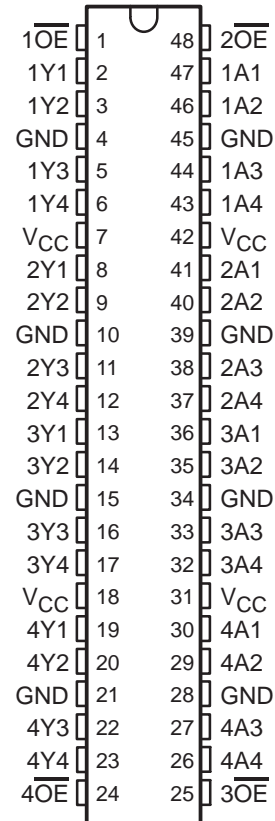


SN54LVT16244B, SN74LVT16244B 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

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- 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
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

SN54LVT16244B . . . WD PACKAGE
SN74LVT16244B . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)



description/ordering information

The 'LVT16244B 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	SN74LVT16244BDL	LVT16244B
		Tape and reel	SN74LVT16244BDLR	
	TSSOP – DGG	Tape and reel	SN74LVT16244BDGGR	LVT16244B
	TVSOP – DGV	Tape and reel	SN74LVT16244BDGVR	VD244B
	VFBGA – GQL	Tape and reel	SN74LVT16244BGQLR	VD244B
VFBGA – ZQL (Pb-free)	SN74LVT16244BZQLR			
-55°C to 125°C	CFP – WD	Tube	SNJ54LVT16244BWD	SNJ54LVT16244BWD

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



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SN54LVT16244B, SN74LVT16244B

3.3-V ABT 16-BIT BUFFERS/DRIVERS

WITH 3-STATE OUTPUTS

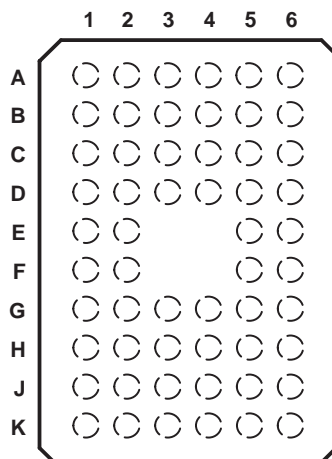
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description/ordering information (continued)

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

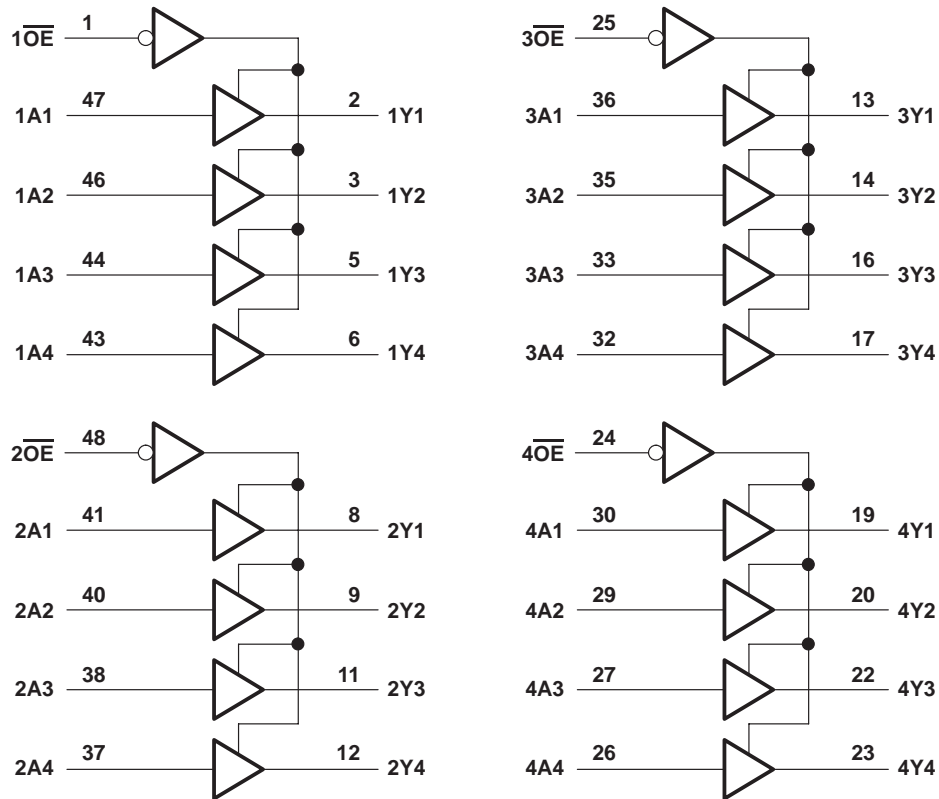
FUNCTION TABLE
(each 4-bit buffer)

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

SN54LVT16244B, SN74LVT16244B
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logic diagram (positive logic)



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

SN54LVT16244B, SN74LVT16244B

3.3-V ABT 16-BIT BUFFERS/DRIVERS

WITH 3-STATE OUTPUTS

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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 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 : SN54LVT16244B	96 mA
SN74LVT16244B	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVT16244B	48 mA
SN74LVT16244B	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)

		SN54LVT16244B		SN74LVT16244B		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	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 inputs of the device must 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.

SN54LVT16244B, SN74LVT16244B 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

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

PARAMETER	TEST CONDITIONS	SN54LVT16244B			SN74LVT16244B			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}	$V_{CC} = 2.7\text{ V}$, $I_I = -18\text{ mA}$			-1.2			-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	0.2		V	
		$I_{OL} = 24\text{ mA}$		0.5	0.5			
	$V_{CC} = 3\text{ V}$	$I_{OL} = 16\text{ mA}$		0.4	0.4			
		$I_{OL} = 32\text{ mA}$		0.5	0.5			
		$I_{OL} = 48\text{ mA}$		0.55	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	1			
		$V_I = 0$		-5	-5			
I_{off}	$V_{CC} = 0$, V_I or $V_O = 0\text{ to }4.5\text{ V}$					± 100		μA
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	0.19		mA	
		Outputs low		5	5			
		Outputs disabled		0.19	0.19			
ΔI_{CC}^\ddagger	$V_{CC} = 3\text{ V to }3.6\text{ V}$, 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 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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3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

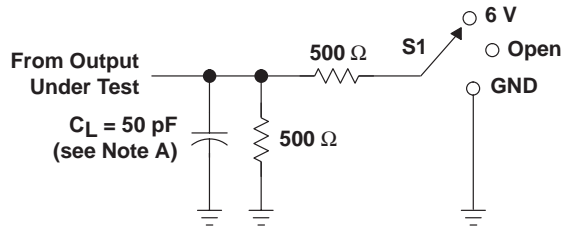
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switching characteristics over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT16244B				SN74LVT16244B				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	

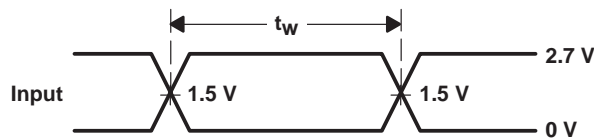
† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION

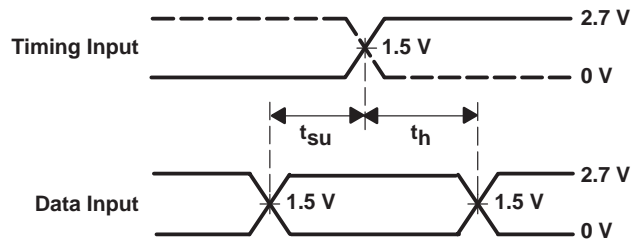


LOAD CIRCUIT

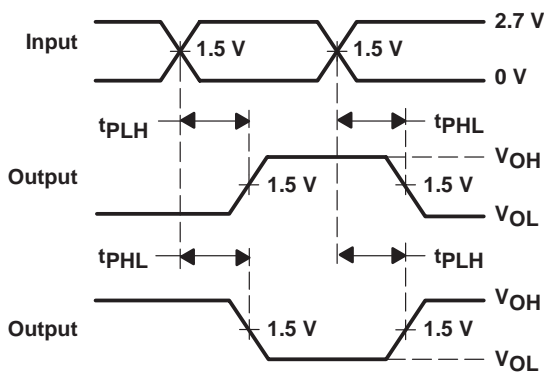
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



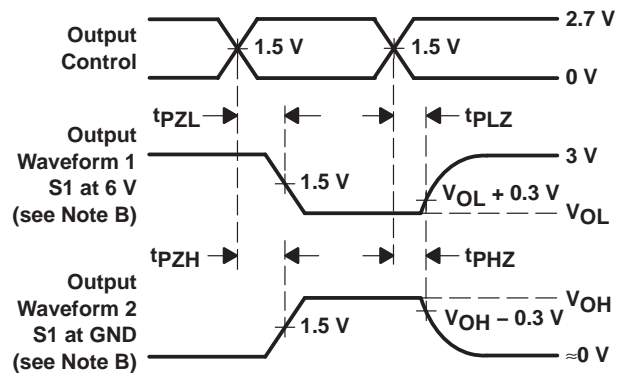
VOLTAGE WAVEFORMS
PULSE DURATION



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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
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⁾
SN74LVT16244BDGGR	ACTIVE	TSSOP	DGG	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVT16244BDGVR	ACTIVE	TVSOP	DGV	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVT16244BDL	ACTIVE	SSOP	DL	48	25	None	CU NIPDAU	Level-1-235C-UNLIM
SN74LVT16244BDLR	ACTIVE	SSOP	DL	48	1000	None	CU NIPDAU	Level-1-235C-UNLIM
SN74LVT16244BGQLR	ACTIVE	VFBGA	GQL	56	1000	None	SNPB	Level-1-240C-UNLIM
SN74LVT16244BZQLR	ACTIVE	VFBGA	ZQL	56	1000	Pb-Free (RoHS)	SNAGCU	Level-1-260C-UNLIM

⁽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.

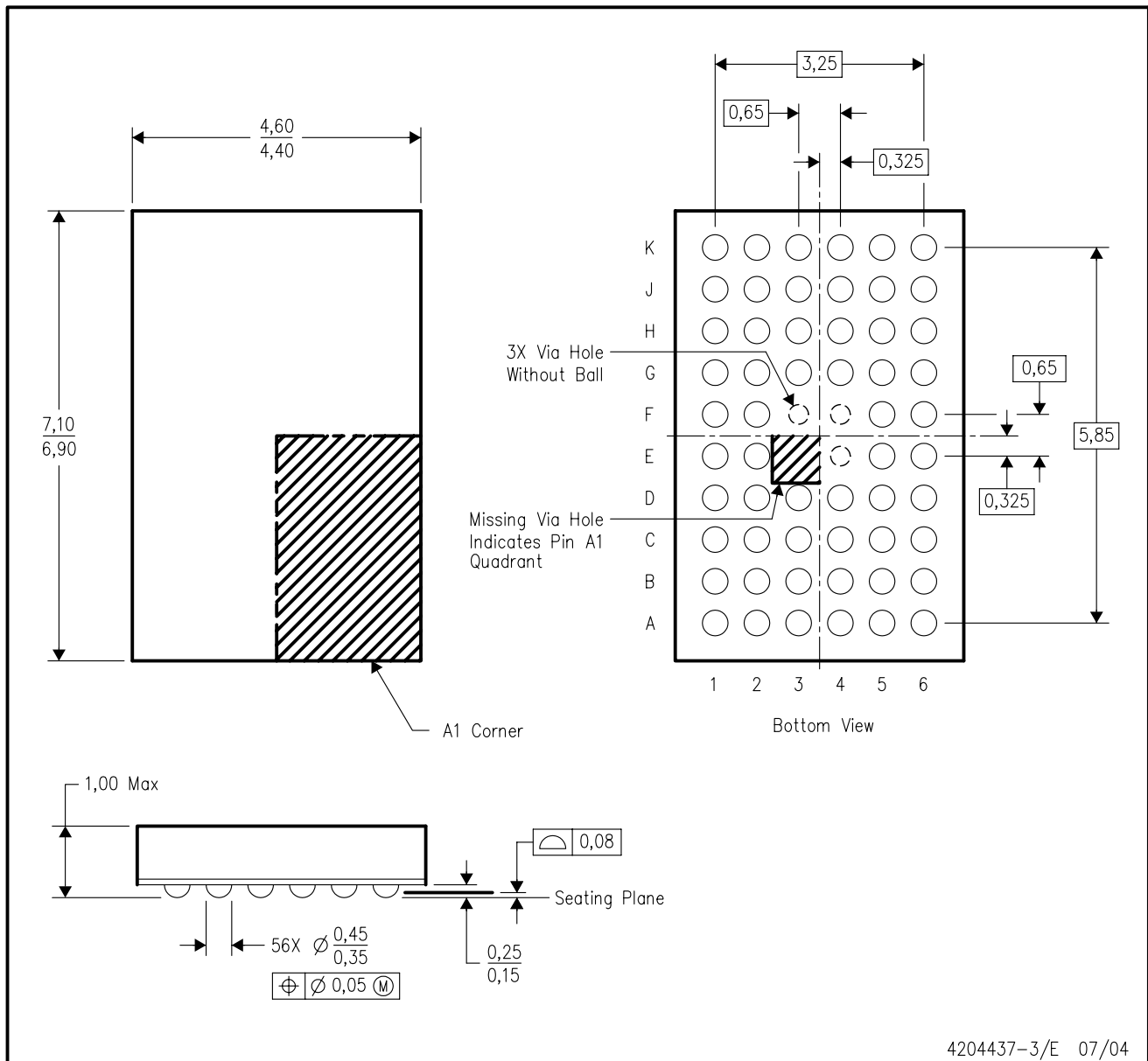
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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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

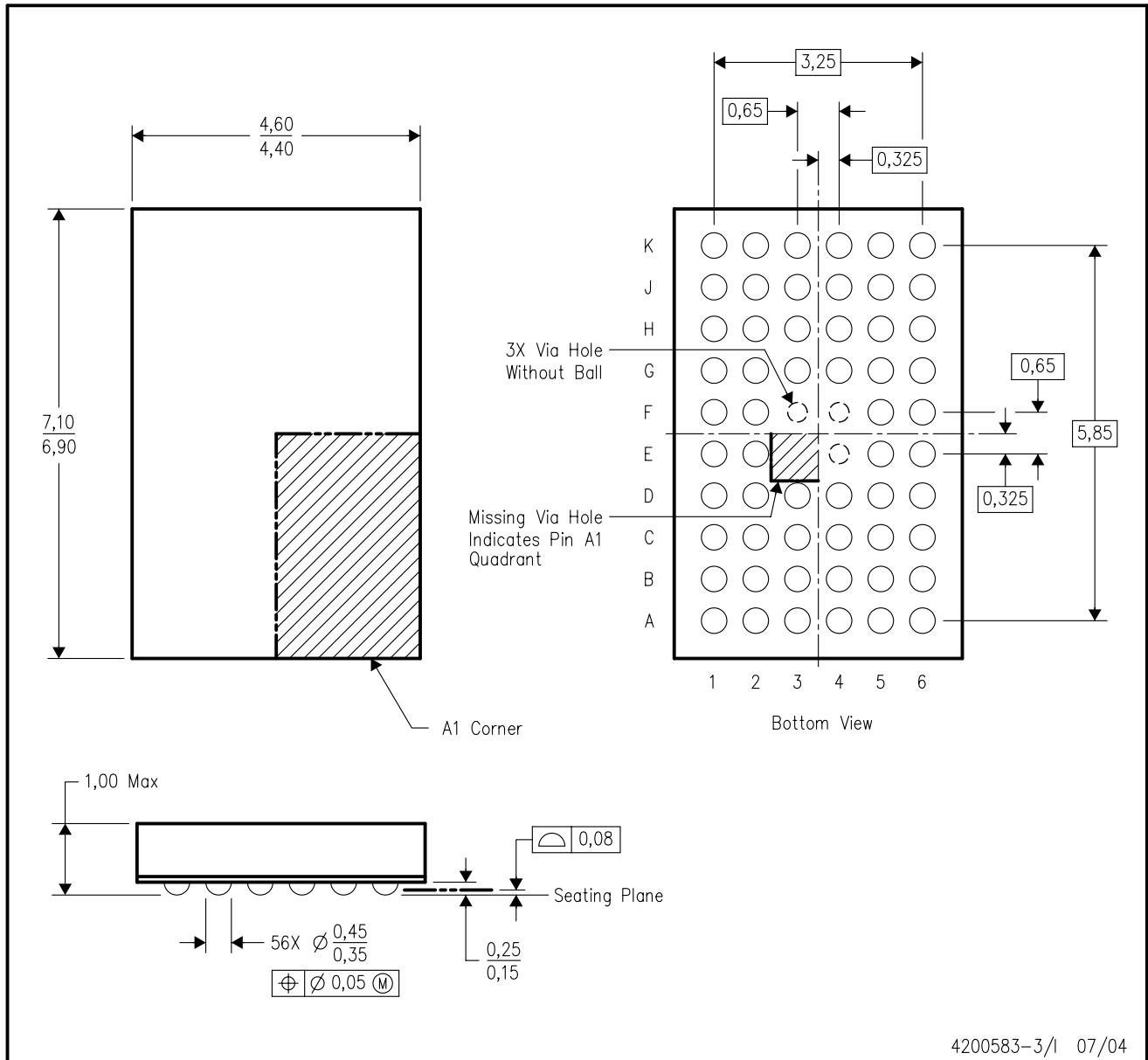
24 PINS SHOWN



- 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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