

T-46-13-47

# PAL20R8 Family

## 20L8, 20R8 20R6, 20R4

### Features/Benefits

- Standard 24-pin architectures
- TTL and CMOS versions
- High speed, as fast as 15 ns t<sub>PD</sub> for PAL20R8B Series
- Low power, as low as zero standby for PALC20R8Z Series
- Security fuse/cell on all devices

### Description

The PAL20R8 Series consists of four devices, each with twenty array inputs and eight outputs. The devices have either 0, 4, 6, or 8 registered outputs, with the remaining being combinatorial.

The PAL device transfer function is the familiar Boolean sum of products. The PAL device consists of a programmable AND array driving a fixed OR array. Product terms with all bits programmed (disconnected) assume the logical high state, and product terms with both true and complement of any signal connected assume the logical low state.

### Variable Input/Output Pin Ratio

The registered devices have twelve dedicated input lines, and each combinatorial output is an I/O pin. The combinatorial device has fourteen dedicated input lines, and only six of the eight combinatorial outputs are I/O pins. Buffers for device inputs have complementary outputs to provide user-programmable input signal polarity. Unused input pins should be tied directly to VCC or GND.

### Programmable Three-State Outputs

Each output has a three-state output buffer with programmable three-state control. On combinatorial outputs, a product term controls the buffer, allowing enable and disable to be a function of any combination of device inputs or output feedback. The output provides a bidirectional I/O pin in the combinatorial configuration, and may be configured as a dedicated input if the buffer is always disabled.

### Registers with Feedback

Registered outputs are provided for data storage and synchronization. Registers are composed of D-type flip-flops which are loaded on the low-to-high transition of the clock input.

### Polarity

All outputs are active low.

### Performance

Several speed/power versions are available.

| SUFFIX | t <sub>PD</sub><br>(ns) | I <sub>CC</sub><br>(mA) |
|--------|-------------------------|-------------------------|
| B      | 15                      | 210                     |
| B-2    | 25                      | 105                     |
| A      | 25                      | 210                     |
| A-2    | 35                      | 105                     |
| Z-35   | 35                      | 0.1                     |
| Z-45   | 45                      | 0.1                     |

### Preload and Power-Up Reset

The B-2 and CMOS Series offer register preload for device testability. The registers can be preloaded from the outputs by using super-voltages (see waveforms at end of section) in order to simplify functional testing. The B-2 Series also offers Power-Up Reset, whereby the registers power up to a logic LOW, setting the active-low outputs to a logic HIGH.

### Packages

The commercial PAL20R8 Series is available in the plastic SKINNYDIP (NS) and ceramic SKINNYDIP (JS) packages. The PAL20R8B/A/A-2 Series is available in the plastic leaded chip carrier with no-connects on 4, 8, 11, and 19 (NL), while the PAL20R8B-2/Z-35/Z-45 Series is available in the plastic leaded chip carrier with no-connects on 1, 8, 15, and 22 (FN). The PALC20R8Z-35/45 Series is also available in the ceramic windowed SKINNYDIP (QS) package.

### Package Drawings

(refer to PAL Device Package Outlines, page 3-179)

### PAL20R8 Series

| DEVICE  | DEDICATED INPUTS | OUTPUTS       |            |
|---------|------------------|---------------|------------|
|         |                  | COMBINATORIAL | REGISTERED |
| PAL20L8 | 12               | 8 (6 I/O)     | 0          |
| PAL20R8 | 10               | 0             | 8          |
| PAL20R6 | 10               | 2 I/O         | 6          |
| PAL20R4 | 10               | 4 I/O         | 4          |

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JANUARY 1988

**PAL20R8 Series**  
20L8, 20R8, 20R6, 20R4

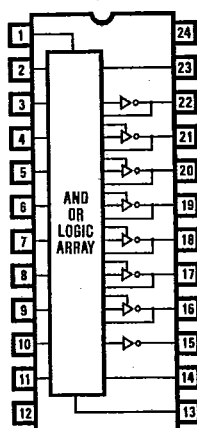
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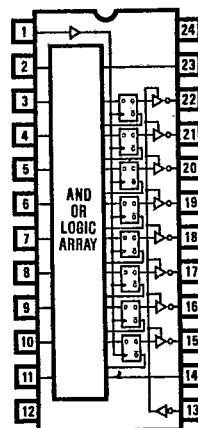
96D 27181 D

**DIP Pinouts**

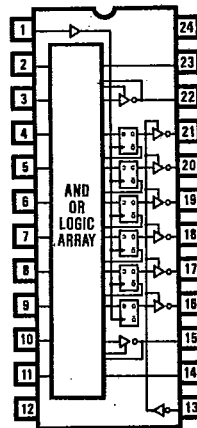
20L8A/A-2/B/B-2/Z-35/Z-45



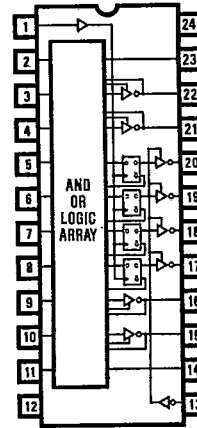
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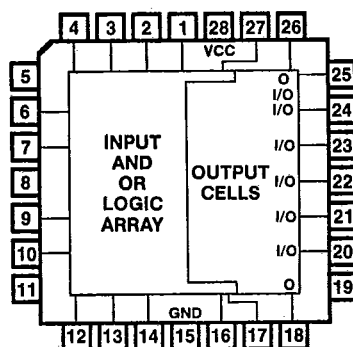
20R6A/A-2/B/B-2/Z-35/Z-45



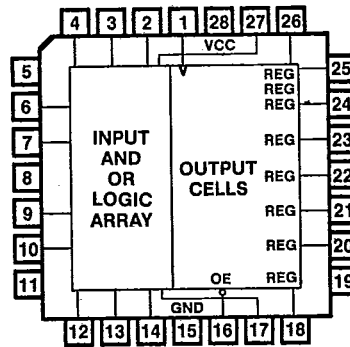
20R4A/A-2/B/B-2/Z-35/Z-45

**PLCC Pinouts (NL)**

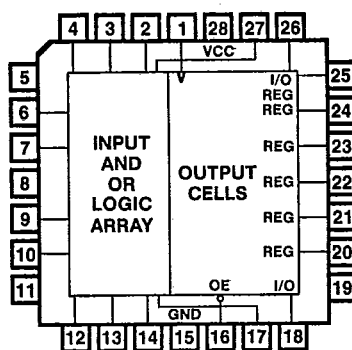
20L8A/A-2/B



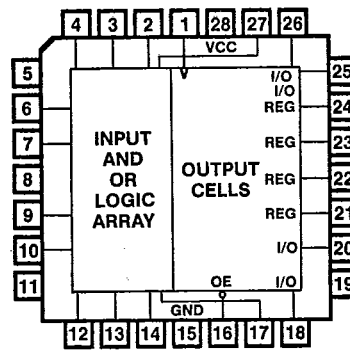
20R8A/A-2/B



20R6A/A-2/B



20R4A/A-2/B



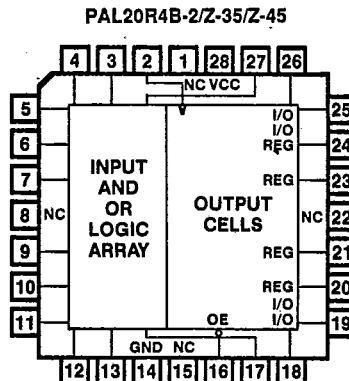
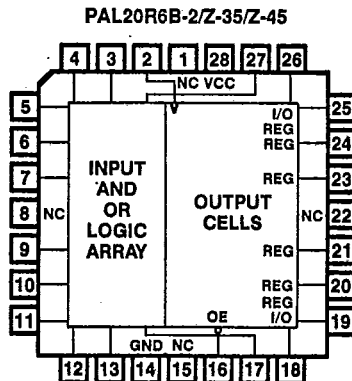
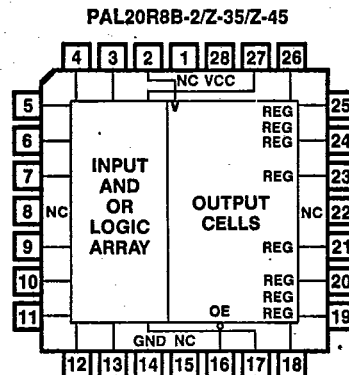
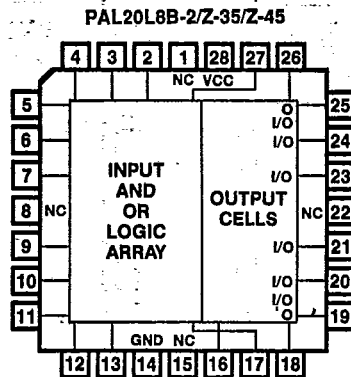
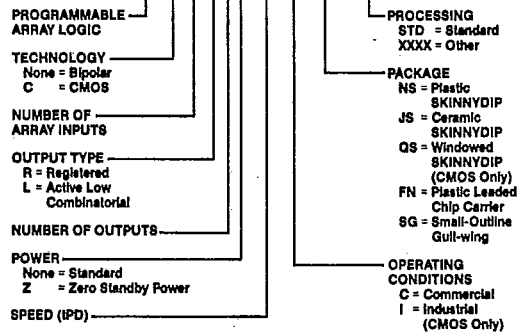
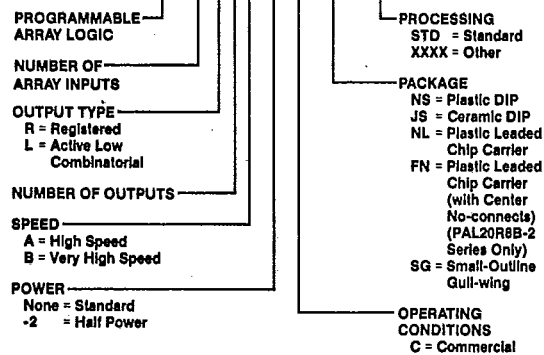
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**PAL20R8 Series**  
**20L8, 20R8, 20R6, 20R4**

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96D 27182 D

**PLCC Pinouts (FN)****Ordering Information — Newer Products****PALC20R8Z-35 C QS STD****Ordering Information — Older Products****PAL20R8B-2 C NS STD**

**PAL20R8B Series****20L8B, 20R8B, 20R6B, 20R4B**

T-46-13-47

**0257526 ADV MICRO PLA/PLE/ARRAYS**  
**Absolute maximum ratings****96D 27183 D**

|                          |                           |                              |
|--------------------------|---------------------------|------------------------------|
| Supply voltage $V_{CC}$  | Operating -0.5 V to 7.0 V | Programming -0.5 V to 12.0 V |
| Input voltage            | -1.5 V to 5.5 V           | -1.0 V to 22.0 V             |
| Off-state output voltage | 5.5 V                     | 12.0 V                       |
| Storage temperature      | -65°C to +150°C           |                              |

**Operating Conditions**

| SYMBOL   | PARAMETER                                   | COMMERCIAL <sup>1</sup> |     |      | UNIT |
|----------|---------------------------------------------|-------------------------|-----|------|------|
|          |                                             | MIN                     | TYP | MAX  |      |
| $V_{CC}$ | Supply voltage                              | 4.75                    | 5   | 5.25 | V    |
| $t_w$    | Width of clock                              | Low                     |     | 10   | ns   |
|          |                                             | High                    |     | 6    |      |
| $t_{su}$ | Set up time from input or feedback to clock | 20R8B, 20R6B, 20R4B     | 15  | 10   | ns   |
| $t_h$    | Hold time                                   | 0                       | -10 |      | ns   |
| $T_A$    | Operating free-air temperature              | 0                       | 25  | 75   | °C   |

**Electrical Characteristics Over Operating Conditions**

| SYMBOL      | PARAMETER                    | TEST CONDITIONS        |                            | MIN   | TYP   | MAX  | UNIT          |
|-------------|------------------------------|------------------------|----------------------------|-------|-------|------|---------------|
| $V_{IL}^2$  | Low-level input voltage      |                        |                            |       |       | 0.8  | V             |
| $V_{IH}^2$  | High-level input voltage     |                        |                            | 2     |       |      | V             |
| $V_{IC}$    | Input clamp voltage          | $V_{CC} = \text{MIN}$  | $I_I = -18 \text{ mA}$     | -0.8  | -1.5  |      | V             |
| $I_{IL}^3$  | Low-level input current      | $V_{CC} = \text{MAX}$  | $V_I = 0.4 \text{ V}$      | -0.02 | -0.25 |      | mA            |
| $I_{IH}^3$  | High-level input current     | $V_{CC} = \text{MAX}$  | $V_I = 2.4 \text{ V}$      |       | 25    |      | $\mu\text{A}$ |
| $I_I$       | Maximum input current        | $V_{CC} = \text{MAX}$  | $V_I = 5.5 \text{ V}$      |       | 100   |      | $\mu\text{A}$ |
| $V_{OL}$    | Low-level output voltage     | $V_{CC} = \text{MIN}$  | $I_{OL} = 24 \text{ mA}$   | 0.3   | 0.5   |      | V             |
| $V_{OH}$    | High-level output voltage    | $V_{CC} = \text{MIN}$  | $I_{OH} = -3.2 \text{ mA}$ | 2.4   | 2.8   |      | V             |
| $I_{OZL}^3$ | Off-state output current     | $V_{CC} = \text{MAX}$  | $V_O = 0.4 \text{ V}$      |       | -100  |      | $\mu\text{A}$ |
| $I_{OZH}^3$ |                              |                        | $V_O = 2.4 \text{ V}$      |       | 100   |      | $\mu\text{A}$ |
| $I_{OS}^4$  | Output short-circuit current | $V_{CC} = 5 \text{ V}$ | $V_O = 0 \text{ V}$        | -30   | -70   | -130 | mA            |
| $I_{CC}$    | Supply current               | $V_{CC} = \text{MAX}$  |                            | 140   | 210   |      | mA            |

**Switching Characteristics Over Operating Conditions**

| SYMBOL    | PARAMETER                                |                     | TEST CONDITIONS                          | MIN | TYP | MAX | UNIT |
|-----------|------------------------------------------|---------------------|------------------------------------------|-----|-----|-----|------|
| $t_{PD}$  | Input or feedback to output              | 20L8B, 20R6B, 20R4B | $R_1 = 200 \Omega$<br>$R_2 = 390 \Omega$ | 12  | 15  |     | ns   |
| $t_{CLK}$ | Clock to output or feedback except 20L8B |                     |                                          | 8   | 12  |     | ns   |
| $t_{PZX}$ | Pin 13 to output enable except 20L8B     |                     |                                          | 10  | 15  |     | ns   |
| $t_{PXZ}$ | Pin 13 to output disable except 20L8B    |                     |                                          | 8   | 12  |     | ns   |
| $t_{EA}$  | Input to output enable                   | 20L8B, 20R6B, 20R4B |                                          | 12  | 18  |     | ns   |
| $t_{ER}$  | Input to output disable                  | 20L8B, 20R6B, 20R4B |                                          | 12  | 15  |     | ns   |
| $f_{MAX}$ | Maximum frequency                        | External            |                                          | 37  | 40  |     | MHz  |
|           |                                          | No feedback         |                                          | 45  | 50  |     |      |

- The PAL20R8B Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of  $I_{IL}$  and  $I_{OZL}$  (or  $I_{IH}$  and  $I_{OZH}$ ).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

**PAL20R8B-2 Series****20L8B-2, 20R8B-2, 20R6B-2, 20R4B-2**

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96D 27184 D

**Absolute Maximum Ratings**

|                          | Operating       | Programming      |
|--------------------------|-----------------|------------------|
| Supply voltage $V_{CC}$  | -0.5 V to 7.0 V | -0.5 V to 12.0 V |
| Input voltage            | -1.5 V to 5.5 V | -1.0 V to 22.0 V |
| Off-state output voltage | 5.5 V           | 12.0 V           |
| Storage temperature      |                 | -65°C to +150°C  |

**Operating Conditions**

| SYMBOL   | PARAMETER                                  |      | MIN  | COMMERCIAL <sup>1</sup><br>TYP | MAX  | UNIT |
|----------|--------------------------------------------|------|------|--------------------------------|------|------|
| $V_{CC}$ | Supply voltage                             |      | 4.75 | 5                              | 5.25 | V    |
| $t_w$    | Width of clock                             | Low  | 15   | 10                             |      | ns   |
|          |                                            | High | 15   | 10                             |      |      |
| $t_{su}$ | Setup time from input or feedback to clock |      | 25   | 15                             |      | ns   |
| $t_h$    | Hold time                                  |      | 0    | -10                            |      | ns   |
| $T_A$    | Operating free-air temperature             |      | 0    | 25                             | 75   | °C   |

**Electrical Characteristics Over Operating Conditions**

| SYMBOL      | PARAMETER                    | TEST CONDITIONS                                  |                            | MIN   | TYP   | MAX  | UNIT          |
|-------------|------------------------------|--------------------------------------------------|----------------------------|-------|-------|------|---------------|
| $V_{IL}^2$  | Low-level input voltage      |                                                  |                            |       |       | 0.8  | V             |
| $V_{IH}^2$  | High-level input voltage     |                                                  |                            | 2     |       |      | V             |
| $V_{IC}$    | Input clamp voltage          | $V_{CC} = \text{MIN}$                            | $I_I = -18 \text{ mA}$     | -0.8  | -1.5  |      | V             |
| $I_{IL}^3$  | Low-level input current      | $V_{CC} = \text{MAX}$                            | $V_I = 0.4 \text{ V}$      | -0.02 | -0.25 |      | mA            |
| $I_{IH}^3$  | High-level input current     | $V_{CC} = \text{MAX}$                            | $V_I = 2.4 \text{ V}$      |       | 25    |      | $\mu\text{A}$ |
| $I_I$       | Maximum input current        | $V_{CC} = \text{MAX}$                            | $V_I = 5.5 \text{ V}$      |       | 100   |      | $\mu\text{A}$ |
| $V_{OL}$    | Low-level output voltage     | $V_{CC} = \text{MIN}$                            | $I_{OL} = 24 \text{ mA}$   | 0.3   | 0.5   |      | V             |
| $V_{OH}$    | High-level output voltage    | $V_{CC} = \text{MIN}$                            | $I_{OH} = -3.2 \text{ mA}$ | 2.4   | 3.4   |      | V             |
| $I_{OZL}^3$ | Off-state output current     | $V_{CC} = \text{MAX}$                            | $V_O = 0.4 \text{ V}$      |       | -100  |      | $\mu\text{A}$ |
| $I_{OZH}^3$ |                              |                                                  | $V_O = 2.4 \text{ V}$      |       | 100   |      | $\mu\text{A}$ |
| $I_{OS}^4$  | Output short-circuit current | $V_{CC} = 5 \text{ V}$                           | $V_O = 0 \text{ V}$        | -30   | -70   | -130 | mA            |
| $I_{CC}$    | Supply current               | $V_{CC} = \text{MAX}$                            |                            | 80    | 105   |      | mA            |
| $C_{IN}$    | Input capacitance            | $V_{IN} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$  |                            | 6     |       |      | pF            |
| $C_{OUT}$   | Output capacitance           | $V_{OUT} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$ |                            | 9     |       |      | pF            |

Notes: 1. The PAL20R8B-2 Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.

2. These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.

3. I/O pin leakage is the worst case of  $I_{IL}$  and  $I_{OZL}$  (or  $I_{IH}$  and  $I_{OZH}$ ).

4. No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

**Switching Characteristics** Over Operating Conditions

| SYMBOL           | PARAMETER                                                |                              | TEST CONDITIONS                                  | COMMERCIAL <sup>1</sup> |      | UNIT |     |
|------------------|----------------------------------------------------------|------------------------------|--------------------------------------------------|-------------------------|------|------|-----|
|                  |                                                          |                              |                                                  | MIN                     | TYP  | MAX  |     |
| t <sub>PD</sub>  | Input or feedback to output<br>20L8B-2, 20R6B-2, 20R4B-2 |                              | R <sub>1</sub> = 200 Ω<br>R <sub>2</sub> = 390 Ω |                         | 15   | 25   | ns  |
| t <sub>CLK</sub> | Clock to output or feedback                              | 20R8B-2, 20R6B-2,<br>20R4B-2 |                                                  |                         | 10   | 15   | ns  |
| t <sub>PZX</sub> | Pin 13 to output enable                                  |                              |                                                  |                         | 10   | 20   | ns  |
| t <sub>PXZ</sub> | Pin 13 to output disable                                 |                              |                                                  |                         | 11   | 20   | ns  |
| t <sub>EA</sub>  | Input to output enable                                   | 20L8B-2, 20R6B-2,<br>20R4B-2 |                                                  |                         | 10   | 25   | ns  |
| t <sub>ER</sub>  | Input to output disable                                  |                              |                                                  |                         | 13   | 25   | ns  |
| f <sub>MAX</sub> | Maximum frequency<br>20R8B-2, 20R6B-2, 20R4B-2           | External                     |                                                  |                         | 25   | 30   | MHz |
|                  |                                                          | Internal                     |                                                  |                         | 28.5 | 35   |     |
|                  |                                                          | No feedback                  |                                                  |                         | 33.3 | 40   |     |

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### Absolute Maximum Ratings

|                          | Operating       | Programming      |
|--------------------------|-----------------|------------------|
| Supply voltage $V_{CC}$  | -0.5 V to 7.0 V | -0.5 V to 12.0 V |
| Input voltage            | -1.5 V to 5.5 V | -1.0 V to 22.0 V |
| Off-state output voltage | 5.5 V           | 12.0 V           |
| Storage temperature      |                 | -65°C to +150°C  |

### Operating Conditions

| SYMBOL          | PARAMETER                                   |                     | COMMERCIAL |     |      | UNIT |
|-----------------|---------------------------------------------|---------------------|------------|-----|------|------|
|                 |                                             |                     | MIN        | TYP | MAX  |      |
| V <sub>CC</sub> | Supply voltage                              |                     | 4.75       | 5   | 5.25 | V    |
| t <sub>w</sub>  | Width of clock                              | Low                 | 15         | 7   |      | ns   |
|                 |                                             | High                | 15         | 7   |      |      |
| t <sub>su</sub> | Set up time from input or feedback to clock | 20R8A, 20R6A, 20R4A | 25         | 15  |      | ns   |
| t <sub>h</sub>  | Hold time                                   |                     | 0          | -10 |      | ns   |
| T <sub>A</sub>  | Operating free-air temperature              |                     | 0          | 25  | 75   | °C   |

### Electrical Characteristics Over Operating Conditions

| SYMBOL      | PARAMETER                    | TEST CONDITIONS        |                            | MIN   | TYP   | MAX  | UNIT          |
|-------------|------------------------------|------------------------|----------------------------|-------|-------|------|---------------|
| $V_{IL}^1$  | Low-level input voltage      |                        |                            |       |       | 0.8  | V             |
| $V_{IH}^1$  | High-level input voltage     |                        |                            | 2     |       |      | V             |
| $V_{IC}$    | Input clamp voltage          | $V_{CC} = \text{MIN}$  | $I_I = -18 \text{ mA}$     | -0.8  | -1.5  |      | V             |
| $I_{IL}^2$  | Low-level input current      | $V_{CC} = \text{MAX}$  | $V_I = 0.4 \text{ V}$      | -0.02 | -0.25 |      | mA            |
| $I_{IH}^2$  | High-level input current     | $V_{CC} = \text{MAX}$  | $V_I = 2.4 \text{ V}$      |       | 25    |      | $\mu\text{A}$ |
| $I_I$       | Maximum input current        | $V_{CC} = \text{MAX}$  | $V_I = 5.5 \text{ V}$      |       | 100   |      | $\mu\text{A}$ |
| $V_{OL}$    | Low-level output voltage     | $V_{CC} = \text{MIN}$  | $I_{OL} = 24 \text{ mA}$   | 0.3   | 0.5   |      | V             |
| $V_{OH}$    | High-level output voltage    | $V_{CC} = \text{MIN}$  | $I_{OH} = -3.2 \text{ mA}$ | 2.4   | 2.8   |      | V             |
| $I_{OZL}^2$ | Off-state output current     | $V_{CC} = \text{MAX}$  | $V_O = 0.4 \text{ V}$      |       | -100  |      | $\mu\text{A}$ |
| $I_{OZH}^2$ |                              |                        | $V_O = 2.4 \text{ V}$      |       | 100   |      | $\mu\text{A}$ |
| $I_{OS}^3$  | Output short-circuit current | $V_{CC} = 5 \text{ V}$ | $V_O = 0 \text{ V}$        | -30   | -90   | -130 | mA            |
| $I_{CC}$    | Supply current               | $V_{CC} = \text{MAX}$  |                            |       | 160   | 210  | mA            |

- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of  $I_{IL}$  and  $I_{OZL}$  (or  $I_{IH}$  and  $I_{OZH}$ ).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

**PAL20R8A Series**

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**20L8A, 20R8A, 20R6A, 20R4A**

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96D 27187 D

**Switching Characteristics** Over Operating Conditions

| SYMBOL           | PARAMETER                             |                     | TEST CONDITIONS                                                | MIN  | TYP | MAX | UNIT |
|------------------|---------------------------------------|---------------------|----------------------------------------------------------------|------|-----|-----|------|
| t <sub>PD</sub>  | Input or feedback to output           | 20L8A, 20R6A, 20R4A | R <sub>1</sub> = 200 $\Omega$<br>R <sub>2</sub> = 390 $\Omega$ | 15   | 25  |     | ns   |
| t <sub>CLK</sub> | Clock to output or feedback           |                     |                                                                | 10   | 15  |     | ns   |
| t <sub>CF</sub>  | Clock to feedback                     |                     |                                                                | 8    | 10  |     | ns   |
| t <sub>PZX</sub> | Pin 13 to output enable except 20L8A  |                     |                                                                | 10   | 20  |     | ns   |
| t <sub>PXZ</sub> | Pin 13 to output disable except 20L8A |                     |                                                                | 11   | 20  |     | ns   |
| t <sub>EA</sub>  | Input to output enable                | 20L8A, 20R6A, 20R4A |                                                                | 10   | 25  |     | ns   |
| t <sub>ER</sub>  | Input to output disable               | 20L8A, 20R6A, 20R4A |                                                                | 13   | 25  |     | ns   |
| f <sub>MAX</sub> | Maximum frequency                     | External            |                                                                | 25   | 40  |     | MHz  |
|                  |                                       | Internal            |                                                                | 28.5 | 43  |     |      |
|                  |                                       | No feedback         |                                                                | 33   | 71  |     |      |

### Absolute Maximum Ratings

|                          | Operating       | Programming      |
|--------------------------|-----------------|------------------|
| Supply voltage $V_{CC}$  | -0.5 V to 7.0 V | -0.5 V to 12.0 V |
| Input voltage            | -1.5 V to 5.5 V | -1.0 V to 22.0 V |
| Off-state output voltage | 5.5 V           | 12.0 V           |
| Storage temperature      |                 | -65°C to +150°C  |

### Operating Conditions

| Operating Conditions |                                             |  |                           |  |                                        |     |      |      |
|----------------------|---------------------------------------------|--|---------------------------|--|----------------------------------------|-----|------|------|
| SYMBOL               | PARAMETER                                   |  |                           |  | COMMERCIAL <sup>1</sup><br>MIN TYP MAX |     |      | UNIT |
| V <sub>CC</sub>      | Supply voltage                              |  |                           |  | 4.75                                   | 5   | 5.25 | V    |
| t <sub>w</sub>       | Width of clock                              |  | Low                       |  | 25                                     | 10  |      | ns   |
|                      |                                             |  | High                      |  | 25                                     | 10  |      |      |
| t <sub>su</sub>      | Set up time from input or feedback to clock |  | 20R8A-2, 20R6A-2, 20R4A-2 |  | 35                                     | 25  |      | ns   |
| t <sub>h</sub>       | Hold time                                   |  |                           |  | 0                                      | -15 |      | ns   |
| T <sub>A</sub>       | Operating free-air temperature              |  |                           |  | 0                                      | 25  | 75   | °C   |

### Electrical Characteristics Over Operating Conditions

| SYMBOL      | PARAMETER                    | TEST CONDITIONS        |                            | MIN | TYP   | MAX   | UNIT          |
|-------------|------------------------------|------------------------|----------------------------|-----|-------|-------|---------------|
| $V_{IL}^2$  | Low-level input voltage      |                        |                            |     |       | 0.8   | V             |
| $V_{IH}^2$  | High-level input voltage     |                        |                            | 2   |       |       | V             |
| $V_{IC}$    | Input clamp voltage          | $V_{CC} = \text{MIN}$  | $I_I = -18 \text{ mA}$     |     | -0.8  | -1.5  | V             |
| $I_{IL}^3$  | Low-level input current      | $V_{CC} = \text{MAX}$  | $V_I = 0.4 \text{ V}$      |     | -0.02 | -0.25 | mA            |
| $I_{IH}^3$  | High-level input current     | $V_{CC} = \text{MAX}$  | $V_I = 2.4 \text{ V}$      |     |       | 25    | $\mu\text{A}$ |
| $I_I$       | Maximum input current        | $V_{CC} = \text{MAX}$  | $V_I = 5.5 \text{ V}$      |     |       | 100   | $\mu\text{A}$ |
| $V_{OL}$    | Low-level output voltage     | $V_{CC} = \text{MIN}$  | $I_{OL} = 24 \text{ mA}$   |     | 0.3   | 0.5   | V             |
| $V_{OH}$    | High-level output voltage    | $V_{CC} = \text{MIN}$  | $I_{OH} = -3.2 \text{ mA}$ | 2.4 | 2.8   |       | V             |
| $I_{OZL}^3$ | Off-state output current     | $V_{CC} = \text{MAX}$  | $V_O = 0.4 \text{ V}$      |     |       | -100  | $\mu\text{A}$ |
| $I_{OZH}^3$ |                              |                        | $V_O = 2.4 \text{ V}$      |     |       | 100   | $\mu\text{A}$ |
| $I_{OS}^4$  | Output short-circuit current | $V_{CC} = 5 \text{ V}$ | $V_O = 0 \text{ V}$        | -30 | -70   | -130  | mA            |
| $I_{CC}$    | Supply current               | $V_{CC} = \text{MAX}$  |                            |     | 80    | 105   | mA            |

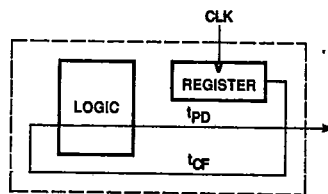
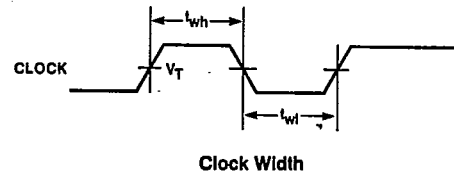
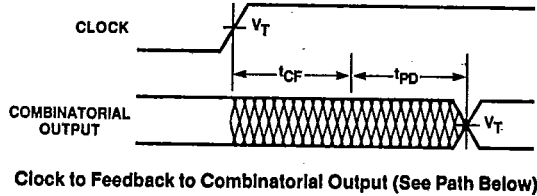
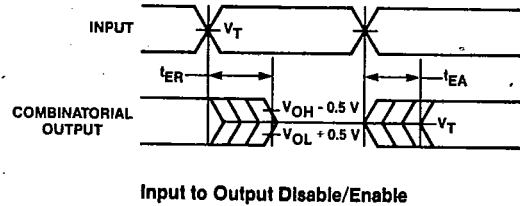
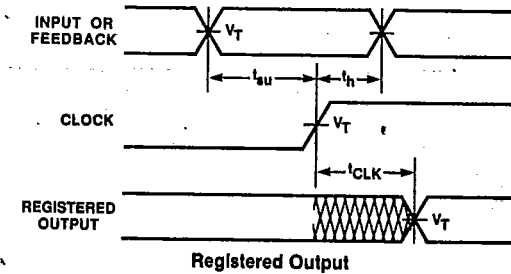
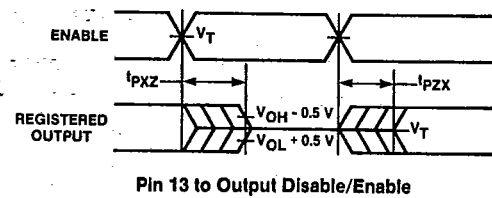
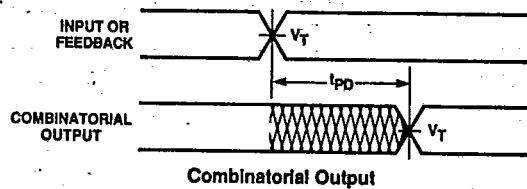
- The PAL20R8A-2 Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of  $I_{IL}$  and  $I_{OZL}$  (or  $I_{IH}$  and  $I_{OZH}$ ).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

**Switching Characteristics** Over Operating Conditions

| SYMBOL    | PARAMETER                                  |                           | TEST CONDITIONS                                        | MIN | TYP | MAX | UNIT |
|-----------|--------------------------------------------|---------------------------|--------------------------------------------------------|-----|-----|-----|------|
| $t_{PD}$  | Input or feedback to output                | 20L8A-2, 20R6A-2, 20R4A-2 | Commercial<br>$R_1 = 200 \Omega$<br>$R_2 = 390 \Omega$ | 25  | 35  | ns  |      |
| $t_{CLK}$ | Clock to output or feedback except 20L8A-2 |                           |                                                        | 15  | 25  | ns  |      |
| $t_{PZX}$ | Pin 13 to output enable except 20L8A-2     |                           |                                                        | 15  | 25  | ns  |      |
| $t_{PXZ}$ | Pin 13 to output disable except 20L8A-2    |                           |                                                        | 15  | 25  | ns  |      |
| $t_{EA}$  | Input to output enable                     | 20L8A-2, 20R6A-2, 20R4A-2 |                                                        | 25  | 35  | ns  |      |
| $t_{ER}$  | Input to output disable                    | 20L8A-2, 20R6A-2, 20R4A-2 |                                                        | 25  | 35  | ns  |      |
| $f_{MAX}$ | Maximum frequency                          | External                  |                                                        | 16  | 25  | MHz |      |
|           |                                            | No feedback               |                                                        | 20  | 50  |     |      |

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**Switching Waveforms**

- Notes:
1.  $V_T = 1.5 V$
  2. Input pulse amplitude 0 V to 3.0 V
  3. Input rise and fall times 2-5 ns typical

**Key to Timing Diagrams**

| WAVEFORM | INPUTS                          | OUTPUTS                                |
|----------|---------------------------------|----------------------------------------|
|          | DON'T CARE;<br>CHANGE PERMITTED | CHANGING;<br>STATE UNKNOWN             |
|          | NOT<br>APPLICABLE               | CENTER LINE IS<br>HIGH IMPEDANCE STATE |
|          | MUST BE STEADY                  | WILL BE STEADY                         |

**Switching Test Load**

(refer to page 5-164)

**Programmers/Development Systems**

(refer to Programmer Reference Guide, page 3-81)

**Register Preload Waveform**

(refer to page 5-164)

**Power-Up Reset Waveform**

(refer to page 5-164)

**Schematic of Inputs and Outputs**

(refer to page 5-164)

# CMOS PALC20R8Z-35/45 Series

T-46-13-47

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## Absolute Maximum Ratings

|                                                      |                            |
|------------------------------------------------------|----------------------------|
| Supply voltage $V_{CC}$                              | -0.5 V to 7.0 V            |
| DC input voltage, $V_I$                              | -0.5 V to $V_{CC} + 0.5$ V |
| DC output voltage, $V_O$                             | -0.5 V to $V_{CC} + 0.5$ V |
| DC output source/sink current per output pin, $I_O$  | $\pm 35$ mA                |
| DC $V_{CC}$ or ground current, $I_{CC}$ or $I_{GND}$ | $\pm 100$ mA               |
| Input diode current, $I_{IK}$ :                      |                            |
| $V_I < 0$                                            | -20 mA                     |
| $V_I > V_{CC}$                                       | +20 mA                     |
| Output diode current, $I_{OK}$ :                     |                            |
| $V_O < 0$                                            | -20 mA                     |
| $V_O > V_{CC}$                                       | +20 mA                     |
| Storage temperature                                  | -65°C to 150°C             |
| Static discharge voltage                             | >2001 V                    |
| Latchup current                                      | >100 mA                    |

## Operating Conditions

| SYMBOL          | PARAMETER                                  |                      | INDUSTRIAL <sup>1</sup> |     |     |     |     |     | COMMERCIAL |     |      |      |     |      | UNIT |
|-----------------|--------------------------------------------|----------------------|-------------------------|-----|-----|-----|-----|-----|------------|-----|------|------|-----|------|------|
|                 |                                            |                      | -50                     |     |     | -40 |     |     | -45        |     |      | -35  |     |      |      |
|                 |                                            |                      | MIN                     | TYP | MAX | MIN | TYP | MAX | MIN        | TYP | MAX  | MIN  | TYP | MAX  |      |
| V <sub>CC</sub> | Supply voltage                             |                      | 4.5                     | 5   | 5.5 | 4.5 | 5   | 5.5 | 4.75       | 5   | 5.25 | 4.75 | 5   | 5.25 | V    |
| t <sub>w</sub>  | Width of clock                             | 20R8<br>20R6<br>20R4 | 15                      | 10  |     | 15  | 10  |     | 15         | 10  |      | 15   | 10  |      | ns   |
| t <sub>su</sub> | Setup time from input or feedback to clock |                      | 45                      | 30  |     | 35  | 25  |     | 40         | 30  |      | 30   | 25  |      | ns   |
| t <sub>h</sub>  | Hold time                                  |                      | 0                       | -15 |     | 0   | -15 |     | 0          | -15 |      | 0    | -15 |      | ns   |
| T <sub>A</sub>  | Operating free-air temperature             |                      | -40                     | 25  | 85  | -40 | 25  | 85  | 0          | 25  | 75   | 0    | 25  | 75   | °C   |

## Electrical Characteristics Over Operating Conditions

| SYMBOL     | PARAMETER                             | TEST CONDITIONS                                                           | MIN  | TYP  | MAX      | UNIT          |
|------------|---------------------------------------|---------------------------------------------------------------------------|------|------|----------|---------------|
| $V_{IL}^2$ | Low-level input voltage               |                                                                           | 0    |      | 0.8      | V             |
| $V_{IH}^2$ | High-level input voltage              |                                                                           | 2    |      | $V_{CC}$ | V             |
| $I_{IL}$   | Low-level input current               | $V_{CC} = \text{MAX}$ $V_I = \text{GND}$                                  |      |      | -1       | $\mu\text{A}$ |
| $I_{IH}$   | High-level input current              | $V_{CC} = \text{MAX}$ $V_I = V_{CC}$                                      |      |      | 1        | $\mu\text{A}$ |
| $V_{OL}$   | Low-level output voltage              | $V_{CC} = \text{MIN}$ $I_{OL} = 8 \text{ mA}$                             |      | 0.25 | 0.45     | V             |
|            |                                       | $V_{CC} = 5 \text{ V}$ $I_{OL} = 1 \mu\text{A}$                           |      |      | 0.05     |               |
| $V_{OH}$   | High-level output voltage             | $V_{CC} = \text{MIN}$ $I_{OH} = -6 \text{ mA}^3$                          | 3.76 | 4.1  |          | V             |
|            |                                       | $V_{CC} = 5 \text{ V}$ $I_{OH} = -1 \mu\text{A}$                          | 4.95 |      |          |               |
| $I_{OZL}$  | Off-state output current              | $V_{CC} = \text{MAX}$ $V_O = \text{GND}$                                  |      | 0    | -10      | $\mu\text{A}$ |
| $I_{OZH}$  |                                       | $V_{CC} = \text{MAX}$ $V_O = V_{CC}$                                      |      | 0    | 10       | $\mu\text{A}$ |
| $I_{CC}$   | Standby supply current <sup>4</sup>   | $I_O = 0 \text{ mA}$ , $V_I = \text{GND}$ or $V_{CC}$                     |      | 0    | 100      | $\mu\text{A}$ |
|            | Operating supply current <sup>5</sup> | $f = 1 \text{ MHz}$ $I_O = 0 \text{ mA}$ , $V_I = \text{GND}$ or $V_{CC}$ |      | 7    | 10       | mA            |
| $C_{IN}$   | Input capacitance <sup>8</sup>        | $V_{IN} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$                           |      | 6    |          | pF            |
| $C_{OUT}$  | Output capacitance <sup>8</sup>       | $V_{OUT} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$                          |      | 9    |          | pF            |

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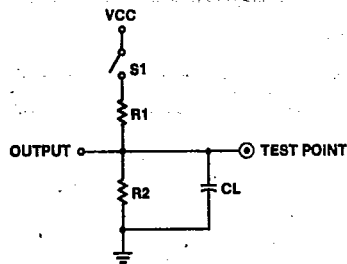
## CMOS PALC20R8Z-35/45 Series

T-46-13-47

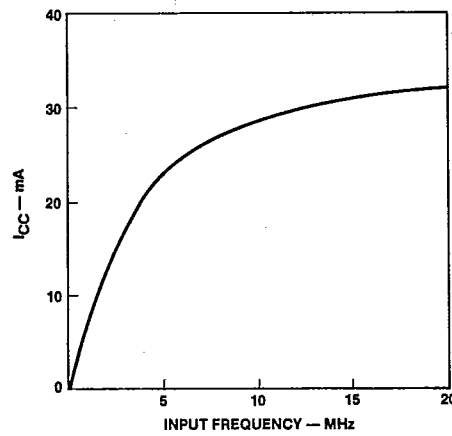
## Switching Characteristics Over Operating Conditions

| SYMBOL     | PARAMETER <sup>7</sup>                          |                                            | INDUSTRIAL         |                    |  | COMMERCIAL         |                    |  | UNIT |
|------------|-------------------------------------------------|--------------------------------------------|--------------------|--------------------|--|--------------------|--------------------|--|------|
|            |                                                 |                                            | -50<br>MIN TYP MAX | -40<br>MIN TYP MAX |  | -45<br>MIN TYP MAX | -35<br>MIN TYP MAX |  |      |
| $t_{PD}$   | Input or feedback to output<br>20L8, 20R6, 20R4 |                                            | 45 50              | 35 40              |  | 40 45              | 30 35              |  | ns   |
| $t_{CLK}$  | Clock to output or feedback                     | 20R8<br>20R6<br>20R4                       | 20 25              | 15 20              |  | 20 25              | 15 20              |  | ns   |
| $t_{PZX}$  | Pin 13 (DIP) to output enable                   | 20L8<br>20R6<br>20R4                       | 20 25              | 15 20              |  | 20 25              | 15 20              |  | ns   |
| $t_{PXZ}$  | Pin 13 (DIP) to output disable                  | 20L8<br>20R6<br>20R4                       | 20 25              | 15 20              |  | 20 25              | 15 20              |  | ns   |
| $t_{EA}^6$ | Input to output enable                          | 20R8<br>20R6<br>20R4                       | 45 50              | 35 40              |  | 40 45              | 30 35              |  | ns   |
| $t_{ER}^6$ | Input to output disable                         | 20R8<br>20R6<br>20R4                       | 45 50              | 35 40              |  | 40 45              | 30 35              |  | ns   |
| $f_{MAX}$  | Maximum frequency                               | External feedback ( $1/t_{su} + t_{CLK}$ ) | 14.2 20            | 18.1 25            |  | 15.3 20            | 20 25              |  | MHz  |

1. The PALC20R8Z Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
2. These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
3. JEDEC standard no. 7 for high-speed CMOS devices.
4. Disabled output pins =  $V_{CC}$  or GND.
5. Frequency of any input or clock. See graph page 5.
6. Equivalent function to  $t_{PZX}/t_{PXZ}$  but using product term control.
7. Test conditions (see Test Load)  $R_1 = 440 \Omega$ ,  $R_2 = 190 \Omega$ .
8. Sampled but not 100% tested.

**Switching Test Load  
-PALC20R8Z Series**

| SPECIFICATION     | SWITCH S1                  | $C_L$ | MEASURED<br>OUTPUT VALUE                       |
|-------------------|----------------------------|-------|------------------------------------------------|
| $t_{PD}, t_{CLK}$ | Closed                     | 50 pF | 1.5 V                                          |
| $t_{PZX}, t_{EA}$ | Z→H: closed<br>Z→L: closed | 50 pF | 2.0 V<br>0.8 V                                 |
| $t_{PXZ}, t_{ER}$ | H→Z: closed<br>L→Z: closed | 5 pF  | H→Z: $V_{OH} - 0.5$ V<br>L→Z: $V_{OL} + 0.5$ V |

 **$I_{CC}$  vs. Frequency - PALC20R8Z Series**Typical:  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$ 

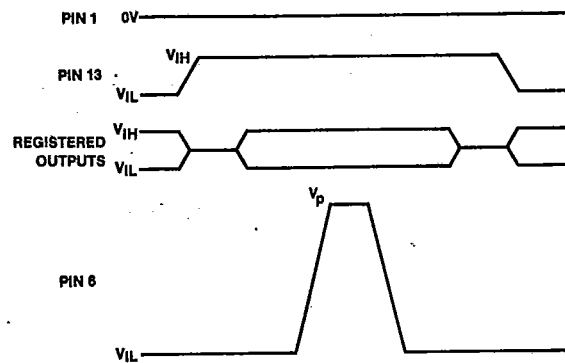
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### Output Register PRELOAD -PALC20R8Z Series

The PRELOAD function allows the register to be loaded from data placed on the output pins. This feature aids functional testing of state sequencer designs by allowing direct setting of output states for improved test coverage. The PRELOAD procedure (using DIP pin numbers) is as follows:

1. Raise  $V_{CC}$  to 5 V.
2. Disable output registers by setting pin 13 to  $V_{IH}$ . Set pin 1 to 0 V.
3. Apply  $V_{IL}/V_{IH}$  (as desired) to all registered outputs.
4. Pulse pin 6 to  $V_p$  (12 V), then back to 0 V.
5. Remove  $V_{IL}/V_{IH}$  from all registered outputs.
6. Lower pin 13 to  $V_{IL}$  to enable the registered outputs.
7. Verify for  $V_{OL}/V_{OH}$  at all registered outputs.



### Key to Timing Diagrams

| WAVEFORM | INPUTS                          | OUTPUTS                                |
|----------|---------------------------------|----------------------------------------|
|          | DON'T CARE;<br>CHANGE PERMITTED | CHANGING;<br>STATE UNKNOWN             |
|          | NOT<br>APPLICABLE               | CENTER LINE IS<br>HIGH IMPEDANCE STATE |
|          | MUST BE STEADY                  | WILL BE STEADY                         |

### Programming and Erasing -PALC20R8Z Series

The PALC20R8Z Series can be programmed on standard logic programmers. The PALC20R8Z Series may be erased by ultraviolet light when contained in the windowed package.

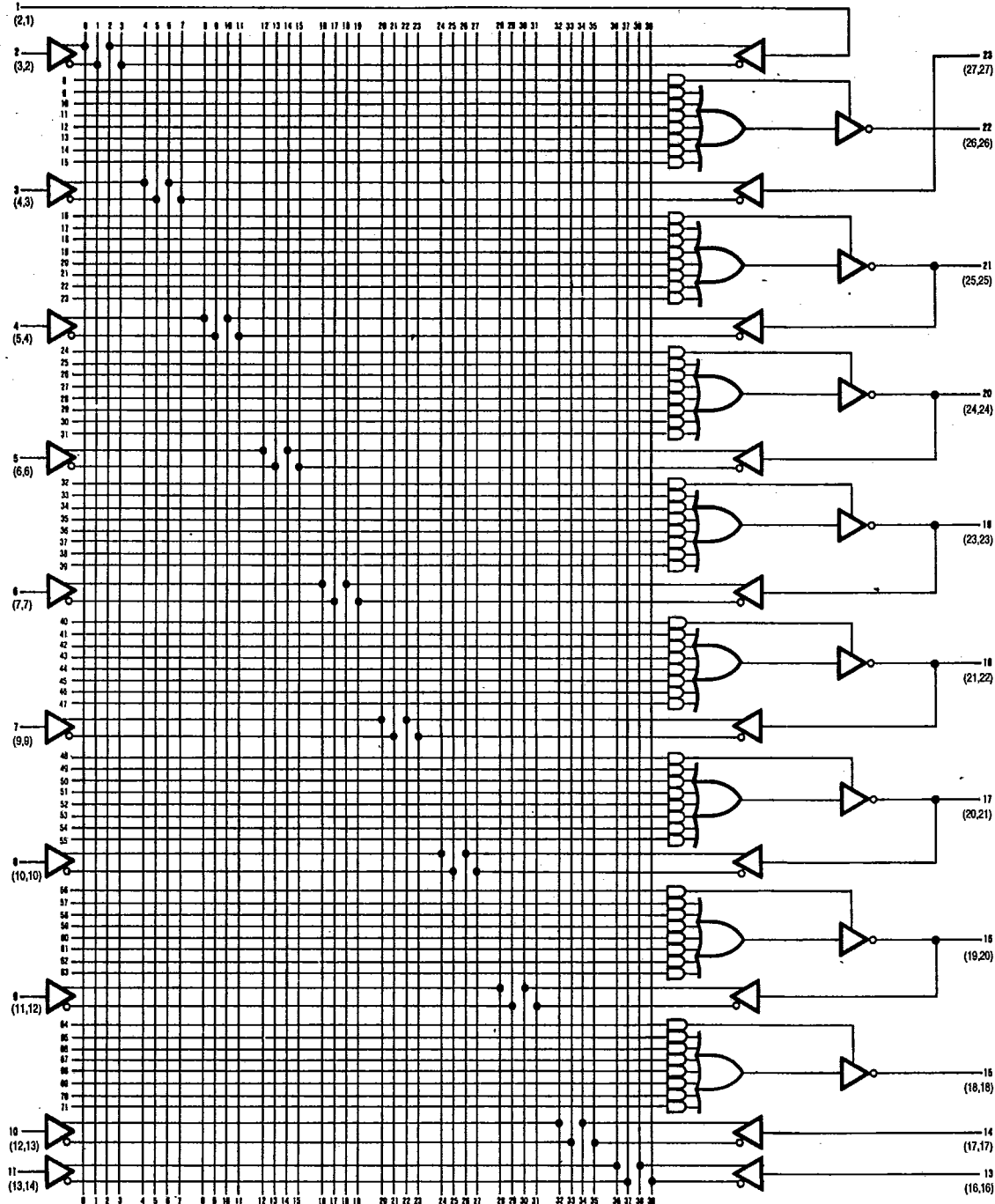
For erasure, the recommended ultraviolet light wavelength is 2537 Angstroms. The minimum dose required is 72,000 mW-sec/cm<sup>2</sup> (UV intensity x exposure time). For an ultraviolet lamp with a 20 mW/cm<sup>2</sup> power rating, the minimum exposure time would be 72,000/20 seconds = 60 minutes. The device needs to be within one inch of the lamp during erasure.

Permanent damage may result if the device is exposed to high-intensity UV light for an extended period of time. The recommended maximum dosage is 7258 W-sec/cm<sup>2</sup>.

Wavelengths of light less than 4000 Angstroms can partially erase the device in the windowed package. For this reason, an opaque label should be placed over the window, especially if the device will be exposed to sunlight or fluorescent lighting for extended periods of time.

**Logic Diagram**  
**DIP (FN, NL) Pinouts**

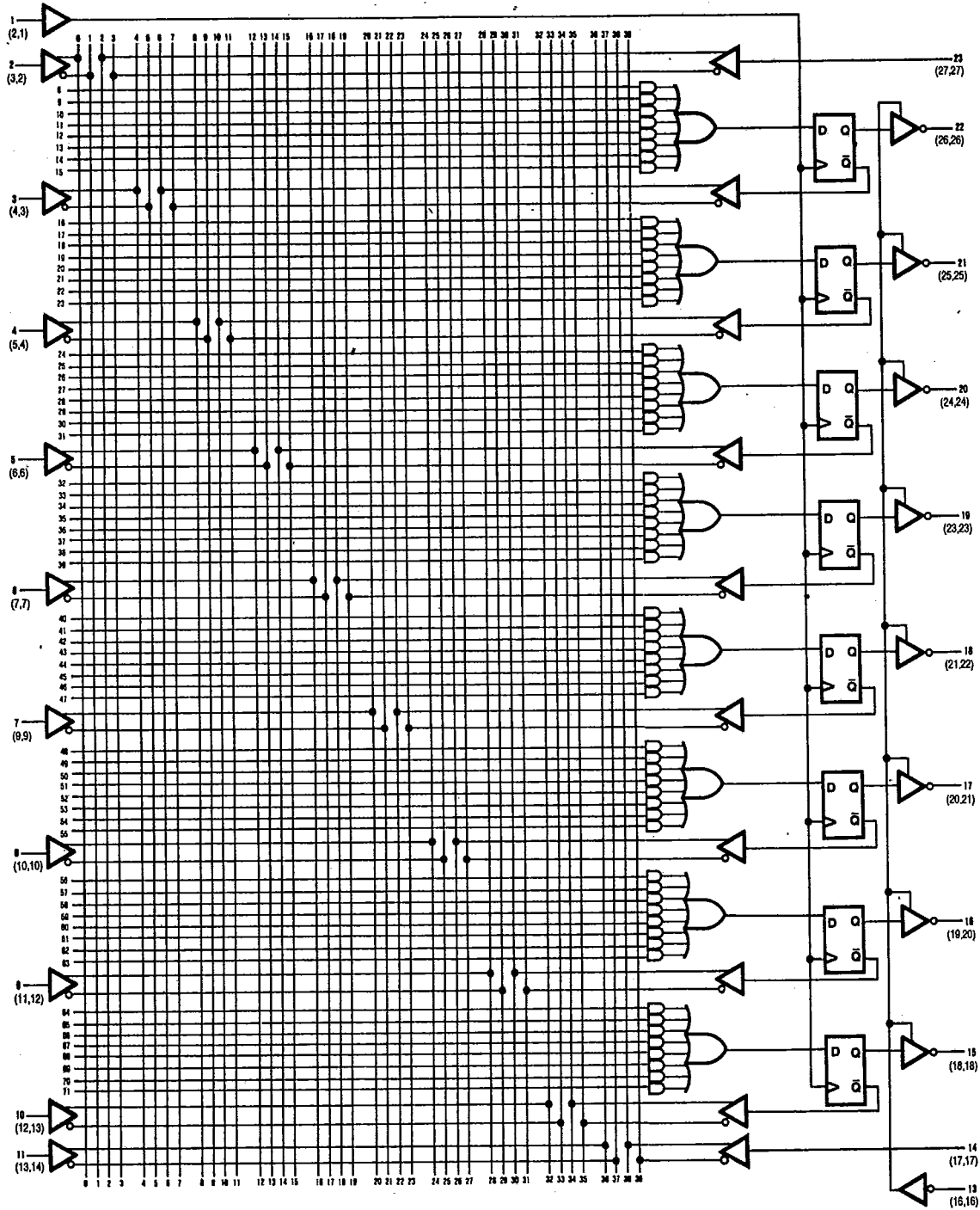
20L8



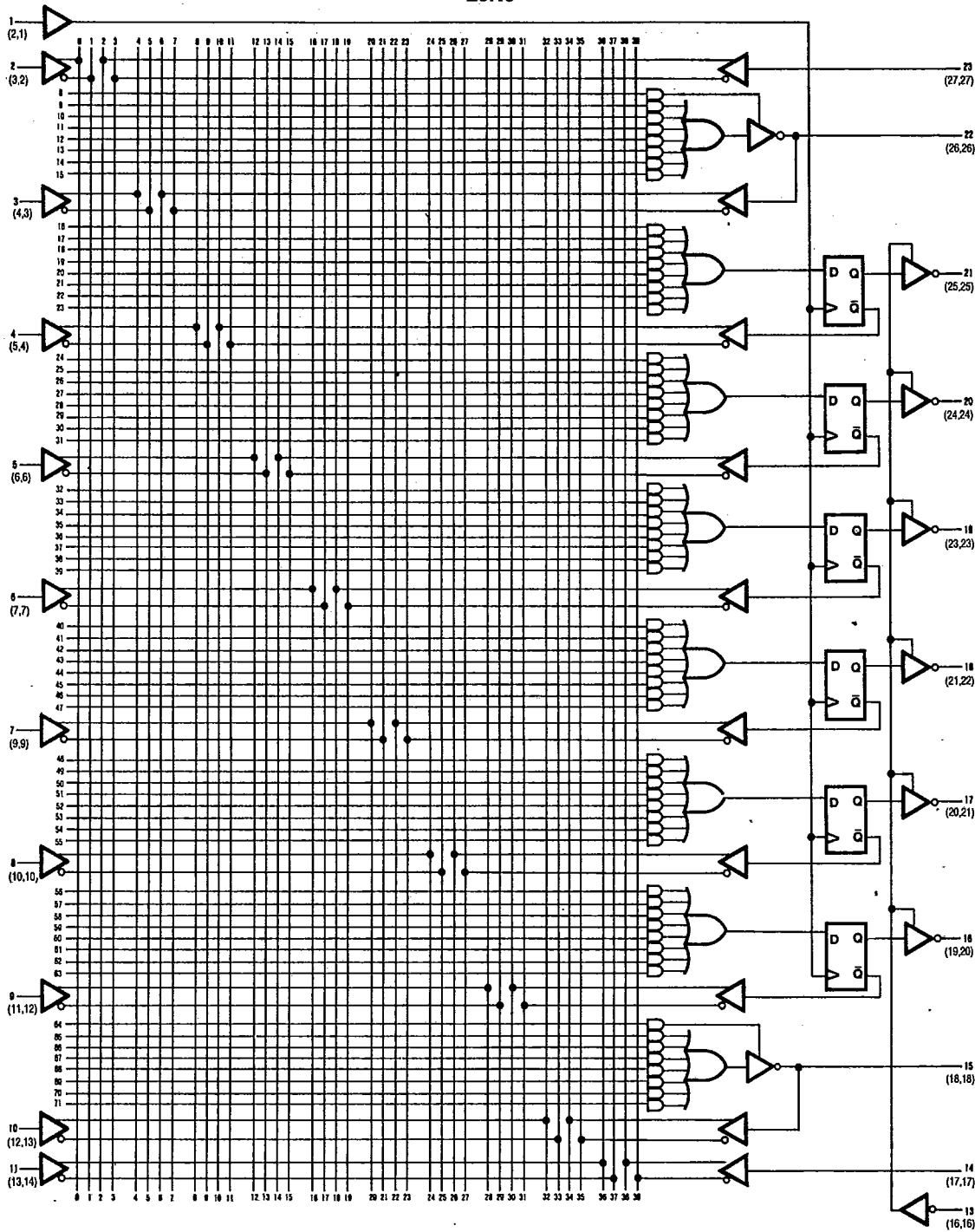
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Logic Diagram DIP (FN, NL) Pinouts 20R8



Logic Diagram DIP (FN, NL) Pinouts 20R6



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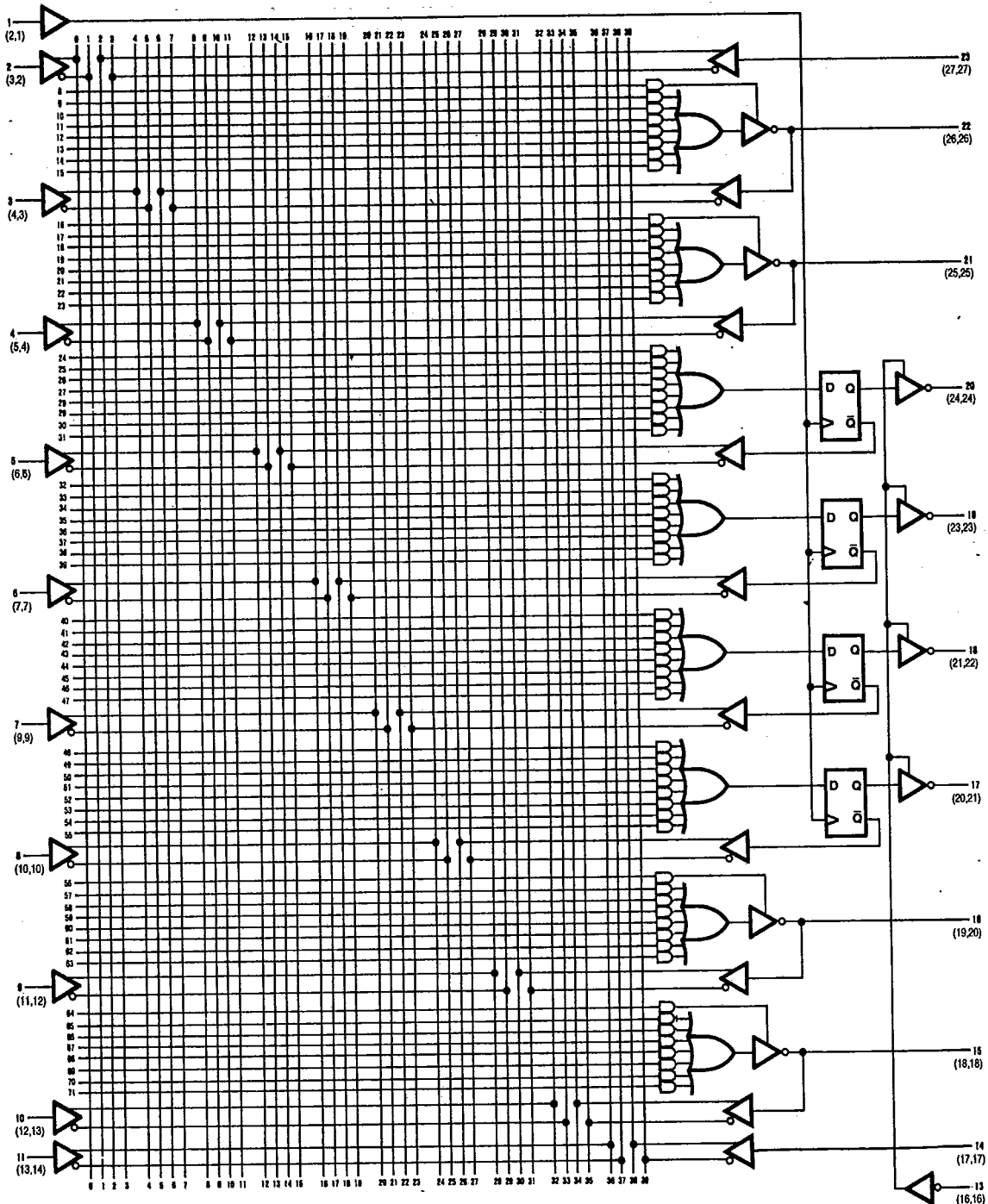
**PAL20R8 Series**  
20L8, 20R8, 20R6, 20R4

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Logic Diagram DIP (FN, NL) Pinouts 20R4

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