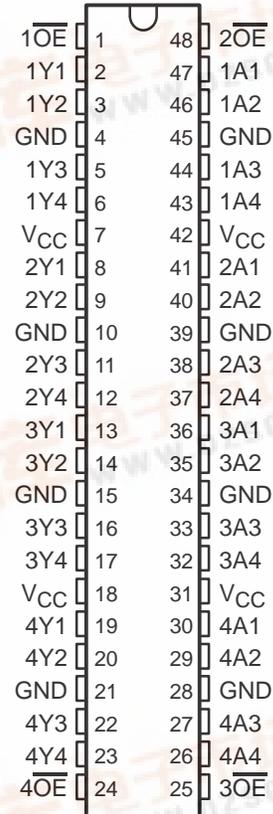


SN54LVTH16240, SN74LVTH16240 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS684C – MARCH 1997 – REVISED APRIL 1999

- **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**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Latch-Up Performance Exceeds 500 mA Per JESD 17**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Package Options Include Plastic Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54LVTH16240 . . . WD PACKAGE
SN74LVTH16240 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

These 16-bit buffers/drivers are designed specifically for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment.

The 'LVTH16240 devices are designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters.

The devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. The devices provide inverting outputs and symmetrical active-low output-enable (OE) inputs.

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, 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.

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.

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SN54LVTH16240, SN74LVTH16240

3.3-V ABT 16-BIT BUFFERS/DRIVERS

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description (continued)

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

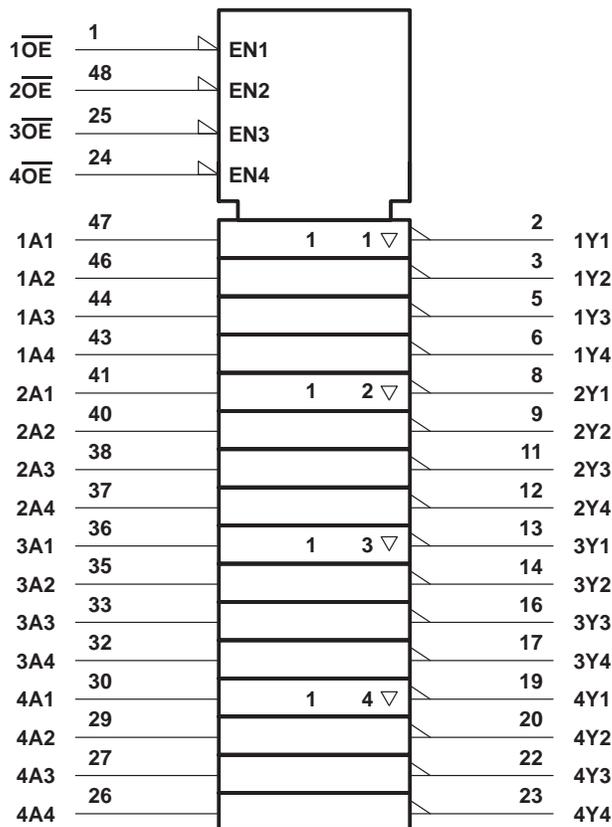
These devices are fully specified for hot-insertion applications using I_{off} and power-up 3-state. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

The SN54LVTH16240 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LVTH16240 is characterized for operation from -40°C to 85°C .

FUNCTION TABLE
(each 4-bit buffer)

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

logic symbol†

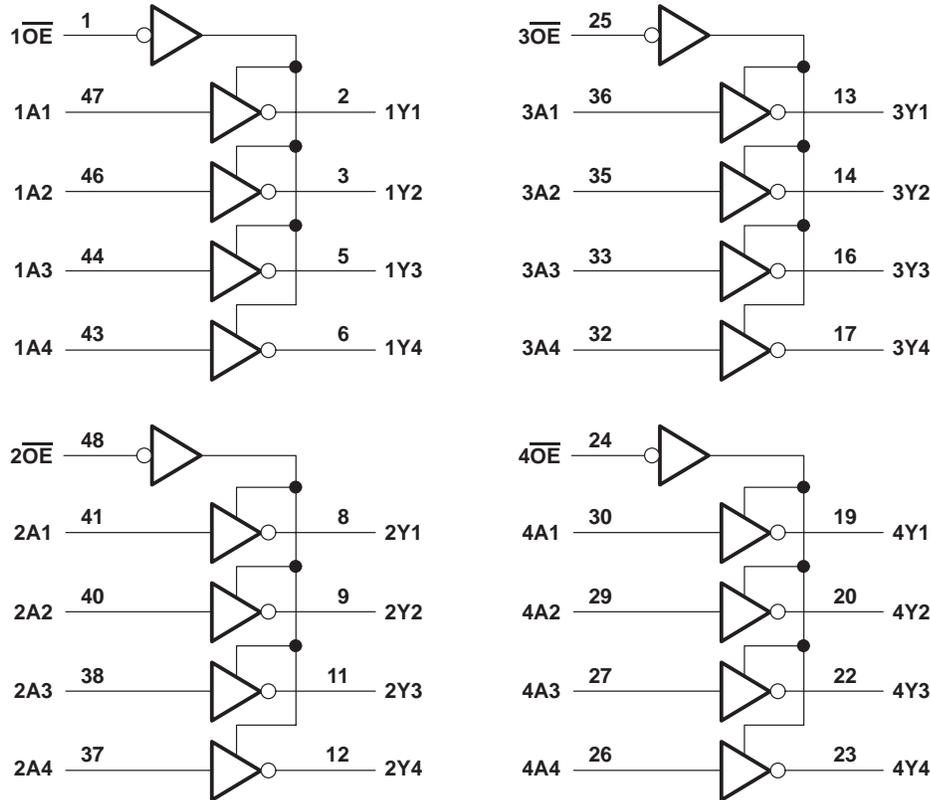


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

SN54LVTH16240, SN74LVTH16240 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

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logic diagram (positive logic)



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 : SN54LVTH16240	96 mA
SN74LVTH16240	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVTH16240	48 mA
SN74LVTH16240	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, θ_{JA} (see Note 3): DGG package	89°C/W
DL package	94°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.

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recommended operating conditions (see Note 4)

		SN54LVTH16240		SN74LVTH16240		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	ns/V
Δt/ΔV _{CC}	Power-up ramp rate	200		200		μs/V
T _A	Operating free-air temperature	-55	125	-40	85	°C

NOTE 4: All unused control 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.

SN54LVTH16240, SN74LVTH16240 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	SN54LVTH16240		SN74LVTH16240		UNIT	
		MIN	TYP†	MAX	MIN		TYP†
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	
		$I_{OL} = 24\text{ mA}$		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	$V_{CC} = 0\text{ or }3.6\text{ V}$, $V_I = 5.5\text{ V}$			10		10	
	Control inputs $V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}\text{ or GND}$			± 1		± 1	
	Data inputs $V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$		1		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	
$I_{I(\text{hold})}$	Data inputs $V_{CC} = 3\text{ V}$	$V_I = 0.8\text{ V}$		75		75	
		$V_I = 2\text{ V}$		-75		-75	
	$V_{CC} = 3.6\text{ V}\ddagger$, $V_I = 0\text{ to }3.6\text{ V}$					500 -750	
I_{OZH}	$V_{CC} = 3.6\text{ V}$, $V_O = 3\text{ V}$			5		5	
I_{OZL}	$V_{CC} = 3.6\text{ V}$, $V_O = 0.5\text{ V}$			-5		-5	
I_{OZPU}	$V_{CC} = 0\text{ to }1.5\text{ V}$, $V_O = 0.5\text{ V to }3\text{ V}$, $OE = \text{don't care}$			$\pm 100^*$		± 100	
I_{OZPD}	$V_{CC} = 1.5\text{ V to }0$, $V_O = 0.5\text{ V to }3\text{ V}$, $OE = \text{don't care}$			$\pm 100^*$		± 100	
I_{CC}	$V_{CC} = 3.6\text{ V}$, $I_O = 0$, $V_I = V_{CC}\text{ or GND}$	Outputs high		0.19		0.19	
		Outputs low		5		5	
		Outputs disabled		0.19		0.19	
$\Delta I_{CC}\S$	$V_{CC} = 3\text{ V to }3.6\text{ V}$, One input at $V_{CC} - 0.6\text{ V}$, Other inputs at $V_{CC}\text{ or GND}$			0.2		0.2	
C_i	$V_I = 3\text{ V or }0$			4		4	
C_o	$V_O = 3\text{ V or }0$			9		9	

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

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

‡ 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_{CC} or GND.

SN54LVTH16240, SN74LVTH16240
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switching characteristics over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

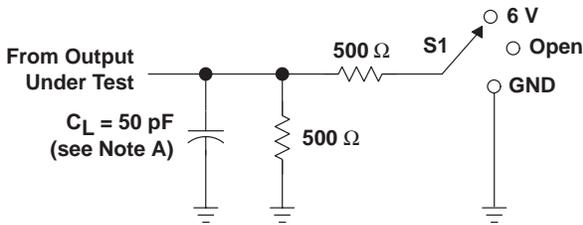
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH16240				SN74LVTH16240				UNIT	
			$V_{CC} = 3.3 V \pm 0.3 V$		$V_{CC} = 2.7 V$		$V_{CC} = 3.3 V \pm 0.3 V$			$V_{CC} = 2.7 V$		
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
t_{PLH}	A	Y	1	3.6		4.1	1	2.2	3.5		4	ns
t_{PHL}			1	3.6		4.1	1	2.7	3.5		4	
t_{PZH}	\overline{OE}	Y	1	4.2		5.1	1	2.6	4		4.9	ns
t_{PZL}			1.1	4.6		4.8	1.2	2.6	4.4		4.6	
t_{PHZ}	\overline{OE}	Y	1.9	4.7		5.2	2	3.4	4.5		5	ns
t_{PLZ}			1.9	4.4		4.5	2	3.2	4.2		4.2	
$t_{sk(o)}$									0.5		0.5	ns

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

SN54LVTH16240, SN74LVTH16240 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

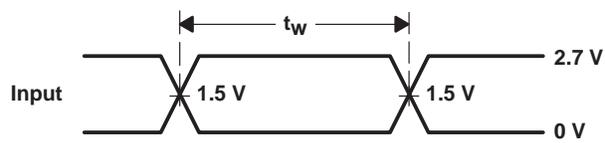
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PARAMETER MEASUREMENT INFORMATION

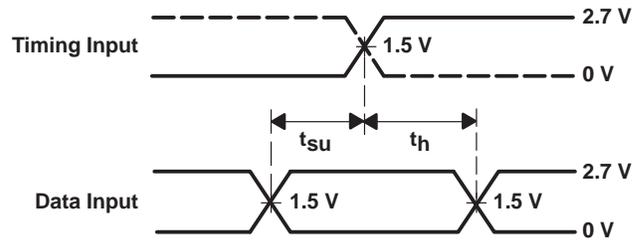


LOAD CIRCUIT

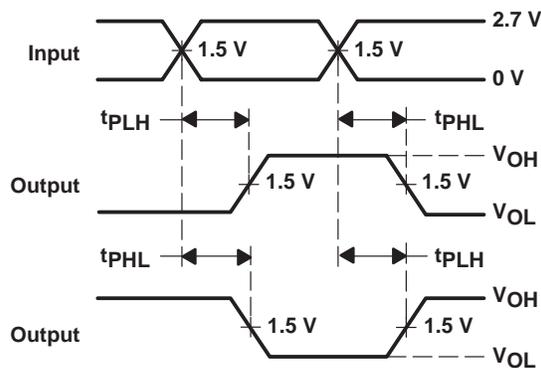
TEST	S1
t_{PHL}/t_{PLH}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PHZ}	GND



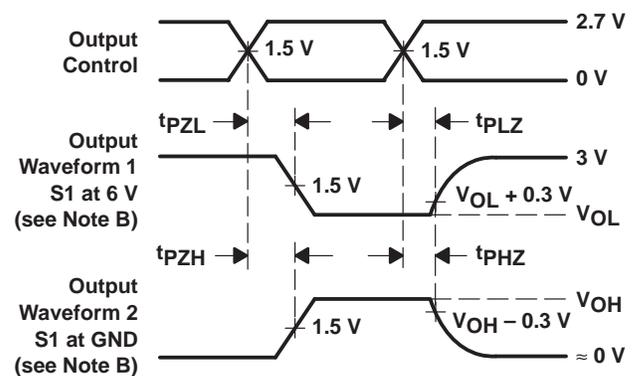
VOLTAGE WAVEFORMS
PULSE DURATION



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

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
74LVTH16240DGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16240DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16240DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16240DLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16240DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16240DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	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.

OBSELETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

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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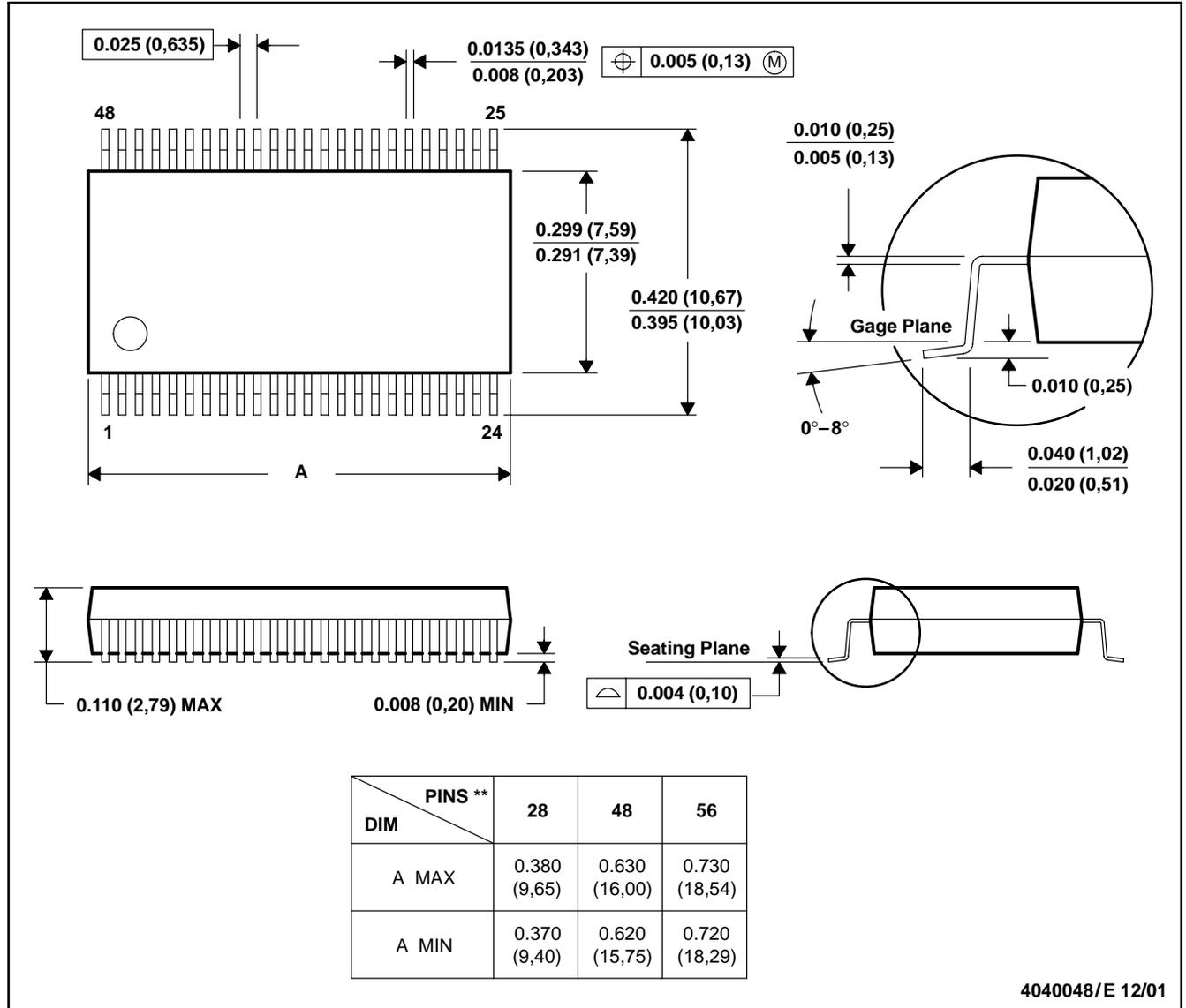
MECHANICAL DATA

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

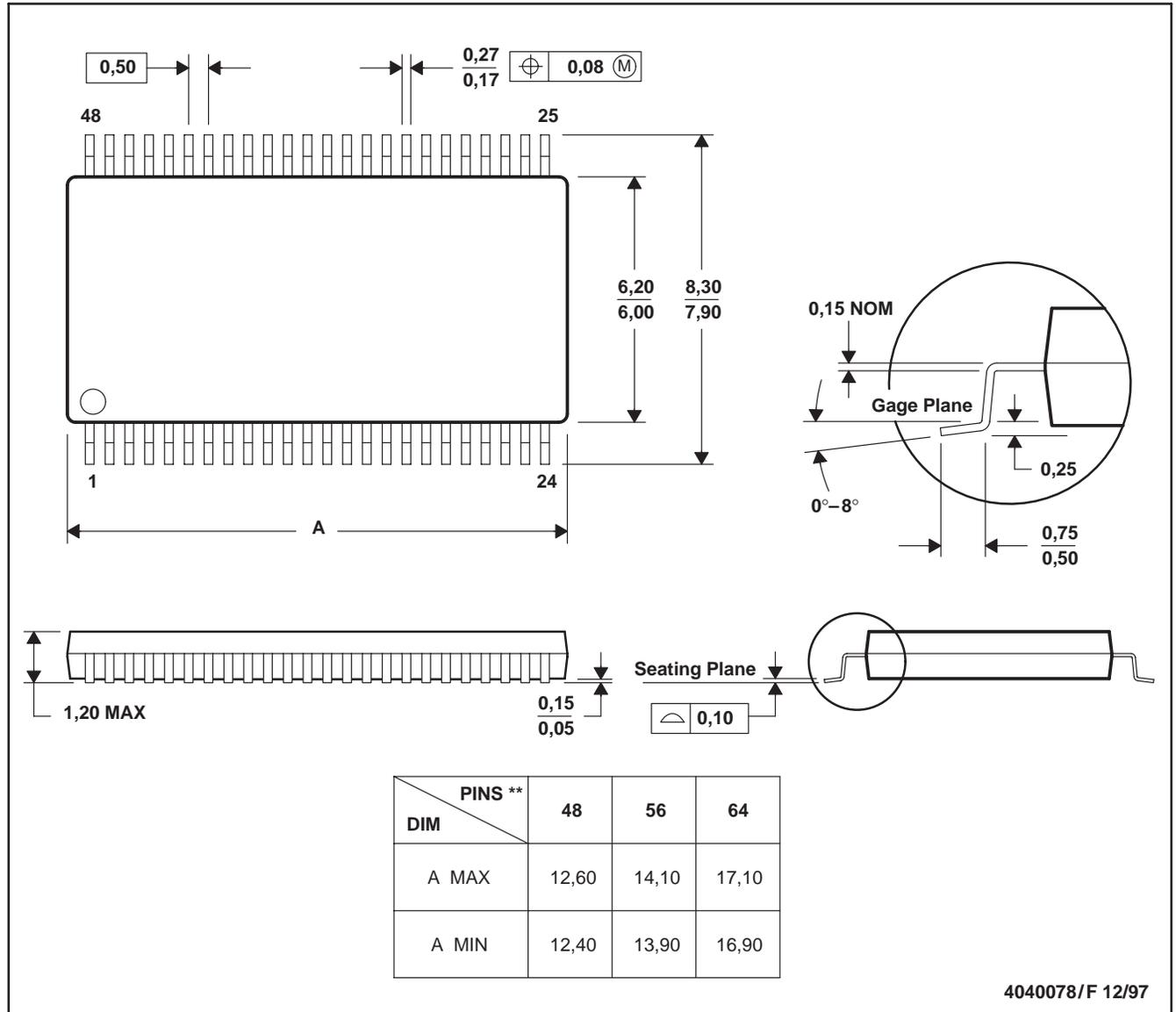
MECHANICAL DATA

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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