

FEATURES

- Member of the Texas Instruments Widebus™ Family
- EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process
- DOC™ (Dynamic Output Control) Circuit Dynamically Changes Output Impedance, Resulting in Noise Reduction Without Speed Degradation
- Less Than 2-ns Maximum Propagation Delay at 2.5-V and 3.3-V V_{CC}
- Dynamic Drive Capability Is Equivalent to Standard Outputs With I_{OH} and I_{OL} of ± 24 mA at 2.5-V V_{CC}
- Overvoltage-Tolerant Inputs/Outputs Allow Mixed-Voltage-Mode Data Communications
- I_{off} Supports Partial-Power-Down Mode Operation
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
- Latch-Up Performance Exceeds 250 mA Per JESD 78
- Package Options Include Plastic Thin Shrink Small-Outline (DGG) and Thin Very Small-Outline (DGV) Packages

DESCRIPTION

A Dynamic Output Control (DOC™) circuit is implemented, which, during the transition, initially lowers the output impedance to effectively drive the load and, subsequently, raises the impedance to reduce noise. Figure 1 shows typical V_{OL} vs I_{OL} and V_{OH} vs I_{OH} curves to illustrate the output impedance and drive capability of the circuit. At the beginning of the signal transition, the DOC circuit provides a maximum dynamic drive that is equivalent to a high-drive standard-output device. For more information, refer to the TI application reports, *AVC Logic Family Technology and Applications*, literature number SCEA006, and *Dynamic Output Control (DOC™) Circuitry Technology and Applications*, literature number SCEA009.

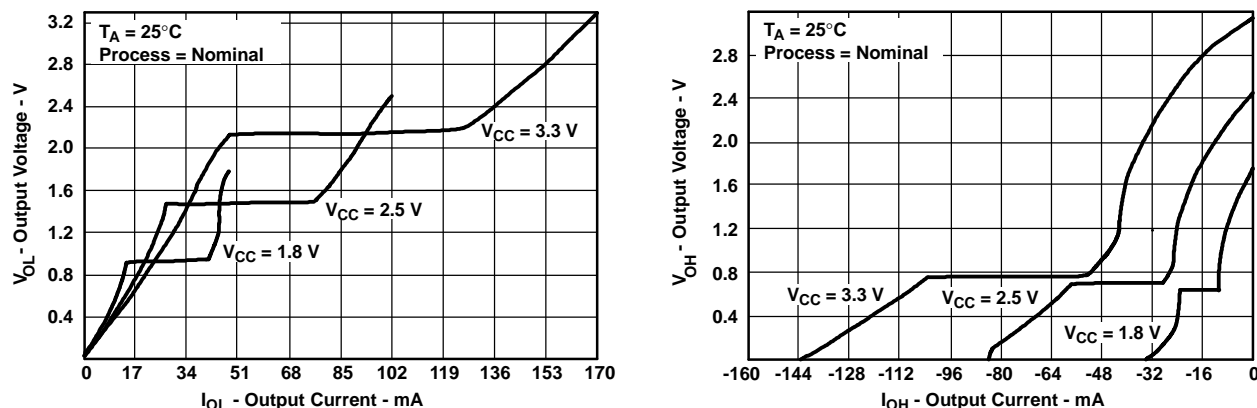


Figure 1. Output Voltage vs Output Current

This 16-bit (dual octal) noninverting bus transceiver is operational at 1.2-V to 3.6-V V_{CC} , but is designed specifically for 1.65-V to 3.6-V V_{CC} operation.

The SN74AVC16245 is designed for asynchronous communication between data buses. The control-function implementation minimizes external timing requirements.

This device can be used as two 8-bit transceivers or one 16-bit transceiver. It allows data transmission 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 device so that the buses are effectively isolated.



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SN74AVC16245

16-BIT BUS TRANSCEIVER

WITH 3-STATE OUTPUTS

SCES142L–JULY 1998–REVISED MAY 2005

DESCRIPTION (CONTINUED)

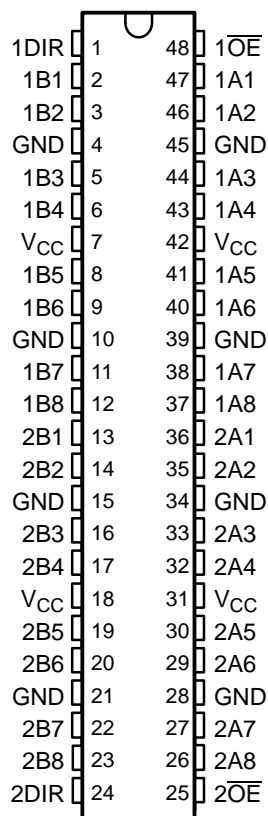
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

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 SN74AVC16245 is characterized for operation from -40°C to 85°C .

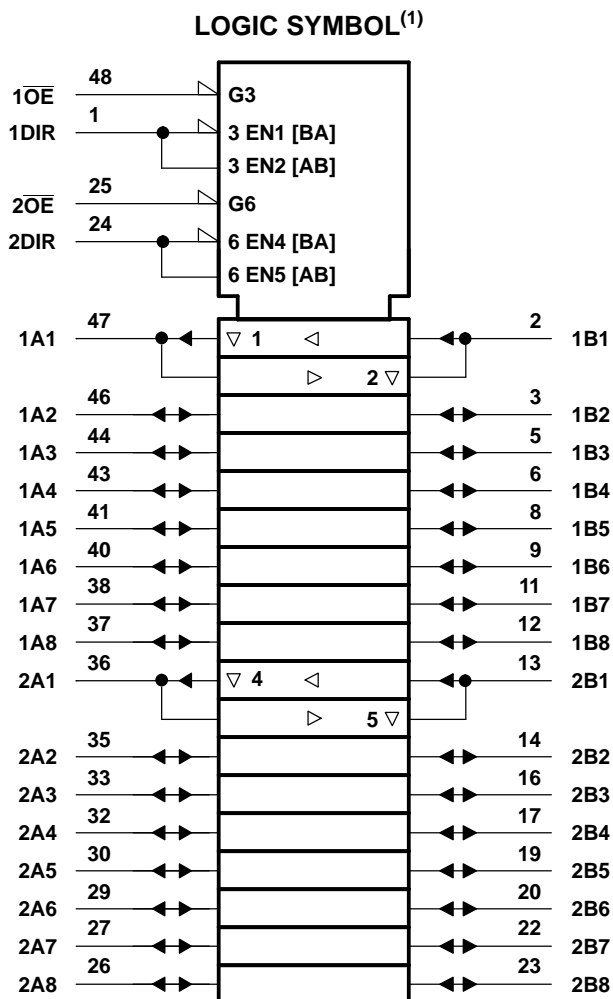
TERMINAL ASSIGNMENTS

DGG OR DGV PACKAGE
(TOP VIEW)

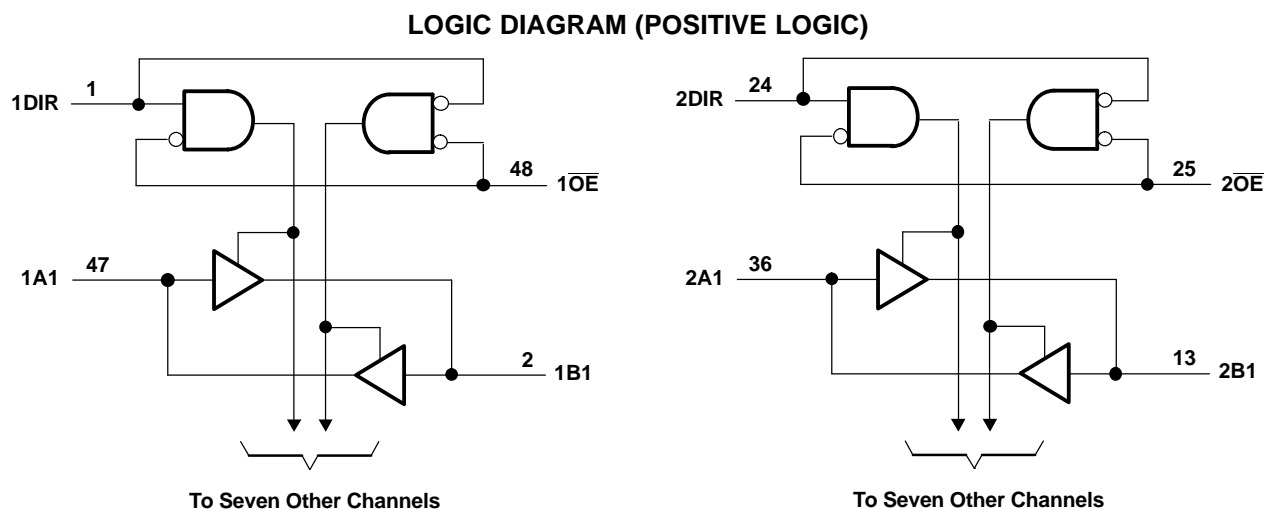


FUNCTION TABLE
(EACH 8-BIT TRANSCEIVER)

| INPUTS | | OPERATION |
|-----------------|-----|-----------------|
| \overline{OE} | DIR | |
| L | L | B data to A bus |
| L | H | A data to B bus |
| H | X | Isolation |



(1) This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.



SN74AVC16245

16-BIT BUS TRANSCEIVER

WITH 3-STATE OUTPUTS

SCES142L–JULY 1998–REVISED MAY 2005

Absolute Maximum Ratings⁽¹⁾

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

| | | MIN | MAX | UNIT |
|---------------|--|-------------|----------------|------|
| V_{CC} | Supply voltage range | –0.5 | 4.6 | V |
| V_I | Input voltage range ⁽²⁾ | –0.5 | 4.6 | V |
| V_O | Voltage range applied to any input/output when the output is in the high-impedance or power-off state ⁽²⁾ | –0.5 | 4.6 | V |
| V_O | Voltage range applied to any input/output when the output is in the high or low state ⁽²⁾⁽³⁾ | –0.5 | $V_{CC} + 0.5$ | V |
| I_{IK} | Input clamp current | $V_I < 0$ | –50 | mA |
| I_{OK} | Output clamp current | $V_O < 0$ | –50 | mA |
| I_O | Continuous output current | | ±50 | mA |
| | Continuous current through each V_{CC} or GND | | ±100 | mA |
| θ_{JA} | Package thermal impedance ⁽⁴⁾ | DGG package | 70 | °C/W |
| | | DGV package | 58 | |
| T_{stg} | Storage temperature range | –65 | 150 | °C |

- (1) 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.
- (2) The input 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 4.6 V maximum if the output current rating is observed.
- (4) The package thermal impedance is calculated in accordance with JESD 51.

Recommended Operating Conditions⁽¹⁾

| | | MIN | MAX | UNIT | |
|------------------|---|------------------------------------|------------------------|-----------------|----|
| V _{CC} | Supply voltage | Operating | 1.4 | 3.6 | V |
| | | Data retention only | 1.2 | | |
| V _{IH} | High-level input voltage | V _{CC} = 1.2 V | V _{CC} | | V |
| | | V _{CC} = 1.4 V to 1.6 V | 0.65 × V _{CC} | | |
| | | V _{CC} = 1.65 V to 1.95 V | 0.65 × V _{CC} | | |
| | | V _{CC} = 2.3 V to 2.7 V | 1.7 | | |
| | | V _{CC} = 3 V to 3.6 V | 2 | | |
| V _{IL} | Low-level input voltage | V _{CC} = 1.2 V | GND | | V |
| | | V _{CC} = 1.4 V to 1.6 V | 0.35 × V _{CC} | | |
| | | V _{CC} = 1.65 V to 1.95 V | 0.35 × V _{CC} | | |
| | | V _{CC} = 2.3 V to 2.7 V | 0.7 | | |
| | | V _{CC} = 3 V to 3.6 V | 0.8 | | |
| V _I | Input voltage | 0 | 3.6 | V | |
| V _O | Output voltage | Active state | 0 | V _{CC} | V |
| | | 3-state | 0 | 3.6 | |
| I _{OHS} | Static high-level output current ⁽²⁾ | V _{CC} = 1.4 V to 1.6 V | −2 | | mA |
| | | V _{CC} = 1.65 V to 1.95 V | −4 | | |
| | | V _{CC} = 2.3 V to 2.7 V | −8 | | |
| | | V _{CC} = 3 V to 3.6 V | −12 | | |
| I _{OLS} | Static low-level output current ⁽²⁾ | V _{CC} = 1.4 V to 1.6 V | 2 | | mA |
| | | V _{CC} = 1.65 V to 1.95 V | 4 | | |
| | | V _{CC} = 2.3 V to 2.7 V | 8 | | |
| | | V _{CC} = 3 V to 3.6 V | 12 | | |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 1.4 V to 3.6 V | 5 | ns/V | |
| T _A | Operating free-air temperature | | −40 | 85 | °C |

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

(2) Dynamic drive capability is equivalent to standard outputs with I_{OH} and I_{OL} of ±24 mA at 2.5-V V_{CC}. See Figure 1 for V_{OL} vs I_{OL} and V_{OH} vs I_{OH} characteristics. Refer to the TI application reports, *AVC Logic Family Technology and Applications*, literature number SCEA006, and *Dynamic Output Control (DOC™) Circuitry Technology and Applications*, literature number SCEA009.

SN74AVC16245

16-BIT BUS TRANSCEIVER

WITH 3-STATE OUTPUTS

SCES142L–JULY 1998–REVISED MAY 2005

Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | V _{CC} | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|--------------------------------|----------------|--|-----------------|-----------------------|--------------------|-------|------|
| V _{OH} | | I _{OHS} = −100 μA | 1.4 V to 3.6 V | V _{CC} − 0.2 | | | V |
| | | I _{OHS} = −2 mA, V _{IH} = 0.91 V | 1.4 V | 1.05 | | | |
| | | I _{OHS} = −4 mA, V _{IH} = 1.07 V | 1.65 V | 1.2 | | | |
| | | I _{OHS} = −8 mA, V _{IH} = 1.7 V | 2.3 V | 1.75 | | | |
| | | I _{OHS} = −12 mA, V _{IH} = 2 V | 3 V | 2.3 | | | |
| V _{OL} | | I _{OLS} = 100 μA | 1.4 V to 3.6 V | | | 0.2 | V |
| | | I _{OLS} = 2 mA, V _{IL} = 0.49 V | 1.4 V | | | 0.4 | |
| | | I _{OLS} = 4 mA, V _{IL} = 0.57 V | 1.65 V | | | 0.45 | |
| | | I _{OLS} = 8 mA, V _{IL} = 0.7 V | 2.3 V | | | 0.55 | |
| | | I _{OLS} = 12 mA, V _{IL} = 0.8 V | 3 V | | | 0.7 | |
| I _I | Control inputs | V _I = V _{CC} or GND | 3.6 V | | | ±2.5 | μA |
| I _{off} | | V _I or V _O = 3.6 V | 0 | | | ±10 | μA |
| I _{OZ} ⁽²⁾ | | V _O = V _{CC} or GND, V _I ($\overline{\text{OE}}$) = V _{CC} | 3.6 V | | | ±12.5 | μA |
| I _{CC} | | V _I = V _{CC} or GND, I _O = 0 | 3.6 V | | | 40 | μA |
| C _i | Control inputs | V _I = V _{CC} or GND | 2.5 V | | | 3 | pF |
| | | | 3.3 V | | | 3 | |
| C _{io} | A or B ports | V _O = V _{CC} or GND | 2.5 V | | | 9 | pF |
| | | | 3.3 V | | | 9 | |

(1) Typical values are measured at T_A = 25°C.

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

Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 2](#) through [Figure 5](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} = 1.2 V | V _{CC} = 1.5 V ± 0.1 V | | V _{CC} = 1.8 V ± 0.15 V | | V _{CC} = 2.5 V ± 0.2 V | | V _{CC} = 3.3 V ± 0.3 V | | UNIT |
|------------------|------------------------|-------------|-------------------------|---------------------------------|-----|----------------------------------|-----|---------------------------------|-----|---------------------------------|-----|------|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{pd} | A or B | B or A | 3.9 | 0.8 | 4 | 0.7 | 3 | 0.6 | 1.9 | 0.5 | 1.7 | ns |
| t _{en} | $\overline{\text{OE}}$ | A or B | 8.4 | 1.5 | 9.2 | 1.4 | 7 | 1 | 4.3 | 0.7 | 3.7 | ns |
| t _{dis} | $\overline{\text{OE}}$ | A or B | 8.4 | 2.3 | 9.3 | 2.2 | 7 | 1.1 | 4 | 1.2 | 3.9 | ns |

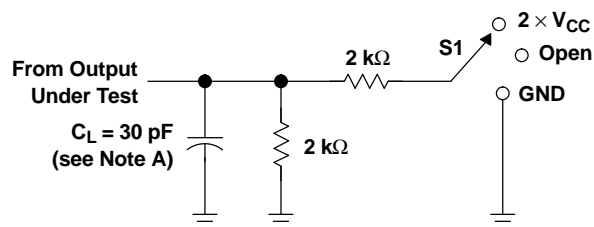
Operating Characteristics

T_A = 25°C

| PARAMETER | | TEST CONDITIONS | V _{CC} = 1.8 V | V _{CC} = 2.5 V | V _{CC} = 3.3 V | UNIT |
|-----------------|-------------------------------|------------------|-------------------------|-------------------------|-------------------------|------|
| | | | TYP | TYP | TYP | |
| C _{pd} | Power dissipation capacitance | Outputs enabled | 35 | 38 | 44 | pF |
| | | Outputs disabled | 6 | 6 | 7 | |

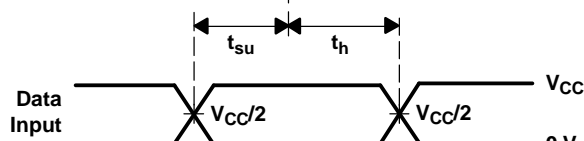
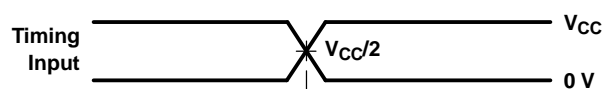
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 1.2\text{ V}$ AND $1.5\text{ V} \pm 0.1\text{ V}$

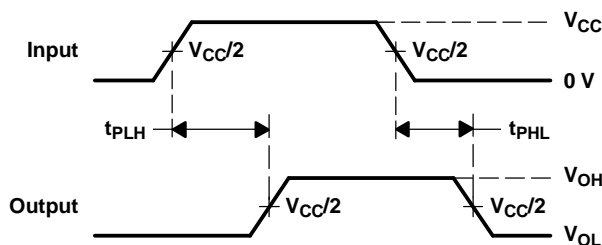


LOAD CIRCUIT

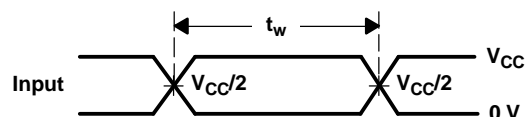
| TEST | S1 |
|-------------------|-------------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



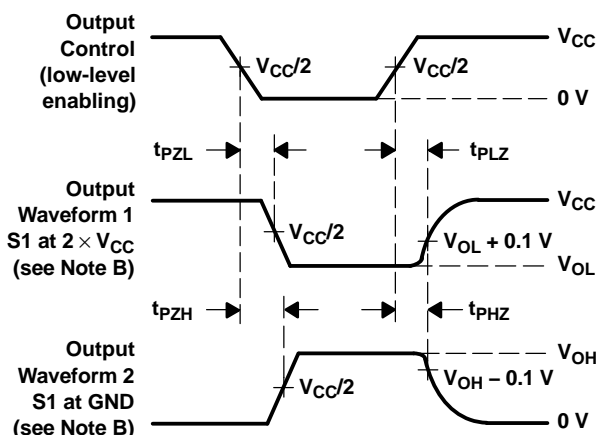
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



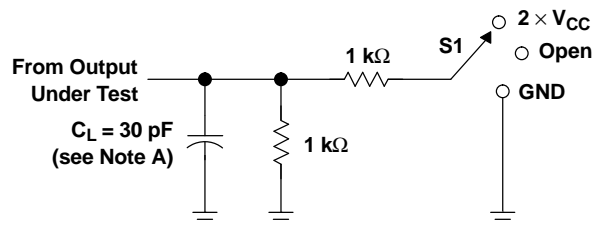
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- NOTES:
- C_L includes probe and jig capacitance.
 - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 - The outputs are measured one at a time, with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 2. Load Circuit and Voltage Waveforms

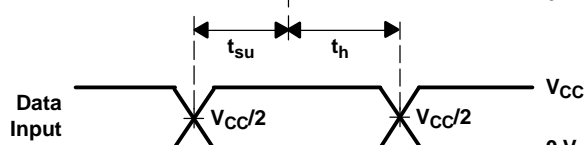
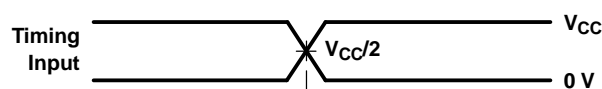
PARAMETER MEASUREMENT INFORMATION

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

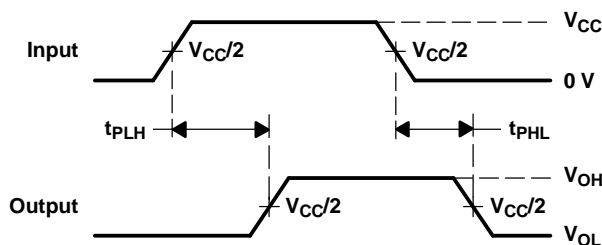


LOAD CIRCUIT

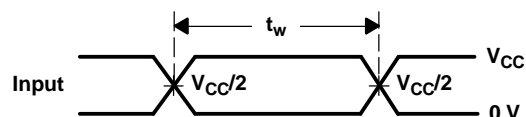
| TEST | S1 |
|-------------------|---------------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | 2 \times V_{CC} |
| t_{PHZ}/t_{PZH} | GND |



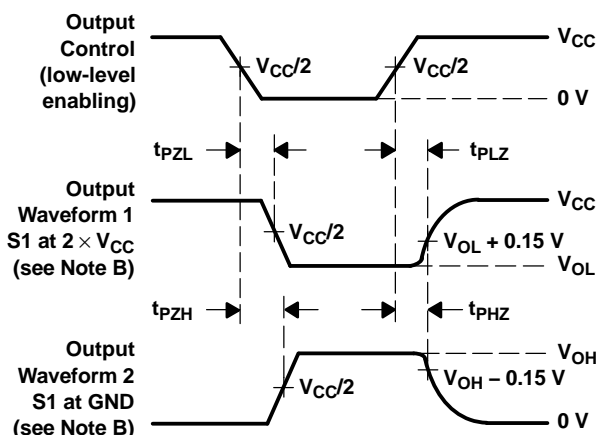
**VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS
PULSE DURATION**



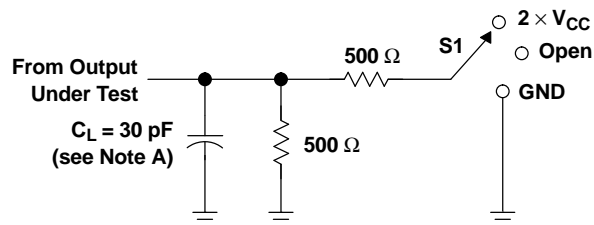
**VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES**

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

Figure 3. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

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

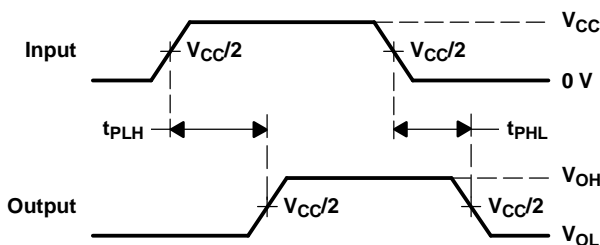


LOAD CIRCUIT

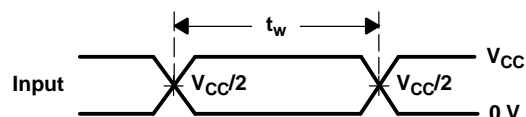
| TEST | S1 |
|-------------------|-------------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | 2 $\times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



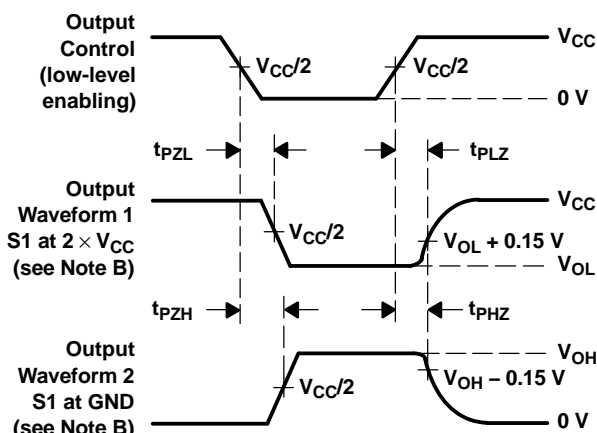
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



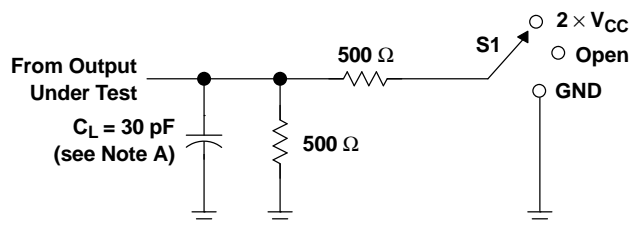
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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

Figure 4. Load Circuit and Voltage Waveforms

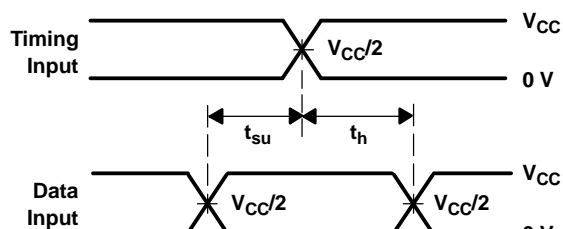
PARAMETER MEASUREMENT INFORMATION

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

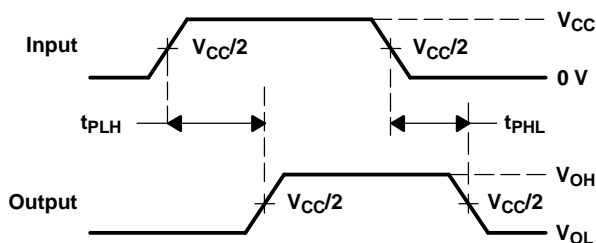


LOAD CIRCUIT

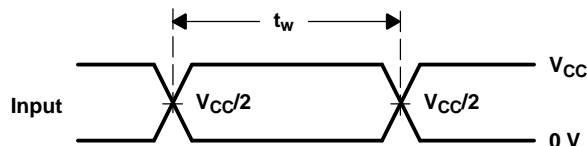
| TEST | S1 |
|-------------------|-------------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | 2 $\times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



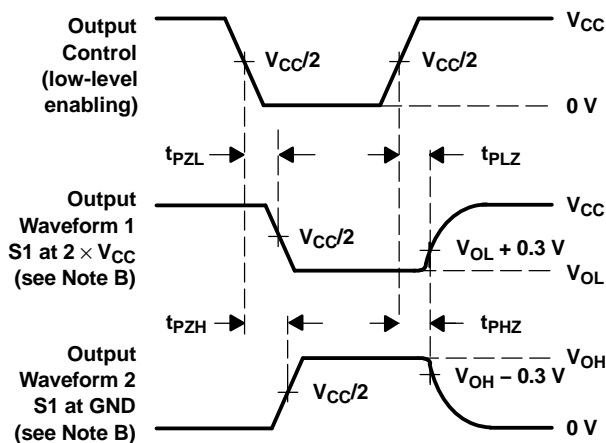
**VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS
PULSE DURATION**



**VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES**

- NOTES:
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 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 5. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| 74AVC16245DGVRG4 | ACTIVE | TVSOP | DGV | 48 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CVA245 | Samples |
| SN74AVC16245DGGR | ACTIVE | TSSOP | DGG | 48 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | AVC16245 | Samples |
| SN74AVC16245DGVR | ACTIVE | TVSOP | DGV | 48 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CVA245 | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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TAPE AND REEL INFORMATION


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AVC16245DGGR | TSSOP | DGG | 48 | 2000 | 330.0 | 24.4 | 8.6 | 13.0 | 1.8 | 12.0 | 24.0 | Q1 |
| SN74AVC16245DGVR | TVSOP | DGV | 48 | 2000 | 330.0 | 16.4 | 7.1 | 10.2 | 1.6 | 12.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVC16245DGGR | TSSOP | DGG | 48 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74AVC16245DGVR | TVSOP | DGV | 48 | 2000 | 853.0 | 449.0 | 35.0 |

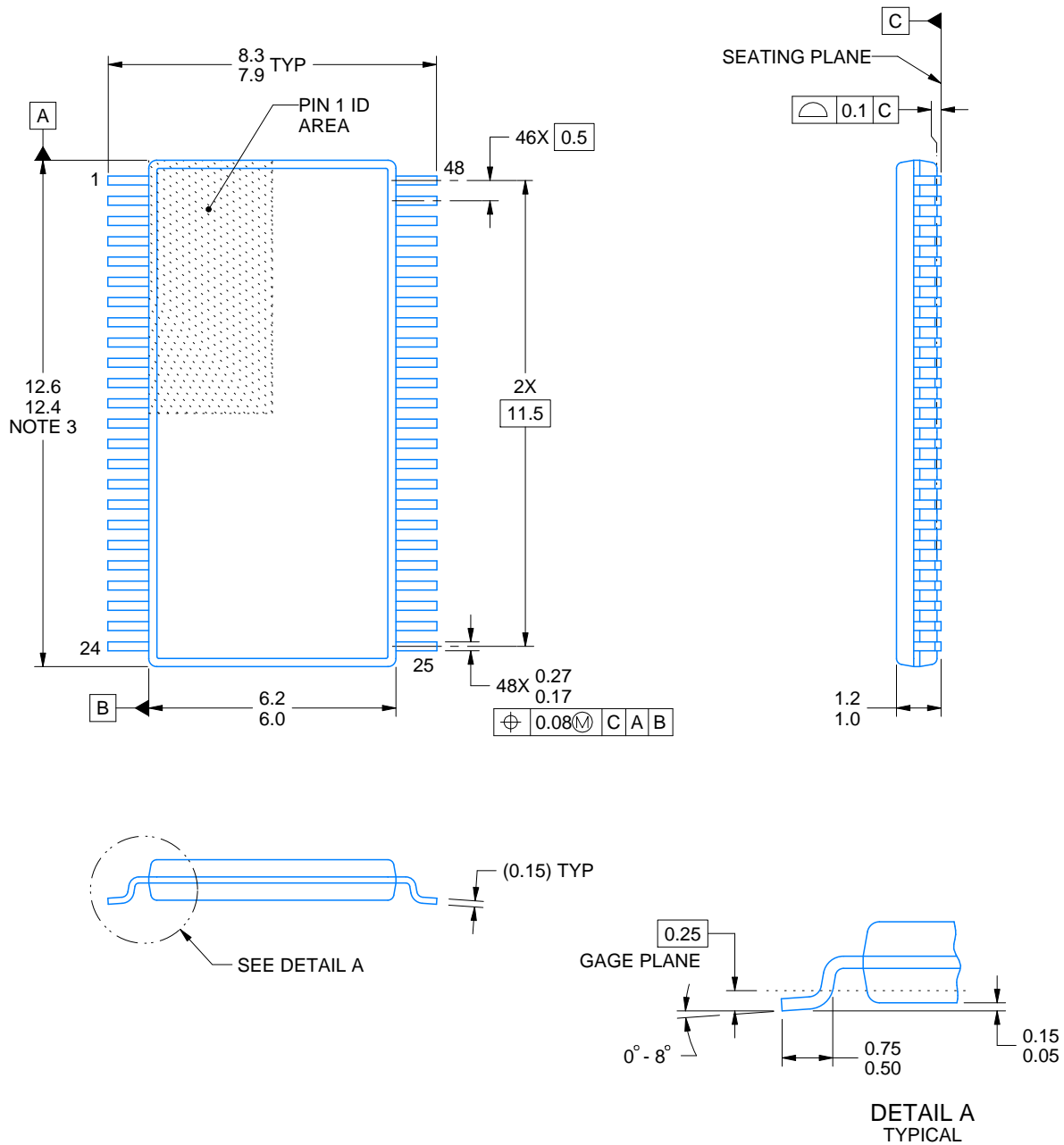
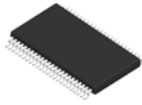
DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194



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NOTES:

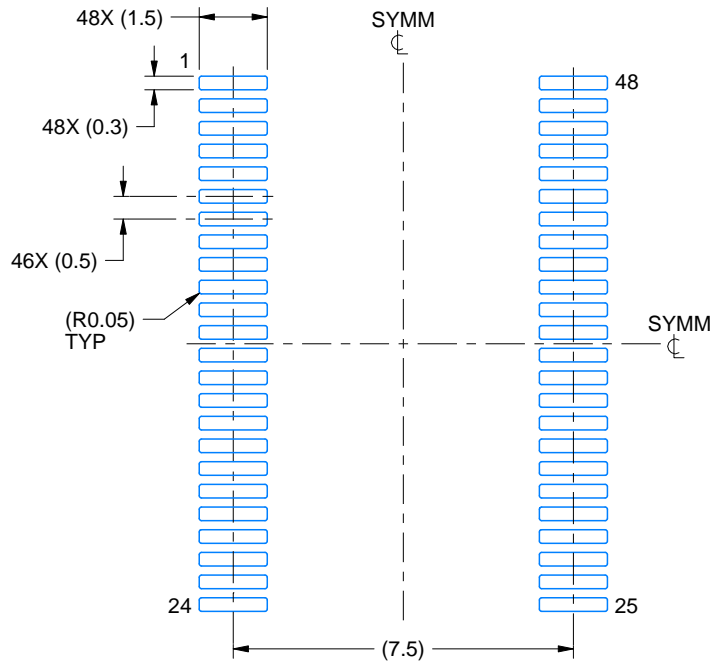
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

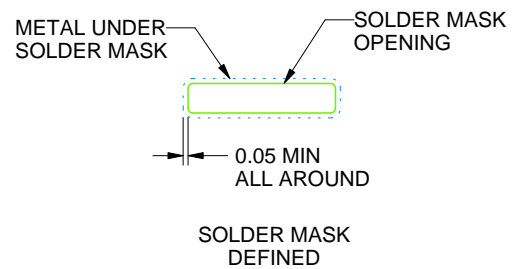
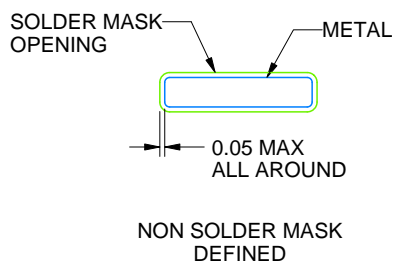
DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

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NOTES: (continued)

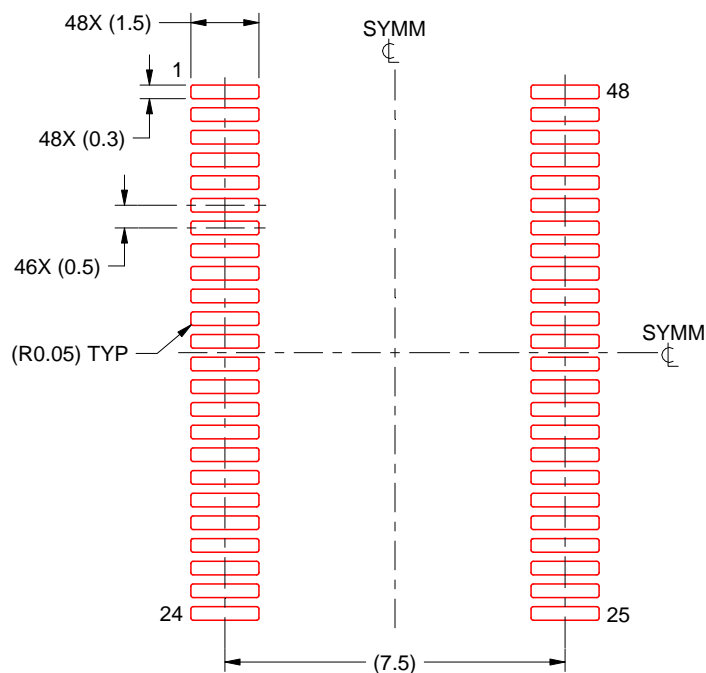
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

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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.

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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