CMOS 8-Bit Microcontroller

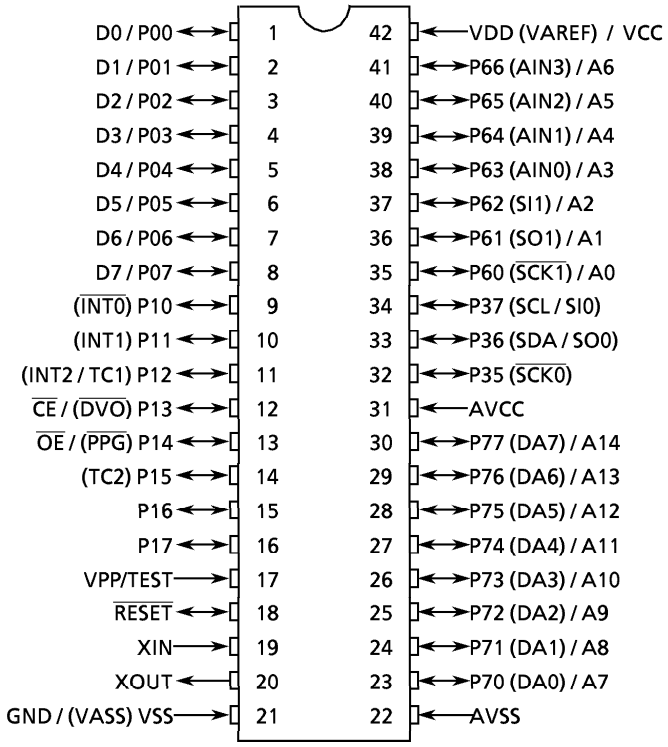
TMP87P844N

The 87P844 are a One-Time PROM microcontroller with low-power 64K bits (8 Kbytes) electrically programmable read only memory for the 87C444/844 system evaluation. The 87P844 is pin compatible with the 87C444/844. The operations possible with the 87C444/844 can be performed by writing programs to PROM. The 87P844 can write and verify in the same way as the TMM27256AD using an adaptor socket BM11108 and an EPROM programmer.

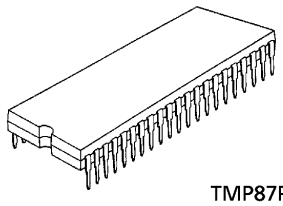
Part No	OTP	RAM	Package	Adaptor socket
TMP87P844N	8 K × 8-bit	256 × 8-bit	P-SDIP42-600-1.78	BM11108

Pin Assignments (Top View)

P-SDIP42-600-1.78



P-SDIP42-600-1.78



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Pin Function

The 87P844 have two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87P844 is pin compatible with the 87C844/444 and the 87P844 are pin compatible with the 87C844/444 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin Name (MCU mode)
A14 ~ A7	Input	PROM address inputs	P76 to P70
A6 ~ A0			P67 to P60
D7 ~ 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
P11	I/O	PROM mode setting pins. Be fixed at high level.	
P36			
P12			
P10		PROM mode setting pins. Be fixed at low level.	
P17 ~ P15			
P37 , P35			
RESET			
XIN	Input	Connect an 8 MHz oscillator to stabilize the internal state.	
XOUT	Output		
AVCC	Power Supply	+ 5 V	
AVSS		0 V (GND)	

OPERATIONAL DESCRIPTION

The following explains the 87P844 hardware configuration and operation. The configuration and functions of the 87P844 are the same as those of the 87C444/844, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. OPERATING MODE

The 87P844 have 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 87C444/844 (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The 87P844 have a 8K × 8-bit (addresses $E000_H$-$FFFF_H$ in the MCU mode, addresses 6000_H-$7FFF_H$ in the PROM mode) of program memory (OTP).
To use the 87P844 as the system evaluation for the 87C444/844, the program should be written to the program memory area as shown in Figure 1-1.

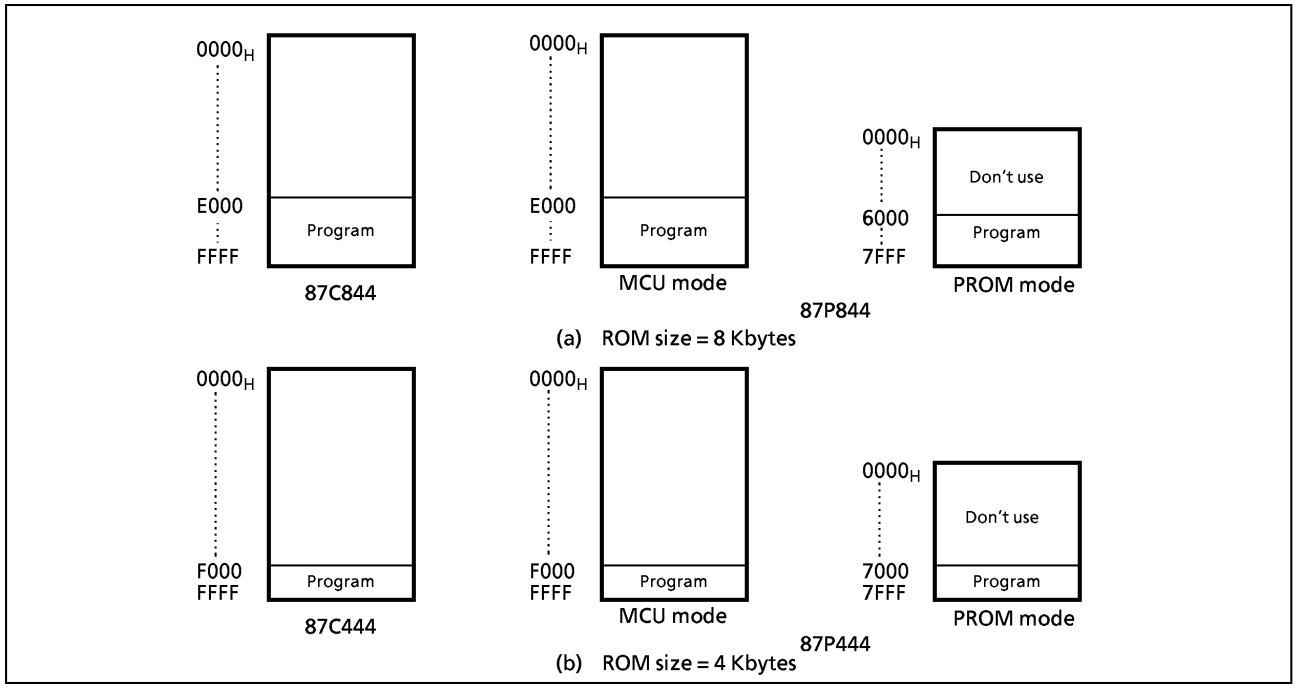


Figure 1-1. Program Memory Area

Note: Either write the data FFH to the unused area or set the PROM programmer to access only the program storage 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}	Except sink open drain pin, but include $\overline{RESET}$	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	Sink open drain pin except $\overline{RESET}$	– 0.3 to 5.5	
Output Current (Per 1 pin)	I_{OUT1}	Ports P0, P1, P3, P6, P7	3.2	mA
Output Current (Total)	ΣI_{OUT1}	Ports P0, P1, P3, P6, P7	120	mA
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	Tsld		260 (10s)	°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}		fc = 8 MHz	NORMAL mode	4.5	5.5	V
				IDLE mode			
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			$V_{DD} \times 0.75$		
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				$V_{DD} \times 0.25$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 to 5.5 V		1	8.0	MHz

Note: 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.

D.C. Characteristics

(V_{SS} = 0 V, T_{opr} = – 30 to 70°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 / 0V	–	–	± 2	μA
	I_{IN2}	Open drain ports and Tri-state ports					
	I_{IN3}	$\overline{RESET}$					
Input Resistance	R_{IN2}	$\overline{RESET}$		100	220	450	kΩ
	R_{IN3}	Port P7		4	6	10	
Output Leakage Current	I_{LO1}	Open drain ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	–	2	μA
	I_{LO2}	Tri-state ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V / 0 V	–	–	± 2	
Output High Voltage	V_{OH1}	Tri- state ports	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	V
	V_{OH2}	Port P7	V_{DD} = 4.5 V, I_{OH} = – 0.2 mA				
Output Low Voltage	V_{OL}	Except XOUT	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
Supply Current in NORMAL mode			V_{DD} = 5.5 V V_{IN} = 5.3 V / 0.2 V fc = 8 MHz	–	8	14	mA
Supply Current in IDLE mode				–	4	6	mA

Note 1: Typical values show those at T_{opr} = 25°C, V_{DD} = 5V.
Note 2: Input Current: I_{IN1}, I_{IN3} ; The current through pull-up or pull-down resistor is not included.
Note 3: I_{DD} does not include I_{AREF} / I_{DREF}.

A/D Conversion Characteristics

(Topr = – 30 to 70°C: V_{SS} = V_{ASS} = 0 V)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}	V_{DD} = V_{AREF}	4.5	–	5.5	V
Analog Input Voltage	V_{AIN}		V_{ASS}	–	V_{AREF}	V
Analog Supply Current	I_{AREF}		–	0.5	1.0	mA
Nonlinearity Error		V_{AREF} = V_{DD} = 5.000 V V_{ASS} = V_{SS} = 0.000 V	–	–	± 2	LSB
Zero point Error			–	–	± 2	
Full Scale Error			–	–	± 2	
Total Error			–	–	± 3	

D/A Conversion Characteristics

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

Parameter		Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage		A_{VCC}		4.5	–	V_{DD}	V
Current Dissipation		I_{DREF}	No Loading, All channel operating	–	–	25	mA
Resolution				–	–	8	bits
Accuracy	Nonlinearity Error		A_{VCC} = 5.000 V: A_{VSS} = 0.000 V	–	–	± 2.0	LSB
	Differential Nonlinearity Error		Monotonicity Guarantee (Note)	–	–	± 3/4	
Settling time		T_{SU}	Loading condition: c = 15 pF	–	–	20	ms
OP-Amp output Voltage Range		V_{AO}	No Loading	0.03	–	A_{VCC} – 0.25	V
			I_{AO} = 1.2 mA / I_{AO} = – 200 μA	0.3	–	A_{VCC} – 0.3	
OP-Amp output Drive Range		I_{AO}	A_{VCC} – 0.5 to 0.5V	–	+ 2/ – 1	–	mA
Maximum Capacitors connected to D/A output		C_{OL}		–	–	15	pF

Note: Differential nonlinearity error does not include quantizing error.

A.C. Characteristics

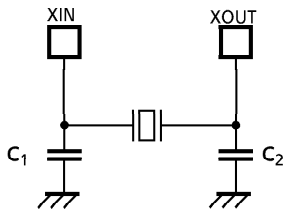
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, T_{opr} = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	tcy	In NORMAL mode	0.5	–	4	μs
		In NORMAL mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input) , fc = 8 MHz	62.5	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					

Recommended Oscillating Condition

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, T_{opr} = – 30 to 70°C)

Parameter	Oscillator	Frequency	Recommended Oscillator		Recommended Conditions	
					C_1	C_2
High-frequency	Ceramic Resonator	8 MHz	KYOCERA	KBR8.0M	30 pF	30 pF
	Crystal Oscillator	8 MHz	TOYOKOM	210B 8.0000	20 pF	20 pF



High-frequency

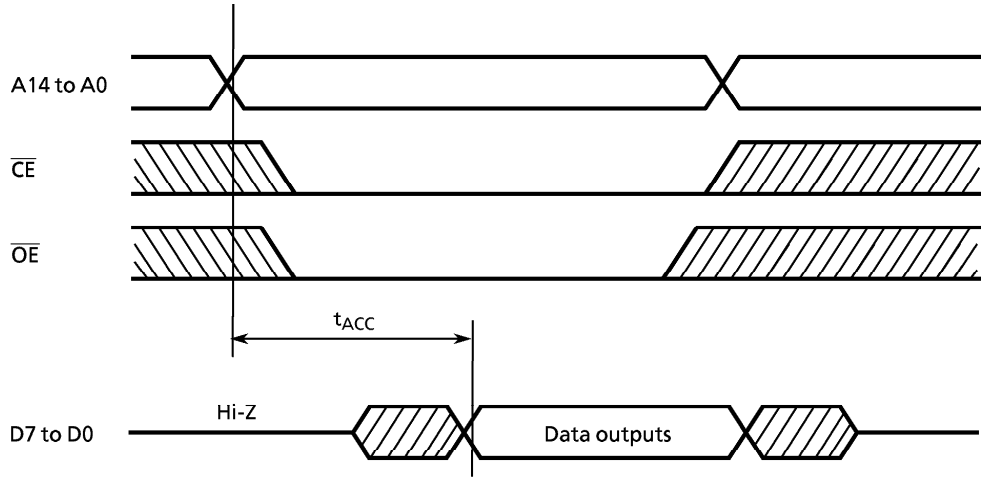
Note: To keep reliable operation, shield the device electrically with the metal plate on its package mold surface against the high electric field, for example, by CRT (Cathode Ray Tube).

D.C./A.C. Characteristics (PROM mode) (V_{SS} = 0 V)

(1) Read Operation

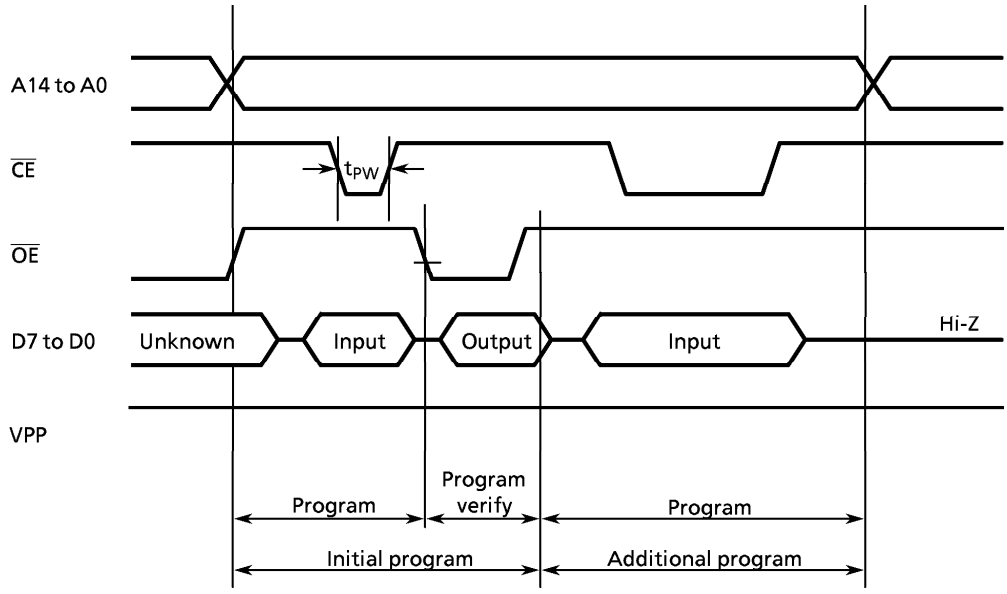
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		4.75	–	6.0	V
Program Power Supply Voltage	V_{PP}					
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	1.5tcyc + 300	–	ns

Note: tcyc = 500ns at 8MHz



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

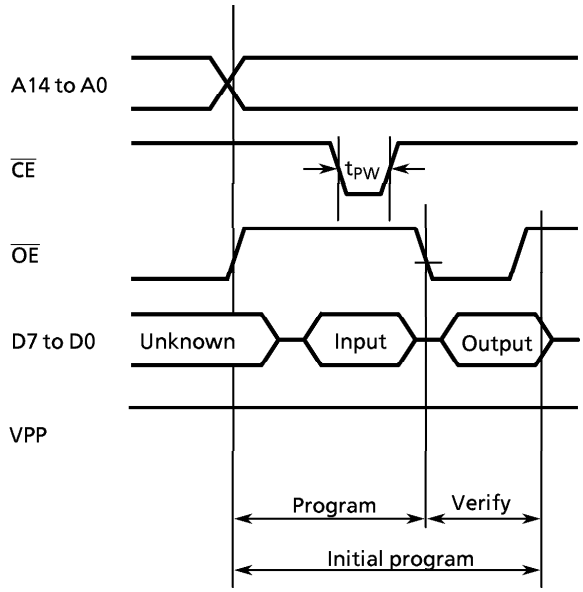
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		5.75	6.0	6.25	V
Program Power Supply Voltage	V_{PP}		12.0	12.5	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.0 V ± 0.25 V, V_{pp} = 12.5 V ± 0.5 V	0.95	1.0	1.05	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 decreased.
Note 2: 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.
Note 3: 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 write 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 V ± 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.
Note 2: 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.
Note 3: 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.