

SN74AVCH2T45 2-Bit, 2-Supply, Bus Transceiver with Configurable Level-Shifting and **Translation and 3-State Outputs**

1 Features

- Available in the Texas Instruments NanoFree™ Package
- V_{CC} Isolation
- 2-Rail Design
- I/Os are 4.6V Tolerant
- Partial Power-Down-Mode Operation
- Bus Hold on Data Inputs
- Maximum Data Rates
 - 500Mbps (1.8V to 3.3V)
 - 320Mbps (< 1.8V to 3.3V)
 - 320Mbps (Level-Shifting to 2.5V or 1.8V)
 - 280Mbps (Level-Shifting to 1.5V)
 - 240Mbps (Level-Shifting to 1.2V)
- Latch-Up Performance Exceeds 100mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22

2 Applications

- Smartphone
- Servers
- Desktop PCs and Notebooks
- Other Portable Devices

3 Description

This 2-bit non-inverting bus transceiver uses two separate configurable power-supply rails. The A ports are designed to track V_{CCA} and accepts any supply voltage from 1.2V to 3.6V. The B ports are designed to track V_{CCB} and accepts any supply voltage from 1.2V to 3.6V. This allows for universal low-voltage bidirectional translation and level-shifting between any of the 1.2V, 1.5V, 1.8V, 2.5V, and 3.3V voltage nodes.

The SN74AVCH2T45 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR pin) input activate either the B-port outputs or the A-port outputs. The device transmits data from the A bus to the B bus when the B-port outputs are activated and from the B bus to the A bus when the A-port outputs are activated. The SN74AVCH2T45 features active bus-hold circuitry, which holds unused or un-driven inputs at a valid logic state. TI does not recommend using pull-up or pull-down resistors with the bus-hold circuitry.

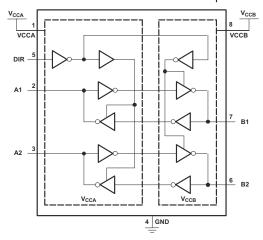
This device is fully specified for partial-power-down applications using $I_{\text{off}}.$ The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. The V_{CC} isolation feature ensures that if either V_{CC} input is at GND, then both outputs are in the high-impedance state. The bus-hold circuitry on the powered-up side always stays active.

Active bus-hold circuitry holds unused or un-driven inputs at a valid logic state. NanoFree package technology is a major breakthrough in IC packaging concepts, using the die as the package.

Package Information

| PART NUMBER | PACKAGE (1) | PACKAGE SIZE (2) |
|--------------|-----------------|------------------|
| | DCT (SSOP, 8) | 2.95mm × 4.00mm |
| SN74AVCH2T45 | DCU (VSSOP, 8) | 3.10mm × 2.00mm |
| | YZP, (DSBGA, 8) | 1.89mm × 0.89mm |

- (1)For more information, see Section 11
- (2)The package size (length × width) is a nominal value and includes pins where applicable



Logic Diagram (Positive Logic)

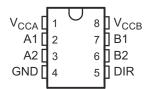


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4 Pin Configurations and Functions



GND | 69 4 569 | DIR A2 | 69 3 669 | B2 A1 | 69 2 769 | B1 V_{CCA} | 64 1 869 | V_{CCB}

Figure 4-1. DCT and DCU Packages 8-Pin SSOP and VSSOP Top View

Figure 4-2. YZP Package 8-Pin DSBGA Bottom View

Table 4-1. Pin Functions

| | PIN | | |
|------|----------------|-------|---|
| NAME | SSOP, VSSOP | DSBGA | DESCRIPTION |
| VCCA | 1 | A1 | Supply Voltage A |
| VCCB | 8 | A2 | Supply Voltage B |
| GND | 4 | D1 | Ground |
| A1 | 2 | B1 | Output or input depending on state of DIR. Output level depends on V _{CCA} . |
| A2 | 3 | C1 | Output or input depending on state of DIR. Output level depends on V _{CCA} . |
| B1 | 7 | B2 | Output or input depending on state of DIR. Output level depends on V _{CCB} . |
| B2 | 6 | C2 | Output or input depending on state of DIR. Output level depends on V _{CCB} . |
| DIR | 5 | D2 | Direction Pin, Connect to GND or to VCCA. |



5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

| | | | MIN | MAX | UNIT |
|--------------------------------------|---|--------------------|------|------------------------|------|
| V _{CCA} V _{CCB} | Supply voltage | | -0.5 | 4.6 | V |
| | | I/O ports (A port) | -0.5 | 4.6 | |
| VI | Input voltage ⁽²⁾ | I/O ports (B port) | -0.5 | 4.6 | V |
| | | Control inputs | -0.5 | 4.6 | |
| V | Voltage range applied to any output in the high-impedance or power-off | A port | -0.5 | 4.6 | V |
| Vo | state ⁽²⁾ | B port | -0.5 | 4.6 | V |
| V | Valtage range applied to any output in the high or law state(2) (3) | A port | -0.5 | V _{CCA} + 0.5 | V |
| Vo | Voltage range applied to any output in the high or low state ^{(2) (3)} | B port | -0.5 | V _{CCB} + 0.5 | V |
| I _{IK} | Input clamp current | V _I < 0 | | -50 | mA |
| I _{OK} | Output clamp current | V _O < 0 | | -50 | mA |
| Io | Continuous output current | | | ±50 | mA |
| | Continuous current through V _{CCA} , V _{CCB} , or GND | | | ±100 | mA |
| TJ | Junction temperature | | -40 | 150 | °C |
| T _{stg} | Storage temperature | | -65 | 150 | °C |

⁽¹⁾ Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Section 5.3. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

5.2 ESD Ratings

| | | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|------|
| | | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ±8000 | |
| V _(ESD) | Electrostatic discharge | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ±1000 | V |
| | | Machine Model (MM), Per JEDEC specification JESD22-A115-A | ±200 | |

⁽¹⁾ JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.

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⁽²⁾ The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

³⁾ The output positive-voltage rating may be exceeded up to 4.6V maximum if the output current rating is observed.

⁽²⁾ JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.



5.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)(3) (4) (5)

| | | | V _{CCI} ⁽¹⁾ | V _{CCO} (2) | MIN | NOM | MAX | UNIT |
|----------------|---|--|---------------------------------|----------------------|--|-----|-------------------------|------|
| V_{CCA} | Supply voltag | je | | | 1.2 | | 3.6 | ٧ |
| V_{CCB} | Supply voltag | je | | | 1.2 | | 3.6 | V |
| | | | 1.2V to 1.95V | | V _{CCI} ⁽¹⁾ × 0.65 | | | |
| V_{IH} | High-level input voltage | Data inputs ⁽⁴⁾ | 1.95V to 2.7V | | 1.6 | | | V |
| | par ranaga | | 2.7V to 3.6V | | 2 | | | |
| | | | 1.2V to 1.95V | | | Vo | CCI (1) × 0.35 | |
| V_{IL} | Low-level input voltage | Data inputs ⁽⁴⁾ | 1.95V to 2.7V | | | | 0.7 | V |
| | par ranaga | | 2.7V to 3.6V | | | | 0.8 | |
| | | | 1.2V to 1.95V | | V _{CCA} × 0.65 | | | |
| V_{IH} | High-level input voltage | DIR (referenced to V _{CCA}) ⁽⁵⁾ | 1.95 V to 2.7V | | 1.6 | | | V |
| | input voltage | *CCA) | 2.7V to 3.6V | | 2 | | | |
| | | | 1.2V to 1.95V | | | , | V _{CCA} × 0.35 | |
| V_{IL} | Low-level DIR (referenced to input voltage V_{CCA}) ⁽⁵⁾ | | 1.95V to 2.7V | | | | 0.7 | V |
| | input voltage | VCCA) | 2.7V to 3.6V | | | | 0.8 | |
| VI | Input voltage | | | | 0 | | 3.6 | V |
| Vo | Output | Active state | | | 0 | | V _{CCO} (2) | ٧ |
| v _O | voltage | 3-state | | | 0 | | 3.6 | V |
| | | | | 1.2V | | | -3 | |
| | | | | 1.4V to 1.6V | | | -6 | |
| I_{OH} | High-level ou | tput current | | 1.65V to 1.95V | | | -8 | mA |
| | | | | 2.3V to 2.7V | | | -9 | |
| | | | | 3V to 3.6V | | | -12 | |
| | | | | 1.2V | | | 3 | |
| | | | | 1.4V to 1.6V | | | 6 | |
| I_{OL} | Low-level out | put current | | 1.65V to 1.95V | | | 8 | mA |
| | Low-level output current | | 2.3V to 2.7V | | | 9 | | |
| | | | | 3V to 3.6V | | | 12 | |
| Δt/Δν | Input transition | n rise or fall rate | | | | | 5 | ns/V |
| T _A | Operating fre | e-air temperature | | | -40 | | 85 | °C |

⁽¹⁾ V_{CCI} is the voltage associated with the input port supply VCCA or VCCB.

⁽²⁾ V_{CCO} is the voltage associated with the output port supply VCCA or VCCB.

⁽³⁾ 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.

⁽⁴⁾ For V_{CCI} values not specified in the data sheet, V_{IH} min = $V_{CCI} \times 0.7V$, V_{IL} max = $V_{CCI} \times 0.3V$.

⁽⁵⁾ 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.



5.4 Thermal Information

| | | | SN74AVCH2T45 | | | | | |
|-----------------------|--|------------|--------------|-------------|------|--|--|--|
| | THERMAL METRIC (1) | DCT (SSOP) | DCU (VSSOP) | YZP (DSBGA) | UNIT | | | |
| | | 8 PINS | 8 PINS | 8 PINS | | | | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 183.1 | 246.9 | 105.8 | | | | |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 101.5 | 95.2 | 1.6 | | | | |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 111.0 | 158.4 | 10.8 | °C/W | | | |
| ΨЈТ | Junction-to-top characterization parameter | 27.6 | 34.1 | 3.1 | | | | |
| Ψ_{JB} | Junction-to-board characterization parameter | 109.2 | 157.5 | 10.8 | | | | |

⁽¹⁾ For more information about traditional and new thermal metrics, see the IC Package Thermal Metrics application report.

5.5 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)(5) (6)

| PARAMETER | TEST CONDIT | IONS | V _{CCA} | V _{CCB} | | T _A = 25°C | : | –40°C to | 85°C | | UNIT | |
|----------------------------------|--|----------------------------------|------------------|------------------|-----|-----------------------|-------|------------------------|------|------|------|--|
| PARAMETER | TEST CONDIT | IONS | | V CCB | MIN | TYP | MAX | MIN | TYP | MAX | UNIT | |
| | I _{OH} = -100μA | | 1.2V to 3.6V | 1.2V to 3.6V | | | | V _{CCO} - 0.2 | | | | |
| | I _{OH} = -3mA | | 1.2V | 1.2V | | 0.95 | | | | | | |
| (7) | I _{OH} = -6mA | .,, | 1.4V | 1.4V | | | | 1.05 | | | ., | |
| V _{OH} ⁽⁷⁾ | I _{OH} = -8mA | V _I = V _{IH} | 1.65V | 1.65V | | | | 1.2 | | | V | |
| | I _{OH} = -9mA | | 2.3V | 2.3V | | | | 1.75 | | | | |
| | I _{OH} = -12mA | | 3V | 3V | | | | 2.3 | | | | |
| | I _{OL} = 100μA | | 1.2V to 3.6V | 1.2V to 3.6V | | | | | | 0.2 | | |
| | I _{OL} = 3mA | | 1.2V | 1.2V | | 0.15 | | | | | | |
| V _{OL} ⁽⁷⁾ | I _{OL} = 6mA | ., ., | 1.4V | 1.4V | | | | | | 0.35 | ., | |
| | I _{OL} = 8mA | $V_I = V_{IL}$ | 1.65V | 1.65V | | | | | | 0.45 | V | |
| | I _{OL} = 9mA | | 2.3V | 2.3V | | | | | | 0.55 | | |
| | I _{OL} = 12mA | • | 3V | 3V | | | | | | 0.7 | | |
| I _I (7) DIR input | V _I = V _{CCA} or GND |) | 1.2V to 3.6V | 1.2V to 3.6V | | ±0.025 | ±0.25 | | | ±1 | μA | |
| | V _I = 0.42V | | 1.2V | 1.2V | | 25 | | | | | | |
| | V _I = 0.49V | | 1.4V | 1.4V | | | | 15 | | | | |
| I _{BHL} ⁽¹⁾ | V _I = 0.58V | | 1.65V | 1.65V | | | | 25 | | | μA | |
| | V _I = 0.7V | | 2.3V | 2.3V | | | | 45 | | | | |
| | V _I = 0.8V | | 3.3V | 3.3V | | | | 100 | | | | |
| | V _I = 0.78V | | 1.2V | 1.2V | | -25 | | | | | | |
| | V _I = 0.91V | | 1.4V | 1.4V | | | | -15 | | | | |
| I _{BHH} ⁽²⁾ | V _I = 1.07V | | 1.65V | 1.65V | | | | -25 | | | μA | |
| | V _I = 1.6V | | 2.3V | 2.3V | | | | -45 | | | | |
| | V _I = 2V | | 3.3V | 3.3V | | | | -100 | | | | |
| | | | 1.2V | 1.2V | | 50 | | | | | | |
| | | | 1.6V | 1.6V | | | | 125 | | | | |
| I _{BHLO} ⁽³⁾ | V _I = 0 to V _{CC} | | 1.95V | 1.95V | | | | 200 | | | μA | |
| | | | 2.7V | 2.7V | | | | 300 | | | | |
| | | | 3.6V | 3.6V | | | | 500 | | | | |
| | | | 1.2V | 1.2V | | -50 | | | | | | |
| | | | 1.6V | 1.6V | | | | -125 | | | | |
| _{внно} ⁽⁴⁾ | $V_I = 0$ to V_{CC} | | 1.95V | 1.95V | | | | -200 | | | μA | |
| | | 1 0 10 100 | | 2.7V | | | | -300 | | | · . | |
| | | _ | 3.6V | 3.6V | | | | -500 | | | | |
| A port | | | 0V | 0V to 3.6V | | ±0.1 | ±1 | | | ±5 | | |
| l _{off} (8) B port | $V_{\rm I}$ or $V_{\rm O} = 0$ to 3.6 | δV | 0V to 3.6V | 0V | | ±0.1 | ±1 | | | ±5 | μA | |

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over recommended operating free-air temperature range (unless otherwise noted)(5) (6)

| | | 1 3 | <u>'</u> |) \ | | | | | |
|-----------------------------------|--|---|------------------|------------------|-----|----------|------|---------------|------|
| DAD | AMETER | TEST CONDITIONS | V _{CCA} | V _{CCB} | Т | A = 25°C | | –40°C to 85°C | UNIT |
| FAIN | AMETER | TEST CONDITIONS | V CCA | ▼ CCB | MIN | TYP | MAX | MIN TYP MA | |
| I _{OZ} (8) | B port | V _O = V _{CCO} or GND, | 0V | 3.6V | | ±0.5 | ±2.5 | 1 | 5 |
| loz (°) | A port | V _I = V _{CCI} or GND | 3.6V | 0V | | ±0.5 | ±2.5 | 1 | 5 μΑ |
| | • | | 1.2V to 3.6V | 1.2V to 3.6V | | | | 1 | 0 |
| I _{CCA} (8) | $V_{I} = V_{CCI} \text{ or GND, } I_{O}$ | | 0V | 3.6V | | | | - | 2 µA |
| | | | 3.6V | 0V | | | | 1 | 0 |
| | | | 1.2V to 3.6V | 1.2V to 3.6V | | | | 1 | 0 |
| I _{CCB} (8) | | $V_I = V_{CCI}$ or GND, $I_O = 0$ | 0V | 3.6V | | | | 1 | 0 μΑ |
| | | | 3.6V | 0V | | | | - | 2 |
| I _{CCA} + I _C | СВ | $V_I = V_{CCI}$ or GND, $I_O = 0$ | 1.2V to 3.6V | 1.2V to 3.6V | | | | 2 | 0 μΑ |
| Ci | Control inputs | V _I = 3.3V or GND | 3.3V | 3.3V | | 2.5 | | | pF |
| C _{io} | A or B port | V _I = 3.3 V or GND | 3.3V | 3.3V | | 6 | | | pF |

- (1) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} maximum. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} maximum.
- (2) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} mininum. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} minimum.
- (3) An external driver must source at least I_{BHLO} to switch this node from low to high.
- (4) An external driver must sink at least I_{BHHO} to switch this node from high to low.
- (5) V_{CCO} is the voltage associated with the output port supply VCCA or VCCB.
- (6) V_{CCI} is the voltage associated with the input port supply VCCA or VCCB.
- (7) V_{OH}: Output High Voltage; V_{OL}: Output Low Voltage; I_I: Control Input Current.
- (8) Ioff: Partial Power Down Output current; Ioz: Hi-Z Output Current; Icca: Supply A Current; Icca: Supply B Current.

5.6 Switching Characteristics: $V_{CCA} = 1.2V$

over recommended operating free-air temperature range, $V_{CCA} = 1.2V$ (see Figure 6-1)

| PARAMETER | FROM | то | V _{CCB} = 1.2V | V _{CCB} = 1.5V | V _{CCB} = 1.8V | V _{CCB} = 2.5V | V _{CCB} = 3.3V | UNIT | |
|--|---------|----------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------|--|
| FARAMETER | (INPUT) | (OUTPUT) | TYP | TYP | TYP | TYP | TYP | UNIT | |
| t _{PLH} ⁽²⁾ | А | В | 3.1 | 2.6 | 2.4 | 2.2 | 2.2 | no | |
| t _{PHL} ⁽²⁾ | A | Ь | 3.1 | 2.6 | 2.4 | 2.2 | 2.2 | ns | |
| t _{PLH} ⁽²⁾ | В | А | 3.4 | 3.1 | 3 | 2.9 | 2.9 | no | |
| t _{PHL} ⁽²⁾ | Б | A | 3.4 | 3.1 | 3 | 2.9 | 2.9 | ns | |
| t _{PHZ} ⁽²⁾ | DIR | А | 5.2 | 5.2 | 5.1 | 5 | 4.8 | no | |
| t _{PLZ} (2) | אוט | A | 5.2 | 5.2 | 5.1 | 5 | 4.8 | ns | |
| t _{PHZ} ⁽²⁾ | DIR | D | 5 | 4 | 3.8 | 2.8 | 3.2 | no | |
| t _{PLZ} ⁽²⁾ | אוט | В | 5 | 4 | 3.8 | 2.8 | 3.2 | ns | |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | DIR | А | 8.4 | 7.1 | 6.8 | 5.7 | 6.1 | ns | |
| t _{PZL} ^{(2) (1)} | DIIX | ^ | 8.4 | 7.1 | 6.8 | 5.7 | 6.1 | 115 | |
| t _{PZH} ^{(2) (1)} | DIR | В | 8.3 | 7.8 | 7.5 | 7.2 | 7 | no | |
| t _{PZL} ^{(2) (1)} | אוט | D | 8.3 | 7.8 | 7.5 | 7.2 | 7 | ns | |

⁽¹⁾ The enable time is a calculated value derived using the formula shown in the Section 8.2.2.2.1 section.

⁽²⁾ t_{PLH}: Low-to-high Propagation Delay; t_{PH}: High-to-Low Propagation Delay; t_{PHZ}: High-to-Hi-Z Propagation Delay; t_{PLZ}: Low-to-Hi-Z Propagation Delay; t_{PZH}: Hi-Z-to-Low Propagation Delay



5.7 Switching Characteristics: $V_{CCA} = 1.5V$

over recommended operating free-air temperature range, V_{CCA} = 1.5V ± 0.1V (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2V | V _{CCB} = 1.5V ± 0.1V | | V _{CCB} = 1.8V ± 0.15V | | V _{CCB} = 2.5V ± 0.2V | | V _{CCB} = 3.3V ± 0.3V | | UNIT |
|--|-----------------|----------------|-------------------------|-----------------------------------|------|------------------------------------|------|-----------------------------------|------|-----------------------------------|------|------|
| | | (OUTPUT) | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{PLH} (2) | А | В | 2.8 | 0.7 | 5.4 | 0.5 | 4.6 | 0.4 | 3.7 | 0.3 | 3.5 | no |
| t _{PHL} (2) | A | В | 2.8 | 0.7 | 5.4 | 0.5 | 4.6 | 0.4 | 3.7 | 0.3 | 3.5 | ns |
| t _{PLH} (2) | В | А | 2.7 | 0.8 | 5.4 | 0.7 | 5.2 | 0.6 | 4.9 | 0.5 | 4.7 | ns |
| t _{PHL} (2) | D | _ A | 2.7 | 0.8 | 5.4 | 0.7 | 5.2 | 0.6 | 4.9 | 0.5 | 4.7 | 115 |
| t _{PHZ} (2) | DIR | ^ | 3.9 | 1.3 | 8.5 | 1.3 | 7.8 | 1.1 | 7.7 | 1.4 | 7.6 | ns |
| t _{PLZ} (2) | אוט | A | 3.9 | 1.3 | 8.5 | 1.3 | 7.8 | 1.1 | 7.7 | 1.4 | 7.6 | 115 |
| t _{PHZ} (2) | DIR | В | 4.7 | 1.1 | 7 | 1.4 | 6.9 | 1.2 | 6.9 | 1.7 | 7.1 | ns |
| t _{PLZ} (2) | אוט | Ь | 4.7 | 1.1 | 7 | 1.4 | 6.9 | 1.2 | 6.9 | 1.7 | 7.1 | 115 |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | NID | А | 7.4 | | 12.4 | | 12.1 | | 11.8 | | 11.8 | ne |
| t _{PZL} ⁽²⁾ ⁽¹⁾ | DIR | | 7.4 | | 12.4 | | 12.1 | | 11.8 | | 11.8 | ns |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | DIR | В | 6.7 | | 13.9 | | 12.4 | | 11.4 | | 11.1 | no |
| t _{PZL} ^{(2) (1)} | אוט | D | 6.7 | | 13.9 | | 12.4 | | 11.4 | | 11.1 | ns |

⁽¹⁾ The enable time is a calculated value derived using the formula shown in the Section 8.2.2.2.1 section.

Product Folder Links: SN74AVCH2T45

⁽²⁾ t_{PLH}: Low-to-high Propagation Delay; t_{PHL}: High-to-Low Propagation Delay; t_{PHZ}: High-to-Hi-Z Propagation Delay; t_{PZ}: Low-to-Hi-Z Propagation Delay; t_{PZ}: Hi-Z-to-Low Propagation Delay



5.8 Switching Characteristics: $V_{CCA} = 1.8V$

over recommended operating free-air temperature range, V_{CCA} = 1.8V ± 0.15V (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2V | | V _{CCB} = 1.8V ± 0.15V | | V _{CCB} = 2.5V ± 0.2V | | V _{CCB} = 3.3V ± 0.3V | | UNIT | |
|--|-----------------|----------------|-------------------------|-----|------------------------------------|-----|-----------------------------------|-----|-----------------------------------|-----|------|-----|
| | | (OUTPUT) | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{PLH} ⁽²⁾ | А | В | 2.7 | 0.5 | 5.2 | 0.4 | 4.3 | 0.2 | 3.4 | 0.2 | 3.1 | no |
| t _{PHL} (2) | ^ | Б | 2.7 | 0.5 | 5.2 | 0.4 | 4.3 | 0.2 | 3.4 | 0.2 | 3.1 | ns |
| t _{PLH} ⁽²⁾ | В | А | 2.4 | 0.7 | 4.7 | 0.5 | 4.4 | 0.5 | 4 | 0.4 | 3.8 | ns |
| t _{PHL} ⁽²⁾ | Б | _ ^ | 2.4 | 0.7 | 4.7 | 0.5 | 4.4 | 0.5 | 4 | 0.4 | 3.8 | 115 |
| t _{PHZ} ⁽²⁾ | DIR | А | 3.7 | 1.3 | 8.1 | 0.7 | 6.9 | 1.4 | 5.3 | 1.1 | 5.2 | ne |
| t _{PLZ} (2) | אוט | A | 3.7 | 1.3 | 8.1 | 0.7 | 6.9 | 1.4 | 5.3 | 1.1 | 5.2 | ns |
| t _{PHZ} ⁽²⁾ | DIR | В | 4.4 | 1.3 | 5.8 | 1.3 | 5.9 | 0.8 | 5.7 | 1.5 | 5.9 | no |
| t _{PLZ} ⁽²⁾ | DIK | ь | 4.4 | 1.3 | 5.8 | 1.3 | 5.9 | 0.8 | 5.7 | 1.5 | 5.9 | ns |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | NID | А | 6.8 | | 10.5 | | 10.3 | | 9.7 | | 9.7 | ne |
| t _{PZL} ^{(2) (1)} | DIR | _ ^ | 6.8 | | 10.5 | | 10.3 | | 9.7 | | 9.7 | ns |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | DIR | В | 6.4 | | 13.3 | | 11.2 | | 8.7 | | 8.3 | no |
| t _{PZL} ^{(2) (1)} | אוט | D | 6.4 | | 13.3 | | 11.2 | | 8.7 | | 8.3 | ns |

⁽¹⁾ The enable time is a calculated value derived using the formula shown in the Section 8.2.2.2.1 section.

5.9 Switching Characteristics: V_{CCA} = 2.5V

over recommended operating free-air temperature range, $V_{CCA} = 2.5V \pm 0.2V$ (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2V | V _{CCB} = ± 0. | | V _{CCB} = ± 0.1 | | V _{CCB} = ± 0.2 | | V _{CCB} = ± 0.3 | | UNIT | |
|-------------------------------------|-----------------|----------------|-------------------------|-------------------------|------|--------------------------|------|--------------------------|-----|--------------------------|-----|------|-----|
| | (IIVFOT) | (OUTPUT) | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | | |
| t _{PLH} ⁽²⁾ | А | В | 2.6 | 0.4 | 4.9 | 0.2 | 4 | 0.2 | 3 | 0.2 | 2.6 | ns | |
| t _{PHL} (2) | | ь | 2.6 | 0.4 | 4.9 | 0.2 | 4 | 0.2 | 3 | 0.2 | 2.6 | 115 | |
| t _{PLH} (2) | В | А | 2.1 | 0.6 | 3.8 | 0.5 | 3.4 | 0.4 | 3 | 0.3 | 2.8 | ns | |
| t _{PHL} ⁽²⁾ | Б | ^ | 2.1 | 0.6 | 3.8 | 0.5 | 3.4 | 0.4 | 3 | 0.3 | 2.8 | 115 | |
| t _{PHZ} ⁽²⁾ | DIR | А | 2.4 | 0.7 | 7.9 | 0.8 | 6.4 | 0.8 | 5 | 0.5 | 4.3 | ns | |
| t _{PLZ} (2) | | DIIX | ^ | 2.4 | 0.7 | 7.9 | 0.8 | 6.4 | 0.8 | 5 | 0.5 | 4.3 | 115 |
| t _{PHZ} (2) | DIR | В | 3.8 | 1 | 4.3 | 0.6 | 4.3 | 0.5 | 4.2 | 1.1 | 4.1 | no | |
| t _{PLZ} (2) | אוט | Б | 3.8 | 1 | 4.3 | 0.6 | 4.3 | 0.5 | 4.2 | 1.1 | 4.1 | ns | |
| t _{PZH} ^{(2) (1)} | DIB | А | 5.9 | | 8.5 | | 7.7 | | 7.2 | | 6.9 | ns | |
| t _{PZL} (2) (1) | אוט | DIR | ^ | 5.9 | | 8.5 | | 7.7 | | 7.2 | | 6.9 | 115 |
| t _{PZH} ^{(2) (1)} | DIR | В | 5 | | 12.8 | | 10.4 | | 8 | | 6.9 | ne | |
| t _{PZL} (2) (1) | אוט | ט | 5 | | 12.8 | | 10.4 | | 8 | | 6.9 | ns | |

⁽¹⁾ The enable time is a calculated value derived using the formula shown in the Section 8.2.2.2.1 section.

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⁽²⁾ t_{PLH}: Low-to-high Propagation Delay; t_{PHZ}: High-to-Low Propagation Delay; t_{PHZ}: High-to-Hi-Z Propagation Delay; t_{PZ}: Low-to-Hi-Z Propagation Delay; t_{PZ}: Hi-Z-to-Low Propagation Delay

⁽²⁾ t_{PLH}: Low-to-high Propagation Delay; t_{PHL}: High-to-Low Propagation Delay; t_{PHZ}: High-to-Hi-Z Propagation Delay; t_{PZ}: Low-to-Hi-Z Propagation Delay; t_{PZ}: Hi-Z-to-Low Propagation Delay

5.10 Switching Characteristics: $V_{CCA} = 3.3V$

over recommended operating free-air temperature range, $V_{CCA} = 3.3V \pm 0.3V$ (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CCB} = 1.2V | V _{CCB} = ± 0. | | V _{CCB} = ± 0.1 | | V _{CCB} = ± 0.2 | | V _{CCB} = ± 0.3 | | UNIT | | | |
|--|-----------------|----------------|-------------------------|-------------------------|------|--------------------------|------|--------------------------|-----|--------------------------|-----|------|-----|-----|-----|
| | (INPUT) | (001701) | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | | | | |
| t _{PLH} ⁽²⁾ | А | В | 2.5 | 0.3 | 4.7 | 0.2 | 3.8 | 0.2 | 2.8 | 0.2 | 2.4 | ns | | | |
| t _{PHL} ⁽²⁾ | , A | Б | 2.5 | 0.3 | 4.7 | 0.2 | 3.8 | 0.2 | 2.8 | 0.2 | 2.4 | 115 | | | |
| t _{PLH} ⁽²⁾ | В | Α | 2.1 | 0.6 | 3.6 | 0.4 | 3.1 | 0.3 | 2.6 | 0.3 | 2.4 | ns | | | |
| t _{PHL} ⁽²⁾ | Б | Ь | ^ | 2.1 | 0.6 | 3.6 | 0.4 | 3.1 | 0.3 | 2.6 | 0.3 | 2.4 | 115 | | |
| t _{PHZ} ⁽²⁾ | DIR | Α | 2.9 | 1.1 | 8 | 1 | 6.5 | 1.3 | 4.7 | 1.2 | 4 | ns | | | |
| t _{PLZ} (2) | אוט | A | 2.9 | 1.1 | 8 | 1 | 6.5 | 1.3 | 4.7 | 1.2 | 4 | 115 | | | |
| t _{PHZ} ⁽²⁾ | DIR | В | 3.4 | 0.5 | 6.6 | 0.3 | 5.6 | 0.3 | 4.6 | 1.1 | 4.2 | no | | | |
| t _{PLZ} (2) | אוט | Б | 3.4 | 0.5 | 6.6 | 0.3 | 5.6 | 0.3 | 4.6 | 1.1 | 4.2 | ns | | | |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | DIR | А | 5.5 | | 10.2 | | 8.7 | | 7.2 | | 6.6 | ns | | | |
| t _{PZL} ^{(2) (1)} | אוט | DIK | אוט | אוט | ^ | 5.5 | | 10.2 | | 8.7 | | 7.2 | | 6.6 | 115 |
| t _{PZH} ⁽²⁾ ⁽¹⁾ | DIR | В | 5.4 | | 12.7 | - | 10.3 | | 7.5 | | 6.4 | no | | | |
| t _{PZL} ⁽²⁾ ⁽¹⁾ | אוט | D | 5.4 | | 12.7 | | 10.3 | | 7.5 | | 6.4 | ns | | | |

- The enable time is a calculated value derived using the formula shown in the Section 8.2.2.2.1 section.
- t_{PLH}: Low-to-high Propagation Delay; t_{PHL}: High-to-Low Propagation Delay; t_{PHZ}: High-to-Hi-Z Propagation Delay; t_{PLZ}: Low-to-Hi-Z Propagation Delay; t_{PZH}: Hi-Z-to-High Propagation Delay; t_{PZL}: Hi-Z-to-Low Propagation Delay

5.11 Operating Characteristics

 $T_{\Lambda} = 25^{\circ}C$

| 1A - 23 | <u> </u> | | | | | | | |
|----------------------|--------------------------------|--------------------------------|--|--|--|--|----------------------------|------|
| P | ARAMETER | TEST CONDITIONS | V _{CCA} = V _{CCB} = 1.2V | V _{CCA} = V _{CCB} = 1.5V | V _{CCA} = V _{CCB} = 1.8V | V _{CCA} = V _{CCB} = 2.5V | $V_{CCA} = V_{CCB} = 3.3V$ | UNIT |
| | | CONDITIONS | TYP | TYP | TYP | TYP | TYP | |
| C _{pdA} (1) | A-port input, B-port output | $C_L = 0,$ $f = 10MHz,$ | 3 | 3 | 3 | 3 | 4 | pF |
| OpdA | B-port input, A-port output | $t_r^{(2)} = t_f^{(2)} = 1$ ns | 13 | 13 | 14 | 15 | 15 | ρi |
| C _{pdB} (1) | A-port input, B-port output | $C_L = 0,$ f = 10MHz, | 13 | 13 | 14 | 15 | 15 | 5 |
| OpdB (*) | B-port input, A-port output | $t_r^{(2)} = t_f^{(2)} = 1$ ns | 3 | 3 | 3 | 3 | 4 | pF |

Product Folder Links: SN74AVCH2T45

- Power dissipation capacitance per transceiver (1)
- t_r: Rise time; t_f: Fall time

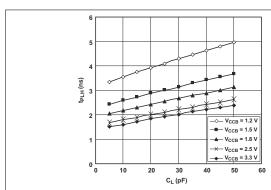
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5.12 Typical Characteristics

5.12.1 Typical Propagation Delay (A to B) vs Load Capacitance, T_A = 25°C, V_{CCA} = 1.8V



to High

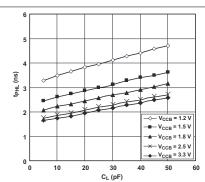


Figure 5-1. Typical A-to-B Propagation Delay, Low | Figure 5-2. Typical A-to-B Propagation Delay, High to Low

5.12.2 Typical Propagation Delay (A to B) vs Load Capacitance, T_A = 25°C, V_{CCA} = 2.5V

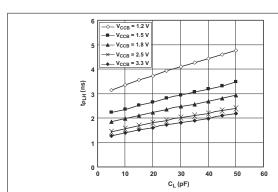


Figure 5-3. Typical A-to-B Propagation Delay, Low to High

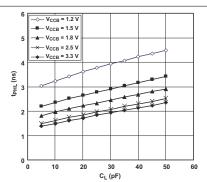


Figure 5-4. Typical A-to-B Propagation Delay, High to Low

5.12.3 Typical Propagation Delay (A to B) vs Load Capacitance, T_A = 25°C, V_{CCA} = 3.3V

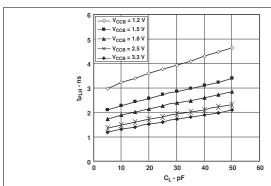


Figure 5-5. Typical A-to-B Propagation Delay, Low to High

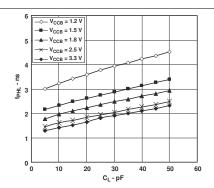
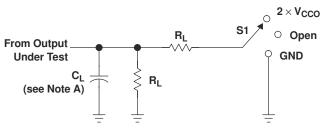


Figure 5-6. Typical A-to-B Propagation Delay, High to Low



6 Parameter Measurement Information

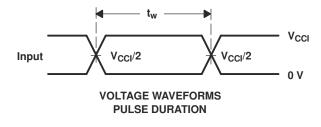
6.1

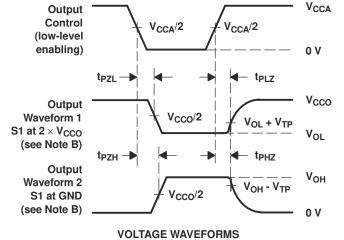


| TEST | S1 |
|------------------------------------|----------------------|
| t _{pd} | Open |
| t _{PLZ} /t _{PZL} | 2 × V _{CCO} |
| t _{PHZ} /t _{PZH} | GND |

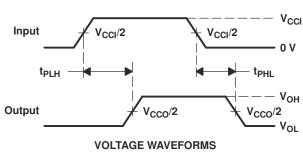
LOAD CIRCUIT

| V _{CCO} | CL | 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 ± 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 |





ENABLE AND DISABLE TIMES



PROPAGATION DELAY TIMES

- NOTES: A. C_L includes probe and jig capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz, $Z_O = 50 \Omega$, $dv/dt \geq 1 V/ns$.
 - D. The outputs are measured one at a time, with one transition per measurement.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PLH} and t_{PHL} are the same as t_{pd} .
 - H. V_{CCI} is the V_{CC} associated with the input port.
 - I. V_{CCO} is the V_{CC} associated with the output port.

Figure 6-1. Load Circuit and Voltage Waveforms

7 Detailed Description

7.1 Overview

This dual-bit non-inverting bus transceiver uses two separate configurable power-supply rails. The A port is designed to track V_{CCA} and accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track V_{CCB} and accepts any supply voltage from 1.2 V to 3.6 V. This allows for universal low-voltage bidirectional translation and level-shifting between any of the 1.2 V, 1.5 V, 1.8 V, 2.5 V, and 3.3 V voltage nodes.

The SN74AVCH2T45 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR pin) input activate either the B-port outputs or the A-port outputs. The device transmits data from the A bus to the B bus when the B-port outputs are activated and from the B bus to the A bus when the A-port outputs are activated.

The SN74AVCH2T45 features active bus-hold circuitry.

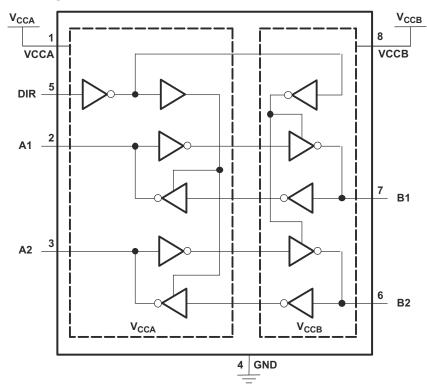
The DIR input is powered by supply voltage from VCCA.

This device is fully specified for partial-power-down applications using off output current (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 VCC input is at GND, both ports are put in a high-impedance state. This will prevent a false high or low logic being presented at the output.

NanoFree package technology is a major breakthrough in IC packaging concepts, using the die as the package.

7.2 Functional Block Diagram





7.3 Feature Description

7.3.1 VCC Isolation

The V_{CC} isolation feature ensures that if either V_{CCA} or V_{CCB} are at GND, both ports will be in a high-impedance state (I_{OZ} shown in the Section 7.2). This prevents false logic levels from being presented to either bus.

7.3.2 2-Rail Design

Fully configurable 2-rail design allows each port to operate over the full 1.2 V to 3.6 V power-supply range.

7.3.3 IO Ports are 4.6 V Tolerant

The IO ports are up to 4.6 V tolerant

7.3.4 Partial Power Down Mode

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

7.3.5 Bus Hold on Data Inputs

Active bus-hold circuitry holds unused or un-driven inputs at a valid logic state. TI does not recommend using pull-up or pull-down resistors with the bus-hold circuitry.

7.4 Device Functional Modes

Table 7-1. Function Table (Each Transceiver)

| INPUT DIR | OPERATION |
|--------------|-----------------|
| L | B data to A bus |
| Н | A data to B bus |

Product Folder Links: SN74AVCH2T45

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information

The SN74AVCH2T45 is used to shift IO voltage levels from one voltage domain to another. Each bus (bus A and bus B) have independent power supplies, and a direction pin is used to control the direction of data flow.

8.2 Typical Applications

8.2.1 Unidirectional Logic Level-Shifting Application

Figure 8-1 is an example of the SN74AVCH2T45 circuit used in a unidirectional logic level-shifting application.

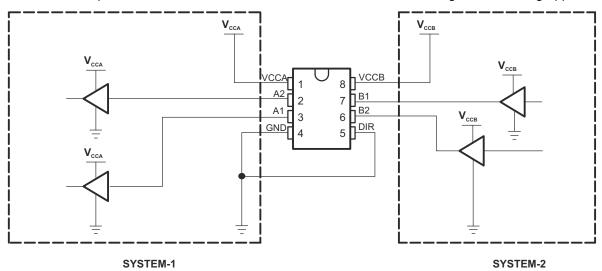


Figure 8-1. Unidirectional Logic Level-Shifting Application

8.2.1.1 Design Requirements

This device uses drivers which are enabled depending on the state of the DIR pin. The designer must know the intended flow of data and take care not to violate any of the high or low logic levels. Active bus-hold circuitry holds unused or un-driven inputs at a valid logic state. TI does not recommend using pull-up or pull-down resistors with the bus-hold circuitry.

8.2.1.2 Detailed Design Procedure

Table 8-1 lists the pins and pin descriptions of the SN74AVCH2T45 connections with SYSTEM-1 and SYSTEM-2.



Table 8-1. SN74AVCH2T45 Pin Connections With SYSTEM-1 and SYSTEM-2

| PIN | NAME | DESCRIPTION |
|-----|------|--|
| 1 | VCCA | SYSTEM-1 supply voltage (1.2V to 3.6V) |
| 2 | A1 | Output level depends on V _{CCA} . |
| 3 | A2 | Output level depends on V _{CCA} . |
| 4 | GND | Device GND |
| 5 | DIR | The GND (low-level) determines B-port to A-port direction. |
| 6 | B2 | Input threshold value depends on V _{CCB} . |
| 7 | B1 | Input threshold value depends on V _{CCB} . |
| 8 | VCCB | SYSTEM-2 supply voltage (1.2V to 3.6V) |

8.2.1.3 Application Curve

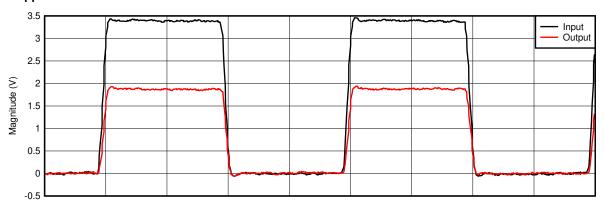


Figure 8-2. 3.3- to 1.8-V Level-Shifting With 1MHz Square Wave

D002

8.2.2 Bidirectional Logic Level-Shifting Application

Figure 8-3 shows the SN74AVCH2T45 used in a bidirectional logic level-shifting application. Because the SN74AVCH2T45 does not have an output-enable (OE) pin, system designers should take precautions to avoid bus contention between SYSTEM-1 and SYSTEM-2 when changing directions.

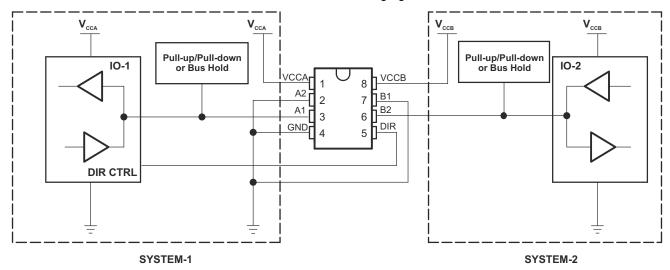


Figure 8-3. Bidirectional Logic Level-Shifting Application

8.2.2.1 Design Requirements

This device uses drivers which are enabled depending on the state of the DIR pin. The designer must know the intended flow of data and take care not to violate any of the high or low logic levels. Active bus-hold circuitry holds unused or un-driven inputs at a valid logic state. TI does not recommend using pull-up or pull-down resistors with the bus-hold circuitry.

8.2.2.2 Detailed Design Procedure

Table 8-2 lists a sequence that shows data transmission from SYSTEM-1 to SYSTEM-2 and then from SYSTEM-2 to SYSTEM-1.

| STATE | DIR CTRL | IO-1 | IO-2 | DESCRIPTION |
|-------|----------|--------|--------|--|
| 1 | Н | Output | Input | SYSTEM-1 data to SYSTEM-2 |
| 2 | Н | Hi-Z | Hi-Z | SYSTEM-2 is getting ready to send data to SYSTEM-1. IO-1 and IO-2 are disabled. The bus-line state depends on pull-up or pull-down. ⁽¹⁾ |
| 3 | L | Hi-Z | Hi-Z | DIR bit is flipped. IO-1 and IO-2 still are disabled. The bus-line state depends on pull-up or pull-down. ⁽¹⁾ |
| 4 | L | Input | Output | SYSTEM-2 data to SYSTEM-1 |

Table 8-2. Data Transmission Sequence

(1) SYSTEM-1 and SYSTEM-2 must use the same conditions, i.e., both pullup or both pulldown.



8.2.2.2.1 Enable Times

Calculate the enable times for the SN74AVCH2T45 using the following formulas:

$$t_{PZH} (DIR to A) = t_{PLZ} (DIR to B) + t_{PLH} (B to A)$$
(1)

$$t_{PZL}$$
 (DIR to A) = t_{PHZ} (DIR to B) + t_{PHL} (B to A) (2)

$$t_{PZH}$$
 (DIR to B) = t_{PLZ} (DIR to A) + t_{PLH} (A to B) (3)

$$t_{PZL} (DIR to B) = t_{PHZ} (DIR to A) + t_{PHL} (A to B)$$
(4)

In a bidirectional application, these enable times provide the maximum delay from the time the DIR bit is switched until an output is expected. For example, if the SN74AVCH2T45 initially is transmitting from A to B, the DIR bit is switched; the B port of the device must be disabled before presenting it with an input. After the B port has been disabled, an input signal applied to it appears on the corresponding A port after the specified propagation delay.

8.2.2.3 Application Curve

Refer to Figure 8-2.

8.3 Power Supply Recommendations

A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies. To guard against such power-up problems, take the following precautions:

- 1. Connect ground before any supply voltage is applied.
- 2. Power up V_{CCA}.
- 3. V_{CCB} can be ramped up along with or after V_{CCA} .

Table 8-3. Typical Total Static Power Consumption (I_{CCA} + I_{CCB})

| V _{CCB} | V _{CCA} | | | | | | | | |
|------------------|------------------|-------|-------|-------|-------|-------|------|--|--|
| ▼ CCB | 0V | 1.2V | 1.5V | 1.8V | 2.5V | 3.3V | UNIT | | |
| 0V | 0 | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 | | | |
| 1.2V | < 0.5 | < 1 | < 1 | < 1 | < 1 | 1 | | | |
| 1.5V | < 0.5 | < 1 | < 1 | < 1 | < 1 | 1 | | | |
| 1.8V | < 0.5 | < 1 | < 1 | < 1 | < 1 | < 1 | μA | | |
| 2.5V | < 0.5 | 1 | < 1 | < 1 | < 1 | < 1 | | | |
| 3.3V | < 0.5 | 1 | < 1 | < 1 | < 1 | < 1 | | | |

8.4 Layout

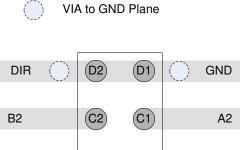
8.4.1 Layout Guidelines

To ensure reliability of the device, following common printed-circuit board layout guidelines is recommended.

- Bypass capacitors should be used on power supplies. Place the capacitors as close as possible to the VCCA, VCCB pin and GND pin.
- Short trace lengths should be used to avoid excessive loading.



8.4.2 Layout Example



(B1)

(A1)

Α1

VCCA

Figure 8-4. Layout Example for YZP Package

(B2)

(A2)

B1

VCCB



9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation see the following:

Implications of Slow or Floating CMOS Inputs, SCBA004

9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.3 Support Resources

TI E2E[™] support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

9.4 Trademarks

NanoFree[™] and TI E2E[™] are trademarks of Texas Instruments.

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9.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.6 Glossary

TI Glossary

This glossary lists and explains terms, acronyms, and definitions.

Submit Document Feedback

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10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision H (April 2015) to Revision I (February 2025) | Page |
|--|------|
| Updated the numbering format for tables, figures, and cross-references throughout the doc Updated DCT and DCU Thermal Information | |
| Added the Receiving Notifications of Documentation Updates, Support Resources, Electros Caution, and Glossary sections | • |
| Changes from Revision G (April 2015) to Revision H (April 2015) | Page |
| Added additional applications | |
| Updated Overview section. | 13 |
| Updated Layout Guidelines section. | 18 |
| Changes from Revision F (November 2007) to Revision G (February 2015) | Page |
| Added ESD Ratings table, Feature Description section, Device Functional Modes, Application Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section. | and |

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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PACKAGING INFORMATION

| Orderable part number | Status | Material type | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material | MSL rating/ Peak reflow | Op temp (°C) | Part marking (6) |
|-----------------------|--------|---------------|-----------------|-----------------------|-----------------|-------------------------------|----------------------------|--------------|------------------|
| 74AVCH2T45DCTTE4 | Active | Production | SSOP (DCT) 8 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTR | Active | Production | SSOP (DCT) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTR.A | Active | Production | SSOP (DCT) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTR.B | Active | Production | SSOP (DCT) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTRG4 | Active | Production | SSOP (DCT) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTRG4.A | Active | Production | SSOP (DCT) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTRG4.B | Active | Production | SSOP (DCT) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTT | Active | Production | SSOP (DCT) 8 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCTT.B | Active | Production | SSOP (DCT) 8 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2 Z |
| SN74AVCH2T45DCUR | Active | Production | VSSOP (DCU) 8 | 3000 LARGE T&R | Yes | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | (ET2R, T2) EZ |
| SN74AVCH2T45DCUR.A | Active | Production | VSSOP (DCU) 8 | 3000 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 85 | (ET2R, T2) EZ |
| SN74AVCH2T45DCUR.B | Active | Production | VSSOP (DCU) 8 | 3000 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 85 | (ET2R, T2) EZ |
| SN74AVCH2T45DCURG4 | Active | Production | VSSOP (DCU) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2R |
| SN74AVCH2T45DCURG4.A | Active | Production | VSSOP (DCU) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2R |
| SN74AVCH2T45DCURG4.B | Active | Production | VSSOP (DCU) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | ET2R |
| SN74AVCH2T45DCUT | Active | Production | VSSOP (DCU) 8 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (ET2R, T2) EZ |
| SN74AVCH2T45DCUT.B | Active | Production | VSSOP (DCU) 8 | 250 SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (ET2R, T2) EZ |
| SN74AVCH2T45YZPR | Active | Production | DSBGA (YZP) 8 | 3000 LARGE T&R | Yes | SNAGCU | Level-1-260C-UNLIM | -40 to 85 | TFN |
| SN74AVCH2T45YZPR.B | Active | Production | DSBGA (YZP) 8 | 3000 LARGE T&R | Yes | SNAGCU | Level-1-260C-UNLIM | -40 to 85 | TFN |

PACKAGE OPTION ADDENDUM

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- (1) Status: For more details on status, see our product life cycle.
- (2) Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.
- (4) Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION





| A0 | Dimension designed to accommodate the component width |
|----|---|
| В0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|-----------------|--------------------|---|------|--------------------------|--------------------------|------------|------------|------------|------------|-----------|------------------|
| SN74AVCH2T45DCTR | SSOP | DCT | 8 | 3000 | 180.0 | 13.0 | 3.35 | 4.5 | 1.55 | 4.0 | 12.0 | Q3 |
| SN74AVCH2T45DCTRG4 | SSOP | DCT | 8 | 3000 | 180.0 | 13.0 | 3.35 | 4.5 | 1.55 | 4.0 | 12.0 | Q3 |
| SN74AVCH2T45DCTT | SSOP | DCT | 8 | 250 | 180.0 | 13.0 | 3.35 | 4.5 | 1.55 | 4.0 | 12.0 | Q3 |
| SN74AVCH2T45DCUR | VSSOP | DCU | 8 | 3000 | 180.0 | 9.0 | 2.25 | 3.4 | 1.0 | 4.0 | 8.0 | Q3 |
| SN74AVCH2T45DCURG4 | VSSOP | DCU | 8 | 3000 | 180.0 | 8.4 | 2.25 | 3.35 | 1.05 | 4.0 | 8.0 | Q3 |
| SN74AVCH2T45YZPR | DSBGA | YZP | 8 | 3000 | 178.0 | 9.2 | 1.02 | 2.02 | 0.63 | 4.0 | 8.0 | Q1 |



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*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVCH2T45DCTR | SSOP | DCT | 8 | 3000 | 182.0 | 182.0 | 20.0 |
| SN74AVCH2T45DCTRG4 | SSOP | DCT | 8 | 3000 | 182.0 | 182.0 | 20.0 |
| SN74AVCH2T45DCTT | SSOP | DCT | 8 | 250 | 182.0 | 182.0 | 20.0 |
| SN74AVCH2T45DCUR | VSSOP | DCU | 8 | 3000 | 182.0 | 182.0 | 20.0 |
| SN74AVCH2T45DCURG4 | VSSOP | DCU | 8 | 3000 | 202.0 | 201.0 | 28.0 |
| SN74AVCH2T45YZPR | DSBGA | YZP | 8 | 3000 | 220.0 | 220.0 | 35.0 |





NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

 2. This drawing is subject to change without notice.

 3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
 4. Reference JEDEC registration MO-187 variation CA.





NOTES: (continued)

- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.





NOTES: (continued)

- 7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 8. Board assembly site may have different recommendations for stencil design.







NOTES:

- 1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

 2. This drawing is subject to change without notice.

 3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.





NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.





NOTES: (continued)

- 7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 8. Board assembly site may have different recommendations for stencil design.





DIE SIZE BALL GRID ARRAY



NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- 2. This drawing is subject to change without notice.



DIE SIZE BALL GRID ARRAY



NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



DIE SIZE BALL GRID ARRAY



NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.



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