MOS INTEGRATED CIRCUIT

μPD27C4000

4 M BIT CMOS PROM

DESCRIPTION

The μPD27C4000 is a 4 194 304-bit electrically programmable read-only memory. The word organization is selectable (word mode: 256K words by 16 bits, byte mode: 512K words by 8 bits). The device is fabricated using an advanced CMOS process which substantially saves power in operating and standby modes and is of use for a low power supply system.

The μPD27C4000DZ is available in a standard 40-pin cerdip package with a quartz window as an ultraviolet (UV) erasable PROM. The μPD27C4000CZ and μPD27C4000GW are available in plastic packages as ONE TIME PROMs.

FEATURES

- Word organization: 256K words by 16 bits (word mode)
  512K words by 8 bits (byte mode)
- Electrically programmable
- Fast access time: (See ORDERING INFORMATION)
- Low power dissipation: 50 mA MAX. active current
  100 μA MAX. standby current
- High speed programming mode
- Input/Output TTL-compatible
- Single +5 V power supply
- Three state outputs
- Pinout compatibility with 40-pin mask ROM, μPD23C4000s

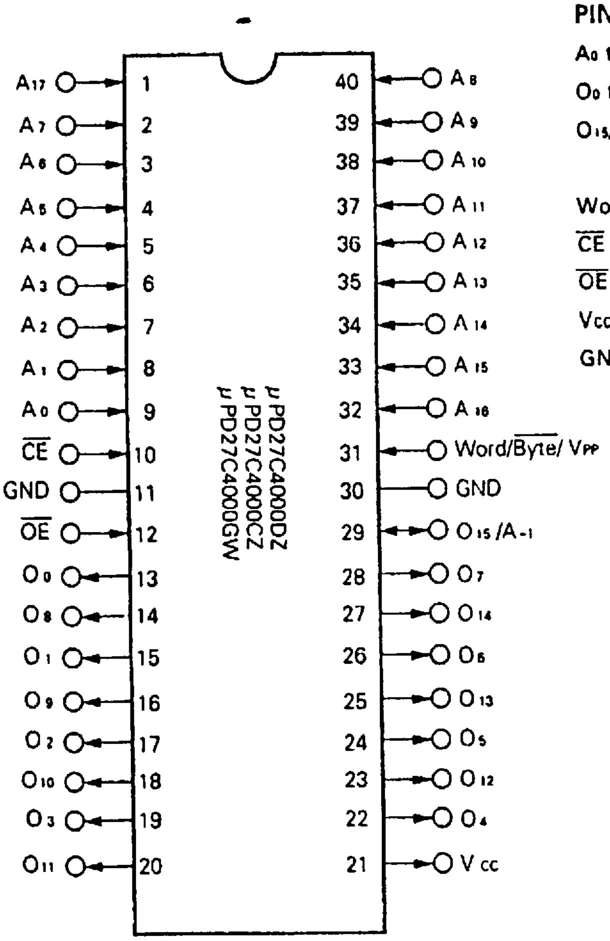
ORDERING INFORMATION

PART NUMBER	ACCESS TIME (MAX.)	PACKAGE TYPE	FUNCTION	QUALITY GRADE
μPD27C4000DZ-15	150 ns	40-pin Ceramic DIP with a quartz window (600 mil) (Mask programmable ROM compatible)	UV EPROM	STANDARD
μPD27C4000DZ-17	170 ns			
μPD27C4000DZ-20	200 ns			
μPD27C4000CZ-15	150 ns	40-pin Plastic DIP (600 mil) (Mask programmable ROM compatible)	ONE TIME PROM	
μPD27C4000CZ-17	170 ns			
μPD27C4000CZ-20	200 ns			
μPD27C4000GW-15	150 ns	40-pin Plastic SOP (525 mil) (Mask programmable ROM compatible)		
μPD27C4000GW-17	170 ns			
μPD27C4000GW-20	200 ns			

Note μPD27C4000 is compatible with the μPD23C4000.

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.

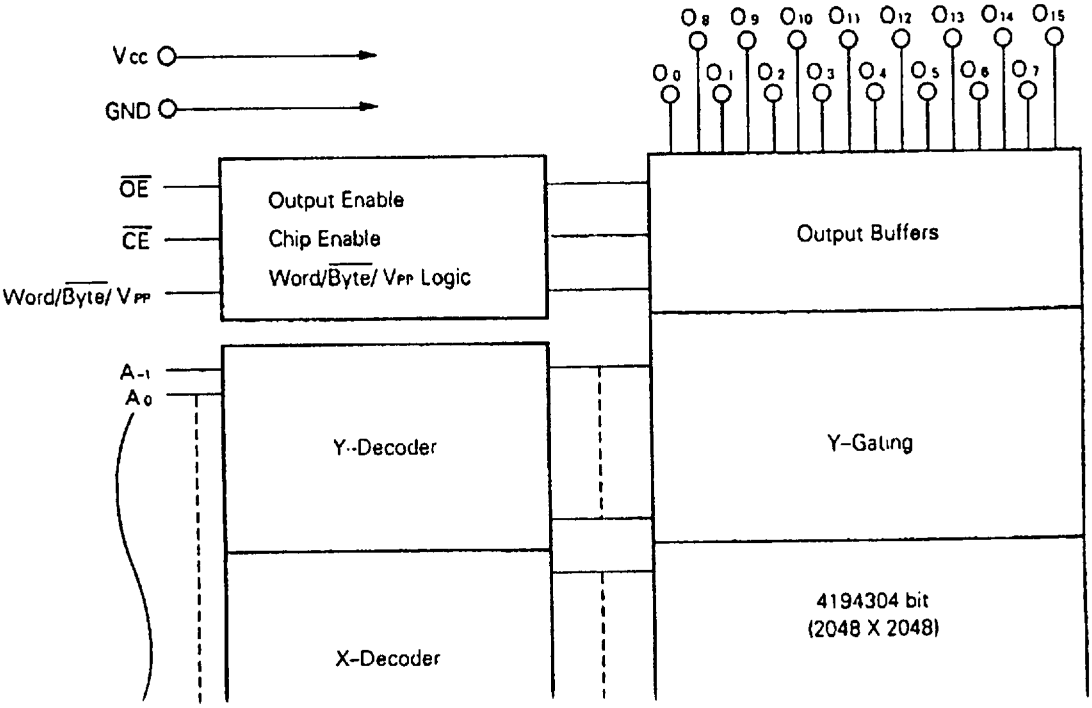
PIN CONFIGURATION (Top View)



PIN NAMES

A_0 to A_{17}	: Address Inputs
O_0 to O_7, O_8 to O_{14}	: Data Outputs
O_{15}/A_{-1}	: Data 15 Output (word mode)/ LSB Address Input (byte mode)
Word/ $\overline{\text{Byte}}$/ V_{PP}	: Mode Selects/Program Voltage
$\overline{\text{CE}}$	: Chip Enable
$\overline{\text{OE}}$	: Output Enable
V_{CC}	: Supply Voltage
GND	: Ground

BLOCK DIAGRAM



1. μPD27C4000 Operating Mode

MODE SELECTION

Symbol Mode	$\overline{CE}$	$\overline{OE}$	Word/$\overline{Byte}$/V_{PP}	V_{CC}	O_0 to O_7	O_8 to O_{14}	O_{15}/A_{-1}
Read (Word mode)	V_{IL}	V_{IL}	V_{IH}	+5 V	D_{OUT}	D_{OUT}	D_{OUT}
Read (Byte mode)	V_{IL}	V_{IL}	V_{IL}	+5 V	D_{OUT}	High-Z	LSB
Output Disable	V_{IL}	V_{IH}	X	+5 V	High-Z	High-Z	High-Z
Standby	V_{IH}	X	X	+5 V	High-Z	High-Z	High-Z
Program	V_{IL}	V_{IH}	+12.5 V	+6.5 V	D_{IN}	D_{IN}	D_{IN}
Program Verify	X	V_{IL}	+12.5 V	+6.5 V	D_{OUT}	D_{OUT}	D_{OUT}
Program Inhibit	V_{IH}	V_{IH}	+12.5 V	+6.5 V	High-Z	High-Z	High-Z

X can be either V_{IL} or V_{IH}

(1) Read Mode (Word Mode)

Setting Word/$\overline{Byte}$/V_{PP} to "1", $\overline{CE}$ to "0" and $\overline{OE}$ to "0" puts the device into the read mode (Word Mode), and the data is valid at the output pins O_0 to O_{15} after t_{ACC} from stabilizing all addresses, after t_{CE} from the falling edge of $\overline{CE}$ or after t_{OE} from the falling edge of $\overline{OE}$.

(2) Read Mode (Byte Mode)

Setting Word/$\overline{Byte}$/V_{PP} to "0", $\overline{CE}$ to "0" and $\overline{OE}$ to "0" puts the device into the read mode (Byte Mode), and the data is valid at the output pins O_0 to O_7 after t_{ACC} from stabilizing all addresses, after t_{CE} from the falling edge of $\overline{CE}$ or after t_{OE} from the falling edge of $\overline{OE}$. In this case of byte mode, O_8 to O_{14} are high-impedance, O_{15}/A_{-1} is LSB address input.

(3) Output Disable

Setting $\overline{OE}$ to "1" puts pins O_0 to O_{15} into the high-impedance state to disable data to be output. Therefore, when multiple μPD27C4000s are connected to the data bus, data can be read from any one of them by controlling $\overline{OE}$.

(4) Standby Mode

Setting $\overline{CE}$ to "1" puts the device into the standby mode, and the current at pin V_{CC} drops from 50 mA to 1 mA. The standby current varies depending on the level of $\overline{CE}$: 1 mA max. (I_{CCS1}) with $\overline{CE} = V_{IH}$ min. or 100 μA max. (I_{CCS2}) with $\overline{CE} \geq V_{CC} - 0.2$ V. In this mode, pins O_0 to O_{15} are in the high-impedance state regardless of the state of $\overline{OE}$.

(5) Program Mode

The programming flowchart is shown in Fig. 1.

The μPD27C4000 is shipped with bits being set to all "1". Programming causes relevant bits to change to "0". Programming starts by setting Vcc to +6.5 V and Word/$\overline{\text{Byte}}$/ V_{PP} to +12.5 V and initial address. Data to be programmed can be directly input in the 16-bit format through the data bus.

The 0.1 ms program pulse (active low) is applied to pin $\overline{CE}$ with $\overline{OE}$ = "1" for the initial address, and immediately $\overline{OE}$ is set to "0" to verify the data. If programming is not performed by applying the program pulse once, the program and program verification are executed X times ($X \leq 10$) repeatedly to verify the 1-word, and then the programming is complete. On completion of 1-word programming, the address is incremented. The same sequence is repeated up to the last address.

Note: Byte Program Mode is not supported.

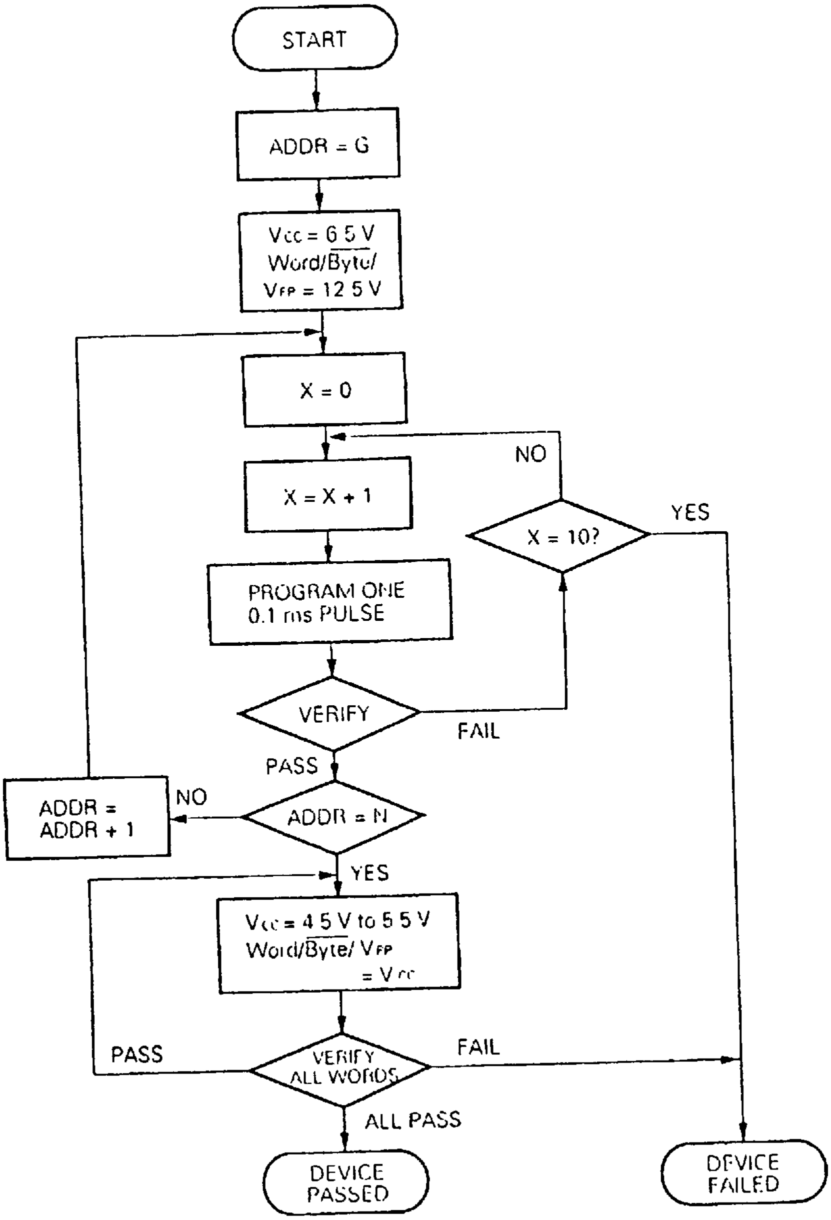
(6) Program Verify Mode

This mode is used to verify that the device is correctly programmed. After programming, check for the correct programming to each bit position in this mode. The programmed data can be verified with $\overline{OE}$ = "0".

(7) Program Inhibit Mode

This mode is used to program one of multiple μPD27C4000s whose pins $\overline{OE}$, Word/$\overline{\text{Byte}}$/ V_{PP} and O_0 to O_{15} are connected in parallel. Programming is performed in the program mode described above. Other μPD27C4000s can be inhibited from being programmed by setting their $\overline{CE}$ pins to "1" while the one device is programmed.

Fig. 1 Programming Flowchart



G = FIRST ADDR
N = LAST ADDR

2. Electrical Specifications

ABSOLUTE MAXIMUM RATINGS*

Operating Temperature	–10 to +80	°C
Storage Temperature: ONE TIME PROM	–55 to +125	°C
Storage Temperature: UV EPROM	–65 to +125	°C
Output Voltage	–0.6 to +7	V
Input Voltage	–0.6 to +7	V
Input Voltage: A_9	–0.6 to +13.5	V
Supply Voltage: V_{CC}	–0.6 to +7	V
Program Voltage: Word/$\overline{\text{Byte}}$/V_{PP}	–0.6 to +13.5	V

*COMMENT: Exposing the device to stress above those listed in Absolute Maximum Ratings could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational sections of this specification. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

READ OPERATION

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage V_{CC}	V_{CC}	4.5	5.0	5.5	V
Input High Voltage	V_{IH}	2.0		V_{CC} +0.3	V
Input Low Voltage	V_{IL}	–0.3		0.8	V
Operating Temperature	Ta	0		70	°C

DC CHARACTERISTICS (Recommended Operating Conditions unless otherwise noted)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Output High Voltage	V_{OH1}	2.4			V	I_{OH} = –400 μA
	V_{OH2}	V_{CC}–0.7			V	I_{OH} = –100 μA
Output Low Voltage	V_{OL}			0.45	V	I_{OL} = 2.1 mA
Output Leakage Current	I_{LO}	–10		10	μA	V_{OUT} = 0 to V_{CC}, $\overline{OE}$ = V_{IH}
Input Leakage Current	I_{LI}	–10		10	μA	V_{IN} = 0 to V_{CC}
Word/$\overline{\text{Byte}}$/V_{PP} Current	I_{PP}		1	100	μA	Word/$\overline{\text{Byte}}$/V_{PP} = 0 to V_{CC}
V_{CC} Current (active)	I_{CCA1}			50	mA	$\overline{CE}$ = V_{IL}, V_{IN} = V_{IH}
	I_{CCA2}			50	mA	f = 6.7 MHz, I_{OUT} = 0 mA
V_{CC} Current (standby)	I_{CCS1}			1	mA	$\overline{CE}$ = V_{IH} MIN.
	I_{CCS2}		1	100	μA	$\overline{CE}$ ≥ V_{CC} –0.2 V, V_{IN} = 0 to V_{CC}

AC CHARACTERISTICS (Recommended Operating Conditions unless otherwise noted)

PARAMETER	SYMBOL	μPD27C4000-15		μPD27C4000-17		μPD27C4000-20		UNIT	TEST CONDITION
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Address to Output Delay	t_{ACC}		150		170		200	ns	$\overline{CE} = \overline{OE} = V_{IL}$
$\overline{CE}$ to Output Delay	t_{CE}		150		170		200	ns	$\overline{OE} = V_{IL}$
$\overline{OE}$ to Output Delay	t_{OE}		70		70		75	ns	$\overline{CE} = V_{IL}$
$\overline{OE}$ or $\overline{CE}$ High to Output Float	t_{DF}	0	55	0	55	0	60	ns	$\overline{CE} = V_{IL}$ or $\overline{OE} = V_{IL}$
Address to Output Hold	t_{OH}	0		0		0		ns	$\overline{CE} = \overline{OE} = V_{IL}$
Word/$\overline{\text{Byte}}$ Access Time	t_{WB}		150		170		200	ns	$\overline{CE} = \overline{OE} = V_{IL}$

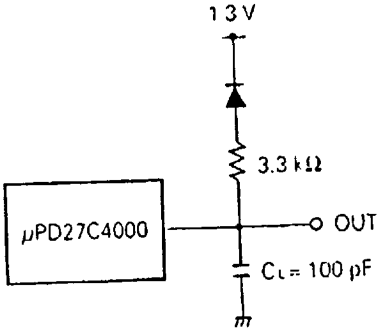
TEST CONDITIONS

- Output Load: See Fig. 2
- Input Rise and Fall Time ≤ 20 ns
- Input Pulse Levels: 0.45 V and 2.4 V
- Timing Measurement Reference Level

  Input : 0.8 V and 2.0 V

  Output: 0.8 V and 2.0 V

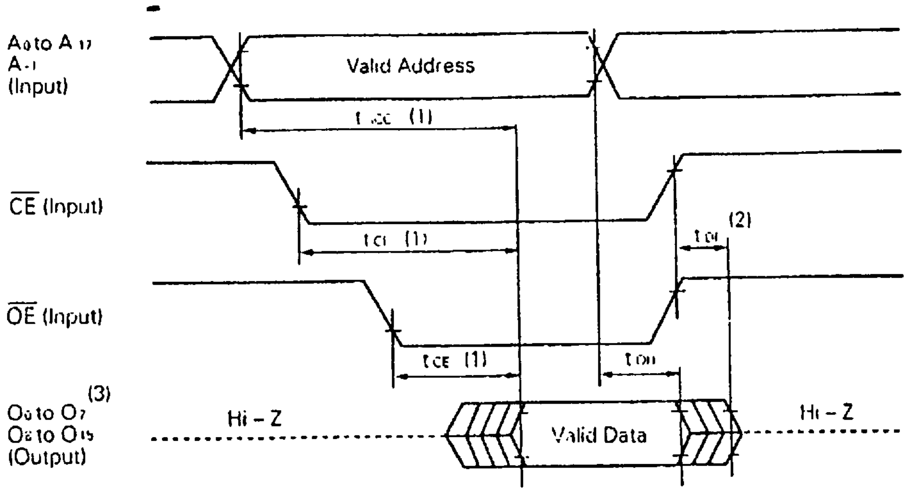
Fig. 2 Output Load



CAPACITANCE (Ta = 25 °C, f = 1 MHz)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Capacitance	C_{IN}			14	pF	$V_{IN} = 0$ V
Output Capacitance	C_{OUT}			16	pF	$V_{OUT} = 0$ V

Read Mode Timing



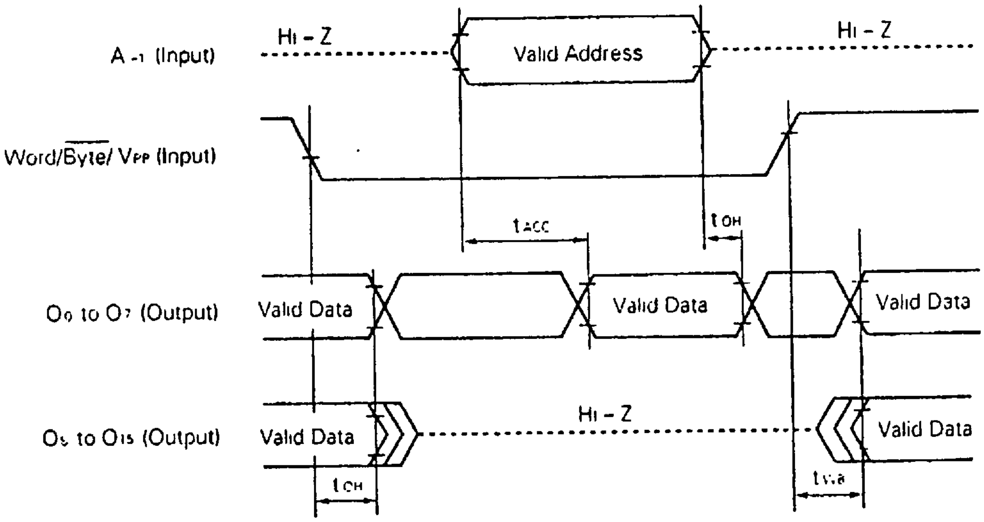
Notes: (1) For read operation, the definition of access time is as follows

$\overline{CE}$ Input Conditions	$\overline{OE}$ Input Conditions	Access Time Definition
before stabilizing address	before ($t_{ACC} - t_{OE}$)	t_{ACC}
	after ($t_{ACC} - t_{OE}$)	t_{OE}
after stabilizing address	before ($t_{CE} - t_{OE}$)	t_{CE}
	after ($t_{CE} - t_{OE}$)	t_{OE}

(2) t_{DF} is specified from $\overline{OE}$ or $\overline{CE}$, whichever occurs first

(3) In the byte mode, O_8 to O_{14} are high-impedance (O_{15} is A_{-1})

Word/Byte Switch Timing



Note: (1) $\overline{CE} = V_{IL}$, $\overline{OE} = V_{IL}$

PROGRAM OPERATION

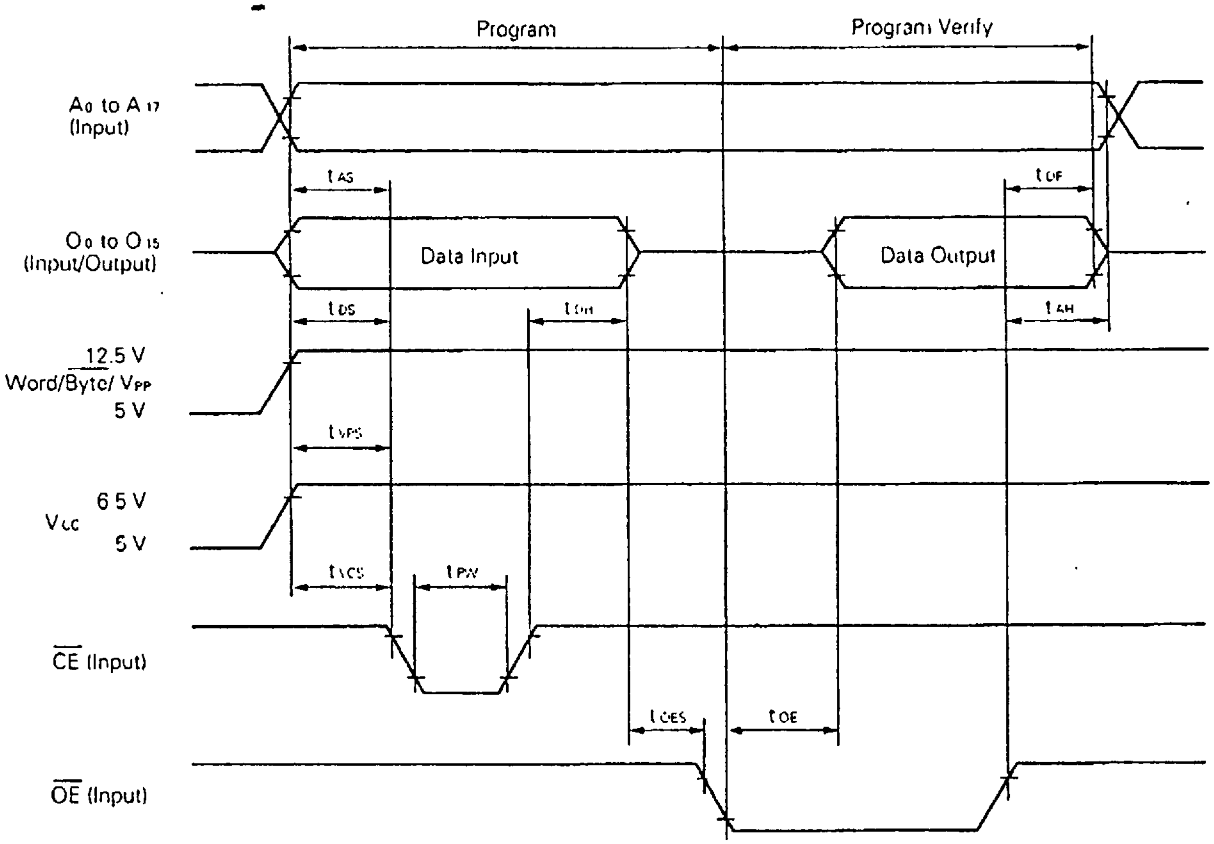
DC CHARACTERISTICS (T_a = 25 ±5 °C, V_{CC} = 6.5 ±0.25 V, Word/$\overline{\text{Byte}}$/V_{PP} = 12.5 ±0.3 V)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input High Voltage	V_{IH}	2.4		V_{CC} +0.3	V	
Input Low Voltage	V_{IL}	-0.3		0.8	V	
Input Leakage Current	I_{LI}	-10		10	µA	V_{IN} = 0 to V_{CC}
Output High Voltage	V_{OH}	2.4			V	I_{OH} = -400 µA
Output Low Voltage	V_{OL}			0.45	V	I_{OL} = 2.1 mA
V_{CC} Current	I_{CC}			50	mA	
Word/$\overline{\text{Byte}}$/V_{PP} Current	I_{PP}			50	mA	$\overline{\text{CE}}$ = V_{IL}, $\overline{\text{OE}}$ = V_{IH}

AC CHARACTERISTICS (T_a = 25 ±5 °C, V_{CC} = 6.5 ±0.25 V, Word/$\overline{\text{Byte}}$/V_{PP} = 12.5 ±0.3 V)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Address Setup Time	t_{AS}	2			µs	
$\overline{\text{OE}}$ Setup Time	t_{OES}	2			µs	
Data Setup Time	t_{DS}	2			µs	
Address Hold Time	t_{AH}	2			µs	
Data Hold Time	t_{DH}	2			µs	
$\overline{\text{OE}}$ High to Output Float	t_{DF}	0		130	ns	
Word/$\overline{\text{Byte}}$/V_{PP} Setup Time	t_{VPS}	2			µs	
V_{CC} Setup Time	t_{VCS}	2			µs	
Program Pulse Width	t_{PW}	0.095	0.1	0.105	ms	
$\overline{\text{OE}}$ to Output Delay	t_{OE}			150	ns	

Programming Mode Timing



Notes: (1) Vcc must be applied simultaneously or before **Word/$\overline{\text{Byte}}$/V_{PP}** and removed simultaneously or after **Word/$\overline{\text{Byte}}$/V_{PP}**.

(2) **Word/$\overline{\text{Byte}}$/V_{PP}** must not be greater than +13.5 V including overshoot.

(3) Removing and reinserting the device while a voltage of 12.5 V is applied to pin **Word/$\overline{\text{Byte}}$/V_{PP}** may affect the device reliability.

3. ERASURE

Programmed data on the μPD27C4000DZ can be erased by exposing it to light with a wavelength shorter than 400 nm. Exposure to direct sunlight or fluorescent light could also erase the data. Consequently, mask the window to prevent unintentional erasure by ultraviolet rays.

Data is typically erased by 254 nm ultraviolet rays. A lighting level of 15 w · s/cm^2 (min.) is required to completely erase written data (ultraviolet ray intensity X exposure time).

It takes approximately 20 minutes to completely erase with an ultraviolet lamp rated at 12 mw/cm^2. Place the μPD27C4000DZ within 2.5 cm from the lamp tubes. Remove any filter on the lamp.

4. SCREENING OF ONE TIME PROM

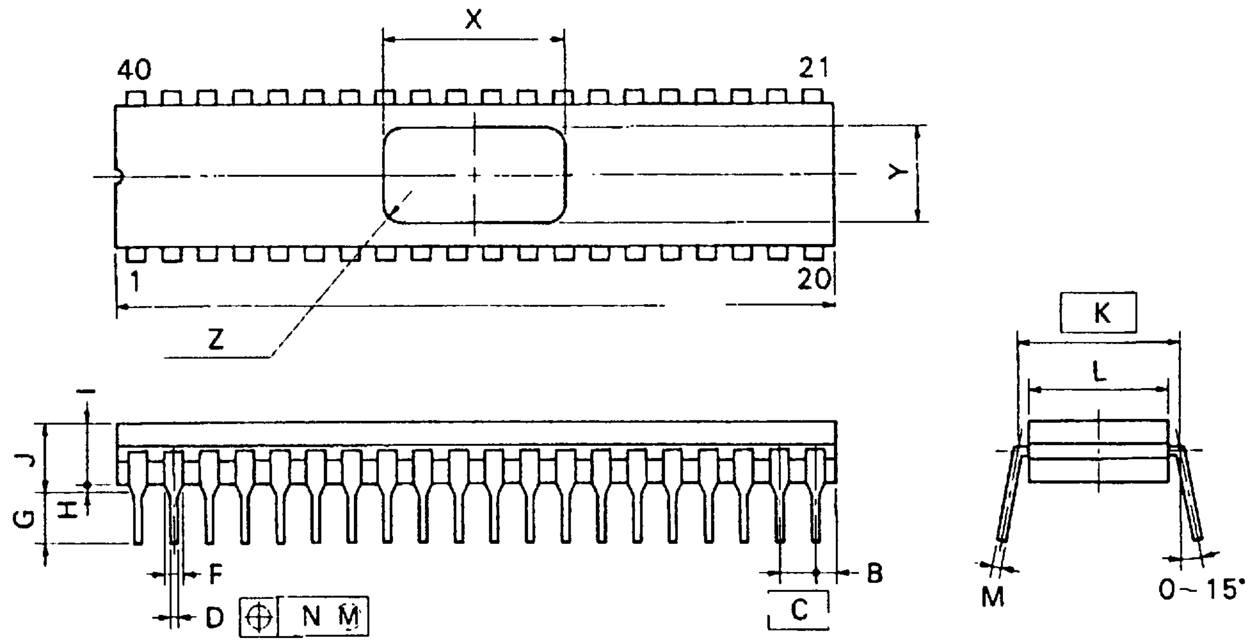
Initial-data-retention failure in the ONE TIME PROM cannot be eliminated before shipment to the customers due to the characteristic of this product itself.

In case of expecting reliability equivalent to conventional EPROM, NEC recommends the following screening at customer's site for the elimination of both programming failure and data retention failure.

(1) After programming data, verify data and reject failures.
(2) Perform high-temperature storage at 125 °C for 24 ± 4 hours.
(3) Verify data again and reject failures.

PACKAGE INFORMATION

40 PIN CERAMIC DIP (CERDIP) (WINDOW) (600mil)



P40DW 100-600WA2

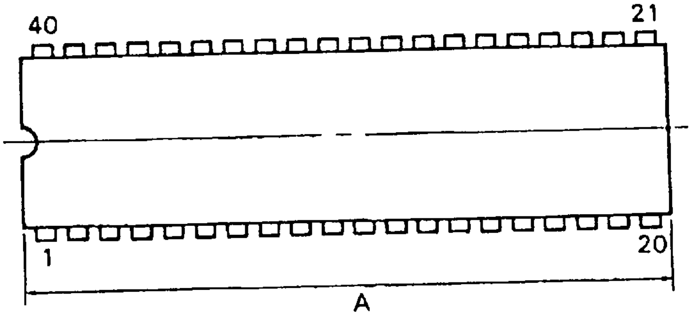
NOTES

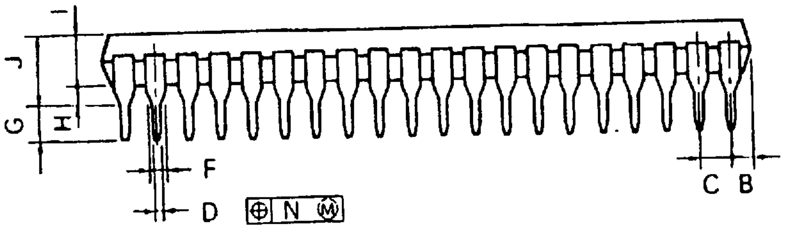
1) Each lead centerline is located within 0 25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.

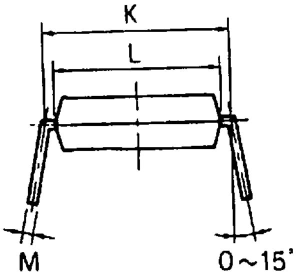
2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	53.34 MAX.	2.100 MAX.
B	2 54 MAX.	0.100 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	$0\ 50^{\pm 0\ 10}$	$0.020^{+0\ 004}_{-0\ 005}$
F	1.2 MIN.	0.047 MIN.
G	$3.5^{\pm 0\ 3}$	$0.138^{\pm 0\ 012}$
H	0.51 MIN.	0.020 MIN.
I	3.80	0.150
J	5 08 MAX.	0.200 MAX.
K	15.24 (T.P.)	0.600 (T P.)
L	14 66	0 577
M	$0.25^{\pm 0\ 05}$	$0\ 010^{+0\ 002}_{-0\ 003}$
N	0.25	0.01
X	12.5	0 492
Y	8.5	0.335
Z	4 R2 0	4-R0 079

40PIN PLASTIC DIP (600 mil)







P40C-100-600A

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	53.34 MAX.	2.100 MAX.
B	2.54 MAX.	0.100 MAX.
C	2.54 (T.P.)	0.100 (T P.)
D	0 50 $^{0\ 10}$	0 020 $^{0\ 004}_{0\ 005}$
F	1.2 MIN.	0.047 MIN.
G	3.6 $^{0\ 3}$	0.142 $^{\cdot 0\ 012}$
H	0 51 MIN	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.72 MAX.	0 226 MAX.
K	15.24 (T.P.)	0 600 (T.P)
L	13.2	0.520
M	0.25 $^{\cdot 0\ 10}_{0\ 05}$	0.010 $^{\cdot 0\ 004}_{0\ 003}$
N	0.25	0 01

RECOMMENDED SOLDERING CONDITIONS

The following conditions (see table below) must be met when soldering this product. Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

TYPES OF THROUGH HOLE MOUNT DEVICE

[μPD27C4000DZ, 27C4000CZ]

Soldering process	Soldering conditions	Symbol
Wave soldering	Solder temperature : 260 °C or below, Flow time : 10 seconds or below	WS60-00

[MEMO]

The information in this document is subject to change without notice.
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 the field where very high reliability is required including, but not limited to, aerospace equipment, submarine cables, nuclear reactor control systems and life support systems. If customers intend to use NEC devices for above applications or those intend to use "Standard" quality grade NEC devices for the application not intended by NEC, please contact our sales people in advance.
Application examples recommended by NEC Corporation

Standard: Data processing and office equipment, Communication equipment (terminal, mobile), Test and Measurement equipment, Audio and Video equipment, Other consumer products, Industrial robots, etc.

Special: Automotive and Transportation equipment, Communication equipment (trunk line), Train and Traffic control devices, Burning control systems, antidisaster systems, anticrime systems etc