CMOS 8-BIT MICROCONTROLLER

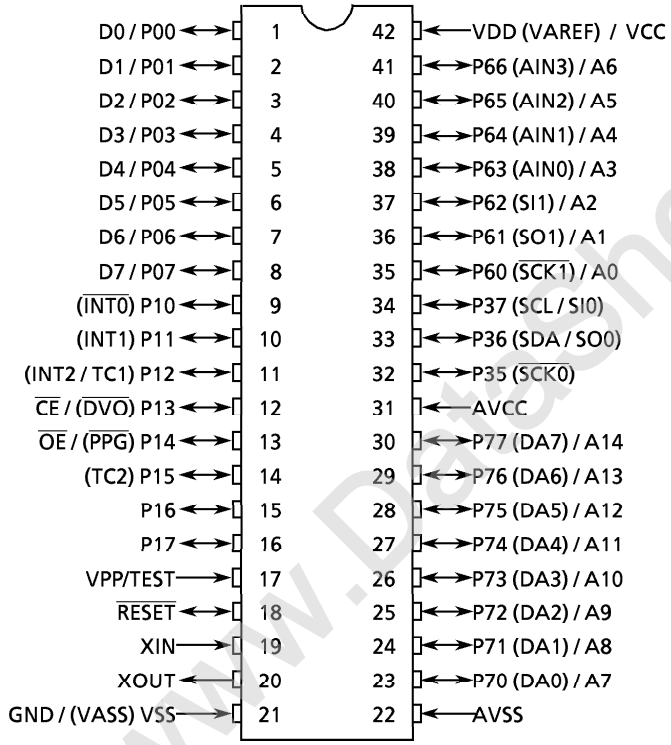
TMP87P844N

The 87P844 are a One-Time PROM microcontroller with low-power 64K bits (8K bytes) 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.

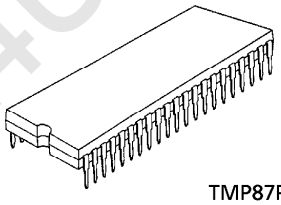
PART No	OTP	RAM	PACKAGE	Adaptor socket
TMP87P844N	8K × 8-bit	256 × 8-bit	SDIP42-P-600-1.78	BM11108

PIN ASSIGNMENTS (TOP VIEW)

SDIP42-P-600-1.78



SDIP42-P-600-1.78



TMP87P844N

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 ~ P70
A6 ~ A0			P67 ~ P60
D7 ~ D0	I/O	PROM data input/outputs	P07 ~ P00
$\overline{CE}$	Input	Chip enable signal input (active low)	P13
$\overline{OE}$		Output enable signal input (active low)	P14
VPP	Power supply	+ 12.5V / 5V (Program supply voltage)	TEST
VCC		+ 5V	VDD
GND		0V	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	+ 5V	
AVSS		0V (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.

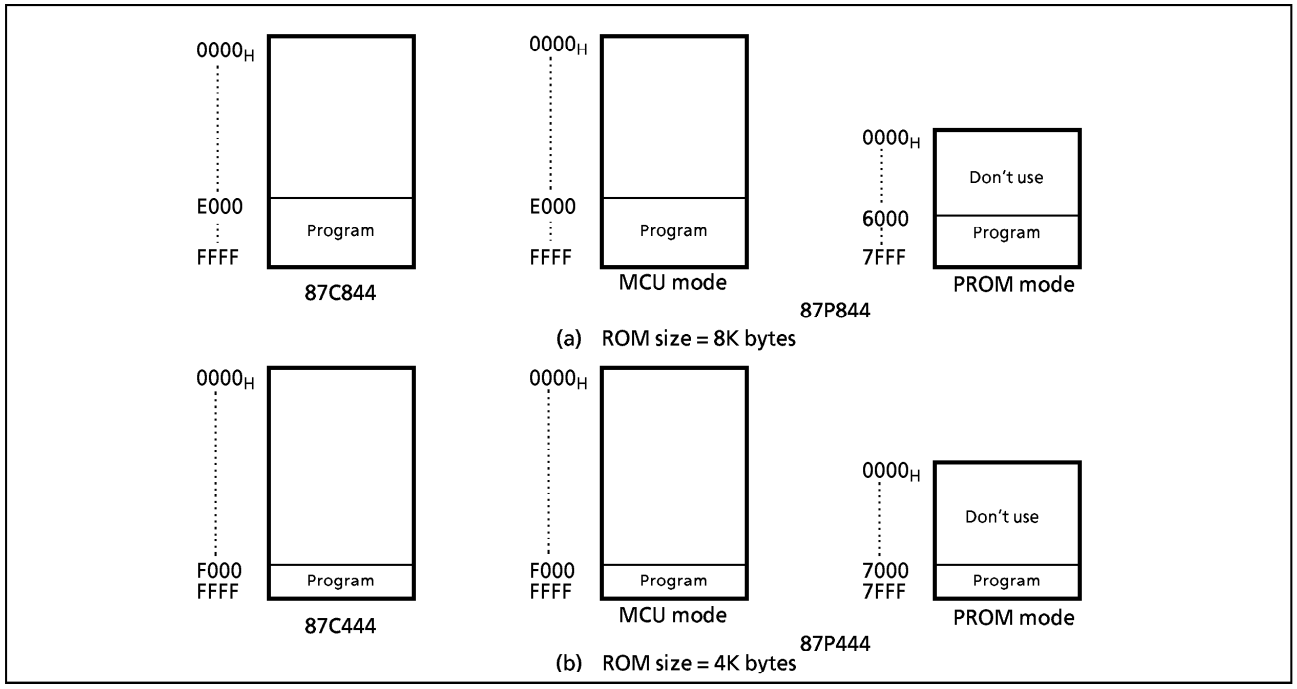


Figure 1-1. Program Memory Area

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

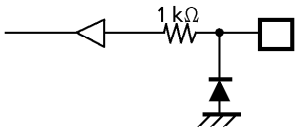
1.1.2 Data Memory

The 87P844 have an on-chip 256 × 8-bit data memory (static RAM).

1.1.3 Input/Output Circuitry

(1) Control pins

The control pins of the 87P844 are the same as those of the 87C444/844 except that the TEST pin has is no built-in pull-down resistance.



Note : TEST pin has no built-in pull-down resistance

Figure 1-2. TEST pin

(2) I/O ports

The I/O circuitries of 87P844 I/O ports the are the same I/O circuitries of the 87C444/844.

1.2 PROM mode

The PROM mode is activated by setting the TEST, $\overline{\text{RESET}}$ pin and the ports P17-P10, P37-P35 and P77 as shown in Figure 1-2. The PROM mode is used to write and verify programs with a general-purpose PROM programmer. The high-speed programming mode can be used for program operation.
The 87P844 are not supported an *electric signature* mode, so the ROM type must be set to TC57256AD.
Set the adaptor socket switch to "N".

Note : Please set the high-speed programming mode according to each manual of PROM programmer.

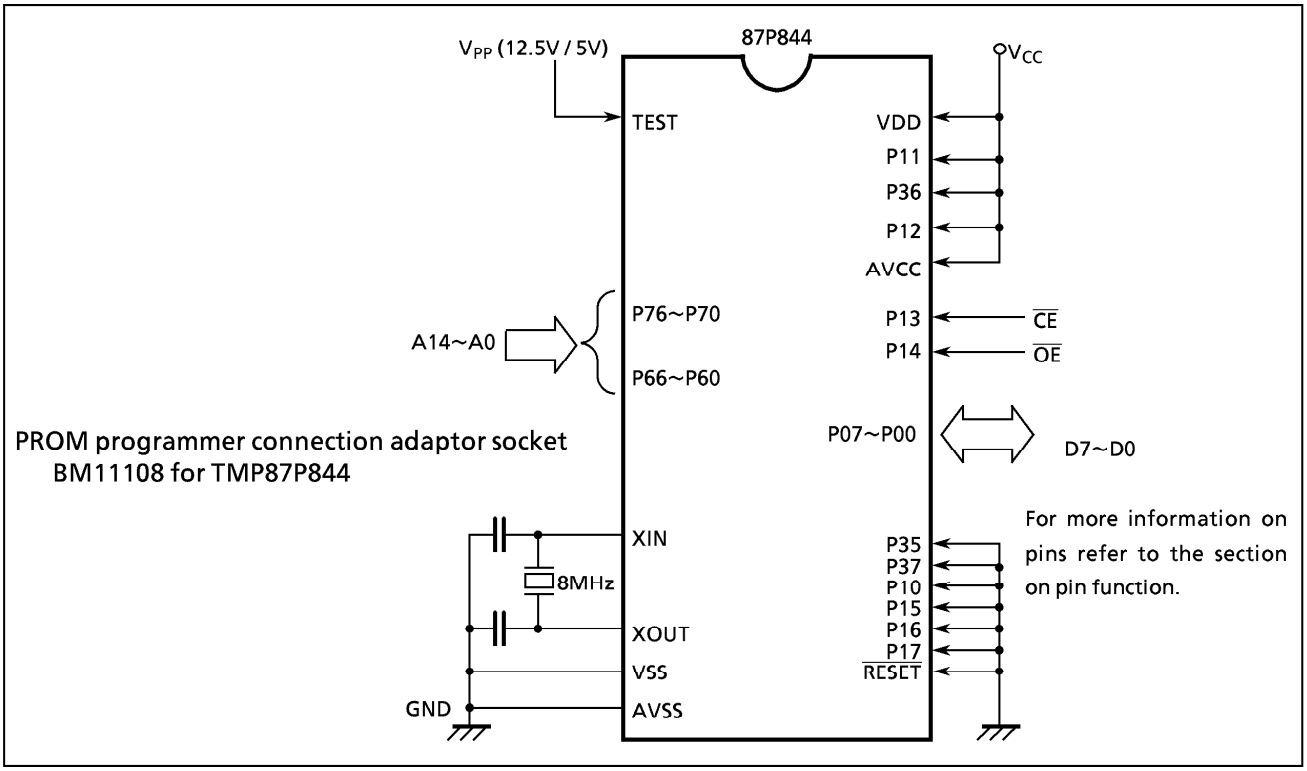


Figure 1-3. Setting for PROM Mode

1.2.1 Programming Flowchart (High-speed Programming Mode – I)

The high-speed programming mode is achieved by applying the program voltage (+ 12.5V) to the VPP pin when Vcc = 6V. After the address and input data are stable, the data is programmed by applying a single 1ms program pulse to the $\overline{CE}$ input. The programmed data is verified. If incorrect, another 1ms program pulse is applied and then the programmed data is verified. This process should be repeated (up to 25 times) until the program operates correctly. Programming for one address is ended by applying additional program pulse with width 3 times that needed for initial programming (number of programmed times × 1ms). After that, change the address and input data, and program as before. When programming has been completed, the data in all addresses should be verified with Vcc = Vpp = 5V.

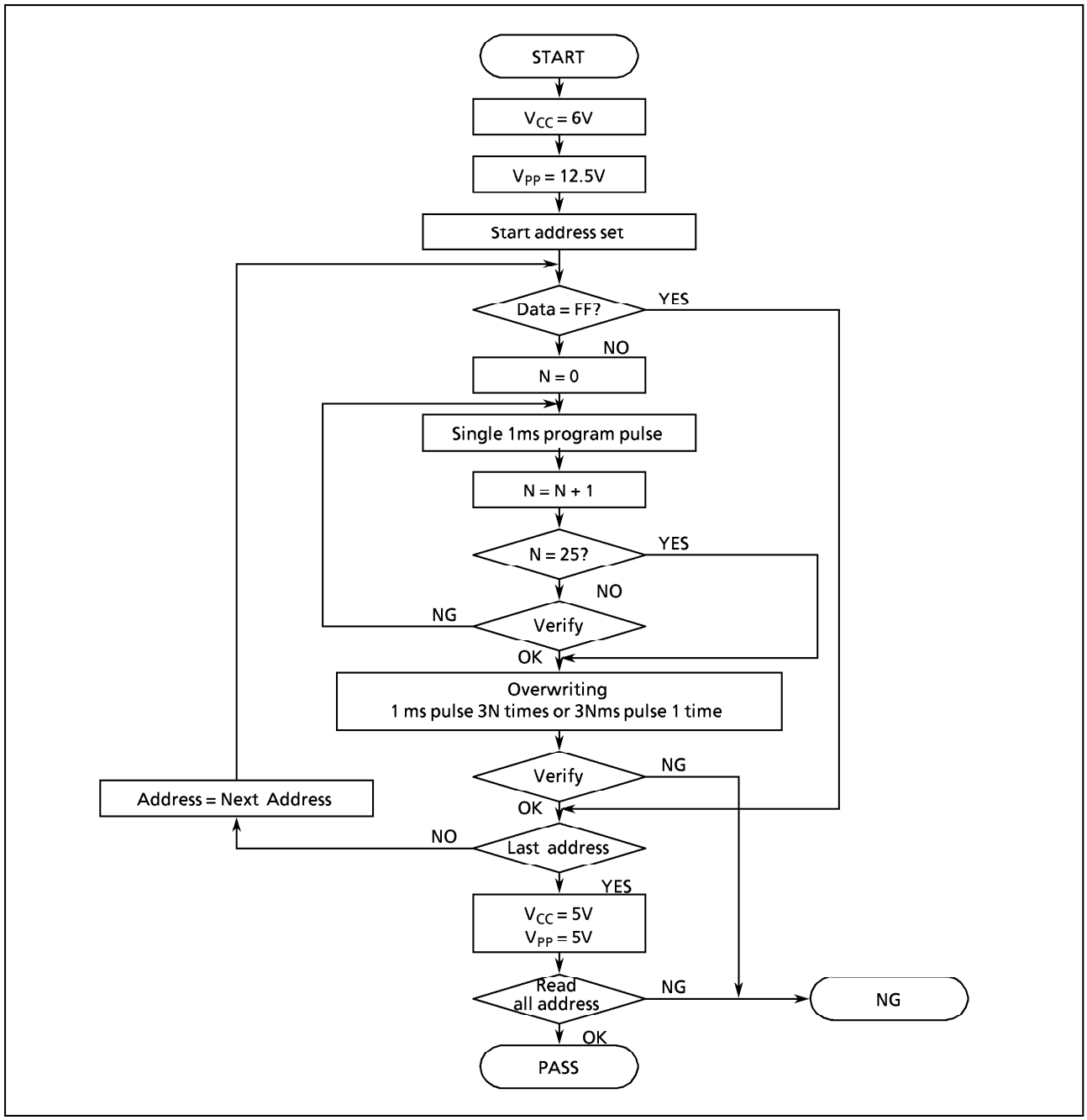


Figure 1-4. Flow Chart of High-speed Programming Mode - I

1.2.2 Programming Flowchart (High-speed Programming Mode-II)

The high-speed programming mode is achieved by applying the program voltage (+ 12.75 V) to the Vpp pin when Vcc = 6.25 V. After the address and input data are stable, the data is programmed by applying a single 0.1ms program pulse to the $\overline{CE}$ input. The programmed data is verified. If incorrect, another 0.1ms program pulse is applied and then the programmed data is verified. This process should be repeated (up to 25 times) until the program operates correctly. After that, change the address and input data, and program as before. When programming has been completed, the data in all addresses should be verified with Vcc = Vpp = 5 V.

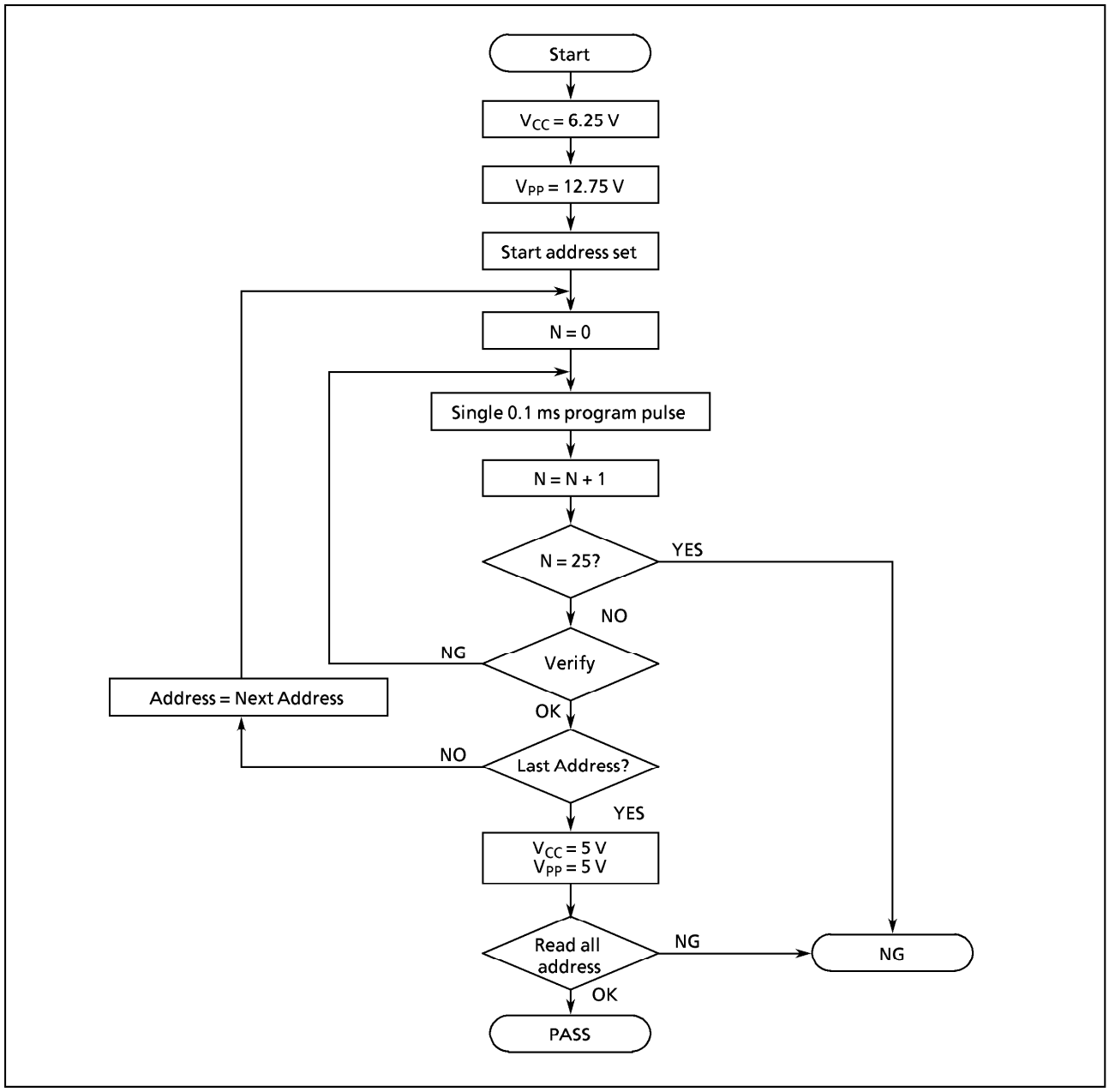


Figure 1-5. Flowchart of High-speed Programming Mode - II

1.2.3 Writing method for general-purpose PROM program

(1) Adapters
BM11108 : TMP87P844N

(2) Adapter setting
Switch (SW1) is set to side N.

(3) PROM programmer specifying
i) PROM type is specified to TC57256AD.
Writing voltage : 12.5 V (high-speed program I mode)
12.75 V (high-speed program II mode)

ii) Data transfer (copy) (note 1)
In TMP87P844, EPROM is within the addresses 6000 to 7FFFH. Data is required to be transferred (copied) to the addresses where it is possible to write. The program area in MCU mode and PROM mode is referred to "Program memory area" in figure 1-1.

Ex. In the block transfer (copy) mode, executed as below.
ROM capacity of 8KB : transferred addresses E000 to FFFFH to addresses 6000 to 7FFFH

iii) Writing address is specified. (note 1)
Start address : 6000H
End address : 7FFFH

(4) Writing
Writing/Verifying is required to be executed in accordance with PROM programmer operating procedure.

Note 1 : The specifying method is referred to the PROM programmer description. The data in addresses 0000 to 5FFFH must be specified to FFH.

Note 2 : When MCU is set to an adapter or the adapter is set to PROM programmer, a position of pin 1 must be adjusted. If the setting is reversed, MCU, the adapter and PROM program is damaged.

Note 3 : TMP87P844 does not support the electric signature mode (hereinafter referred to as "signature"). If the signature is used in PROM program, a device is damaged due to applying 12V ± 0.5V to the address pin 9 (A9). The signature must not be used.

ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS (V_{SS} = 0V)

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}	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	V
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 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 30 to 70	°C

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	NORMAL mode	4.5	5.5	V
				IDLE mode			
Input High Voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geqq 4.5V$		$V_{DD} \times 0.70$	V_{DD}	V
	V_{IH2}	Hysteresis input			$V_{DD} \times 0.75$		
Input Low Voltage	V_{IL1}	Except hysteresis input	$V_{DD} \geqq 4.5V$		0	$V_{DD} \times 0.30$	V
	V_{IL2}	Hysteresis input				$V_{DD} \times 0.25$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5~5.5V		1	8.0	MHz

D.C. CHARACTERISTICS (V_{SS} = 0V, 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} = 5.5V, V_{IN} = 5.5V / 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} = 5.5V, V_{OUT} = 5.5V	–	–	2	μA
	I_{LO2}	Tri-state ports	V_{DD} = 5.5V, V_{OUT} = 5.5V/0V	–	–	± 2	
Output High Voltage	V_{OH1}	Tri- state ports	V_{DD} = 4.5V, I_{OH} = – 0.7 mA	4.1	–	–	V
	V_{OH2}	Port P7	V_{DD} = 4.5V, I_{OH} = – 0.2 mA				
Output Low Voltage	V_{OL}	Except XOUT	V_{DD} = 4.5V, I_{OL} = 1.6 mA	–	–	0.4	V
Supply Current in NORMAL mode			V_{DD} = 5.5V V_{IN} = 5.3V/0.2V 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} = 0V)

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} = 5.000V V_{ASS} = V_{SS} = 0.000V	–	–	± 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 $5.5V$, 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		$A_{VCC} = 5.000V : A_{VSS} = 0.000V$	–		± 2.0	LSB
	Differential Nonlinearity Error		Monotonicity Guarantee (Note1)	–		± 3/4	LSB
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 / $I_{AO} = -200\,\mu A$	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 1 : Differential nonlinearity error does not include quantizing error.

A.C. CHARACTERISTICS

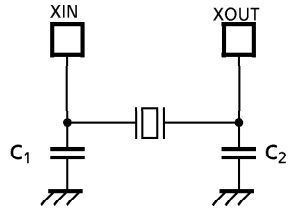
($V_{SS} = 0V$, $V_{DD} = 4.5$ to $5.5V$, $T_{opr} = -30$ to $70\,°C$)

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

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

PARAMETER	OSCILLATOR	FREQUENCY	RECOMMENDED OSCILLATOR		RECOMMENDED CONDITIONS C_1	RECOMMENDED CONDITIONS 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

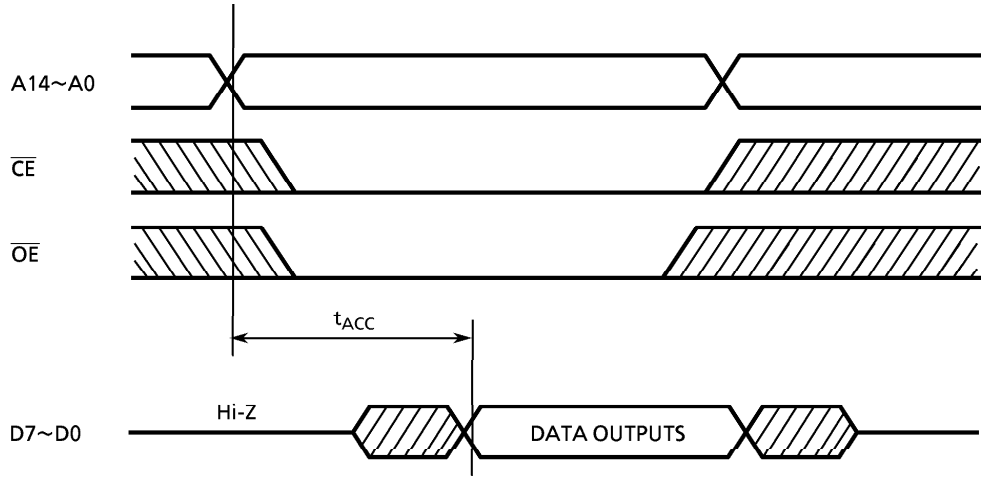
Note : To keep reliable operation, shield the device electrically with the metal plate on its package mold surface against the high electric field, for example, by CRT (Cathode Ray Tube).

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

(1) READ OPERATION

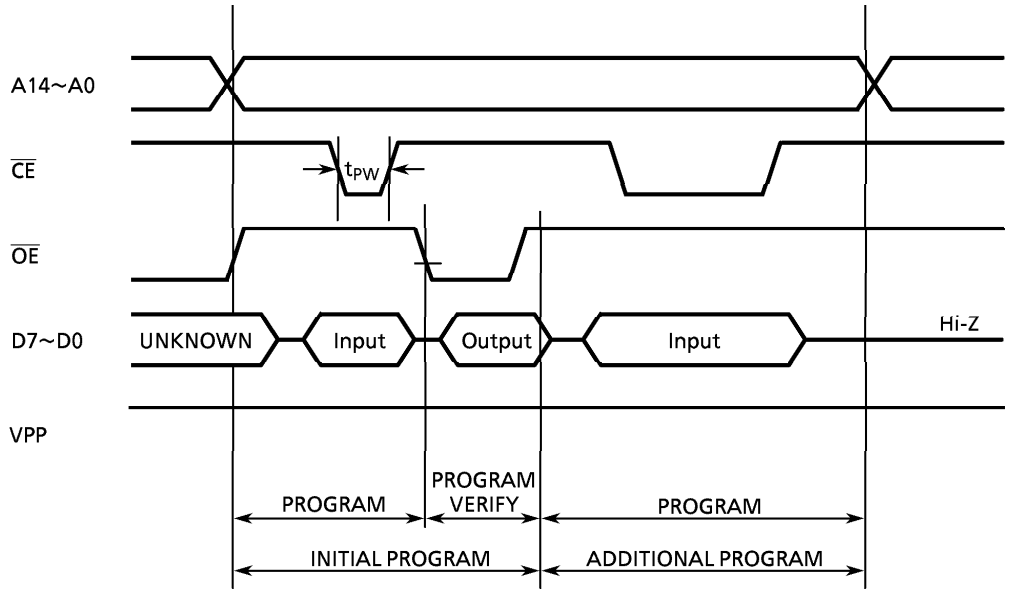
PARAMETER	SYMBOL	CONDITIONS	Min.	Typ.	Max.	UNIT
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Power Supply Voltage	V_{CC}		4.75	–	6.0	V
Program Power Supply Voltage	V_{PP}					
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25V	–	1.5tcyc + 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} = 6.0V ± 0.25V, V_{pp} = 12.5V ± 0.5V	0.95	1.0	1.05	ms



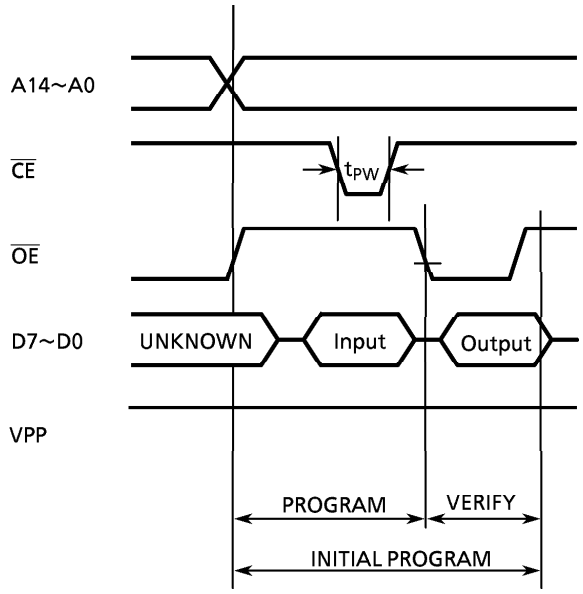
Caution 1: *When V_{cc} power supply is turned on or after, V_{pp} must be increased. When V_{cc} power supply is turned off or before, V_{pp} must be decreased.*

Caution 2: *The device must not be set to the EPROM programmer or picked up from it under applying the program voltage (12.5V ± 0.5V) to the V_{pp} pin as the device is damaged.*

Caution 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} = 6.25V ± 0.25V, V_{pp} = 12.75V ± 0.25V	0.095	0.1	0.105	ms



Caution 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.*

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Caution 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.*