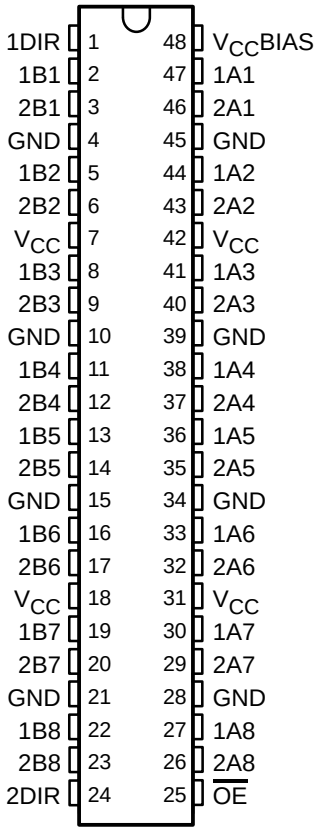
- **Members of the Texas Instruments Widebus™ Family**
- **Support the VME64 ETL Specification**
- **Reduced, TTL-Compatible, Input Threshold Range**
- **High-Drive Outputs ($I_{OH}$ = –60 mA, $I_{OL}$ = 90 mA) Support 25-Ω Incident-Wave Switching**
- **$V_{CC}$BIAS Pin Minimizes Signal Distortion During Live Insertion**
- **Internal Pullup Resistor on $\overline{OE}$ Keeps Outputs in High-Impedance State During Power Up or Power Down**
- **Distributed $V_{CC}$ and GND Pins Minimize High-Speed Switching Noise**
- **Equivalent 25-Ω Series Damping Resistor on B Port**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**

**SN54ABTE16245 . . . WD PACKAGE**
**SN74ABTE16245 . . . DGG OR DL PACKAGE**
**(TOP VIEW)**




## description

The ’ABTE16245 devices are 16-bit (dual-octal) noninverting 3-state transceivers designed for synchronous two-way communication between data buses. The control-function implementation minimizes external timing requirements. These devices can be used as two 8-bit transceivers or one 16-bit transceiver. They allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending on 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. When $\overline{OE}$ is low, the device is active.

The B port has an equivalent 25-Ω series output resistor to reduce ringing. Active bus-hold inputs also are on the B port to hold unused or floating inputs at a valid logic level.

The A port provides for the precharging of the outputs via $V_{CC}$BIAS, which establishes a voltage between 1.3 V and 1.7 V when $V_{CC}$ is not connected.

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.

**ORDERING INFORMATION**

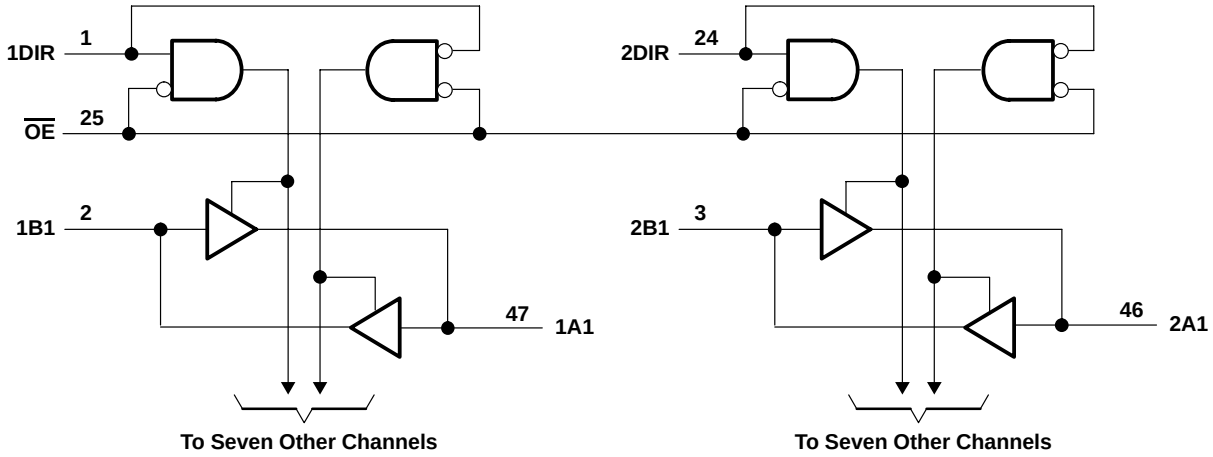
| $T_A$ | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|
| –40°C to 85°C | SSOP – DL | Tube | SN74ABTE16245DL | ABTE16245 |
| | | Tape and reel | SN74ABTE16245DLR | |
| | TSSOP – DGG | Tape and reel | SN74ABTE16245DGGR | ABTE16245 |
| –55°C to 125°C | CFP – WD | Tube | SNJ54ABTE16245WD | SNJ54ABTE16245WD |

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

**FUNCTION TABLE**
**(each 8-bit section)**

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

## logic diagram (positive logic)




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

Supply voltage range, $V_{CC}$ and $V_{CC}$BIAS . . . . . –0.5 V to 7 V
Input voltage range, $V_I$ (except I/O ports) (see Note 1) . . . . . –0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, $V_O$ . . . . . –0.5 V to 5.5 V
Current into any output in the low state, $I_O$ . . . . . 128 mA
Input clamp current, $I_{IK}$ ($V_I < 0$) . . . . . –18 mA
Output clamp current, $I_{OK}$ ($V_O < 0$) . . . . . –50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DGG package . . . . . 70°C/W
DL package . . . . . 63°C/W
Storage temperature range, $T_{stg}$ . . . . . –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 negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 3)

| | | | SN54ABTE16245 | | | SN74ABTE16245 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$, $V_{CC}BIAS$ | Supply voltage | | 4.5 | 5 | 5.5 | 4.5 | 5 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | $\overline{OE}$ | 2 | | | 2 | | | V |
| | | Except $\overline{OE}$ | 1.6 | | | 1.6 | | | |
| $V_{IL}$ | Low-level input voltage | $\overline{OE}$ | | | 0.8 | | | 0.8 | V |
| | | Except $\overline{OE}$ | | | 1.4 | | | 1.4 | |
| $V_I$ | Input voltage | | 0 | | $V_{CC}$ | 0 | | $V_{CC}$ | V |
| $I_{OH}$ | High-level output current | B bus | | | –12 | | | –12 | mA |
| | | A bus | | | –24 | | | –60 | |
| $I_{OL}$ | Low-level output current | B bus | | | 12 | | | 12 | mA |
| | | A bus | | | 64 | | | 90 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | Outputs enabled | | | 10 | | | 10 | ns/V |
| $T_A$ | Operating free-air temperature | | –55 | | 125 | –40 | | 85 | °C |

NOTE 3: 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.

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

| PARAMETER | | TEST CONDITIONS | | SN54ABTE16245 | | | SN74ABTE16245 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $V_{IK}$ | | $V_{CC}$ = 4.5 V, | $I_I$ = –18 mA | | | –1.2 | | | –1.2 | V |
| $V_{OH}$ | B port | $V_{CC}$ = 5.5 V, | $I_{OH}$ = –100 μA | | | $V_{CC}$–0.2 | | | $V_{CC}$–0.2 | V |
| | | $V_{CC}$ = 4.5 V | $I_{OH}$ = –1 mA | 2.4 | | | 2.4 | | | |
| | | | $I_{OH}$ = –12 mA | 2 | | | 2 | | | |
| | A port | $V_{CC}$ = 5.5 V, | $I_{OH}$ = –1 mA | | | 4.5 | | | 4.5 | |
| | | $V_{CC}$ = 4.5 V | $I_{OH}$ = –32 mA | 2.4 | | | 2.4 | | | |
| | | | $I_{OH}$ = –64 mA | | | | 2 | | | |
| $V_{OL}$ | B port | $V_{CC}$ = 4.5 V | $I_{OL}$ = 1 mA | | | 0.4 | | | 0.4 | V |
| | | | $I_{OL}$ = 12 mA | | | | | | 0.8 | |
| | A port | $V_{CC}$ = 4.5 V | $I_{OL}$ = 64 mA | | | 0.55 | | | 0.55 | |
| | | | $I_{OL}$ = 90 mA | | | | | | 0.9 | |
| $I_{I(hold)}$ | B port | $V_{CC}$ = 4.5 V | $V_I$ = 0.8 V | 100 | | | 100 | | | μA |
| | | | $V_I$ = 2 V | –100 | | | –100 | | | |
| | | $V_{CC}$ = 5.5 V, | $V_I$ = 0 to 5.5 V | | | ±500 | | | ±500 | |
| $I_I$ | Control inputs | $V_{CC}$ = 5.5 V, | $V_I$ = $V_{CC}$ or GND | | | ±1 | | | ±1 | μA |
| | A or B ports | | | | | ±20 | | | ±20 | |
| $I_{OZH}$‡ | A port | $V_{CC}$ = 5.5 V, | $V_O$ = 2.7 V | | | 10 | | | 10 | μA |
| $I_{OZL}$‡ | A port | $V_{CC}$ = 5.5 V, | $V_O$ = 0.5 V | | | –10 | | | –10 | μA |
| $I_O$ | A port | $V_{CC}$ = 5.5 V, | $V_O$ = 2.5 V | –50 | –120 | –180 | –50 | | –180 | mA |
| | B port | | | –25 | –52 | –90 | –25 | | –90 | |
| $I_{off}$ | | $V_{CC}$ = 0, $V_I$ or $V_O \le$ 4.5 V, $V_{CC}$BIAS = 0 | | | | ±100 | | | ±100 | μA |
| $I_{CC}$ | A or B ports | $V_{CC}$ = 5.5 V, $I_O$ = 0, $V_I$ = $V_{CC}$ or GND | Outputs high | | 28 | 36 | | 28 | 36 | mA |
| | | | Outputs low | | 38 | 48 | | 38 | 48 | |
| | | | Outputs disabled | | 20 | 32 | | 20 | 32 | |
| $I_{CCD}$ | A or B ports | $V_{CC}$ = 5 V, $C_L$ = 50 pF | $\overline{OE}$ high | | 0.02 | | | 0.02 | | mA/ MHz |
| | | | $\overline{OE}$ low | | 0.33 | | | 0.33 | | |
| $C_i$ | Control inputs | $V_I$ = 2.5 V or 0.5 V | | | | 10 | | 2.5 | 4 | pF |
| $C_{io}$ | I/O ports | $V_O$ = 2.5 V or 0.5 V | | | | 13 | | 4.5 | 8 | pF |

† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡ The parameters $I_{OZH}$ and $I_{OZL}$ include the input leakage current.

### live-insertion specifications over recommended operating free-air temperature range

| PARAMETER | | TEST CONDITIONS | | | SN54ABTE16245 | | | SN74ABTE16245 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $I_{CC}$ ($V_{CC}$BIAS) | | $V_{CC}$ = 0 to 4.5 V, $V_{CC}$BIAS = 4.5 V to 5.5 V, $I_{O(DC)}$ = 0 | | | | 250 | 700 | | 250 | 700 | µA |
| | | $V_{CC}$ = 4.5 V to 5.5 V‡, $V_{CC}$BIAS = 4.5 V to 5.5 V, $I_{O(DC)}$ = 0 | | | | | 20 | | | 20 | |
| $V_O$ | A port | $V_{CC}$ = 0 | $V_{CC}$BIAS = 4.5 V to 5.5 V | | 1.1 | 1.5 | 1.9 | 1.1 | 1.5 | 1.9 | V |
| | | | $V_{CC}$BIAS = 4.75 V to 5.25 V | | 1.3 | 1.5 | 1.7 | 1.3 | 1.5 | 1.7 | |
| $I_O$ | A port | $V_{CC}$ = 0, | $V_{CC}$BIAS = 4.5 V | $V_O$ = 0 | –20 | | –100 | –20 | | –100 | µA |
| | | | | $V_O$ = 3 V | 20 | | 100 | 20 | | 100 | µA |

† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡ $V_{CC}$ – 0.5 V < $V_{CC}$BIAS

### switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L$ = 50 pF (unless otherwise noted) (see Figure 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ = 5 V, $T_A$ = 25°C | | | SN54ABTE16245 | | SN74ABTE16245 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{PLH}$ | A | B | 1.5 | 3.3 | 4.2 | 1.5 | 5.4 | 1.5 | 5.2 | ns |
| $t_{PHL}$ | | | 1.5 | 3.8 | 4.6 | 1.5 | 5.4 | 1.5 | 5.2 | |
| $t_{PLH}$ | B | A | 1.5 | 3 | 3.8 | 1.5 | 4.7 | 1.5 | 4.5 | ns |
| $t_{PHL}$ | | | 1.5 | 3.1 | 4 | 1.5 | 4.7 | 1.5 | 4.5 | |
| $t_{PZH}$ | $\overline{OE}$ | A | 2 | 3.9 | 5.3 | 2 | 6.4 | 2 | 6.2 | ns |
| $t_{PZL}$ | | | 2 | 4.4 | 5.9 | 2 | 7 | 2 | 6.8 | |
| $t_{PZH}$ | $\overline{OE}$ | B | 2 | 4.5 | 6 | 2 | 7.3 | 2 | 7.1 | ns |
| $t_{PZL}$ | | | 2 | 5 | 6.4 | 2 | 7.5 | 2 | 7.3 | |
| $t_{PHZ}$ | $\overline{OE}$ | A | 2 | 4.9 | 5.9 | 2 | 7 | 2 | 6.7 | ns |
| $t_{PLZ}$ | | | 2 | 3.7 | 4.6 | 2 | 5.4 | 2 | 5.1 | |
| $t_{PHZ}$ | $\overline{OE}$ | B | 2 | 5.2 | 6.2 | 2 | 7.2 | 2 | 7 | ns |
| $t_{PLZ}$ | | | 2 | 4 | 5 | 2 | 5.8 | 2 | 5.5 | |

**extended switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L$ = 50 pF (unless otherwise noted) (see Figure 2)**

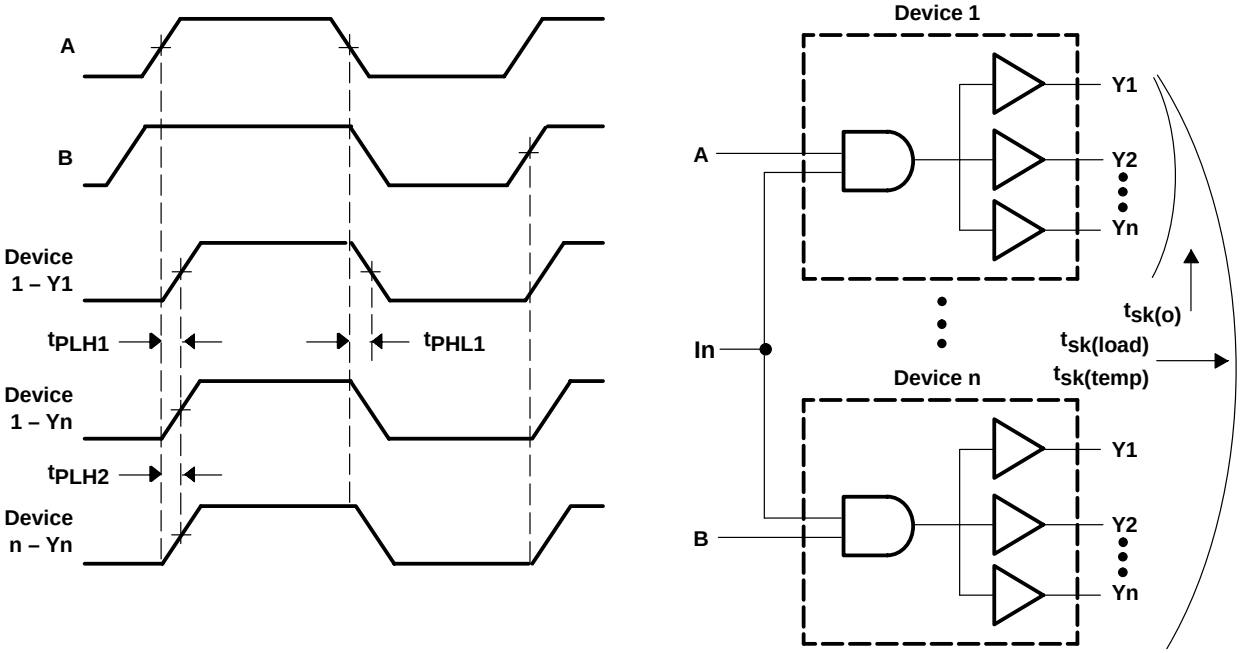
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD | $V_{CC}$ = 5 V, $T_A$ = 25°C | | | SN54ABTE16245 | | SN74ABTE16245 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{PLH}$ | B | A | $R_X$ = 13 Ω | 1.5 | 3.2 | 4 | 1.5 | 5 | 1.5 | 4.8 | ns |
| $t_{PHL}$ | | | | 1.5 | 3.8 | 4.7 | 1.5 | 5.8 | 1.5 | 5.6 | |
| $t_{PLH}$ | B | A | $R_X$ = 26 Ω | 1.5 | 3.1 | 4 | 1.5 | 4.8 | 1.5 | 4.6 | ns |
| $t_{PHL}$ | | | | 1.5 | 3.5 | 4.4 | 1.5 | 5.2 | 1.5 | 4.9 | |
| $t_{PLH}$ | B | A | $R_X$ = 56 Ω | 1.5 | 3 | 3.8 | 1.5 | 4.7 | 1.5 | 4.5 | ns |
| $t_{PHL}$ | | | | 1.5 | 3.3 | 4.2 | 1.5 | 5.1 | 1.5 | 4.7 | |
| $t_{sk(p)}$ | B | A | $R_X$ = Open | | 0.1 | 0.6 | | 2 | | 2 | ns |
| | A | B | $R_X$ = Open | | 0.4 | 0.8 | | 2 | | 2 | |
| | B | A | $R_X$ = 26 Ω | | 0.3 | 0.8 | | 2 | | 2 | |
| $t_{sk(o)}$ | B | A | $R_X$ = Open | | 0.3 | 0.7 | | 1.3 | | 1.3 | ns |
| | A | B | $R_X$ = Open | | 0.7 | 1.1 | | 1.3 | | 1.3 | |
| | B | A | $R_X$ = 26 Ω | | 0.5 | 1 | | 1.3 | | 1.3 | |
| $t_t$† | B | A | $R_X$ = 26 Ω | 0.5 | 0.8 | 1.5 | 0.5 | 1.5 | 0.5 | 1.5 | ns |
| $t_t$‡ | A | B | $R_X$ = Open | 3.5 | 5.5 | 7.3 | 3.5 | 8.1 | 3.5 | 7.9 | ns |

† $t_t$ is measured between 1 V and 2 V of the output waveform.
‡ $t_t$ is measured between 10% and 90% of the output waveform.

**extended output characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L$ = 50 pF (see Figures 1 and 2)**

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | LOAD | SN54ABTE16245 | | SN74ABTE16245 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | MAX | MIN | MAX | |
| $t_{sk(temp)}$ | A | B | $V_{CC}$ = constant, $\Delta T_A$ = 20°C | | | 3 | | 2.5 | ns |
| | B | A | | $R_X$ = 56 Ω | | 4.5 | | 4 | |
| $t_{sk(load)}$ | B | B | $V_{CC}$ = constant, Temperature = constant | $R_X$ = 13, 26, or 56 Ω | | 4.5 | | 4 | ns |

## PARAMETER MEASUREMENT INFORMATION




NOTES: A. Pulse skew, $t_{sk(p)}$, is defined as the difference in propagation-delay times $t_{PLH1}$ and $t_{PHL1}$ on the same terminal at identical operating conditions.

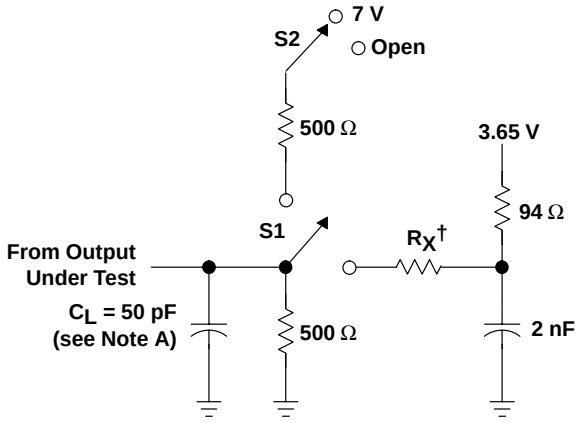
B. Output skew, $t_{sk(o)}$, is defined as the difference in propagation delay of any two outputs of the same device switching in the same direction (e.g., $|t_{PLH1} - t_{PLH2}|$).

C. Temperature skew, $t_{sk(temp)}$, is the output skew of two devices, both having the same value of $V_{CC} \pm 1\%$ and with package temperature differences of 20°C.

D. Load skew, $t_{sk(load)}$, is measured with $R_X$ in Figure 2 at 13 Ω for one unit and 56 Ω for the other unit.

**Figure 1. Voltage Waveforms for Extended Characteristics**

## PARAMETER MEASUREMENT INFORMATION

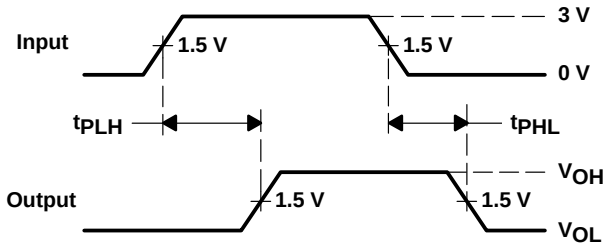



† $R_X = 13, 26, \text{or } 56\ \Omega$

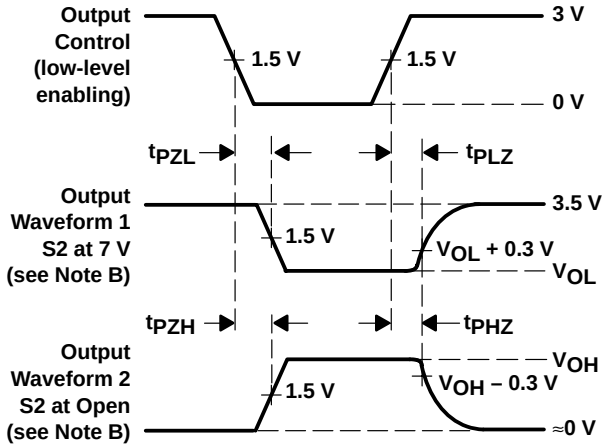
**LOAD CIRCUIT FOR OUTPUTS**

| SWITCHING TABLE LOADS | S1 | S2 |
|---|---|---|
| $t_{PLH}/t_{PHL}$ (A and B port) | Up | Open |
| $t_{PLZ}/t_{PZL}$ | Up | 7 V |
| $t_{PHZ}/t_{PZH}$ | Up | Open |

| EXTENDED SWITCHING TABLE LOADS | S1 | S2 |
|---|---|---|
| $t_{PLH}/t_{PHL}/t_{sk}$ (A port) | Down | X |
| $t_{PLH}/t_{PHL}/t_{sk}$ (B port) | Up | Open |
| $t_t$ (A port) (see Note E) | Down | X |
| $t_t$ (B port) (see Note F) | Up | Open |




**VOLTAGE WAVEFORMS**
**PROPAGATION DELAY TIMES**




**VOLTAGE WAVEFORMS**
**ENABLE AND DISABLE TIMES**

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 ≤ 10 MHz, $Z_O = 50\ \Omega$, $t_r \le 2.5$ ns, $t_f \le 2.5$ ns.
D. The outputs are measured one at a time with one transition per measurement.
E. $t_t$ is measured between 1 V and 2 V of the output waveform.
F. $t_t$ is measured between 10% and 90% of the output waveform.

**Figure 2. Load Circuit and Voltage Waveforms**

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