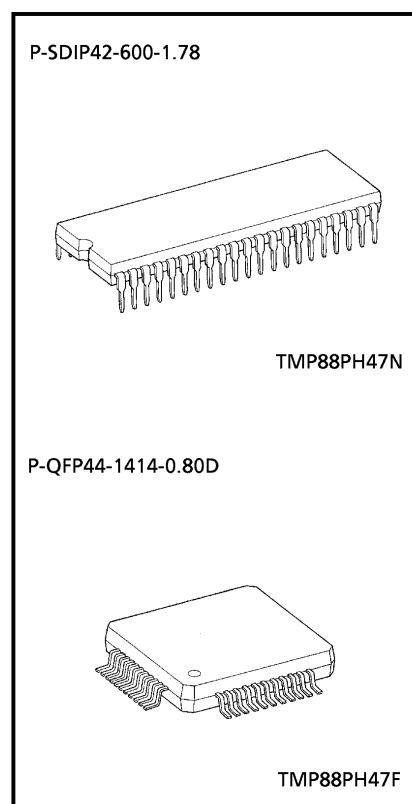


CMOS 8-Bit Microcontroller

TMP88PH47N, TMP88PH47F

The 88PH47 is a One-Time PROM microcontroller with low-power 514 Kbits (16 Kbytes + 256 bytes) electrically programmable read only memory for the 88CH47 system evaluation. The 88PH47 is pin compatible with the 88CH47. The operations possible with the 88CH47 can be performed by writing programs to PROM. The 88PH47 can write and verify in the same way as the TC571000 using an adaptor socket and an EPROM programmer.

Part No.	OTP	RAM	Package	Adaptor Soket
TMP88PH47N	16 Kbytes	512 Kbytes	P-SDIP42-600-1.78	BM11167
TMP88PH47F			P-QFP44-144-0.80D	BM11168

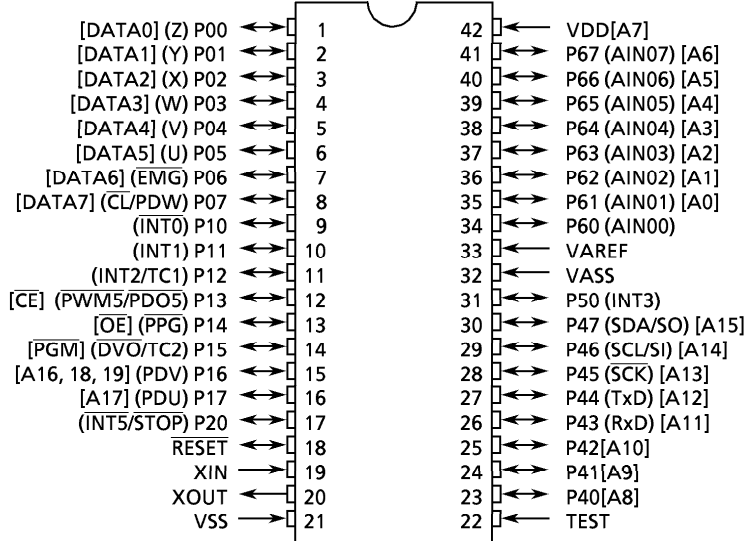


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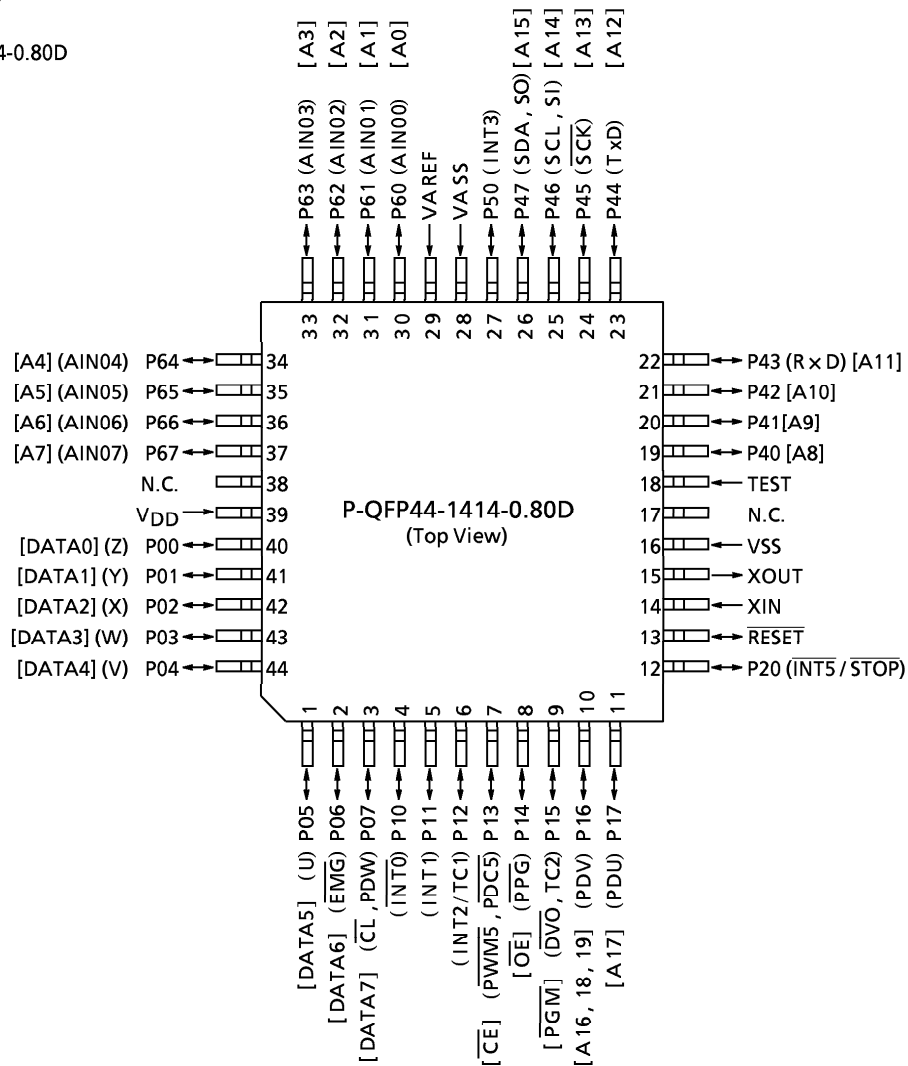
Pin Assignments (Top View)

P-SDIP42-600-1.78



TMP88PH47F

P-QFP44-1414-0.80D



Pin Function

The 88PH47 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 88PH47 is pin compatible with the 88CH47 (fix the TEST pin at "L" level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin Name (MCU mode)
A17	Input	PROM address inputs	P17
A16, A18, A19			P16
A15 to A8			P47 to P40
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 supply	+ 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.	
P12, P10			
P20			
\overline{RESET}			
XIN	Input	Connect an 16 MHz oscillator to stabilize the internal state.	
XOUT	Output		
VAREF	Power Supply	0 V (GND)	
VASS			

Operational Description

The following explains the 88PH47 hardware configuration and operation. The configuration and functions of the 88PH47 are the same as those of the 88CH47, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. OPERATING MODE

The 88PH47 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 88CH47 (the TEST/VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The 88PH47 has a 16K bytes (addresses 4000_H to 07FFF_H in the MCU mode, addresses 0000_H to 3FFF_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 88PH47 for system evaluation of 88CH47, write the program to the program storage area shown in Figure 1-1.

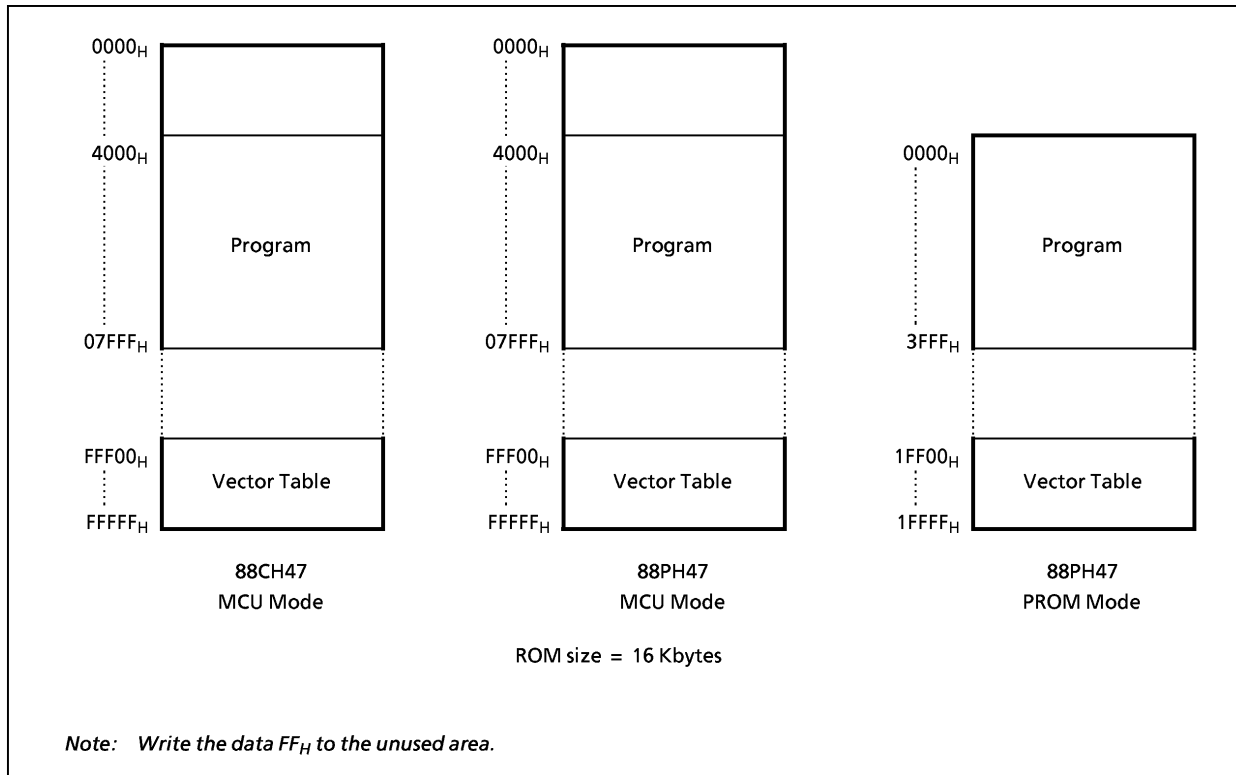


Figure 1-1. Program Memory Area

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}	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	V
Output Current	I_{OUT1}	Ports P1, P2, P4, P5, P6	3.2	mA
	I_{OUT2}	Port P0	20	
	I_{OUT3}	Port P3	30	
Output Current	ΣI_{OUT1}	Ports P1, P2, P4, P5, P6	120	mA
	ΣI_{OUT2}	Port P0	60	
Power Dissipation [$T_{opr} = 70^{\circ}\text{C}$]	PD	TMP88PH47N	600	mW
		TMP88PH47F	350	
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}		- 40 to 85	$^{\circ}\text{C}$

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

 $(V_{SS} = 0\text{ V}, T_{opr} = -40\text{ to }85^{\circ}\text{C})$

Parameter	Symbol	Pins	Conditions	Min	Max	Unit	
Supply Voltage	V_{DD}		$f_c =$ 16 MHz	NORMAL mode	4.5	5.5	V
				IDLE mode			
				STOP mode	2.0		
Input High Voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geq 4.5\text{ V}$	$V_{DD} \times 0.70$	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	$V_{DD} = 4.5\text{ to }5.5\text{ V}$	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 f_c : The condition of supply voltage range is the value in NORMAL and IDLE modes.

D.C. 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}	TEST with pull-down		20	70	170	kΩ
	R _{IN}	RESET		90	220	510	
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	-	
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

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)

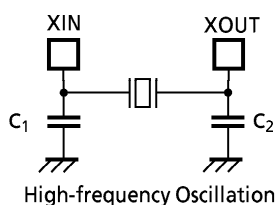
Note 2: Total error includes all errors except quantization error.

A.C. 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	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, 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 CSA16.00MXZ	5pF	5pF
			MURATA CST16.00MXW	built-in 5pF	built-in 5pF



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.

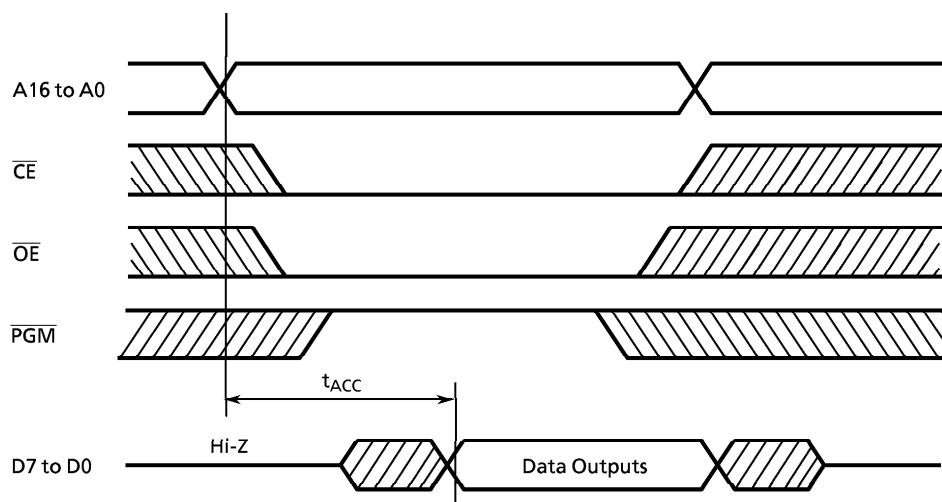
D.C./A.C. Characteristics (PROM mode)

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

(1) Read Operation

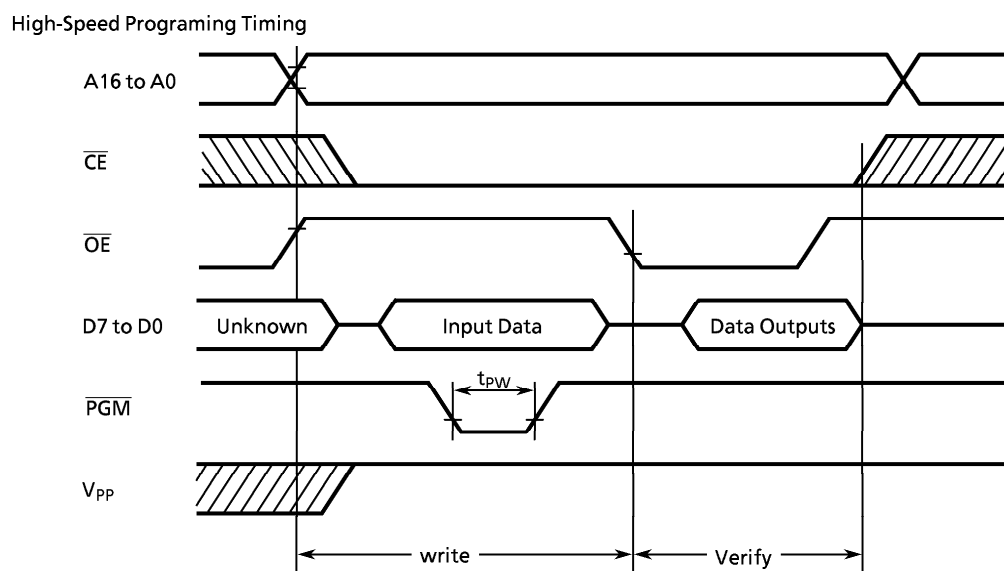
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		4.75	5.0	5.25	V
Program Power Supply Voltage	V_{PP}					V
Address Access Time	t_{ACC}	$V_{CC} = 5.0 \pm 0.25\text{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

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



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.