

**TOSHIBA**

TOSHIBA Original CMOS 8-Bit Microcontroller

**TLCS-870 Series**

TMP87PH40ANG

TMP87PH40AFG

TMP87PM40ANG

TMP87PM40AFG

Not Recommended  
for New Design

**TOSHIBA CORPORATION**

Semiconductor Company

**Important Notices**

Thank you for your continued patronage of Toshiba microcontrollers.

This page gives you important information on using Toshiba microcontrollers. Please be sure to check each item for proper use of our products.

Not Recommended  
for New Design

**Toshiba Microcontrollers 870 Family  
(TMP87PM40) (TMP87PM40A)**

Dear Customer

### **Note on Using the TLCS-870 Series OTP Products**

With regard to the TLCS-870 Series OTP microcontrollers listed above, the following problem has been identified. If this issue presents you with any problem, please contact your local Toshiba sales office.

#### **[Problem]**

When the power supply start-up is over 10ms, a maximum of approximately 25  $\mu$ A of DC current may pass through the OTP control circuit in some rare cases. On these rare occasions, the supply current values in SLOW, SLEEP and STOP modes cannot meet the values specified in the technical datasheet.

There is no problem in other DC characteristics, and operational functions and mask ROM products.

#### **[Alternative products]**

When a set can be developed newly, we will recommend the following alternate products.

Object products	Alternative products
TMP87PM40	TMP86PM49
TMP87PM40A	TMP86PM49

Not Recommended  
for New Design

## Document Change Notification

The purpose of this notification is to inform customers about the launch of the Pb-free version of the device. The introduction of a Pb-free replacement affects the datasheet. Please understand that this notification is intended as a temporary substitute for a revision of the datasheet.

Changes to the datasheet may include the following, though not all of them may apply to this particular device.

1. Part number

Example: TMPxxxxxF      TMPxxxxxFG

All references to the previous part number were left unchanged in body text. The new part number is indicated on the prelims pages (cover page and this notification).

2. Package code and package dimensions

Example: LQFP100-P-1414-0.50C      LQFP100-P-1414-0.50F

All references to the previous package code and package dimensions were left unchanged in body text. The new ones are indicated on the prelims pages.

3. Addition of notes on lead solderability

Now that the device is Pb-free, notes on lead solderability have been added.

4. RESTRICTIONS ON PRODUCT USE

The previous (obsolete) provision might be left unchanged on page 1 of body text. A new replacement is included on the next page.

5. Publication date of the datasheet

The publication date at the lower right corner of the prelims pages applies to the new device.

1. Part number
2. Package code and dimensions

Previous Part Number (in Body Text)	Previous Package Code (in Body Text)	New Part Number	New Package Code	OTP
TMP87PH40AN	SDIP64-P-750-1.78	TMP87PH40ANG	SDIP64-P-750-1.78	—
TMP87PH40AF	QFP64-P-1420-1.00A	TMP87PH40AFG	QFP64-P-1420-1.00A	—
TMP87PM40AN	SDIP64-P-750-1.78	TMP87PM40ANG	SDIP64-P-750-1.78	—
TMP87PM40AF	QFP64-P-1420-1.00A	TMP87PM40AFG	QFP64-P-1420-1.00A	—

\*: For the dimensions of the new package, see the attached Package Dimensions diagram.

### 3. Addition of notes on lead solderability

The following solderability test is conducted on the new device.

Lead solderability of Pb-free devices (with the G suffix)

Test	Test Conditions	Remark
Solderability	(1) Use of Lead (Pb) ·solder bath temperature = 230°C ·dipping time = 5 seconds ·the number of times = once ·use of R-type flux (2) Use of Lead (Pb)-Free ·solder bath temperature = 245°C ·dipping time = 5 seconds ·the number of times = once ·use of R-type flux	Leads with over 95% solder coverage till lead forming are acceptable.

Not Recommended for New Design

#### 4. RESTRICTIONS ON PRODUCT USE

The following replaces the “RESTRICTIONS ON PRODUCT USE” on page 1 of body text.

#### RESTRICTIONS ON PRODUCT USE

20070701-EN

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and 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 comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products 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 TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.
- 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.

#### 5. Publication date of the datasheet

The publication date of this datasheet is printed at the lower right corner of this notification.

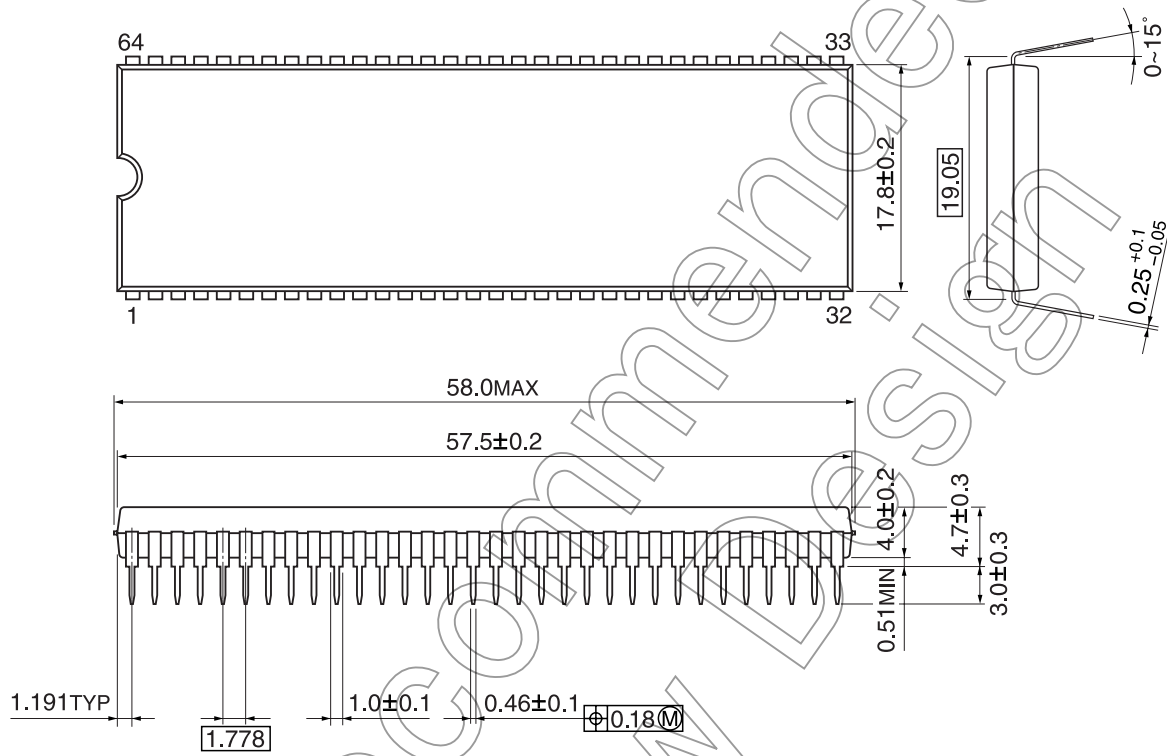
Not Recommended for New Design

(Annex)

### Package Dimensions

SDIP64-P-750-1.78

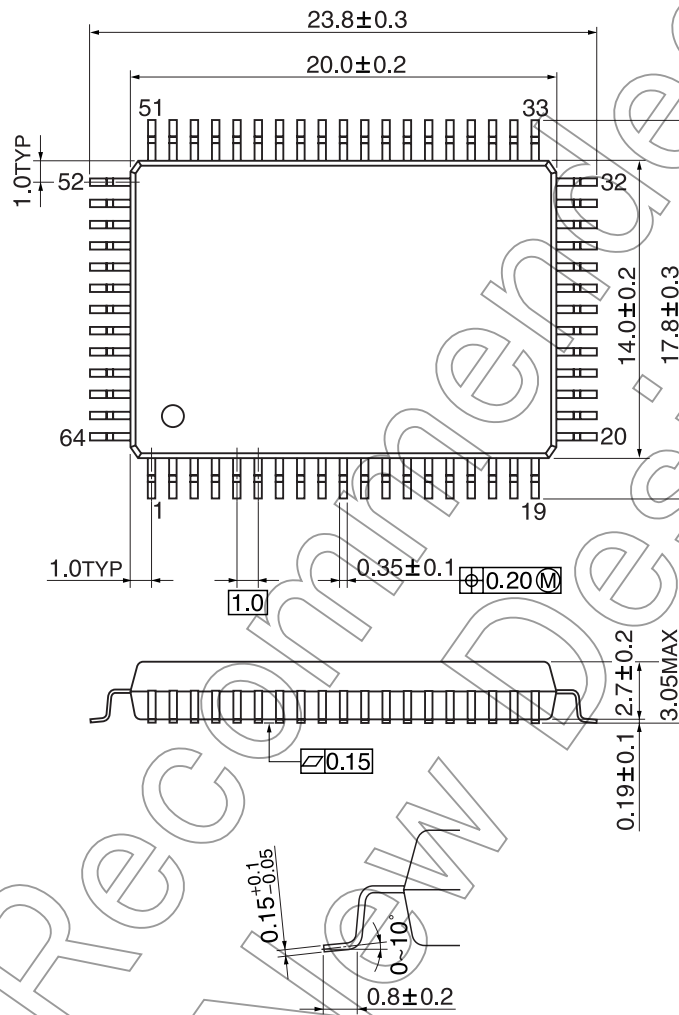
Unit: mm



Not Recommended for New Design

QFP64-P-1420-1.00A

Unit: mm



Not Recommended for New Design



CMOS 8-Bit Microcontroller

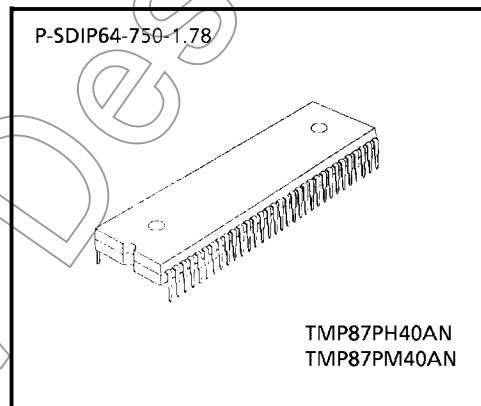
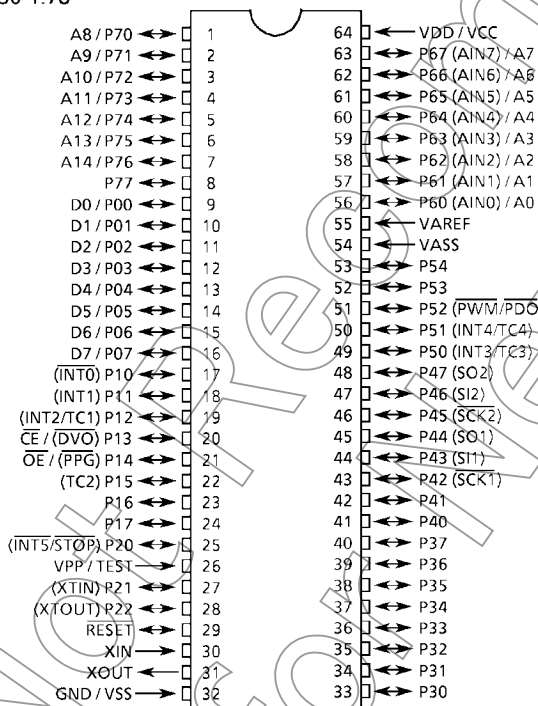
**TMP87PH40AN, TMP87PH40AF, TMP87PM40AN, TMP87PM40AF**

The 87PH40A is a One-Time PROM microcontroller with low-power 128 K bits (16 Kbytes) electrically programmable read only memory for the 87C840/CC40/CH40 system evaluation. The 87PM40A is a One-time PROM microcontroller with low-power 256 K bits (32 Kbytes) electrically programmable read only memory for the 87CK40A/M40A system evaluation. The 87PH40A/PM40A are pin compatible with the 87C840/CC40/CH40/CK40A/CM40A. The operations possible with the 87C840/CC40/CH40/CK40A/CM40A can be performed by writing programs to PROM. The 87PH40A/PM40A can write and verify in the same way as the TC57256AD using an adaptor socket BM1136/BM1137/BM11714 and an EPROM programmer.

Part No	OTP	RAM	Package	Adapter socket
TMP87PH40AN	16 K x 8-bit	512 x 8-bit	P-SDIP64-750-1.78	BM1136
TMP87PH40AF			P-QFP64-1420-1.00A	BM1137
TMP87PM40AN	32 K x 8-bit	1K x 8-bit	P-SDIP64-750-1.78	BM11714
TMP87PM40AF			P-QFP64-1420-1.00A	BM1137

**Pin Assignments (Top View) - (1)**

P-SDIP64-750-1.78

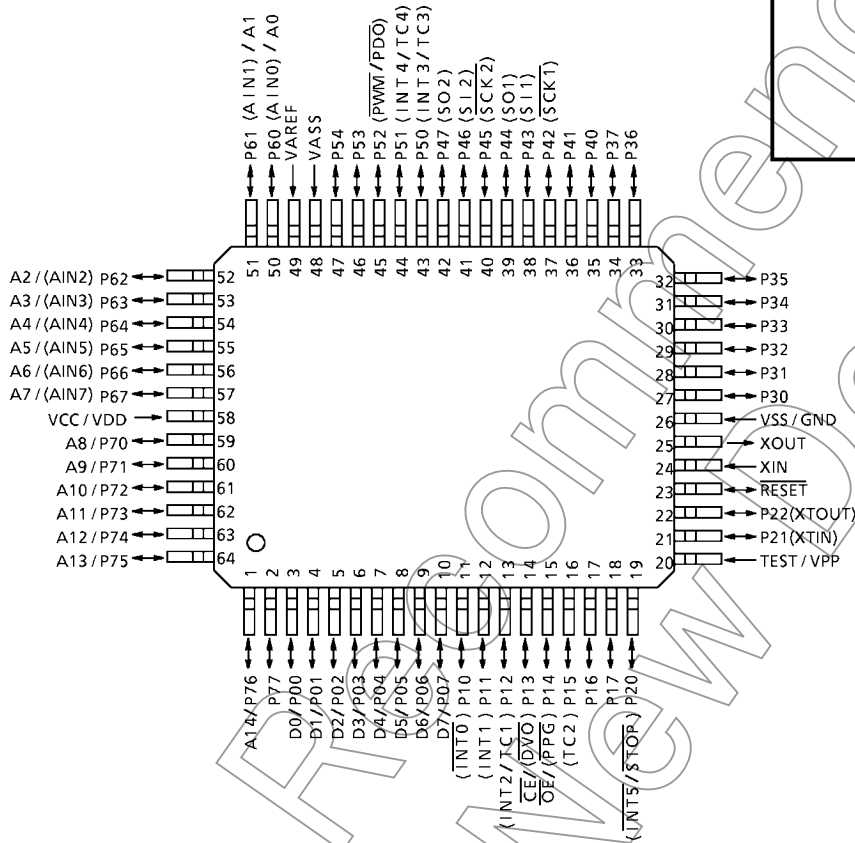
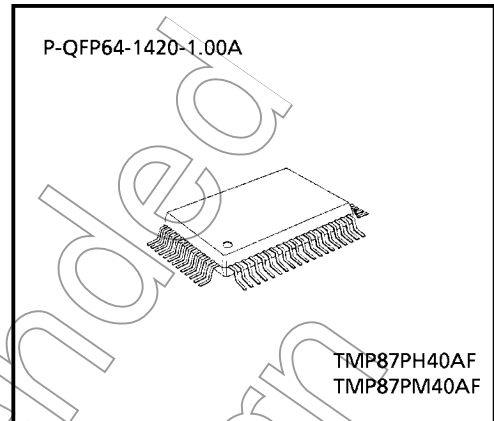


980910EBP1

- 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) - (2)

P-QFP64-1420-1.00A



Not for New Designs

**Pin Function**

The 87PH40A/PM40A have two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PH40A/PM40A are pin compatible with the 87C840/CC40/CH40/CK40A/CM40A (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin Name (MCU mode)
A14 to A8	Input	PROM address inputs	P76 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
VPP	Power supply	+ 12.5V / 5V (Program supply voltage)	TEST
VCC		+ 5V	VDD
GND		0V	VSS
P37 to P30		Pull-up with resistance for input processing	
P47 to P40			
P54 to P50			
P11	I/O	PROM mode setting pins. Be fixed at high level.	
P21			
P77			
P17 to P15			
P12, P10		PROM mode setting pins. Be fixed at low level.	
P22, P20			
RESET			
XIN	Input	Connect an 8MHz or 4MHz oscillator to stabilize the internal state.	
XOUT	Output		
VAREF	Power Supply	0 V (GND)	
VASS			

## Operational Description

The following explains the 87PH40A/PM40A hardware configuration and operation. The configuration and functions of the 87PH40A are the same as those of the 87C840/CC40/CH40, 87PM40A are the same as those of the 87CK40A/CM40A, except in that a one-time PROM is used instead of an on-chip mask ROM.

The 87PH40A/PM40A are placed in the single-clock mode during reset. To use the dual-clock mode, the low-frequency oscillator should be turned on by executing [SET (SYSCR2). XTEN] instruction at the beginning of the program.

### 1. Operating Mode

The 87PH40A/PM40A 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 87C840/CC40/CH40/CK40A/CM40A (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

##### 1.1.1 Program Memory

The 87PH40A has a 16 K × 8-bit (addresses C000<sub>H</sub> to FFFF<sub>H</sub> in the MCU mode, addresses 4000<sub>H</sub> to 7FFF<sub>H</sub> in the PROM mode), the 87PM40A has a 32 K × 8-bit (address 8000<sub>H</sub> to FFFF<sub>H</sub> in the MCU mode, address 0000<sub>H</sub> to 7FFF<sub>H</sub> in the PROM mode) of program memory (OTP).

To use the 87PH40A/PM40A as the system evaluation for the 87C840/CC40/CH40/CK40A/CM40A, the program should be written to the program memory area as shown in Figure 1-1.

Not Recommended for New Design

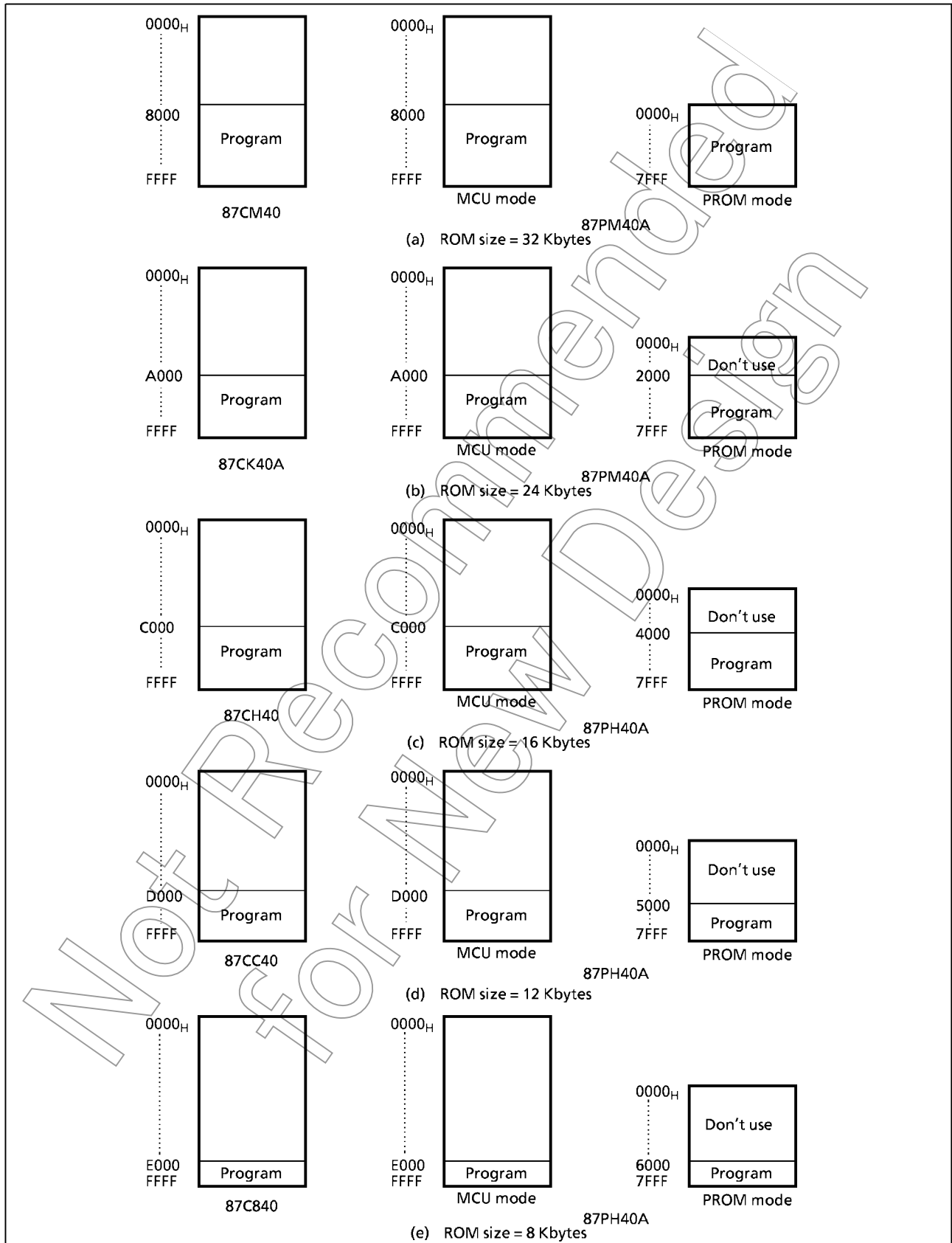


Figure 1-1. Program Memory Area

*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 87PH40A has an on-chip 512 × 8-bit data memory (static RAM). The 87PM40A has an on-chip 1K × 8-bit data memory (static RAM).

**1.1.3 Input/Output Circuitry**

(1) Control pins

The control pins of the 87PH40A/PM40A are the same as those of the 87C840/CC40/CH40/CK40A/CM40A except that the TEST pin has no built-in pull-down resistance.

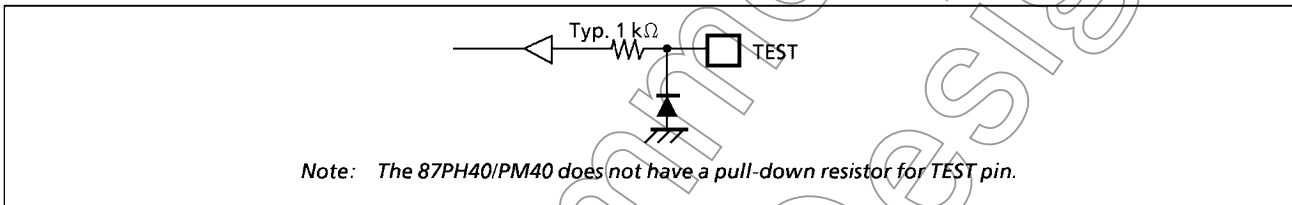


Figure 1-2. TEST pin

(2) I/O ports

The I/O circuitries of 87PH40A/PM40A I/O ports are the same as the code A type I/O circuitries of the 87C840/CC40/CH40/CK40A/CM40A.

When using as an evaluator of other I/O codes (B, C, G), external pull-up resistors are required.

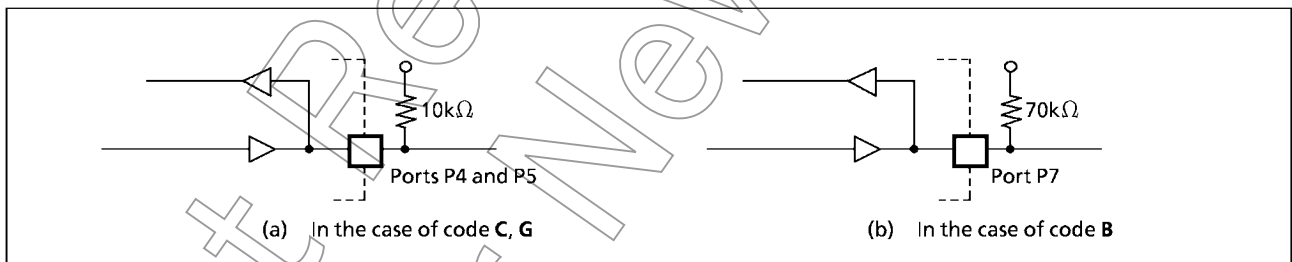


Figure 1-3. I/O Circuitry Code and External Circuitry

1.2 PROM Mode

The PROM mode is activated by setting the TEST, RESET pin and the ports P17-P10, P22-P20 and P77 as shown in Figure 1-4. 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 87PH40A/PM40A are not supported an *electric signature* mode, so the ROM type must be set to TC57256AD.

Set the adaptor socket switch to "P".

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

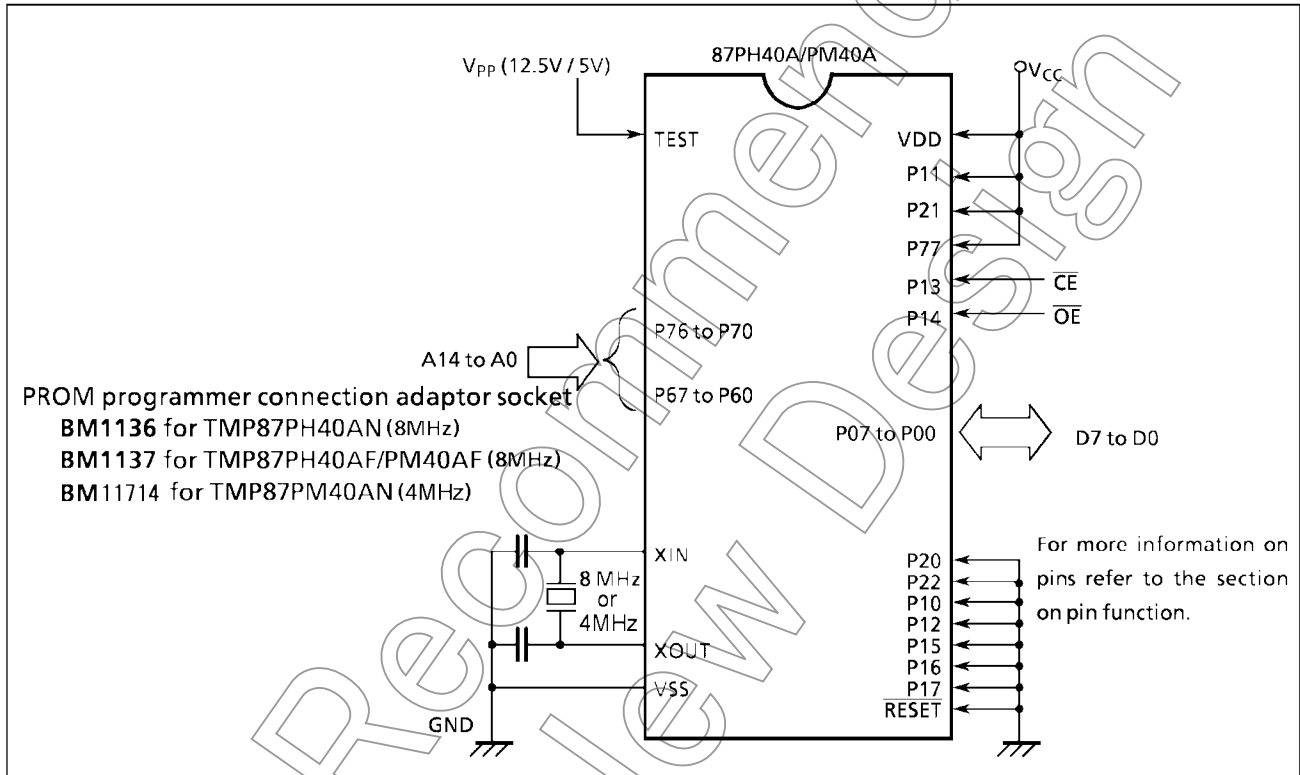


Figure 1-4. Setting for PROM Mode

Not Recommended for

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

The high-speed programming mode is achieved by applying the program voltage (+ 12.5 V) to the Vpp pin when Vcc = 6 V. After the address and input data are stable, the data is programmed by applying a single 1ms program pulse to the 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 × 1 ms). 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.

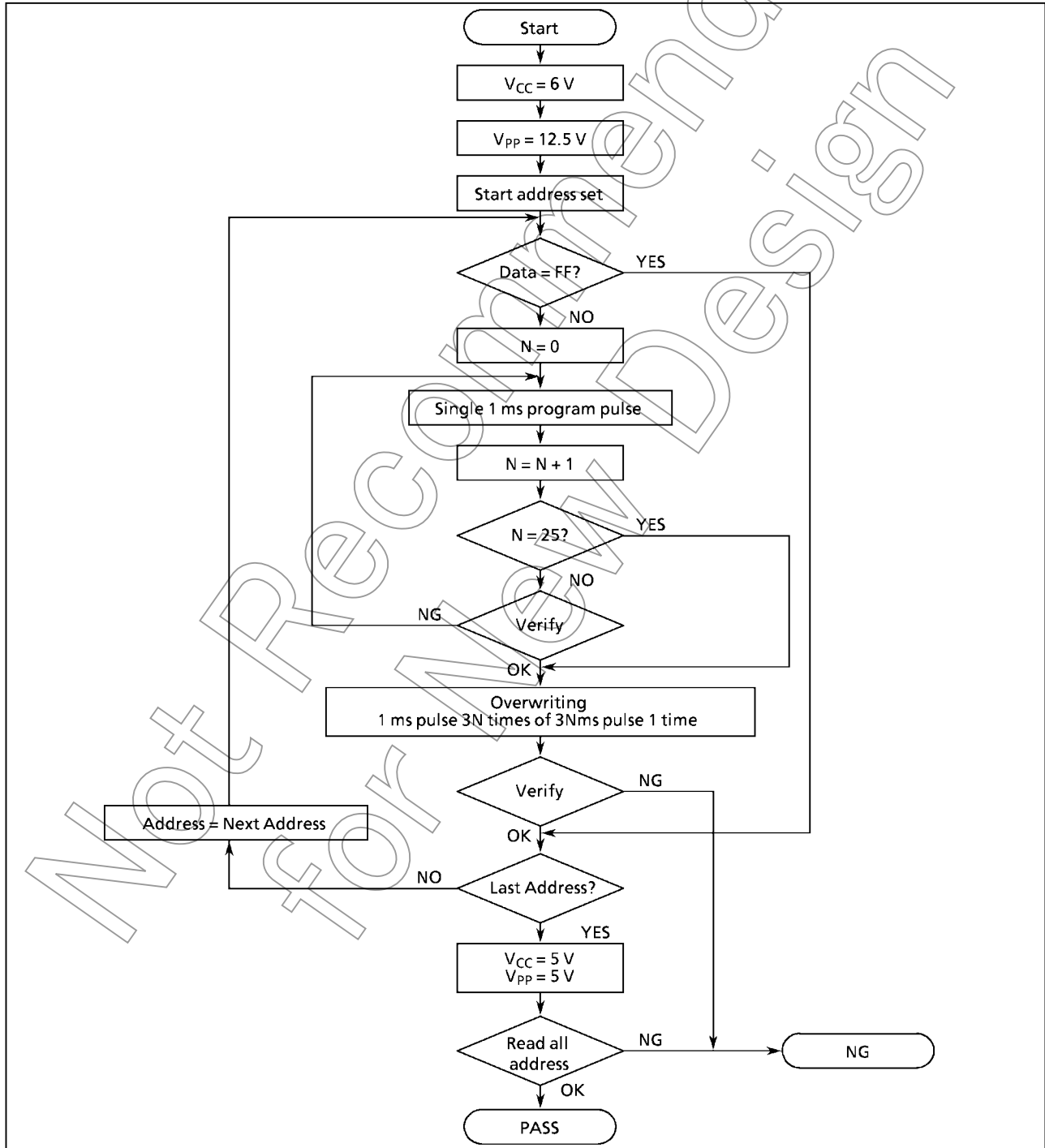


Figure 1-5. Flowchart of High-speed Programming Mode - I



**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.

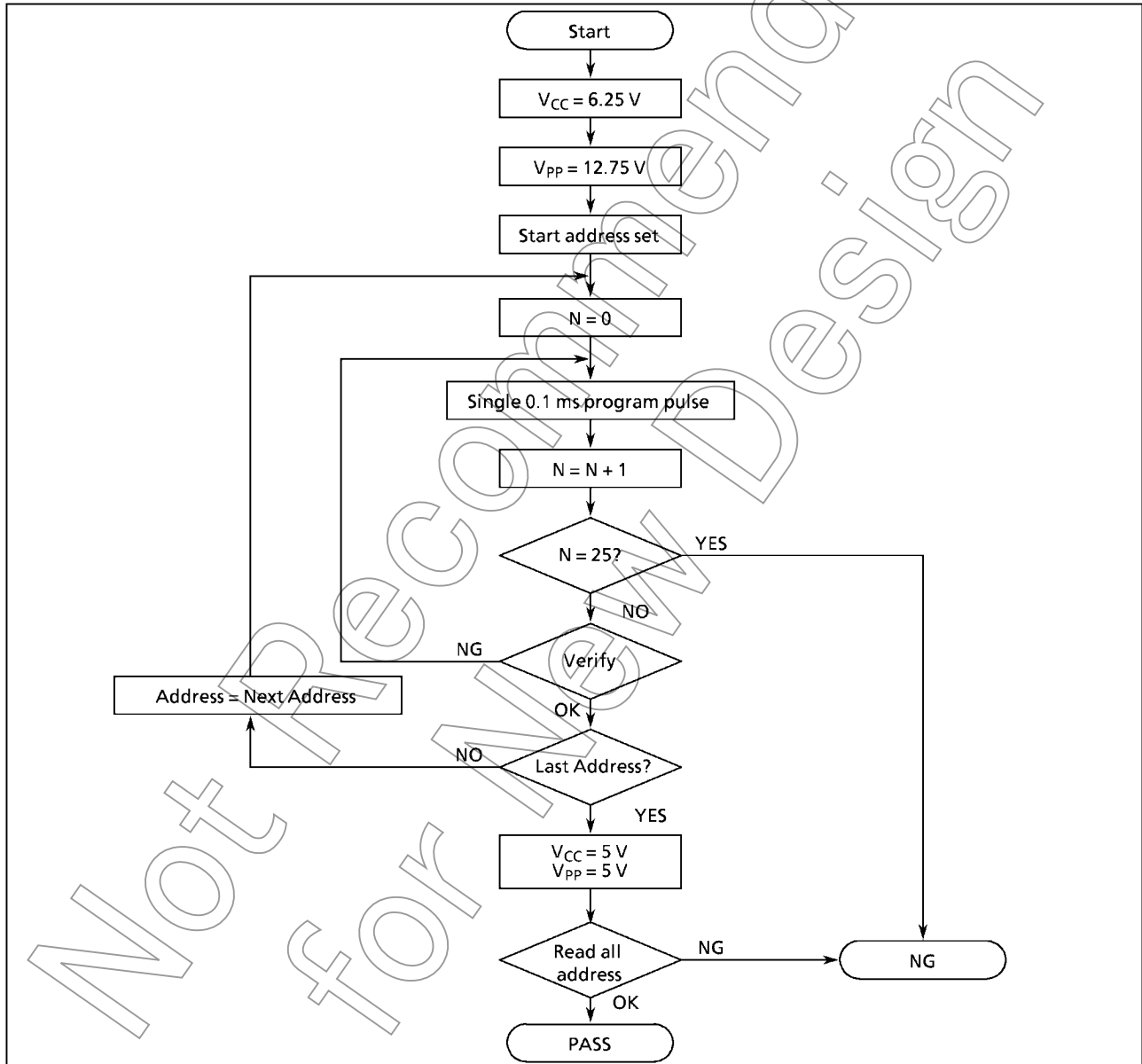


Figure 1-6. Flowchart of High-speed Programming Mode - II

### 1.2.3 Writing Method for General-purpose PROM Program

(1) Adapters

BM1136: TMP87PH40AN

BM1137: TMP87PH40AF, 87PM40AF

BM11714: TMP87PM40AN

(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 TMP87PH40A, EPROM is within the addresses 4000 to 7FFFH. In TMP87PM40A, EPROM is within the address 0000 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 16KB: transferred addresses C000 to FFFFH to addresses 4000 to 7FFFH

iii) Writing address is specified. (note 1)

TMP87PH40A: Start address: 4000H

End address: 7FFFH

TMP87PM40A: Start address: 0000H

End address: 7FFFH

(4) Writing

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

**Note 1:** In case of TMP87PH40A, the specifying method is referred to the PROM programmer description. The data in addresses 0000 to 3FFFH 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:** TMP87PH40A, 87PM40A do 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 12 V  $\pm$  0.5 V to the address pin 9 (A9). The signature must not be used.

## Electrical Characteristics

## Absolute Maximum Ratings

 $(V_{SS} = 0V)$ 

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	$V_{DD}$		-0.3 to 7	V
Program Voltage	$V_{PP}$	TEST / $V_{PP}$ pin	-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 P2 and RESET	-0.3 to $V_{DD} + 0.3$	V
	$V_{OUT2}$	Sink open drain pin except port P2, RESET	-0.3 to 10	
Output Current (Per 1 pin)	$I_{OUT1}$	Ports P0, P1, P2, P4, P5, P6, P7	3.2	mA
	$I_{OUT2}$	Port P3	30	
Output Current (Total)	$\Sigma I_{OUT1}$	Ports P0, P1, P2, P4, P5, P6, P7	120	mA
	$\Sigma I_{OUT2}$	Port P3	120	
Power Dissipation [ $T_{opr} = 70^{\circ}C$ ]	PD	TMP87PH40AN/PM40AN	600	mW
		TMP87PH40AF/PM40AF	350	
Soldering Temperature (time)	$T_{sld}$		260 (10s)	$^{\circ}C$
Storage Temperature	$T_{stg}$		-55 to 125	$^{\circ}C$
Operating Temperature	$T_{opr}$		-30 to 70	$^{\circ}C$

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

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

Parameter	Symbol	Pins	Conditions	Min	Max	Unit	
Supply Voltage	$V_{DD}$		$f_c = 8 \text{ MHz}$	NORMAL1, 2 mode	4.5	6.0	V
				IDLE1, 2 mode			
			$f_c = 4.2 \text{ MHz}$	NORMAL1, 2 mode	2.7		
				IDLE1, 2 mode			
			$f_s = 32.768 \text{ kHz}$	SLOW mode	2.0		
				SLEEP mode			
	STOP mode						
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	$V_{DD} = 4.5 \text{ to } 6 \text{ V}$	0.4	8.0	MHz	
			$V_{DD} = 2.7 \text{ to } 6 \text{ V}$		4.2		
	$f_s$	XTIN, XTOUT		30.0	34.0	kHz	

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  $f_c$ ; Supply voltage range is specified in NORMAL mode and IDLE mode.

D.C. Characteristics

(V<sub>SS</sub> = 0 V, T<sub>opr</sub> = - 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit	
Hysteresis Voltage	V <sub>HS</sub>	Hysteresis inputs	V <sub>DD</sub> = 5.0V	-	0.9	-	V	
Input Current	I <sub>IN1</sub>	TEST	V <sub>DD</sub> = 5.5V V <sub>IN</sub> = 5.5V/0V	-	-	± 2	μA	
	I <sub>IN2</sub>	Open drain ports and tri-state ports						
	I <sub>IN3</sub>	RESET, STOP						
Input Resistance	R <sub>IN2</sub>	RESET		100	220	450	kΩ	
Output Leakage Current	I <sub>LO1</sub>	Open drain ports	V <sub>DD</sub> = 5.5V, V <sub>OUT</sub> = 5.5V	-	-	2	μA	
	I <sub>LO2</sub>	Tri-state ports	V <sub>DD</sub> = 5.5V, V <sub>OUT</sub> = 5.5V/0V	-	-	± 2		
Output High Voltage	V <sub>OH2</sub>	Tri-state ports	V <sub>DD</sub> = 4.5V, I <sub>OH</sub> = - 0.7mA	4.1	-	-	V	
Output Low Voltage	V <sub>OL</sub>	Except XOUT and port P3	V <sub>DD</sub> = 4.5V, I <sub>OL</sub> = 1.6mA	-	-	0.4	V	
Output Low Current	I <sub>OL3</sub>	Port P3	V <sub>DD</sub> = 4.5V, V <sub>OL</sub> = 1.0V	-	20	-	mA	
Supply Current in NORMAL 1, 2 mode	I <sub>DD</sub>		V <sub>DD</sub> = 5.5V f <sub>c</sub> = 8 MHz	87PH40A	-	9	14	mA
Supply Current in IDLE 1, 2 mode			f <sub>s</sub> = 32.768 kHz	87PM40A	-	12	18	
Supply Current in SLOW mode			V <sub>IN</sub> = 5.3V/0.2V	87PH40A	-	4	6	mA
Supply Current in SLEEP mode			V <sub>DD</sub> = 3.0V f <sub>s</sub> = 32.768 kHz	87PM40A	-	4.5	6	
Supply Current in STOP mode			V <sub>IN</sub> = 2.8V/0.2V		-	15	30	μA
Supply Current in STOP mode			V <sub>DD</sub> = 5.5V V <sub>IN</sub> = 5.3V/0.2V		-	0.5	10	μA

Note1: Typical values show those at T<sub>opr</sub> = 25°C.

Note 2: Input Current I<sub>IN1</sub>, I<sub>IN3</sub>; The current through pull-up or pull-down resistor is not included.

Note 3: I<sub>DD</sub>; Except for I<sub>REF</sub>

A / D Conversion Characteristics

(V<sub>SS</sub> = 0 V, V<sub>DD</sub> = 2.7 to 5.5 V, T<sub>opr</sub> = - 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V <sub>AREF</sub>	V <sub>AREF</sub> - V <sub>ASS</sub> ≥ 2.5 V	2.7	-	V <sub>DD</sub>	V
	V <sub>ASS</sub>		V <sub>SS</sub>	-	1.5	
Analog Input Voltage	V <sub>AIN</sub>		V <sub>ASS</sub>	-	V <sub>AREF</sub>	V
Analog Supply Current	I <sub>REF</sub>	V <sub>AREF</sub> = 5.5 V, V <sub>ASS</sub> = 0.0 V	-	0.5	1.0	mA
Nonlinearity Error		V <sub>DD</sub> = 5.0 V, V <sub>SS</sub> = 0.0 V V <sub>AREF</sub> = 5.000 V	-	-	± 1	LSB
Zero Point Error		V <sub>ASS</sub> = 0.000 V or	-	-	± 1	
Full Scale Error		V <sub>DD</sub> = 2.7 V, V <sub>SS</sub> = 0.0 V V <sub>AREF</sub> = 2.700 V	-	-	± 1	
Total Error		V <sub>ASS</sub> = 0.000 V	-	-	± 2	

Note : The above errors has no quantizing error.

A.C. Characteristics

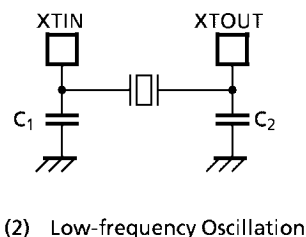
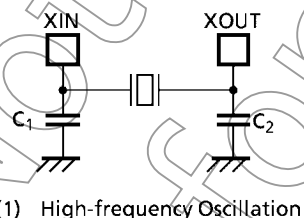
( $V_{SS} = 0\text{ V}$ ,  $V_{DD} = 4.5\text{ to }6.0\text{ V}$ ,  $T_{opr} = -30\text{ to }70^\circ\text{C}$ )

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	$t_{cy}$	In NORMAL1, 2 modes	0.5	-	10	$\mu\text{s}$
		In IDLE1, 2 modes				
		In SLOW mode	117.6	-	133.3	
		In SLEEP mode				
High Level Clock Pulse Width	$t_{WCH}$	For external clock operation (XIN input), $f_c = 8\text{ MHz}$	50	-	-	ns
Low Level Clock Pulse Width	$t_{WCL}$					
High Level Clock Pulse Width	$t_{WSH}$	For external clock operation (XTIN input), $f_s = 32.768\text{ kHz}$	14.7	-	-	$\mu\text{s}$
Low Level Clock Pulse Width	$t_{WSL}$					

Recommended Oscillating Conditions

( $V_{SS} = 0\text{ V}$ ,  $V_{DD} = 4.5\text{ to }6.0\text{ V}$ ,  $T_{opr} = -30\text{ to }70^\circ\text{C}$ )

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator		Recommended Constant	
					$C_1$	$C_2$
High-frequency Oscillation	Ceramic Resonator	8 MHz	KYOCERA	KBR8.0M	30pF	30pF
		4 MHz	KYOCERA	KBR4.0MS		
	Crystal Oscillator	8 MHz	TOYOCOM	210B 8.0000	20pF	20pF
		4 MHz	TOYOCOM	204B 4.0000		
Low-frequency Oscillation	Crystal Oscillator	32.768 kHz	NDK	MX-38T	15pF	15pF



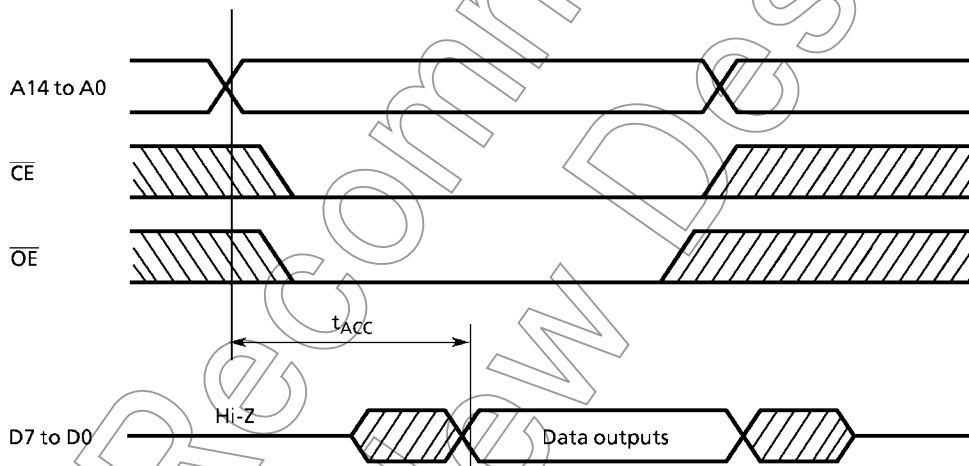
Note: When used in high electric field such as a picture tube, the package is recommended to be electrically shielded to maintain a regular operation.

D.C./A.C. Characteristics (PROM mode) (V<sub>SS</sub> = 0V)

(1) Read Operation (T<sub>opr</sub> = -30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V <sub>IH4</sub>		V <sub>CC</sub> × 0.7	–	V <sub>CC</sub>	V
Input Low Voltage	V <sub>IL4</sub>		0	–	V <sub>CC</sub> × 0.12	V
Power Supply Voltage	V <sub>CC</sub>		4.75	5.00	5.25	V
Program Power Supply Voltage	V <sub>PP</sub>		V <sub>CC</sub> - 0.6	V <sub>CC</sub>	V <sub>CC</sub> + 0.6	
Address Access Time	t <sub>ACC</sub>	V <sub>CC</sub> = 5.0 ± 0.25V	–	1.5tcyc + 300	–	ns

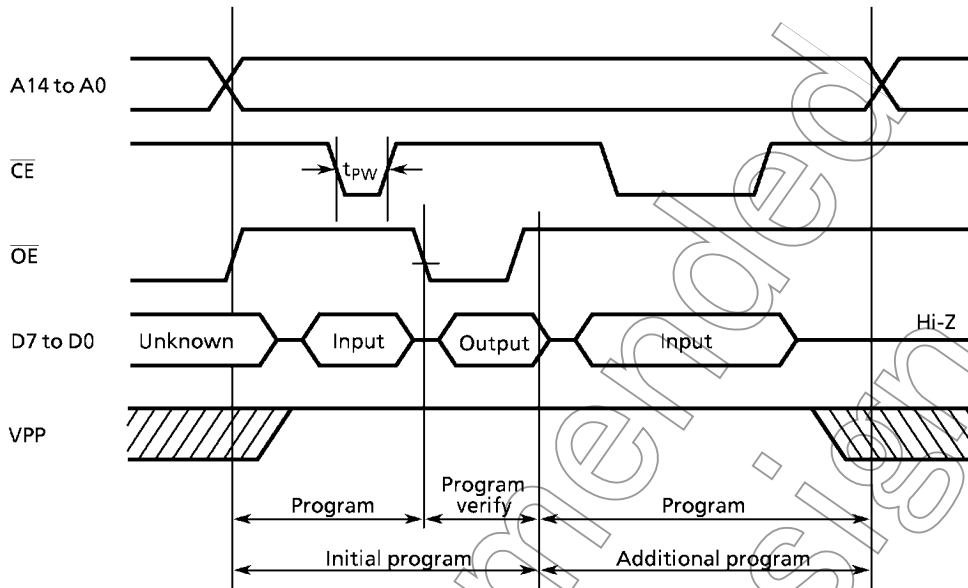
Note: tcyc = 500 ns at 8 MHz



Timing Waveforms of Read Operation

(2) Program Operation (High-Speed Write Mode - I) (T<sub>opr</sub> = 25 ± 5°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V <sub>IH4</sub>		V <sub>CC</sub> × 0.7	–	V <sub>CC</sub>	V
Input Low Voltage	V <sub>IL4</sub>		0	–	V <sub>CC</sub> × 0.12	V
Power Supply Voltage	V <sub>CC</sub>		5.75	6.0	6.25	V
Program Power Supply Voltage	V <sub>PP</sub>		12.0	12.5	13.0	V
Initial Program Pulse Width	t <sub>PW</sub>	V <sub>CC</sub> = 6.0 V ± 0.25 V, V <sub>PP</sub> = 12.5 ± 0.25 V	0.95	1.0	1.05	ms



Timing Waveforms of Programming Operation

**Note 1:** When  $V_{cc}$  power supply is turned on or after,  $V_{pp}$  must be increased.

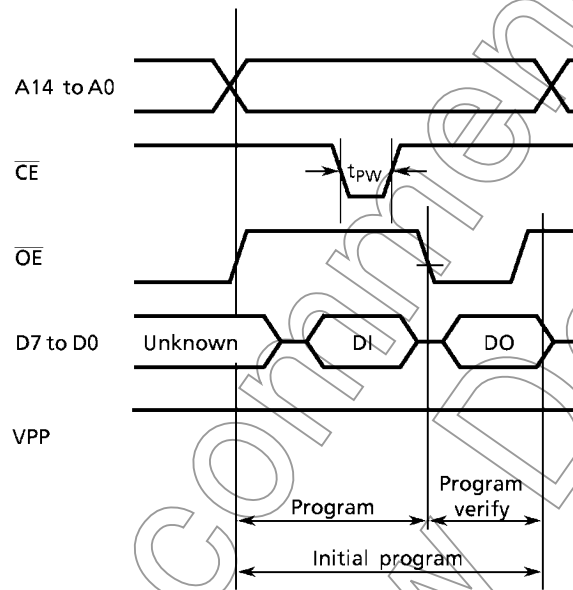
When  $V_{cc}$  power supply is turned off or before,  $V_{pp}$  must be decreased.

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

**Note 3:** Be sure to execute the recommended programming mode with the recommended programming adaptor. If a mode or an adaptor except the above, the misoperation sometimes occurs.

(3) Program Operation (High speed write mode - II) ( $T_{opr} = 25 \pm 5^{\circ}\text{C}$ )

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	$t_{PW}$	$V_{CC} = 6.25 \text{ V} \pm 0.25 \text{ V}$ , $V_{PP} = 12.75 \text{ V} \pm 0.25 \text{ V}$	0.095	0.1	0.105	ms



Note: DO ; Data output (I0 to I7)  
DI ; Data input (I0 to I7)

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 ( $12.75 \text{ V} \pm 0.25 \text{ V}$ ) to the  $V_{PP}$  pin as the device is damaged.

Note 3: Be sure to execute the recommended programming mode with the recommended programming adaptor. If a mode or an adaptor except the above, the misoperation sometimes occurs.