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OP/IL  
 NEC

**Description**

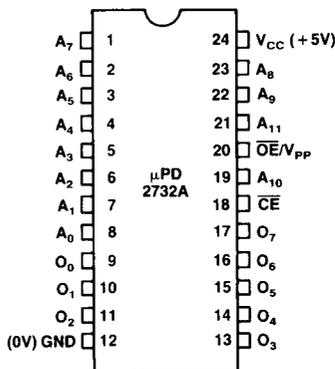
The μPD2732A is a 32,768- (4,096 x 8) bit ultraviolet erasable and electrically programmable read-only memory (EPROM). It operates from a single +5V supply, making it ideal for microprocessor applications. It features an output enable control and offers a standby mode with an attendant 75% savings in power consumption.

A distinctive feature of the μPD2732A is a separate output enable control (OE) from the chip enable control (CE). The OE control eliminates bus contention in multiple-bus microprocessor systems. The μPD2732A features fast, simple one-pulse programming controlled by TTL-level signals. Total programming time for all 32,768 bits is only 210 seconds.

**Features**

- Ultraviolet erasable and electrically programmable
- Access time — 200ns max
- Single location programming
- Programmable with single pulse
- Low power dissipation: 125mA max active current  
 30mA max standby current
- Input/Output TTL-compatible for reading and programming
- Single +5V power supply
- 24-pin ceramic DIP
- 21V programming

**Pin Configuration**



**Single Copy**  
**Handle With Care**

**Pin Names**

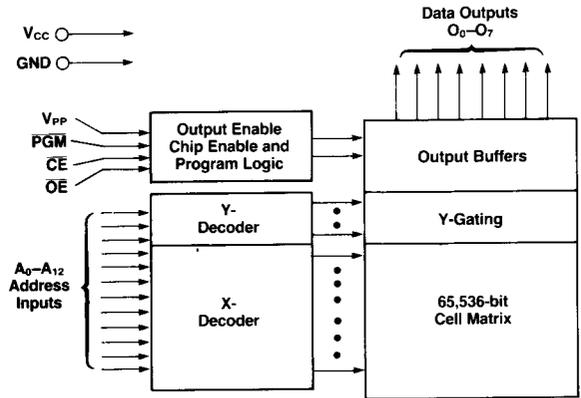
A <sub>0</sub> -A <sub>11</sub>	Addresses
OE	Output Enable
O <sub>0</sub> -O <sub>7</sub>	Data Outputs
CE	Chip Enable

**Mode Selection**

Pins	CE	OE/V <sub>PP</sub>	V <sub>CC</sub>	Outputs
<b>Mode</b>				
Read	V <sub>IL</sub>	V <sub>IL</sub>	+5	D <sub>OUT</sub>
Standby	V <sub>IH</sub>	Don't Care	+5	High Z
Program	V <sub>IL</sub>	V <sub>PP</sub>	+5	D <sub>IN</sub>
Program Verify	V <sub>IL</sub>	V <sub>IL</sub>	+5	D <sub>OUT</sub>
Program Inhibit	V <sub>IH</sub>	V <sub>PP</sub>	+5	High Z

Table 1 — Mode Selection

**Block Diagram**



**Absolute Maximum Ratings\***

T <sub>a</sub> = 25°C	
Operating Temperature	-10°C to +80°C
Storage Temperature	-65°C to +125°C
Output Voltage	-0.3V to +6V
Input Voltage	-0.3V to +6.5V
Supply Voltage V <sub>CC</sub>	-0.3V to +6V
Supply Voltage V <sub>PP</sub>	-0.3V to +22V

\*COMMENT: Exposing the device to stresses 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.

**Capacitance**

Parameter	Symbol	Limits			Unit	Test Conditions
		Min	Typ	Max		
Input Capacitance Except OE/V <sub>PP</sub>	C <sub>IN1</sub>		4	6	pF	V <sub>IN</sub> = 0V
OE/V <sub>PP</sub> Input Capacitance	C <sub>IN2</sub>			20	pF	V <sub>IN</sub> = 0V
Output Capacitance	C <sub>OUT</sub>			12	pF	V <sub>OUT</sub> = 0V

**DC Characteristics**

**Read Mode and Standby Mode**  
 T<sub>a</sub> = 0°C to +70°C; V<sub>CC</sub> = +5V ± 5%

Parameter	Symbol	Limits			Unit	Test Conditions
		Min	Typ	Max		
Output High Voltage	V <sub>OH</sub>	2.4			V	I <sub>OH</sub> = -400μA
Output Low Voltage	V <sub>OL</sub>		0.45		V	I <sub>OL</sub> = 2.1mA
Input High Voltage	V <sub>IH</sub>	2.0		V <sub>CC</sub> + 1	V	
Input Low Voltage	V <sub>IL</sub>	-0.1		0.8	V	
Output Leakage Current	I <sub>LO</sub>			10	μA	V <sub>OUT</sub> = 5.25V
Input except OE/V <sub>PP</sub> Leakage Current	I <sub>LI1</sub>			10	μA	V <sub>IN</sub> = 5.25V
OE/V <sub>PP</sub> Leakage Current	I <sub>LI2</sub>			10	μA	V <sub>IN</sub> = 5.25V
V <sub>CC</sub> Current	Standby	I <sub>CC1</sub>		30	mA	CE = V <sub>IH</sub> , OE/V <sub>PP</sub> = V <sub>IL</sub>
	Active	I <sub>CC2</sub>		125	mA	OE/V <sub>PP</sub> = CE = V <sub>IL</sub>

## DC Characteristics (Cont.)

### Program, Program Verify, and Program Inhibit Modes

$T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ;  $V_{CC} = +5\text{V} \pm 5\%$ ;  $V_{PP} = +21\text{V} \pm 0.5\text{V}$

Parameter	Symbol	Limits			Unit	Test Conditions
		Min	Typ	Max		
Input High Voltage	$V_{IH}$	2.0		$V_{CC} + 1$	V	
Input Low Voltage	$V_{IL}$	-0.1		0.8	V	
Input Leakage Current	$I_{LI}$			10	$\mu\text{A}$	$V_{IN} = V_{IL}$ or $V_{IH}$
Output High Voltage	$V_{OH}$	2.4			V	$I_{OH} = -400\mu\text{A}$
Output Low Voltage	$V_{OL}$			0.45	V	$I_{OL} = 2.1\text{mA}$
$V_{CC}$ Current	$I_{CC}$		85	125	mA	
$V_{PP}$ Current	$I_{PP}$			30	mA	$\overline{CE} = V_{IL}$ , $\overline{OE} = V_{PP}$

## AC Characteristics

### Read Mode and Standby Mode

$T_a = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ;  $V_{CC} = +5\text{V} \pm 5\%$

Parameter	Symbol	Limits						Unit	Test Conditions
		2732A-2		2732A		2732A-3			
Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Address to Output Delay	$t_{ACC}$	200	250	300	ns				$\overline{CE} = \overline{OE}/V_{PP} = V_{IL}$
CE to Output Delay	$t_{CE}$	200	250	300	ns				$\overline{OE} = V_{IL}$
Output Enable to Output Delay	$t_{OE}$	70	100	150	ns				$\overline{CE} = V_{IL}$
Output Enable High to Output Float	$t_{DF}$	60	90	130	ns				$\overline{CE} = V_{IH}$
Address to Output Hold	$t_{OH}$	0	0	0	ns				$\overline{CE} = \overline{OE} = V_{IL}$

### Test Conditions —

Output Load: 1 TTL gate and  $C_L = 100\text{pF}$

Input Rise and Fall Times: 20ns

Input Pulse Levels: 0.8V to 2.2V

Timing Measurement Reference Levels:

Inputs: 1.0V and 2.0V

Outputs: 0.8V and 2.0V

### Program, Program Verify, and Program Inhibit Modes

$T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ;  $V_{CC} = +5\text{V} \pm 5\%$ ;  $V_{PP} = +21\text{V} \pm 0.5\text{V}$

Parameter	Symbol	Limits			Unit	Test Conditions
		Min	Typ	Max		
Address Setup Time	$t_{AS}$	2			$\mu\text{s}$	
OE Setup Time	$t_{OES}$	2			$\mu\text{s}$	
Data Setup Time	$t_{DS}$	2			$\mu\text{s}$	
Address Hold Time	$t_{AH}$	0			$\mu\text{s}$	
OE Hold Time	$t_{OEH}$	2			$\mu\text{s}$	
Data Hold Time	$t_{DH}$	2			$\mu\text{s}$	
Output Enable to Output Float Delay	$t_{DF}$	0		130	ns	
Data Valid from CE	$t_{DV}$			1	$\mu\text{s}$	$\overline{CE} = V_{IL}$ , $\overline{OE} = V_{IL}$
Program Pulse Width	$t_{PW}$	45	50	55	ms	
Program Pulse Rise Time	$t_{PRT}$	50			ns	
$V_{PP}$ Recovery Time	$t_{VR}$	2			$\mu\text{s}$	

### Test Conditions —

Input Pulse Levels: 0.8V to 2.2V

Input Timing Reference Levels: 1.0V and 2.0V

Output Timing Reference Levels: 0.8V and 2V

Input Rise and Fall Times: 20ns

## Function

The  $\mu\text{PD}2732\text{A}$  operates from a single +5V power supply, making it ideal for microprocessor applications.

Programming of the  $\mu\text{PD}2732\text{A}$  is achieved with a single 50ms TTL pulse. Total programming time for all 32,768 bits is only 210 seconds. Due to the simplicity of the programming requirements, devices on boards and in systems may be easily programmed without any special programmer.

The  $\mu\text{PD}2732\text{A}$  features a Standby mode which reduces the power dissipation from a maximum active power dissipation of 656mW to a maximum standby power dissipation of 158mW. This results in a 75% savings with no increase in access time.

Erasure of the  $\mu\text{PD}2732\text{A}$  programmed data can be attained when exposed to light with wavelengths shorter than approximately 4,000 Angstroms ( $\text{\AA}$ ). It should be noted that constant exposure to direct sunlight or room level fluorescent lighting could erase the  $\mu\text{PD}2732\text{A}$ . Consequently, if the  $\mu\text{PD}2732\text{A}$  is to be exposed to these types of lighting conditions for long periods of time, its window should be masked to prevent unintentional erasure.

The recommended erasure procedure for the  $\mu\text{PD}2732\text{A}$  is exposure to ultraviolet light with wavelengths of 2,537 Angstroms ( $\text{\AA}$ ). The integrated dose (i.e., UV intensity x exposure time) for erasure should be not less than 15W-sec/cm<sup>2</sup>. The erasure time is approximately 15 to 20 minutes using an ultraviolet lamp of 12,000 $\mu\text{W}/\text{cm}^2$  power rating.

During erasure, the  $\mu\text{PD}2732\text{A}$  should be placed within 1 inch of the lamp tubes. If the lamps have filters on the tubes, the filters should be removed before erasure.

## Operation

The five operation modes of the  $\mu\text{PD}2732\text{A}$  are listed in Table 1. In the Read mode the only power supply required is a +5V supply. During programming, all inputs are TTL levels except for  $\overline{OE}/V_{PP}$  which is pulsed from TTL level to 21V.

### Read Mode

When  $\overline{CE}$  and  $\overline{OE}/V_{PP}$  are at a low (0) level, read is set and data is available at the outputs after  $t_{OE}$  from the falling edge of  $\overline{OE}$  and  $t_{ACC}$  after setting the address.

### Standby Mode

The  $\mu\text{PD}2732\text{A}$  is placed in a Standby mode with the application of a high (1) level TTL signal to the  $\overline{CE}$  input. In this mode, the outputs are in a high impedance state, independent of the  $\overline{OE}/V_{PP}$  input. The active power dissipation is reduced by 75% from 656mW to 158mW.

### Program Mode

Programming begins by erasing all data and consequently having all bits in the high (1) level state. Data is then entered by programming a low (0) level TTL signal into the chosen bit location.

The  $\mu\text{PD}2732\text{A}$  is placed in the Program mode by applying a high (1) level TTL signal to the  $\overline{CE}$  and with  $\overline{OE}/V_{PP}$  at +21V. The data to be programmed is applied to the output pins in 8-bit parallel form at TTL levels.

Any location can be programmed at any time, either individually, sequentially, or at random.

When multiple  $\mu\text{PD}2732\text{As}$  are connected in parallel, except for  $\overline{CE}$ , individual  $\mu\text{PD}2732\text{As}$  can be programmed by applying a low (0) level TTL pulse to the  $\overline{CE}$  input of the desired  $\mu\text{PD}2732\text{A}$  to be programmed.

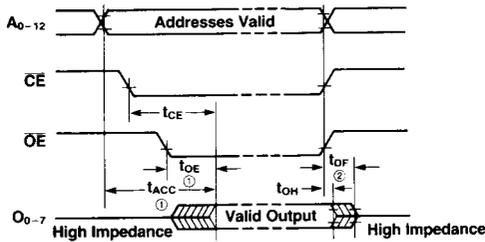
Programming of multiple  $\mu\text{PD}2732\text{As}$  in parallel with the same data is easily accomplished. All the like inputs are tied together and programmed by applying a low (0) level TTL pulse to the  $\overline{CE}$  inputs.

### Program Inhibit Mode

Programming multiple  $\mu\text{PD}2732\text{As}$  in parallel with different data is easier with the Program Inhibit mode. Except for  $\overline{CE}$ , all like inputs (including  $\overline{OE}$ ) of the parallel  $\mu\text{PD}2732\text{As}$  may be common. Programming is accomplished by applying the TTL-level program pulse to the  $\overline{CE}$  input with  $\overline{OE}/V_{PP}$  at +21V. A high (1) level applied to the  $\overline{CE}$  of the other  $\mu\text{PD}2732\text{A}$  will inhibit it from being programmed.

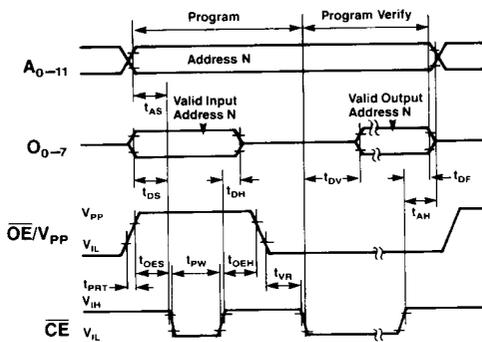
## Timing Waveforms

### Read Mode



- Notes:**
- ①  $\overline{OE}$  may be delayed up to  $t_{ACC} - t_{OE}$  after the falling edge of  $\overline{CE}$  for read mode without impact on  $t_{ACC}$ .
  - ②  $t_{DF}$  is specified from  $\overline{OE}$  or  $\overline{CE}$ , whichever occurs first.

### Program Mode ①



- Note:** ① 0.1 $\mu$ F capacitor must be connected between  $\overline{OE}/V_{PP}$  and ground to suppress spurious voltage transients which may damage the device.

## Program Verify Mode

A verify should be performed on the programmed bits to determine that the data was correctly programmed. The program verify can be performed with  $\overline{CE}$  and  $\overline{OE}/V_{PP}$  at low (0) levels.

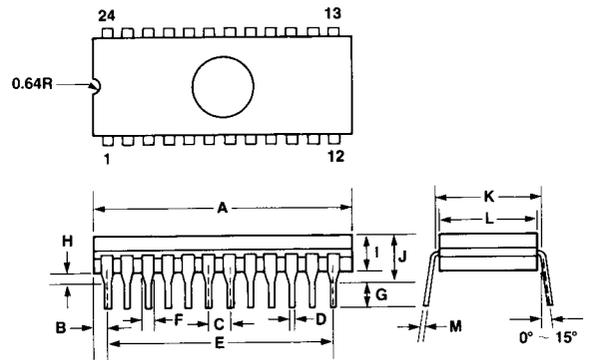
## Output Deselect

The data outputs of two or more  $\mu$ PD2732As may be wire-ORed together to the same data bus. In order to prevent bus contention problems between devices, all but the selected  $\mu$ PD2732As should be deselected by raising the  $\overline{OE}/V_{PP}$  input to a TTL high.

## Window Label

An opaque window label is provided unattached for the convenience of the user. The window label filters ultra-violet light frequencies, thus preventing accidental erasure or long-term degradation caused by ambient light or sunlight.

## Package Outline $\mu$ PD2732AD (Cerdip)



Item	Millimeters	Inches
A	33.02 Max	1.3 Max
B	2.54	0.1
C	2.54 $\pm$ 0.25	0.1 $\pm$ 0.01
D	0.5 $\pm$ 0.10	0.020 $\pm$ 0.004
E	27.94	1.10
F	1.3	0.05
G	2.54 Min	0.1 Min
H	0.51 Min	0.020 Min
I	5.08 Max	0.20 Max
J	5.59 Max	0.22 Max
K	15.24	0.60
L	14.66	0.58
M	0.25 $\pm$ 0.05	0.010 $\pm$ 0.002

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