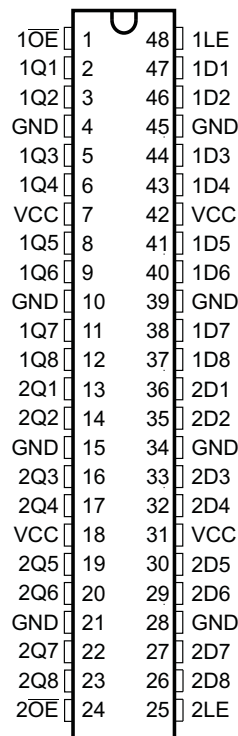


FEATURES

- Controlled Baseline
 - One Assembly/Test Site, One Fabrication Site
- Extended Temperature Performance of -55°C to 125°C
- Enhanced Diminishing Manufacturing Sources (DMS) Support
- Enhanced Product-Change Notification
- Qualification Pedigree ⁽¹⁾
- Member of the Texas Instruments Widebus™ Family
- Output Ports Have Equivalent $22\text{-}\Omega$ Series Resistors, So No External Resistors Are Required
- Supports Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})
- Supports Unregulated Battery Operation Down to 2.7 V
- Typical V_{OLP} (Output Ground Bounce) $<0.8\text{ V}$ at $V_{\text{CC}} = 3.3\text{ V}$, $T_{\text{A}} = 25^{\circ}\text{C}$
- I_{off} and Power-Up 3-State Support Hot Insertion
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Latch-Up Performance Exceeds 500 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

DL PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The SN74LVTH162373 is a 16-bit transparent D-type latch with 3-state outputs designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment. This device is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

ORDERING INFORMATION

| T_{A} | PACKAGE ⁽¹⁾ | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|--|----------------------------|-----------------------|------------------|
| -55°C to 125°C | SSOP – DL Tape and reel | CLVTH162373MDLREP | LVTH162373EP |

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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SN74LVTH162373-EP

3.3-V ABT 16-BIT TRANSPARENT D-TYPE LATCH WITH 3-STATE OUTPUTS

SCBS811A–JULY 2006–REVISED JULY 2006

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

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 a 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 interface or pullup components.

\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 outputs, which are designed to source or sink up to 12 mA, include equivalent 22- Ω series resistors to reduce overshoot and undershoot.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

When V_{CC} is between 0 and 1.5 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, \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.

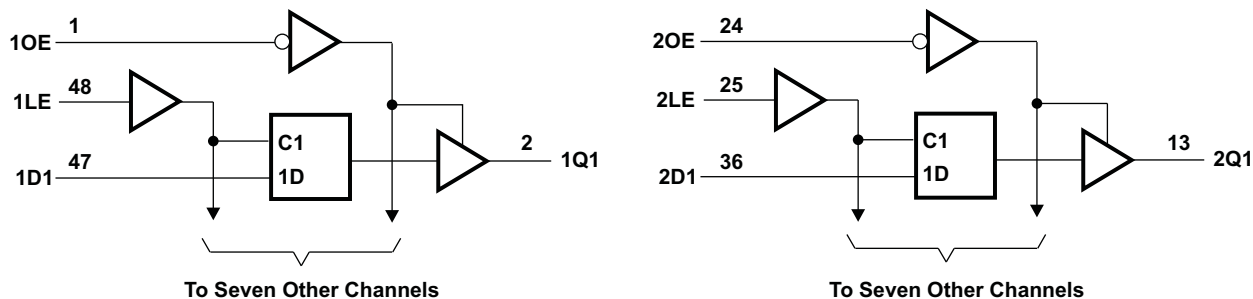
This device is fully specified for hot-insertion applications using I_{off} and power-up 3-state. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

This device 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 set up at the D inputs.

**FUNCTION TABLE
(EACH 8-BIT SECTION)**

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

LOGIC DIAGRAM (POSITIVE LOGIC)



Absolute Maximum Ratings⁽¹⁾

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

| | | MIN | MAX | UNIT |
|---------------|---|-----------|----------------|------|
| V_{CC} | Supply voltage range | –0.5 | 4.6 | V |
| V_I | Input voltage range ⁽²⁾ | –0.5 | 7 | V |
| V_O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | –0.5 | 7 | V |
| V_O | Voltage range applied to any output in the high state ⁽²⁾ | –0.5 | $V_{CC} + 0.5$ | V |
| I_O | Current into any output in the low state | | 30 | mA |
| I_O | Current into any output in the high state ⁽³⁾ | | 30 | mA |
| I_{IK} | Input clamp current | $V_I < 0$ | –50 | mA |
| I_{OK} | Output clamp current | $V_O < 0$ | –50 | mA |
| θ_{JA} | Package thermal impedance ⁽⁴⁾ | | 63 | °C/W |
| T_{stg} | Storage temperature range ⁽⁵⁾ | –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 and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (3) This current flows only when the output is in the high state and $V_O > V_{CC}$.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.
- (5) Long-term high-temperature storage and/or extended use at maximum recommended operating conditions may result in a reduction of overall device life. See http://www.ti.com/ep_quality for additional information on enhanced plastic packaging.

Recommended Operating Conditions⁽¹⁾

| | | MIN | MAX | UNIT |
|--------------------------|------------------------------------|-----|-----|-----------------|
| V_{CC} | Supply voltage | 2.7 | 3.6 | V |
| V_{IH} | High-level input voltage | 2 | | V |
| V_{IL} | Low-level input voltage | | 0.8 | V |
| V_I | Input voltage | | 5.5 | V |
| I_{OH} | High-level output current | | –12 | mA |
| I_{OL} | Low-level output current | | 12 | mA |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | | 10 | ns/V |
| | | | | Outputs enabled |
| $\Delta t/\Delta V_{CC}$ | Power-up ramp rate | 200 | | μs/V |
| T_A | Operating free-air temperature | –55 | 125 | °C |

- (1) All unused control 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.

SN74LVTH162373-EP

3.3-V ABT 16-BIT TRANSPARENT D-TYPE LATCH

WITH 3-STATE OUTPUTS

SCBS811A–JULY 2006–REVISED JULY 2006

Electrical Characteristics

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

| PARAMETER | TEST CONDITIONS | | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|-----------------------|--|------------------------------|-----|--------------------|-----------------|---------------|
| V_{IK} | $V_{CC} = 2.7\text{ V}$, | $I_I = -18\text{ mA}$ | | | -1.2 | V |
| V_{OH} | $V_{CC} = 3\text{ V}$, | $I_{OH} = -12\text{ mA}$ | 2 | | | V |
| V_{OL} | $V_{CC} = 3\text{ V}$, | $I_{OL} = 12\text{ mA}$ | | | 0.8 | V |
| I_I | $V_{CC} = 0\text{ or }3.6\text{ V}$, | $V_I = 5.5\text{ V}$ | | | 10 | μA |
| | Control inputs $V_{CC} = 3.6\text{ V}$, | $V_I = V_{CC}\text{ or GND}$ | | | ± 1 | |
| | Data inputs $V_{CC} = 3.6\text{ V}$ | $V_I = V_{CC}$ | | | 1 | |
| $I_{I(\text{hold})}$ | Data inputs $V_{CC} = 3\text{ V}$ | $V_I = 0.8\text{ V}$ | 75 | | | μA |
| | | $V_I = 2\text{ V}$ | -75 | | | |
| I_{OZH} | $V_{CC} = 3.6\text{ V}$, | $V_O = 3\text{ V}$ | | | 5 | μA |
| I_{OZL} | $V_{CC} = 3.6\text{ V}$, | $V_O = 0.5\text{ V}$ | | | -5 | μA |
| I_{OZPU} | $V_{CC} = 0\text{ to }1.5\text{ V}$, $V_O = 0.5\text{ V to }3\text{ V}$, $\overline{OE} = \text{don't care}$ | | | | $\pm 100^{(1)}$ | μA |
| I_{OZPD} | $V_{CC} = 1.5\text{ V to }0$, $V_O = 0.5\text{ V to }3\text{ V}$, $\overline{OE} = \text{don't care}$ | | | | $\pm 100^{(1)}$ | μA |
| I_{CC} | $V_{CC} = 3.6\text{ V}$, $I_O = 0$, $V_I = V_{CC}\text{ or GND}$ | Outputs high | | | 0.19 | mA |
| | | Outputs low | | | 5 | |
| | | Outputs disabled | | | 0.19 | |
| $\Delta I_{CC}^{(2)}$ | $V_{CC} = 3\text{ V to }3.6\text{ V}$, One input at $V_{CC} - 0.6\text{ V}$, Other inputs at $V_{CC}\text{ or GND}$ | | | | 0.2 | mA |
| C_i | $V_I = 3\text{ V or }0$ | | | 3 | | pF |
| C_o | $V_O = 3\text{ V or }0$ | | | 9 | | pF |

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

(2) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.

Timing Requirements

over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 1](#))

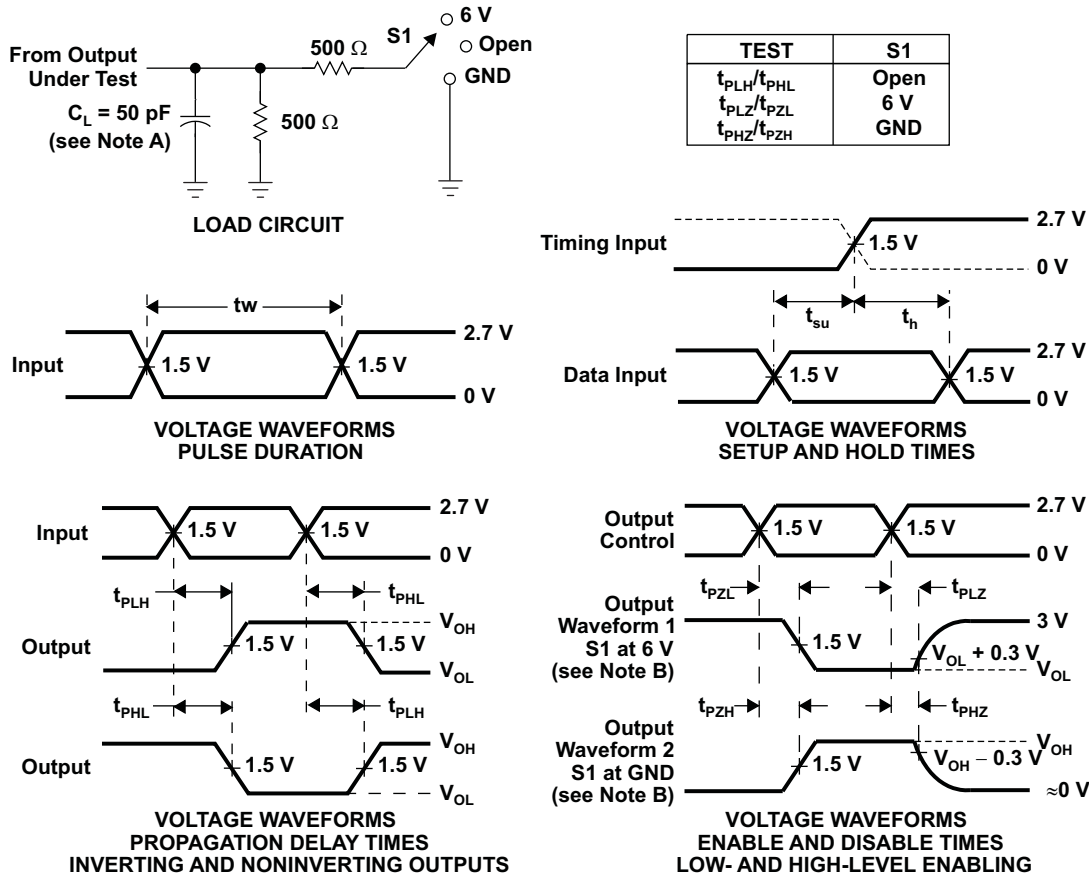
| | | $V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$ | | $V_{CC} = 2.7\text{ V}$ | | UNIT |
|----------|-----------------------------|---|-----|-------------------------|-----|------|
| | | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration, LE high | 3 | | 3 | | ns |
| t_{su} | Setup time, data before LE↓ | 1.3 | | 0.6 | | ns |
| t_h | Hold time, data after LE↓ | 1 | | 1.1 | | ns |

Switching Characteristics

over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$ | | $V_{CC} = 2.7\text{ V}$ | | UNIT |
|-----------|-----------------|----------------|---|-----|-------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| t_{PLH} | D | Q | 1.8 | 5 | 5.7 | | ns |
| t_{PHL} | | | 1.8 | 4.4 | 4.8 | | |
| t_{PLH} | LE | Q | 2.1 | 5.4 | 6.2 | | ns |
| t_{PHL} | | | 2.1 | 4.9 | 4.7 | | |
| t_{PZH} | \overline{OE} | Q | 1.7 | 5.6 | 7 | | ns |
| t_{PZL} | | | 1.7 | 5.3 | 5.9 | | |
| t_{PHZ} | \overline{OE} | Q | 2.3 | 6.3 | 6.6 | | ns |
| t_{PLZ} | | | 1 | 7.4 | 6.4 | | |

PARAMETER MEASUREMENT INFORMATION



- 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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
- D. The outputs are measured one at a time, with one 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⁾ |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CLVTH162373MDLREP | ACTIVE | SSOP | DL | 48 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| V62/06654-01XE | 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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- Catalog: [SN74LVTH162373](#)
- Military: [SN54LVTH162373](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CLVTH162373MDLREP | 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) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CLVTH162373MDLREP | SSOP | DL | 48 | 1000 | 346.0 | 346.0 | 49.0 |

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
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