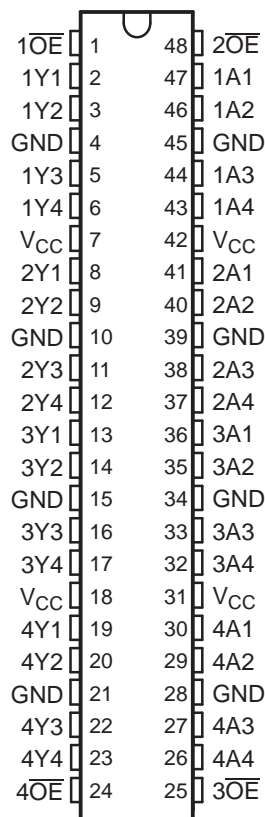


FEATURES

- 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°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 Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- 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)

SN54LVTH162244... WD PACKAGE
SN74LVTH162244... DGG OR DL PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	FBGA – GRD	Reel of 1000	74LVTH162244GRDR	LL2244
	FBGA – ZRD (Pb-free)		74LVTH162244ZRDR	
	SSOP – DL	Tube of 25	SN74LVTH162244DL	LVTH162244
			SN74LVTH162244DLG4	
		Reel of 1000	SN74LVTH162244DLR	
			74LVTH162244DLRG4	
	TSSOP – DGG	Reel of 2000	SN74LVTH162244DGGR	LVTH162244
			74LVTH162244DGGRG4	
			74LVTH162244GRE4	
	VFBGA – GQL	Reel of 1000	SN74LVTH162244KR	LL2244
74LVTH162244ZQLR				
–55°C to 125°C	CFP – WD	Tube	SNJ54LVTH162244WD	SNJ54LVTH162244WD

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



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.

SN54LVTH162244, SN74LVTH162244 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS258N–JUNE 1993–REVISED NOVEMBER 2006

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

The LVTH162244 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.

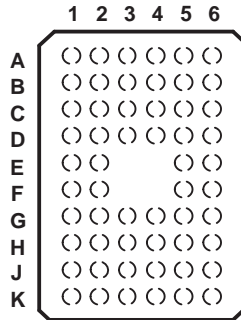
The outputs, which are designed to source or sink up to 12 mA, include equivalent 22- Ω series resistors to reduce overshoot and undershoot.

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)**

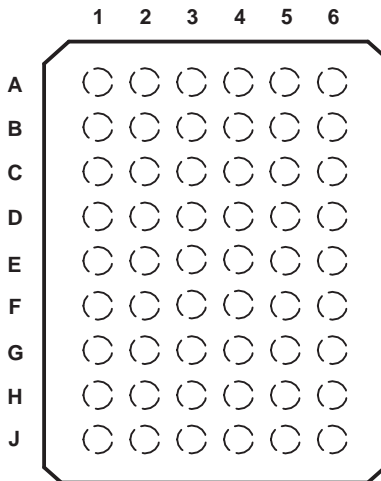


**TERMINAL ASSIGNMENTS⁽¹⁾
(56-Ball GQL/ZQL Package)**

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

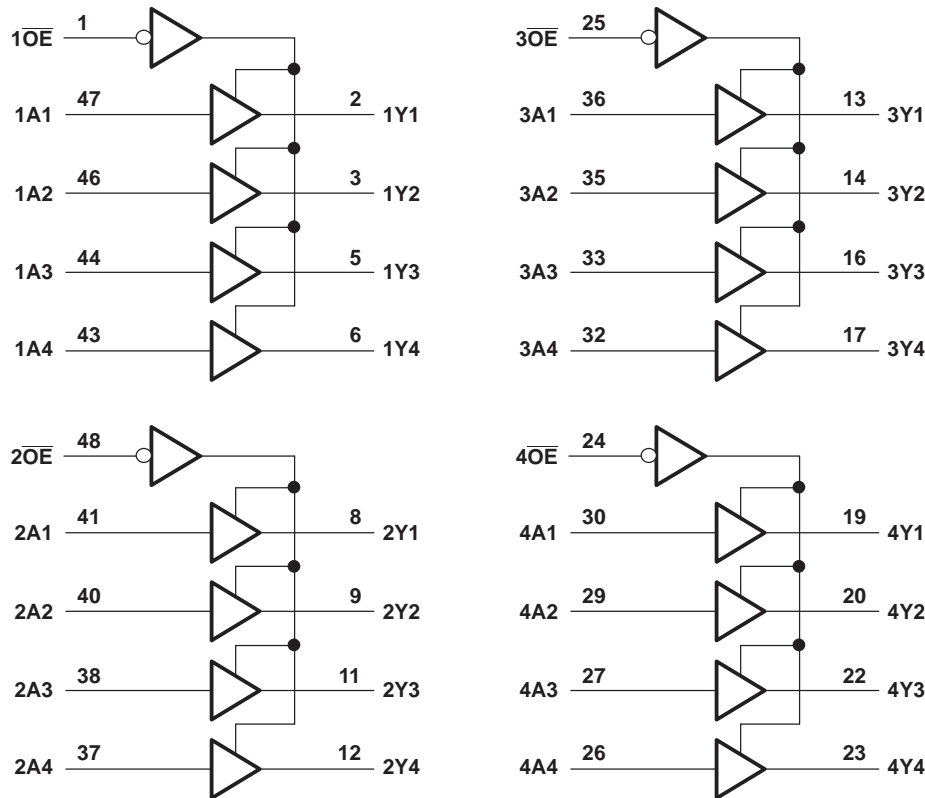
**FUNCTION TABLE
(EACH 4-BIT BUFFER)**

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

SN54LVTH162244, SN74LVTH162244 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, 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
		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⁾

		SN54LVTH162244		SN74LVTH162244		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	Outputs enabled		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 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.

Electrical Characteristics

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

PARAMETER		TEST CONDITIONS		SN54LVTH162244		SN74LVTH162244		UNIT
				MIN	TYP ⁽¹⁾	MAX	MIN	
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		2		V
V _{OL}		V _{CC} = 3 V,	I _{OL} = 12 mA			0.8	0.8	V
I _I	Control inputs	V _{CC} = 0 or 3.6 V, V _I = 5.5 V				10	10	μA
		V _{CC} = 3.6 V, V _I = V _{CC} or GND				±1	±1	
		V _{CC} = 3.6 V		V _I = V _{CC}			1	
	Data inputs	V _{CC} = 3.6 V				–5	–5	
		V _I = 0						
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				4	4	pF
C _o		V _O = 3 V or 0				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 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.

SN54LVTH162244, SN74LVTH162244
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

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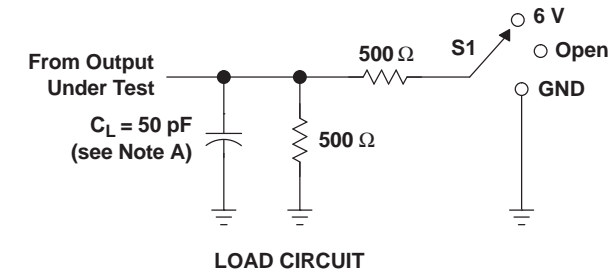
Switching Characteristics

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

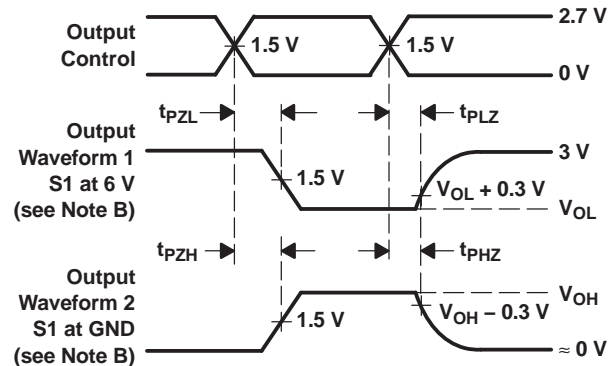
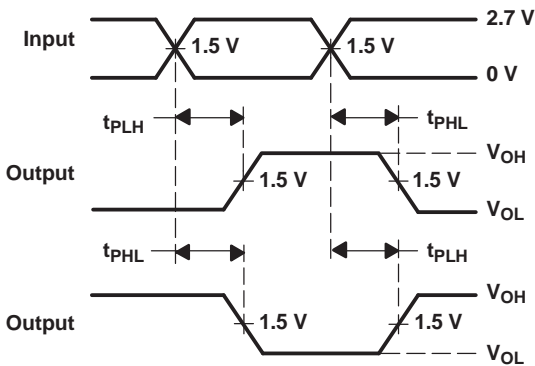
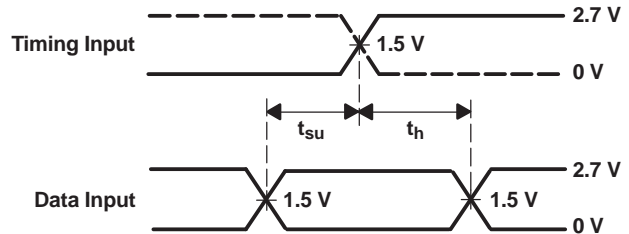
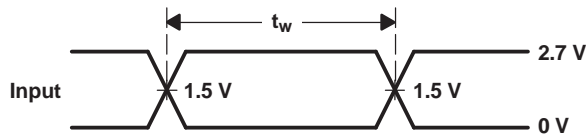
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH162244				SN74LVTH162244				UNIT	
			$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$			$V_{CC} = 2.7\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP ⁽¹⁾	MAX	MIN		MAX
t_{PLH}	A	Y	1.1	4.6	5.1		1.4	3.4	4	4.8		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	5.0	5.4		ns
t_{PLZ}			1	5.9	5.8		2	4.2	5.0	5.4		
$t_{sk(LH)}$								0.5			ns	
$t_{sk(HL)}$								0.5				

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

PARAMETER MEASUREMENT INFORMATION



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



- 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 part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
5962-9680901QXA	Active	Production	CFP (WD) 48	15 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9680901QX A SNJ54LVTH16224 4WD
5962-9680901VXA	Active	Production	CFP (WD) 48	15 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9680901VX A SNV54LVTH16224 4WD
74LVTH162244DLR1G4	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
74LVTH162244DLR1G4.B	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
8W2244DGGRG4	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
8W2244DGGRG4.B	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SN74LVTH162244DGGR	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SN74LVTH162244DGGR.B	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SN74LVTH162244DL	Active	Production	SSOP (DL) 48	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SN74LVTH162244DL.B	Active	Production	SSOP (DL) 48	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SN74LVTH162244DLR	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SN74LVTH162244DLR.B	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH162244
SNJ54LVTH162244WD	Active	Production	CFP (WD) 48	15 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9680901QX A SNJ54LVTH16224 4WD

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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 SN54LVTH162244, SN54LVTH162244-SP, SN74LVTH162244 :

- Catalog : [SN74LVTH162244](#), [SN54LVTH162244](#)
- Enhanced Product : [SN74LVTH162244-EP](#), [SN74LVTH162244-EP](#)
- Military : [SN54LVTH162244](#)
- Space : [SN54LVTH162244-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

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

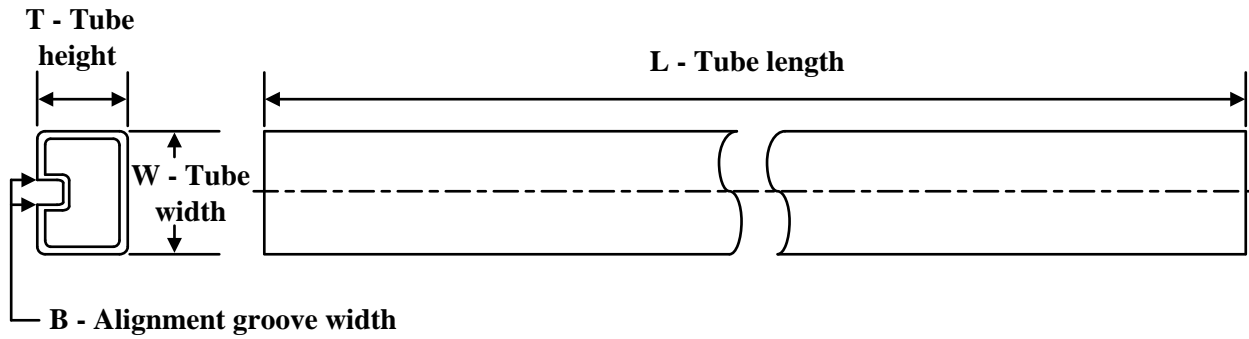

*All dimensions are nominal

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
74LVTH162244DLR1G4	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1
8W2244DGGRG4	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
SN74LVTH162244DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
SN74LVTH162244DLR	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)
74LVTH162244DLR1G4	SSOP	DL	48	1000	367.0	367.0	55.0
8W2244DGGRG4	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74LVTH162244DGGR	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74LVTH162244DLR	SSOP	DL	48	1000	367.0	367.0	55.0

TUBE


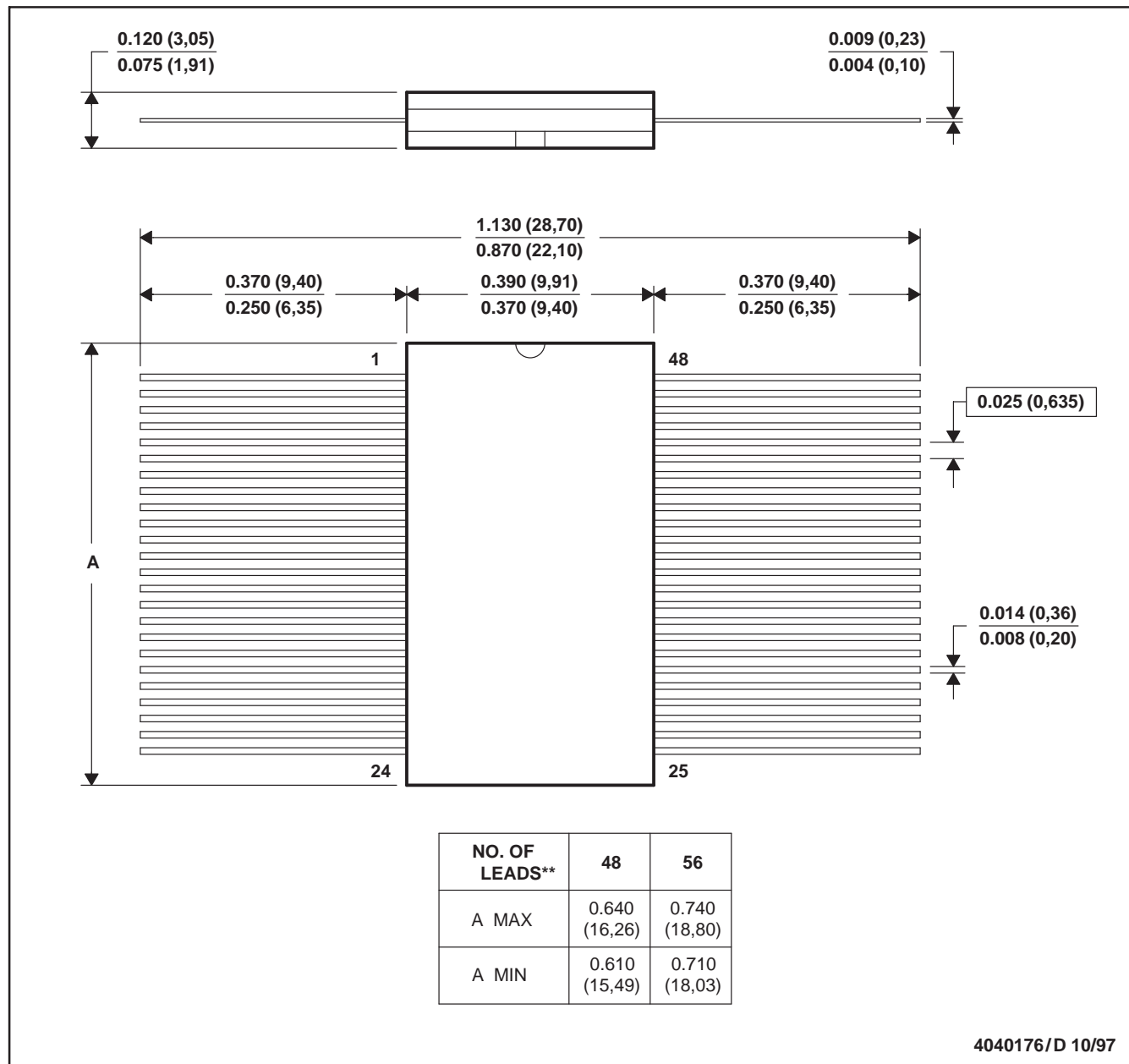
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74LVTH162244DL	DL	SSOP	48	25	473.7	14.24	5110	7.87
SN74LVTH162244DL.B	DL	SSOP	48	25	473.7	14.24	5110	7.87

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

DL (R-PDSO-G48)

PLASTIC SMALL-OUTLINE PACKAGE



- 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

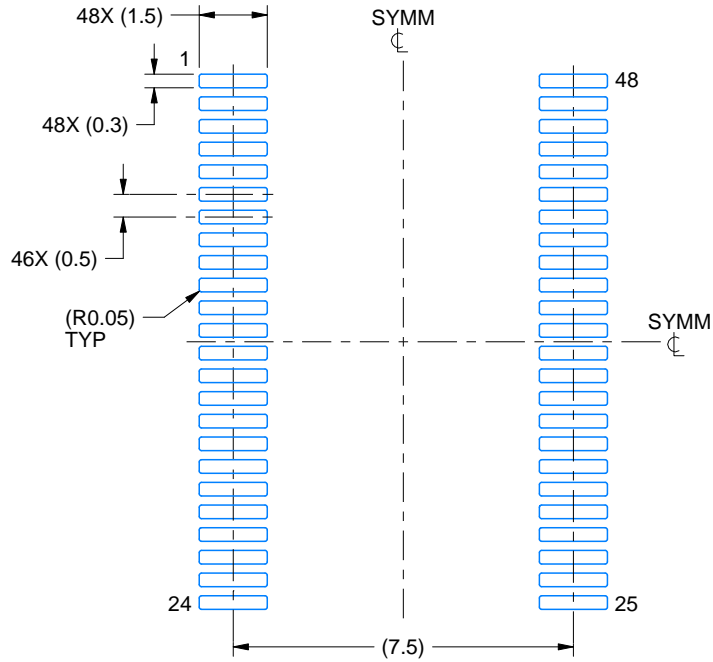
PowerPAD is a trademark of Texas Instruments.

EXAMPLE BOARD LAYOUT

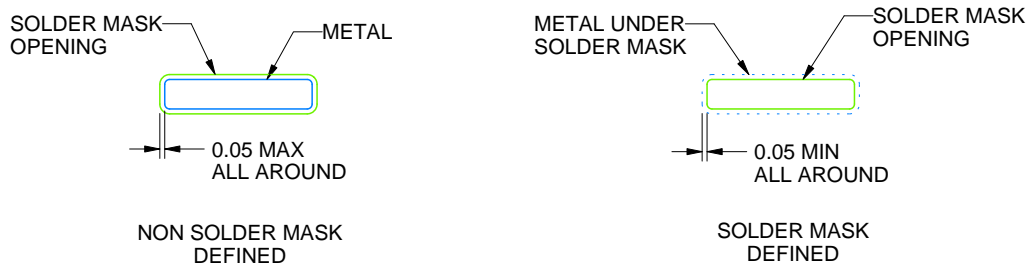
DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4214859/B 11/2020

NOTES: (continued)

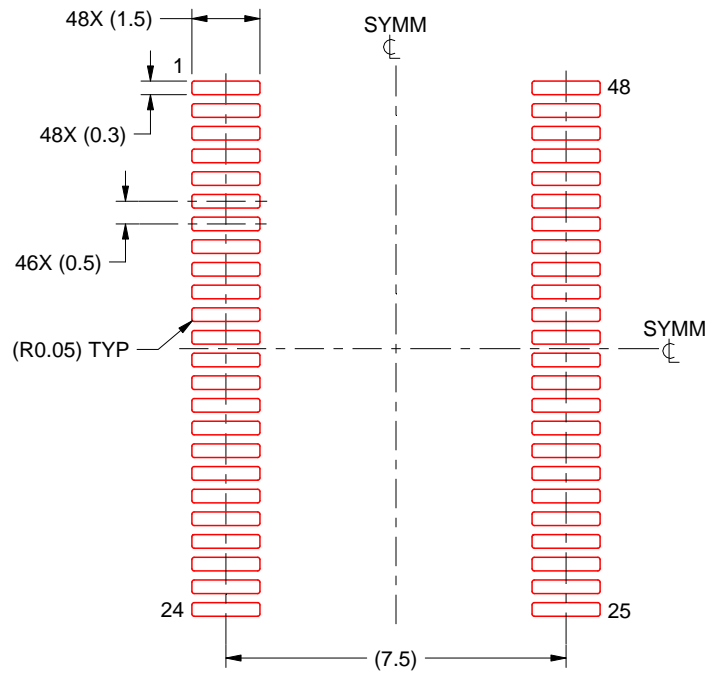
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4214859/B 11/2020

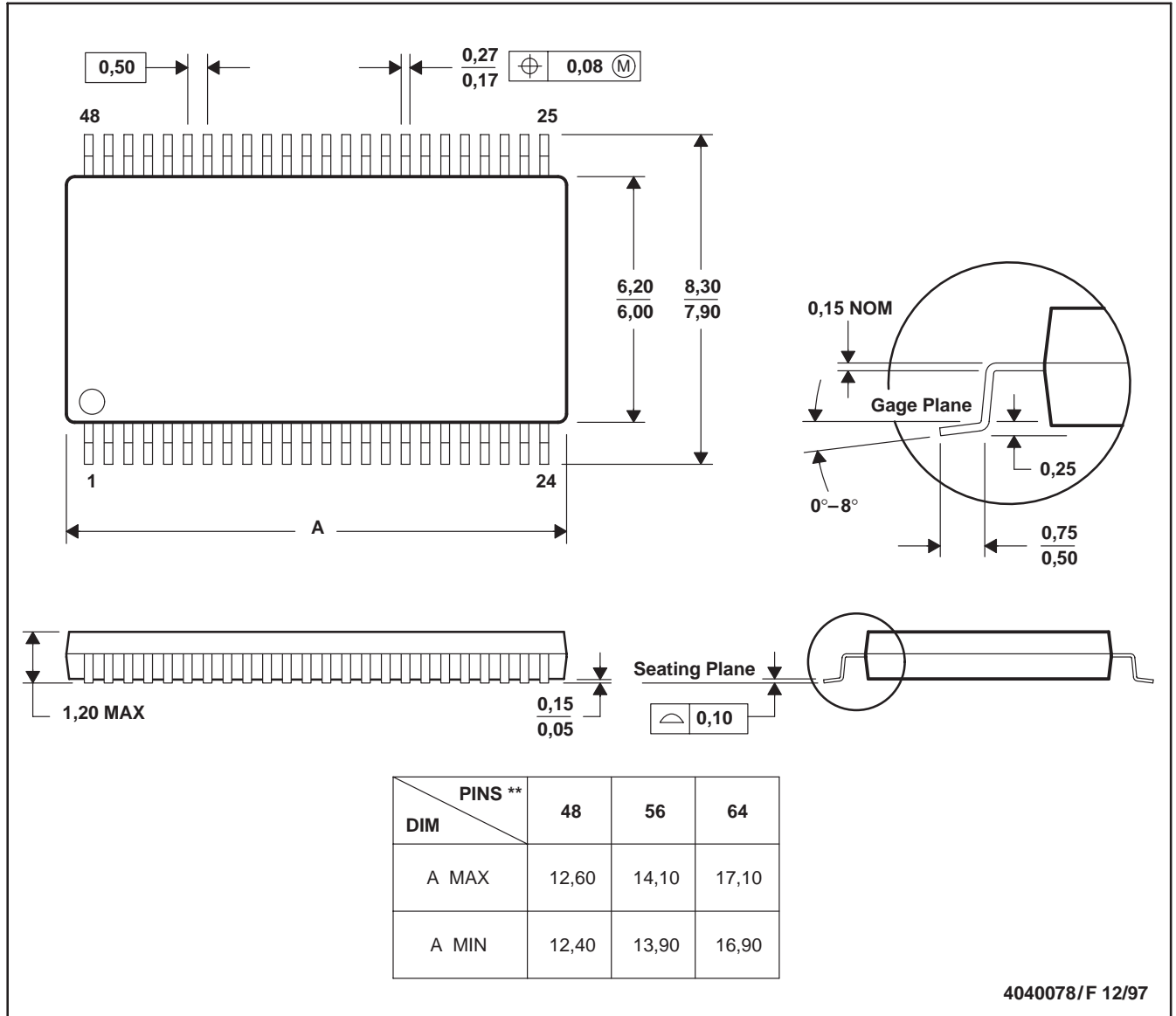
NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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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