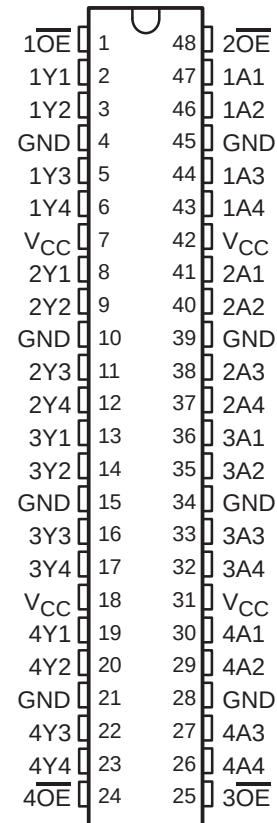


# SN54LVT16244B, SN74LVT16244B 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

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- Members of the Texas Instruments *Widebus™* Family
- State-of-the-Art Advanced BiCMOS Technology (ABT) Design for 3.3-V Operation and Low Static-Power Dissipation
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V  $V_{CC}$ )
- $I_{off}$  and Power-Up 3-State Support Hot Insertion
- Support Unregulated Battery Operation Down to 2.7 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)
- 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

SN54LVT16244B . . . WD PACKAGE  
SN74LVT16244B . . . DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



## description

The 'LVT16244B devices are 16-bit buffers and line drivers 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. These devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. These devices provide true outputs and symmetrical active-low output-enable ( $\overline{OE}$ ) inputs.

When  $V_{CC}$  is between 0 and 1.5-V, the devices are 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.

These devices are 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 devices when they are 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.

The SN54LVT16244B is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74LVT16244B is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TEXAS  
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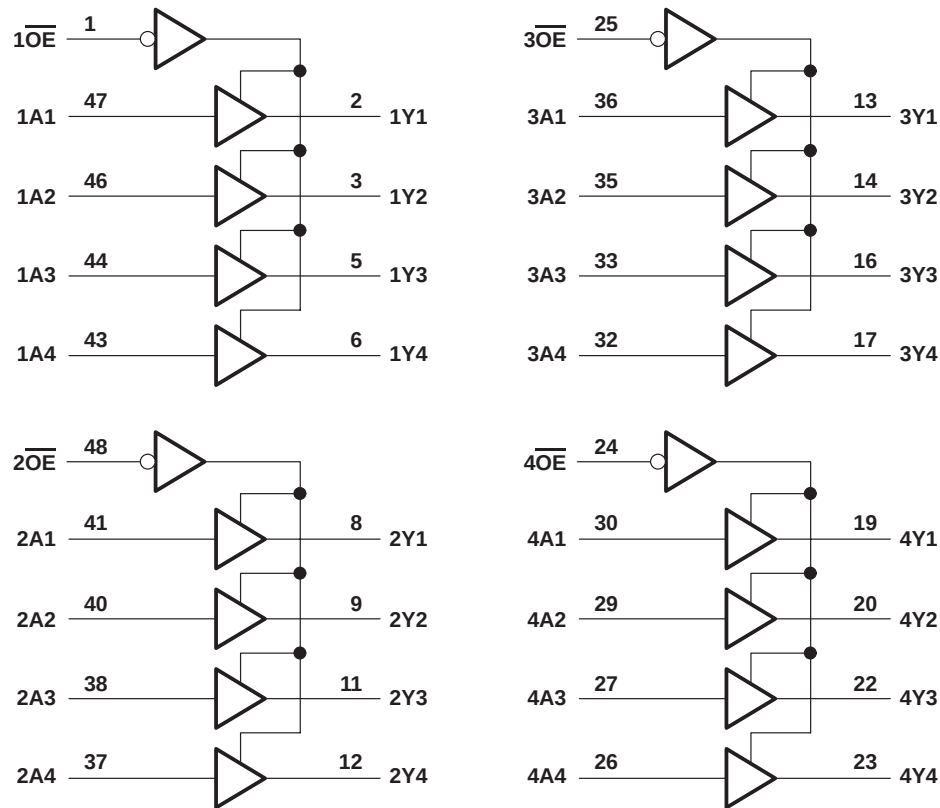
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| INPUTS                 |   | OUTPUT<br>Y |
|------------------------|---|-------------|
| $\overline{\text{OE}}$ | A |             |
| L                      | H | H           |
| L                      | L | L           |
| H                      | X | Z           |

|                  |    |     |     |    |     |
|------------------|----|-----|-----|----|-----|
| $\overline{1OE}$ | 1  | EN1 |     |    |     |
| $\overline{2OE}$ | 48 | EN2 |     |    |     |
| $\overline{3OE}$ | 25 | EN3 |     |    |     |
| $\overline{4OE}$ | 24 | EN4 |     |    |     |
|                  |    |     |     |    |     |
|                  |    |     |     |    |     |
| 1A1              | 47 | 1   | 1 ▽ | 2  | 1Y1 |
| 1A2              | 46 |     |     | 3  | 1Y2 |
| 1A3              | 44 |     |     | 5  | 1Y3 |
| 1A4              | 43 |     |     | 6  | 1Y4 |
| 2A1              | 41 |     |     | 8  | 2Y1 |
| 2A2              | 40 | 1   | 2 ▽ | 9  | 2Y2 |
| 2A3              | 38 |     |     | 11 | 2Y3 |
| 2A4              | 37 |     |     | 12 | 2Y4 |
| 3A1              | 36 |     |     | 13 | 3Y1 |
| 3A2              | 35 | 1   | 3 ▽ | 14 | 3Y2 |
| 3A3              | 33 |     |     | 16 | 3Y3 |
| 3A4              | 32 |     |     | 17 | 3Y4 |
| 4A1              | 30 |     |     | 19 | 4Y1 |
| 4A2              | 29 | 1   | 4 ▽ | 20 | 4Y2 |
| 4A3              | 27 |     |     | 22 | 4Y3 |
| 4A4              | 26 |     |     | 23 | 4Y4 |



logic diagram (positive logic)



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

|                                                                                                  |                            |
|--------------------------------------------------------------------------------------------------|----------------------------|
| Supply voltage range, $V_{CC}$                                                                   | –0.5 V to 4.6 V            |
| Input voltage range, $V_I$ (see Note 1)                                                          | –0.5 V to 7 V              |
| Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1) | –0.5 V to 7 V              |
| Voltage range applied to any output in the high state, $V_O$ (see Note 1)                        | –0.5 V to $V_{CC} + 0.5$ V |
| Current into any output in the low state, $I_{OL}$ : SN54LVT16244B                               | 96 mA                      |
| SN74LVT16244B                                                                                    | 128 mA                     |
| Current into any output in the high state, $I_{OH}$ (see Note 2): SN54LVT16244B                  | 48 mA                      |
| SN74LVT16244B                                                                                    | 64 mA                      |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ )                                                      | –50 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ )                                                     | –50 mA                     |
| Package thermal impedance, $\theta_{JA}$ (see Note 3): DGG package                               | 70°C/W                     |
| DGV package                                                                                      | 58°C/W                     |
| DL package                                                                                       | 63°C/W                     |
| Storage temperature range, $T_{stg}$                                                             | –65°C to 150°C             |

<sup>†</sup> 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. This current flows only when the output is in the high state and  $V_O > V_{CC}$ .  
3. The package thermal impedance is calculated in accordance with JESD 51.

# SN54LVT16244B, SN74LVT16244B

## 3.3-V ABT 16-BIT BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

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#### recommended operating conditions (see Note 4)

|                     |                                    |                 | SN54LVT16244B |     | SN74LVT16244B |     | UNIT |
|---------------------|------------------------------------|-----------------|---------------|-----|---------------|-----|------|
|                     |                                    |                 | MIN           | MAX | MIN           | MAX |      |
| V <sub>CC</sub>     | Supply voltage                     |                 | 2.7           | 3.6 | 2.7           | 3.6 | V    |
| V <sub>IH</sub>     | High-level input voltage           |                 | 2             |     | 2             |     | V    |
| V <sub>IL</sub>     | Low-level input voltage            |                 |               | 0.8 |               | 0.8 | V    |
| V <sub>I</sub>      | Input voltage                      |                 |               | 5.5 |               | 5.5 | V    |
| I <sub>OH</sub>     | High-level output current          |                 |               | –24 |               | –32 | mA   |
| I <sub>OL</sub>     | Low-level output current           |                 |               | 48  |               | 64  | mA   |
| Δt/Δv               | Input transition rise or fall rate | Outputs enabled |               | 10  |               | 10  | ns/V |
| Δt/ΔV <sub>CC</sub> | Power-up ramp rate                 |                 | 200           |     | 200           |     | μs/V |
| T <sub>A</sub>      | Operating free-air temperature     |                 | –55           | 125 | –40           | 85  | °C   |

NOTE 4: All unused inputs of the device must 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.

**SN54LVT16244B, SN74LVT16244B**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

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

| PARAMETER                |                | TEST CONDITIONS                                                                                                           | SN54LVT16244B |                                   |             | SN74LVT16244B |                  |           | UNIT          |
|--------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------|-------------|---------------|------------------|-----------|---------------|
|                          |                |                                                                                                                           | MIN           | TYP <sup>†</sup>                  | MAX         | MIN           | TYP <sup>†</sup> | MAX       |               |
| $V_{IK}$                 |                | $V_{CC} = 2.7\text{ V}$ ,<br>$I_I = -18\text{ mA}$                                                                        |               |                                   | -1.2        |               |                  | -1.2      | V             |
| $V_{OH}$                 |                | $V_{CC} = 2.7\text{ V to } 3.6\text{ V}$ ,<br>$I_{OH} = -100\text{ }\mu\text{A}$                                          | $V_{CC}-0.2$  |                                   |             | $V_{CC}-0.2$  |                  |           | V             |
|                          |                | $V_{CC} = 2.7\text{ V}$ ,<br>$I_{OH} = -8\text{ mA}$                                                                      | 2.4           |                                   |             | 2.4           |                  |           |               |
|                          |                | $V_{CC} = 3\text{ V}$                                                                                                     | 2             |                                   |             | 2             |                  |           |               |
|                          |                |                                                                                                                           |               |                                   |             |               |                  |           |               |
| $V_{OL}$                 |                | $V_{CC} = 2.7\text{ V}$                                                                                                   |               | $I_{OL} = 100\text{ }\mu\text{A}$ | 0.2         |               |                  | 0.2       | V             |
|                          |                |                                                                                                                           |               | $I_{OL} = 24\text{ mA}$           | 0.5         |               |                  | 0.5       |               |
|                          |                | $V_{CC} = 3\text{ V}$                                                                                                     |               | $I_{OL} = 16\text{ mA}$           | 0.4         |               |                  | 0.4       |               |
|                          |                |                                                                                                                           |               | $I_{OL} = 32\text{ mA}$           | 0.5         |               |                  | 0.5       |               |
|                          |                |                                                                                                                           |               | $I_{OL} = 48\text{ mA}$           | 0.55        |               |                  |           |               |
|                          |                |                                                                                                                           |               | $I_{OL} = 64\text{ mA}$           |             |               |                  | 0.55      |               |
| $I_I$                    |                | $V_{CC} = 0\text{ or } 3.6\text{ V}$ ,<br>$V_I = 5.5\text{ V}$                                                            |               |                                   | 50          |               |                  | 10        | $\mu\text{A}$ |
|                          | Control inputs | $V_{CC} = 3.6\text{ V}$ ,<br>$V_I = V_{CC}\text{ or GND}$                                                                 |               |                                   | $\pm 1$     |               |                  | $\pm 1$   |               |
|                          | Data inputs    | $V_{CC} = 3.6\text{ V}$                                                                                                   |               | $V_I = V_{CC}$                    | 1           |               |                  | 1         |               |
|                          |                |                                                                                                                           |               | $V_I = 0$                         | -5          |               |                  | -5        |               |
| $I_{off}$                |                | $V_{CC} = 0$ , $V_I$ or $V_O = 0\text{ to } 4.5\text{ V}$                                                                 |               |                                   |             |               |                  | $\pm 100$ | $\mu\text{A}$ |
| $I_{OZH}$                |                | $V_{CC} = 3.6\text{ V}$ ,<br>$V_O = 3\text{ V}$                                                                           |               |                                   | 5           |               |                  | 5         | $\mu\text{A}$ |
| $I_{OZL}$                |                | $V_{CC} = 3.6\text{ V}$ ,<br>$V_O = 0.5\text{ V}$                                                                         |               |                                   | -5          |               |                  | -5        | $\mu\text{A}$ |
| $I_{OZPU}$               |                | $V_{CC} = 0\text{ to } 1.5\text{ V}$ , $V_O = 0.5\text{ V to } 3\text{ V}$ ,<br>$\overline{OE} = \text{don't care}$       |               |                                   | $\pm 100^*$ |               |                  | $\pm 100$ | $\mu\text{A}$ |
| $I_{OZPD}$               |                | $V_{CC} = 1.5\text{ V to } 0$ , $V_O = 0.5\text{ V to } 3\text{ V}$ ,<br>$\overline{OE} = \text{don't care}$              |               |                                   | $\pm 100^*$ |               |                  | $\pm 100$ | $\mu\text{A}$ |
| $I_{CC}$                 |                | $V_{CC} = 3.6\text{ V}$ , $I_O = 0$ ,<br>$V_I = V_{CC}\text{ or GND}$                                                     |               | Outputs high                      | 0.19        |               |                  | 0.19      | mA            |
|                          |                |                                                                                                                           |               | Outputs low                       | 5           |               |                  | 5         |               |
|                          |                |                                                                                                                           |               | Outputs disabled                  | 0.19        |               |                  | 0.19      |               |
| $\Delta I_{CC}^\ddagger$ |                | $V_{CC} = 3\text{ V to } 3.6\text{ V}$ , One input at $V_{CC} - 0.6\text{ V}$ ,<br>Other inputs at $V_{CC}\text{ or GND}$ |               |                                   | 0.2         |               |                  | 0.2       | mA            |
| $C_i$                    |                | $V_I = 3\text{ V or } 0$                                                                                                  |               |                                   | 4           |               |                  | 4         | pF            |
| $C_o$                    |                | $V_O = 3\text{ V or } 0$                                                                                                  |               |                                   | 9           |               |                  | 9         | pF            |

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

<sup>†</sup> All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup> This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

**SN54LVT16244B, SN74LVT16244B**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

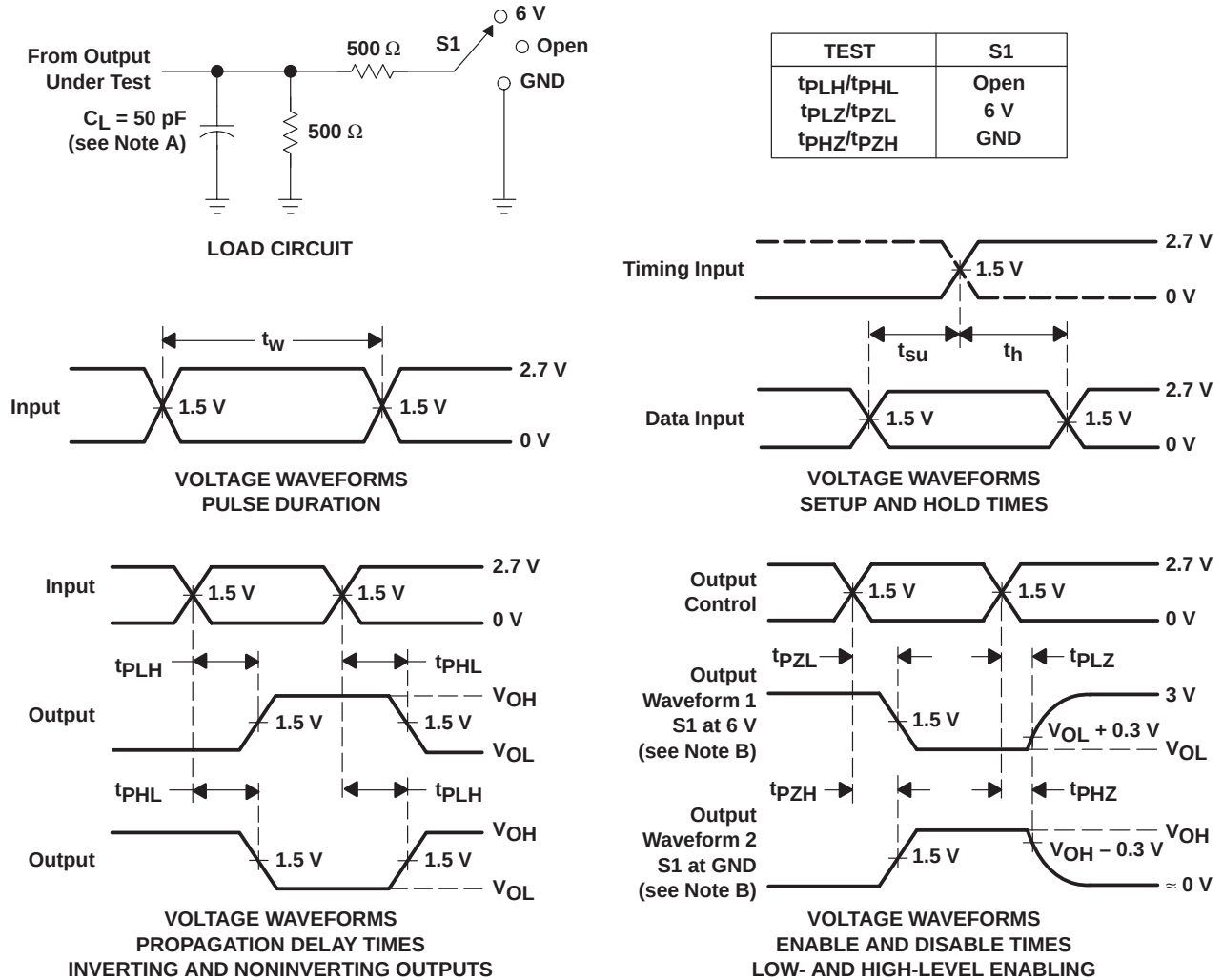
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switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF  
(unless otherwise noted) (see Figure 1)

| PARAMETER          | FROM<br>(INPUT) | TO<br>(OUTPUT) | SN54LVT16244B                      |     |                         |     | SN74LVT16244B                      |      |     |                         | UNIT |     |
|--------------------|-----------------|----------------|------------------------------------|-----|-------------------------|-----|------------------------------------|------|-----|-------------------------|------|-----|
|                    |                 |                | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 2.7 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |      |     | V <sub>CC</sub> = 2.7 V |      |     |
|                    |                 |                | MIN                                | MAX | MIN                     | MAX | MIN                                | TYP† | MAX | MIN                     |      | MAX |
| t <sub>PLH</sub>   | A               | Y              | 1.1                                | 4.4 |                         | 4.6 | 1.2                                | 2.3  | 3.2 |                         | 3.7  | ns  |
| t <sub>PHL</sub>   |                 |                | 1.1                                | 3.6 |                         | 3.9 | 1.2                                | 2    | 3.2 |                         | 3.7  |     |
| t <sub>PZH</sub>   | OE              | Y              | 1.1                                | 4.6 |                         | 5.4 | 1.2                                | 2.6  | 4   |                         | 5    | ns  |
| t <sub>PZL</sub>   |                 |                | 1.1                                | 5.4 |                         | 6.2 | 1.2                                | 2.7  | 4   |                         | 5    |     |
| t <sub>PHZ</sub>   | OE              | Y              | 1.6                                | 5.7 |                         | 6.2 | 2.2                                | 3.3  | 4.5 |                         | 5    | ns  |
| t <sub>PLZ</sub>   |                 |                | 1.2                                | 5   |                         | 4.7 | 2                                  | 3.1  | 4.2 |                         | 4.4  |     |
| t <sub>sk(o)</sub> |                 |                |                                    |     |                         |     |                                    |      | 0.5 |                         |      | ns  |

<sup>†</sup> All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

## PARAMETER MEASUREMENT INFORMATION



- 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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .  
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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