

# SN74LVC16245

## 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS314A – NOVEMBER 1993 – REVISED DECEMBER 1994

- Member of the Texas Instruments *Widebus™* Family
- *EPIC™* (Enhanced-Performance Implanted CMOS) Submicron Process
- Typical  $V_{OLP}$  (Output Ground Bounce) < 0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot) > 2 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Bus-Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages

### description

This 16-bit (dual-octal) noninverting bus transceiver is designed for 2.7-V to 3.6-V  $V_{CC}$  operation.

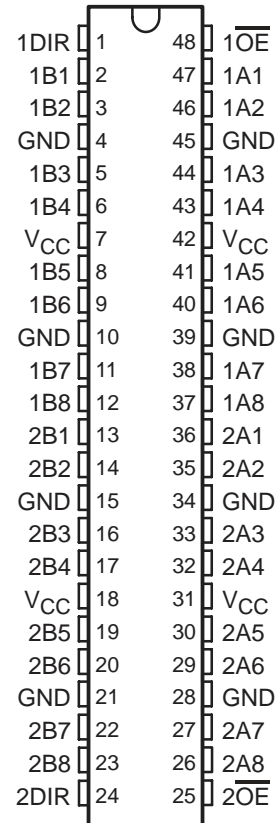
The SN74LVC16245 is designed for asynchronous communication between data buses. The control function implementation minimizes external timing requirements.

This device can be used as two 8-bit transceivers or one 16-bit transceiver. It allows data transmission from the A bus to the B bus or from the B bus to the A bus, depending upon the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so that the buses are effectively isolated.

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

The SN74LVC16245 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

DGG OR DL PACKAGE  
(TOP VIEW)



FUNCTION TABLE  
(each 8-bit section)

| INPUTS          |     | OPERATION       |
|-----------------|-----|-----------------|
| $\overline{OE}$ | DIR |                 |
| L               | L   | B data to A bus |
| L               | H   | A data to B bus |
| H               | X   | Isolation       |



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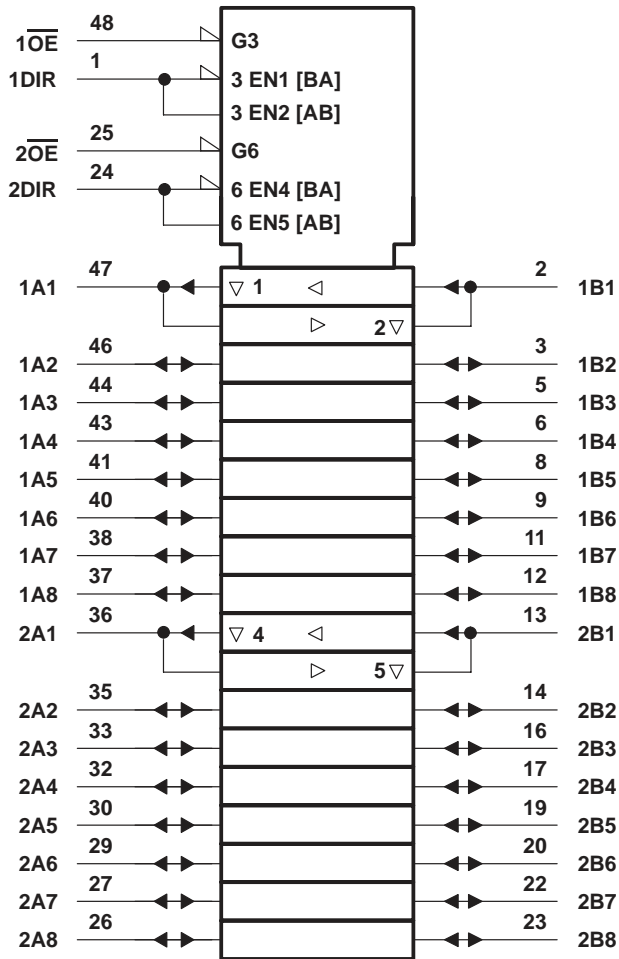
# SN74LVC16245

## 16-BIT BUS TRANSCEIVER

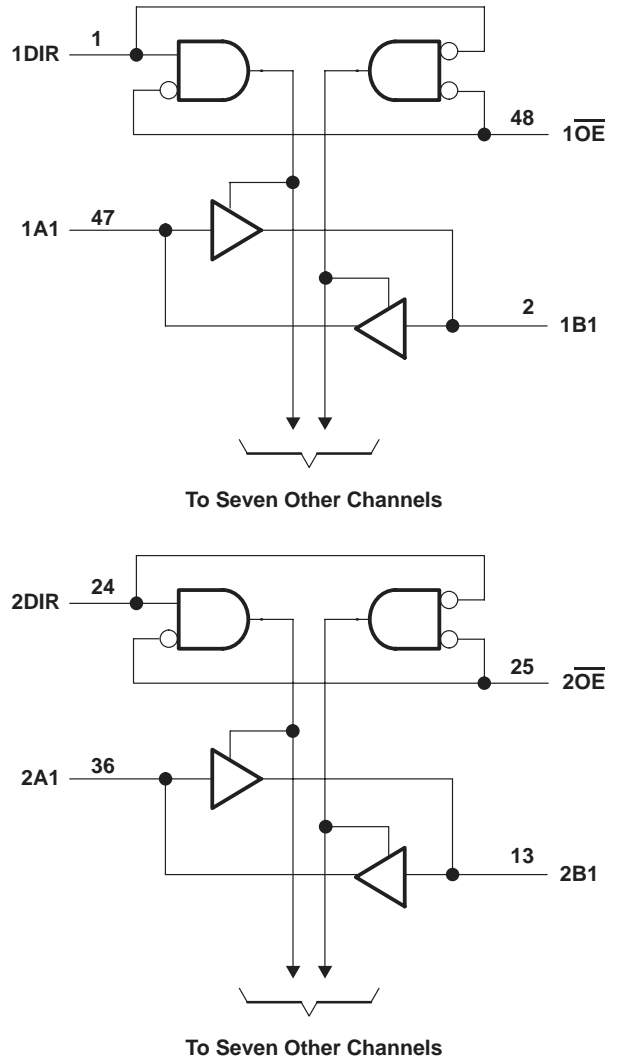
### WITH 3-STATE OUTPUTS

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#### logic symbol†



#### logic diagram (positive logic)



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

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## 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

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

|  |                            |
|--|----------------------------|
| Supply voltage range, $V_{CC}$ .....   | –0.5 V to 4.6 V            |
| Input voltage range, $V_I$ (except I/O ports) (see Note 1) .....                                     | –0.5 V to 4.6 V            |
| Input voltage range, $V_I$ (I/O ports) (see Notes 1 and 2) .....                                     | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, $V_O$ (see Notes 1 and 2) .....  | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....  | –50 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....                                 | ±50 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....                                     | ±50 mA                     |
| Continuous current through $V_{CC}$ or GND .....   | ±100 mA                    |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DGG package ..... | 0.85 W                     |
| DL package .....   | 1.2 W                      |
| Operating free-air temperature range, $T_A$ .....  | –40°C to 85°C              |
| Storage temperature range .....  | –65°C to 150°C             |

† 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 clamp-current ratings are observed.  
 2. This value is limited to 4.6 V maximum.  
 3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

### recommended operating conditions (see Note 4)

|                     |                                    | MIN                       | MAX      | UNIT |
|---------------------|------------------------------------|---------------------------|----------|------|
| $V_{CC}$            | Supply voltage                     | 2.7                       | 3.6      | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 2.7$ V to 3.6 V |          | V    |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 2.7$ V to 3.6 V |          | V    |
| $V_I$               | Input voltage                      | 0                         | $V_{CC}$ | V    |
| $V_O$               | Output voltage                     | 0                         | $V_{CC}$ | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 2.7$ V          | –12      | mA   |
|                     |                                    | $V_{CC} = 3$ V            | –24      |      |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 2.7$ V          | 12       | mA   |
|                     |                                    | $V_{CC} = 3$ V            | 24       |      |
| $\Delta t/\Delta V$ | Input transition rise or fall rate | 0                         | 10       | ns/V |
| $T_A$               | Operating free-air temperature     | –40                       | 85       | °C   |

NOTE 4: Unused or floating control pins must be held high or low.



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## 16-BIT BUS TRANSCEIVER

### WITH 3-STATE OUTPUTS

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

| PARAMETER             |                | TEST CONDITIONS  | V <sub>CC</sub> | MIN                  | TYP† | MAX  | UNIT |
|-----------------------|----------------|--|-----------------|----------------------|------|------|------|
| V <sub>OH</sub>       |                | I <sub>OH</sub> = -100 μA  | MIN to MAX‡     | V <sub>CC</sub> -0.2 |      |      | V    |
|                       |                | I <sub>OH</sub> = -12 mA   | 2.7             | 2.2                  |      |      |      |
|                       |                | I <sub>OH</sub> = -24 mA   | 3               | 2.4                  |      |      |      |
| V <sub>OL</sub>       |                | I <sub>OL</sub> = 100 μA   | MIN to MAX‡     |                      |      | 0.2  | V    |
|                       |                | I <sub>OL</sub> = 12 mA  | 2.7             |                      |      | 0.4  |      |
|                       |                | I <sub>OL</sub> = 24 mA  | 3               |                      |      | 0.55 |      |
| I <sub>I</sub>        | Control inputs | V <sub>I</sub> = V <sub>CC</sub> or GND  | 3.6             |                      |      | ±5   | μA   |
| I <sub>I</sub> (hold) | Data inputs    | V <sub>I</sub> = 0.8 V   | 3               | 75                   |      |      | μA   |
|                       |                | V <sub>I</sub> = 2 V   |                 | -75                  |      |      |      |
| I <sub>OZ</sub> §     |                | V <sub>O</sub> = V <sub>CC</sub> or GND  | 3.6             |                      |      | ±10  | μA   |
| I <sub>CC</sub>       |                | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0  | 3.6             |                      |      | 40   | μA   |
| ΔI <sub>CC</sub>      |                | V <sub>CC</sub> = 3 V to 3.6 V, One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND |                 |                      |      | 500  | μA   |
| C <sub>i</sub>        | Control inputs | V <sub>I</sub> = V <sub>CC</sub> or GND  | 3.3             | 2.5                  |      |      | pF   |
| C <sub>io</sub>       | A or B ports   | V <sub>O</sub> = V <sub>CC</sub> or GND  | 3.3             | 3.5                  |      |      | pF   |

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

‡ For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

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

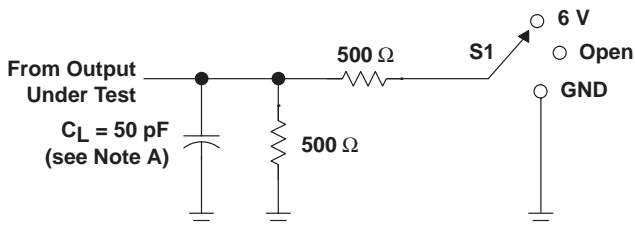
switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT)    | TO (OUTPUT) | V <sub>CC</sub> = 3.3 V ± 0.3 V |      |     | V <sub>CC</sub> = 2.7 V |     | UNIT |
|------------------|-----------------|-------------|---------------------------------|------|-----|-------------------------|-----|------|
|                  |                 |             | MIN                             | TYP† | MAX | MIN                     | MAX |      |
| t <sub>pd</sub>  | A               | B           | 1.5                             | 3.8  | 6.5 | 7.5                     |     | ns   |
| t <sub>en</sub>  | $\overline{OE}$ | B           | 1.5                             | 4.7  | 8   | 9                       |     | ns   |
| t <sub>dis</sub> | $\overline{OE}$ | B           | 1.5                             | 4.8  | 7.5 | 8.5                     |     | ns   |

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

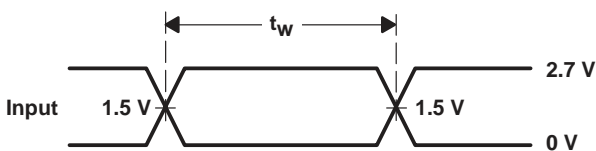


PARAMETER MEASUREMENT INFORMATION

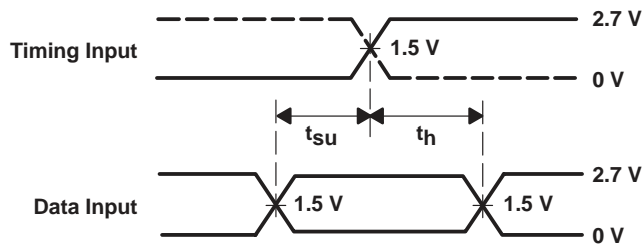


LOAD CIRCUIT FOR OUTPUTS

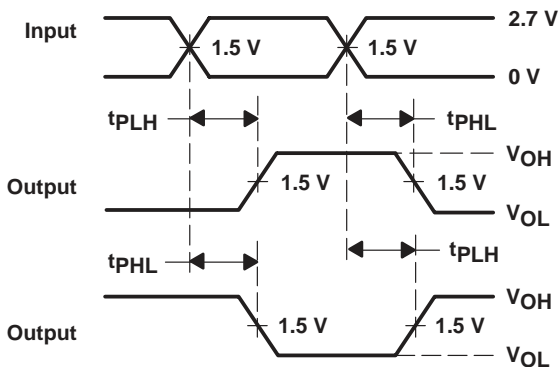
| TEST              | S1   |
|-------------------|------|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | 6 V  |
| $t_{PHZ}/t_{PZH}$ | GND  |



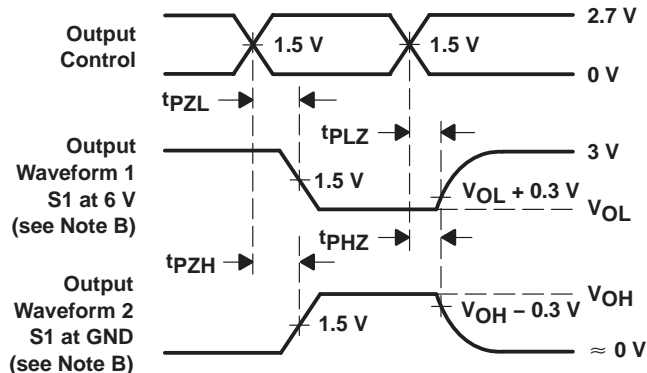
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- 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,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  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<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|------------------|----------------------|--------------|--------------------------|---------|
| SN74LVC16245DL   | OBSOLETE      | SSOP         | DL              | 48   |             | TBD             | Call TI          | Call TI              | -40 to 85    |                          |         |
| SN74LVC16245DLR  | OBSOLETE      | SSOP         | DL              | 48   |             | TBD             | Call TI          | Call TI              | -40 to 85    |                          |         |

(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.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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|                               |  |
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