

## SN74LVC1G79 Single Positive-Edge-Triggered D-Type Flip-Flop

### 1 Features

- Available in the Texas Instruments NanoFree™ Package
- 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)
- Supports 5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Supports Down Translation to  $V_{CC}$
- Max  $t_{pd}$  of 6 ns at 3.3 V and 50 pF load
- Low Power Consumption, 10- $\mu$ A Max  $I_{CC}$
- $\pm 24$ -mA Output Drive at 3.3 V
- $I_{off}$  supports Partial-Power-Down Mode and Back-Drive Protection

### 2 Applications

- Test and Measurement
- Enterprise Switching
- Telecom Infrastructure
- Personal Electronics
- White Goods

### 3 Description

The SN74LVC1G79 device is a single positive-edge-triggered D-type flip-flop that is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

When data at the data (D) input meets the setup time requirement, the data is transferred to the Q output on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold-time interval, data at the D input can be changed without affecting the level at the output.

NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

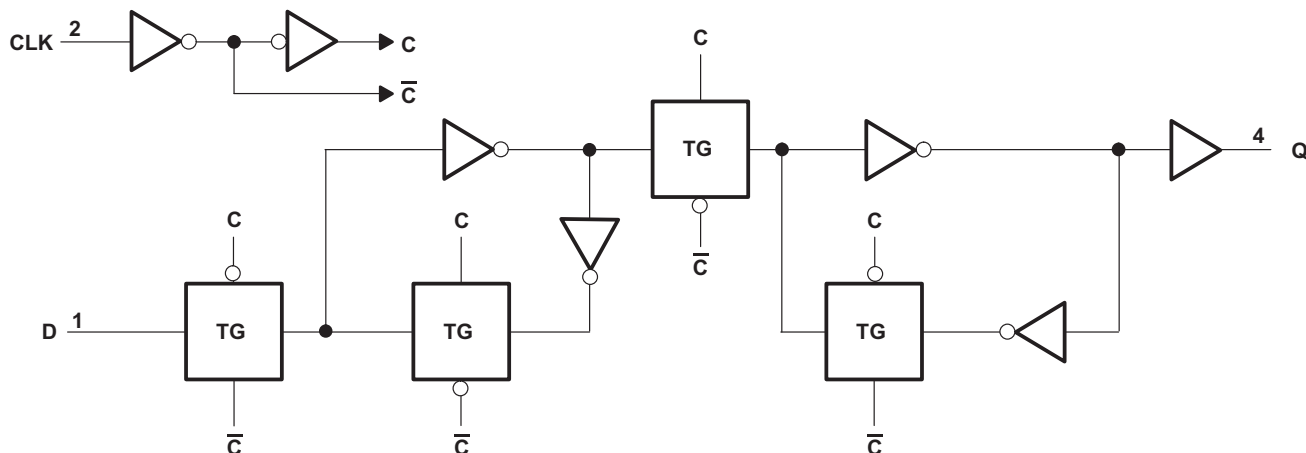
This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs when the device is powered down. This inhibits current backflow into the device which prevents damage to the device.

#### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE
SN74LVC1G79DBV	SOT-23 (5)	2.90 mm x 1.60 mm
SN74LVC1G79DCK	SC70 (5)	2.00 mm x 1.25 mm
SN74LVC1G79DRL	SOT (5)	1.60 mm x 1.20 mm
SN74LVC1G79YZP	DSBGA (5)	1.14 mm x 0.91 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

#### Logic Diagram (Positive Logic)



Copyright © 2017, Texas Instruments Incorporated



## Table of Contents

<p><b>1 Features</b> ..... 1</p> <p><b>2 Applications</b> ..... 1</p> <p><b>3 Description</b> ..... 1</p> <p><b>4 Revision History</b> ..... 2</p> <p><b>5 Pin Configuration and Functions</b> ..... 3</p> <p><b>6 Specifications</b> ..... 4</p> <p>    6.1 Absolute Maximum Ratings ..... 4</p> <p>    6.2 ESD Ratings ..... 4</p> <p>    6.3 Recommended Operating Conditions ..... 5</p> <p>    6.4 Thermal Information ..... 5</p> <p>    6.5 Electrical Characteristics ..... 6</p> <p>    6.6 Timing Requirements: <math>T_A = -40^\circ\text{C}</math> to <math>+85^\circ\text{C}</math> ..... 6</p> <p>    6.7 Timing Requirements: <math>T_A = -40^\circ\text{C}</math> to <math>+125^\circ\text{C}</math> ..... 6</p> <p>    6.8 Switching Characteristics: <math>C_L = 15\text{ pF}</math>, <math>T_A = -40^\circ\text{C}</math> to <math>+85^\circ\text{C}</math> ..... 7</p> <p>    6.9 Switching Characteristics: <math>C_L = 30</math> or <math>50\text{ pF}</math>, <math>T_A = -40^\circ\text{C}</math> to <math>+85^\circ\text{C}</math> ..... 7</p> <p>    6.10 Switching Characteristics: <math>C_L = 30\text{ pF}</math> or <math>50\text{ pF}</math>, <math>T_A = -40^\circ\text{C}</math> to <math>+125^\circ\text{C}</math> ..... 7</p> <p>    6.11 Operating Characteristics ..... 7</p> <p>    6.12 Typical Characteristics ..... 8</p> <p><b>7 Parameter Measurement Information</b> ..... 9</p>	<p><b>8 Detailed Description</b> ..... 11</p> <p>    8.1 Overview ..... 11</p> <p>    8.2 Functional Block Diagram ..... 11</p> <p>    8.3 Feature Description ..... 11</p> <p>    8.4 Device Functional Modes ..... 12</p> <p><b>9 Application and Implementation</b> ..... 13</p> <p>    9.1 Application Information ..... 13</p> <p>    9.2 Typical Application ..... 13</p> <p><b>10 Power Supply Recommendations</b> ..... 14</p> <p><b>11 Layout</b> ..... 14</p> <p>    11.1 Layout Guidelines ..... 14</p> <p>    11.2 Layout Example ..... 14</p> <p><b>12 Device and Documentation Support</b> ..... 15</p> <p>    12.1 Documentation Support ..... 15</p> <p>    12.2 Receiving Notification of Documentation Updates ..... 15</p> <p>    12.3 Community Resources ..... 15</p> <p>    12.4 Trademarks ..... 15</p> <p>    12.5 Electrostatic Discharge Caution ..... 15</p> <p>    12.6 Glossary ..... 15</p> <p><b>13 Mechanical, Packaging, and Orderable Information</b> ..... 15</p>
--	--

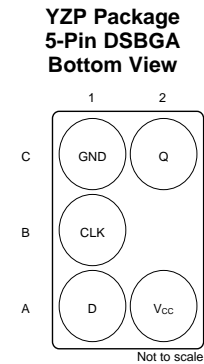
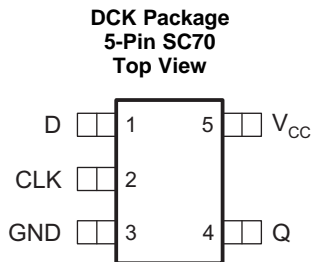
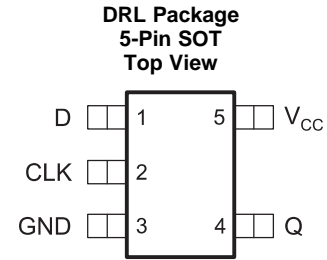
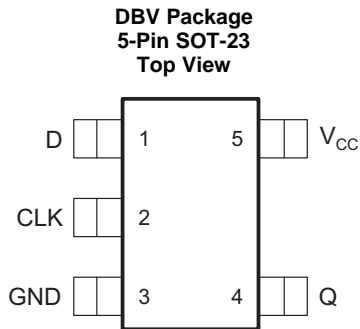
## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision T (December 2013) to Revision U	Page
<ul style="list-style-type: none"> <li>• Added <i>Device Information</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i>, <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... 1</li> <li>• Changed thermal information to align with JEDEC standards. .... 5</li> </ul>	

Changes from Revision S (November 2007) to Revision T	Page
<ul style="list-style-type: none"> <li>• Updated document to new TI data sheet format ..... 1</li> <li>• Removed Ordering Information table. .... 1</li> <li>• Updated <math>I_{off}</math> in Features. .... 1</li> <li>• Updated operating temperature range. .... 5</li> <li>• Added ESD warning. .... 15</li> </ul>	

## 5 Pin Configuration and Functions



See mechanical drawings for dimensions.

### Pin Functions

NAME	PIN		I/O	DESCRIPTION
	DBV, DCK, DRL	YZP		
D	1	A1	I	Data input
CLK	2	B1	I	Positive-Edge-Triggered Clock input
GND	3	C1	—	Ground
Q	4	C2	O	Non-inverted output
V <sub>CC</sub>	5	A2	—	Positive Supply

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	-0.5	6.5	V
V <sub>I</sub>	Input voltage <sup>(2)</sup>	-0.5	6.5	V
V <sub>O</sub>	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	-0.5	6.5	V
V <sub>O</sub>	Voltage range applied to any output in the high or low state <sup>(2)(3)</sup>	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0	-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0	-50	mA
I <sub>O</sub>	Continuous output current		±50	mA
	Continuous current through V <sub>CC</sub> or GND		±100	mA
T <sub>stg</sub>	Storage temperature	-65	150	°C
T <sub>J</sub>	Junction temperature		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<sub>CC</sub> is provided in the *Recommended Operating Conditions* table.

### 6.2 ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±2000
		Charged device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	±1000
		Machine Model (MM), A115-A	200

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT	
V <sub>CC</sub>	Supply voltage	Operating	1.65	5.5	V
		Data retention only	1.5		
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7		
		V <sub>CC</sub> = 3 V to 3.6 V	2		
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7 × V <sub>CC</sub>		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.35 × V <sub>CC</sub>		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7		
		V <sub>CC</sub> = 3 V to 3.6 V	0.8		
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.3 × V <sub>CC</sub>		
V <sub>I</sub>	Input voltage	0	5.5	V	
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	V	
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 1.65 V	–4		mA
		V <sub>CC</sub> = 2.3 V	–8		
		V <sub>CC</sub> = 3 V	–16		
			–24		
		V <sub>CC</sub> = 4.5 V	–32		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 1.65 V	4		mA
		V <sub>CC</sub> = 2.3 V	8		
		V <sub>CC</sub> = 3 V	16		
			24		
		V <sub>CC</sub> = 4.5 V	32		
Δt/Δv	Input transition rise or fall rate	V <sub>CC</sub> = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V	20		ns/V
		V <sub>CC</sub> = 3.3 V ± 0.3 V	10		
		V <sub>CC</sub> = 5 V ± 0.5 V	5		
T <sub>A</sub>	Operating free-air temperature	–40	125	°C	

(1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. See [Implications of Slow or Floating CMOS Inputs](#), SCBA004.

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>	SN74LVC1G79				UNIT	
	DBV (SOT-23)	DCK (SC70)	DRL (SOT)	YZP (DSBGA)		
	5 PINS	5 PINS	5 PINS	5 PINS		
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	247.2	277.6	294.3	144.4	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	154.5	179.5	129.9	1.3	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	86.8	75.9	143.4	39.9	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	58.0	49.7	14.3	0.5	°C/W
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	86.4	75.1	144.0	39.7	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 6.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = –40°C to +85°C			T <sub>A</sub> = –40°C to +125°C			UNIT
			MIN	TYP <sup>(1)</sup>	MAX	MIN	TYP <sup>(1)</sup>	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = –100 μA	1.65 V to 5.5 V	V <sub>CC</sub> – 0.1			V <sub>CC</sub> – 0.1			V
	I <sub>OH</sub> = –4 mA	1.65 V	1.2			1.2			
	I <sub>OH</sub> = –8 mA	2.3 V	1.9			1.9			
	I <sub>OH</sub> = –16 mA	3 V	2.4			2.4			
	I <sub>OH</sub> = –24 mA		2.3			2.3			
	I <sub>OH</sub> = –32 mA	4.5 V	3.8			3.8			
V <sub>OL</sub>	I <sub>OL</sub> = 100 μA	1.65 V to 5.5 V	0.1			0.1			V
	I <sub>OL</sub> = 4 mA	1.65 V	0.45			0.45			
	I <sub>OL</sub> = 8 mA	2.3 V	0.3			0.3			
	I <sub>OL</sub> = 16 mA	3 V	0.4			0.4			
	I <sub>OL</sub> = 24 mA		0.55			0.55			
	I <sub>OL</sub> = 32 mA	4.5 V	0.55			0.55			
I <sub>I</sub>	All inputs V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V	±10			±5			μA
I <sub>off</sub>	V <sub>I</sub> or V <sub>O</sub> = 5.5 V	0	±10			±10			μA
I <sub>CC</sub>	V <sub>I</sub> = 5.5 V or GND, I <sub>O</sub> = 0	1.65 V to 5.5 V	10			10			μA
ΔI <sub>CC</sub>	One input at V <sub>CC</sub> – 0.6 V, Other inputs at V <sub>CC</sub> or GND	3 V to 5.5 V	500			500			μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V	4			4			pF

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

## 6.6 Timing Requirements: T<sub>A</sub> = –40°C to +85°C

 over operating free-air temperature range (unless otherwise noted) (see [Figure 3](#))

PARAMETER		T <sub>A</sub> = –40°C to +85°C								UNIT	
		V <sub>CC</sub> = 1.8 ± 0.15 V		V <sub>CC</sub> = 2.5 ± 0.2 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 5 V ± 0.5 V			
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
f <sub>clock</sub>	Clock frequency	160		160		160		160		MHz	
t <sub>w</sub>	Pulse duration, CLK high or low	2.5		2.5		2.5		2.5		ns	
t <sub>su</sub>	Setup time before CLK↑	Data high	2.2		1.4		1.3		1.2		ns
		Data low	2.6		1.4		1.3		1.2		
t <sub>h</sub>	Hold time, data after CLK↑	0.3		0.4		1		0.5		ns	

## 6.7 Timing Requirements: T<sub>A</sub> = –40°C to +125°C

 over operating free-air temperature range (unless otherwise noted) (see [Figure 3](#))

PARAMETER		T <sub>A</sub> = –40°C to +125°C								UNIT	
		V <sub>CC</sub> = 1.8 ± 0.15 V		V <sub>CC</sub> = 2.5 ± 0.2 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 5 V ± 0.5 V			
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
f <sub>clock</sub>	Clock frequency	160		160		160		160		MHz	
t <sub>w</sub>	Pulse duration, CLK high or low	2.5		2.5		2.5		2.5		ns	
t <sub>su</sub>	Setup time before CLK↑	Data high	2.2		1.4		1.3		1.2		ns
		Data low	2.6		1.4		1.3		1.2		
t <sub>h</sub>	Hold time, data after CLK↑	0.3		0.4		1		0.5		ns	

### 6.8 Switching Characteristics: $C_L = 15\text{ pF}$ , $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$

over recommended operating free-air temperature range,  $C_L = 15\text{ pF}$  (unless otherwise noted) (see [Figure 3](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$								UNIT
			$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		$V_{CC} = 5\text{ V}$ $\pm 0.5\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			160		160		160		160		MHz
$t_{\text{pd}}$	CLK	Q	2.5	9.1	1.2	6	1	4	0.8	3.8	ns

### 6.9 Switching Characteristics: $C_L = 30$ or $50\text{ pF}$ , $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$

over recommended operating free-air temperature range,  $C_L = 30\text{ pF}$  or  $50\text{ pF}$  (unless otherwise noted) (see [Figure 4](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$								UNIT
			$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		$V_{CC} = 5\text{ V}$ $\pm 0.5\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			160		160		160		160		MHz
$t_{\text{pd}}$	CLK	Q	3.9	9.9	2	7	1.7	5	1	4.5	ns

### 6.10 Switching Characteristics: $C_L = 30\text{ pF}$ or $50\text{ pF}$ , $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$

over recommended operating free-air temperature range,  $C_L = 30\text{ pF}$  or  $50\text{ pF}$  (unless otherwise noted) (see [Figure 4](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$								UNIT
			$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		$V_{CC} = 5\text{ V}$ $\pm 0.5\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			160		160		160		160		MHz
$t_{\text{pd}}$	CLK	Q	3.9	12	2	8.5	1.7	6	1	5	ns

### 6.11 Operating Characteristics

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

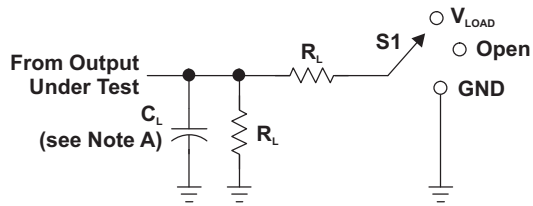
PARAMETER	TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	$V_{CC} = 5\text{ V}$	UNIT	
		TYP	TYP	TYP	TYP		
$C_{\text{pd}}$	Power dissipation capacitance	f = 10 MHz	26	26	27	30	pF

### 6.12 Typical Characteristics

This plot shows the different  $I_{CC}$  values for various voltages on the data input (D). Voltage sweep on the input is from 0 V to 6.5 V.



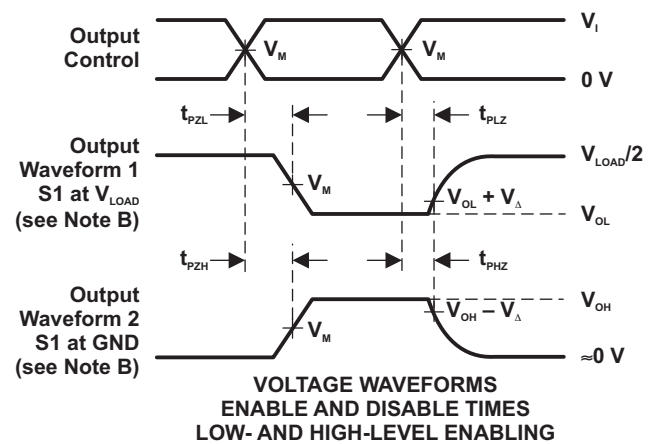
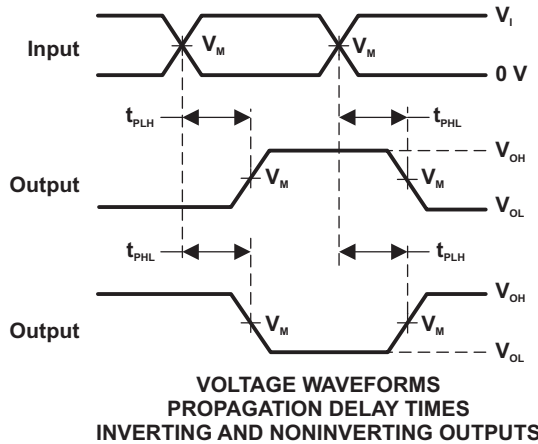
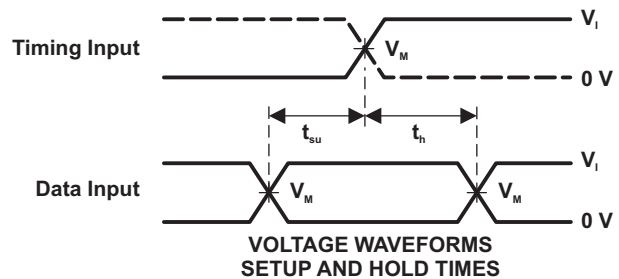
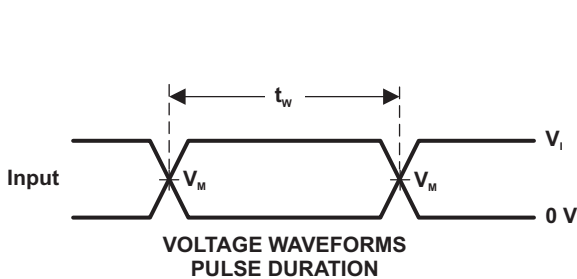
## 7 Parameter Measurement Information



LOAD CIRCUIT

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

$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_i$	$t_r/t_f$					
$1.8\text{ V} \pm 0.15\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	1 M $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	1 M $\Omega$	0.15 V
$3.3\text{ V} \pm 0.3\text{ V}$	3 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	15 pF	1 M $\Omega$	0.3 V
$5\text{ V} \pm 0.5\text{ V}$	$V_{CC}$	$\leq 2.5\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	1 M $\Omega$	0.3 V



- 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 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.

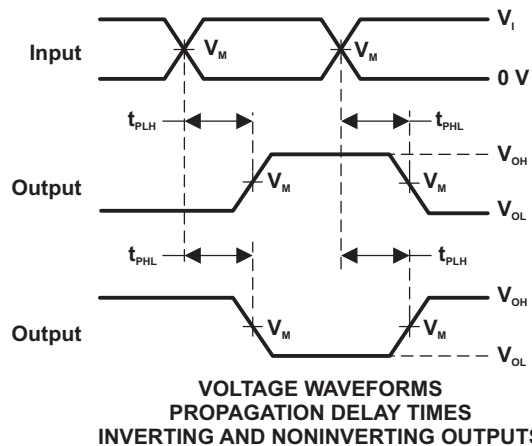
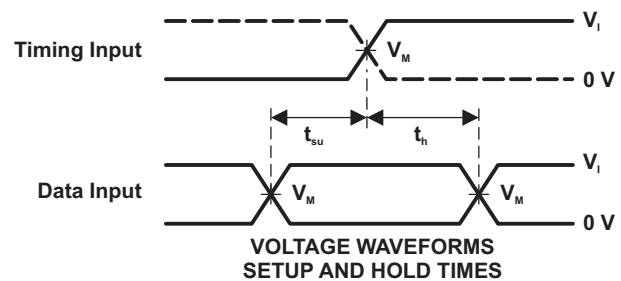
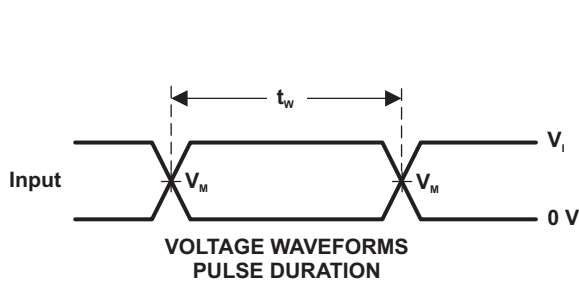
Figure 3. Load Circuit and Voltage Waveforms

**Parameter Measurement Information (continued)**

**LOAD CIRCUIT**

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

$V_{CC}$	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
$3.3\text{ V} \pm 0.3\text{ V}$	3 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
$5\text{ V} \pm 0.5\text{ V}$	$V_{CC}$	$\leq 2.5\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 $\Omega$	0.3 V



- 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  $t_{on}$ .  
 G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .  
 H. All parameters and waveforms are not applicable to all devices.

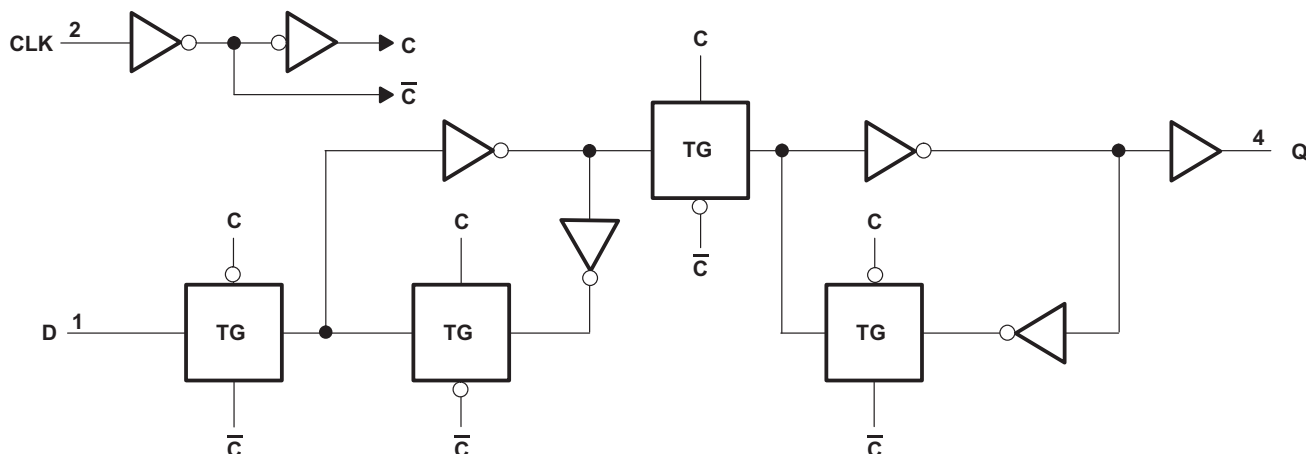
**Figure 4. Load Circuit and Voltage Waveforms**

## 8 Detailed Description

### 8.1 Overview

The SN74LVC1G79 is a single positive-edge-triggered D-type flip-flop. Data at the input (D) is transferred to the output (Q) on the positive-going edge of the clock pulse when the setup time requirement is met. Because the clock triggering occurs at a voltage level, it is not directly related to the rise time of the clock pulse. This allows for data at the input to be changed without affecting the level at the output, following the hold-time interval.

### 8.2 Functional Block Diagram



Copyright © 2017, Texas Instruments Incorporated

Figure 5. Logic Diagram (Positive Logic)

### 8.3 Feature Description

#### 8.3.1 Balanced High-Drive CMOS Push-Pull Outputs

A balanced output allows the device to sink and source similar currents. The high drive capability of this device creates fast edges into light loads so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. It is important for the power output of the device to be limited to avoid thermal runaway and damage due to over-current. The electrical and thermal limits defined in the [Absolute Maximum Ratings](#) must be followed at all times.

#### 8.3.2 Standard CMOS Inputs

Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the [Electrical Characteristics](#). The worst case resistance is calculated with the maximum input voltage, given in the [Recommended Operating Conditions](#), and the maximum input leakage current, given in the [Electrical Characteristics](#), using ohm's law ( $R = V \div I$ ).

Signals applied to the inputs need to have fast edge rates, as defined by  $\Delta t/\Delta v$  in [Recommended Operating Conditions](#) to avoid excessive currents and oscillations. If tolerance to a slow or noisy input signal is required, a device with a Schmitt-trigger input should be utilized to condition the input signal prior to the standard CMOS input.

## Feature Description (continued)

### 8.3.3 Clamp Diodes

The inputs and outputs to this device have negative clamping diodes.

**CAUTION**

Voltages beyond the values specified in the [Absolute Maximum Ratings](#) table can cause damage to the device. The input negative-voltage and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

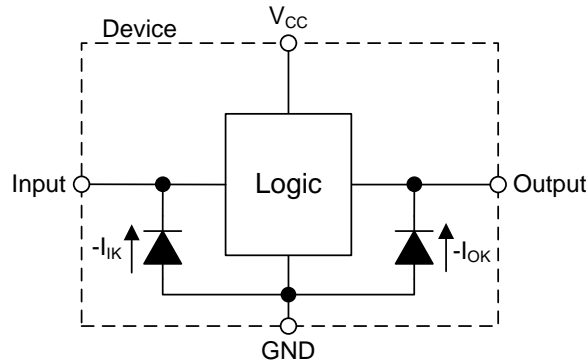


Figure 6. Electrical Placement of Clamping Diodes for Each Input and Output

### 8.3.4 Partial Power Down ( $I_{off}$ )

The inputs and outputs for this device enter a high impedance state when the supply voltage is 0 V. The maximum leakage into or out of any input or output pin on the device is specified by  $I_{off}$  in the [Electrical Characteristics](#).

### 8.3.5 Over-Voltage Tolerant Inputs

Input signals to this device can be driven above the supply voltage so long as they remain below the maximum input voltage value specified in the [Absolute Maximum Ratings](#).

## 8.4 Device Functional Modes

Table 1 lists the functional modes of SN74LVC1G79.

Table 1. Function Table

INPUTS		OUTPUT Y
CLK	D	
↑	H	H
↑	L	L
L	X	$Q_0$

## 9 Application and Implementation

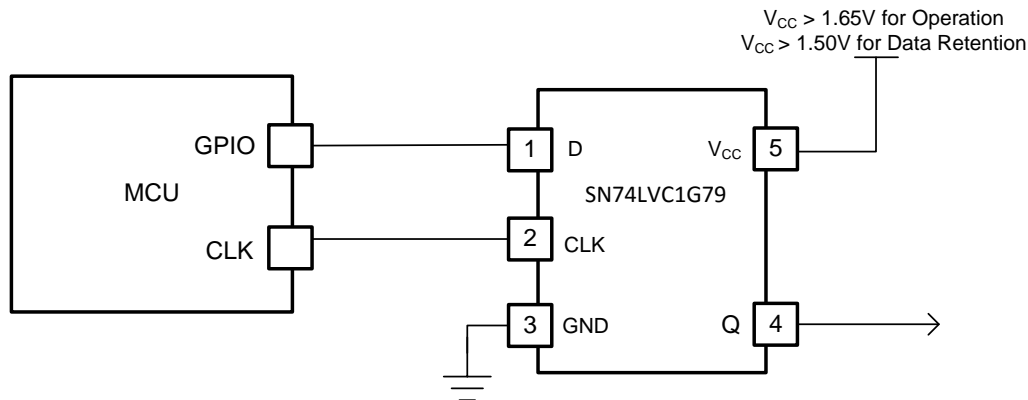
### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

A useful application for the SN74LVC1G79 is using it as a data latch with low-voltage data retention. This application implements the use of a microcontroller GPIO pin to act as a clock to set the output state and a second GPIO to provide the input data. If the SN74LVC1G79 is being powered from 1.8 V and there is concern that a power glitch could exist as low as 1.5 V, the device will retain the state of the Q output. An example of this data retention is shown in Figure 8 where the  $V_{CC}$  drops to 1.5 V and the Q output maintains the HIGH output state when  $V_{CC}$  returns to 1.8 V. If the  $V_{CC}$  voltage drops below 1.5 V, data retention is not guaranteed.

### 9.2 Typical Application



Copyright © 2017, Texas Instruments Incorporated

Figure 7. Low Voltage Data Retention With SN74LVC1G79

#### 9.2.1 Design Requirements

The SN74LVC1G79 device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits.

#### 9.2.2 Detailed Design Procedure

- Recommended input conditions:
  - For rise time and fall time specifications, see  $\Delta t/\Delta v$  in [Recommended Operating Conditions](#).
  - For specified high and low levels, see  $V_{IH}$  and  $V_{IL}$  in [Recommended Operating Conditions](#).
  - Input voltages are recommended to not go below 0 V and not exceed 5.5 V for any  $V_{CC}$ . See [Recommended Operating Conditions](#).
- Recommended output conditions:
  - Load currents should not exceed  $\pm 50$  mA. See [Absolute Maximum Ratings](#).
  - Output voltages are recommended to not go below 0 V and not exceed the  $V_{CC}$  voltage. See [Recommended Operating Conditions](#).

## Typical Application (continued)

### 9.2.3 Application Curve

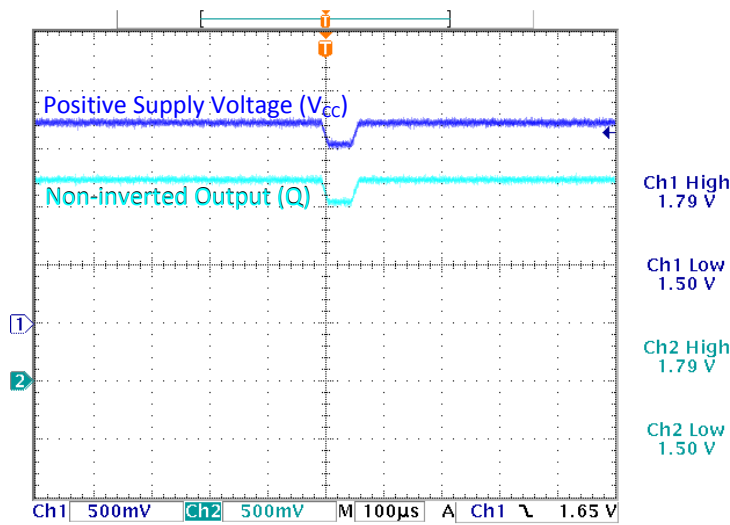


Figure 8. Data Retention With  $V_{CC}$  Glitch Down to 1.5 V

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating listed in [Recommended Operating Conditions](#). A 0.1- $\mu\text{F}$  bypass capacitor is recommended to be connected from the VCC terminal to GND to prevent power disturbance. To reject different frequencies of noise, use multiple bypass capacitors in parallel. Capacitors with values of 0.1  $\mu\text{F}$  and 1  $\mu\text{F}$  are commonly used in parallel. The bypass capacitor must be installed as close to the power terminal as possible for best results.

## 11 Layout

### 11.1 Layout Guidelines

When a PCB trace turns a corner at a 90° angle, a reflection can occur. A reflection occurs primarily because of the change of width of the trace. At the apex of the turn, the trace width increases to 1.414 times the width. This increase upsets the transmission-line characteristics, especially the distributed capacitance and self-inductance of the trace which results in the reflection. Not all PCB traces can be straight and therefore some traces must turn corners. [Figure 9](#) shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

### 11.2 Layout Example



Figure 9. Trace Example

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

- [Implications of Slow or Floating CMOS Inputs](#), SCBA004
- [Understanding and Interpreting Standard Logic Data Sheets](#), SZZA036
- [Power-Up Behavior of Clocked Devices](#), SCHA005

### 12.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 12.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.4 Trademarks

NanoFree, E2E are trademarks of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 12.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser based versions of this data sheet, refer to the left hand navigation.

**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)
<a href="#">SN74LVC1G79DBVR</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(C795, C79F, C79J, C79R)
SN74LVC1G79DBVR.A	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C795, C79F, C79J, C79R)
SN74LVC1G79DBVR.B	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C795, C79F, C79J, C79R)
<a href="#">SN74LVC1G79DBVT</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(C795, C79F, C79J, C79R)
SN74LVC1G79DBVT.B	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C795, C79F, C79J, C79R)
<a href="#">SN74LVC1G79DBVTG4</a>	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C79F
SN74LVC1G79DBVTG4.B	Active	Production	SOT-23 (DBV)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C79F
<a href="#">SN74LVC1G79DCKR</a>	Active	Production	SC70 (DCK)   5	3000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(CR5, CRF, CRJ, CR R)
SN74LVC1G79DCKR.A	Active	Production	SC70 (DCK)   5	3000   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(CR5, CRF, CRJ, CR R)
SN74LVC1G79DCKR.B	Active	Production	SC70 (DCK)   5	3000   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(CR5, CRF, CRJ, CR R)
<a href="#">SN74LVC1G79DCKRG4</a>	Active	Production	SC70 (DCK)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CR5
SN74LVC1G79DCKRG4.B	Active	Production	SC70 (DCK)   5	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CR5
<a href="#">SN74LVC1G79DCKT</a>	Active	Production	SC70 (DCK)   5	250   SMALL T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(CR5, CRF, CRJ, CR R)
SN74LVC1G79DCKT.B	Active	Production	SC70 (DCK)   5	250   SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(CR5, CRF, CRJ, CR R)
<a href="#">SN74LVC1G79DCKTG4</a>	Active	Production	SC70 (DCK)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CR5
SN74LVC1G79DCKTG4.B	Active	Production	SC70 (DCK)   5	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CR5
<a href="#">SN74LVC1G79DRLR</a>	Active	Production	SOT-5X3 (DRL)   5	4000   LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(CR7, CRR)
SN74LVC1G79DRLR.A	Active	Production	SOT-5X3 (DRL)   5	4000   LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(CR7, CRR)
SN74LVC1G79DRLR.B	Active	Production	SOT-5X3 (DRL)   5	4000   LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(CR7, CRR)
<a href="#">SN74LVC1G79YZPR</a>	Active	Production	DSBGA (YZP)   5	3000   LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	(CR7, CRN)
SN74LVC1G79YZPR.B	Active	Production	DSBGA (YZP)   5	3000   LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	(CR7, CRN)

(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.

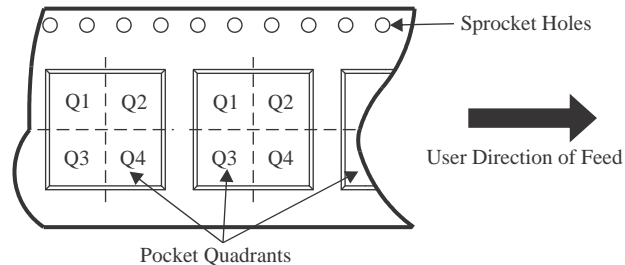
#### OTHER QUALIFIED VERSIONS OF SN74LVC1G79 :

- Automotive : [SN74LVC1G79-Q1](#)
- Enhanced Product : [SN74LVC1G79-EP](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**TAPE AND REEL INFORMATION**

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


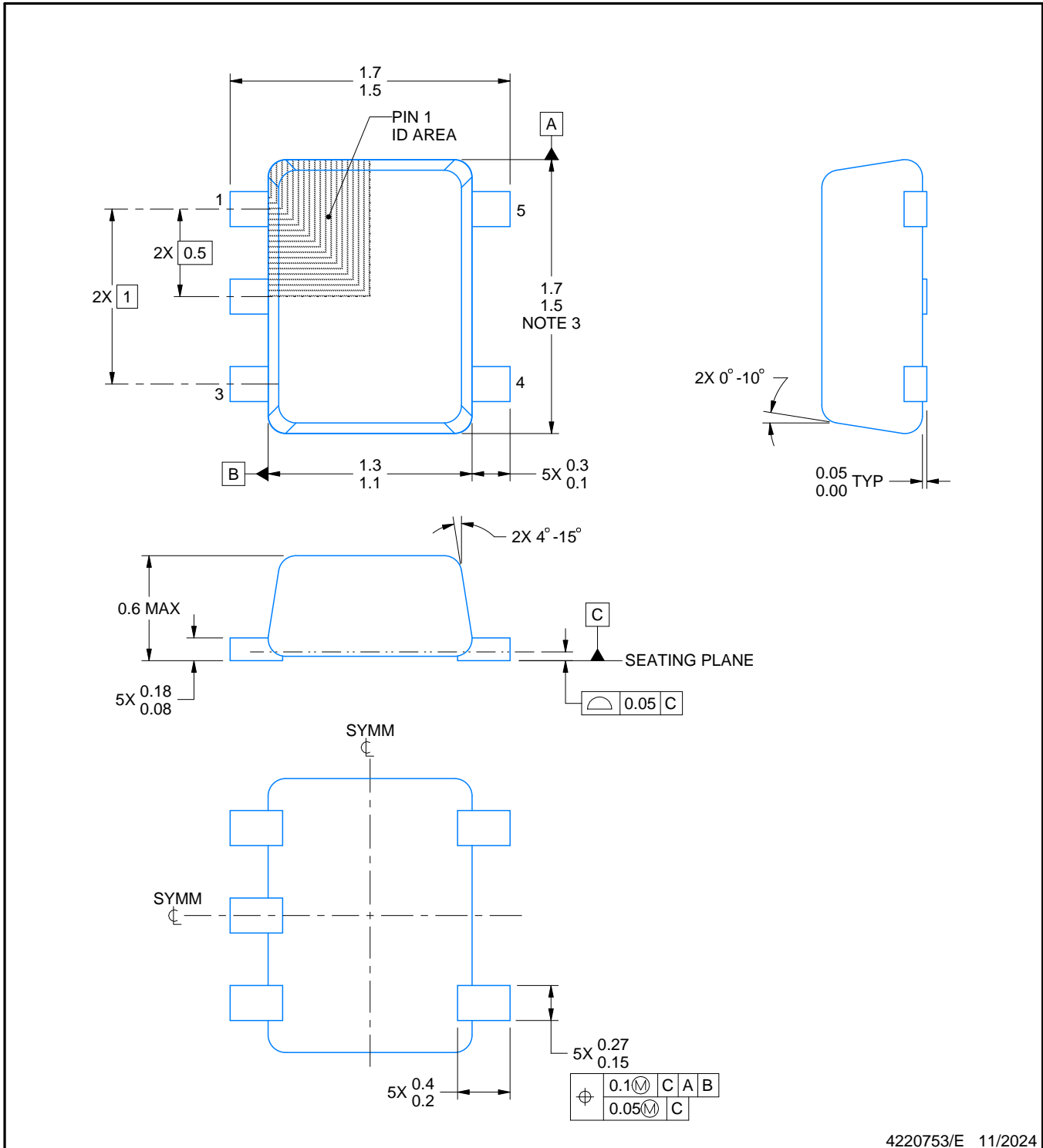
\*All dimensions are nominal

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
SN74LVC1G79DBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
SN74LVC1G79DBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
SN74LVC1G79DBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
SN74LVC1G79DBVTG4	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
SN74LVC1G79DCKR	SC70	DCK	5	3000	178.0	8.4	2.25	2.45	1.2	4.0	8.0	Q3
SN74LVC1G79DCKRG4	SC70	DCK	5	3000	178.0	9.2	2.4	2.4	1.22	4.0	8.0	Q3
SN74LVC1G79DCKT	SC70	DCK	5	250	180.0	8.4	2.3	2.55	1.2	4.0	8.0	Q3
SN74LVC1G79DCKTG4	SC70	DCK	5	250	178.0	9.2	2.4	2.4	1.22	4.0	8.0	Q3
SN74LVC1G79DRLR	SOT-5X3	DRL	5	4000	180.0	8.4	1.98	1.78	0.69	4.0	8.0	Q3
SN74LVC1G79YZPR	DSBGA	YZP	5	3000	178.0	9.2	1.02	1.52	0.63	4.0	8.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC1G79DBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
SN74LVC1G79DBVT	SOT-23	DBV	5	250	210.0	185.0	35.0
SN74LVC1G79DBVT	SOT-23	DBV	5	250	210.0	185.0	35.0
SN74LVC1G79DBVTG4	SOT-23	DBV	5	250	180.0	180.0	18.0
SN74LVC1G79DCKR	SC70	DCK	5	3000	208.0	191.0	35.0
SN74LVC1G79DCKRG4	SC70	DCK	5	3000	180.0	180.0	18.0
SN74LVC1G79DCKT	SC70	DCK	5	250	210.0	185.0	35.0
SN74LVC1G79DCKTG4	SC70	DCK	5	250	180.0	180.0	18.0
SN74LVC1G79DRLR	SOT-5X3	DRL	5	4000	202.0	201.0	28.0
SN74LVC1G79YZPR	DSBGA	YZP	5	3000	220.0	220.0	35.0



4220753/E 11/2024

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-293 Variation UAAD-1

# EXAMPLE BOARD LAYOUT

DRL0005A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE  
SCALE:30X



SOLDERMASK DETAILS

4220753/E 11/2024

NOTES: (continued)

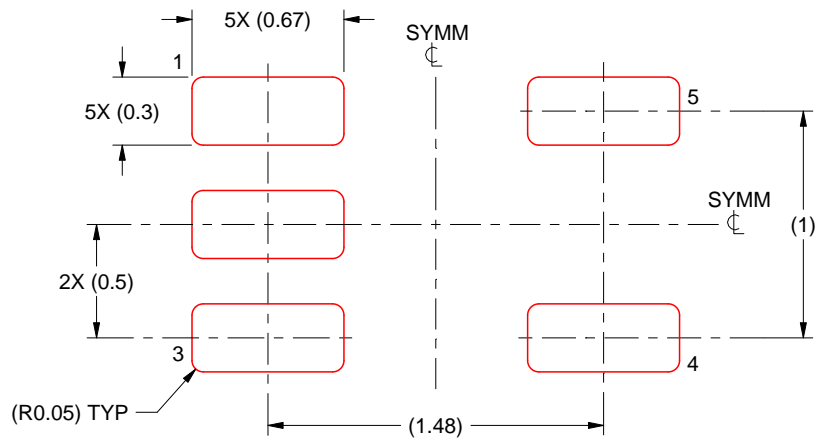
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DRL0005A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICK STENCIL  
SCALE:30X

4220753/E 11/2024

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.



# EXAMPLE BOARD LAYOUT

YZP0005

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:40X



SOLDER MASK DETAILS  
NOT TO SCALE

4219492/A 05/2017

NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 ([www.ti.com/lit/snva009](http://www.ti.com/lit/snva009)).

# EXAMPLE STENCIL DESIGN

YZP0005

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICK STENCIL  
SCALE:40X

4219492/A 05/2017

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

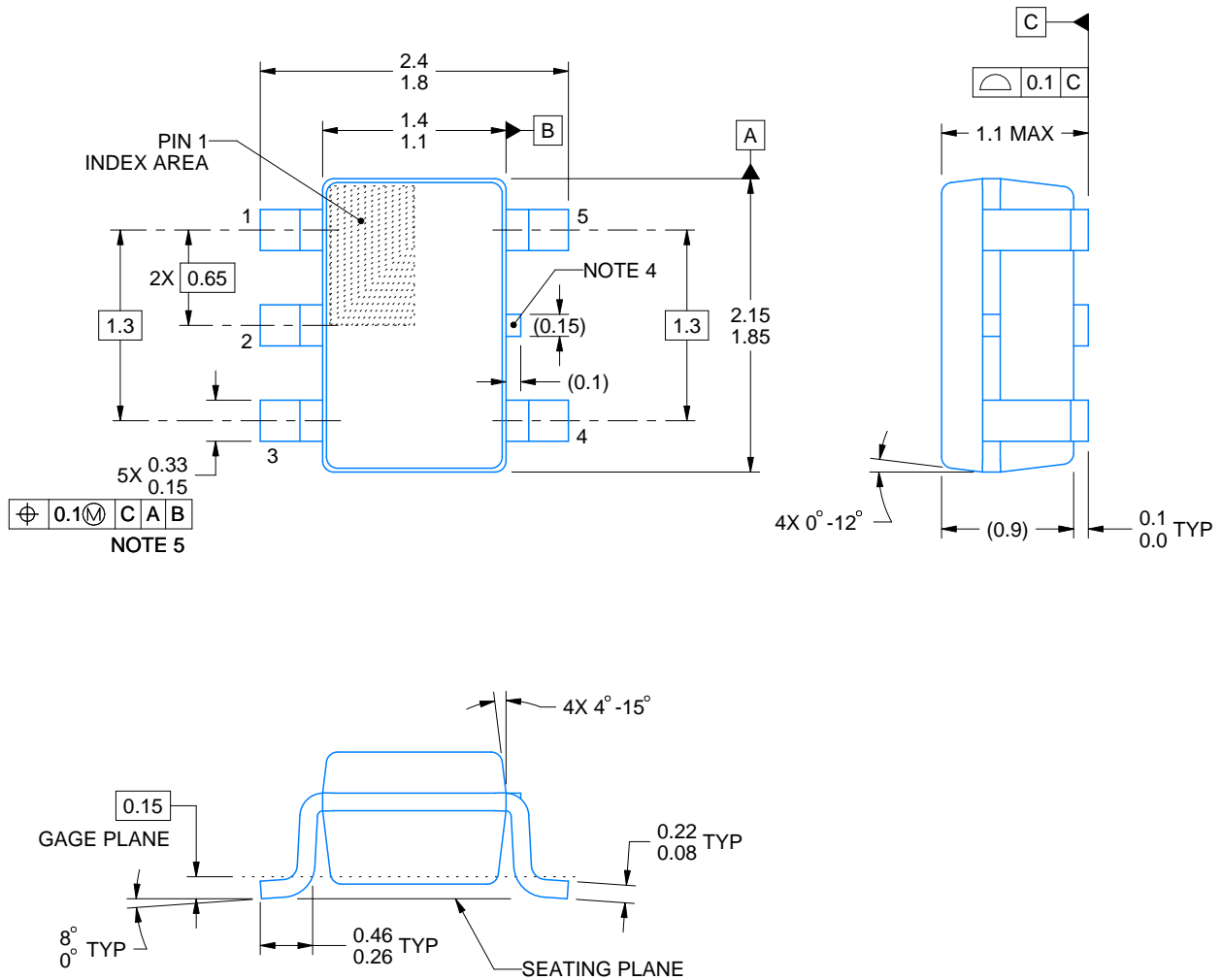
# DCK0005A



# PACKAGE OUTLINE

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



4214834/G 11/2024

**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. Reference JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.
6. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

# EXAMPLE BOARD LAYOUT

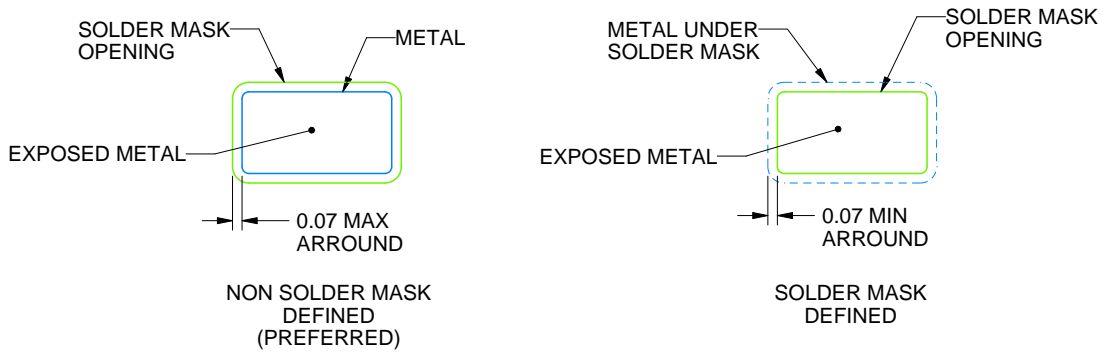
DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X



SOLDER MASK DETAILS

4214834/G 11/2024

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE: 18X

4214834/G 11/2024

NOTES: (continued)

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



# EXAMPLE BOARD LAYOUT

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

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

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025