- **Members of the Texas Instruments Widebus ™ Family**
- **Output Ports Have Equivalent 25-Ω Series Resistors, So No External Resistors Are Required**
- **Typical V_{OLP} (Output Ground Bounce) <1 V at V_{CC} = 5 V, T_A = 25°C**
- **High-Impedance State During Power Up and Power Down**
- **I_{off} and Power-Up 3-State Support Hot Insertion**
- **Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Latch-Up Performance Exceeds 500 mA Per JESD-17**

description/ordering information

The 'ABT162244 devices are 16-bit buffers and 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. These devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. These devices provide noninverting outputs and symmetrical active-low output-enable ($\overline{OE}$) inputs.

The outputs, which are designed to source or sink up to 12 mA, include equivalent 25-Ω series resistors to reduce overshoot and undershoot.

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.

SN54ABT162244 . . . WD PACKAGE
SN74ABT162244 . . . 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	$3\overline{OE}$

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	SSOP – DL	Tube	SN74ABT162244DL	ABT162244
		Tape and reel	SN74ABT162244DLR	
	TSSOP – DGG	Tape and reel	SN74ABT162244DGGR	ABT162244
	TVSOP – DGV	Tape and reel	SN74ABT162244DGVR	AH2244
−55°C to 125°C	CFP – WD	Tube	SNJ54ABT162244WD	SNJ54ABT162244WD

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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description/ordering information (continued)

These devices are fully specified for hot-insertion applications using I_{off} and power-up 3-state. The I_{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
(each 4-bit buffer)

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

logic diagram (positive logic)
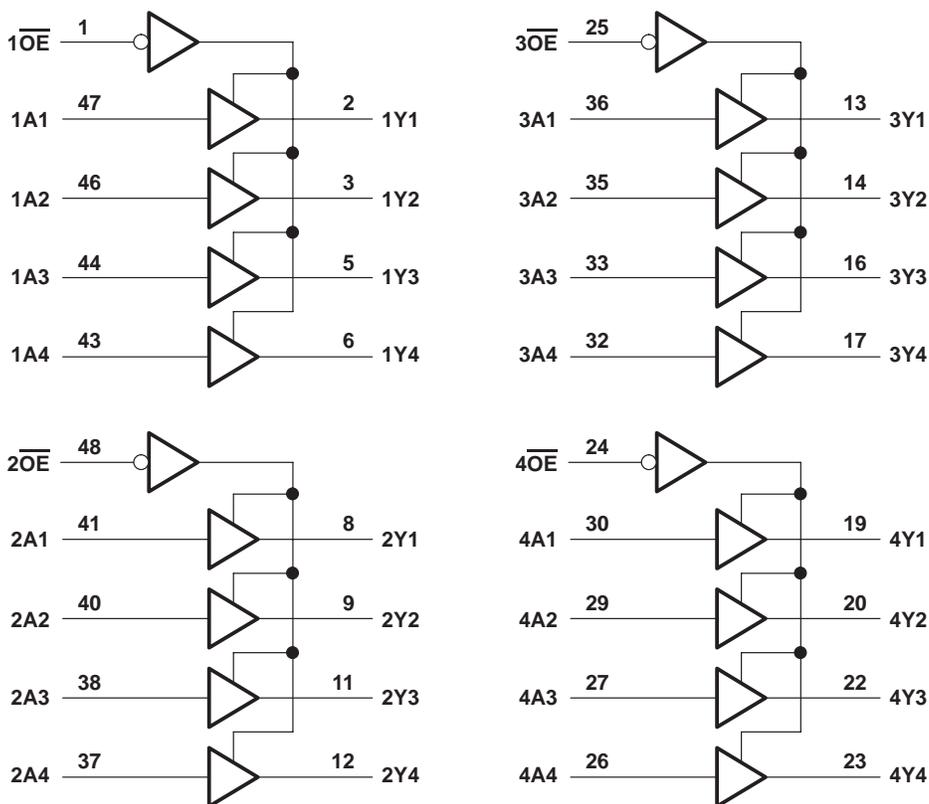
TEXAS
INSTRUMENTS
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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} .... −0.5 V to 7 V
Input voltage range, V_I (see Note 1) .... −0.5 V to 7 V
Voltage range applied to any output in the high or power-off state, V_O .... −0.5 V to 5.5 V
Current into any output in the low state, I_O .... 30 mA
Input clamp current, I_{IK} ($V_I < 0$) .... −18 mA
Output clamp current, I_{OK} ($V_O < 0$) .... −50 mA
Package thermal impedance, θ_{JA} (see Note 2): DGG package .... 70°C/W
                                          DGV package .... 58°C/W
                                          DL package .... 63°C/W
Storage temperature range, T_{stg} .... −65°C to 150°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 negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

			SN54ABT162244		SN74ABT162244		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		4.5	5.5	4.5	5.5	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		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current			−3		−12	mA
I_{OL}	Low-level output current			8		12	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		µs/V
T_A	Operating free-air temperature		−55	125	−40	85	°C

NOTES: 3. 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.

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

PARAMETER		TEST CONDITIONS		$T_A = 25°C$			SN54ABT162244		SN74ABT162244		UNIT
				MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V_{IK}		$V_{CC} = 4.5$ V,	$I_I = -18$ mA			−1.2		−1.2		−1.2	V
V_{OH}		$V_{CC} = 4.5$ V,	$I_{OH} = -1$ mA	3.35			3.35		3.35		V
		$V_{CC} = 5$ V,	$I_{OH} = -1$ mA	3.85			3.85		3.85		
		$V_{CC} = 4.5$ V	$I_{OH} = -3$ mA	3.1			3.1		3.1		
			$I_{OH} = -12$ mA	2.6*					2.6		
V_{OL}		$V_{CC} = 4.5$ V	$I_{OL} = 8$ mA		0.4			0.8		0.65	V
			$I_{OL} = 12$ mA		0.8*					0.8	
V_{hys}					100						mV
I_I		$V_{CC} = 0$ to 5.5 V, $V_I = V_{CC}$ or GND				±1		±1		±1	μA
I_{OZPU}		$V_{CC} = 0$ to 2.1 V, $V_O = 0.5$ V to 2.7 V, $\overline{OE} = X$				±50		±50		±50	μA
I_{OZPD}		$V_{CC} = 2.1$ V to 0, $V_O = 0.5$ V to 2.7 V, $\overline{OE} = X$				±50		±50		±50	μA
I_{OZH}		$V_{CC} = 2.1$ V to 5.5 V, $V_O = 2.7$ V, $\overline{OE} \geq 2$ V				10		10		10	μA
I_{OZL}		$V_{CC} = 2.1$ V to 5.5 V, $V_O = 0.5$ V, $\overline{OE} \geq 2$ V				−10		−10		−10	μA
I_{off}		$V_{CC} = 0$, V_I or $V_O \leq 4.5$ V				±100				±100	μA
I_{CEX}		$V_{CC} = 5.5$ V, $V_O = 5.5$ V	Outputs high			50		50		50	μA
I_O		$V_{CC} = 5.5$ V,	$V_O = 2.5$ V	−25	−55	−100	−25	−100	−25	−100	mA
I_{CC}‡		$V_{CC} = 5.5$ V, $I_O = 0$, $V_I = V_{CC}$ or GND	Outputs high			2		2		2	mA
			Outputs low			30		30		30	
			Outputs disabled			2		2		2	
ΔI_{CC}§	Data inputs	$V_{CC} = 5.5$ V, One input at 3.4 V, Other inputs at V_{CC} or GND	Outputs enabled			50		50		50	μA
			Outputs disabled			50		50		50	
	Control inputs	$V_{CC} = 5.5$ V, One input at 3.4 V, Other inputs at V_{CC} or GND				50		50		50	
C_i		$V_I = 2.5$ V or 0.5 V			3						pF
C_o		$V_O = 2.5$ V or 0.5 V			8						pF

* On products compliant to MIL-PRF-38535, this parameter does not apply.
† All typical values are at $V_{CC} = 5$ V.
‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.
§ This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ABT162244					UNIT
			V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
t_{PLH}	A	Y	1	2.5	3.6	1	4.1	ns
t_{PHL}			1	3.1	4.7	1	5.3	
t_{PZH}	$\overline{OE}$	Y	1	3.2	4.8	1	5.6	ns
t_{PZL}			1	3.2	4.7	1	5.5	
t_{PHZ}	$\overline{OE}$	Y	1	3.2	5.3	1	6.3	ns
t_{PLZ}			1	3.1	4.6	1	4.9	

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT162244					UNIT
			V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
t_{PLH}	A	Y	1	2.5	3.2	1	3.9	ns
t_{PHL}			1	3.1	4	1	4.8	
t_{PZH}	$\overline{OE}$	Y	1	3.2	4.2	1	5.4	ns
t_{PZL}			1	3.2	4.1	1	5.1	
t_{PHZ}	$\overline{OE}$	Y	1	3.2	4	1	4.6	ns
t_{PLZ}			1	3.1	3.9	1	4.5	

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5

SN54ABT162244, SN74ABT162244
16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

SCBS238E – JUNE 1992 – REVISED JUNE 2004
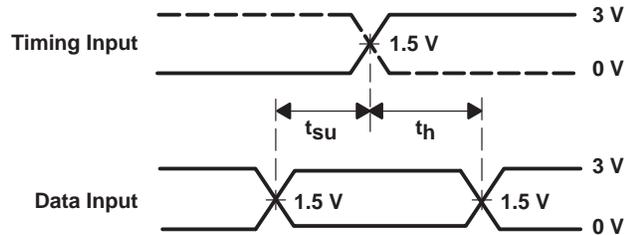
PARAMETER MEASUREMENT INFORMATION
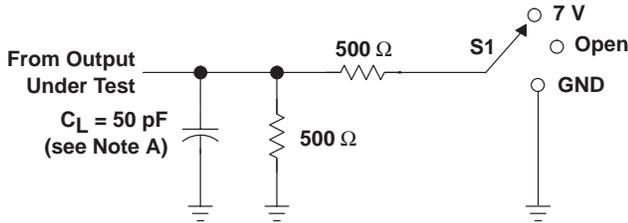
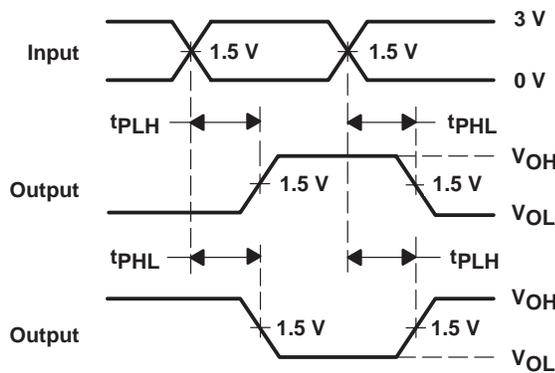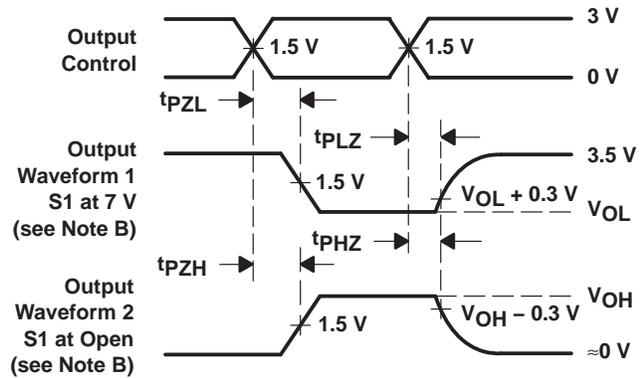| TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

LOAD CIRCUIT
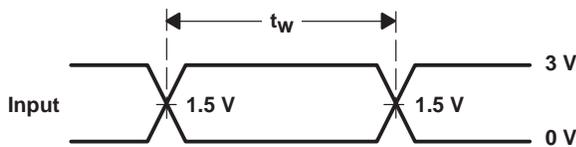
**VOLTAGE WAVEFORMS
PULSE DURATION**

**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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 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

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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
5962-9458701QXA	ACTIVE	CFP	WD	48	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9458701QX A SNJ54ABT162244 WD	Samples
74ABT162244DGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT162244	Samples
SN74ABT162244DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT162244	Samples
SN74ABT162244DGVR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	AH2244	Samples
SN74ABT162244DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT162244	Samples
SN74ABT162244DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT162244	Samples
SNJ54ABT162244WD	ACTIVE	CFP	WD	48	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9458701QX A SNJ54ABT162244 WD	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/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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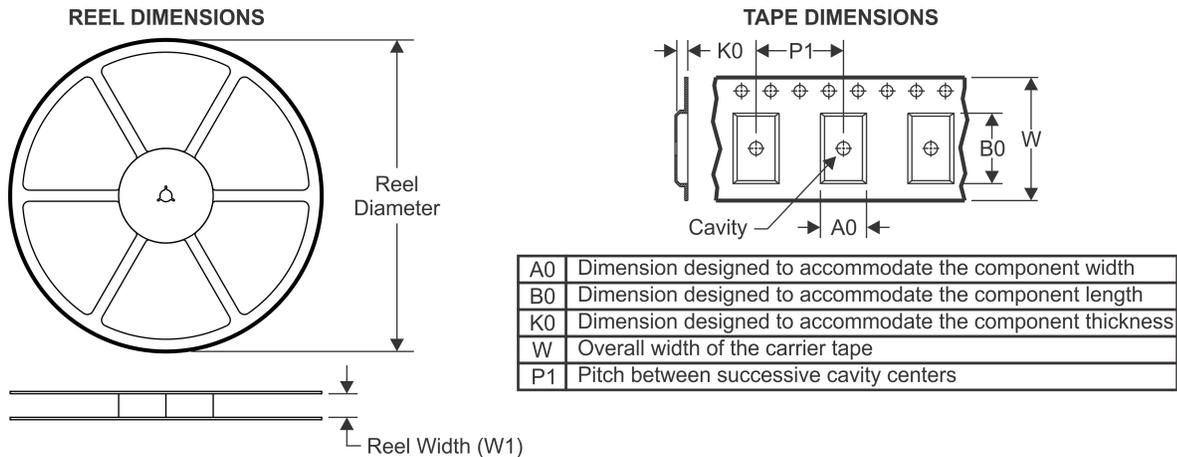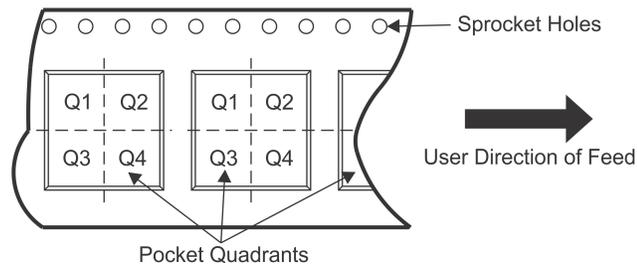
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF SN54ABT162244, SN74ABT162244 :

● Catalog: SN74ABT162244

● Military: SN54ABT162244

NOTE: Qualified Version Definitions:

  ● Catalog - TI's standard catalog product

  ● Military - QML certified for Military and Defense Applications

PACKAGE MATERIALS INFORMATION

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
SN74ABT162244DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
SN74ABT162244DGVR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1
SN74ABT162244DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1

PACKAGE MATERIALS INFORMATION

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TAPE AND REEL BOX DIMENSIONS
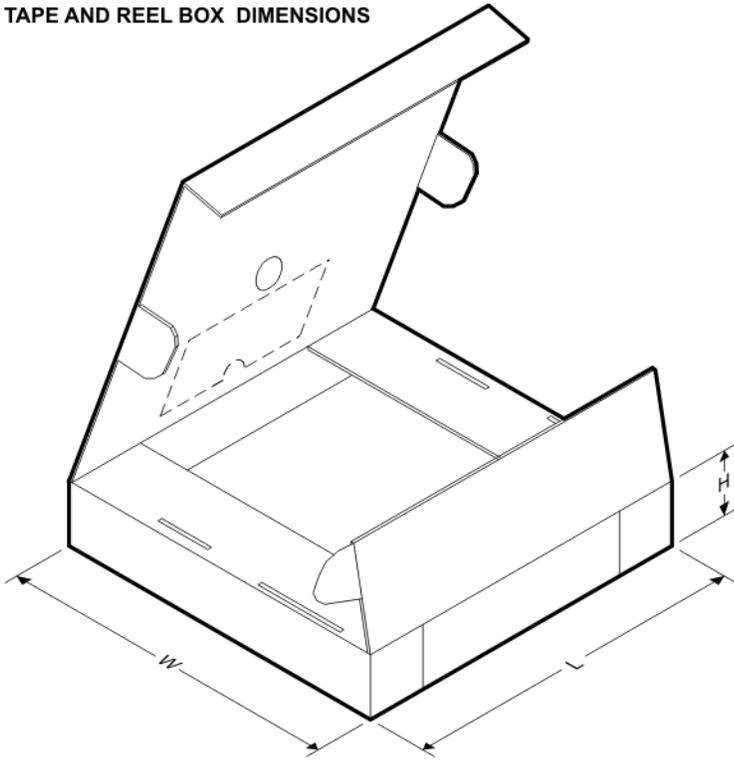
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT162244DGGR	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74ABT162244DGVR	TVSOP	DGV	48	2000	367.0	367.0	38.0
SN74ABT162244DLR	SSOP	DL	48	1000	367.0	367.0	55.0

DL (R−PDSO−G48)   PLASTIC SMALL−OUTLINE PACKAGE
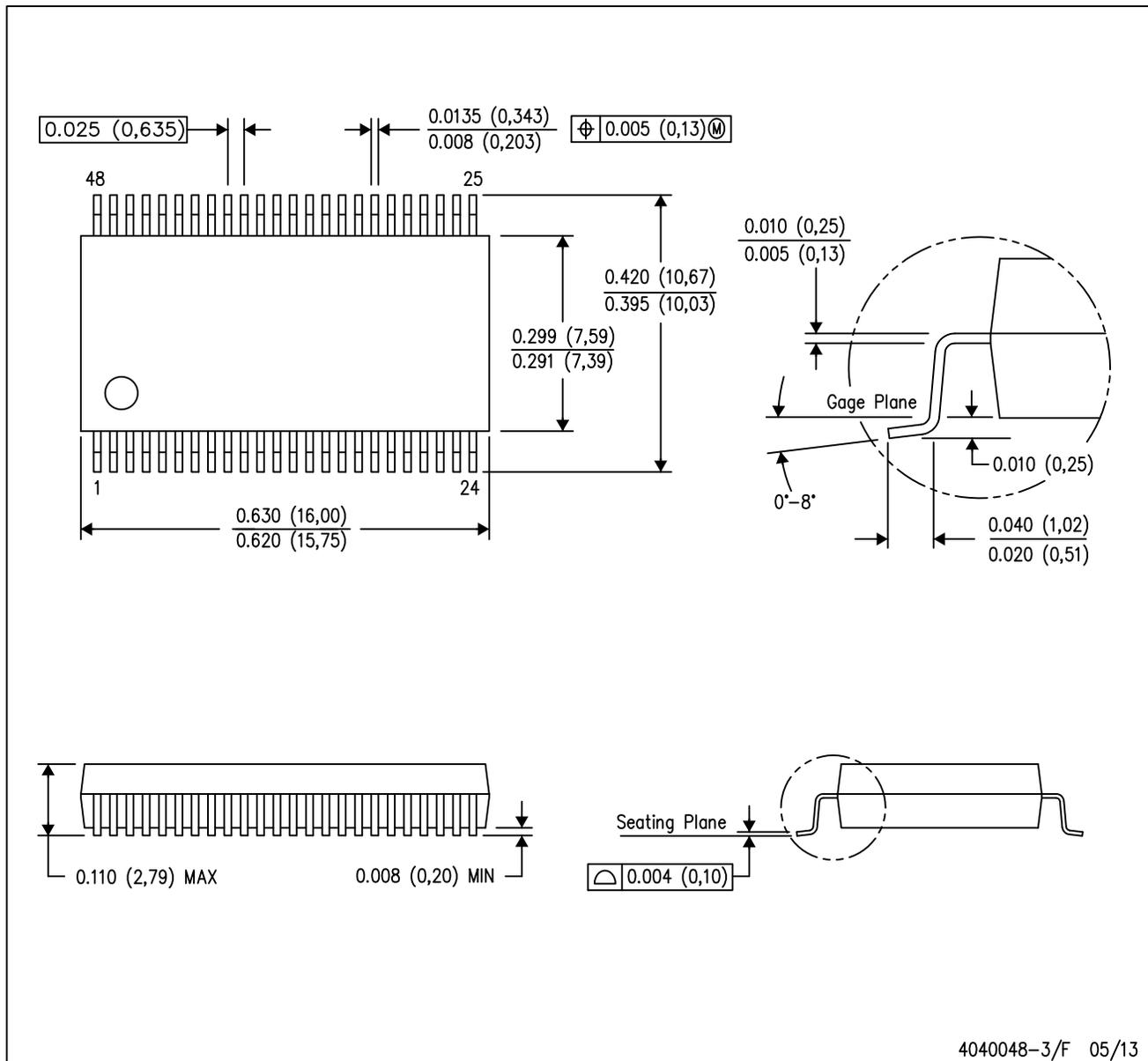
0.025 (0,635)

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

0°−8°

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

1   24

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

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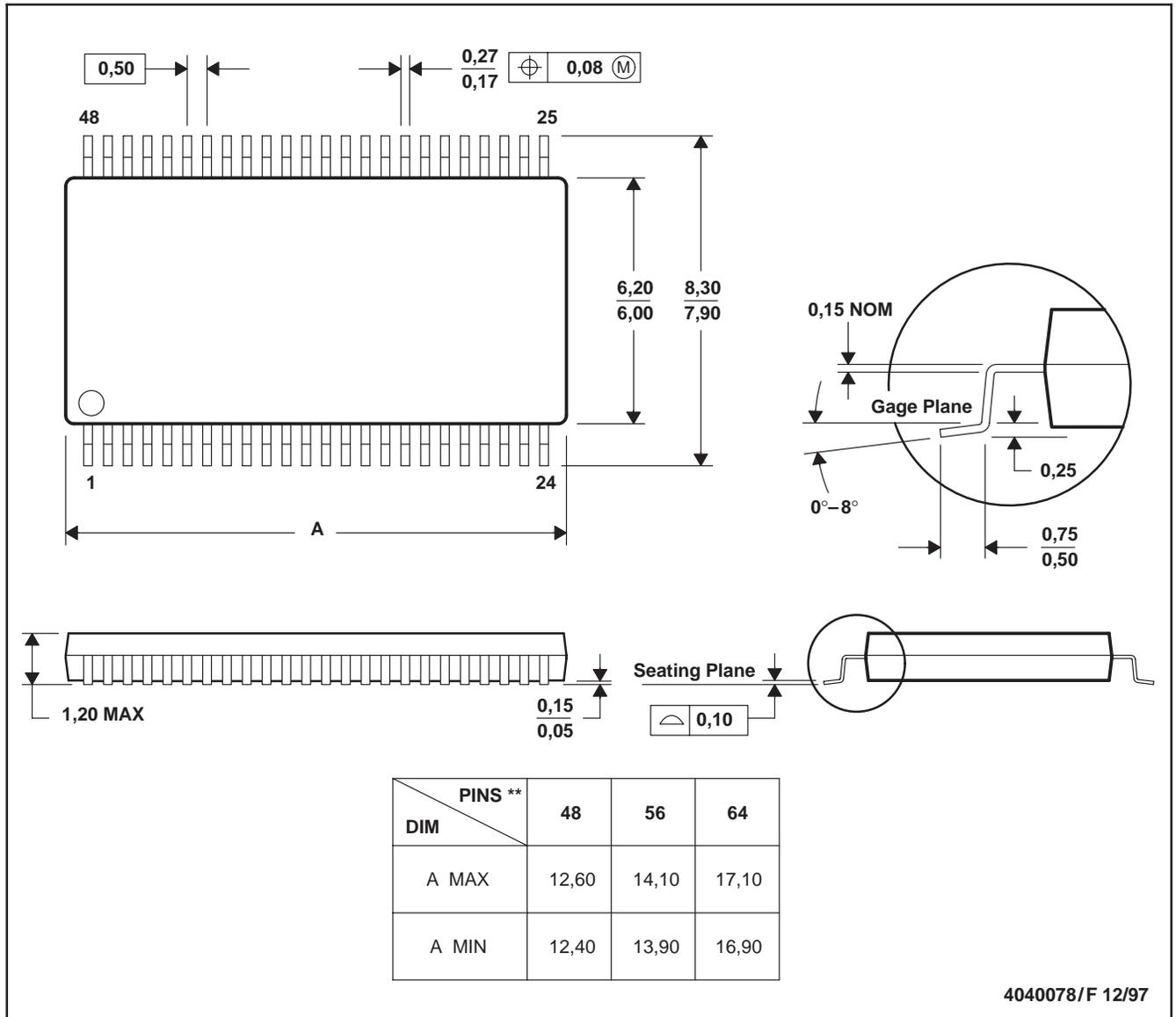
Seating Plane

△ 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

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

24 PINS SHOWN

0,40

0,23
0,13   ⊕   0,07 Ⓜ

24   13

4,50   6,60
4,30   6,20

0,16 NOM

Gage Plane

0,25

0°–8°

0,75
0,50

1   12

A

1,20 MAX

0,15
0,05

Seating Plane

0,08

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
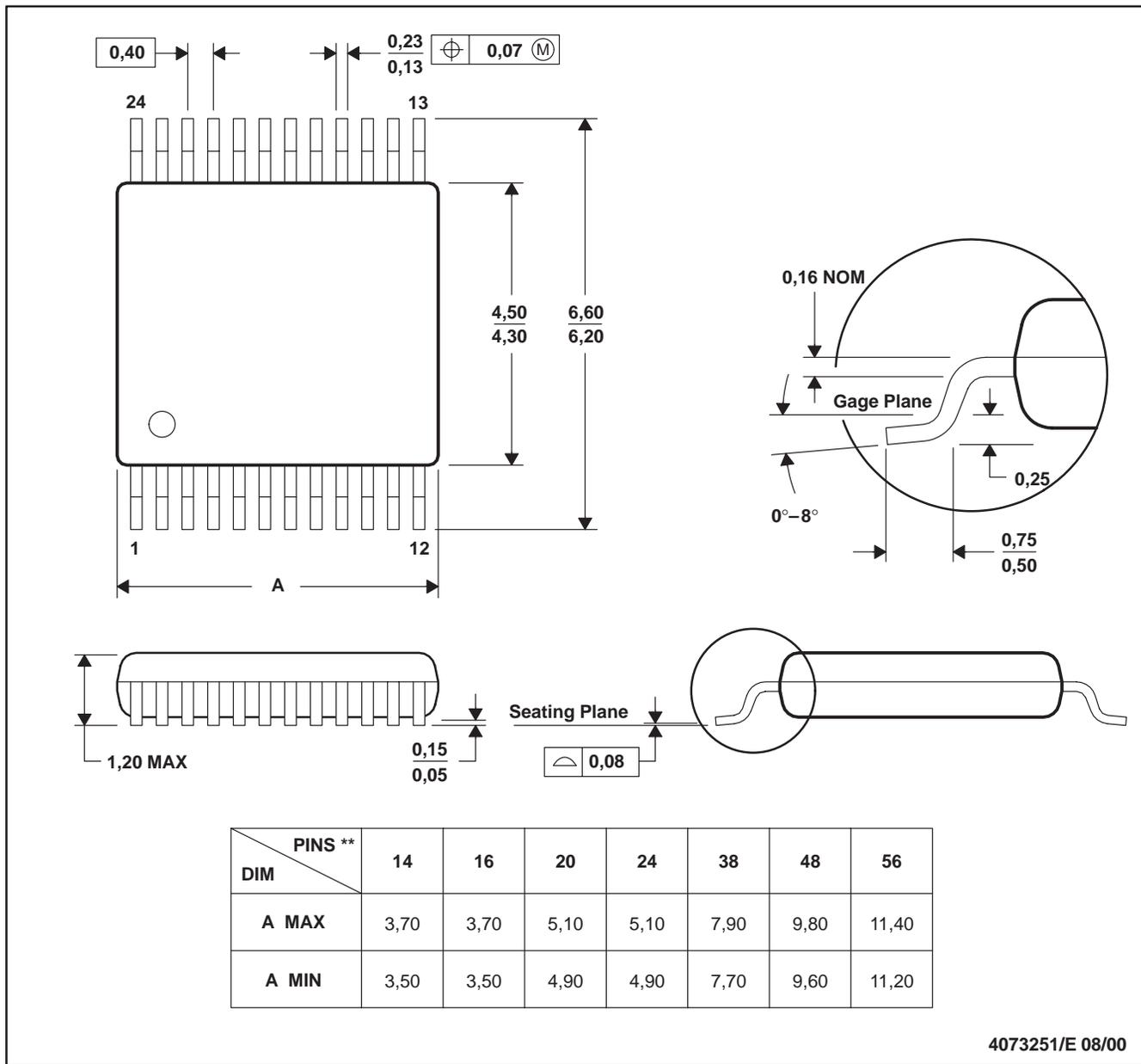
4073251/E 08/00

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

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MECHANICAL DATA

WD (R-GDFP-F**)   **CERAMIC DUAL FLATPACK**

48 LEADS SHOWN
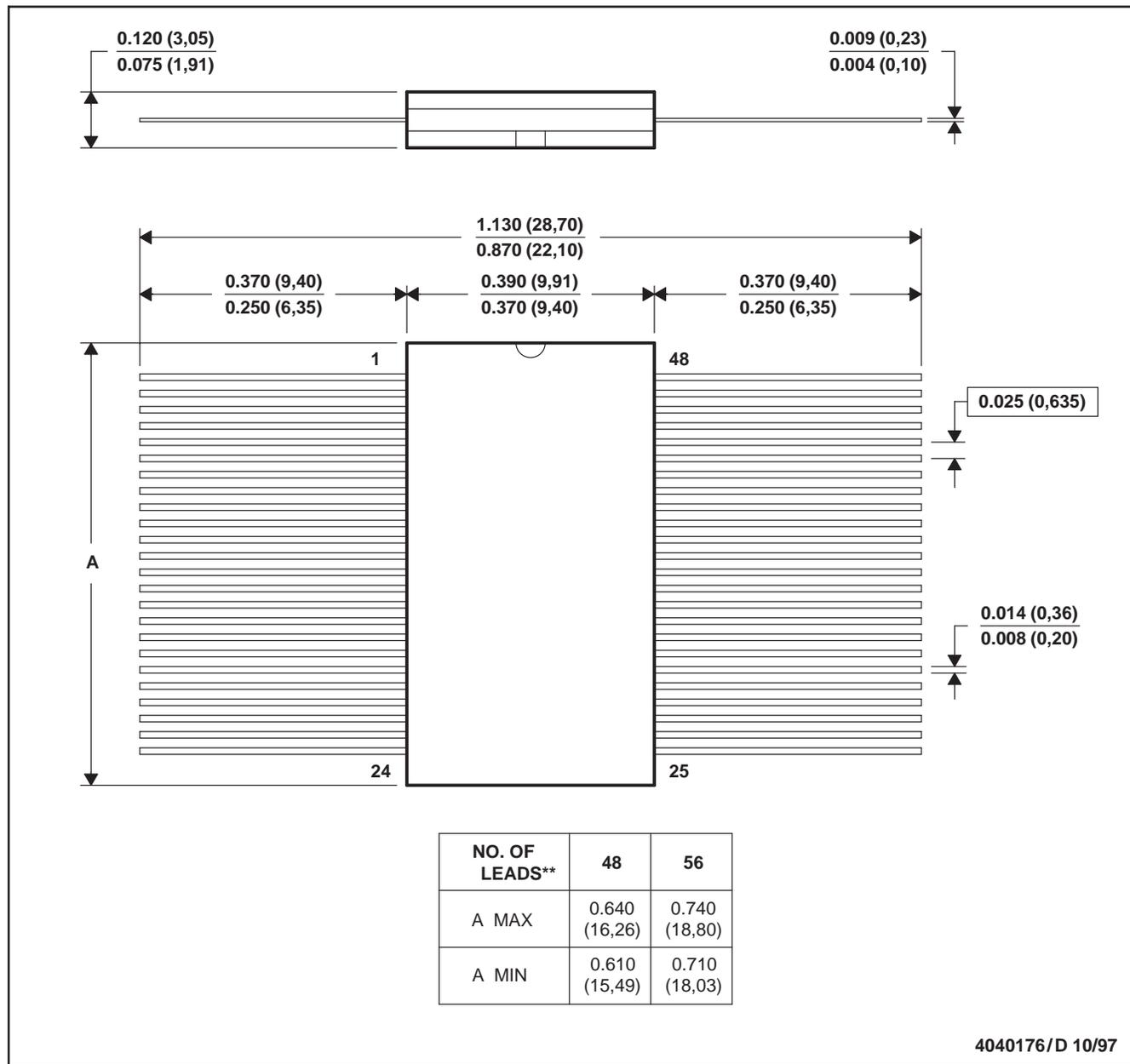
NO. OF LEADS**	48	56
A MAX	0.640 (16,26)	0.740 (18,80)
A MIN	0.610 (15,49)	0.710 (18,03)

4040176 / D 10/97

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

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

48 PINS SHOWN

	PINS **	48	56	64
DIM				
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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