

# SN54LVTH126, SN74LVTH126 3.3-V ABT QUADRUPLE BUS BUFFERS WITH 3-STATE OUTPUTS

SCBS746B – JULY 2000 - REVISED OCTOBER 2003

- 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
- 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)

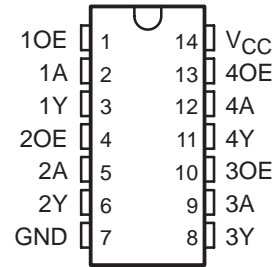
## description/ordering information

These bus buffers 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.

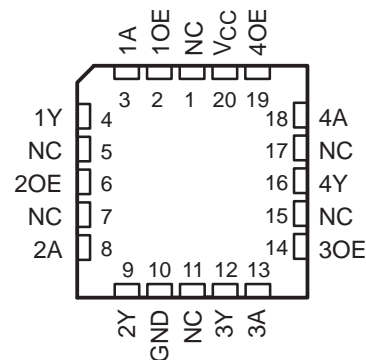
The 'LVTH126 devices feature independent line drivers with 3-state outputs. Each output is in the high-impedance state when the associated output-enable (OE) input is low.

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.

SN54LVTH126 . . . J OR W PACKAGE  
SN74LVTH126 . . . D, DB, DGV, NS, OR PW PACKAGE  
(TOP VIEW)



SN54LVTH126 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SOIC – D	Tube	SN74LVTH126D	LVTH126
		Tape and reel	SN74LVTH126DR	
	SOP – NS	Tape and reel	SN74LVTH126NSR	LVTH126
	SSOP – DB	Tape and reel	SN74LVTH126DBR	LXH126
	TSSOP – PW	Tube	SN74LVTH126PW	LXH126
		Tape and reel	SN74LVTH126PWR	
–55°C to 125°C	TVSOP – DGV	Tape and reel	SN74LVTH126DGVR	LXH126
	CDIP – J	Tube	SNJ54LVTH126J	SNJ54LVTH126J
	CFP – W	Tube	SNJ54LVTH126W	SNJ54LVTH126W
	LCCC – FK	Tube	SNJ54LVTH126FK	SNJ54LVTH126FK

† 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).



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 **TEXAS  
INSTRUMENTS**

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# SN54LVTH126, SN74LVTH126

## 3.3-V ABT QUADRUPLE BUS BUFFERS WITH 3-STATE OUTPUTS

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### description/ordering information (continued)

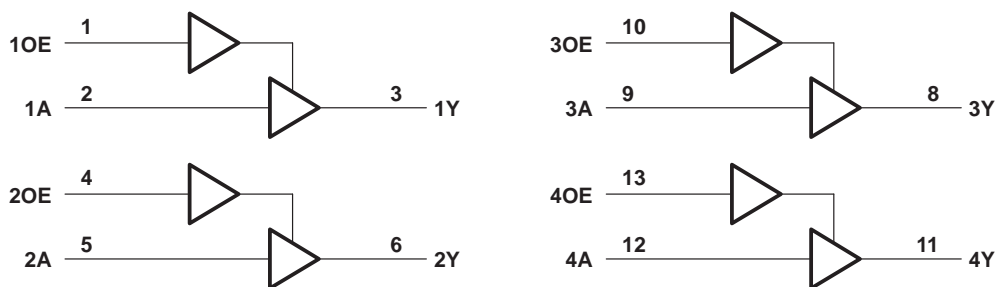
When  $V_{CC}$  is between 0 and 1.5 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability 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.

FUNCTION TABLE  
(each buffer)

INPUTS		OUTPUT
OE	A	Y
H	H	H
H	L	L
L	X	Z

### logic diagram (positive logic)



Pin numbers shown are for the D, DB, DGV, J, NS, PW, and W packages.

# SN54LVTH126, SN74LVTH126 3.3-V ABT QUADRUPLE BUS BUFFERS WITH 3-STATE OUTPUTS

SCBS746B – JULY 2000 - REVISED OCTOBER 2003

## 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, $I_O$ : SN54LVTH126 .....	96 mA
SN74LVTH126 .....	128 mA
Current into any output in the high state, $I_O$ (see Note 2): SN54LVTH126 .....	48 mA
SN74LVTH126 .....	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, $\theta_{JA}$ (see Note 3): D package .....	86°C/W
DB package .....	96°C/W
DGV package .....	127°C/W
NS package .....	76°C/W
PW package .....	113°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 51-7.

## recommended operating conditions (see Note 4)

		SN54LVTH126		SN74LVTH126		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
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled			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

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.

# SN54LVTH126, SN74LVTH126

## 3.3-V ABT QUADRUPLE BUS BUFFERS

### WITH 3-STATE OUTPUTS

SCBS746B – JULY 2000 - REVISED OCTOBER 2003

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

PARAMETER	TEST CONDITIONS		SN54LVTH126		SN74LVTH126		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			
	$V_{CC} = 3\text{ V}$	$I_{OH} = -24\text{ mA}$	2		2			
$V_{OL}$	$V_{CC} = 2.7\text{ V}$	$I_{OL} = 100\text{ }\mu\text{A}$	0.2		0.2		V	
		$I_{OL} = 24\text{ mA}$	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		0.55			
$I_I$	$V_{CC} = 0\text{ or }3.6\text{ V}$ , $V_I = 5.5\text{ V}$		10		10		$\mu\text{A}$	
	Control inputs	$V_{CC} = 3.6\text{ V}$ , $V_I = V_{CC}\text{ or GND}$		$\pm 1$		$\pm 1$		
	Data inputs	$V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}$		1			
	$V_I = 0$		-5					
$I_{off}$	$V_{CC} = 0$ , $V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$				$\pm 100$		$\mu\text{A}$	
$I_{I(\text{hold})}$	Data inputs	$V_{CC} = 3\text{ V}$	$V_I = 0.8\text{ V}$		75		$\mu\text{A}$	
			$V_I = 2\text{ V}$		-75			
		$V_{CC} = 3.6\text{ V}\ddagger$ , $V_I = 0\text{ to }3.6\text{ V}$				$\pm 500$		
$I_{OZH}$	$V_{CC} = 3.6\text{ V}$ , $V_O = 3\text{ V}$		5		5		$\mu\text{A}$	
$I_{OZL}$	$V_{CC} = 3.6\text{ V}$ , $V_O = 0.5\text{ V}$		-5		-5		$\mu\text{A}$	
$I_{OZPU}$	$V_{CC} = 0\text{ to }1.5\text{ V}$ , $V_O = 0.5\text{ V to }3\text{ V}$ , OE = don't care		$\pm 50^*$		$\pm 50$		$\mu\text{A}$	
$I_{OZPD}$	$V_{CC} = 1.5\text{ V to }0$ , $V_O = 0.5\text{ V to }3\text{ V}$ , OE = don't care		$\pm 50^*$		$\pm 50$		$\mu\text{A}$	
$I_{CC}$	$V_{CC} = 3.6\text{ V}$ , $I_O = 0$ , $V_I = V_{CC}\text{ or GND}$	Outputs high		0.12	0.19	0.12	0.19	mA
		Outputs low		4.5	7	4.5	7	
		Outputs disabled		0.12	0.19	0.12	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 $V_{CC}\text{ or GND}$		0.3		0.2		mA	
$C_i$	$V_I = 3\text{ V or }0$		4		4		pF	
$C_o$	$V_O = 3\text{ V or }0$		6.5		6.5		pF	

\* 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  $V_{CC}\text{ or GND}$ .

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



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SCBS746B – JULY 2000 - REVISED OCTOBER 2003

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH126				SN74LVTH126				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	4.8		5.5	1	2.3	3.8		4.5	ns
$t_{PHL}$			1	4.9		5.4	1	2.4	3.9		4.4	
$t_{PZH}$	OE	Y	1	6.4		7.1	1	3.6	5.4		6.1	ns
$t_{PZL}$			1.1	6.2		6.8	1.1	3.6	5.2		5.8	
$t_{PHZ}$	OE	Y	1	4.8		5.3	1	2.2	3.8		4.3	ns
$t_{PLZ}$			1.3	6.5		7.1	1.3	3.6	5.5		6.1	

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

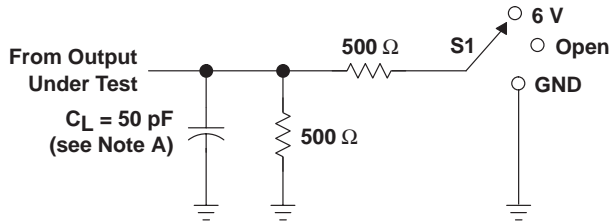
# SN54LVTH126, SN74LVTH126

## 3.3-V ABT QUADRUPLE BUS BUFFERS

### WITH 3-STATE OUTPUTS

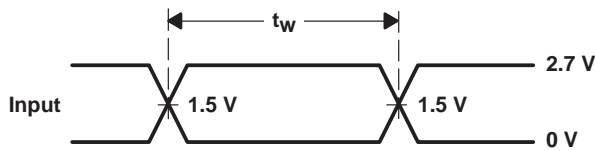
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#### PARAMETER MEASUREMENT INFORMATION

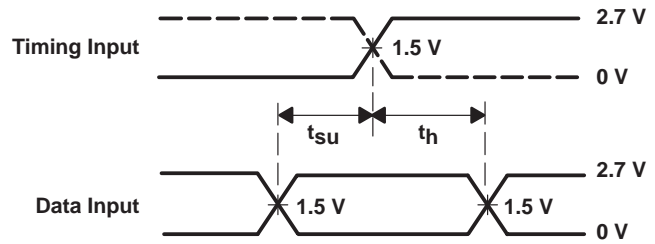


LOAD CIRCUIT

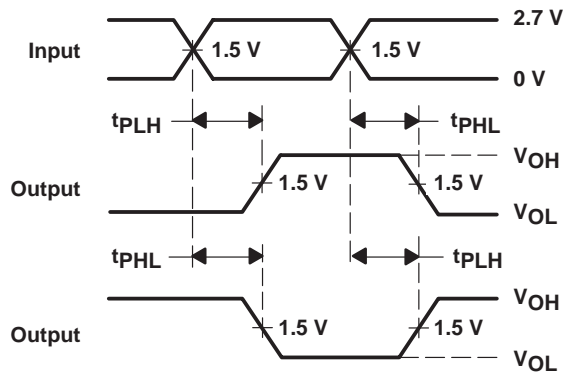
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND



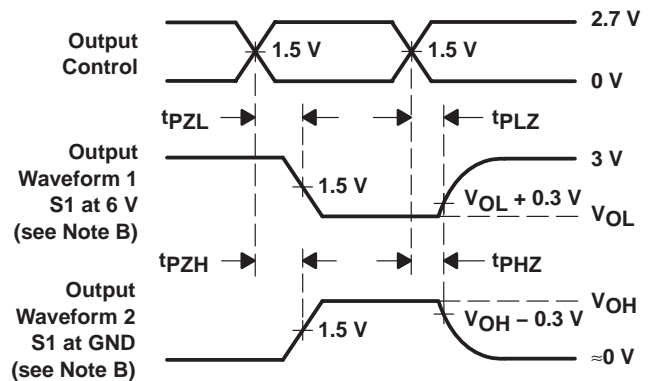
VOLTAGE WAVEFORMS  
PULSE DURATION



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:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - 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 finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LVTH126D	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH126	<a href="#">Samples</a>
SN74LVTH126DBR	ACTIVE	SSOP	DB	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LXH126	<a href="#">Samples</a>
SN74LVTH126DGVR	ACTIVE	TVSOP	DGV	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LXH126	<a href="#">Samples</a>
SN74LVTH126DR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH126	<a href="#">Samples</a>
SN74LVTH126NSR	ACTIVE	SO	NS	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVTH126	<a href="#">Samples</a>
SN74LVTH126PW	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LXH126	<a href="#">Samples</a>
SN74LVTH126PWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LXH126	<a href="#">Samples</a>
SN74LVTH126PWRG4	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LXH126	<a href="#">Samples</a>

(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.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead finish/Ball material - Orderable Devices 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.

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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
SN74LVTH126DBR	SSOP	DB	14	2000	330.0	16.4	8.35	6.6	2.4	12.0	16.0	Q1
SN74LVTH126DGVR	TVSOP	DGV	14	2000	330.0	12.4	6.8	4.0	1.6	8.0	12.0	Q1
SN74LVTH126DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74LVTH126NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74LVTH126PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVTH126DBR	SSOP	DB	14	2000	356.0	356.0	35.0
SN74LVTH126DGVR	TVSOP	DGV	14	2000	356.0	356.0	35.0
SN74LVTH126DR	SOIC	D	14	2500	356.0	356.0	35.0
SN74LVTH126NSR	SO	NS	14	2000	356.0	356.0	35.0
SN74LVTH126PWR	TSSOP	PW	14	2000	356.0	356.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74LVTH126D	D	SOIC	14	50	506.6	8	3940	4.32
SN74LVTH126PW	PW	TSSOP	14	90	530	10.2	3600	3.5

## MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-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 flash or protrusion, not to exceed 0,15.

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

# DB0014A



# PACKAGE OUTLINE

## SSOP - 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-150.

# EXAMPLE BOARD LAYOUT

DB0014A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220762/A 05/2024

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

DB0014A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220762/A 05/2024

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.





D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040047-5/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211283-3/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211284-2/G 08/15

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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