

SN54AHC16373, SN74AHC16373
16-BIT TRANSPARENT D-TYPE LATCHES
WITH 3-STATE OUTPUTS

SCLS329G – MARCH 1996 – REVISED JANUARY 2000

- **Members of the Texas Instruments Widebus™ Family**
- **EPIC™ (Enhanced-Performance Implanted CMOS) Process**
- **Operating Range 2-V to 5.5-V V_{CC}**
- **Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Package Options Include Plastic Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), and Thin Very Small-Outline (DGV) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

description

The 'AHC16373 devices are 16-bit transparent D-type latches with 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

These devices can be used as two 8-bit latches or one 16-bit latch. When the latch-enable (LE) input is high, the Q outputs follow the data (D) inputs. When LE is taken low, the Q outputs are latched at the levels at the D inputs.

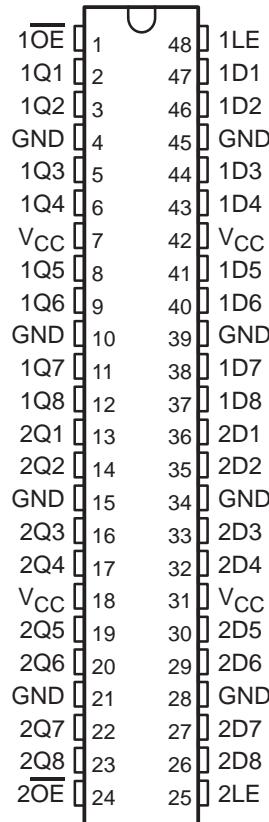
A buffered output-enable (\overline{OE}) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased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

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.

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

The SN54AHC16373 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74AHC16373 is characterized for operation from -40°C to 85°C .

SN54AHC16373 . . . WD PACKAGE
SN74AHC16373 . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)



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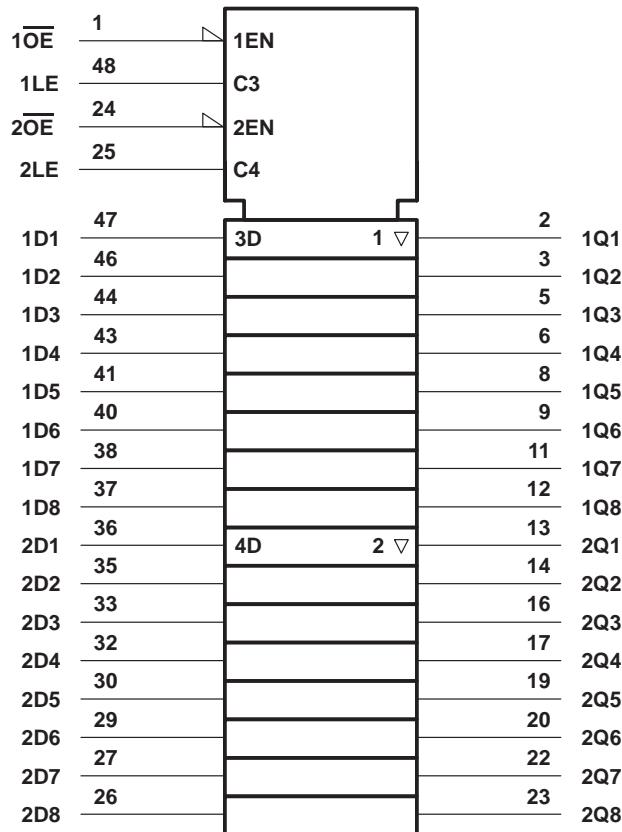
**SN54AHC16373, SN74AHC16373
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FUNCTION TABLE
(each 8-bit latch)

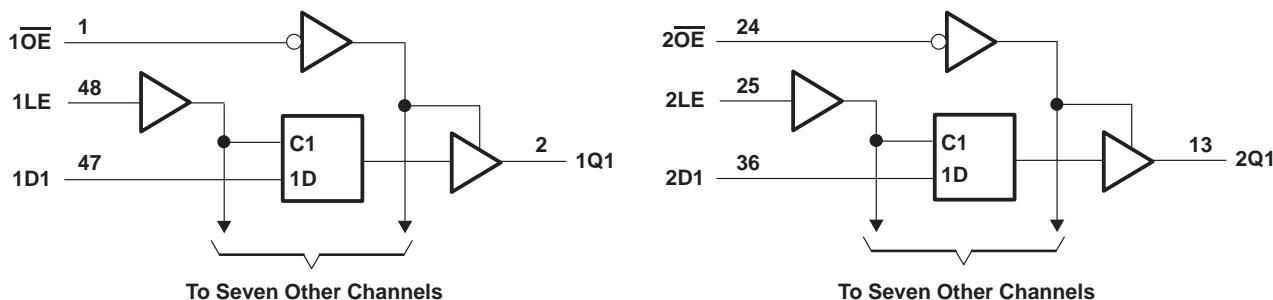
| INPUTS | | | OUTPUT |
|-----------------|----|---|--------|
| \overline{OE} | LE | D | Q |
| L | H | H | H |
| L | H | L | L |
| L | L | X | Q_0 |
| H | X | X | Z |

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



SN54AHC16373, SN74AHC16373 16-BIT TRANSPARENT D-TYPE LATCHES WITH 3-STATE OUTPUTS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

† 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.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 3)

| | | SN54AHC16373 | | SN74AHC16373 | | UNIT |
|-----------------|------------------------------------|---------------------------------|-----------------|--------------|-----------------|------|
| | | MIN | MAX | MIN | MAX | |
| V _{CC} | Supply voltage | 2 | 5.5 | 2 | 5.5 | V |
| V _{IH} | High-level input voltage | V _{CC} = 2 V | 1.5 | 1.5 | 1.5 | V |
| | | V _{CC} = 3 V | 2.1 | 2.1 | 2.1 | |
| | | V _{CC} = 5.5 V | 3.85 | 3.85 | 3.85 | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | 0.5 | 0.5 | 0.5 | V |
| | | V _{CC} = 3 V | 0.9 | 0.9 | 0.9 | |
| | | V _{CC} = 5.5 V | 1.65 | 1.65 | 1.65 | |
| V _I | Input voltage | 0 | 5.5 | 0 | 5.5 | V |
| V _O | Output voltage | 0 | V _{CC} | 0 | V _{CC} | V |
| I _{OH} | High-level output current | V _{CC} = 2 V | -50 | -50 | -50 | µA |
| | | V _{CC} = 3.3 V ± 0.3 V | -4 | -4 | -4 | mA |
| | | V _{CC} = 5 V ± 0.5 V | -8 | -8 | -8 | |
| I _{OL} | Low-level output current | V _{CC} = 2 V | 50 | 50 | 50 | µA |
| | | V _{CC} = 3.3 V ± 0.3 V | 4 | 4 | 4 | mA |
| | | V _{CC} = 5 V ± 0.5 V | 8 | 8 | 8 | |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 3.3 V ± 0.3 V | 100 | 100 | 100 | ns/V |
| | | V _{CC} = 5 V ± 0.5 V | 20 | 20 | 20 | |
| T _A | Operating free-air temperature | -55 | 125 | -40 | 85 | °C |

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



**SN54AHC16373, SN74AHC16373
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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | V _{CC} | T _A = 25°C | | | SN54AHC16373 | | SN74AHC16373 | | UNIT |
|-----------------|---|-----------------|-----------------------|-------|-----|--------------|-----|--------------|-----|------|
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | I _{OH} = -50 µA | 2 V | 1.9 | | | 1.9 | | 1.9 | | V |
| | | 3 V | 2.9 | | | 2.9 | | 2.9 | | |
| | | 4.5 V | 4.4 | | | 4.4 | | 4.4 | | |
| | I _{OH} = -4 mA | 3 V | 2.58 | | | 2.48 | | 2.48 | | |
| | I _{OH} = -8 mA | 4.5 V | 3.94 | | | 3.8 | | 3.8 | | |
| V _{OL} | I _{OL} = 50 µA | 2 V | | 0.1 | | 0.1 | | 0.1 | | V |
| | | 3 V | | 0.1 | | 0.1 | | 0.1 | | |
| | | 4.5 V | | 0.1 | | 0.1 | | 0.1 | | |
| | I _{OL} = 4 mA | 3 V | | 0.36 | | 0.5 | | 0.44 | | |
| | I _{OL} = 8 mA | 4.5 V | | 0.36 | | 0.5 | | 0.44 | | |
| I _I | V _I = V _{CC} or GND | 0 V to 5.5 V | | ±0.1 | | ±1* | | ±1 | µA | |
| I _{OZ} | V _O = V _{CC} or GND, V _I = V _{IL} or V _{IH} | 5.5 V | | ±0.25 | | ±2.5 | | ±2.5 | µA | |
| I _{CC} | V _I = V _{CC} or GND, I _O = 0 | 5.5 V | | 4 | | 40 | | 40 | µA | |
| C _i | V _I = V _{CC} or GND | 5 V | 2.5 | 10 | | | | 10 | pF | |
| C _o | V _O = V _{CC} or GND | 5 V | 4 | | | | | | pF | |

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.

timing requirements over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

| | | T _A = 25°C | | SN54AHC16373 | | SN74AHC16373 | | UNIT |
|-----------------|-----------------------------|-----------------------|-----|--------------|-----|--------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _w | Pulse duration, LE high | 5 | | 5 | | 5 | | ns |
| t _{su} | Setup time, data before LE↓ | 4 | | 4 | | 4 | | ns |
| t _h | Hold time, data after LE↓ | 1 | | 1 | | 1 | | ns |

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

| | | T _A = 25°C | | SN54AHC16373 | | SN74AHC16373 | | UNIT |
|-----------------|-----------------------------|-----------------------|-----|--------------|-----|--------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _w | Pulse duration, LE high | 5 | | 5 | | 5 | | ns |
| t _{su} | Setup time, data before LE↓ | 4 | | 4 | | 4 | | ns |
| t _h | Hold time, data after LE↓ | 1 | | 1 | | 1 | | ns |

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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | TA = 25°C | | | SN54AHC16373 | | SN74AHC16373 | | UNIT |
|--------------------|-----------------|----------------|------------------------|-----------|-------|-----|--------------|-----|--------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| t _{PLH} | D | Q | C _L = 15 pF | 7.3* | 13* | 1* | 15* | 1 | 15 | 1 | ns |
| t _{PHL} | | | | 7.3* | 13* | 1* | 15* | 1 | 15 | 1 | |
| t _{PLH} | LE | Q | C _L = 15 pF | 7* | 13* | 1* | 15* | 1 | 15 | 1 | ns |
| t _{PHL} | | | | 7* | 13* | 1** | 15* | 1 | 15 | 1 | |
| t _{PZH} | \overline{OE} | Q | C _L = 15 pF | 7.3* | 13* | 1* | 15* | 1 | 15 | 1 | ns |
| t _{PZL} | | | | 7.3* | 13* | 1* | 15* | 1 | 15 | 1 | |
| t _{PHZ} | \overline{OE} | Q | C _L = 15 pF | 10* | 14* | 1* | 16* | 1 | 16 | 1 | ns |
| t _{PLZ} | | | | 10* | 14* | 1* | 16* | 1 | 16 | 1 | |
| t _{PLH} | D | Q | C _L = 50 pF | 9.8 | 14 | 1 | 16 | 1 | 16 | 1 | ns |
| t _{PHL} | | | | 9.8 | 14 | 1 | 16 | 1 | 16 | 1 | |
| t _{PLH} | LE | Q | C _L = 50 pF | 9.5 | 14.5 | 1 | 16.5 | 1 | 16.5 | 1 | ns |
| t _{PHL} | | | | 9.5 | 14.5 | 1 | 16.5 | 1 | 16.5 | 1 | |
| t _{PZH} | \overline{OE} | Q | C _L = 50 pF | 9.3 | 14.9 | 1 | 16 | 1 | 16 | 1 | ns |
| t _{PZL} | | | | 8 | 14.9 | 1 | 16 | 1 | 16 | 1 | |
| t _{PHZ} | \overline{OE} | Q | C _L = 50 pF | 10.4 | 15.5 | 1 | 17 | 1 | 17 | 1 | ns |
| t _{PLZ} | | | | 11.6 | 15.5 | 1 | 17 | 1 | 17 | 1 | |
| t _{sk(o)} | | | C _L = 50 pF | | 1.5** | | | | | 1.5 | ns |

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

** On products compliant to MIL-PRF-38535, this parameter does not apply.

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | TA = 25°C | | | SN54AHC16373 | | SN74AHC16373 | | UNIT |
|--------------------|-----------------|----------------|------------------------|-----------|------|-----|--------------|-----|--------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| t _{PLH} | D | Q | C _L = 15 pF | 5* | 8.2* | 1* | 9.5* | 1 | 9.5 | 1 | ns |
| t _{PHL} | | | | 5* | 8.2* | 1* | 9.5* | 1 | 9.5 | 1 | |
| t _{PLH} | LE | Q | C _L = 15 pF | 4.9* | 8.5* | 1* | 9.5* | 1 | 9.5 | 1 | ns |
| t _{PHL} | | | | 4.9* | 8.5* | 1* | 9.5* | 1 | 9.5 | 1 | |
| t _{PZH} | \overline{OE} | Q | C _L = 15 pF | 5.5* | 9.1* | 1* | 10* | 1 | 10 | 1 | ns |
| t _{PZL} | | | | 5.5* | 9.1* | 1* | 10* | 1 | 10 | 1 | |
| t _{PHZ} | \overline{OE} | Q | C _L = 15 pF | 5* | 9.5* | 1* | 10* | 1 | 10 | 1 | ns |
| t _{PLZ} | | | | 5* | 9.5* | 1* | 10* | 1 | 10 | 1 | |
| t _{PLH} | D | Q | C _L = 50 pF | 6.5 | 9.2 | 1 | 10.5 | 1 | 10.5 | 1 | ns |
| t _{PHL} | | | | 6.5 | 9.2 | 1 | 10.5 | 1 | 10.5 | 1 | |
| t _{PLH} | LE | Q | C _L = 50 pF | 6.4 | 9.5 | 1 | 10.5 | 1 | 10.5 | 1 | ns |
| t _{PHL} | | | | 6.4 | 9.5 | 1 | 10.5 | 1 | 10.5 | 1 | |
| t _{PZH} | \overline{OE} | Q | C _L = 50 pF | 6 | 10.1 | 1 | 11.5 | 1 | 11.5 | 1 | ns |
| t _{PZL} | | | | 6 | 10.1 | 1 | 11.5 | 1 | 11.5 | 1 | |
| t _{PHZ} | \overline{OE} | Q | C _L = 50 pF | 6.5 | 10.5 | 1 | 11.5 | 1 | 11.5 | 1 | ns |
| t _{PLZ} | | | | 7.5 | 10.5 | 1 | 11.5 | 1 | 11.5 | 1 | |
| t _{sk(o)} | | | C _L = 50 pF | | 1** | | | | | 1 | ns |

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

** On products compliant to MIL-PRF-38535, this parameter does not apply.

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 **TEXAS
INSTRUMENTS**

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noise characteristics, $V_{CC} = 5$ V, $C_L = 50$ pF, $T_A = 25^\circ\text{C}$ (see Note 4)

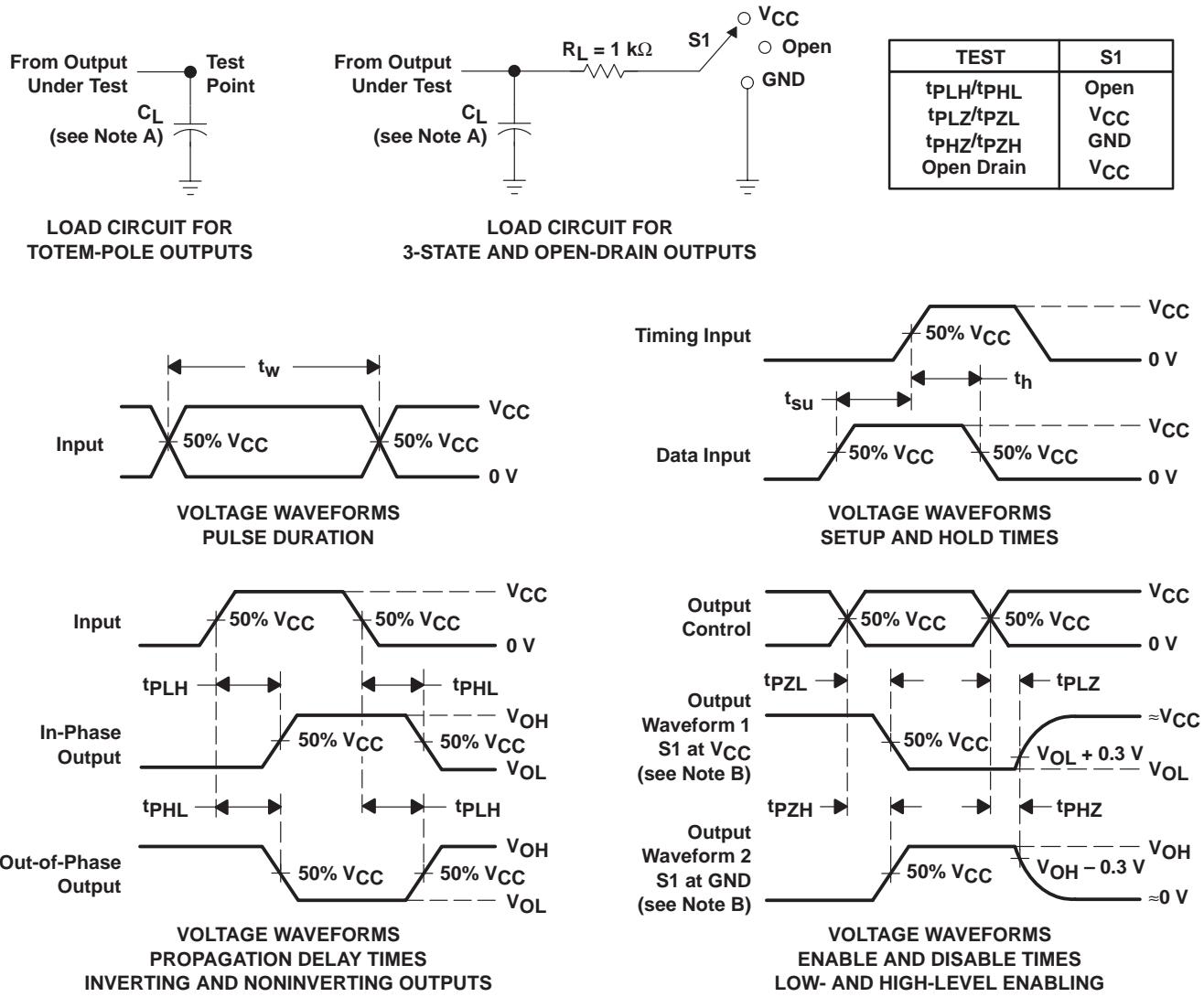
| PARAMETER | SN74AHC16373 | | | UNIT |
|--|--------------|------|-----|------|
| | MIN | TYP | MAX | |
| $V_{OL(P)}$ Quiet output, maximum dynamic V_{OL} | 0.34 | 0.8 | | V |
| $V_{OL(V)}$ Quiet output, minimum dynamic V_{OL} | –0.1 | –0.8 | | V |
| $V_{OH(V)}$ Quiet output, minimum dynamic V_{OH} | 4.6 | | | V |
| $V_{IH(D)}$ High-level dynamic input voltage | 3.5 | | | V |
| $V_{IL(D)}$ Low-level dynamic input voltage | | 1.5 | | V |

NOTE 4: Characteristics are for surface-mount packages only.

operating characteristics, $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | TYP | UNIT |
|--|----------------------|-----|------|
| C_{pd} Power dissipation capacitance | No load, $f = 1$ MHz | 21 | pF |

PARAMETER MEASUREMENT INFORMATION



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: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 3 \text{ ns}$, $t_f \leq 3 \text{ ns}$.
- The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 74AHC16373DGGRE4 | ACTIVE | TSSOP | DGG | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| 74AHC16373DGGRG4 | ACTIVE | TSSOP | DGG | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| 74AHC16373DGVRE4 | ACTIVE | TVSOP | DGV | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| 74AHC16373DGVRG4 | ACTIVE | TVSOP | DGV | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AHC16373DGGR | ACTIVE | TSSOP | DGG | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AHC16373DGVR | ACTIVE | TVSOP | DGV | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AHC16373DL | ACTIVE | SSOP | DL | 48 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AHC16373DLG4 | ACTIVE | SSOP | DL | 48 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AHC16373DLR | ACTIVE | SSOP | DL | 48 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AHC16373DLRG4 | ACTIVE | SSOP | DL | 48 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

⁽¹⁾ 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.

⁽²⁾ 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.

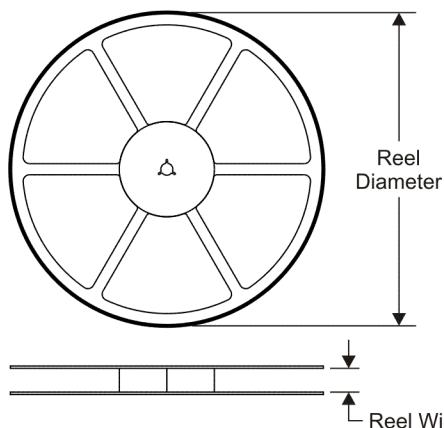
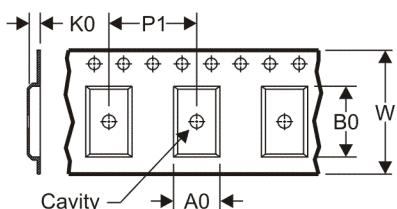
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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)

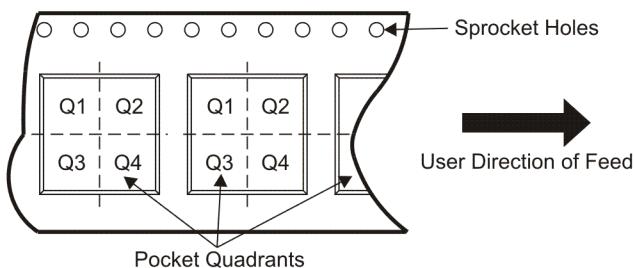
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


| | |
|----|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AHC16373DGGR | TSSOP | DGG | 48 | 2000 | 330.0 | 24.4 | 8.6 | 15.8 | 1.8 | 12.0 | 24.0 | Q1 |
| SN74AHC16373DGVR | TVSOP | DGV | 48 | 2000 | 330.0 | 16.4 | 7.1 | 10.2 | 1.6 | 12.0 | 16.0 | Q1 |
| SN74AHC16373DLR | SSOP | DL | 48 | 1000 | 330.0 | 32.4 | 11.35 | 16.2 | 3.1 | 16.0 | 32.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS

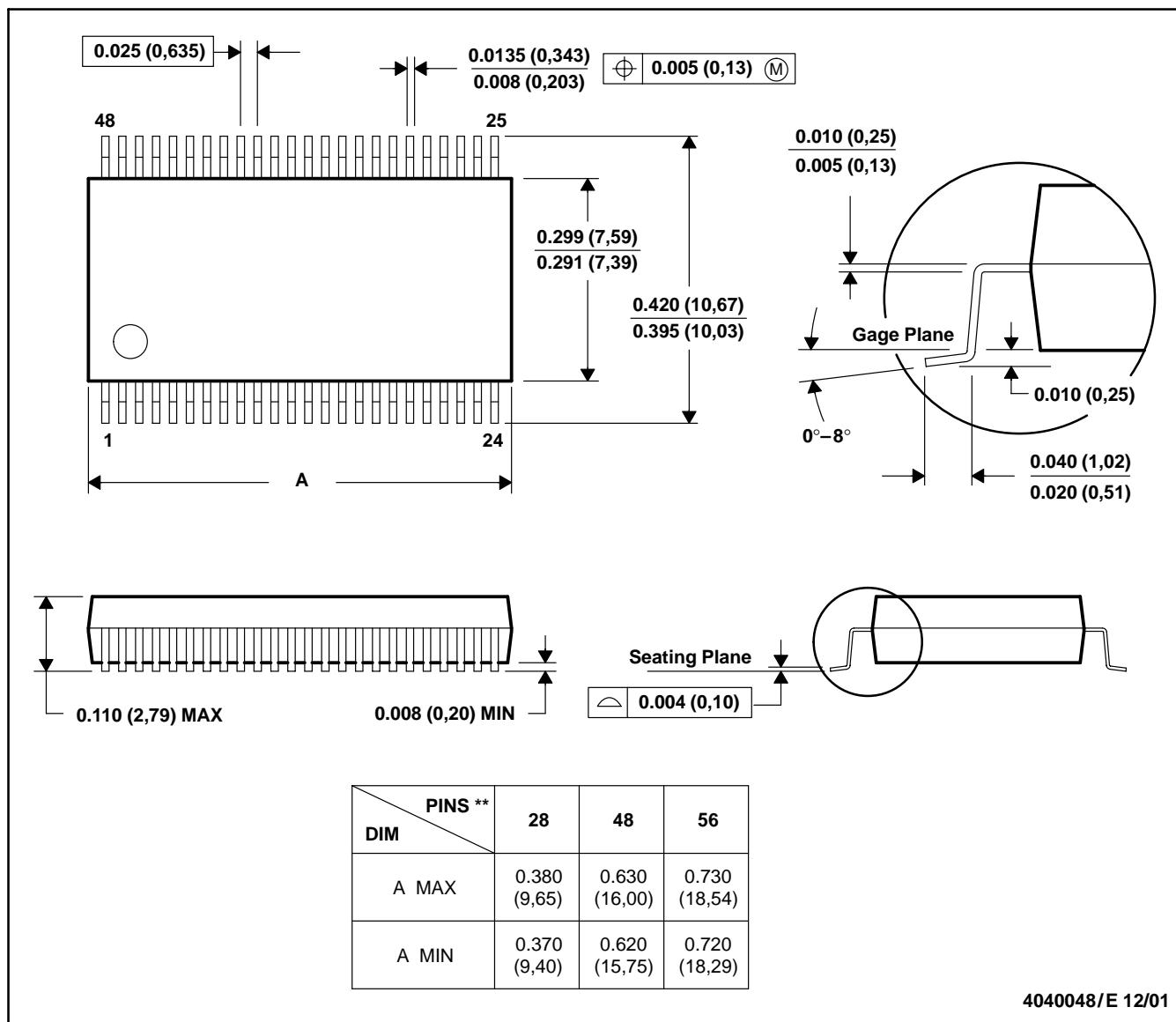

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AHC16373DGGR | TSSOP | DGG | 48 | 2000 | 346.0 | 346.0 | 41.0 |
| SN74AHC16373DGVR | TVSOP | DGV | 48 | 2000 | 346.0 | 346.0 | 33.0 |
| SN74AHC16373DLR | SSOP | DL | 48 | 1000 | 346.0 | 346.0 | 49.0 |

DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

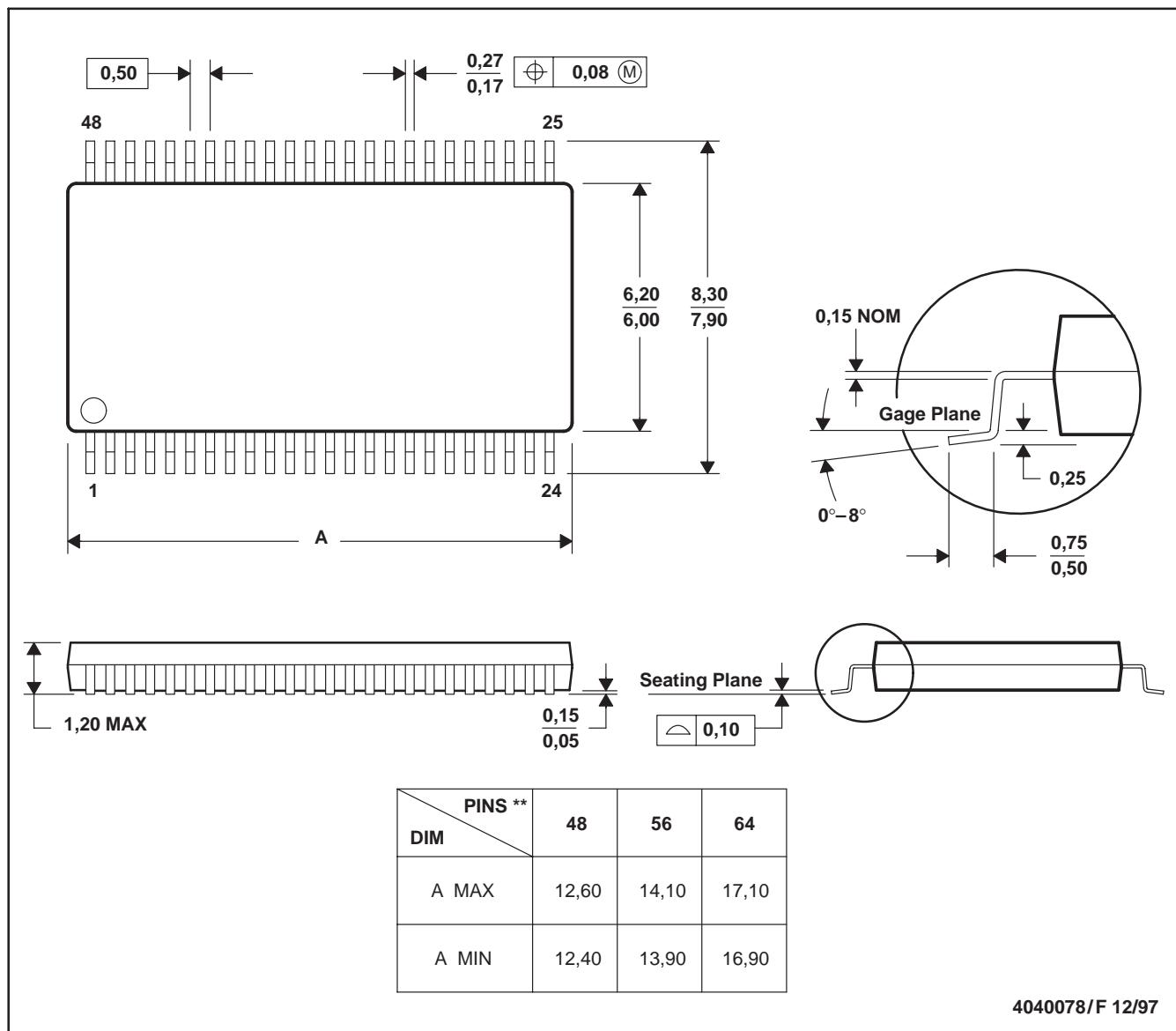


NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MO-118

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



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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