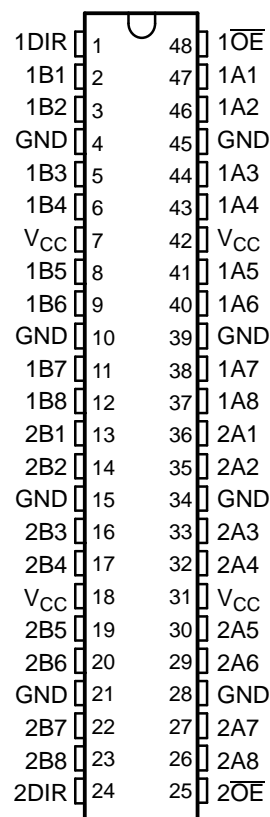


FEATURES

- Member 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

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	FBGA – GRD	Tape and reel	SN74LVT16245BGRDR	VD245B
	FBGA – ZRD (Pb-free)		SN74LVT16245BZRDR	
	SSOP – DL	Tube	SN74LVT16245BDL	LVT16245B
		Tape and reel	SN74LVT16245BDLR	
			74LVT16245BDLRG4	
	TSSOP – DGG	Tape and reel	SN74LVT16245BDGGR	LVT16245B
			74LVT16245BDGGRE4	
	TVSOP – DGV	Tape and reel	SN74LVT16245BDGVR	VD245B
74LVT16245BDGVRE4				
VFBGA – GQL	Tape and reel	SN74LVT16245BGQLR	VD245B	
		VFBGA – ZQL (Pb-free)		SN74LVT16245BZQLR
–55°C to 125°C	CFP – WD	Tube	SNJ54LVT16245BWD	SNJ54LVT16245BWD

(1) 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.

Widebus is a trademark of Texas Instruments.

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

SCBS715D—FEBRUARY 2000—REVISED FEBRUARY 2006

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

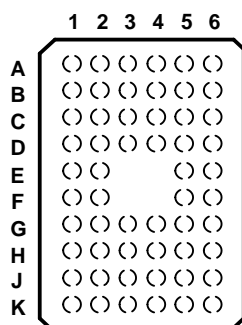
The 'LVT16245B devices are 16-bit (dual-octal) noninverting 3-state transceivers designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment.

These devices are designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable (\overline{OE}) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess I_{CC} and I_{CCZ} .

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)**

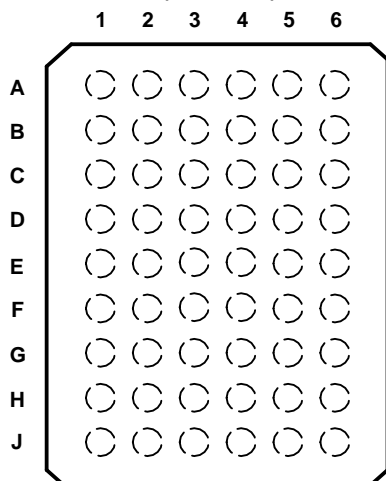


**TERMINAL ASSIGNMENTS⁽¹⁾
(56-Ball GQL/ZQL Package)**

	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}

(1) NC – No internal connection

**GRD OR ZRD PACKAGE
(TOP VIEW)**



**TERMINAL ASSIGNMENTS⁽¹⁾
(54-Ball GRD/ZRD Package)**

	1	2	3	4	5	6
A	1B1	NC	1DIR	1 \overline{OE}	NC	1A1
B	1B3	1B2	NC	NC	1A2	1A3
C	1B5	1B4	V_{CC}	V_{CC}	1A4	1A5
D	1B7	1B6	GND	GND	1A6	1A7
E	2B1	1B8	GND	GND	1A8	2A1
F	2B3	2B2	GND	GND	2A2	2A3
G	2B5	2B4	V_{CC}	V_{CC}	2A4	2A5
H	2B7	2B6	NC	NC	2A6	2A7
J	2B8	NC	2DIR	2 \overline{OE}	NC	2A8

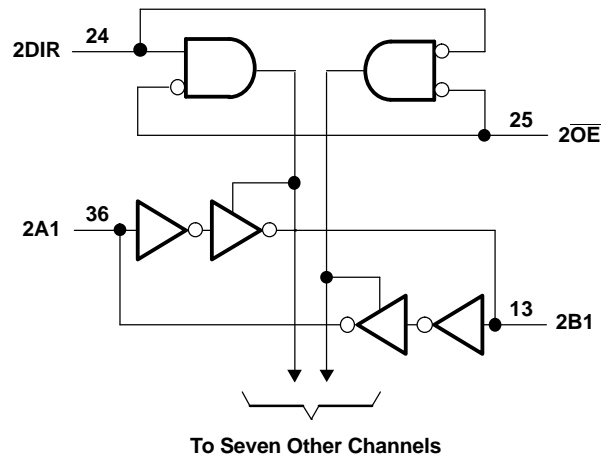
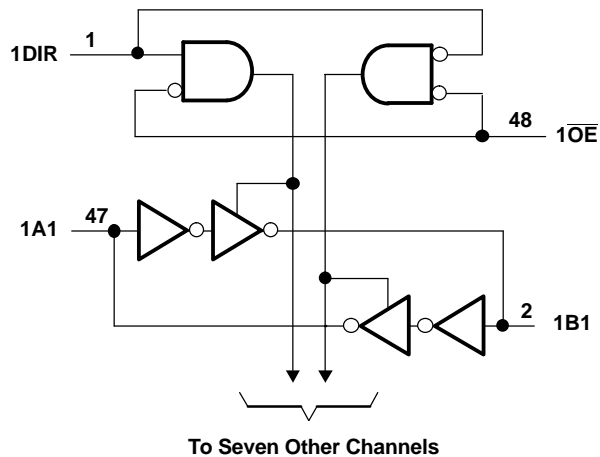
(1) NC – No internal connection

FUNCTION TABLE⁽¹⁾
(EACH 8-BIT SECTION)

CONTROL INPUTS		OUTPUT CIRCUITS		OPERATION
\overline{OE}	DIR	A PORT	B PORT	
L	L	Enabled	Hi-Z	B data to A bus
L	H	Hi-Z	Enabled	A data to B bus
H	X	Hi-Z	Hi-Z	Isolation

(1) Input circuits of the data I/Os always are active.

LOGIC DIAGRAM (POSITIVE LOGIC)



SN54LVT16245B, SN74LVT16245B

3.3-V ABT 16-BIT BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS715D—FEBRUARY 2000—REVISED FEBRUARY 2006

Absolute Maximum Ratings⁽¹⁾

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		−0.5	4.6	V
V_I	Input voltage range ⁽²⁾		−0.5	7	V
V_O	Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾		−0.5	7	V
V_O	Voltage range applied to any output in the high state ⁽²⁾		−0.5	$V_{CC} + 0.5$	V
I_O	Current into any output in the low state	SN54LVT16245B		96	mA
		SN74LVT16245B		128	
I_O	Current into any output in the high state ⁽³⁾	SN54LVT16245B		48	mA
		SN74LVT16245B		64	
I_{IK}	Input clamp current	$V_I < 0$		−50	mA
I_{OK}	Output clamp current	$V_O < 0$		−50	mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	DGG package		70	°C/W
		DGV package		58	
		DL package		63	
		GQL/ZQL package		42	
		GRD/ZRD package		36	
T_{stg}	Storage temperature range		−65	150	°C

- (1) 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.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This current flows only when the output is in the high state and $V_O > V_{CC}$.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾

			SN54LVT16245B ⁽²⁾		SN74LVT16245B		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
Δt/Δv	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
Δt/ΔV _{CC}	Power-up ramp rate		200		200		μs/V
T _A	Operating free-air temperature		–55	125	–40	85	°C

(1) All unused or undriven (floating) inputs (I/Os) of the device must be held at logic HIGH or LOW (preferably V_{CC} or GND) to ensure proper device operation and minimize power. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

(2) Product preview

SN54LVT16245B, SN74LVT16245B

3.3-V ABT 16-BIT BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS715D—FEBRUARY 2000—REVISED FEBRUARY 2006

Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	SN54LVT16245B ⁽¹⁾			SN74LVT16245B			UNIT
			MIN	TYP ⁽²⁾	MAX	MIN	TYP ⁽²⁾	MAX	
V_{IK}		$V_{CC} = 2.7\text{ V}$, $I_I = -18\text{ mA}$			-1.2			-1.2	V
V_{OH}		$V_{CC} = 2.7\text{ to }3.6\text{ V}$, $I_{OH} = -100\text{ }\mu\text{A}$	$V_{CC} - 0.2$			$V_{CC} - 0.2$			V
		$V_{CC} = 2.7\text{ V}$, $I_{OH} = -8\text{ mA}$	2.4			2.4			
	$V_{CC} = 3\text{ V}$	$I_{OH} = -24\text{ mA}$	2						
		$I_{OH} = -32\text{ mA}$				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				
		$I_{OL} = 64\text{ mA}$						0.55	
I_I	Control inputs	$V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}\text{ or GND}$			± 1			± 1	μA
		$V_{CC} = 0\text{ or }3.6\text{ V}$, $V_I = 5.5\text{ V}$			10			10	
	A or B port ⁽³⁾	$V_{CC} = 3.6\text{ V}$, $V_I = 5.5\text{ V}$			20			20	
		$V_I = V_{CC}$			5			1	
		$V_I = 0$			-5			-5	
I_{off}		$V_{CC} = 0$, $V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$						± 100	μA
I_{OZPU}		$V_{CC} = 0\text{ to }1.5\text{ V}$, $V_O = 0.5\text{ V to }3\text{ V}$, $\overline{OE} = \text{don't care}$			$\pm 100^{(4)}$			± 100	μA
I_{OZPD}		$V_{CC} = 1.5\text{ V to }0$, $V_O = 0.5\text{ V to }3\text{ V}$, $\overline{OE} = \text{don't care}$			$\pm 100^{(4)}$			± 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	
$\Delta I_{CC}^{(5)}$		$V_{CC} = 3\text{ V to }3.6\text{ V}$, 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_{io}		$V_O = 3\text{ V or }0$		10			10		pF

(1) Product preview

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

(3) Unused pins at $V_{CC}\text{ or GND}$.

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

(5) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than $V_{CC}\text{ or GND}$.

Switching Characteristics

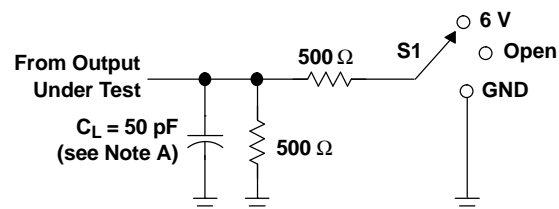
over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT16245B ⁽¹⁾				SN74LVT16245B				UNIT	
			V _{CC} = 3.3 V ± 0.3 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V			V _{CC} = 2.7 V		
			MIN	MAX	MIN	MAX	MIN	TYP ⁽²⁾	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}	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}	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

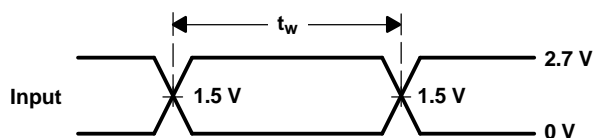
(1) Product preview

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

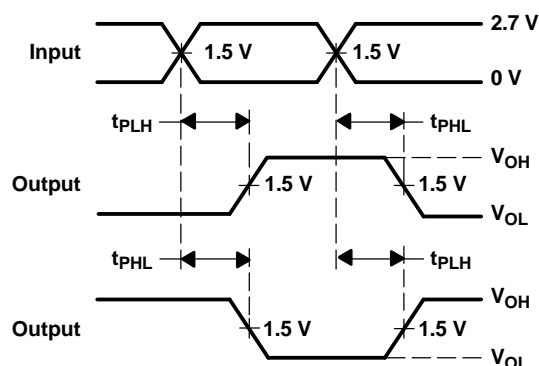
PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

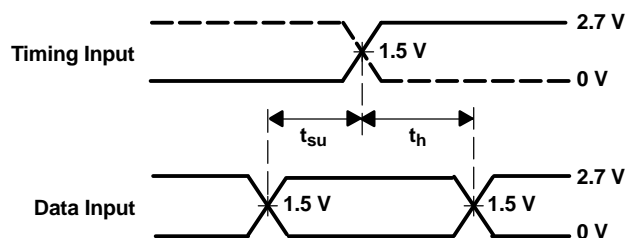


VOLTAGE WAVEFORMS
PULSE DURATION

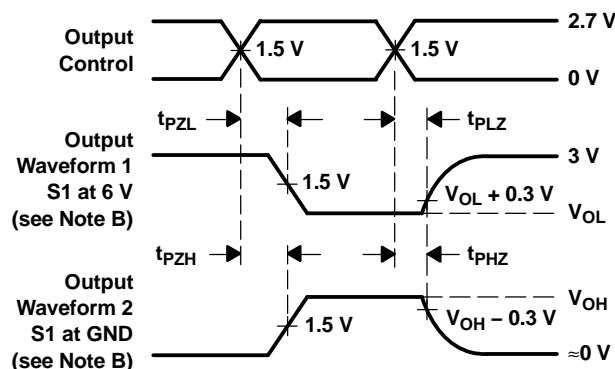


VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS

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



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- C_L includes probe and jig capacitance.
 - 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.
 - All input pulses are supplied by generators having the following characteristics: PRR $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 - 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⁾
74LVT16245BDGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVT16245BDGVRE4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVT16245BDLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT16245BDGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT16245BDGVR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT16245BDL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT16245BDLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT16245BDLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT16245BGQLR	ACTIVE	BGA MICROSTAR JUNIOR	GQL	56	1000	TBD	SNPB	Level-1-240C-UNLIM
SN74LVT16245BGRDR	ACTIVE	BGA MICROSTAR JUNIOR	GRD	54	1000	TBD	SNPB	Level-1-240C-UNLIM
SN74LVT16245BZQLR	ACTIVE	BGA MICROSTAR JUNIOR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM
SN74LVT16245BZRDR	ACTIVE	BGA MICROSTAR JUNIOR	ZRD	54	1000	Green (RoHS & no Sb/Br)	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 - 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

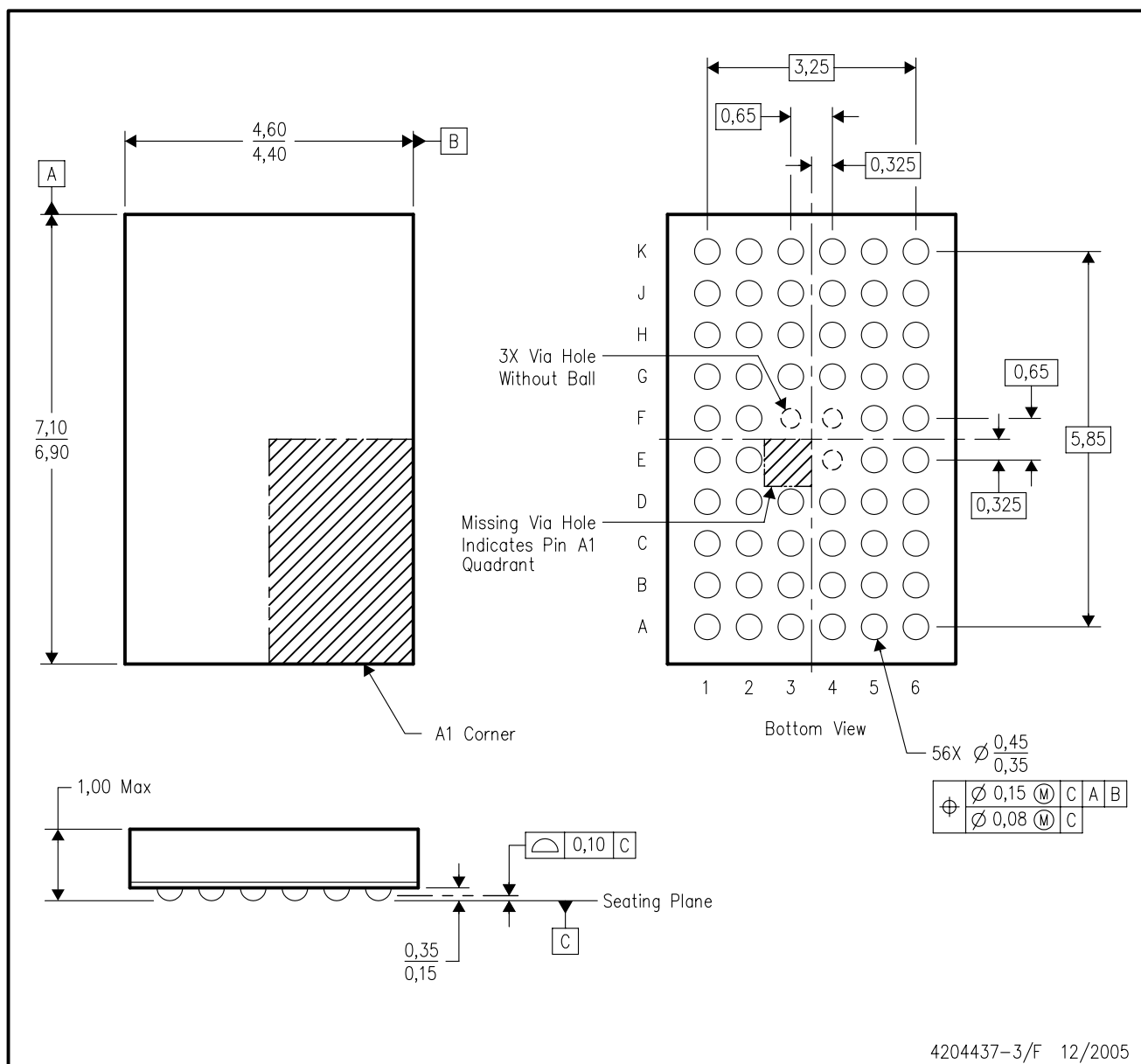
temperature.

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ZQL (R-PBGA-N56)

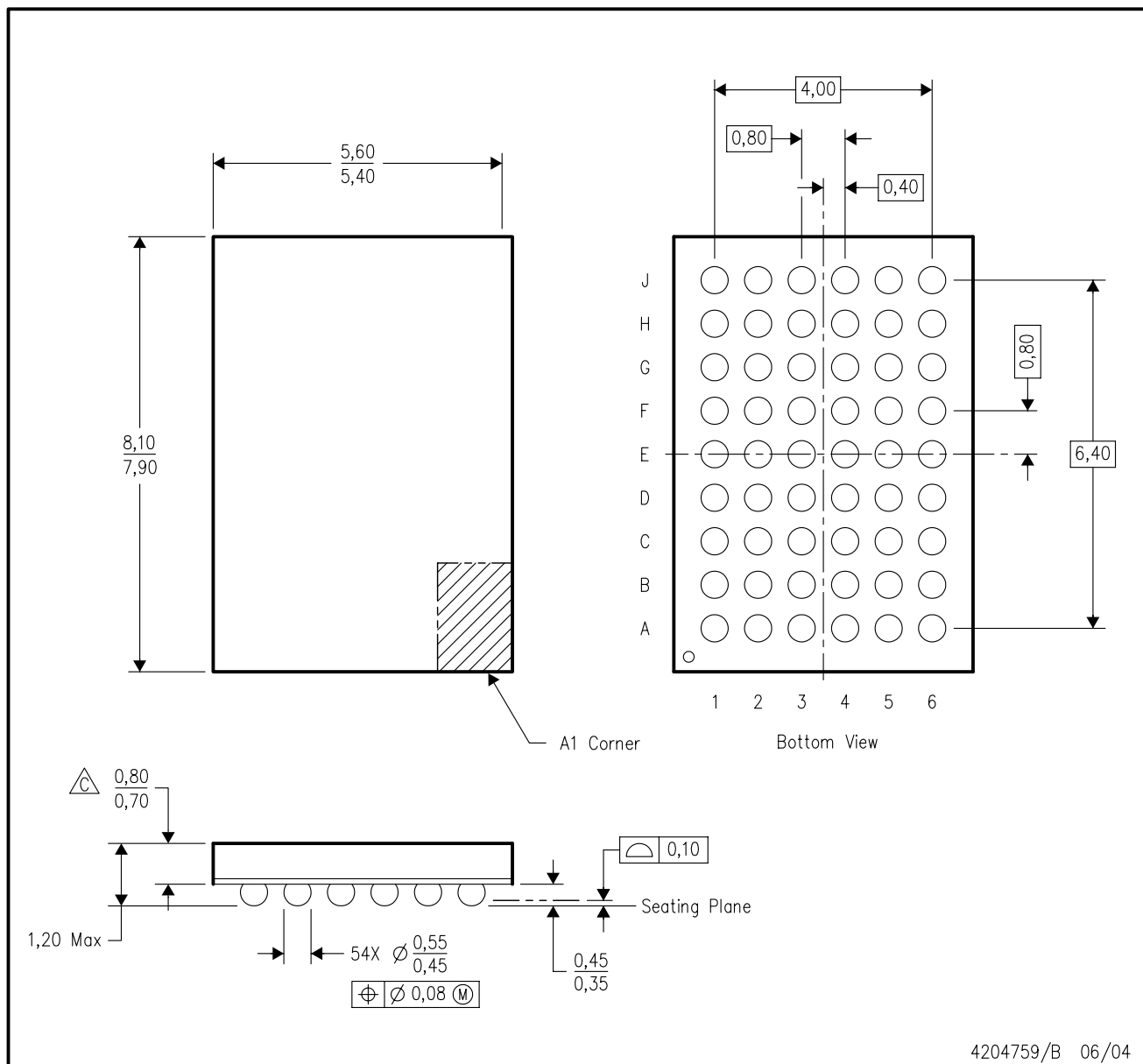
PLASTIC BALL GRID ARRAY




- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - 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).

GRD (R-PBGA-N54)

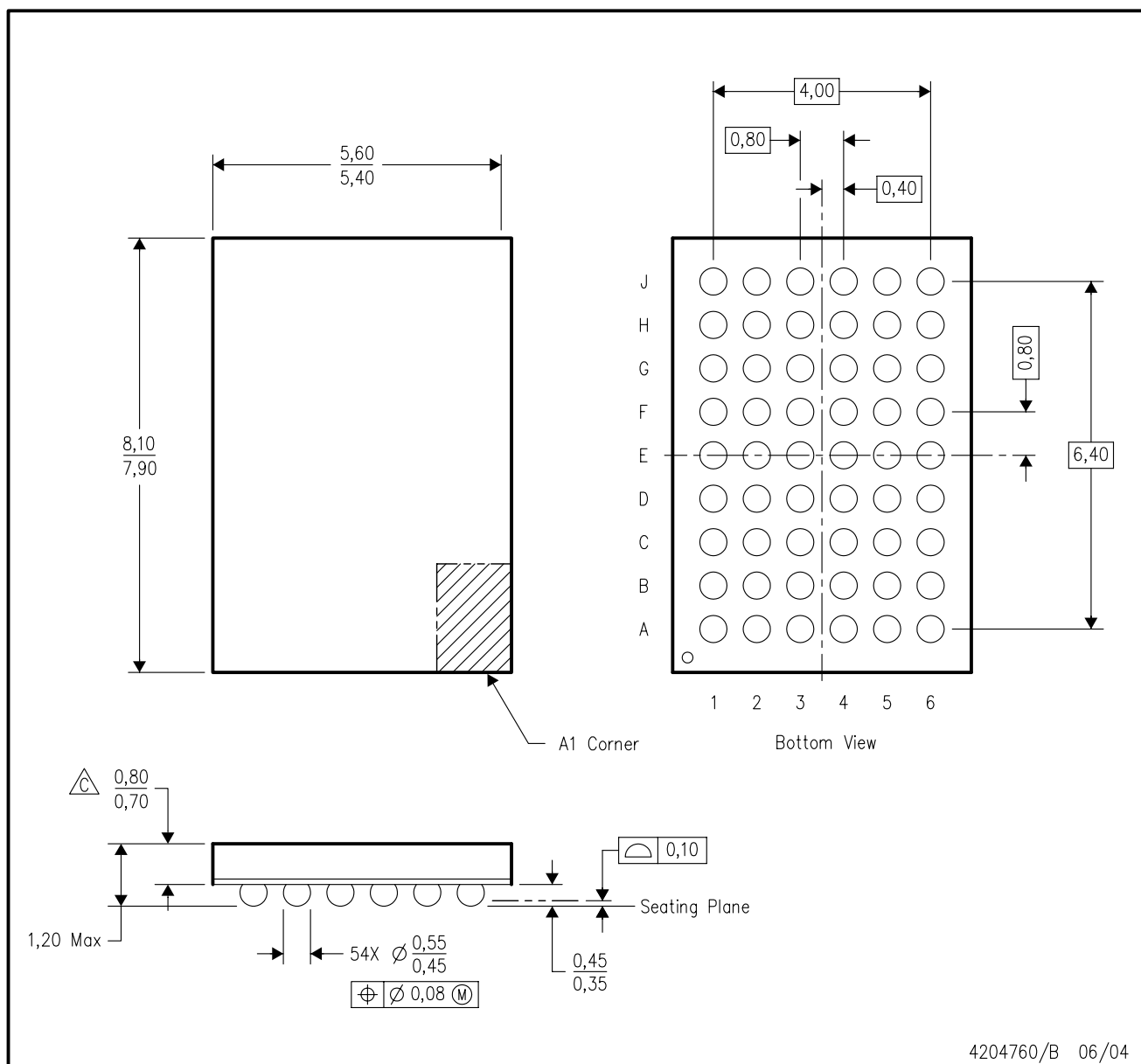
PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 -  C. Falls within JEDEC MO-205 variation DD.
 - D. This package is tin-lead (SnPb). Refer to the 54 ZRD package (drawing 4204760) for lead-free.

ZRD (R-PBGA-N54)

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-205 variation DD.
 - D. This package is lead-free. Refer to the 54 GRD package (drawing 4204759) for tin-lead (SnPb).

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

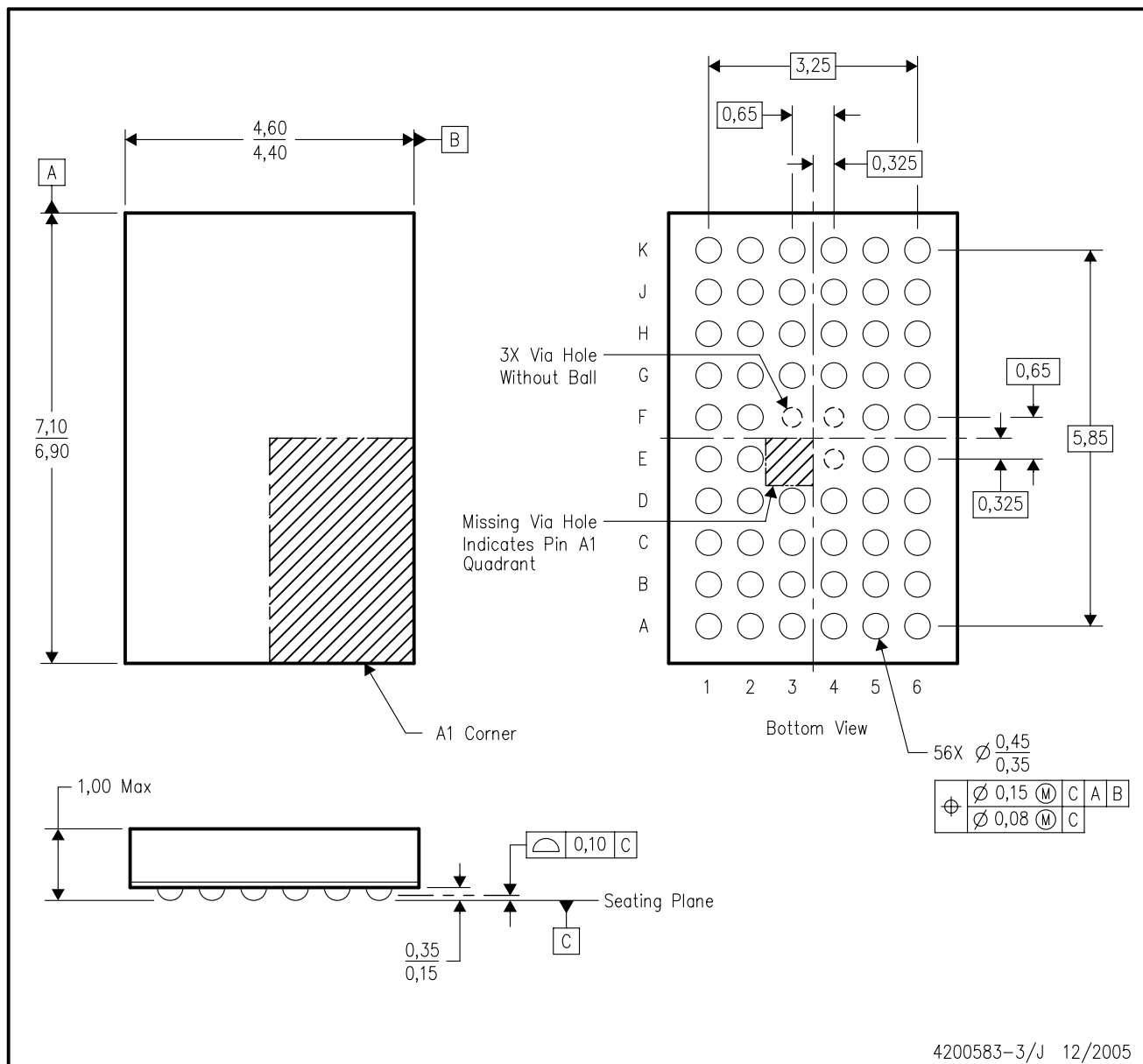
24 PINS SHOWN



- 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



4200583-3/J 12/2005

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - 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

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