CMOS 8-Bit Microcontroller

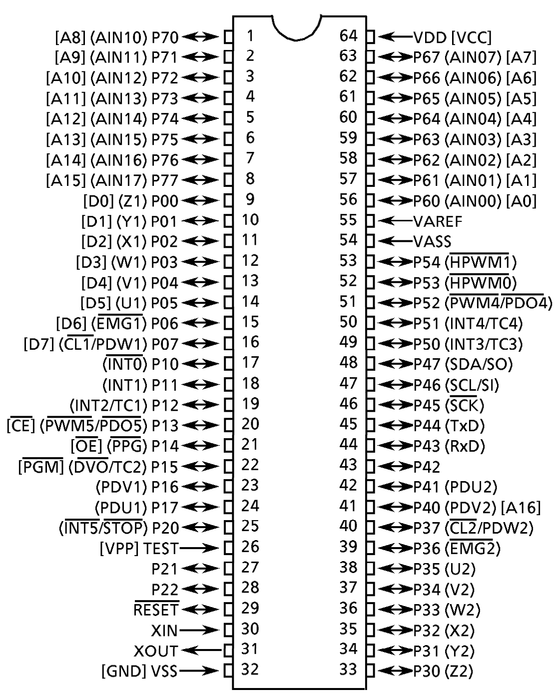
TMP88PS49N, TMP88PS49F

The TMP88PS49 is a One-Time PROM microcontroller with low-power 514 Kbits (64 Kbytes + 256 bytes) electrically programmable read only memory for the TMP88CK49/CM49 system evaluation. The TMP88PS49 is pin compatible with the TMP88CK49/CM49/CS48A/CK48/CM48. The operations possible with the TMP88CK49/CM49/CS48A/CK48/CM48 can be performed by writing programs to PROM. However, when it is used as TMP88CK48/CM48 please do not use the second Programmable motor driver (PMD2), Timer / Counter 5 (TC5), Timer / Counter 6 (TC6) and High-speed PWM (HPWM1), and as TMP88CS48A please do not use the second Programmable motor driver (PMD2). The TMP88PS49 can write and verify in the same way as the TC571000 using an adaptor socket BM11110A/BM11111A and an EPROM programmer.

Part No.	OTP	RAM	Package	Adaptor Soket
TMP88PS49N	64 Kbytes + 256 bytes	2 Kbytes	P-SDIP64-750-1.78	BM11110A
TMP88PS49F			P-QFP64-1420-1.00A	BM11111A

Pin Assignments (Top View)

P-SDIP64-750-1.78



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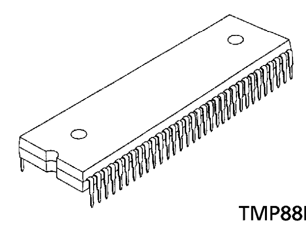
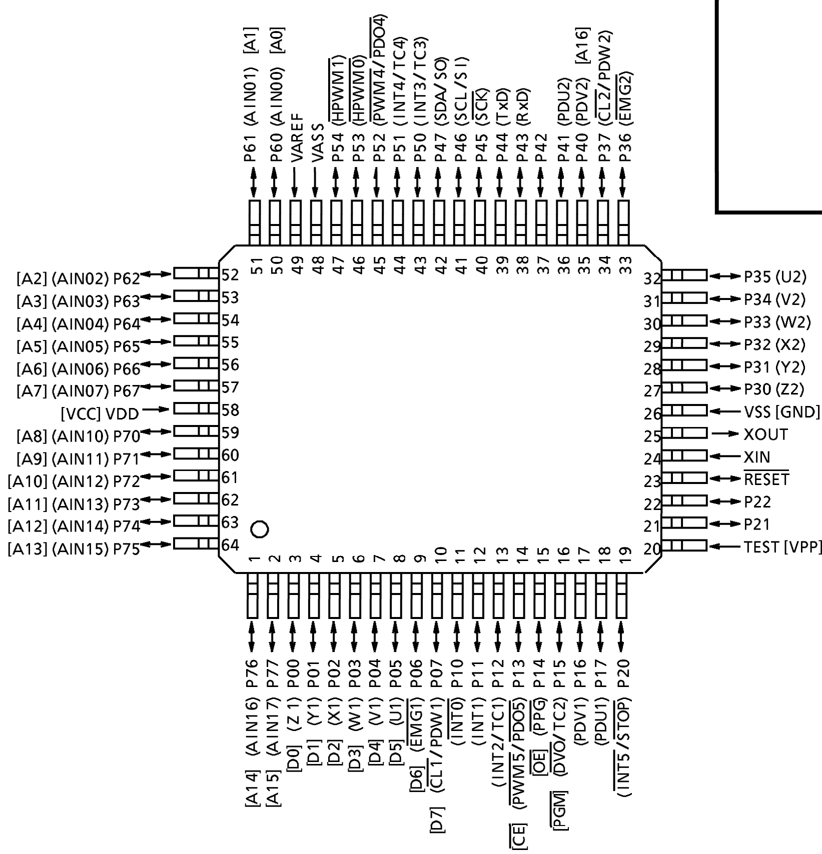


TMP88PS49N

980910EBP1

Pin Assignments (Top View)

P-QFP64-1420-1.00A



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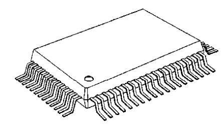


TMP88PS49F

Pin Function

The TMP88PS49 has two modes: MCU and PROM.

(1) MCU mode
In this mode, the TMP88PS49 is pin compatible with the TMP88CK49/CM49/CS48A/CK48/CM48 (fix the TEST pin at "L" level).

(2) PROM mode

Pin Name (PROM mode)	Input / Output	Functions	Pin Name (MCU mode)
A16	Input	PROM address inputs	P40
A15 to A8			P77 to P70
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
$\overline{PGM}$		Program enable signal input	P15
VPP	Power suppluy	+ 12.75 V/5 V (Program supply voltage)	TEST
VCC		+ 6.25 V/5 V	VDD
GND		0 V	VSS
P37 to P30	I/O	Pull-up with resistance for input processing	
P47 to P41			
P54 to P50			
P11		PROM mode setting pin. Be fixed at "H" level.	
P21			
P12 , P10		PROM mode setting pin. Be fixed at "L" level.	
P17 to P16			
P22 , P20			
$\overline{RESET}$			
XIN	Input	Connect an 16 MHz oscillator to stabilize the internal state.	
XOUT	Output		
VAREF	Power Suppluy	0 V (GND)	
VASS			

Operational Description

The following explains the TMP88PS49 hardware configuration and operation. The configuration and functions of the TMP88PS49 are the same as those of the TMP88CK49/CM49/CS48A/CK48/CM48, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. Operating Mode

The TMP88PS49 has two modes: MCU and PROM.

1.1 MCU mode

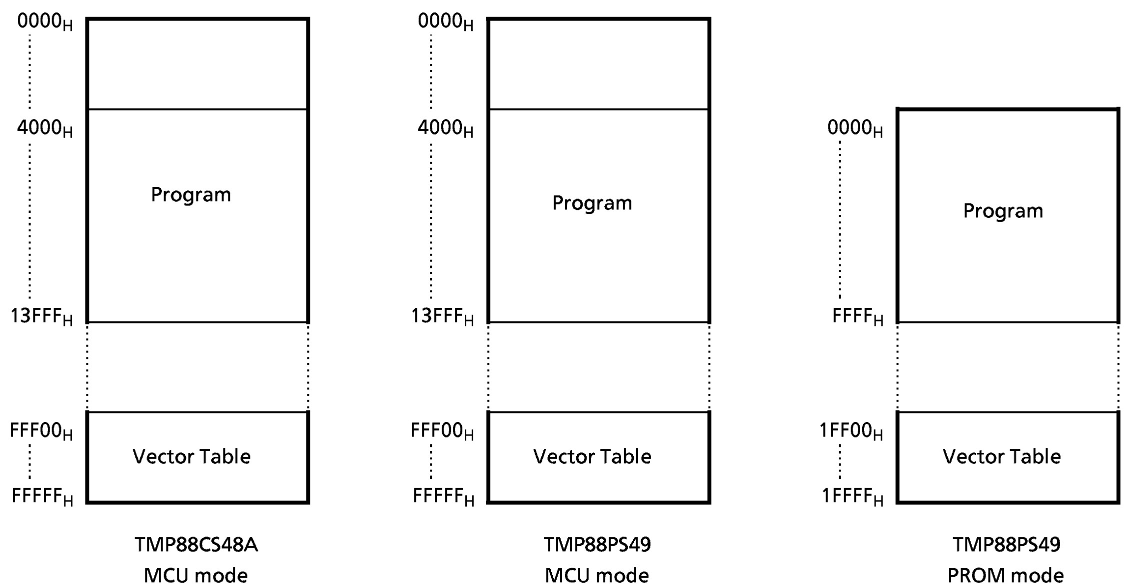
The MCU mode is activated by fixing the TEST/VPP pin at "L" level.

In the MCU mode, operation is the same as with the TMP88CK49/CM49/CS48A/CK48/CM48 (the TEST/VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The TMP88PS49 has a 64 Kbytes (addresses 4000_H to $13FFF_H$ in the MCU mode, addresses 0000_H to $FFFF_H$ in the PROM mode) and 256 bytes (addresses $FFF00_H$ to $FFFFF_H$ in the MCU mode, addresses $1FF00_H$ to $1FFFF_H$ in the PROM mode) of program memory (OTP).

If using TMP88PS49 for system evaluation of TMP88CK49/CM49/CS48A/CK48/CM48, write the program to the program memory area shown in figure 1-1.



(a) ROM size = 64 Kbytes

Figure 1-1. Program Memory Area (1/2)

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}	Port P21, P22, $\overline{RESET}$, Tri-state port	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	Port P20, Sink open drain port	– 0.3 to 5.5	
Output Current	I_{OUT1}	Ports P1, P2, P4, P5, P6, P7	3.2	mA
	I_{OUT2}	Port P0	20	
	I_{OUT3}	Port P3	30	
Output Current	ΣI_{OUT1}	Ports P1, P2, P4, P5, P6, P7	120	mA
	ΣI_{OUT2}	Port P0	60	
	ΣI_{OUT3}	Port P3	120	
Power Dissipation [Topr = 70°C]	PD	TMP88PS49N	600	mW
		TMP88PS49F	350	
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 40 to 85	°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 Opeating Conditions (V_{SS} = 0 V, Topr = – 40 to 85°C)

Parameter	Symbol	Pins	Conditions		Min	Max	Unit
Supply Voltage	V_{DD}		fc = 16 MHz	NORMAL mode	4.5	5.5	V
				IDLE 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	V_{DD} = 4.5 to 5.5 V		8.0	16.0	MHz

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.

DC Characteristics (V_{SS} = 0 V, Topr = – 40 to 85°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}	Sink open drain, Tri-state ports					
	I_{IN3}	$\overline{\text{RESET}}$, $\overline{\text{STOP}}$					
Input Resistor (*)	R_{IN}	$\overline{\text{RESET}}$		90	220	510	kΩ
Output Leakage Current	I_{OL}	Sink open drain, Tri-state ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V/0 V	–	–	± 2	μA
Output High Voltage	V_{OH}	Tri-state ports	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	V
Output Low Current	I_{OL1}	Except XOUT, Ports P0, P3.	V_{DD} = 4.5 V, V_{OL} = 0.4 V	–	1.6	–	mA
	I_{OL2}	Port P0	V_{DD} = 4.5 V, V_{OL} = 1.0 V	6	10	–	
	I_{OL3}	Port P3		–	20	–	
Supply Current in NORMAL Mode			V_{DD} = 5.5 V V_{IN} = 5.3 V/0.2 V fc = 16.0 MHz	–	32	40	mA
Supply Current in IDLE Mode				–	24	30	mA
Supply Current in STOP Mode			V_{DD} = 5.5 V V_{IN} = 5.3 V/0.2 V	–	0.5	20	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 registor is not included, when the input resistor (pull-up or pull-down) is contained.
Note 3: IDD except I_{REF}.

AD Conversion Characteristics (Topr = – 40 to 85°C)

Parameter	Symbol	Conditions	Min	Typ.	Max			Unit
					ADCDR1	ADCDR2		
						ACK = 0	ACK = 1	
Analog Reference Voltage	V_{AREF}	$V_{AREF} - V_{ASS} \geqq 3.5$ V	V_{DD} – 1.0	—	V_{DD}			V
	V_{ASS}		V_{SS}	—	1.0			
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
Non-Linearity Error		V_{DD} = 5.0 V, V_{SS} = 0.0 V V_{AREF} = 5.000 V V_{ASS} = 0.000 V	—	—	± 1	± 3	± 2	LSB
Zero Point Error			—	—	± 1	± 3	± 2	
Full Scale Error			—	—	± 1	± 3	± 2	
Total Error			—	—	± 2	± 6	± 4	

Note 1: ADCDR1: 8-bit AD conversion result (1LSB = ΔV_{AREF}/256)
ADCDR2: 10-bit AD conversion result (1LSB = ΔV_{AREF}/1024)
Note 2: Total error includes all errors except quantization error.

AC Characteristics

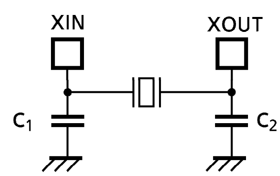
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 40 to 85°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	tcy	NORMAL mode	0.25	–	0.5	μs
		IDLE mode				
"H" Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input)	31.25	–	62.5	ns
"L" Level Clock Pulse Width	t_{WCL}					

Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 40 to 85°C)

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator	Recommended Constant	
				C_1	C_2
High-frequency Oscillation	Ceramic Resonator	16 MHz	MURATA CSA 16.00 MXZ	5 pF	5 pF
			MURATA CST 16.00 MXZ	built-in 5 pF	built-in 5 pF



High-frequency Oscillation

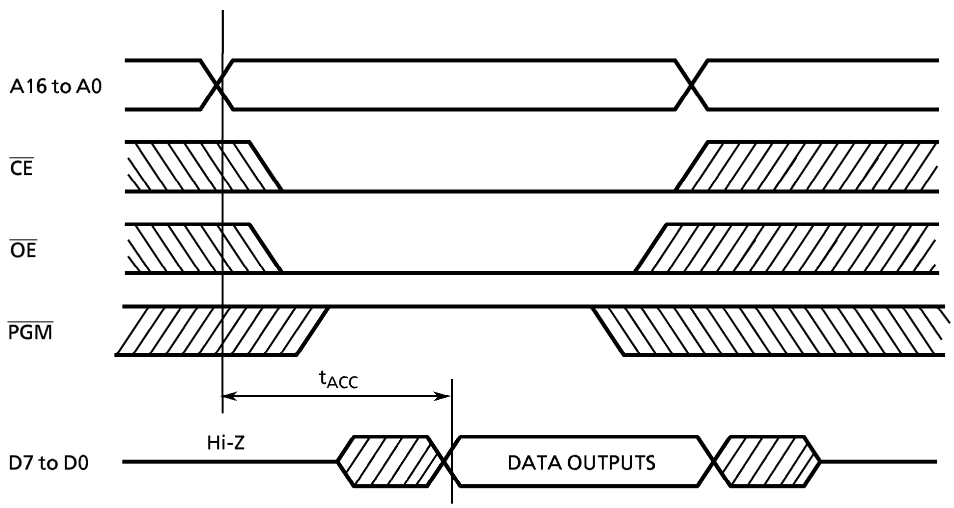
Note: An electrical shield by metal shield on the surface of IC package should be recommendable in order to prevent the device from the high electric fieldstress applied from CRT (Cathode Ray Tube) for continuous reliable operation.

DC/AC Characteristics (PROM mode) (V_{SS} = 0 V, Topr = – 30 to 70°C)

(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	–	1.5tcyc + 300	–	ns

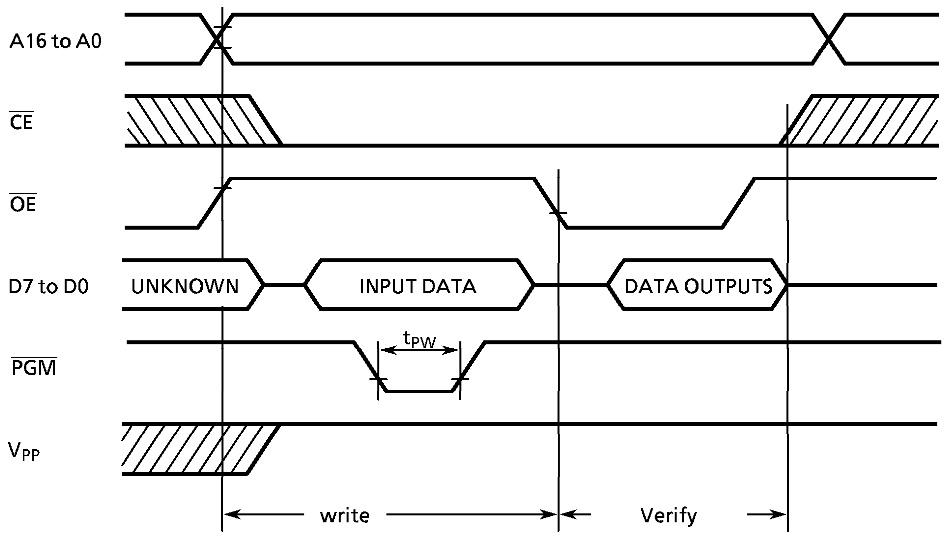
Note: tcyc = 250 ns at 16 MHz



(2) High-Speed Programming 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}		6.0	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} = 6.0 V	0.095	0.1	0.105	ms

High-Speed Programing Timing



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 (2.75 V ± 0.5 V = V) to the V_{pp} pin as the device is damaged.