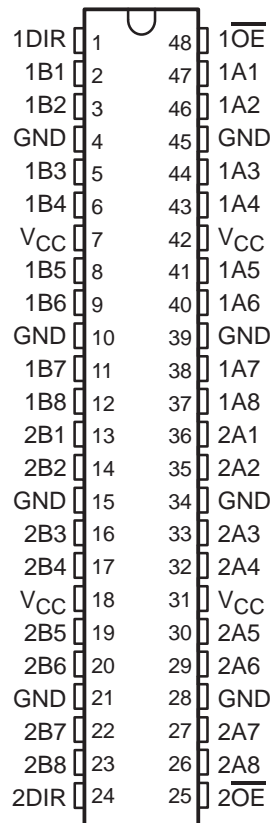


# SN54LVT16245B, SN74LVT16245B 3.3-V ABT 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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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
- Distributed  $V_{CC}$  and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- 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)

SN54LVT16245B . . . WD PACKAGE  
SN74LVT16245B . . . DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



## description/ordering information

The 'LVT16245B devices are 16-bit (dual-octal) noninverting 3-state transceivers 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.

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP – DL	Tube	SN74LVT16245BDL	LVT16245B
		Tape and reel	SN74LVT16245BDLR	
	TSSOP – DGG	Tape and reel	SN74LVT16245BDGGR	LVT16245B
	TVSOP – DGV	Tape and reel	SN74LVT16245BDGVR	VD245B
	VFBGA – GQL	Tape and reel	SN74LVT16245BGQLR	VD245B
SN74LVT16245BZQLR				
-55°C to 125°C	CFP – WD	Tube	SNJ54LVT16245BWD	SNJ54LVT16245BWD

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



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# SN54LVT16245B, SN74LVT16245B

## 3.3-V ABT 16-BIT BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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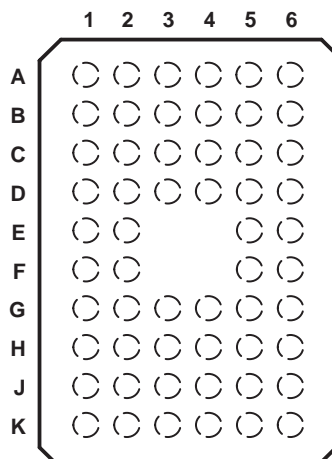
#### description/ordering information (continued)

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. They allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the devices so that the buses are effectively isolated.

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	1DIR	NC	NC	NC	NC	1 $\overline{OE}$
B	1B2	1B1	GND	GND	1A1	1A2
C	1B4	1B3	$V_{CC}$	$V_{CC}$	1A3	1A4
D	1B6	1B5	GND	GND	1A5	1A6
E	1B8	1B7			1A7	1A8
F	2B1	2B2			2A2	2A1
G	2B3	2B4	GND	GND	2A4	2A3
H	2B5	2B6	$V_{CC}$	$V_{CC}$	2A6	2A5
J	2B7	2B8	GND	GND	2A8	2A7
K	2DIR	NC	NC	NC	NC	2 $\overline{OE}$

NC – No internal connection

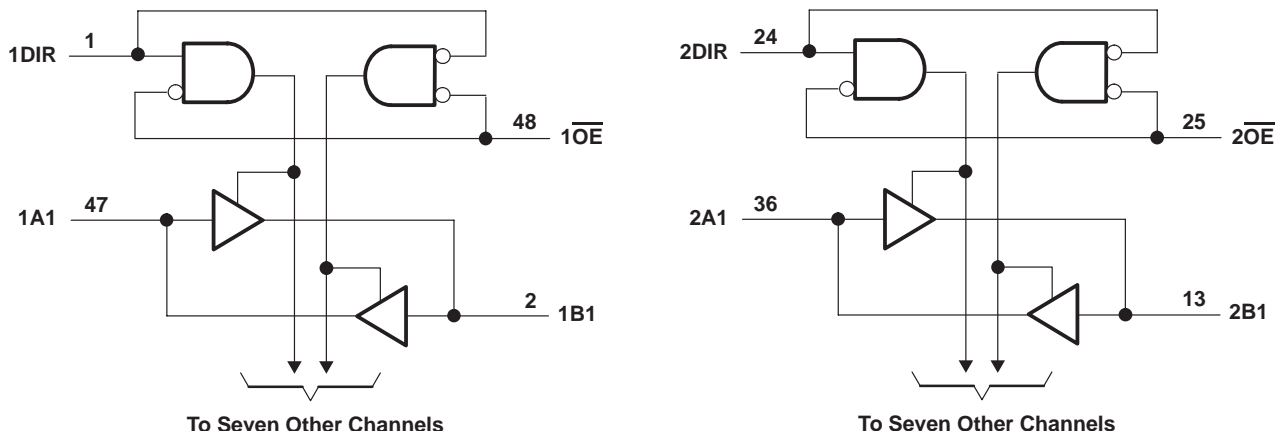
**FUNCTION TABLE  
(each 8-bit section)**

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

# SN54LVT16245B, SN74LVT16245B 3.3-V ABT 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## logic diagram (positive logic)



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

## 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, $I_O$ : SN54LVT16245B .....	96 mA
SN74LVT16245B .....	128 mA
Current into any output in the high state, $I_O$ (see Note 2): SN54LVT16245B .....	48 mA
SN74LVT16245B .....	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, $\theta_{JA}$ (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.



# SN54LVT16245B, SN74LVT16245B

## 3.3-V ABT 16-BIT BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

SCBS715C – FEBRUARY 2000 – REVISED SEPTEMBER 2003

#### recommended operating conditions (see Note 4)

		SN54LVT16245B		SN74LVT16245B		UNIT
		MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage	2.7	3.6	2.7	3.6	V
V <sub>IH</sub>	High-level input voltage	2		2		V
V <sub>IL</sub>	Low-level input voltage		0.8		0.8	V
V <sub>I</sub>	Input voltage		5.5		5.5	V
I <sub>OH</sub>	High-level output current		-24		-32	mA
I <sub>OL</sub>	Low-level output current		48		64	mA
Δt/Δv	Input transition rise or fall rate	Outputs enabled		10	10	ns/V
Δt/ΔV <sub>CC</sub>	Power-up ramp rate	200		200		μs/V
T <sub>A</sub>	Operating free-air temperature	-55	125	-40	85	°C

NOTE 4: All unused inputs of the device must at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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# SN54LVT16245B, SN74LVT16245B 3.3-V ABT 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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

PARAMETER		TEST CONDITIONS		SN54LVT16245B			SN74LVT16245B			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	
$I_I$		Control inputs $V_{CC} = 3.6\text{ V}$ , $V_I = V_{CC}\text{ or GND}$ $V_{CC} = 0\text{ or }3.6\text{ V}$ , $V_I = 5.5\text{ V}$		$\pm 1$			$\pm 1$			$\mu\text{A}$
				A or B ports‡ $V_{CC} = 3.6\text{ V}$		10			10	
		$V_I = 5.5\text{ V}$				20			20	
		$V_I = V_{CC}$		5			1			
		$V_I = 0$		-5			-5			
$I_{off}$		$V_{CC} = 0$ , $V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$					$\pm 100$			$\mu\text{A}$
$I_{OZPU}$		$V_{CC} = 0\text{ to }1.5\text{ V}$ , $V_O = 0.5\text{ V to }3\text{ V}$ , $OE = \text{don't care}$		$\pm 100^*$			$\pm 100$			$\mu\text{A}$
$I_{OZPD}$		$V_{CC} = 1.5\text{ V to }0$ , $V_O = 0.5\text{ V to }3\text{ V}$ , $OE = \text{don't care}$		$\pm 100^*$			$\pm 100$			$\mu\text{A}$
$I_{CC}$		$V_{CC} = 3.6\text{ V}$ , $I_O = 0$ , $V_I = V_{CC}\text{ or GND}$		Outputs high		0.19			0.19	mA
				Outputs low		5			5	
				Outputs disabled		0.19			0.19	
$\Delta I_{CC}^{\S}$		$V_{CC} = 3\text{ V to }3.6$ , 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
$C_{io}$		$V_O = 3\text{ V or }0$		10			10			pF

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

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

‡ Unused pins at  $V_{CC}$  or GND.

§ 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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**SN54LVT16245B, SN74LVT16245B**  
**3.3-V ABT 16-BIT BUS TRANSCEIVERS**  
**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)	SN54LVT16245B				SN74LVT16245B				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 or B	B or A	0.5	4.5		4.6	1.5	2.3	3.3		3.7	ns
$t_{PHL}$			0.5	4.4		3.9	1.3	2.1	3.3		3.5	
$t_{PZH}$	$\overline{OE}$	A or B	0.5	6.5		6.6	1.5	2.8	4.5		5.3	ns
$t_{PZL}$			0.5	5.4		6.2	1.6	2.9	4.6		5.2	
$t_{PHZ}$	$\overline{OE}$	A or B	1	6.8		7	2.3	3.7	5.1		5.5	ns
$t_{PLZ}$			1	6.2		6.3	2.2	3.5	5.1		5.4	
$t_{sk(o)}$								0.5			ns	

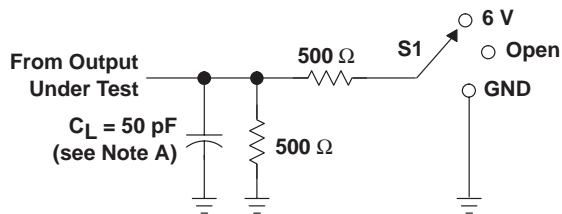
† All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

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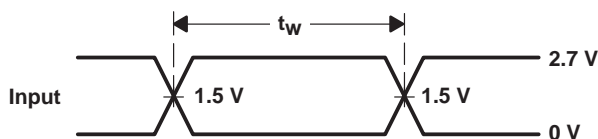
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PARAMETER MEASUREMENT INFORMATION

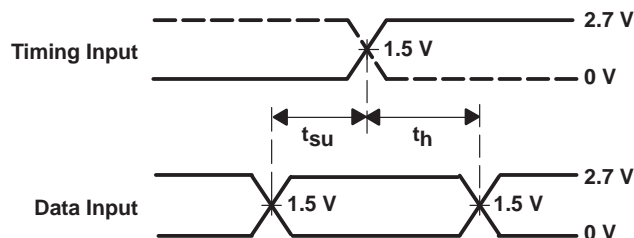


LOAD CIRCUIT

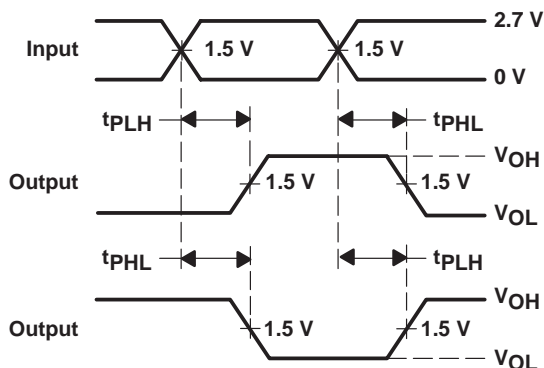
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND



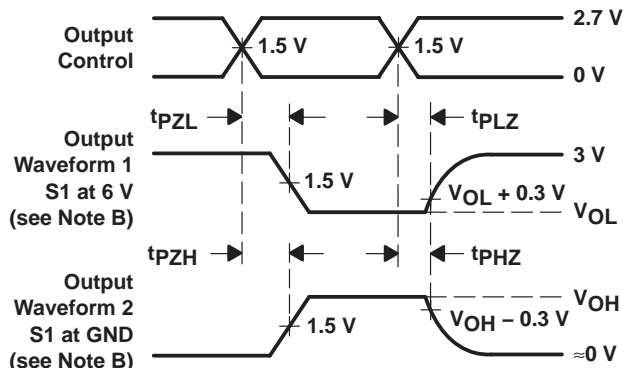
VOLTAGE WAVEFORMS  
PULSE DURATION



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:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  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 <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74LVT16245BDGGR	ACTIVE	TSSOP	DGG	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVT16245BDGVR	ACTIVE	TVSOP	DGV	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVT16245BDL	ACTIVE	SSOP	DL	48	25	None	CU NIPDAU	Level-1-235C-UNLIM
SN74LVT16245BDLR	ACTIVE	SSOP	DL	48	1000	None	CU NIPDAU	Level-1-235C-UNLIM
SN74LVT16245BGQLR	ACTIVE	VFBGA	GQL	56	1000	None	SNPB	Level-1-240C-UNLIM
SN74LVT16245BZQLR	ACTIVE	VFBGA	ZQL	56	1000	Pb-Free (RoHS)	SNAGCU	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.

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

<sup>(2)</sup> 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.

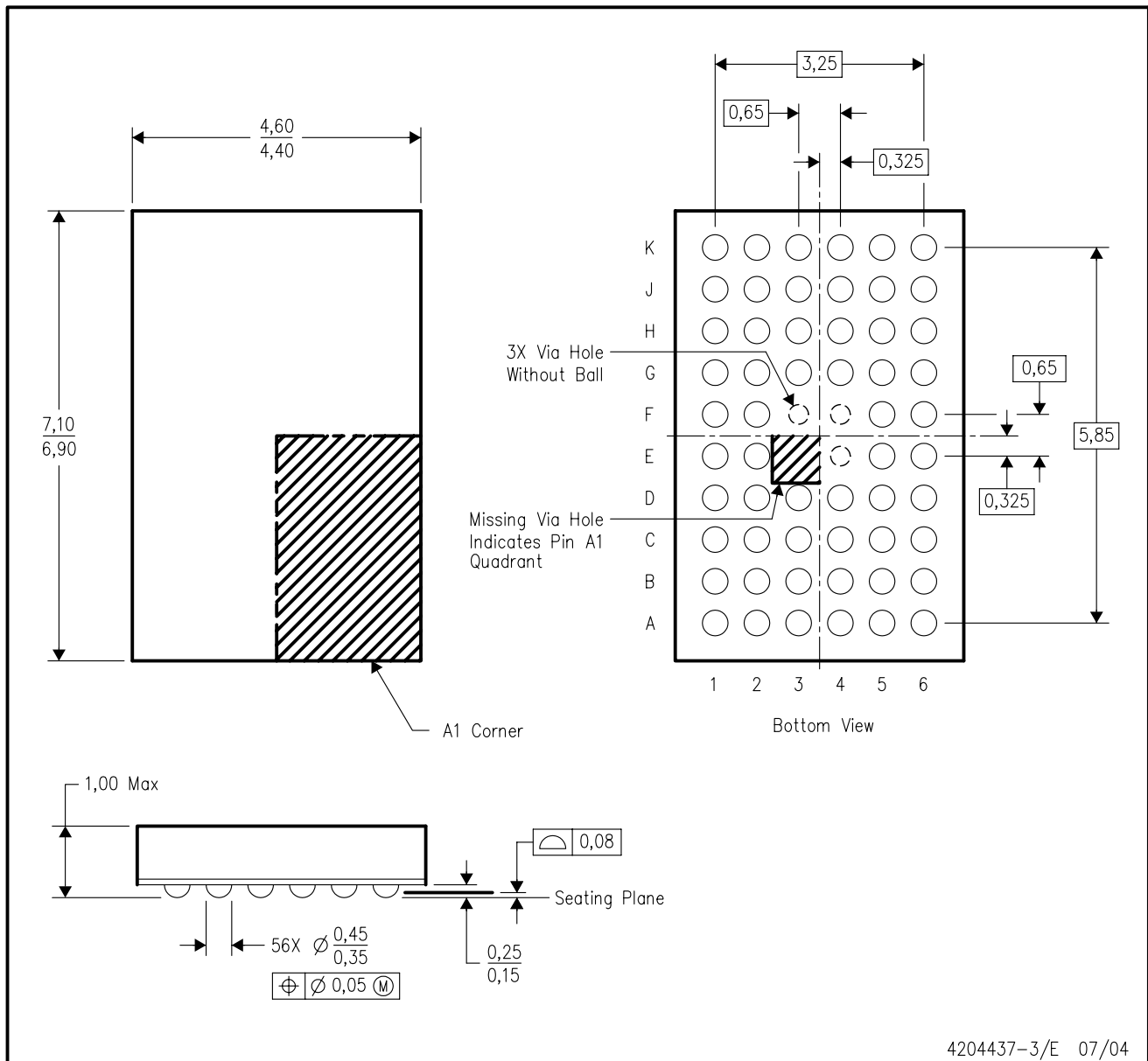
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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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

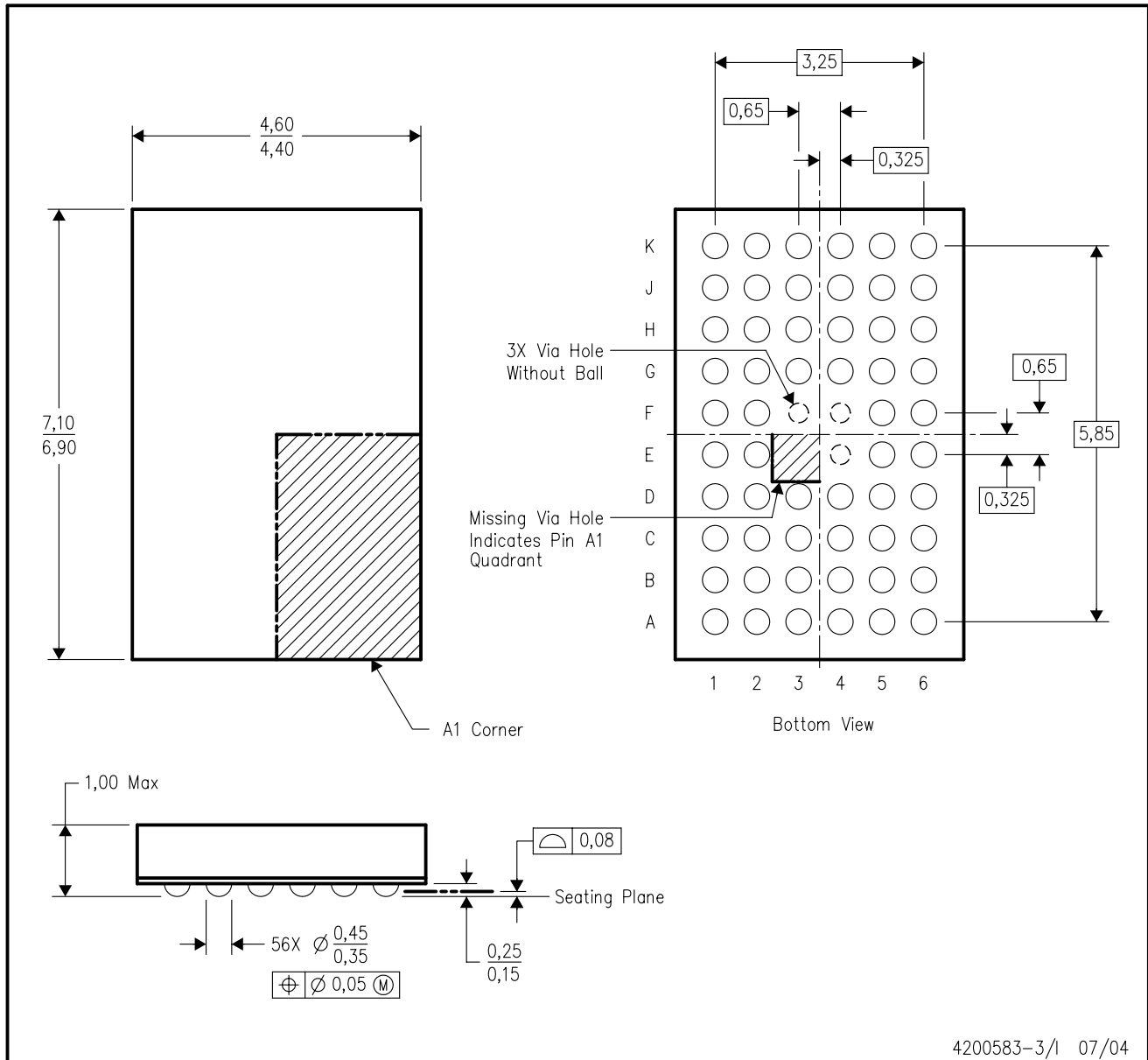


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- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

GQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY

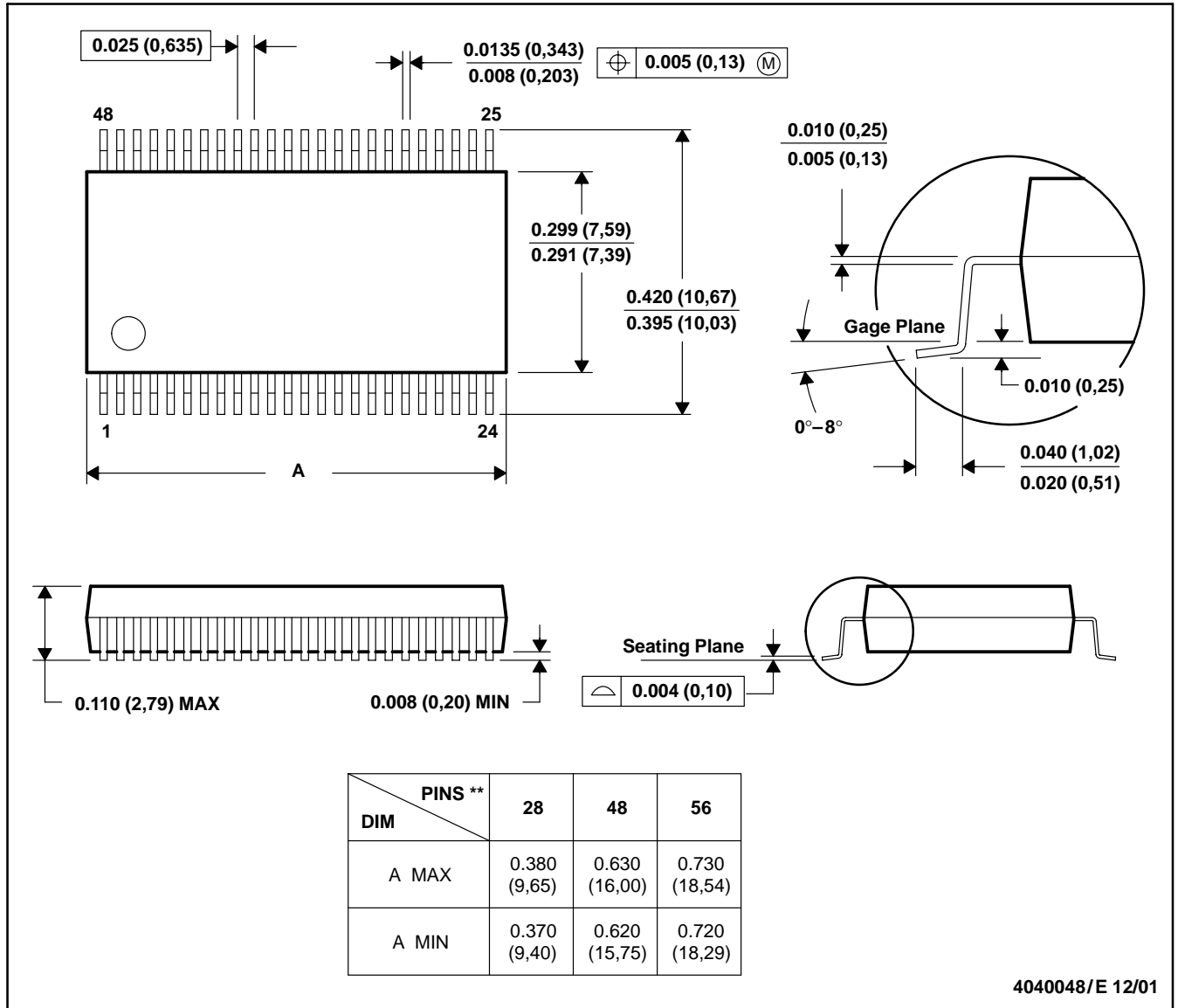


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-225 variation BA.
  - D. This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

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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