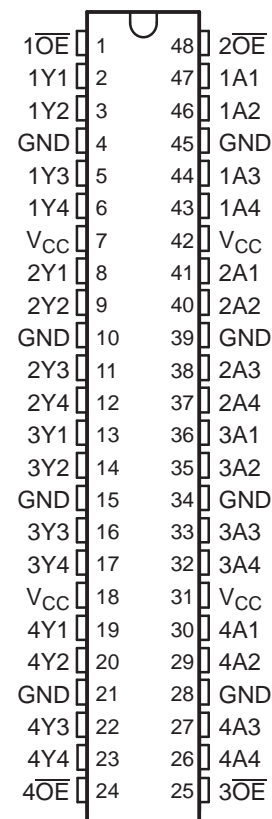


FEATURES

- 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
- Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

SN54LVT162244A . . . WD PACKAGE
SN74LVT162244A . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The 'LVT162244A 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.

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.



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.

SN54LVT162244A, SN74LVT162244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

SCBS718D–JUNE 2000–REVISED DECEMBER 2006

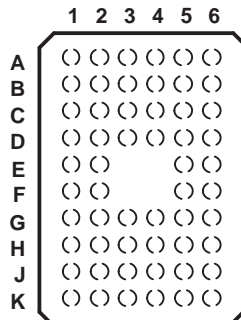
DESCRIPTION/ORDERING INFORMATION (CONTINUED)

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	FBGA – GRD	Reel of 1000	SN74LVT162244AGRDR	LZ244A
	FBGA – ZRD (Pb-free)		SN74LVT162244AZRDR	
	SSOP – DL	Tube of 25	SN74LVT162244ADL	LVT162244A
			SN74LVT162244ADLG4	
		Reel of 1000	SN74LVT162244ADLR	
			74LVT162244ADLRG4	
	TSSOP – DGG	Reel of 2000	SN74LVT162244ADGGR	LVT162244A
			74LVT162244ADGGRE4	
	TVSOP – DGV	Reel of 2000	SN74LVT162244ADGVR	LZ244A
			74LVT162244ADGVRE4	
VFBGA – GQL	Reel of 1000	SN74LVT162244AGQLR	LZ244A	
		SN74LVT162244AZQLR		
VFBGA – ZQL				
–55°C to 125°C	CFP – WD	Tube	SNJ544LVT162244AWD ⁽²⁾	SNJ54LVT162244AWD

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

GQL OR ZQL PACKAGE
(TOP VIEW)

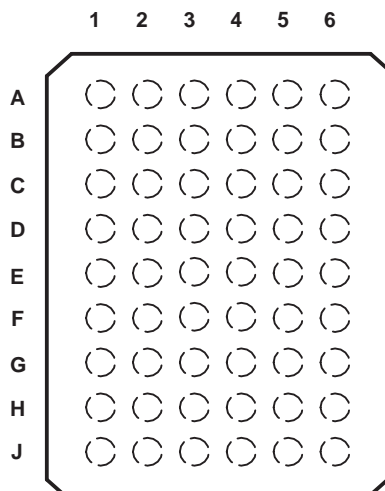


TERMINAL ASSIGNMENTS⁽¹⁾
(56-Ball GQL/ZQL Package)

	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

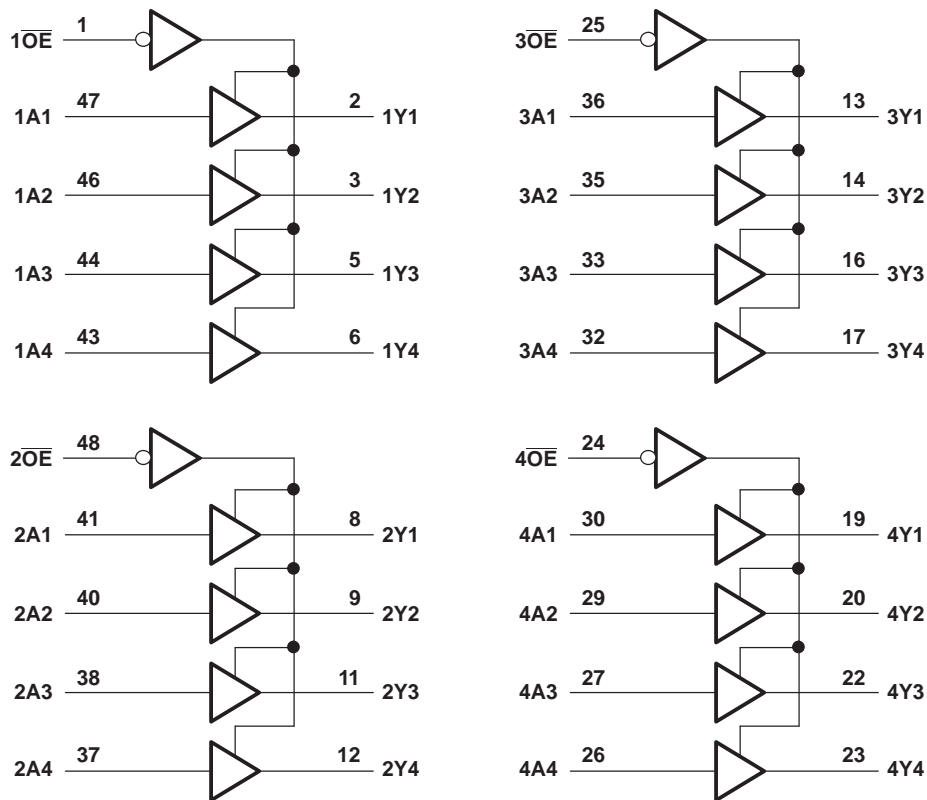
FUNCTION TABLE
(each 4-bit buffer/driver)

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

SN54LVT162244A, SN74LVT162244A
3.3-V ABT 16-BIT BUFFERS/DRIVERS
WITH 3-STATE OUTPUTS

SCBS718D–JUNE 2000–REVISED DECEMBER 2006

LOGIC DIAGRAM (POSITIVE LOGIC)



Pin numbers shown are for the DGG, DGV, 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
		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) 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⁾

		SN54LVT162244A ⁽²⁾		SN74LVT162244A		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	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.
- (2) Product preview

SN54LVT162244A, SN74LVT162244A 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS718D–JUNE 2000–REVISED DECEMBER 2006

Electrical Characteristics

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

PARAMETER	TEST CONDITIONS		SN54LVT162244A ⁽¹⁾			SN74LVT162244A			UNIT
			MIN	TYP ⁽²⁾	MAX	MIN	TYP ⁽²⁾	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						V
V_{OL}	$V_{CC} = 3\text{ V}$,	$I_{OL} = 12\text{ mA}$			0.8			0.8	V
I_I	Control inputs	$V_{CC} = 0\text{ or }3.6\text{ V}$,	$V_I = 5.5\text{ V}$		10			10	μA
		$V_{CC} = 3.6\text{ V}$,	$V_I = V_{CC}\text{ or GND}$		± 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	μA
I_{OZH}	$V_{CC} = 3.6\text{ V}$,	$V_O = 3\text{ V}$			5			5	μA
I_{OZL}	$V_{CC} = 3.6\text{ V}$,	$V_O = 0.5\text{ V}$			-5			-5	μA
I_{OZPU}	$V_{CC} = 0\text{ to }1.5\text{ V}$, $V_O = 0.5\text{ V to }3\text{ V}$, $\overline{OE} = \text{don't care}$				± 100 ⁽³⁾			± 100	μA
I_{OZPD}	$V_{CC} = 1.5\text{ V to }0$, $V_O = 0.5\text{ V to }3\text{ V}$, $\overline{OE} = \text{don't care}$				± 100 ⁽³⁾			± 100	μA
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	
ΔI_{CC} ⁽⁴⁾	$V_{CC} = 3\text{ V to }3.6\text{ V}$, One input at $V_{CC} - 0.6\text{ V}$, Other inputs at $V_{CC}\text{ or GND}$				0.2			0.2	mA
C_i	$V_I = 3\text{ V or }0$				4			4	pF
C_o	$V_O = 3\text{ V or }0$				9			9	pF

(1) Product preview

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

(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

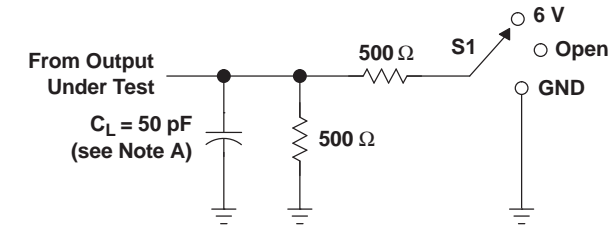
over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT162244A ⁽¹⁾				SN74LVT162244A				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 ⁽²⁾	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		5.4	ns
t_{PLZ}			1	5.9		5.8	2	4.2	5		5.4	
$t_{sk(LH)}$								0.5			ns	
$t_{sk(HL)}$								0.5				

(1) Product preview

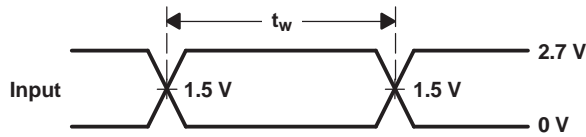
(2) All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION

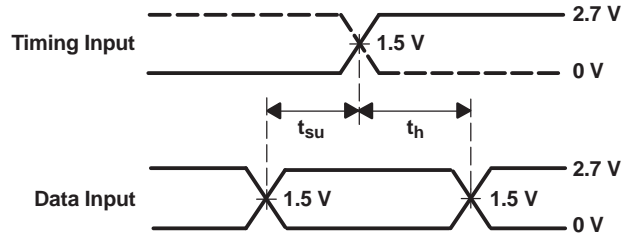


LOAD CIRCUIT

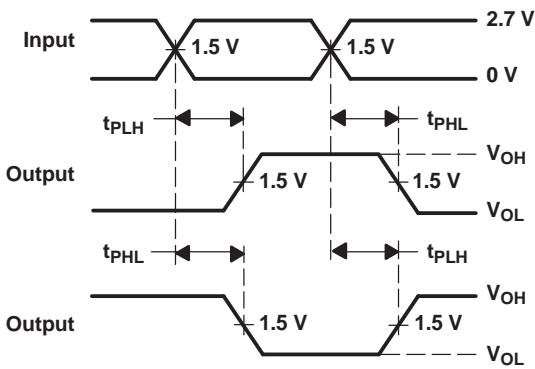
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



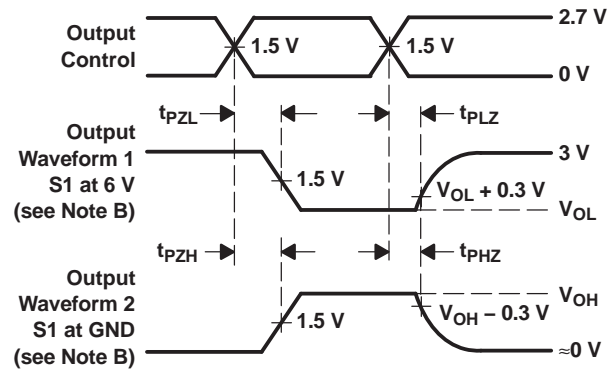
VOLTAGE WAVEFORMS
PULSE DURATION



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

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)
74LVT162244ADGGRE4	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A
74LVT162244ADGVRG4	Active	Production	TVSOP (DGV) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LZ244A
74LVT162244ADGVRG4.B	Active	Production	TVSOP (DGV) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LZ244A
SN74LVT162244ADGGR	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A
SN74LVT162244ADGGR.B	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A
SN74LVT162244ADGVR	Active	Production	TVSOP (DGV) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LZ244A
SN74LVT162244ADGVR.B	Active	Production	TVSOP (DGV) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LZ244A
SN74LVT162244ADL	Active	Production	SSOP (DL) 48	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A
SN74LVT162244ADL.B	Active	Production	SSOP (DL) 48	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A
SN74LVT162244ADLR	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A
SN74LVT162244ADLR.B	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVT162244A

(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.

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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.

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

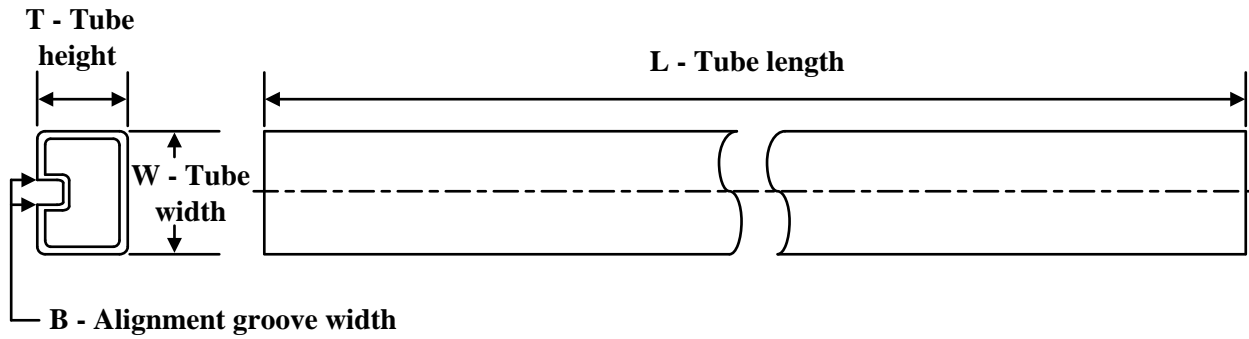

*All dimensions are nominal

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
74LVT162244ADGVRG4	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1
SN74LVT162244ADGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
SN74LVT162244ADGVR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1
SN74LVT162244ADLR	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)
74LVT162244ADGVRG4	TVSOP	DGV	48	2000	356.0	356.0	35.0
SN74LVT162244ADGGR	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74LVT162244ADGVR	TVSOP	DGV	48	2000	356.0	356.0	35.0
SN74LVT162244ADLR	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)
SN74LVT162244ADL	DL	SSOP	48	25	473.7	14.24	5110	7.87
SN74LVT162244ADL.B	DL	SSOP	48	25	473.7	14.24	5110	7.87

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



4073251/E 08/00

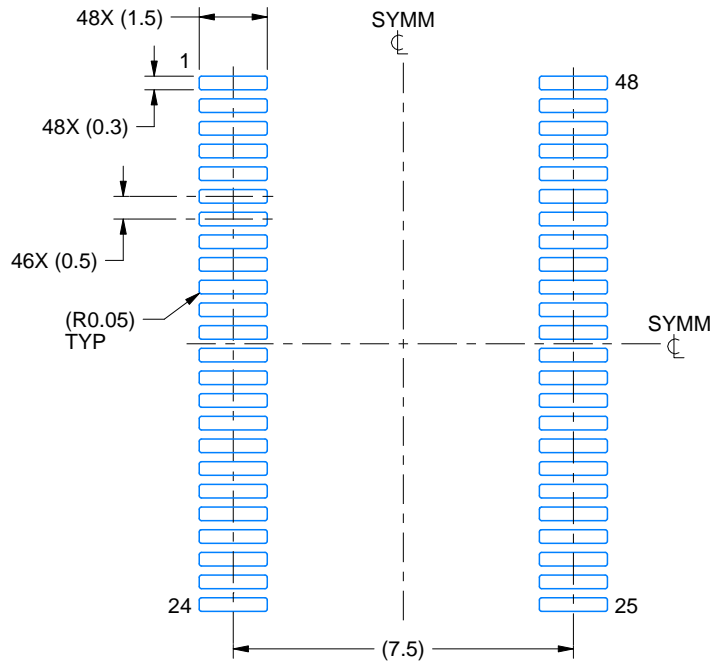
- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

EXAMPLE BOARD LAYOUT

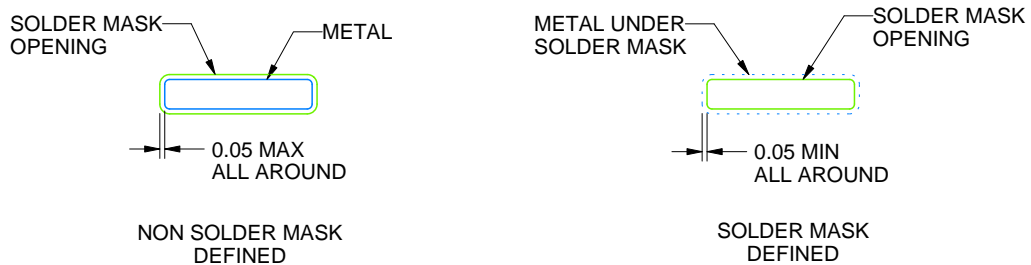
DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4214859/B 11/2020

NOTES: (continued)

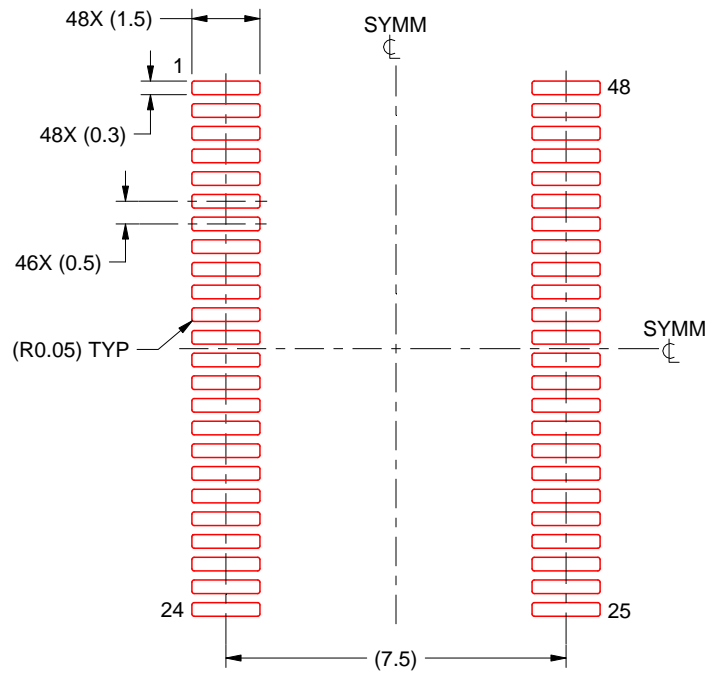
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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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