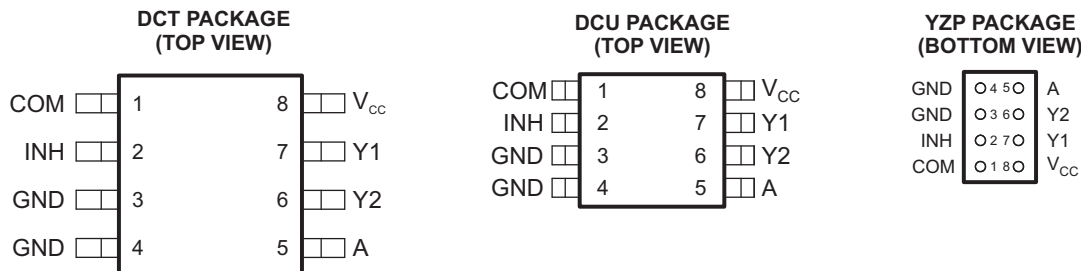


## FEATURES

- Available in the Texas Instruments NanoFree™ Package
- 1.65-V to 5.5-V  $V_{CC}$  Operation
- High On-Off Output Voltage Ratio
- High Degree of Linearity
- High Speed, Typically 0.5 ns ( $V_{CC} = 3$  V,  $C_L = 50$  pF)
- Low On-State Resistance, Typically 96.5  $\Omega$  ( $V_{CC} = 4.5$  V)
- 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)



See mechanical drawings for dimensions.

## DESCRIPTION/ORDERING INFORMATION

This dual analog multiplexer/demultiplexer is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The SN74LVC2G53 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.

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

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 <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(2)</sup>
–40°C to 85°C	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Reel of 3000	SN74LVC2G53YZPR	__ _C4_
		Reel of 3000	SN74LVC2G53DCTR	C53__ _
	SSOP – DCT	Reel of 3000	SN74LVC2G53DCUR	C53_
		Reel of 250	SN74LVC2G53DCUT	

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

(2) DCT: The actual top-side marking has three additional characters that designate the year, month, and assembly/test site.

DCU: The actual top-side marking has one additional character that designates the assembly/test site.

YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).



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.

NanoFree is a trademark of Texas Instruments.

# SN74LVC2G53

## SINGLE-POLE DOUBLE-THROW (SPDT) ANALOG SWITCH

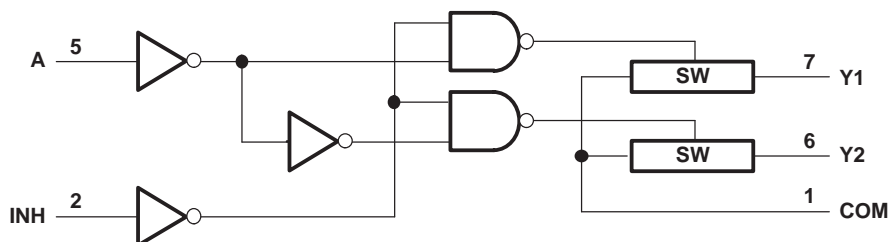
### 2:1 ANALOG MULTIPLEXER/DEMULTIPLEXER

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**FUNCTION TABLE**

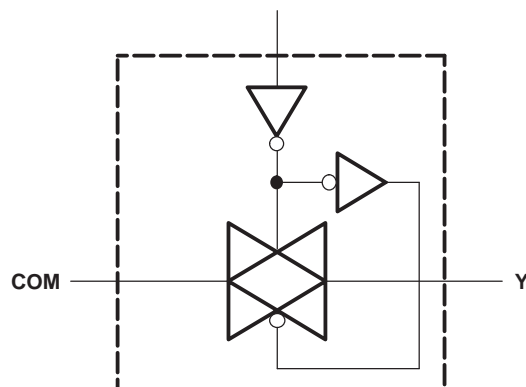
CONTROL INPUTS		ON CHANNEL
INH	A	
L	L	Y1
L	H	Y2
H	X	None

**LOGIC DIAGRAM (POSITIVE LOGIC)**



NOTE A: For simplicity, the test conditions shown in Figures 1 through 4 and 6 through 10 are for the demultiplexer configuration. Signals can be passed from COM to Y1 (Y2) or from Y1 (Y2) to COM.

**SIMPLIFIED SCHEMATIC, EACH SWITCH (SW)**



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

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

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage range <sup>(2)</sup>	–0.5	6.5	V
$V_I$	Input voltage range <sup>(2)(3)</sup>	–0.5	6.5	V
$V_O$	Switch I/O voltage range <sup>(2)(3)(4)</sup>	–0.5	$V_{CC} + 0.5$	V
$I_{IK}$	Control input clamp current	$V_I < 0$	–50	mA
$I_{I/O}$	I/O port diode current	$V_{I/O} < 0$ or $V_{I/O} > V_{CC}$	±50	mA
$I_T$	On-state switch current	$V_{I/O} = 0$ to $V_{CC}$	±50	mA
	Continuous current through $V_{CC}$ or GND		±100	mA
$\theta_{JA}$	Package thermal impedance <sup>(5)</sup>	DCT package	220	°C/W
		DCU package	227	
		YZP package	102	
$T_{stg}$	Storage temperature range	–65	150	°C

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to ground, unless otherwise specified.
- (3) The input and output 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) The package thermal impedance is calculated in accordance with JESD 51-7.

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

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	1.65	5.5	V
$V_{I/O}$	I/O port voltage	0	$V_{CC}$	V
$V_{IH}$	High-level input voltage, control input	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$V_{CC} \times 0.65$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	$V_{CC} \times 0.7$	
		$V_{CC} = 3 \text{ V to } 3.6 \text{ V}$	$V_{CC} \times 0.7$	
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	$V_{CC} \times 0.7$	
$V_{IL}$	Low-level input voltage, control input	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$V_{CC} \times 0.35$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	$V_{CC} \times 0.3$	
		$V_{CC} = 3 \text{ V to } 3.6 \text{ V}$	$V_{CC} \times 0.3$	
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	$V_{CC} \times 0.3$	
$V_I$	Control input voltage	0	5.5	V
$\Delta t/\Delta v$	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	
$T_A$	Operating free-air temperature	–40	85	°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	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>INH</sub> = V <sub>IL</sub> (see Figure 1 and Figure 2)	I <sub>S</sub> = 4 mA	1.65 V	13		30	Ω
			I <sub>S</sub> = 8 mA	2.3 V	10		20	
			I <sub>S</sub> = 24 mA	3 V	8.5		17	
			I <sub>S</sub> = 32 mA	4.5 V	6.5		13	
r <sub>on(p)</sub>	Peak on-state resistance	V <sub>I</sub> = V <sub>CC</sub> to GND, V <sub>INH</sub> = V <sub>IL</sub> (see Figure 1 and Figure 2)	I <sub>S</sub> = 4 mA	1.65 V	86.5		120	Ω
			I <sub>S</sub> = 8 mA	2.3 V	23		30	
			I <sub>S</sub> = 24 mA	3 V	13		20	
			I <sub>S</sub> = 32 mA	4.5 V	8		15	
Δr <sub>on</sub>	Difference of on-state resistance between switches	V <sub>I</sub> = V <sub>CC</sub> to GND, V <sub>C</sub> = V <sub>IH</sub> (see Figure 1 and Figure 2)	I <sub>S</sub> = 4 mA	1.65 V			7	Ω
			I <sub>S</sub> = 8 mA	2.3 V			5	
			I <sub>S</sub> = 24 mA	3 V			3	
			I <sub>S</sub> = 32 mA	4.5 V			2	
I <sub>S(off)</sub>	Off-state switch leakage current	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>INH</sub> = V <sub>IH</sub> (see Figure 3)		5.5 V			±1 ±0.1 <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>INH</sub> = V <sub>IL</sub> , V <sub>O</sub> = Open (see Figure 4)		5.5 V			±1 ±0.1 <sup>(1)</sup>	μA
I <sub>I</sub>	Control input current	V <sub>C</sub> = V <sub>CC</sub> or GND		5.5 V			±1 ±0.1 <sup>(1)</sup>	μA
I <sub>CC</sub>	Supply current	V <sub>C</sub> = V <sub>CC</sub> or GND		5.5 V			1	μA
ΔI <sub>CC</sub>	Supply-current change	V <sub>C</sub> = V <sub>CC</sub> – 0.6 V		5.5 V			500	μA
C <sub>ic</sub>	Control input capacitance			5 V			3.5	pF
C <sub>io(off)</sub>	Switch input/output capacitance	Y		5 V			6.5	pF
		COM					10	
C <sub>io(on)</sub>	Switch input/output capacitance			5 V			19.5	pF

(1) T<sub>A</sub> = 25°C

## Switching Characteristics

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

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>(1)</sup>	COM or Y	Y or COM		2		1.2		0.8		0.6	ns
t <sub>en</sub> <sup>(2)</sup>	INH	COM or Y	3.3	9	2.5	6.1	2.2	5.4	1.8	4.5	ns
t <sub>dis</sub> <sup>(3)</sup>			3.2	10.9	2.3	8.3	2.3	8.1	1.6	8	
t <sub>en</sub> <sup>(2)</sup>	A	COM or Y	2.9	10.3	2.1	7.2	1.9	5.8	1.3	5.4	ns
t <sub>dis</sub> <sup>(3)</sup>			2.1	9.4	1.4	7.9	1.1	7.2	1	5	

(1) 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).

(2) t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.

(3) t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.

## Analog Switch Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CC}$	TYP	UNIT
Frequency response (switch on)	COM or Y	Y or COM	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = \text{sine wave}$ (see <a href="#">Figure 6</a> )	1.65 V	35	MHz
				2.3 V	120	
				3 V	190	
				4.5 V	215	
			$C_L = 5\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = \text{sine wave}$ (see <a href="#">Figure 6</a> )	1.65 V	>300	
				2.3 V	>300	
				3 V	>300	
				4.5 V	>300	
Crosstalk <sup>(1)</sup> (between switches)	COM or Y	Y or COM	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see <a href="#">Figure 7</a> )	1.65 V	–58	dB
				2.3 V	–58	
				3 V	–58	
				4.5 V	–58	
			$C_L = 5\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see <a href="#">Figure 7</a> )	1.65 V	–42	
				2.3 V	–42	
				3 V	–42	
				4.5 V	–42	
Crosstalk (control input to signal output)	INH	COM or Y	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (square wave) (see <a href="#">Figure 8</a> )	1.65 V	35	mV
				2.3 V	50	
				3 V	70	
				4.5 V	100	
Feedthrough attenuation (switch off)	COM or Y	Y or COM	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see <a href="#">Figure 9</a> )	1.65 V	–60	dB
				2.3 V	–60	
				3 V	–60	
				4.5 V	–60	
			$C_L = 5\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see <a href="#">Figure 9</a> )	1.65 V	–50	
				2.3 V	–50	
				3 V	–50	
				4.5 V	–50	
Sine-wave distortion	COM or Y	Y or COM	$C_L = 50\text{ pF}$ , $R_L = 10\text{ k}\Omega$ , $f_{in} = 1\text{ kHz}$ (sine wave) (see <a href="#">Figure 10</a> )	1.65 V	0.1	%
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	
			$C_L = 50\text{ pF}$ , $R_L = 10\text{ k}\Omega$ , $f_{in} = 10\text{ kHz}$ (sine wave) (see <a href="#">Figure 10</a> )	1.65 V	0.15	
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	

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

## 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	$C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$	9	10	10	12	pF

# SN74LVC2G53

## SINGLE-POLE DOUBLE-THROW (SPDT) ANALOG SWITCH

### 2:1 ANALOG MULTIPLEXER/DEMULTIPLEXER

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#### PARAMETER MEASUREMENT INFORMATION

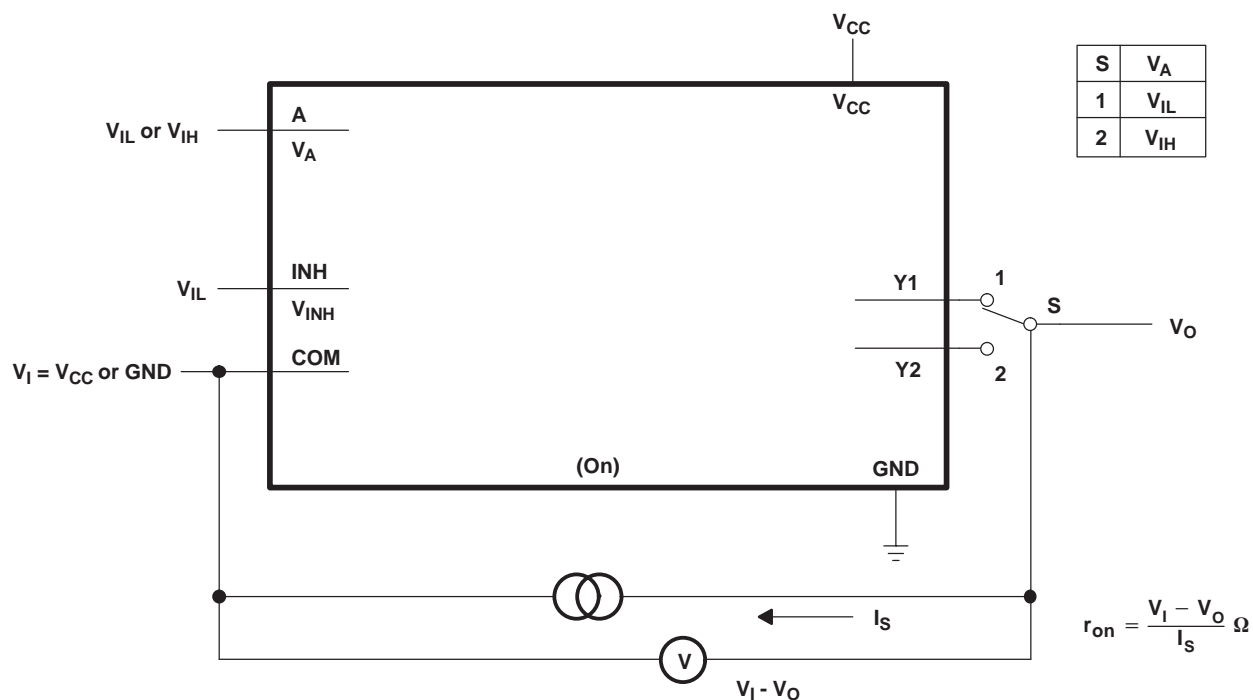


Figure 1. On-State Resistance Test Circuit

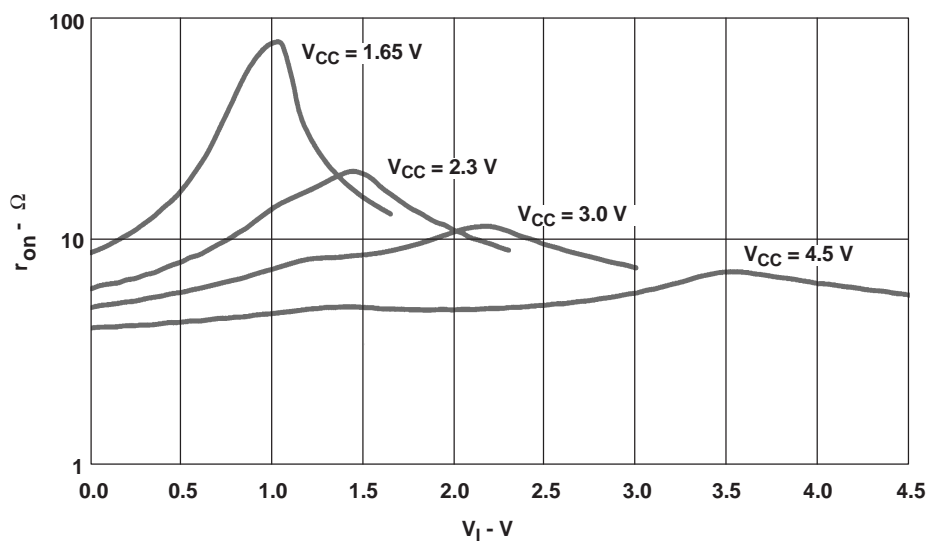


Figure 2. Typical  $r_{on}$  as a Function of Input Voltage ( $V_I$ ) for  $V_I = 0$  to  $V_{CC}$

## PARAMETER MEASUREMENT INFORMATION

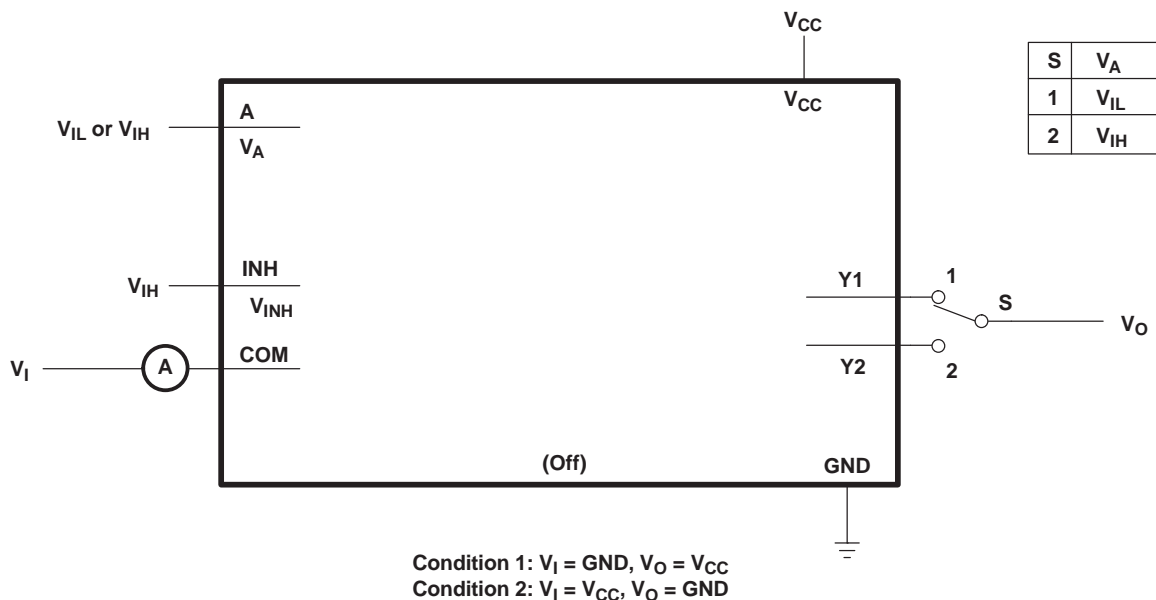


Figure 3. Off-State Switch Leakage-Current Test Circuit

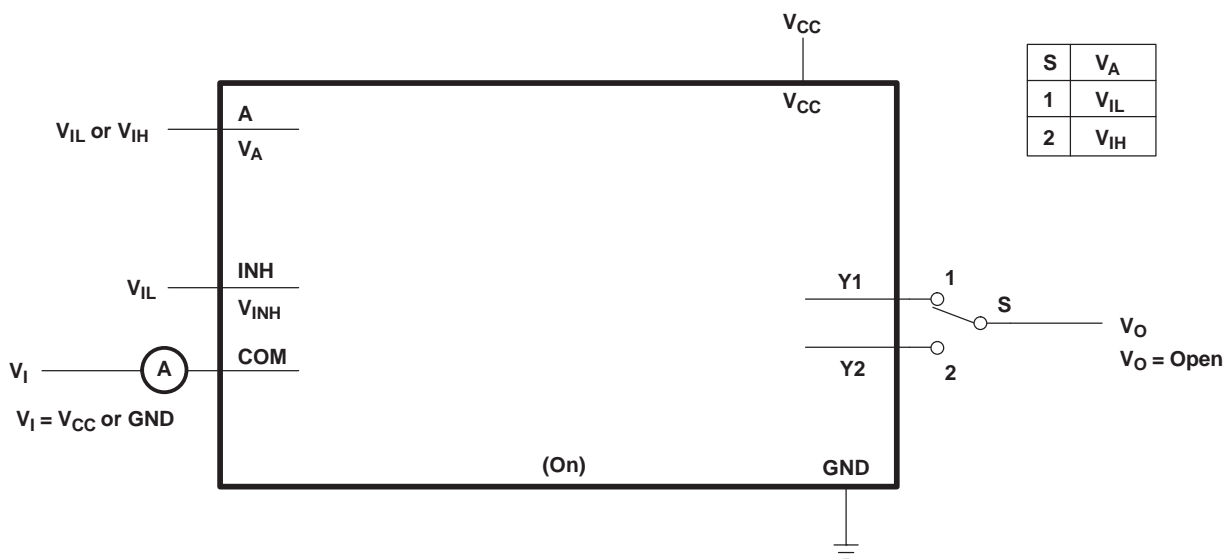


Figure 4. On-State Switch Leakage-Current Test Circuit

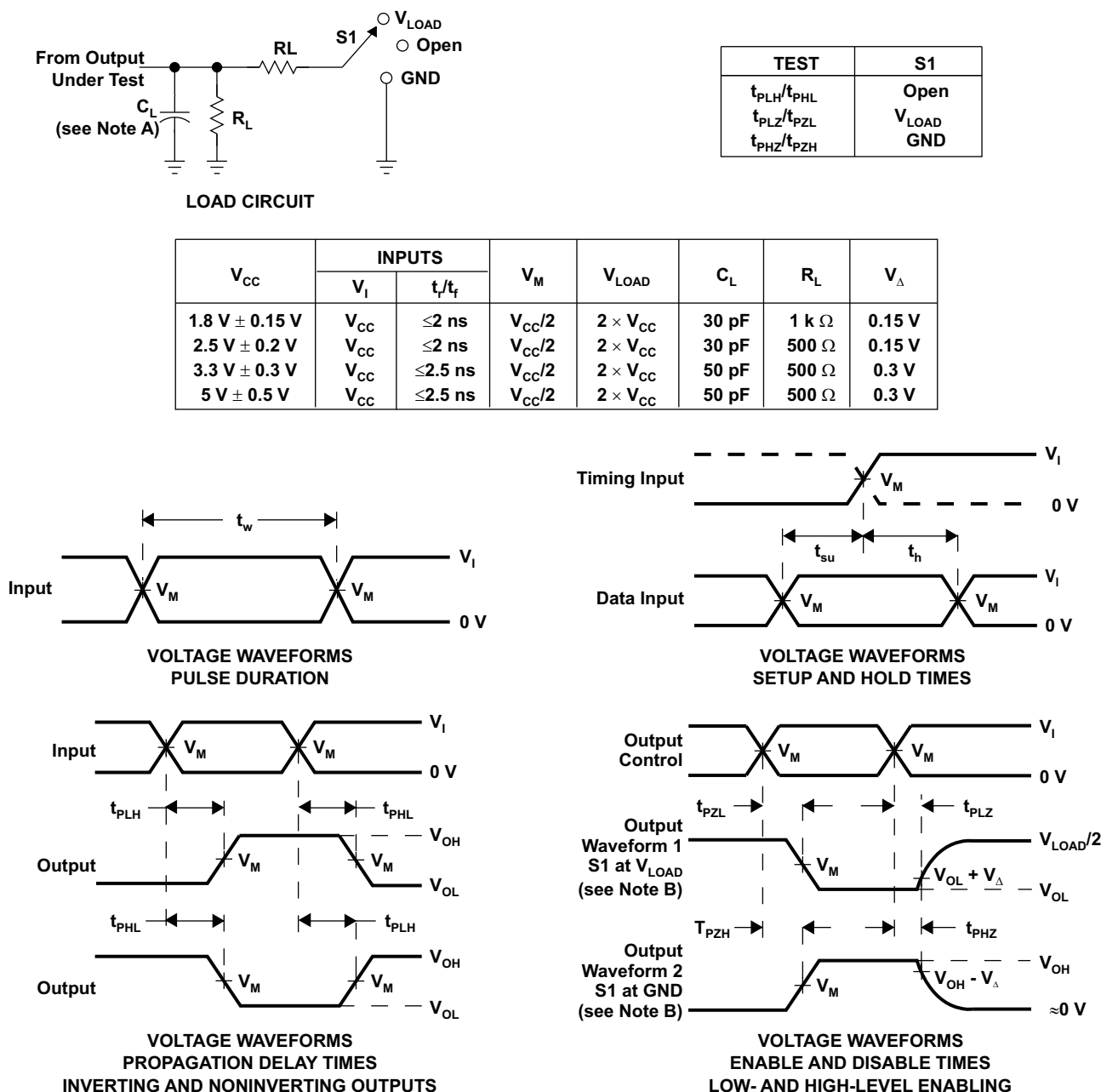
# SN74LVC2G53

## SINGLE-POLE DOUBLE-THROW (SPDT) ANALOG SWITCH

### 2:1 ANALOG MULTIPLEXER/DEMULTIPLEXER

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## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\text{ }\Omega$
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 5. Load Circuit and Voltage Waveforms



## PARAMETER MEASUREMENT INFORMATION

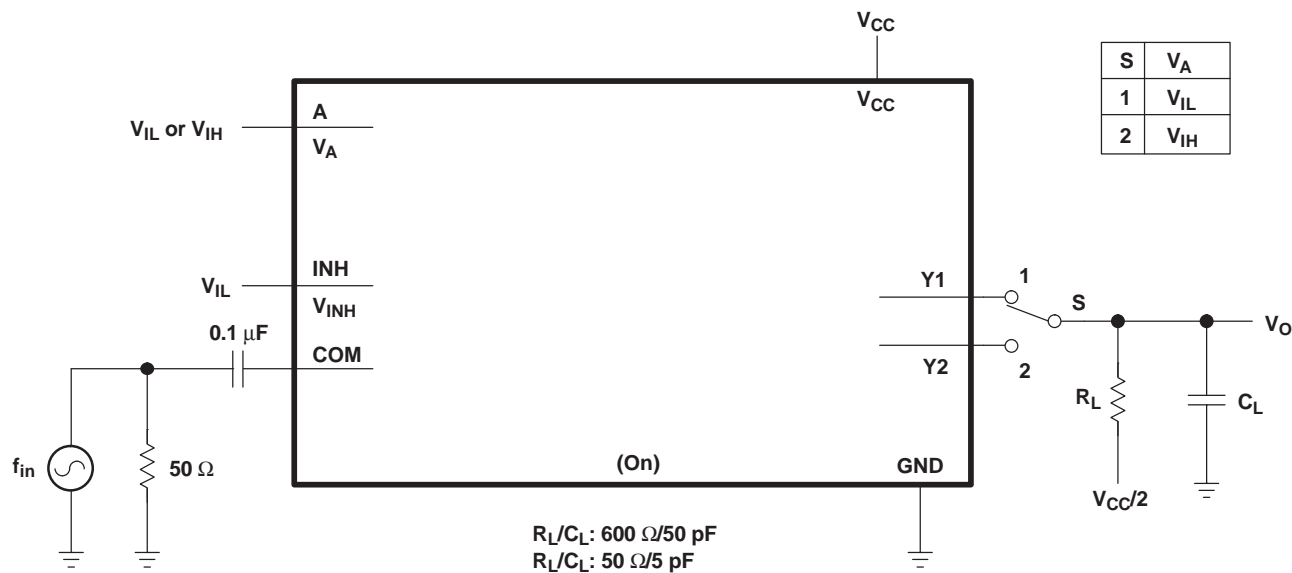


Figure 6. Frequency Response (Switch On)

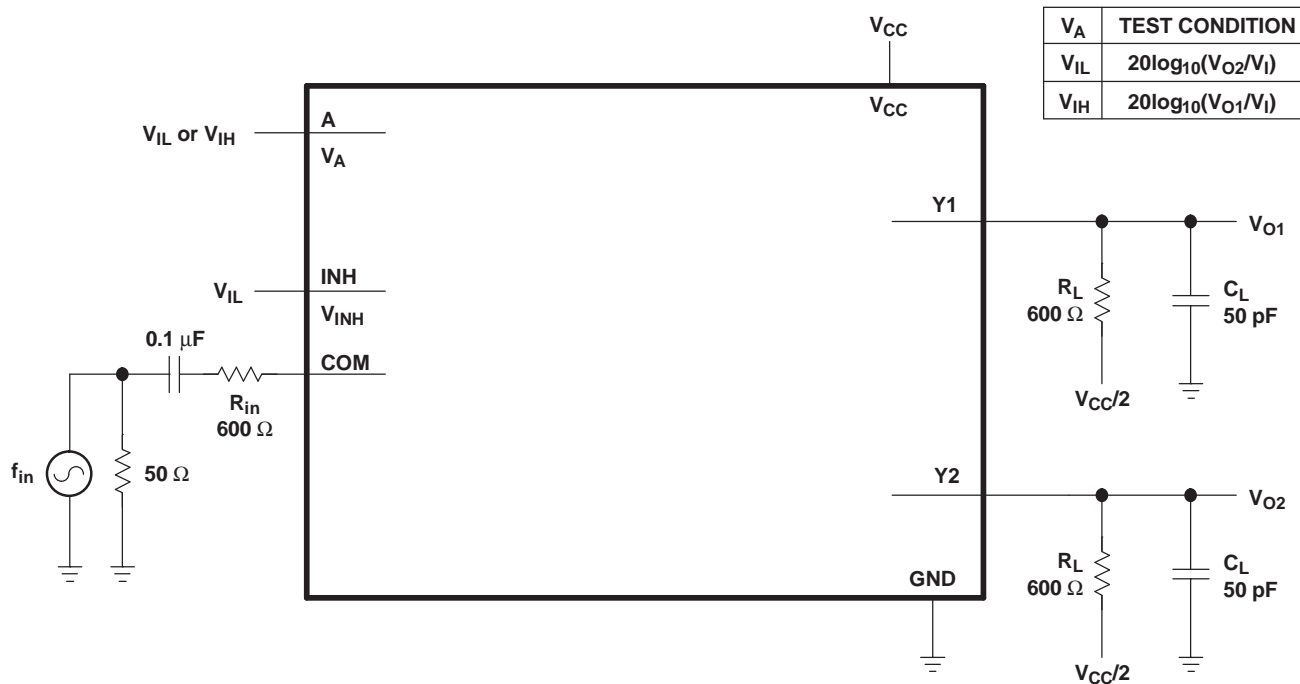
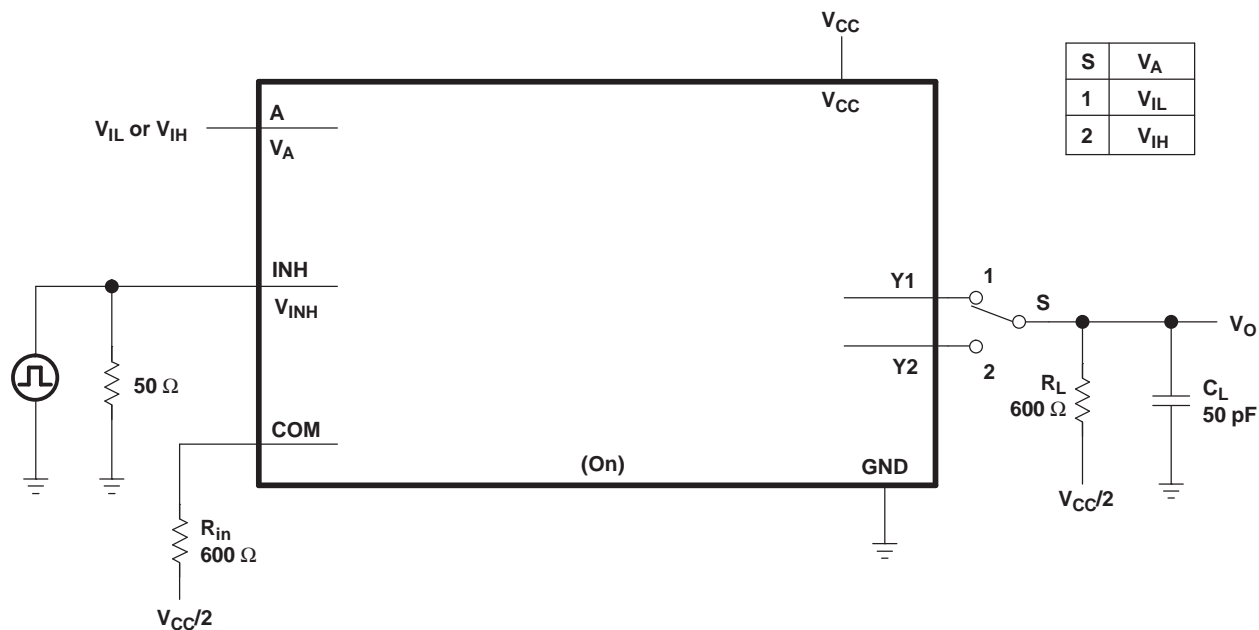


Figure 7. Crosstalk (Between Switches)

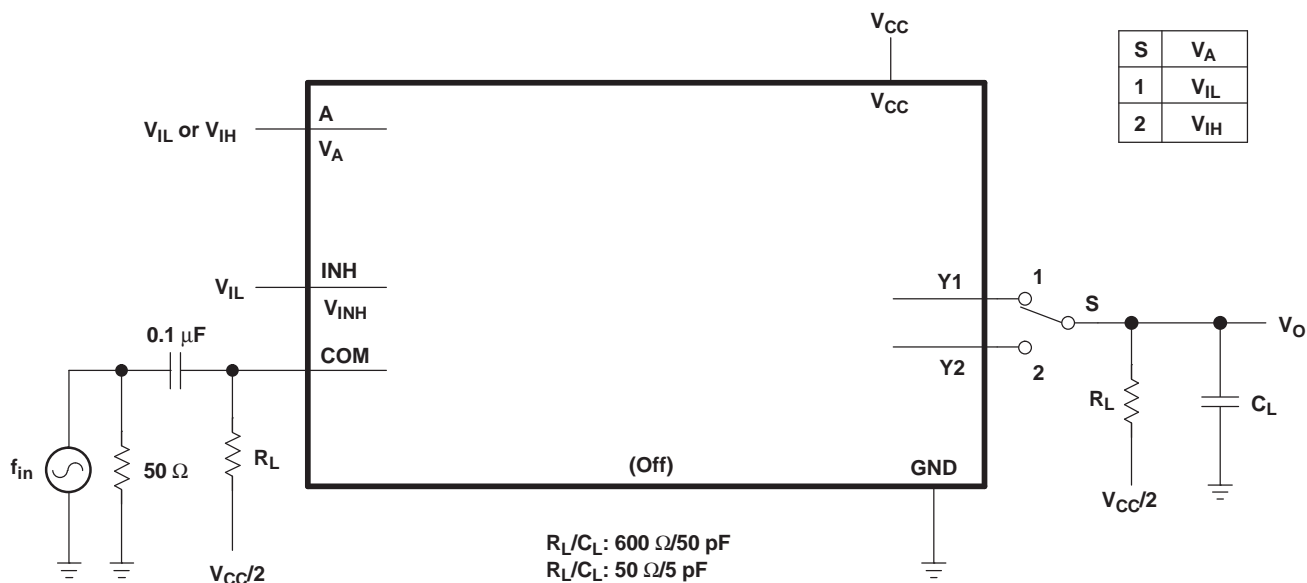
**SN74LVC2G53**  
**SINGLE-POLE DOUBLE-THROW (SPDT) ANALOG SWITCH**  
**2:1 ANALOG MULTIPLEXER/DEMULTIPLEXER**

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**PARAMETER MEASUREMENT INFORMATION**



**Figure 8. Crosstalk (Control Input, Switch Output)**



**Figure 9. Feedthrough (Switch Off)**

PARAMETER MEASUREMENT INFORMATION

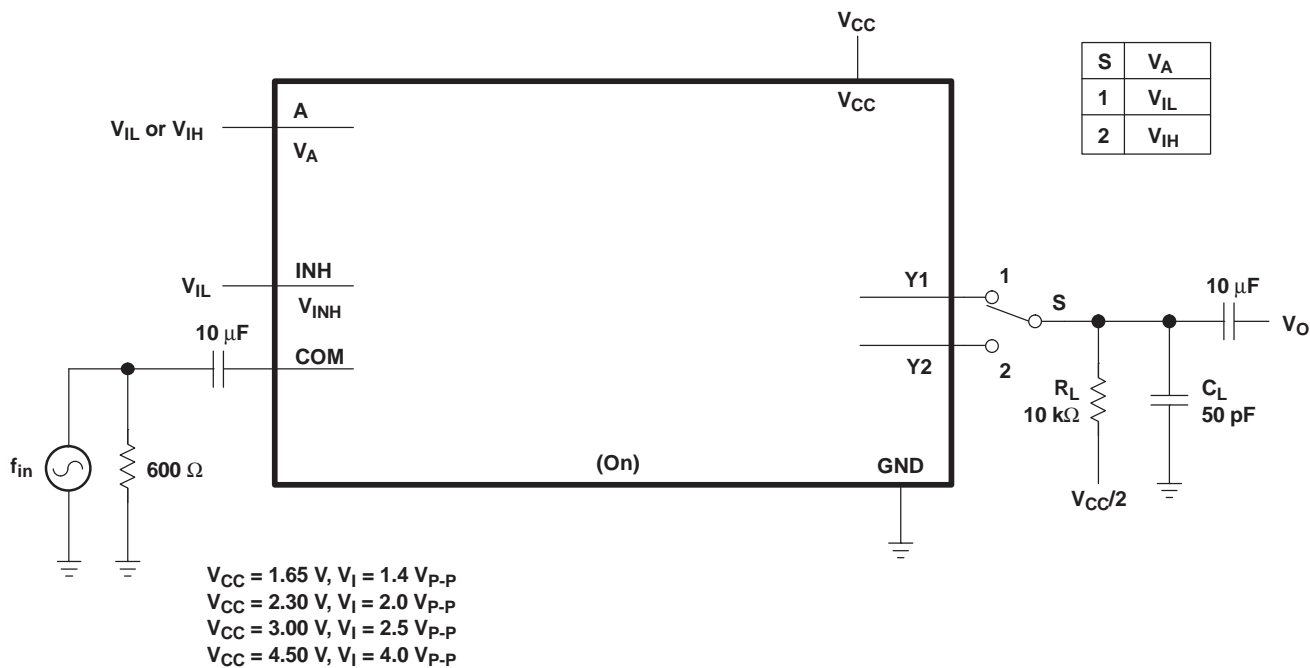


Figure 10. Sine-Wave Distortion

**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>
SN74LVC2G53DCTR	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCTRE4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCTRG4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCUR	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCURE4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCURG4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCUT	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53DCUTE4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G53YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	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.

**OBsolete:** 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.

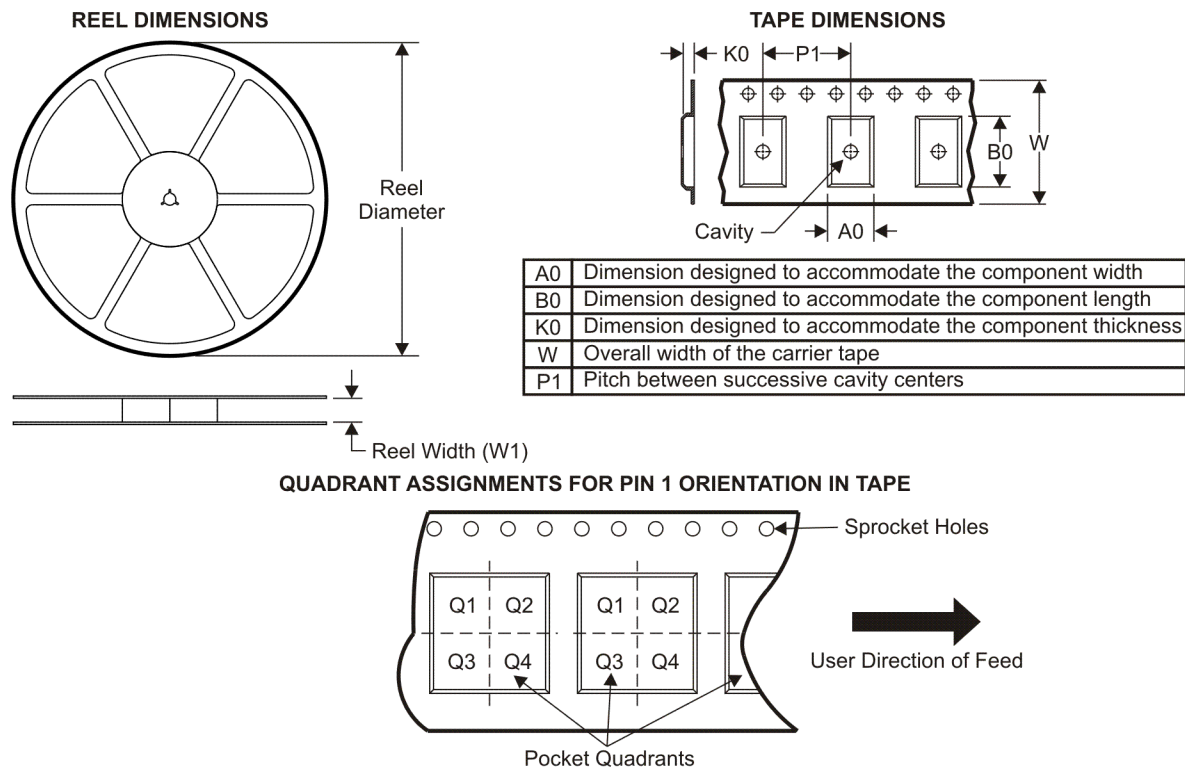
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**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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**TAPE AND REEL INFORMATION**


\*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
SN74LVC2G53DCUR	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC2G53YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1

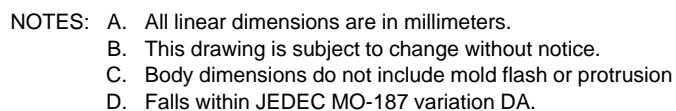
## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

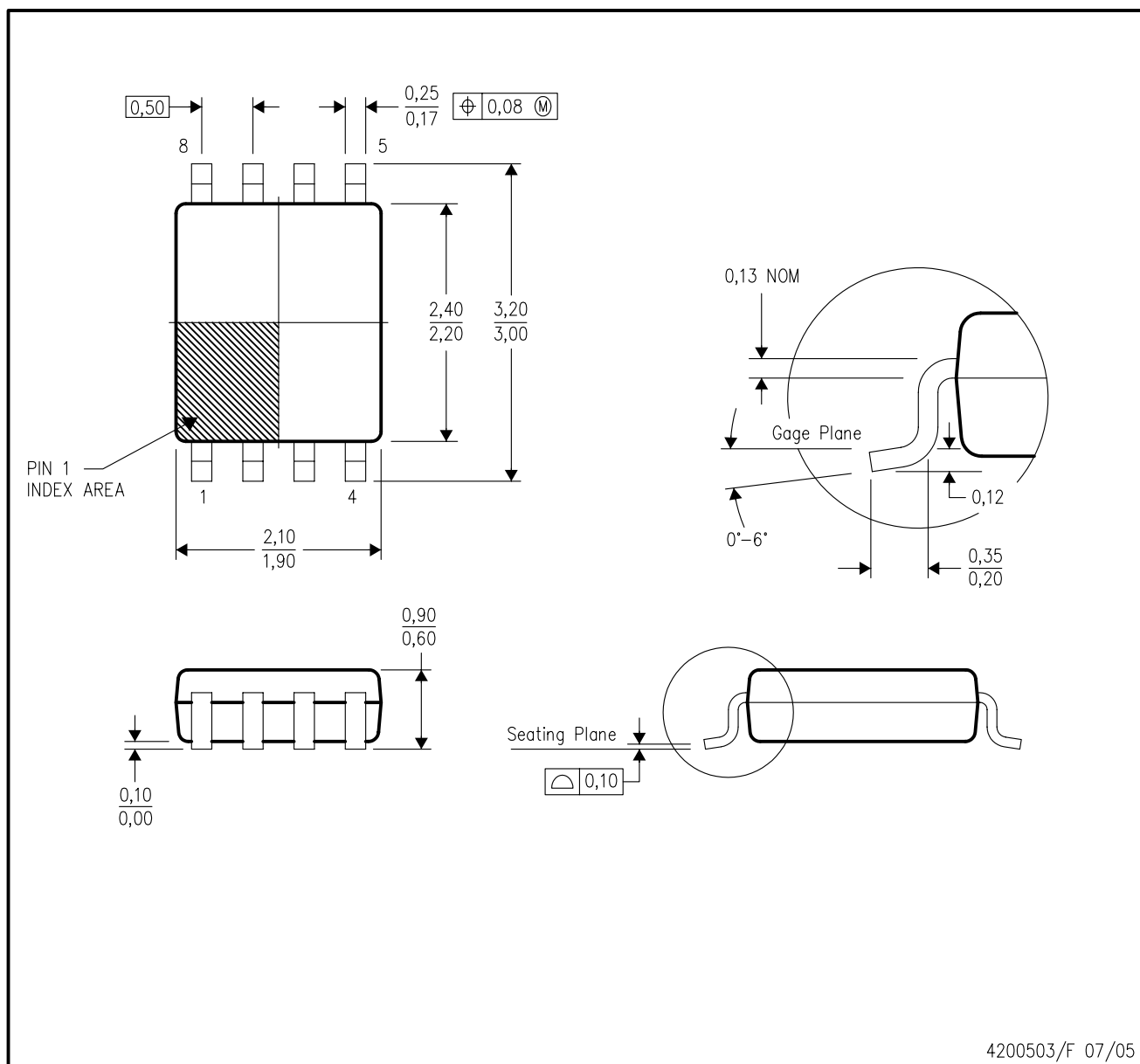
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC2G53DCUR	US8	DCU	8	3000	202.0	201.0	28.0
SN74LVC2G53YZPR	DSBGA	YZP	8	3000	220.0	220.0	34.0

## PLASTIC SMALL-OUTLINE PACKAGE



DCU (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



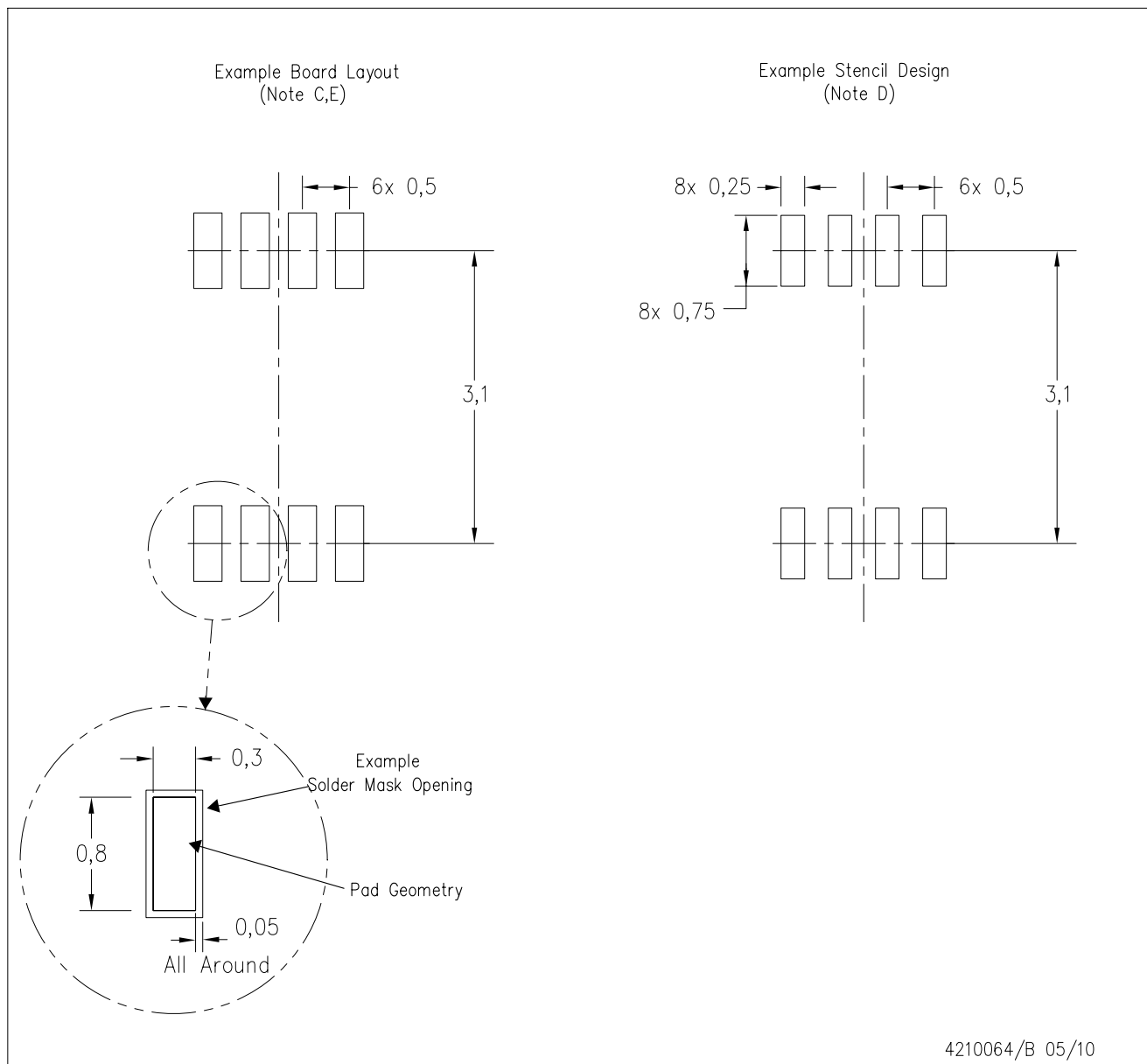
## NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- Falls within JEDEC MO-187 variation CA.



DCU (S-PDSO-G8)

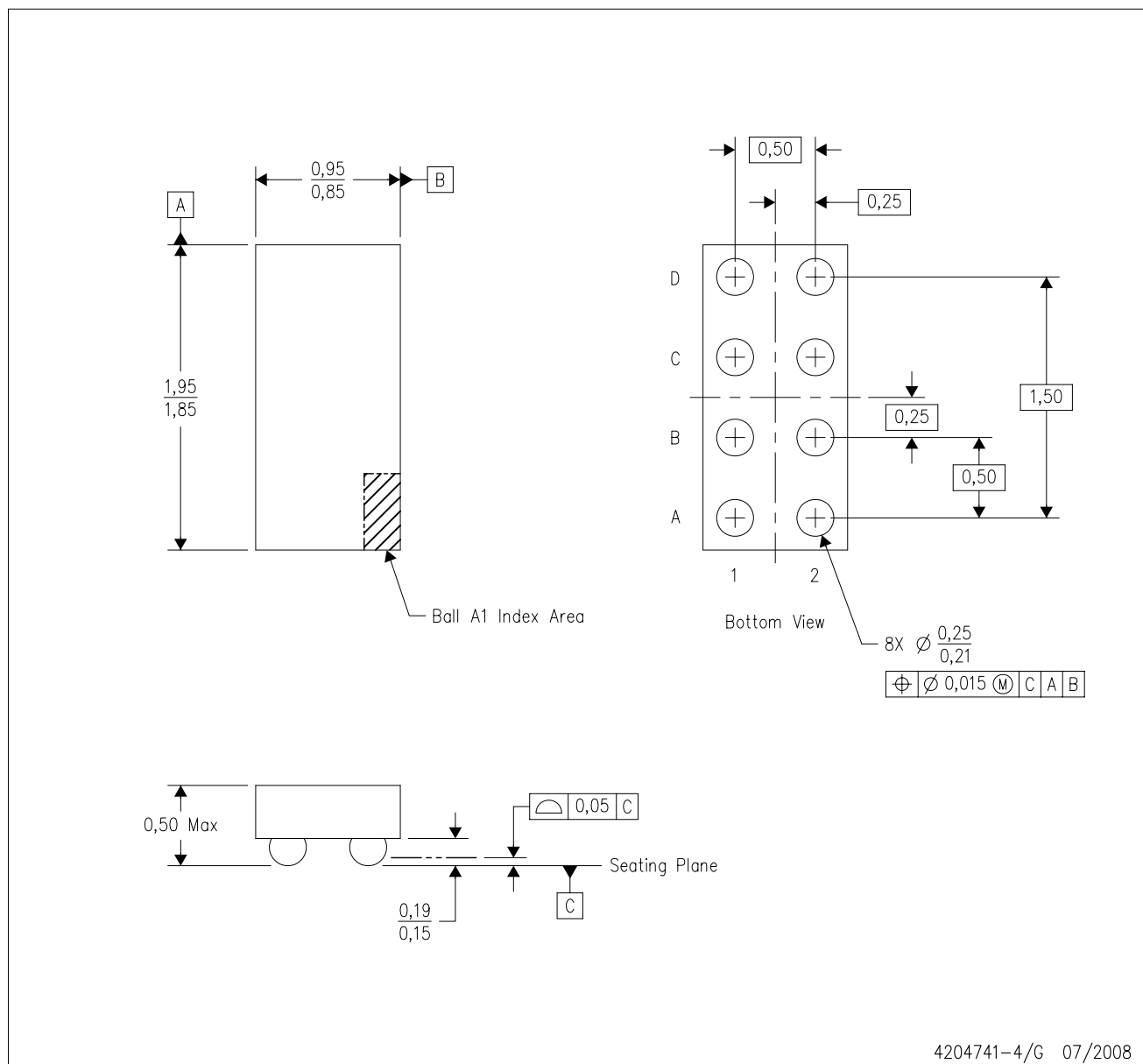
PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)



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

YZP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - D. This package is lead-free. Refer to the 8 YEP package (drawing 4204725) for tin-lead (SnPb).

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