

FEATURES

- Members of the Texas Instruments Widebus™ Family
- Output Ports Have Equivalent 22-Ω Series Resistors, So No External Resistors Are Required
- 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)

SN54LVT162244A . . . WD PACKAGE
SN74LVT162244A . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)

1 $\overline{OE}$	1	48	2 $\overline{OE}$
1Y1	2	47	1A1
1Y2	3	46	1A2
GND	4	45	GND
1Y3	5	44	1A3
1Y4	6	43	1A4
V_{CC}	7	42	V_{CC}
2Y1	8	41	2A1
2Y2	9	40	2A2
GND	10	39	GND
2Y3	11	38	2A3
2Y4	12	37	2A4
3Y1	13	36	3A1
3Y2	14	35	3A2
GND	15	34	GND
3Y3	16	33	3A3
3Y4	17	32	3A4
V_{CC}	18	31	V_{CC}
4Y1	19	30	4A1
4Y2	20	29	4A2
GND	21	28	GND
4Y3	22	27	4A3
4Y4	23	26	4A4
4 $\overline{OE}$	24	25	3 $\overline{OE}$

DESCRIPTION/ORDERING INFORMATION

The LVT162244A 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.

The outputs, which are designed to source or sink up to 12 mA, include equivalent 22-Ω series resistors to reduce overshoot and undershoot.

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.



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.

SN54LVT162244A, SN74LVT162244A

3.3-V ABT 16-BIT BUFFERS/DRIVERS

WITH 3-STATE OUTPUTS

SCBS718D – JUNE 2000 – REVISED DECEMBER 2006

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

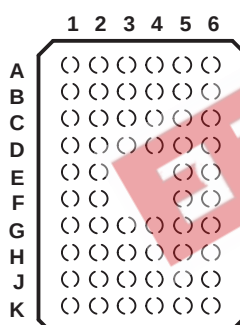
ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	FBGA – GRD	Reel of 1000	SN74LVT162244AGRDR	LZ244A
	FBGA – ZRD (Pb-free)		SN74LVT162244AZRDR	
	SSOP – DL	Tube of 25	SN74LVT162244ADL	LVT162244A
			SN74LVT162244ADLG4	
		Reel of 1000	SN74LVT162244ADLR	
			74LVT162244ADLRG4	
	TSSOP – DGG	Reel of 2000	SN74LVT162244ADGGR	LVT162244A
			74LVT162244ADGGRE4	
	TVSOP – DGV	Reel of 2000	SN74LVT162244ADGVR	LZ244A
			74LVT162244ADGVRE4	
–55°C to 125°C	VFBGA – GQL	Reel of 1000	SN74LVT162244AGQLR	LZ244A
	VFBGA – ZQL		SN74LVT162244AZQLR	
	CFP – WD	Tube	SNJ544LVT162244AWD ⁽²⁾	SNJ54LVT162244AWD

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

(2) Product preview

GQL OR ZQL PACKAGE
(TOP VIEW)

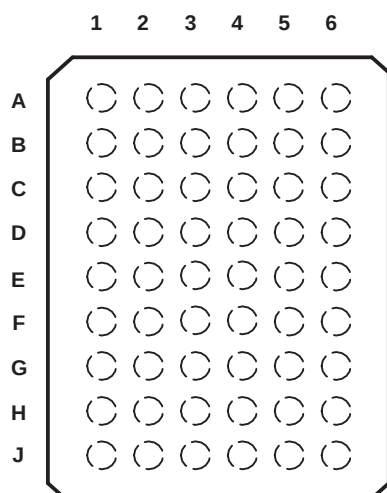


TERMINAL ASSIGNMENTS⁽¹⁾
(56-Ball GQL/ZQL Package)

	1	2	3	4	5	6
A	1OE	NC	NC	NC	NC	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	4OE	NC	NC	NC	NC	3OE

(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	1Y1	NC	1 $\overline{OE}$	2 $\overline{OE}$	NC	1A1
B	1Y3	1Y2	NC	NC	1A2	1A3
C	2Y1	1Y4	V _{CC}	V _{CC}	1A4	2A1
D	2Y3	2Y2	GND	GND	2A2	2A3
E	3Y1	2Y4	GND	GND	2A4	3A1
F	3Y3	3Y2	GND	GND	3A2	3A3
G	4Y1	3Y4	V _{CC}	V _{CC}	3A4	4A1
H	4Y3	4Y2	NC	NC	4A2	4A3
J	4Y4	NC	4 $\overline{OE}$	3 $\overline{OE}$	NC	4A4

(1) NC – No internal connection

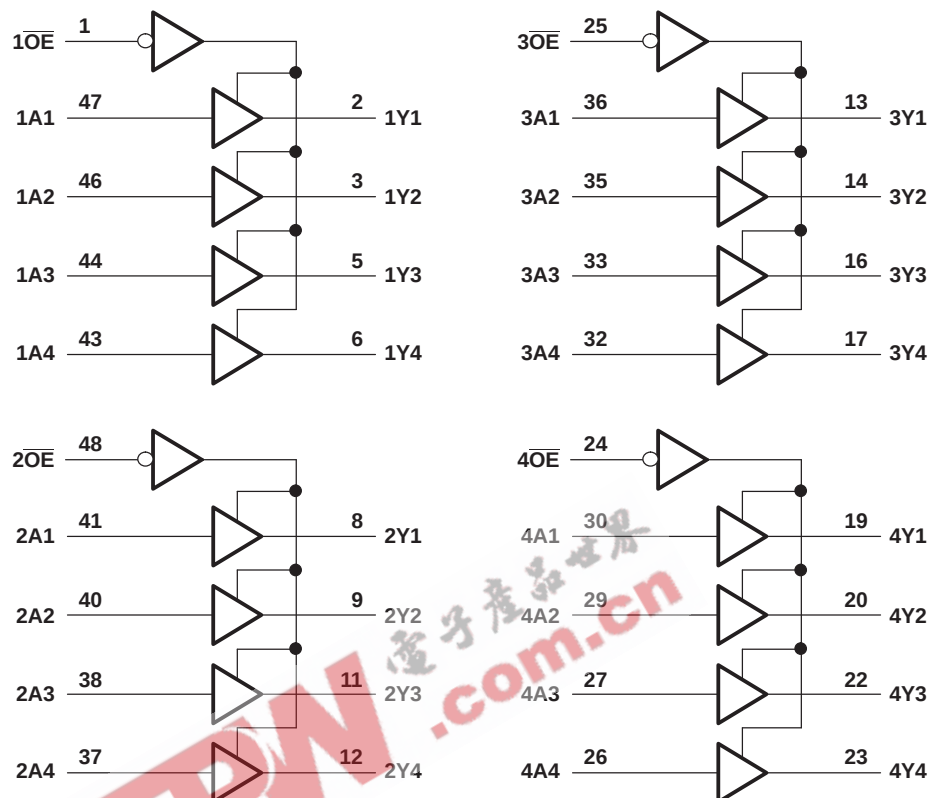
FUNCTION TABLE
(each 4-bit buffer/driver)

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

SN54LVT162244A, SN74LVT162244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
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⁽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		30	mA
I _O	Current into any output in the high state ⁽³⁾		30	mA
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 clamp-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⁾

		SN54LVT162244A ⁽²⁾		SN74LVT162244A		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		−12		−12	mA
I _{OL}	Low-level output current		12		12	mA
Δt/Δv	Input transition rise or fall rate		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 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.

(2) Product preview

SN54LVT162244A, SN74LVT162244A

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		SN54LVT162244A ⁽¹⁾			SN74LVT162244A			UNIT
				MIN	TYP ⁽²⁾	MAX	MIN	TYP ⁽²⁾	MAX	
V _{IK}		V _{CC} = 2.7 V, I _I = −18 mA		−1.2			−1.2			V
V _{OH}		V _{CC} = 3 V, I _{OH} = −12 mA		2						V
V _{OL}		V _{CC} = 3 V, I _{OL} = 12 mA		0.8			0.8			V
I _I		V _{CC} = 0 or 3.6 V, V _I = 5.5 V		10			10			μA
	Control inputs	V _{CC} = 3.6 V, V _I = V _{CC} or GND		±1			±1			
	Data inputs	V _{CC} = 3.6 V	V _I = V _{CC}	1			1			
			V _I = 0	−5			−5			
I _{off}		V _{CC} = 0, V _I or V _O = 0 to 4.5 V					±100			μA
I _{OZH}		V _{CC} = 3.6 V, V _O = 3 V		5			5			μA
I _{OZL}		V _{CC} = 3.6 V, V _O = 0.5 V		−5			−5			μA
I _{OZPU}		V _{CC} = 0 to 1.5 V, V _O = 0.5 V to 3 V, OE = don't care		±100 ⁽³⁾			±100			μA
I _{OZPD}		V _{CC} = 1.5 V to 0, V _O = 0.5 V to 3 V, OE = don't care		±100 ⁽³⁾			±100			μA
I _{CC}	V _{CC} = 3.6 V, I _O = 0, V _I = V _{CC} or GND	Outputs high		0.19			0.19			mA
		Outputs low		5			5			
		Outputs disabled		0.19			0.19			
ΔI _{CC} ⁽⁴⁾		V _{CC} = 3 V to 3.6 V, One input at V _{CC} − 0.6 V, Other inputs at V _{CC} or GND		0.2			0.2			mA
C _i		V _I = 3 V or 0		4			4			pF
C _o		V _O = 3 V or 0		9			9			pF

(1) Product preview

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

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

(4) 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

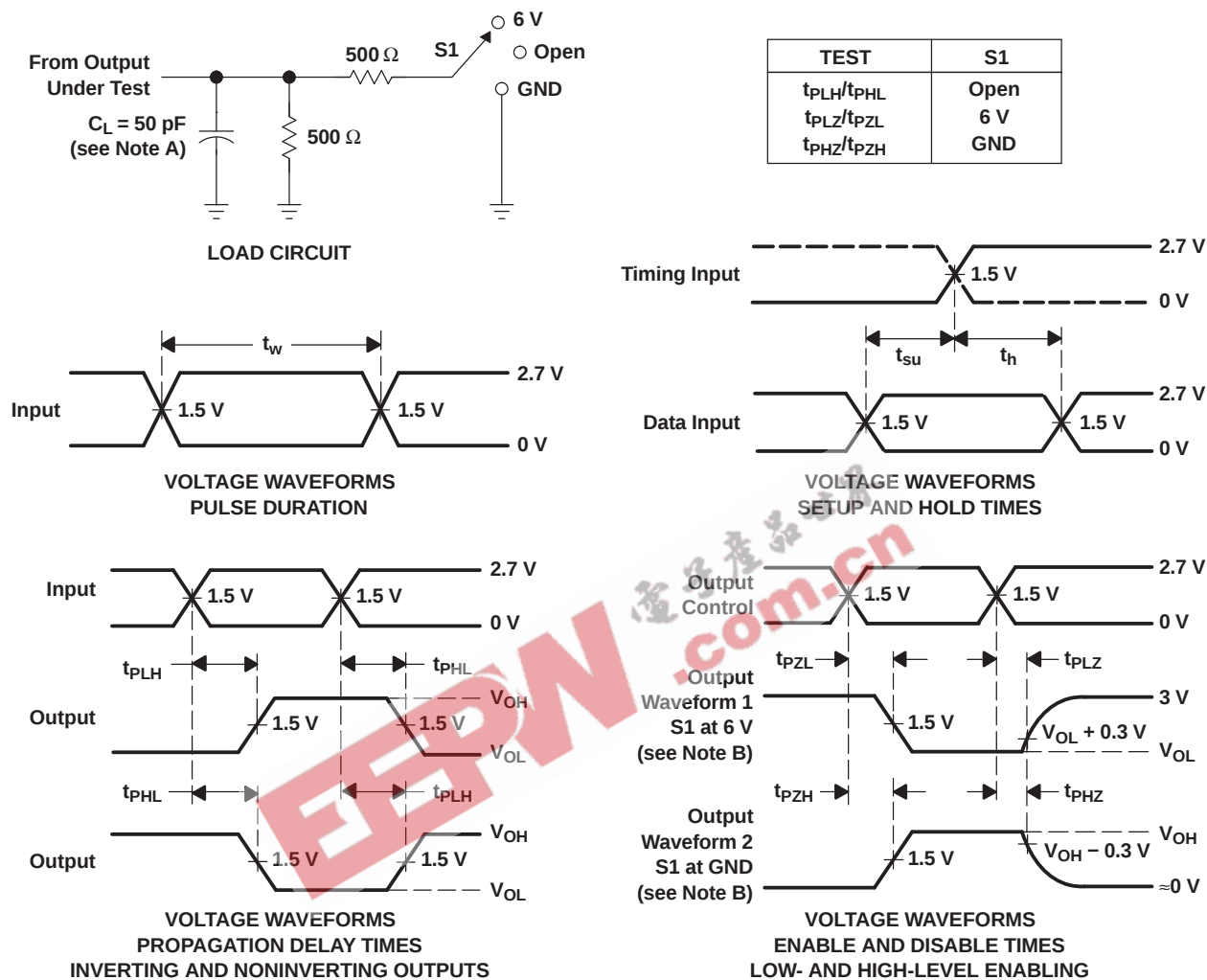
over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT162244A ⁽¹⁾				SN74LVT162244A				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	Y	1.1	4.6	5.1		1.4	3.4	4	4.8		ns
t _{PHL}			1.1	3.9	4.5		1.2	2.9	3.6	4.1		
t _{PZH}	$\overline{OE}$	Y	1.1	5.4	6.7		1.2	3.9	5.1	6.5		ns
t _{PZL}			1.3	4.9	6.1		1.4	3.8	4.5	5.8		
t _{PHZ}	$\overline{OE}$	Y	1.6	5.9	6.5		2.2	4.4	5	5.4		ns
t _{PLZ}			1	5.9	5.8		2	4.2	5	5.4		
t _{sk(LH)}							0.5					ns
t _{sk(HL)}							0.5					

(1) Product preview

(2) 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⁾
74LVT162244ADGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVT162244ADGVRE4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVT162244ADLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT162244ADGGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT162244ADGVGR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT162244ADL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT162244ADLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT162244ADLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVT162244AGQLR	NRND	BGA MICROSTAR JUNIOR	GQL	56	1000	TBD	SNPB	Level-1-240C-UNLIM
SN74LVT162244AGRDR	ACTIVE	BGA MICROSTAR JUNIOR	GRD	54	1000	TBD	SNPB	Level-1-240C-UNLIM
SN74LVT162244AZQLR	ACTIVE	BGA MICROSTAR JUNIOR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM
SN74LVT162244AZRDR	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)

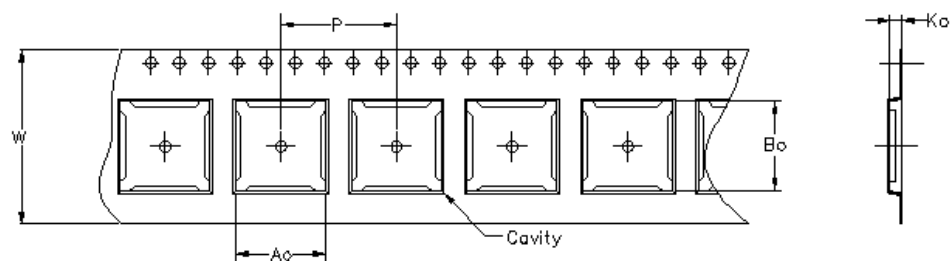
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder

temperature.

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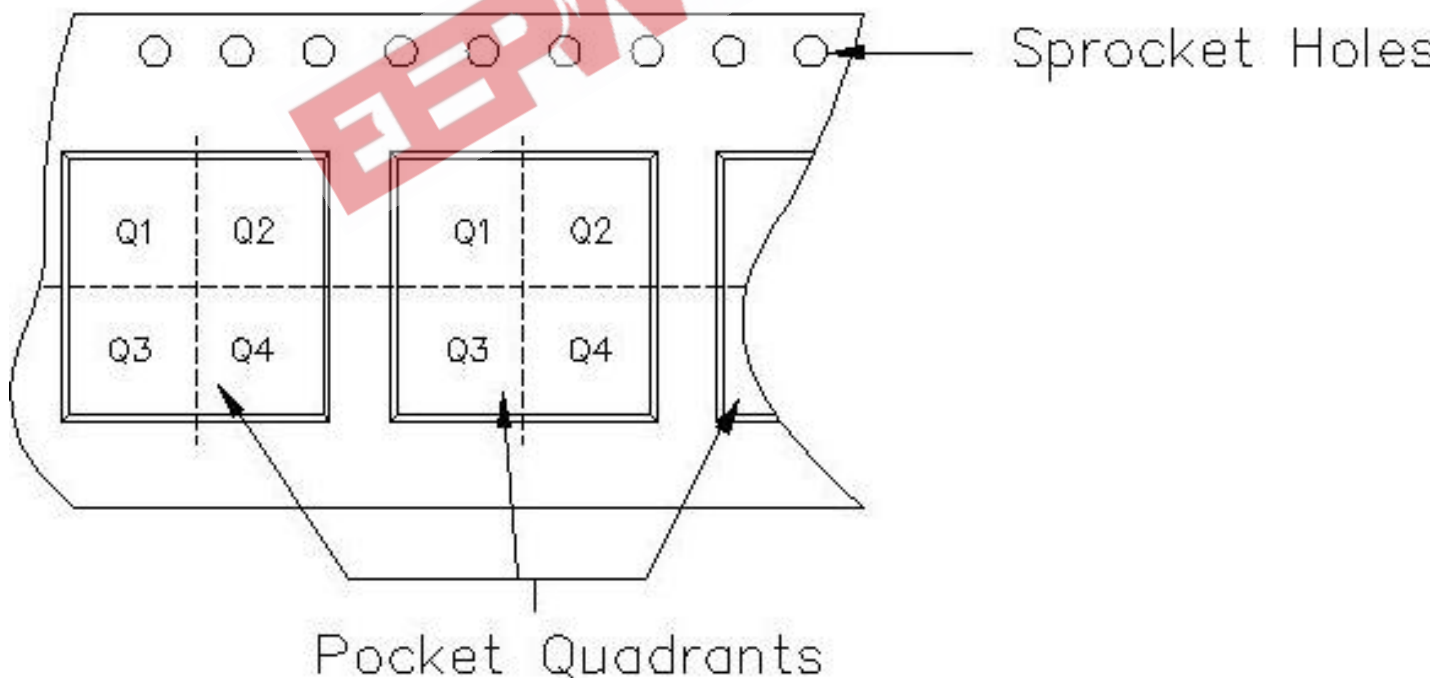
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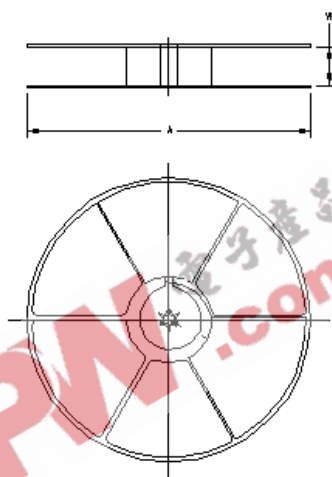
Carrier tape design is defined largely by the component length, width, and thickness.

A_o = Dimension designed to accommodate the component width.
B_o = Dimension designed to accommodate the component length.
K_o = Dimension designed to accommodate the component thickness.
W = Overall width of the carrier tape.
P = Pitch between successive cavity centers.



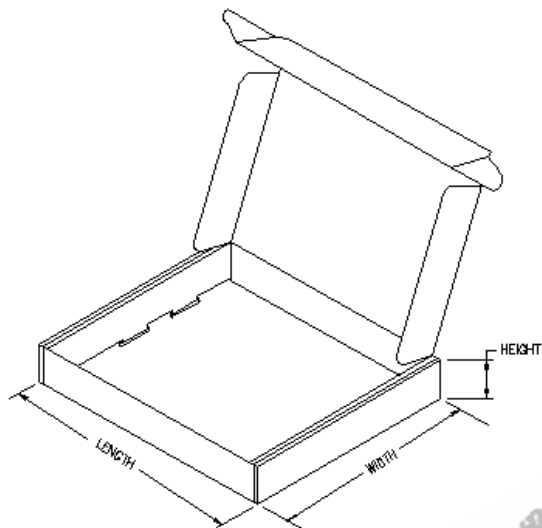
TAPE AND REEL INFORMATION

Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LVT162244ADGGR	DGG	48	MLA	330	24	8.6	15.8	1.8	12	24	Q1
SN74LVT162244ADGVR	DGV	48	MLA	330	24	6.8	10.1	1.6	12	24	Q1
SN74LVT162244ADLR	DL	48	MLA	330	32	11.35	16.2	3.1	16	32	Q1
SN74LVT162244AGQLR	GQL	56	HIJ	330	16	4.8	7.3	1.45	8	16	Q1
SN74LVT162244AGRDR	GRD	54	HIJ	330	16	5.8	8.3	1.55	8	16	Q1
SN74LVT162244AZQLR	ZQL	56	HIJ	330	16	4.8	7.3	1.45	8	16	Q1
SN74LVT162244AZRDR	ZRD	54	HIJ	330	16	5.8	8.3	1.55	8	16	Q1



TAPE AND REEL BOX INFORMATION

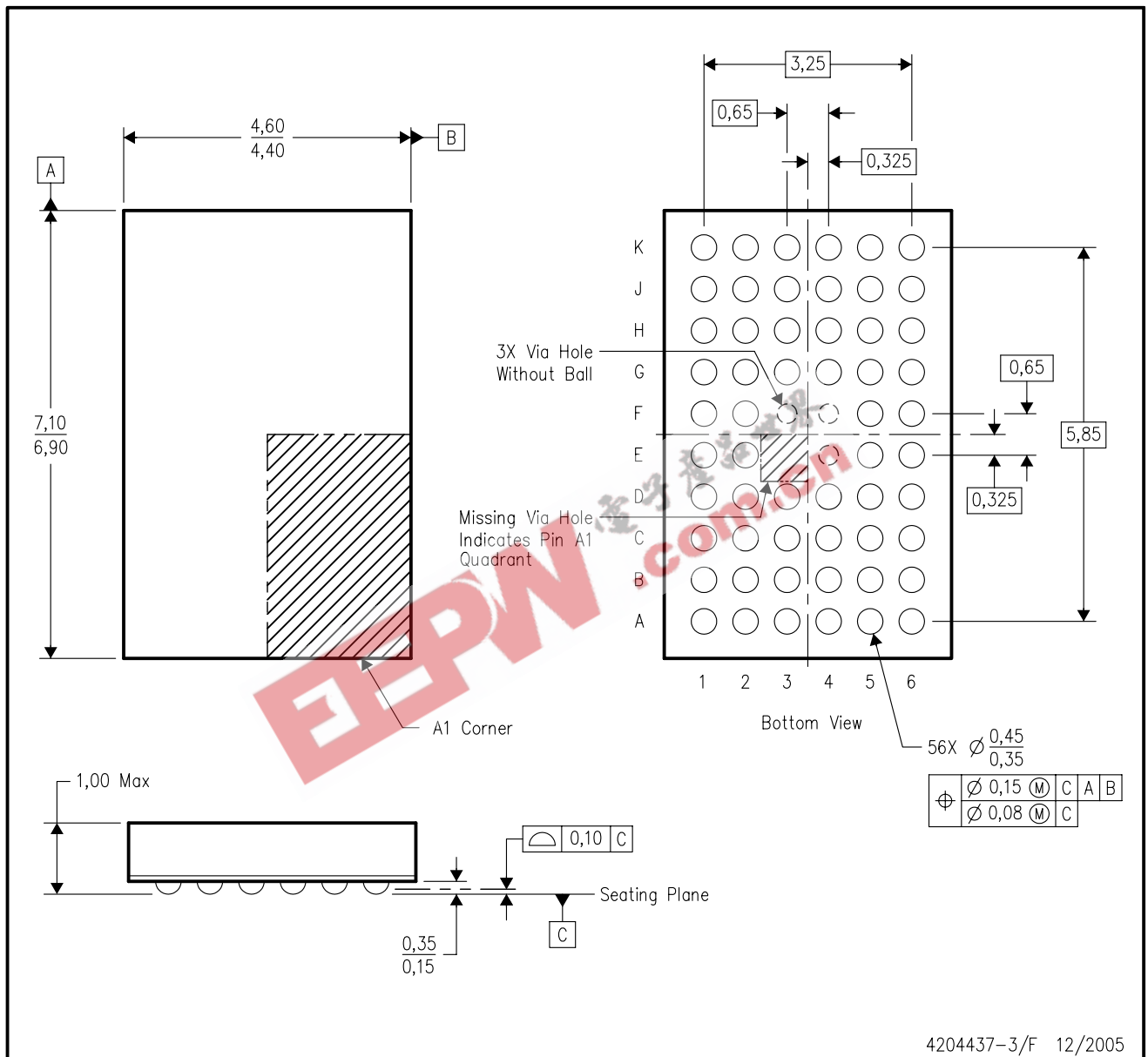
Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
SN74LVT162244ADGGR	DGG	48	MLA	333.2	333.2	31.75
SN74LVT162244ADGVR	DGV	48	MLA	333.2	333.2	31.75
SN74LVT162244ADLR	DL	48	MLA	336.6	342.9	41.3
SN74LVT162244AGQLR	GQL	56	HIJ	346.0	346.0	33.0
SN74LVT162244AGRDR	GRD	54	HIJ	346.0	346.0	33.0
SN74LVT162244AZQLR	ZQL	56	HIJ	346.0	346.0	33.0
SN74LVT162244AZRDR	ZRD	54	HIJ	346.0	346.0	33.0



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ZQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY

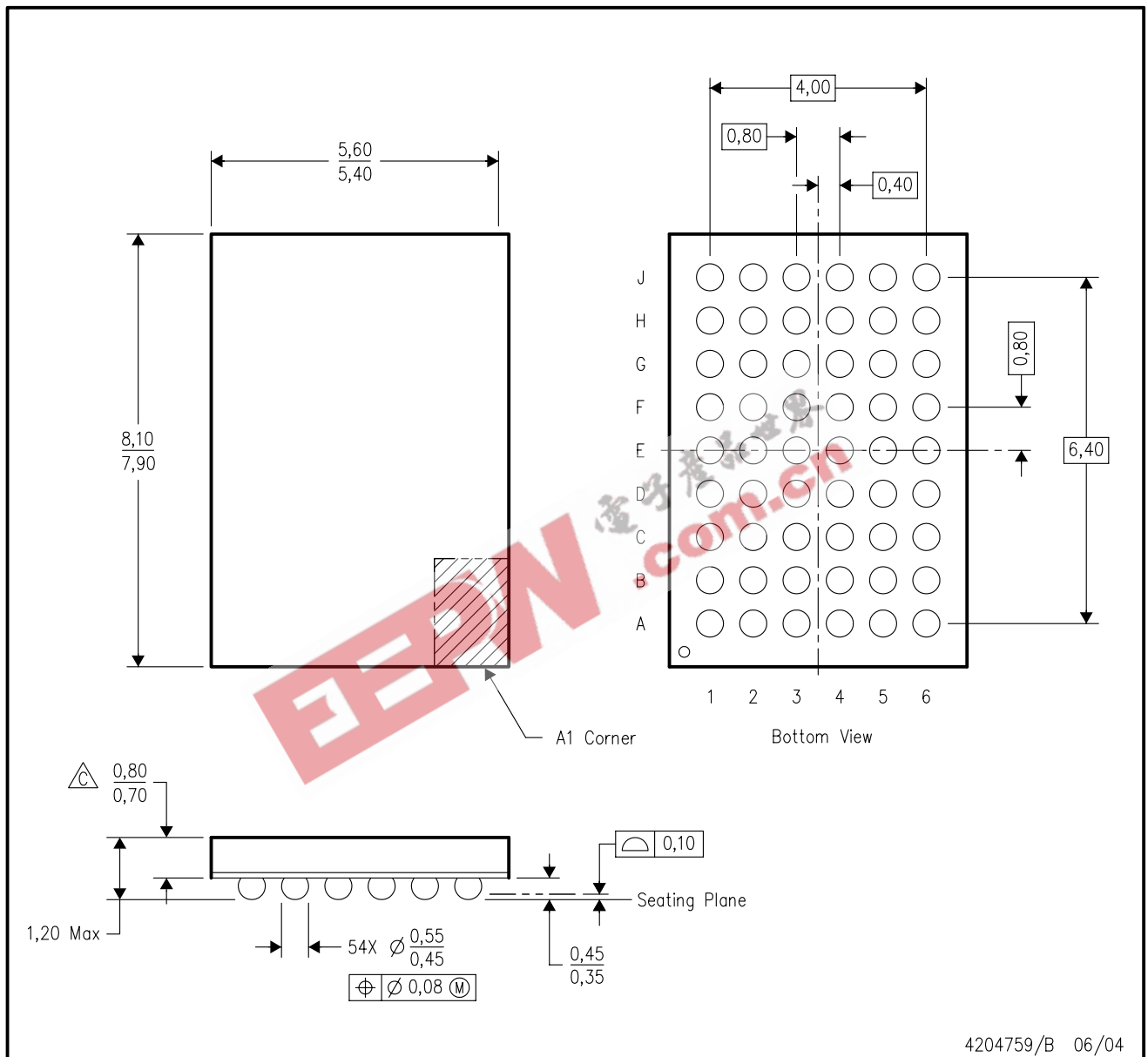


- NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MO-225 variation BA.
D. This package is lead-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

MECHANICAL DATA

GRD (R-PBGA-N54)

PLASTIC BALL GRID ARRAY

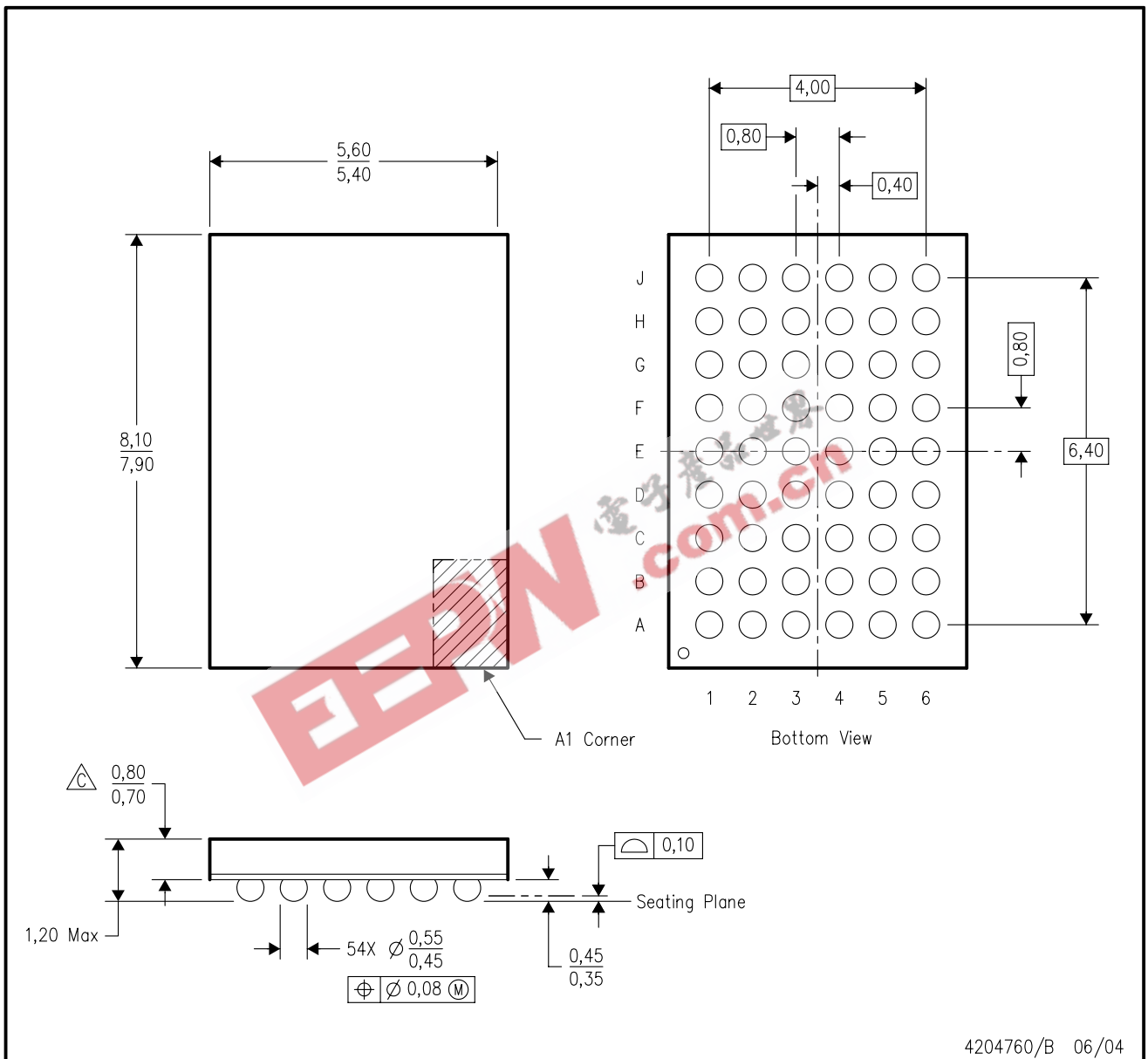


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-205 variation DD.
 - D. This package is tin-lead (SnPb). Refer to the 54 ZRD package (drawing 4204760) for lead-free.

MECHANICAL DATA

ZRD (R-PBGA-N54)

PLASTIC BALL GRID ARRAY



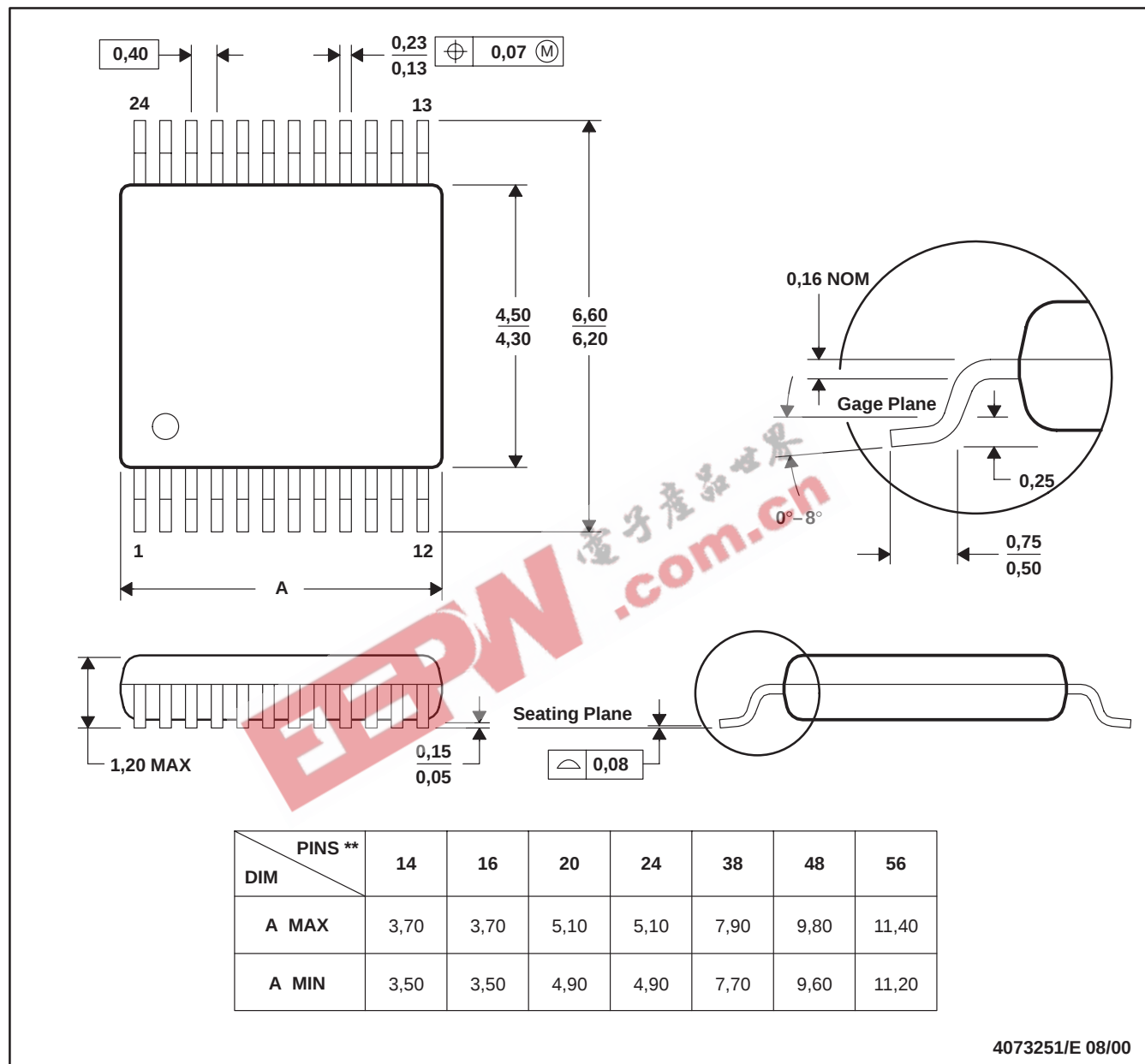
MECHANICAL DATA

MPDS006C – FEBRUARY 1996 – REVISED AUGUST 2000

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN

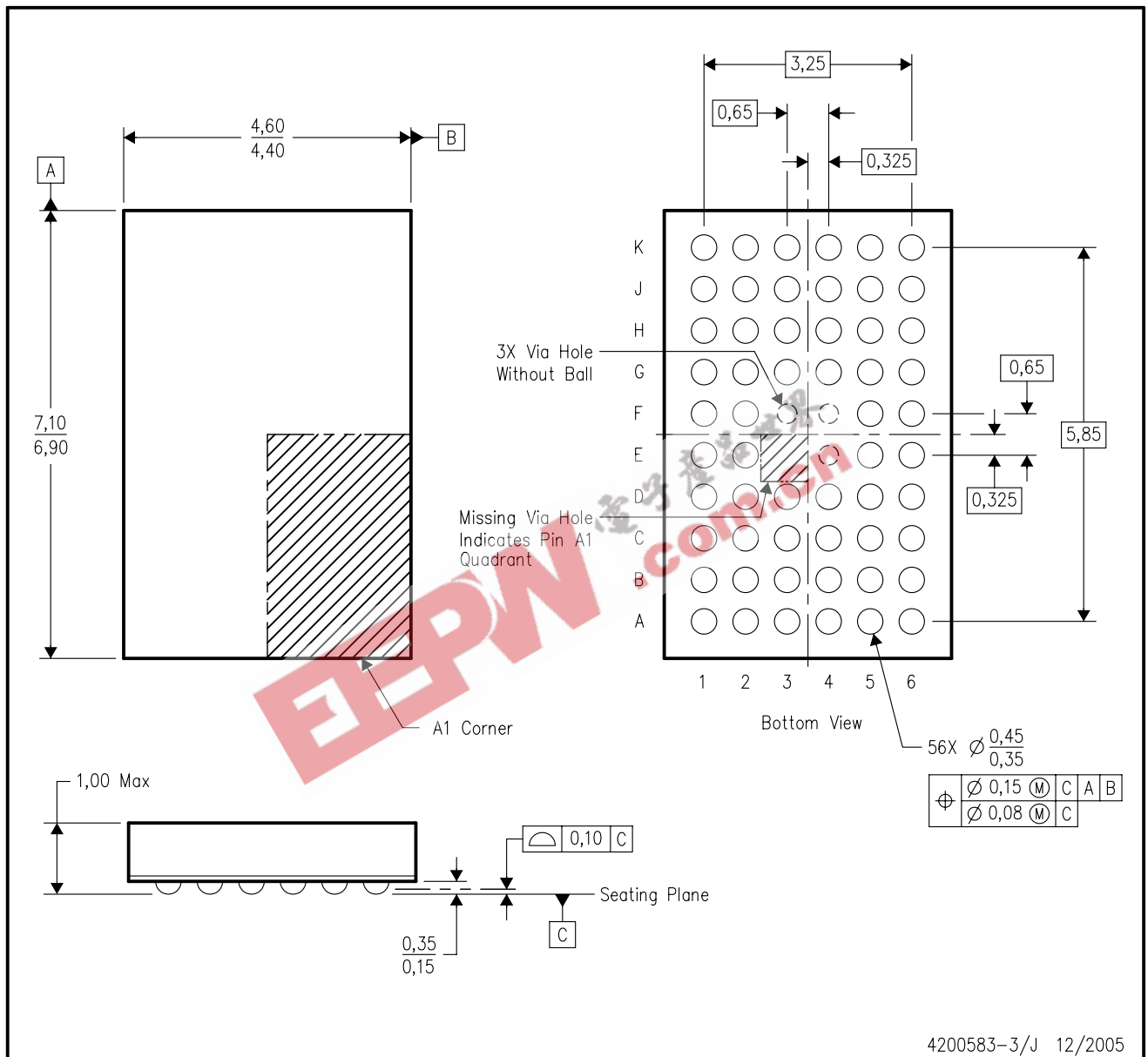


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 - D. Falls within JEDEC: 24/48 Pins – MO-153
14/16/20/56 Pins – MO-194

MECHANICAL DATA

GQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



4200583-3/J 12/2005

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - Falls within JEDEC MO-225 variation BA.
 - This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

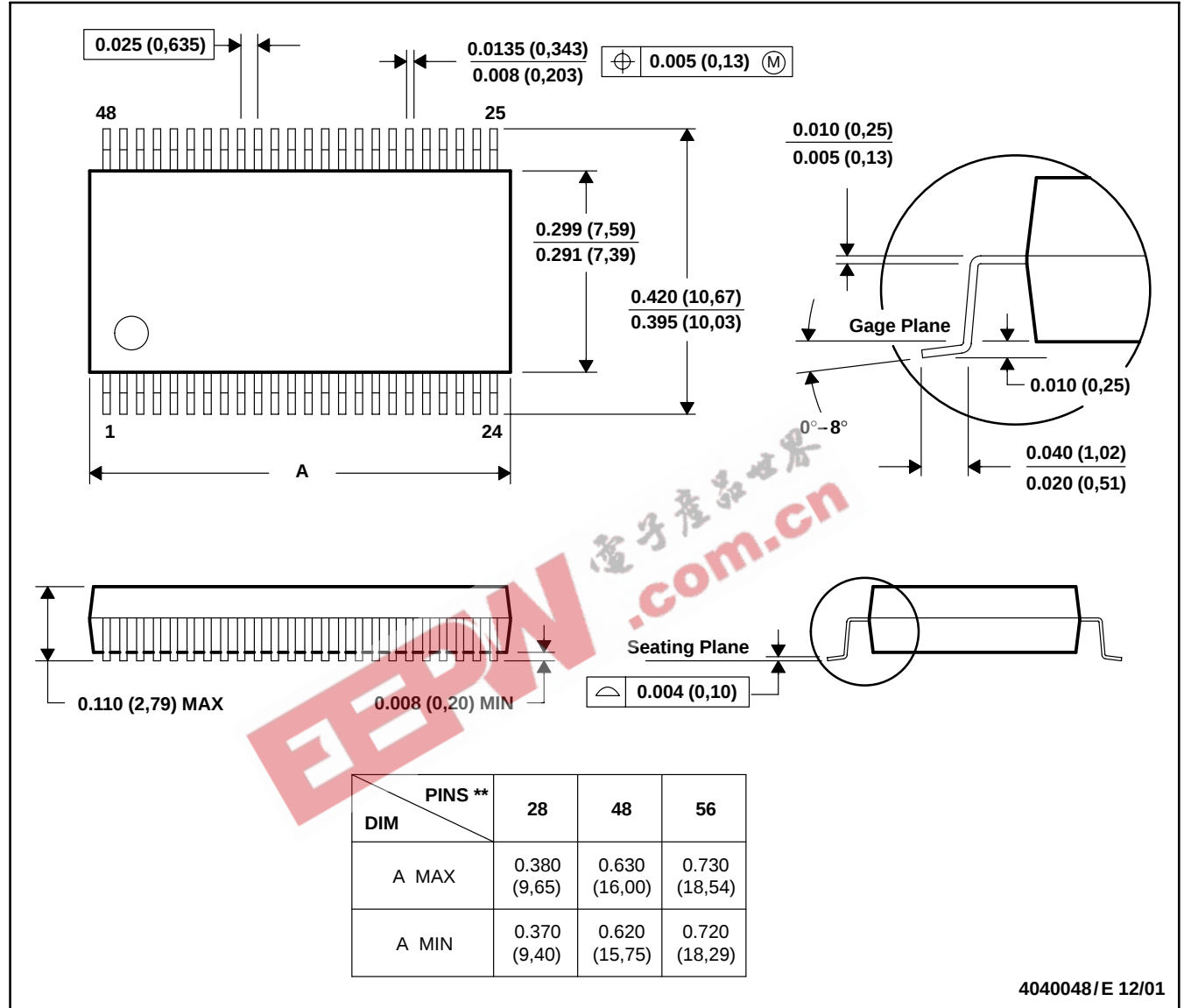
MECHANICAL DATA

MSS0001C – JANUARY 1995 – REVISED DECEMBER 2001

DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MO-118

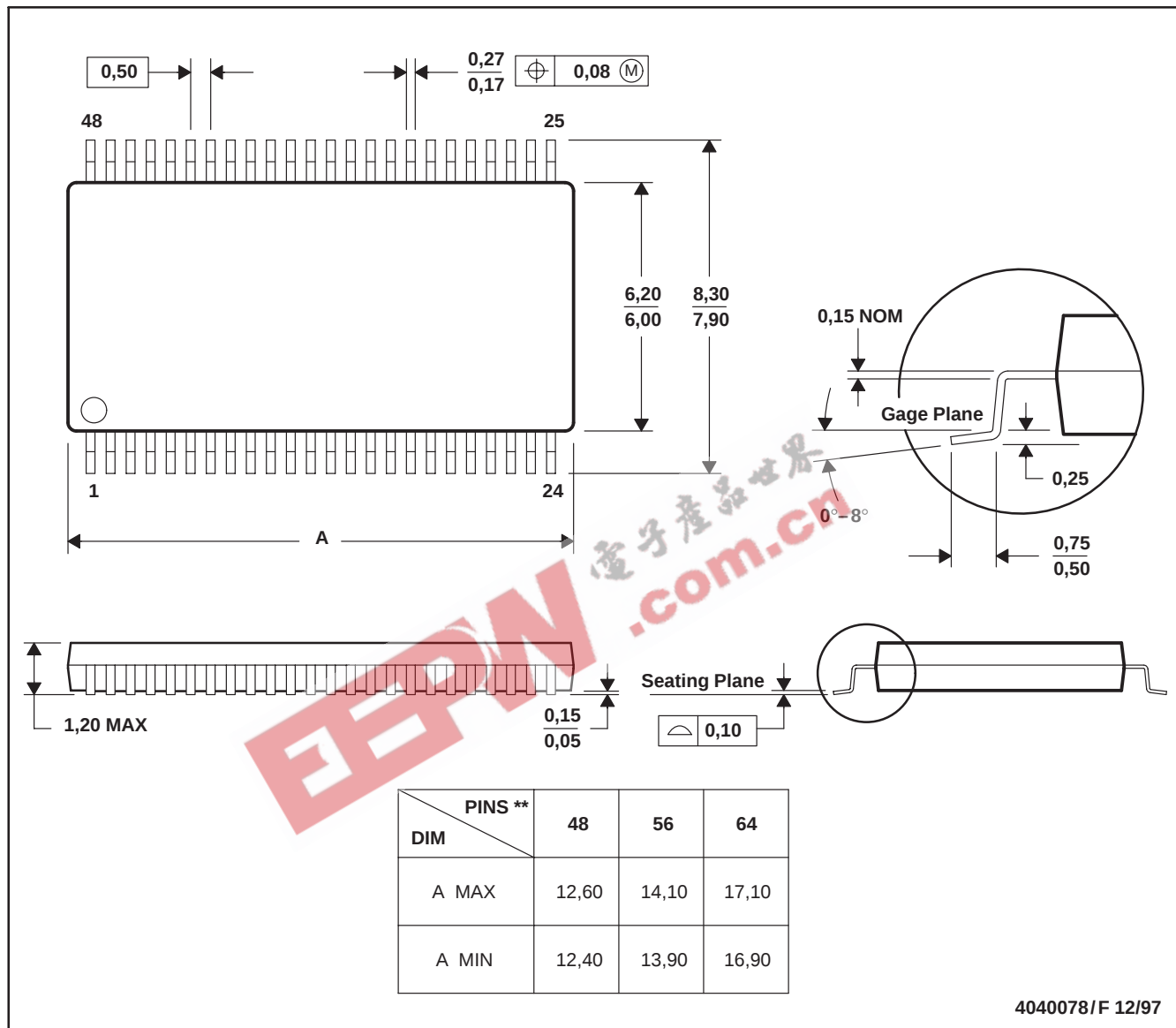
MECHANICAL DATA

MTSS003D – JANUARY 1995 – REVISED JANUARY 1998

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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