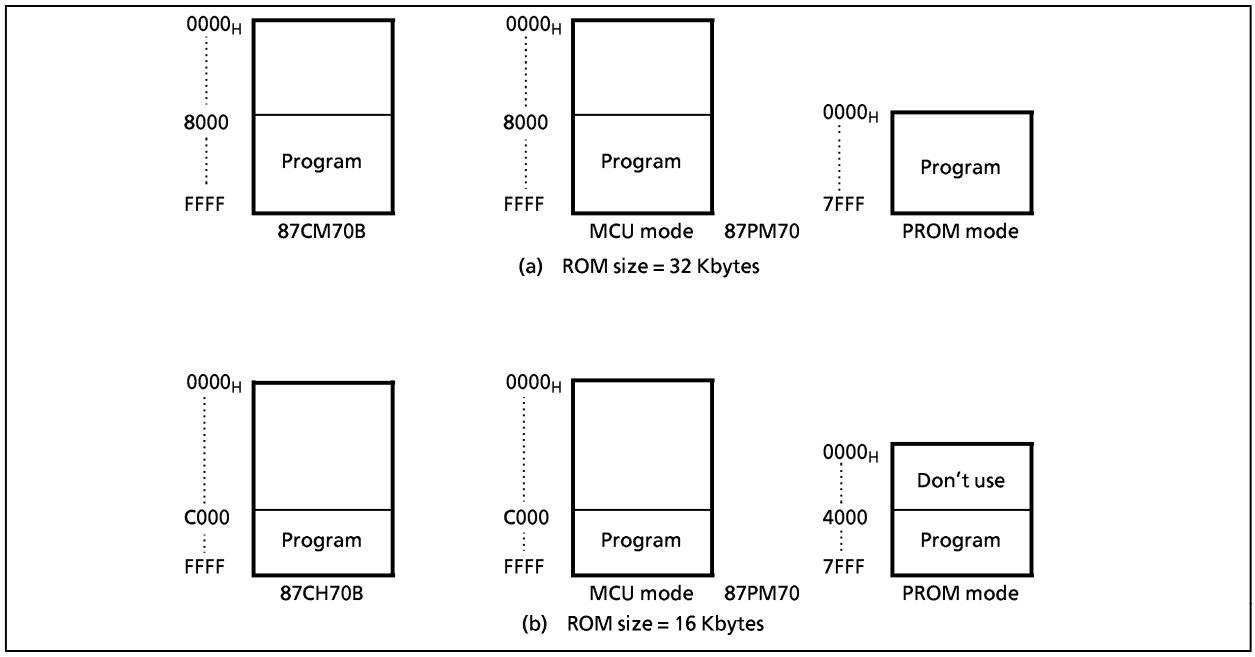


Figure 1-1. Program Memory Area

Electrical Characteristics

Absolute Maximum Ratings (V_{SS} = 0 V)

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V_{DD}		– 0.3 to 7	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, P4, P5, XOUT	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	P3	– 0.3 to 10	
	V_{OUT3}	Source open drain ports	V_{DD} – 40 to V_{DD} + 0.3	
Output Current (Per 1 pin)	I_{OUT1}	P0, P1, P2, P3, P4, P5	3.2	mA
	I_{OUT3}	P8, P9 (segment output)	– 12	
	I_{OUT4}	P6, P7 (digit output)	– 25	
Output Current (Total)	ΣI_{OUT1}	P0, P1, P2, P3, P4, P5	120	mA
	ΣI_{OUT2}	P6, P7, P8, P9	– 120	
Power Dissipation [Topr = 70°C]	PD		350	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}		NORMAL1, 2 modes	4.5	6.0	V
			IDLE1, 2 modes			
			SLOW mode	2.7		
			SLEEP mode			
			STOP mode	2.0		
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		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: Power supply voltage V_{DD}: At fc = 8 MHz, fs = 32.768 kHz

Note 3: Input Voltage V_{IH3} V_{IL3}; In SLOW, SLEEP or STOP 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}	Port P4 with pull-down		30	70	150	kΩ
	R_{IN2}	$\overline{RESET}$		100	220	450	
Pull-down Resistance	R_K	Source open drain ports	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	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_{OH2}	Tri-state ports	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	V
	V_{OH3}	P8, P9	V_{DD} = 4.5 V, I_{OH} = – 5 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}	P6, P7	V_{DD} = 4.5 V, V_{OH} = 2.4 V	–	– 15	–	mA
Supply Current in NORMAL 1, 2 modes	I_{DD}		V_{DD} = 5.5 V fc = 8 MHz fs = 32.768 kHz V_{IN} = 5.3 V / 0.2 V	–	12	18	mA
Supply Current in IDLE 1, 2 modes				–	4.5	6	
Supply Current in SLOW mode			V_{DD} = 3.0 V fs = 32.768 kHz V_{IN} = 2.8 V / 0.2 V	–	30	60	μA
Supply Current in SLEEP mode				–	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-upor pull-down) is contained.

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

A/D Conversion Characteristics

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Analog Input Voltage Range	V_{AIN}	CIN5 to CIN0		V_{SS}	–	V_{DD}	V
Conversion Error			V_{DD} = 5.0 V	–	–	± 1.5	LSB

A.C. Characteristics

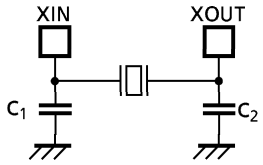
(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL1, 2 modes	0.5	–	10	μs
		In 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), 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}					

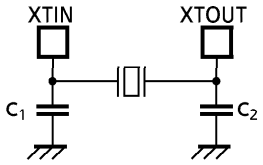
Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 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	30 pF	30 pF
		4 MHz	KYOCERA	KBR4.0MS		
			MURATA	CSA4.00MG		
	Crystal Oscillator	8 MHz	TOYOCOM	210B 8.0000	20 pF	20 pF
		4 MHz	TOYOCOM	204B 4.0000		
Low-frequency Oscillation	Crystal Oscillator	32.768 kHz	NDK	MX-38T	15 pF	15 pF



(1) High-frequency Oscillation



(2) Low-frequency Oscillation

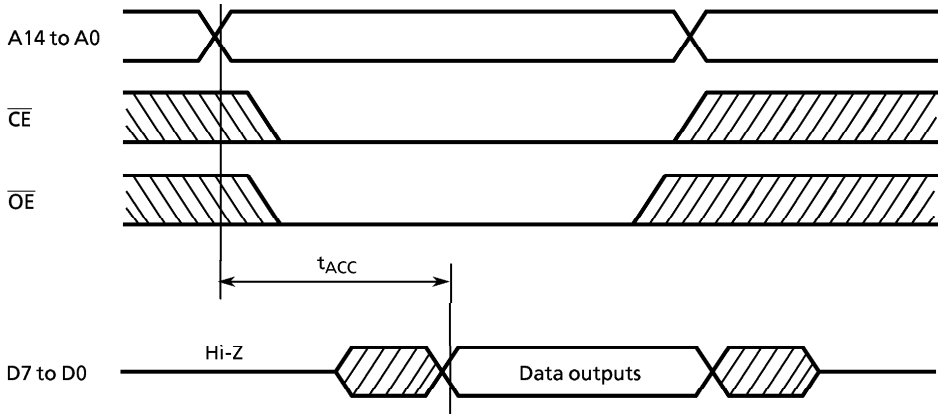
Note: An electrical shield by metal shield plate on the surface of the IC package should be recommendable in order to prevent the device from the high electric fieldstress applied for continuous reliable operation.

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

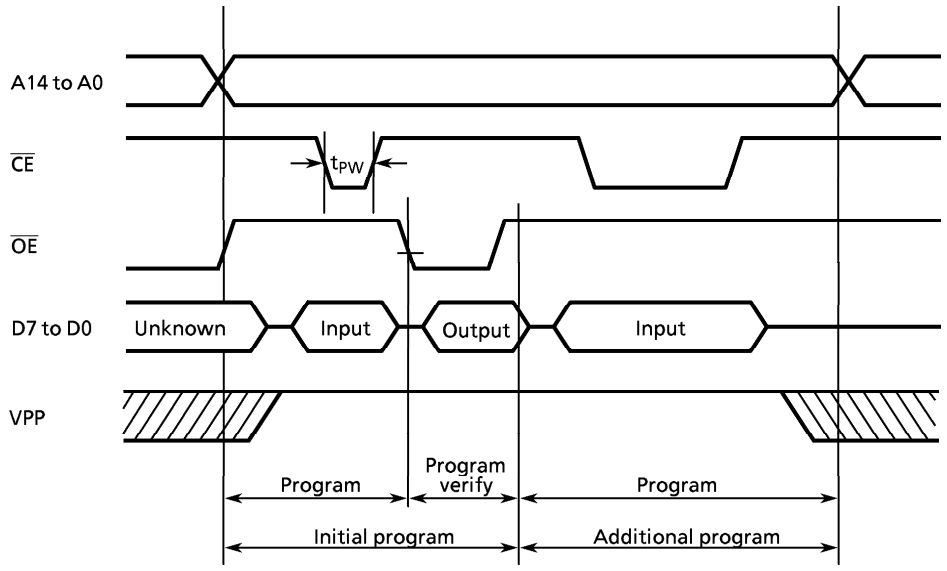
Note: tcyc = 500 ns at 8 MHz



Timing Waveforms of Read Operation

(2) Program Operation (High-Speed program mode- Ⅰ) (Topr = 25 ± 5°C)

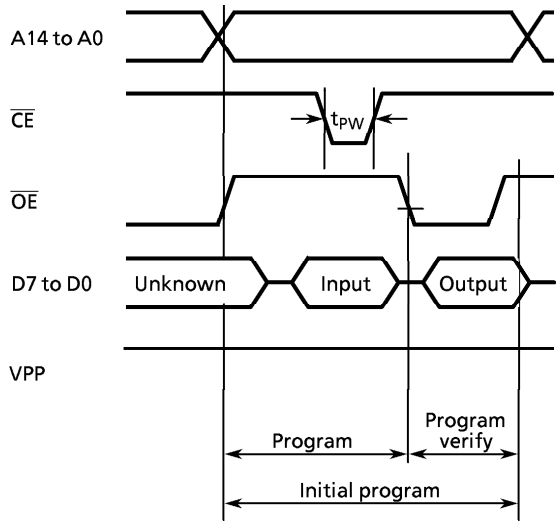
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		5.75	6.0	6.25	V
Program Power Supply Voltage	V_{PP}		12.0	12.5	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.0 V ± 0.25 V V_{PP} = 12.5 ± 0.5 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 (12.5 V ± 0.5 V) to the V_{pp} pin as the device is damaged.
Note3: 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.

(3) Program Operation (High-Speed program 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 ± 0.25 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 (12.5 V ± 0.5 V) to the V_{pp} pin as the device is damaged.
Note3: 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.