

# Zero Power CMOS Hard Array Logic ZHAL™ 24A Series

## Features/Benefits

- Zero standby power
- Low power operation
- High-speed CMOS technology
- HC and HCT compatible
- 24-pin SKINNYDIP® and 28-pin PLCC packages save space
- Low power alternative for most 24-pin PAL® devices, including 20L8/ 20R8/ 20R6/ 20R4

## Description

This family of Zero Power Hard Array Logic (ZHAL) devices utilizes a unique architecture that is designed for a high degree of flexibility in implementing most patterns of the listed 24-pin PAL/HAL® devices. Prototyping should be done using standard PAL devices before converting to ZHAL circuits for production. ZHAL devices are fabricated by Monolithic Memories with custom metallization masks defined by a user-supplied HAL Design Specification.

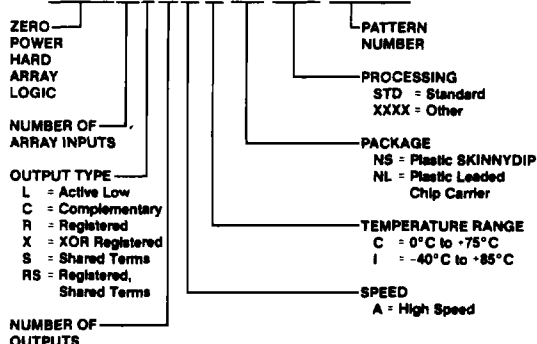
The ZHAL devices are ideal in low-power applications that require high-speed operation. These attributes are achieved through the use of Monolithic Memories' advanced high-speed CMOS process. Now system designers have the option of using a ZHAL device that matches fast PAL device speeds, but with the added feature of zero standby power. These features are needed in power-critical areas such as portable digital equipment or lap-top computers.

## Ordering Information

| PART NUMBER | PACKAGE | ARRAY INPUTS | OUTPUTS |     |
|-------------|---------|--------------|---------|-----|
|             |         |              | COMB    | REG |
| ZHAL12L10A  | NS, NL  | 12           | 10      | —   |
| ZHAL14L8A   | NS, NL  | 14           | 8       | —   |
| ZHAL16L6A   | NS, NL  | 16           | 6       | —   |
| ZHAL18L4A   | NS, NL  | 18           | 4       | —   |
| ZHAL20L2A   | NS, NL  | 20           | 2       | —   |
| ZHAL20C1A   | NS, NL  | 20           | 2       | —   |
| ZHAL20L8A   | NS, NL  | 20           | 8       | —   |
| ZHAL20R8A   | NS, NL  | 20           | —       | 8   |
| ZHAL20R6A   | NS, NL  | 20           | 2       | 6   |
| ZHAL20R4A   | NS, NL  | 20           | 4       | 4   |
| ZHAL20L10A  | NS, NL  | 20           | 10      | —   |
| ZHAL20X10A  | NS, NL  | 20           | —       | 10  |
| ZHAL20X8A   | NS, NL  | 20           | 2       | 8   |
| ZHAL20X4A   | NS, NL  | 20           | 6       | 4   |
| ZHAL20S10A  | NS, NL  | 20           | 10      | —   |
| ZHAL20RS10A | NS, NL  | 20           | —       | 10  |
| ZHAL20RS8A  | NS, NL  | 20           | 2       | 8   |
| ZHAL20RS4A  | NS, NL  | 20           | 6       | 4   |

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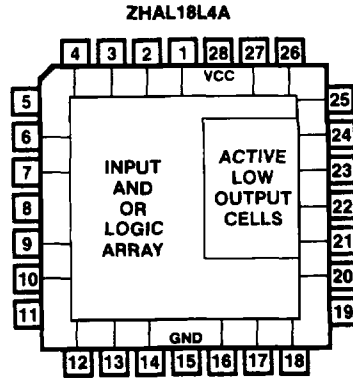
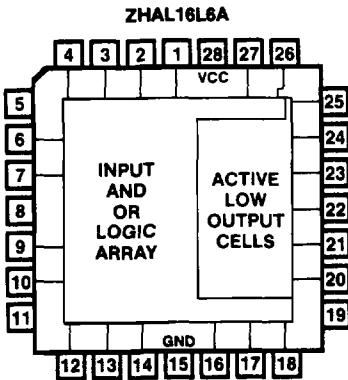
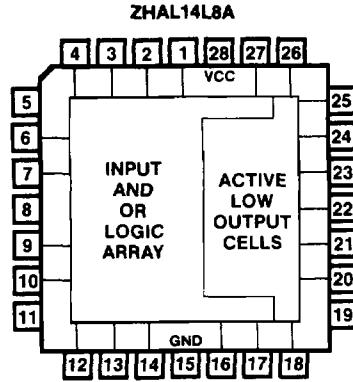
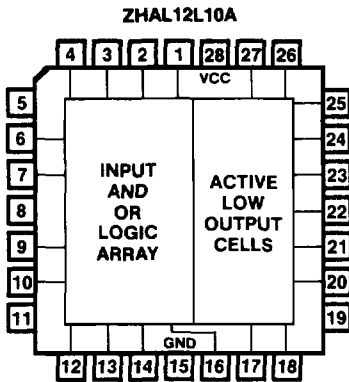
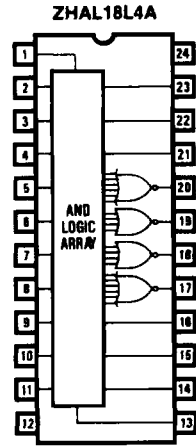
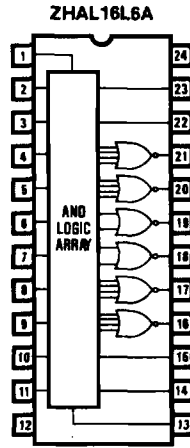
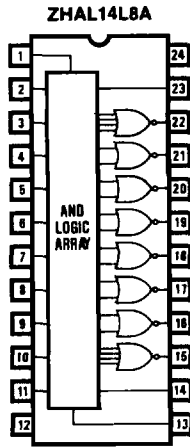
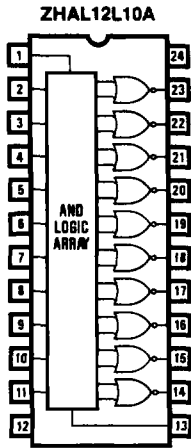
## ZHAL20L10A C NS STD H01234



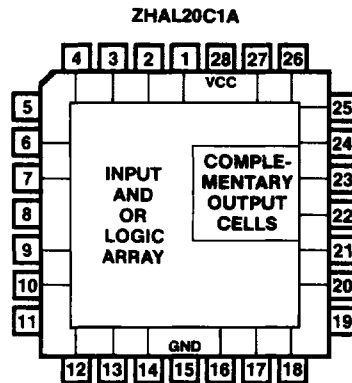
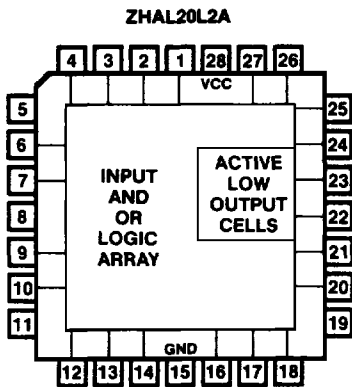
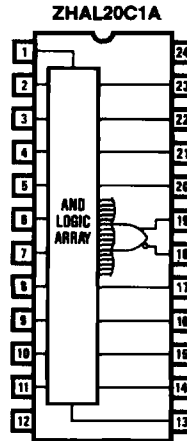
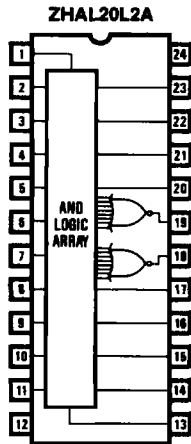
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JANUARY 1988

## Pin Configurations — DIP and PLCC

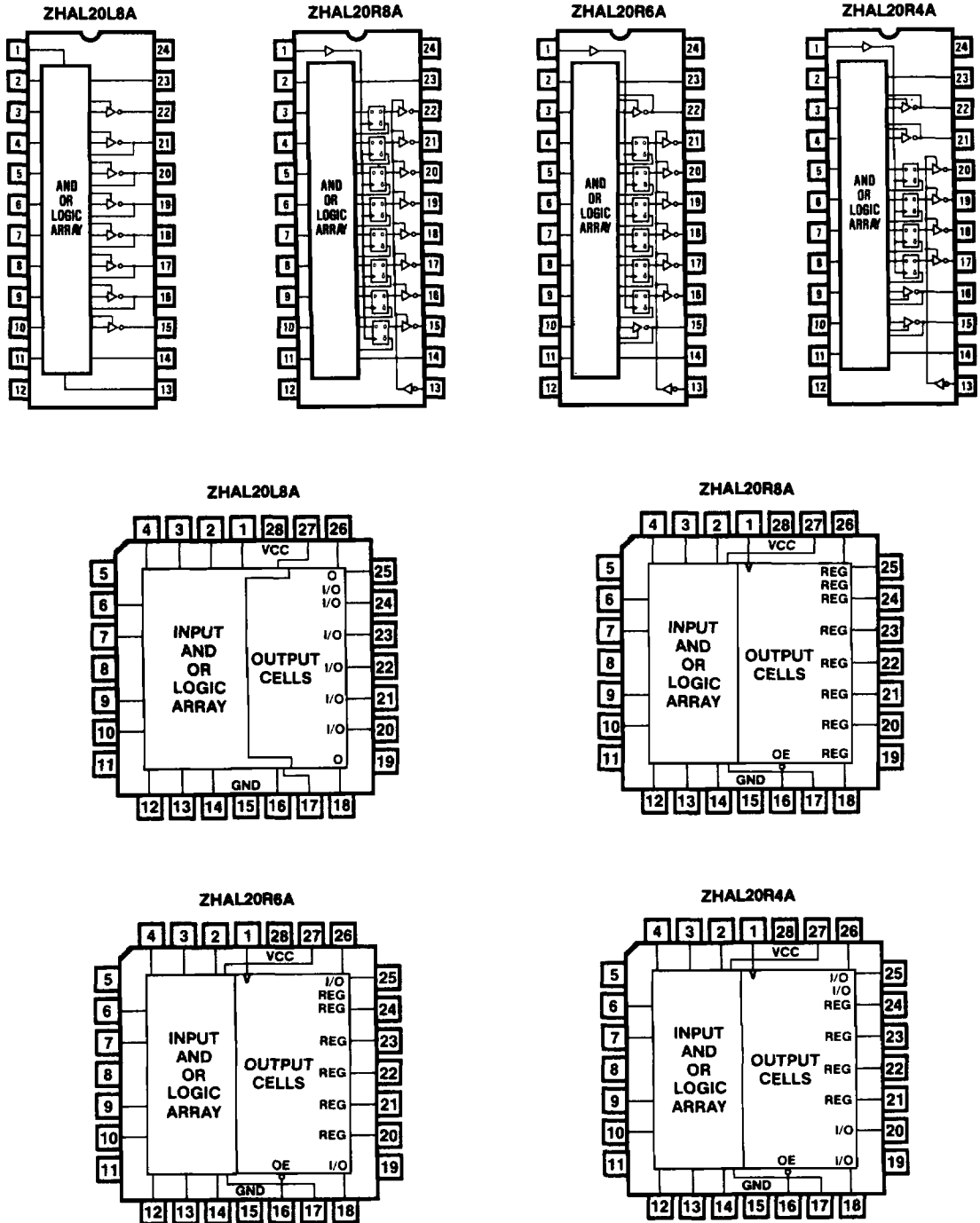


## Pin Configurations — DIP and PLCC

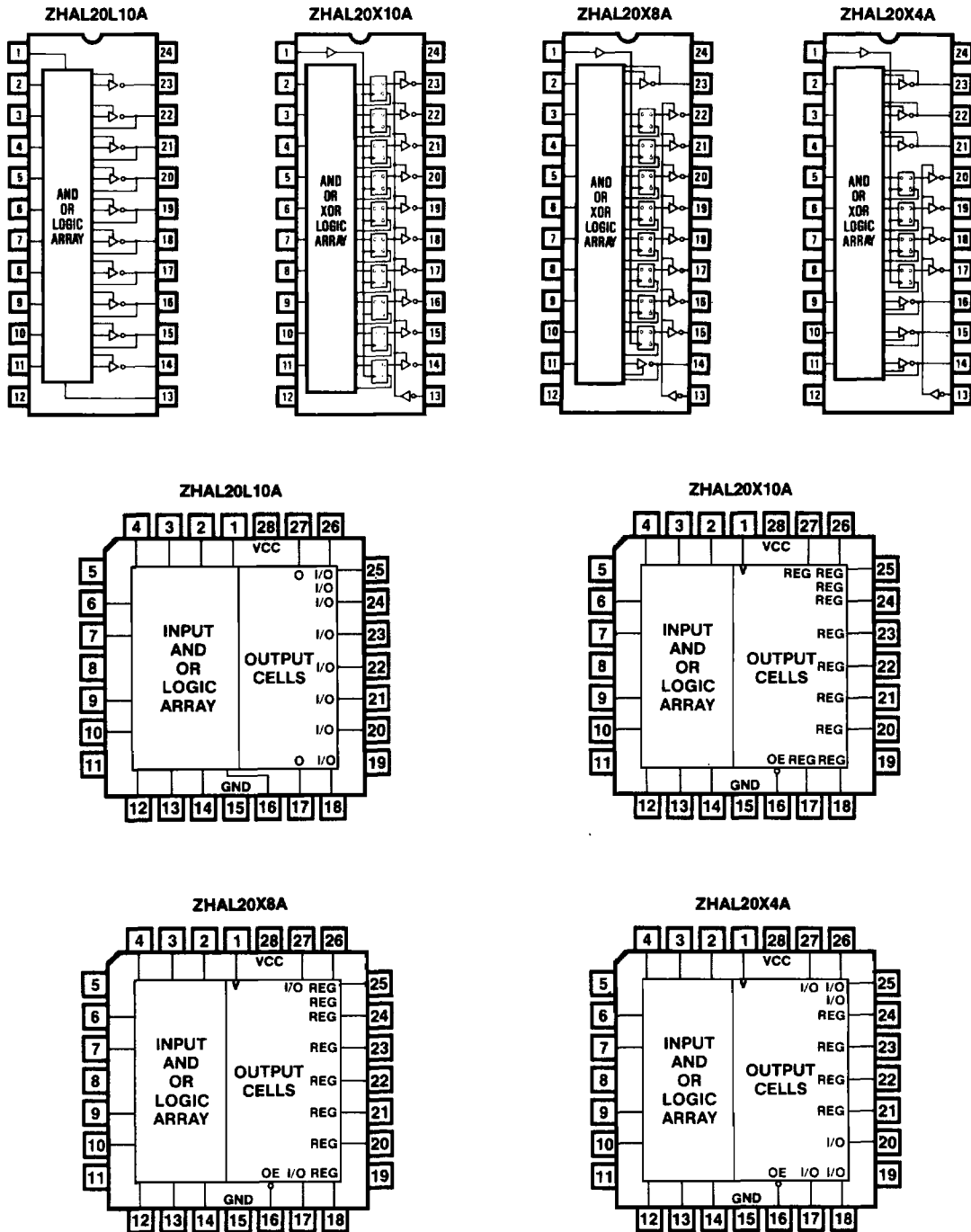


## ZHAL24A Series

### Pin Configurations — DIP and PLCC

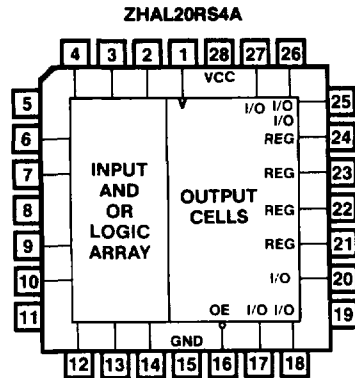
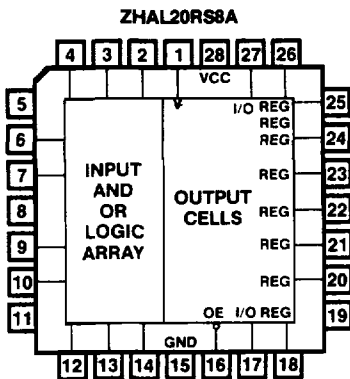
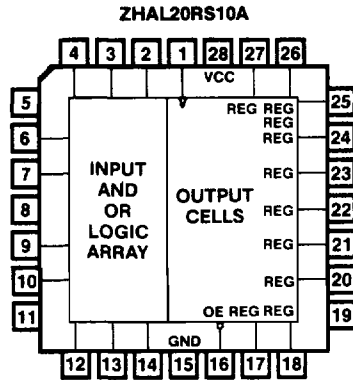
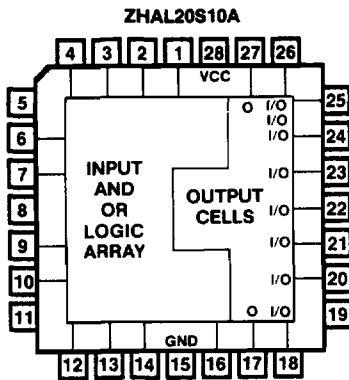
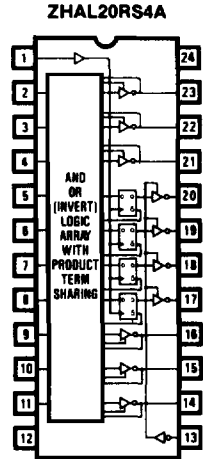
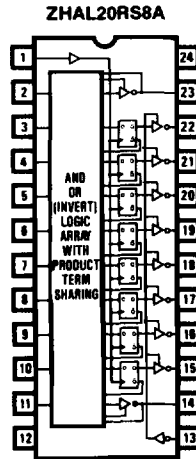
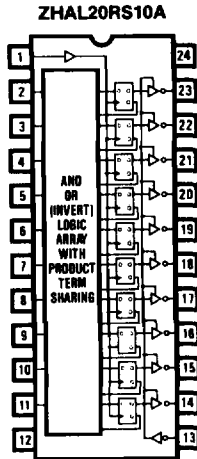
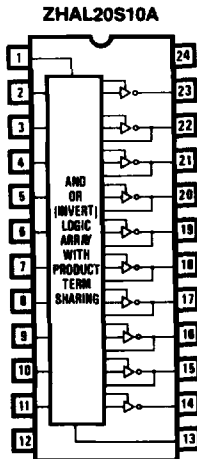


## Pin Configurations – DIP and PLCC



## ZHAL24A Series

### Pin Configurations — DIP and PLCC



# ZHAL24A Series 12L10A, 14L8A, 16L6A, 18L4A, 20L2A, 20C1A

## Operating Conditions

| SYMBOL   | PARAMETER                      | INDUSTRIAL |     |     | COMMERCIAL |     |      | UNIT |
|----------|--------------------------------|------------|-----|-----|------------|-----|------|------|
|          |                                | MIN        | TYP | MAX | MIN        | TYP | MAX  |      |
| $V_{CC}$ | Supply voltage                 | 4.5        | 5   | 5.5 | 4.75       | 5   | 5.25 | V    |
| $T_A$    | Operating free-air temperature | -40        | 25  | 85  | 0          | 25  | 75   | °C   |

## Electrical Characteristics Over Operating Conditions

| SYMBOL                        | PARAMETER                           | TEST CONDITION                                                            |                                  | MIN               | TYP | MAX             | UNIT |
|-------------------------------|-------------------------------------|---------------------------------------------------------------------------|----------------------------------|-------------------|-----|-----------------|------|
| V <sub>IL</sub> <sup>1</sup>  | Low-level input voltage             |                                                                           |                                  | 0                 |     | 0.8             | V    |
| V <sub>IH</sub> <sup>1</sup>  | High-level input voltage            |                                                                           |                                  | 2                 |     | V <sub>CC</sub> | V    |
| I <sub>IL</sub>               | Low-level input current             | V <sub>CC</sub> = MAX V <sub>I</sub> = GND                                |                                  |                   |     | -1              | μA   |
| I <sub>IH</sub>               | High-level input current            | V <sub>CC</sub> = MAX V <sub>I</sub> = V <sub>CC</sub>                    |                                  |                   |     | 1               | μA   |
| V <sub>OL</sub>               | Low-level output voltage            | V <sub>CC</sub> = MIN                                                     | I <sub>OL</sub> = 8 mA           |                   | 0.1 | 0.4             | V    |
|                               |                                     | V <sub>CC</sub> = 5 V                                                     | I <sub>OL</sub> = 1 μA           |                   |     | 0.05            |      |
| V <sub>OH</sub>               | High-level output voltage           | V <sub>CC</sub> = MIN                                                     | I <sub>OH</sub> = -6 mA          | 3.76 <sup>2</sup> | 4.1 |                 | V    |
|                               |                                     | V <sub>CC</sub> = 5 V                                                     | I <sub>OH</sub> = -1 μA          | 4.95              |     |                 |      |
| I <sub>OZL</sub> <sup>3</sup> | Off-state output current            | V <sub>CC</sub> = MAX                                                     | V <sub>O</sub> = GND             |                   | 0   | -10             | μA   |
| I <sub>OZH</sub> <sup>3</sup> |                                     |                                                                           | V <sub>O</sub> = V <sub>CC</sub> |                   | 0   | 10              | μA   |
| I <sub>CC</sub>               | Standby supply current <sup>4</sup> | I <sub>O</sub> = 0 mA, V <sub>I</sub> = GND or V <sub>CC</sub>            |                                  |                   | 0   | 100             | μA   |
|                               | Operating supply current            | f = 1 MHz, I <sub>O</sub> = 0 mA, V <sub>I</sub> = GND or V <sub>CC</sub> |                                  |                   | 2   | 5 <sup>5</sup>  | mA   |

## Switching Characteristics Over Operating Conditions

| SYMBOL   | PARAMETER       | TEST CONDITIONS<br>(See Test Load)                 | INDUSTRIAL |     |                 | COMMERCIAL |     |                 | UNIT |
|----------|-----------------|----------------------------------------------------|------------|-----|-----------------|------------|-----|-----------------|------|
|          |                 |                                                    | MIN        | TYP | MAX             | MIN        | TYP | MAX             |      |
| $t_{PD}$ | Input to output | $R_L = 1 \text{ K}\Omega$<br>$C_L = 50 \text{ pF}$ |            | 13  | 25 <sup>6</sup> |            | 13  | 25 <sup>6</sup> | ns   |

- Notes:
- 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.
  - JEDEC standard no. 7 for high-speed CMOS devices.
  - Applies to pins 14-23 for DIP (pins 17, 18, 20-27 for PLCC).
  - Disable output pins =  $V_{CC}$  or GND.
  - Add 3 mA per additional 1.0 MHz of operation over 1 MHz.
  - For outputs with more than 12 inputs in a product term,  $t_{PD} = 30 \text{ ns}$ .

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## ZHAL24A Series 20L8A, 20R8A, 20R6A, 20R4A

### Operating Conditions

| SYMBOL          | PARAMETER                                  |                           | INDUSTRIAL      |     |     | COMMERCIAL      |     |      | UNIT |
|-----------------|--------------------------------------------|---------------------------|-----------------|-----|-----|-----------------|-----|------|------|
|                 |                                            |                           | MIN             | TYP | MAX | MIN             | TYP | MAX  |      |
| V <sub>CC</sub> | Supply voltage                             |                           | 4.5             | 5   | 5.5 | 4.75            | 5   | 5.25 | V    |
| t <sub>w</sub>  | Width of clock                             | 20R8A,<br>20R6A,<br>20R4A | 15              | 4   |     | 15              | 4   |      | ns   |
| t <sub>su</sub> | Setup time from input or feedback to clock |                           | 20 <sup>1</sup> | 11  |     | 20 <sup>1</sup> | 11  |      | ns   |
| t <sub>h</sub>  | Hold time                                  |                           | 0               | -10 |     | 0               | -10 |      | ns   |
| T <sub>A</sub>  | Operating free-air temperature             |                           | -40             | 25  | 85  | 0               | 25  | 75   | °C   |

### Electrical Characteristics Over Operating Conditions

| SYMBOL                        |                                     | PARAMETER                |                                                                           | TEST CONDITION                                |                   | MIN | TYP            | MAX             | UNIT |
|-------------------------------|-------------------------------------|--------------------------|---------------------------------------------------------------------------|-----------------------------------------------|-------------------|-----|----------------|-----------------|------|
| V <sub>IL</sub> <sup>2</sup>  |                                     | Low-level input voltage  |                                                                           |                                               |                   | 0   |                | 0.8             | V    |
| V <sub>IH</sub> <sup>2</sup>  |                                     | High-level input voltage |                                                                           |                                               |                   | 2   |                | V <sub>CC</sub> | V    |
| I <sub>IL</sub>               |                                     | Low-level input current  |                                                                           | V <sub>CC</sub> = MAX    V <sub>I</sub> = GND |                   |     |                | -1              | μA   |
| I <sub>IH</sub>               | High-level input current            | Pin 10 <sup>3</sup>      | V <sub>CC</sub> = MAX    V <sub>I</sub> = V <sub>CC</sub>                 |                                               |                   | 8   | 30             | μA              |      |
|                               |                                     | All other pins           |                                                                           |                                               |                   |     | 1              | μA              |      |
| V <sub>OL</sub>               | Low-level output voltage            |                          | V <sub>CC</sub> = MIN                                                     | I <sub>OL</sub> = 8 mA                        |                   | 0.1 | 0.4            | V               |      |
|                               |                                     |                          | V <sub>CC</sub> = 5 V                                                     | I <sub>OL</sub> = 1 μA                        |                   |     | 0.05           |                 |      |
| V <sub>OH</sub>               | High-level output voltage           |                          | V <sub>CC</sub> = MIN                                                     | I <sub>OH</sub> = -6 mA                       | 3.76 <sup>4</sup> | 4.1 |                | V               |      |
|                               |                                     |                          | V <sub>CC</sub> = 5 V                                                     | I <sub>OH</sub> = -1 μA                       | 4.95              |     |                |                 |      |
| I <sub>OZL</sub> <sup>5</sup> | Off-state output current            |                          | V <sub>CC</sub> = MAX                                                     | V <sub>O</sub> = GND                          |                   | 0   | -10            | μA              |      |
| I <sub>OZH</sub> <sup>5</sup> |                                     |                          |                                                                           | V <sub>O</sub> = V <sub>CC</sub>              |                   | 0   | 10             | μA              |      |
| I <sub>CC</sub>               | Standby supply current <sup>6</sup> |                          | I <sub>O</sub> = 0 mA, V <sub>I</sub> = GND or V <sub>CC</sub>            |                                               |                   | 0   | 100            | μA              |      |
|                               | Operating supply current            |                          | f = 1 MHz, I <sub>O</sub> = 0 mA, V <sub>I</sub> = GND or V <sub>CC</sub> |                                               |                   | 2   | 5 <sup>7</sup> | mA              |      |

### Switching Characteristics Over Operating Conditions

| SYMBOL                        | PARAMETER                                          |                           | TEST CONDITIONS<br>(See Test Load)              | INDUSTRIAL<br>MIN    TYP    MAX |                 | COMMERCIAL<br>MIN    TYP    MAX |                 | UNIT |
|-------------------------------|----------------------------------------------------|---------------------------|-------------------------------------------------|---------------------------------|-----------------|---------------------------------|-----------------|------|
| t <sub>PD</sub>               | Input or feedback to output<br>20L8A, 20R6A, 20R4A |                           | R <sub>L</sub> = 1 KΩ<br>C <sub>L</sub> = 50 pF | 13                              | 25 <sup>1</sup> | 13                              | 25 <sup>1</sup> | ns   |
| t <sub>CLK</sub>              | Clock to output or feedback<br>20R8A, 20R6A, 20R4A |                           |                                                 | 8                               | 15              | 8                               | 15              | ns   |
| t <sub>PZX</sub>              | Input to<br>output enable                          | 20L8A,<br>20R6A,<br>20R4A |                                                 | 12                              | 25              | 12                              | 25              | ns   |
| t <sub>PXZ</sub> <sup>8</sup> | Input to<br>output disable                         |                           |                                                 | 12                              | 25              | 12                              | 25              | ns   |
| t <sub>PXZ</sub> <sup>8</sup> | Pin 13 (DIP)                                       | 20R8A,<br>20R6A,<br>20R4A |                                                 | 10                              | 20              | 10                              | 20              | ns   |
| t <sub>PZX</sub>              | to output<br>disable/enable                        |                           |                                                 |                                 |                 |                                 |                 |      |
| f <sub>MAX</sub>              | Maximum<br>frequency                               |                           |                                                 |                                 | 28.5            | 40                              | 28.5            | 40   |

- Notes: 1. For outputs with more than 12 inputs in a product term, t<sub>su</sub> = 25 ns and t<sub>PD</sub> = 30 ns.  
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. Pin 10 DIP, pin 13 PLCC (PRELOAD pin). Applies to registered devices only.  
4. JEDEC standard no. 7 for high-speed CMOS devices.  
5. Applies to pins 14-23 for DIP (pins 17, 18, 20-27 for PLCC).  
6. Disable output pins = V<sub>CC</sub> or GND.  
7. Add 3 mA per additional 1.0 MHz of operation over 1 MHz.  
8. C<sub>L</sub> = 5 pF.

# ZHAL24A Series 20L10A, 20X10A, 20X8A, 20X4A

## Operating Conditions

| SYMBOL          | PARAMETER                                     |                            | INDUSTRIAL      |     |     | COMMERCIAL      |     |      | UNIT |
|-----------------|-----------------------------------------------|----------------------------|-----------------|-----|-----|-----------------|-----|------|------|
|                 |                                               |                            | MIN             | TYP | MAX | MIN             | TYP | MAX  |      |
| V <sub>CC</sub> | Supply voltage                                |                            | 4.5             | 5   | 5.5 | 4.75            | 5   | 5.25 | V    |
| t <sub>w</sub>  | Width of clock                                | 20X10A,<br>20X8A,<br>20X4A | 15              | 5   |     | 15              | 5   |      | ns   |
| t <sub>su</sub> | Setup time from<br>input or feedback to clock |                            | 25 <sup>1</sup> | 15  |     | 25 <sup>1</sup> | 15  |      | ns   |
| t <sub>h</sub>  | Hold time                                     |                            | 0               | -10 |     | 0               | -10 |      | ns   |
| T <sub>A</sub>  | Operating free-air temperature                |                            | -40             | 25  | 85  | 0               | 25  | 75   | °C   |

## Electrical Characteristics Over Operating Conditions

| SYMBOL      | PARAMETER                           |                     | TEST CONDITION                                                              |                           | 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            | Pin 10 <sup>3</sup> | $V_{CC} = \text{MAX}$                                                       | $V_I = V_{CC}$            |                   | 8   | 30             | $\mu\text{A}$ |
|             |                                     | All other pins      |                                                                             |                           |                   |     | 1              | $\mu\text{A}$ |
| $V_{OL}$    | Low-level output voltage            |                     | $V_{CC} = \text{MIN}$                                                       | $I_{OL} = 8 \text{ mA}$   |                   | 0.1 | 0.4            | V             |
|             |                                     |                     | $V_{CC} = 5 \text{ V}$                                                      | $I_{OL} = 1 \mu\text{A}$  |                   |     | 0.05           |               |
| $V_{OH}$    | High-level output voltage           |                     | $V_{CC} = \text{MIN}$                                                       | $I_{OH} = -6 \text{ mA}$  | 3.76 <sup>4</sup> | 4.1 |                | V             |
|             |                                     |                     | $V_{CC} = 5 \text{ V}$                                                      | $I_{OH} = -1 \mu\text{A}$ | 4.95              |     |                |               |
| $I_{OZL}^5$ | Off-state output current            |                     | $V_{CC} = \text{MAX}$                                                       | $V_O = \text{GND}$        |                   | 0   | -10            | $\mu\text{A}$ |
| $I_{OZH}^5$ |                                     |                     |                                                                             | $V_O = V_{CC}$            |                   | 0   | 10             | $\mu\text{A}$ |
| $I_{CC}$    | Standby supply current <sup>6</sup> |                     | $I_O = 0 \text{ mA}$ , $V_I = \text{GND}$ or $V_{CC}$                       |                           |                   | 0   | 100            | $\mu\text{A}$ |
|             | Operating supply current            |                     | $f = 1 \text{ MHz}$ , $I_O = 0 \text{ mA}$ , $V_I = \text{GND}$ or $V_{CC}$ |                           |                   | 2   | 5 <sup>7</sup> | mA            |

## Switching Characteristics Over Operating Conditions

| SYMBOL                        | PARAMETER                                           |                            | TEST<br>CONDITIONS<br>(See Test Load)           | INDUSTRIAL |                 | COMMERCIAL |                 | UNIT |
|-------------------------------|-----------------------------------------------------|----------------------------|-------------------------------------------------|------------|-----------------|------------|-----------------|------|
|                               |                                                     |                            |                                                 | MIN        | TYP             | MAX        | MIN             |      |
| t <sub>PD</sub>               | Input or feedback to output<br>20L10A, 20X8A, 20X4A |                            | R <sub>L</sub> = 1 KΩ<br>C <sub>L</sub> = 50 pF | 13         | 25 <sup>1</sup> | 13         | 25 <sup>1</sup> | ns   |
| t <sub>CLK</sub>              | Clock to output or feedback<br>20X10A, 20X8A, 20X4A |                            |                                                 | 10         | 15              | 10         | 15              | ns   |
| t <sub>PZX</sub>              | Input to<br>output enable                           | 20L10A,<br>20X8A,<br>20X4A |                                                 | 12         | 25              | 12         | 25              | ns   |
| t <sub>PXZ</sub> <sup>8</sup> | Input to<br>output disable                          |                            |                                                 | 12         | 25              | 12         | 25              | ns   |
| t <sub>PXZ</sub> <sup>8</sup> | Pin 13 (DIP)<br>to output<br>disable/enable         | 20X10A,<br>20X8A,<br>20X4A |                                                 | 15         | 20              | 15         | 20              | ns   |
| t <sub>PZX</sub>              |                                                     |                            |                                                 |            |                 |            |                 |      |
| f <sub>MAX</sub>              | Maximum<br>frequency                                |                            |                                                 |            | 22.2            | 32         | 22.2            | 32   |

Notes: 1 For outputs with more than 12 inputs in a product term,  $t_{SU} = 30 \text{ ns}$  and  $t_{PD} = 30 \text{ ns}$ .

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 Pin 10 DIP, pin 13 PLCC (PRELOAD pin). Applies to registered devices only.

4 JEDEC standard no. 7 for high-speed CMOS devices.

5 Applies to pins 14-23 for DIP (pins 17, 18, 20-27 for PLCC).

6 Disable output pins =  $V_{CC}$  or GND.

7 Add 3 mA per additional 1.0 MHz of operation over 1 MHz.

8  $C_L = 5 \text{ pF}$ .

# ZHAL24A Series 20S10A, 20RS10A, 20RS8A, 20RS4A

## Operating Conditions

| SYMBOL   | PARAMETER                      | INDUSTRIAL<br>MIN TYP MAX | COMMERCIAL<br>MIN TYP MAX | UNIT |
|----------|--------------------------------|---------------------------|---------------------------|------|
| $V_{CC}$ | Supply voltage                 | 4.5 5 5.5                 | 4.75 5 5.25               | V    |
| $t_w$    | Width of clock                 | 15 4                      | 15 4                      | ns   |
| $t_{su}$ | Setup time for input to clock  | 20 <sup>1</sup> 11        | 20 <sup>1</sup> 11        | ns   |
| $t_h$    | Hold time                      | 0 -10                     | 0 -10                     | ns   |
| $T_A$    | Operating free-air temperature | -40 25 85                 | 0 25 75                   | °C   |

## Electrical Characteristics Over Operating Conditions

| SYMBOL      | PARAMETER                           | TEST CONDITION                                                              | 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            | $V_{CC} = \text{MAX}$ $V_I = V_{CC}$                                        | 8 30                  | $\mu\text{A}$ |
|             |                                     |                                                                             | 1                     | $\mu\text{A}$ |
| $V_{OL}$    | Low-level output voltage            | $V_{CC} = \text{MIN}$ $I_{OL} = 8 \text{ mA}$                               | 0.1 0.4               | V             |
|             |                                     | $V_{CC} = 5 \text{ V}$ $I_{OL} = 1 \mu\text{A}$                             | 0.05                  |               |
| $V_{OH}$    | High-level output voltage           | $V_{CC} = \text{MIN}$ $I_{OH} = -6 \text{ mA}$                              | 3.76 <sup>4</sup> 4.1 | V             |
|             |                                     | $V_{CC} = 5 \text{ V}$ $I_{OH} = -1 \mu\text{A}$                            | 4.95                  |               |
| $I_{OZL}^5$ | Off-state output current            | $V_{CC} = \text{MAX}$ $V_O = \text{GND}$                                    | 0 -10                 | $\mu\text{A}$ |
| $I_{OZH}^5$ |                                     |                                                                             | 0 10                  | $\mu\text{A}$ |
| $I_{CC}$    | Standby supply current <sup>6</sup> | $I_O = 0 \text{ mA}$ , $V_I = \text{GND}$ or $V_{CC}$                       | 0 100                 | $\mu\text{A}$ |
|             | Operating supply current            | $f = 1 \text{ MHz}$ , $I_O = 0 \text{ mA}$ , $V_I = \text{GND}$ or $V_{CC}$ | 2 5 <sup>7</sup>      | mA            |

## Switching Characteristics Over Operating Conditions

| SYMBOL      | PARAMETER                                                           | TEST CONDITIONS<br>(See Test Load)                 | INDUSTRIAL<br>MIN TYP MAX | COMMERCIAL<br>MIN TYP MAX | UNIT |
|-------------|---------------------------------------------------------------------|----------------------------------------------------|---------------------------|---------------------------|------|
| $t_{PD}$    | Input or feedback to output<br>20S10A, 20RS8A, 20RS4A               | $R_L = 1 \text{ K}\Omega$<br>$C_L = 50 \text{ pF}$ | 13 25 <sup>1</sup>        | 13 25 <sup>1</sup>        | ns   |
| $t_{CLK}$   | Clock to output or feedback<br>20RS10A, 20RS8A, 20RS4A              |                                                    | 8 15                      | 8 15                      | ns   |
| $t_{PZX}$   | Input to output enable<br>20S10A, 20RS8A, 20RS4A                    |                                                    | 12 25                     | 12 25                     | ns   |
| $t_{PXZ}^8$ | Input to output disable<br>20S10A, 20RS8A, 20RS4A                   |                                                    | 12 25                     | 12 25                     | ns   |
| $t_{PXZ}^8$ | Pin 13 (DIP) to output<br>disable/enable<br>20RS10A, 20RS8A, 20RS4A |                                                    | 10 20                     | 10 20                     | ns   |
| $t_{PZX}$   | Maximum frequency                                                   |                                                    | 28.5 40                   | 28.5 40                   | MHz  |
| $t_{MAX}$   | Maximum frequency                                                   |                                                    | 28.5 40                   | 28.5 40                   | MHz  |

Notes: 1. For outputs with more than 12 inputs in a product term,  $t_{SU} = 25 \text{ ns}$  and  $t_{PD} = 30 \text{ ns}$ .

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. Pin 10 DIP, pin 13 PLCC (PRELOAD pin). Applies to registered devices only.

4. JEDEC standard no. 7 for high-speed CMOS devices.

5. Applies to pins 14-23 for DIP (pins 17, 18, 20-27 for PLCC)

6. Disable output pins =  $V_{CC}$  or GND

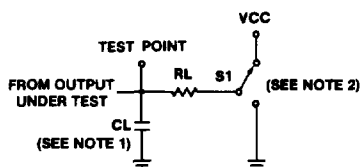
7. Add 3 mA per additional 1.0 MHz of operation over 1 MHz.

8.  $C_L = 5 \text{ pF}$

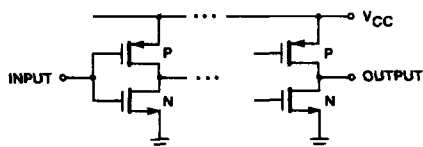
## Absolute Maximum Ratings

|                                                      |                            |
|------------------------------------------------------|----------------------------|
| Supply voltage, $V_{CC}$                             | -0.5 V to 7 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                                  | -85°C to +150°C            |

## Switching Test Load



## Schematic of Inputs and Outputs



## Output Register PRELOAD†

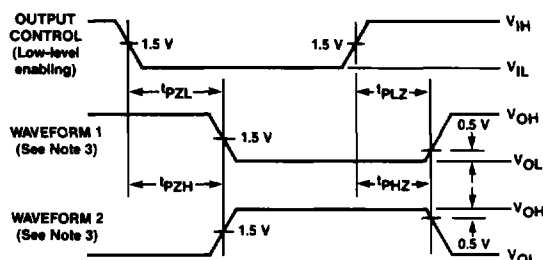
The PRELOAD function allows the register to be loaded from data placed on the output pins. This feature aids functional testing of state sequencer designs by allowing direct setting of output states for improved test coverage. The procedure for PRELOAD using DIP pin numbers, is as follows:

1. Raise  $V_{CC}$  to 4.5 V.
2. Disable output registers by setting pin 13 to  $V_{IH}$ . Set pin 1 to 0 V.
3. Apply  $V_{IL}/V_{IH}$  to all registered outputs.
4. Pulse pin 10 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 output registers.
7. Verify for  $V_{OL}/V_{OH}$  at all registered outputs.

† Note: Only applies to parts with output registers.

Typical  $t_{sup} = 50$  ns  
 $t_{wp} = 100$  ns  
 $t_{hp} = 50$  ns  
 $I_{IH} = 30\mu A$  (Pin 10)

## Enable/Disable Delay



- Notes:
1. CL includes probe and jig capacitance.
  2. When measuring  $t_{PZL}$  and  $t_{PZH}$ , S1 is tied to  $V_{CC}$ . When measuring  $t_{PHZ}$  and  $t_{PLZ}$ , S1 is tied to ground.  $t_{PZX}$  is measured with  $C_L = 50$  pF.  $t_{PXZ}$  is measured with  $C_L = 5$  pF. When measuring propagation delay times of three-state outputs, S1 is open, i.e., not connected to  $V_{CC}$  or ground.
  3. Waveform 1 is for an output with internal conditions such that the output is LOW except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is HIGH except when disabled by the output control.

5

