

# SN74AVCH24T245

## 24-BIT DUAL-SUPPLY BUS TRANSCEIVER

### WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

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- 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, All Outputs 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 24-bit noninverting bus transceiver uses two separate configurable power-supply rails. The SN74AVCH24T245 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 SN74AVCH24T245 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 SN74AVCH24T245 is designed so that the control pins (1DIR, 2DIR, 3DIR, 4DIR, 5DIR, 6DIR,  $1\overline{OE}$ ,  $2\overline{OE}$ ,  $3\overline{OE}$ ,  $4\overline{OE}$ ,  $5\overline{OE}$ , and  $6\overline{OE}$ ) 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  $V_{CCA}$  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 <sup>†</sup>  |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|-----------------------|---------------|-----------------------|------------------|
| –40°C to 85°C | LFBGA – GRG           | Tape and reel | 74AVCH24T245GRGR      | WL245            |
|               | LFBGA – ZRG (Pb-free) |               | 74AVCH24T245ZRGR      |                  |

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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GRG OR ZRG PACKAGE  
(TOP VIEW)

123456

A

B

C

D

E

F

G

H

J

K

L

M

N

P

terminal assignments

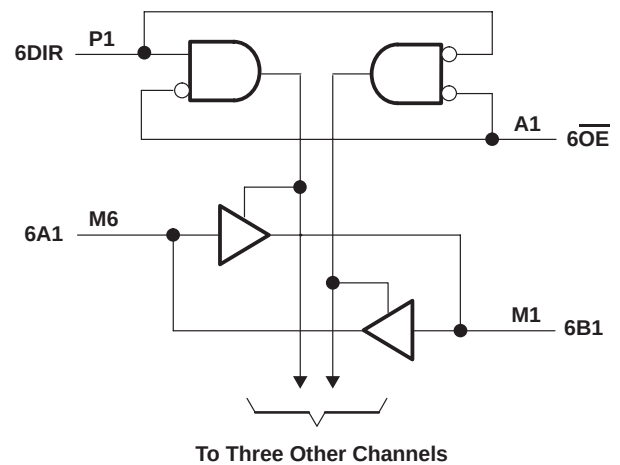
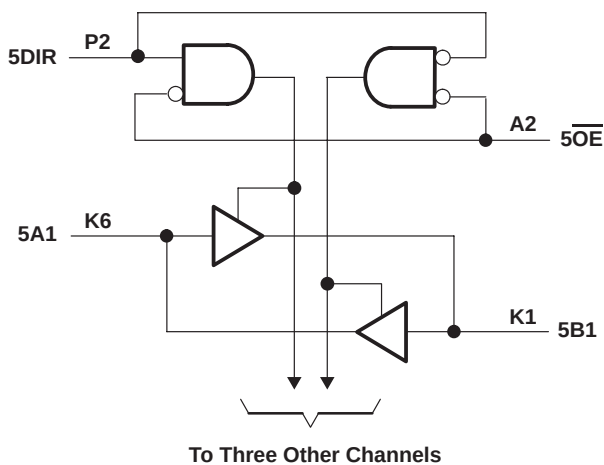
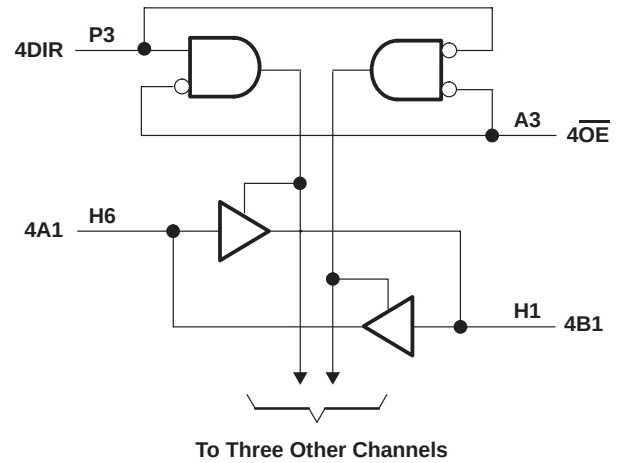
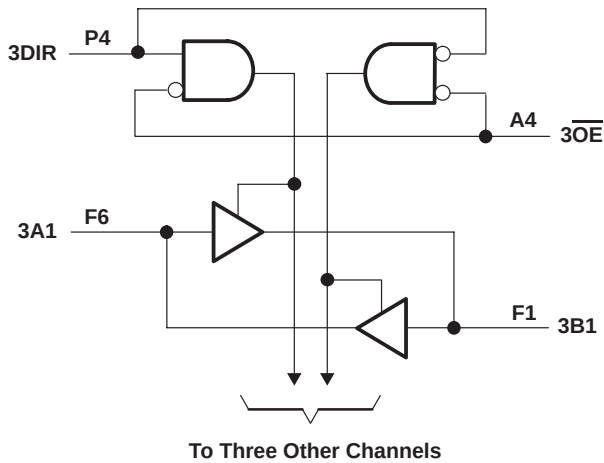
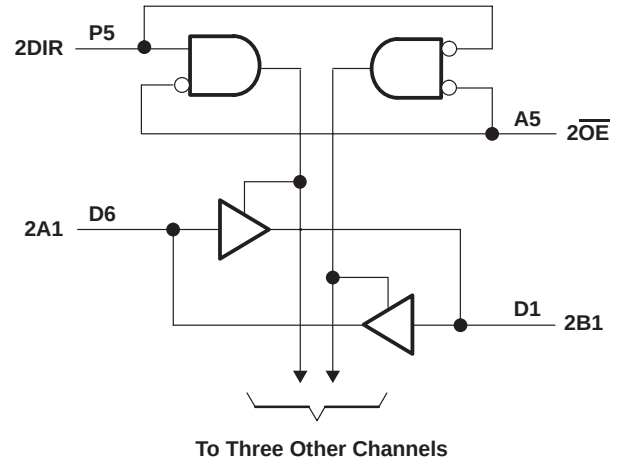
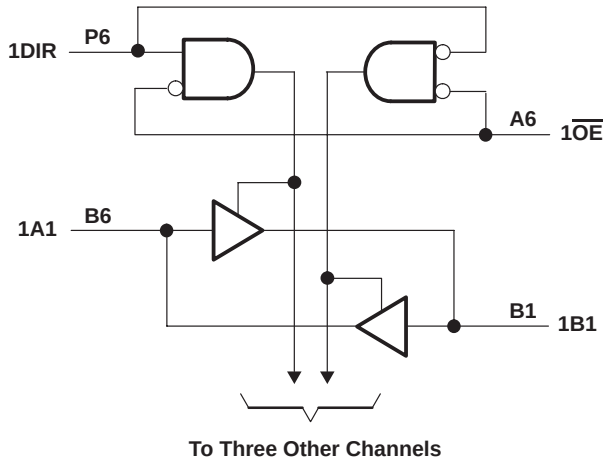
|   | 1                        | 2                        | 3                        | 4                        | 5                        | 6                        |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| A | 6 $\overline{\text{OE}}$ | 5 $\overline{\text{OE}}$ | 4 $\overline{\text{OE}}$ | 3 $\overline{\text{OE}}$ | 2 $\overline{\text{OE}}$ | 1 $\overline{\text{OE}}$ |
| B | 1B1                      | 1B2                      | V <sub>CCB</sub>         | V <sub>CCA</sub>         | 1A2                      | 1A1                      |
| C | 1B3                      | 1B4                      | GND                      | GND                      | 1A4                      | 1A3                      |
| D | 2B1                      | 2B2                      | V <sub>CCB</sub>         | V <sub>CCA</sub>         | 2A2                      | 2A1                      |
| E | 2B3                      | 2B4                      | GND                      | GND                      | 2A4                      | 2A3                      |
| F | 3B1                      | 3B2                      | GND                      | GND                      | 3A2                      | 3A1                      |
| G | 3B3                      | 3B4                      |                          | GND                      | 3A4                      | 3A3                      |
| H | 4B1                      | 4B2                      | V <sub>CCB</sub>         | V <sub>CCA</sub>         | 4A2                      | 4A1                      |
| J | 4B3                      | 4B4                      | GND                      | GND                      | 4A4                      | 4A3                      |
| K | 5B1                      | 5B2                      | GND                      | GND                      | 5A2                      | 5A1                      |
| L | 5B3                      | 5B4                      | V <sub>CCB</sub>         | V <sub>CCA</sub>         | 5A4                      | 5A3                      |
| M | 6B1                      | 6B2                      | GND                      | GND                      | 6A2                      | 6A1                      |
| N | 6B3                      | 6B4                      | V <sub>CCB</sub>         | V <sub>CCA</sub>         | 6A4                      | 6A3                      |
| P | 6DIR                     | 5DIR                     | 4DIR                     | 3DIR                     | 2DIR                     | 1DIR                     |

FUNCTION TABLE  
(each 4-bit section)

| INPUTS                 |     | OPERATION       |
|------------------------|-----|-----------------|
| $\overline{\text{OE}}$ | 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)



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

|                                                                                     |                             |
|-------------------------------------------------------------------------------------|-----------------------------|
| 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, $\theta_{JA}$ (see Note 3): GRG/ZRG package              | 50°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 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 6)

|                  |                                    |                                                    | V <sub>CCI</sub> | V <sub>CCO</sub> | MIN                     | MAX              | UNIT |
|------------------|------------------------------------|----------------------------------------------------|------------------|------------------|-------------------------|------------------|------|
| V <sub>CCA</sub> | Supply voltage                     |                                                    |                  |                  | 1.2                     | 3.6              | V    |
| V <sub>CCB</sub> | Supply voltage                     |                                                    |                  |                  | 1.2                     | 3.6              | V    |
| V <sub>IH</sub>  | High-level input voltage           | Data inputs (see Note 7)                           | 1.2 V to 1.95 V  |                  | V <sub>CCI</sub> × 0.65 |                  | V    |
|                  |                                    |                                                    | 1.95 V to 2.7 V  |                  | 1.6                     |                  |      |
|                  |                                    |                                                    | 2.7 V to 3.6 V   |                  | 2                       |                  |      |
| V <sub>IL</sub>  | Low-level input voltage            | Data inputs (see Note 7)                           | 1.2 V to 1.95 V  |                  | V <sub>CCI</sub> × 0.35 |                  | V    |
|                  |                                    |                                                    | 1.95 V to 2.7 V  |                  | 0.7                     |                  |      |
|                  |                                    |                                                    | 2.7 V to 3.6 V   |                  | 0.8                     |                  |      |
| V <sub>IH</sub>  | High-level input voltage           | DIR (referenced to V <sub>CCA</sub> ) (see Note 8) | 1.2 V to 1.95 V  |                  | V <sub>CCA</sub> × 0.65 |                  | V    |
|                  |                                    |                                                    | 1.95 V to 2.7 V  |                  | 1.6                     |                  |      |
|                  |                                    |                                                    | 2.7 V to 3.6 V   |                  | 2                       |                  |      |
| V <sub>IL</sub>  | Low-level input voltage            | DIR (referenced to V <sub>CCA</sub> ) (see Note 8) | 1.2 V to 1.95 V  |                  | V <sub>CCA</sub> × 0.35 |                  | V    |
|                  |                                    |                                                    | 1.95 V to 2.7 V  |                  | 0.7                     |                  |      |
|                  |                                    |                                                    | 2.7 V to 3.6 V   |                  | 0.8                     |                  |      |
| V <sub>I</sub>   | Input voltage                      |                                                    |                  |                  | 0                       | 3.6              | V    |
| V <sub>O</sub>   | Output voltage                     | Active state                                       |                  |                  | 0                       | V <sub>CCO</sub> | V    |
|                  |                                    | 3-state                                            |                  |                  | 0                       | 3.6              |      |
| I <sub>OH</sub>  | 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 <sub>OL</sub>  | 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                      |                  |      |
| Δt/Δv            | Input transition rise or fall rate |                                                    |                  |                  | 5                       |                  | ns/V |
| T <sub>A</sub>   | Operating free-air temperature     |                                                    |                  |                  | −40                     | 85               | °C   |

- NOTES: 4. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the data input port.  
5. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.  
6. All unused data inputs of the device must be held at V<sub>CCI</sub> 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<sub>CCI</sub> values not specified in the data sheet, V<sub>IH</sub> min = V<sub>CCI</sub> × 0.7 V, V<sub>IL</sub> max = V<sub>CCI</sub> × 0.3 V.  
8. For V<sub>CCI</sub> values not specified in the data sheet, V<sub>IH</sub> min = V<sub>CCA</sub> × 0.7 V, V<sub>IL</sub> max = V<sub>CCA</sub> × 0.3 V.



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

| PARAMETER                      |                                       | TEST CONDITIONS                          |                | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |       |                          | –40°C to 85°C |     | UNIT |
|--------------------------------|---------------------------------------|------------------------------------------|----------------|------------------|------------------|-----------------------|-------|--------------------------|---------------|-----|------|
|                                |                                       |                                          |                |                  |                  | MIN                   | TYP   | MAX                      | MIN           | MAX |      |
| V <sub>OH</sub>                | I <sub>OH</sub> = –100 μA             | V <sub>I</sub> = V <sub>IH</sub>         | 1.2 V to 3.6 V | 1.2 V to 3.6 V   |                  |                       |       | V <sub>CCO</sub> – 0.2 V |               | V   |      |
|                                | I <sub>OH</sub> = –3 mA               |                                          | 1.2 V          | 1.2 V            | 0.95             |                       |       |                          |               |     |      |
|                                | I <sub>OH</sub> = –6 mA               |                                          | 1.4 V          | 1.4 V            |                  |                       |       | 1.05                     |               |     |      |
|                                | I <sub>OH</sub> = –8 mA               |                                          | 1.65 V         | 1.65 V           |                  |                       |       | 1.2                      |               |     |      |
|                                | I <sub>OH</sub> = –9 mA               |                                          | 2.3 V          | 2.3 V            |                  |                       |       | 1.75                     |               |     |      |
|                                | I <sub>OH</sub> = –12 mA              |                                          | 3 V            | 3 V              |                  |                       |       | 2.3                      |               |     |      |
| V <sub>OL</sub>                | I <sub>OL</sub> = 100 μA              | V <sub>I</sub> = V <sub>IL</sub>         | 1.2 V to 3.6 V | 1.2 V to 3.6 V   |                  |                       |       | 0.2                      |               | V   |      |
|                                | I <sub>OL</sub> = 3 mA                |                                          | 1.2 V          | 1.2 V            | 0.15             |                       |       |                          |               |     |      |
|                                | I <sub>OL</sub> = 6 mA                |                                          | 1.4 V          | 1.4 V            |                  |                       |       | 0.35                     |               |     |      |
|                                | I <sub>OL</sub> = 8 mA                |                                          | 1.65 V         | 1.65 V           |                  |                       |       | 0.45                     |               |     |      |
|                                | I <sub>OL</sub> = 9 mA                |                                          | 2.3 V          | 2.3 V            |                  |                       |       | 0.55                     |               |     |      |
|                                | I <sub>OL</sub> = 12 mA               |                                          | 3 V            | 3 V              |                  |                       |       | 0.7                      |               |     |      |
| I <sub>I</sub>                 | Control inputs                        | V <sub>I</sub> = V <sub>CCA</sub> or GND |                | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   | ±0.025                | ±0.25 |                          | ±1            | μA  |      |
| I <sub>BHL</sub> <sup>†</sup>  | V <sub>I</sub> = 0.42 V               |                                          | 1.2 V          | 1.2 V            | 25               |                       |       |                          |               | μA  |      |
|                                | V <sub>I</sub> = 0.49 V               |                                          | 1.4 V          | 1.4 V            |                  |                       |       | 15                       |               |     |      |
|                                | V <sub>I</sub> = 0.58 V               |                                          | 1.65 V         | 1.65 V           |                  |                       |       | 25                       |               |     |      |
|                                | V <sub>I</sub> = 0.7 V                |                                          | 2.3 V          | 2.3 V            |                  |                       |       | 45                       |               |     |      |
|                                | V <sub>I</sub> = 0.8 V                |                                          | 3.3 V          | 3.3 V            |                  |                       |       | 100                      |               |     |      |
| I <sub>BHH</sub> <sup>‡</sup>  | V <sub>I</sub> = 0.78 V               |                                          | 1.2 V          | 1.2 V            | –25              |                       |       |                          |               | μA  |      |
|                                | V <sub>I</sub> = 0.91 V               |                                          | 1.4 V          | 1.4 V            |                  |                       |       | –15                      |               |     |      |
|                                | V <sub>I</sub> = 1.07 V               |                                          | 1.65 V         | 1.65 V           |                  |                       |       | –25                      |               |     |      |
|                                | V <sub>I</sub> = 1.6 V                |                                          | 2.3 V          | 2.3 V            |                  |                       |       | –45                      |               |     |      |
|                                | V <sub>I</sub> = 2 V                  |                                          | 3.3 V          | 3.3 V            |                  |                       |       | –100                     |               |     |      |
| I <sub>BHLO</sub> <sup>§</sup> | V <sub>I</sub> = 0 to V <sub>CC</sub> |                                          | 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 <sub>BHHO</sub> <sup>¶</sup> | V <sub>I</sub> = 0 to V <sub>CC</sub> |                                          | 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                     |               |     |      |

<sup>†</sup> The bus-hold circuit can sink at least the minimum low sustaining current at V<sub>IL</sub> max. I<sub>BHL</sub> should be measured after lowering V<sub>IN</sub> to GND and then raising it to V<sub>IL</sub> max.

<sup>‡</sup> The bus-hold circuit can source at least the minimum high sustaining current at V<sub>IH</sub> min. I<sub>BHH</sub> should be measured after raising V<sub>IN</sub> to V<sub>CC</sub> and then lowering it to V<sub>IH</sub> min.

<sup>§</sup> An external driver must source at least I<sub>BHLO</sub> to switch this node from low to high.

<sup>¶</sup> An external driver must sink at least I<sub>BHHO</sub> to switch this node from high to low.

NOTE 9: V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Notes 10 and 11) (continued)

| PARAMETER                           |                | TEST CONDITIONS                                                                       | V <sub>CCA</sub>                           | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |      |      | –40°C to 85°C |     | UNIT |
|-------------------------------------|----------------|---------------------------------------------------------------------------------------|--------------------------------------------|------------------|-----------------------|------|------|---------------|-----|------|
|                                     |                |                                                                                       |                                            |                  | MIN                   | TYP  | MAX  | MIN           | MAX |      |
| I <sub>off</sub>                    | A port         | V <sub>I</sub> or V <sub>O</sub> = 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 <sub>OZ</sub> <sup>†</sup>        | A or B ports   | V <sub>O</sub> = V <sub>CCO</sub> or GND,<br>V <sub>I</sub> = V <sub>CCI</sub> or GND | $\overline{\text{OE}} = V_{IH}$            | 3.6 V            | 3.6 V                 | ±0.5 | ±2.5 |               | ±5  | μA   |
|                                     | B port         |                                                                                       | $\overline{\text{OE}} = \text{don't care}$ | 0 V              | 3.6 V                 |      |      |               | ±5  |      |
|                                     | A port         |                                                                                       |                                            | 3.6 V            | 0 V                   |      |      |               | ±5  |      |
| I <sub>CCA</sub>                    |                | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0                          | 1.2 V to 3.6 V                             | 1.2 V to 3.6 V   |                       |      |      | 40            |     | μA   |
|                                     |                |                                                                                       | 0 V                                        | 3.6 V            |                       |      |      | –5            |     |      |
|                                     |                |                                                                                       | 3.6 V                                      | 0 V              |                       |      |      | 40            |     |      |
| I <sub>CCB</sub>                    |                | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0                          | 1.2 V to 3.6 V                             | 1.2 V to 3.6 V   |                       |      |      | 40            |     | μA   |
|                                     |                |                                                                                       | 0 V                                        | 3.6 V            |                       |      |      | 40            |     |      |
|                                     |                |                                                                                       | 3.6 V                                      | 0 V              |                       |      |      | –5            |     |      |
| I <sub>CCA</sub> + I <sub>CCB</sub> |                | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0                          | 1.2 V to 3.6 V                             | 1.2 V to 3.6 V   |                       |      |      | 75            |     | μA   |
| C <sub>i</sub>                      | Control inputs | V <sub>I</sub> = 3.3 V or GND                                                         | 3.3 V                                      | 3.3 V            |                       | 3.5  |      |               |     | pF   |
| C <sub>io</sub>                     | A or B ports   | V <sub>O</sub> = 3.3 V or GND                                                         | 3.3 V                                      | 3.3 V            |                       | 7    |      |               |     | pF   |

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

NOTES: 10. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

11. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.

switching characteristics over recommended operating free-air temperature range,  
V<sub>CCA</sub> = 1.2 V (see Figure 1)

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

**SN74AVCH24T245****24-BIT DUAL-SUPPLY BUS TRANSCEIVER****WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS**

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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<br>(INPUT) | TO<br>(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              | 3.6                       | 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<br>(INPUT) | TO<br>(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              | 3.4                       | 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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**WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS**

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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<br>(INPUT) | TO<br>(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<br>(INPUT) | TO<br>(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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## 24-BIT DUAL-SUPPLY BUS TRANSCEIVER

### WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

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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  | $C_L = 0$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | 1                                  | 1                                  | 1                                  | 2                                  | 2                                  | pF   |
|                   |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 2                                  |      |
|                   | B to A | Outputs enabled  |                                                                   | 19                                 | 19                                 | 20                                 | 21                                 | 22                                 |      |
|                   |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 1                                  |      |
| $C_{pdB}^\dagger$ | A to B | Outputs enabled  | $C_L = 0$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | 19                                 | 19                                 | 20                                 | 21                                 | 22                                 | pF   |
|                   |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 1                                  |      |
|                   | B to A | Outputs enabled  |                                                                   | 1                                  | 1                                  | 1                                  | 2                                  | 2                                  |      |
|                   |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 2                                  |      |

$^\dagger$  Power dissipation capacitance per transceiver

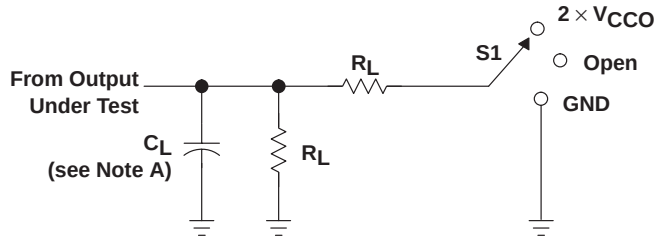
# SN74AVCH24T245

## 24-BIT DUAL-SUPPLY BUS TRANSCEIVER

### WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

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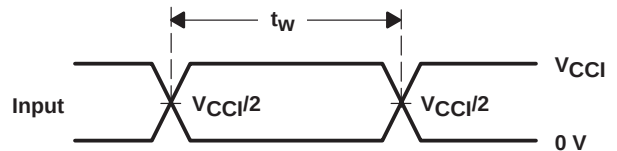
#### PARAMETER MEASUREMENT INFORMATION



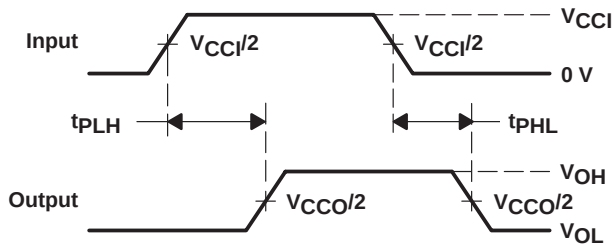
LOAD CIRCUIT

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

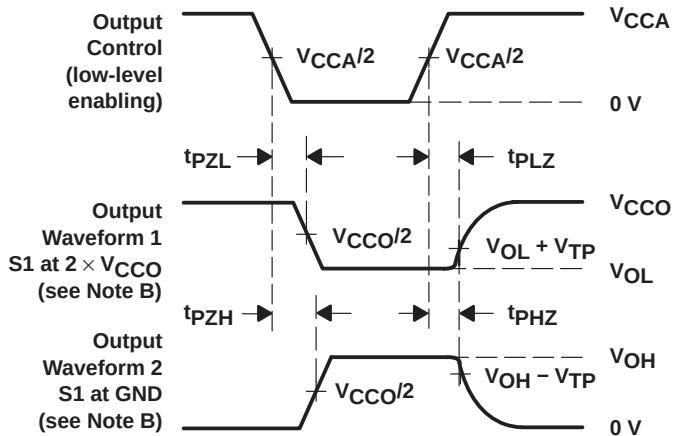
| TEST              | S1                 |
|-------------------|--------------------|
| $t_{pd}$          | Open               |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CCO}$ |
| $t_{PHZ}/t_{PZH}$ | GND                |



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES



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:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $dv/dt \geq 1\text{ V/ns}$ ,  $dv/dt \geq 1\text{ V/ns}$ .
  - 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 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

| Orderable Device   | Status <sup>(1)</sup> | Package Type                     | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|--------------------|-----------------------|----------------------------------|-----------------|------|-------------|----------------------------|------------------|------------------------------|
| SN74AVCH24T245GRGR | ACTIVE                | BGA MI<br>CROSTA<br>R JUNI<br>OR | GRG             | 83   | 1000        | TBD                        | SNPB             | Level-1-240C-UNLIM           |
| SN74AVCH24T245ZRGR | ACTIVE                | BGA MI<br>CROSTA<br>R JUNI<br>OR | ZRG             | 83   | 1000        | Green (RoHS &<br>no Sb/Br) | SNAGCU           | Level-1-260C-UNLIM           |

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

**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)

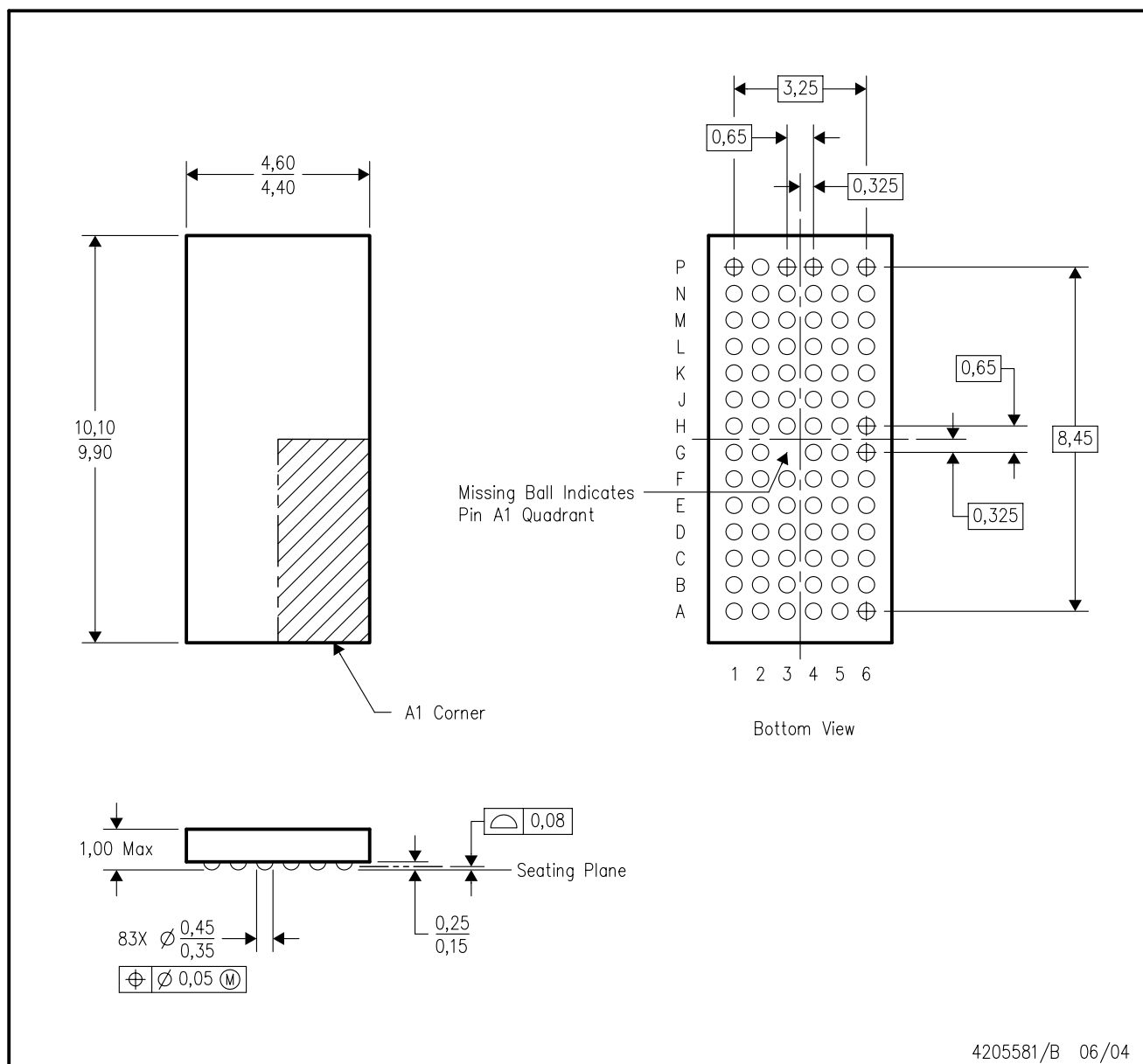
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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GRG (R-PBGA-N83)

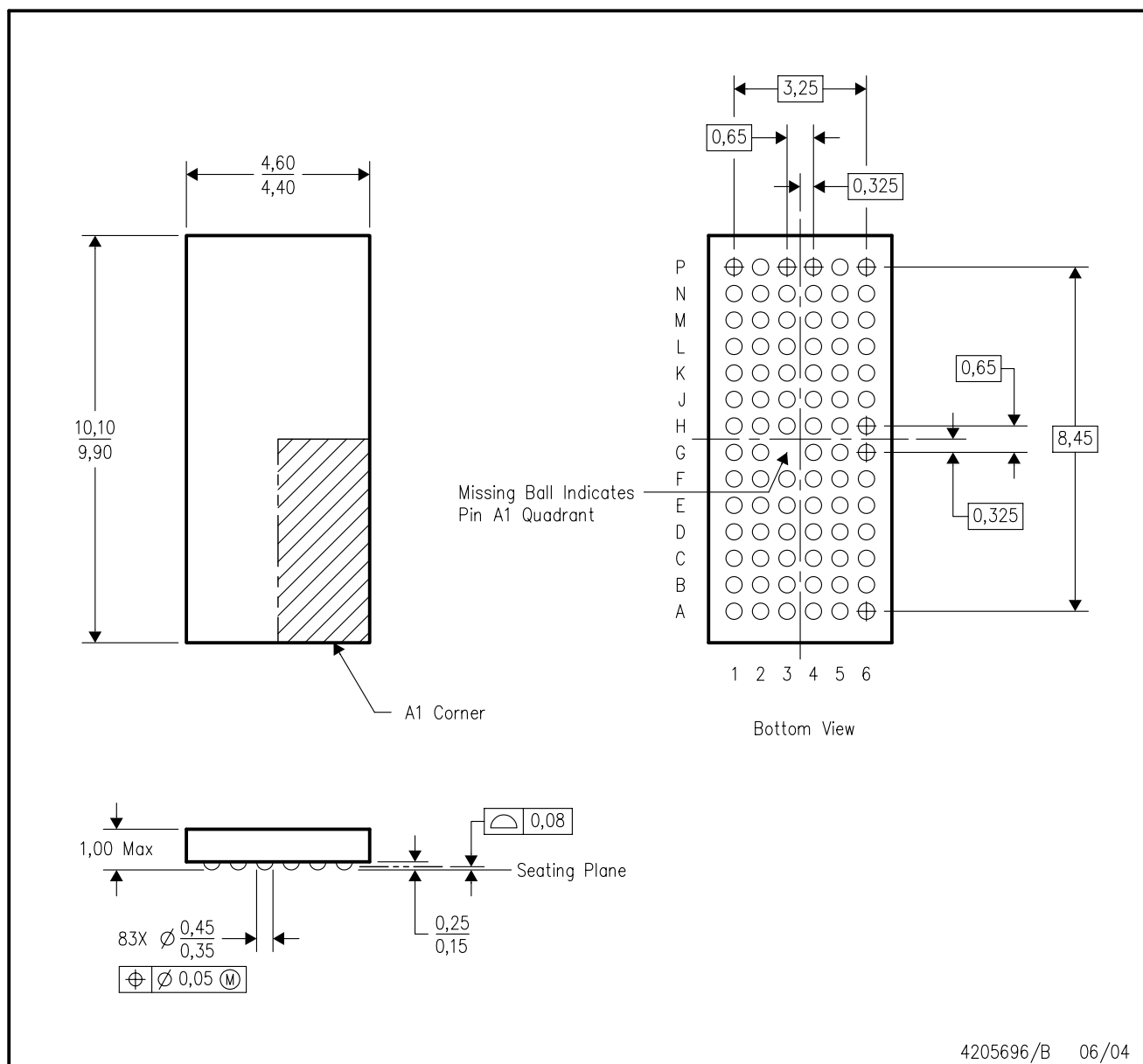
# PLASTIC BALL GRID ARRAY



- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.  
C. JEDEC MO-225 registration is pending.  
D. This package is tin-lead (SnPb). Refer to the 83 ZRG package (drawing 4205696) for lead-free.

## ZRG (R-PBGA-N83)

## PLASTIC BALL GRID ARRAY



## NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- JEDEC MO-225 registration is pending.
- This package is lead-free. Refer to the 83 GRG package (drawing 4205581) for tin-lead (SnPb).

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