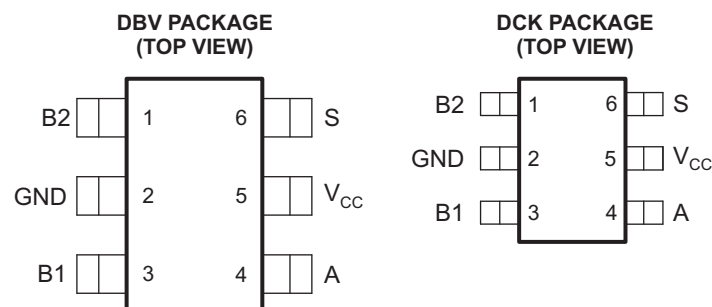


## SINGLE-POLE DOUBLE-THROW ANALOG SWITCH

### FEATURES

- Qualified for Automotive Applications
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- 1.65-V to 5.5-V  $V_{CC}$  Operation
- Useful for Both Analog and Digital Applications
- Specified Break-Before-Make Switching
- Rail-to-Rail Signal Handling
- High Degree of Linearity
- High Speed, Typically 0.5 ns ( $V_{CC} = 3\text{ V}$ ,  $C_L = 50\text{ pF}$ )
- Low On-State Resistance, Typically  $\approx 6\ \Omega$  ( $V_{CC} = 4.5\text{ V}$ )
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II



### DESCRIPTION/ORDERING INFORMATION

This single-pole double-throw (SPDT) analog switch is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The SN74LVC1G3157 can handle both analog and digital signals. The device permits signals with amplitudes of up to  $V_{CC}$  (peak) to be transmitted in either direction.

Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

### ORDERING INFORMATION<sup>(1)</sup>

$T_A$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOT (SOT-23) – DBV	Reel of 3000	1P1G3157QDBVRQ1	CC50
	SOT (SC-70) – DCK	Reel of 3000	1P1G3157QDCKRQ1	C50

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).

(2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

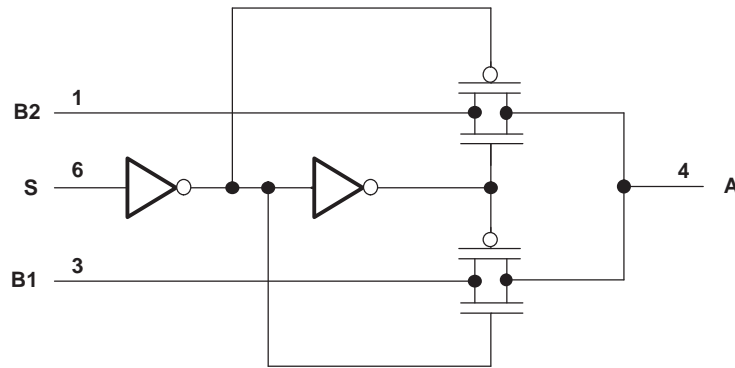
### FUNCTION TABLE

CONTROL INPUTS	ON CHANNEL
L	B1
H	B2



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.

LOGIC DIAGRAM (POSITIVE LOGIC)



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

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range <sup>(2)</sup>	-0.5	6.5	V
V <sub>IN</sub>	Control input voltage range <sup>(2)(3)</sup>	-0.5	6.5	V
V <sub>I/O</sub>	Switch I/O voltage range <sup>(2)(3)(4)(5)</sup>	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	Control input clamp current	V <sub>IN</sub> < 0	-50	mA
I <sub>IOK</sub>	I/O port diode current	V <sub>I/O</sub> < 0	-50	mA
I <sub>I/O</sub>	On-state switch current	V <sub>I/O</sub> = 0 to V <sub>CC</sub> <sup>(6)</sup>	±128	mA
	Continuous current through V <sub>CC</sub> or GND		±100	mA
θ <sub>JA</sub>	Package thermal impedance <sup>(7)</sup>	DBV package	165	°C/W
		DCK package	258	
T <sub>stg</sub>	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) All voltages are with respect to ground, unless otherwise specified.
- (3) The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (4) This value is limited to 5.5 V maximum.
- (5) V<sub>I</sub>, V<sub>O</sub>, V<sub>A</sub>, and V<sub>Bn</sub> are used to denote specific conditions for V<sub>I/O</sub>.
- (6) I<sub>I</sub>, I<sub>O</sub>, I<sub>A</sub>, and I<sub>Bn</sub> are used to denote specific conditions for I<sub>I/O</sub>.
- (7) The package thermal impedance is calculated in accordance with JESD 51-7.

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

			<b>MIN</b>	<b>MAX</b>	<b>UNIT</b>
$V_{CC}$			1.65	5.5	V
$V_{I/O}$			0	$V_{CC}$	V
$V_{IN}$			0	5.5	V
$V_{IH}$	High-level input voltage, control input	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$V_{CC} \times 0.75$		V
		$V_{CC} = 2.3\text{ V to }5.5\text{ V}$	$V_{CC} \times 0.7$		
$V_{IL}$	Low-level input voltage, control input	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$V_{CC} \times 0.25$		V
		$V_{CC} = 2.3\text{ V to }5.5\text{ V}$	$V_{CC} \times 0.3$		
$\Delta t/\Delta v$	Input transition rise/fall time	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	20		ns/V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	20		
		$V_{CC} = 3\text{ V to }3.6\text{ V}$	10		
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	10		
$T_A$			-40	125	°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.

## 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			
r <sub>on</sub>	On-state switch resistance <sup>(2)</sup>	See <a href="#">Figure 1</a> and <a href="#">Figure 2</a>	V <sub>I</sub> = 0 V, I <sub>O</sub> = 4 mA	1.65 V		11	20	Ω			
			V <sub>I</sub> = 1.65 V, I <sub>O</sub> = –4 mA								
			V <sub>I</sub> = 0 V, I <sub>O</sub> = 8 mA	2.3 V		8	12				
			V <sub>I</sub> = 2.3 V, I <sub>O</sub> = –8 mA								
			V <sub>I</sub> = 0 V, I <sub>O</sub> = 24 mA	3 V		7	9.5				
			V <sub>I</sub> = 3 V, I <sub>O</sub> = –24 mA								
			V <sub>I</sub> = 0 V, I <sub>O</sub> = 30 mA	4.5 V		6	7.5				
			V <sub>I</sub> = 2.4 V, I <sub>O</sub> = –30 mA								
			V <sub>I</sub> = 4.5 V, I <sub>O</sub> = –30 mA								
r <sub>range</sub>	On-state switch resistance over signal range <sup>(2)(3)</sup>	0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub> (see <a href="#">Figure 1</a> and <a href="#">Figure 2</a> )	I <sub>A</sub> = –4 mA	1.65 V			140	Ω			
			I <sub>A</sub> = –8 mA	2.3 V			45				
			I <sub>A</sub> = –24 mA	3 V			18				
			I <sub>A</sub> = –30 mA	4.5 V			10				
Δr <sub>on</sub>	Difference in on-state resistance between switches <sup>(2)(4)(5)</sup>	See <a href="#">Figure 1</a>	V <sub>Bn</sub> = 1.15 V, I <sub>A</sub> = –4 mA	1.65 V		0.5	Ω				
			V <sub>Bn</sub> = 1.6 V, I <sub>A</sub> = –8 mA	2.3 V		0.1					
			V <sub>Bn</sub> = 2.1 V, I <sub>A</sub> = –24 mA	3 V		0.1					
			V <sub>Bn</sub> = 3.15 V, I <sub>A</sub> = –30 mA	4.5 V		0.1					
r <sub>on(flat)</sub>	On-state resistance flatness <sup>(2)(4)(6)</sup>	0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub>	I <sub>A</sub> = –4 mA	1.65 V		110	Ω				
			I <sub>A</sub> = –8 mA	2.3 V		26					
			I <sub>A</sub> = –24 mA	3 V		9					
			I <sub>A</sub> = –30 mA	4.5 V		4					
I <sub>off</sub> <sup>(7)</sup>	Off-state switch leakage current	0 ≤ V <sub>I</sub> , V <sub>O</sub> ≤ V <sub>CC</sub> (see <a href="#">Figure 3</a> )	1.65 V to 5.5 V		±1	±0.05	±1 <sup>(1)</sup>	μA			
I <sub>S(on)</sub>	On-state switch leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>O</sub> = Open (see <a href="#">Figure 4</a> )	5.5 V		±1	±0.1 <sup>(1)</sup>	μA				
I <sub>IN</sub>	Control input current	0 ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>	0 V to 5.5 V		±1	±0.05	±1 <sup>(1)</sup>	μA			
I <sub>CC</sub>	Supply current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5 V		1	10	μA				
ΔI <sub>CC</sub>	Supply-current change	V <sub>IN</sub> = V <sub>CC</sub> – 0.6 V	5.5 V			500	μA				
C <sub>in</sub>	Control input capacitance	S	5 V		2.7		pF				
C <sub>io(off)</sub>	Switch input/output capacitance	Bn	5 V		5.2		pF				
C <sub>io(on)</sub>	Switch input/output capacitance	Bn	5 V		17.3		pF				
		A									

(1) T<sub>A</sub> = 25°C

(2) Measured by the voltage drop between I/O pins at the indicated current through the switch. On-state resistance is determined by the lower of the voltages on the two (A or B) ports.

(3) Specified by design

(4) Δr<sub>on</sub> = r<sub>on(max)</sub> – r<sub>on(min)</sub> measured at identical V<sub>CC</sub>, temperature, and voltage levels

(5) This parameter is characterized, but not tested in production.

(6) Flatness is defined as the difference between the maximum and minimum values of on-state resistance over the specified range of conditions.

(7) I<sub>off</sub> is the same as I<sub>S(off)</sub> (off-state switch leakage current).

## Analog Switch Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CC}$	TYP	UNIT
Frequency response (switch on) <sup>(1)</sup>	A or Bn	Bn or A	$R_L = 50 \Omega$ , $f_{in} = \text{sine wave}$ (see Figure 6)	1.65 V	300	MHz
				2.3 V	300	
				3 V	300	
				4.5 V	300	
Crosstalk (between switches) <sup>(2)</sup>	B1 or B2	B2 or B1	$R_L = 50 \Omega$ , $f_{in} = 10 \text{ MHz (sine wave)}$ (see Figure 7)	1.65 V	-54	dB
				2.3 V	-54	
				3 V	-54	
				4.5 V	-54	
Feedthrough attenuation (switch off) <sup>(2)</sup>	A or Bn	Bn or A	$C_L = 5 \text{ pF}$ , $R_L = 50 \Omega$ , $f_{in} = 10 \text{ MHz (sine wave)}$ (see Figure 8)	1.65 V	-57	dB
				2.3 V	-57	
				3 V	-57	
				4.5 V	-57	
Charge injection <sup>(3)</sup>	S	A	$C_L = 0.1 \text{ nF}$ , $R_L = 1 \text{ M}\Omega$ (see Figure 9)	3.3 V	3	pC
				5 V	7	
Total harmonic distortion	A or Bn	Bn or A	$V_I = 0.5 \text{ V}_{p-p}$ , $R_L = 600 \Omega$ , $f_{in} = 600 \text{ Hz to } 20 \text{ kHz}$ (sine wave) (see Figure 10)	1.65 V	0.1	%
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	

(1) Adjust  $f_{in}$  voltage to obtain 0 dBm at output. Increase  $f_{in}$  frequency until dB meter reads -3 dB.

(2) Adjust  $f_{in}$  voltage to obtain 0 dBm at input.

(3) Specified by design

## Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 5 and Figure 11)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$ <sup>(1)</sup>	A or Bn	Bn or A		2		1.2		0.8		0.3	ns
$t_{en}$ <sup>(2)</sup>	S	Bn	7	24	3.5	14	2.5	7.6	1.7	5.7	ns
$t_{dis}$ <sup>(3)</sup>			3	13	2	7.5	1.5	5.3	0.8	3.8	
$t_{B-M}$ <sup>(4)</sup>			0.5		0.5		0.5		0.5		ns

(1)  $t_{pd}$  is the slower of  $t_{PLH}$  or  $t_{PHL}$ . Propagation delay is the calculated RC time constant of the typical on-state resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero output impedance).

(2)  $t_{en}$  is the slower of  $t_{PZL}$  or  $t_{PZH}$ .

(3)  $t_{dis}$  is the slower of  $t_{PLZ}$  or  $t_{PHZ}$ .

(4) Specified by design

PARAMETER MEASUREMENT INFORMATION

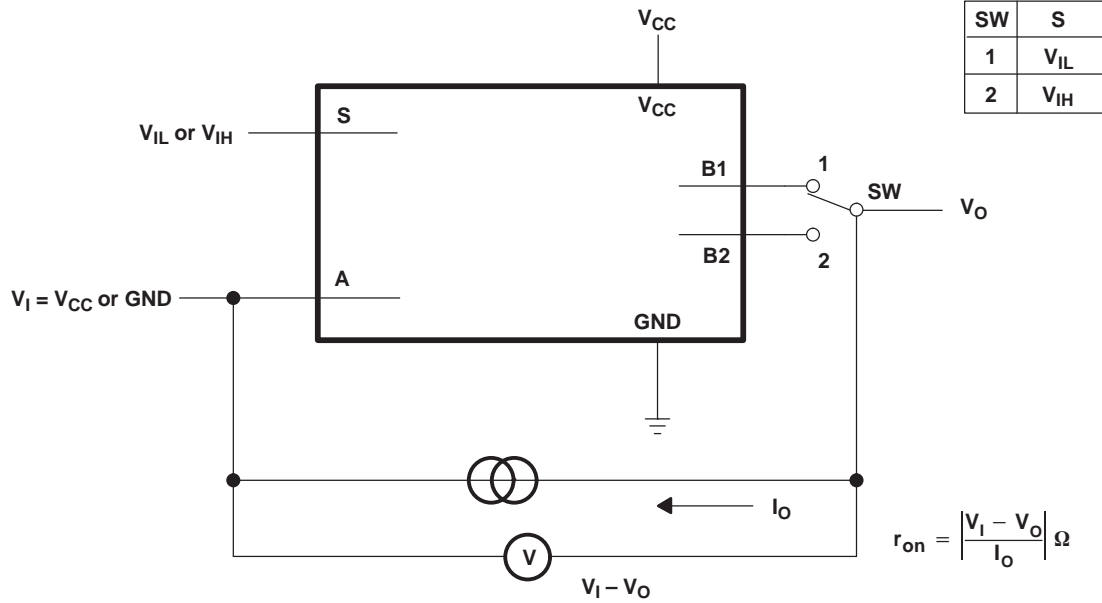


Figure 1. On-State Resistance Test Circuit

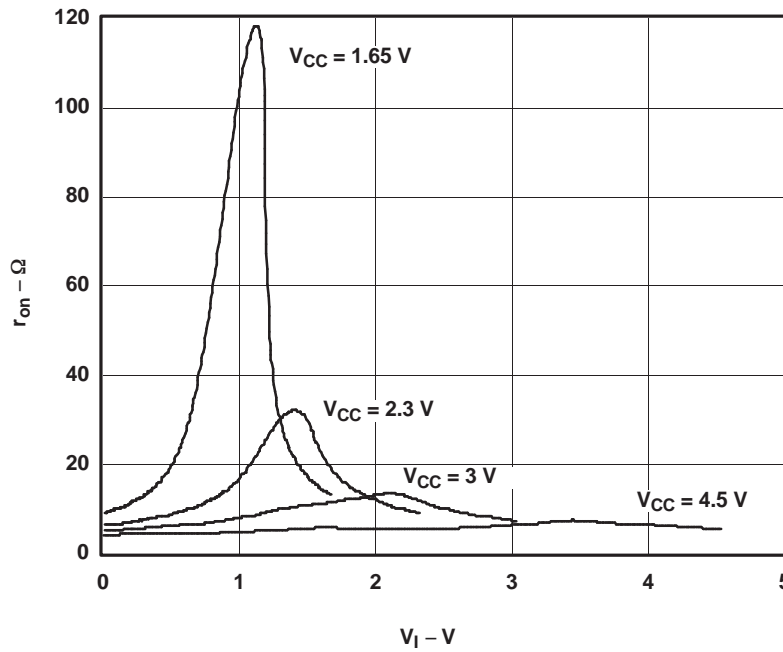
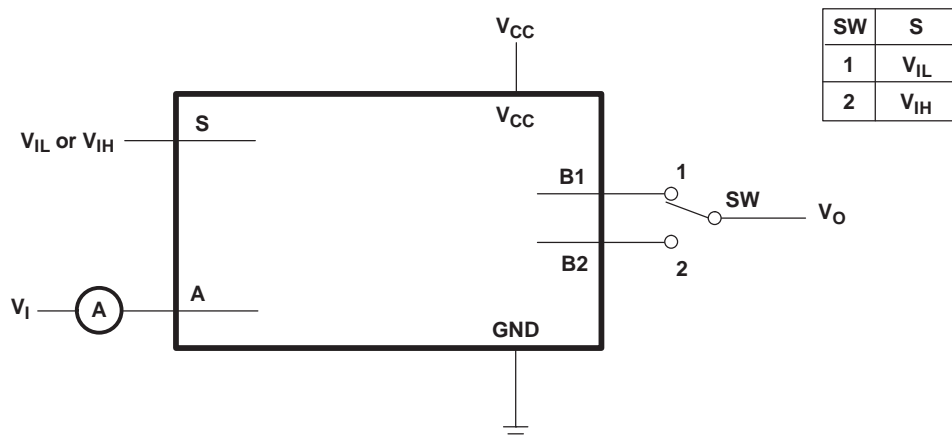


Figure 2. Typical r<sub>on</sub> as a Function of Input Voltage (V<sub>I</sub>) for V<sub>I</sub> = 0 to V<sub>CC</sub>

PARAMETER MEASUREMENT INFORMATION (continued)



Condition 1:  $V_I = GND, V_O = V_{CC}$   
 Condition 2:  $V_I = V_{CC}, V_O = GND$

Figure 3. Off-State Switch Leakage-Current Test Circuit

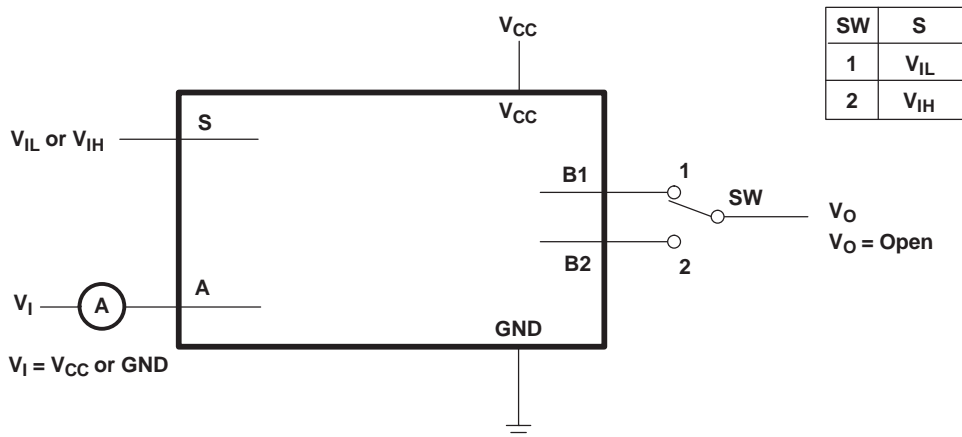
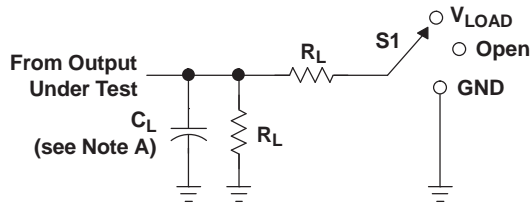


Figure 4. On-State Switch Leakage-Current Test Circuit

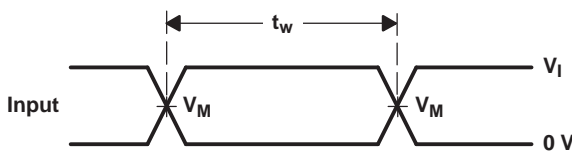
PARAMETER MEASUREMENT INFORMATION (continued)



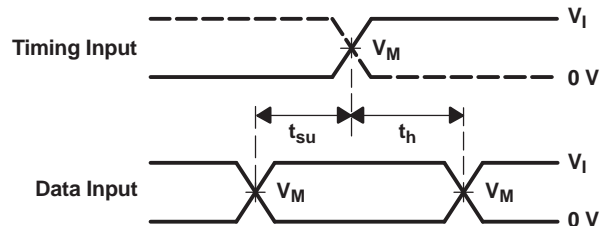
LOAD CIRCUIT

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

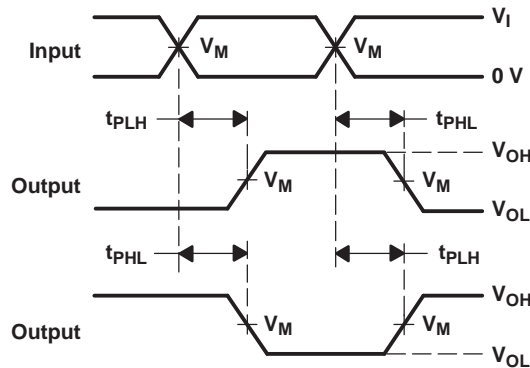
$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8\text{ V} \pm 0.15\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 $\Omega$	0.3 V
$2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 $\Omega$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



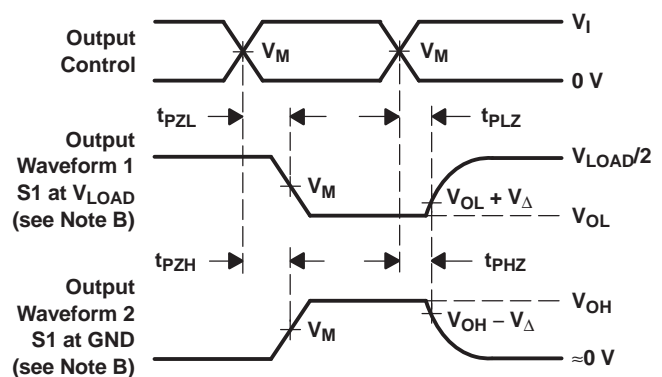
VOLTAGE WAVEFORMS PULSE DURATION



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 5. Load Circuit and Voltage Waveforms



PARAMETER MEASUREMENT INFORMATION (continued)

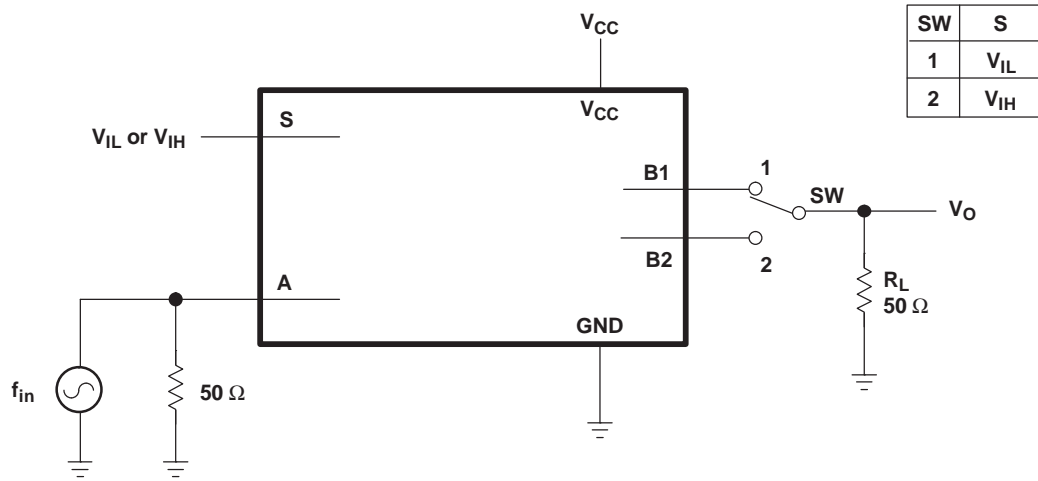


Figure 6. Frequency Response (Switch On)

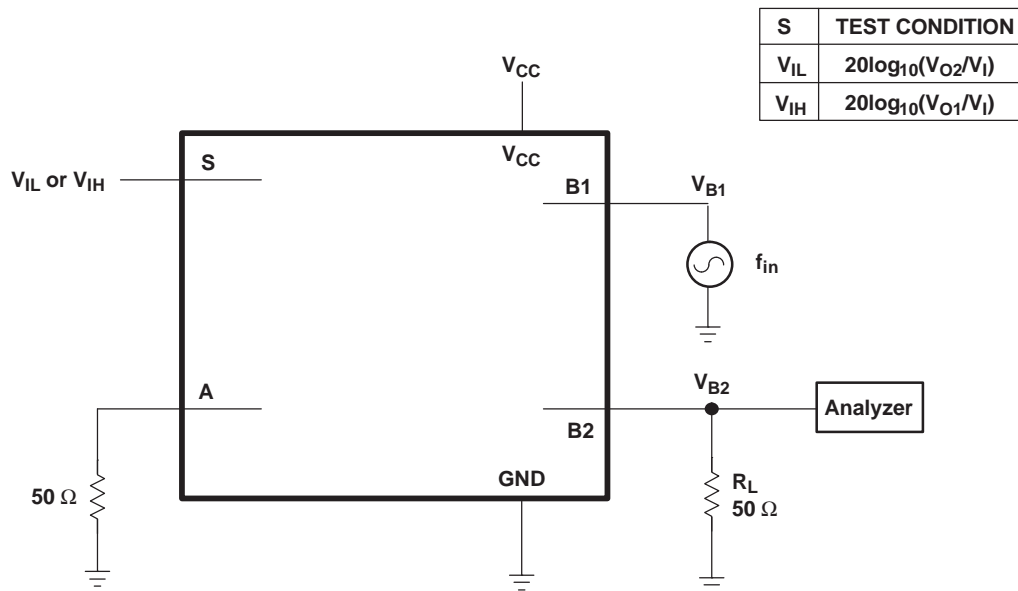


Figure 7. Crosstalk (Between Switches)

PARAMETER MEASUREMENT INFORMATION (continued)

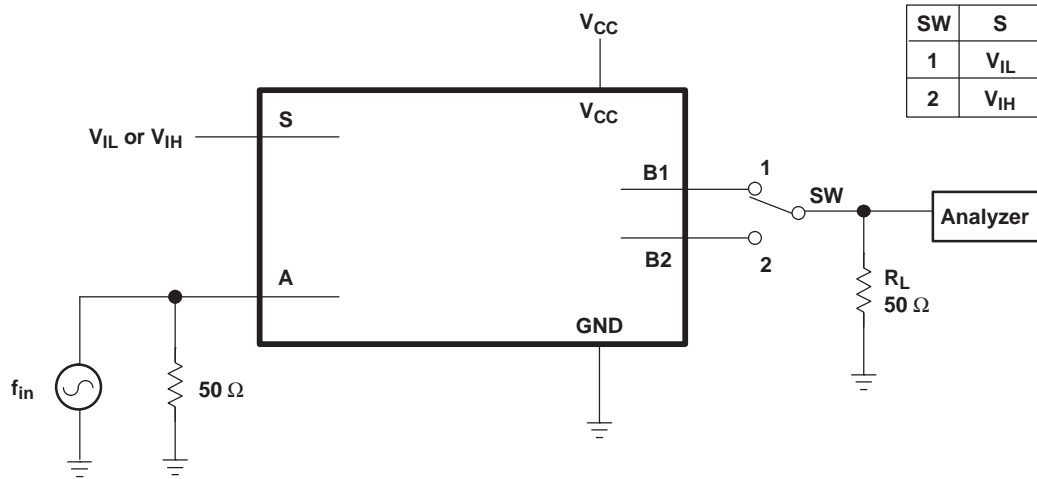


Figure 8. Feedthrough

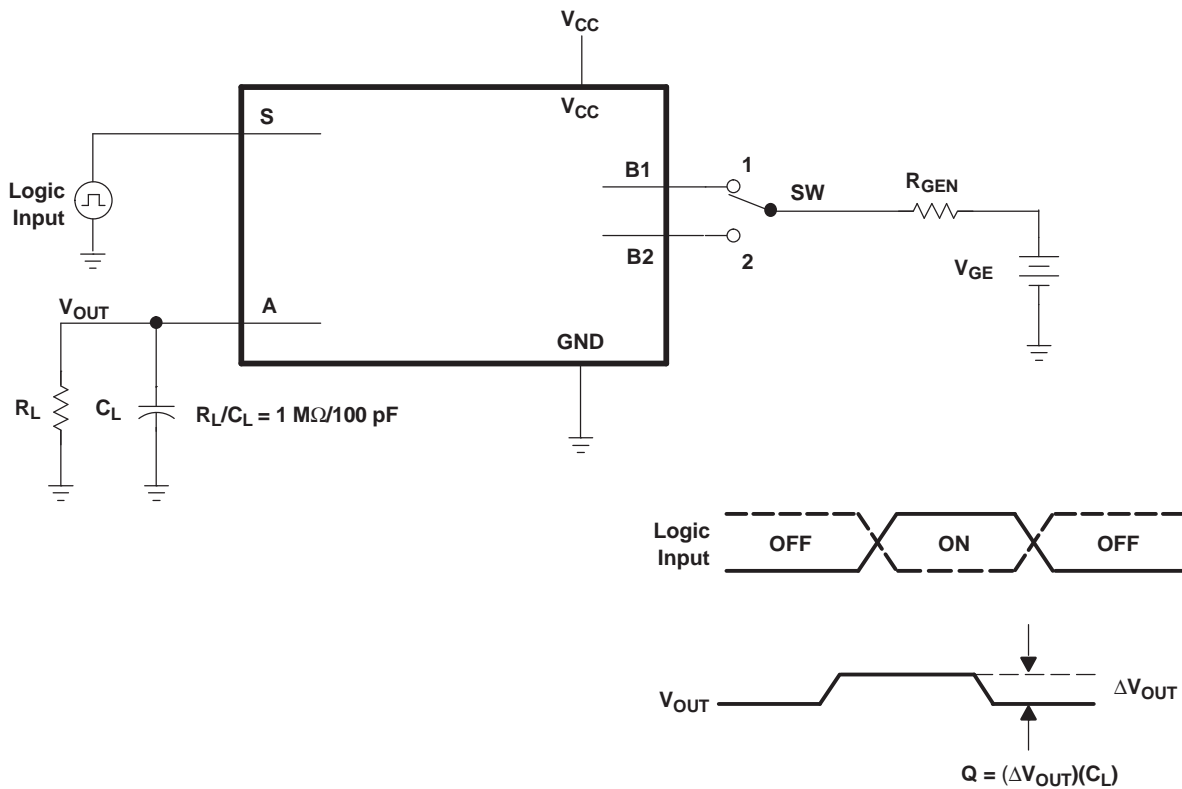


Figure 9. Charge-Injection Test

PARAMETER MEASUREMENT INFORMATION (continued)

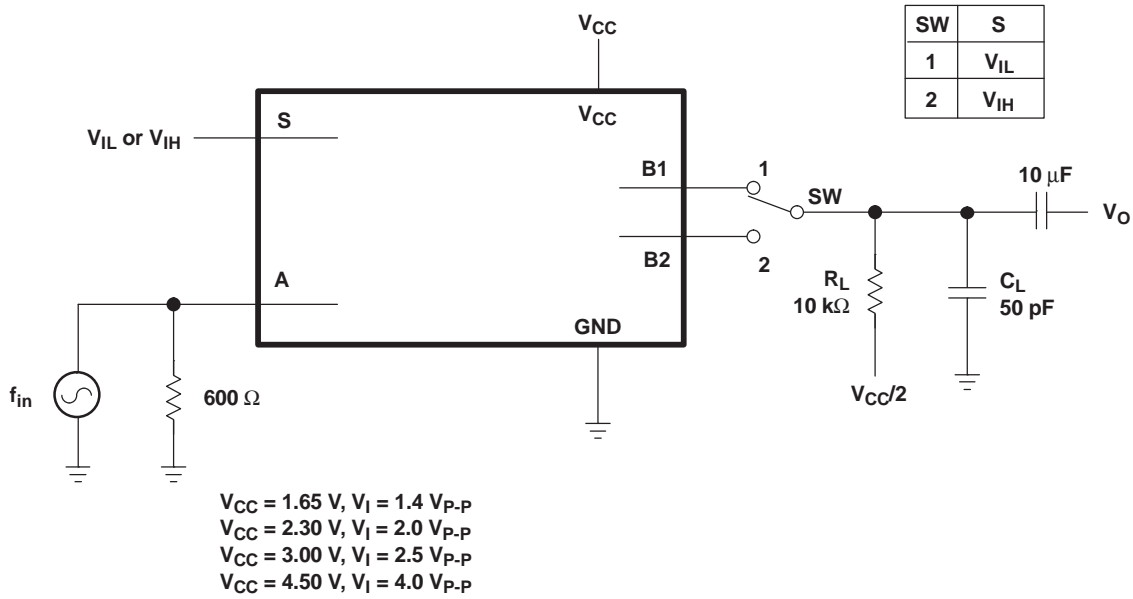


Figure 10. Total Harmonic Distortion

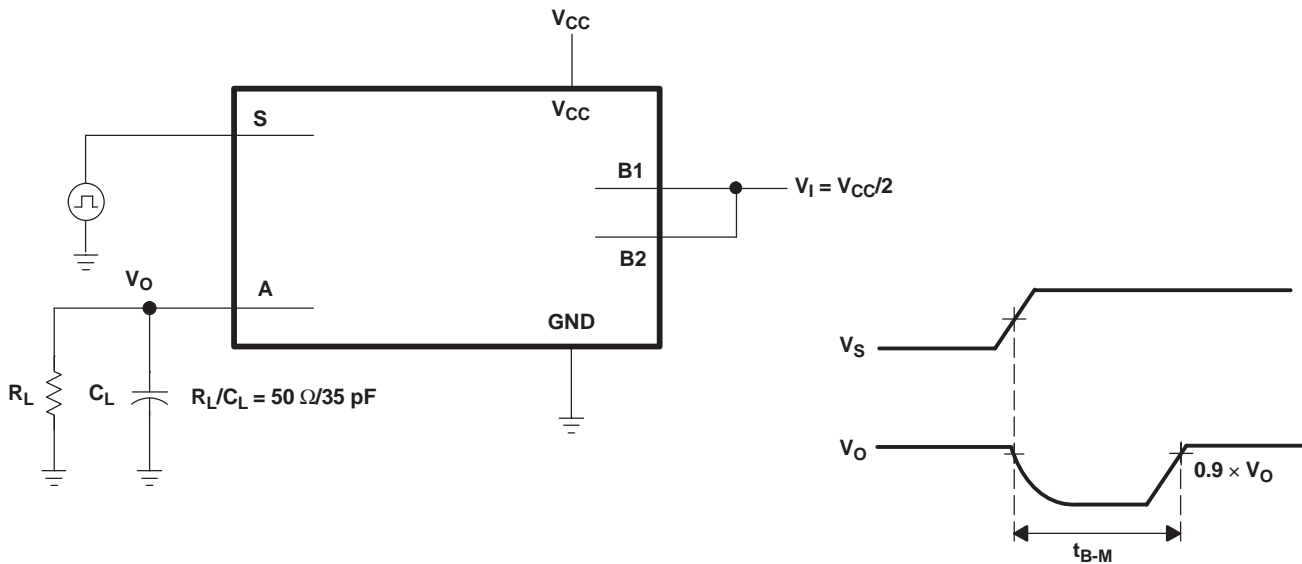


Figure 11. Break-Before-Make Internal Timing

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
1P1G3157QDBVRQ1	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	CC5O	<a href="#">Samples</a>
1P1G3157QDCKRQ1	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C5O	<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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side 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 SN74LVC1G3157-Q1 :**

- Catalog: [SN74LVC1G3157](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

## 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
1P1G3157QDBVRQ1	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
1P1G3157QDCKRQ1	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
1P1G3157QDBVRQ1	SOT-23	DBV	6	3000	203.0	203.0	35.0
1P1G3157QDCKRQ1	SC70	DCK	6	3000	203.0	203.0	35.0

DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE

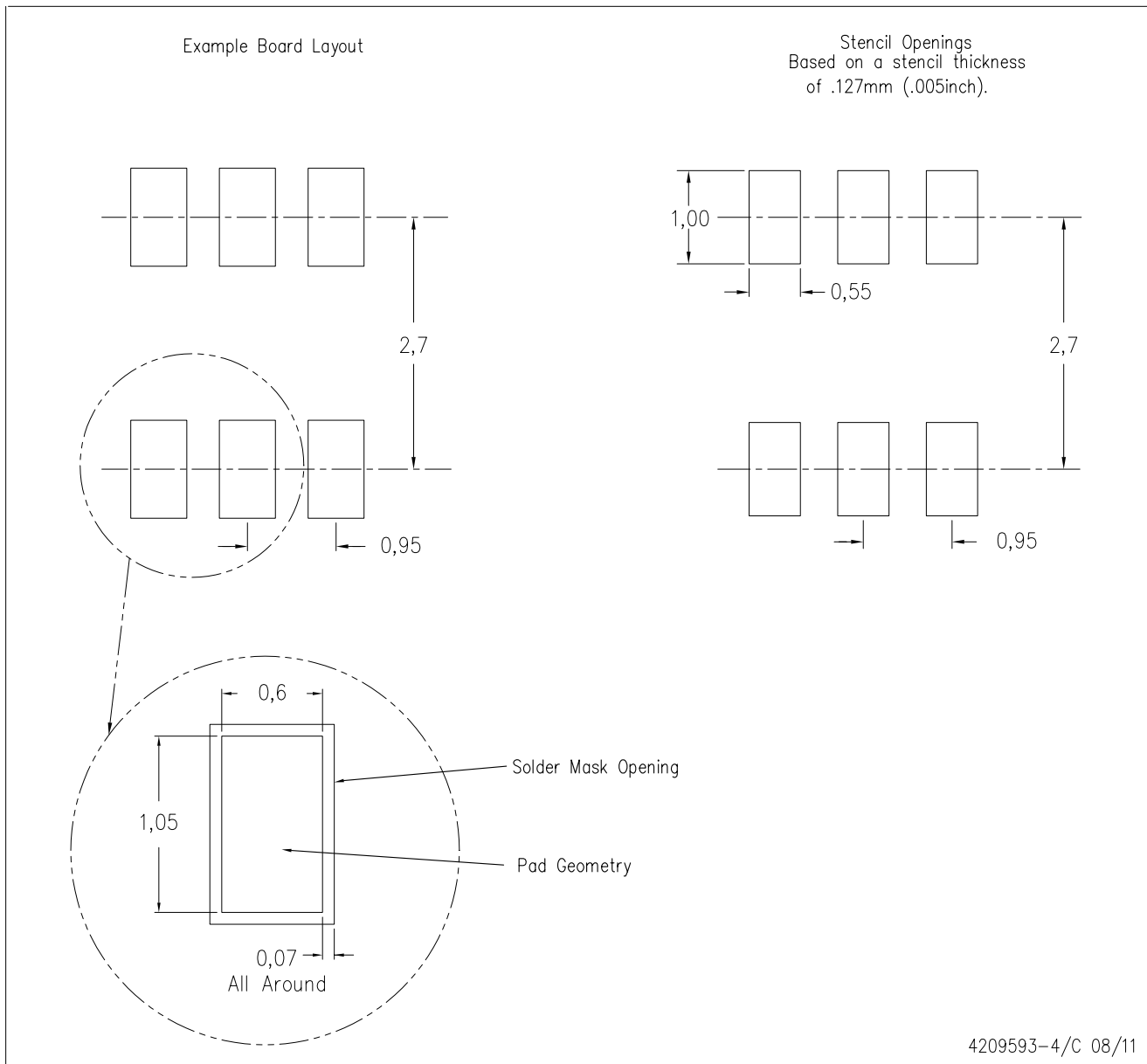


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- $\triangle$  Falls within JEDEC MO-178 Variation AB, except minimum lead width.



DBV (R-PDSO-G6)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



- 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. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-203 variation AB.

DCK (R-PDSO-G6)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)