

SN74LVCH32244A 32-BIT BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS617A – OCTOBER 1998 – REVISED JUNE 1999

- 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, $T_A = 25^\circ\text{C}$
- I_{off} Supports Partial-Power-Down-Mode Operation
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V V_{CC})
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- Packaged in Plastic Fine-Pitch Ball Grid Array Package

description

This 32-bit buffer/driver is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74LVCH32244A is designed specifically to improve the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters.

The device can be used as eight 4-bit buffers, four 8-bit buffers, two 16-bit buffers, or one 32-bit buffer. It provides true outputs and symmetrical active-low output-enable (\overline{OE}) inputs.

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of these devices as translators in a mixed 3.3-V/5-V system environment.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

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.

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

The SN74LVCH32244A is characterized for operation from -40°C to 85°C .

FUNCTION TABLE
(each 4-bit buffer)

| INPUTS | | OUTPUT |
|-----------------|---|--------|
| \overline{OE} | A | Y |
| L | H | H |
| L | L | L |
| H | X | Z |



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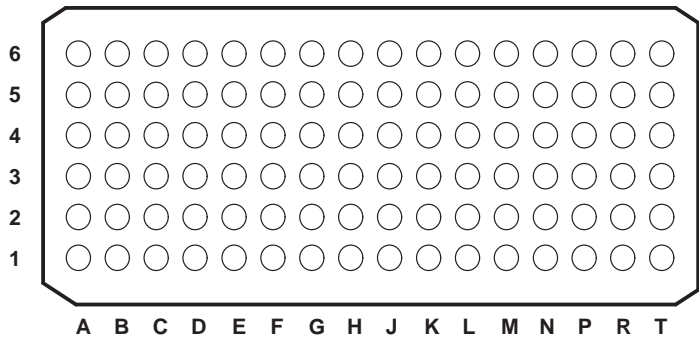
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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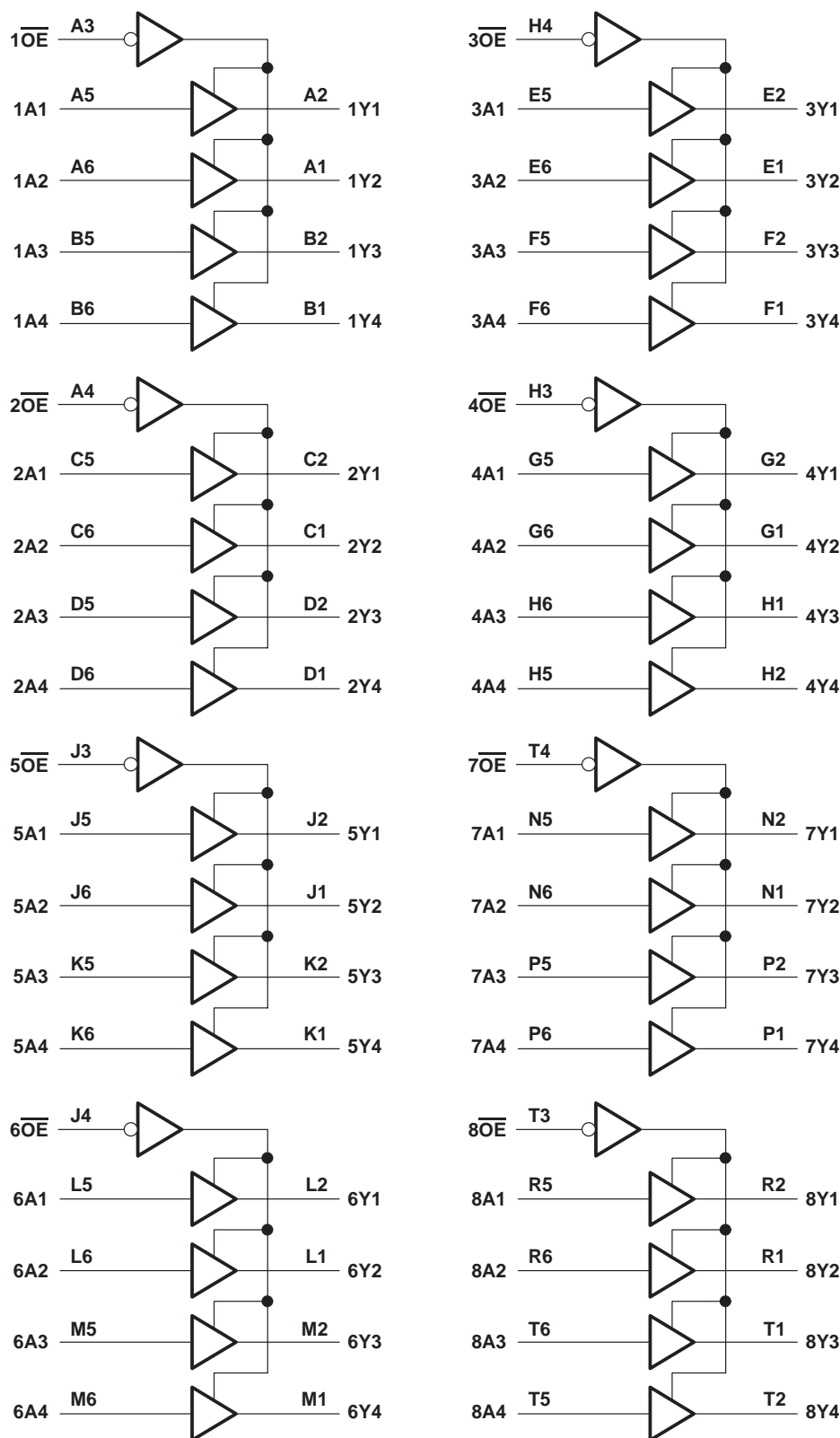
GKE PACKAGE
(TOP VIEW)



terminal assignments

| | | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 6 | 1A2 | 1A4 | 2A2 | 2A4 | 3A2 | 3A4 | 4A2 | 4A3 | 5A2 | 5A4 | 6A2 | 6A4 | 7A2 | 7A4 | 8A2 | 8A3 |
| 5 | 1A1 | 1A3 | 2A1 | 2A3 | 3A1 | 3A3 | 4A1 | 4A4 | 5A1 | 5A3 | 6A1 | 6A3 | 7A1 | 7A3 | 8A1 | 8A4 |
| 4 | 2OE | GND | VCC | GND | GND | VCC | GND | 3OE | 6OE | GND | VCC | GND | GND | VCC | GND | 7OE |
| 3 | 1OE | GND | VCC | GND | GND | VCC | GND | 4OE | 5OE | GND | VCC | GND | GND | VCC | GND | 8OE |
| 2 | 1Y1 | 1Y3 | 2Y1 | 2Y3 | 3Y1 | 3Y3 | 4Y1 | 4Y4 | 5Y1 | 5Y3 | 6Y1 | 6Y3 | 7Y1 | 7Y3 | 8Y1 | 8Y4 |
| 1 | 1Y2 | 1Y4 | 2Y2 | 2Y4 | 3Y2 | 3Y4 | 4Y2 | 4Y3 | 5Y2 | 5Y4 | 6Y2 | 6Y4 | 7Y2 | 7Y4 | 8Y2 | 8Y3 |
| | A | B | C | D | E | F | G | H | J | K | L | M | N | P | R | T |

logic diagram (positive logic)



SN74LVCH32244A

32-BIT BUFFER/DRIVER

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 6.5 V |
| Input voltage range, V_I (see Note 1) | –0.5 V to 6.5 V |
| Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1) | –0.5 V to 6.5 V |
| Voltage range applied to any output in the high or low state, 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} ($V_O < 0$) | –50 mA |
| Continuous output current, I_O | ±50 mA |
| Continuous current through each V_{CC} or GND | ±100 mA |
| Package thermal impedance, θ_{JA} (see Note 3) | 40°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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The value of V_{CC} is provided in the recommended operating conditions table.
3. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 4)

| | | MIN | MAX | UNIT |
|--|-----------------------------|----------------------|----------------------|------|
| V_{CC} Supply voltage | Operating | 1.65 | 3.6 | V |
| | Data retention only | 1.5 | | |
| V_{IH} High-level input voltage | $V_{CC} = 1.65$ V to 1.95 V | $0.65 \times V_{CC}$ | | V |
| | $V_{CC} = 2.3$ V to 2.7 V | 1.7 | | |
| | $V_{CC} = 2.7$ V to 3.6 V | 2 | | |
| V_{IL} Low-level input voltage | $V_{CC} = 1.65$ V to 1.95 V | | $0.35 \times V_{CC}$ | V |
| | $V_{CC} = 2.3$ V to 2.7 V | | 0.7 | |
| | $V_{CC} = 2.7$ V to 3.6 V | | 0.8 | |
| V_I Input voltage | | 0 | 5.5 | V |
| V_O Output voltage | High or low state | 0 | V_{CC} | V |
| | 3-state | 0 | 5.5 | |
| I_{OH} High-level output current | $V_{CC} = 1.65$ V | | –4 | mA |
| | $V_{CC} = 2.3$ V | | –8 | |
| | $V_{CC} = 2.7$ V | | –12 | |
| | $V_{CC} = 3$ V | | –24 | |
| I_{OL} Low-level output current | $V_{CC} = 1.65$ V | | 4 | mA |
| | $V_{CC} = 2.3$ V | | 8 | |
| | $V_{CC} = 2.7$ V | | 12 | |
| | $V_{CC} = 3$ V | | 24 | |
| $\Delta t/\Delta v$ Input transition rise or fall rate | | | 10 | ns/V |
| T_A Operating free-air temperature | | –40 | 85 | °C |

NOTE 4: 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 | | V _{CC} | MIN | TYP† | MAX | UNIT |
|-----------------------|---|--------------------|-----------------|----------------------|------|------|------|
| V _{OH} | I _{OH} = –100 μA | | 1.65 V to 3.6 V | V _{CC} –0.2 | | | V |
| | I _{OH} = –4 mA | | 1.65 V | 1.2 | | | |
| | I _{OH} = –8 mA | | 2.3 V | 1.7 | | | |
| | I _{OH} = –12 mA | | 2.7 V | 2.2 | | | |
| | | | 3 V | 2.4 | | | |
| | I _{OH} = –24 mA | | 3 V | 2.2 | | | |
| V _{OL} | I _{OL} = 100 μA | | 1.65 V to 3.6 V | | | 0.2 | V |
| | I _{OL} = 4 mA | | 1.65 V | | | 0.45 | |
| | I _{OL} = 8 mA | | 2.3 V | | | 0.7 | |
| | I _{OL} = 12 mA | | 2.7 V | | | 0.4 | |
| | I _{OL} = 24 mA | | 3 V | | | 0.55 | |
| I _I | V _I = 0 to 5.5 V | | 3.6 V | | | ±5 | μA |
| I _I (hold) | V _I = 0.58 V | | 1.65 V | 25 | | | μA |
| | V _I = 1.07 V | | | –25 | | | |
| | V _I = 0.7 V | | 2.3 V | 45 | | | |
| | V _I = 1.7 V | | | –45 | | | |
| | V _I = 0.8 V | | 3 V | 75 | | | |
| | V _I = 2 V | | | –75 | | | |
| | V _I = 0 to 3.6 V‡ | | 3.6 V | ±500 | | | |
| I _{off} | V _I or V _O = 5.5 V | | 0 | ±10 | | μA | |
| I _{OZ} | V _O = 0 to 5.5 V | | 3.6 V | ±10 | | μA | |
| I _{CC} | V _I = V _{CC} or GND | I _O = 0 | 3.6 V | 20 | | μA | |
| | 3.6 V ≤ V _I ≤ 5.5 V§ | | | 20 | | | |
| ΔI _{CC} | One input at V _{CC} – 0.6 V, Other inputs at V _{CC} or GND | | 2.7 V to 3.6 V | 500 | | μA | |
| C _i | V _I = V _{CC} or GND | | 3.3 V | 5.5 | | pF | |
| C _o | V _O = V _{CC} or GND | | 3.3 V | 6 | | pF | |

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

‡ This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

§ This applies in the disabled state only.

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figures 1 through 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} = 1.8 V ± 0.15 V | | V _{CC} = 2.5 V ± 0.2 V | | V _{CC} = 2.7 V | | V _{CC} = 3.3 V ± 0.3 V | | UNIT |
|----------------------|------------------------|-------------|-------------------------------------|-----|------------------------------------|-----|-------------------------|-----|------------------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{pd} | A | Y | ¶ | ¶ | ¶ | ¶ | 4.7 | | 1.1 | 4.1 | ns |
| t _{en} | $\overline{\text{OE}}$ | Y | ¶ | ¶ | ¶ | ¶ | 5.8 | | 1 | 4.6 | ns |
| t _{dis} | $\overline{\text{OE}}$ | Y | ¶ | ¶ | ¶ | ¶ | 6.2 | | 1.8 | 5.8 | ns |
| t _{sk(o)} # | | | | | | | | | 1.5 | | ns |

¶ This information was not available at the time of publication.

Skew between any two outputs of the same package switching in the same direction

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32-BIT BUFFER/DRIVER

WITH 3-STATE OUTPUTS

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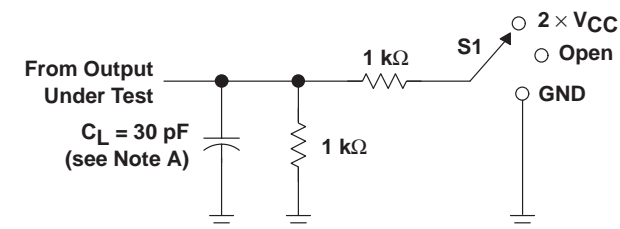
operating characteristics, $T_A = 25^\circ\text{C}$

| PARAMETER | | | TEST CONDITIONS | $V_{CC} = 1.8\text{ V}$ | $V_{CC} = 2.5\text{ V}$ | $V_{CC} = 3.3\text{ V}$ | UNIT |
|-----------|---|------------------|---------------------|-------------------------|-------------------------|-------------------------|------|
| | | | | TYP | TYP | TYP | |
| C_{pd} | Power dissipation capacitance per buffer/driver | Outputs enabled | $f = 10\text{ MHz}$ | † | † | 34 | pF |
| | | Outputs disabled | | † | † | 4 | |

† This information was not available at the time of publication.

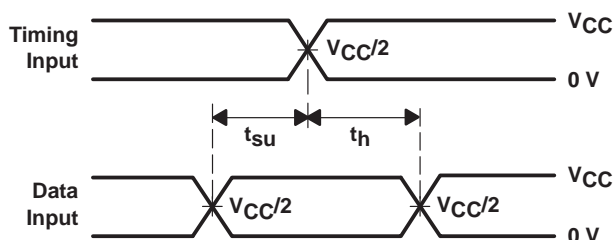
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 1.8\text{ V} \pm 0.15\text{ V}$

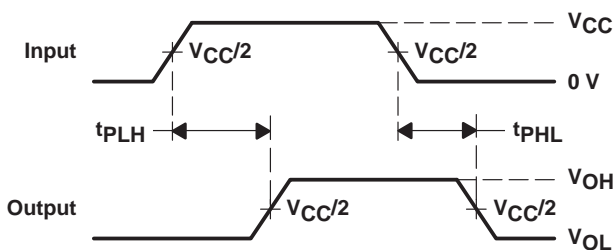


LOAD CIRCUIT

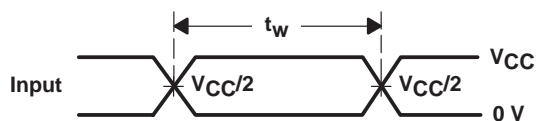
| TEST | S1 |
|-------------------|--------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | 2 × V_{CC} |
| t_{PHZ}/t_{PZH} | GND |



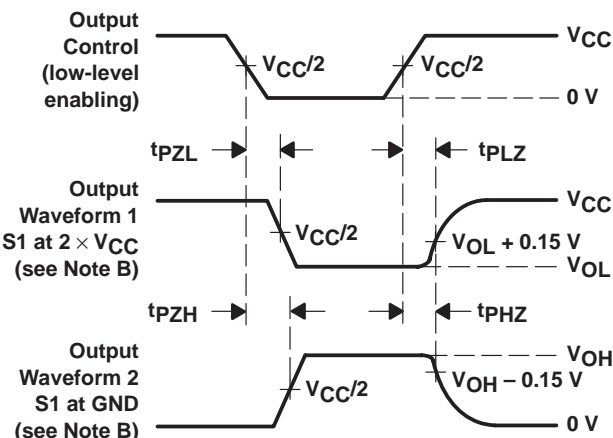
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- 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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 - The outputs are measured one at a time with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

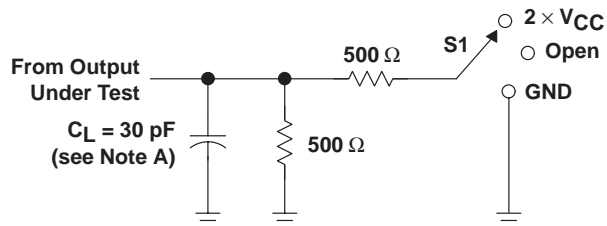
Figure 1. Load Circuit and Voltage Waveforms



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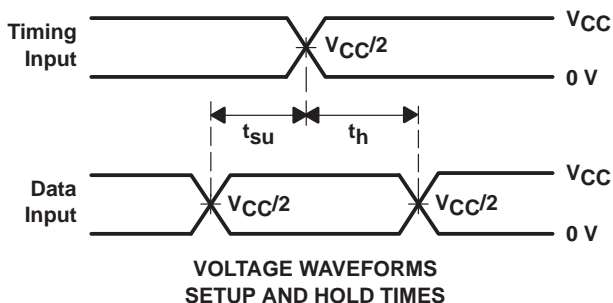
PARAMETER MEASUREMENT INFORMATION

$$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$$

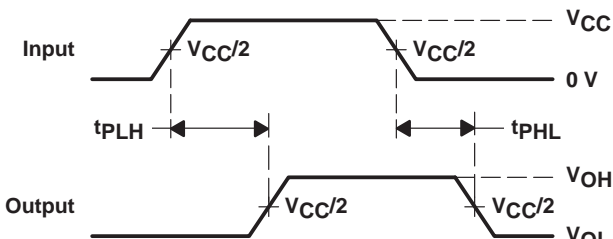


LOAD CIRCUIT

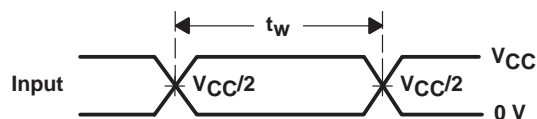
| TEST | S1 |
|-------------------|-------------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



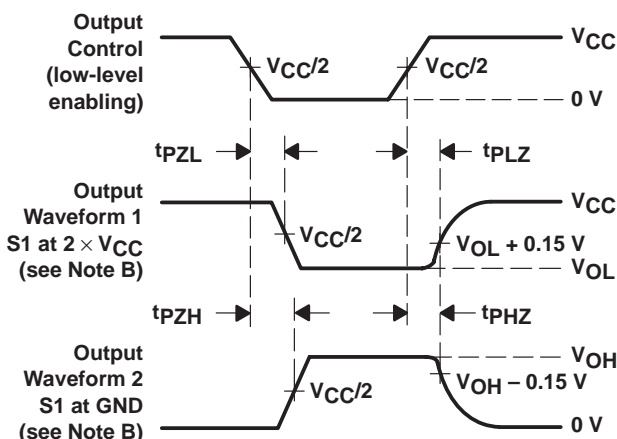
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
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C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2 \text{ ns}$, $t_f \leq 2 \text{ ns}$.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
F. t_{PZL} and t_{PZH} are the same as t_{en} .
G. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 2. Load Circuit and Voltage Waveforms

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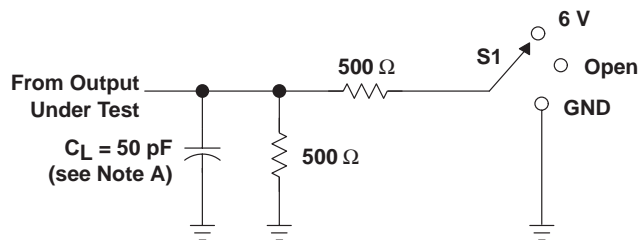
32-BIT BUFFER/DRIVER

WITH 3-STATE OUTPUTS

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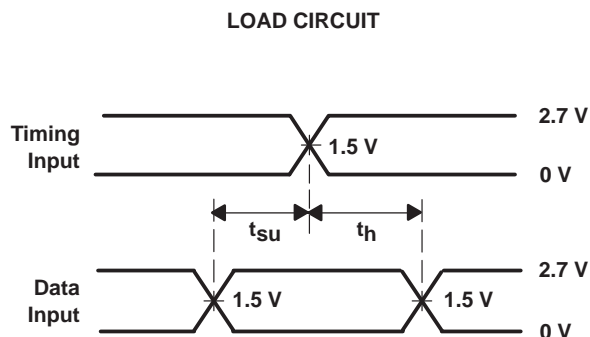
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$

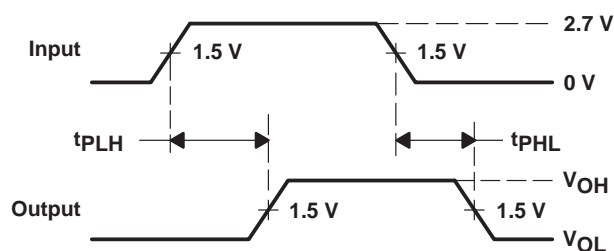


LOAD CIRCUIT

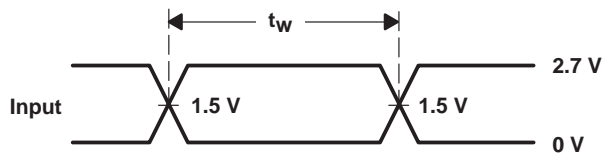
| TEST | S1 |
|-------------------|------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | 6 V |
| t_{PHZ}/t_{PZH} | GND |



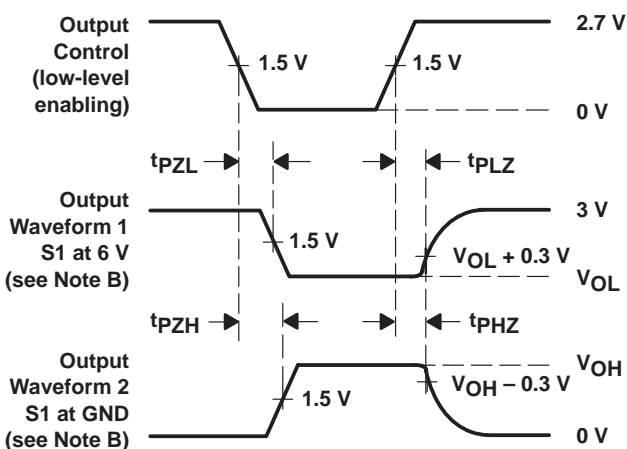
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



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 - The outputs are measured one at a time with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 3. Load Circuit and Voltage Waveforms

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