

# 54AC16244, 74AC16244 16-BIT BUFFERS/LINE DRIVERS WITH 3-STATE OUTPUTS

SCAS120A – MARCH 1990 – REVISED APRIL 1996

- Members of the Texas Instruments *Widebus™* Family
- 3-State Outputs Drive Bus Lines or Buffer Memory Address Registers
- Flow-Through Architecture Optimizes PCB Layout
- Distributed  $V_{CC}$  and GND Configuration Minimizes High-Speed Switching Noise
- *EPIC™* (Enhanced-Performance Implanted CMOS) 1- $\mu$ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages Using 25-mil Center-to-Center Pin Spacings, and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Pin Spacings

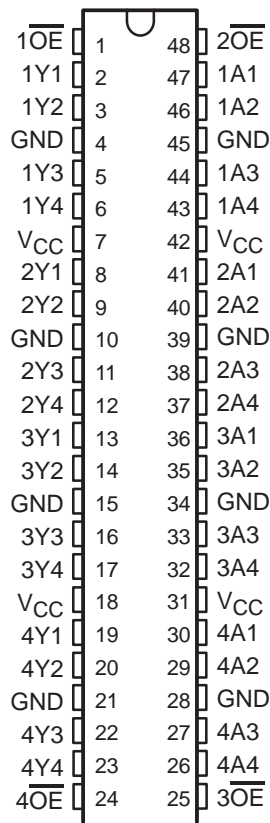
## description

The 'AC16244 are 16-bit buffers/line drivers designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. They can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. These devices provide true outputs and symmetrical active-low output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the device passes noninverted data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

The 74AC16244 is packaged in the TI's shrink small-outline package, which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54AC16244 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The 74AC16244 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

54AC16244 . . . WD PACKAGE  
74AC16244 . . . DGG OR DL PACKAGE  
(TOP VIEW)



FUNCTION TABLE  
(each driver)

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



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 **TEXAS  
INSTRUMENTS**

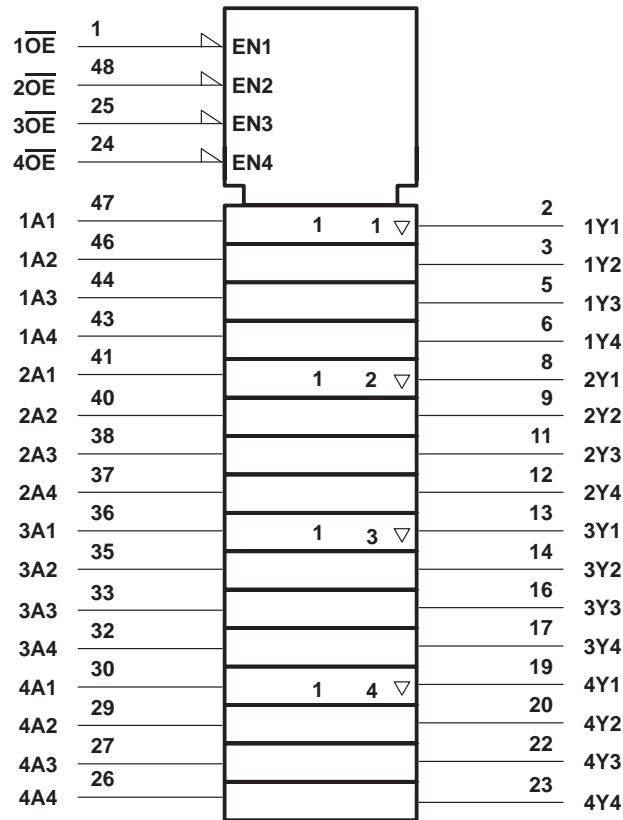
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## logic symbol†

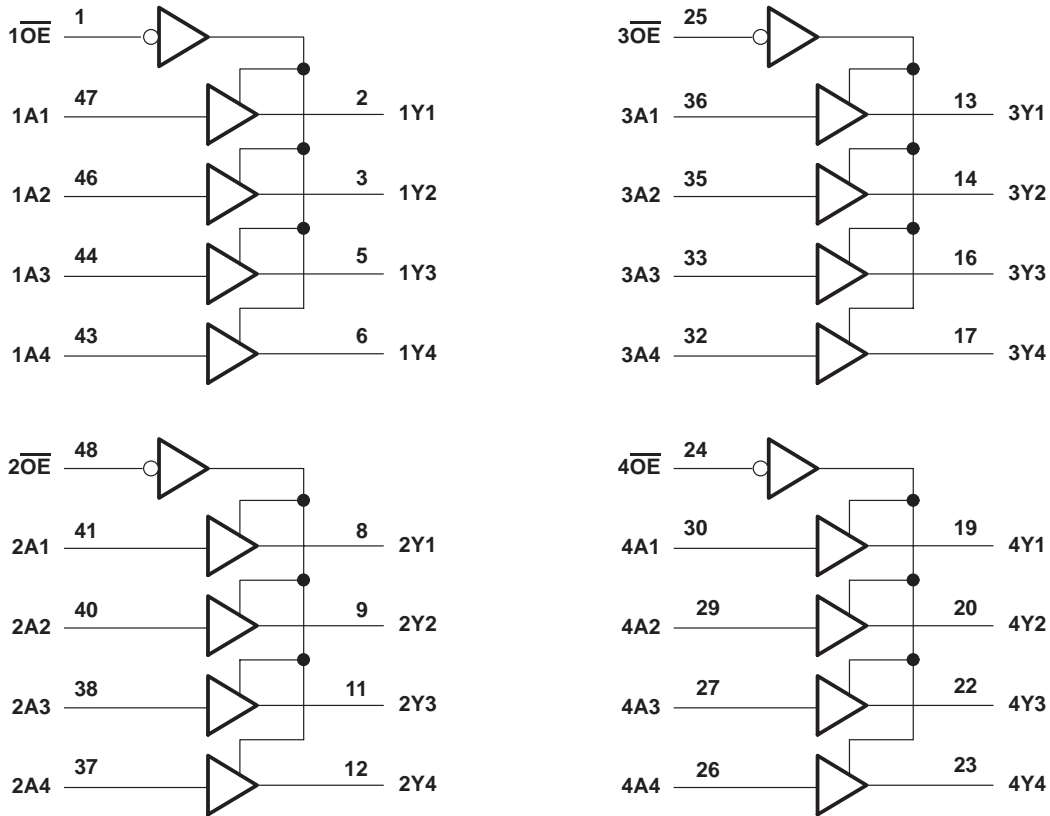


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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**logic diagram (positive logic)**



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

Supply voltage range, $V_{CC}$ .....	-0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....	$\pm 50$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 400$ mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DGG package .....	0.85 W
DL package .....	1.2 W
Storage temperature range, $T_{stg}$ .....	$-65^\circ\text{C}$ to $150^\circ\text{C}$

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The maximum package power dissipation is calculated using a junction temperature of  $150^\circ\text{C}$  and a board trace length of 750 mils.

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## recommended operating conditions (see Note 3)

		54AC16244			74AC16244			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage (see Note 4)	3	5	5.5	3	5	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 3 V		2.1	2.1		V	
		V <sub>CC</sub> = 4.5 V		3.15	3.15			
		V <sub>CC</sub> = 5.5 V		3.85	3.85			
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 3 V			0.9	0.9	V	
		V <sub>CC</sub> = 4.5 V			1.35	1.35		
		V <sub>CC</sub> = 5.5 V			1.65	1.65		
V <sub>I</sub>	Input voltage	0		V <sub>CC</sub>	0	V <sub>CC</sub>	V	
V <sub>O</sub>	Output voltage	0		V <sub>CC</sub>	0	V <sub>CC</sub>	V	
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 3 V			-4	-4	mA	
		V <sub>CC</sub> = 4.5 V			-24	-24		
		V <sub>CC</sub> = 5.5 V			-24	-24		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 3 V			12	12	mA	
		V <sub>CC</sub> = 4.5 V			24	24		
		V <sub>CC</sub> = 5.5 V			24	24		
Δt/Δv	Input transition rise or fall rate	0		10	0	10	ns/V	
T <sub>A</sub>	Operating free-air temperature	-55		125	-40	85	°C	

NOTES: 3. Unused inputs should be tied to V<sub>CC</sub> through a pullup resistor of approximately 5 kΩ or greater to prevent them from floating.  
4. All V<sub>CC</sub> and GND pins must be connected to the proper voltage supply.

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			54AC16244		74AC16244		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = -50 μA	3 V	2.9			2.9		2.9	V	
		4.5 V	4.4			4.4		4.4		
		5.5 V	5.4			5.4		5.4		
	I <sub>OH</sub> = -4 mA	3 V	2.58			2.48		2.48		
		4.5 V	3.94			3.8		3.8		
		5.5 V	4.94			4.8		4.8		
I <sub>OH</sub> = -75 mA <sup>†</sup>	5.5 V				3.85		3.85			
V <sub>OL</sub>	I <sub>OL</sub> = -50 μA	3 V			0.1		0.1	0.1	V	
		4.5 V			0.1		0.1	0.1		
		5.5 V			0.1		0.1	0.1		
	I <sub>OL</sub> = 12 mA	3 V			0.36		0.44	0.44		
		4.5 V			0.36		0.44	0.44		
	I <sub>OL</sub> = 24 mA	4.5 V			0.36		0.44	0.44		
		5.5 V			0.36		0.44	0.44		
I <sub>OL</sub> = 75 mA <sup>†</sup>	5.5 V					1.65	1.65			
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V			±0.1		±1	±1	μA	
I <sub>OZ</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V			±0.5		±5	±5	μA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V			8		80	80	μA	
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V			4.5				pF	
C <sub>o</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V			12					

<sup>†</sup> Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

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switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			54AC16244		74AC16244		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	2	7.1	9.4	2	10.8	2	10.8	ns
$t_{PHL}$			2.4	8.3	10.7	2.4	11.8	2.4	11.8	
$t_{PZH}$	$\overline{OE}$	Y	2.2	7.5	10	2.2	11.5	2.2	11.5	ns
$t_{PZL}$			2.9	10.4	13	2.9	14.6	2.9	14.6	
$t_{PHZ}$	$\overline{OE}$	Y	4.1	6.8	8.4	4.1	9.1	4.1	9.1	ns
$t_{PLZ}$			3.7	6.5	8.1	3.7	8.8	3.7	8.8	

switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			54AC16244		74AC16244		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	1.6	4.6	6.3	1.6	7.1	1.6	7.1	ns
$t_{PHL}$			2	5.3	7	2	7.9	2	7.9	
$t_{PZH}$	$\overline{OE}$	Y	1.7	4.8	6.7	1.7	7.5	1.7	7.5	ns
$t_{PZL}$			2.2	6.1	8.1	2.2	9	2.2	9	
$t_{PHZ}$	$\overline{OE}$	Y	4	6.4	7.8	4	8.4	4	8.4	ns
$t_{PLZ}$			3.5	5.5	7.2	3.5	7.6	3.5	7.6	

operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
$C_{pd}$	Power dissipation capacitance per latch	Outputs enabled	43	pF
		Outputs disabled	7	

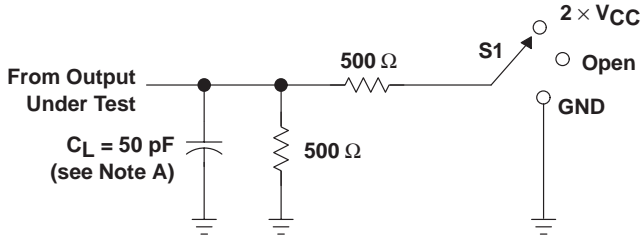
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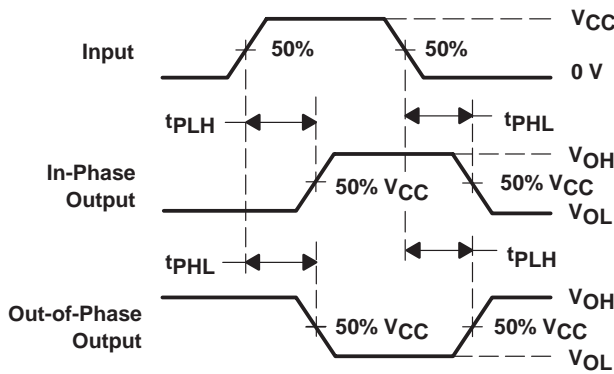
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**PARAMETER MEASUREMENT INFORMATION**

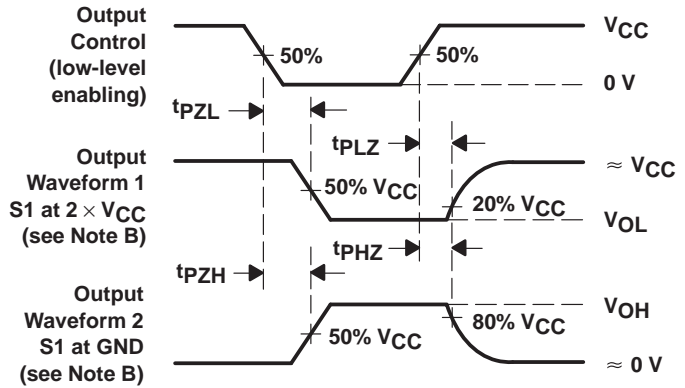


**LOAD CIRCUIT**

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND



**VOLTAGE WAVEFORMS**



**VOLTAGE WAVEFORMS**

- 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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 3 \text{ ns}$ ,  $t_f = 3 \text{ ns}$ .  
 D. The outputs are measured one at a time with one input transition per measurement.

**Figure 1. Load Circuit and Voltage Waveforms**

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
74AC16244DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16244DGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16244DGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16244DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16244DLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16244DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16244DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

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

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

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

**OBSELETE:** TI has discontinued the production of the device.

<sup>(2)</sup> 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)

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

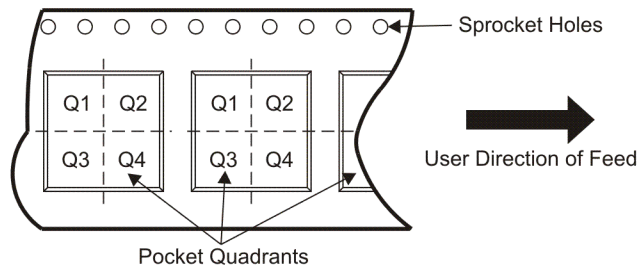
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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

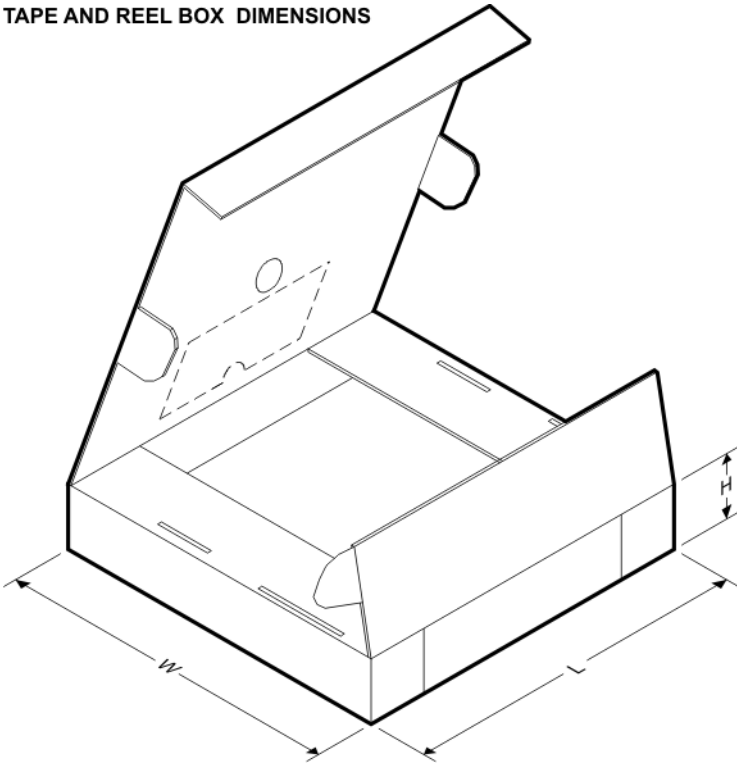


\*All dimensions are nominal

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
74AC16244DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
74AC16244DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1



**TAPE AND REEL BOX DIMENSIONS**



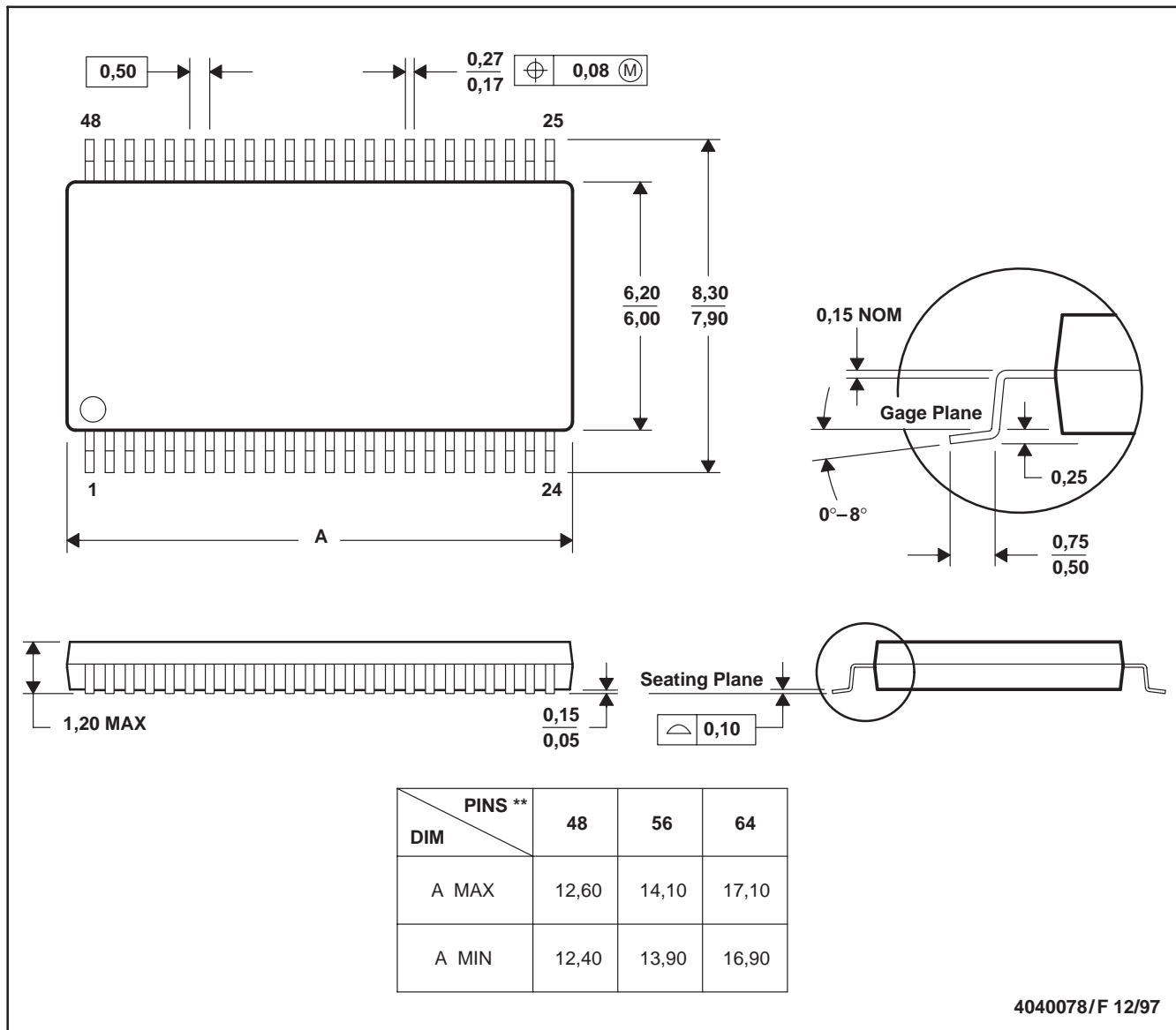
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
74AC16244DGGR	TSSOP	DGG	48	2000	346.0	346.0	41.0
74AC16244DLR	SSOP	DL	48	1000	346.0	346.0	49.0

DGG (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

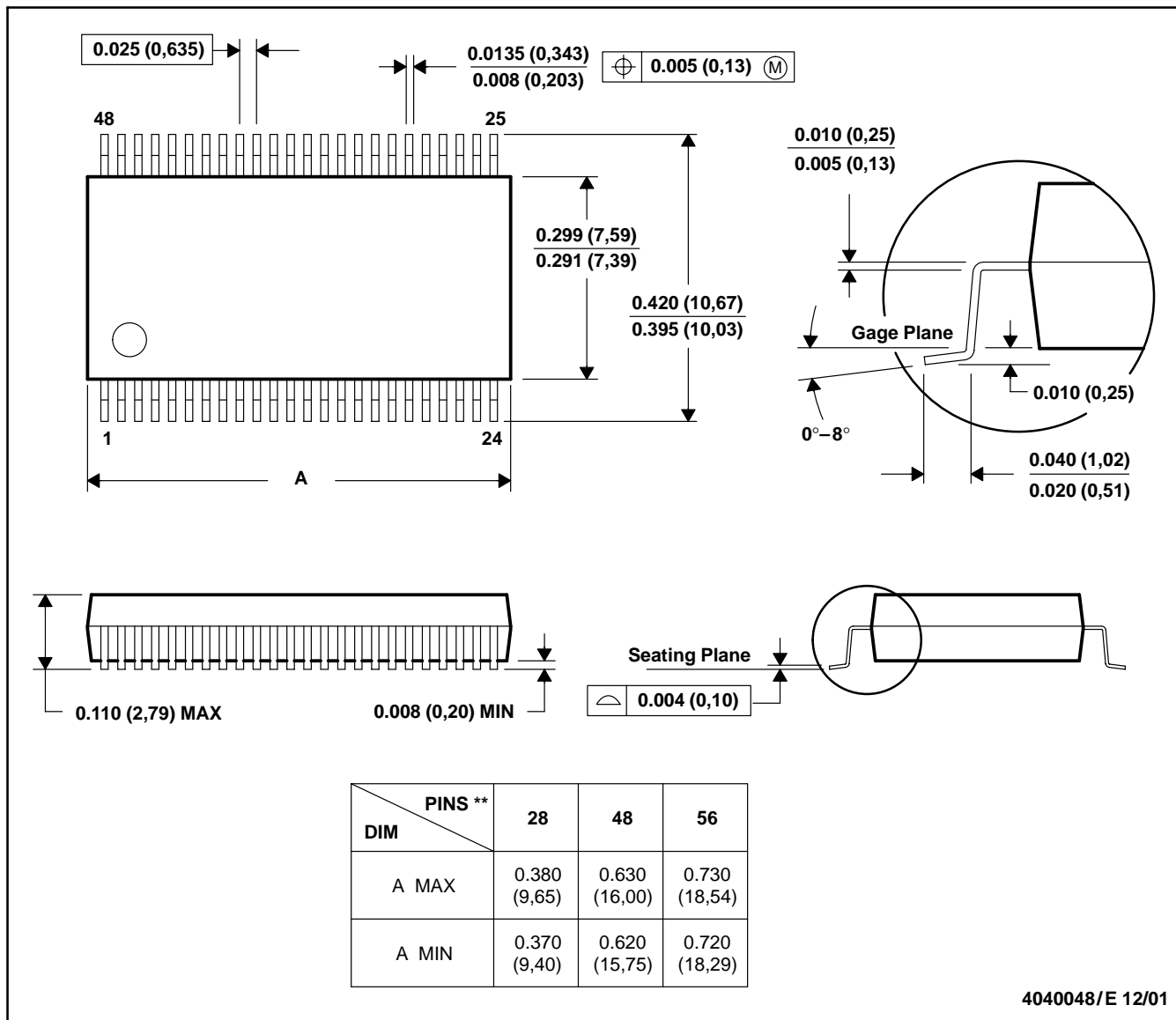


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

DL (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- 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

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Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

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Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
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Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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