

## 2K x 8 Reprogrammable PROM

### Features

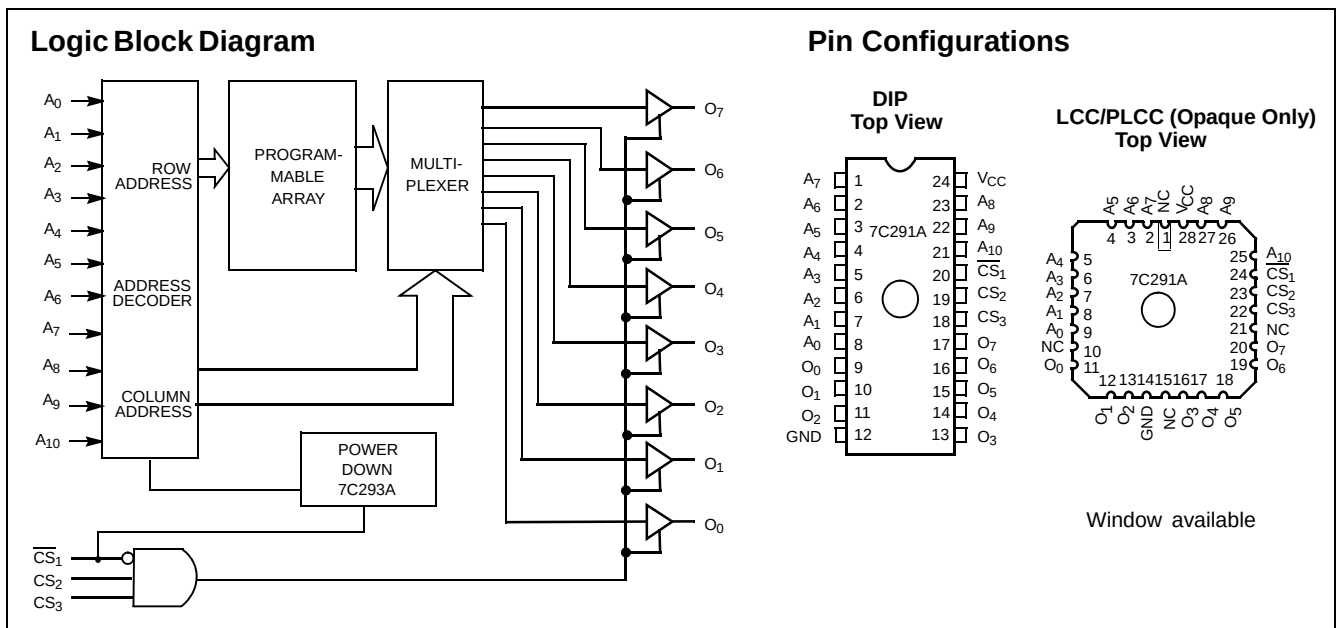
- Windowed for reprogrammability
- CMOS for optimum speed/power
- High speed
  - 20 ns (Commercial)
  - 35 ns (Military)
- Low power
  - 660 mW (Commercial and Military)
- Low standby power
  - 220 mW (Commercial and Military)
- EPROM technology 100% programmable
- Slim 300-mil or standard 600-mil packaging available
- 5V  $\pm 10\%$   $V_{CC}$ , commercial and military
- TTL-compatible I/O
- Direct replacement for bipolar PROMs
- Capable of withstanding >2001V static discharge

### Functional Description

The CY7C291A is a high-performance 2K-word by 8-bit CMOS PROM. It is packaged in a 300-mil ceramic package which may be equipped with an erasure window; when exposed to UV light the PROM is erased and can then be reprogrammed. The memory cells utilize proven EPROM floating-gate technology and byte-wide intelligent programming algorithms.

The CY7C291A is a plug-in replacement for bipolar devices and offers the advantage of lower power, reprogrammability, superior performance and programming yield. The EPROM cell requires only 12.5V for the supervoltage and low current requirements allow for gang programming. The EPROM cells allow for each memory location to be tested 100%, as each location is written into, erased, and repeatedly exercised prior to encapsulation. Each PROM is also tested for AC performance to guarantee that after customer programming the product will meet DC and AC specification limits.

A read is accomplished by placing an active LOW signal on  $\overline{CS}_1$ , and active HIGH signals on  $CS_2$  and  $CS_3$ . The contents of the memory location addressed by the address line ( $A_0$ – $A_{10}$ ) will become available on the output lines ( $O_0$ – $O_7$ ).



## Selection Guide

|                           |          |            | 7C291A-20 | 7C291A-25 | 7C291A-35<br>7C291AL-35 | 7C291A-50 | Unit |
|---------------------------|----------|------------|-----------|-----------|-------------------------|-----------|------|
| Maximum Access Time       |          |            | 20        | 25        | 35                      | 50        | ns   |
| Maximum Operating Current | Standard | Commercial | 120       | 90        | 90                      | 90        | mA   |
|                           |          | Military   |           |           | 90                      |           | mA   |
|                           | L        | Commercial |           |           | 60                      |           | mA   |

## Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... -65°C to +150°C

Ambient Temperature with

Power Applied ..... -55°C to +125°C

Supply Voltage to Ground Potential ..... -0.5V to +7.0V

DC Voltage Applied to Outputs

in High Z State ..... -0.5V to +7.0V

DC Input Voltage ..... -3.0V to +7.0V

DC Program Voltage ..... 13.0V

UV Exposure ..... 7258 Wsec/cm<sup>2</sup>

Static Discharge Voltage ..... >2001V  
(per MIL-STD-883, Method 3015)

Latch-Up Current ..... >200 mA

## Operating Range

| Range                   | Ambient Temperature | V <sub>CC</sub> |
|-------------------------|---------------------|-----------------|
| Commercial              | 0°C to + 70°C       | 5V ±10%         |
| Military <sup>[1]</sup> | -55°C to + 125°C    | 5V ±10%         |

### Note

1. T<sub>A</sub> is the "instant on" case temperature.

**Electrical Characteristics** Over the Operating Range<sup>[2,3]</sup>

| Parameter        | Description                                 | Test Conditions                                               | 7C291A-20 |                 | 7C291A-25 |                 | Unit |
|------------------|---------------------------------------------|---------------------------------------------------------------|-----------|-----------------|-----------|-----------------|------|
|                  |                                             |                                                               | Min.      | Max.            | Min.      | Max.            |      |
| V <sub>OH</sub>  | Output HIGH Voltage                         | V <sub>CC</sub> = Min., I <sub>OH</sub> = -4.0 mA             | 2.4       |                 | 2.4       |                 | V    |
| V <sub>OL</sub>  | Output LOW Voltage                          | V <sub>CC</sub> = Min., I <sub>OL</sub> = 16.0 mA             |           | 0.4             |           | 0.4             | V    |
| V <sub>IH</sub>  | Input HIGH Voltage                          | Guaranteed Input Logical HIGH Voltage for All Inputs          | 2.0       | V <sub>CC</sub> | 2.0       | V <sub>CC</sub> | V    |
| V <sub>IL</sub>  | Input LOW Voltage                           | Guaranteed Input Logical LOW Voltage for All Inputs           |           | 0.8             |           | 0.8             | V    |
| I <sub>IX</sub>  | Input Load Current                          | GND ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>                       | -10       | +10             | -10       | +10             | μA   |
| V <sub>CD</sub>  | Input Diode Clamp Voltage                   |                                                               | Note 3    |                 |           |                 |      |
| I <sub>OZ</sub>  | Output Leakage Current                      | GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> ,<br>Output Disabled | -10       | +10             | -10       | +10             | μA   |
| I <sub>OS</sub>  | Output Short Circuit Current <sup>[4]</sup> | V <sub>CC</sub> = Max., V <sub>OUT</sub> = GND                | -20       | -90             | -20       | -90             | mA   |
| I <sub>CC</sub>  | V <sub>CC</sub> Operating Supply Current    | V <sub>CC</sub> = Max.,<br>I <sub>OUT</sub> = 0 mA            |           | 120             |           | 90              | mA   |
| I <sub>SB</sub>  | Standby Supply Current (7C293A Only)        | V <sub>CC</sub> = Max.,<br>CS <sub>1</sub> = V <sub>IH</sub>  |           | 40              |           | 30              | mA   |
| V <sub>PP</sub>  | Programming Supply Voltage                  |                                                               | 12        | 13              | 12        | 13              | V    |
| I <sub>PP</sub>  | Programming Supply Current                  |                                                               |           | 50              |           | 50              | mA   |
| V <sub>IHP</sub> | Input HIGH Programming Voltage              |                                                               | 3.0       |                 | 3.0       |                 | V    |
| V <sub>ILP</sub> | Input LOW Programming Voltage               |                                                               |           | 0.4             |           | 0.4             | V    |

**Notes**

- See the last page of this specification for Group A subgroup testing information.
- See the "Introduction to CMOS PROMs" section of the Cypress Data Book for general information on testing.
- For test purposes, not more than one output at a time should be shorted. Short circuit test duration should not exceed 30 seconds.

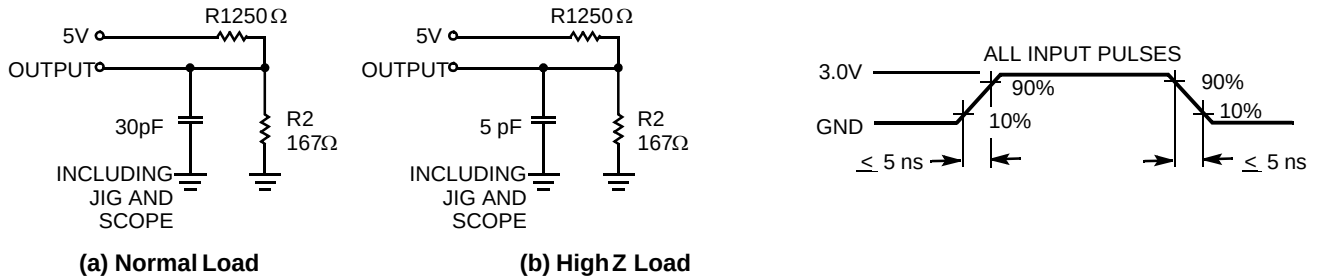
**Electrical Characteristics** Over the Operating Range<sup>[2,3]</sup> (continued)

| Parameter        | Description                                 | Test Conditions                                                              | 7C291AL-35 |      | 7C291A-35<br>7C291A-50 |      | Unit |
|------------------|---------------------------------------------|------------------------------------------------------------------------------|------------|------|------------------------|------|------|
|                  |                                             |                                                                              | Min.       | Max. | Min.                   | Max. |      |
| V <sub>OH</sub>  | Output HIGH Voltage                         | V <sub>CC</sub> = Min., I <sub>OH</sub> = -4.0 mA                            | 2.4        |      | 2.4                    |      | V    |
| V <sub>OL</sub>  | Output LOW Voltage                          | V <sub>CC</sub> = Min., I <sub>OL</sub> = 16.0 mA                            |            | 0.4  |                        | 0.4  | V    |
| V <sub>IH</sub>  | Input HIGH Voltage                          | Guaranteed Input Logical HIGH Voltage for All Inputs                         | 2.0        |      | 2.0                    |      | V    |
| V <sub>IL</sub>  | Input LOW Voltage                           | Guaranteed Input Logical LOW Voltage for All Inputs                          |            | 0.8  |                        | 0.8  | V    |
| I <sub>IX</sub>  | Input Load Current                          | GND ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>                                      | -10        | +10  | -10                    | +10  | μA   |
| V <sub>CD</sub>  | Input Diode Clamp Voltage                   |                                                                              | Note 3     |      |                        |      |      |
| I <sub>OZ</sub>  | Output Leakage Current                      | GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> ,<br>Output Disabled                | -10        | +10  | -10                    | +10  | μA   |
| I <sub>OS</sub>  | Output Short Circuit Current <sup>[4]</sup> | V <sub>CC</sub> = Max., V <sub>OUT</sub> = GND                               | -20        | -90  | -20                    | -90  | mA   |
| I <sub>CC</sub>  | V <sub>CC</sub> Operating Supply Current    | V <sub>CC</sub> = Max.,<br>V <sub>IN</sub> = 2.0V<br>I <sub>OUT</sub> = 0 mA | Commercial | 60   |                        | 90   | mA   |
|                  |                                             |                                                                              | Military   |      |                        | 90   |      |
| I <sub>SB</sub>  | Standby Supply Current<br>(7C293A Only)     | V <sub>CC</sub> = Max.,<br>CS <sub>1</sub> = V <sub>IH</sub>                 | Commercial | 30   |                        | 30   | mA   |
|                  |                                             |                                                                              | Military   |      |                        | 40   |      |
| V <sub>PP</sub>  | Programming Supply Voltage                  |                                                                              | 12         | 13   | 12                     | 13   | V    |
| I <sub>PP</sub>  | Programming Supply Current                  |                                                                              |            | 50   |                        | 50   | mA   |
| V <sub>IHP</sub> | Input HIGH Programming Voltage              |                                                                              | 3.0        |      | 3.0                    |      | V    |
| V <sub>ILP</sub> | Input LOW Programming Voltage               |                                                                              |            | 0.4  |                        | 0.4  | V    |

**Capacitance<sup>[3]</sup>**

| Parameter        | Description        | Test Conditions                                             | Max. | Unit |
|------------------|--------------------|-------------------------------------------------------------|------|------|
| C <sub>IN</sub>  | Input Capacitance  | T <sub>A</sub> = 25°C, f = 1 MHz,<br>V <sub>CC</sub> = 5.0V | 10   | pF   |
| C <sub>OUT</sub> | Output Capacitance |                                                             | 10   | pF   |

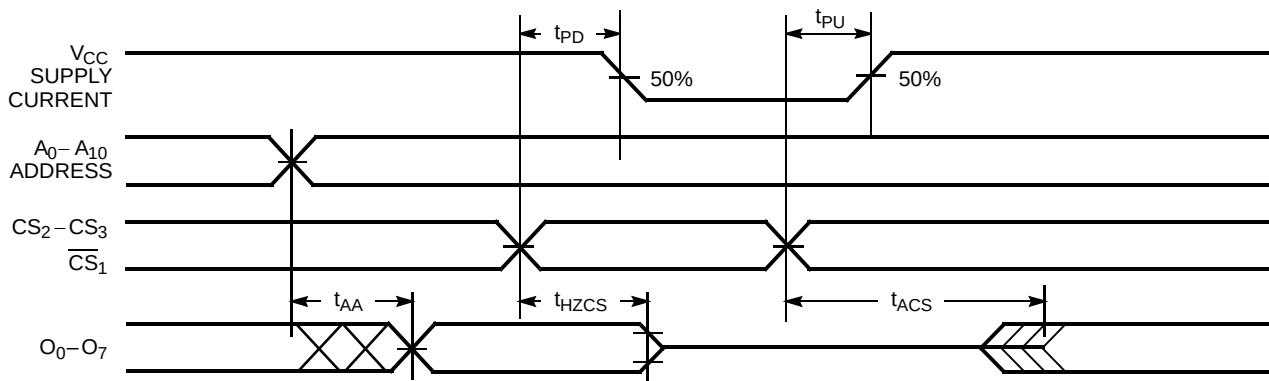
### AC Test Loads and Waveforms<sup>[3]</sup>



Equivalent to: THÉVENIN EQUIVALENT

100Ω

OUTPUT — 2.0V



### Switching Characteristics Over the Operating Range<sup>[2, 3]</sup>

| Parameter   | Description                        | 7C291A-20 |      | 7C291A-25 |      | 7C291A-35<br>7C291AL-35 |      | 7C291A-50 |      | Unit |
|-------------|------------------------------------|-----------|------|-----------|------|-------------------------|------|-----------|------|------|
|             |                                    | Min.      | Max. | Min.      | Max. | Min.                    | Max. | Min.      | Max. |      |
| $t_{AA}$    | Address to Output Valid            |           | 20   |           | 25   |                         | 35   |           | 50   | ns   |
| $t_{HZCS1}$ | Chip Select Inactive to High Z     |           | 15   |           | 15   |                         | 20   |           | 20   | ns   |
| $t_{ACS1}$  | Chip Select Active to Output Valid |           | 15   |           | 15   |                         | 20   |           | 20   | ns   |
| $t_{HZCS2}$ | Chip Select Inactive to High Z     |           | 22   |           | 27   |                         | 35   |           | 45   | ns   |
| $t_{ACS2}$  | Chip Select Active to Output Valid |           | 22   |           | 27   |                         | 35   |           | 45   | ns   |
| $t_{PU}$    | Chip Select Active to Power-Up     | 0         |      | 0         |      | 0                       |      | 0         |      | ns   |
| $t_{PD}$    | Chip Select Inactive to Power-Down |           | 22   |           | 27   |                         | 35   |           | 45   | ns   |

## Erase Characteristics

Wavelengths of light less than 4000 Angstroms begin to erase these PROMs. For this reason, an opaque label should be placed over the window if the PROM is exposed to sunlight or fluorescent lighting for extended periods of time.

The recommended dose of ultraviolet light for erasure is a wavelength of 2537 Angstroms for a minimum dose (UV intensity x exposure time) of 25 Wsec/cm<sup>2</sup>. For an ultraviolet lamp with a 12 mW/cm<sup>2</sup> power rating, the exposure time would be approximately 35 minutes.

These PROMs need to be within 1 inch of the lamp during erasure. Permanent damage may result if the PROM is exposed to high-intensity UV light for an extended period of time. 7258 Wsec/cm<sup>2</sup> is the recommended maximum dosage.

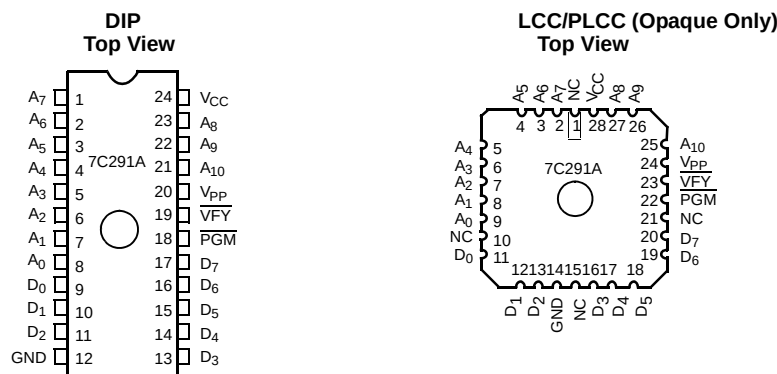
## Programming Information

Programming support is available from Cypress as well as from a number of third-party software vendors. For detailed programming information, including a listing of software packages, please see the PROM Programming Information located at the end of this section. Programming algorithms can be obtained from any Cypress representative.

**Table 1. Mode Selection**

| Mode                          | Pin Function <sup>[5]</sup> |                                 |                  |                  |                 |                                |
|-------------------------------|-----------------------------|---------------------------------|------------------|------------------|-----------------|--------------------------------|
|                               | Read or Output Disable      | A <sub>10</sub> -A <sub>0</sub> | CS <sub>3</sub>  | CS <sub>2</sub>  | CS <sub>1</sub> | O <sub>7</sub> -O <sub>0</sub> |
|                               | Other                       | A <sub>10</sub> -A <sub>0</sub> | PGM              | VFY              | V <sub>PP</sub> | D <sub>7</sub> -D <sub>0</sub> |
| Read                          |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>IH</sub>  | V <sub>IH</sub>  | V <sub>IL</sub> | O <sub>7</sub> -O <sub>0</sub> |
| Output Disable <sup>[6]</sup> |                             | A <sub>10</sub> -A <sub>0</sub> | X                | X                | V <sub>IH</sub> | High Z                         |
| Output Disable                |                             | A <sub>10</sub> -A <sub>0</sub> | X                | V <sub>IL</sub>  | X               | High Z                         |
| Output Disable                |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>IL</sub>  | X                | X               | High Z                         |
| Program                       |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>ILP</sub> | V <sub>IHP</sub> | V <sub>PP</sub> | D <sub>7</sub> -D <sub>0</sub> |
| Program Verify                |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>IHP</sub> | V <sub>ILP</sub> | V <sub>PP</sub> | O <sub>7</sub> -O <sub>0</sub> |
| Program Inhibit               |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>IHP</sub> | V <sub>IHP</sub> | V <sub>PP</sub> | High Z                         |
| Intelligent Program           |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>ILP</sub> | V <sub>IHP</sub> | V <sub>PP</sub> | D <sub>7</sub> -D <sub>0</sub> |
| Blank Check Zeros             |                             | A <sub>10</sub> -A <sub>0</sub> | V <sub>IHP</sub> | V <sub>ILP</sub> | V <sub>PP</sub> | Zeros                          |

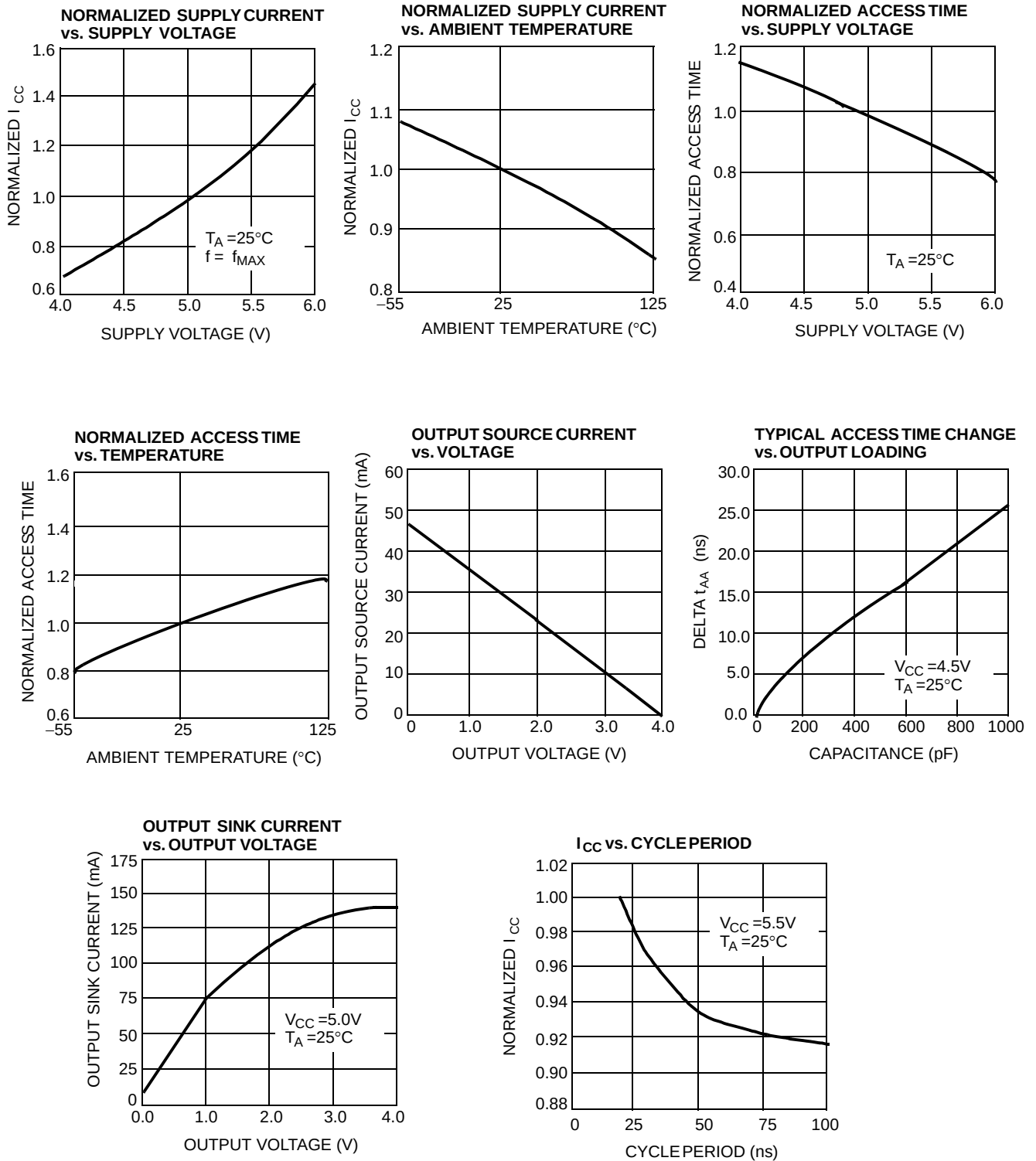
**Figure 1. Programming Pinouts**



### Notes

5. X = "don't care" but not to exceed V<sub>CC</sub> +5%.
6. The power-down mode for the CY7C293A is activated by deselecting CS<sub>1</sub>.

## Typical DC and AC Characteristics



## Ordering Information

| Speed (ns) | I <sub>CC</sub> (mA) | Ordering Code  | Package Name | Package Type                        | Operating Range |
|------------|----------------------|----------------|--------------|-------------------------------------|-----------------|
| 20         | 120                  | CY7C291A-20PC  | P13          | 24-Lead (300-Mil) Molded DIP        | Commercial      |
| 25         | 90                   | CY7C291A-25JC  | J64          | 28-Lead Plastic Leaded Chip Carrier | Commercial      |
|            |                      | CY7C291A-25PC  | P13          | 24-Lead (300-Mil) Molded DIP        |                 |
| 35         | 60                   | CY7C291AL-35JC | J64          | 28-Lead Plastic Leaded Chip Carrier | Commercial      |
|            |                      | CY7C291AL-35PC | P13          | 24-Lead (300-Mil) Molded DIP        |                 |
|            |                      | CY7C291AL-35WC | W14          | 24-Lead (300-Mil) Windowed CerDIP   |                 |
|            | 90                   | CY7C291A-35JC  | J64          | 28-Lead Plastic Leaded Chip Carrier | Commercial      |
|            |                      | CY7C291A-35PC  | P13          | 24-Lead (300-Mil) Molded DIP        |                 |
|            |                      | CY7C291A-35WC  | W14          | 24-Lead (300-Mil) Windowed CerDIP   |                 |
| 50         | 90                   | CY7C291A-35DMB | D14          | 24-Lead (300-Mil) CerDIP            | Military        |
|            |                      | CY7C291A-50PC  | P13          | 24-Lead (300-Mil) Molded DIP        | Commercial      |
|            |                      | CY7C291A-50WMB | W14          | 24-Lead (300-Mil) Windowed CerDIP   | Military        |

## MILITARY SPECIFICATIONS

### Group A Subgroup Testing

### DC Characteristics

| Parameter       | Subgroups |
|-----------------|-----------|
| V <sub>OH</sub> | 1, 2, 3   |
| V <sub>OL</sub> | 1, 2, 3   |
| V <sub>IH</sub> | 1, 2, 3   |
| V <sub>IL</sub> | 1, 2, 3   |
| I <sub>IX</sub> | 1, 2, 3   |
| I <sub>OZ</sub> | 1, 2, 3   |
| I <sub>CC</sub> | 1, 2, 3   |
| I <sub>SB</sub> | 1, 2, 3   |

### SMD Cross Reference

| SMD Number | Suffix | Cypress Number |
|------------|--------|----------------|
| 5962-87650 | 01LX   | CY7C291-50WMB  |
| 5962-87650 | 03LX   | CY7C291-35WMB  |
| 5962-88734 | 023X   | CY7C291A-35LMB |
| 5962-88734 | 033X   | CY7C291A-35LMB |
| 5962-88734 | 04LX   | CY7C291A-25DMB |
| 5962-88734 | 043X   | CY7C291A-25LMB |

### Switching Characteristics

| Parameter         | Subgroups       |
|-------------------|-----------------|
| t <sub>AA</sub>   | 7, 8, 9, 10, 11 |
| t <sub>ACS1</sub> | 7, 8, 9, 10, 11 |

## Package Diagrams

Figure 2. 24-Lead (300-Mil) CerDIP D14

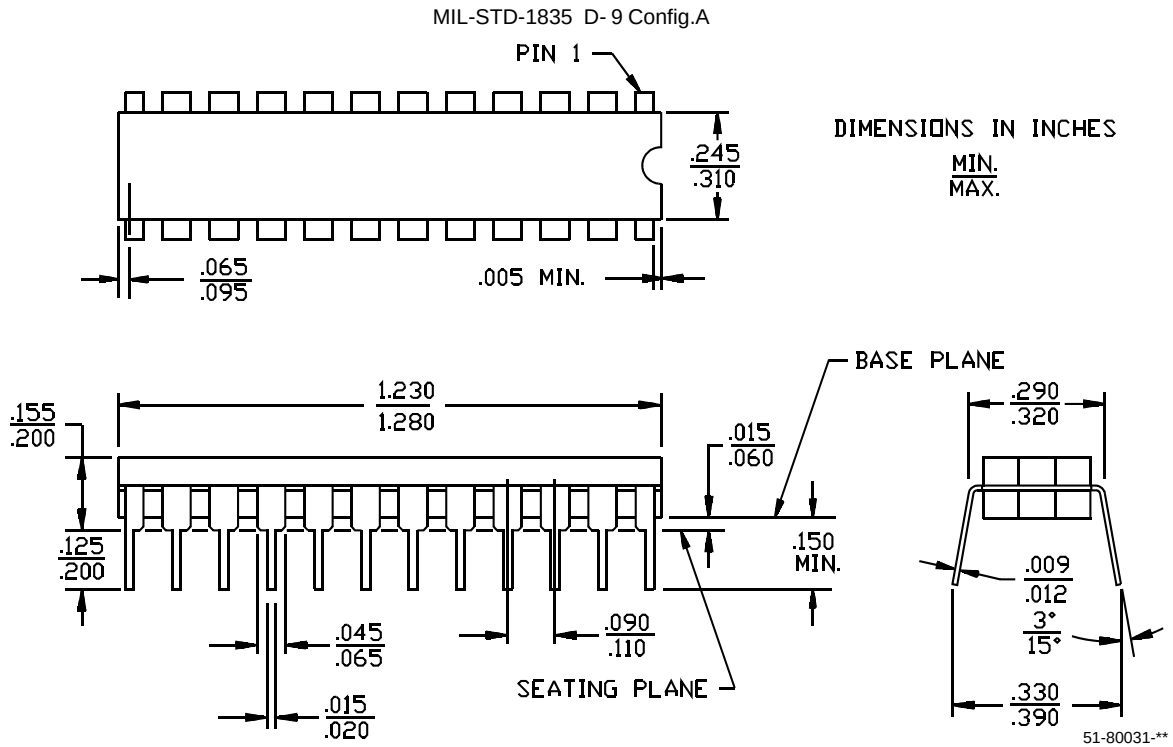
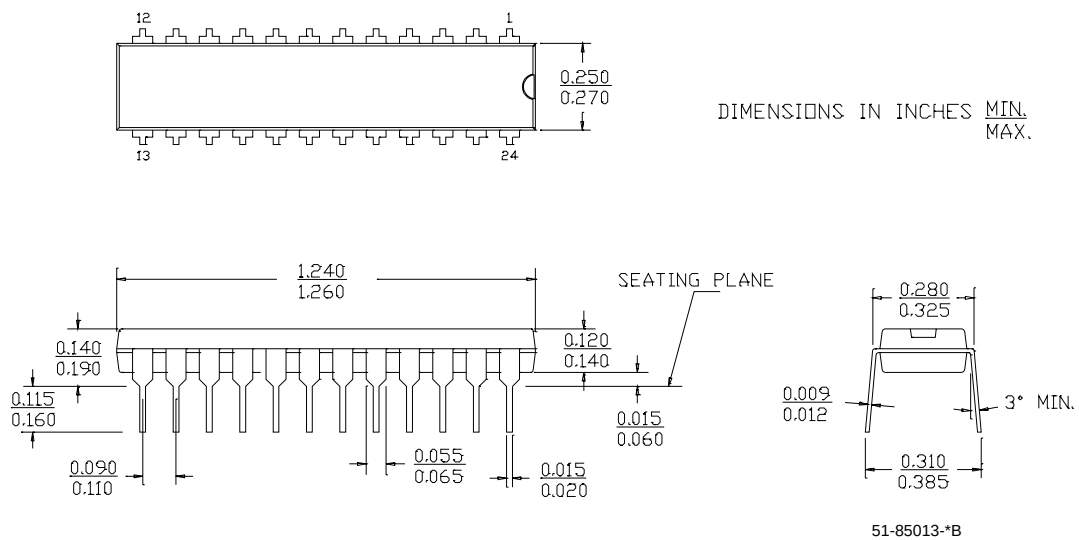
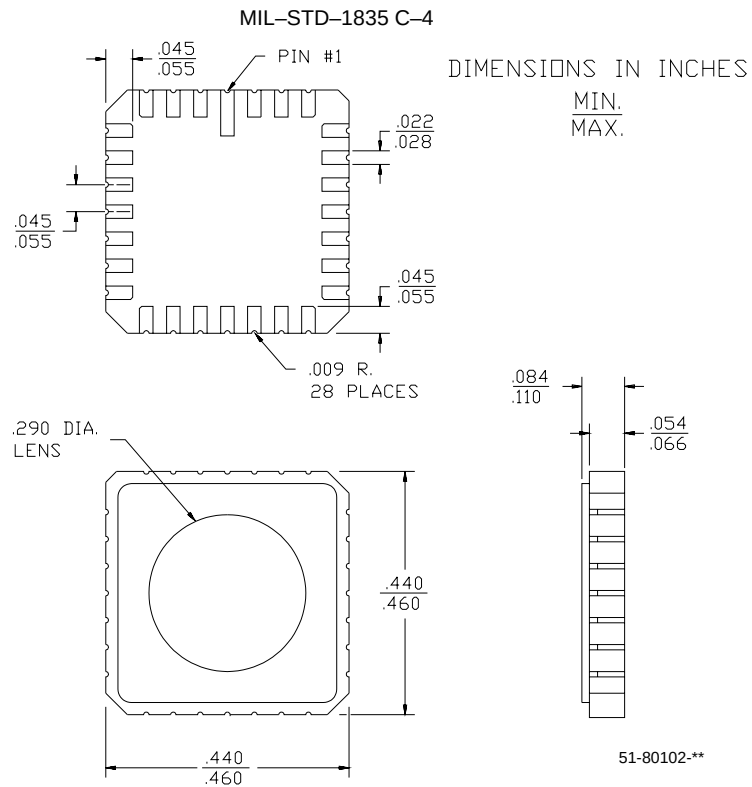


Figure 3. 24-Lead (300-Mil) PDIP P13



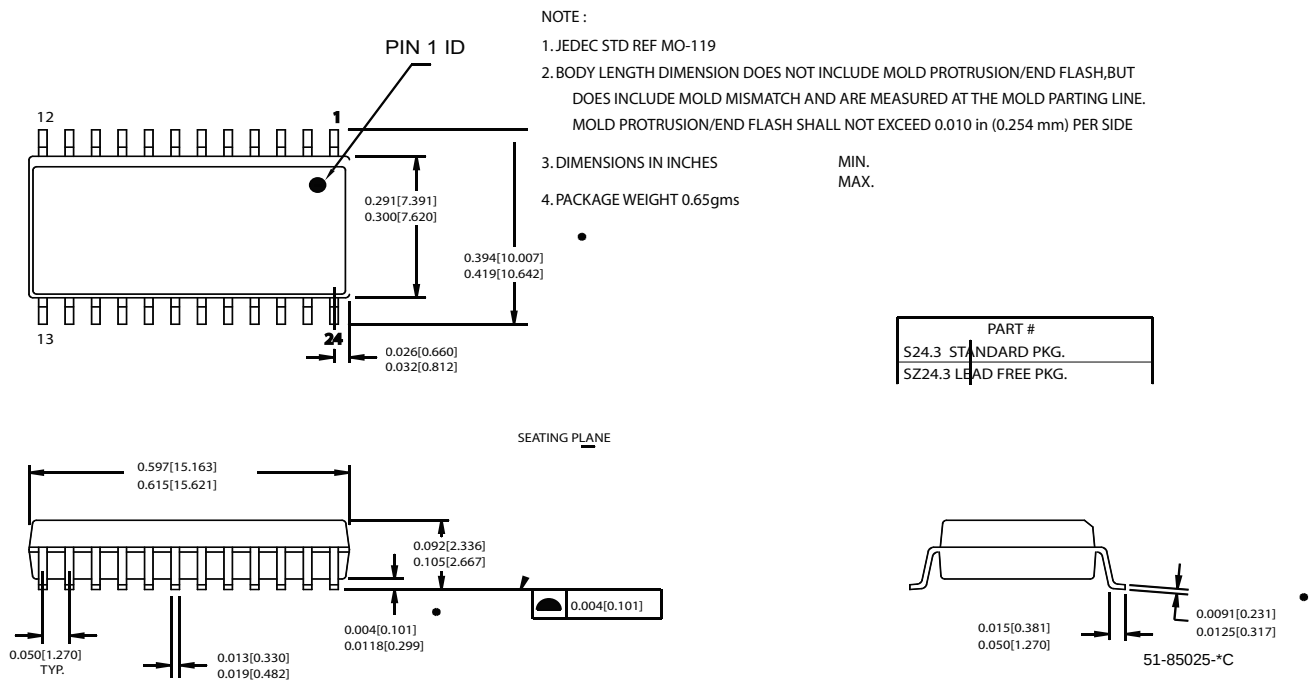
**Package Diagrams** (continued)

**Figure 4. 28-Pin Windowed Leadless Chip Carrier Q64**



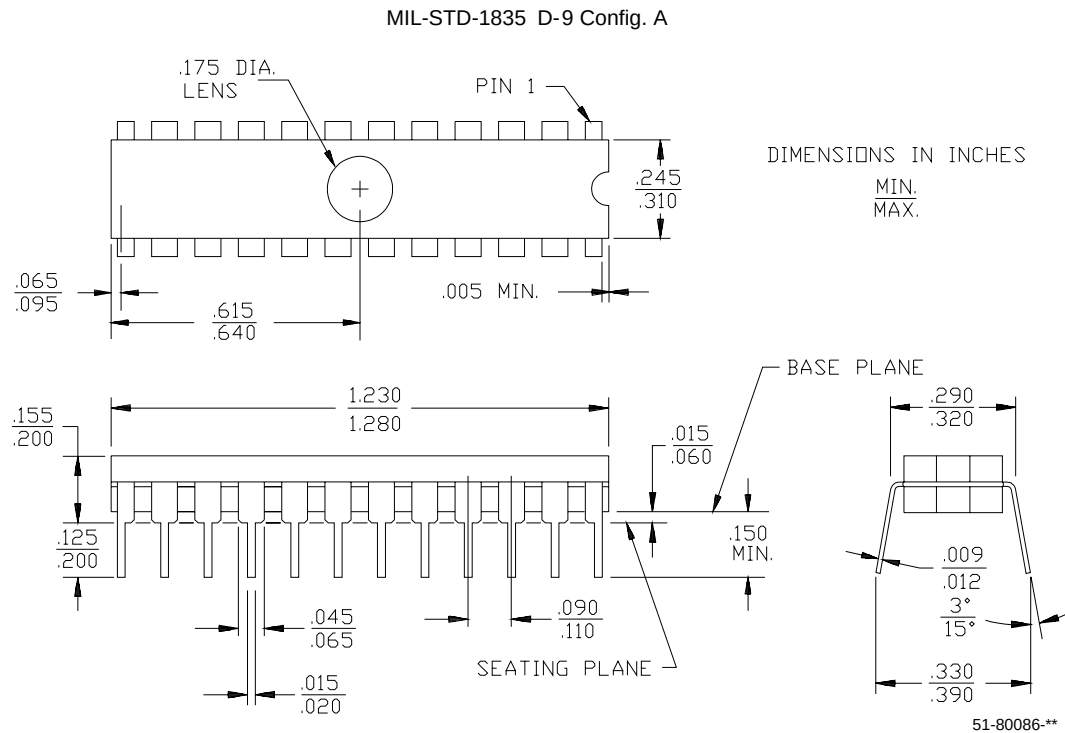
**Package Diagrams (continued)**

**Figure 5. 24 Lead (300 Mil) SOIC - S13**



Package Diagrams (continued)

Figure 6. 24-Lead (300-Mil) Windowed CerDIP W14



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**Document History Page**

| Document Title: CY7C291A 2K x 8 Reprogrammable PROM<br>Document Number: 38-04011 |         |            |                 |                                                |
|----------------------------------------------------------------------------------|---------|------------|-----------------|------------------------------------------------|
| REV.                                                                             | ECN NO. | Issue Date | Orig. of Change | Description of Change                          |
| **                                                                               | 114138  | 03/18/02   | DSG             | Changed from Spec number: 38-00075 to 38-04011 |
| *A                                                                               | 118905  | 10/11/02   | GBI             | Updated ordering information                   |
| *B                                                                               | 499562  | See ECN    | PCI             | Updated ordering information                   |