

SN74AVCH32T245

32-BIT DUAL-SUPPLY BUS TRANSCEIVER

WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

SCES589B – AUGUST 2004 – REVISED APRIL 2005

- Member of the Texas Instruments Widebus+™ Family
- Control Inputs V_{IH}/V_{IL} Levels Are Referenced to V_{CCA} Voltage
- V_{CC} Isolation Feature – If Either V_{CC} Input Is at GND, Both Ports Are in the High-Impedance State
- Overvoltage-Tolerant Inputs/Outputs Allow Mixed-Voltage-Mode Data Communications
- Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.2-V to 3.6-V Power-Supply Range
- I_{off} Supports Partial-Power-Down Mode Operation
- I/Os Are 4.6-V Tolerant
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 8000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

description/ordering information

This 32-bit noninverting bus transceiver uses two separate configurable power-supply rails. The SN74AVCH32T245 is optimized to operate with V_{CCA}/V_{CCB} set at 1.4 V to 3.6 V. It is operational with V_{CCA}/V_{CCB} as low as 1.2 V. The A port is designed to track V_{CCA} . V_{CCA} accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track V_{CCB} . V_{CCB} accepts any supply voltage from 1.2 V to 3.6 V. This allows for universal low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes.

The SN74AVCH32T245 is designed for asynchronous communication between data buses. The device transmits data 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 outputs so the buses are effectively isolated.

The SN74AVCH32T245 is designed so that the control pins (1DIR, 2DIR, 3DIR, 4DIR, $\overline{1OE}$, $\overline{2OE}$, $\overline{3OE}$, and $\overline{4OE}$) are supplied by V_{CCA} .

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.

The V_{CC} isolation feature ensures that if either V_{CC} input is at GND, then both ports are in the high-impedance state.

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.

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.

ORDERING INFORMATION

| T_A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|-----------------------|---------------|-----------------------|------------------|
| –40°C to 85°C | LFBGA – GKE | Tape and reel | SN74AVCH32T245KR | WJ245 |
| | LFBGA – ZKE (Pb-free) | | 74AVCH32T245ZKER | |

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



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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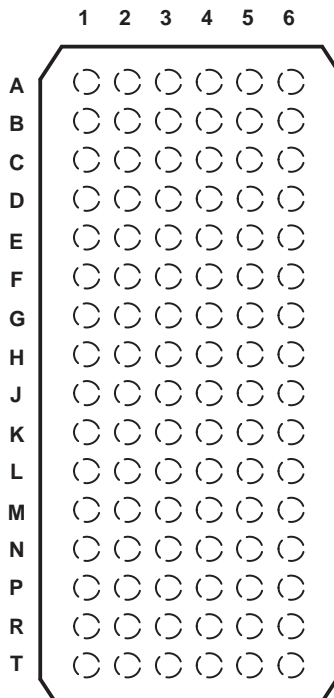
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GKE OR ZKE PACKAGE
(TOP VIEW)



terminal assignments

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|-----|-----|------|------------------|-----|-----|
| A | 1B2 | 1B1 | 1DIR | $\overline{1OE}$ | 1A1 | 1A2 |
| B | 1B4 | 1B3 | GND | GND | 1A3 | 1A4 |
| C | 1B6 | 1B5 | VCCB | VCCA | 1A5 | 1A6 |
| D | 1B8 | 1B7 | GND | GND | 1A7 | 1A8 |
| E | 2B2 | 2B1 | GND | GND | 2A1 | 2A2 |
| F | 2B4 | 2B3 | VCCB | VCCA | 2A3 | 2A4 |
| G | 2B6 | 2B5 | GND | GND | 2A5 | 2A6 |
| H | 2B7 | 2B8 | 2DIR | $\overline{2OE}$ | 2A8 | 2A7 |
| J | 3B2 | 3B1 | 3DIR | $\overline{3OE}$ | 3A1 | 3A2 |
| K | 3B4 | 3B3 | GND | GND | 3A3 | 3A4 |
| L | 3B6 | 3B5 | VCCB | VCCA | 3A5 | 3A6 |
| M | 3B8 | 3B7 | GND | GND | 3A7 | 3A8 |
| N | 4B2 | 4B1 | GND | GND | 4A1 | 4A2 |
| P | 4B4 | 4B3 | VCCB | VCCA | 4A3 | 4A4 |
| R | 4B6 | 4B5 | GND | GND | 4A5 | 4A6 |
| T | 4B7 | 4B8 | 4DIR | $\overline{4OE}$ | 4A8 | 4A7 |

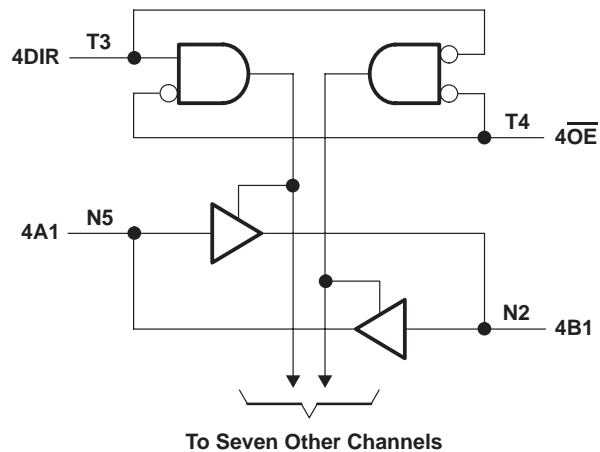
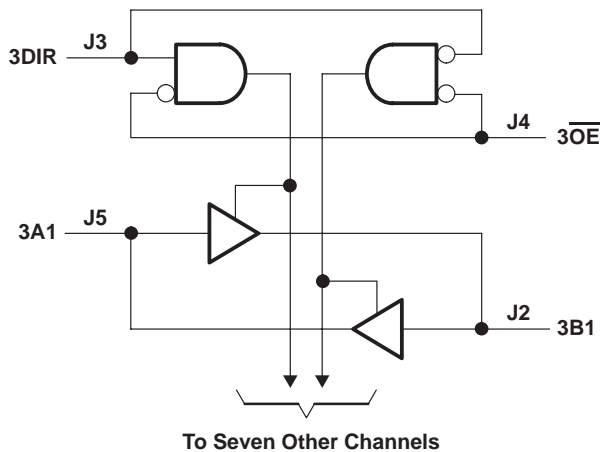
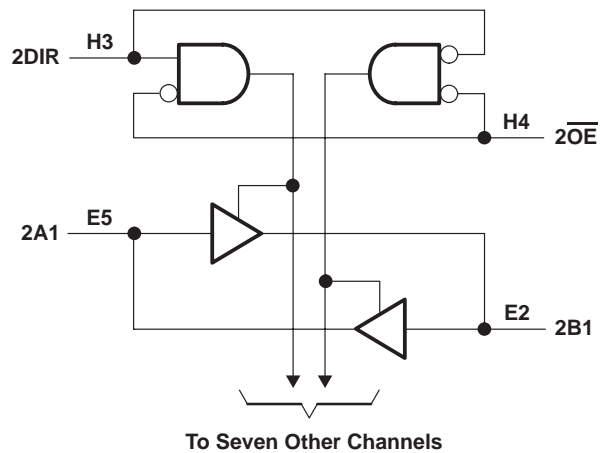
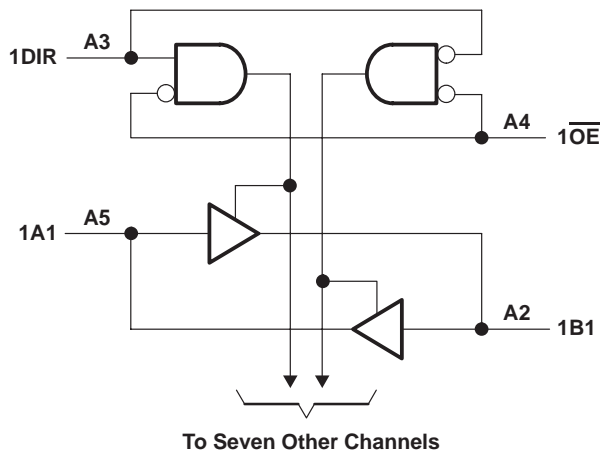
FUNCTION TABLE
(each 8-bit section)

| 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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logic diagram (positive logic)



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

| | |
|---|-----------------------------|
| Supply voltage range, V_{CCA} and V_{CCB} | -0.5 V to 4.6 V |
| Input voltage range, V_I (see Note 1): I/O ports (A port) | -0.5 V to 4.6 V |
| I/O ports (B port) | -0.5 V to 4.6 V |
| Control inputs | -0.5 V to 4.6 V |
| Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1): A port | -0.5 V to 4.6 V |
| B port | -0.5 V to 4.6 V |
| Voltage range applied to any output in the high or low state, V_O (see Notes 1 and 2): A port | -0.5 V to $V_{CCA} + 0.5$ V |
| B port | -0.5 V to $V_{CCB} + 0.5$ 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_{CCA} , V_{CCB} , and GND | ± 100 mA |
| Package thermal impedance, θ_{JA} (see Note 3): GKE/ZKE package | 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 voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.



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recommended operating conditions (see Notes 4 through 8)

| | | V_{CCI} | V_{CCO} | MIN | MAX | UNIT |
|---------------------|------------------------------------|---|------------------|-----------------------|-----------|------|
| V_{CCA} | Supply voltage | | | 1.2 | 3.6 | V |
| V_{CCB} | Supply voltage | | | 1.2 | 3.6 | V |
| V_{IH} | High-level input voltage | Data inputs (see Note 7) | 1.2 V to 1.95 V | $V_{CCI} \times 0.65$ | | V |
| | | | 1.95 V to 2.7 V | 1.6 | | |
| | | | 2.7 V to 3.6 V | 2 | | |
| V_{IL} | Low-level input voltage | Data inputs (see Note 7) | 1.2 V to 1.95 V | $V_{CCI} \times 0.35$ | | V |
| | | | 1.95 V to 2.7 V | 0.7 | | |
| | | | 2.7 V to 3.6 V | 0.8 | | |
| V_{IH} | High-level input voltage | DIR (referenced to V_{CCA}) (see Note 8) | 1.2 V to 1.95 V | $V_{CCA} \times 0.65$ | | V |
| | | | 1.95 V to 2.7 V | 1.6 | | |
| | | | 2.7 V to 3.6 V | 2 | | |
| V_{IL} | Low-level input voltage | DIR (referenced to V_{CCA}) (see Note 8) | 1.2 V to 1.95 V | $V_{CCA} \times 0.35$ | | V |
| | | | 1.95 V to 2.7 V | 0.7 | | |
| | | | 2.7 V to 3.6 V | 0.8 | | |
| V_I | Input voltage | | | 0 | 3.6 | V |
| V_O | Output voltage | Active state | | 0 | V_{CCO} | V |
| | | 3-state | | 0 | 3.6 | |
| I_{OH} | High-level output current | | 1.2 V | -3 | | mA |
| | | | 1.4 V to 1.6 V | -6 | | |
| | | | 1.65 V to 1.95 V | -8 | | |
| | | | 2.3 V to 2.7 V | -9 | | |
| | | | 3 V to 3.6 V | -12 | | |
| I_{OL} | Low-level output current | | 1.2 V | 3 | | mA |
| | | | 1.4 V to 1.6 V | 6 | | |
| | | | 1.65 V to 1.95 V | 8 | | |
| | | | 2.3 V to 2.7 V | 9 | | |
| | | | 3 V to 3.6 V | 12 | | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | | | | 5 | ns/V |
| T_A | Operating free-air temperature | | | -40 | 85 | °C |

- NOTES: 4. V_{CCI} is the V_{CC} associated with the data input port.
5. V_{CCO} is the V_{CC} associated with the output port.
6. All unused data inputs of the device must be held at V_{CCI} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
7. For V_{CCI} values not specified in the data sheet, V_{IH} min = $V_{CCI} \times 0.7$ V, V_{IL} max = $V_{CCI} \times 0.3$ V.
8. For V_{CCI} values not specified in the data sheet, V_{IH} min = $V_{CCA} \times 0.7$ V, V_{IL} max = $V_{CCA} \times 0.3$ V.



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Notes 9 and 10)

| PARAMETER | TEST CONDITIONS | | V _{CCA} | V _{CCB} | T _A = 25°C | | | -40°C TO 85°C | | UNIT |
|---------------------|---------------------------------------|--|------------------|------------------|-----------------------|--------|-------|--------------------------|-----|------|
| | | | | | MIN | TYP | MAX | MIN | MAX | |
| V _{OH} | I _{OH} = -100 μA | V _I = V _{IH} | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | | V _{CCO} - 0.2 V | | V |
| | I _{OH} = -3 mA | | 1.2 V | 1.2 V | 0.95 | | | | | |
| | I _{OH} = -6 mA | | 1.4 V | 1.4 V | | | | 1.05 | | |
| | I _{OH} = -8 mA | | 1.65 V | 1.65 V | | | | 1.2 | | |
| | I _{OH} = -9 mA | | 2.3 V | 2.3 V | | | | 1.75 | | |
| | I _{OH} = -12 mA | | 3 V | 3 V | | | | 2.3 | | |
| V _{OL} | I _{OL} = 100 μA | V _I = V _{IL} | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | | 0.2 | | V |
| | I _{OL} = 3 mA | | 1.2 V | 1.2 V | 0.15 | | | | | |
| | I _{OL} = 6 mA | | 1.4 V | 1.4 V | | | | 0.35 | | |
| | I _{OL} = 8 mA | | 1.65 V | 1.65 V | | | | 0.45 | | |
| | I _{OL} = 9 mA | | 2.3 V | 2.3 V | | | | 0.55 | | |
| | I _{OL} = 12 mA | | 3 V | 3 V | | | | 0.7 | | |
| I _I | Control inputs | V _I = V _{CCA} or GND | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | ±0.025 | ±0.25 | | ±1 | μA |
| I _{BHL} † | V _I = 0.42 V | | 1.2 V | 1.2 V | | 25 | | | | μA |
| | V _I = 0.49 V | | 1.4 V | 1.4 V | | | | 15 | | |
| | V _I = 0.58 V | | 1.65 V | 1.65 V | | | | 25 | | |
| | V _I = 0.7 V | | 2.3 V | 2.3 V | | | | 45 | | |
| | V _I = 0.8 V | | 3.3 V | 3.3 V | | | | 100 | | |
| I _{BHH} ‡ | V _I = 0.78 V | | 1.2 V | 1.2 V | | -25 | | | | μA |
| | V _I = 0.91 V | | 1.4 V | 1.4 V | | | | -15 | | |
| | V _I = 1.07 V | | 1.65 V | 1.65 V | | | | -25 | | |
| | V _I = 1.6 V | | 2.3 V | 2.3 V | | | | -45 | | |
| | V _I = 2 V | | 3.3 V | 3.3 V | | | | -100 | | |
| I _{BHLO} § | V _I = 0 to V _{CC} | | 1.2 V | 1.2 V | | 50 | | | | μA |
| | | | 1.6 V | 1.6 V | | | | 125 | | |
| | | | 1.95 V | 1.95 V | | | | 200 | | |
| | | | 2.7 V | 2.7 V | | | | 300 | | |
| | | | 3.6 V | 3.6 V | | | | 500 | | |
| I _{BHHO} ¶ | V _I = 0 to V _{CC} | | 1.2 V | 1.2 V | | -50 | | | | μA |
| | | | 1.6 V | 1.6 V | | | | -125 | | |
| | | | 1.95 V | 1.95 V | | | | -200 | | |
| | | | 2.7 V | 2.7 V | | | | -300 | | |
| | | | 3.6 V | 3.6 V | | | | -500 | | |

† The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.

‡ The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.

§ An external driver must source at least I_{BHLO} to switch this node from low to high.

¶ An external driver must sink at least I_{BHHO} to switch this node from high to low.

NOTES: 9. V_{CCO} is the V_{CC} associated with the output port.

10. V_{CCI} is the V_{CC} associated with the input port.



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Notes 9 and 10) (continued)

| PARAMETER | TEST CONDITIONS | V _{CCA} | V _{CCB} | T _A = 25°C | | | -40°C TO 85°C | | UNIT | |
|-------------------------------------|---|---|---------------------------------|-----------------------|-------|------|---------------|-----|------|----|
| | | | | MIN | TYP | MAX | MIN | MAX | | |
| I _{off} | A port | V _I or V _O = 0 to 3.6 V | 0 V | 0 to 3.6 V | ±0.1 | ±2.5 | ±5 | | μA | |
| | B port | | 0 to 3.6 V | 0 V | ±0.1 | ±2.5 | ±5 | | | |
| I _{OZ} # | A or B ports | V _O = V _{CCO} or GND, V _I = V _{CCI} or GND | $\overline{OE} = V_{IH}$ | 3.6 V | 3.6 V | ±0.5 | ±2.5 | ±5 | | μA |
| | B port | | $\overline{OE} =$ don't care | 0 V | 3.6 V | | | ±5 | | |
| | A port | | | 3.6 V | 0 V | | | ±5 | | |
| I _{CCA} | V _I = V _{CCI} or GND, I _O = 0 | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | 50 | | μA | | |
| | | 0 V | 3.6 V | | | -10 | | | | |
| | | 3.6 V | 0 V | | | 50 | | | | |
| I _{CCB} | V _I = V _{CCI} or GND, I _O = 0 | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | 50 | | μA | | |
| | | 0 V | 3.6 V | | | 50 | | | | |
| | | 3.6 V | 0 V | | | -10 | | | | |
| I _{CCA} + I _{CCB} | V _I = V _{CCI} or GND, I _O = 0 | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | 90 | | μA | | |
| C _i | Control inputs | V _I = 3.3 V or GND | 3.3 V | 3.3 V | 3.5 | | | | pF | |
| C _{io} | A or B ports | V _O = 3.3 V or GND | 3.3 V | 3.3 V | 7 | | | | pF | |

For I/O ports, the parameter I_{OZ} includes the input leakage current.

NOTES: 9. V_{CCO} is the V_{CC} associated with the output port.

10. V_{CCI} is the V_{CC} associated with the input port.

switching characteristics over recommended operating free-air temperature range,
V_{CCA} = 1.2 V (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2 V | V _{CCB} = 1.5 V | V _{CCB} = 1.8 V | V _{CCB} = 2.5 V | V _{CCB} = 3.3 V | UNIT |
|------------------|-----------------|-------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------|
| | | | TYP | TYP | TYP | TYP | TYP | |
| t _{PLH} | A | B | 4.1 | 3.3 | 3 | 2.8 | 3.2 | ns |
| t _{PHL} | | | 4.1 | 3.3 | 3 | 2.8 | 3.2 | |
| t _{PLH} | B | A | 4.4 | 4 | 3.8 | 3.6 | 3.5 | ns |
| t _{PHL} | | | 4.4 | 4 | 3.8 | 3.6 | 3.5 | |
| t _{PZH} | \overline{OE} | A | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 | ns |
| t _{PZL} | | | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 | |
| t _{PZH} | \overline{OE} | B | 6 | 4.6 | 4 | 3.4 | 3.2 | ns |
| t _{PZL} | | | 6 | 4.6 | 4 | 3.4 | 3.2 | |
| t _{PHZ} | \overline{OE} | A | 6.6 | 6.6 | 6.6 | 6.6 | 6.8 | ns |
| t _{PLZ} | | | 6.6 | 6.6 | 6.6 | 6.6 | 6.8 | |
| t _{PHZ} | \overline{OE} | B | 6 | 4.9 | 4.9 | 4.2 | 5.3 | ns |
| t _{PLZ} | | | 6 | 4.9 | 4.9 | 4.2 | 5.3 | |



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switching characteristics over recommended operating free-air temperature range,
 $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$ (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2 V | V _{CCB} = 1.5 V ± 0.1 V | | V _{CCB} = 1.8 V ± 0.15 V | | V _{CCB} = 2.5 V ± 0.2 V | | V _{CCB} = 3.3 V ± 0.3 V | | UNIT |
|------------------|-----------------|-------------|--------------------------|----------------------------------|------|-----------------------------------|------|----------------------------------|------|----------------------------------|------|------|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{PLH} | A | B | 3.6 | 0.5 | 6.2 | 0.5 | 5.2 | 0.5 | 4.1 | 0.5 | 3.7 | ns |
| t _{PHL} | | | 3.6 | 0.5 | 6.2 | 0.5 | 5.2 | 0.5 | 4.1 | 0.5 | 3.7 | |
| t _{PLH} | B | A | 3.3 | 0.5 | 6.2 | 0.5 | 5.9 | 0.5 | 5.6 | 0.5 | 5.5 | ns |
| t _{PHL} | | | 3.3 | 0.5 | 6.2 | 0.5 | 5.9 | 0.5 | 5.6 | 0.5 | 5.5 | |
| t _{PZH} | \overline{OE} | A | 4.3 | 1 | 10.1 | 1 | 10.1 | 1 | 10.1 | 1 | 10.1 | ns |
| t _{PZL} | | | 4.3 | 1 | 10.1 | 1 | 10.1 | 1 | 10.1 | 1 | 10.1 | |
| t _{PZH} | \overline{OE} | B | 5.6 | 1 | 10.1 | 0.5 | 8.1 | 0.5 | 5.9 | 0.5 | 5.2 | ns |
| t _{PZL} | | | 5.6 | 1 | 10.1 | 0.5 | 8.1 | 0.5 | 5.9 | 0.5 | 5.2 | |
| t _{PHZ} | \overline{OE} | A | 4.5 | 1.5 | 9.1 | 1.5 | 9.1 | 1.5 | 9.1 | 1.5 | 9.1 | ns |
| t _{PLZ} | | | 4.5 | 1.5 | 9.1 | 1.5 | 9.1 | 1.5 | 9.1 | 1.5 | 9.1 | |
| t _{PHZ} | \overline{OE} | B | 5.5 | 1.5 | 8.7 | 1.5 | 7.5 | 1 | 6.5 | 1 | 6.3 | ns |
| t _{PLZ} | | | 5.5 | 1.5 | 8.7 | 1.5 | 7.5 | 1 | 6.5 | 1 | 6.3 | |

switching characteristics over recommended operating free-air temperature range,
 $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$ (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2 V | V _{CCB} = 1.5 V ± 0.1 V | | V _{CCB} = 1.8 V ± 0.15 V | | V _{CCB} = 2.5 V ± 0.2 V | | V _{CCB} = 3.3 V ± 0.3 V | | UNIT |
|------------------|-----------------|-------------|--------------------------|----------------------------------|-----|-----------------------------------|-----|----------------------------------|-----|----------------------------------|-----|------|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{PLH} | A | B | 3.4 | 0.5 | 5.9 | 0.5 | 4.8 | 0.5 | 3.7 | 0.5 | 3.3 | ns |
| t _{PHL} | | | 3.4 | 0.5 | 5.9 | 0.5 | 4.8 | 0.5 | 3.7 | 0.5 | 3.3 | |
| t _{PLH} | B | A | 3 | 0.5 | 5.2 | 0.5 | 4.8 | 0.5 | 4.5 | 0.5 | 4.4 | ns |
| t _{PHL} | | | 3 | 0.5 | 5.2 | 0.5 | 4.8 | 0.5 | 4.5 | 0.5 | 4.4 | |
| t _{PZH} | \overline{OE} | A | 3.4 | 1 | 7.8 | 1 | 7.8 | 1 | 7.8 | 1 | 7.8 | ns |
| t _{PZL} | | | 3.4 | 1 | 7.8 | 1 | 7.8 | 1 | 7.8 | 1 | 7.8 | |
| t _{PZH} | \overline{OE} | B | 5.4 | 1 | 9.2 | 0.5 | 7.4 | 0.5 | 5.3 | 0.5 | 4.5 | ns |
| t _{PZL} | | | 5.4 | 1 | 9.2 | 0.5 | 7.4 | 0.5 | 5.3 | 0.5 | 4.5 | |
| t _{PHZ} | \overline{OE} | A | 4.2 | 1.5 | 7.7 | 1.5 | 7.7 | 1.5 | 7.7 | 1.5 | 7.7 | ns |
| t _{PLZ} | | | 4.2 | 1.5 | 7.7 | 1.5 | 7.7 | 1.5 | 7.7 | 1.5 | 7.7 | |
| t _{PHZ} | \overline{OE} | B | 5.2 | 1.5 | 8.4 | 1.5 | 7.1 | 1 | 5.9 | 1 | 5.7 | ns |
| t _{PLZ} | | | 5.2 | 1.5 | 8.4 | 1.5 | 7.1 | 1 | 5.9 | 1 | 5.7 | |



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switching characteristics over recommended operating free-air temperature range,
 $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$ (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | | UNIT |
|-----------|-----------------|-------------|--------------------------|---|-----|--|-----|---|-----|---|-----|------|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{PLH} | A | B | 3.2 | 0.5 | 5.6 | 0.5 | 4.5 | 0.5 | 3.3 | 0.5 | 2.8 | ns |
| t_{PHL} | | | 3.2 | 0.5 | 5.6 | 0.5 | 4.5 | 0.5 | 3.3 | 0.5 | 2.8 | |
| t_{PLH} | B | A | 2.6 | 0.5 | 4.1 | 0.5 | 3.7 | 0.5 | 3.3 | 0.5 | 3.2 | ns |
| t_{PHL} | | | 2.6 | 0.5 | 4.1 | 0.5 | 3.7 | 0.5 | 3.3 | 0.5 | 3.2 | |
| t_{PZH} | \overline{OE} | A | 2.5 | 0.5 | 5.3 | 0.5 | 5.3 | 0.5 | 5.3 | 0.5 | 5.3 | ns |
| t_{PZL} | | | 2.5 | 0.5 | 5.3 | 0.5 | 5.3 | 0.5 | 5.3 | 0.5 | 5.3 | |
| t_{PZH} | \overline{OE} | B | 5.2 | 0.5 | 9.4 | 0.5 | 7.3 | 0.5 | 5.1 | 0.5 | 4.5 | ns |
| t_{PZL} | | | 5.2 | 0.5 | 9.4 | 0.5 | 7.3 | 0.5 | 5.1 | 0.5 | 4.5 | |
| t_{PHZ} | \overline{OE} | A | 3 | 1 | 6.1 | 1 | 6.1 | 1 | 6.1 | 1 | 6.1 | ns |
| t_{PLZ} | | | 3 | 1 | 6.1 | 1 | 6.1 | 1 | 6.1 | 1 | 6.1 | |
| t_{PHZ} | \overline{OE} | B | 5 | 1 | 7.9 | 1 | 6.6 | 1 | 6.1 | 1 | 5.2 | ns |
| t_{PLZ} | | | 5 | 1 | 7.9 | 1 | 6.6 | 1 | 6.1 | 1 | 5.2 | |

switching characteristics over recommended operating free-air temperature range,
 $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$ (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | | UNIT |
|-----------|-----------------|-------------|--------------------------|---|-----|--|-----|---|-----|---|-----|------|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{PLH} | A | B | 3.2 | 0.5 | 5.5 | 0.5 | 4.4 | 0.5 | 3.2 | 0.5 | 2.7 | ns |
| t_{PHL} | | | 3.2 | 0.5 | 5.5 | 0.5 | 4.4 | 0.5 | 3.2 | 0.5 | 2.7 | |
| t_{PLH} | B | A | 2.8 | 0.5 | 3.7 | 0.5 | 3.3 | 0.5 | 2.8 | 0.5 | 2.7 | ns |
| t_{PHL} | | | 2.8 | 0.5 | 3.7 | 0.5 | 3.3 | 0.5 | 2.8 | 0.5 | 2.7 | |
| t_{PZH} | \overline{OE} | A | 2.2 | 0.5 | 4.3 | 0.5 | 4.2 | 0.5 | 4.1 | 0.5 | 4 | ns |
| t_{PZL} | | | 2.2 | 0.5 | 4.3 | 0.5 | 4.2 | 0.5 | 4.1 | 0.5 | 4 | |
| t_{PZH} | \overline{OE} | B | 5.1 | 0.5 | 9.3 | 0.5 | 7.2 | 0.5 | 4.9 | 0.5 | 4 | ns |
| t_{PZL} | | | 5.1 | 0.5 | 9.3 | 0.5 | 7.2 | 0.5 | 4.9 | 0.5 | 4 | |
| t_{PHZ} | \overline{OE} | A | 3.4 | 0.5 | 5 | 0.5 | 5 | 0.5 | 5 | 0.5 | 5 | ns |
| t_{PLZ} | | | 3.4 | 0.5 | 5 | 0.5 | 5 | 0.5 | 5 | 0.5 | 5 | |
| t_{PHZ} | \overline{OE} | B | 4.9 | 1 | 7.7 | 1 | 6.5 | 1 | 5.2 | 0.5 | 5 | ns |
| t_{PLZ} | | | 4.9 | 1 | 7.7 | 1 | 6.5 | 1 | 5.2 | 0.5 | 5 | |

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

| PARAMETER | | | TEST CONDITIONS | $V_{CCA} =$ $V_{CCB} = 1.2\text{ V}$ | $V_{CCA} =$ $V_{CCB} = 1.5\text{ V}$ | $V_{CCA} =$ $V_{CCB} = 1.8\text{ V}$ | $V_{CCA} =$ $V_{CCB} = 2.5\text{ V}$ | $V_{CCA} =$ $V_{CCB} = 3.3\text{ V}$ | UNIT |
|-------------------|--------|------------------|---|---|---|---|---|---|------|
| | | | | TYP | TYP | TYP | TYP | TYP | |
| C_{pdA}^\dagger | A to B | Outputs enabled | $C_L = 0,$ $f = 10\text{ MHz},$ $t_r = t_f = 1\text{ ns}$ | 1 | 1 | 1 | 1 | 2 | pF |
| | | Outputs disabled | | 1 | 1 | 1 | 1 | 1 | |
| | B to A | Outputs enabled | | 13 | 13 | 14 | 15 | 16 | |
| | | Outputs disabled | | 1 | 1 | 1 | 1 | 1 | |
| C_{pdB}^\dagger | A to B | Outputs enabled | $C_L = 0,$ $f = 10\text{ MHz},$ $t_r = t_f = 1\text{ ns}$ | 13 | 13 | 14 | 15 | 16 | pF |
| | | Outputs disabled | | 1 | 1 | 1 | 1 | 1 | |
| | B to A | Outputs enabled | | 1 | 1 | 1 | 1 | 2 | |
| | | Outputs disabled | | 1 | 1 | 1 | 1 | 1 | |

† Power-dissipation capacitance per transceiver

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typical total static power consumption ($I_{CCA} + I_{CCB}$)

Table 1

| V _{CCB} | V _{CCA} | | | | | | UNIT |
|------------------|------------------|-------|-------|-------|-------|-------|------|
| | 0 V | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 3.3 V | |
| 0 V | 0 | <1 | <1 | <1 | <1 | <1 | μA |
| 1.2 V | <1 | <2 | <2 | <2 | <2 | 2 | |
| 1.5 V | <1 | <2 | <2 | <2 | <2 | 2 | |
| 1.8 V | <1 | <2 | <2 | <2 | <2 | <2 | |
| 2.5 V | <1 | 2 | <2 | <2 | <2 | <2 | |
| 3.3 V | <1 | 2 | <2 | <2 | <2 | <2 | |

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TYPICAL CHARACTERISTICS

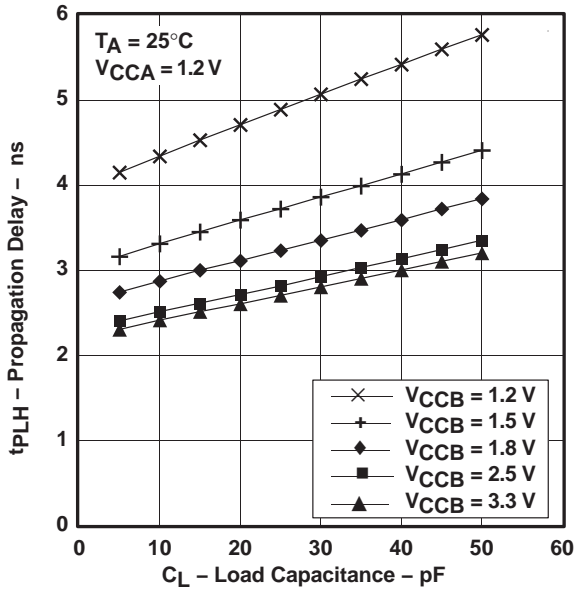


Figure 1

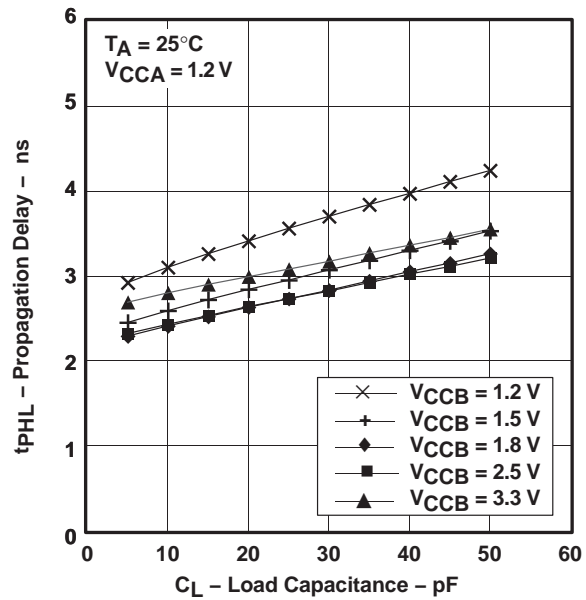


Figure 2

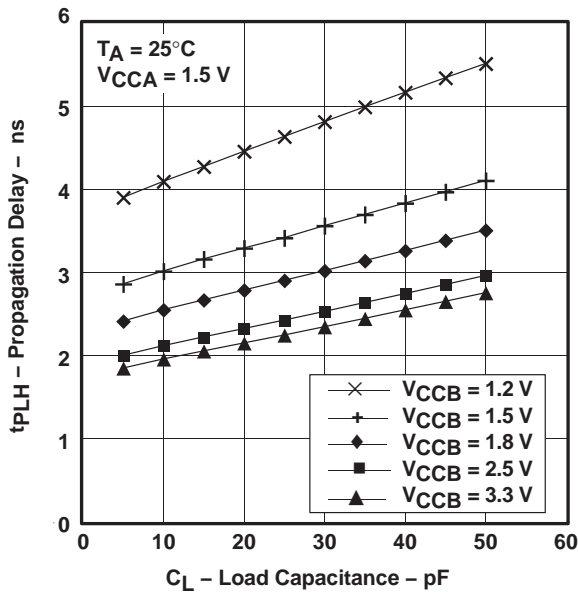


Figure 3

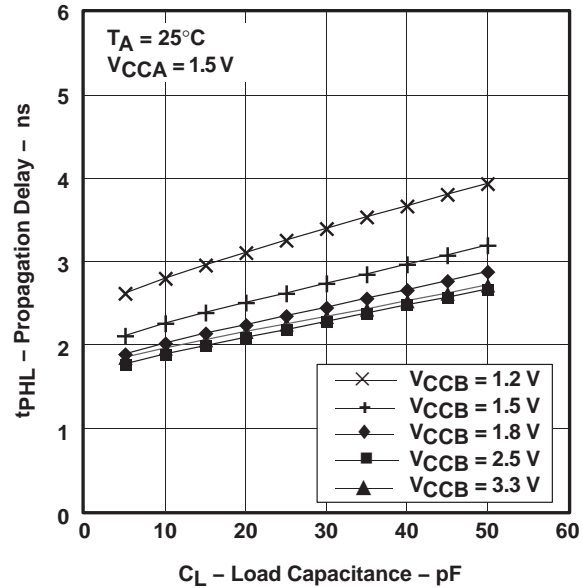


Figure 4

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TYPICAL CHARACTERISTICS

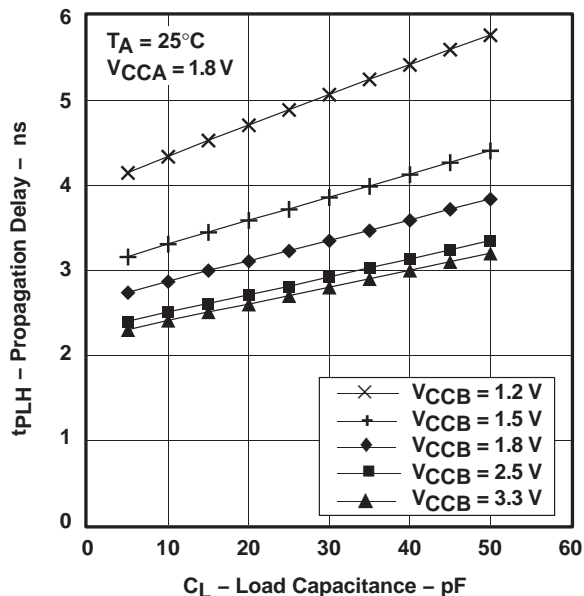


Figure 5

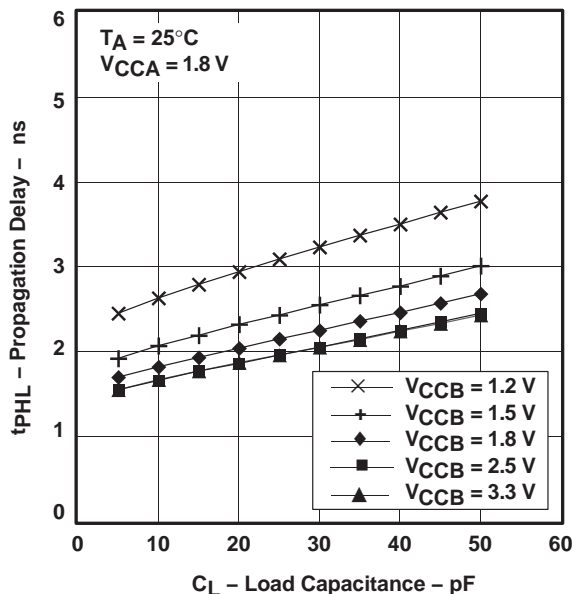


Figure 6

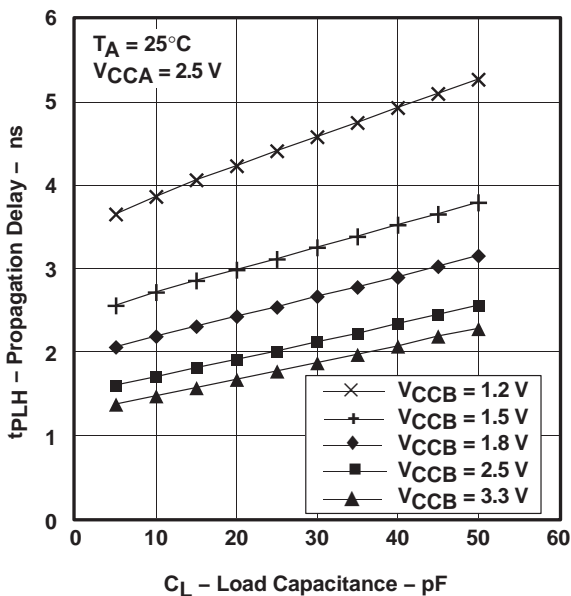


Figure 7

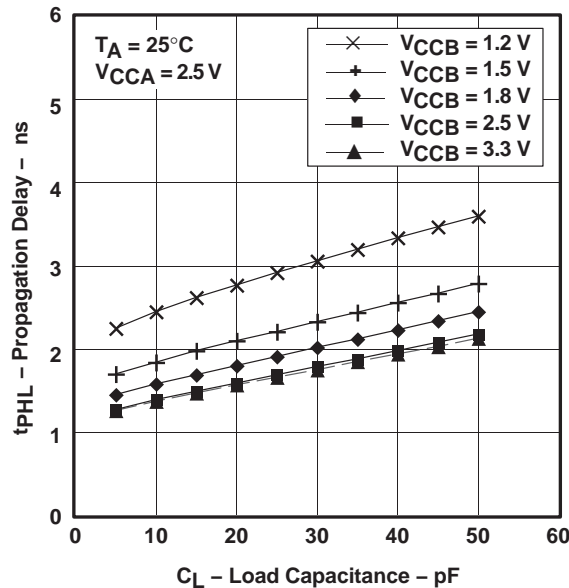


Figure 8

TYPICAL CHARACTERISTICS

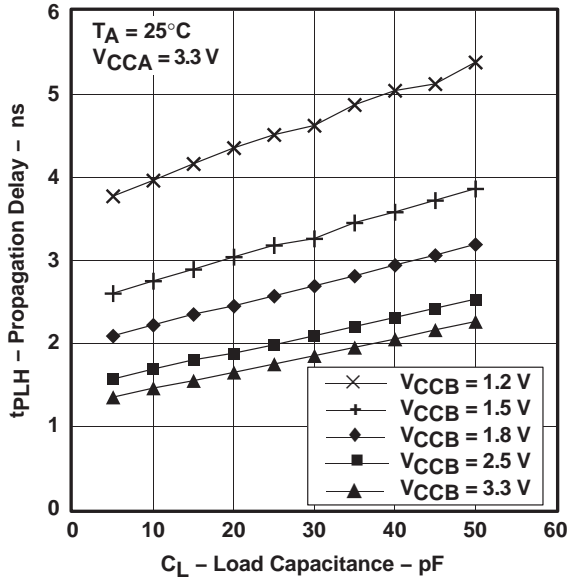


Figure 9

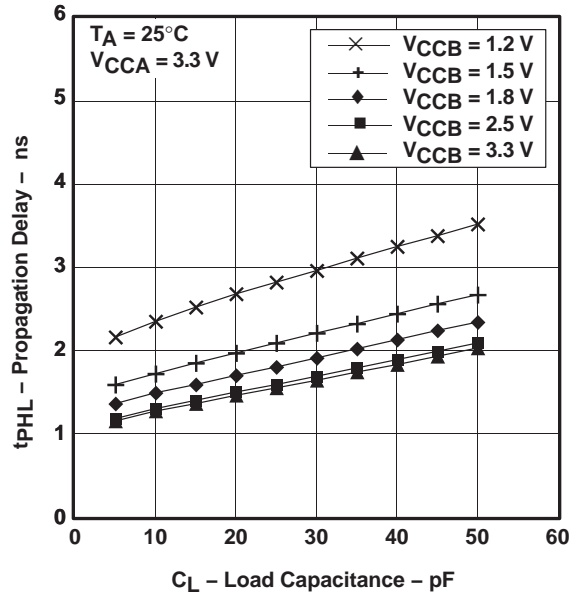
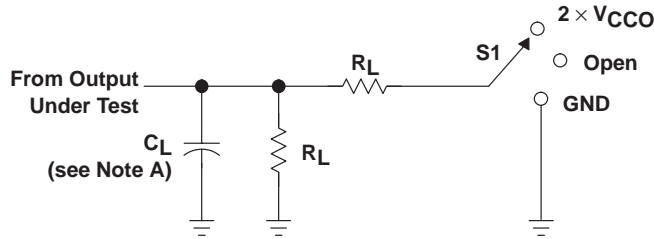


Figure 10

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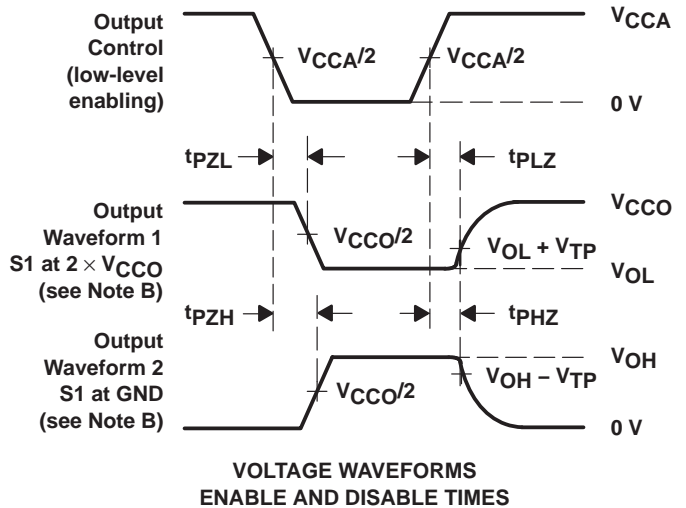
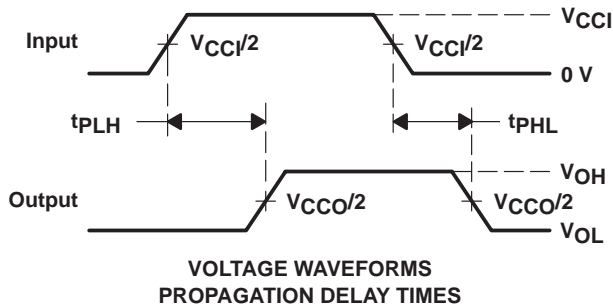
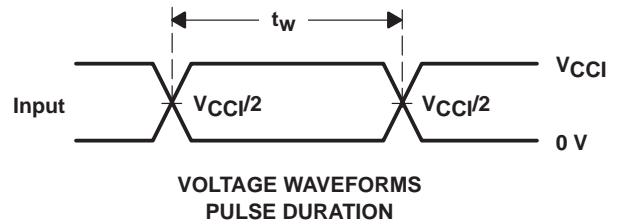
PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

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

| V_{CCO} | C_L | R_L | V_{TP} |
|--------------------|-------|--------------|----------|
| 1.2 V | 15 pF | 2 k Ω | 0.1 V |
| 1.5 V \pm 0.1 V | 15 pF | 2 k Ω | 0.1 V |
| 1.8 V \pm 0.15 V | 15 pF | 2 k Ω | 0.15 V |
| 2.5 V \pm 0.2 V | 15 pF | 2 k Ω | 0.15 V |
| 3.3 V \pm 0.3 V | 15 pF | 2 k Ω | 0.3 V |



- 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 MHz, $Z_O = 50 \Omega$, $dv/dt \geq 1$ V/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} .
 - V_{CCI} is the V_{CC} associated with the input port.
 - V_{CCO} is the V_{CC} associated with the output port.

Figure 11. 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⁾ |
|--------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74AVCH32T245KR | NRND | LFBGA | GKE | 96 | 1000 | TBD | SNPB | Level-2-235C-1 YEAR |
| SN74AVCH32T245ZKER | ACTIVE | LFBGA | ZKE | 96 | 1000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-3-260C-168 HR |

⁽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.

OBSELETE: 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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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 |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AVCH32T245KR | LFBGA | GKE | 96 | 1000 | 330.0 | 24.4 | 5.7 | 13.7 | 2.0 | 8.0 | 24.0 | Q1 |
| SN74AVCH32T245ZKER | LFBGA | ZKE | 96 | 1000 | 330.0 | 24.4 | 5.7 | 13.7 | 2.0 | 8.0 | 24.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVCH32T245KR | LFBGA | GKE | 96 | 1000 | 346.0 | 346.0 | 41.0 |
| SN74AVCH32T245ZKER | LFBGA | ZKE | 96 | 1000 | 346.0 | 346.0 | 41.0 |

GKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



4188953/F 06/04

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-205 variation CC.
 - D. This package is tin-lead (SnPb). Refer to the 96 ZKE package (drawing 4204493) for lead-free.

ZKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



4204493/C 06/04

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-205 variation CC.
 - D. This package is lead-free. Refer to the 96 GKE package (drawing 4188953) for tin-lead (SnPb).

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