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TEXAS INSTRUMENTS

**SN54AHC16244, SN74AHC16244**
SCLS327H – MARCH 1996 – REVISED OCTOBER 2014

# SNx4AHC16244 16-Bit Buffers/Drivers With 3-State Outputs

## 1 Features

- Members of the Texas Instruments *Widebus*™ Family
- *EPIC*™ (Enhanced-Performance Implanted CMOS) Process
- Operating Range 2-V to 5.5-V $V_{CC}$
- Distributed $V_{CC}$ and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)

## 2 Applications

- Motor Drives
- Wireless Infrastructures
- Health and Fitness Wearables
- Telecom Infrastructures
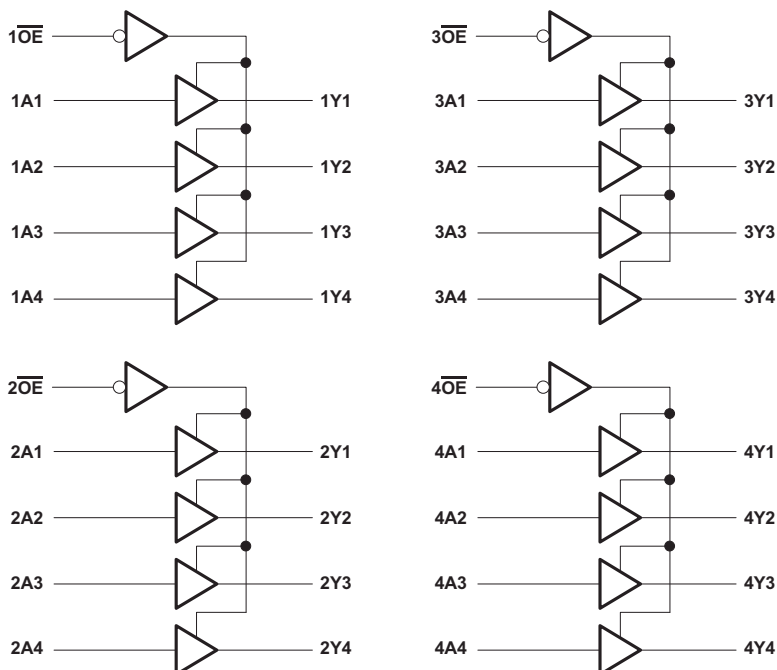- Electronic Points of Sale

## 3 Description

The SNx4AHC16244 devices are 16-bit buffers and line drivers designed specifically to improve the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters.

**Device Information[1]**

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| SNx4AHC16244 | SSOP (48) | 15.80 mm × 7.50 mm |
| | TSSOP (48) | 12.50 mm 6.10 mm |
| | TVSOP (48) | 9.70 mm 4.40 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

## 4 Simplified Schematic

**Distributor of Texas Instruments: Excellent Integrated System Limited**
Datasheet of SN74AHC16244DGVR - IC BUFF/DVR TRI-ST 16BIT 48TVSOP
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## 5 Revision History

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## 6 Pin Configuration and Functions

**SN54AHC16244 . . . WD PACKAGE**
**SN74AHC16244 . . . DGG, DGV, OR DL PACKAGE**
**(TOP VIEW)**

| | | | | |
|---|---|---|---|---|
| 1$\overline{OE}$ | 1 | | 48 | 2$\overline{OE}$ |
| 1Y1 | 2 | | 47 | 1A1 |
| 1Y2 | 3 | | 46 | 1A2 |
| GND | 4 | | 45 | GND |
| 1Y3 | 5 | | 44 | 1A3 |
| 1Y4 | 6 | | 43 | 1A4 |
| $V_{CC}$ | 7 | | 42 | $V_{CC}$ |
| 2Y1 | 8 | | 41 | 2A1 |
| 2Y2 | 9 | | 40 | 2A2 |
| GND | 10 | | 39 | GND |
| 2Y3 | 11 | | 38 | 2A3 |
| 2Y4 | 12 | | 37 | 2A4 |
| 3Y1 | 13 | | 36 | 3A1 |
| 3Y2 | 14 | | 35 | 3A2 |
| GND | 15 | | 34 | GND |
| 3Y3 | 16 | | 33 | 3A3 |
| 3Y4 | 17 | | 32 | 3A4 |
| $V_{CC}$ | 18 | | 31 | $V_{CC}$ |
| 4Y1 | 19 | | 30 | 4A1 |
| 4Y2 | 20 | | 29 | 4A2 |
| GND | 21 | | 28 | GND |
| 4Y3 | 22 | | 27 | 4A3 |
| 4Y4 | 23 | | 26 | 4A4 |
| 4$\overline{OE}$ | 24 | | 25 | 3$\overline{OE}$ |
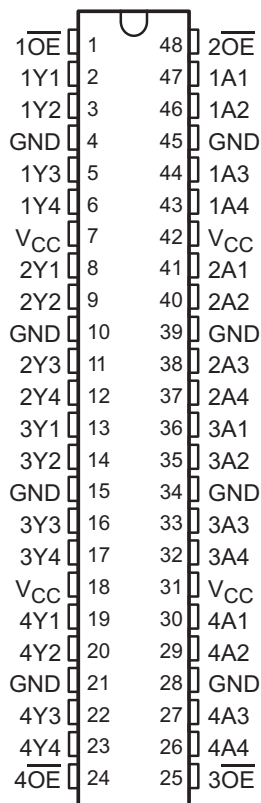
**Pin Functions**

| PIN | | I/O | DESCRIPTION |
|---|---|---|---|
| NO. | NAME | | |
| 1 | 1$\overline{OE}$ | I | Output Enable 1 |
| 2 | 1Y1 | O | 1Y1 Output |
| 3 | 1Y2 | O | 1Y2 Output |
| 4 | GND | — | Ground Pin |
| 5 | 1Y3 | O | 1Y3 Output |
| 6 | 1Y4 | O | 1Y4 Output |
| 7 | $V_{CC}$ | — | Power Pin |
| 8 | 2Y1 | O | 2Y1 Output |
| 9 | 2Y2 | O | 2Y2 Output |
| 10 | GND | — | Ground Pin |
| 11 | 2Y3 | O | 2Y3 Output |
| 12 | 2Y4 | O | 2Y4 Output |
| 13 | 3Y1 | O | 3Y1 Output |
| 14 | 3Y2 | O | 3Y2 Output |
| 15 | GND | — | Ground Pin |
| 16 | 3Y3 | O | 3Y3 Output |
| 17 | 3Y4 | O | 3Y4 Output |
| 18 | $V_{CC}$ | — | Power Pin |

Product Folder Links: *SN54AHC16244  SN74AHC16244*

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## Pin Functions (continued)

| NO. | NAME | I/O | DESCRIPTION |
|-----|------|-----|-------------|
| 19 | 4Y1 | O | 4Y1 Output |
| 20 | 4Y2 | O | 4Y2 Output |
| 21 | GND | — | Ground Pin |
| 22 | 4Y3 | O | 4Y3 Output |
| 23 | 4Y4 | O | 4Y4 Output |
| 24 | 4$\overline{\text{OE}}$ | I | Output Enable 4 |
| 25 | 3$\overline{\text{OE}}$ | I | Output Enable 3 |
| 26 | 4A4 | I | 4A4 Input |
| 27 | 4A3 | I | 4A3 Input |
| 28 | GND | — | Ground Pin |
| 29 | 4A2 | I | 4A2 Input |
| 30 | 4A1 | I | 4A1 Input |
| 31 | $V_{CC}$ | — | Power Pin |
| 32 | 3A4 | I | 3A4 Input |
| 33 | 3A3 | I | 3A3 Input |
| 34 | GND | — | Ground Pin |
| 35 | 3A2 | I | 3A2 Input |
| 36 | 3A1 | I | 3A1 Input |
| 37 | 2A4 | I | 2A4 Input |
| 38 | 2A3 | I | 2A3 Input |
| 39 | GND | — | Ground Pin |
| 40 | 2A2 | I | 2A2 Input |
| 41 | 2A1 | I | 2A1 Input |
| 42 | $V_{CC}$ | — | Power Pin |
| 43 | 1A4 | I | 1A4 Input |
| 44 | 1A3 | I | 1A3 Input |
| 45 | GND | — | Ground Pin |
| 46 | 1A2 | I | 1A2 Input |
| 47 | 1A1 | I | 1A1 Input |
| 48 | 2$\overline{\text{OE}}$ | I | Output Enable 2 |

Product Folder Links: *SN54AHC16244  SN74AHC16244*

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# 7 Specifications

## 7.1 Absolute Maximum Ratings[1]

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

|  |  |  | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage range | | −0.5 | 7 | V |
| $V_I$ | Input voltage range[2] | | −0.5 | 7 | V |
| $V_O$ | Output voltage range[2] | | −0.5 | $V_{CC}$ + 0.5 | V |
| $I_{IK}$ | Input clamp current | $V_I < 0$ | | −20 | mA |
| $I_{OK}$ | Output clamp current | $V_O < 0$ or $V_O > V_{CC}$ | | ±20 | mA |
| $I_O$ | Continuous output current | $V_O = 0$ to $V_{CC}$ | | ±25 | mA |
| | Continuous current through $V_{CC}$ or GND | | | ±75 | mA |

(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 voltage ratings may be exceeded if the input and output current ratings are observed.

## 7.2 Handling Ratings

|  |  |  | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $T_{stg}$ | Storage temperature range | | −65 | 150 | °C |
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins[1] | 0 | 2000 | V |

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

## 7.3 Recommended Operating Conditions

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

|  |  |  | SN54AHC16244[2] | | SN74AHC16244 | | UNIT |
|---|---|---|---|---|---|---|---|
|  |  |  | MIN | MAX | MIN | MAX |  |
| $V_{CC}$ | Supply voltage | | 2 | 5.5 | 2 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | $V_{CC} = 2$ V | 1.5 | | 1.5 | | V |
|  |  | $V_{CC} = 3$ V | 2.1 | | 2.1 | |  |
|  |  | $V_{CC} = 5.5$ V | 3.85 | | 3.85 | |  |
| $V_{IL}$ | Low-level input voltage | $V_{CC} = 2$ V | | 0.5 | | 0.5 | V |
|  |  | $V_{CC} = 3$ V | | 0.9 | | 0.9 | |
|  |  | $V_{CC} = 5.5$ V | | 1.65 | | 1.65 | |
| $V_I$ | Input voltage | | 0 | 5.5 | 0 | 5.5 | V |
| $V_O$ | Output voltage | | 0 | $V_{CC}$ | 0 | $V_{CC}$ | V |
| $I_{OH}$ | High-level output current | $V_{CC} = 2$ V | | −50 | | −50 | µA |
|  |  | $V_{CC} = 3.3$ V ± 0.3 V | | −4 | | −4 | mA |
|  |  | $V_{CC} = 5$ V ± 0.5 V | | −8 | | −8 | |
| $I_{OL}$ | Low-level output current | $V_{CC} = 2$ V | | 50 | | 50 | µA |
|  |  | $V_{CC} = 3.3$ V ± 0.3 V | | 4 | | 4 | mA |
|  |  | $V_{CC} = 5$ V ± 0.5 V | | 8 | | 8 | |
| $\Delta t / \Delta v$ | Input transition rise or fall rate | $V_{CC} = 3.3$ V ± 0.3 V | | 100 | | 100 | ns/V |
|  |  | $V_{CC} = 5$ V ± 0.5 V | | 20 | | 20 | |
| $T_A$ | Operating free-air temperature | | −55 | 125 | −40 | 125 | °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* (SCBA004).
(2)  Product Preview

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## 7.4 Thermal Information

| THERMAL METRIC[1] | SN74AHC16244 | | | UNIT |
|---|---|---|---|---|
| | DGV | DL | DGG | |
| | 48 PINS | 48 PINS | 48 PINS | |
| $R_{\theta JA}$ Junction-to-ambient thermal resistance | 83.5 | 64.6 | 72.5 | °C/W |
| $R_{\theta JC(top)}$ Junction-to-case (top) thermal resistance | 35.7 | 34.5 | 26.8 | |
| $R_{\theta JB}$ Junction-to-board thermal resistance | 46.6 | 36.4 | 39.4 | |
| $\Psi_{JT}$ Junction-to-top characterization parameter | 4.3 | 11.1 | 2.6 | |
| $\Psi_{JB}$ Junction-to-board characterization parameter | 46.0 | 36.1 | 39.1 | |

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report (SPRA953).

## 7.5 Electrical Characteristics

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

| PARAMETER | TEST CONDITIONS | $V_{CC}$ | $T_A$ = 25°C MIN | TYP | MAX | SN54AHC16244[1] MIN | MAX | SN74AHC16244 MIN | MAX | −40°C to 125°C SN74AHC16244 MIN | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | $I_{OH}$ = −50 µA | 2 V | 1.9 | 2 | | 1.9 | | 1.9 | | 1.9 | | V |
| | | 3 V | 2.9 | 3 | | 2.9 | | 2.9 | | 2.9 | | |
| | | 4.5 V | 4.4 | 4.5 | | 4.4 | | 4.4 | | 4.4 | | |
| | $I_{OH}$ = −4 mA | 3 V | 2.58 | | | 2.48 | | 2.48 | | 2.48 | | |
| | $I_{OH}$ = −8 mA | 4.5 V | 3.94 | | | 3.8 | | 3.8 | | 3.8 | | |
| $V_{OL}$ | $I_{OL}$ = 50 µA | 2 V | | | 0.1 | | 0.1 | | 0.1 | | 0.1 | V |
| | | 3 V | | | 0.1 | | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 V | | | 0.1 | | 0.1 | | 0.1 | | 0.1 | |
| | $I_{OL}$ = 4 mA | 3 V | | | 0.36 | | 0.5 | | 0.44 | | 0.44 | |
| | $I_{OL}$ = 8 mA | 4.5 V | | | 0.36 | | 0.5 | | 0.44 | | 0.44 | |
| $I_I$ | $V_I$ = $V_{CC}$ or GND | 0 V to 5.5 V | | | ±0.1 | | ±1[2] | | ±1 | | ±1 | µA |
| $I_{OZ}$ | $V_O$ = $V_{CC}$ or GND | 5.5 V | | | ±0.25 | | ±2.5 | | ±2.5 | | ±2.5 | µA |
| $I_{CC}$ | $V_I$ = $V_{CC}$ or GND, $I_O$ = 0 | 5.5 V | | | 4 | | 40 | | 40 | | 40 | µA |
| $C_i$ | $V_I$ = $V_{CC}$ or GND | 5 V | | 2 | 10 | | 10 | | 10 | | 10 | pF |
| $C_o$ | $V_O$ = $V_{CC}$ or GND | 5 V | | 3.5 | | | | | | | | pF |

(1) Product Preview
(2) On products compliant to MIL-PRF-38535, this parameter is not production tested at $V_{CC}$ = 0 V.

Product Folder Links: *SN54AHC16244  SN74AHC16244*

**SN54AHC16244, SN74AHC16244**

## 7.6 Switching Characteristics, $V_{CC}$ = 3.3 V ± 0.3 V

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A$ = 25°C | | | SN54AHC16244[1] | | SN74AHC16244 | | $T_A$ = −40°C to 125°C SN74AHC16244 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{PLH}$ | A | Y | $C_L$ = 15 pF | | 5.8[2] | 8.4[2] | 1[2] | 10[2] | 1 | 10 | 1 | 11 | ns |
| $t_{PHL}$ | | | | | 5.8[2] | 8.4[2] | 1[2] | 10[2] | 1 | 10 | 1 | 11 | |
| $t_{PZH}$ | $\overline{OE}$ | Y | $C_L$ = 15 pF | | 6.6[2] | 10.6[2] | 1[2] | 12.5[2] | 1 | 12.5 | 1 | 13.5 | ns |
| $t_{PZL}$ | | | | | 6.6[2] | 10.6[2] | 1[2] | 12.5[2] | 1 | 12.5 | 1 | 13.5 | |
| $t_{PHZ}$ | $\overline{OE}$ | Y | $C_L$ = 15 pF | | 5[2] | 11.5[2] | 1[2] | 12.5[2] | 1 | 12.5 | 1 | 13.5 | ns |
| $t_{PLZ}$ | | | | | 5[2] | 11.5[2] | 1[2] | 12.5[2] | 1 | 12.5 | 1 | 13.5 | |
| $t_{PLH}$ | A | Y | $C_L$ = 50 pF | | 8.3 | 11.9 | 1 | 13.5 | 1 | 13.5 | 1 | 14.5 | ns |
| $t_{PHL}$ | | | | | 8.3 | 11.9 | 1 | 13.5 | 1 | 13.5 | 1 | 14.5 | |
| $t_{PZH}$ | $\overline{OE}$ | Y | $C_L$ = 50 pF | | 9.1 | 14.1 | 1 | 16 | 1 | 16 | 1 | 17 | ns |
| $t_{PZL}$ | | | | | 9.1 | 14.1 | 1 | 16 | 1 | 16 | 1 | 17 | |
| $t_{PHZ}$ | $\overline{OE}$ | Y | $C_L$ = 50 pF | | 10.3 | 14 | 1 | 16 | 1 | 16 | 1 | 17 | ns |
| $t_{PLZ}$ | | | | | 10.3 | 14 | 1 | 16 | 1 | 16 | 1 | 17 | |
| $t_{sk(o)}$ | | | $C_L$ = 50 pF | | | 1.5[3] | | | | 1.5 | | 1.5 | ns |

(1) Product Preview
(2) On products compliant to MIL-PRF-38535, this parameter is not production tested.
(3) On products compliant to MIL-PRF-38535, this parameter does not apply.

## 7.7 Switching Characteristics, $V_{CC}$ = 5 V ± 0.5 V

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A$ = 25°C | | | SN54AHC16244[1] | | SN74AHC16244 | | $T_A$ = −40°C to 125°C SN74AHC16244 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{PLH}$ | A | Y | $C_L$ = 15 pF | | 3.9[2] | 6[2] | 1[2] | 7[2] | 1 | 6.5 | 1 | 7 | ns |
| $t_{PHL}$ | | | | | 3.9[2] | 6[2] | 1[2] | 7[2] | 1 | 6.5 | 1 | 7 | |
| $t_{PZH}$ | $\overline{OE}$ | Y | $C_L$ = 15 pF | | 4.7[2] | 7.3[2] | 1[2] | 8.5[2] | 1 | 8.5 | 1 | 9.5 | ns |
| $t_{PZL}$ | | | | | 4.7[2] | 7.3[2] | 1[2] | 8.5[2] | 1 | 8.5 | 1 | 9.5 | |
| $t_{PHZ}$ | $\overline{OE}$ | Y | $C_L$ = 15 pF | | 5[2] | 7.2[2] | 1[2] | 8.5[2] | 1 | 8.5 | 1 | 9 | ns |
| $t_{PLZ}$ | | | | | 5[2] | 7.2[2] | 1[2] | 8.5[2] | 1 | 8.5 | 1 | 9 | |
| $t_{PLH}$ | A | Y | $C_L$ = 50 pF | | 5.4 | 8 | 1 | 9 | 1 | 8.5 | 1 | 9 | ns |
| $t_{PHL}$ | | | | | 5.4 | 8 | 1 | 9 | 1 | 8.5 | 1 | 9 | |
| $t_{PZH}$ | $\overline{OE}$ | Y | $C_L$ = 50 pF | | 6.2 | 9.3 | 1 | 10.5 | 1 | 10.5 | 1 | 11.5 | ns |
| $t_{PZL}$ | | | | | 6.2 | 9.3 | 1 | 10.5 | 1 | 10.5 | 1 | 11.5 | |
| $t_{PHZ}$ | $\overline{OE}$ | Y | $C_L$ = 50 pF | | 6.7 | 9.2 | 1 | 10.5 | 1 | 10.5 | 1 | 11 | ns |
| $t_{PLZ}$ | | | | | 6.7 | 9.2 | 1 | 10.5 | 1 | 10.5 | 1 | 11 | |
| $t_{sk(o)}$ | | | $C_L$ = 50 pF | | | 1[3] | | | | 1 | | 1 | ns |

(1) Product Preview
(2) On products compliant to MIL-PRF-38535, this parameter is not production tested.
(3) On products compliant to MIL-PRF-38535, this parameter does not apply.

## 7.8 Noise Characteristics

$V_{CC}$ = 5 V, $C_L$ = 50 pF, $T_A$ = 25°C[1]

| PARAMETER | | SN74AHC16244 | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| $V_{OL(P)}$ | Quiet output, maximum dynamic $V_{OL}$ | | 0.5 | 0.8 | V |
| $V_{OL(V)}$ | Quiet output, minimum dynamic $V_{OL}$ | | −0.2 | −0.8 | V |
| $V_{OH(V)}$ | Quiet output, minimum dynamic $V_{OH}$ | | 4.8 | | V |
| $V_{IH(D)}$ | High-level dynamic input voltage | 3.5 | | | V |
| $V_{IL(D)}$ | Low-level dynamic input voltage | | | 1.5 | V |

(1) Characteristics are for surface-mount packages only.

Product Folder Links: *SN54AHC16244  SN74AHC16244*

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## 7.9 Operating Characteristics

$V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | | TYP | UNIT |
|---|---|---|---|---|---|
| $C_{pd}$ | Power dissipation capacitance | No load, | f = 1 MHz | 10.5 | pF |

## 7.10 Typical Characteristics
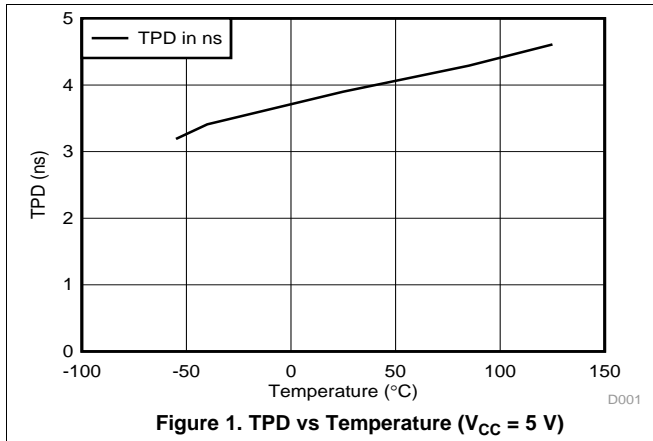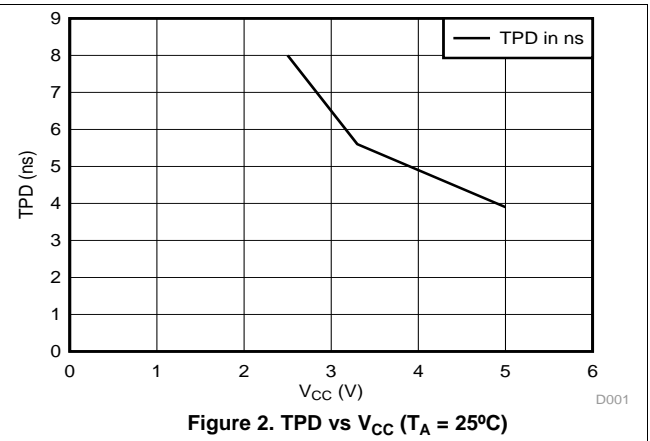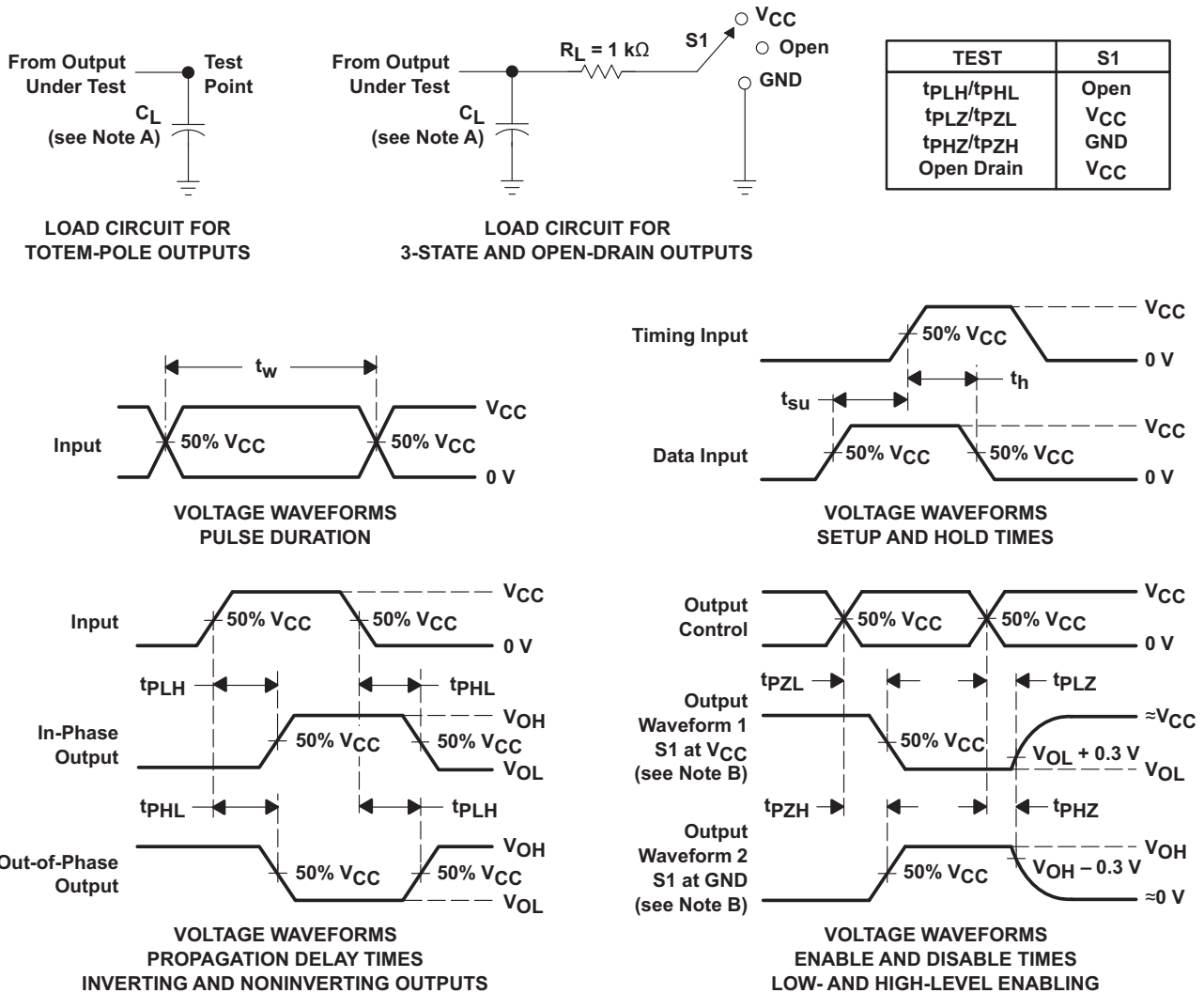


Figure 1. TPD vs Temperature ($V_{CC}$ = 5 V)



Figure 2. TPD vs $V_{CC}$ ($T_A$ = 25ºC)

Product Folder Links: *SN54AHC16244  SN74AHC16244*

# 8 Parameter Measurement Information



| TEST | S1 |
|------|-----|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | $V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND |
| Open Drain | $V_{CC}$ |

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 ≤ 1 MHz, $Z_O$ = 50 Ω, $t_r$ ≤ 3 ns, $t_f$ ≤ 3 ns.
D. The outputs are measured one at a time with one input transition per measurement.

**Figure 3. Load Circuit and Voltage Waveforms**

# 9 Detailed Description

## 9.1 Overview

The SNx4AHC16244 devices are 16-bit buffers and line drivers designed specifically to improve the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters

These devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. They provide true outputs and symmetrical active-low output-enable ($\overline{OE}$) inputs.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to $V_{CC}$ through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver. The SN54AHC16244 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74AHC16244 is characterized for operation from –40°C to 85°C.

## 9.2 Functional Block Diagram
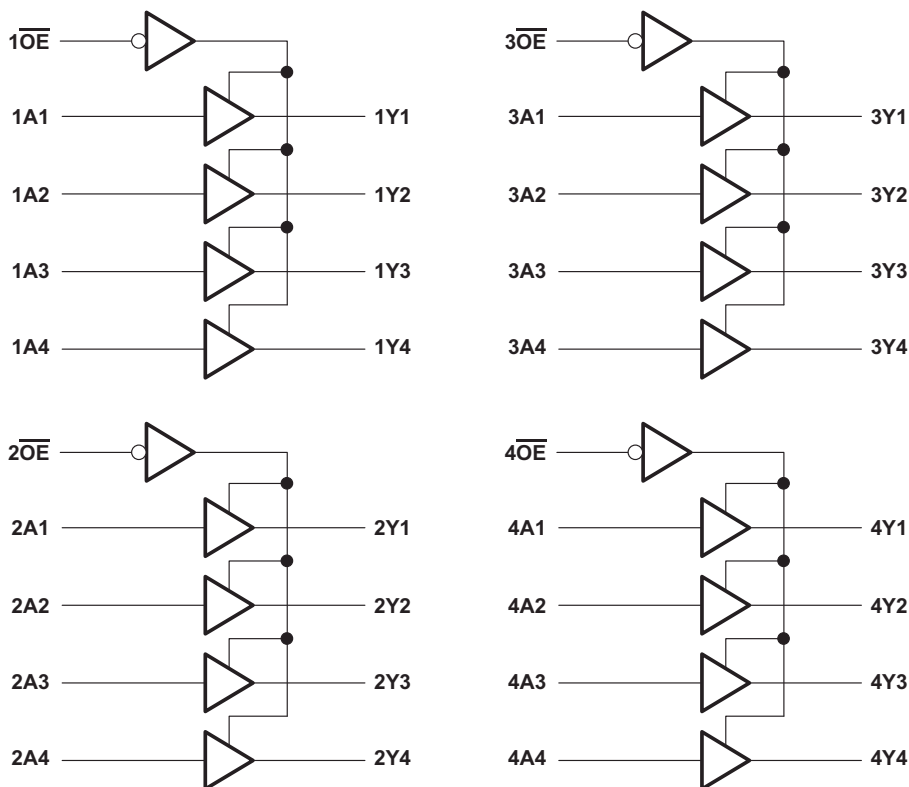


**Figure 4. Logic Diagram (Positive Logic)**

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## Functional Block Diagram (continued)
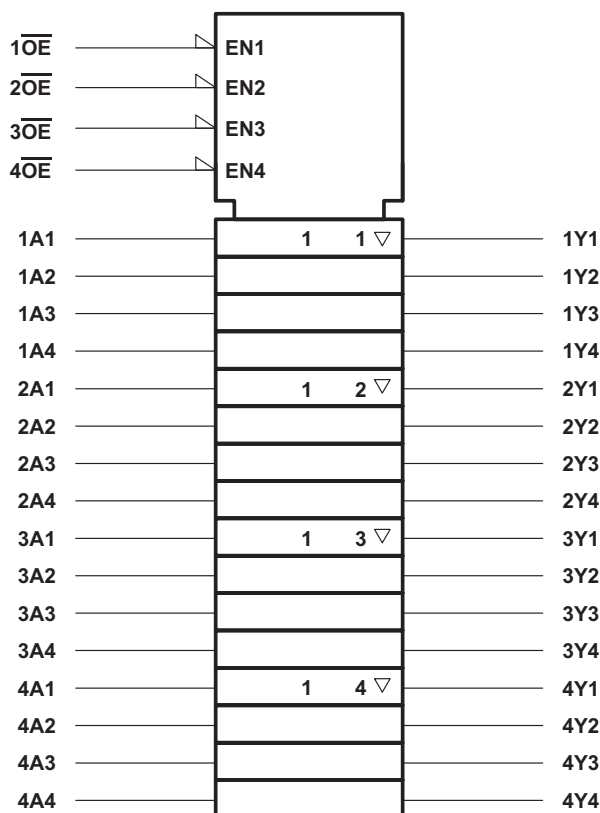


This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**Figure 5.  Logic Symbol**

## 9.3  Feature Description

*   Wide operating voltage range
    *   Operates from 2 V to 5.5 V
*   Allows down voltage translation
    *   Inputs accept voltages up to 5.5 V
*   Slows edges rates, minimizing output ringing

## 9.4  Device Functional Modes

**Table 1. Function Table**
**(Each 4-bit Buffer/Driver)**

| INPUTS | | OUTPUT |
| --- | --- | --- |
| $\overline{OE}$ | A | Y |
| L | H | H |
| L | L | L |
| H | X | High-Z |

Product Folder Links: *SN54AHC16244  SN74AHC16244*

**SN54AHC16244, SN74AHC16244**
SCLS327H –MARCH 1996–REVISED OCTOBER 2014

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## 10 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. Customers should validate and test their design implementation to confirm system functionality.

### 10.1 Application Information

The SN74AHC16244 is a low-drive CMOS device that can be used for a multitude of applications where output ringing is a concern. The low drive and slow edge rates will minimize overshoot and undershoot on the outputs. The inputs are tolerant to 5.5 V at any valid $V_{CC}$. This feature makes it ideal for translating down to the $V_{CC}$ level. Figure 6 shows the reduction in ringing compared to higher-drive parts, such as AC.

### 10.2 Typical Application
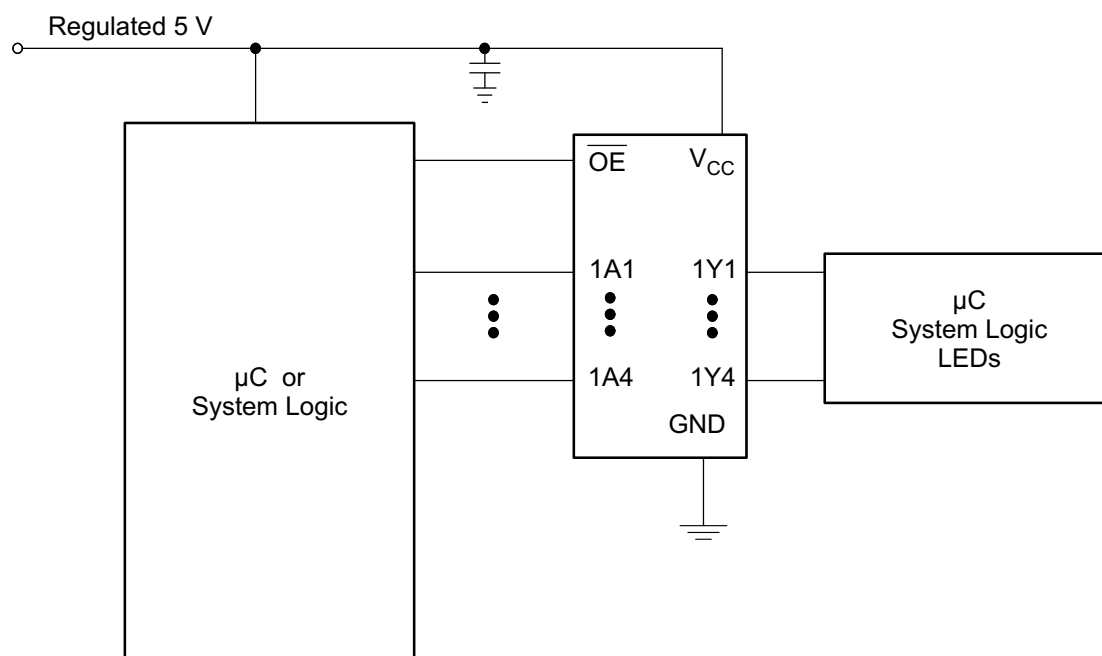


**Figure 6. Application Diagram**

#### 10.2.1 Design Requirements

This device uses CMOS technology and has balanced output drive. Care should be taken to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads, so routing and load conditions should be considered to prevent ringing.

#### 10.2.2 Detailed Design Procedure

1. Recommended input conditions:
   – For rise time and fall time specifications, see ($\Delta t/\Delta V$) in the *Recommended Operating Conditions* table.
   – For specified high and low levels, see ($V_{IH}$ and $V_{IL}$) in the *Recommended Operating Conditions* table.
   – Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid $V_{CC.}$
2. Recommend output conditions:
   – Load currents should not exceed 25 mA per output and 75 mA total for the part.
   – Outputs should not be pulled above $V_{CC.}$

Product Folder Links: *SN54AHC16244  SN74AHC16244*

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## Typical Application  (continued)

### 10.2.3   Application Curves



Figure 7. Switching Characteristics Comparison
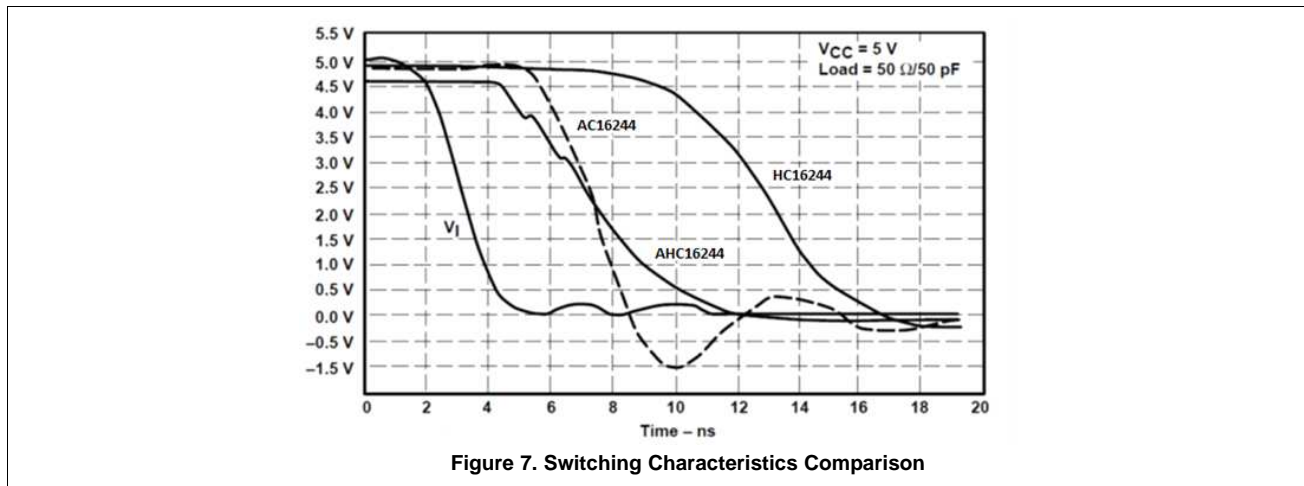
## 11   Power Supply Recommendations

The power supply can be any voltage between the Min and Max supply voltage rating located in the *Recommended Operating Conditions.*

Each $V_{CC}$ terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1 µF capacitor is recommended. If there are multiple $V_{CC}$ terminals then 0.01 µF or 0.022 µF capacitors are recommended for each power terminal. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1 µF and 1.0 µF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for the best results.

## 12   Layout

### 12.1   Layout Guidelines

When using multiple bit logic devices, inputs should not float. In many cases, functions or parts of functions of digital logic devices are unused. Some examples are when only two inputs of a triple-input AND gate are used, or only 3 of the 4-buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. Specified in Figure 8 are rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or $V_{CC}$, whichever makes more sense or is more convenient. It is generally acceptable to float outputs unless the part is a transceiver.

### 12.2   Layout Example
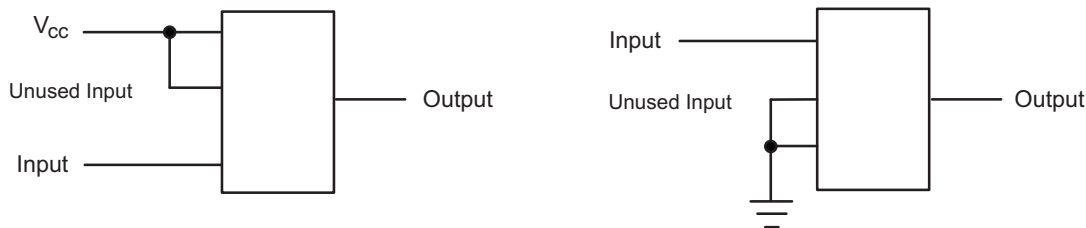


Figure 8.  Layout Diagram

*Submit Documentation Feedback*        13

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## 13 Device and Documentation Support

### 13.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 2. Related Links**

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|---|---|---|---|---|---|
| SN54AHC16244 | Click here | Click here | Click here | Click here | Click here |
| SN74AHC16244 | Click here | Click here | Click here | Click here | Click here |

### 13.2 Trademarks

*Widebus* is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

### 13.3 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 13.4 Glossary

SLYZ022 — *TI Glossary*.
   This glossary lists and explains terms, acronyms, and definitions.

## 14 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.

Product Folder Links: *SN54AHC16244  SN74AHC16244*

**PACKAGE OPTION ADDENDUM**

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16-Oct-2014

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 74AHC16244DGGRG4 | ACTIVE | TSSOP | DGG | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | AHC16244 | Samples |
| SN74AHC16244DGGR | ACTIVE | TSSOP | DGG | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | AHC16244 | Samples |
| SN74AHC16244DGVR | ACTIVE | TVSOP | DGV | 48 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HE244 | Samples |
| SN74AHC16244DL | ACTIVE | SSOP | DL | 48 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | AHC16244 | Samples |
| SN74AHC16244DLG4 | ACTIVE | SSOP | DL | 48 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | AHC16244 | Samples |
| SN74AHC16244DLR | ACTIVE | SSOP | DL | 48 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | AHC16244 | Samples |
| SN74AHC16244DLRG4 | ACTIVE | SSOP | DL | 48 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | AHC16244 | 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)** 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.

Addendum-Page 1

Distributor of Texas Instruments: Excellent Integrated System Limited
Datasheet of SN74AHC16244DGVR - IC BUFF/DVR TRI-ST 16BIT 48TVSOP
Contact us: sales@integrated-circuit.com Website: www.integrated-circuit.com
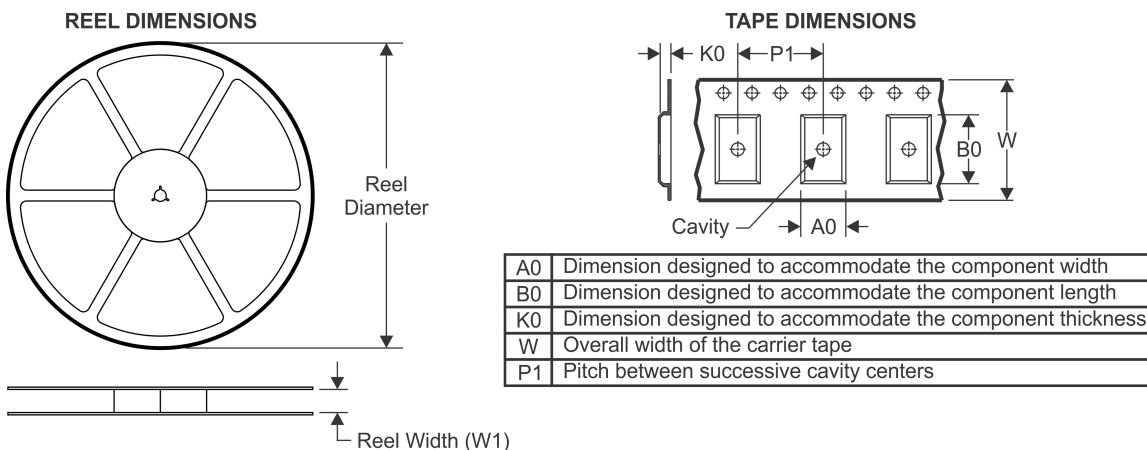
**PACKAGE OPTION ADDENDUM**

(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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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**TEXAS INSTRUMENTS**

# PACKAGE MATERIALS INFORMATION

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5-Aug-2014

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

**TAPE DIMENSIONS**



| A0 | Dimension designed to accommodate the component width |
| B0 | 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**
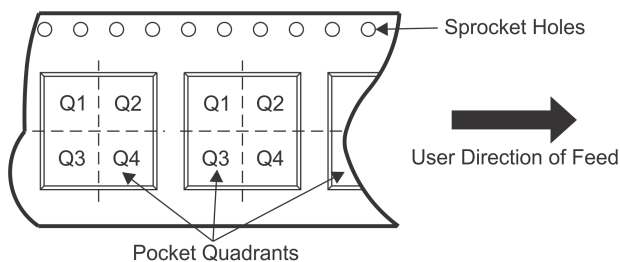


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN74AHC16244DGGR | TSSOP | DGG | 48 | 2000 | 330.0 | 24.4 | 8.6 | 15.8 | 1.8 | 12.0 | 24.0 | Q1 |
| SN74AHC16244DGVR | TVSOP | DGV | 48 | 2000 | 330.0 | 16.4 | 7.1 | 10.2 | 1.6 | 12.0 | 16.0 | Q1 |
| SN74AHC16244DLR | SSOP | DL | 48 | 1000 | 330.0 | 32.4 | 11.35 | 16.2 | 3.1 | 16.0 | 32.0 | Q1 |

**TEXAS INSTRUMENTS**

# PACKAGE MATERIALS INFORMATION

**TAPE AND REEL BOX  DIMENSIONS**
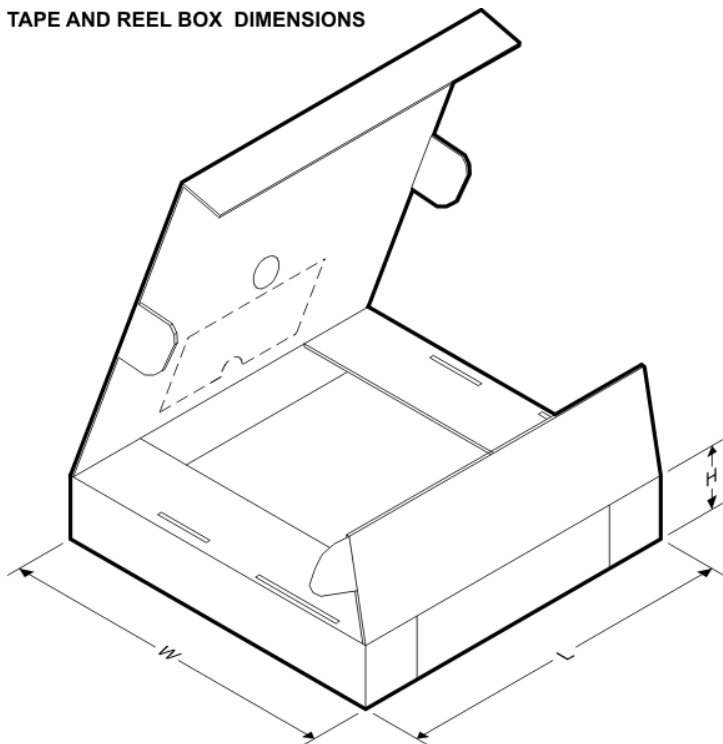


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN74AHC16244DGGR | TSSOP | DGG | 48 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74AHC16244DGVR | TVSOP | DGV | 48 | 2000 | 367.0 | 367.0 | 38.0 |
| SN74AHC16244DLR | SSOP | DL | 48 | 1000 | 367.0 | 367.0 | 55.0 |

## MECHANICAL DATA

**DGV (R-PDSO-G**)**                                     **PLASTIC SMALL-OUTLINE**

**24 PINS SHOWN**
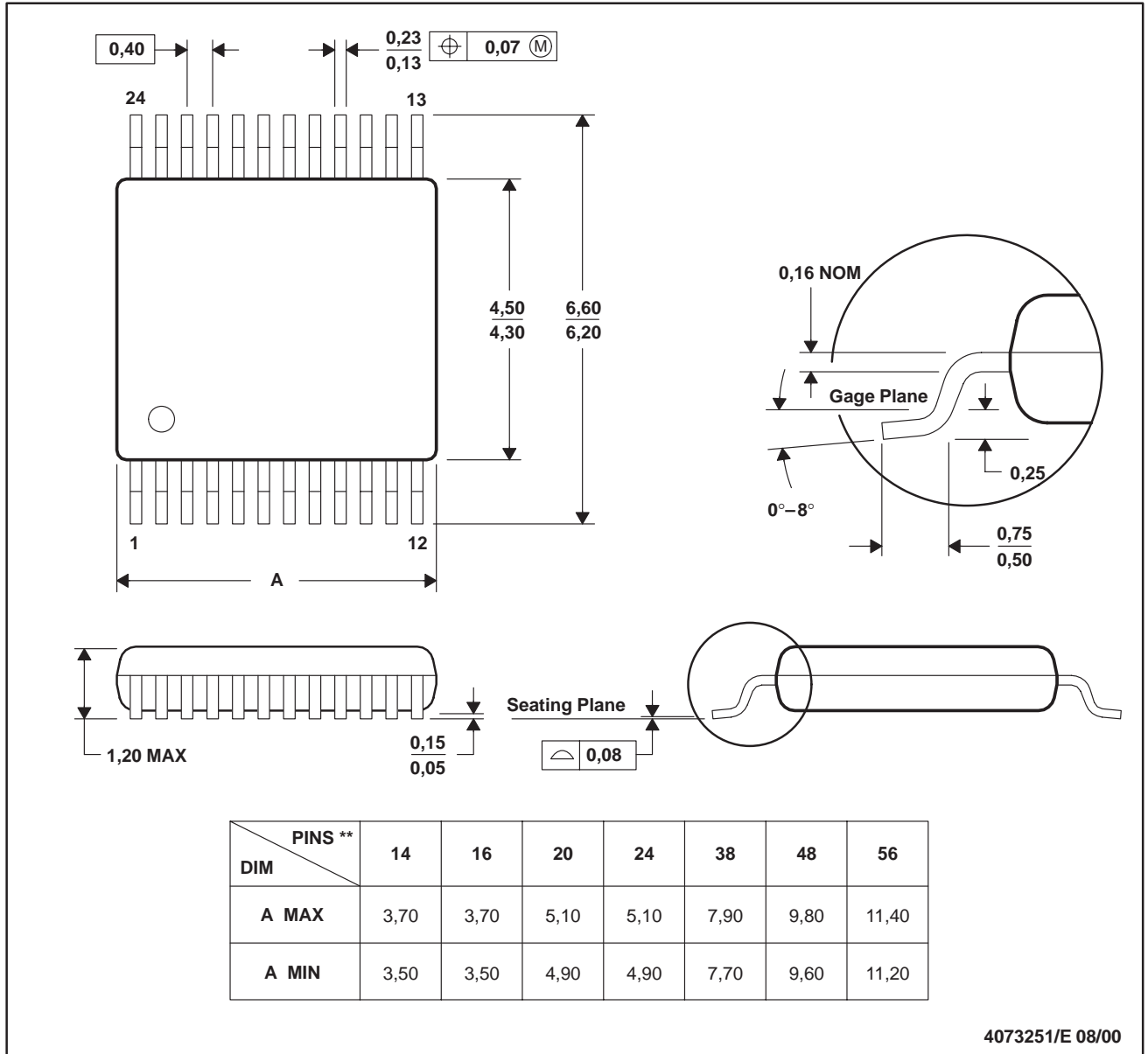


| PINS ** / DIM | 14 | 16 | 20 | 24 | 38 | 48 | 56 |
|---|---|---|---|---|---|---|---|
| A MAX | 3,70 | 3,70 | 5,10 | 5,10 | 7,90 | 9,80 | 11,40 |
| A MIN | 3,50 | 3,50 | 4,90 | 4,90 | 7,70 | 9,60 | 11,20 |

4073251/E 08/00

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

**TEXAS INSTRUMENTS**
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

**MECHANICAL DATA**

DL (R−PDSO−G48)                    PLASTIC SMALL−OUTLINE PACKAGE

0.025 (0,635)

$\dfrac{0.0135\ (0,343)}{0.008\ (0,203)}$

⊕ 0.005 (0,13) Ⓜ

48                                    25

$\dfrac{0.420\ (10,67)}{0.395\ (10,03)}$

$\dfrac{0.299\ (7,59)}{0.291\ (7,39)}$

$\dfrac{0.010\ (0,25)}{0.005\ (0,13)}$

Gage Plane

0.010 (0,25)

1                                    24

0°−8°

$\dfrac{0.630\ (16,00)}{0.620\ (15,75)}$

$\dfrac{0.040\ (1,02)}{0.020\ (0,51)}$

0.110 (2,79) MAX          0.008 (0,20) MIN

Seating Plane

0.004 (0,10)

4040048−3/F   05/13
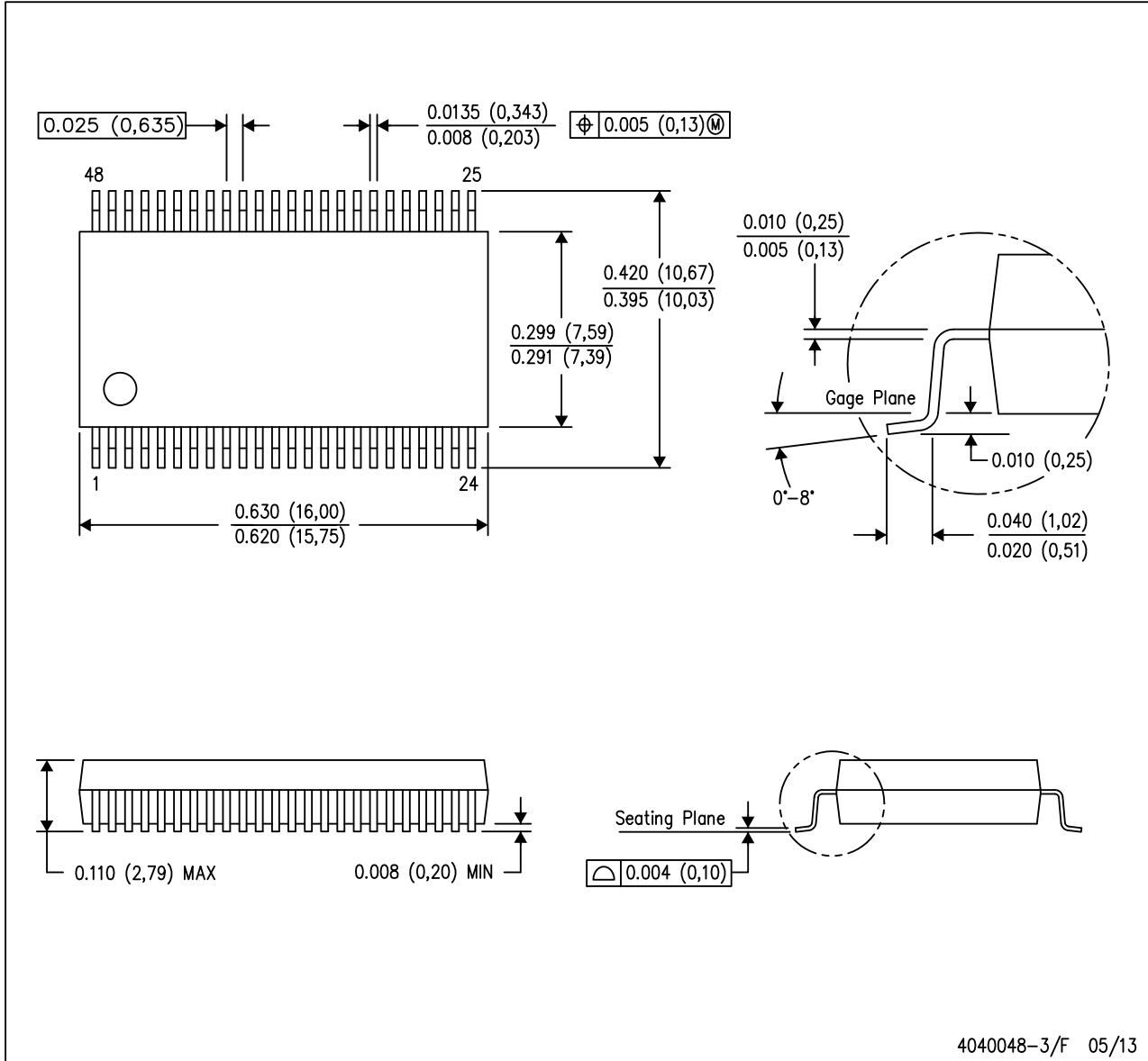
NOTES:    A.   All linear dimensions are in inches (millimeters).
          B.   This drawing is subject to change without notice.
          C.   Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
          D.   Falls within JEDEC MO−118

**PowerPAD is a trademark of Texas Instruments.**

## MECHANICAL DATA

MTSS003D – JANUARY 1995 – REVISED JANUARY 1998

**DGG (R-PDSO-G**)**                                                    **PLASTIC SMALL-OUTLINE PACKAGE**

**48 PINS SHOWN**
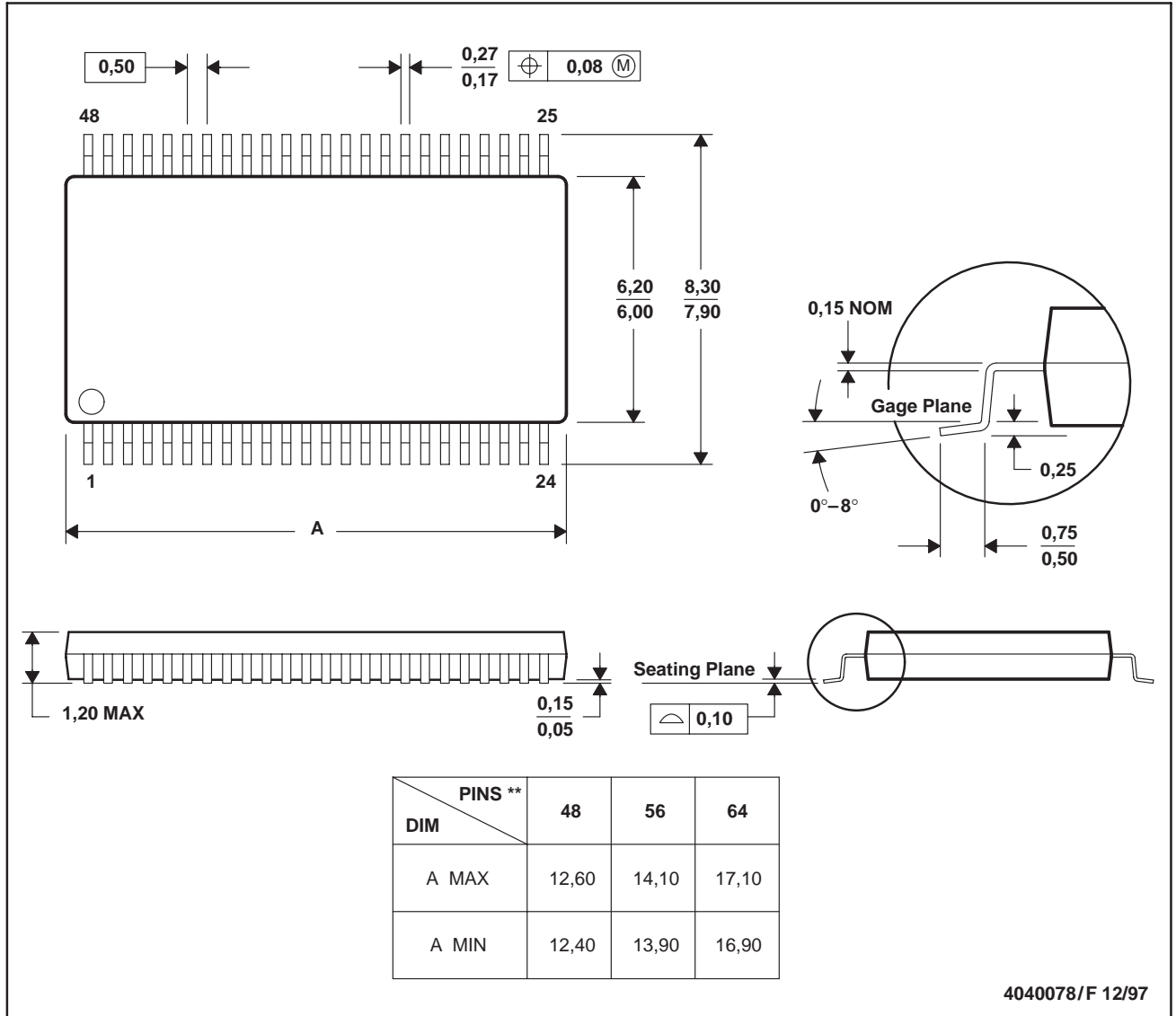


| PINS ** DIM | 48 | 56 | 64 |
|---|---|---|---|
| A  MAX | 12,60 | 14,10 | 17,10 |
| A  MIN | 12,40 | 13,90 | 16,90 |

4040078 / F 12/97

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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## IMPORTANT NOTICE

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| Wireless Connectivity | www.ti.com/wirelessconnectivity | | |