

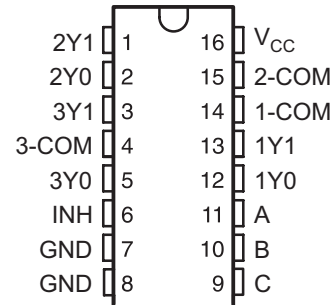
# TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

Check for Samples: [SN74LV4053A-Q1](#)

## 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)
- 2-V to 5.5-V  $V_{CC}$  Operation
- Supports Mixed-Mode Voltage Operation on All Ports
- High On-Off Output-Voltage Ratio
- Low Crosstalk Between Switches
- Individual Switch Controls
- Extremely Low Input Current

D OR PW PACKAGE  
(TOP VIEW)



## DESCRIPTION

This triple 2-channel CMOS analog multiplexer/demultiplexer is designed for 2-V to 5.5-V  $V_{CC}$  operation.

The SN74LV4053A handles both analog and digital signals. Each channel permits signals with amplitudes 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<sup>(1)</sup>

$T_A$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 105°C	SOIC – D	Tape and reel	SN74LV4053ATDRQ1	L4053AQ
	TSSOP – PW	Tape and reel	SN74LV4053ATPWRQ1	L4053AQ
–40°C to 125°C	TSSOP – PW	Tape and reel	SN74LV4053AQPWRQ1	4053AQ1

- (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).

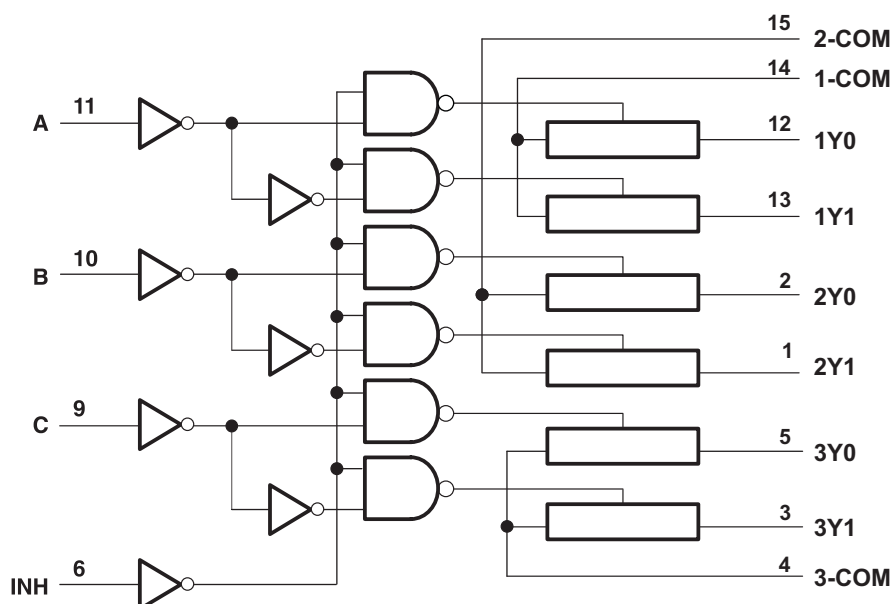
## FUNCTION TABLE

INPUTS				ON CHANNEL
INH	C	B	A	
L	L	L	L	1Y0, 2Y0, 3Y0
L	L	L	H	1Y1, 2Y0, 3Y0
L	L	H	L	1Y0, 2Y1, 3Y0
L	L	H	H	1Y1, 2Y1, 3Y0
L	H	L	L	1Y0, 2Y0, 3Y1
L	H	L	H	1Y1, 2Y0, 3Y1
L	H	H	L	1Y0, 2Y1, 3Y1
L	H	H	H	1Y1, 2Y1, 3Y1
H	X	X	X	None



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)

$V_{CC}$	Supply voltage range		–0.5 V to 7 V
$V_I$	Input voltage range <sup>(2)</sup>		–0.5 V to 7 V
$V_{IO}$	Switch I/O voltage range <sup>(2) (3)</sup>		–0.5 V to $V_{CC} + 0.5$ V
$I_{IK}$	Input clamp current	$V_I < 0$	–20 mA
$I_{IOK}$	I/O diode current	$V_{IO} < 0$	–50 mA
$I_T$	Switch through current	$V_{IO} = 0$ to $V_{CC}$	±25 mA
	Continuous current through $V_{CC}$ or GND		±50 mA
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	D package	73°C/W
		PW package	108°C/W
$T_{stg}$	Storage temperature range		–65°C to 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 and output negative-voltage ratings may be exceeded if the input and output 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.

## RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage		2 <sup>(2)</sup>	5.5	V
V <sub>IH</sub>	High-level input voltage, control inputs	V <sub>CC</sub> = 2 V	1.5	V <sub>CC</sub> × 0.7	V
		V <sub>CC</sub> = 2.3 V to 2.7 V			
		V <sub>CC</sub> = 3 V to 3.6 V			
		V <sub>CC</sub> = 4.5 V to 5.5 V			
V <sub>IL</sub>	Low-level input voltage, control inputs	V <sub>CC</sub> = 2 V	0.5	V <sub>CC</sub> × 0.3	V
		V <sub>CC</sub> = 2.3 V to 2.7 V			
		V <sub>CC</sub> = 3 V to 3.6 V			
		V <sub>CC</sub> = 4.5 V to 5.5 V			
V <sub>I</sub>	Control input voltage		0	5.5	V
V <sub>IO</sub>	Input/output voltage		0	V <sub>CC</sub>	V
Δt/Δv	Input transition rise or fall rate	V <sub>CC</sub> = 2.3 V to 2.7 V	200	100	ns/V
		V <sub>CC</sub> = 3 V to 3.6 V			
		V <sub>CC</sub> = 4.5 V to 5.5 V	20		
T <sub>A</sub>	Operating free-air temperature	SN74LV4053ATDRQ1, SN74LV4053ATPWRQ1	−40	105	°C
T <sub>A</sub>	Operating free-air temperature	SN74LV4053AQPWRQ1	−40	125	

- (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](#).
- (2) With supply voltages at or near 2 V, the analog switch on-state resistance becomes very nonlinear. It is recommended that only digital signals be transmitted at these low supply voltages.

## ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40 to 105°C		T <sub>A</sub> = -40 to 125°C		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
r <sub>on</sub> On-state switch resistance	I <sub>T</sub> = 2 mA, V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>INH</sub> = V <sub>IL</sub> (see Figure 1)	2.3 V		41	180		225		225	Ω
		3 V		30	150		190		190	
		4.5 V		23	75		100		100	
r <sub>on(p)</sub> Peak on-state resistance	I <sub>T</sub> = 2 mA, V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>INH</sub> = V <sub>IL</sub>	2.3 V		139	500		600		600	Ω
		3 V		63	180		225		225	
		4.5 V		35	100		125		125	
Δr <sub>on</sub> Difference in on-state resistance between switch	I <sub>T</sub> = 2 mA, V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>INH</sub> = V <sub>IL</sub>	2.3 V		2	30		40		40	Ω
		3 V		1.6	20		30		30	
		4.5 V		1.3	15		20		20	
I <sub>I</sub> Control input current	V <sub>I</sub> = 5.5 V or GND	0 V to 5.5 V			±0.1		±1		±2	μA
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 2)	5.5 V			±0.1		±1		±2	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> (see Figure 3)	5.5 V			±0.1		±1		±2	μA
I <sub>CC</sub> Supply current	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V					20		40	μA
C <sub>IC</sub> Control input capacitance	f = 10 MHz	3.3 V		2						pF
C <sub>IS</sub> Common terminal capacitance		3.3 V		8.2						pF
C <sub>OS</sub> Switch terminal capacitance		3.3 V		5.6						pF
C <sub>F</sub> Feedthrough capacitance				0.5						pF

## SWITCHING CHARACTERISTICS

V<sub>CC</sub> = 3.3 V ± 0.3 V, over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40 to 105°C		T <sub>A</sub> = -40 to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub> Propagation delay time t <sub>PHL</sub>	COM or Y <sub>n</sub>	Y <sub>n</sub> or COM	C <sub>L</sub> = 50 pF (see Figure 4)		2.9	9		12		14	ns
t <sub>PZH</sub> Enable delay time t <sub>PZL</sub>	INH	COM or Y <sub>n</sub>	C <sub>L</sub> = 50 pF (see Figure 5)		6.1	20		25		25	ns
t <sub>PHZ</sub> Disable delay time t <sub>PLZ</sub>	INH	COM or Y <sub>n</sub>	C <sub>L</sub> = 50 pF (see Figure 5)		8.9	20		25		25	ns

## SWITCHING CHARACTERISTICS

 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ , over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			$T_A = -40\text{ to }105^\circ\text{C}$		$T_A = -40\text{ to }125^\circ\text{C}$		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$ Propagation delay time $t_{PHL}$	COM or Yn	Yn or COM	$C_L = 50\text{ pF}$ (see Figure 4)		1.8	6		8		10	ns
$t_{PZH}$ Enable delay time $t_{PZL}$	INH	COM or Yn	$C_L = 50\text{ pF}$ (see Figure 5)		4.3	14		18		18	ns
$t_{PHZ}$ Disable delay time $t_{PLZ}$	INH	COM or Yn	$C_L = 50\text{ pF}$ (see Figure 5)		6.3	14		18		18	ns

## ANALOG SWITCH CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CC}$	$T_A = 25^\circ\text{C}$			UNIT
					MIN	TYP	MAX	
Frequency response (switch on)	COM or Yn	Yn or COM	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) <sup>(1)</sup> (see Figure 6)	2.3 V		30		MHz
				3 V		35		
				4.5 V		50		
Crosstalk (between any switches)	COM or Yn	Yn or COM	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see Figure 7)	2.3 V		–45		dB
				3 V		–45		
				4.5 V		–45		
Crosstalk (control input to signal output)	INH	COM or Yn	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (square wave) (see Figure 8)	2.3 V		20		mV
				3 V		35		
				4.5 V		65		
Feedthrough attenuation (switch off)	COM or Yn	Yn or COM	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ <sup>(2)</sup> (see Figure 9)	2.3 V		–45		dB
				3 V		–45		
				4.5 V		–45		
Sine-wave distortion	COM or Yn	Yn or COM	$C_L = 50\text{ pF}$ , $R_L = 10\text{ k}\Omega$ , $f_{in} = 1\text{ kHz}$ (sine wave) (see Figure 10)	$V_I = 2\text{ Vp-p}$	2.3 V		0.1	%
				$V_I = 2.5\text{ Vp-p}$	3 V		0.1	
				$V_I = 4\text{ Vp-p}$	4.5 V		0.1	

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

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

## OPERATING CHARACTERISTICS

 $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	$C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$	5.3	pF

## PARAMETER MEASUREMENT INFORMATION

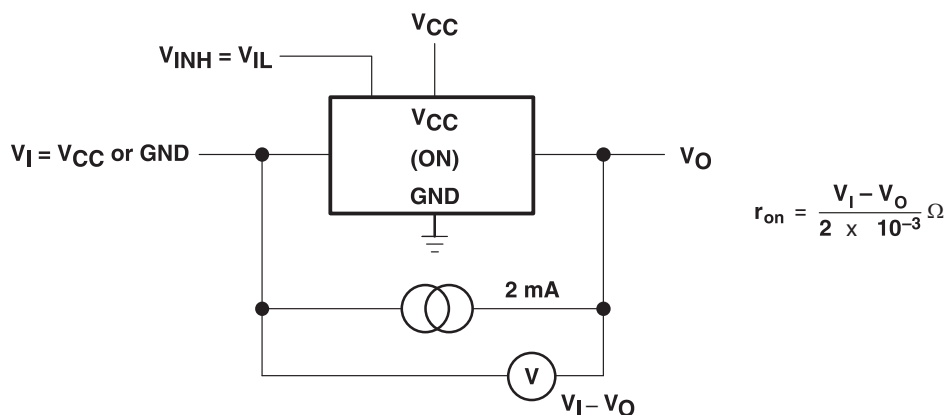


Figure 1. On-State Resistance Test Circuit

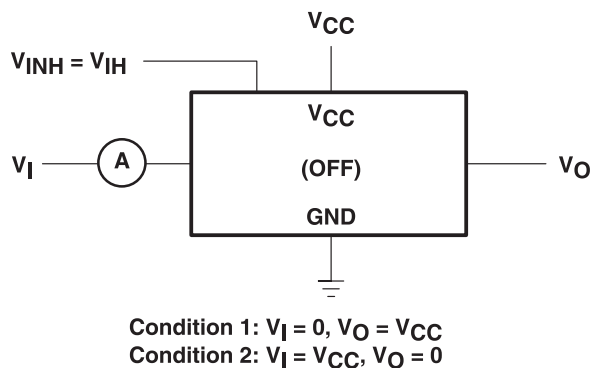


Figure 2. Off-State Switch Leakage-Current Test Circuit

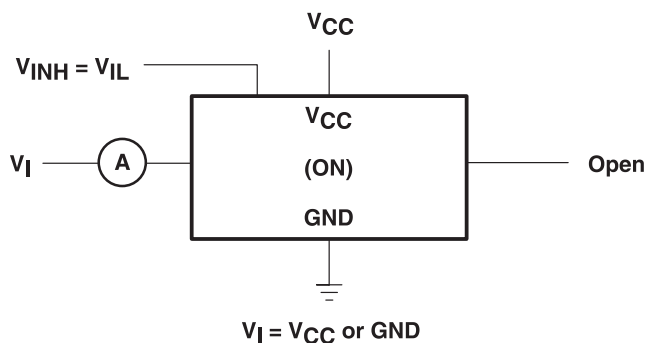


Figure 3. On-State Switch Leakage-Current Test Circuit

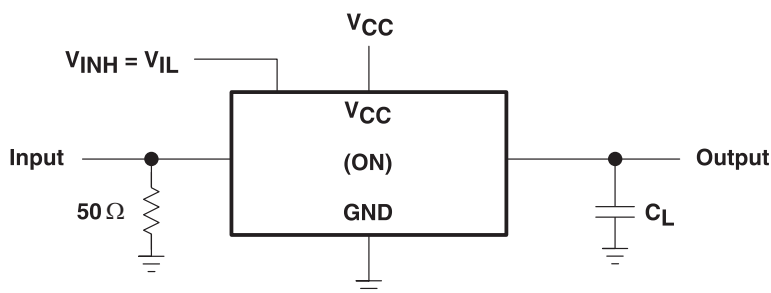
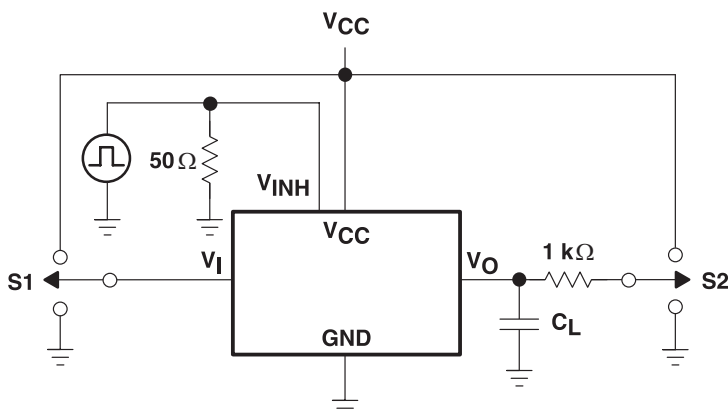


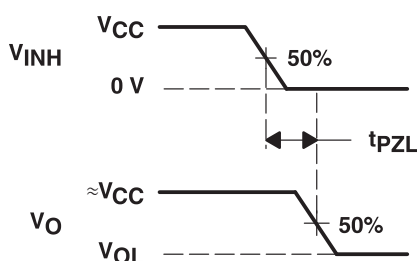
Figure 4. Propagation Delay Time, Signal Input to Signal Output

# PARAMETER MEASUREMENT INFORMATION (continued)

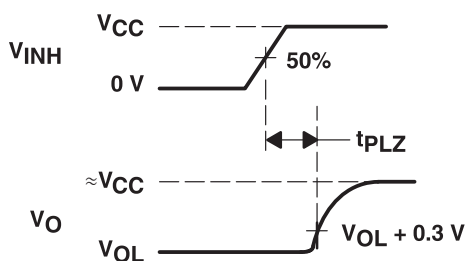
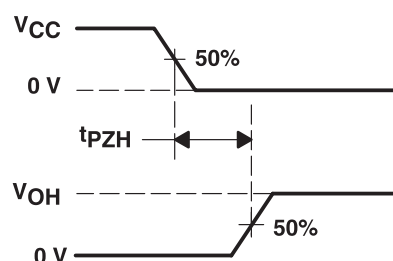


TEST	S1	S2
$t_{PLZ}/t_{PZL}$	GND	$V_{CC}$
$t_{PHZ}/t_{PZH}$	$V_{CC}$	GND

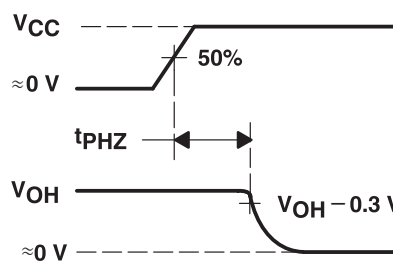
TEST CIRCUIT



( $t_{PZL}$ ,  $t_{PZH}$ )

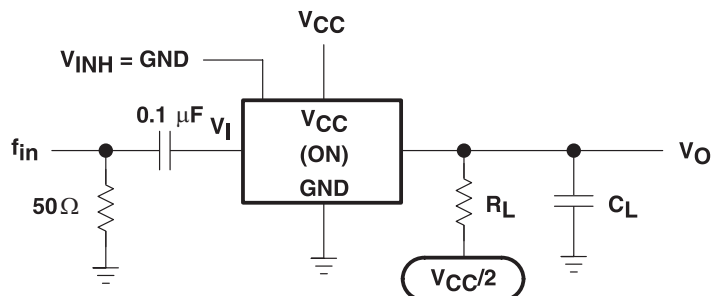


( $t_{PZL}$ ,  $t_{PZH}$ )



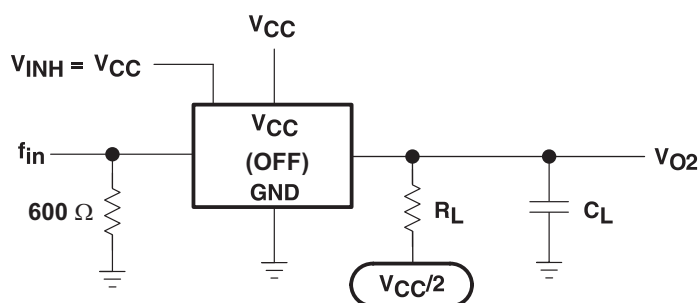
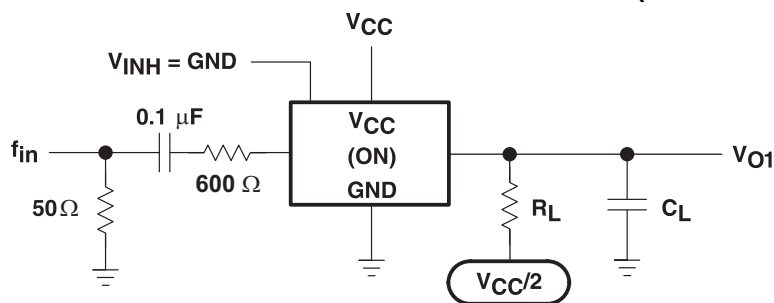
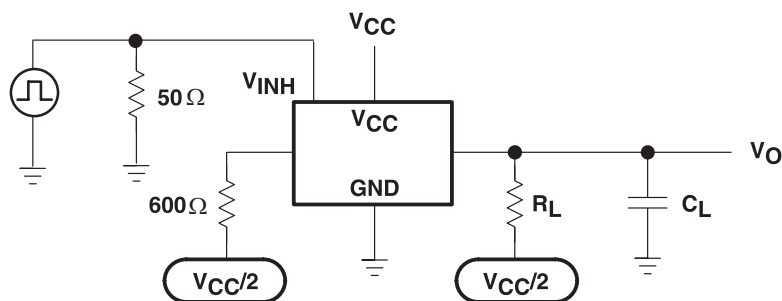
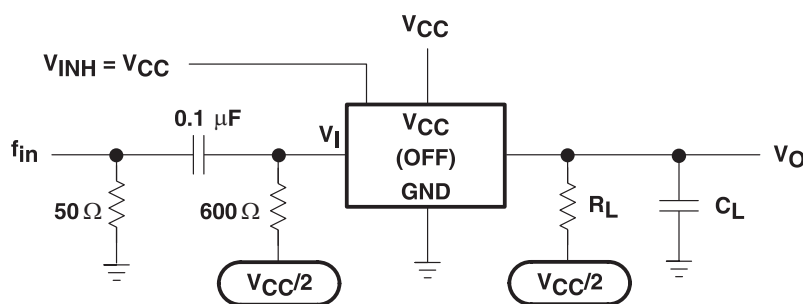
VOLTAGE WAVEFORMS

Figure 5. Switching Time ( $t_{PZL}$ ,  $t_{PLZ}$ ,  $t_{PZH}$ ,  $t_{PHZ}$ ), Control to Signal Output



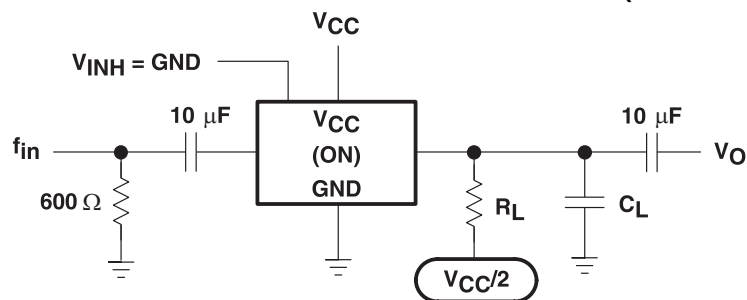
NOTE A:  $f_{in}$  is a sine wave.

Figure 6. Frequency Response (Switch On)

**PARAMETER MEASUREMENT INFORMATION (continued)****Figure 7. Crosstalk Between Any Two Switches****Figure 8. Crosstalk Between Control Input and Switch Output****Figure 9. Feedthrough Attenuation (Switch Off)**



**PARAMETER MEASUREMENT INFORMATION (continued)**



**Figure 10. Sine-Wave Distortion**

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CLV4053ATPWRG4Q1	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4053AQ	<a href="#">Samples</a>
SN74LV4053AQPWRQ1	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	4053AQ1	<a href="#">Samples</a>
SN74LV4053ATDRQ1	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4053AQ	<a href="#">Samples</a>
SN74LV4053ATPWRQ1	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4053AQ	<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.

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

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

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

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

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

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

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

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

**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 SN74LV4053A-Q1 :**

- Catalog: [SN74LV4053A](#)
- Enhanced Product: [SN74LV4053A-EP](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

## 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
CLV4053ATPWRG4Q1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV4053AQPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV4053ATPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CLV4053ATPWRG4Q1	TSSOP	PW	16	2000	367.0	367.0	35.0
SN74LV4053AQPWRQ1	TSSOP	PW	16	2000	853.0	449.0	35.0
SN74LV4053ATPWRQ1	TSSOP	PW	16	2000	853.0	449.0	35.0

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



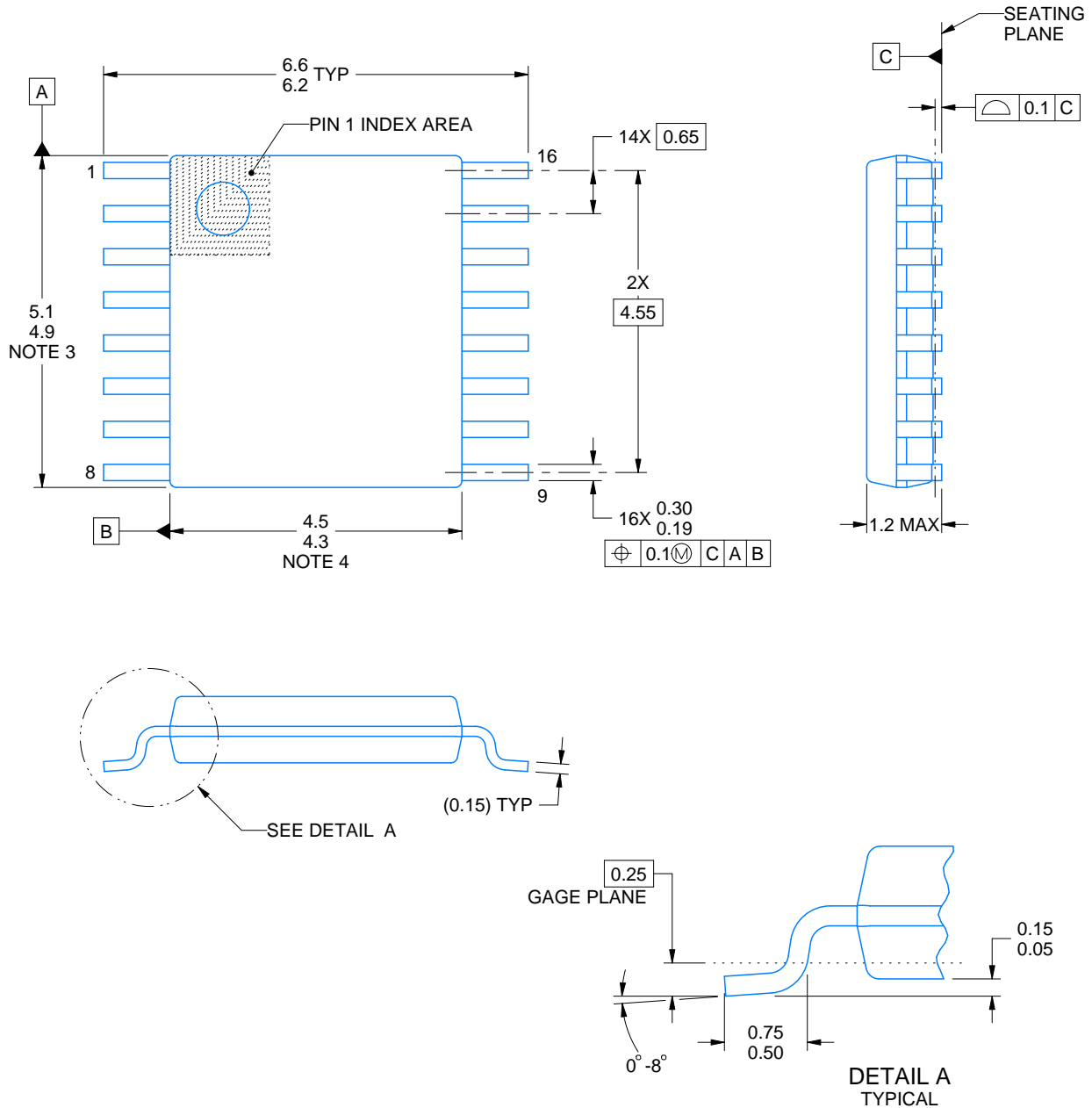
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



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



4220204/A 02/2017

## 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. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.



# EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

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

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220204/A 02/2017

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.

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