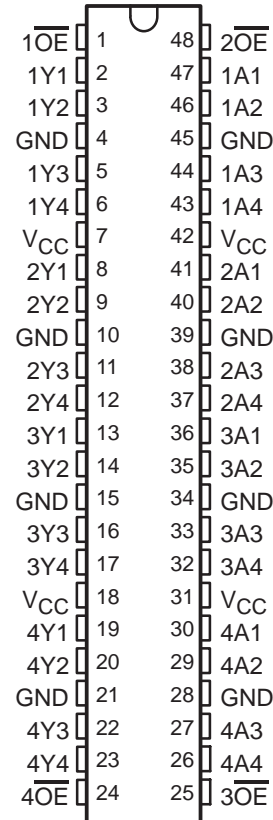


SN54LVTH16244A, SN74LVTH16244A 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS142P – MAY 1992 – REVISED SEPTEMBER 2003

- Members of the Texas Instruments Widebus™ Family
- State-of-the-Art Advanced BiCMOS Technology (ABT) Design for 3.3-V Operation and Low Static-Power Dissipation
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})
- Support Unregulated Battery Operation Down to 2.7 V
- Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- I_{off} and Power-Up 3-State Support Hot Insertion
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 500 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)

SN54LVTH16244A . . . WD PACKAGE
SN74LVTH16244A . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)



description/ordering information

The 'LVTH16244A devices are 16-bit buffers and line drivers designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment. These devices 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.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP – DL	Tube	SN74LVTH16244ADL	LVTH16244A
		Tape and reel	SN74LVTH16244ADLR	
	TSSOP – DGG	Tape and reel	SN74LVTH16244ADGGR	LVTH16244A
	TVSOP – DGV	Tape and reel	SN74LVTH16244ADGVR	LL244A
	VFBGA – GQL	Tape and reel	SN74LVTH16244AGQLR	LL244A
VFBGA – ZQL (Pb-free)	SN74LVTH16244AZQLR			
-55°C to 125°C	CFP – WD	Tube	SNJ54LVTH16244AWD	SNJ54LVTH16244AWD

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



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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SN54LVTH16244A, SN74LVTH16244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

SCBS142P – MAY 1992 – REVISED SEPTEMBER 2003

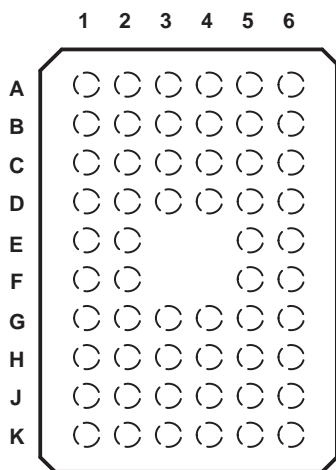
description/ordering information (continued)

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

When V_{CC} is between 0 and 1.5-V, the devices are in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5-V, \overline{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.

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.

GQL OR ZQL PACKAGE
(TOP VIEW)



terminal assignments

	1	2	3	4	5	6
A	$\overline{1OE}$	NC	NC	NC	NC	$\overline{2OE}$
B	1Y2	1Y1	GND	GND	1A1	1A2
C	1Y4	1Y3	V_{CC}	V_{CC}	1A3	1A4
D	2Y2	2Y1	GND	GND	2A1	2A2
E	2Y4	2Y3			2A3	2A4
F	3Y1	3Y2			3A2	3A1
G	3Y3	3Y4	GND	GND	3A4	3A3
H	4Y1	4Y2	V_{CC}	V_{CC}	4A2	4A1
J	4Y3	4Y4	GND	GND	4A4	4A3
K	$\overline{4OE}$	NC	NC	NC	NC	$\overline{3OE}$

NC – No internal connection

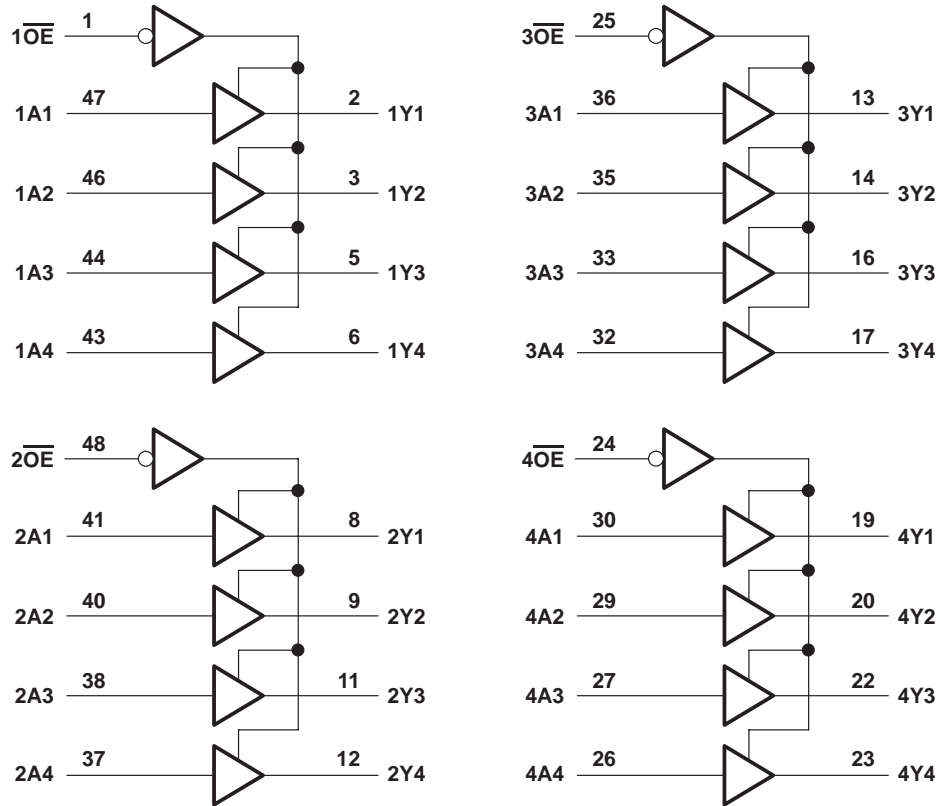
FUNCTION TABLE
(each 4-bit buffer)

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

SN54LVTH16244A, SN74LVTH16244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

SCBS142P – MAY 1992 – REVISED SEPTEMBER 2003

logic diagram (positive logic)



Pin numbers shown are for the DGG, DGV, DL, and WD packages.

SN54LVTH16244A, SN74LVTH16244A

3.3-V ABT 16-BIT BUFFERS/DRIVERS

WITH 3-STATE OUTPUTS

SCBS142P – MAY 1992 – REVISED SEPTEMBER 2003

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

Supply voltage range, V_{CC}	–0.5 V to 4.6 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high state, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Current into any output in the low state, I_O : SN54LVTH16244A	96 mA
SN74LVTH16244A	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVTH16244A	48 mA
SN74LVTH16244A	64 mA
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package	70°C/W
DGV package	58°C/W
DL package	63°C/W
GQL/ZQL package	42°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. This current flows only when the output is in the high state and $V_O > V_{CC}$.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

	SN54LVTH16244A		SN74LVTH16244A		UNIT
	MIN	MAX	MIN	MAX	
V_{CC} Supply voltage	2.7	3.6	2.7	3.6	V
V_{IH} High-level input voltage	2		2		V
V_{IL} Low-level input voltage		0.8		0.8	V
V_I Input voltage		5.5		5.5	V
I_{OH} High-level output current		–24		–32	mA
I_{OL} Low-level output current		48		64	mA
$\Delta t/\Delta v$ Input transition rise or fall rate	Outputs enabled		10	10	ns/V
$\Delta t/\Delta V_{CC}$ Power-up ramp rate	200		200		μ s/V
T_A Operating free-air temperature	–55	125	–40	85	°C

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



SN54LVTH16244A, SN74LVTH16244A 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS142P – MAY 1992 – REVISED SEPTEMBER 2003

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

PARAMETER	TEST CONDITIONS	SN54LVTH16244A		SN74LVTH16244A		UNIT	
		MIN	TYP†	MAX	MIN		TYP†
V_{IK}	$V_{CC} = 2.7\text{ V}$, $I_I = -18\text{ mA}$			-1.2			V
V_{OH}	$V_{CC} = 2.7\text{ V to }3.6\text{ V}$, $I_{OH} = -100\text{ }\mu\text{A}$	$V_{CC}-0.2$		$V_{CC}-0.2$		V	
	$V_{CC} = 2.7\text{ V}$, $I_{OH} = -8\text{ mA}$	2.4		2.4			
	$V_{CC} = 3\text{ V}$	2		2			
V_{OL}	$V_{CC} = 2.7\text{ V}$	$I_{OL} = 100\text{ }\mu\text{A}$		0.2		V	
		$I_{OL} = 24\text{ mA}$		0.5			
	$V_{CC} = 3\text{ V}$	$I_{OL} = 16\text{ mA}$		0.4			
		$I_{OL} = 32\text{ mA}$		0.5			
		$I_{OL} = 48\text{ mA}$		0.55			
		$I_{OL} = 64\text{ mA}$		0.55			
I_I	$V_{CC} = 0\text{ or }3.6\text{ V}$, $V_I = 5.5\text{ V}$	50		10		μA	
	Control inputs $V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}\text{ or GND}$	± 1		± 1			
	Data inputs $V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$		1			
		$V_I = 0$		-5			
I_{off}	$V_{CC} = 0$, $V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$			± 100		μA	
$I_{I(\text{hold})}$	Data inputs $V_{CC} = 3\text{ V}$	$V_I = 0.8\text{ V}$		75		μA	
		$V_I = 2\text{ V}$		-75			
	$V_{CC} = 3.6\text{ V}\ddagger$, $V_I = 0\text{ to }3.6\text{ V}$			500 -750			
I_{OZH}	$V_{CC} = 3.6\text{ V}$, $V_O = 3\text{ V}$	5		5		μA	
I_{OZL}	$V_{CC} = 3.6\text{ V}$, $V_O = 0.5\text{ V}$	-5		-5		μA	
I_{OZPU}	$V_{CC} = 0\text{ to }1.5\text{ V}$, $V_O = 0.5\text{ V to }3\text{ V}$, $OE = \text{don't care}$	$\pm 100^*$		± 100		μA	
I_{OZPD}	$V_{CC} = 1.5\text{ V to }0$, $V_O = 0.5\text{ V to }3\text{ V}$, $OE = \text{don't care}$	$\pm 100^*$		± 100		μA	
I_{CC}	$V_{CC} = 3.6\text{ V}$, $I_O = 0$, $V_I = V_{CC}\text{ or GND}$	Outputs high		0.19		mA	
		Outputs low		5			
		Outputs disabled		0.19			
$\Delta I_{CC}\S$	$V_{CC} = 3\text{ V to }3.6\text{ V}$, One input at $V_{CC} - 0.6\text{ V}$, Other inputs at $V_{CC}\text{ or GND}$	0.2		0.2		mA	
C_i	$V_I = 3\text{ V or }0$	4		4		pF	
C_o	$V_O = 3\text{ V or }0$	9		9		pF	

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

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

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

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



SN54LVTH16244A, SN74LVTH16244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

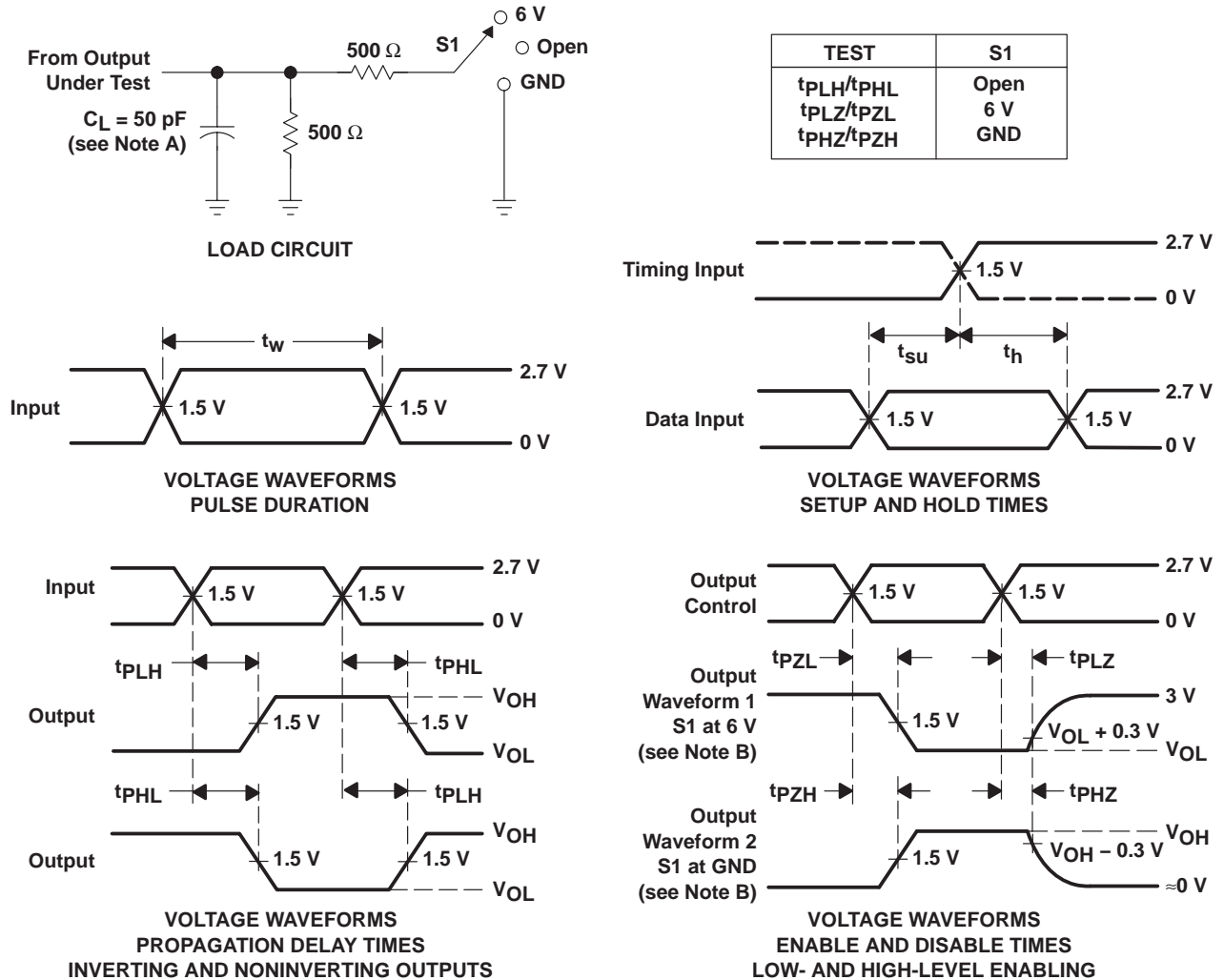
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switching characteristics over recommended operating free-air temperature range, $C_L = 50 \text{ pF}$
(unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH16244A				SN74LVTH16244A				UNIT	
			$V_{CC} = 3.3 \text{ V}$ $\pm 0.3 \text{ V}$		$V_{CC} = 2.7 \text{ V}$		$V_{CC} = 3.3 \text{ V}$ $\pm 0.3 \text{ V}$			$V_{CC} = 2.7 \text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
t_{PLH}	A	Y	1.1	4.4	4.6		1.2	2.3	3.2	3.7		ns
t_{PHL}			1.1	3.6	3.9		1.2	2	3.2	3.7		
t_{PZH}	\overline{OE}	Y	1.1	4.6	5.4		1.2	2.6	4	5		ns
t_{PZL}			1.1	5.4	6.2		1.2	2.7	4	5		
t_{PHZ}	\overline{OE}	Y	1.6	5.7	6.2		2.2	3.3	4.5	5		ns
t_{PLZ}			1.2	5	4.7		2	3.1	4.2	4.4		
$t_{sk(o)}$								0.5			ns	

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

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. C_L includes probe and jig capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 D. The outputs are measured one at a time with one transition per measurement.

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⁾
5962-9668501QXA	ACTIVE	CFP	WD	48	1	None	Call TI	Level-NC-NC-NC
5962-9668501VXA	ACTIVE	CFP	WD	48	1	None	Call TI	Level-NC-NC-NC
SN74LVTH16244ADGGR	ACTIVE	TSSOP	DGG	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVTH16244ADGVR	ACTIVE	TVSOP	DGV	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVTH16244ADL	ACTIVE	SSOP	DL	48	25	None	CU NIPDAU	Level-1-235C-UNLIM
SN74LVTH16244ADLR	ACTIVE	SSOP	DL	48	1000	None	CU NIPDAU	Level-1-235C-UNLIM
SN74LVTH16244AGQLR	ACTIVE	VFBGA	GQL	56	1000	None	SNPB	Level-1-240C-UNLIM
SN74LVTH16244AZQLR	ACTIVE	VFBGA	ZQL	56	1000	Pb-Free (RoHS)	SNAGCU	Level-1-260C-UNLIM
SNJ54LVTH16244AWD	ACTIVE	CFP	WD	48	1	None	Call TI	Level-NC-NC-NC

⁽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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

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

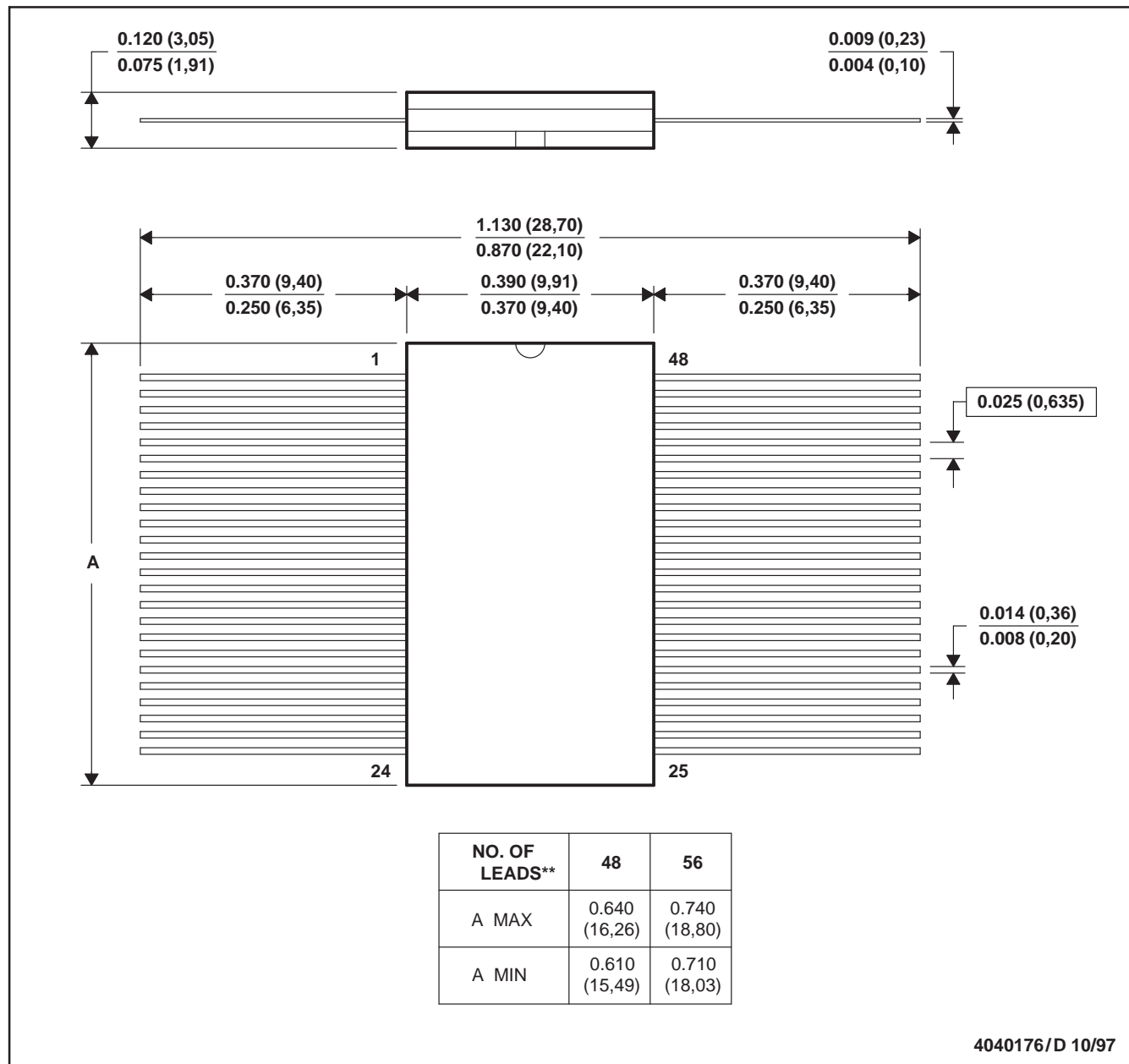
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WD (R-GDFP-F**)

CERAMIC DUAL FLATPACK

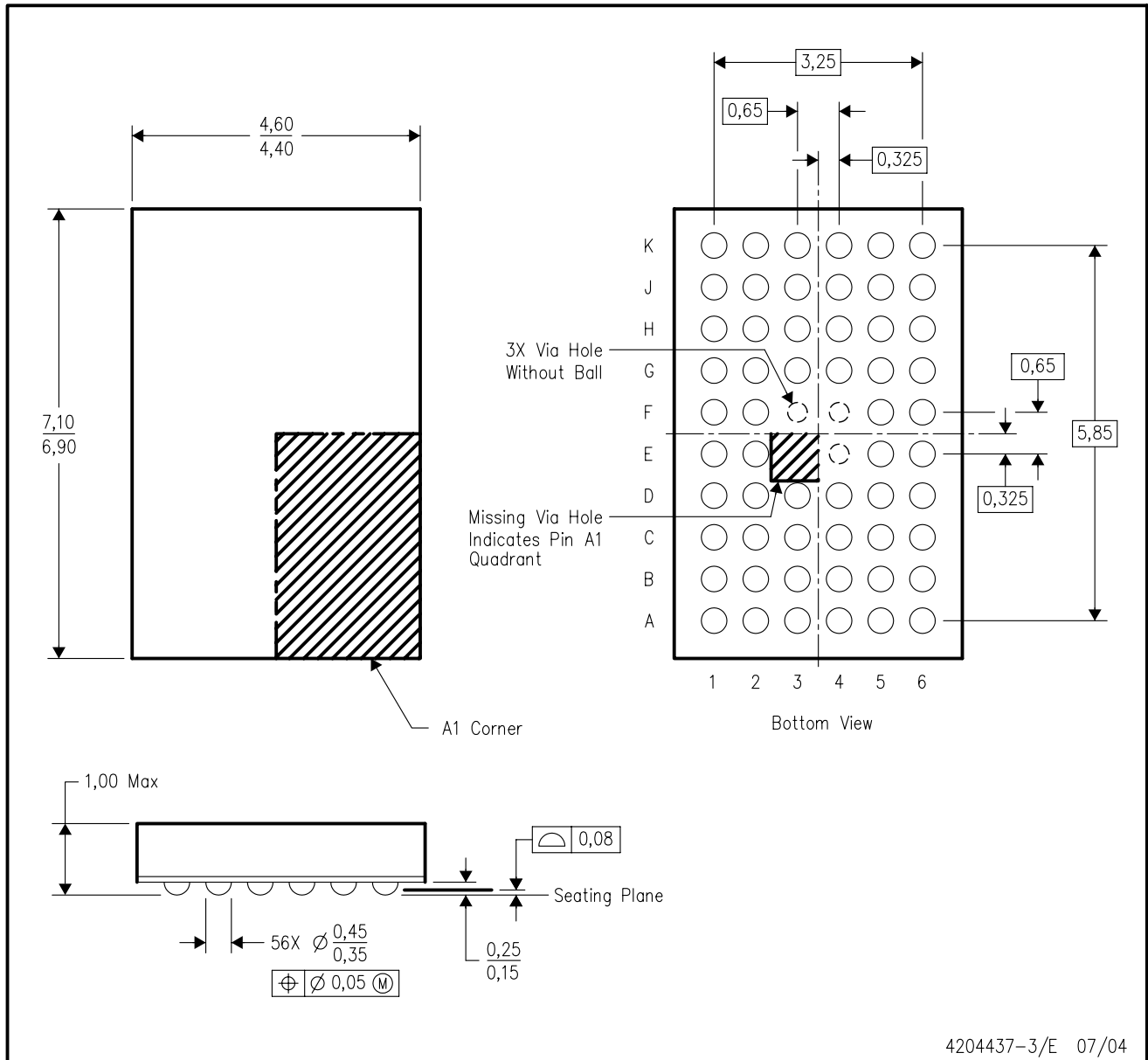
48 LEADS SHOWN



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

ZQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-225 variation BA.
 - D. This package is lead-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

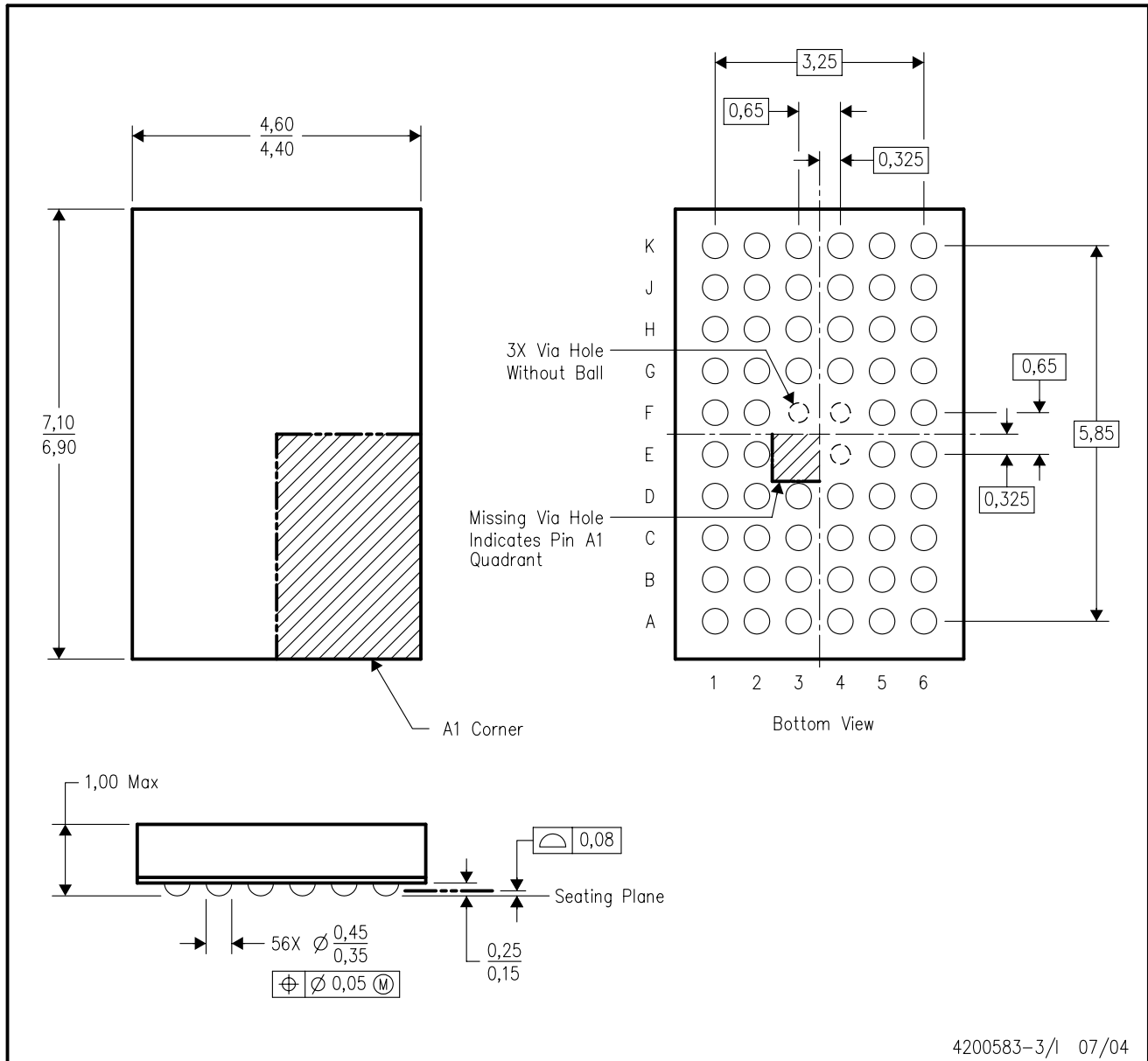
24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold 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

GQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-225 variation BA.
 - D. This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

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

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



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

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