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SN54LVTH16244A, SN74LVTH16244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS
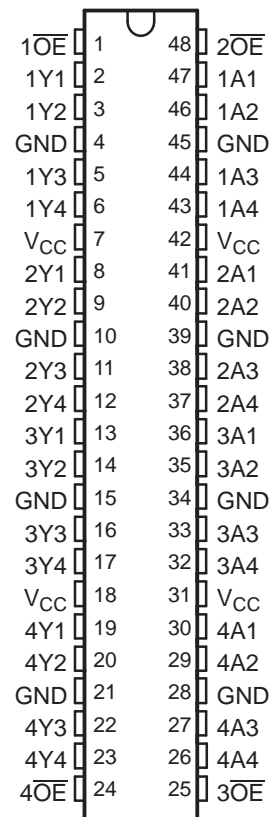SCBS142T−MAY 1992−REVISED NOVEMBER 2006

FEATURES

- **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°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)

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 '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.

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.

![warning triangle icon] 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.

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ORDERING INFORMATION

T_A	PACKAGE[1]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	FBGA – GRD	Reel of 1000	SN74LVTH16244AGRDR	LL244A
	FBGA – ZRD (Pb-free)		SN74LVTH16244AZRDR	
	SSOP – DL	Tube of 25	SN74LVTH16244ADL	LVTH16244A
			SN74LVTH16244ADLG4	
		Reel of 1000	SN74LVTH16244ADLR	
			74LVTH16244ADLRG4	
	TSSOP – DGG	Reel of 2000	SN74LVTH16244ADGGR	LVTH16244A
			74LVTH16244ADGGRE4	
			74LVTH16244ADGGRG4	
	TVSOP – DGV	Reel of 2000	SN74LVTH16244ADGVR	LL244A
			74LVTH16244ADGVRE4	
	VFBGA – GQL	Reel of 1000	SN74LVTH16244AGQLR	LL244A
	VFBGA – ZQL (Pb-free)		SN74LVTH16244AZQLR	
−55°C to 125°C	CFP – WD	Tube	SNJ54LVTH16244AWD	SNJ54LVTH16244AWD

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
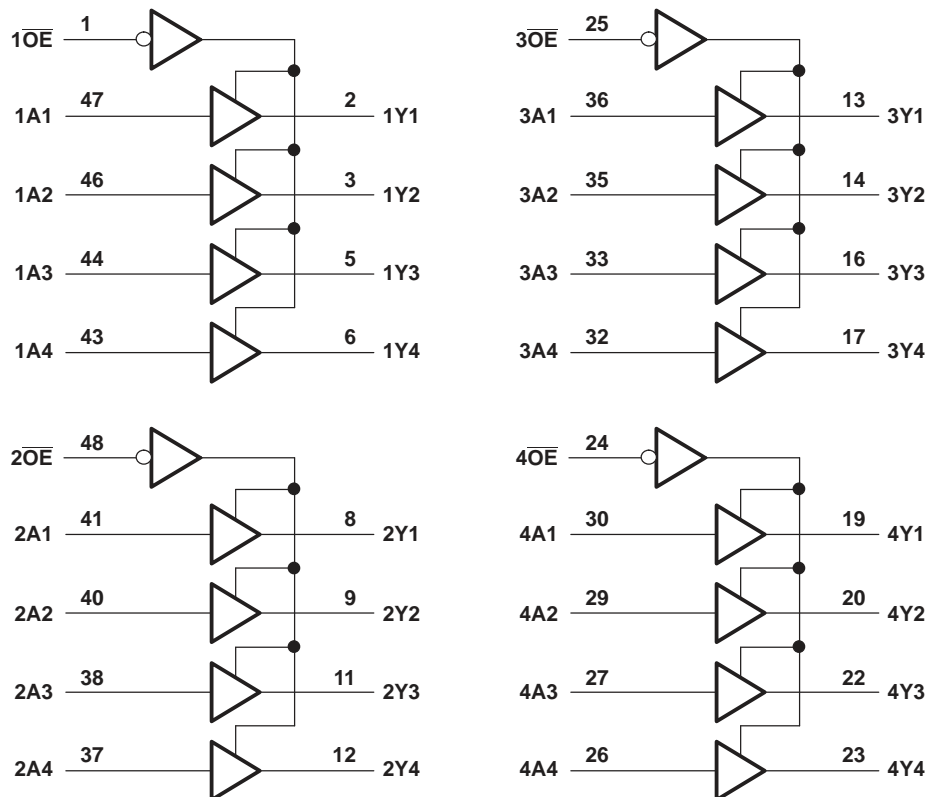
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3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

SCBS142T−MAY 1992−REVISED NOVEMBER 2006

GQL OR ZQL PACKAGE
(TOP VIEW)
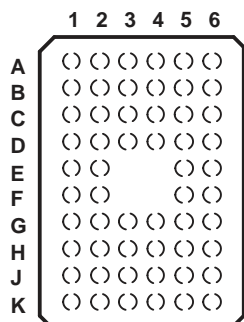
TERMINAL ASSIGNMENTS[1]
(56-Ball GQL/ZQL Package)

	1	2	3	4	5	6
A	1$\overline{\text{OE}}$	NC	NC	NC	NC	2$\overline{\text{OE}}$
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	4$\overline{\text{OE}}$	NC	NC	NC	NC	3$\overline{\text{OE}}$

(1) NC – No internal connection

GRD OR ZRD PACKAGE
(TOP VIEW)
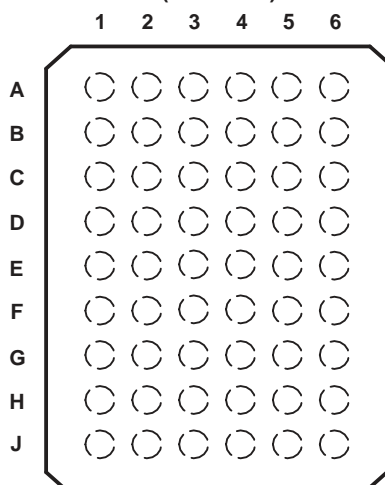
TERMINAL ASSIGNMENTS[1]
(54-Ball GRD/ZRD Package)

	1	2	3	4	5	6
A	1Y1	NC	1$\overline{\text{OE}}$	2$\overline{\text{OE}}$	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$\overline{\text{OE}}$	3$\overline{\text{OE}}$	NC	4A4

(1) NC – No internal connection

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FUNCTION TABLE
(EACH 4-BIT BUFFER)

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

LOGIC DIAGRAM (POSITIVE LOGIC)

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

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

SCBS142T−MAY 1992−REVISED NOVEMBER 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	
I_O	Current into any output in the low state	SN54LVTH16244A		96	V
		SN74LVTH16244A		128	
I_O	Current into any output in the high state [3]	SN54LVTH16244A		48	V
		SN74LVTH16244A		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 clamp-current ratings are observed.
(3) The 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]

			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			−25		−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		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.

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Electrical Characteristics

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

PARAMETER		TEST CONDITIONS		SN54LVTH16244A MIN TYP[1] MAX	SN74LVTH16244A MIN TYP[1] MAX	UNIT
V_{IK}		V_{CC} = 2.7 V,	I_I = −18 mA	−1.2	−1.2	V
V_{OH}		V_{CC} = 2.7 V to 3.6 V,	I_{OL} = −100 µA	V_{CC} − 0.2	V_{CC} − 0.2	V
		V_{CC} = 2.7 V,	I_{OH} = −8 mA	2.4	2.4	
		V_{CC} = 3 V	I_{OH} = −24 mA	2		
			I_{OH} = −32 mA		2	
V_{OL}		V_{CC} = 2.7 V	I_{OL} = 100 µA	0.2	0.2	V
			I_{OL} = 24 mA	0.5	0.5	
		V_{CC} = 3 V	I_{OL} = 16 mA	0.4	0.4	
			I_{OL} = 32 mA	0.5	0.5	
			I_{OL} = 48 mA	0.55		
			I_{OL} = 64 mA		0.55	
I_I		V_{CC} = 0 or 3.6 V,	V_I = 5.5 V	50	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
$I_{I(hold)}$	Data inputs	V_{CC} = 3 V	V_I = 0.8 V	75	75	µA
			V_I = 2 V	−75	−75	
		V_{CC} = 3.6 V[2],	V_I = 0 to 3.6 V		500 − 750	
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, $\overline{OE}$ = don't care		±100[3]	±100	µA
I_{OZPD}		V_{CC} = 1.5 V to 0, V_O = 0.5 V to 3 V, $\overline{OE}$ = 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 V		4	4	pF
C_o		V_O = 3 V or 0 V		9	9	pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.
(3) On products compliant to MIL-PRF-38535, this parameter does not apply.
(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.
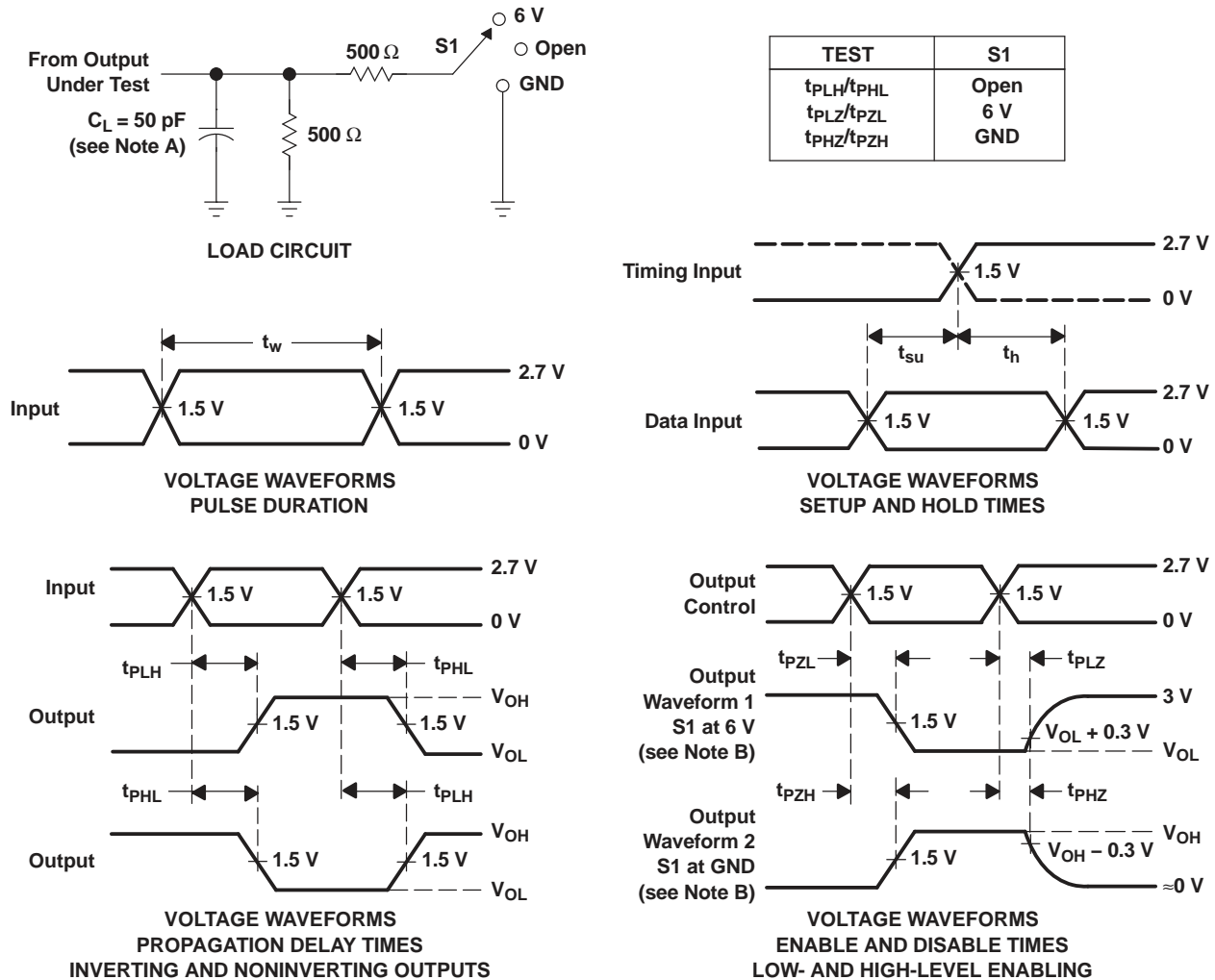
Switching Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH16244A V_{CC} = 3.3 V ± 0.3 V MIN	MAX	V_{CC} = 2.7 V MIN	MAX	SN74LVTH16244A V_{CC} = 3.3 V ± 0.3 V MIN	TYP[1]	MAX	V_{CC} = 2.7 V MIN	MAX	UNIT
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	
$t_{sk(LH)}$									0.5			ns
$t_{sk(HL)}$									0.5			

(1)   All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

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PARAMETER MEASUREMENT INFORMATION

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

LOAD CIRCUIT

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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 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 [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/ Ball Finish	MSL Peak Temp [3]	Samples (Requires Login)
5962-9668501QXA	ACTIVE	CFP	WD	48	1	TBD	Call TI	Call TI	
5962-9668501VXA	ACTIVE	CFP	WD	48	1	TBD	A42	N / A for Pkg Type	
74LVTH16244ADGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74LVTH16244ADGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74LVTH16244ADGVRE4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74LVTH16244ADGVRG4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74LVTH16244ADLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVTH16244ADGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVTH16244ADGVR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVTH16244ADL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVTH16244ADLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVTH16244ADLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVTH16244AGQLR	LIFEBUY	BGA MICROSTAR JUNIOR	GQL	56	1000	TBD	SNPB	Level-1-240C-UNLIM	
SN74LVTH16244AGRDR	LIFEBUY	BGA MICROSTAR JUNIOR	GRD	54	1000	TBD	SNPB	Level-1-240C-UNLIM	
SN74LVTH16244AZQLR	ACTIVE	BGA MICROSTAR JUNIOR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	
SN74LVTH16244AZRDR	ACTIVE	BGA MICROSTAR JUNIOR	ZRD	54	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
SNJ54LVTH16244AWD	ACTIVE	CFP	WD	48	1	TBD	A42	N / A for Pkg Type	

(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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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF SN54LVTH16244A, SN54LVTH16244A-SP, SN74LVTH16244A :

● Catalog: SN74LVTH16244A, SN54LVTH16244A

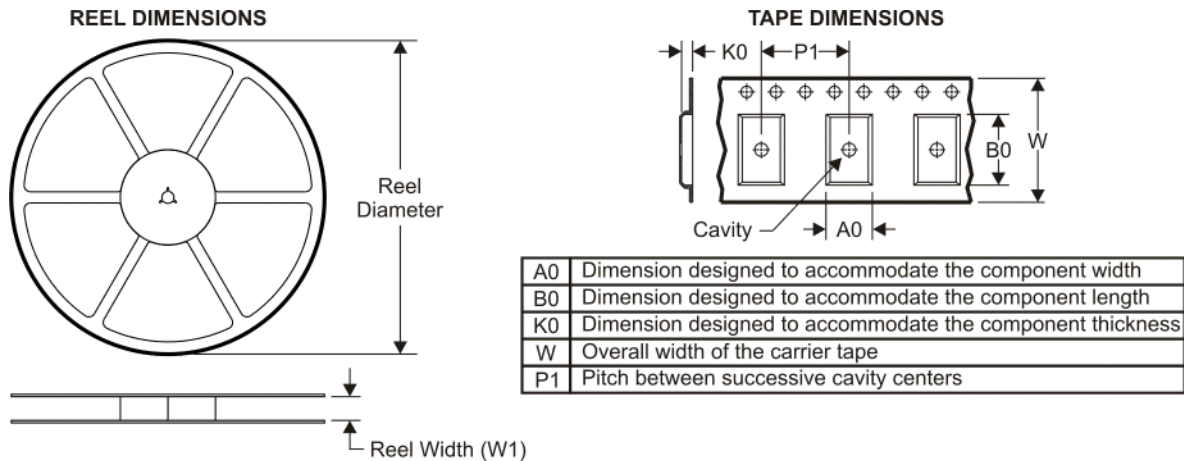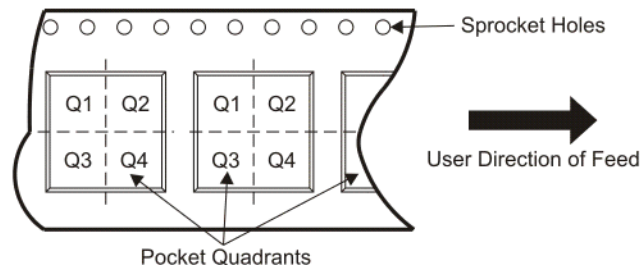● Enhanced Product: SN74LVTH16244A-EP, SN74LVTH16244A-EP

● Military: SN54LVTH16244A

● Space: SN54LVTH16244A-SP

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

- Enhanced Product - Supports Defense, Aerospace and Medical Applications

- Military - QML certified for Military and Defense Applications

- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LVTH16244ADGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
SN74LVTH16244ADGVR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1
SN74LVTH16244ADLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1
SN74LVTH16244AGQLR	BGA MICROSTAR JUNIOR	GQL	56	1000	330.0	16.4	4.8	7.3	1.45	8.0	16.0	Q1
SN74LVTH16244AGRDR	BGA MICROSTAR JUNIOR	GRD	54	1000	330.0	16.4	5.8	8.3	1.55	8.0	16.0	Q1
SN74LVTH16244AZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	330.0	16.4	4.8	7.3	1.45	8.0	16.0	Q1
SN74LVTH16244AZRDR	BGA MICROSTAR JUNIOR	ZRD	54	1000	330.0	16.4	5.8	8.3	1.55	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVTH16244ADGGR	TSSOP	DGG	48	2000	346.0	346.0	41.0
SN74LVTH16244ADGVR	TVSOP	DGV	48	2000	346.0	346.0	33.0
SN74LVTH16244ADLR	SSOP	DL	48	1000	346.0	346.0	49.0
SN74LVTH16244AGQLR	BGA MICROSTAR JUNIOR	GQL	56	1000	333.2	345.9	28.6
SN74LVTH16244AGRDR	BGA MICROSTAR JUNIOR	GRD	54	1000	333.2	345.9	28.6
SN74LVTH16244AZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	333.2	345.9	28.6
SN74LVTH16244AZRDR	BGA MICROSTAR JUNIOR	ZRD	54	1000	333.2	345.9	28.6

WD (R-GDFP-F**)   CERAMIC DUAL FLATPACK

48 LEADS SHOWN
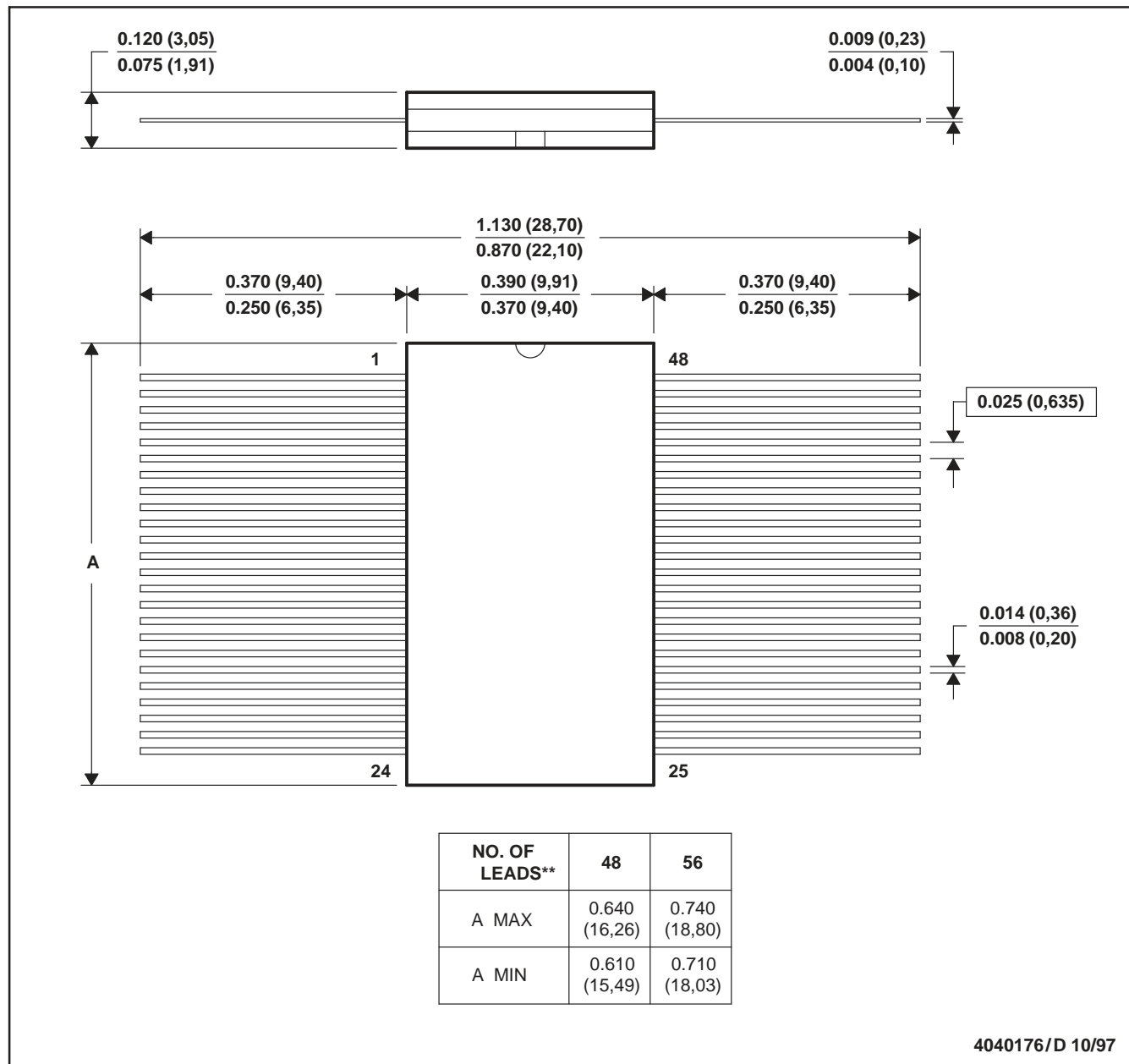
0.120 (3,05)
0.075 (1,91)

0.009 (0,23)
0.004 (0,10)

1.130 (28,70)
0.870 (22,10)

0.370 (9,40)
0.250 (6,35)

0.390 (9,91)
0.370 (9,40)

0.370 (9,40)
0.250 (6,35)

1   48

0.025 (0,635)

A

0.014 (0,36)
0.008 (0,20)

24   25

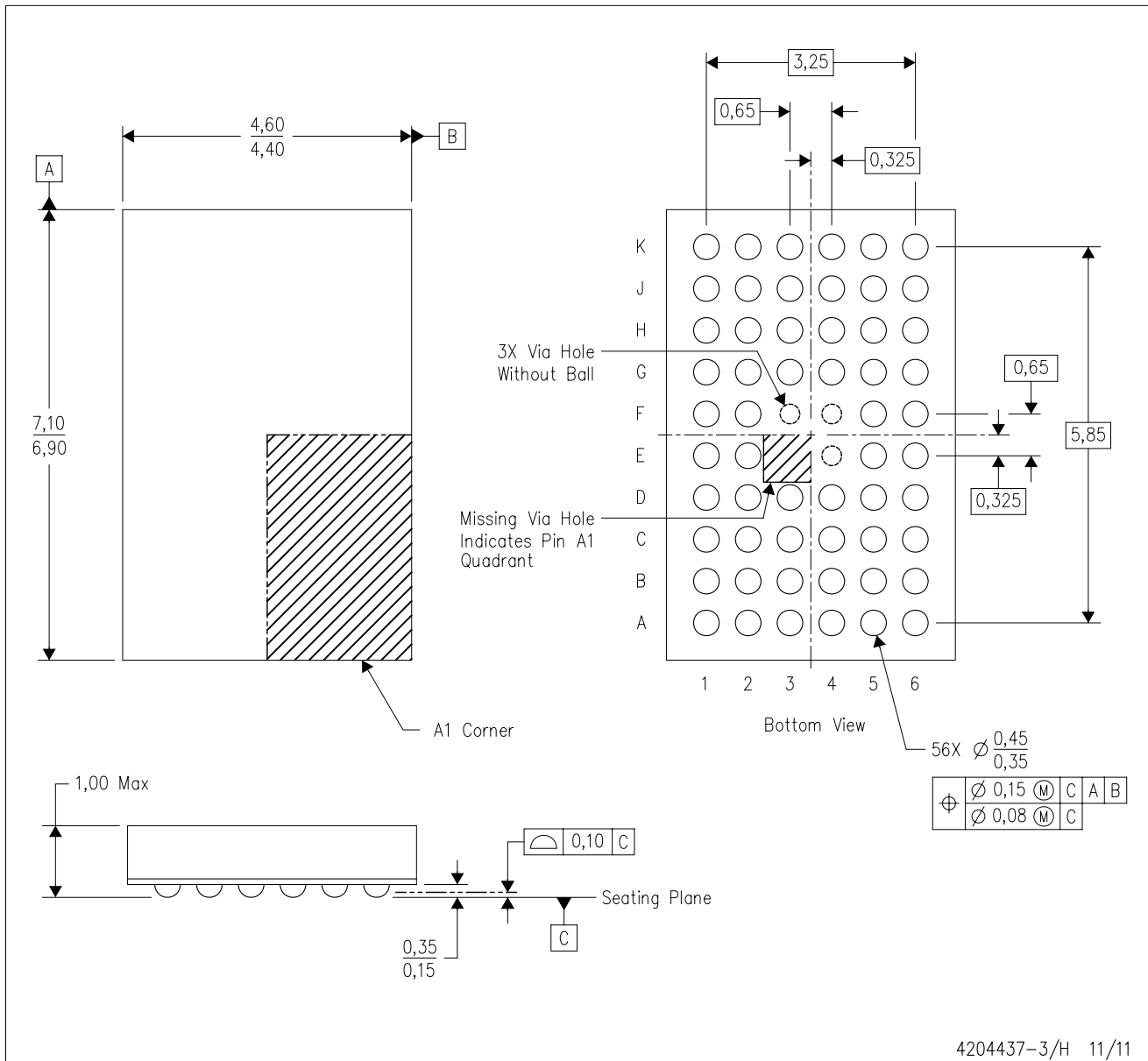| NO. OF LEADS**	48	56
A MAX	0.640 (16,26)	0.740 (18,80)
A MIN	0.610 (15,49)	0.710 (18,03)

4040176/D 10/97

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

TEXAS INSTRUMENTS
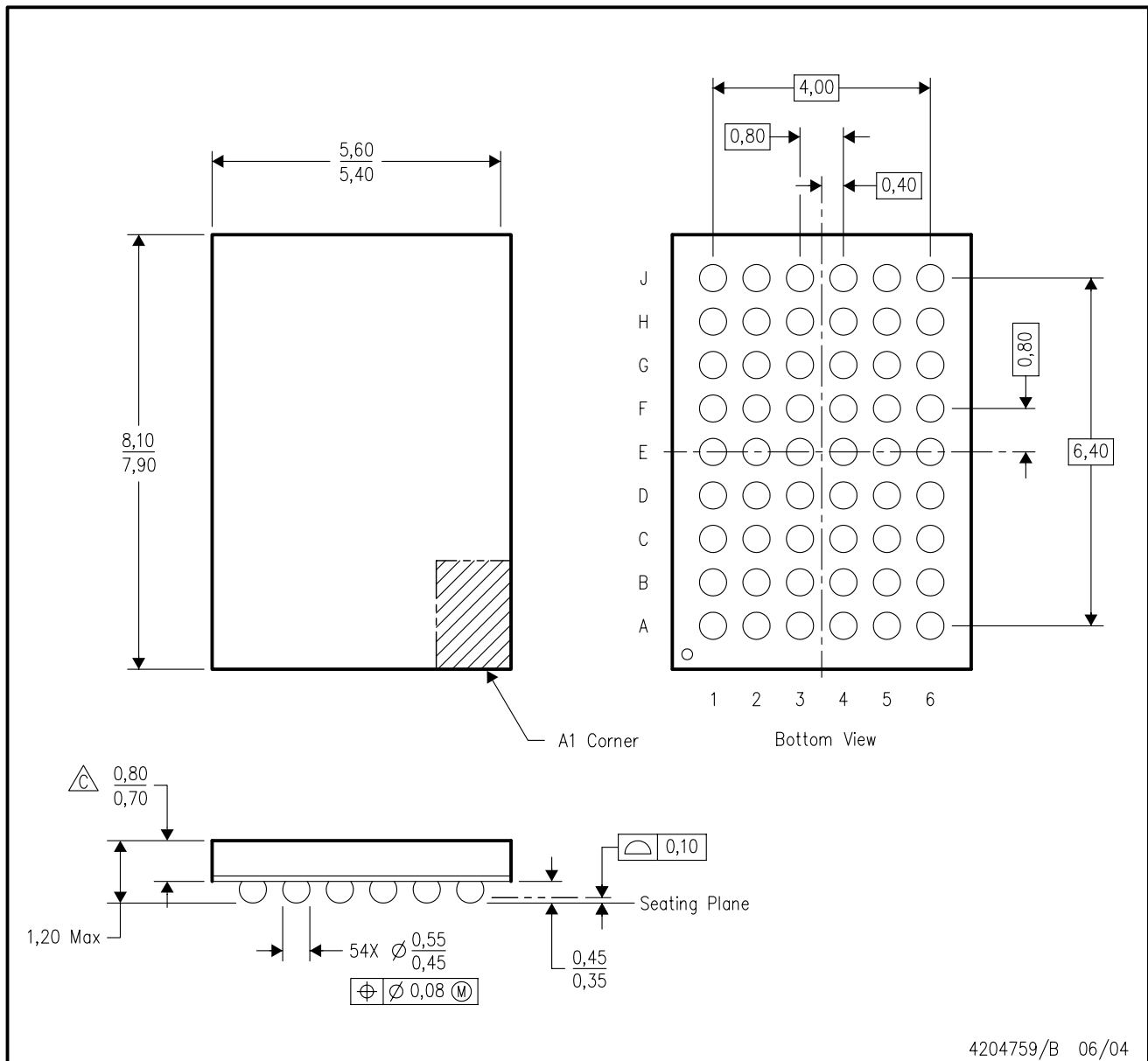
ZQL (R−PBGA−N56)   PLASTIC BALL GRID ARRAY

4,60
4,40   B

A

7,10
6,90

3,25

0,65

0,325

K
J
H
G
F
E
D
C
B
A

3X Via Hole
Without Ball

0,65

5,85

0,325

Missing Via Hole
Indicates Pin A1
Quadrant

1 2 3 4 5 6

Bottom View

A1 Corner

56X Ø 0,45
        0,35

1,00 Max

0,10 C

Seating Plane

0,35
0,15

C

⌖ Ø 0,15 Ⓜ C A B
   Ø 0,08 Ⓜ C

4204437−3/H 11/11

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−285 variation BA−2.
         D.   This package is Pb−free. Refer to the 56 GQL package (drawing 4200583) for tin−lead (SnPb).

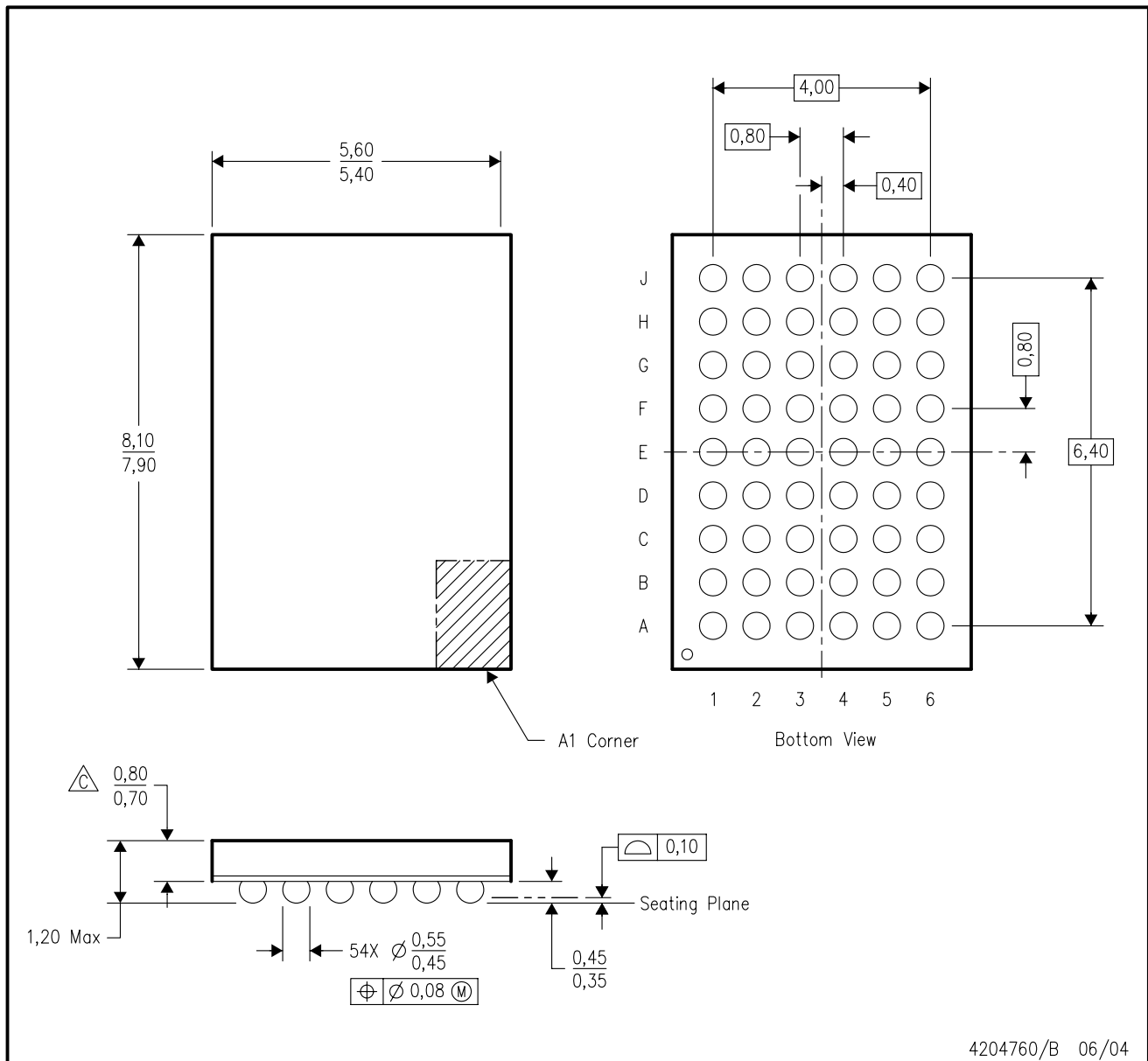**MicroStar Junior is a trademark of Texas Instruments**

GRD (R−PBGA−N54)   PLASTIC BALL GRID ARRAY

4,00

0,80

0,40

5,60
5,40

8,10
7,90

J
H
G
F
E
D
C
B
A

0,80

6,40

1   2   3   4   5   6

Bottom View

A1 Corner

C 0,80
   0,70

0,10

Seating Plane

1,20 Max

54X Ø 0,55
         0,45

0,45
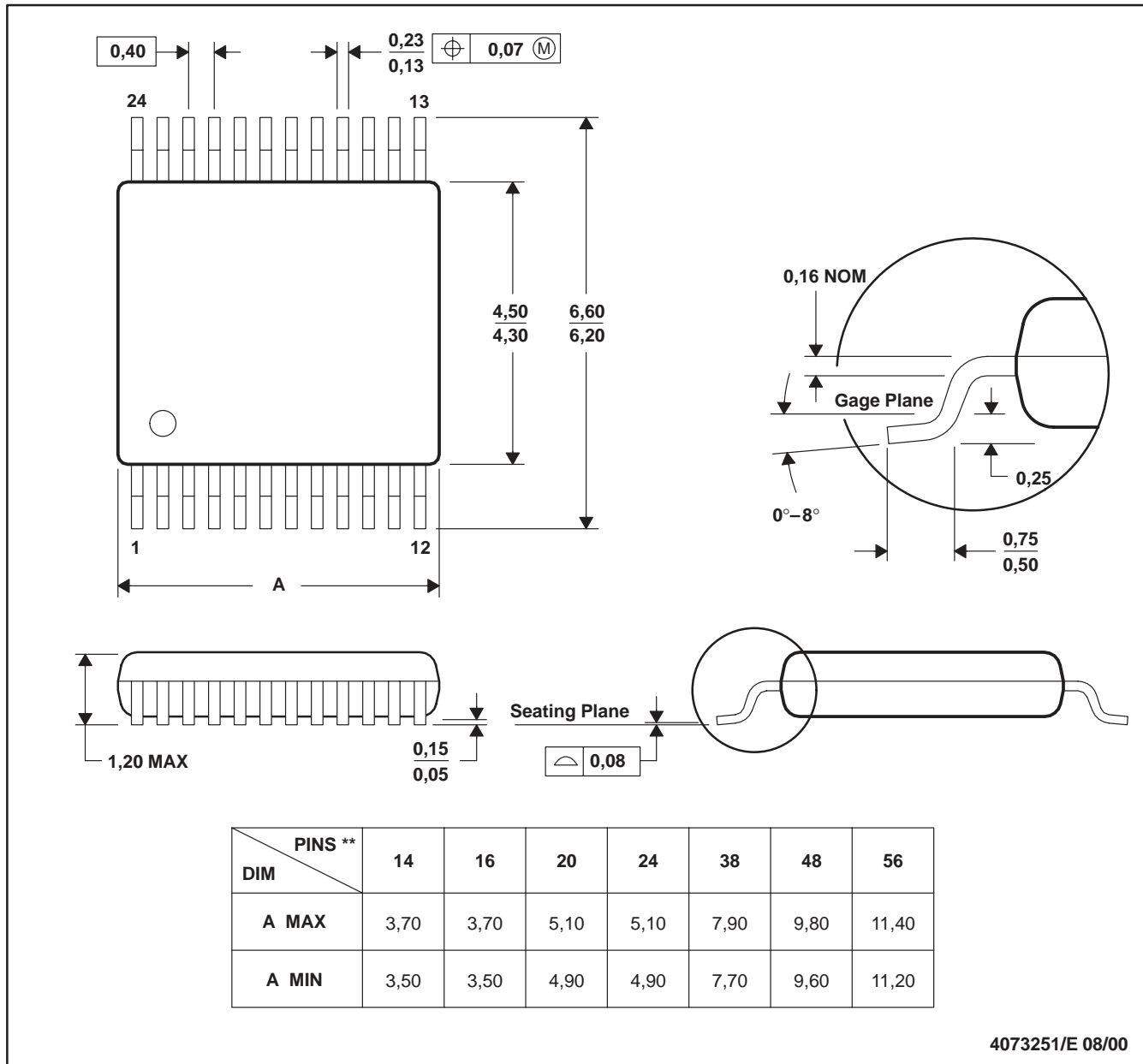0,35

⊕ Ø 0,08 Ⓜ

4204759/B 06/04

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

A1 Corner

Bottom View

1 2 3 4 5 6

J H G F E D C B A

4,00
0,80
0,40
0,80
6,40
5,60 / 5,40
8,10 / 7,90

0,80 / 0,70

1,20 Max

54X ∅ 0,55 / 0,45
⊕ ∅ 0,08 Ⓜ

0,10
Seating Plane
0,45 / 0,35

4204760/B 06/04

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).

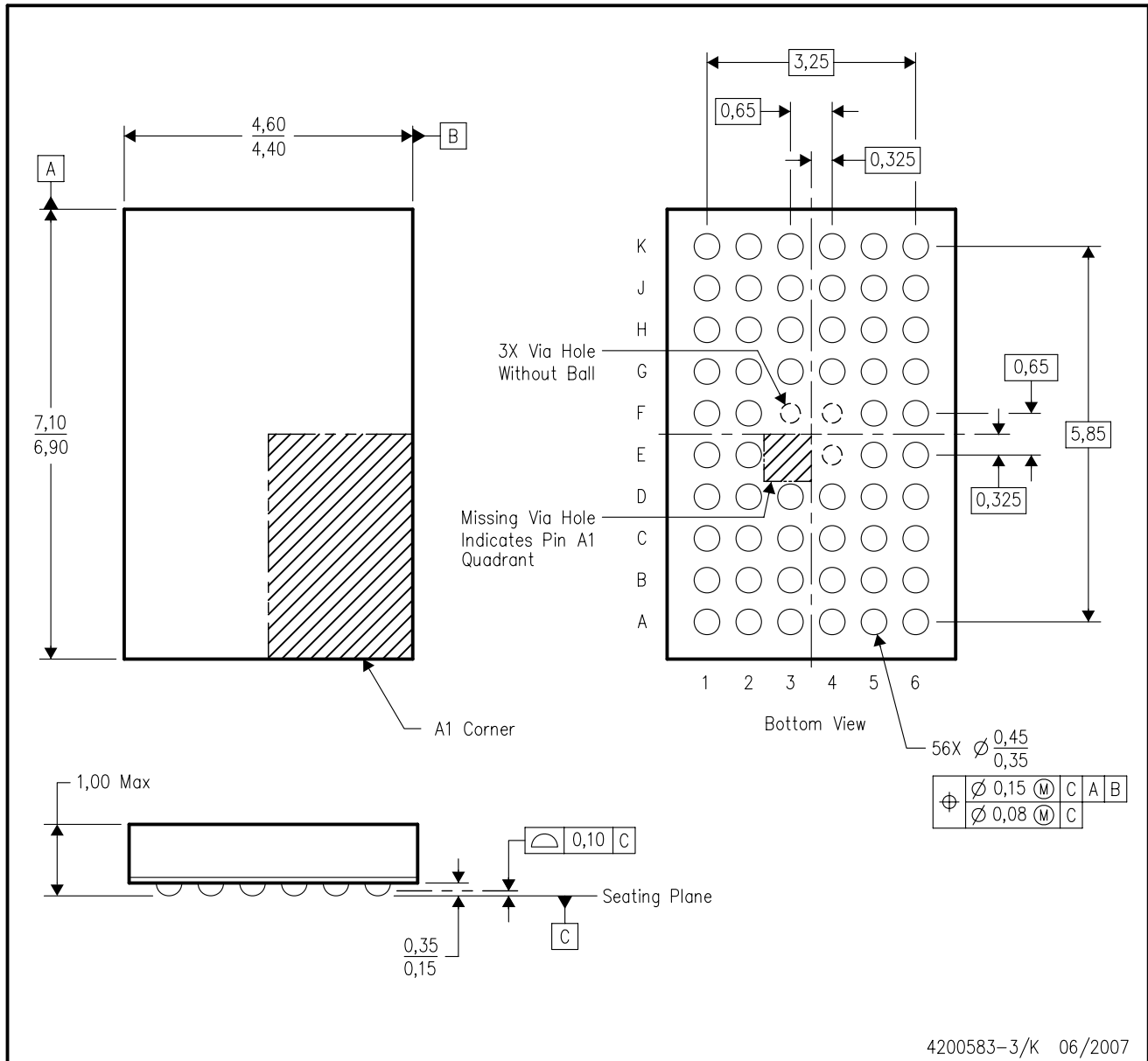**DGV (R-PDSO-G**)**   **PLASTIC SMALL-OUTLINE**

24 PINS SHOWN

0,40

0,23
0,13   ⊕   0,07 Ⓜ

24   13

4,50   6,60
4,30   6,20

0,16 NOM

Gage Plane

0°−8°

0,25

0,75
0,50

1   12

A

1,20 MAX

0,15
0,05

Seating Plane

△ 0,08

DIM \ PINS **	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

4073251/E 08/00

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
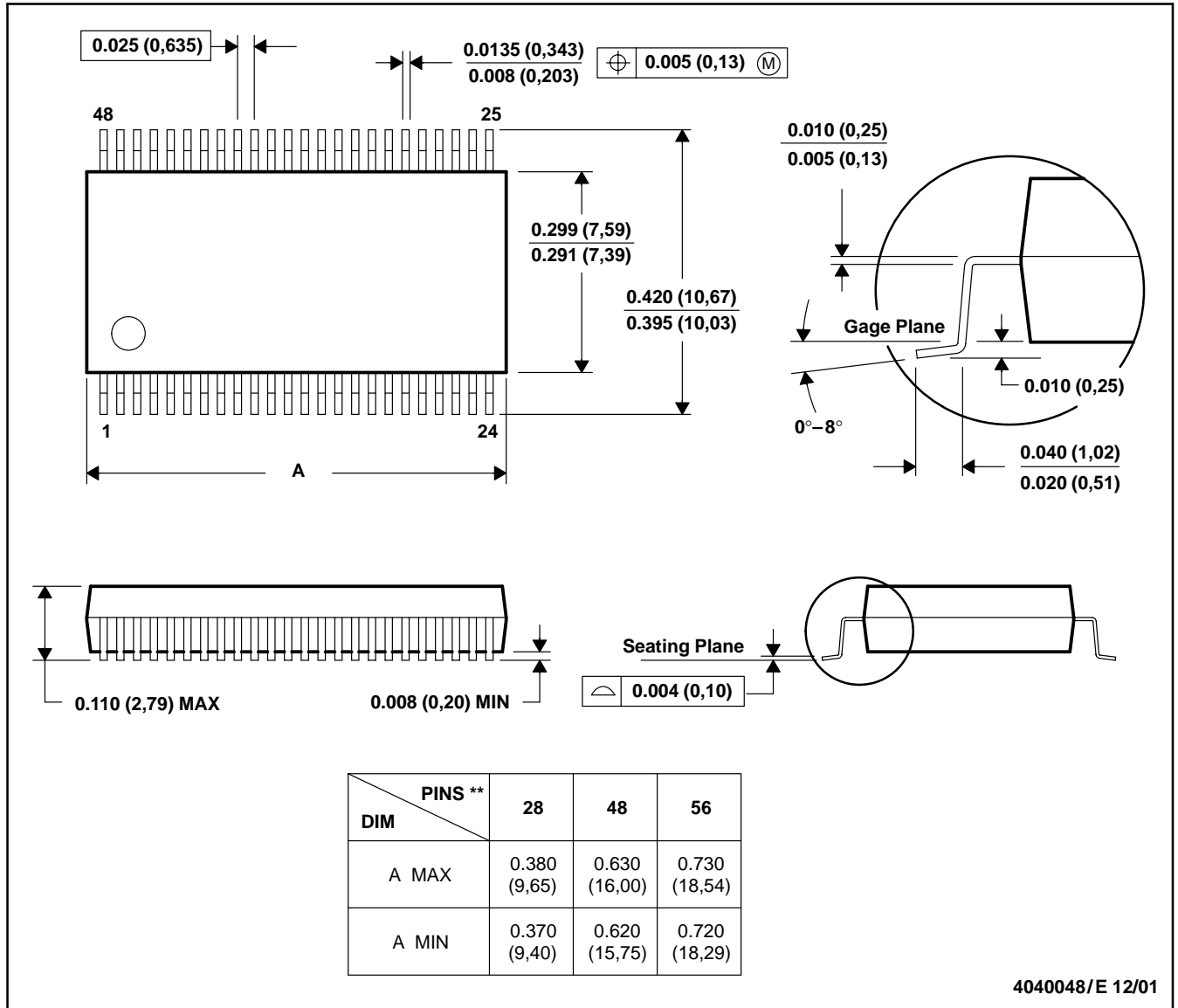
GQL (R−PBGA−N56)   PLASTIC BALL GRID ARRAY

4,60
4,40   B

A

7,10
6,90

A1 Corner

3,25

0,65

0,325

K
J
H
G
F
E
D
C
B
A

1 2 3 4 5 6

3X Via Hole
Without Ball

Missing Via Hole
Indicates Pin A1
Quadrant

0,65

0,325

5,85

Bottom View

56X Ø $\frac{0,45}{0,35}$

⊕	Ø 0,15 Ⓜ	C	A	B
	Ø 0,08 Ⓜ	C		

1,00 Max

0,10 C

Seating Plane

0,35
0,15

C

4200583−3/K 06/2007

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−285 variation BA−2.
         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

PINS **	28	48	56
DIM			
A MAX	0.380 (9,65)	0.630 (16,00)	0.730 (18,54)
A MIN	0.370 (9,40)	0.620 (15,75)	0.720 (18,29)

4040048 / E 12/01

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
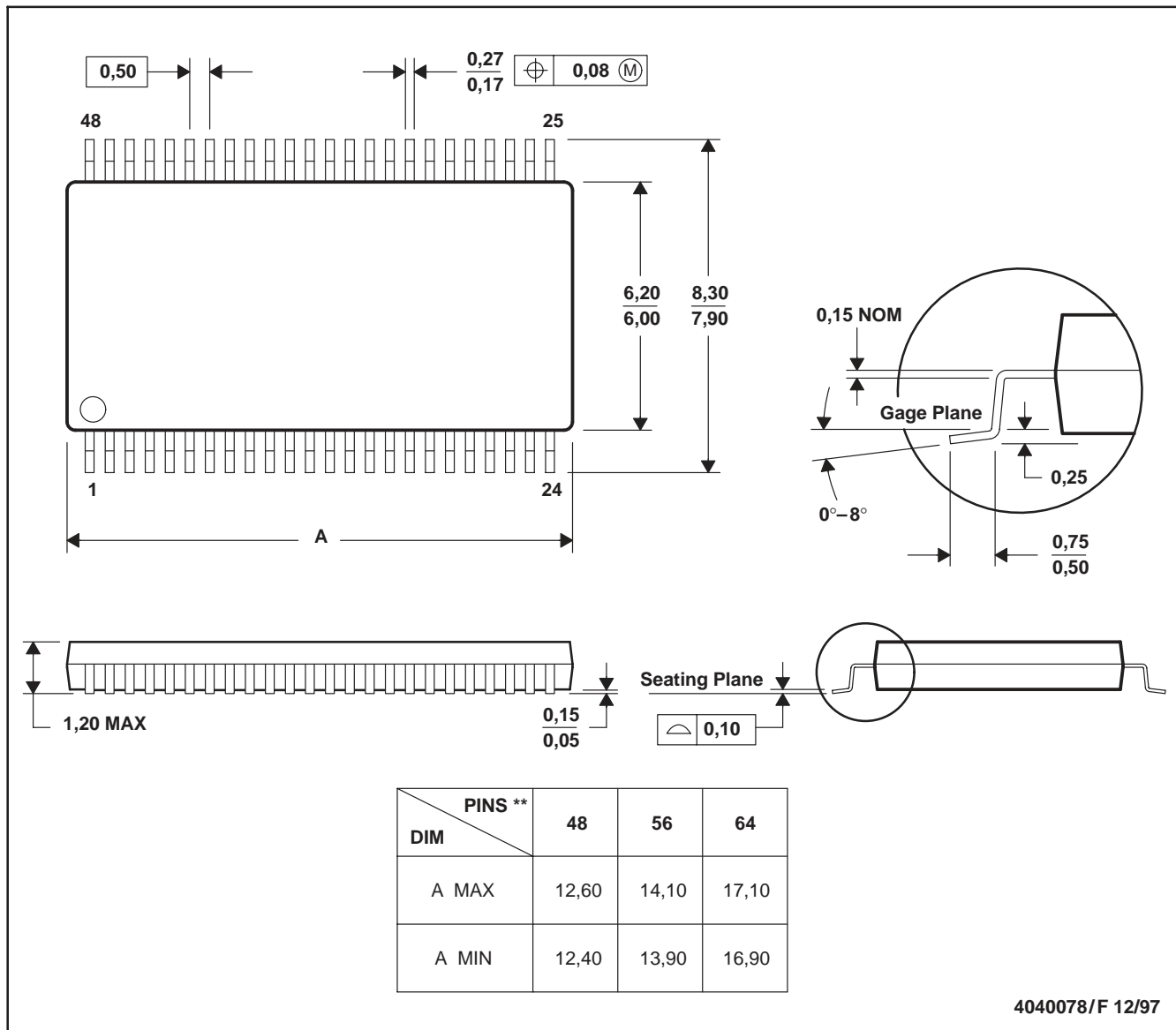
48 PINS SHOWN

PINS ** DIM	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

4040078 / F 12/97

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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