

**NEC**

MOS INTEGRATED CIRCUIT

**$\mu$ PD78CP14**

**8-BIT SINGLE-CHIP MICROCOMPUTER**



The  $\mu$ PD78CP14 is a product provided by replacing  $\mu$ PD78C14 internal mask ROM with PROM.

$\mu$ PD78CP14DW/KB/R (for evaluation of  $\mu$ PD78C11A, 78C12A, 78C14) which is reprogrammable and  $\mu$ PD78CP14CW/G/GF/L of one time ROM version which is programmable only once (for small production) are provided.

### Features:

- o Compatible with  $\mu$ PD78C11A, 78C12A, 78C14 (87AD series)
- o Internal PROM: 16384 words x 8 bits  
The internal PROM capacity can be changed conforming to the  $\mu$ PD78C11A, 78C12A, 78C14 by using software.
- o PROM programming characteristics:  $\mu$ PD27C256A compatible. ★
- o Single power supply: 5 V  $\pm$ 10 % (one-time PROM product) ★  
5 V  $\pm$ 5 % (EPROM product)
- o Compatible with QTOP<sup>TM</sup> microcomputer ★

Remarks The QTOP Microcomputer is the general term for "One-time single-chip microcomputer with on-chip PROM totally supported from program writing to seating, screening, and verification" offered by NEC.

### Ordering Information

Part number	Package	Program memory
$\mu$ PD78CP14CW	64-pin plastic shrink DIP (750 mil)	One-time PROM
$\mu$ PD78CP14G-36	64-pin plastic QUIP	One-time PROM
$\mu$ PD78CP14GF-3BE	64-pin plastic flat-pack (14 x 20 mm)	One-time PROM
$\mu$ PD78CP14L	68-pin plastic QFJ ( 950 mil)	One-time PROM
$\mu$ PD78CP14DW	64-pin ceramic shrink DIP with a window (750 mil)	EPROM
$\mu$ PD78CP14KB	64-pin ceramic WQFN	EPROM
$\mu$ PD78CP14R	64-pin ceramic QUIP with a window	EPROM

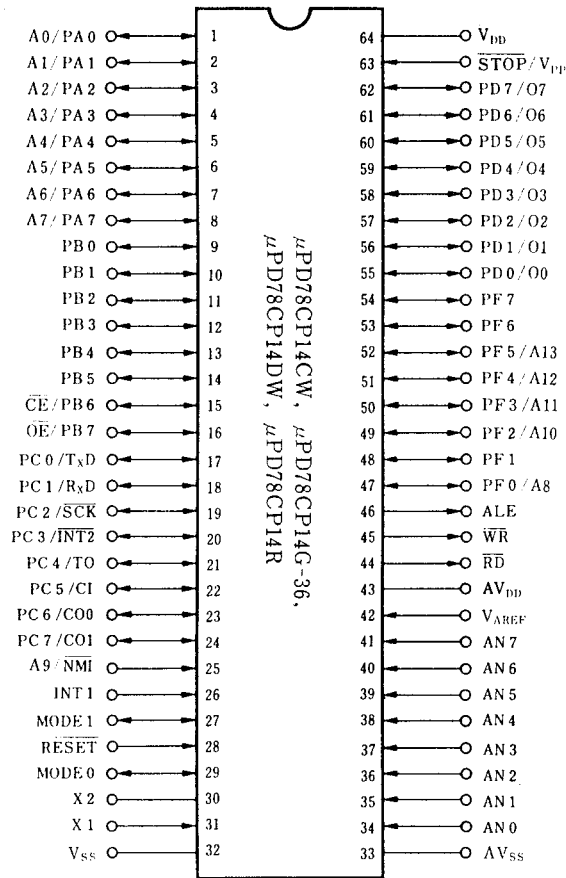
## **Quality grade**

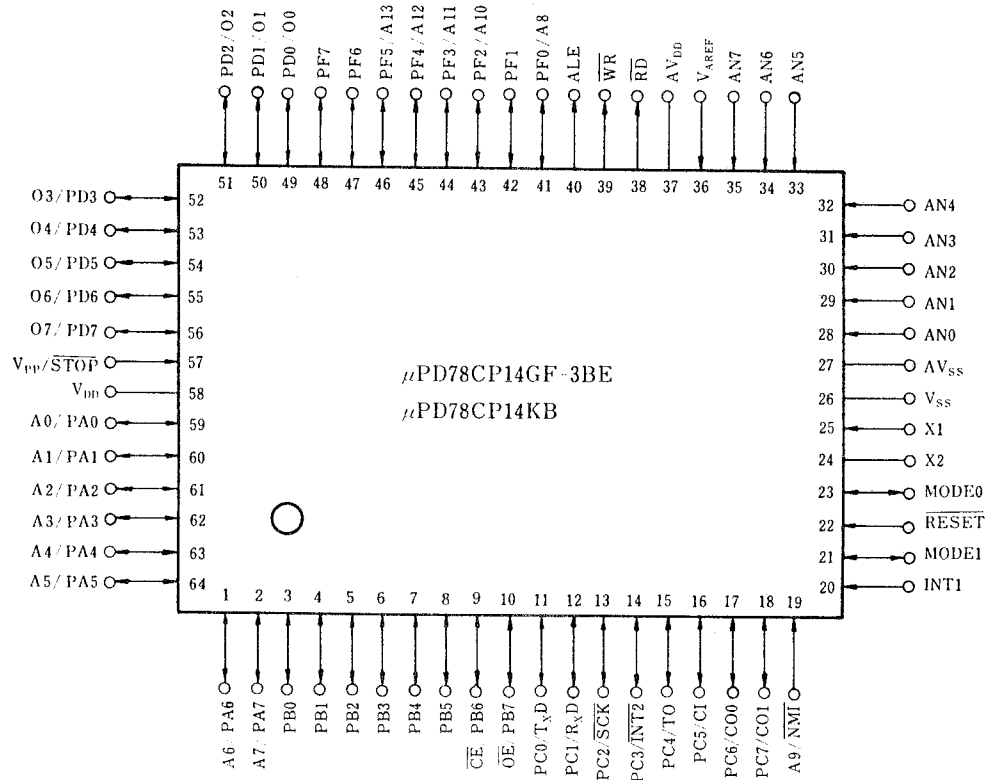
### **Standard**

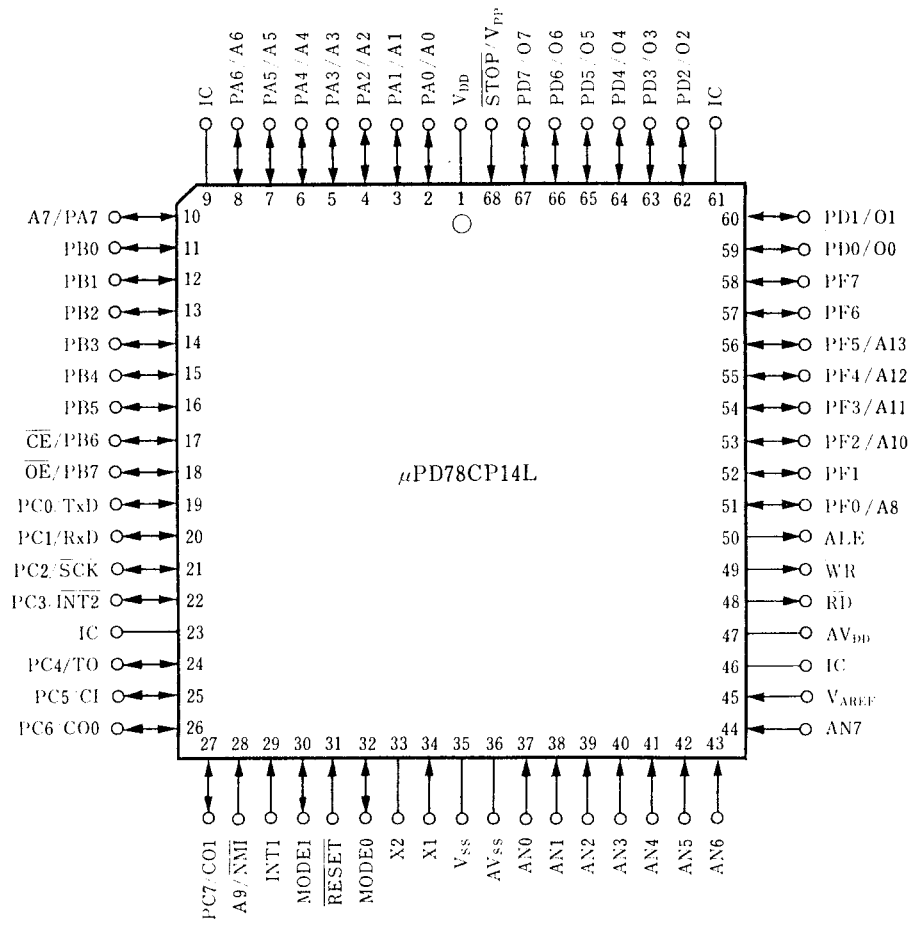
Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

**This document represents the portion common to the one-time PROM and EPROM products as PROM.**

# Pin Configuration (Top View)

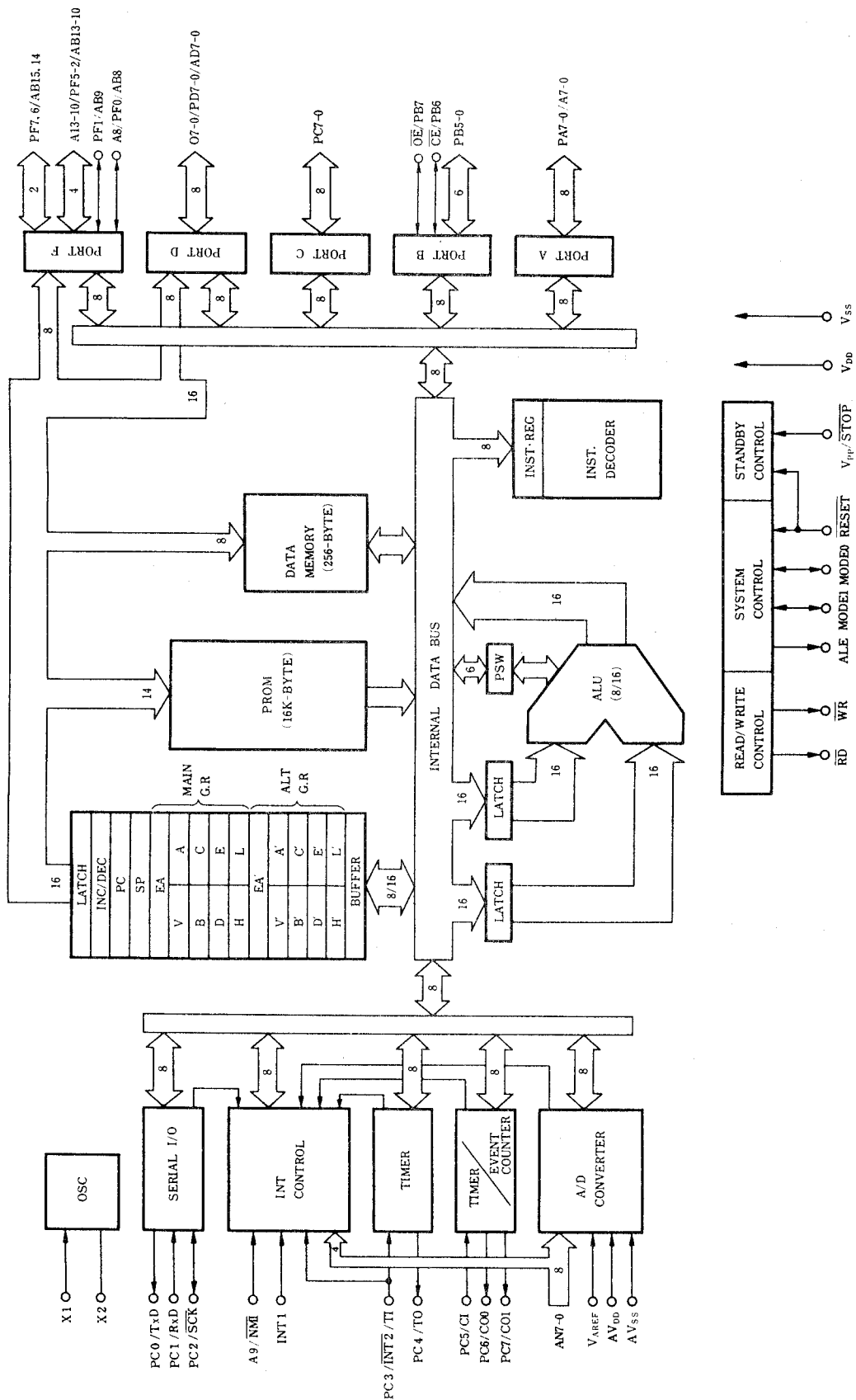






IC .....Internally Connected

# Block Diagram





## Contents

	<u>Page</u>
<b>1. PIN FUNCTION</b> .....	9
1.1 Port Functions .....	9
1.2 Functions Other Than Ports (During Normal Operation) .....	10
1.3 Functions Other Than Ports (During PROM Write, Verify, Read) .....	12
1.4 Recommended Conditions for Unused Pin .....	13
<b>2. MEMORY CONFIGURATION</b> .....	14
<b>3. MEMORY EXTENSION</b> .....	18
3.1 MODE Pins .....	18
3.2 MEMORY MAPPING Register (MM) .....	19
<b>4. PROM PROGRAMMING</b> .....	23
4.1 PROM Programming Operation Mode .....	25
4.2 PROM Write Procedure .....	26
4.3 PROM Read Procedure .....	27
<b>5. EPROM ERASE (ONLY PACKAGE PRODUCTS WITH CERAMIC WINDOW).</b>	29
<b>6. WINDOW SEAL     (ONLY FOR PACKAGE PRODUCTS WITH CERAMIC WINDOW)</b> .....	30
<b>7. ONE-TIME PROM PRODUCT SCREENING</b> .....	31
<b>8. ELECTRICAL SPECIFICATIONS</b> .....	32
<b>9. CHARACTERISTIC CURVES (REFERENCE VALUE)</b> .....	51
<b>10. PACKAGE INFORMATION</b> .....	54

	<u>Page</u>
11. RECOMMENDED CONDITIONS FOR SOLDERING .....	61
12. DIFFERENCES BETWEEN $\mu$ PD78CP14 AND MASK ROM PRODUCTS .....	63
APPENDIX A DEVELOPMENT TOOLS .....	64
★ APPENDIX B PACKAGE INFORMATION OF CONVERSION SOCKETS AND RECOMMENDED PATTERNS FOR BOARD FIXING .....	66

## 1. PIN FUNCTIONS

### 1.1 Port Functions

Pin name	I/O	Function
PA7-0 (Port A)	I/O	8-bit input/output port. Input or output can be specified for each bit.
PB7-0 (Port B)		
PC7-0 (Port C)		
PD7-0 (Port D)		8-bit input/output port. Input or output can be specified for each byte.
PF7-0 (Port F)		8-bit input/output port. Input or output can be specified for each bit.

**Remarks** In these port pins, there are dual function pins described in 1.2 (at normal operation) and 1.3 (at PROM writing/verify/reading)

## 1.2 Functions Other Than Ports (During Normal Operation)

Pin name	I/O	Other uses	Function
TxD (Transmit data)	O	PC0	Serial data output pin.
RxD (Receive data)	I	PC1	Serial data input pin.
$\overline{\text{SCK}}$ (serial clock)	I/O	PC2	Serial clock input/output pin. When the internal clock is used, this line functions as an output and when an external clock source is used, this line functions as an input.
$\overline{\text{INT2}}$ (Interrupt request)	I	PC3	Maskable interrupt input (rising-edge triggered.)
TI (Timer input)	I		Timer external clock input pin.
Zero-cross	I		Zero cross detection pin of AC input.
TO (Timer output)	O	PC4	Square wave with pulse width of one internal clock cycle for timer count reference used as a half-cycle output.
CI (Counter input)	I	PC5	External pulse input pin to timer/event counter.
CO0, 1 (Counter output 0, 1)	O	PC6,7	Programmable square wave output according to timer/event counter.
AD7-0 (Address/data bus 7-0)	I/O	PD7-0	These lines are used as a multiplexed address/data bus with external memory.
AB15-8 (Address bus 15-8)	O	PF7-0	These lines are used as an address bus with external memory.
$\overline{\text{WR}}$ (Write strobe)	O		Store signal output for external memory write operation. This signal is HIGH except during external memory data write cycles. When the $\overline{\text{RESET}}$ signal is LOW or the hardware STOP mode is engaged, this line is placed in a high-impedance state.

Pin name	I/O	Other uses	Function
$\overline{RD}$ (Read strobe)	0		Strobe signal output for external memory read operation. This signal is HIGH except during external memory read cycles. When the $\overline{RESET}$ signal is LOW or the hardware STOP mode is engaged, this line is placed in a high-impedance state.
ALE (Address latch enable)	0		This line is used for the strobe signal to externally latch the lower-order address on the PD7-PD0 lines for external memory access. When the $\overline{RESET}$ signal is LOW or the hardware STOP mode is engaged, this line is placed in a high-impedance state.
MODE0 MODE1 (Mode)	I/O I/O		Set the MODE0 pin to 0 (low level) and the MODE1 pin to 1 (high level) (Note 1.)
$\overline{NMI}$ (Non-maskable interrupt)	I		Nonmaskable interrupt input (falling-edge triggered).
INT1 (Interrupt request)	I		Maskable interrupt input (rising-edge triggered.) This line can also be used for AC input zero cross detection.
AN7-0 (Analog input)	I		8-line analog input to A/D converter. Lines AN7-AN4 provide edge falling-edge detection input.
$V_{AREF}$ (Reference voltage)	I		For use as both A/D converter reference voltage and A/D converter operation control.
$AV_{DD}$ (Analog $V_{DD}$ )			Power supply line for A/D converter.
$AV_{SS}$ (Analog $V_{SS}$ )			GND potential for A/D converter.
X1, X2 (Crystal)			Crystal-oscillator input for system clock timing. When an external clock source is used, the timing pulses are input on X1. The X1 inversion signal is input to X2.

Note Pull up. Pull-up resistance R is  $4 \leq R \leq 0.4 t_{CYC}$  [k $\Omega$ ]  
( $t_{CYC}$ : ns units)

Pin name	I/O	Other uses	Function
$\overline{\text{RESET}}$ (Reset)	I		System reset (active-low) input. Input line for hardware STOP mode control signal. When a low level is input, oscillation stops.
$\overline{\text{STOP}}$ (Stop)	I		Input line for hardware STOP mode control signal. When a low level is input, oscillation stops.
$V_{DD}$			+5 V power supply line.
$V_{SS}$			GND potential line.

### 1.3 Functions Other Than Ports (During PROM Write, Verify, Read)

Pin name	I/O	Other uses	Function
A7-0	I	PA7-0	Low-order eight-bit input pins of address.
$\overline{\text{CE}}$	I	PB6	Chip enable signal input pin.
$\overline{\text{OE}}$	I	PB7	Output enable signal input pin.
O7-0	I/O	PD7-0	Data input/output pins.
A13-10 A8	I	PF5-2 PF0	High-order 6-bit input pins address.
A9	I	$\overline{\text{NMI}}$	
MODE0 MODE1	I		Set the MODE0 pin to 1 (high) and the MODE1 pin to 0 (low).
$\overline{\text{RESET}}$	I		Set the RESET pin to 0 (low).
$V_{PP}$		$\overline{\text{STOP}}$	High voltage apply pin. When EPROM is read, high level (1) is input.

★ **Caution** Input low level for PF6 during PROM write, verify, read.

#### 1.4 Recommended Conditions for Unused Pin

Pin	Recommended connection
PA7-0 B7-0 C7-0 PD7-0 PF7-0	Connect to $V_{DD}$ or $V_{SS}$ via resistor.
$\overline{RD}$ $\overline{WR}$ ALE	Open
$\overline{STOP}$	Connect to $V_{DD}$
INT1, $\overline{NMI}$	Connect to $V_{DD}$ or $V_{SS}$
$AV_{DD}$	Connect to $V_{DD}$
$V_{AREF}$ $AV_{SS}$	Connect to $V_{SS}$
AN7-0	Connect to $AV_{SS}$ or $AV_{DD}$

## 2. MEMORY CONFIGURATION

$\mu$ PD78CP14 memory can be operated in any of the following three modes as specified:

- o  $\mu$ PD78C11A mode (see Figure 2-1)
- o  $\mu$ PD78C12A mode (see Figure 2-2)
- o  $\mu$ PD78C14 mode (see Figure 2-3)

In addition, the internal PROM address range can be specified to map external memory (except PROM) efficiently (See 3.2).

The vector area, call table area, and internal RAM are common to all the modes.

Internal RAM data can be retained with low consumption current by setting the hardware or software STOP mode or the HALT mode.



Figure 2-1. Memory Map ( $\mu$ PD78C11A Mode)

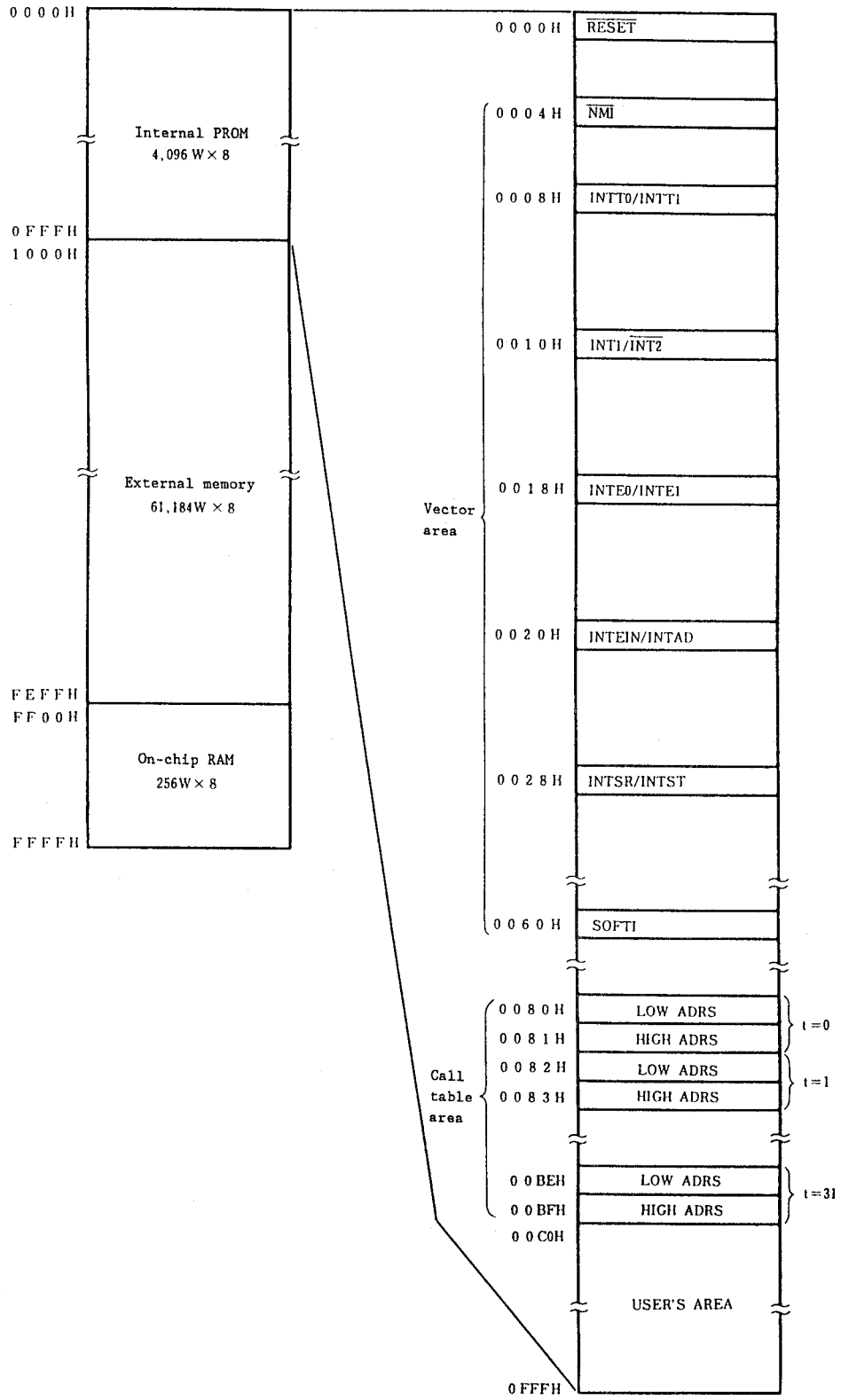


Figure 2-2. Memory Map ( $\mu$ PD78C12A Mode)

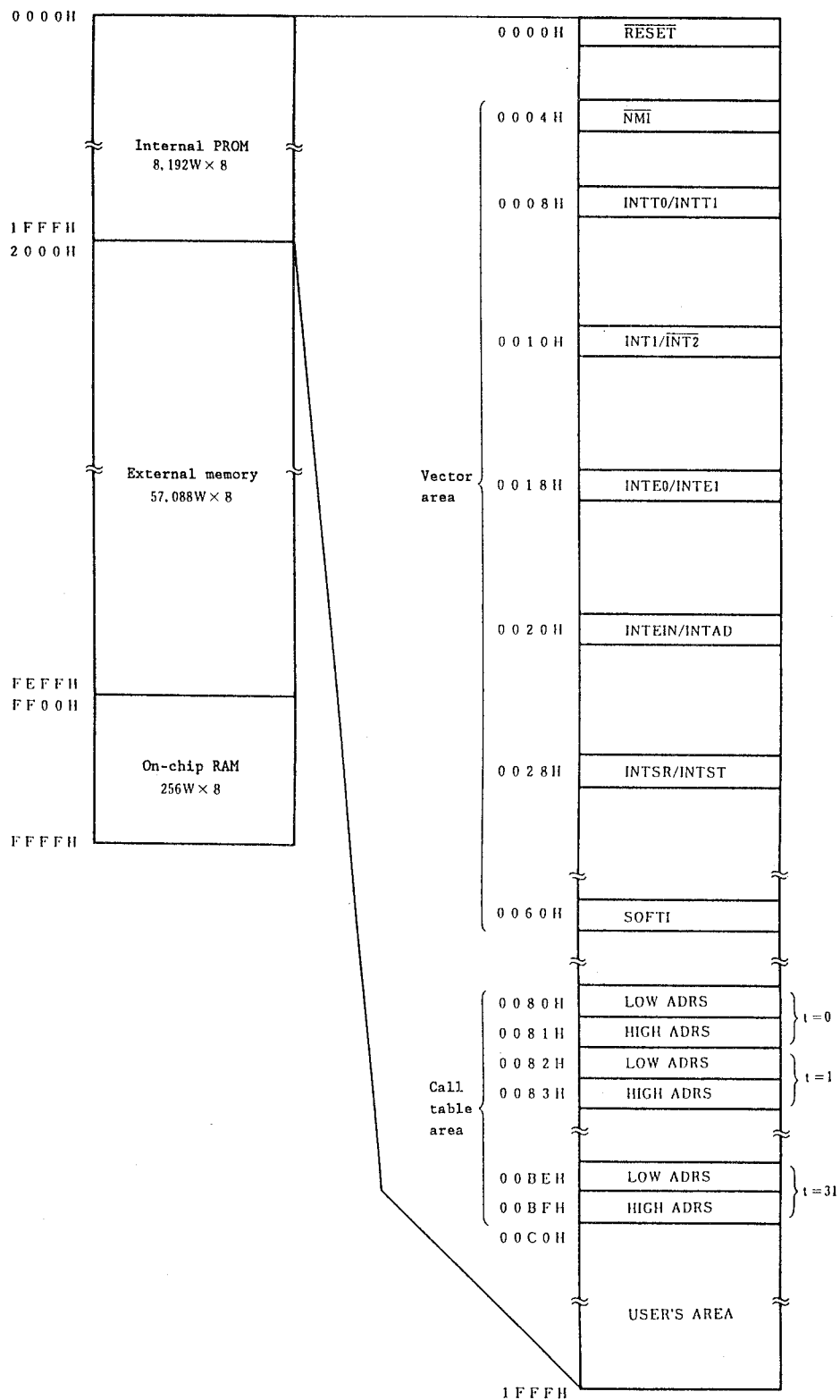
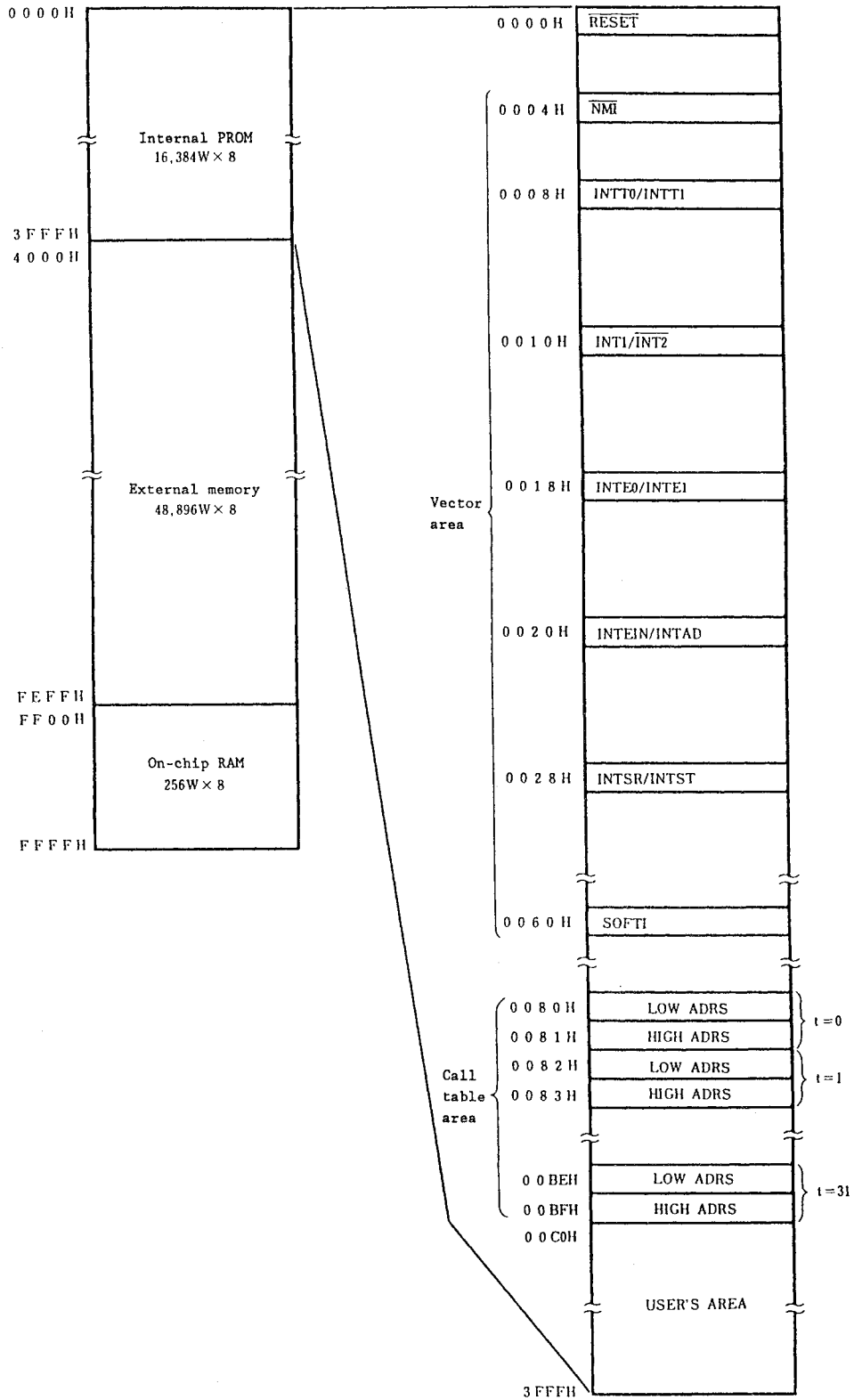


Figure 2-3. Memory Map ( $\mu$ PD78C14 Mode)



### 3. MEMORY EXTENSION

The  $\mu$ PD78CP14 enables external memory extension by using the MEMORY MAPPING register (MM) or the MODE0 and MODE1 pins. The internal PROM access range can be specified by using MEMORY MAPPING register bits 7 and 6.

#### 3.1 MODE Pins

The  $\mu$ PD78CP14 enables the user to change the programming mode and normal operation mode by setting the MODE0 and MODE1 pins.

Table 3-1 lists mode setting by using the MODE pins.

**Table 3-1 Mode Setting by Using MODE Pins**

MODE1	MODE0	Operation mode
L	L	Setting prohibited
L	H	Programming mode (Note)
H	L	Normal operation mode
H	H	Setting prohibited

**Note** See 4.

To make the MODE0 and MODE1 pins high, use pull-up resistor of  $4 \leq R \leq 0.4 t_{CYC}[k \text{ ohms}]$  ( $t_{CYC}$ : ns units).

### 3.2 MEMORY MAPPING Register (MM)

The MEMORY MAPPING register is an 8-bit register used for the following control:

- PD7-PD0, PF7-PF0 port/extension mode specification.
- Control as to whether or not internal RAM access is enabled.
- Internal PROM access range specification

Figure 3-1 shows the MEMORY MAPPING register format.

#### (1) MM0-MM2 bits

The MM0-MM2 bits are used to PD7-PD0 port/extension mode, input/output, PF7-PF0 address output specification.

As shown in Figure 3-1, the capacity of external memory that can be connected to the  $\mu$ PD78CP14 can be selected among the following four types:

- 256 bytes
- 4K bytes
- 16K bytes
- 48K, 56K, or 60K bytes (according to how MM6 and MM7 bits are set)

The PF7-PF0 port pins not used for address output can be used as general purpose port pins.

When  $\overline{\text{RESET}}$  is input or the hardware STOP mode is entered, the bits are cleared and the PD7-PD0 pins are used as an input port (output high impedance).

**(2) MM3 bit (RAE)**

The MM3 bit is used to specify whether internal RAM access is enabled (RAE=1) or not (RAE=0).

When standby operation is performed or external RAM connected is used without using internal RAM, set the MM3 bit to "0".

Even if  $\overline{\text{RESET}}$  is input during normal operation, the bit contents are held. However, the RAE bit becomes undefined at power on reset, thus the bit must be initialized by using an instruction.

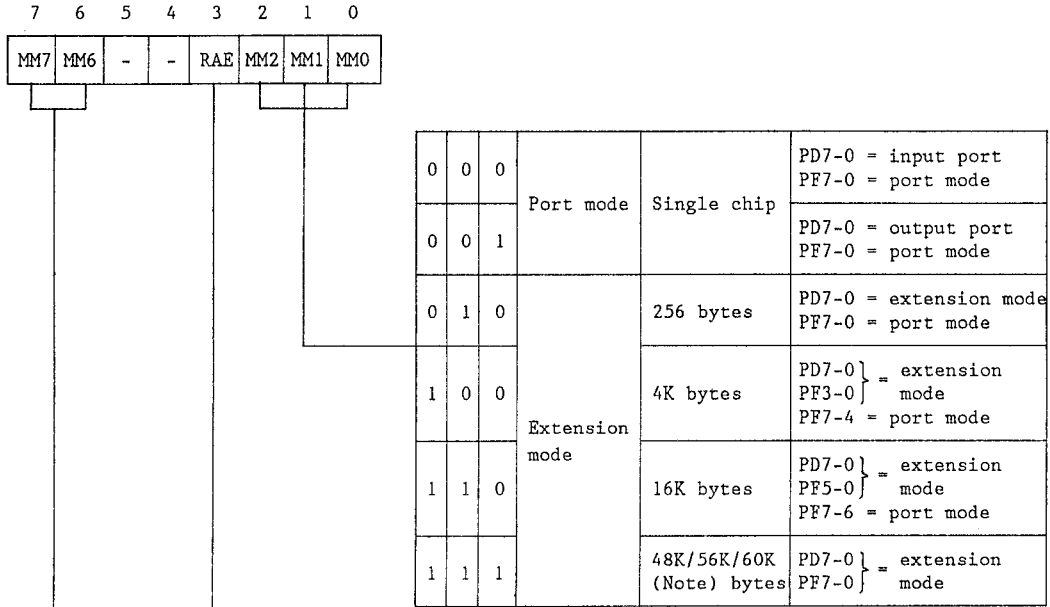
**(3) MM6 and MM7 bits**

The MM6 and MM7 bits are used to specify the internal PROM access range.

When  $\overline{\text{STOP}}$  or  $\overline{\text{RESET}}$  is input, the MM6 and MM7 bits are cleared and the 16K-byte mode ( $\mu\text{PD78C14}$  mode) is selected.

The bits are effective only for the  $\mu\text{PD78CP14}$  and 78CG14. When data is written into the bits on the  $\mu\text{PD78C11A}$ , 78C12A/14, or 78C14 the CPU ignores it. Therefore, the programs developed on the  $\mu\text{PD78CP14}$  can be moved to mask ROM as they are.

Figure 3-1. MEMORY MAPPING Register Format



**Note** According to how the MM7 and MM6 bits are set.

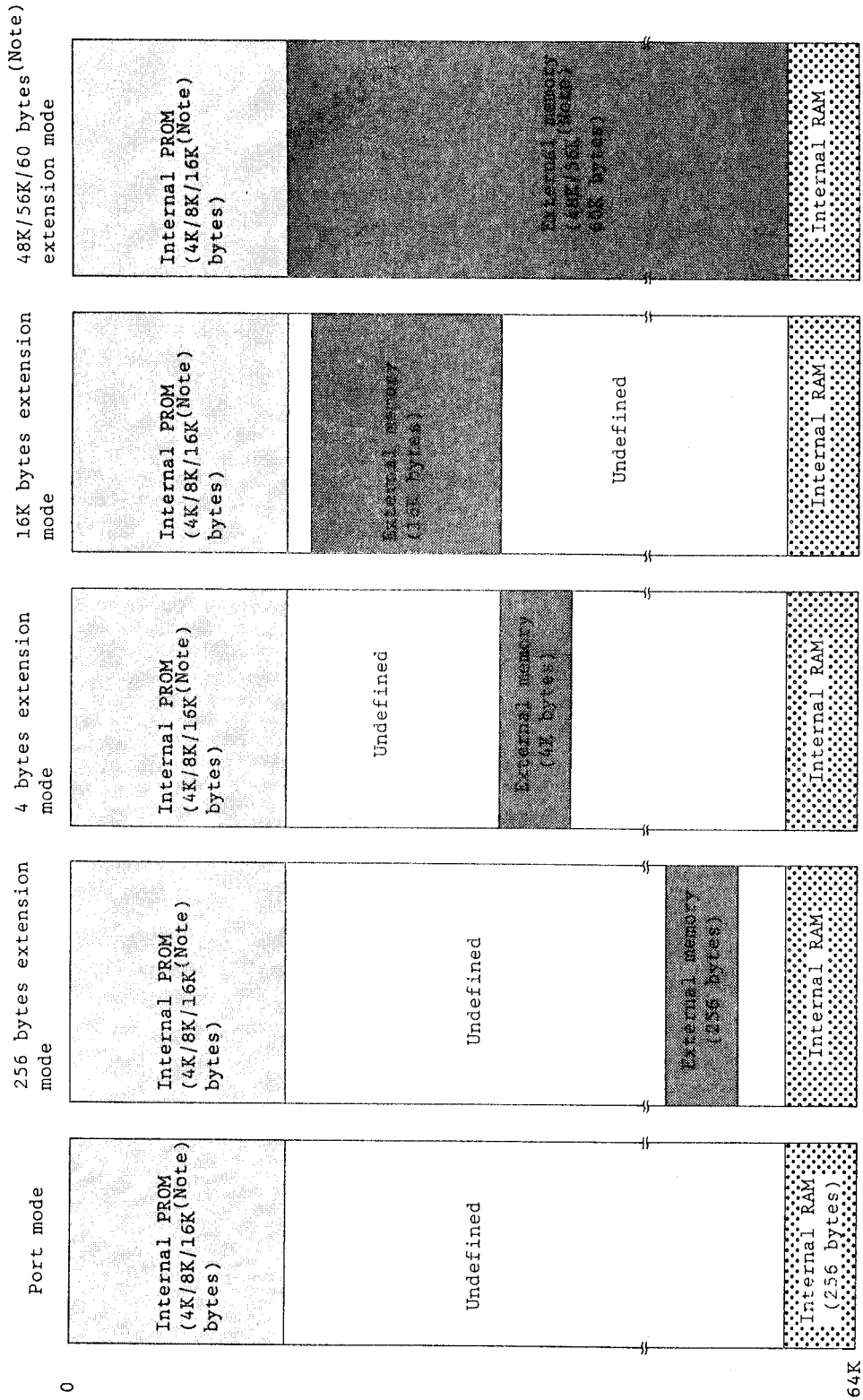
**Internal RAM access**

0	Disable
1	Enable

**Internal PROM access**

0	0	Access to the 0000H-3FFFH address area of internal PROM ( $\mu$ PD78C14 mode)
0	1	Access to the 0000H-1FFFH address area of internal PROM ( $\mu$ PD78C12A mode)
0	1	Access to the 0000H-0FFFH address area of internal PROM ( $\mu$ PD78C11A mode)
1	1	Setting prohibited

**Figure 3-2. External Extension Mode Set by Using MEMORY MAPPING Register**



**Note** The capacity can be selected among the three types by setting the MM6 and MM7 bits.



#### 4. PROM PROGRAMMING

The  $\mu$ PD78CP14 contains 16384 x 8 bit PROM for internal program memory. Table 4-1 lists the pins used to write and verify the PROM.

The  $\mu$ PD78CP14 programming timing is compatible with the  $\mu$ PD27C256A programming timing.

Also refer to the  $\mu$ PD27C256A documents.

**Table 4-1. Pin Functions in PROM Programming**

Pin name	Function
$\overline{\text{RESET}}$	Low level input (during write/verify, read)
MODE0	High level input (during write/verify, read)
MODE1	Low level input (during write/verify, read)
PF6	Low level input (during write/verify, read)
$V_{\text{PP}}$ <sup>Note</sup>	High voltage input (during write/verify), high level input (during read)
$\overline{\text{CE}}$ <sup>Note</sup>	Chip enable input
$\overline{\text{OE}}$ <sup>Note</sup>	Output enable input
A13-0 <sup>Note</sup>	Address input
07-0 <sup>Note</sup>	Data input (during write, data output (during verify/read)
$V_{\text{DD}}$ <sup>Note</sup>	Supply voltage input

**Note** These pins are compatible with the  $\mu$ PD27C256A pins.

**Cautions 1.** Cover the  $\mu$ PD78CP14 containing an erasion window with shading cover film except in EPROM erasion.

2. The  $\mu$ PD78CP14 of one time PROM product which does not contain an erasion window cannot be erased with ultraviolet rays.
3. The  $\mu$ PD78CP14 does not contain memory at 4000H-7FFFH.  
If read operation is performed, FFH is always read.

To program in the  $\mu$ PD27C256A,

- (1) set PROM programmer 4000H-7FFFH buffer to all FFH; or
- (2) program the ROM 0000H-3FFFH area only.

#### 4.1 PROM Programming Operation Mode

The PROM programming operation mode is set as listed in Table 4-2. At the time, treat every pin not used for programming as listed in Table 4-3.

**Table 4-2. EPROM Programming Mode**

Operation mode	(Note) $\overline{\text{CE}}$	(Note) $\overline{\text{OE}}$	(Note) $V_{\text{PP}}$	(Note) $V_{\text{DD}}$	$\overline{\text{RESET}}$	MODE0	MODE1	PF6
Program	L	H	+12.5 V	+6 V	L	H	L	L
Program verify	H	L						
Program inhibit	H	H						
Read	L	L	+5 V	+5 V				
Output disable	L	H						
Standby	H	L/H						

**Note** These pins are compatible with the  $\mu\text{PD27C256A}$  pins.

**Caution** When  $V_{\text{PP}}$  is set to +12.5 V and  $V_{\text{DD}}$  is set to +6 V, both  $\overline{\text{CE}}$  and  $\overline{\text{OE}}$  must not be set L simultaneously.

**Table 4-3. Recommended Conditions for Unused Pins  
(in PROM programming mode)**

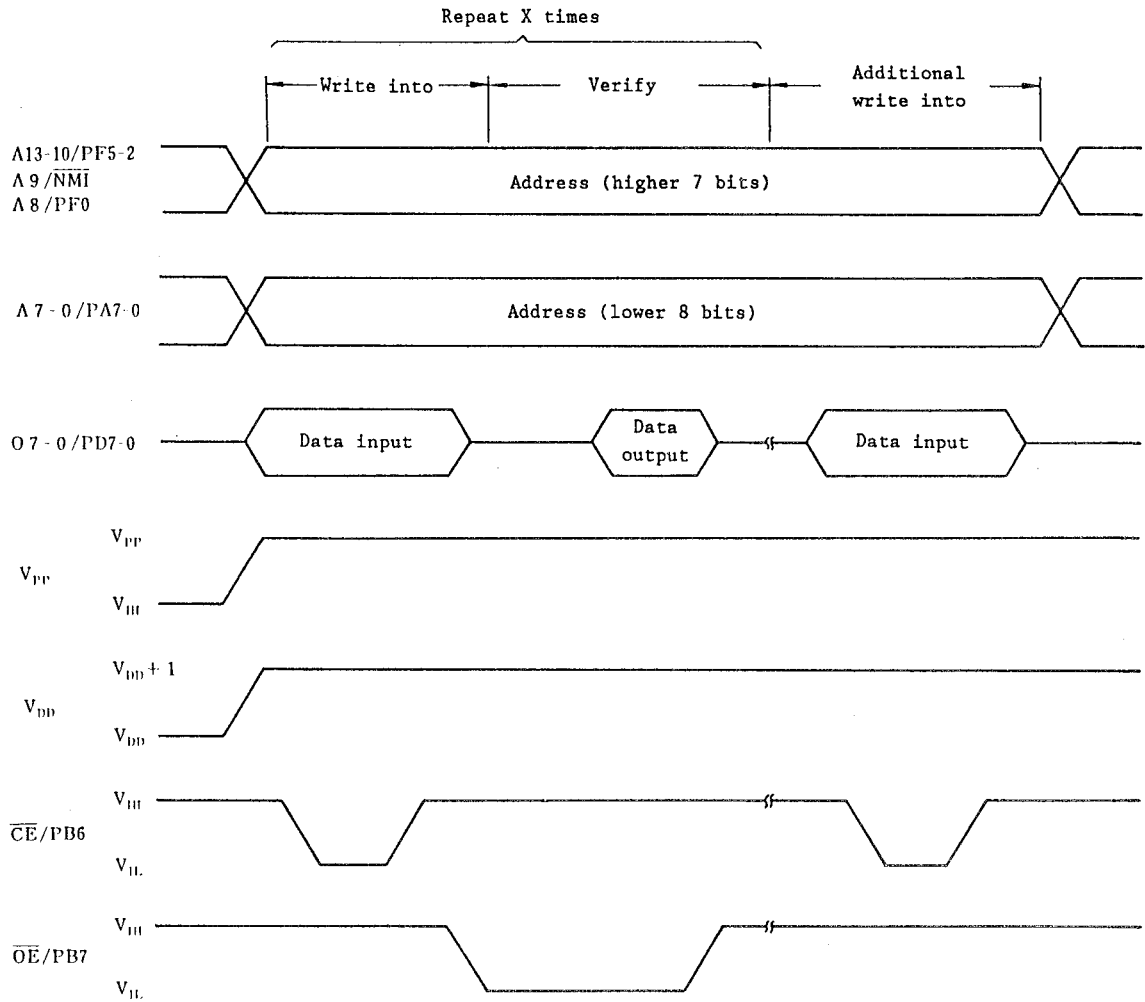
Pin	Recommended connection method
INT1	Connect to $V_{\text{SS}}$
X1	
AN0-7	
$V_{\text{AREF}}$	
$V_{\text{DD}}$	
$V_{\text{SS}}$	
Pins except above	
X2	Open

## 4.2 PROM Write Procedure

Data is written into PROM according to the following procedure:  
(High speed write is enabled.)

- (1) Pull down unused pins to  $V_{SS}$  via a resistor and supply +6 V to  $V_{DD}$  and +12.5 V to  $V_{PP}$ .
- (2) Supply initial address.
- (3) Supply write data.
- (4) Supply 1 ms program pulse (active low) to the  $\overline{CE}$  pin.
- (5) Verify mode. If data is written, proceed to (7). If data is not written, repeat (3) to (5). If data cannot be written after the steps are repeated 25 times, proceed to (6).
- (6) Judge that the EPROM is a faulty device. Stop write operation.
- (7) Supply write data. Supply X (number of (3)-(5) repetitions) x 3 ms program pulse (additional write).
- (8) Increment the address.
- (9) Repeat (3) to (8) until the last address is reached.

Figure 4-1. PROM Write/Verify Timing



### 4.3 PROM Read Procedure

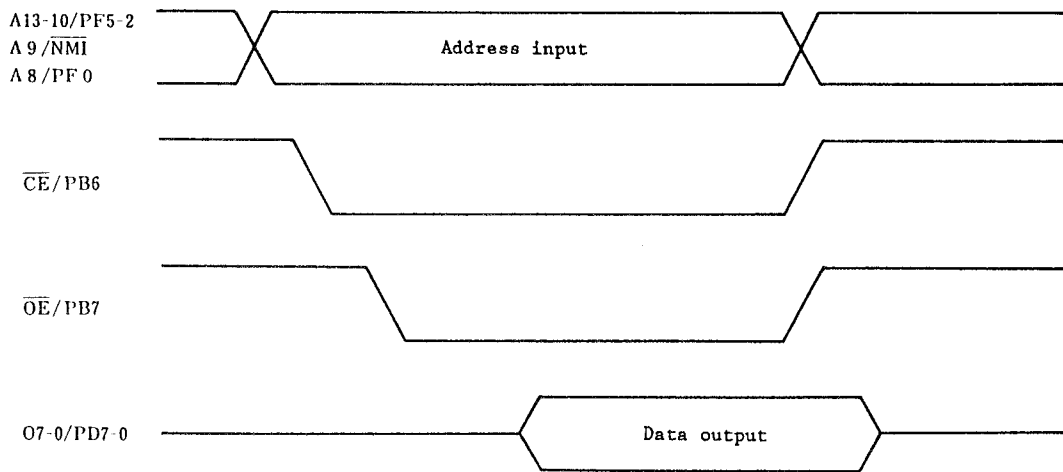
The PROM contents can be read onto the external data bus (07-00) according to the following procedure:

- (1) Pull down THE unused pins to GND via a resistor.
- (2) Supply 5 V to the  $V_{DD}$  and  $V_{PP}$  pins.

- (3) Input the address of the data to be read to the A13-A0 pins.
- (4) Read mode
- (5) Output data to the 07-00 pins.

Figure 4-2 shows the (2) to (5) timing.

**Figure 4-2. PROM Read Timing**



## 5. EPROM ERASE (ONLY PACKAGE PRODUCTS WITH CERAMIC WINDOW)

The  $\mu$ PD78CP14 enables the programmed EPROM data contents to be erased by light rays whose wavelength is shorter than about 400 nm. The programmed EPROM data contents may also be erased if the uncovered window is exposure to direct sunlight or a fluorescent light for several hours. Thus, to protect the data contents, cover the  $\mu$ PD78CP14 with an opaque film so as to prevent ultraviolet rays from entering it through the top window. Shading cover film whose quality is guaranteed is attached to the package product with a window containing EPROM by NEC for shipping.

For normal EPROM erase, place the  $\mu$ PD78CP14 under an ultraviolet light source (254 nm). The minimum amount of radiation exposure required to erase the  $\mu$ PD78CP14 completely is  $15 \text{ W.s/cm}^2$  (ultraviolet ray strength x erase time). This corresponds to about 15 to 20 minutes when using a ultraviolet ray lamp of  $12000 \text{ uW/cm}^2$ . However, note that the erase time may be prolonged by aging of the ultraviolet lamp, dirty package window, etc. The distance between the ultraviolet lamp and the  $\mu$ PD78CP14 should be within 2.5 cm.

**6. WINDOW SEAL (ONLY FOR PACKAGE PRODUCTS WITH CERAMIC WINDOW)**

To prevent light other than EPROM erasion lamps from causing an error or light from causing the internal circuitry other than EPROM to malfunction, put a protective seal on the window except when the EPROM contents are erased.



## 7. ONE-TIME PROM PRODUCT SCREENING

The one-time PROM products ( $\mu$ PD78CP14CW, 78CP14G-36, 78CP14GF-3BE, and 78CP14L) cannot be completely tested by NEC prior to shipment because of the structures. For screening, it is recommended to verify PROM after storing the necessary data under a storage temperature of 125 and a storage time of 24 hours after writing the data.

NEC has a service of one-time PROM write to scaling to screening to verification for pay under the name of QTOP MICON. For details, ask the salesperson.

## 8. ELECTRICAL SPECIFICATIONS

The  $\mu$ PD78CP14 has a few differences as follows in electric between one-time PROM product and EPROM product. There is no different electric specifications other than the parameters listed in Table 8-1.

★ **Table 8-1. Differences in Electric Specifications between One-time PROM Product and EPROM Product**

Products Parameter	One-time PROM Product			EPROM product		
	Conditions	TYP.	MAX.	Conditions	TYP.	MAX.
Operation power supply voltage range ( $V_{DD}$ )	5 V $\pm$ 10 %			5 V $\pm$ 5 %		
Data retention current ( $I_{DDDR}$ )	$V_{DDDR} = 2.5$ V	1 $\mu$ A	15 $\mu$ A	$V_{DDDR} = 2.5$ V		300 $\mu$ A
	$V_{DDDR} = 5$ V $\pm$ 10 %	10 $\mu$ A	50 $\mu$ A	$V_{DDDR} = 5$ V $\pm$ 5 %		1 mA

**Absolute Maximum Ratings** ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Test condition	Ratings	Unit
Power supply voltage	$V_{DD}$		-0.5 to +7.0	V
	$AV_{DD}$		$AV_{SS}$ to $V_{DD}+0.5$	V
	$AV_{SS}$		-0.5 to +0.5	V
	$V_{PP}$		-0.5 to +13.5	V
Input voltage	$V_I$	Except for $\overline{NMI}/A9$ pin	-0.5 to $V_{DD}+0.5$	V
		$\overline{NMI}/A9$ pin	-0.5 to +13.5	V
Output voltage	$V_O$		-0.5 to $V_{DD}+0.5$	V
Output low current	$I_{OL}$	All outputs	4.0	mA
		Total, all outputs	100	mA
Output high current	$I_{OH}$	All outputs	-2.0	mA
		Total, all outputs	-50	mA
A/D converter reference input voltage	$V_{AREF}$		-0.5 to $AV_{DD}+0.3$	V
Operation temperature	$T_{opt}$		-40 to +85	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-65 to +150	$^\circ\text{C}$

★ **Oscillator Characteristics**

(One time PROM product): ( $T_a = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{DD} = 5.0\text{ V} \pm 10\%$ ,  $V_{SS} = AV_{SS} = 0\text{ V}$ ,  $V_{DD} - 0.8\text{ V} \leq AV_{DD} \leq V_{DD}$ ,  $3.4\text{ V} \leq V_{AREF} \leq AV_{DD}$ )

(EPROM product): ( $T_a = -40$  to  $+85^{\circ}\text{C}$ ,  $V_{DD} = +5.0\text{ V} \pm 5\%$ ,  $V_{SS} = AV_{SS} = 0\text{ V}$ ,  $V_{DD} - 0.8\text{ V} \leq AV_{DD} \leq V_{DD}$ ,  $3.4\text{ V} \leq V_{AREF} \leq AV_{DD}$ )

Resonator	Recommended circuit	Parameter	Test condition	MIN.	MAX.	Unit
Ceramic or crystal resonator		Oscillation frequency ( $f_{xx}$ )		6	15	MHz
External clock		X1 input frequency ( $f_x$ )		6	15	MHz
		X1 input rise, fall time ( $t_r, t_f$ )		0	20	ns
		X1 input high, low level width ( $t_{\phi H}, t_{\phi L}$ )		20	167	ns

- Caution 1. Put the oscillator close to the X1 and X2 pins as much as possible.
2. Do not pass any other signal line through the shaded region.

**Capacitance** ( $T_a = 25^\circ\text{C}$ ,  $V_{DD} = V_{SS} = 0\text{ V}$ )

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input capacitance	$C_I$	$f_C = 1\text{ MHz}$ Unmeasured pins returned to 0 V			10	pF
Output capacitance	$C_O$				20	pF
Input/output capacitance	$C_{IO}$				20	pF

**DC Characteristics**

(One time PROM product): ( $T_a = -40$  to  $+85^\circ\text{C}$ ,  $V_{DD} = AV_{DD} = +5.0\text{ V} \pm 10\%$ ,  $V_{SS} = AV_{SS} = 0\text{ V}$ ) ★

(EPROM product) : ( $T_a = -40$  to  $+85^\circ\text{C}$ ,  $V_{DD} = AV_{DD} = +5.0\text{ V} \pm 5\%$ ,  $V_{SS} = AV_{SS} = 0\text{ V}$ )

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input low voltage	$V_{IL1}$	Except for $\overline{\text{RESET}}$ , $\overline{\text{STOP}}$ , $\overline{\text{NMI}}$ , $\overline{\text{SCK}}$ INT1, TI, or AN4-AN7	0		0.8	V
	$V_{IL2}$	$\overline{\text{RESET}}$ , $\overline{\text{STOP}}$ , $\overline{\text{NMI}}$ , $\overline{\text{SCK}}$ , INT1, TI, or AN4-AN7	0		$0.2V_{DD}$	V
Input high voltage	$V_{IH1}$	Except for $\overline{\text{RESET}}$ , $\overline{\text{STOP}}$ , $\overline{\text{NMI}}$ , $\overline{\text{SCK}}$ INT1, TI, AN4-AN7, X1, or X2	2.2		$V_{DD}$	V
	$V_{IH2}$	$\overline{\text{RESET}}$ , $\overline{\text{STOP}}$ , $\overline{\text{NMI}}$ , $\overline{\text{SCK}}$ , INT1, TI, AN4-AN7, X1, or X2	$0.8V_{DD}$		$V_{DD}$	V
Output low voltage	$V_{OL}$	$I_{OL} = 2.0\text{ mA}$			0.45	V
Output high voltage	$V_{OH}$	$I_{OH} = -1.0\text{ mA}$	$V_{DD}-1.0$			V
		$I_{OH} = -100\ \mu\text{A}$	$V_{DD}-0.5$			V
Input current	$I_I$	INT1 (Note 1), TI(PC3) (Note 2); $0\text{ V} \leq V_I \leq V_{DD}$			$\pm 200$	$\mu\text{A}$
Input leakage current	$I_{LI}$	Except for INT1, TI(PC3); $0\text{ V} \leq V_I \leq V_{DD}$			$\pm 10$	$\mu\text{A}$
Output leakage current	$I_{LO}$	$0\text{ V} \leq V_O \leq V_{DD}$			$\pm 10$	$\mu\text{A}$
$AV_{DD}$ power supply current	$AI_{DD1}$	Operating mode $f_{XX} = 15\text{ MHz}$		0.5	1.3	mA
	$AI_{DD2}$	STOP mode		10	20	$\mu\text{A}$

(to be continued)

(Cont'd)

Parameter	Symbol	Test condition		MIN.	TYP.	MAX.	Unit	
V <sub>DD</sub> power supply current	I <sub>DD1</sub>	Operating mode f <sub>XX</sub> = 15 MHz			16	32	mA	
	I <sub>DD2</sub>	HALT mode f <sub>XX</sub> = 15 MHz			8	15	mA	
Data retention voltage	V <sub>DDDR</sub>	Hardware or software STOP mode		2.5			V	
★ ★ Data retention current	I <sub>DDDR</sub>	Hardware/ Software (Note 3) STOP mode	One-time PROM product	V <sub>DDDR</sub> = 2.5 V		1	15	μA
				V <sub>DDDR</sub> = 5 V ± 10%		10	50	μA
			EPROM product	V <sub>DDDR</sub> = 2.5 V			300	μA
				V <sub>DDDR</sub> = 5 V ± 10%			1	mA

**Note 1.** Assume that self-bias is generated by setting the ZCM register.

2. Assume that self-bias is generated by setting the ZCM register when the control mode is set in the MCC register.

3. When self-bias is not generated.

## AC Characteristics

(One-time PROM product: (Ta = -40°C to +85°C, V<sub>DD</sub> = AV<sub>DD</sub> = +5.0 V ±10%, V<sub>SS</sub> = AV<sub>SS</sub> = 0 V)

(EPROM product : (Ta = -40°C to +85°C, V<sub>DD</sub> = AV<sub>DD</sub> = +5.0 V ±5%, V<sub>SS</sub> = AV<sub>SS</sub> = 0 V)

## Read/write Operation:

Parameter	Symbol	Test condition	MIN.	MAX.	Unit
X1 input cycle time	t <sub>CYC</sub>		66	167	ns
Address setup time to ALE ↓	t <sub>AL</sub>		30		ns
Address hold time from ALE ↓	t <sub>LA</sub>	f <sub>XX</sub> =15 MHz, CL=150 pF	35		ns
Address → $\overline{RD}$ ↓ delay time	t <sub>AR</sub>		100		ns
$\overline{RD}$ ↓ → address float time	t <sub>AFR</sub>	C <sub>L</sub> =150 pF		20	ns
Address → data input time	t <sub>AD</sub>			250	ns
ALE ↓ → data input time	t <sub>LDR</sub>	f <sub>XX</sub> =15 MHz, CL=150 pF		135	ns
$\overline{RD}$ ↓ → data input time	t <sub>RD</sub>			120	ns
ALE ↓ → $\overline{RD}$ ↓ delay time	t <sub>LR</sub>		15		ns
Data hold time from $\overline{RD}$ ↑	t <sub>RDH</sub>	CL=150 pF	0		ns
$\overline{RD}$ ↑ → ALE ↑ delay time	t <sub>RL</sub>	f <sub>XX</sub> =15 MHz, CL=150 pF	80		ns
$\overline{RD}$ low level width	t <sub>RR</sub>	When data is read f <sub>XX</sub> =15 MHz, CL=150 pF	215		ns
		When OP code is fetched f <sub>XX</sub> =15 MHz, CL=150 pF	415		ns
ALE high level width	t <sub>LL</sub>	f <sub>XX</sub> =15 MHz, CL=150 pF	90		ns
Address → $\overline{WR}$ ↓ delay time	t <sub>AW</sub>	f <sub>XX</sub> =15 MHz, CL=150 pF	100		ns
ALE ↓ → data output time	t <sub>LDW</sub>			180	ns
$\overline{WR}$ ↓ → data output time	t <sub>WD</sub>	CL=150 pF		100	ns
ALE ↓ → $\overline{WR}$ ↓ delay time	t <sub>LW</sub>		15		ns
Data setup time to $\overline{WR}$ ↑	t <sub>DW</sub>		165		ns
Data hold time from $\overline{WR}$ ↑	t <sub>WDH</sub>	f <sub>XX</sub> =15 MHz, CL=150 pF	60		ns
$\overline{WR}$ ↑ → ALE ↑ delay time	t <sub>WL</sub>		80		ns
$\overline{WR}$ low level width	t <sub>WW</sub>		215		ns

### Zero-cross Characteristics:

Parameter	Symbol	Test condition	MIN.	MAX.	Unit
Zero-cross detection input	$V_{ZX}$	AC coupling	1	1.8	$V_{AC_{P-P}}$
Zero-cross accuracy	$A_{ZX}$	60-Hz sine wave		$\pm 135$	mV
Zero-cross detection input frequency	$f_{ZX}$		0.05	1	kHz

### Serial Operation:

Parameter	Symbol	Test condition	MIN.	MAX.	Unit
$\overline{SCK}$ cycle time	$t_{CYK}$	$\overline{SCK}$ input (Note 1)	800		ns
		$\overline{SCK}$ input (Note 2)	400		ns
		$\overline{SCK}$ output	1.6		$\mu s$
$\overline{SCK}$ low level width	$t_{KKL}$	$\overline{SCK}$ input (Note 1)	335		ns
		$\overline{SCK}$ input (Note 2)	160		ns
		$\overline{SCK}$ output	700		ns
$\overline{SCK}$ high level width	$t_{KKH}$	$\overline{SCK}$ input (Note 1)	335		ns
		$\overline{SCK}$ input (Note 2)	160		ns
		$\overline{SCK}$ output	700		ns
RxD setup time to $\overline{SCK}$ $\uparrow$	$t_{RXK}$	(Note 1)	80		ns
RxD hold time from $\overline{SCK}$ $\uparrow$	$t_{KRX}$	(Note 1)	80		ns
$\overline{SCK}$ $\downarrow \rightarrow$ TxD delay time	$t_{KTX}$	(Note 1)		210	ns

**Notes 1.** When the clock rate is x1 in the asynchronous mode or the synchronous mode or I/O interface mode is set

**2.** When the clock rate is x16 or x64 in the asynchronous mode

★ **Remark** The numeric values in the table apply when  $f_{XX} = 15$  MHz,  $C_L = 150$ pF.



Other Operations:

Parameter	Symbol	Test condition	MIN.	MAX.	Unit
TI high, low level width	$t_{TIH}$ , $t_{TIL}$		6		$t_{CYC}$
CI high, low level width	$t_{CI1H}$ , $t_{CI1L}$	<ul style="list-style-type: none"> <li>o Event count mode</li> <li>o Frequency measurement mode</li> </ul>	6		$t_{CYC}$
	$t_{CI2H}$ , $t_{CI2L}$	<ul style="list-style-type: none"> <li>o Pulse width measurement mode</li> <li>o ECNT latch, clear input</li> <li>o INTEIN set input</li> </ul>	48		$t_{CYC}$
$\overline{NMI}$ high, low level width	$t_{NIH}$ , $t_{NIL}$		10		us
INT1 high, low level width	$t_{I1H}$ , $t_{I1L}$		36		$t_{CYC}$
$\overline{INT2}$ high, low level width	$t_{I2H}$ , $t_{I2L}$		36		$t_{CYC}$
AN4-7 high, low level width	$t_{ANH}$ , $t_{ANL}$		36		$t_{CYC}$
$\overline{RESET}$ high, low level width	$t_{RSH}$ , $t_{RSL}$		10		us

★

## A/D Converter Characteristics

(One-time PROM product: ( $T_a = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{DD} = 5.0\text{V} \pm 10\%$ ,  $V_{SS} = AV_{SS} = 0\text{V}$ ,  $V_{DD} - 0.8\text{V} \leq AV_{DD} \leq V_{DD}$ ,  $3.4\text{V} \leq V_{AREF} \leq AV_{DD}$ )

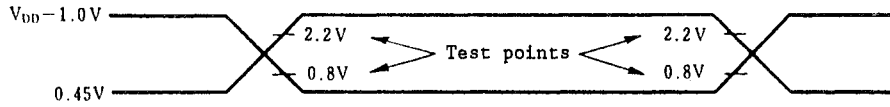
(EPROM product : ( $T_a = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{DD} = 5.0\text{V} \pm 5\%$ ,  $V_{SS} = AV_{SS} = 0\text{V}$ ,  $V_{DD} - 0.8\text{V} \leq AV_{DD} \leq V_{DD}$ ,  $3.4\text{V} \leq V_{AREF} \leq AV_{DD}$ )

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Resolution			8			Bits
Absolute accuracy (Note)		$3.4\text{V} \leq V_{AREF} \leq AV_{DD}$ , $66\text{ns} \leq t_{CYC} \leq 167\text{ns}$			$\pm 0.8\%$	FSR
		$4.0 \leq V_{AREF} \leq AV_{DD}$ , $66\text{ns} \leq t_{CYC} \leq 167\text{ns}$			$\pm 0.6\%$	FSR
		$T_a = -10$ to $+70^\circ\text{C}$ , $4.0 \leq V_{AREF} \leq AV_{DD}$ , $66\text{ns} \leq t_{CYC} \leq 167\text{ns}$			$\pm 0.4\%$	FSR
Conversion time	$t_{CONV}$	$66\text{ns} \leq t_{CYC} \leq 110\text{ns}$	576			$t_{CYC}$
		$110\text{ns} \leq t_{CYC} \leq 167\text{ns}$	432			$t_{CYC}$
Sampling time	$t_{SAMP}$	$66\text{ns} \leq t_{CYC} \leq 110\text{ns}$	96			$t_{CYC}$
		$110\text{ns} \leq t_{CYC} \leq 167\text{ns}$	72			$t_{CYC}$
Analog input voltage	$V_{IAN}$	AN0 to AN7 (including the unused pins)	0		$V_{AREF}$	V
Analog input impedance	$R_{AN}$			50		$\text{M}\Omega$
Reference voltage	$V_{AREF}$		3.4		$AV_{DD}$	V
$V_{AREF}$ current	$I_{AREF1}$	Operating mode		1.5	3.0	mA
	$I_{AREF2}$	STOP mode		0.7	1.5	mA
$AV_{DD}$ power supply current	$A_{IDD1}$	Operating mode $f_{XX} = 15\text{MHz}$		0.5	1.3	mA
	$A_{IDD2}$	STOP mode		10	20	$\mu\text{A}$

★

Note Quantization error ( $\pm 1/2$  LSB) is not contained.

## AC Timing Test Points



## AC Characteristic Calculation Expressions Dependent on $t_{CYC}$

Parameter	Calculation expression	MIN./MAX.	Unit
$t_{AL}$	2T-100	MIN.	ns
$t_{LA}$	T-30	MIN.	ns
$t_{AR}$	3T-100	MIN.	ns
$t_{AD}$	7T-220	MAX.	ns
$t_{LDR}$	5T-200	MAX.	ns
$t_{RD}$	4T-150	MAX.	ns
$t_{LR}$	T-50	MIN.	ns
$t_{RL}$	2T-50	MIN.	ns
$t_{RR}$	4T-50 (when data is read)	MIN.	ns
	7T-50 (when OP code is fetched)		
$t_{LL}$	2T-40	MIN.	ns
$t_{AW}$	3T-100	MIN.	ns
$t_{LDW}$	T+110	MAX.	ns
$t_{LW}$	T-50	MIN.	ns
$t_{DW}$	4T-100	MIN.	ns
$t_{WDH}$	2T-70	MIN.	ns
$t_{WL}$	2T-50	MIN.	ns
$t_{WW}$	4T-50	MIN.	ns

(to be continued)

(Cont'd)

Parameter	Calculation expression	MIN./MAX.	Unit
★ $t_{CYK}$	$6T$ ( $\overline{SCK}$ input (Note 1)) / $12T$ ( $\overline{SCK}$ input) (Note 2)	MIN.	ns
	$24T$ ( $\overline{SCK}$ output)		
★ $t_{KKL}$	$2.5T + 5$ ( $\overline{SCK}$ input (Note 1)) / $5T + 5$ ( $\overline{SCK}$ input) (Note 2)	MIN.	ns
	$12T - 100$ ( $\overline{SCK}$ output)		
★ $t_{KKH}$	$2.5T + 5$ ( $\overline{SCK}$ input) (Note 1) / $5T + 5$ ( $\overline{SCK}$ input) (Note 2)	MIN.	ns
	$12T - 100$ ( $\overline{SCK}$ output)		

**Note 1.** When the clock rate is x16 or x64 in the asynchronous mode.

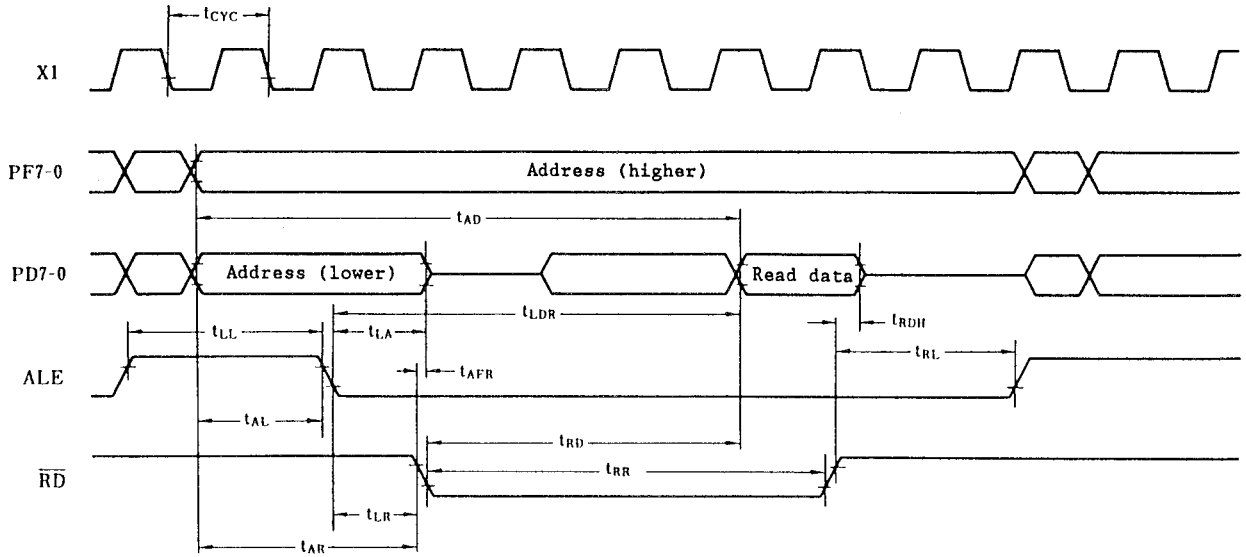
**2.** When the clock rate is x1 in the asynchronous mode or the synchronous mode or I/O interface mode is set

**Remarks 1.**  $T = t_{CYC} = 1/f_{XX}$

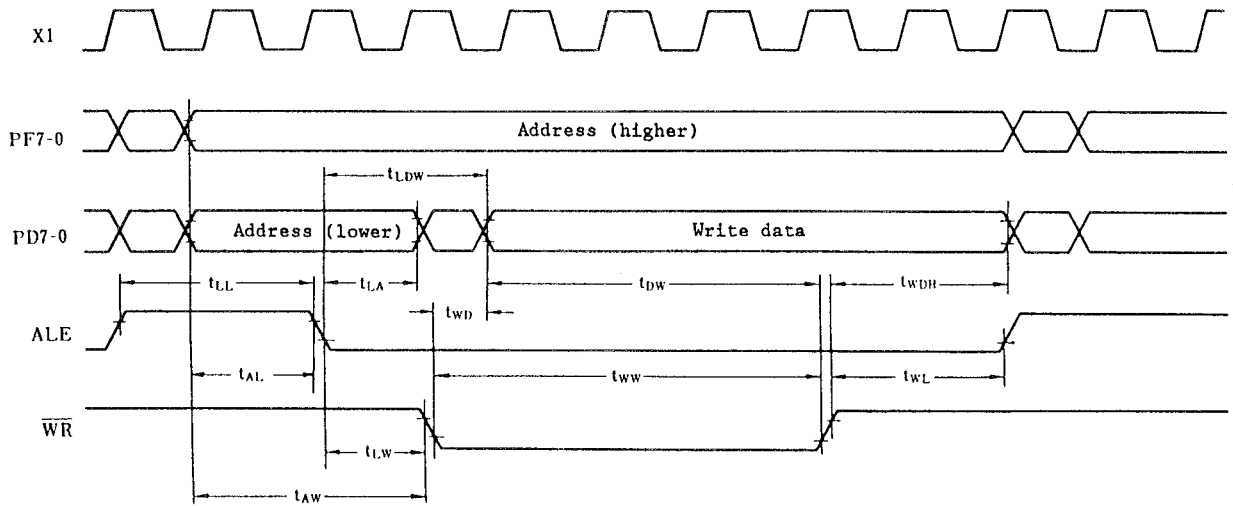
**2.** Parameters not listed in the table do not depend on the oscillation frequency ( $f_{XX}$ ).

## Timing Waveforms

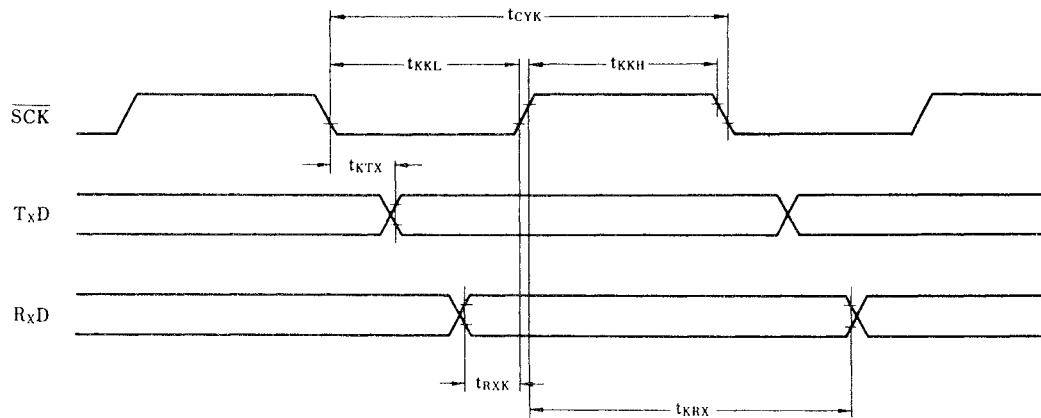
### Read Operation



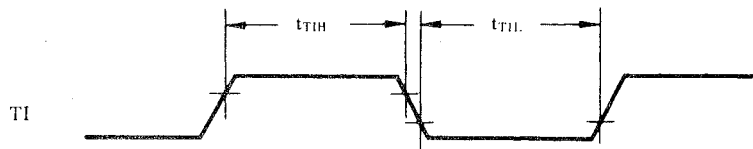
### Write Operation



## Serial Operation

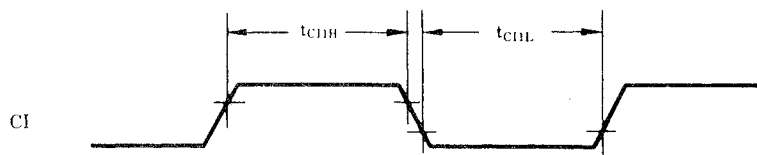


## Timer Input Timing

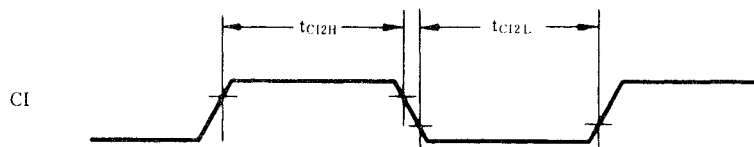


## Timer/event Counter Input Timing

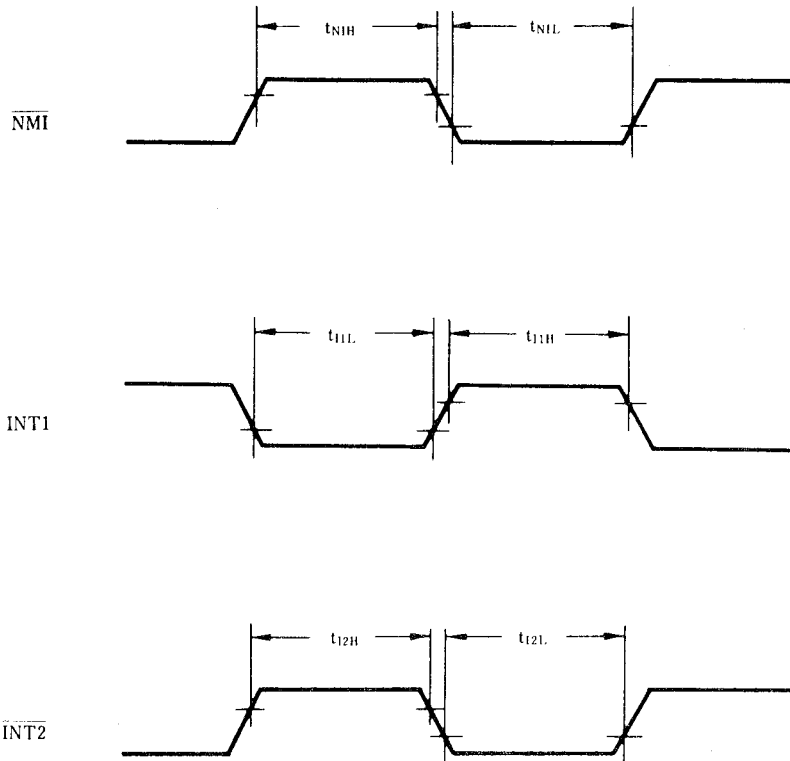
Event counter mode



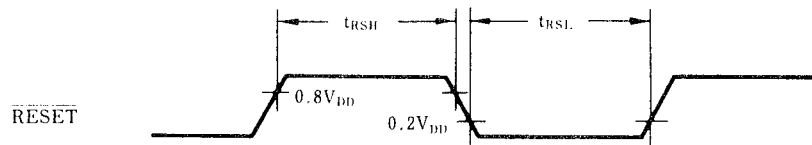
Pulse width measurement mode



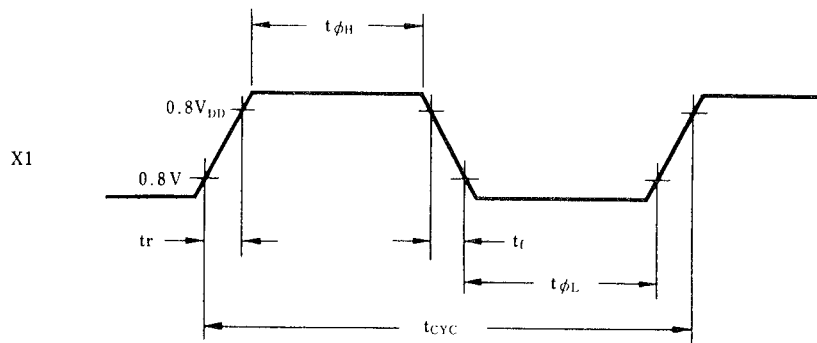
## Interrupt Input Timing



## Reset Input Timing



## External Clock Timing

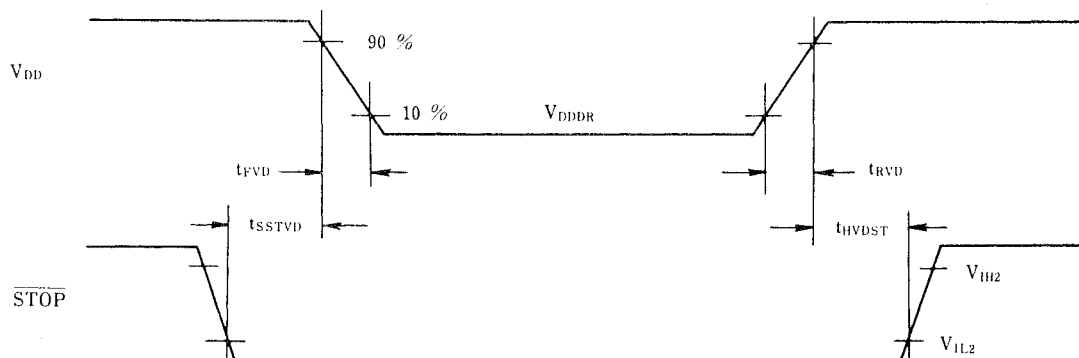


**Data Memory STOP Mode Low Power Supply Voltage Data Retention Characteristics (Ta = -40°C to +85°C)**

Parameter	Symbol	Test condition		MIN.	TYP.	MAX.	Unit	
Data retention power supply voltage	$V_{DDDR}$			2.5		5.25	V	
★ Data retention power supply current	$I_{DDDR}$	One-time PROM product	$V_{DDDR} = 2.5\text{ V}$		1	15	$\mu\text{A}$	
			$V_{DDDR} = 5\text{ V} \pm 10\%$		10	50	$\mu\text{A}$	
		EPROM product	$V_{DDDR} = 2.5\text{ V}$				300	$\mu\text{A}$
			$V_{DDDR} = 5\text{ V} \pm 5\%$				1	mA
$V_{DD}$ rise, fall time	$t_{RVD}, t_{FVD}$			200			$\mu\text{s}$	
$\overline{\text{STOP}}$ setup time to $V_{DD}$	$t_{SSSTVD}$			$12T+0.5$ (Note)			$\mu\text{s}$	
$\overline{\text{STOP}}$ hold time from $V_{DD}$	$t_{HVDST}$			$12T+0.5$ (Note)			$\mu\text{s}$	

**Note**  $T = t_{CYC} = 1/f_{XX}$

**Data Retention Timing**





**DC Programming Characteristics** ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $\text{MODE1} = V_{\text{IL}}$ ,  
 $\text{MODE0} = V_{\text{IH}}$ ,  $V_{\text{SS}} = 0\text{ V}$ )

Parameter	Symbol	Symbol (Note)	Test condition	MIN.	TYP.	MAX.	Unit
Input high voltage	$V_{\text{IH}}$	$V_{\text{IH}}$		2.2		$V_{\text{DDP}} + 0.3$	V
Input low voltage	$V_{\text{IL}}$	$V_{\text{IL}}$		-0.3		0.8	V
Input leakage current	$I_{\text{LIP}}$	$I_{\text{LI}}$	$0 \leq V_{\text{I}} \leq V_{\text{DDP}}$ ; except for INT1, TI(PC3)			$\pm 10$	$\mu\text{A}$
Output high voltage	$V_{\text{OH}}$	$V_{\text{OH}}$	$I_{\text{OH}} = -1.0\text{ mA}$	$V_{\text{DD}} - 1.0$			V
Output low voltage	$V_{\text{OL}}$	$V_{\text{OL}}$	$I_{\text{OL}} = 2.0\text{ mA}$			0.45	V
Output leakage current	$I_{\text{LO}}$	-	$0 \leq V_{\text{O}} \leq V_{\text{DDP}}$ , $\text{OE} = V_{\text{IH}}$			$\pm 10$	$\mu\text{A}$
$V_{\text{DDP}}$ power supply voltage	$V_{\text{DDP}}$	$V_{\text{DD}}$	EPROM programming mode	5.75	6.0	6.25	V
			EPROM read mode	4.5	5.0	5.5	V
$V_{\text{PP}}$ power supply voltage	$V_{\text{PP}}$	$V_{\text{PP}}$	EPROM programming mode	12.2	12.5	12.8	V
			EPROM read mode	$V_{\text{PP}} = V_{\text{DDP}}$			V
$V_{\text{DDP}}$ power supply voltage	$I_{\text{DD}}$	$I_{\text{DD}}$	EPROM programming mode			30	$\text{mA}$
			EPROM read mode $\overline{\text{CE}} = V_{\text{IL}}$ , $V_{\text{I}} = V_{\text{IH}}$			30	$\text{mA}$
$V_{\text{PP}}$ power supply voltage	$I_{\text{PP}}$	$I_{\text{PP}}$	EPROM programming mode $\overline{\text{CE}} = V_{\text{IL}}$ , $\overline{\text{OE}} = V_{\text{IH}}$			30	$\text{mA}$
			EPROM read mode		1	100	$\mu\text{A}$

**Note** Corresponding  $\mu\text{PD27C256A}$  symbols.

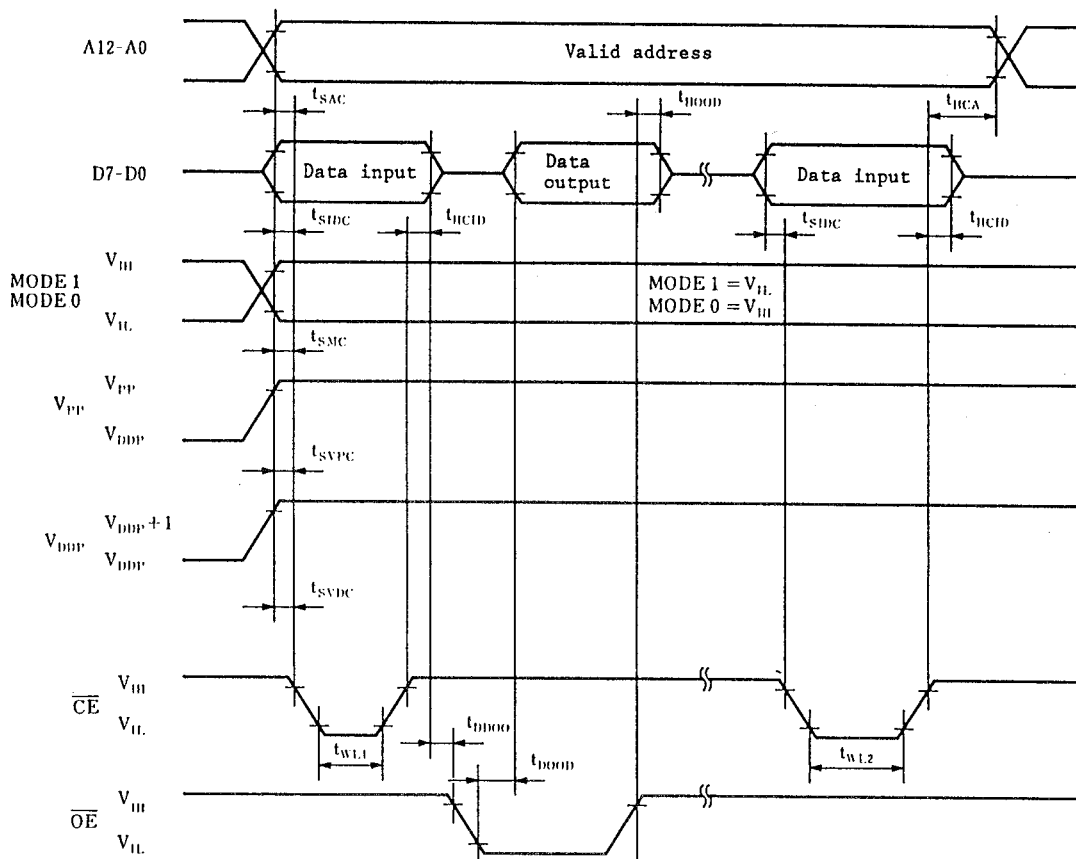
**AC Programming Characteristics** ( $T_a = 25 \pm 5^\circ\text{C}$ ,  $\text{MODE1} = V_{\text{IL}}$ ,  $\text{MODE0} = V_{\text{IH}}$ ,  $V_{\text{SS}} = 0 \text{ V}$ )

Parameter	Symbol	Symbol (Note 1)	Test condition	MIN.	TYP.	MAX.	Unit
Address setup time to $\overline{\text{CE}} \downarrow$	$t_{\text{SAC}}$	$t_{\text{AS}}$		2			$\mu\text{s}$
Data $\rightarrow \overline{\text{OE}} \downarrow$ delay time	$t_{\text{DDOO}}$	$t_{\text{OES}}$		2			$\mu\text{s}$
Input data setup time to $\overline{\text{CE}} \downarrow$	$t_{\text{SIDC}}$	$t_{\text{DS}}$		2			$\mu\text{s}$
Address hold time from $\overline{\text{CE}} \uparrow$	$t_{\text{HCA}}$	$t_{\text{AH}}$		2			$\mu\text{s}$
Input data hold time from $\overline{\text{CE}} \uparrow$	$t_{\text{HCID}}$	$t_{\text{DH}}$		2			$\mu\text{s}$
Output data hold time from $\overline{\text{OE}} \uparrow$	$t_{\text{HOOD}}$	$t_{\text{DF}}$		0		130	ns
$V_{\text{PP}}$ setup time to $\overline{\text{CE}} \downarrow$	$t_{\text{SVPC}}$	$t_{\text{VPS}}$		2			$\mu\text{s}$
$V_{\text{DDP}}$ setup time to $\overline{\text{CE}} \downarrow$	$t_{\text{SVDC}}$	$t_{\text{VDS}}$		2			$\mu\text{s}$
Initial program pulse width	$t_{\text{WL1}}$	$t_{\text{PW}}$		0.95	1.0	1.05	ms
Added program pulse width	$t_{\text{WL2}}$	$t_{\text{OPW}}$		2.85		78.75	ms
EPROM programming/read mode setup time to $\overline{\text{CE}} \downarrow$ (Note 2)	$t_{\text{SMC}}$	-		2			$\mu\text{s}$
Address $\rightarrow$ data output time	$t_{\text{DAOD}}$	$t_{\text{ACC}}$	$\overline{\text{OE}} = V_{\text{IL}}$			2	$\mu\text{s}$
$\overline{\text{CE}} \downarrow \rightarrow$ data output time	$t_{\text{DCOD}}$	$t_{\text{CE}}$				1	$\mu\text{s}$
$\overline{\text{OE}} \downarrow \rightarrow$ data output time	$t_{\text{DOOD}}$	$t_{\text{OE}}$				1	$\mu\text{s}$
Data hold time from $\overline{\text{OE}} \uparrow$	$t_{\text{HCOD}}$	$t_{\text{DF}}$		0		130	ns
Data hold time from address	$t_{\text{HAOD}}$	$t_{\text{OH}}$	$\overline{\text{OE}} = V_{\text{IL}}$	0			ns

**Note 1.** Corresponding  $\mu\text{PD27C256A}$  symbols.

**2.** When  $\text{MODE1} = V_{\text{IL}}$  and  $\text{MODE0} = V_{\text{IH}}$ .

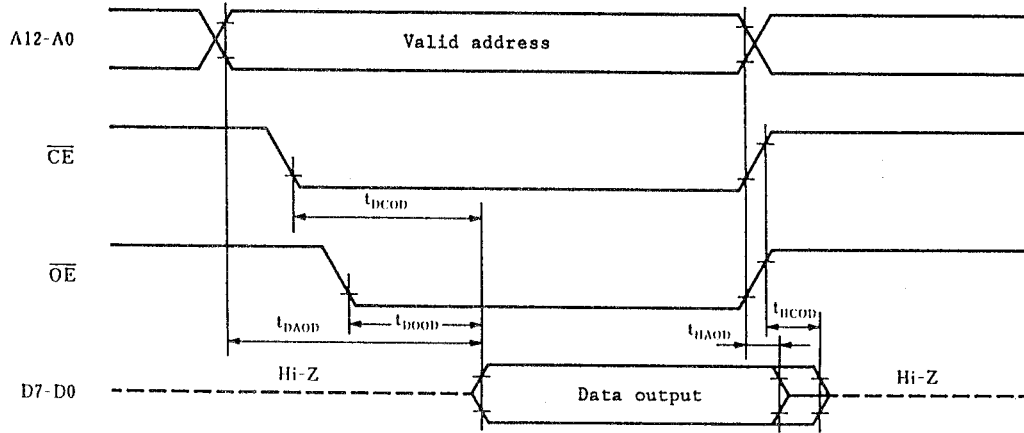
## PROM Programming Mode Timing



Caution 1. Apply voltage to  $V_{DDP}$  before  $V_{pp}$  and turn off  $V_{DDP}$  after  $V_{pp}$ .

2. Do not apply voltage of +13 V or more containing overshoot to  $V_{pp}$ .

## PROM Read Mode Timing

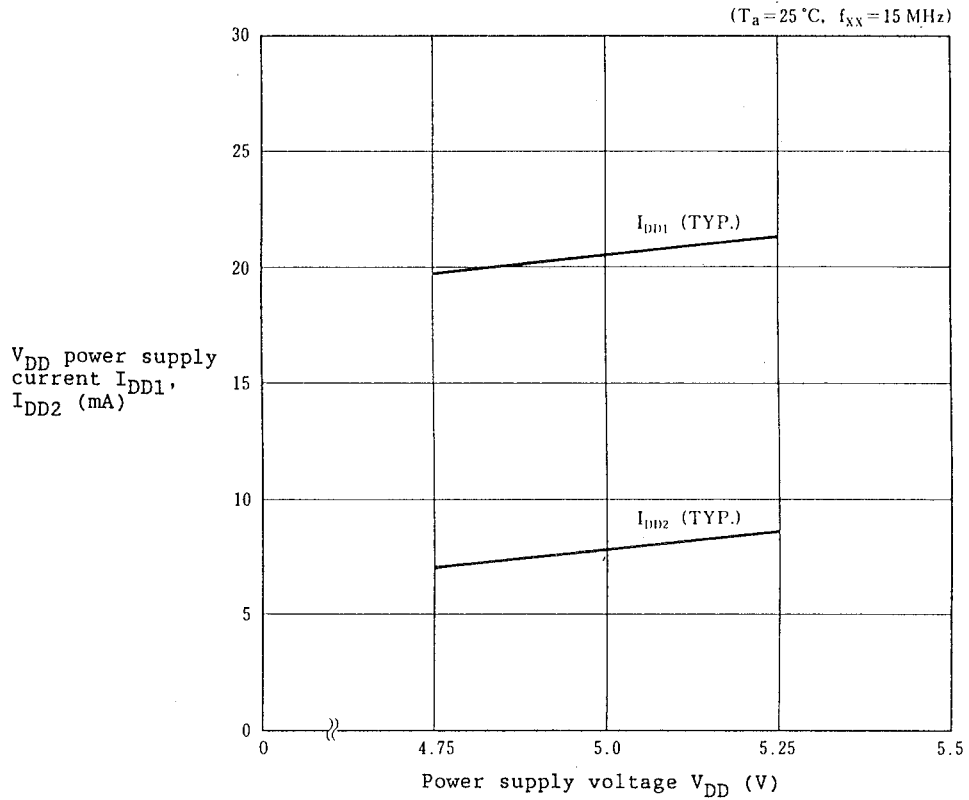


- Caution 1. To read EPROM within the  $t_{DAOB}$  range, the delay time of  $\overline{OE}$  input from the  $\overline{CE}$  falling edge must be within  $t_{DAOB} - t_{DOOD}$ .
2.  $t_{HCOD}$  is the time from the state in which either  $\overline{OE}$  or  $\overline{CE}$  first becomes  $V_{IH}$ .

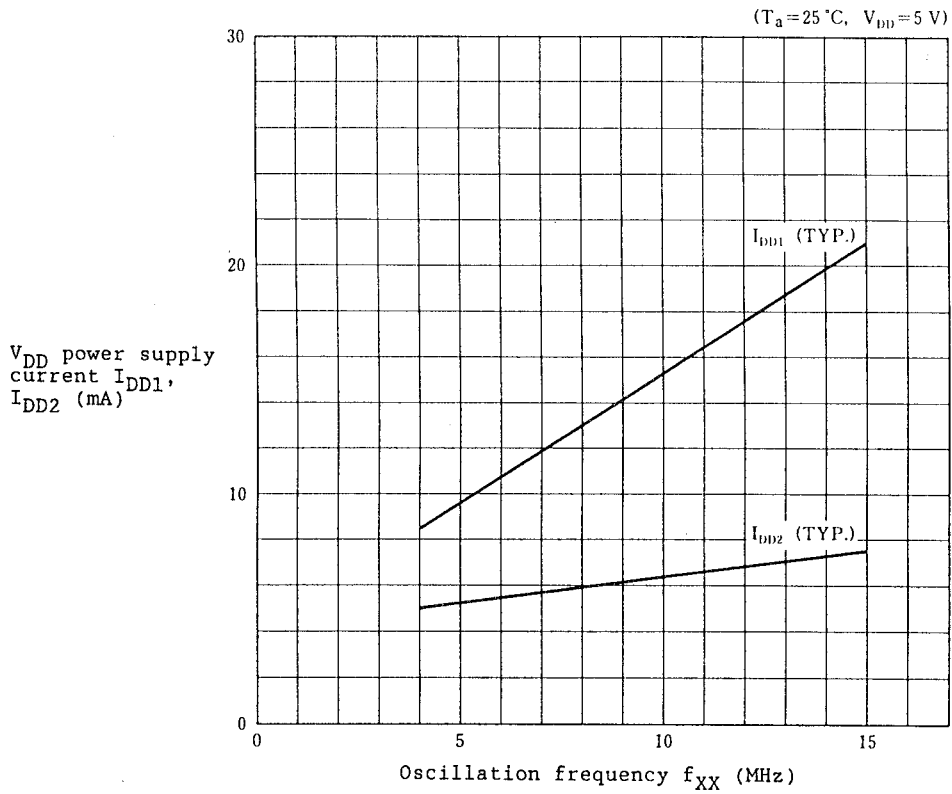
## 9. CHARACTERISTIC CURVES (reference value)

★

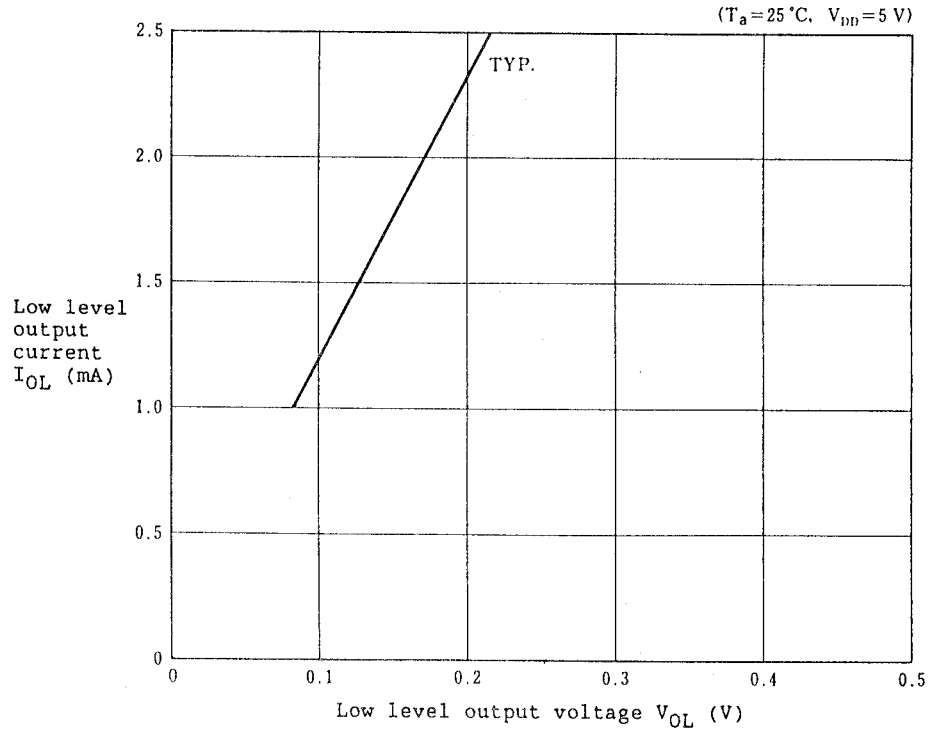
$I_{DD1}, I_{DD2}$  vs  $V_{DD}$



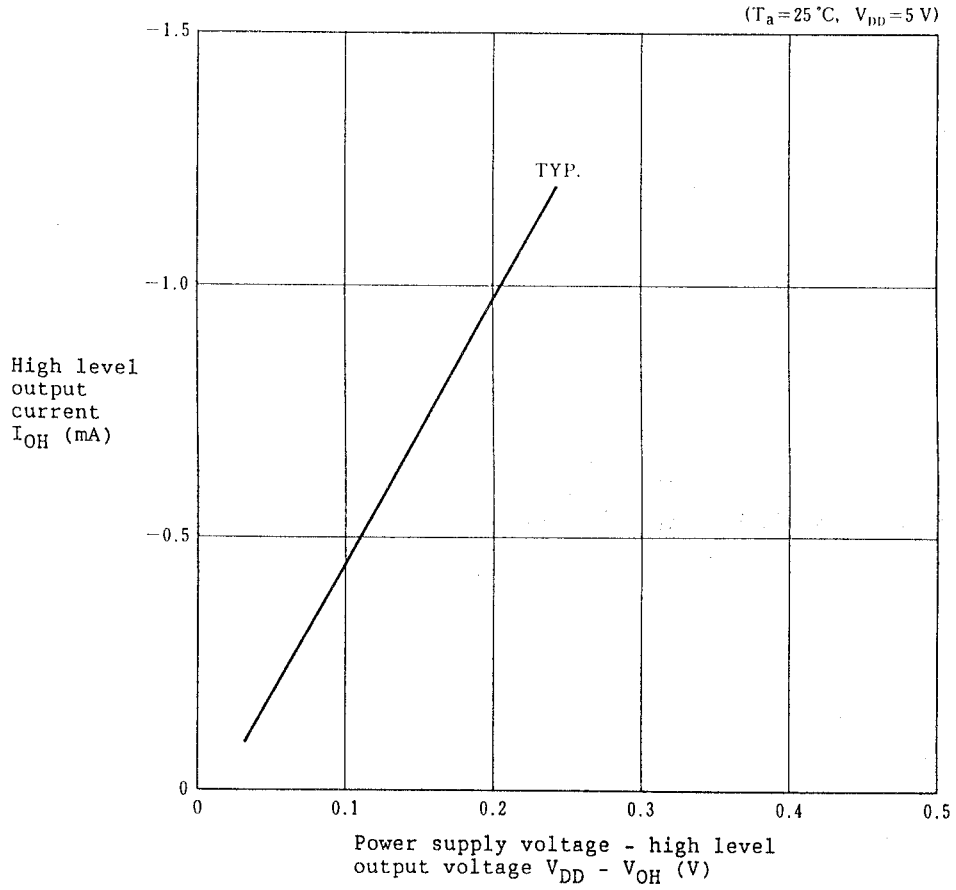
$I_{DD1}, I_{DD2}$  vs  $f_{XX}$



$I_{OL}$  vs  $V_{OL}$

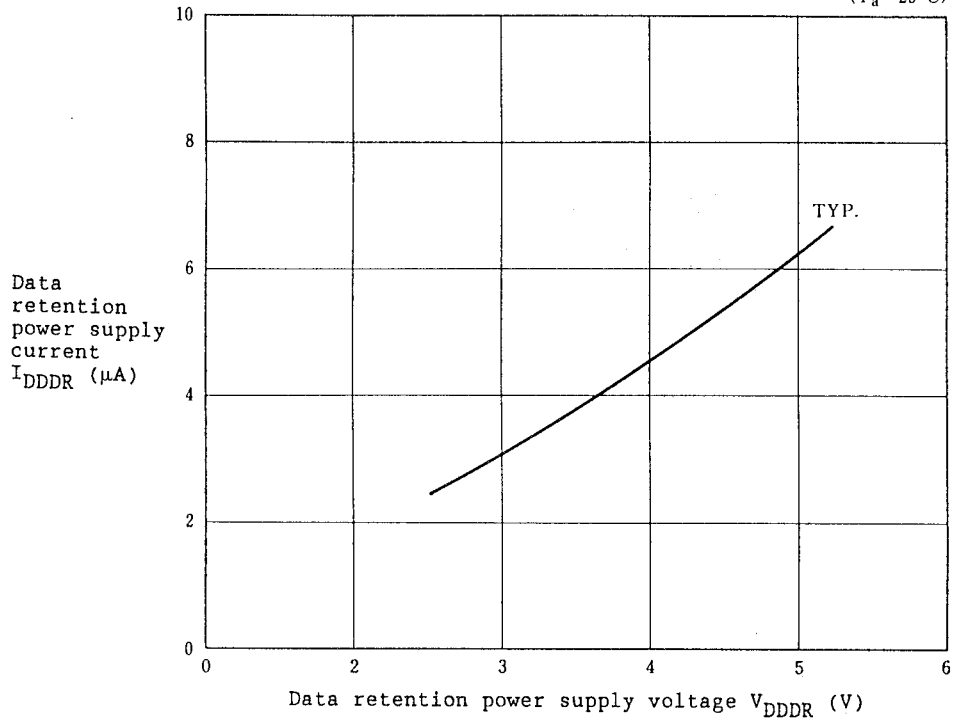


$I_{OH}$  vs  $V_{OH}$



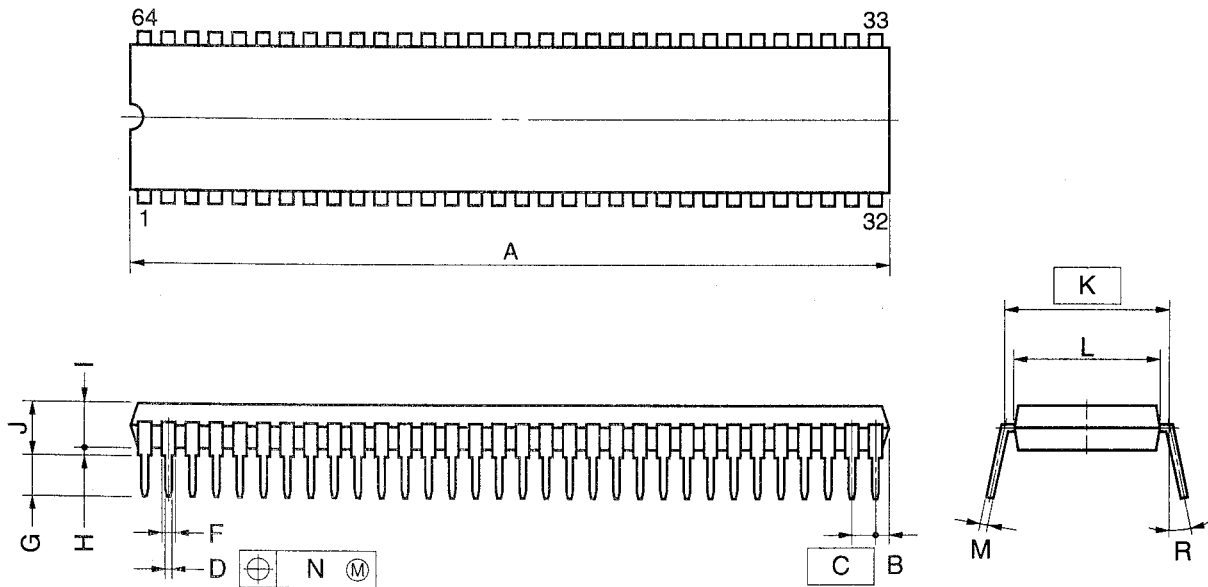
$I_{DDDR}$  vs  $V_{DDDR}$

( $T_a = 25^\circ\text{C}$ )



## 10. PACKAGE INFORMATION

### 64 PIN PLASTIC SHRINK DIP (750 mil)



#### NOTE

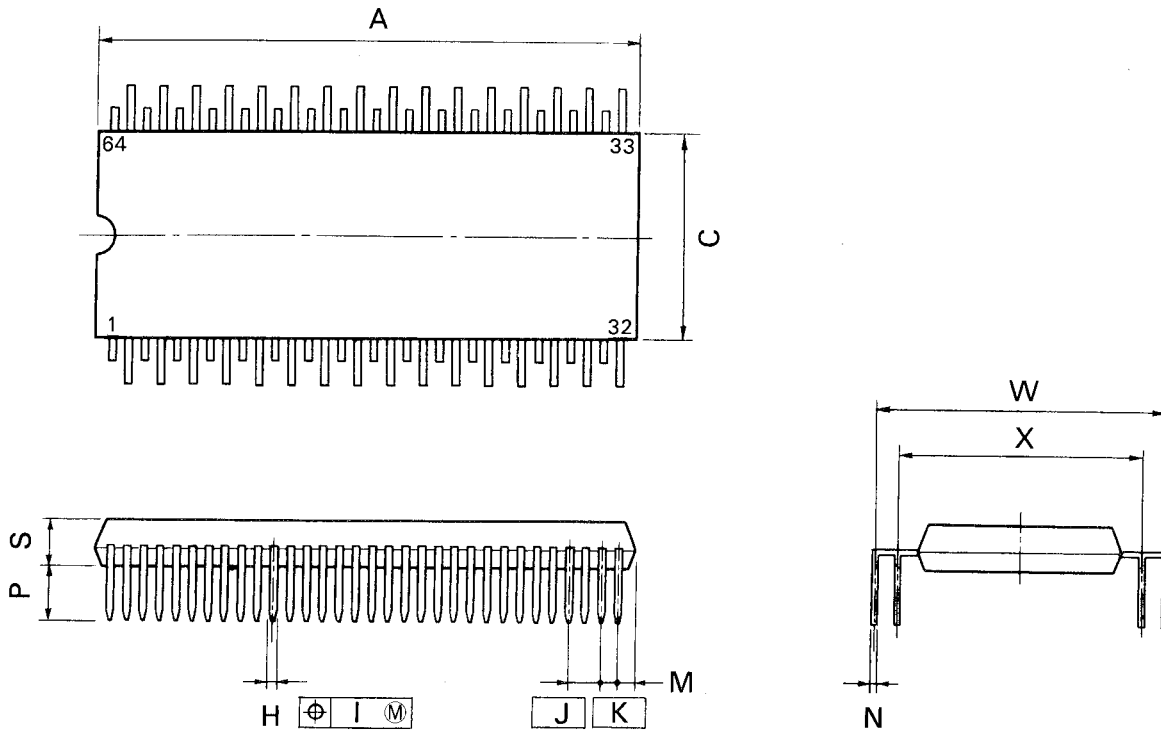
- 1) Each lead centerline is located within 0.17 mm (0.007 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	58.68 MAX.	2.311 MAX.
B	1.78 MAX.	0.070 MAX.
C	1.778 (T.P.)	0.070 (T.P.)
D	0.50±0.10	0.020 <sup>+0.004</sup> <sub>-0.005</sub>
F	0.9 MIN.	0.035 MIN.
G	3.2±0.3	0.126±0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	19.05 (T.P.)	0.750 (T.P.)
L	17.0	0.669
M	0.25 <sup>+0.10</sup> <sub>-0.05</sub>	0.010 <sup>+0.004</sup> <sub>-0.003</sub>
N	0.17	0.007
R	0~15°	0~15°

P64C-70-750A,C-1



## 64 PIN PLASTIC QUIP



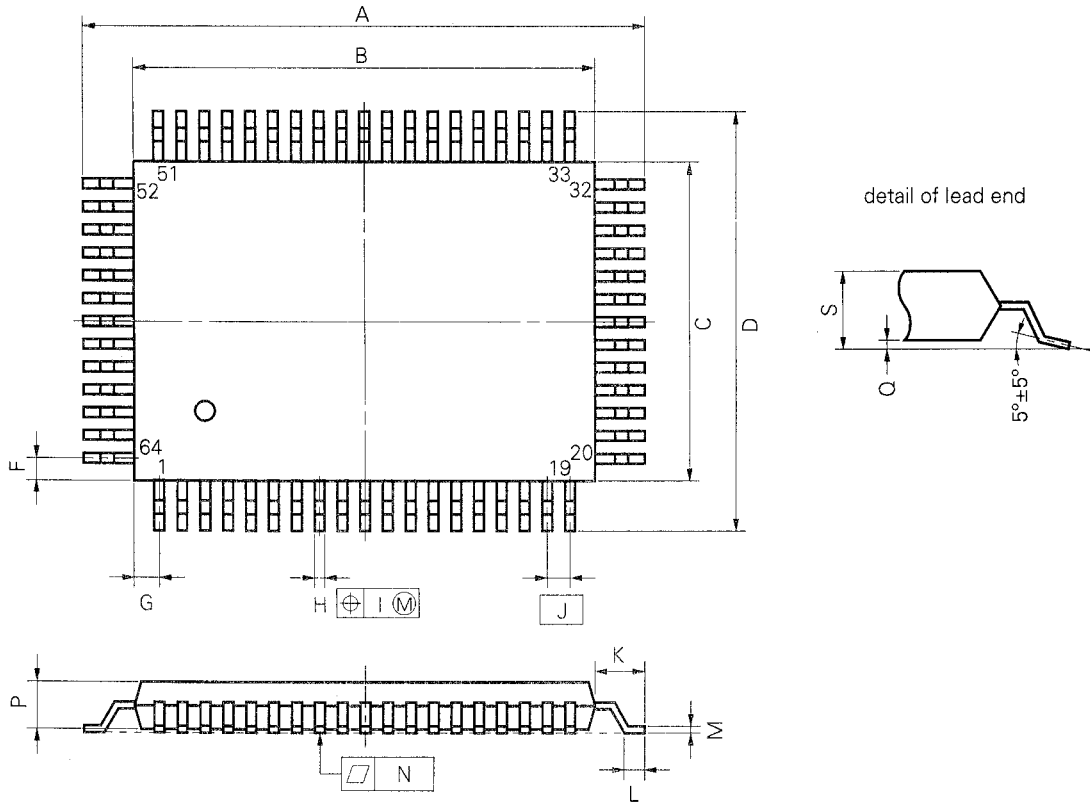
### NOTE

Each lead centerline is located within 0.25 mm (0.010 inch) of its true position (T.P.) at maximum material condition.

P64GQ-100-36

ITEM	MILLIMETERS	INCHES
A	41.5 <sup>+0.3</sup> <sub>-0.2</sub>	1.634 <sup>+0.012</sup> <sub>-0.008</sub>
C	16.5	0.650
H	0.50 <sup>+0.10</sup>	0.020 <sup>+0.004</sup> <sub>-0.003</sub>
I	0.25	0.010
J	2.54 (T.P.)	0.100 (T.P.)
K	1.27 (T.P.)	0.050 (T.P.)
M	1.1 <sup>+0.25</sup> <sub>-0.10</sub>	0.043 <sup>+0.011</sup> <sub>-0.004</sub>
N	0.25 <sup>+0.10</sup> <sub>-0.08</sub>	0.010 <sup>+0.004</sup> <sub>-0.003</sub>
P	4.0 <sup>+0.3</sup>	0.157 <sup>+0.012</sup> <sub>-0.008</sub>
S	3.6 <sup>+0.1</sup>	0.142 <sup>+0.004</sup> <sub>-0.003</sub>
W	24.13 <sup>+1.05</sup>	0.950 <sup>+0.042</sup>
X	19.05 <sup>+1.05</sup>	0.750 <sup>+0.042</sup>

**64 PIN PLASTIC QFP (14x20)**



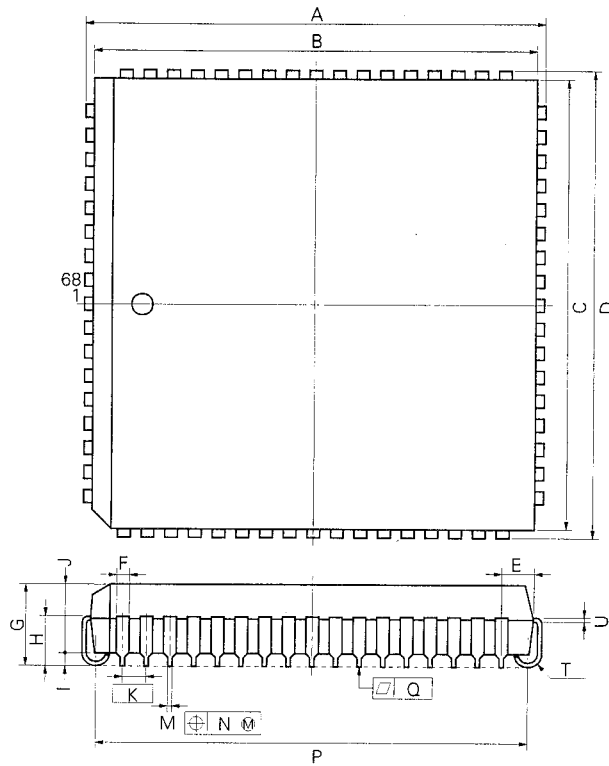
P64GF-100-3B8,3BE,3BR-1

**NOTE**

Each lead centerline is located within 0.20 mm (0.008 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	23.6±0.4	0.929±0.016
B	20.0±0.2	0.795 <sup>+0.009</sup> <sub>-0.008</sub>
C	14.0±0.2	0.551 <sup>+0.009</sup> <sub>-0.008</sub>
D	17.6±0.4	0.693±0.016
F	1.0	0.039
G	1.0	0.039
H	0.40±0.10	0.016 <sup>+0.004</sup> <sub>-0.005</sub>
I	0.20	0.008
J	1.0 (T.P.)	0.039 (T.P.)
K	1.8±0.2	0.071 <sup>+0.008</sup> <sub>-0.009</sub>
L	0.8±0.2	0.031 <sup>+0.009</sup> <sub>-0.008</sub>
M	0.15 <sup>+0.10</sup> <sub>-0.05</sub>	0.006 <sup>+0.004</sup> <sub>-0.003</sub>
N	0.12	0.005
P	2.7	0.106
Q	0.1±0.1	0.004±0.004
S	3.0 MAX.	0.119 MAX.

**68 PIN PLASTIC QFJ (□950 mil)**



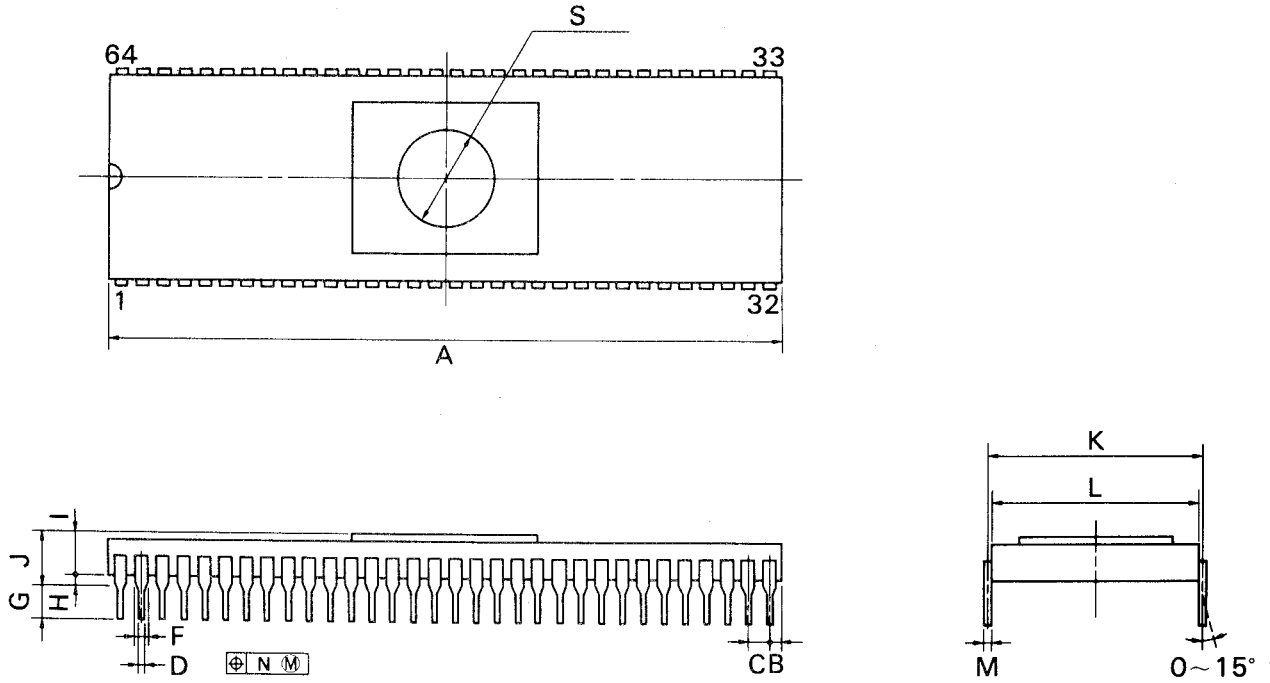
P68L-50A1-2

**NOTE**

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	25.2±0.2	0.992±0.008
B	24.20	0.953
C	24.20	0.953
D	25.2±0.2	0.992±0.008
E	1.94±0.15	0.076 <sup>+0.007</sup> <sub>-0.006</sub>
F	0.6	0.024
G	4.4±0.2	0.173 <sup>+0.009</sup> <sub>-0.008</sub>
H	2.8±0.2	0.110 <sup>+0.009</sup> <sub>-0.008</sub>
I	0.9 MIN.	0.035 MIN.
J	3.4	0.134
K	1.27 (T.P.)	0.050 (T.P.)
M	0.40±1.0	0.016 <sup>+0.004</sup> <sub>-0.005</sub>
N	0.12	0.005
P	23.12±0.20	0.910 <sup>+0.009</sup> <sub>-0.008</sub>
Q	0.15	0.006
T	R 0.8	R 0.031
U	0.20 <sup>+0.10</sup> <sub>-0.05</sub>	0.008 <sup>+0.004</sup> <sub>-0.002</sub>

# 64PIN CERAMIC SHRINK DIP (750 mil)



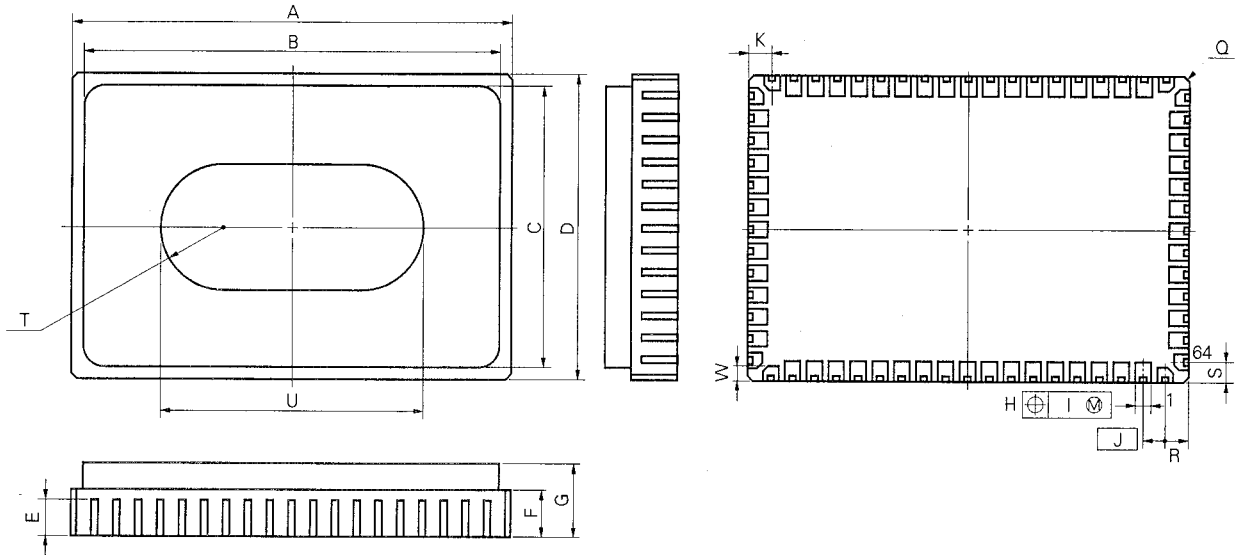
P64DW-70-750A

## NOTES

- 1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	58.68 MAX.	2.310 MAX.
B	1.78 MAX.	0.070 MAX.
C	1.778 (T.P.)	0.070 (T.P.)
D	0.46 $\pm 0.05$	0.018 $\pm 0.002$
F	0.8 MIN.	0.031 MIN.
G	3.5 $\pm 0.3$	0.138 $\pm 0.012$
H	1.0 MIN.	0.039 MIN.
I	3.0	0.118
J	5.08 MAX.	0.200 MAX.
K	19.05 (T.P.)	0.750 (T.P.)
L	18.8	0.740
M	0.25 $\pm 0.05$	0.010 $\begin{smallmatrix} +0.002 \\ -0.003 \end{smallmatrix}$
N	0.25	0.01
S	$\phi$ 8.89	$\phi$ 0.350

# 64 PIN CERAMIC WQFN



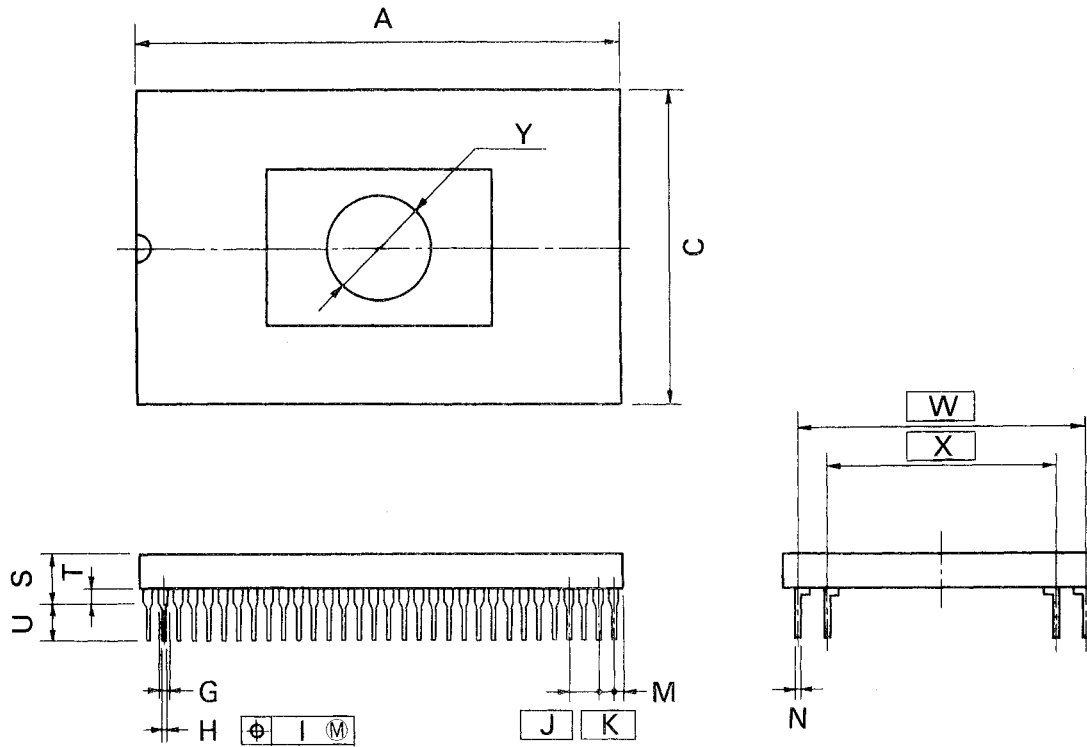
## NOTE

Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.

X64KW-100A-2

ITEM	MILLIMETERS	INCHES
A	20.0±0.4	0.787 <sup>+0.017</sup> <sub>-0.016</sub>
B	19.0	0.748
C	13.2	0.520
D	14.0±0.4	0.551±0.016
E	1.64	0.065
F	2.14	0.084
G	3.556 MAX.	0.140 MAX.
H	0.7±0.10	0.028 <sup>+0.004</sup> <sub>-0.005</sub>
I	0.10	0.004
J	1.0 (T.P.)	0.039 (T.P.)
K	1.0±0.2	0.039 <sup>+0.009</sup> <sub>-0.008</sub>
Q	C 0.25	C 0.010
R	1.0	0.039
S	1.0	0.039
T	R 3.0	R 0.118
U	12.0	0.472
W	0.8±0.2	0.031 <sup>+0.009</sup> <sub>-0.008</sub>

# 64 PIN CERAMIC QUIP (WINDOW)



P64RQ-100-A

## NOTE

Each lead centerline is located within 0.25 mm (0.010 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	41.91 MAX.	1.650 MAX.
C	26.67 <sup>±0.4</sup>	1.050 <sup>±0.016</sup>
G	0.92 MIN.	0.036 MIN.
H	0.46 <sup>±0.05</sup>	0.018 <sup>±0.002</sup>
I	0.25	0.010
J	2.54 (T.P.)	0.100 (T.P.)
K	1.27 (T.P.)	0.050 (T.P.)
M	1.27 MAX.	0.050 MAX.
N	0.25 <sup>±0.05</sup>	0.010 <sup>±0.003</sup>
S	4.72 MAX.	0.186 MAX.
T	1.0 MIN.	0.039 MIN.
U	3.5 <sup>±0.3</sup>	0.138 <sup>±0.013</sup>
W	24.13	0.950
X	19.05	0.750
Y	φ8.89	φ0.350

## 11. RECOMMENDED CONDITIONS FOR SOLDERING

★

Solder the  $\mu$ PD78CP14 under the recommended conditions listed in Table 11-1.

For details of the recommended conditions, refer to the **Semiconductor Device Mount Manual (IEI-616)**.

Consult the sales person about soldering methods and soldering conditions not listed in the table.

**Table 11-1. Soldering Conditions for Surface Mount Type**

**(1)  $\mu$ PD78CP14GF-3BE: 64-pin Plastic QFP (14x20 mm)**

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235°C, Time: Within 30s (at 210°C or higher), Count: Within twice, limited number of days: Seven (Note) (after seven days, prebake at 125°C is required for 20 hours) <Attention> (1) Perform the second reflow at the time the device temperature is lowered to the room temperature from the heating by the first reflow. (2) Do not wash the soldered portion with the flux following the first reflow.	IR35-207-2
VPS	Package peak temperature: 215°C, Time: Within 40S (at 200°C or higher), Count: Within twice, limited number of days: Seven (Note) (after seven days, prebake at 125°C is required for 20 hours) <Attention> (1) Perform the second reflow at the time the device temperature is lowered to the room temperature from the heating by the first reflow. (2) Do not wash the soldered portion with the flux following the first reflow.	VP15-207-2
Wave soldering	Soldering tank temperature: 260°C or less, Time: Within 10s, Count: Once, Preheating temperature: 120°C MAX. (package surface temperature), limited number of days: Seven (after seven days, prebake at 125°C is required for 20 hours)	WS60-207-1
Pin part heating	Pin part temperature: 300°C or less, Time: Within 3s (per frame of device)	—

**Note** It is the number of storage days under the storage conditions of 25°C and 65% RH or less after the dry pack is opened.

**Caution Do not use the soldering methods together (except the pin part heating).**

**(2)  $\mu$ PD78CP14L: 68-pin plastic QFJ (□950 mil)**

Soldering Method	Soldering Conditions	Recommended Condition Symbol
VPS	Package peak temperature: 215°C, Time: Within 40s (200°C or higher), Count: Once, limited number of days: Two (Note) (after two days, prebake at 125°C is required for 16 hours)	VP15-162-1
Pin part heating	Pin part temperature: 300°C or less, Time: Within 3s (per frame of device)	—

Note It is the number of storage days under the storage conditions of 25°C and 65% RH or less after the dry pack is opened.

**Table 11-2. Soldering Conditions for Insertion Type**

$\mu$ PD78CP14CW: 64-pin plastic shrink DIP (750 mil)  
 $\mu$ PD78CP14G-36: 64-pin plastic QUIP  
 $\mu$ PD78CP14DW: 64-pin shrink DIP with a ceramic window (750 mil)  
 $\mu$ PD78CP14R: 64-pin QUIP with a ceramic window

Soldering Method	Soldering Conditions
Wave Soldering (pin part only)	Soldering tank temperature: 260°C or less, Time: Within 10s
Pin part heating	Pin part temperature: 300°C or less, Time: Within 3s (per pin part)

Note Apply wave soldering only to the pin part and be careful so as not to bring solder injection directly into contact with the package.



## 12. DIFFERENCES BETWEEN $\mu$ PD78CP14 AND MASK ROM PRODUCTS

Table 12-1 Differences between  $\mu$ PD78CP14 and Mask ROM Products

Item	$\mu$ PD78CP14	$\mu$ PD78C14	$\mu$ PD78C12A	$\mu$ PD78C11/A
Internal program memory	<ul style="list-style-type: none"> <li>o PROM</li> <li>o 16384 x 8 bits</li> </ul>	<ul style="list-style-type: none"> <li>o Mask ROM</li> <li>o 16384 x 8 bits</li> </ul>	<ul style="list-style-type: none"> <li>o Mask ROM</li> <li>o 8192 x 8 bits</li> </ul>	<ul style="list-style-type: none"> <li>o Mask ROM</li> <li>o 4096 x 8 bits</li> </ul>
Pin	PB7/ $\overline{OE}$		PB7	
	PB6/ $\overline{CE}$		PB6	
	$\overline{STOP}/V_{PP}$		$\overline{STOP}$	
	$\overline{NMI}/A9$		$\overline{NMI}$	
	PA7-0/A7-0		PA7-0	
	PF5-2/A13-10		PF5-2	
	PF0/A8		PF0	
	PD7-0/O7-0		PD7-0	
Mode set by using MODE pins (when MODE0 is set to 1 and MODE 1 to 0)	PROM programming mode	<ul style="list-style-type: none"> <li>. Operation as <math>\mu</math>PD78C10A (ROMless mode)</li> <li>. External memory 16K extension mode</li> </ul>		
MODE0 pin input/output function	Input only	Input/output		
Emulation mode	Not included	Included		
Specification of internal ROM access range by using MM register	Made	Not made		
Package	<ul style="list-style-type: none"> <li>. 64-pin plastic shrink-DIP (750 mil)</li> <li>. 64-pin plastic QUIP</li> <li>. 64-pin plastic QFP (14 x 20 mil)</li> <li>. 68-pin QFJ (<math>\square</math> 950 mil)</li> <li>. 64-pin ceramic shrink DIP with a window (750 mil)</li> <li>. 64-pin ceramic QUIP with a window</li> <li>. 64-pin ceramic WQFN</li> </ul>	<ul style="list-style-type: none"> <li>. 64-pin plastic shrink DIP (750 mm)</li> <li>. 64-pin plastic QUIP</li> <li>. 64-pin plastic QUIP straight</li> <li>. 64-pin plastic QFP (thickness 2.7 mm)</li> <li>. 64-pin plastic QFP (14 x 20 mm) (thickness 2.05 mm) (Note)</li> <li>. 68-pin plastic QFJ (<math>\square</math> 950 mil)</li> </ul>		

**Note** Only  $\mu$ PD78C14.

★

## APPENDIX A. DEVELOPMENT TOOLS

The following development tools are provided for system development using the  $\mu$ PD78CP14:

### Language processor

87AD series relocatable assembler	This program converts programs written in mnemonics into object code that can be executed by microcomputers. In addition, the program contains the functions of automatic symbol table generation, branch instruction optimization process, etc.			
	Host machine	OS	Distribution media	Ordering code (product name)
	PC-9800 series	MS-DOS <sup>TM</sup> Ver. 2.11 to (Note) Ver. 5.00A	3.5-inch 2HD	$\mu$ S5A13RA87
			5-inch 2HD	$\mu$ S5A10RA87
IBM PC/AT <sup>TM</sup>	PC DOS <sup>TM</sup> (Ver. 3.1)	5-inch 2HC	$\mu$ S7B10RA87	

### PROM write tools

Hard- ware	PG-1500	PG-1500 is a PROM programmer which enables you to program single chip microcomputers containing PROM in stand-alone or host machine operation by connecting an attached board and optional programmer adapter to PG-1500. It also enables you to program typical PROM devices of 256 bits to 4M bits.			
	PA-78CP14CW/ GF/GQ/KB/L	PROM programmer adapters for the $\mu$ PD78CP14, connected to PG-1500 for use.			
	PA-78CP14CW	$\mu$ PD78CP14CW, 78CP14DW			
	PA-78CP14GF	$\mu$ PD78CP14GF-3BE			
	PA-78CP14GQ	$\mu$ PD78CP14G-36, 78CP14R			
	PA-78CP14KB	$\mu$ PD78CP14KB			
Soft- ware	PG-1500 controller	PG-1500 and a host machine are connected by a serial or parallel interface and PG-1500 is controlled on the host machine.			
		Host machine	OS	Distribution media	Part number (product name)
		PC-9800 series	MS-DOS Ver. 2.11 to (Note) Ver. 5.00A	3.5-inch 2HD	$\mu$ S5A13PG1500
				5-inch 2HD	$\mu$ S5A10PG1500
		IBM PC series	PC DOS (Ver. 3.1)	5-inch 2D	$\mu$ S7B11PG1500

**Note** Task-swap function, provided to Ver. 5.00/5.00A, is not available on this software.

Remarks Operation of the assembler, PG-1500 controller, etc., is guaranteed only on the host machine under the operating system listed above.

### Debugging tool

In-circuit emulator (IE-78C11-M) is provided as the program debugging tool of the  $\mu$ PD78CP14. The system configuration is listed below:

Hard-ware	IE-78C11-M	IE-78C11-M is an in-circuit emulator for the 87AD series. For plastic quad-in-line packages, use IE-78C11-M only. For plastic shrunk-dual-in-line packages, use IE-78C11-M and a conversion socket in combination. IE-78C11-M can be connected to a host machine and PROM programmer for efficient debugging.			
	EV-9001-64	Conversion socket for plastic shrunk-dual-in-line packages. Use the conversion socket and IE-78C11-M in combination.			
	EV-9200G-64	Conversion socket for 64-pin WQFN. Use EV-9200G-64 and $\mu$ PD78CP14KB for substitution for 64-pin plastic QFP with a window.			
Soft-ware	IE-78C11-M control program	IE-78C11-M and a host machine are connected by RS-232-C interface and IE-78C11-M is controlled on the host machine.			
		Host machine	OS	Distribution media	Part number (product name)
		PC-9800 series	MS-DOS (Ver. 2.11 to Ver. 3.30D)	3.5-inch 2HD	$\mu$ S5A13IE78C11
				5-inch 2HD	$\mu$ S5A10IE78C11
IBM PC/AT	PC DOS (Ver. 3.1)	5-inch 2HC	$\mu$ S7B10IE78C11		

Remarks Operation of the assembler, IE controller, etc., is guaranteed only on the host machine under the operating system listed above.

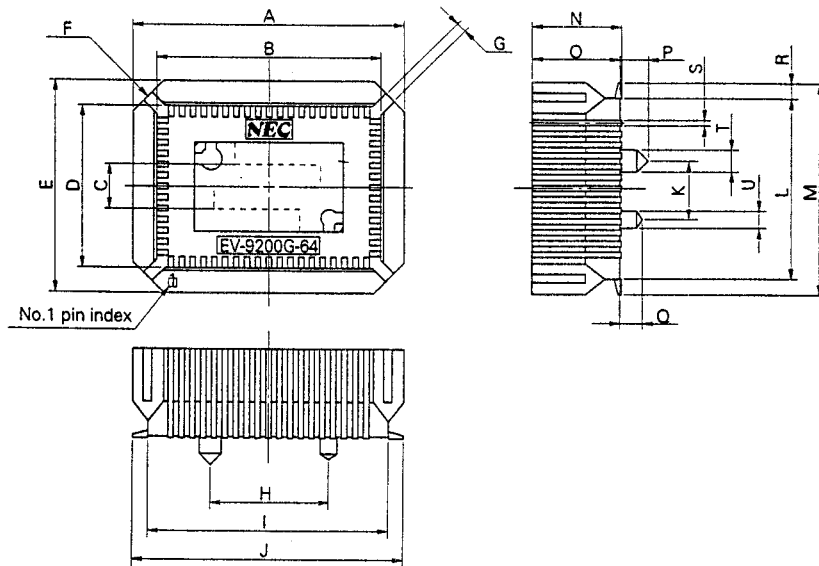
★

**APPENDIX B.  
PACKAGE INFORMATION OF CONVERSION SOCKETS AND  
RECOMMENDED PATTERNS FOR BOARD FIXING**

**FIGURE B-1. Package Drawings of Conversion Socket  
(EV-9200G-64) (Reference)**

Based on EV-9200G-64

(1) Package drawing (in mm)

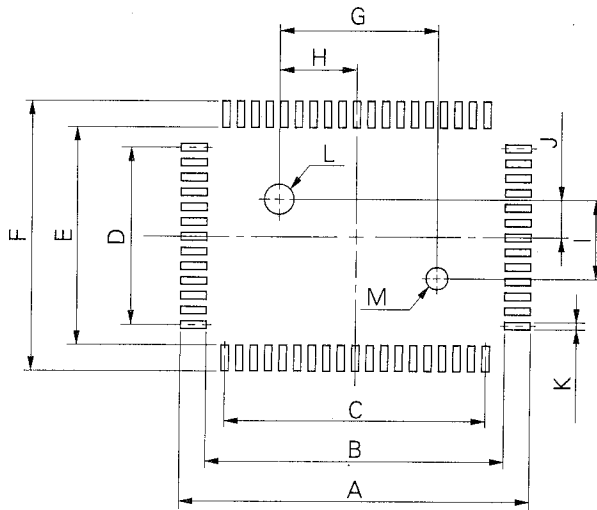


EV-9200G-64-G0

ITEM	MILLIMETERS	INCHES
A	25.0	0.984
B	20.30	0.799
C	4.0	0.157
D	14.45	0.569
E	19.0	0.748
F	4-C 2.8	4-C 0.11
G	0.8	0.031
H	11.0	0.433
I	22.0	0.866
J	24.7	0.972
K	5.0	0.197
L	16.2	0.638
M	18.9	0.744
O	8.0	0.315
N	7.8	0.307
P	2.5	0.098
Q	2.0	0.079
R	1.35	0.053
S	0.35±0.1	0.014 <sup>+0.004</sup> <sub>-0.005</sub>
T	∅2.3	∅0.091
U	∅1.5	∅0.059

**FIGURE B-2. Recommended Patterns for Board Fixing of Conversion Socket (EV-9200G-64) (Reference)**

Based on EV-9200G-64  
(2) Pad drawing (in mm)



EV-9200G-64-P0

ITEM	MILLIMETERS	INCHES
A	25.7	1.012
B	21.0	0.827
C	$1.0 \pm 0.02 \times 18 = 18.0 \pm 0.05$	$0.039^{+0.002}_{-0.001} \times 0.709 = 0.709^{+0.002}_{-0.003}$
D	$1.0 \pm 0.02 \times 12 = 12.0 \pm 0.05$	$0.039^{+0.002}_{-0.001} \times 0.472 = 0.472^{+0.003}_{-0.002}$
E	15.2	0.598
F	19.9	0.783
G	$11.00 \pm 0.08$	$0.433^{+0.004}_{-0.003}$
H	$5.50 \pm 0.03$	$0.217^{+0.001}_{-0.002}$
I	$5.00 \pm 0.08$	$0.197^{+0.003}_{-0.004}$
J	$2.50 \pm 0.03$	$0.098^{+0.002}_{-0.001}$
K	$0.6 \pm 0.02$	$0.024^{+0.001}_{-0.002}$
L	$\phi 2.36 \pm 0.03$	$\phi 0.093^{+0.001}_{-0.002}$
M	$\phi 1.57 \pm 0.03$	$\phi 0.062^{+0.001}_{-0.002}$

**Caution** Dimensions of mount pad for EV-9200 and that for target device (QFP) may be different in some parts. For the recommended mount pad dimensions for QFP, refer to "SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (IEI-1207).

## NOTES FOR CMOS DEVICES

### ① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

**Note** Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

### ② HANDLING OF UNUSED INPUT PINS FOR CMOS

**Note** No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND with a resistor, if it is considered to have a possibility of being on output pins. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

### ③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

**Note** Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

QTOP is a trademark of NEC Corporation.

MS-DOS is a trademark of Microsoft Corporation USA.

PC/AT and PC DOS are trademarks of IBM Corporation USA.

{MEMO}

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

The devices listed in this document are not suitable for use in aerospace equipment, submarine cables, nuclear reactor control systems and life support systems. If customers intend to use NEC devices for above applications or they intend to use "Standard" quality grade NEC devices for applications not intended by NEC, please contact our sales people in advance.

Application examples recommended by NEC Corporation

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, Other consumer products, etc.

Special: Automotive and Transportation equipment, Traffic control systems, Antidisaster systems, Anticrime systems, etc.