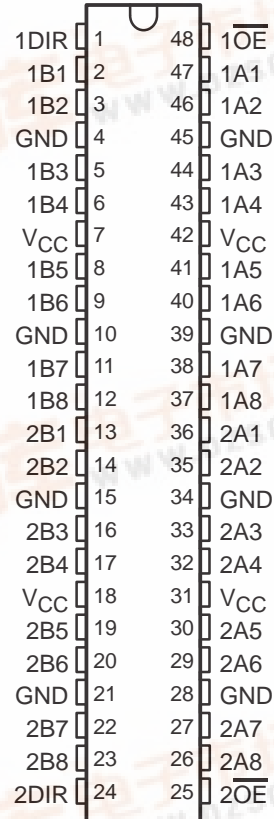


# 3.3-V ABT 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS143P – MAY 1992 – REVISED SEPTEMBER 2003

- **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<sub>CC</sub>)**
- **Support Unregulated Battery Operation Down to 2.7 V**
- **Typical V<sub>OLP</sub> (Output Ground Bounce) <0.8 V at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C**
- **Distributed V<sub>CC</sub> and GND Pins Minimize High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **I<sub>off</sub> 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)

SN54LVTH16245A . . . WD PACKAGE  
SN74LVTH16245A . . . DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



## description/ordering information

The 'LVTH16245A devices are 16-bit (dual-octal) noninverting 3-state transceivers designed for low-voltage (3.3-V) V<sub>CC</sub> operation, but with the capability to provide a TTL interface to a 5-V system environment.

## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74LVTH16245ADL	LVTH16245A
		Tape and reel	SN74LVTH16245ADLR	
	TSSOP – DGG	Tape and reel	SN74LVTH16245ADGGR	LVTH16245A
	TVSOP – DGV	Tape and reel	SN74LVTH16245ADGVR	LL245A
	VFBGA – GQL	Tape and reel	SN74LVTH16245AGQLR	LL245A
SN74LVTH16245AZQLR				
–55°C to 125°C	CFP – WD	Tube	SNJ54LVTH16245AWD	SNJ54LVTH16245AWD

† 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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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# SN54LVTH16245A, SN74LVTH16245A

## 3.3-V ABT 16-BIT BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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#### description/ordering information (continued)

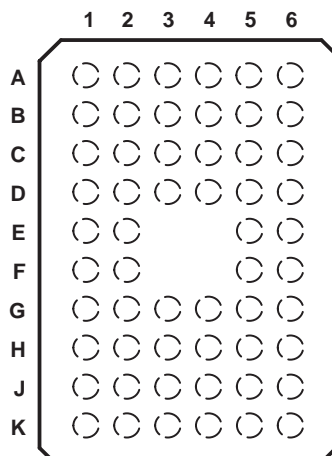
These devices can be used as two 8-bit transceivers or one 16-bit transceiver. They allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable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

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.

GQL OR ZQL PACKAGE  
(TOP VIEW)



#### terminal assignments

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

NC – No internal connection

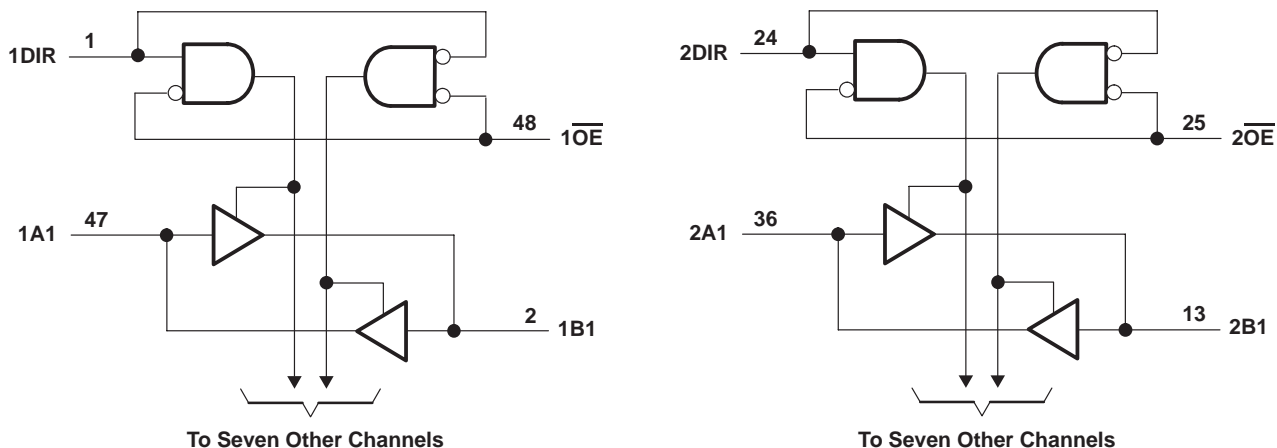
FUNCTION TABLE  
(each 8-bit section)

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

# SN54LVTH16245A, SN74LVTH16245A 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, $I_O$ : SN54LVTH16245A .....	96 mA
SN74LVTH16245A .....	128 mA
Current into any output in the high state, $I_O$ (see Note 2): SN54LVTH16245A .....	48 mA
SN74LVTH16245A .....	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.

**SN54LVTH16245A, SN74LVTH16245A**  
**3.3-V ABT 16-BIT BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

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

		SN54LVTH16245A		SN74LVTH16245A		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 control inputs of the device must be held 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.

# SN54LVTH16245A, SN74LVTH16245A 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	SN54LVTH16245A			SN74LVTH16245A			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
V <sub>IK</sub>		V <sub>CC</sub> = 2.7 V, I <sub>I</sub> = -18 mA	-1.2			-1.2			V
V <sub>OH</sub>		V <sub>CC</sub> = 2.7 V to 3.6 V, I <sub>OH</sub> = -100 μA	V <sub>CC</sub> -0.2			V <sub>CC</sub> -0.2			V
		V <sub>CC</sub> = 2.7 V, I <sub>OH</sub> = -8 mA	2.4			2.4			
		V <sub>CC</sub> = 3 V	2			2			
V <sub>OL</sub>		V <sub>CC</sub> = 2.7 V	I <sub>OL</sub> = 100 μA		0.2			0.2	V
			I <sub>OL</sub> = 24 mA		0.5			0.5	
		V <sub>CC</sub> = 3 V	I <sub>OL</sub> = 16 mA		0.4			0.4	
			I <sub>OL</sub> = 32 mA		0.5			0.5	
			I <sub>OL</sub> = 48 mA		0.55				
			I <sub>OL</sub> = 64 mA					0.55	
I <sub>I</sub>		Control inputs	V <sub>CC</sub> = 3.6 V, V <sub>I</sub> = V <sub>CC</sub> or GND		±1			±1	μA
			V <sub>CC</sub> = 0 or 3.6 V, V <sub>I</sub> = 5.5 V		10			10	
I <sub>I</sub>		A or B ports‡	V <sub>CC</sub> = 3.6 V	V <sub>I</sub> = 5.5 V		20			20
				V <sub>I</sub> = V <sub>CC</sub>		5			1
				V <sub>I</sub> = 0		-5			-5
I <sub>off</sub>		V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5 V				±100			μA
I <sub>I</sub> (hold)		A or B ports	V <sub>CC</sub> = 3 V	V <sub>I</sub> = 0.8 V		75			75
				V <sub>I</sub> = 2 V		-75			-75
			V <sub>CC</sub> = 3.6 V§, V <sub>I</sub> = 0 to 3.6 V				500 -750		
I <sub>OZPU</sub>		V <sub>CC</sub> = 0 to 1.5 V, V <sub>O</sub> = 0.5 V to 3 V, OE = don't care	±100*			±100			μA
I <sub>OZPD</sub>		V <sub>CC</sub> = 1.5 V to 0, V <sub>O</sub> = 0.5 V to 3 V, OE = don't care	±100*			±100			μA
I <sub>CC</sub>		V <sub>CC</sub> = 3.6 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND	Outputs high		0.19			0.19	mA
			Outputs low		5			5	
			Outputs disabled		0.19			0.19	
ΔI <sub>CC</sub> ¶		V <sub>CC</sub> = 3 V to 3.6, One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND	0.2			0.2			mA
C <sub>i</sub>		V <sub>I</sub> = 3 V or 0	4			4			pF
C <sub>io</sub>		V <sub>O</sub> = 3 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<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

‡ Unused pins at V<sub>CC</sub> or GND.

§ This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

¶ This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V<sub>CC</sub> or GND.

**SN54LVTH16245A, SN74LVTH16245A**  
**3.3-V ABT 16-BIT BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

SCBS143P – MAY 1992 – REVISED SEPTEMBER 2003

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

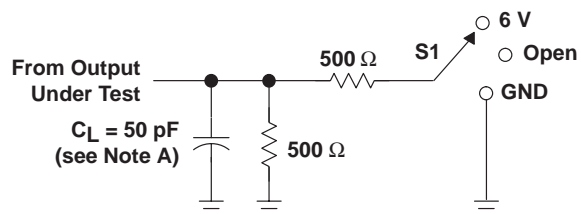
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH16245A				SN74LVTH16245A				UNIT	
			$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CC} = 2.7 \text{ V}$		$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$			$V_{CC} = 2.7 \text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
$t_{PLH}$	A or B	B or A	0.5	4.5	4.6		1.5	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	0.5		ns	

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

# SN54LVTH16245A, SN74LVTH16245A 3.3-V ABT 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

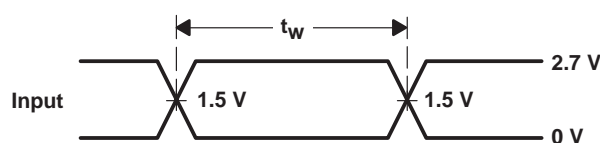
SCBS143P – MAY 1992 – REVISED SEPTEMBER 2003

## PARAMETER MEASUREMENT INFORMATION

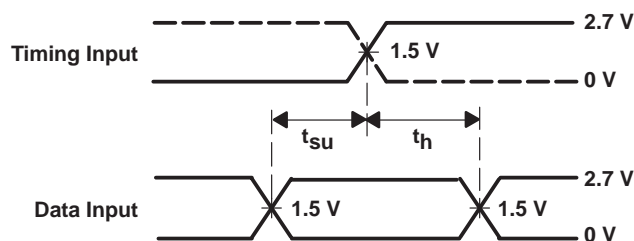


LOAD CIRCUIT

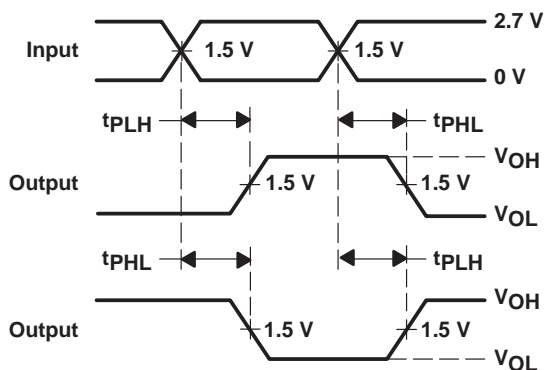
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND



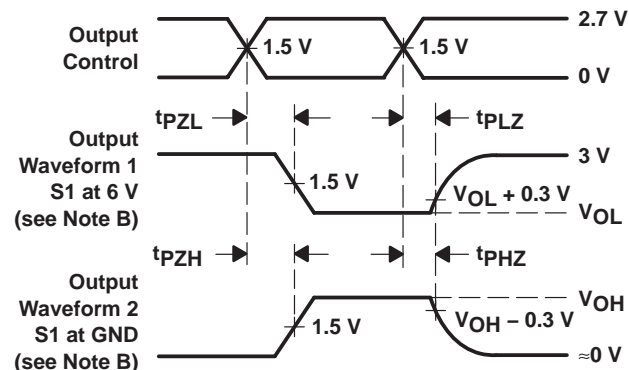
VOLTAGE WAVEFORMS  
PULSE DURATION



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

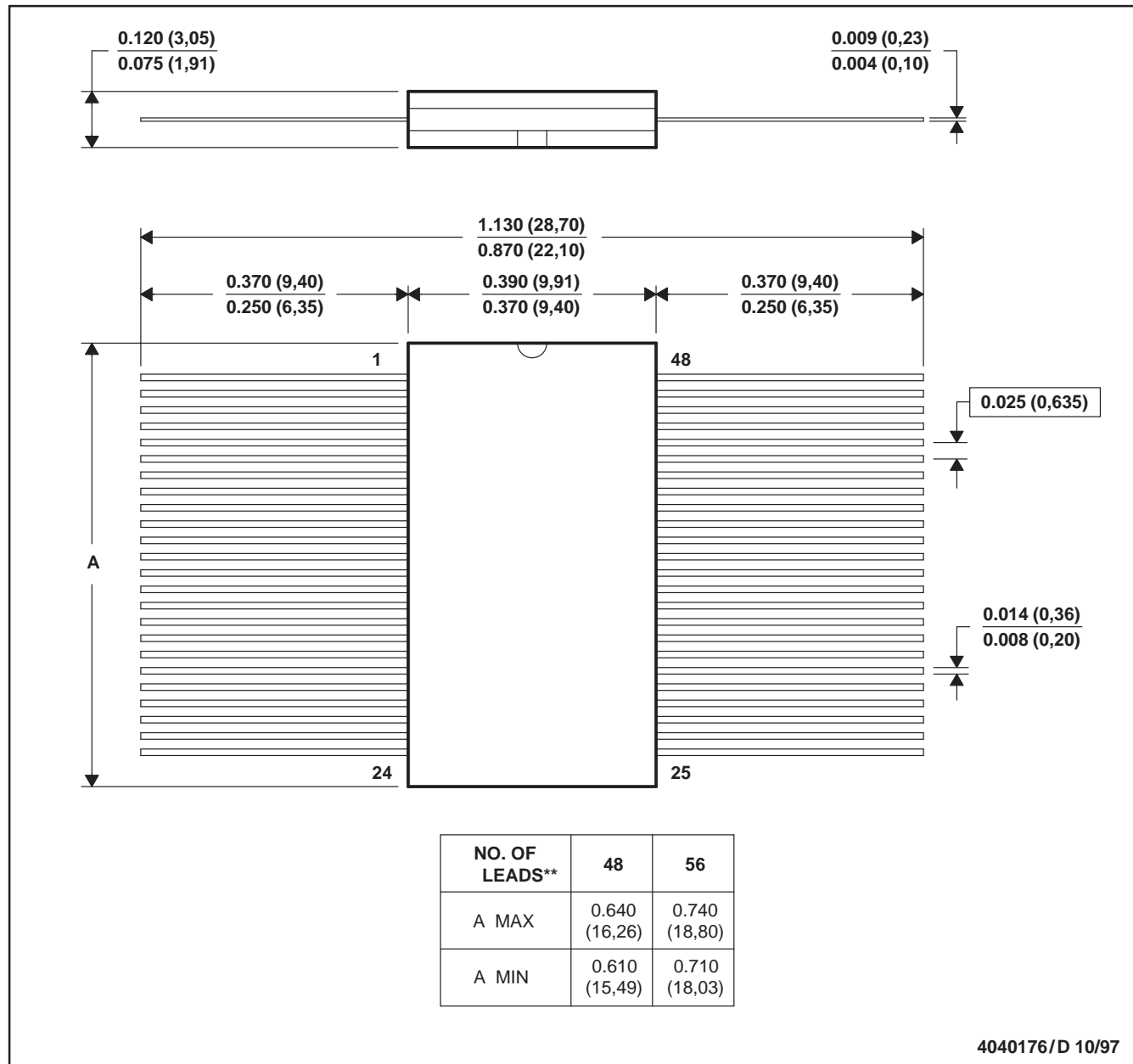
# MECHANICAL DATA

MCFP010B – JANUARY 1995 – REVISED NOVEMBER 1997

WD (R-GDFP-F\*\*)

CERAMIC DUAL FLATPACK

48 LEADS SHOWN



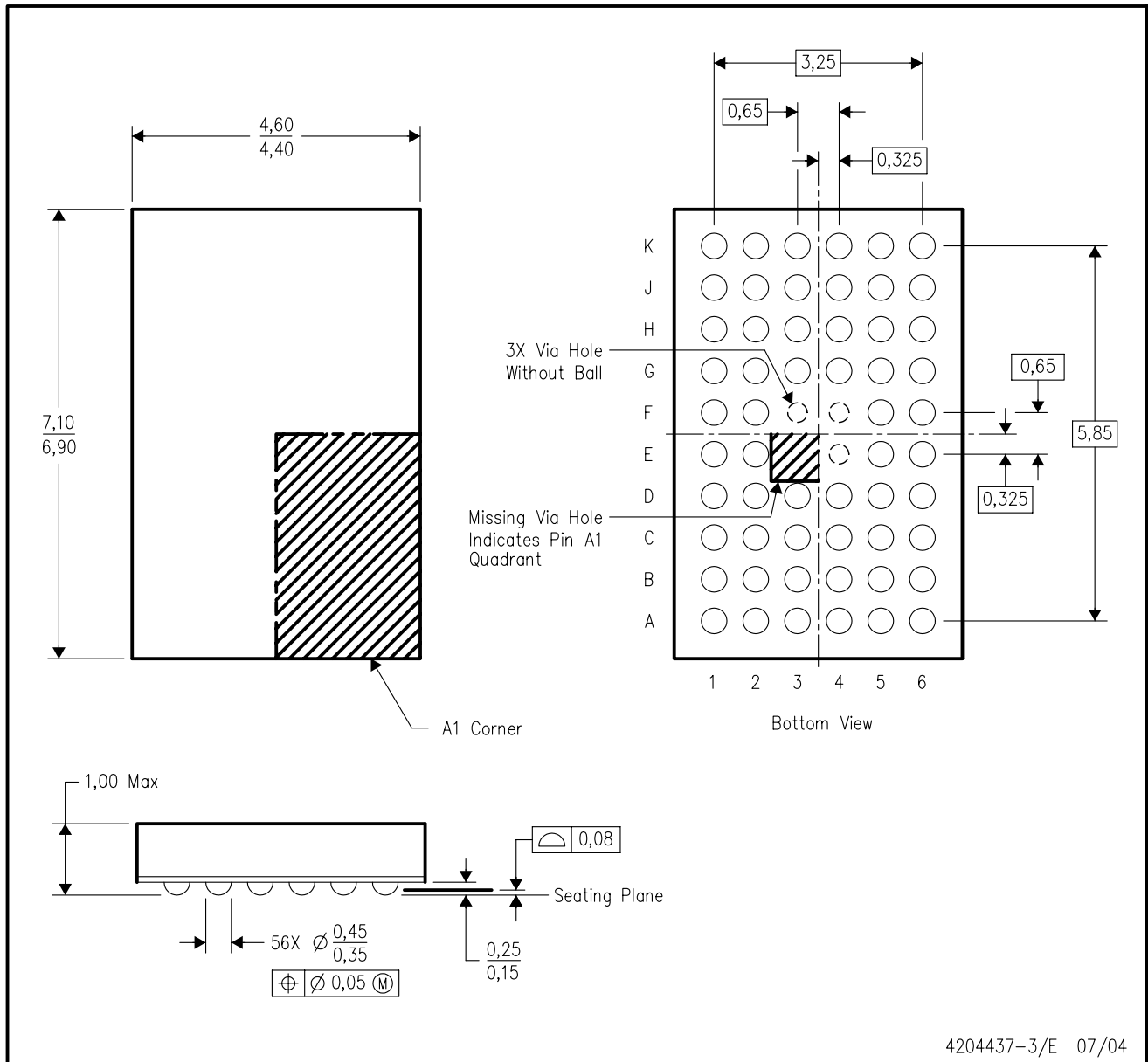
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only
  - E. Falls within MIL STD 1835: GDFP1-F48 and JEDEC MO-146AA  
GDFP1-F56 and JEDEC MO-146AB



# MECHANICAL DATA

ZQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Falls within JEDEC MO-225 variation BA.
  - This package is lead-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

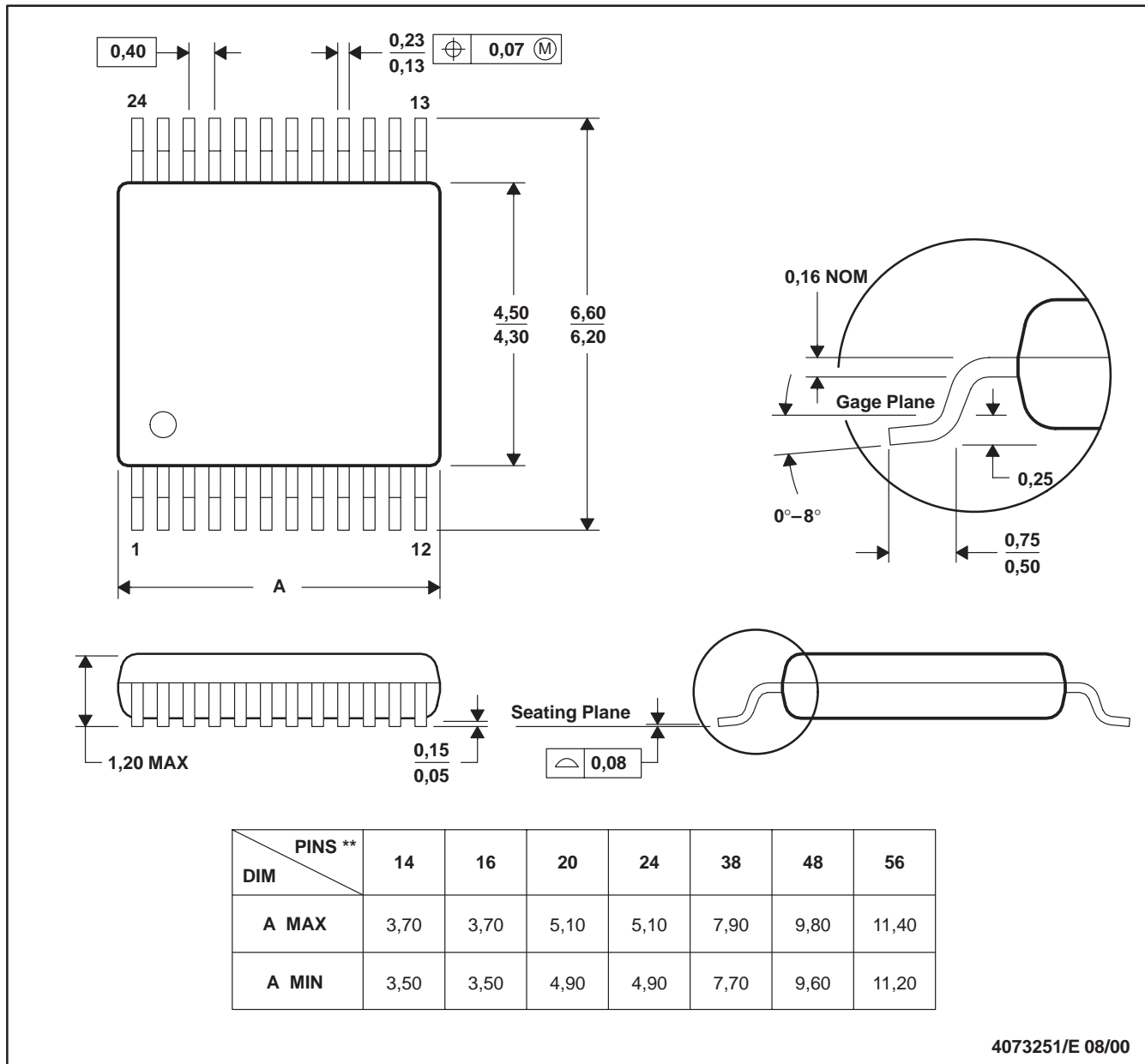
# MECHANICAL DATA

MPDS006C – FEBRUARY 1996 – REVISED AUGUST 2000

## DGV (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

24 PINS SHOWN

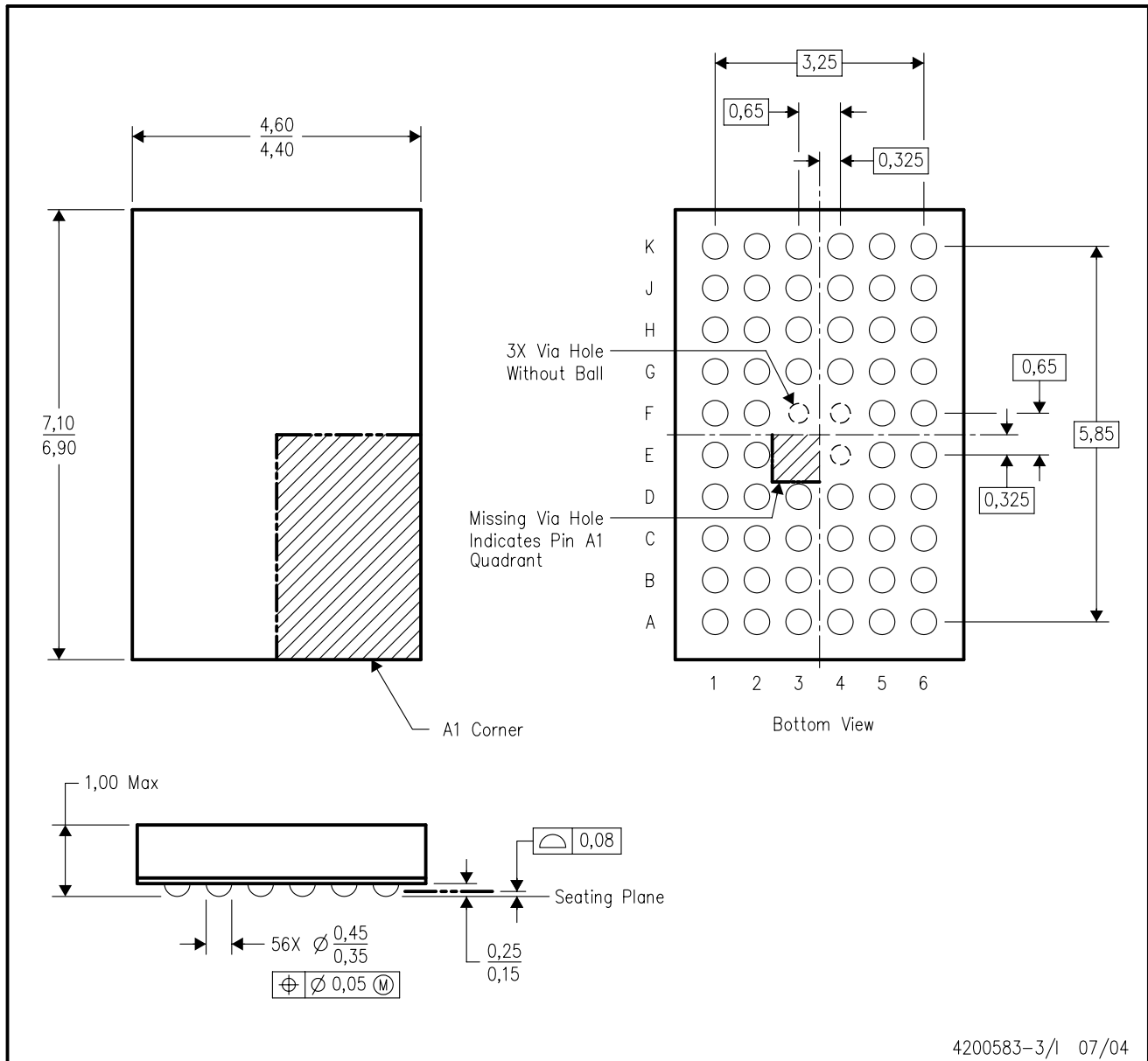


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

# MECHANICAL DATA

GQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



- 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.

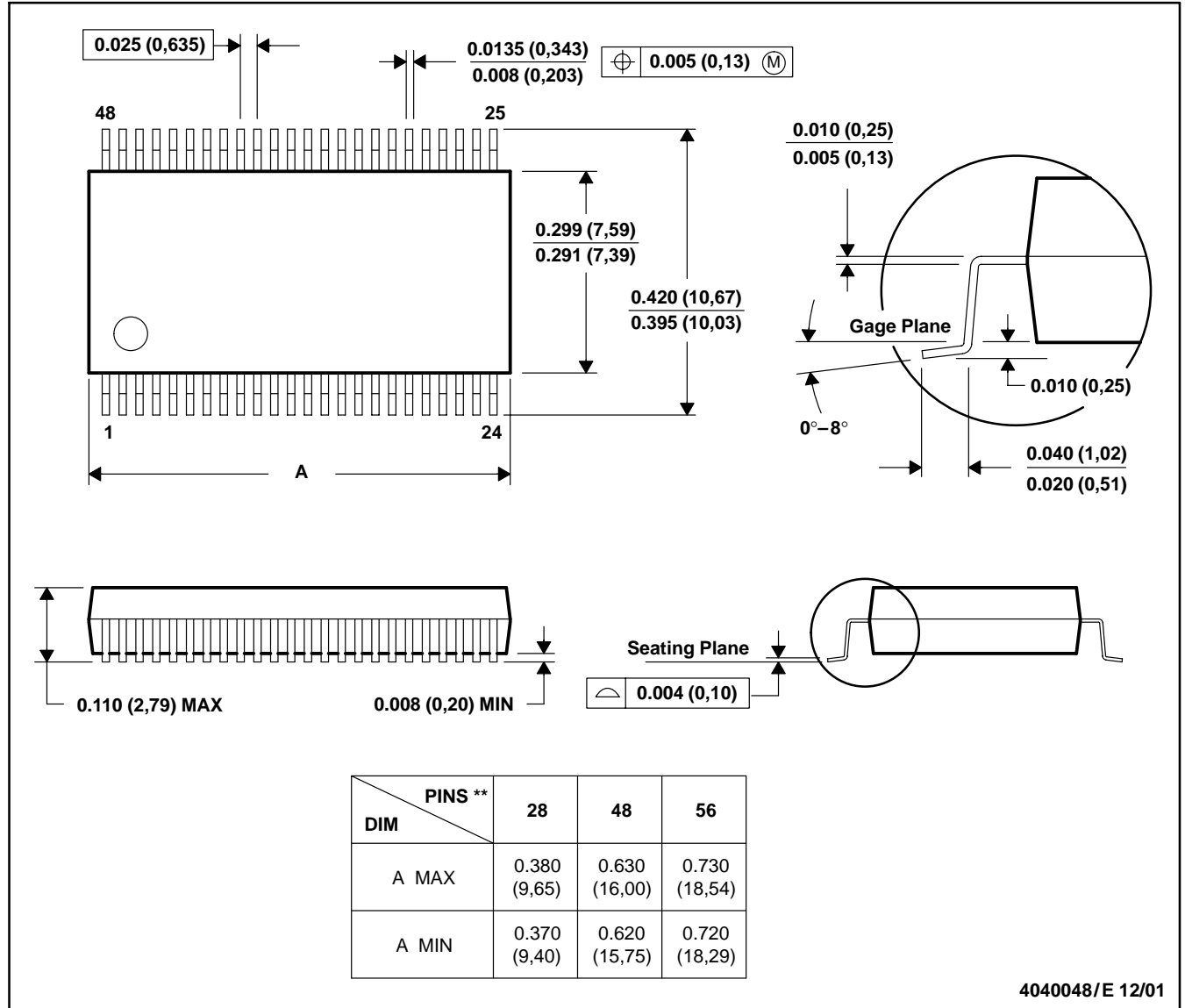
# MECHANICAL DATA

MSS0001C – JANUARY 1995 – REVISED DECEMBER 2001

**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

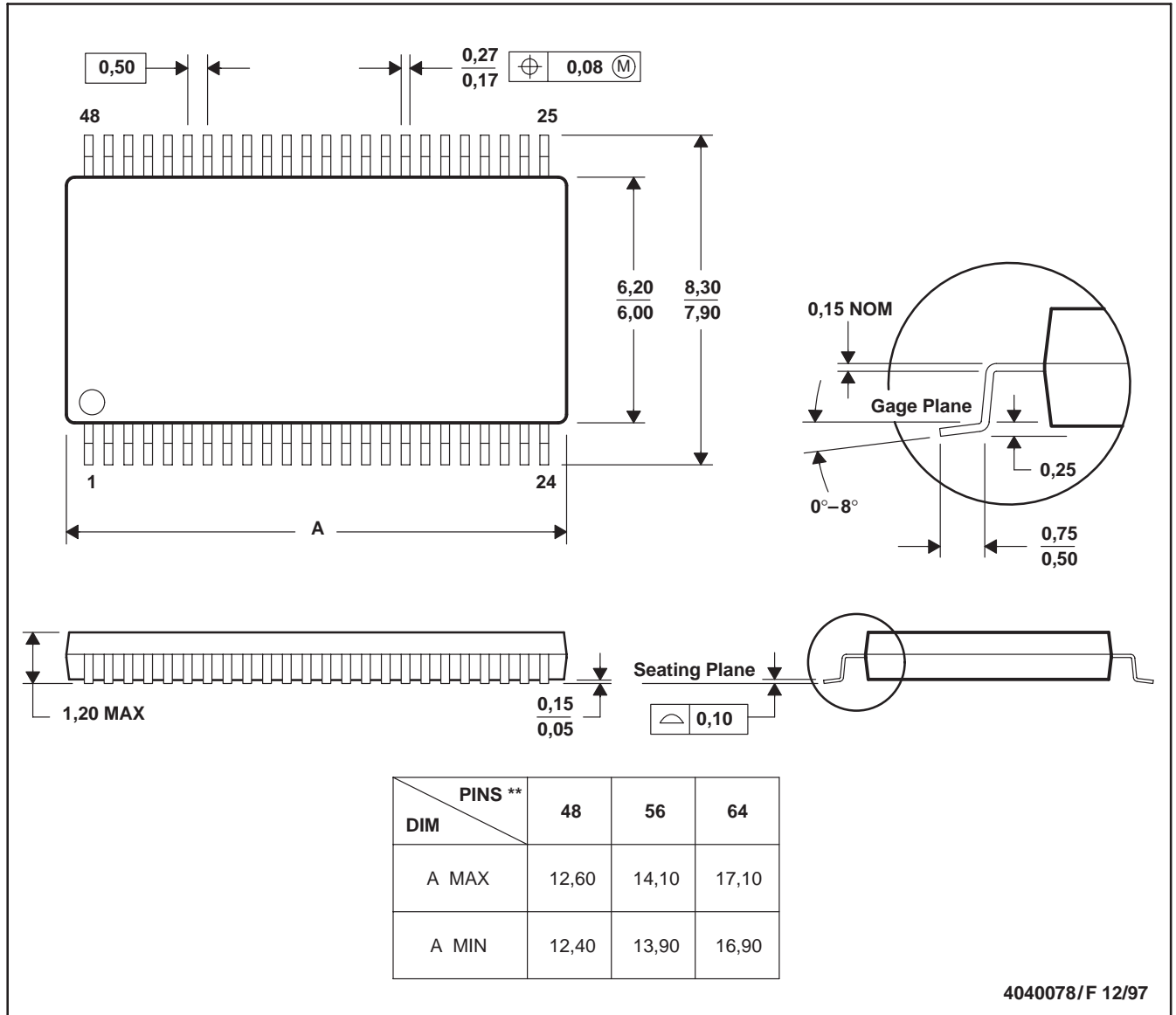
# MECHANICAL DATA

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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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
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Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
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Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265