

CMOS 8-Bit Microcontroller

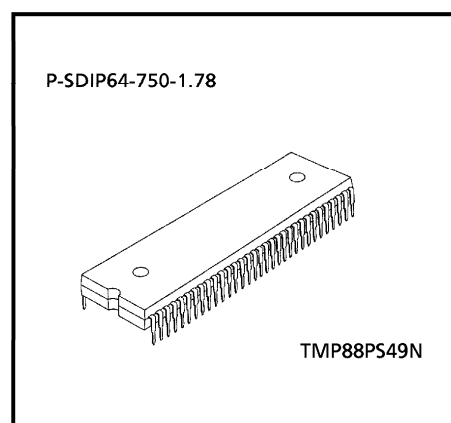
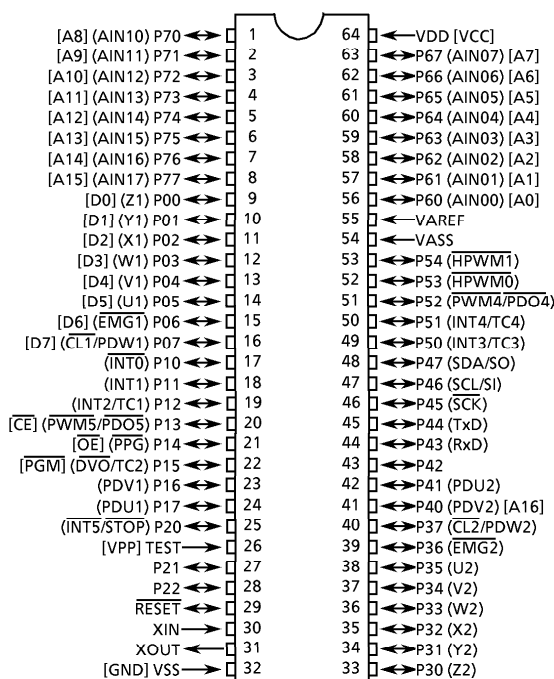
TMP88PS49N, TMP88PS49F

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 Scket
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

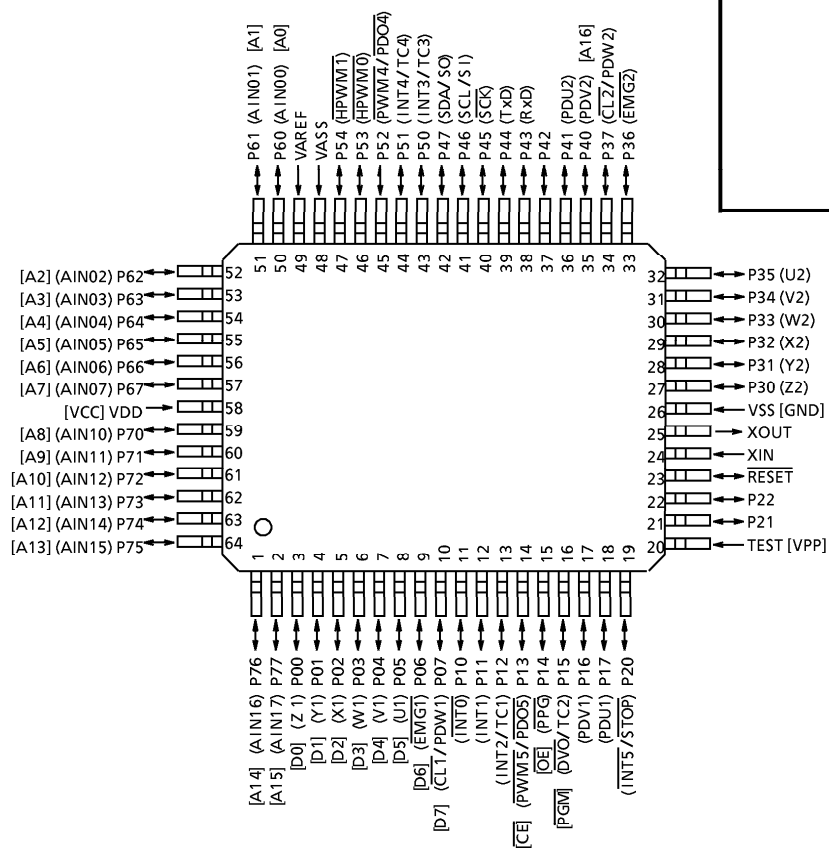


980910EBP1

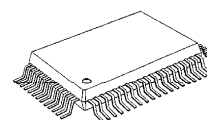
- For a discussion of how the reliability of microcontrollers can be predicted, please refer to Section 1.3 of the chapter entitled Quality and Reliability Assurance / Handling Precautions.
- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

Pin Assignments (Top View)

P-QFP64-1420-1.00A



P-QFP64-1420-1.00A



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	
$\overline{\text{CE}}$	Input	Chip enable signal input (active low)	P13	
$\overline{\text{OE}}$		Output enable signal input (active low)	P14	
$\overline{\text{PGM}}$		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	PROM mode setting pin. Be fixed at "H" level.	
P47 to P41				
P54 to P50				
P11		PROM mode setting pin. Be fixed at "L" level.		
P21				
P12 , P10				
P17 to P16				
P22 , P20				
$\overline{\text{RESET}}$				
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.

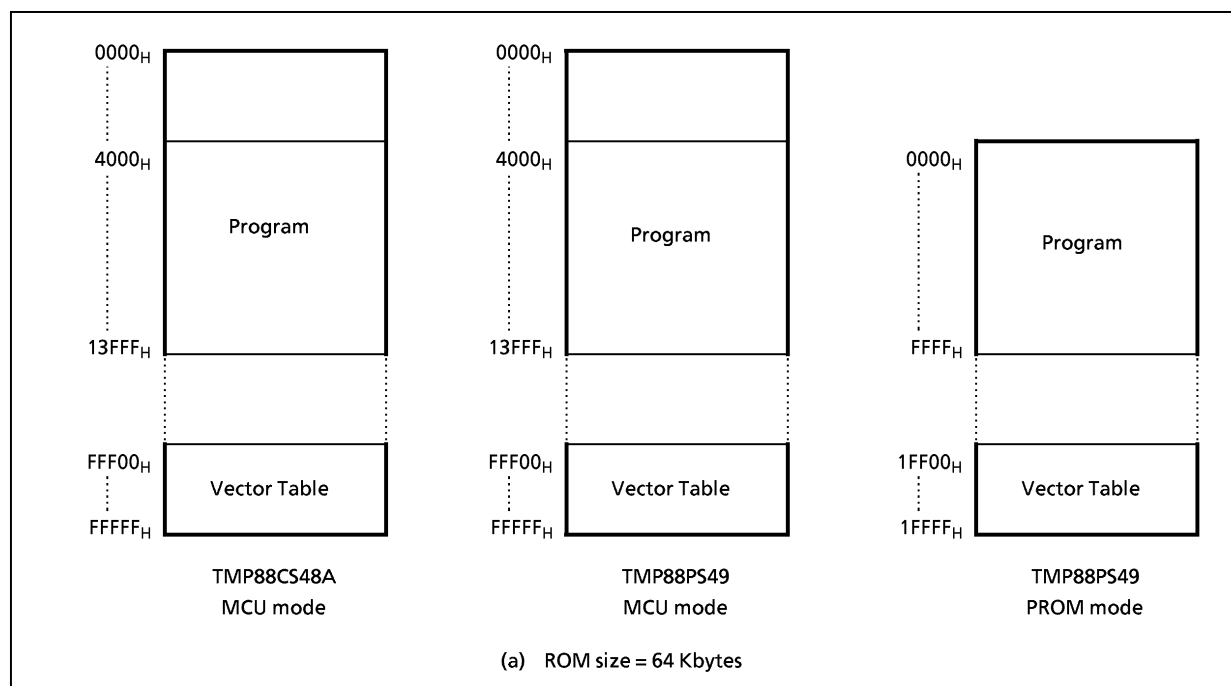


Figure 1-1. Program Memory Area (1/2)

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, 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	Σ I _{OUT1}	Ports P1, P2, P4, P5, P6, P7	120	mA
	Σ I _{OUT2}	Port P0	60	
	Σ I _{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 Operating Conditions

(V_{SS} = 0 V, Topr = – 40 to 85°C)

Parameter	Symbol	Pins	Conditions	Min	Max	Unit
Supply Voltage	V _{DD}		fc = 16 MHz	4.5	5.5	V
			NORMAL mode			
			IDLE mode	2.0		
Input High Voltage	V _{IH1}	Except hysteresis input	V _{DD} ≥ 4.5 V	V _{DD} × 0.70	V _{DD}	V
	V _{IH2}	Hysteresis input		V _{DD} × 0.75		
	V _{IH3}		V _{DD} < 4.5 V	V _{DD} × 0.90		
Input Low Voltage	V _{IL1}	Except hysteresis input	V _{DD} ≥ 4.5 V	0	V _{DD} × 0.30	V
	V _{IL2}	Hysteresis input			V _{DD} × 0.25	
	V _{IL3}		V _{DD} < 4.5 V		V _{DD} × 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, T_{opr} = – 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}	RESET, STOP					
Input Resistor (*)	R _{IN}	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 f _C = 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 T_{opr} = 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 or pull-down) is contained.Note 3: I_{DD} except I_{REF}.

AD Conversion Characteristics

(T_{opr} = – 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} ≥ 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

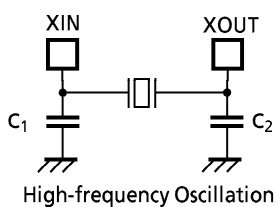
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, T_{opr} = – 40 to 85°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t _{cy}	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, T_{opr} = – 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



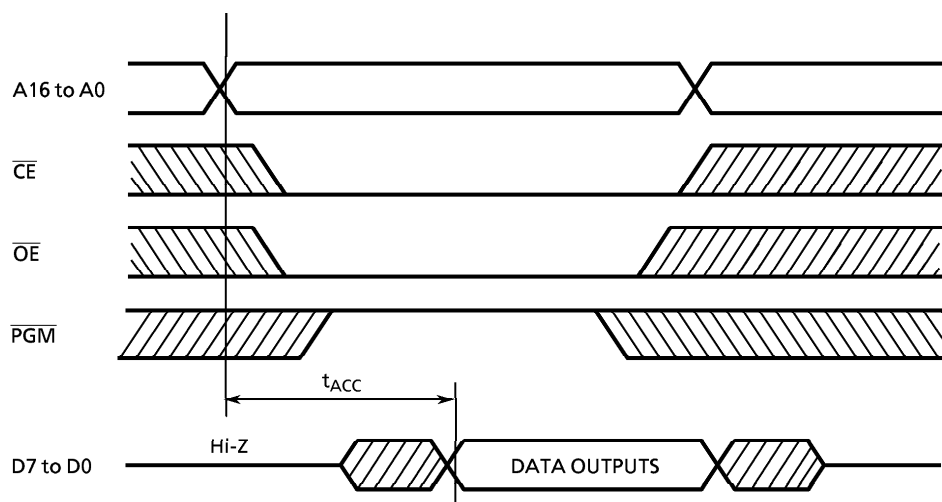
Note: An electrical shield by metal shield on the surface of IC package should be recommendable in order to prevent the device from the high electric fieldstress applied from CRT (Cathode Ray Tube) for continuous reliable operation.

DC/AC Characteristics (PROM mode)

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

(1) Read Operation

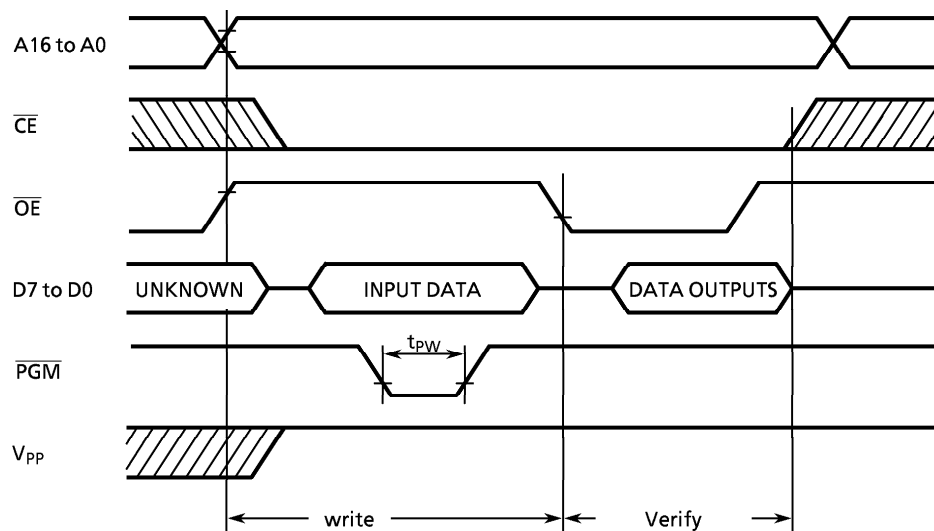
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		4.75	5.0	5.25	V
Program Power Supply Voltage	V_{PP}					
Address Access Time	t_{ACC}	$V_{CC} = 5.0 \pm 0.25\text{ V}$	–	$1.5t_{cyc} + 300$	–	ns

Note: $t_{cyc} = 250\text{ ns}$ 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}	$V_{CC} = 6.0\text{ V}$	0.095	0.1	0.105	ms

High-Speed Programming 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 ($2.75\text{ V} \pm 0.5\text{ V} = V$) to the V_{pp} pin as the device is damaged.