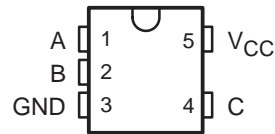


# SN74LVC1G66-Q1 SINGLE BILATERAL ANALOG SWITCH

SCES499D – OCTOBER 2003 – REVISED JANUARY 2008

- Qualified for Automotive Applications
- 1.65-V to 5.5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- High On-Off Output Voltage Ratio
- 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  $\approx 5.5\ \Omega$  ( $V_{CC} = 4.5\text{ V}$ )
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II

DBV or DCK PACKAGE  
(TOP VIEW)



## description/ordering information

This single analog switch is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The SN74LVC1G66 can handle both analog and digital signals. The device permits signals with amplitudes of up to 5.5 V (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†

$T_A$	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKINGS§
-40°C to 125°C	SOT (SOT-23) – DBV	Reel of 3000	1P1G66QDBVRQ1	C66_
	SOT (SOT-70) – DCK	Reel of 3000	1P1G66QDCKRQ1	C6_

† 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 <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

§ The actual top-side marking has one additional character that designates the wafer fab/assembly site.

## FUNCTION TABLE

CONTROL INPUT (C)	SWITCH
L	OFF
H	ON



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

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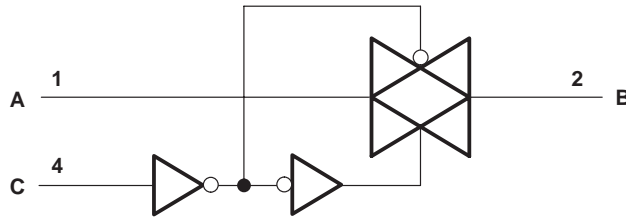
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# SN74LVC1G66-Q1

## SINGLE BILATERAL ANALOG SWITCH

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### logic diagram (positive logic)



### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, $V_{CC}$ (see Note 1)	–0.5 V to 6.5 V
Input voltage range, $V_I$ (see Notes 1 and 2)	–0.5 V to 6.5 V
Switch I/O voltage range, $V_{I/O}$ (see Notes 1, 2, and 3)	–0.5 V to $V_{CC} + 0.5$ V
Control input clamp current, $I_{IK}$ ( $V_I < 0$ )	–50 mA
I/O port diode current, $I_{I/OK}$ ( $V_{I/O} < 0$ )	–50 mA
On-state switch current, $I_T$ ( $V_{I/O} = 0$ to $V_{CC}$ )	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND	$\pm 100$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DBV package	206°C/W
DCK package	252°C/W
ESD rating, HBM (see Note 5)	2 (H2) kV
ESD rating, CDM (see Note 5)	1 (C5) kV
ESD rating, MM (see Note 5)	200 (M3) V
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. All voltages are with respect to ground, unless otherwise specified.
  2. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
  3. This value is limited to 5.5 V maximum.
  4. The package thermal impedance is calculated in accordance with JESD 51-7.
  5. ESD Protection Level per AEC Q100 classification.

# SN74LVC1G66-Q1

## SINGLE BILATERAL ANALOG SWITCH

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### recommended operating conditions (see Note 5)

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	1.65	5.5	V
V <sub>I/O</sub>	I/O port voltage	0	V <sub>CC</sub>	V
V <sub>IH</sub>	High-level input voltage, control input	V <sub>CC</sub> = 1.65 V to 1.95 V	V <sub>CC</sub> × 0.65	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	V <sub>CC</sub> × 0.7	
		V <sub>CC</sub> = 3 V to 3.6 V	V <sub>CC</sub> × 0.7	
		V <sub>CC</sub> = 4.5 V to 5.5 V	V <sub>CC</sub> × 0.7	
V <sub>IL</sub>	Low-level input voltage, control input	V <sub>CC</sub> = 1.65 V to 1.95 V	V <sub>CC</sub> × 0.35	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	V <sub>CC</sub> × 0.3	
		V <sub>CC</sub> = 3 V to 3.6 V	V <sub>CC</sub> × 0.3	
		V <sub>CC</sub> = 4.5 V to 5.5 V	V <sub>CC</sub> × 0.3	
V <sub>I</sub>	Control input voltage	0	5.5	V
Δt/Δv	Input transition rise/fall time	V <sub>CC</sub> = 1.65 V to 1.95 V	20	ns/V
		V <sub>CC</sub> = 2.3 V to 2.7 V	20	
		V <sub>CC</sub> = 3 V to 3.6 V	10	
		V <sub>CC</sub> = 4.5 V to 5.5 V	10	
T <sub>A</sub>	Operating free-air temperature	-40	125	°C

NOTE 6: All unused inputs of the device must be held at V<sub>CC</sub> 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†	MAX	UNIT
r <sub>on</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>C</sub> = V <sub>IH</sub> (see Figure 1)	I <sub>S</sub> = 4 mA	1.65 V	12	35	Ω
		I <sub>S</sub> = 8 mA	2.3 V	9	30	
		I <sub>S</sub> = 16 mA	3 V	9	30	
		I <sub>S</sub> = 16 mA	4.5 V	5.5	25	
r <sub>on(p)</sub>	V <sub>I</sub> = V <sub>CC</sub> to GND, V <sub>C</sub> = V <sub>IH</sub> (see Figure 1)	I <sub>S</sub> = 4 mA	1.65 V	74.5	165	Ω
		I <sub>S</sub> = 8 mA	2.3 V	20	60	
		I <sub>S</sub> = 16 mA	3 V	12.5	35	
		I <sub>S</sub> = 16 mA	4.5 V	7.5	25	
I <sub>S(off)</sub>	V <sub>I</sub> = V <sub>CC</sub> and V <sub>O</sub> = GND or V <sub>I</sub> = GND and V <sub>O</sub> = V <sub>CC</sub> , V <sub>C</sub> = V <sub>IL</sub> (see Figure 2)	5.5 V		±1	±0.1†	μA
I <sub>S(on)</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>C</sub> = V <sub>IH</sub> , V <sub>O</sub> = Open (see Figure 3)	5.5 V		±1	±0.1†	μA
I <sub>I</sub>	V <sub>C</sub> = V <sub>CC</sub> or GND	5.5 V		±1	±0.1†	μA
I <sub>CC</sub>	V <sub>C</sub> = V <sub>CC</sub> or GND	5.5 V		10	1†	μA
ΔI <sub>CC</sub>	V <sub>C</sub> = V <sub>CC</sub> - 0.6 V	5.5 V			500	μA
C <sub>ic</sub>		5 V		2		pF
C <sub>io(off)</sub>		5 V		6		pF
C <sub>io(on)</sub>		5 V		13		pF

† T<sub>A</sub> = 25°C



# SN74LVC1G66-Q1

## SINGLE BILATERAL ANALOG SWITCH

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switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1.8 V ± 0.15 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub> <sup>†</sup>	A or B	B or A	5.5		3.2		2.8		2.6		ns
t <sub>en</sub> <sup>‡</sup>	C	A or B	2.5	14	1.9	9.5	1.8	8	1.5	7.2	ns
t <sub>dis</sub> <sup>§</sup>	C	A or B	2.2	12	1.4	8.9	2	8.4	1.4	6.9	ns

<sup>†</sup> t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>. The 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).

<sup>‡</sup> t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.

<sup>§</sup> t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.

### analog switch characteristics, T<sub>A</sub> = 25°C

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V <sub>CC</sub>	TYP	UNIT
Frequency response <sup>¶</sup> (switch ON)	A or B	B or A	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = sine wave (see Figure 5)	1.65 V	35	MHz
				2.3 V	120	
				3 V	175	
				4.5 V	195	
			C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω, f <sub>in</sub> = sine wave (see Figure 5)	1.65 V	>300	
				2.3 V	>300	
				3 V	>300	
				4.5 V	>300	
Crosstalk (control input to signal output)	C	A or B	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = 1 MHz (square wave) (see Figure 6)	1.65 V	35	mV
				2.3 V	50	
				3 V	70	
				4.5 V	100	
Feedthrough attenuation <sup>#</sup> (switch OFF)	A or B	B or A	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = 1 MHz (sine wave) (see Figure 7)	1.65 V	-58	dB
				2.3 V	-58	
				3 V	-58	
				4.5 V	-58	
			C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω, f <sub>in</sub> = 1 MHz (sine wave) (see Figure 7)	1.65 V	-42	
				2.3 V	-42	
				3 V	-42	
				4.5 V	-42	
Sine-wave distortion	A or B	B or A	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 10 kΩ, f <sub>in</sub> = 1 kHz (sine wave) (see Figure 8)	1.65 V	0.1	%
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	
			C <sub>L</sub> = 50 pF, R <sub>L</sub> = 10 kΩ, f <sub>in</sub> = 10 kHz (sine wave) (see Figure 8)	1.65 V	0.15	
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	

<sup>¶</sup> Adjust f<sub>in</sub> voltage to obtain 0 dBm at output. Increase f<sub>in</sub> frequency until dB meter reads -3 dB.

<sup>#</sup> Adjust f<sub>in</sub> voltage to obtain 0 dBm at input.



# SN74LVC1G66-Q1 SINGLE BILATERAL ANALOG SWITCH

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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	
$C_{pd}$ Power dissipation capacitance	$f = 10\text{ MHz}$	8	9	9	11	pF

# SN74LVC1G66-Q1 SINGLE BILATERAL ANALOG SWITCH

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## PARAMETER MEASUREMENT INFORMATION

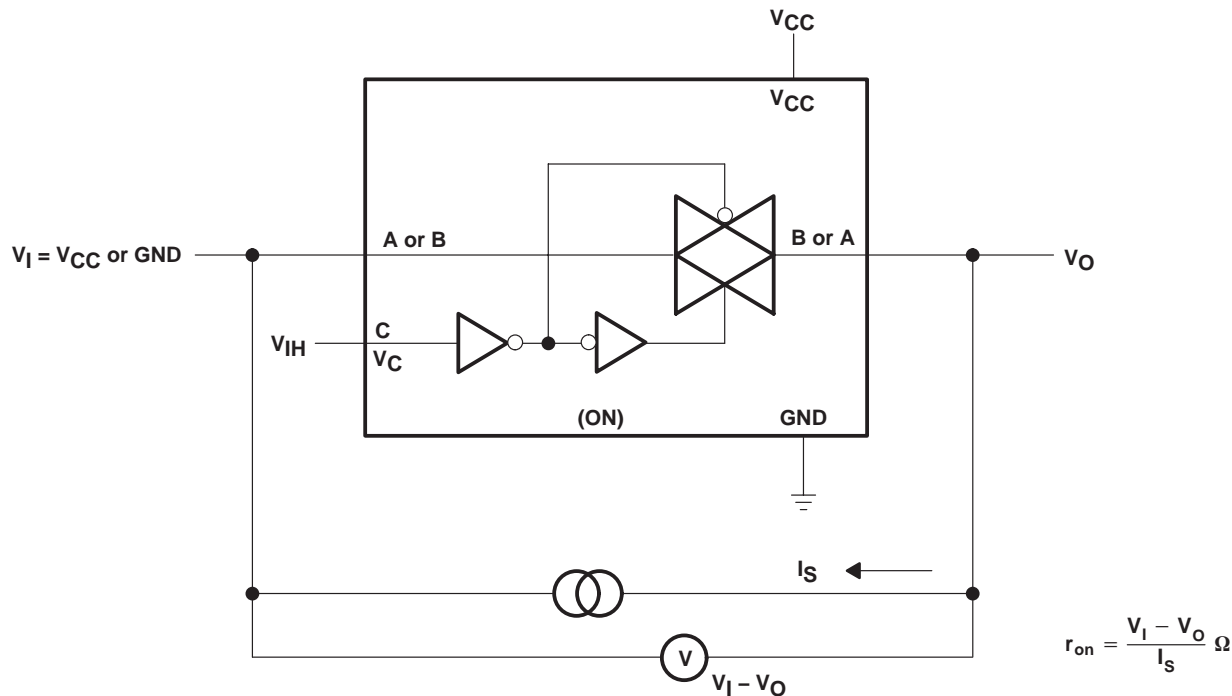


Figure 1. On-State Resistance Test Circuit

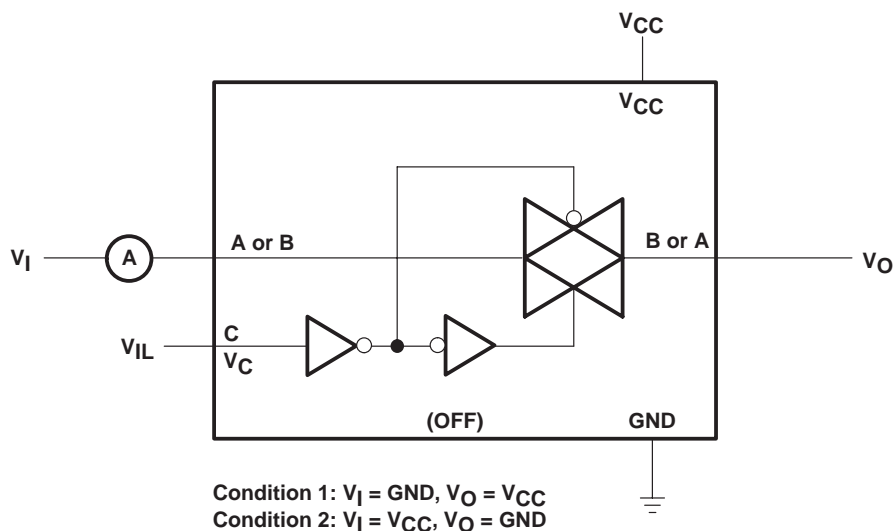


Figure 2. Off-State Switch Leakage-Current Test Circuit

PARAMETER MEASUREMENT INFORMATION

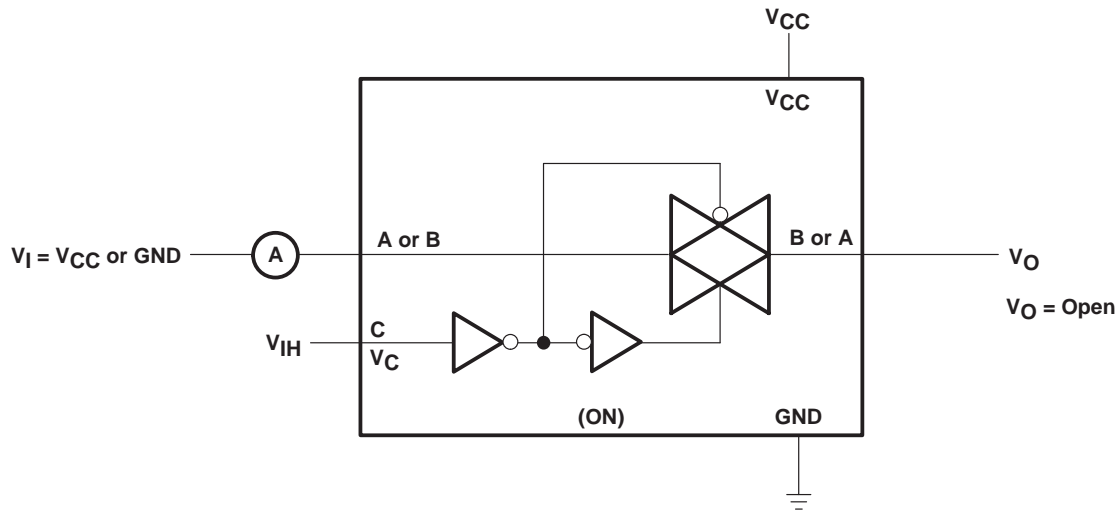
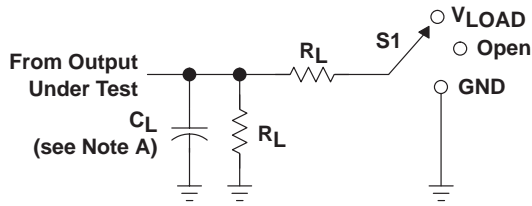


Figure 3. On-State Leakage-Current Test Circuit

# SN74LVC1G66-Q1 SINGLE BILATERAL ANALOG SWITCH

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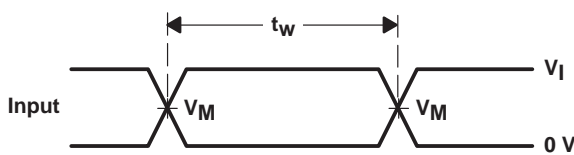
## PARAMETER MEASUREMENT INFORMATION



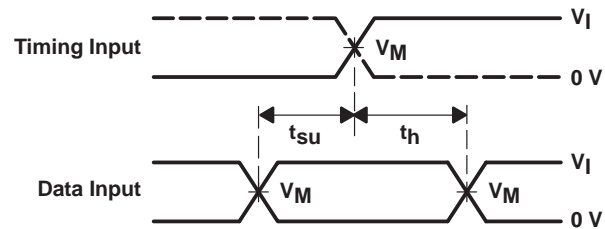
LOAD CIRCUIT

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

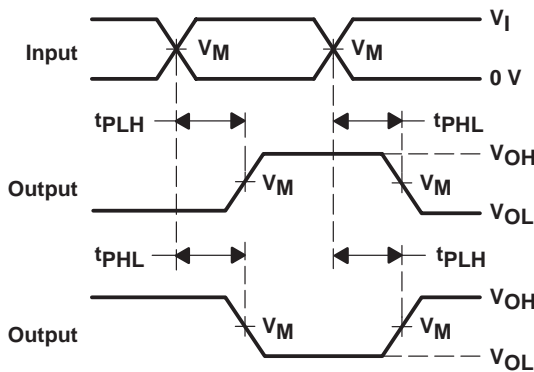
$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8\text{ V} \pm 0.15\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$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



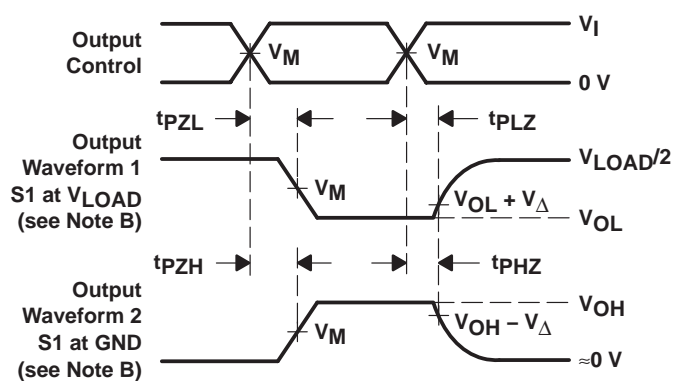
VOLTAGE WAVEFORMS  
PULSE DURATION



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 4. Load Circuit and Voltage Waveforms



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PARAMETER MEASUREMENT INFORMATION

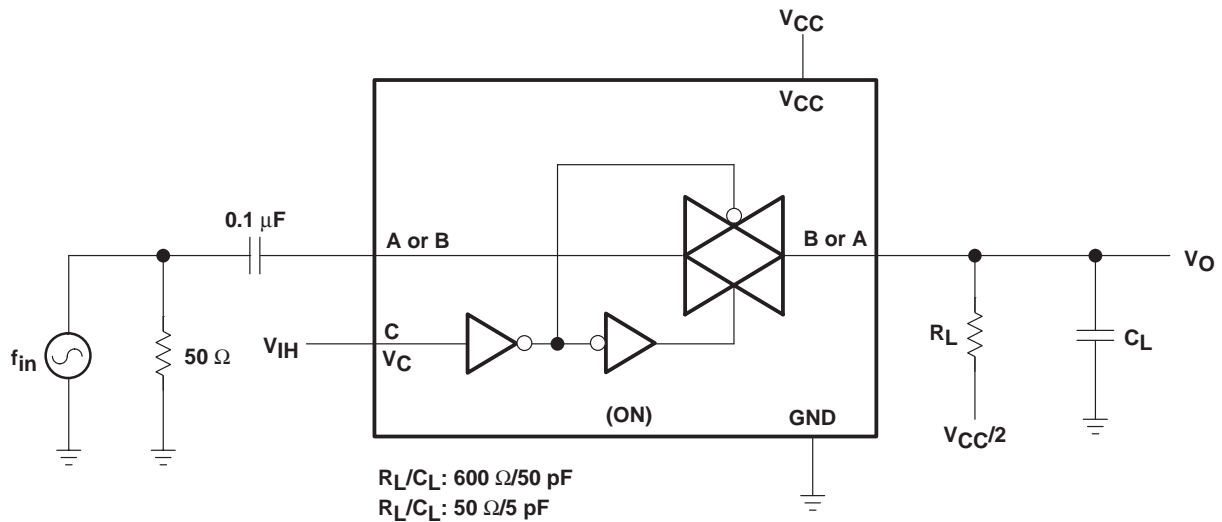


Figure 5. Frequency Response (Switch ON)

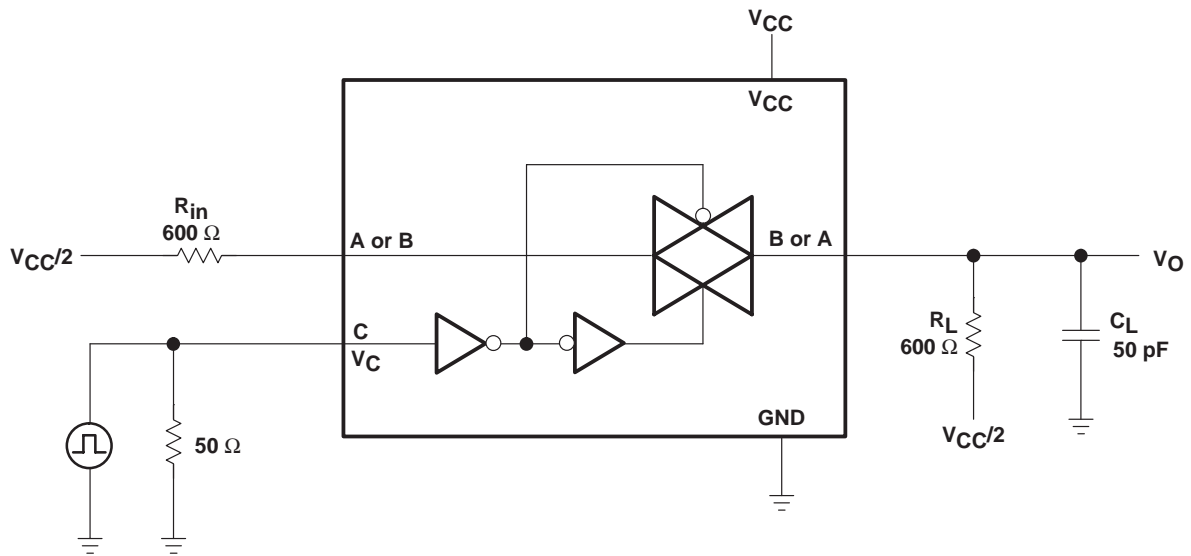


Figure 6. Crosstalk (Control Input – Switch Output)

# SN74LVC1G66-Q1 SINGLE BILATERAL ANALOG SWITCH

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## PARAMETER MEASUREMENT INFORMATION

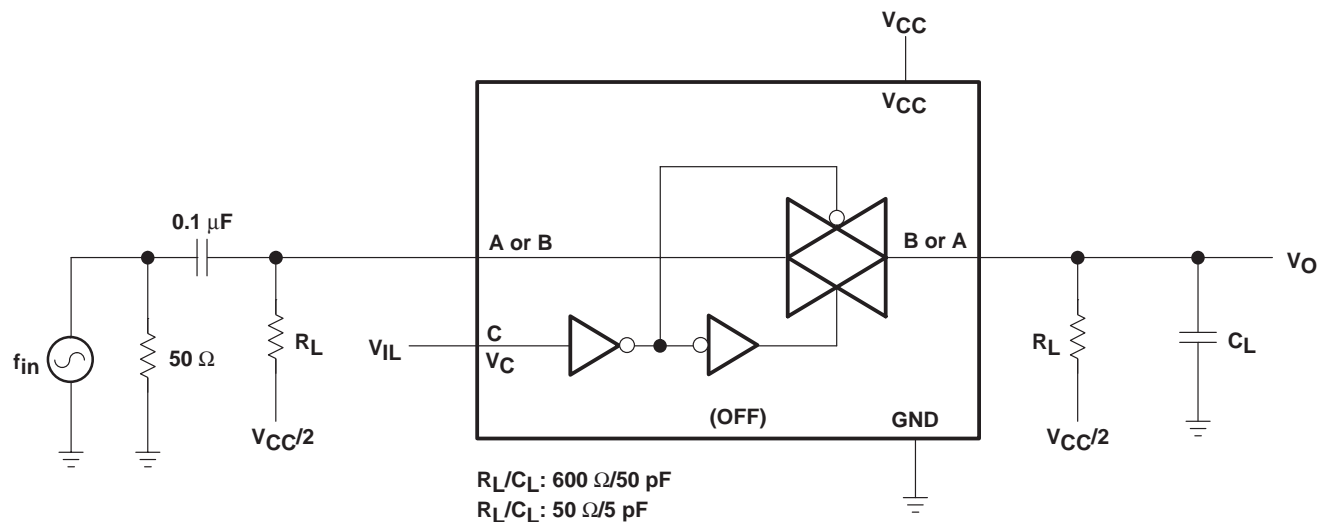


Figure 7. Feed Through (Switch OFF)

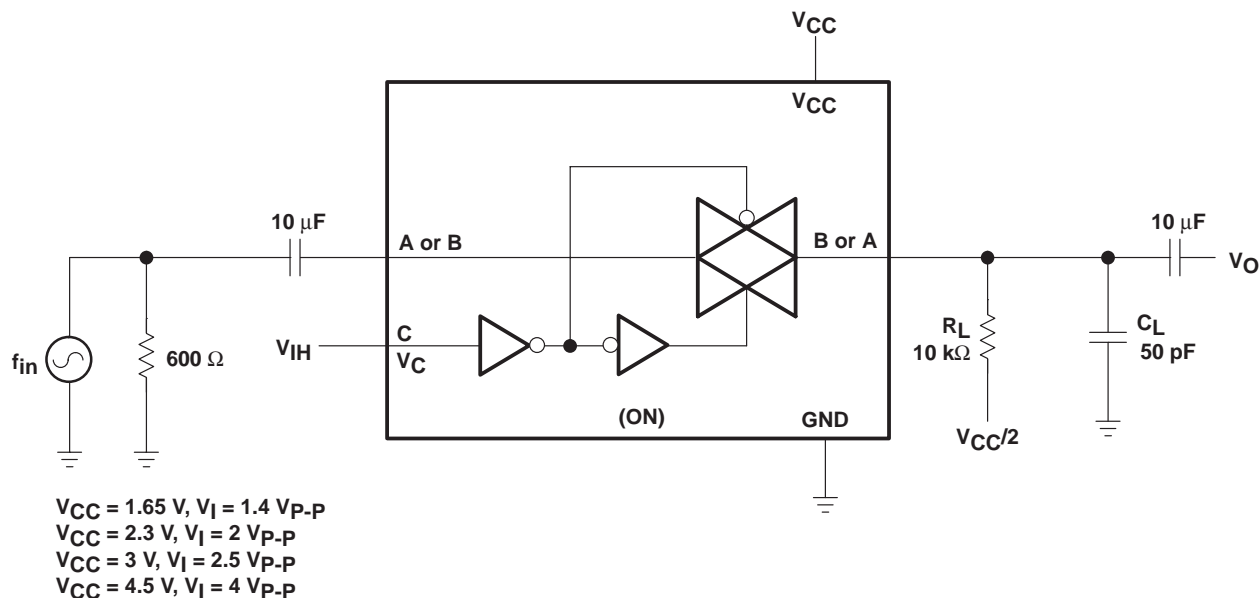


Figure 8. Sine-Wave Distortion

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
1P1G66QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	TBD	Call TI	Level-1-220C-UNLIM
SN74LVC1G66QDCKRQ1	ACTIVE	SC70	DCK	5	3000	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

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

<sup>(2)</sup> 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)

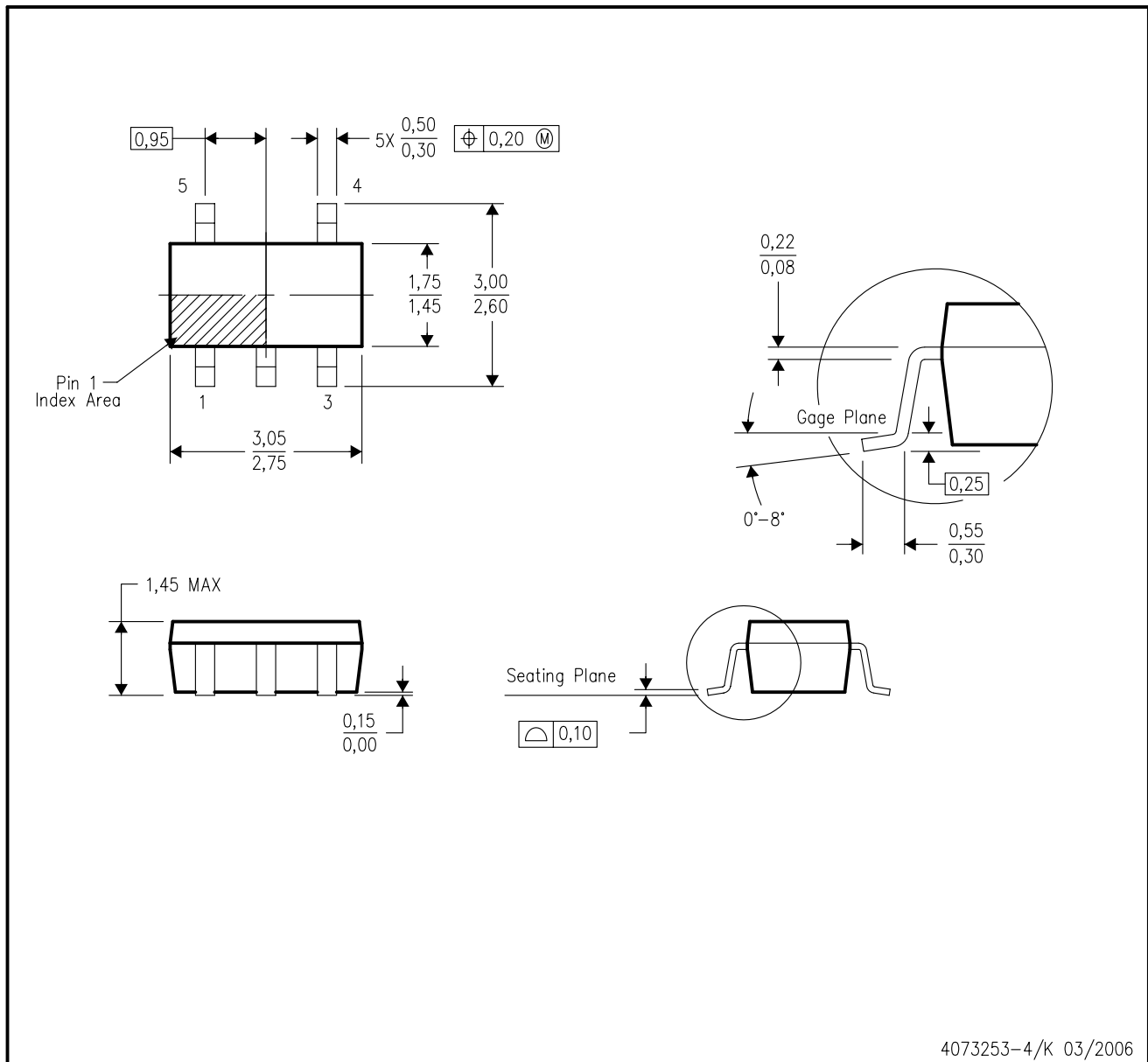
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DBV (R-PDSO-G5)

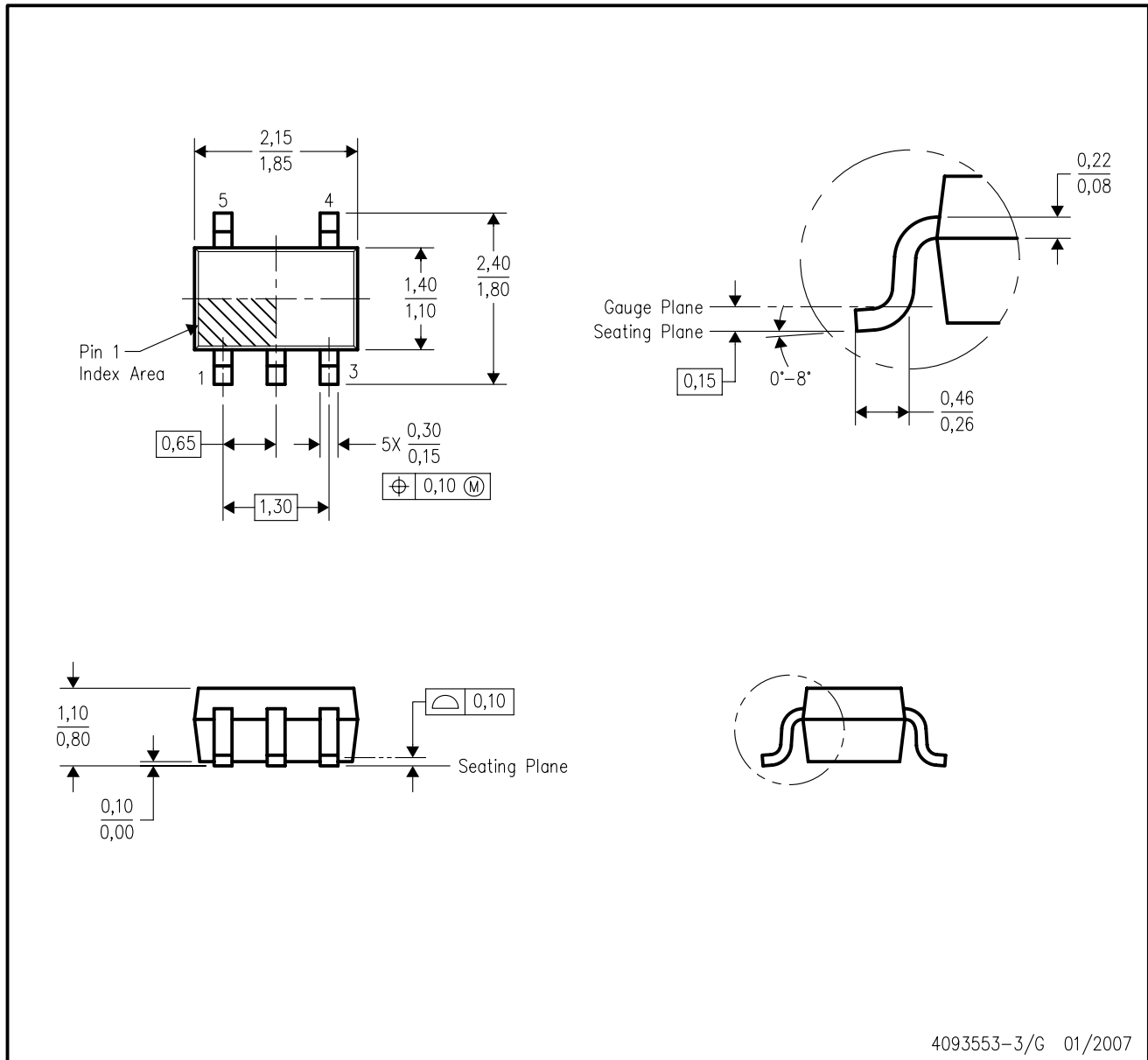
PLASTIC SMALL-OUTLINE PACKAGE



- 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-178 Variation AA.

DCK (R-PDSO-G5)

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 AA.

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