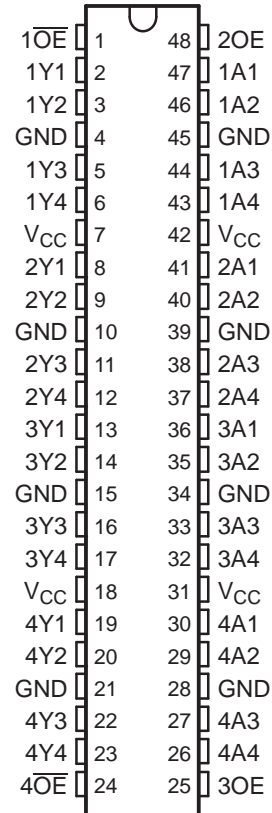


## FEATURES

- 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
- 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
- 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

SN54LVTH162241 . . . WD PACKAGE  
SN74LVTH162241 . . . DGG OR DL PACKAGE  
(TOP VIEW)



## DESCRIPTION/ORDERING INFORMATION

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 devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. The devices provide noninverting outputs and complementary output-enable (OE and  $\overline{OE}$ ) 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.



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.

**SN54LVTH162241, SN74LVTH162241**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

SCBS692E–MAY 1997–REVISED NOVEMBER 2006

**DESCRIPTION/ORDERING INFORMATION (CONTINUED)**

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 and OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sinking/current-sourcing capability of the driver.

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 SN54LVTH162241 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74LVTH162241 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**ORDERING INFORMATION**

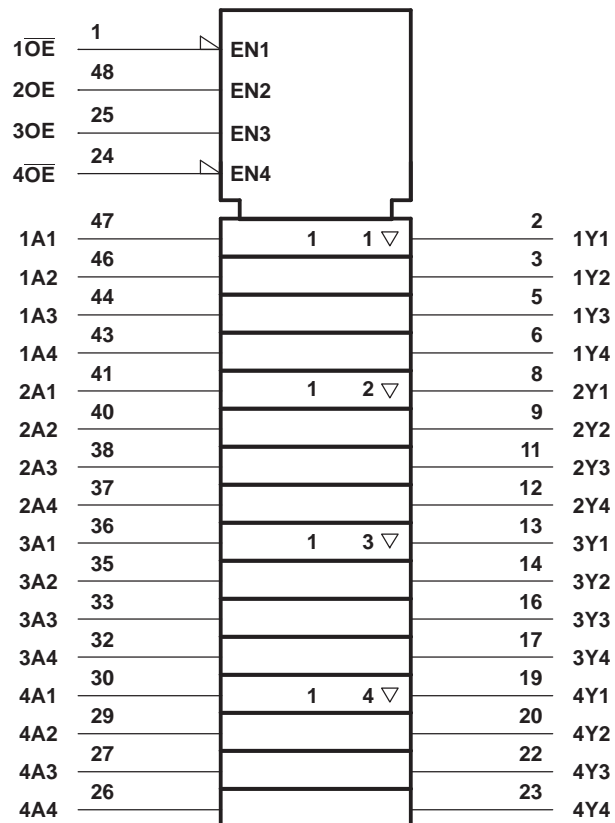
$T_A$	PACKAGE		ORDERABLE PART NUMBER	TOP-SIDE MARKING
$-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$	SSOP – DL	Reel of 1000	74LVTH162241DLRG4	LVTH162241
			74LVTH162241DLR	
		Tube of 25	SN74LVTH162241DL	
			SN74LVTH162241DLG4	
	TSSOP – DGG	Reel of 2000	74LVTH162241DGGRE4	
			SN74LVTH162241DGGR	

**FUNCTION TABLES**

INPUTS		OUTPUTS 1Y, 4Y
$1\overline{OE}, 4\overline{OE}$	1A, 4A	
L	H	H
L	L	L
H	X	Z

INPUTS		OUTPUTS 2Y, 3Y
2OE, 3OE	2A, 3A	
H	H	H
H	L	L
L	X	Z

**LOGIC SYMBOL<sup>(1)</sup>**

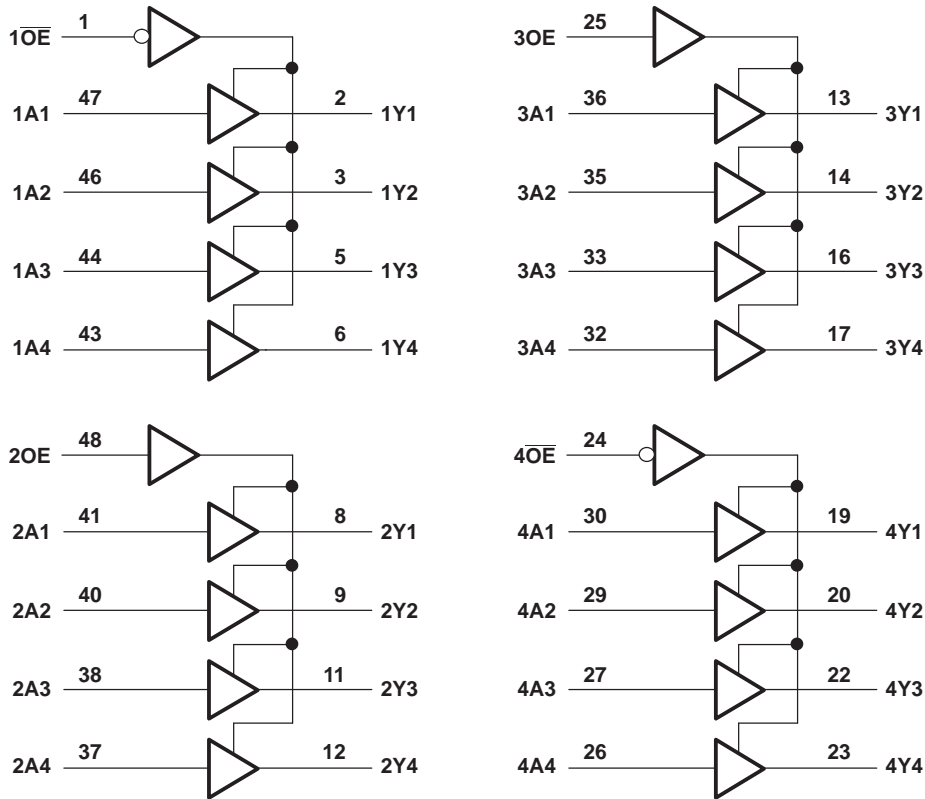


(1) This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

# SN54LVTH162241, SN74LVTH162241 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS692E—MAY 1997—REVISED NOVEMBER 2006

## LOGIC DIAGRAM (POSITIVE LOGIC)



## Absolute Maximum Ratings<sup>(1)</sup>

over recommended 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 <sup>(2)</sup>	-0.5	7	V
$V_O$	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	-0.5	7	V
$V_O$	Voltage range applied to any output in the high state <sup>(2)</sup>	-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 <sup>(3)</sup>		30	mA
$I_{IK}$	Input clamp current	$V_I < 0$	-50	mA
$I_{OK}$	Output clamp current	$V_O < 0$	-50	mA
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>		89	°C/W
			94	
$T_{stg}$	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.

**Recommended Operating Conditions<sup>(1)</sup>**

		SN54LVTH162241		SN74LVTH162241		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
$\Delta t/\Delta v$	Input transition rise or fall rate		10		10	ns/V
	Outputs enabled					
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200		200		$\mu$ s/V
$T_A$	Operating free-air temperature	–55	125	–40	85	$^{\circ}$ 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.

# SN54LVTH162241, SN74LVTH162241 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS692E–MAY 1997–REVISED NOVEMBER 2006

## Electrical Characteristics

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

PARAMETER	TEST CONDITIONS		SN54LVTH162241			SN74LVTH162241			UNIT
			MIN	TYP <sup>(1)</sup>	MAX	MIN	TYP <sup>(1)</sup>	MAX	
$V_{IK}$	$V_{CC} = 2.7\text{ V}$ ,	$I_I = -18\text{ mA}$			-1.2			-1.2	V
$V_{OH}$	$V_{CC} = 3\text{ V}$ ,	$I_{OH} = -12\text{ mA}$	2			2			
$V_{OL}$	$V_{CC} = 3\text{ V}$	$I_{OL} = 12\text{ mA}$			0.8			0.8	
$I_I$	Control inputs	$V_{CC} = 0\text{ or }3.6\text{ V}$ ,	$V_I = 5.5\text{ V}$			10		10	$\mu\text{A}$
		$V_{CC} = 3.6\text{ V}$ ,	$V_I = V_{CC}\text{ or GND}$			$\pm 1$		$\pm 1$	
	Data inputs	$V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$ $V_I = 0$			1 -5		1 -5	
$I_{off}$	$V_{CC} = 0$ ,	$V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$			$\pm 100$			$\pm 100$	
$I_{I(\text{hold})}$	Data inputs	$V_{CC} = 3\text{ V}$	$V_I = 0.8\text{ V}$ $V_I = 2\text{ V}$	75 -75		75 -75			$\mu\text{A}$
		$V_{CC} = 3.6\text{ V}$ , <sup>(2)</sup>	$V_I = 0\text{ to }3.6\text{ V}$					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	
$I_{OZPU}$	$V_{CC} = 0\text{ to }1.5\text{ V}$ , $V_O = 0.5\text{ V to }3\text{ V}$ , $OE = \text{don't care}$				$\pm 100$ <sup>(3)</sup>			$\pm 100$	
$I_{OZPD}$	$V_{CC} = 1.5\text{ V to }0$ , $V_O = 0.5\text{ V to }3\text{ V}$ , $OE = \text{don't care}$				$\pm 100$ <sup>(3)</sup>			$\pm 100$	
$I_{CC}$	$V_{CC} = 3.6\text{ V}$ , $I_O = 0$ , $V_I = V_{CC}\text{ or GND}$	Outputs high			0.19			0.19	mA
		Outputs low			5			5	
		Outputs disabled			0.19			0.19	
$\Delta I_{CC}$ <sup>(4)</sup>	$V_{CC} = 3\text{ V to }3.6\text{ V}$ , 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	pF
$C_o$	$V_O = 3\text{ V or }0$				9			9	

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

(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 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.

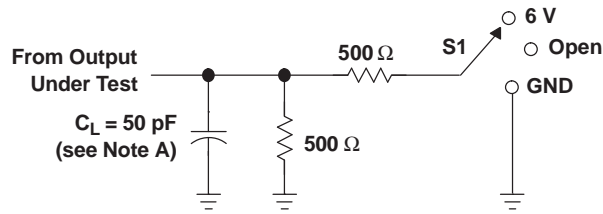
## Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 1](#))

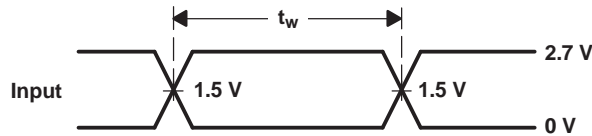
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH162241				SN74LVTH162241				UNIT	
			$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$			$V_{CC} = 2.7\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP <sup>(1)</sup>	MAX	MIN		MAX
$t_{PLH}$	A	Y	1.3	4.3		4.9	1.4	3	4.1		4.7	ns
$t_{PHL}$			1.3	4.3		4.9	1.4	2.4	4.1		4.7	
$t_{PZH}$	$\overline{OE}$ or OE	Y	1.1	5.2		5.9	1.2	3.5	4.9		5.7	ns
$t_{PZL}$			1.4	5		5.4	1.5	3.5	4.8		5.2	
$t_{PHZ}$	$\overline{OE}$ or OE	Y	1.9	5.5		6.2	2	3.7	5.3		5.9	ns
$t_{PLZ}$			1.9	5.2		5.7	2	3.6	4.9		5.4	
$t_{sk(LH)}$									0.5		0.5	ns
$t_{sk(HL)}$									0.5		0.5	

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

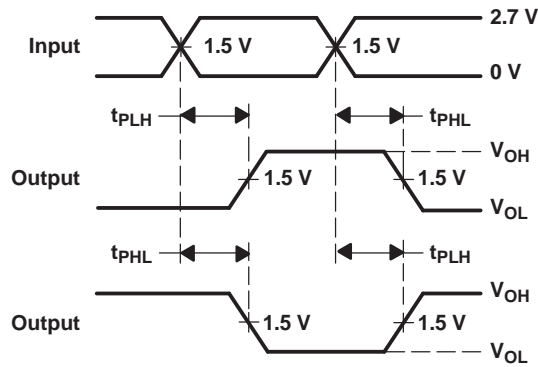
PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

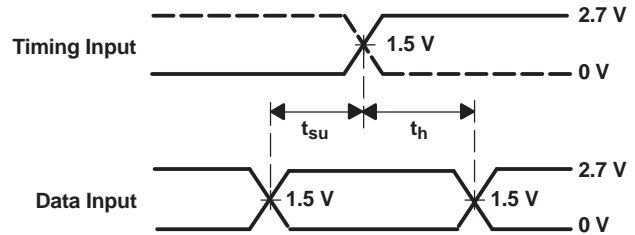


VOLTAGE WAVEFORMS  
PULSE DURATION

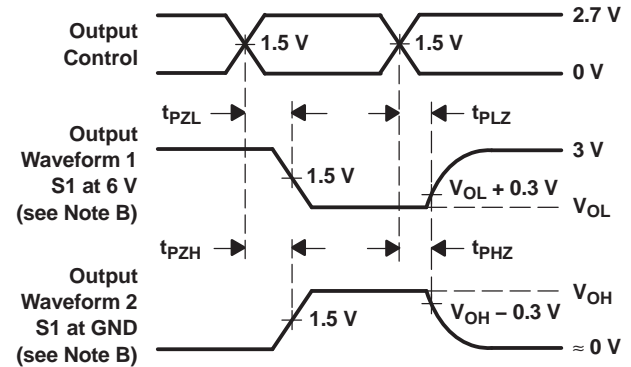


VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS

TEST	S1
$t_{pd}$	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: 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 <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
74LVTH162241DGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVTH162241DGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVTH162241DLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74LVTH162241DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH162241DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH162241DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH162241DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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**TAPE AND REEL INFORMATION**



**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
SN74LVTH162241DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
SN74LVTH162241DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVTH162241DGGR	TSSOP	DGG	48	2000	346.0	346.0	41.0
SN74LVTH162241DLR	SSOP	DL	48	1000	346.0	346.0	49.0

DGG (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

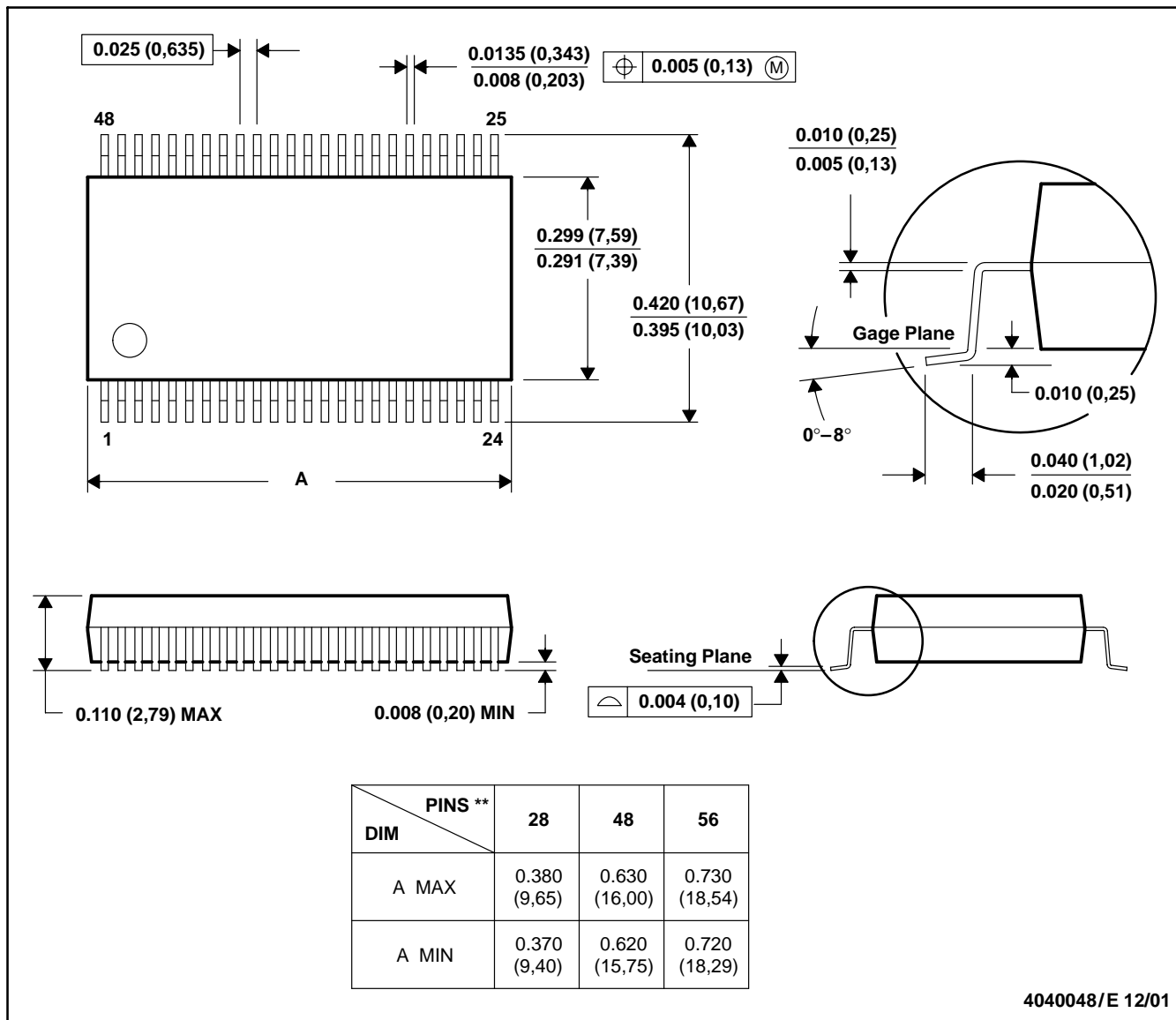


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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

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