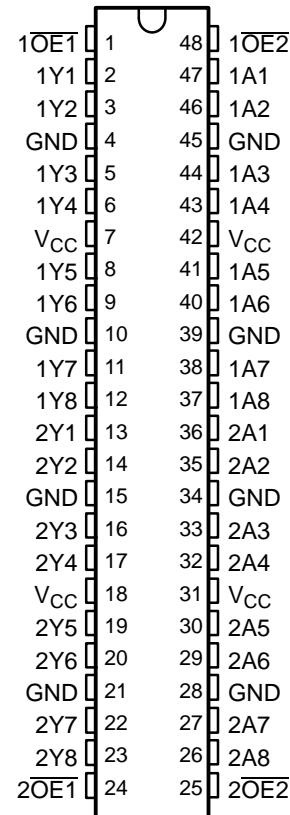


## FEATURES

- Member of the Texas Instruments Widebus™ Family
- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 3.7 ns at 3.3 V
- Typical  $V_{OLP}$  (Output Ground Bounce) <0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot) >2 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V  $V_{CC}$ )
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

**DGG, DGV, OR DL PACKAGE  
(TOP VIEW)**



## DESCRIPTION/ORDERING INFORMATION

This 16-bit buffer/driver is designed for 1.65-V to 3.6-V  $V_{CC}$  operation and provides a high-performance bus interface for wide data paths.

The 3-state control gate is a 2-input AND gate with active-low inputs so that, if either output-enable ( $\overline{OE1}$  or  $\overline{OE2}$ ) input is high, all corresponding outputs are in the high-impedance state.

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of these devices as translators in a mixed 3.3-V/5-V system environment.

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.

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>	ORDERABLE PART NUMBER	TOP-SIDE MARKING
$-40^\circ\text{C}$ to $85^\circ\text{C}$	SSOP – DL	Tube	SN74LVCH16540ADL
		Tape and reel	SN74LVCH16540ADLR
	TSSOP – DGG	Tape and reel	SN74LVCH16540ADGGR
	TVSOP – DGV	Tape and reel	SN74LVCH16540ADGVR

(1) 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).



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.

## DESCRIPTION/ORDERING INFORMATION (CONTINUED)

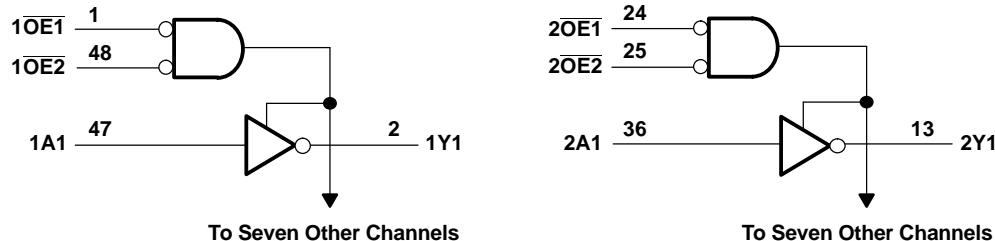
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

**FUNCTION TABLE  
(EACH 8-BIT SECTION)**

INPUTS			OUTPUT Y
$\overline{OE1}$	$\overline{OE2}$	A	
L	L	L	H
L	L	H	L
H	X	X	Z
X	H	X	Z

**LOGIC DIAGRAM (POSITIVE LOGIC)**



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

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

			MIN	MAX	UNIT
$V_{CC}$	Supply voltage range		-0.5	6.5	V
$V_I$	Input voltage range <sup>(2)</sup>		-0.5	6.5	V
$V_O$	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> <sup>(3)</sup>		-0.5	6.5	V
$V_O$	Voltage range applied to any output in the high or low state <sup>(2)</sup> <sup>(3)</sup>		-0.5	$V_{CC} + 0.5$	V
$I_{IK}$	Input clamp current	$V_I < 0$		-50	mA
$I_{OK}$	Output clamp current	$V_O < 0$		-50	mA
$I_O$	Continuous output current			±50	mA
	Continuous current through each $V_{CC}$ or GND			±100	mA
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	DGG package		70	°C/W
		DGV package		58	
		DL package		63	
$T_{stg}$	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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of  $V_{CC}$  is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

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

			MIN	MAX	UNIT
$V_{CC}$	Supply voltage	Operating	1.65	3.6	V
		Data retention only	1.5		
$V_{IH}$	High-level input voltage	$V_{CC} = 1.65$ V to 1.95 V	$0.65 \times V_{CC}$		V
		$V_{CC} = 2.3$ V to 2.7 V	1.7		
		$V_{CC} = 2.7$ V to 3.6 V	2		
$V_{IL}$	Low-level input voltage	$V_{CC} = 1.65$ V to 1.95 V	$0.35 \times V_{CC}$		V
		$V_{CC} = 2.3$ V to 2.7 V	0.7		
		$V_{CC} = 2.7$ V to 3.6 V	0.8		
$V_I$	Input voltage		0	5.5	V
$V_O$	Output voltage	High or low state	0	$V_{CC}$	V
		3-state	0	5.5	
$I_{OH}$	High-level output current	$V_{CC} = 1.65$ V		-4	mA
		$V_{CC} = 2.3$ V		-8	
		$V_{CC} = 2.7$ V		-12	
		$V_{CC} = 3$ V		-24	
$I_{OL}$	Low-level output current	$V_{CC} = 1.65$ V		4	mA
		$V_{CC} = 2.3$ V		8	
		$V_{CC} = 2.7$ V		12	
		$V_{CC} = 3$ V		24	
$\Delta t/\Delta V$	Input transition rise or fall rate			10	ns/V
$T_A$	Operating free-air temperature		-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.

**SN74LVCH16540A**  
**16-BIT BUFFER/DRIVER**  
**WITH 3-STATE OUTPUTS**

SCAS569H—MARCH 1996—REVISED MARCH 2005

 **TEXAS**  
**INSTRUMENTS**  
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**Electrical Characteristics**

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>OH</sub>	I <sub>OH</sub> = -100 µA	1.65 V to 3.6 V	V <sub>CC</sub> - 0.2			V
	I <sub>OH</sub> = -4 mA	1.65 V		1.2		
	I <sub>OH</sub> = -8 mA	2.3 V		1.7		
	I <sub>OH</sub> = -12 mA	2.7 V		2.2		
	I <sub>OH</sub> = -24 mA	3 V		2.4		
V <sub>OL</sub>	I <sub>OL</sub> = 100 µA	1.65 V to 3.6 V		0.2		V
	I <sub>OL</sub> = 4 mA	1.65 V		0.45		
	I <sub>OL</sub> = 8 mA	2.3 V		0.7		
	I <sub>OL</sub> = 12 mA	2.7 V		0.4		
	I <sub>OL</sub> = 24 mA	3 V		0.55		
I <sub>I</sub>	V <sub>I</sub> = 0 to 5.5 V	3.6 V		±5	µA	
I <sub>I(hold)</sub>	V <sub>I</sub> = 0.58 V	1.65 V		(2)		µA
	V <sub>I</sub> = 1.07 V			(2)		
	V <sub>I</sub> = 0.7 V	2.3 V		45		
	V <sub>I</sub> = 1.7 V			-45		
	V <sub>I</sub> = 0.8 V	3 V		75		
	V <sub>I</sub> = 2 V			-75		
	V <sub>I</sub> = 0 to 3.6 V <sup>(3)</sup>	3.6 V		±500		
I <sub>off</sub>	V <sub>I</sub> or V <sub>O</sub> = 5.5 V	0		±10	µA	
I <sub>OZ</sub>	V <sub>O</sub> = 0 to 5.5 V	3.6 V		±10	µA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	I <sub>O</sub> = 0	3.6 V		20	µA
	3.6 V ≤ V <sub>I</sub> ≤ 5.5 V <sup>(4)</sup>				20	
ΔI <sub>CC</sub>	One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND	2.7 V to 3.6 V		500	µA	
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V		5	pF	
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V		6.5	pF	

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

(2) This information was not available at the time of publication.

(3) This is the bus-hold maximum dynamic current required to switch the input from one state to another.

(4) This applies in the disabled state only.

**Switching Characteristics**

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1.8 V ± 0.15 V	V <sub>CC</sub> = 2.5 V ± 0.2 V	V <sub>CC</sub> = 2.7 V	V <sub>CC</sub> = 3.3 V ± 0.3 V	UNIT	
			MIN	MAX	MIN	MAX		
t <sub>pd</sub>	A	Y	(1)	(1)	(1)	(1)	4.5	1 3.7 ns
t <sub>en</sub>	OE	Y	(1)	(1)	(1)	(1)	5.9	1.5 4.8 ns
t <sub>dis</sub>	OE	Y	(1)	(1)	(1)	(1)	6.3	1.6 5.9 ns

(1) This information was not available at the time of publication.

## Operating Characteristics

$T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	$V_{CC} = 1.8 \text{ V}$	$V_{CC} = 2.5 \text{ V}$	$V_{CC} = 3.3 \text{ V}$	UNIT
		TYP	TYP	TYP	
$C_{pd}$ Power dissipation capacitance per buffer/driver	Outputs enabled	(1)	(1)	34	pF
	Outputs disabled	(1)	(1)	2	

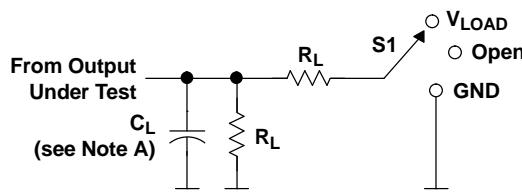
(1) This information was not available at the time of publication.

**SN74LVCH16540A**  
**16-BIT BUFFER/DRIVER**  
**WITH 3-STATE OUTPUTS**

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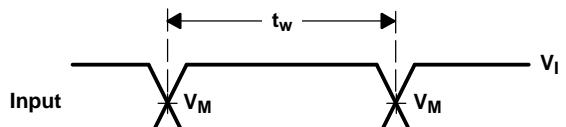
**PARAMETER MEASUREMENT INFORMATION**



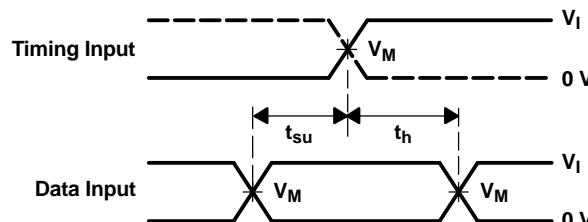
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$V_{LOAD}$
$t_{PHZ}/t_{PZH}$	GND

**LOAD CIRCUIT**

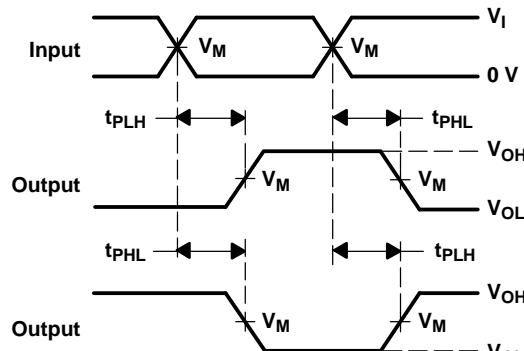
$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_\Delta$
	$V_I$	$t_r/t_f$					
$1.8 \text{ V} \pm 0.15 \text{ V}$	$V_{CC}$	$\leq 2 \text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5 \text{ V} \pm 0.2 \text{ V}$	$V_{CC}$	$\leq 2 \text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
$3.3 \text{ V} \pm 0.3 \text{ V}$	2.7 V	$\leq 2.5 \text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V



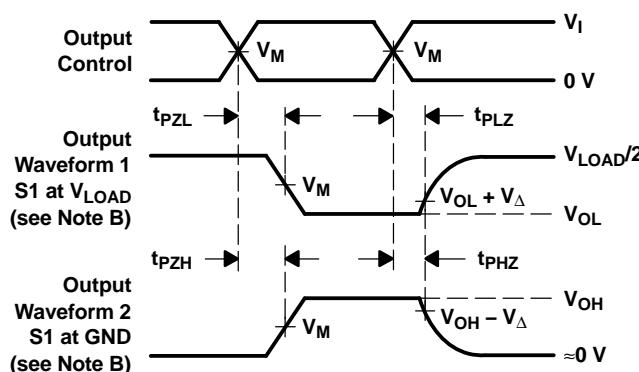
**VOLTAGE WAVEFORMS  
PULSE DURATION**



**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  $\leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ .
- D. The outputs are measured one at a time, with one transition per measurement.
- E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
- H. All parameters and waveforms are not applicable to all devices.

**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)
SN74LVCH16540ADGGR	Active	Production	TSSOP (DGG)   48	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVCH16540A
SN74LVCH16540ADGGR.B	Active	Production	TSSOP (DGG)   48	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVCH16540A
SN74LVCH16540ADL	Active	Production	SSOP (DL)   48	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVCH16540A
SN74LVCH16540ADL.B	Active	Production	SSOP (DL)   48	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVCH16540A

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

<sup>(2)</sup> **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.

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

<sup>(4)</sup> **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.

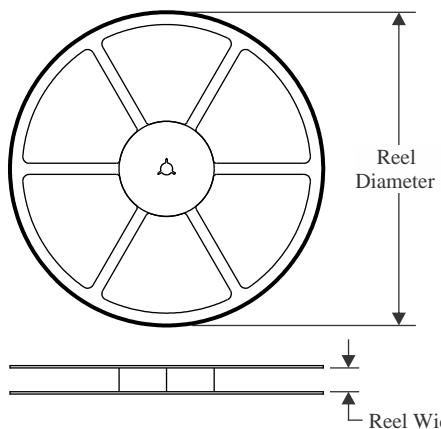
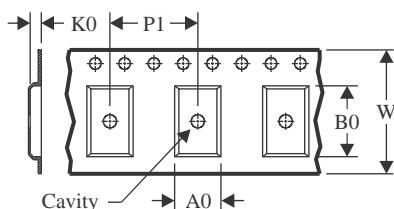
<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature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

<sup>(6)</sup> **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.

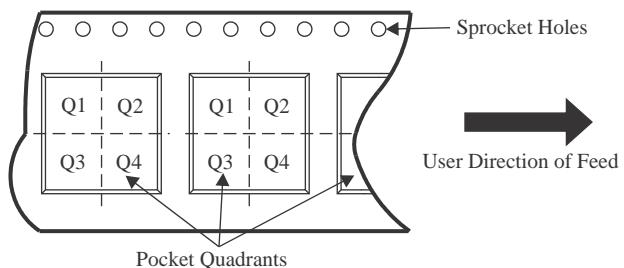
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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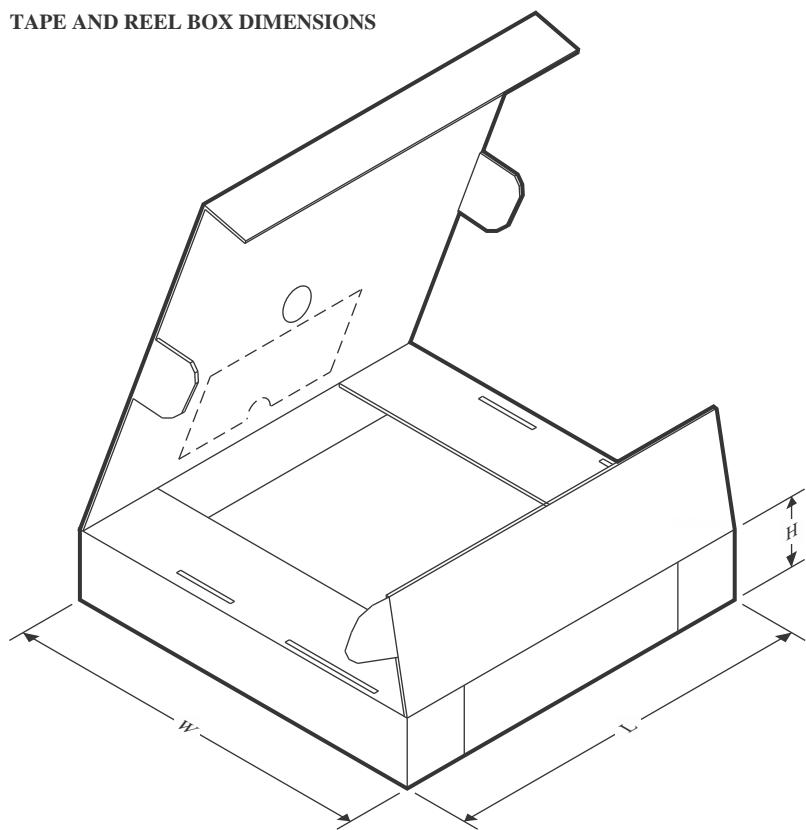
**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


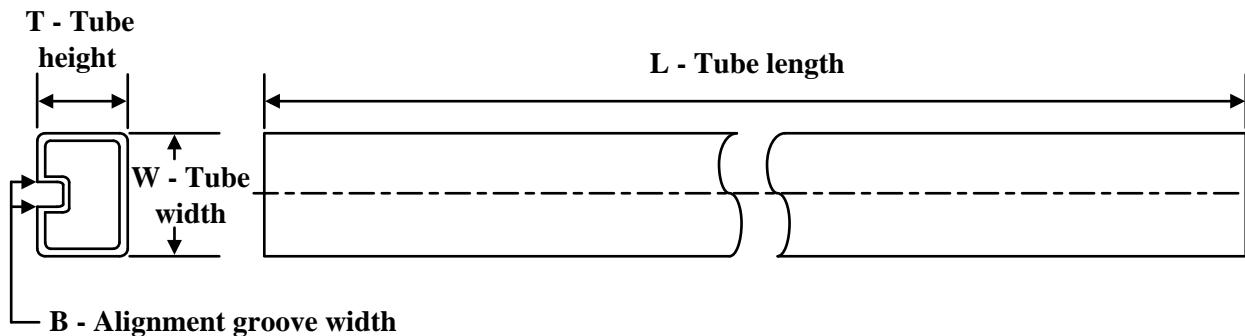
\*All dimensions are nominal

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
SN74LVCH16540ADGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVCH16540ADGGR	TSSOP	DGG	48	2000	356.0	356.0	45.0

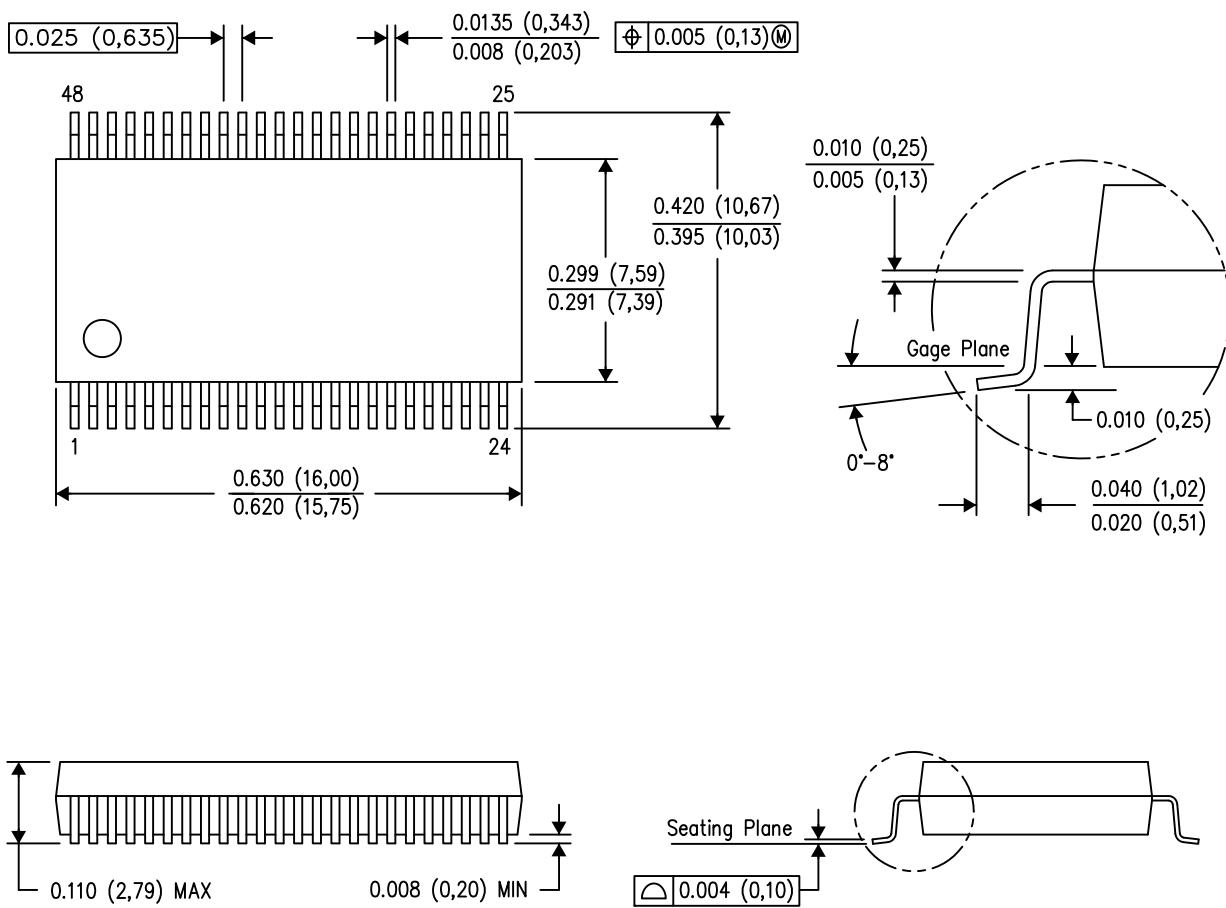
**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T ( $\mu$ m)	B (mm)
SN74LVCH16540ADL	DL	SSOP	48	25	473.7	14.24	5110	7.87
SN74LVCH16540ADL.B	DL	SSOP	48	25	473.7	14.24	5110	7.87

DL (R-PDSO-G48)

## PLASTIC SMALL-OUTLINE PACKAGE



4040048-3/F 05/13

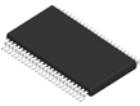
NOTES:

- 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 M0-118

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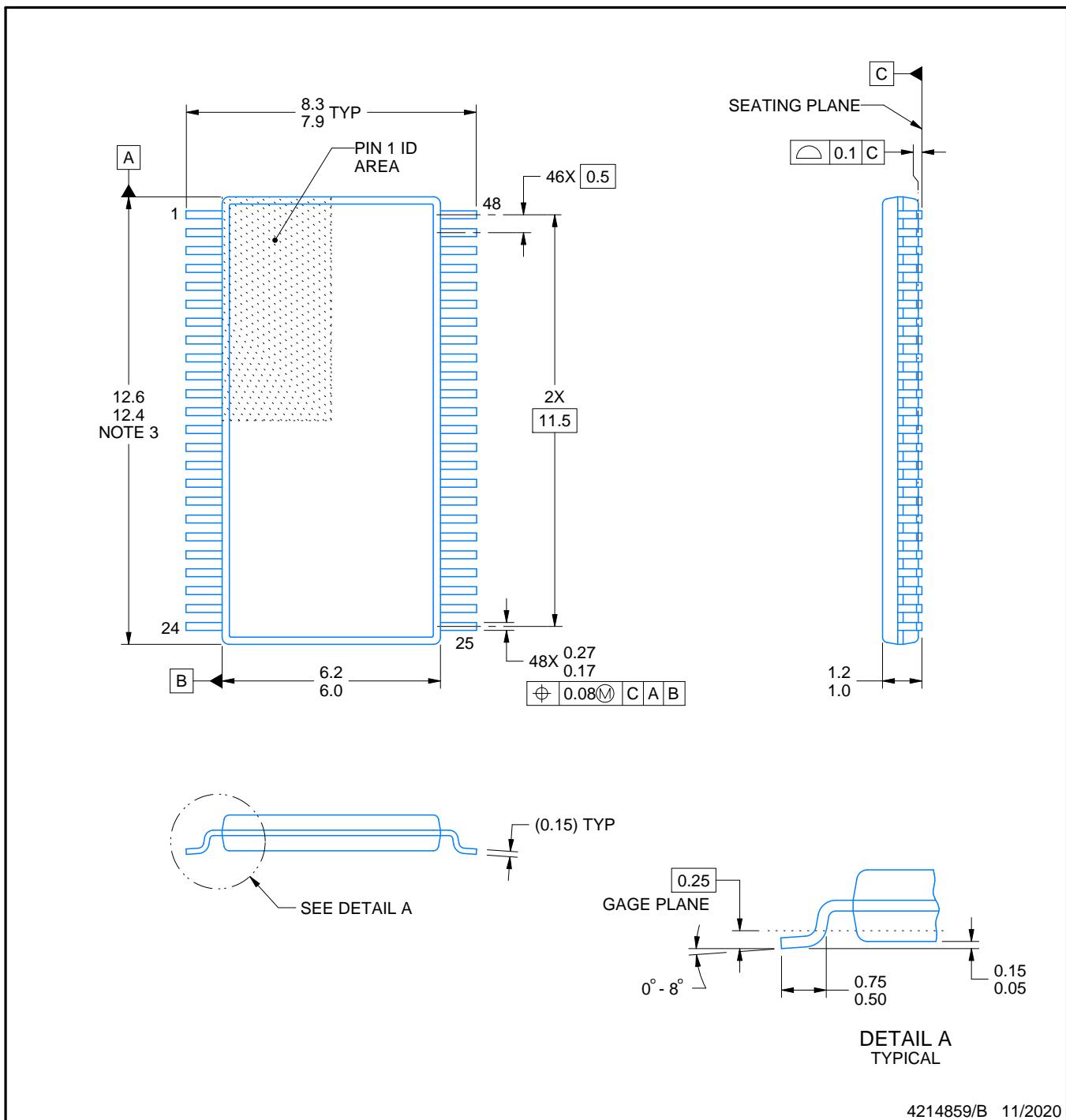
## PACKAGE OUTLINE

**DGG0048A**



## **TSSOP - 1.2 mm max height**

## SMALL OUTLINE PACKAGE



## NOTES:

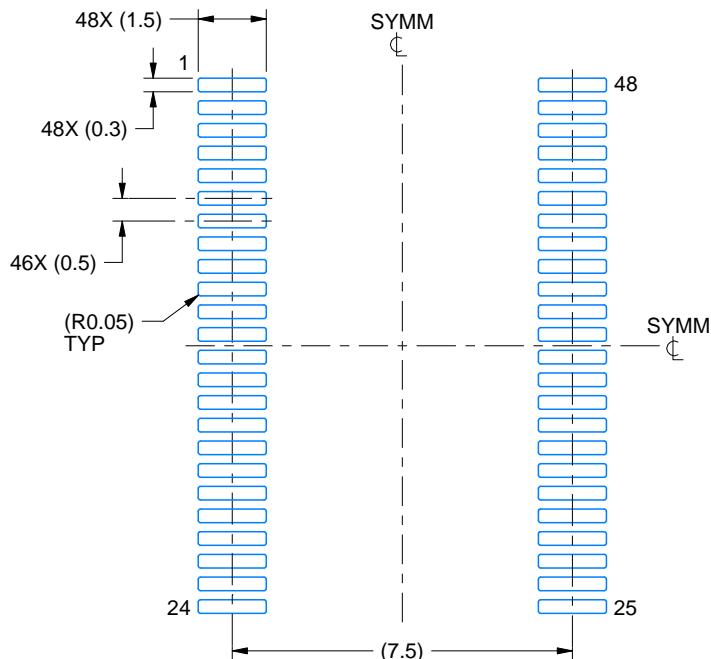
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

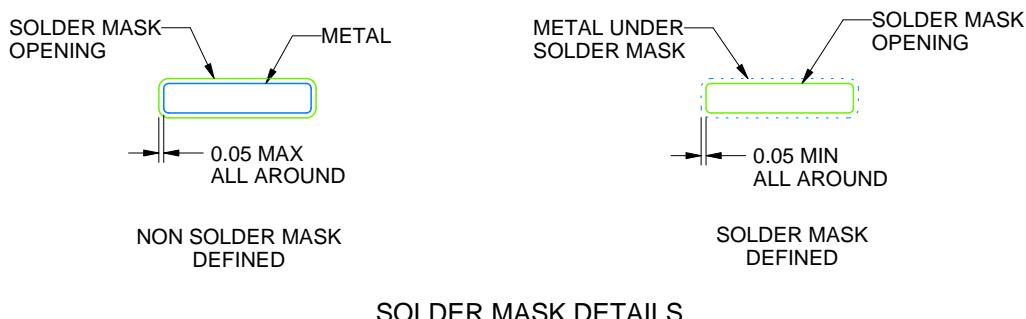
DGG0048A

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.

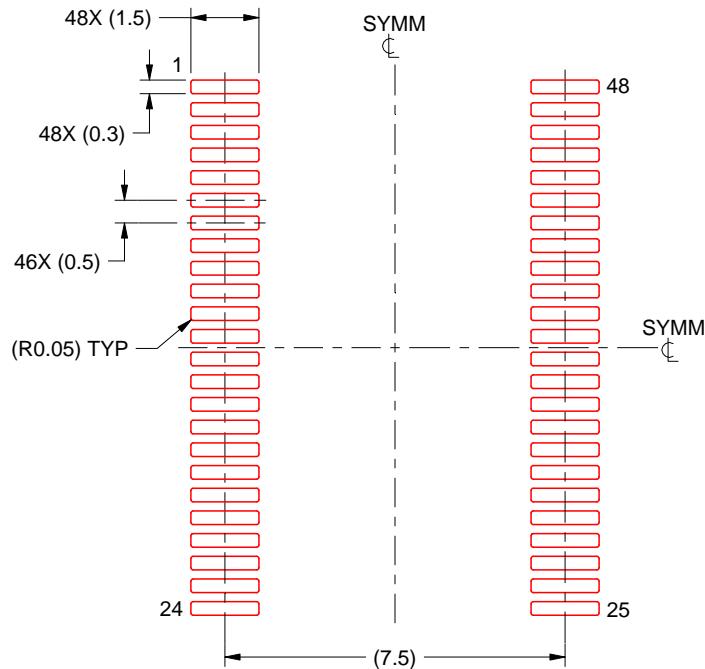
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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

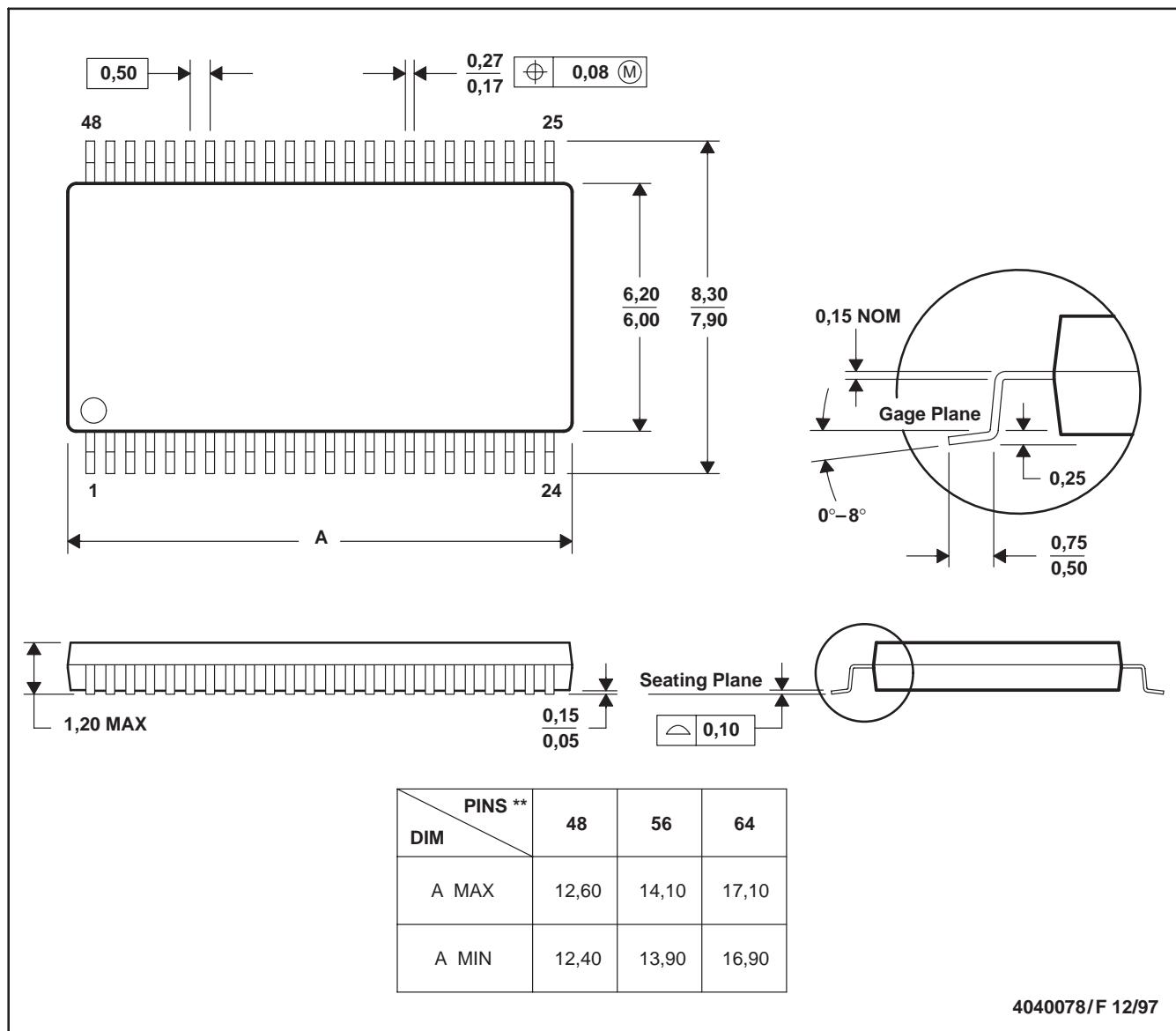
NOTES: (continued)

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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