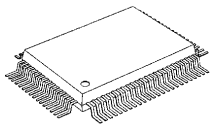
CMOS 8-Bit Microcontroller

TMP87PP71F

The TMP87PP71 is a One-Time PROM microcontroller with low-power 384 K bits (48 Kbytes) electrically programmable read only memory for the TMP87CM71/N71/P71 system evaluation. The TMP87PP71 is pin compatible with the TMP87CM/71/N71/P71. The operations possible with the TMP87CM71/N71/P71 can be performed by writing programs to PROM. The TMP87PP71 can write and verify in the same way as the TC571000D using an adaptor socket BM11107 and an EPROM programmer.

Part No.	OTP	RAM	Package	Adapter Socket
TMP87PP71F	48 K × 8-bit	1.5 K × 8-bit	P-QFP80-1420-0.80B	BM11107

P-QFP80-1420-0.80B

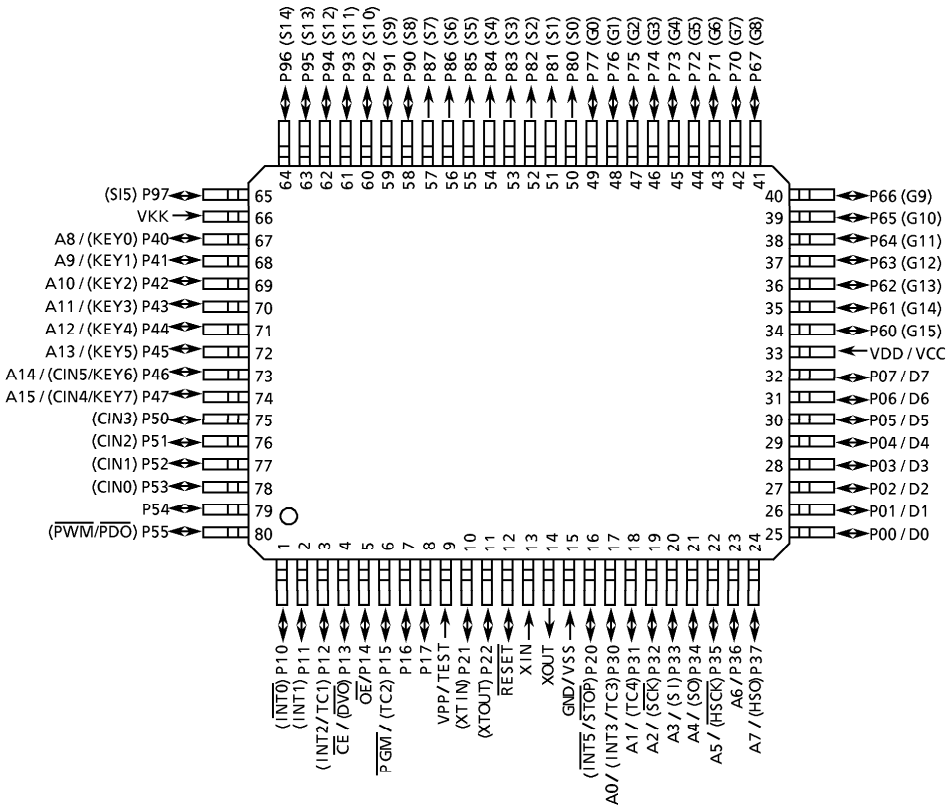


TMP87PP71F

000707EBA1

Pin Assignments (Top View)

P-QFP80-1420-0.80B



Pin Function

The TMP87PP71 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the TMP87PP71 is pin compatible with the TMP87CM71/N71/P71 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input / Output	Functions	Pin Name (MCU mode)
A15 to A8	Input	PROM address inputs	P47 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
$\overline{PGM}$		Program control input (active low)	P15
VPP	Power supply	+ 12.75 V / 5 V (Program supply voltage)	TEST
VCC		+ 6.25 V / 5 V	VDD
GND		0 V	VSS
P55 to P51	I/O	Pull-down with resistance for input processing	
P11		PROM mode setting pin. Be fixed at high level.	
P21			
P50			
P17, P16		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 TMP87PP71 hardware configuration and operation. The configuration and functions of the TMP87PP71 are the same as those of the TMP87CM71/N71/P71, except in that a one-time PROM is used instead of an on-chip mask ROM.

The TMP87PP71 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 TMP87PP71 has two modes: MCU and PROM.

1.1 MCU Mode

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

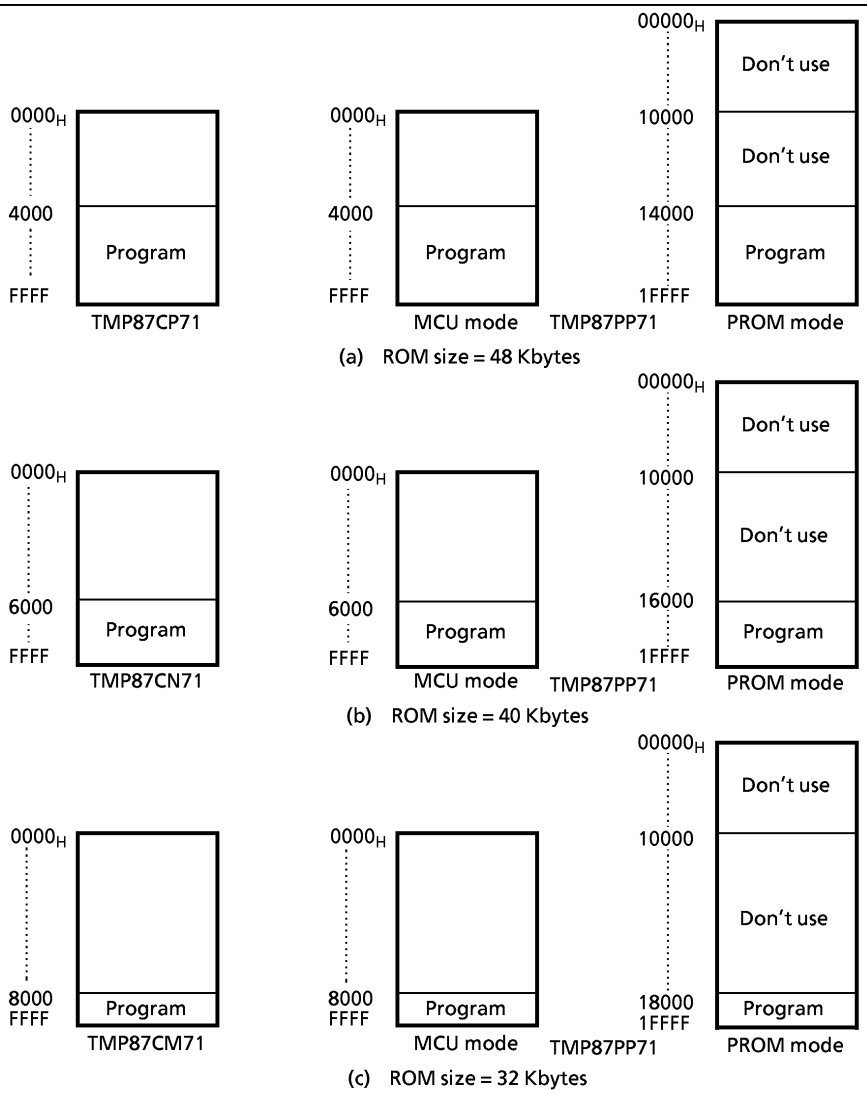
In the MCU mode, operation is the same as with the TMP87CM71/N71/P71 (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The TMP87PP71 has a 48K × 8-bit (addresses 4000_H to $FFFF_H$ in the MCU mode, addresses 14000_H to $1FFFF_H$ in the PROM mode) of program memory (OTP).

To use the TMP87PP71 as the system evaluation for the TMP87CM71/N71/P71/S71, the program should be written to the program memory area as shown in Figure 1-1.

Note: When accessing addresses 00000H to 13FFFH of program memory in the PROM mode, blank, read or verify mode may not be guaranteed the operation; use addresses 14000H to 1FFFFH.



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

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 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, XOUT	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	Source open drain pin	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_{OU4}	P6, P7 ports (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} = 0V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions		Min	Max	Unit
Supply Voltage	V_{DD}		fc = 8 MHz	NORMAL1, 2 mode	4.5	5.5	V
				IDLE1, 2 modes			
			fc = 4.2 MHz	NORMAL1, 2 mode	2.7		
				IDLE1, 2 mode			
			fs = 32.768 kHz	SLOW mode			
				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	VDD = 4.5 to 5.5V		0.4	8.0	MHz
			VDD = 2.7 to 5.5V			4.2	
	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 NORMAL1/2 mode and IDLE1/2 mode.

DC 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 ports	V_{DD} = 5.5 V, V_{OUT} = – 30 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	20	mA
Supply Current in IDLE 1, 2 modes				–	6	10	
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 AD conversion is 1.2 mA.

AD Conversion Characteristics

(V_{SS} = 0 V, V_{DD} = 2.7 / 4.5 to 5.5 V, Topr = – 30 to 70°C)

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

AC Characteristics

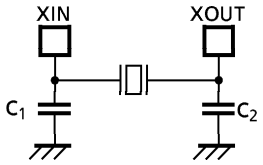
(V_{SS} = 0 V, V_{DD} = 2.7 / 4.5 to 5.5 V, Topr = – 30 to 70°C)

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

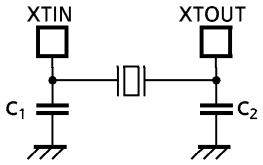
Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 2.7/4.5 to 5.5 V, Topr = – 30 to 70°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		
Low-frequency Oscillation	Crystal Oscillator	32.768 kHz	NDK	MX-38T	15pF	15pF



(1) High-frequency Oscillation



(2) Low-frequency Oscillation

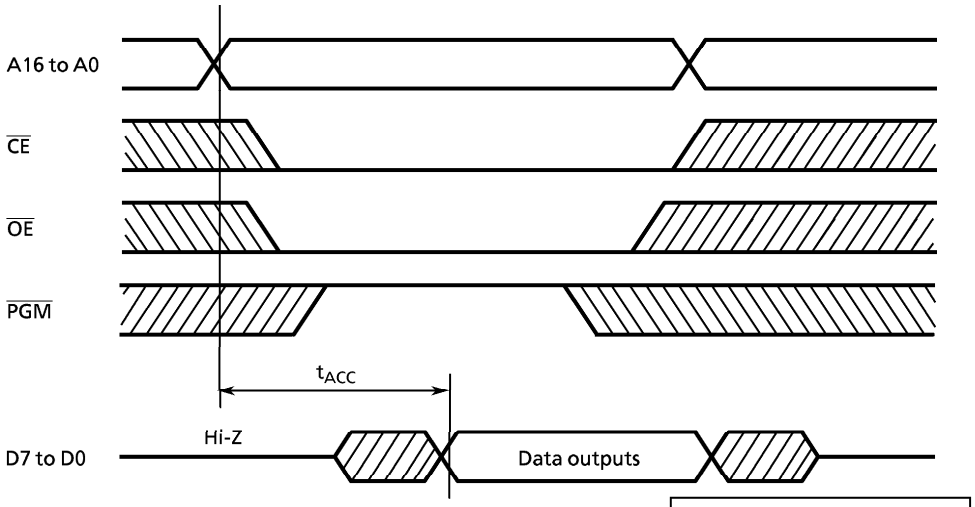
Note: An electrical shield by metal shield plate on the surface of the IC package should be recommendable in order to prevent the device from the high electric fieldstress applied for continuous reliable operation.

DC/AC 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

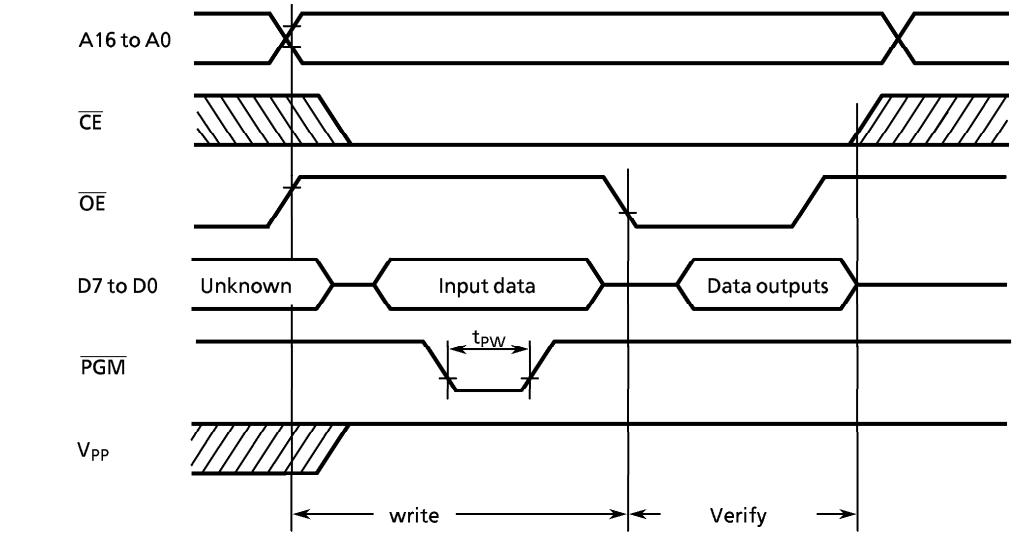


Note: tcyc = 500 ns at 8 MHz

(2) Program Operation (High-Speed program mode) (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}		6.00	6.25	6.5	V
Program Power Supply Voltage	V_{PP}		12.5	12.75	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.25 V V_{PP} = 12.75 ± 0.25	0.095	0.1	0.105	ms

High-Speed Programing Timing



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 = V) to the V_{pp} pin as the device is damaged.
Note3: Do not apply the parameter of program voltage (more than + 13 V) including overshoot to the V_{pp} pin.
Note4: 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.