

## FEATURES

- Member of the Texas Instruments Widebus™ Family
- EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process
- Checks Parity
- Able to Cascade With a Second SN74ALVCH16903
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), and Thin Very Small-Outline (DGV) Packages

## DESCRIPTION

This 12-bit universal bus driver is designed for 2.3-V to 3.6-V  $V_{CC}$  operation.

The SN74ALVCH16903 has dual outputs and can operate as a buffer or an edge-triggered register. In both modes, parity is checked on APAR, which arrives one cycle after the data to which it applies. The  $\overline{YERR}$  output, which is produced one cycle after APAR, is open drain.

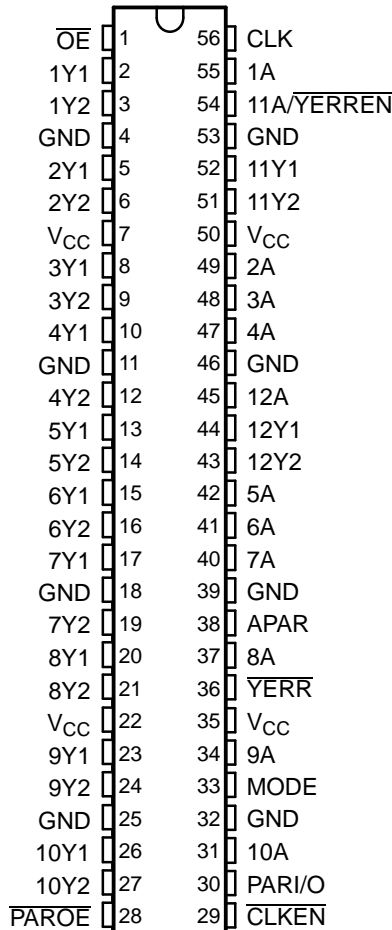
MODE selects one of the two data paths. When MODE is low, the device operates as an edge-triggered register. On the positive transition of the clock (CLK) input and when the clock-enable ( $\overline{CLKEN}$ ) input is low, data set up at the A inputs is stored in the internal registers. On the positive transition of CLK and when  $\overline{CLKEN}$  is high, only data set up at the 9A–12A inputs is stored in their internal registers. When MODE is high, the device operates as a buffer and data at the A inputs passes directly to the outputs. 11A/ $\overline{YERR}$  serves a dual purpose; it acts as a normal data bit and also enables  $\overline{YERR}$  data to be clocked into the YERR output register.

When used as a single device, parity output enable ( $\overline{PAROE}$ ) must be tied high; when parity input/output (PARI/O) is low, even parity is selected and when PARI/O is high, odd parity is selected. When used in pairs and  $\overline{PAROE}$  is low, the parity sum is output on PARI/O for cascading to the second SN74ALVCH16903. When used in pairs and  $\overline{PAROE}$  is high, PARI/O accepts a partial parity sum from the first SN74ALVCH16903.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the 24 outputs and  $\overline{YERR}$  in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components.

$\overline{OE}$  does not affect the internal operation of the device. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



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**SN74ALVCH16903**  
**3.3-V 12-BIT UNIVERSAL BUS DRIVER**  
**WITH PARITY CHECKER AND DUAL 3-STATE OUTPUTS**

SCES095D—MARCH 1997—REVISED SEPTEMBER 2004

**DESCRIPTION (CONTINUED)**

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

The SN74ALVCH16903 is characterized for operation from 0°C to 70°C.

**FUNCTION TABLES**

**FUNCTION**

| INPUTS          |      |                    |     |   | OUTPUTS                                |   |
|-----------------|------|--------------------|-----|---|--|---|
| $\overline{OE}$ | MODE | $\overline{CLKEN}$ | CLK | A | 1Yn <sup>(1)</sup> –8Yn <sup>(1)</sup> | 9Yn <sup>(1)</sup> –12Yn <sup>(1)</sup> |
| L               | L    | L                  | ↑   | H | H                                      | H                                       |
| L               | L    | L                  | ↑   | L | L                                      | L                                       |
| L               | L    | H                  | ↑   | H | Y <sub>0</sub>                         | H                                       |
| L               | L    | H                  | ↑   | L | Y <sub>0</sub>                         | L                                       |
| L               | H    | X                  | X   | H | H                                      | H                                       |
| L               | H    | X                  | X   | L | L                                      | L                                       |
| H               | X    | X                  | X   | X | Z                                      | Z                                       |

(1) n = 1 or 2

**PARITY FUNCTION**

| INPUTS          |                        |                           |        |                                  |      | OUTPUT<br>YERR |
|-----------------|------------------------|---------------------------|--------|----------------------------------|------|----------------|
| $\overline{OE}$ | $\overline{PAROE}$ (1) | 11A/YERREN <sup>(2)</sup> | PARI/O | $\Sigma$ OF INPUTS<br>1A–10A = H | APAR |                |
| L               | H                      | L                         | L      | 0, 2, 4, 6, 8, 10                | L    | H              |
| L               | H                      | L                         | L      | 1, 3, 5, 7, 9                    | L    | L              |
| L               | H                      | L                         | L      | 0, 2, 4, 6, 8, 10                | H    | L              |
| L               | H                      | L                         | L      | 1, 3, 5, 7, 9                    | H    | H              |
| L               | H                      | L                         | H      | 0, 2, 4, 6, 8, 10                | L    | L              |
| L               | H                      | L                         | H      | 1, 3, 5, 7, 9                    | L    | H              |
| L               | H                      | L                         | H      | 0, 2, 4, 6, 8, 10                | H    | H              |
| L               | H                      | L                         | H      | 1, 3, 5, 7, 9                    | H    | L              |
| H               | X                      | X                         | X      | X                                | X    | H              |
| L               | X                      | H                         | X      | X                                | X    | H              |

(1) When used as a single device,  $\overline{PAROE}$  must be tied high.

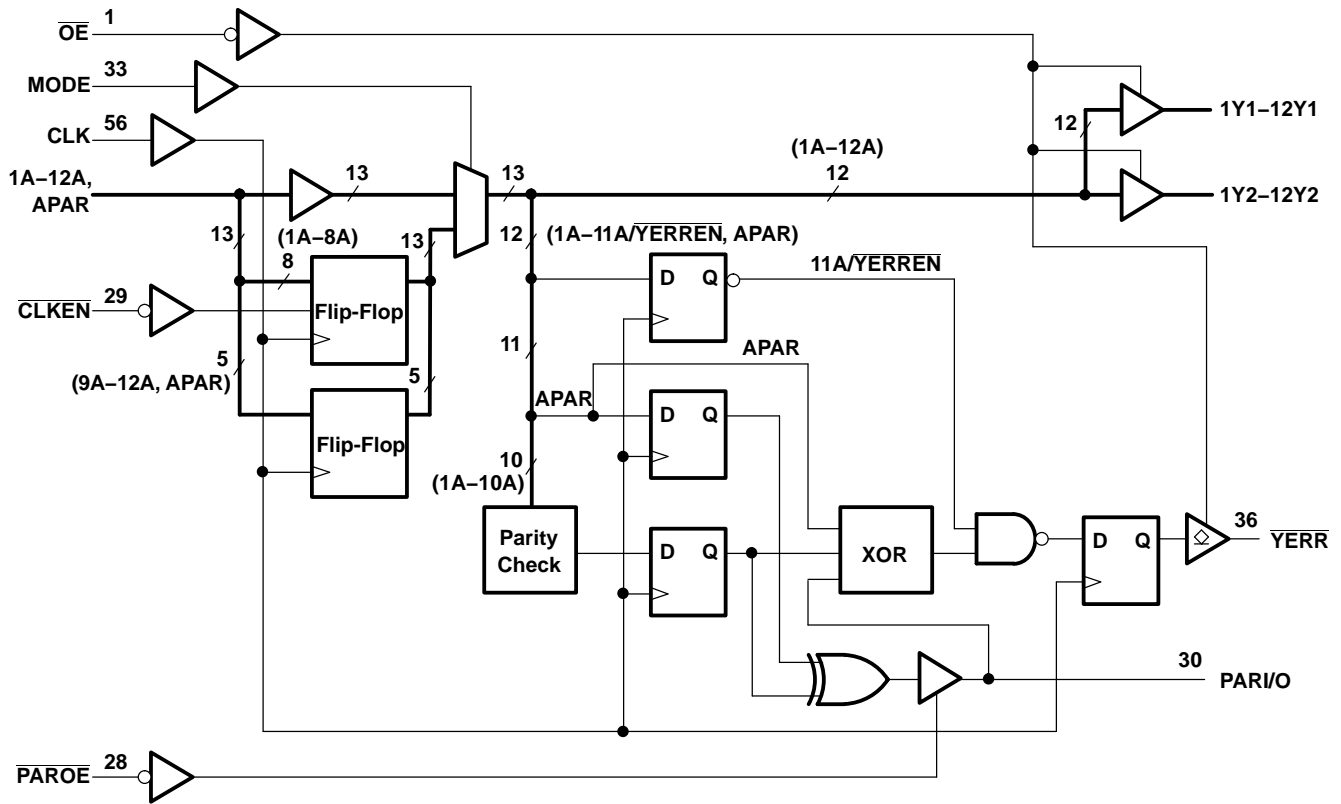
(2) Valid after appropriate number of clock pulses have set internal register

**PARI/O FUNCTION<sup>(1)</sup>**

| INPUTS             |                                  |      | OUTPUT<br>PARI/O |
|--------------------|----------------------------------|------|------------------|
| $\overline{PAROE}$ | $\Sigma$ OF INPUTS<br>1A–10A = H | APAR |                  |
| L                  | 0, 2, 4, 6, 8, 10                | L    | L                |
| L                  | 1, 3, 5, 7, 9                    | L    | H                |
| L                  | 0, 2, 4, 6, 8, 10                | H    | H                |
| L                  | 1, 3, 5, 7, 9                    | H    | L                |
| H                  | X                                | X    | Z                |

(1) This table applies to the first device of a cascaded pair of SN74ALVCH16903 devices.

**LOGIC DIAGRAM (POSITIVE LOGIC)**



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SCES095D–MARCH 1997–REVISED SEPTEMBER 2004

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

over operating free-air temperature range (unless otherwise noted)

|  |  | MIN                | MAX                   | UNIT    |
|--|--|--------------------|-----------------------|---------|
| V <sub>CC</sub>  | Supply voltage range                     | -0.5               | 4.6                   | V       |
| V <sub>I</sub>   | Input voltage range <sup>(2)</sup>       | -0.5               | 4.6                   | V       |
| V <sub>O</sub>   | Output voltage range <sup>(2)(3)</sup>   | -0.5               | V <sub>CC</sub> + 0.5 | V       |
| I <sub>IK</sub>  | Input clamp current                      | V <sub>I</sub> < 0 |                       | -50 mA  |
| I <sub>OK</sub>  | Output clamp current                     | V <sub>O</sub> < 0 |                       | -50 mA  |
| I <sub>O</sub>   | Continuous output current                |                    |                       | ±50 mA  |
| Continuous current through each V <sub>CC</sub> or GND |  |                    |                       | ±100 mA |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(4)</sup> | DGG package        |                       | 81      |
|  |  | DGV package        |                       | 86      |
|  |  | DL package         |                       | 74      |
| T <sub>stg</sub>                                       | Storage temperature range                | -65                | 150                   | °C      |

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 4.6 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51.

**RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>**

|                 |                                    | MIN                              | MAX             | UNIT        |     |
|-----------------|------------------------------------|----------------------------------|-----------------|-------------|-----|
| V <sub>CC</sub> | Supply voltage                     | 2.3                              | 3.6             | V           |     |
| V <sub>IH</sub> | High-level input voltage           | V <sub>CC</sub> = 2.3 V to 2.7 V |                 | 1.7         |     |
|                 |                                    | V <sub>CC</sub> = 2.7 V to 3.6 V |                 | 2           |     |
| V <sub>IL</sub> | Low-level input voltage            | V <sub>CC</sub> = 2.3 V to 2.7 V |                 | 0.7         |     |
|                 |                                    | V <sub>CC</sub> = 2.7 V to 3.6 V |                 | 0.8         |     |
| V <sub>I</sub>  | Input voltage                      | 0                                | V <sub>CC</sub> | V           |     |
| V <sub>O</sub>  | Output voltage                     | 0                                | V <sub>CC</sub> | V           |     |
| I <sub>OH</sub> | High-level output current          | V <sub>CC</sub> = 2.3 V          |                 | Y port      | -12 |
|                 |                                    | V <sub>CC</sub> = 2.7 V          |                 |             | -12 |
|                 |                                    | V <sub>CC</sub> = 3 V            |                 | PARI/O      | -12 |
|                 |                                    |                                  |                 | Y port      | -24 |
| I <sub>OL</sub> | Low-level output current           | V <sub>CC</sub> = 2.3 V          |                 | Y port      | 12  |
|                 |                                    | V <sub>CC</sub> = 2.7 V          |                 |             | 12  |
|                 |                                    | V <sub>CC</sub> = 3 V            |                 | PARI/O      | 12  |
|                 |                                    |                                  |                 | Y port      | 24  |
|                 |                                    |                                  |                 | YERR output | 24  |
| Δt/Δv           | Input transition rise or fall rate | 0                                | 10              | ns/V        |     |
| T <sub>A</sub>  | Operating free-air temperature     | 0                                | 70              | °C          |     |

- (1) All unused control inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

**ELECTRICAL CHARACTERISTICS**

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                      |                           | TEST CONDITIONS  | V <sub>CC</sub>         | MIN                   | TYP <sup>(1)</sup> | MAX  | UNIT |
|--------------------------------|---------------------------|--|-------------------------|-----------------------|--------------------|------|------|
| V <sub>OH</sub>                | Y port                    | I <sub>OH</sub> = -100 μA  | 2.3 V to 3.6 V          | V <sub>CC</sub> - 0.2 |                    |      | V    |
|                                |                           | I <sub>OH</sub> = -6 mA,   | V <sub>IH</sub> = 1.7 V | 2.3 V                 | 2                  |      |      |
|                                |                           |  |                         | 2.3 V                 | 1.7                |      |      |
|                                |                           | I <sub>OH</sub> = -12 mA   | V <sub>IH</sub> = 2 V   | 2.7 V                 | 2.2                |      |      |
|                                |                           |  |                         | 3 V                   | 2.4                |      |      |
|                                | I <sub>OH</sub> = -24 mA, | V <sub>IH</sub> = 2 V  | 3 V                     | 2                     |                    |      |      |
| PARI/O                         | I <sub>OH</sub> = -12 mA, | V <sub>IH</sub> = 2 V  | 3 V                     | 2                     |                    |      |      |
| V <sub>OL</sub>                | Y port                    | I <sub>OL</sub> = 100 μA   | 2.3 V to 3.6 V          |                       |                    | 0.2  | V    |
|                                |                           | I <sub>OL</sub> = 6 mA,  | V <sub>IL</sub> = 0.7 V | 2.3 V                 |                    | 0.4  |      |
|                                |                           |  |                         | 2.3 V                 |                    | 0.7  |      |
|                                |                           | I <sub>OL</sub> = 12 mA  | V <sub>IL</sub> = 0.8 V | 2.7 V                 |                    | 0.4  |      |
|                                |                           |  |                         | 3 V                   |                    | 0.55 |      |
|                                | I <sub>OL</sub> = 24 mA,  | V <sub>IL</sub> = 0.8 V  | 3 V                     |                       | 0.55               |      |      |
| PARI/O                         | I <sub>OL</sub> = 12 mA,  | V <sub>IL</sub> = 0.8 V  | 3 V                     |                       | 0.55               |      |      |
|                                | YERR output               | I <sub>OL</sub> = 24 mA  | 3 V                     |                       |                    | 0.5  |      |
| I <sub>I</sub>                 |                           | V <sub>I</sub> = V <sub>CC</sub> or GND                                      | 3.6 V                   |                       |                    | ±5   | μA   |
| I <sub>I(hold)</sub>           |                           | V <sub>I</sub> = 0.7 V   | 2.3 V                   | 45                    |                    |      | μA   |
|                                |                           | V <sub>I</sub> = 1.7 V   | 2.3 V                   | -45                   |                    |      |      |
|                                |                           | V <sub>I</sub> = 0.8 V   | 3 V                     | 75                    |                    |      |      |
|                                |                           | V <sub>I</sub> = 2 V   | 3 V                     | -75                   |                    |      |      |
|                                |                           | V <sub>I</sub> = 0 to 3.6 V <sup>(2)</sup>                                   | 3.6 V                   |                       |                    | ±500 |      |
| I <sub>OH</sub>                | YERR output               | V <sub>O</sub> = V <sub>CC</sub>   | 0 to 3.6 V              |                       |                    | ±10  | μA   |
| I <sub>OZ</sub> <sup>(3)</sup> |                           | V <sub>O</sub> = V <sub>CC</sub> or GND                                      | 3.6 V                   |                       |                    | ±10  | μA   |
| I <sub>CC</sub>                |                           | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0                  | 3.6 V                   |                       |                    | 40   | μA   |
| ΔI <sub>CC</sub>               |                           | One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND | 3 V to 3.6 V            |                       |                    | 750  | μA   |
| C <sub>i</sub>                 | Control inputs            | V <sub>I</sub> = V <sub>CC</sub> or GND                                      | 3.3 V                   | 5.5                   |                    |      | pF   |
|                                | Data inputs               |  |                         | 5.5                   |                    |      |      |
| C <sub>o</sub>                 | YERR output               | V <sub>O</sub> = V <sub>CC</sub> or GND                                      | 3.3 V                   | 5                     |                    |      | pF   |
|                                | Data outputs              |  |                         | 6                     |                    |      |      |
| C <sub>io</sub>                | PARI/O                    | V <sub>O</sub> = V <sub>CC</sub> or GND                                      | 3.3 V                   | 7                     |                    |      | pF   |

 (1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

 (3) For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

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**TIMING REQUIREMENTS**

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1 and Figure 4)

|   |                                |   |               | $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ |      | $V_{CC} = 2.7\text{ V}$ |     | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ |     | UNIT |
|---|--------------------------------|---|---------------|--|------|-------------------------|-----|--|-----|------|
|   |                                |   |               | MIN                                      | MAX  | MIN                     | MAX | MIN                                      | MAX |      |
| $f_{\text{clock}}$                              | Clock frequency                |   |               | 125                                      |      | 125                     |     | 125                                      |     | MHz  |
| $t_w$   | Pulse duration, CLK $\uparrow$ |   |               | 3  |      | 3                       |     | 3  |     | ns   |
| $t_{\text{su}}$                                 | Setup time                     | 1A–12A before CLK $\uparrow$                        | Register mode | 1.7                                      | 1.9  | 1.45                    |     |  | ns  |      |
|   |                                | 1A–10A before CLK $\uparrow$                        | Buffer mode   | 5.9                                      | 5.2  | 4.4                     |     |  |     |      |
|   |                                | APAR before CLK $\uparrow$                          | Register mode | 1.2                                      | 1.5  | 1.3                     |     |  |     |      |
|   |                                |   | Buffer mode   | 4.6                                      | 3.6  | 3.1                     |     |  |     |      |
|   |                                | PARI/O before CLK $\uparrow$                        | Both modes    | 2.4                                      | 2    | 1.7                     |     |  |     |      |
|   |                                | 11A/ $\overline{\text{YERR}}$ before CLK $\uparrow$ | Buffer mode   | 2  | 1.9  | 1.6                     |     |  |     |      |
| $\overline{\text{CLKEN}}$ before CLK $\uparrow$ | Register mode                  | 2.5   | 2.6           | 2.2                                      |      |                         |     |  |     |      |
| $t_h$   | Hold time                      | 1A–12A after CLK $\uparrow$                         | Register mode | 0.4                                      | 0.25 | 0.55                    |     |  | ns  |      |
|   |                                | 1A–10A after CLK $\uparrow$                         | Buffer mode   | 0.25                                     | 0.25 | 0.25                    |     |  |     |      |
|   |                                | APAR after CLK $\uparrow$                           | Register mode | 0.7                                      | 0.4  | 0.7                     |     |  |     |      |
|   |                                |   | Buffer mode   | 0.25                                     | 0.25 | 0.25                    |     |  |     |      |
|   |                                | PARI/O after CLK $\uparrow$                         | Register mode | 0.25                                     | 0.25 | 0.4                     |     |  |     |      |
|   |                                |   | Buffer mode   | 0.25                                     | 0.25 | 0.5                     |     |  |     |      |
|   |                                | 11A/ $\overline{\text{YERR}}$ after CLK $\uparrow$  | Buffer mode   | 0.25                                     | 0.25 | 0.4                     |     |  |     |      |
| $\overline{\text{CLKEN}}$ after CLK $\uparrow$  | Register mode                  | 0.25  | 0.5           | 0.4                                      |      |                         |     |  |     |      |

**SWITCHING CHARACTERISTICS**

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 and Figure 4)

| PARAMETER             |               | FROM (INPUT)              | TO (OUTPUT)              | $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ |     | $V_{CC} = 2.7\text{ V}$ |     | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ |     | UNIT |
|-----------------------|---------------|---------------------------|--------------------------|--|-----|-------------------------|-----|--|-----|------|
|                       |               |                           |                          | MIN                                      | MAX | MIN                     | MAX | MIN                                      | MAX |      |
| $f_{\text{max}}$      |               |                           |                          | 125                                      |     | 125                     |     | 125                                      |     | MHz  |
| $t_{\text{pd}}$       | Buffer mode   | A                         | Y                        | 1  | 4.4 | 4.2                     | 1.1 | 3.8                                      | ns  |      |
|                       | Both modes    | CLK                       | $\overline{\text{YERR}}$ | 1  | 5.7 | 4.9                     | 1.4 | 4.4                                      |     |      |
| $t_{\text{pd}}^{(1)}$ | Both modes    |                           | CLK                      | PARI/O                                   | 1   | 6.8                     | 5.2 | 1.3                                      | 4.5 | ns   |
| $t_{\text{pd}}$       | Both modes    | MODE                      | Y                        | 1  | 5.9 | 5.8                     | 1.3 | 4.9                                      | ns  |      |
| $t_{\text{PLH}}$      | Register mode | CLK                       | Y                        | 1  | 6.1 | 5.5                     | 1.2 | 4.8                                      | ns  |      |
| $t_{\text{PHL}}$      |               |                           |                          | 1  | 5.9 | 4.9                     | 1.2 | 4.6                                      |     |      |
| $t_{\text{en}}$       | Both modes    | $\overline{\text{OE}}$    | Y                        | 1.1                                      | 6.5 | 6.4                     | 1.4 | 5.4                                      | ns  |      |
|                       |               | $\overline{\text{PAROE}}$ | PARI/O                   | 1  | 5.6 | 6                       | 1   | 4.8                                      |     |      |
| $t_{\text{dis}}$      | Both modes    | $\overline{\text{OE}}$    | Y                        | 1  | 6.4 | 5.2                     | 1.7 | 5  | ns  |      |
|                       |               | $\overline{\text{PAROE}}$ | PARI/O                   | 1  | 3.2 | 3.8                     | 1.2 | 3.8                                      |     |      |
| $t_{\text{PLH}}$      | Both modes    | $\overline{\text{OE}}$    | $\overline{\text{YERR}}$ | 1  | 3.6 | 4.2                     | 1.9 | 4  | ns  |      |
| $t_{\text{PHL}}$      |               |                           |                          | 1.2                                      | 5.1 | 4.9                     | 1.5 | 4.2                                      |     |      |

(1) See Figure 2 and Figure 5 for the load specification.

**SIMULTANEOUS SWITCHING CHARACTERISTICS<sup>(1)</sup>**

(see Figure 3 and Figure 6)

| PARAMETER |               | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ |     | $V_{CC} = 2.7\text{ V}$ |     | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ |     | UNIT |
|-----------|---------------|--------------|-------------|--|-----|-------------------------|-----|--|-----|------|
|           |               |              |             | MIN                                      | MAX | MIN                     | MAX | MIN                                      | MAX |      |
| $t_{PLH}$ | Register mode | CLK          | Y           | 1.8                                      | 6.5 | 6.1                     |     | 1.8                                      | 5   | ns   |
| $t_{PHL}$ |               |              |             | 1.4                                      | 5.9 | 5.1                     |     | 1.7                                      | 4.5 |      |

(1) All outputs switching

**OPERATING CHARACTERISTICS FOR BUFFER MODE**

$T_A = 25^\circ\text{C}$

| PARAMETER |                               |                  | TEST CONDITIONS                    | $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | UNIT |
|-----------|-------------------------------|------------------|------------------------------------|--|--|------|
|           |                               |                  |                                    | TYP                                      | TYP                                      |      |
| $C_{pd}$  | Power dissipation capacitance | Outputs enabled  | $C_L = 0, \quad f = 10\text{ MHz}$ | 57.5                                     | 65                                       | pF   |
|           |                               | Outputs disabled |                                    | 15                                       | 17.5                                     |      |

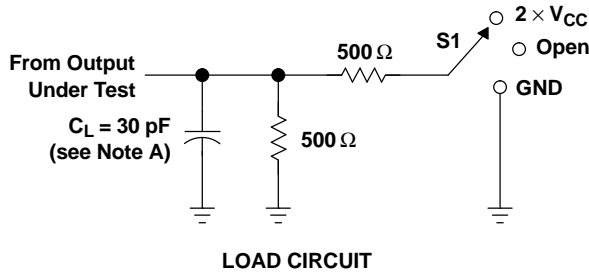
**OPERATING CHARACTERISTICS FOR REGISTER MODE**

$T_A = 25^\circ\text{C}$

| PARAMETER |                               |                  | TEST CONDITIONS                    | $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | UNIT |
|-----------|-------------------------------|------------------|------------------------------------|--|--|------|
|           |                               |                  |                                    | TYP                                      | TYP                                      |      |
| $C_{pd}$  | Power dissipation capacitance | Outputs enabled  | $C_L = 0, \quad f = 10\text{ MHz}$ | 57                                       | 87.5                                     | pF   |
|           |                               | Outputs disabled |                                    | 16.5                                     | 34                                       |      |

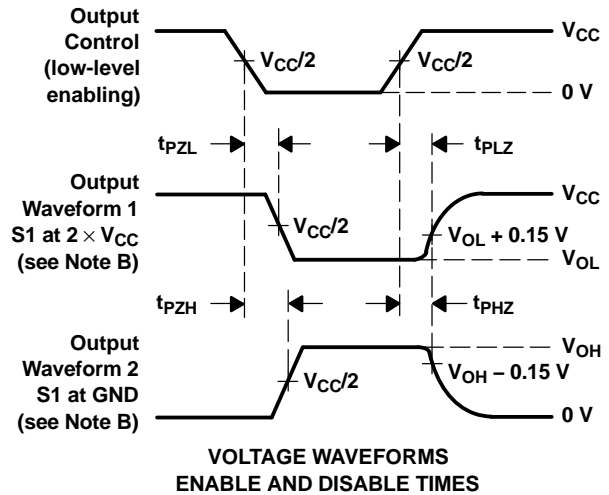
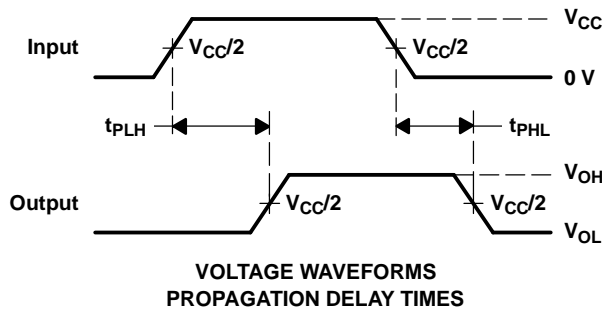
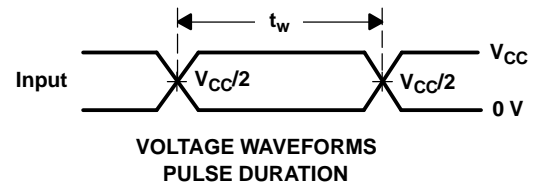
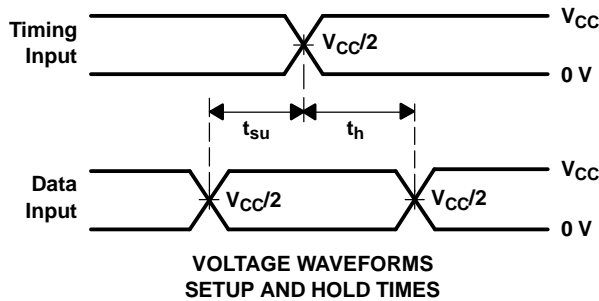
**PARAMETER MEASUREMENT INFORMATION**

$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$



| TEST              | S1                |
|-------------------|-------------------|
| $t_{pd}$          | Open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |

| YERR                   | S1                |
|------------------------|-------------------|
| $t_{PHL}$ (see Note H) | $2 \times V_{CC}$ |
| $t_{PLH}$ (see Note I) | $2 \times V_{CC}$ |

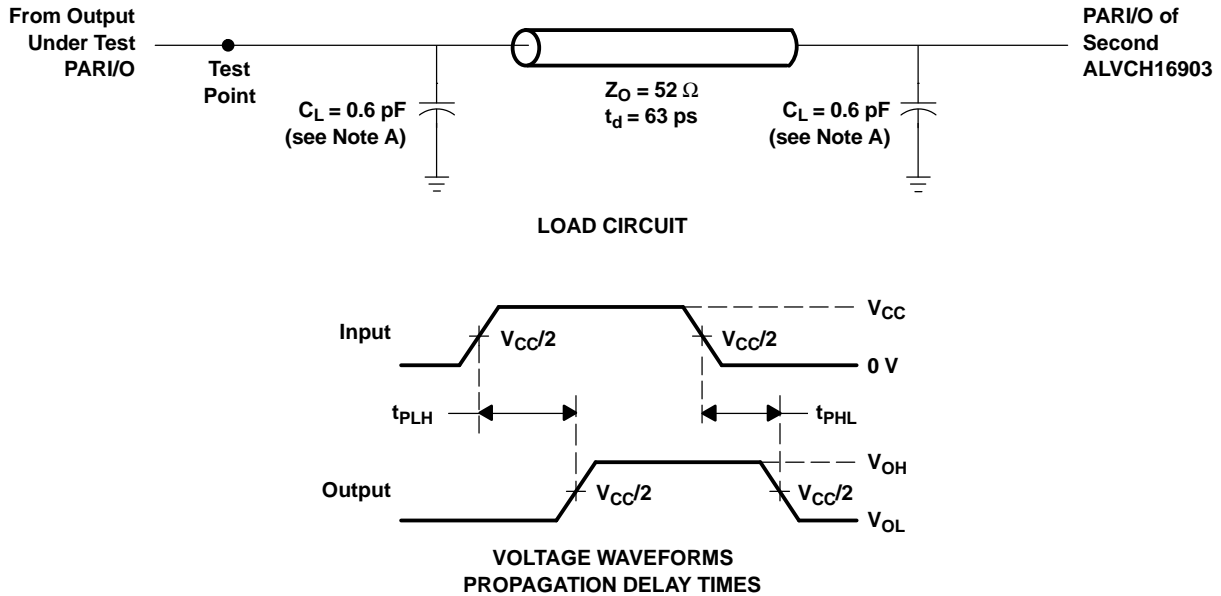


- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2\text{ ns}$ ,  $t_f \leq 2\text{ ns}$ .  
D. The outputs are measured one at a time, with one transition per measurement.  
E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .  
H.  $t_{PHL}$  is measured at  $V_{CC}/2$ .  
I.  $t_{PLH}$  is measured at  $V_{OL} + 0.15\text{ V}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

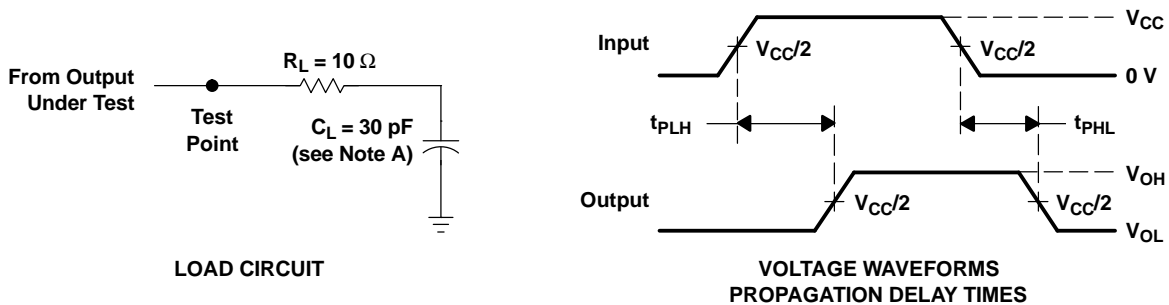


PARAMETER MEASUREMENT INFORMATION  
 $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2\text{ ns}$ ,  $t_f \leq 2\text{ ns}$ .  
C.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 2. Load Circuit and Voltage Waveforms

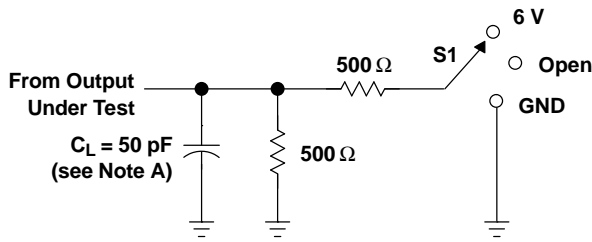


- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2\text{ ns}$ ,  $t_f \leq 2\text{ ns}$ .

Figure 3. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$

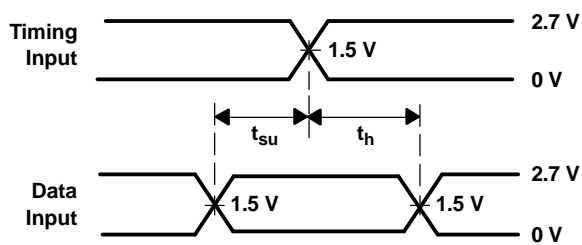


LOAD CIRCUIT

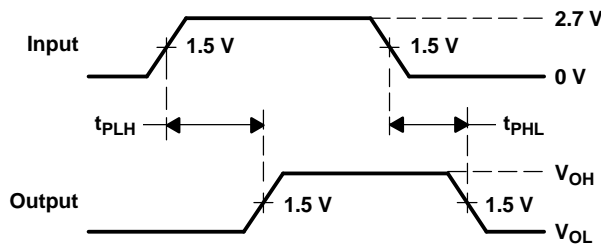
| TEST              | S1   |
|-------------------|------|
| $t_{pd}$          | Open |
| $t_{PLZ}/t_{PZL}$ | 6 V  |
| $t_{PHZ}/t_{PZH}$ | GND  |

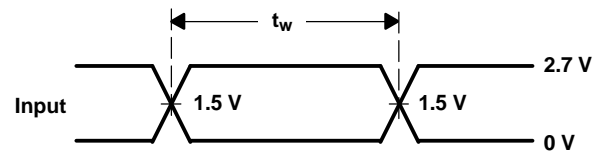
| $\overline{YERR}$      | S1  |
|------------------------|-----|
| $t_{PHL}$ (see Note H) | 6 V |
| $t_{PLH}$ (see Note I) | 6 V |



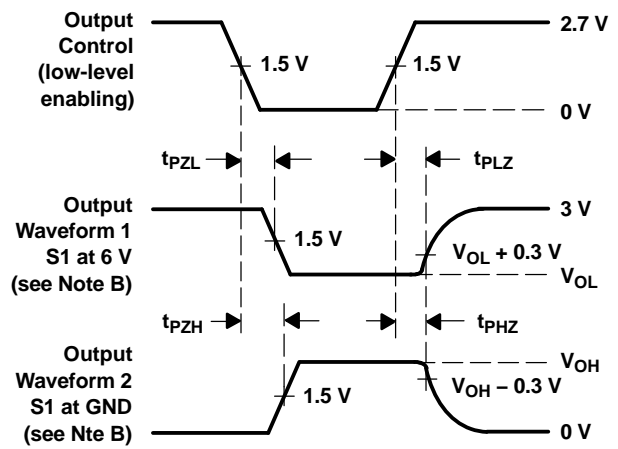
VOLTAGE WAVEFORMS  
 SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
 PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS  
 PULSE DURATION

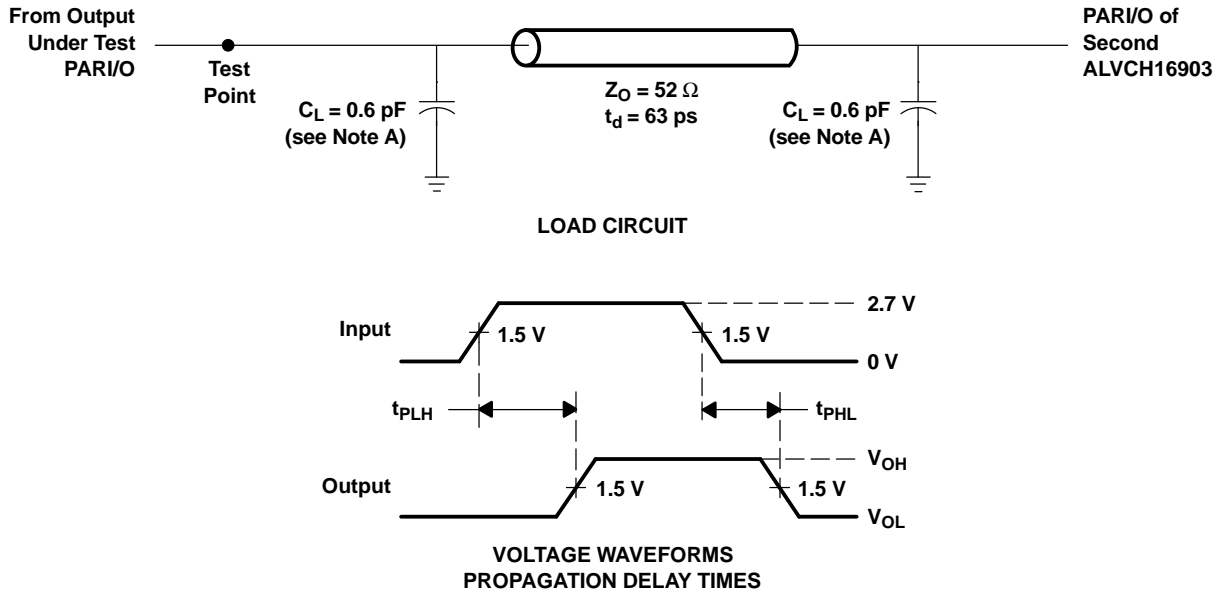


VOLTAGE WAVEFORMS  
 ENABLE AND DISABLE TIMES

- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2.5\text{ ns}$ ,  $t_f \leq 2.5\text{ ns}$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - $t_{PHL}$  is measured at 1.5 V.
  - $t_{PLH}$  is measured at  $V_{OL} + 0.3\text{ V}$ .

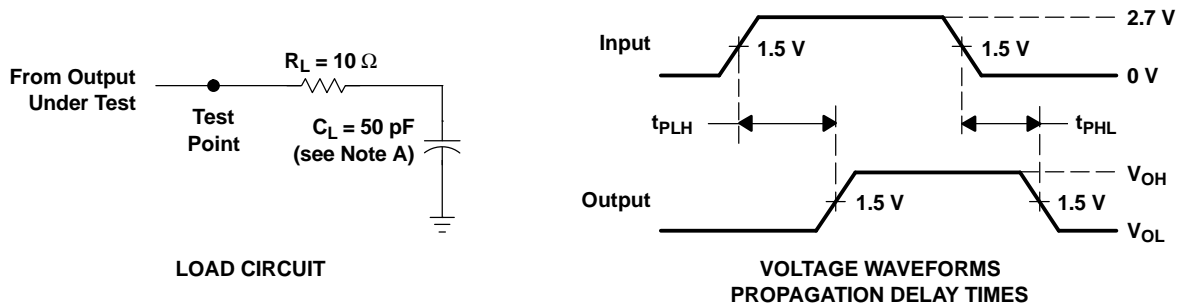
Figure 4. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION  
 $V_{CC} = 2.7\text{ V}$  AND  $3.3\text{ V} \pm 0.3\text{ V}$



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2.5\text{ ns}$ ,  $t_f \leq 2.5\text{ ns}$ .  
C.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 5. Load Circuit and Voltage Waveforms



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2.5\text{ ns}$ ,  $t_f \leq 2.5\text{ ns}$ .

Figure 6. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device   | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|--------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 74ALVCH16903DGGRE4 | ACTIVE                | TSSOP        | DGG             | 56   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ALVCH16903DGGRG4 | ACTIVE                | TSSOP        | DGG             | 56   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ALVCH16903DGVRE4 | ACTIVE                | TVSOP        | DGV             | 56   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ALVCH16903DGVRG4 | ACTIVE                | TVSOP        | DGV             | 56   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ALVCH16903DLG4   | ACTIVE                | SSOP         | DL              | 56   | 20          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ALVCH16903DLRG4  | ACTIVE                | SSOP         | DL              | 56   | 1000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALVCH16903DGGR | ACTIVE                | TSSOP        | DGG             | 56   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALVCH16903DGVR | ACTIVE                | TVSOP        | DGV             | 56   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALVCH16903DL   | ACTIVE                | SSOP         | DL              | 56   | 20          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALVCH16903DLR  | ACTIVE                | SSOP         | DL              | 56   | 1000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74ALVCH16903DGGR | TSSOP        | DGG             | 56   | 2000 | 330.0              | 24.4               | 8.6     | 15.6    | 1.8     | 12.0    | 24.0   | Q1            |
| SN74ALVCH16903DGVR | TVSOP        | DGV             | 56   | 2000 | 330.0              | 24.4               | 6.8     | 11.7    | 1.6     | 12.0    | 24.0   | Q1            |
| SN74ALVCH16903DLR  | SSOP         | DL              | 56   | 1000 | 330.0              | 32.4               | 11.35   | 18.67   | 3.1     | 16.0    | 32.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**



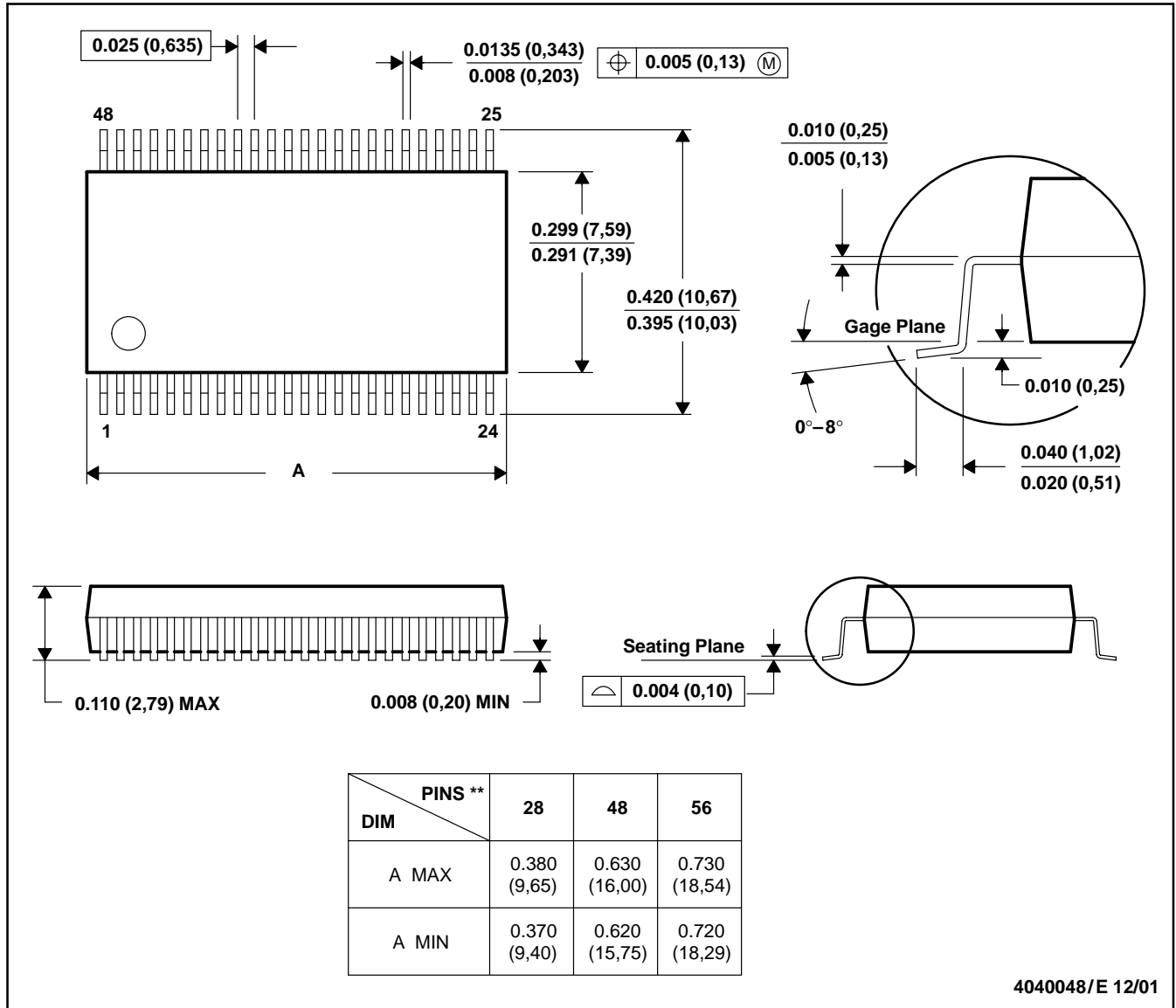
\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74ALVCH16903DGGR | TSSOP        | DGG             | 56   | 2000 | 346.0       | 346.0      | 41.0        |
| SN74ALVCH16903DGVR | TVSOP        | DGV             | 56   | 2000 | 346.0       | 346.0      | 41.0        |
| SN74ALVCH16903DLR  | SSOP         | DL              | 56   | 1000 | 346.0       | 346.0      | 49.0        |

DL (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

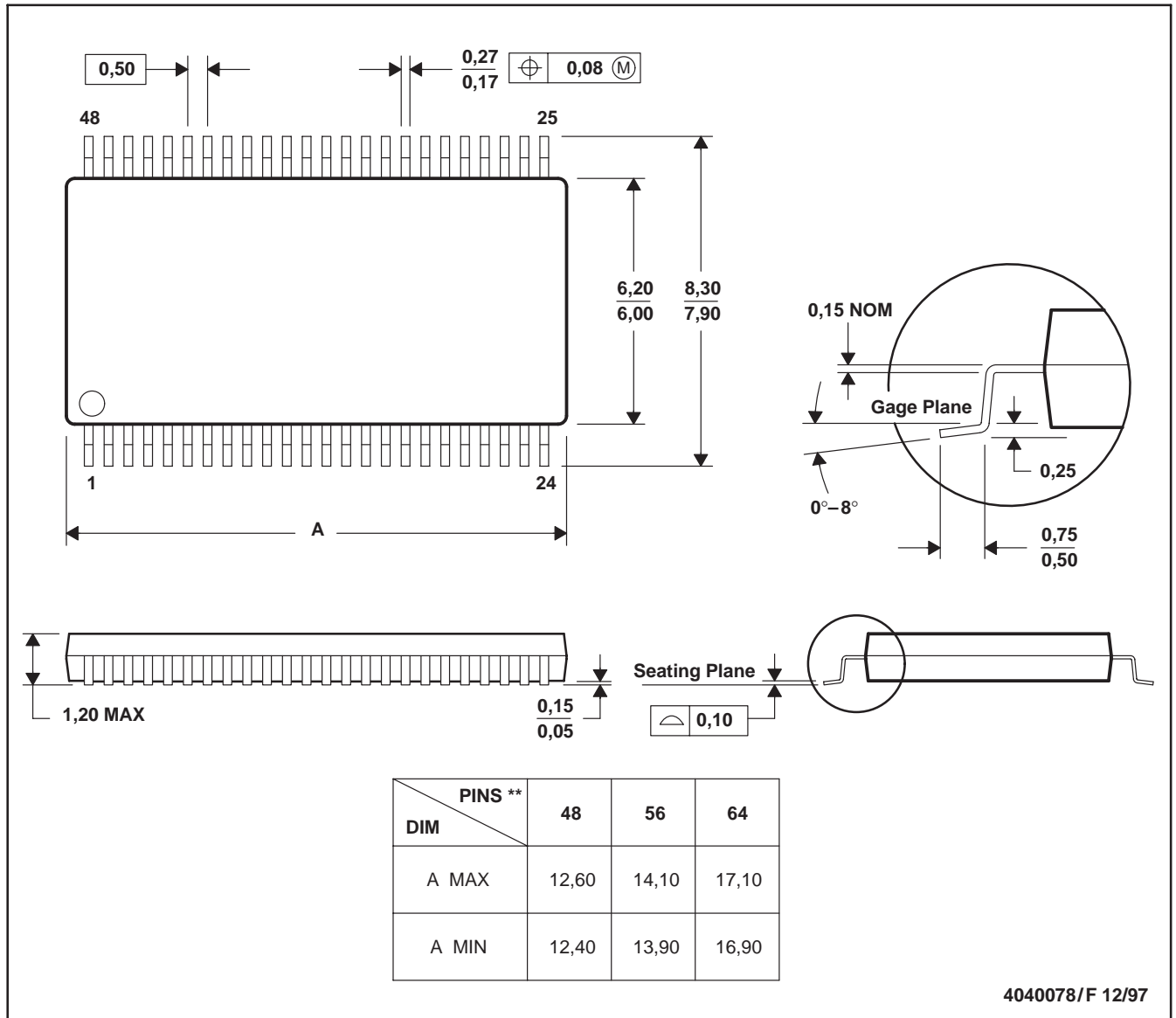


- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MO-118

DGG (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153



DGV (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



4073251/E 08/00

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

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