

## SCBS700F – JULY 1997 – REVISED AUGUST 2009

|                 |    |    |                 |
|-----------------|----|----|-----------------|
| OEAB            | 1  | 56 | GND             |
| LEAB            | 2  | 55 | CLKAB           |
| A1              | 3  | 54 | B1              |
| GND             | 4  | 53 | GND             |
| A2              | 5  | 52 | B2              |
| A3              | 6  | 51 | B3              |
| V <sub>CC</sub> | 7  | 50 | V <sub>CC</sub> |
| A4              | 8  | 49 | B4              |
| A5              | 9  | 48 | B5              |
| A6              | 10 | 47 | B6              |
| GND             | 11 | 46 | GND             |
| A7              | 12 | 45 | B7              |
| A8              | 13 | 44 | B8              |
| A9              | 14 | 43 | B9              |
| A10             | 15 | 42 | B10             |
| A11             | 16 | 41 | B11             |
| A12             | 17 | 40 | B12             |
| GND             | 18 | 39 | GND             |
| A13             | 19 | 38 | B13             |
| A14             | 20 | 37 | B14             |
| A15             | 21 | 36 | B15             |
| V <sub>CC</sub> | 22 | 35 | V <sub>CC</sub> |
| A16             | 23 | 34 | B16             |
| A17             | 24 | 33 | B17             |
| GND             | 25 | 32 | GND             |
| A18             | 26 | 31 | B18             |
| OEBA            | 27 | 30 | CLKBA           |
| LEBA            | 28 | 29 | GND             |

# SN54LVTH16501, SN74LVTH16501

## 3.3-V ABT 18-BIT UNIVERSAL BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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#### description/ordering information (continued)

Data flow in each direction is controlled by output-enable ( $\overline{\text{OEAB}}$  and  $\overline{\text{OEBA}}$ ), latch-enable ( $\text{LEAB}$  and  $\text{LEBA}$ ), and clock ( $\text{CLKAB}$  and  $\text{CLKBA}$ ) inputs. For A-to-B data flow, the devices operate in the transparent mode when  $\text{LEAB}$  is high. When  $\text{LEAB}$  is low, the A data is latched if  $\text{CLKAB}$  is held at a high or low logic level. If  $\text{LEAB}$  is low, the A data is stored in the latch/flip-flop on the low-to-high transition of  $\text{CLKAB}$ . When  $\overline{\text{OEAB}}$  is high, the outputs are active. When  $\overline{\text{OEAB}}$  is low, the outputs are in the high-impedance state.

Data flow for B to A is similar to that of A to B but uses  $\overline{\text{OEBA}}$ ,  $\text{LEBA}$ , and  $\text{CLKBA}$ . The output enables are complementary ( $\overline{\text{OEAB}}$  is active high and  $\overline{\text{OEBA}}$  is active low).

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.

When  $V_{\text{CC}}$  is between 0 and 1.5 V, the devices are in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V,  $\overline{\text{OE}}$  should be tied to  $V_{\text{CC}}$  through a pullup resistor and  $\text{OE}$  should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sinking/current-sourcing capability of the driver.

These devices are fully specified for hot-insertion applications using  $I_{\text{off}}$  and power-up 3-state. The  $I_{\text{off}}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

FUNCTION TABLE<sup>†</sup>

| INPUTS |      |       |   | OUTPUT<br>B      |
|--------|------|-------|---|------------------|
| OEAB   | LEAB | CLKAB | A |                  |
| L      | X    | X     | X | Z                |
| H      | H    | X     | L | L                |
| H      | H    | X     | H | H                |
| H      | L    | ↑     | L | L                |
| H      | L    | ↑     | H | H                |
| H      | L    | H     | X | $B_0^{\ddagger}$ |
| H      | L    | L     | X | $B_0^{\S}$       |

<sup>†</sup> A-to-B data flow is shown; B-to-A flow is similar, but uses  $\overline{\text{OEBA}}$ ,  $\text{LEBA}$ , and  $\text{CLKBA}$ .

<sup>‡</sup> Output level before the indicated steady-state input conditions were established, provided that  $\text{CLKAB}$  was high before  $\text{LEAB}$  went low

<sup>§</sup> Output level before the indicated steady-state input conditions were established

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|                                                                                                     |       |                            |
|-----------------------------------------------------------------------------------------------------|-------|----------------------------|
| Supply voltage range, $V_{CC}$                                                                      | ..... | -0.5 V to 4.6 V            |
| Input voltage range, $V_I$ (see Note 1)                                                             | ..... | -0.5 V to 7 V              |
| Voltage range applied to any output in the high-impedance<br>or power-off state, $V_O$ (see Note 1) | ..... | -0.5 V to 7 V              |
| Voltage range applied to any output in the high state, $V_O$ (see Note 1)                           | ..... | -0.5 V to $V_{CC} + 0.5$ V |
| Current into any output in the low state, $I_O$ : SN54LVTH16501                                     | ..... | 96 mA                      |
| SN74LVTH16501                                                                                       | ..... | 128 mA                     |
| Current into any output in the high state, $I_O$ (see Note 2): SN54LVTH16501                        | ..... | 48 mA                      |
| SN74LVTH16501                                                                                       | ..... | 64 mA                      |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ )                                                         | ..... | -50 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ )                                                        | ..... | -50 mA                     |
| Package thermal impedance, $\theta_{JA}$ (see Note 3): DGG package                                  | ..... | 64°C/W                     |
| DL package                                                                                          | ..... | 56°C/W                     |
| Storage temperature range, $T_{Sta}$                                                                | ..... | -65°C to 150°C             |

NOTES:

1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This current flows only when the output is in the high state and  $V_O > V_{CC}$ .
3. The package thermal impedance is calculated in accordance with JESD 51-7.

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## 3.3-V ABT 18-BIT UNIVERSAL BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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#### recommended operating conditions (see Note 4)

|                          |                                    |                 | SN54LVTH16501 |     | SN74LVTH16501 |     | UNIT      |
|--------------------------|------------------------------------|-----------------|---------------|-----|---------------|-----|-----------|
|                          |                                    |                 | MIN           | MAX | MIN           | MAX |           |
| $V_{CC}$                 | Supply voltage                     |                 | 2.7           | 3.6 | 2.7           | 3.6 | V         |
| $V_{IH}$                 | High-level input voltage           |                 | 2             |     | 2             |     | V         |
| $V_{IL}$                 | Low-level input voltage            |                 |               | 0.8 |               | 0.8 | V         |
| $V_I$                    | Input voltage                      |                 |               | 5.5 |               | 5.5 | V         |
| $I_{OH}$                 | High-level output current          |                 |               | -24 |               | -32 | mA        |
| $I_{OL}$                 | Low-level output current           |                 |               | 48  |               | 64  | mA        |
| $\Delta t/\Delta v$      | Input transition rise or fall rate | Outputs enabled |               | 10  |               | 10  | ns/V      |
| $\Delta t/\Delta V_{CC}$ | Power-up ramp rate                 |                 | 200           |     | 200           |     | $\mu$ s/V |
| $T_A$                    | Operating free-air temperature     |                 | -55           | 125 | -40           | 85  | °C        |

NOTE 4: All unused control inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# SN54LVTH16501, SN74LVTH16501

## 3.3-V ABT 18-BIT UNIVERSAL BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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

| PARAMETER             |                | TEST CONDITIONS                                                                                              |                                  | SN54LVTH16501        |      |     | SN74LVTH16501        |      |     | UNIT |    |
|-----------------------|----------------|--------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------|------|-----|----------------------|------|-----|------|----|
|                       |                |                                                                                                              |                                  | MIN                  | TYP† | MAX | MIN                  | TYP† | MAX |      |    |
| V <sub>IK</sub>       |                | V <sub>CC</sub> = 2.7 V, I <sub>I</sub> = -18 mA                                                             |                                  | -1.2                 |      |     | -1.2                 |      |     | V    |    |
| V <sub>OH</sub>       |                | V <sub>CC</sub> = 2.7 V to 3.6 V, I <sub>OH</sub> = -100 μA                                                  |                                  | V <sub>CC</sub> -0.2 |      |     | V <sub>CC</sub> -0.2 |      |     | V    |    |
|                       |                | V <sub>CC</sub> = 2.7 V, I <sub>OH</sub> = -8 mA                                                             |                                  | 2.4                  |      |     | 2.4                  |      |     |      |    |
|                       |                | V <sub>CC</sub> = 3 V                                                                                        | I <sub>OH</sub> = -24 mA         | 2                    |      |     |                      |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OH</sub> = -32 mA         |                      |      |     | 2                    |      |     |      |    |
| V <sub>OL</sub>       |                | V <sub>CC</sub> = 2.7 V                                                                                      | I <sub>OL</sub> = 100 μA         | 0.2                  |      |     | 0.2                  |      |     | V    |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 24 mA          | 0.5                  |      |     | 0.5                  |      |     |      |    |
|                       |                | V <sub>CC</sub> = 3 V                                                                                        | I <sub>OL</sub> = 16 mA          | 0.4                  |      |     | 0.4                  |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 32 mA          | 0.5                  |      |     | 0.5                  |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 48 mA          | 0.55                 |      |     |                      |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 64 mA          |                      |      |     | 0.55                 |      |     |      |    |
| I <sub>I</sub>        | Control inputs | V <sub>CC</sub> = 3.6 V, V <sub>I</sub> = V <sub>CC</sub> or GND                                             |                                  | ±1                   |      |     | ±1                   |      |     | μA   |    |
|                       |                | V <sub>CC</sub> = 0 or 3.6 V, V <sub>I</sub> = 5.5 V                                                         |                                  | 10                   |      |     | 10                   |      |     |      |    |
|                       | A or B ports‡  | V <sub>CC</sub> = 3.6 V                                                                                      | V <sub>I</sub> = 5.5 V           |                      | 120  |     |                      | 20   |     |      |    |
|                       |                |                                                                                                              | V <sub>I</sub> = V <sub>CC</sub> |                      | 1    |     |                      | 1    |     |      |    |
|                       |                |                                                                                                              | V <sub>I</sub> = 0               |                      | -5   |     |                      | -5   |     |      |    |
| I <sub>off</sub>      |                | V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5 V                                           |                                  |                      |      |     | ±100                 |      |     | μA   |    |
| I <sub>I</sub> (hold) | A or B ports   | V <sub>CC</sub> = 3 V                                                                                        | V <sub>I</sub> = 0.8 V           |                      | 75   |     |                      | 75   |     |      | μA |
|                       |                |                                                                                                              | V <sub>I</sub> = 2 V             |                      | -75  |     |                      | -75  |     |      |    |
|                       |                | V <sub>CC</sub> = 3.6 V§, V <sub>I</sub> = 0 to 3.6 V                                                        |                                  |                      |      |     | ±500                 |      |     |      |    |
| I <sub>OZPU</sub>     |                | V <sub>CC</sub> = 0 to 1.5 V, V <sub>O</sub> = 0.5 V to 3 V, OE/OE = don't care                              |                                  | ±100*                |      |     | ±100                 |      |     | μA   |    |
| I <sub>OZPD</sub>     |                | V <sub>CC</sub> = 1.5 V to 0, V <sub>O</sub> = 0.5 V to 3 V, OE/OE = don't care                              |                                  | ±100*                |      |     | ±100                 |      |     | μA   |    |
| I <sub>CC</sub>       |                | V <sub>CC</sub> = 3.6 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND                         | Outputs high                     |                      | 0.19 |     |                      | 0.19 |     |      | mA |
|                       |                |                                                                                                              | Outputs low                      |                      | 5    |     |                      | 5    |     |      |    |
|                       |                |                                                                                                              | Outputs disabled                 |                      | 0.19 |     |                      | 0.19 |     |      |    |
| ΔI <sub>CC</sub> ¶    |                | V <sub>CC</sub> = 3 V to 3.6 V, One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND |                                  | 0.2                  |      |     | 0.2                  |      |     | mA   |    |
| C <sub>i</sub>        |                | V <sub>I</sub> = 3 V or 0                                                                                    |                                  | 4                    |      |     | 4                    |      |     | pF   |    |
| C <sub>io</sub>       |                | V <sub>O</sub> = 3 V or 0                                                                                    |                                  | 10                   |      |     | 10                   |      |     | pF   |    |

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

† All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ Unused pins at  $V_{CC}\text{ or GND}$

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

¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}\text{ or GND}$ .

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## 3.3-V ABT 18-BIT UNIVERSAL BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

|                    |                 |                   |          | SN54LVTH16501                      |     |                         |     | SN74LVTH16501                      |     |                         |     | UNIT |  |
|--------------------|-----------------|-------------------|----------|------------------------------------|-----|-------------------------|-----|------------------------------------|-----|-------------------------|-----|------|--|
|                    |                 |                   |          | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 2.7 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 2.7 V |     |      |  |
|                    |                 |                   |          | MIN                                | MAX | MIN                     | MAX | MIN                                | MAX | MIN                     | MAX |      |  |
| f <sub>clock</sub> | Clock frequency |                   |          | 150                                |     | 150                     |     | 150                                |     | 150                     |     | MHz  |  |
| t <sub>w</sub>     | Pulse duration  | LE high           |          | 3.3                                |     | 3.3                     |     | 3.3                                |     | 3.3                     |     | ns   |  |
|                    |                 | CLK high or low   |          | 3.3                                |     | 3.3                     |     | 3.3                                |     | 3.3                     |     |      |  |
| t <sub>su</sub>    | Setup time      | A before CLKAB↑   |          | 2.5                                |     | 2.8                     |     | 2.1                                |     | 2.4                     |     | ns   |  |
|                    |                 | B before CLKBA↑   |          | 2.5                                |     | 2.8                     |     | 2.1                                |     | 2.4                     |     |      |  |
|                    |                 | A or B before LE↓ | CLK high |                                    | 3.4 |                         | 2.8 |                                    | 2.4 |                         | 1.6 |      |  |
|                    |                 |                   | CLK low  |                                    | 2.2 |                         | 1.3 |                                    | 1.4 |                         | 0.5 |      |  |
| t <sub>h</sub>     | Hold time       | A or B after CLK↑ |          | 2.2                                |     | 1.5                     |     | 1                                  |     | 0                       |     | ns   |  |
|                    |                 | A or B after LE↓  |          | 2.1                                |     | 1.9                     |     | 1.7                                |     | 1.7                     |     |      |  |

switching characteristics over recommended operating free-air temperature range,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see Figure 1)

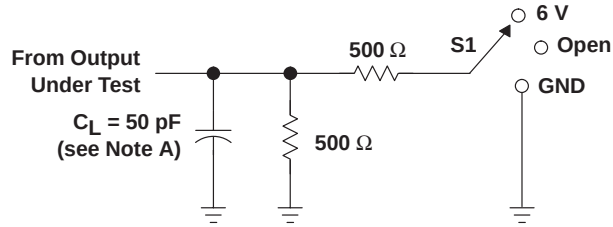
| PARAMETER        | FROM<br>(INPUT)                  | TO<br>(OUTPUT) | SN54LVTH16501                      |     |                         |     | SN74LVTH16501                      |      |     |                         | UNIT |     |
|------------------|----------------------------------|----------------|------------------------------------|-----|-------------------------|-----|------------------------------------|------|-----|-------------------------|------|-----|
|                  |                                  |                | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 2.7 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |      |     | V <sub>CC</sub> = 2.7 V |      |     |
|                  |                                  |                | MIN                                | MAX | MIN                     | MAX | MIN                                | TYP† | MAX | MIN                     |      | MAX |
| f <sub>max</sub> |                                  |                | 150                                |     | 150                     |     | 150                                |      |     | 150                     |      | MHz |
| t <sub>PLH</sub> | B or A                           | A or B         | 1.2                                | 4.3 | 4.7                     |     | 1.3                                | 2.7  | 3.7 | 4                       |      | ns  |
| t <sub>PHL</sub> |                                  |                | 1.2                                | 4.3 | 4.6                     |     | 1.3                                | 2.4  | 3.7 | 4                       |      |     |
| t <sub>PLH</sub> | LEBA or LEAB                     | A or B         | 1.4                                | 6.2 | 6.6                     |     | 1.5                                | 3.4  | 5.1 | 5.7                     |      | ns  |
| t <sub>PHL</sub> |                                  |                | 1.4                                | 5.9 | 6.5                     |     | 1.5                                | 3.5  | 5.1 | 5.7                     |      |     |
| t <sub>PLH</sub> | CLKBA or CLKAB                   | A or B         | 1.2                                | 6   | 6.7                     |     | 1.3                                | 3.5  | 5.1 | 5.7                     |      | ns  |
| t <sub>PHL</sub> |                                  |                | 1.2                                | 5.9 | 6.6                     |     | 1.3                                | 3.4  | 5.1 | 5.7                     |      |     |
| t <sub>PZH</sub> | $\overline{\text{OEBA}}$ or OEAB | A or B         | 1.2                                | 5.5 | 5.9                     |     | 1.3                                | 3.4  | 4.8 | 5.5                     |      | ns  |
| t <sub>PZL</sub> |                                  |                | 1.2                                | 5.5 | 5.9                     |     | 1.3                                | 3.4  | 4.8 | 5.5                     |      |     |
| t <sub>PHZ</sub> | $\overline{\text{OEBA}}$ or OEAB | A or B         | 1.6                                | 6.3 | 6.7                     |     | 1.7                                | 4.2  | 5.8 | 6.3                     |      | ns  |
| t <sub>PLZ</sub> |                                  |                | 1.6                                | 6.1 | 6.6                     |     | 1.7                                | 3.8  | 5.8 | 6.3                     |      |     |

$^\dagger$  All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

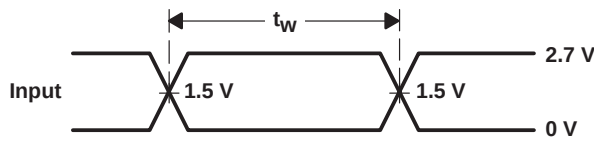
# SN54LVTH16501, SN74LVTH16501 3.3-V ABT 18-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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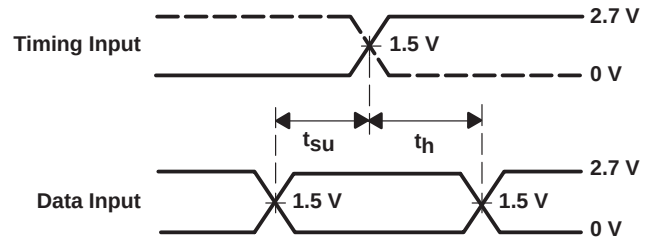
## PARAMETER MEASUREMENT INFORMATION



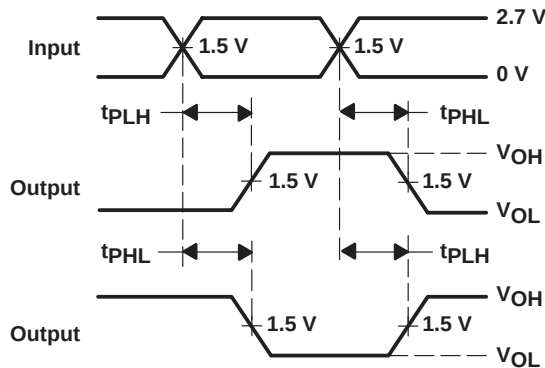
LOAD CIRCUIT



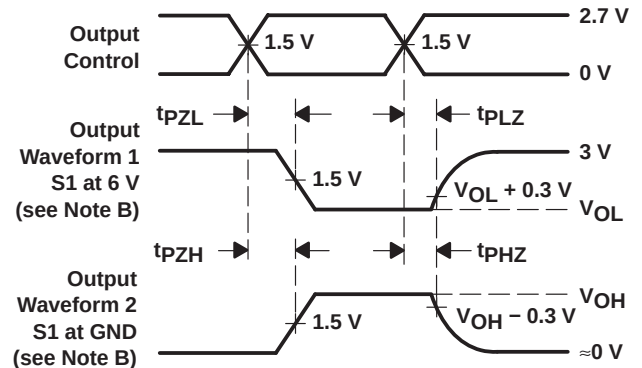
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- 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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .  
D. The outputs are measured one at a time with one transition per measurement.  
E. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

| Orderable Device  | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)                     | Samples                 |
|-------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|---------------------------------------------|-------------------------|
| 5962-9677701QXA   | ACTIVE        | CFP          | WD                 | 56   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-9677701QX<br>A<br>SNJ54LVTH16501<br>WD | <a href="#">Samples</a> |
| 74LVTH16501DGGRE4 | ACTIVE        | TSSOP        | DGG                | 56   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | LVTH16501                                   | <a href="#">Samples</a> |
| 74LVTH16501DLRG4  | ACTIVE        | SSOP         | DL                 | 56   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | LVTH16501                                   | <a href="#">Samples</a> |
| SN74LVTH16501DGGR | ACTIVE        | TSSOP        | DGG                | 56   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | LVTH16501                                   | <a href="#">Samples</a> |
| SN74LVTH16501DL   | ACTIVE        | SSOP         | DL                 | 56   | 20             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | LVTH16501                                   | <a href="#">Samples</a> |
| SN74LVTH16501DLG4 | ACTIVE        | SSOP         | DL                 | 56   | 20             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | LVTH16501                                   | <a href="#">Samples</a> |
| SN74LVTH16501DLR  | ACTIVE        | SSOP         | DL                 | 56   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | LVTH16501                                   | <a href="#">Samples</a> |
| SNJ54LVTH16501WD  | ACTIVE        | CFP          | WD                 | 56   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-9677701QX<br>A<br>SNJ54LVTH16501<br>WD | <a href="#">Samples</a> |

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)



- (3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF SN54LVTH16501, SN74LVTH16501 :**

- Catalog: [SN74LVTH16501](#)
- Enhanced Product: [SN74LVTH16501-EP](#), [SN74LVTH16501-EP](#)
- Military: [SN54LVTH16501](#)

**NOTE:** Qualified Version Definitions:

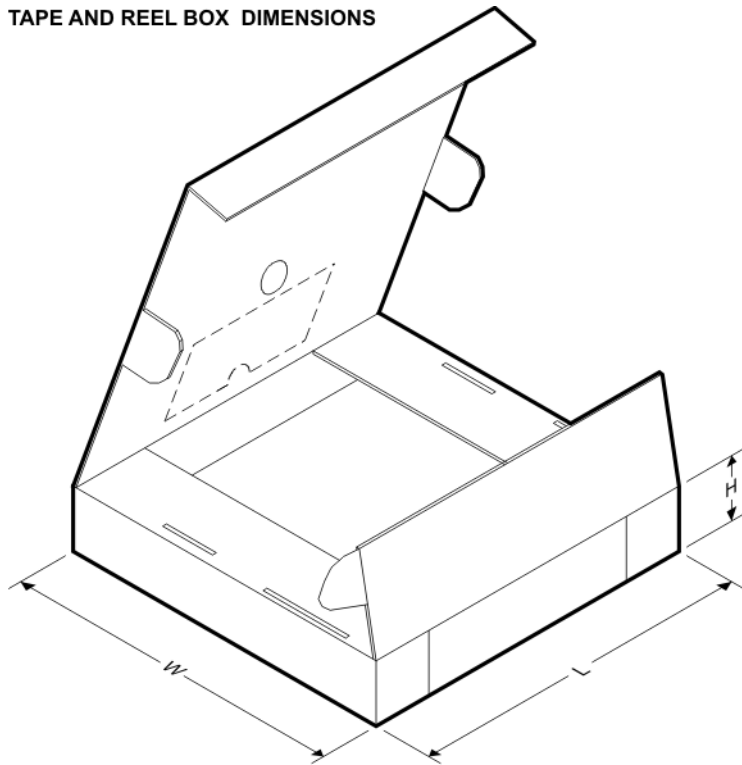
- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

**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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LVTH16501DGGR | TSSOP        | DGG             | 56   | 2000 | 330.0              | 24.4               | 8.6     | 15.6    | 1.8     | 12.0    | 24.0   | Q1            |
| SN74LVTH16501DLR  | SSOP         | DL              | 56   | 1000 | 330.0              | 32.4               | 11.35   | 18.67   | 3.1     | 16.0    | 32.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



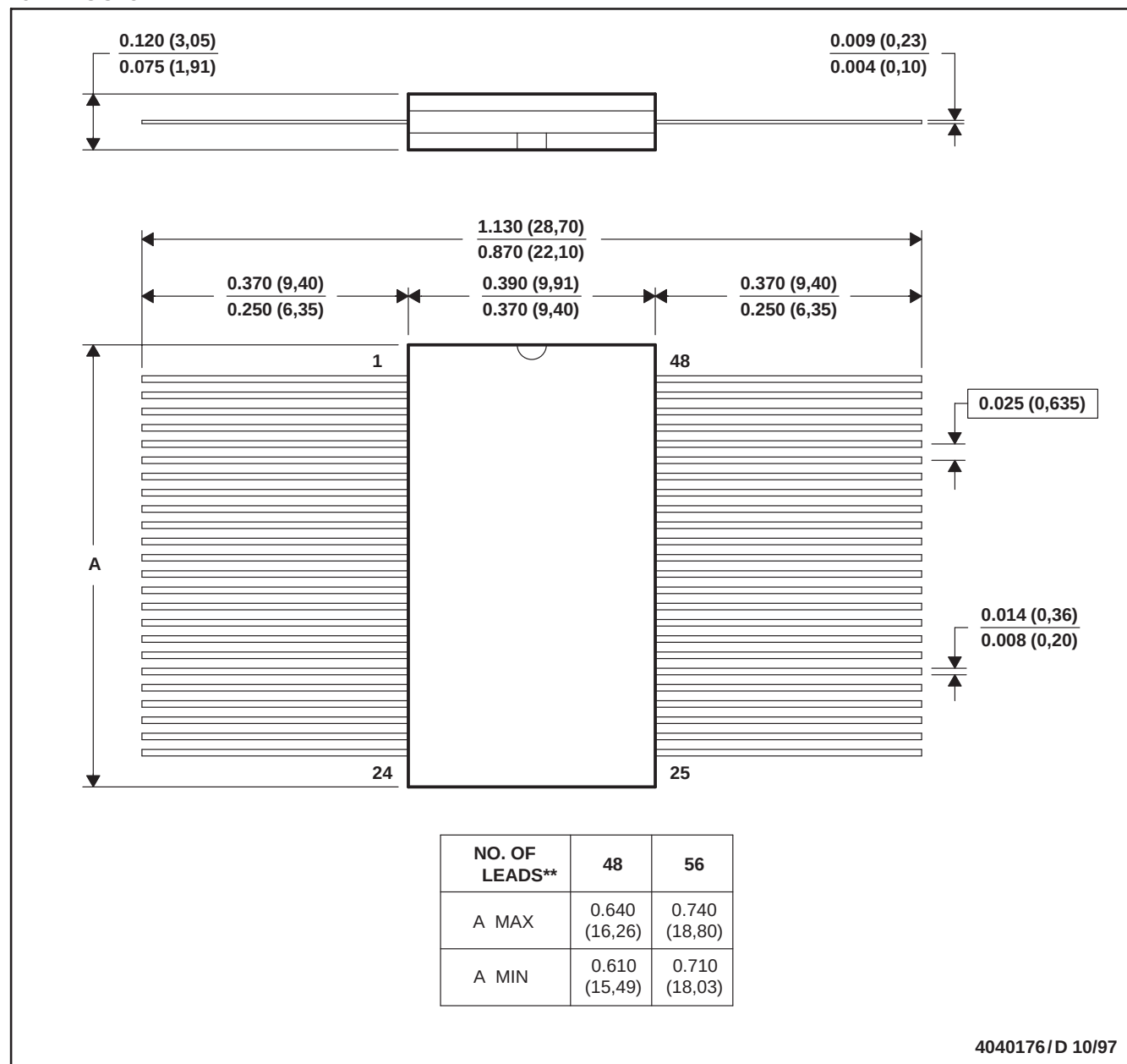
\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVTH16501DGGR | TSSOP        | DGG             | 56   | 2000 | 367.0       | 367.0      | 45.0        |
| SN74LVTH16501DLR  | SSOP         | DL              | 56   | 1000 | 367.0       | 367.0      | 55.0        |

## WD (R-GDFP-F\*\*)

## CERAMIC DUAL FLATPACK

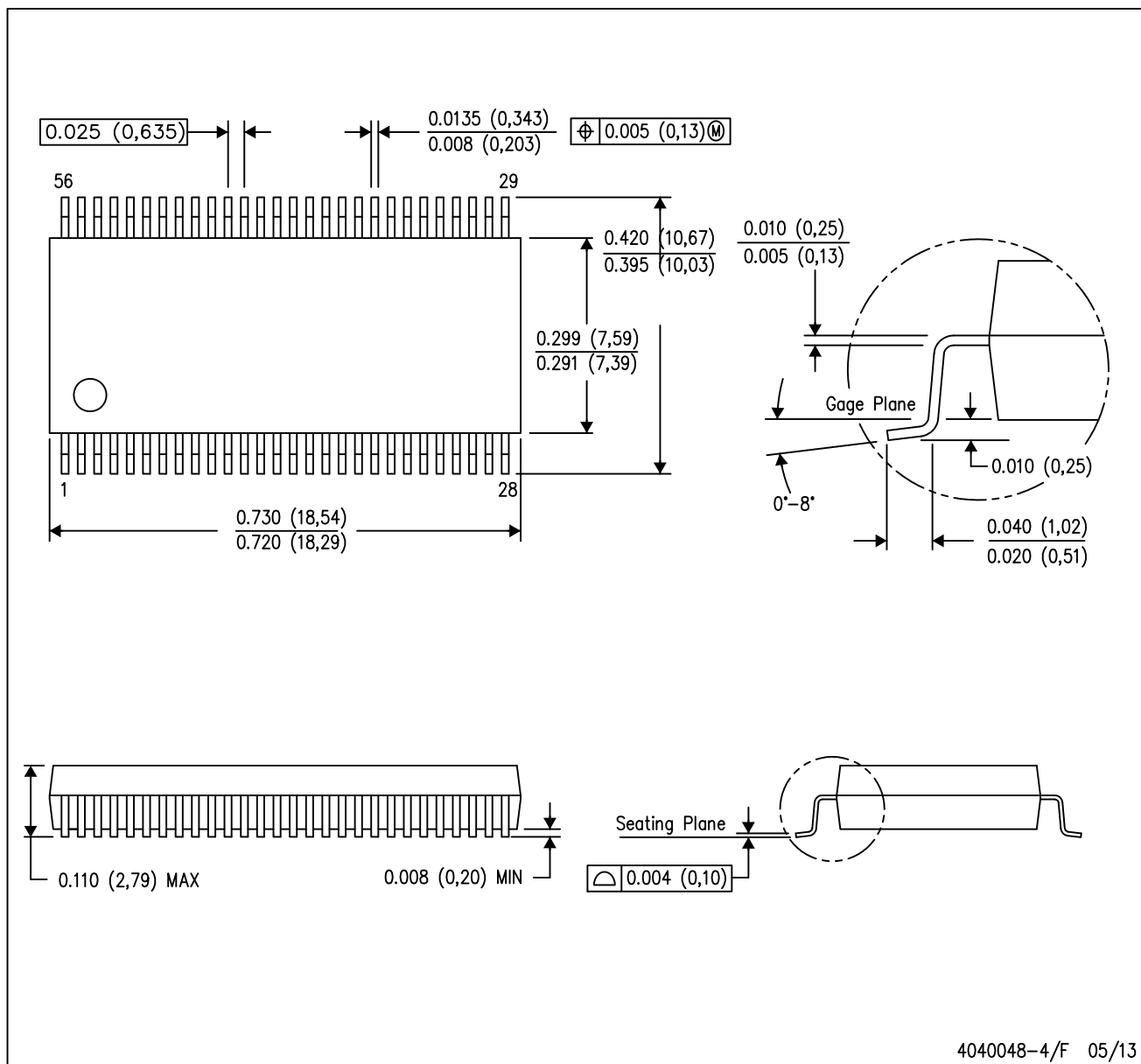
48 LEADS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification only.  
 E. Falls within MIL STD 1835: GDFP1-F48 and JEDEC MO-146AA  
 GDFP1-F56 and JEDEC MO-146AB

DL (R-PDSO-G56)

PLASTIC SMALL-OUTLINE PACKAGE

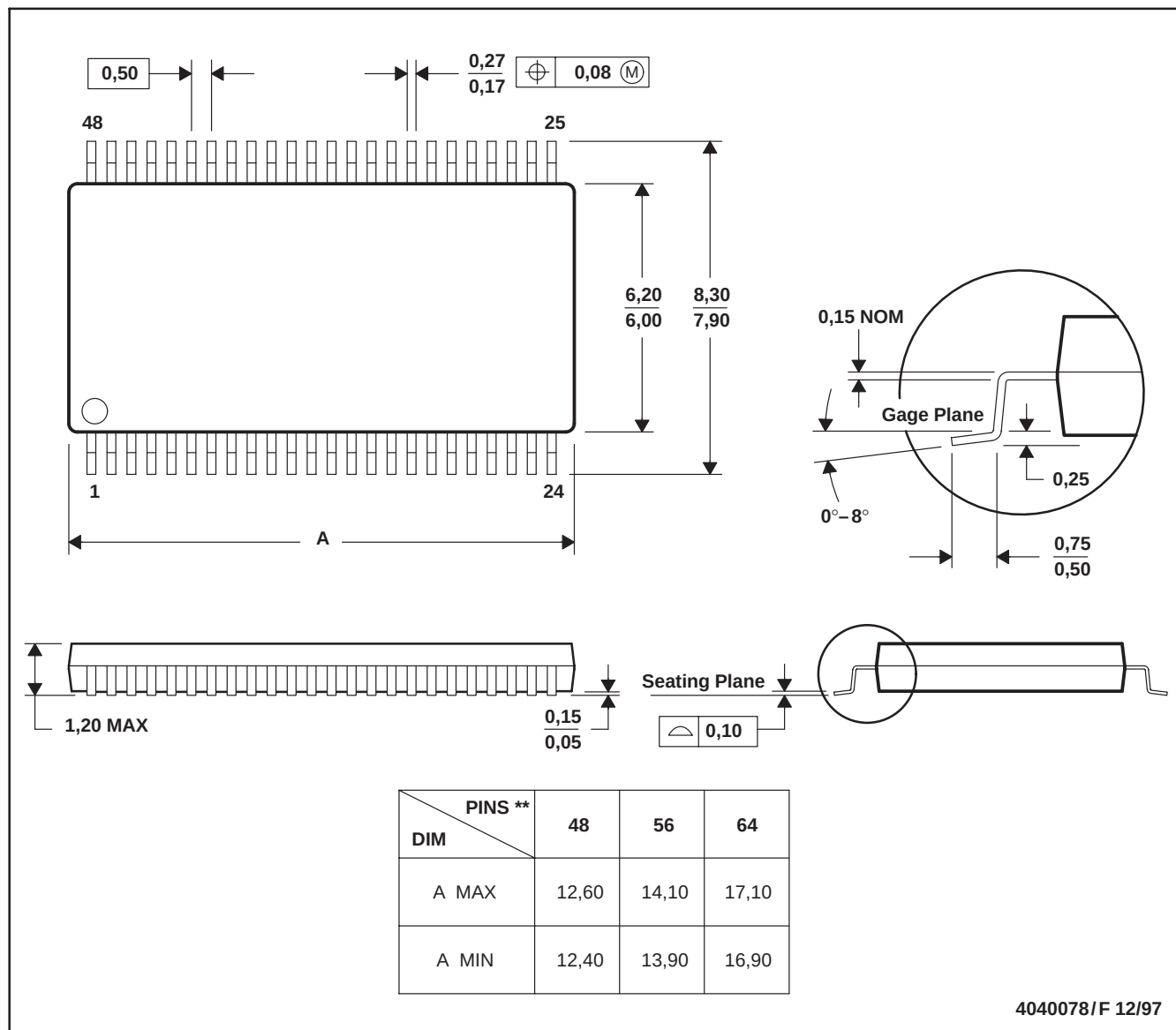


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed  $0.006$  (0,15).
  - Falls within JEDEC MO-118

## 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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| DLP® Products                | <a href="http://www.dlp.com">www.dlp.com</a>                                         |
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| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
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### Applications

|                               |                                                                                          |
|-------------------------------|------------------------------------------------------------------------------------------|
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| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
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