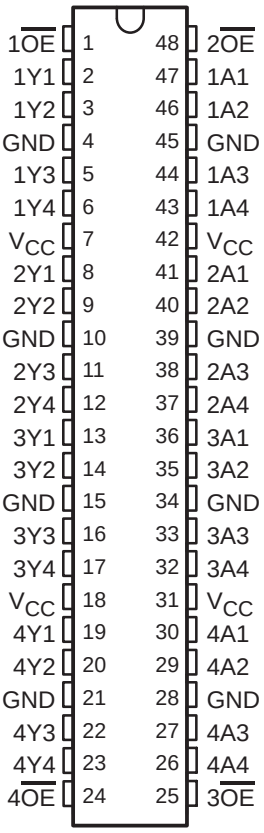
- **Members of the Texas Instruments Widebus ™ Family**
- **Output Ports Have Equivalent 25-Ω Series Resistors, So No External Resistors Are Required**
- **Typical V_{OLP} (Output Ground Bounce) <1 V at V_{CC} = 5 V, T_A = 25°C**
- **High-Impedance State During Power Up and Power Down**
- **I_{off} and 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**

SN54ABT162244 . . . WD PACKAGE
SN74ABT162244 . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)



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.

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.

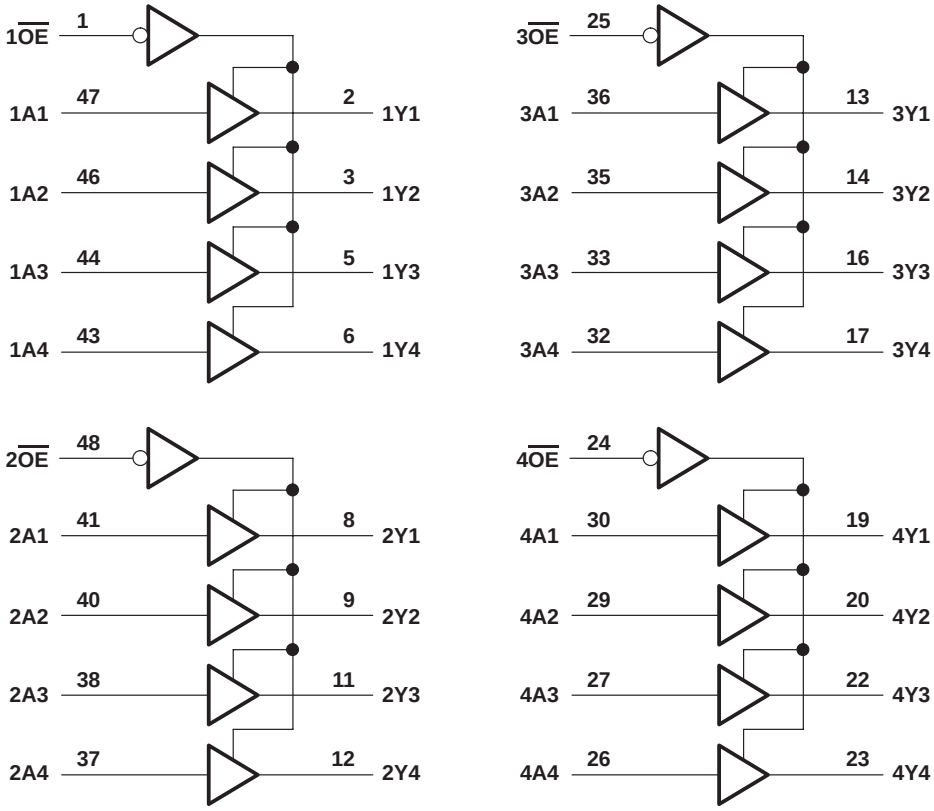
description/ordering information (continued)

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)



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, $\overline{OE}$ ≥ 2 V				10		10		10	µA
I_{OZL}		V_{CC} = 2.1 V to 5.5 V, V_O = 0.5 V, $\overline{OE}$ ≥ 2 V				−10		−10		−10	µA
I_{off}		V_{CC} = 0, V_I or V_O ≤ 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.

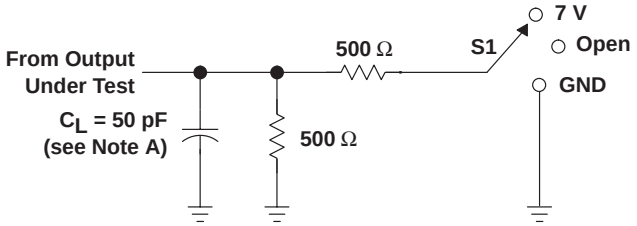
switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 1)

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)

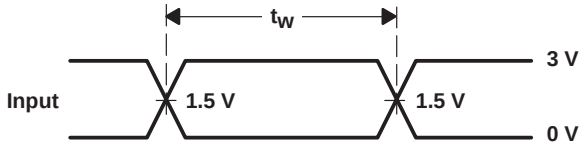
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT162244					UNIT
			V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
t_{PLH}	A	Y	1	2.5	3.2	1	3.9	ns
t_{PHL}			1	3.1	4	1	4.8	
t_{PZH}	$\overline{OE}$	Y	1	3.2	4.2	1	5.4	ns
t_{PZL}			1	3.2	4.1	1	5.1	
t_{PHZ}	$\overline{OE}$	Y	1	3.2	4	1	4.6	ns
t_{PLZ}			1	3.1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

PARAMETER MEASUREMENT INFORMATION

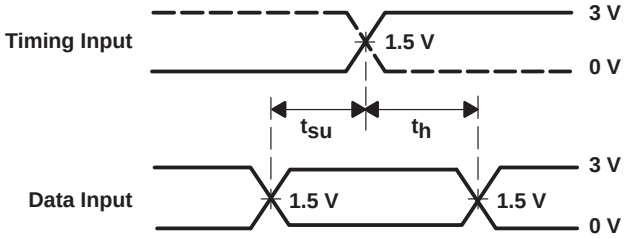


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

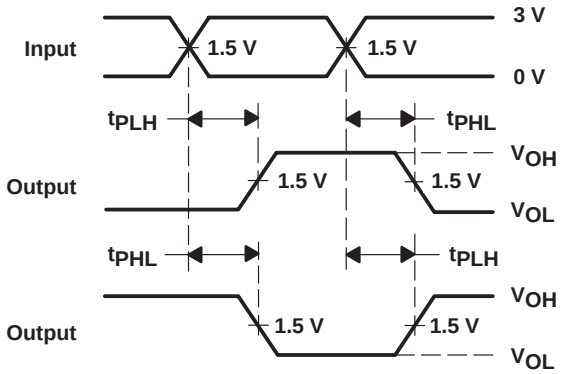
LOAD CIRCUIT



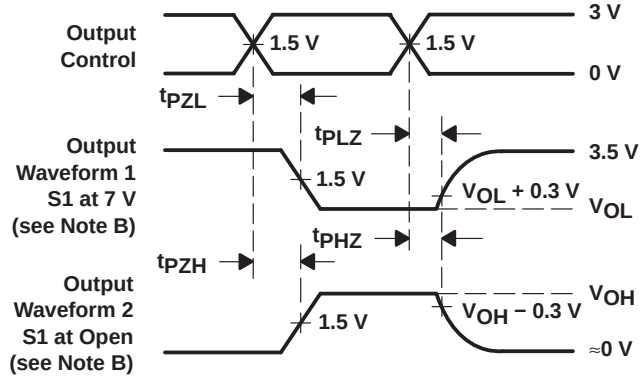
VOLTAGE WAVEFORMS
PULSE DURATION



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

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/ Ball Finish	MSL Peak Temp [3]	Samples (Requires Login)
5962-9458701QXA	ACTIVE	CFP	WD	48	1	TBD	Call TI	Call TI	
74ABT162244DGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74ABT162244DGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74ABT162244DGVRE4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74ABT162244DGVRG4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74ABT162244DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162244DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162244DGVR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162244DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162244DLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162244DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SNJ54ABT162244WD	ACTIVE	CFP	WD	48	1	TBD	A42	N / A for Pkg Type	

[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.

OTHER QUALIFIED VERSIONS OF SN54ABT162244, SN74ABT162244 :

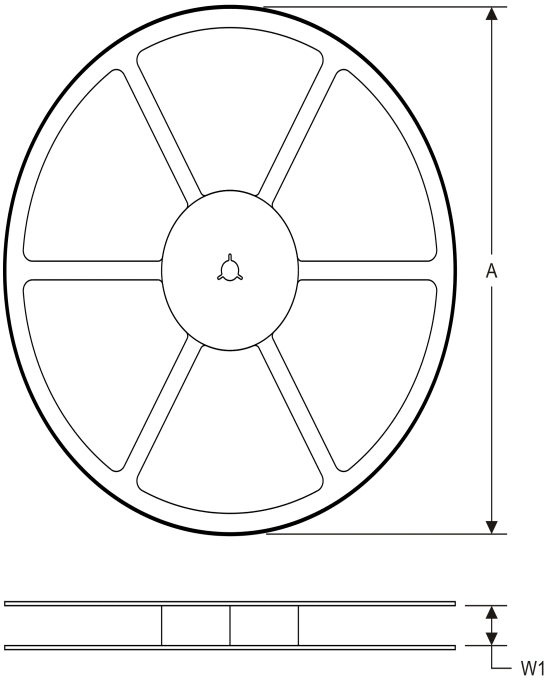
- Catalog: SN74ABT162244
- Military: SN54ABT162244

NOTE: Qualified Version Definitions:

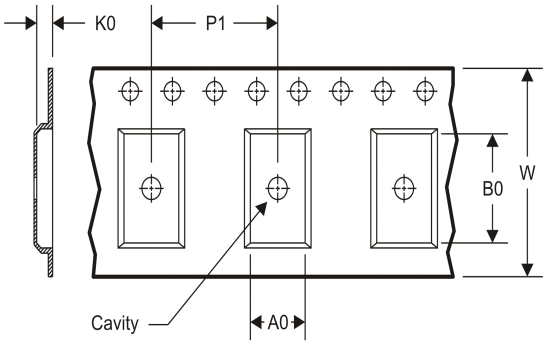
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



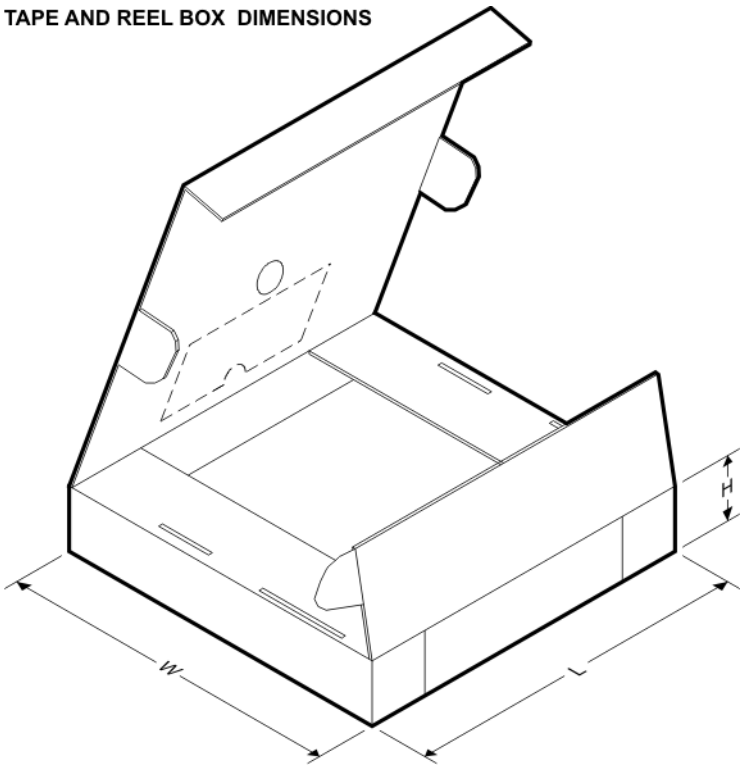
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
SN74ABT162244DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	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

TAPE AND REEL BOX DIMENSIONS

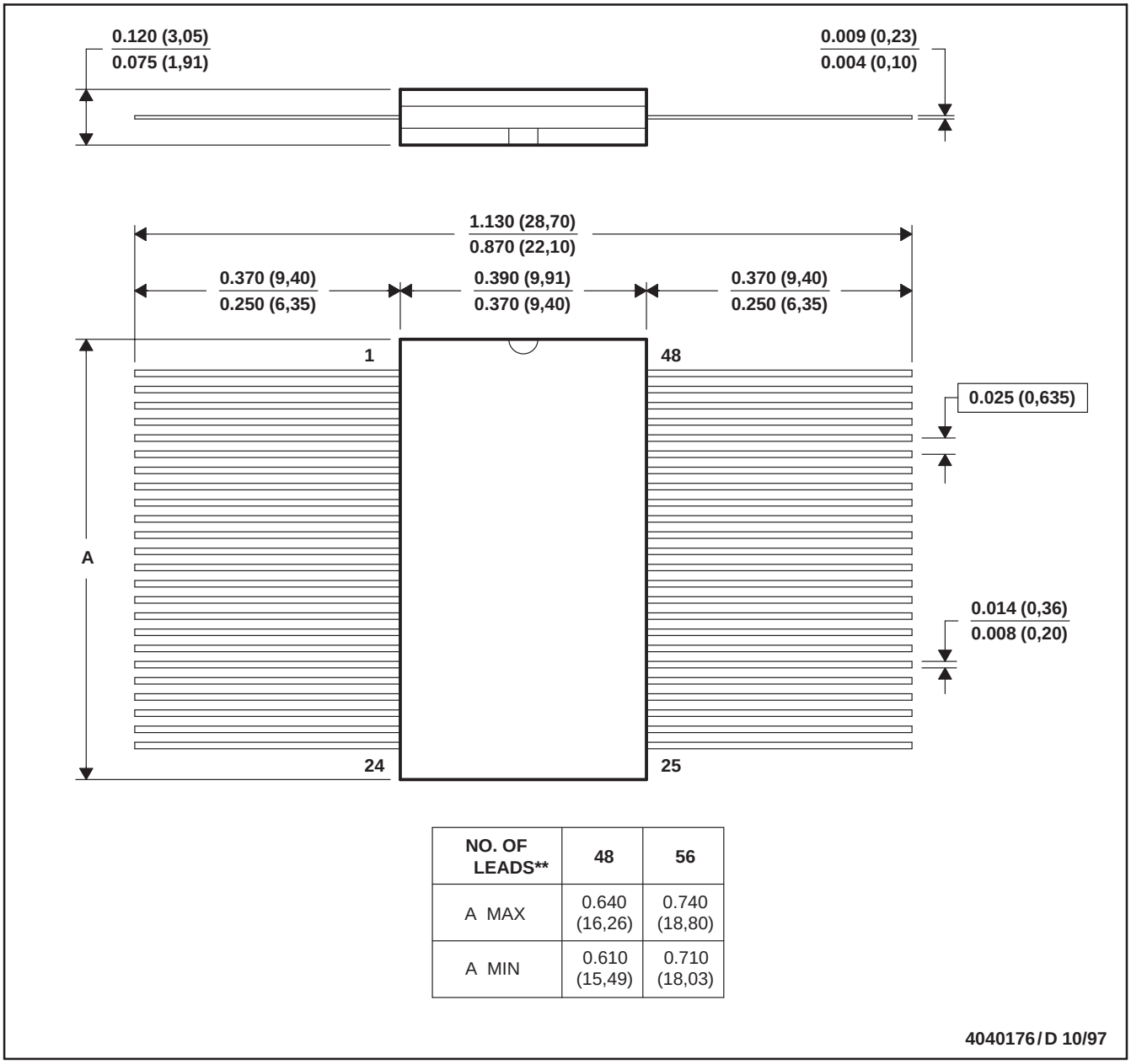


*All dimensions are nominal

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

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

48 LEADS SHOWN



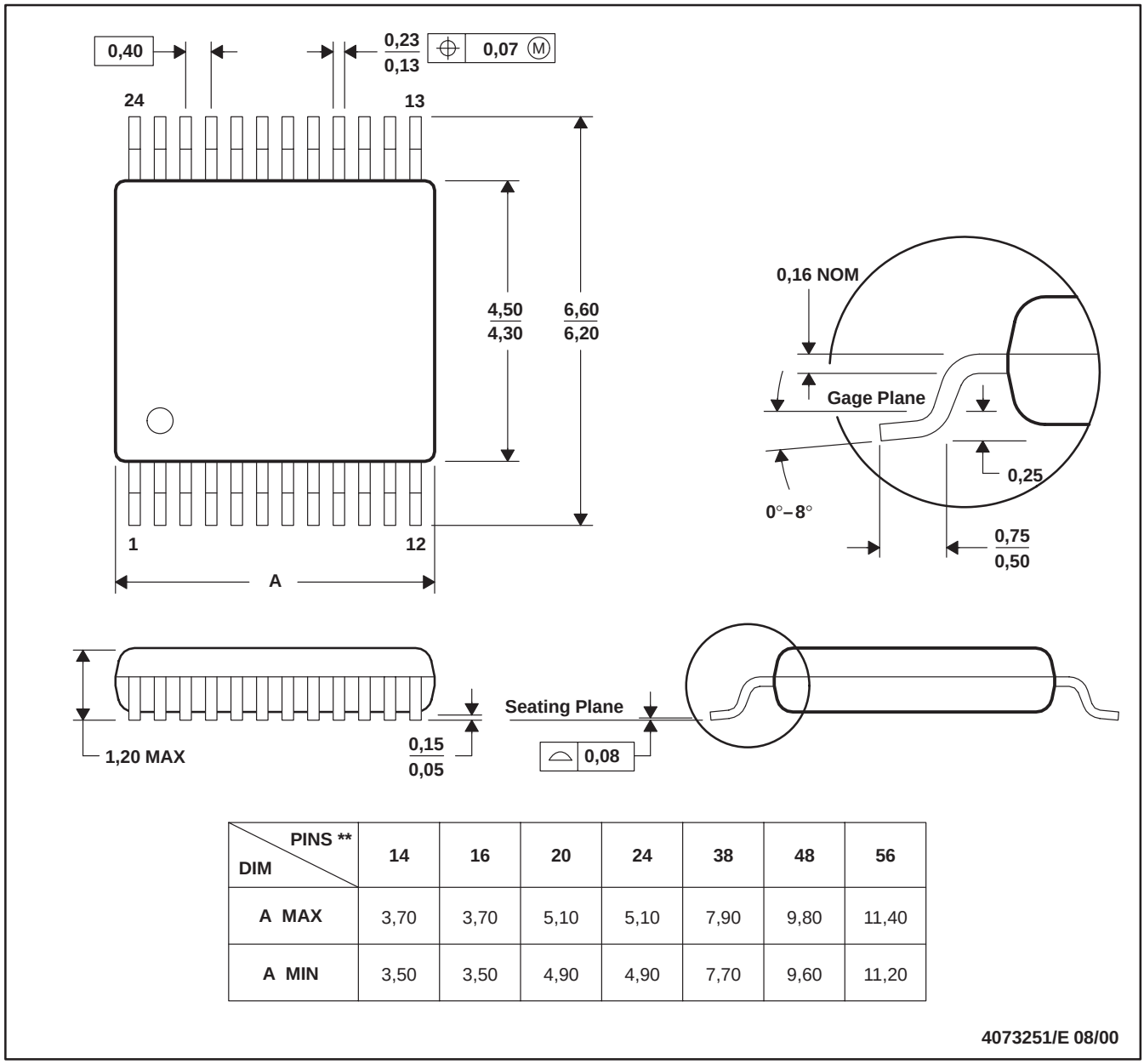
NO. OF LEADS**	48	56
A MAX	0.640 (16,26)	0.740 (18,80)
A MIN	0.610 (15,49)	0.710 (18,03)

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

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

24 PINS SHOWN



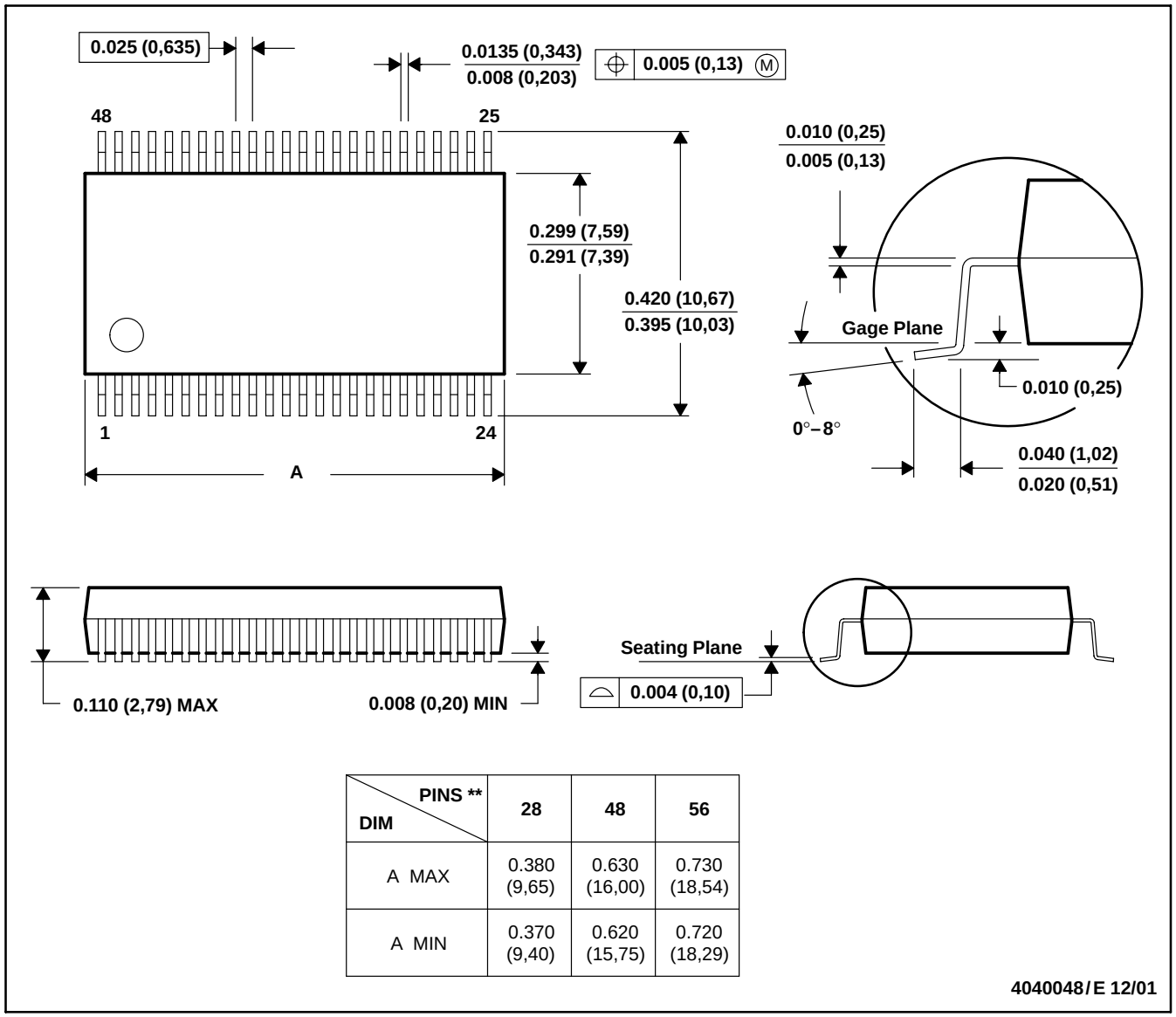
DIM \ PINS **	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

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

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

48 PINS SHOWN



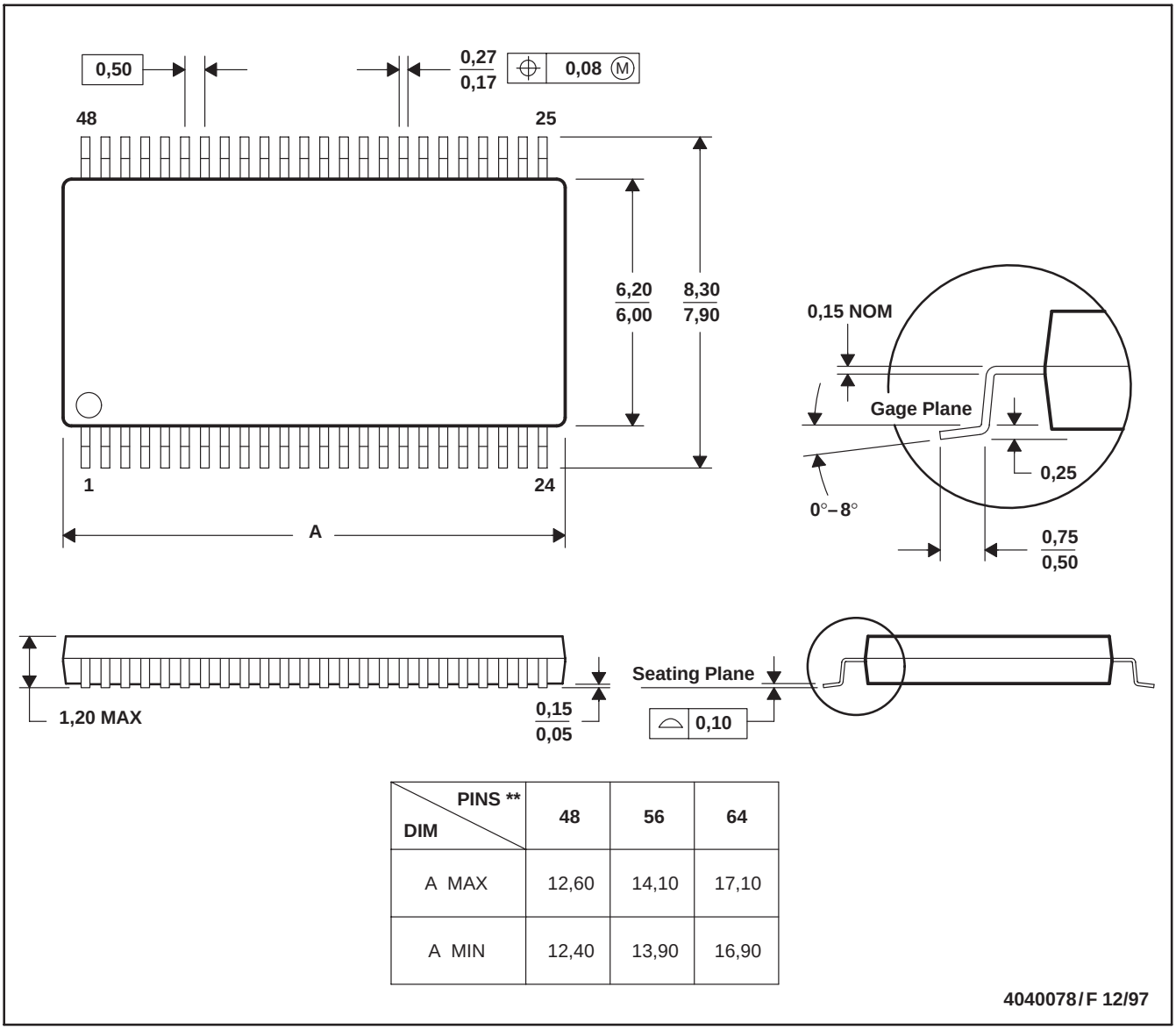
DIM \ PINS **	28	48	56
A MAX	0.380 (9,65)	0.630 (16,00)	0.730 (18,54)
A MIN	0.370 (9,40)	0.620 (15,75)	0.720 (18,29)

4040048/E 12/01

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

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

48 PINS SHOWN



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

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46C and to discontinue any product or service per JESD48B. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Mobile Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265