

SN74LV4053A-EP

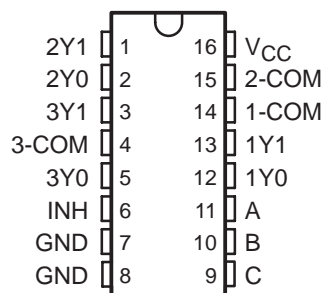
TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

- **Controlled Baseline**
 - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –40°C to 105°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **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**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **ESD Protection Exceeds JESD 22**
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

D OR PW PACKAGE
(TOP VIEW)



description/ordering information

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

T_A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 105°C	SOIC – D	Tape and reel	SN74LV4053ATDREP	LV4053ATEP
	TSSOP – PW	Tape and reel	SN74LV4053ATPWREP	L4053EP

‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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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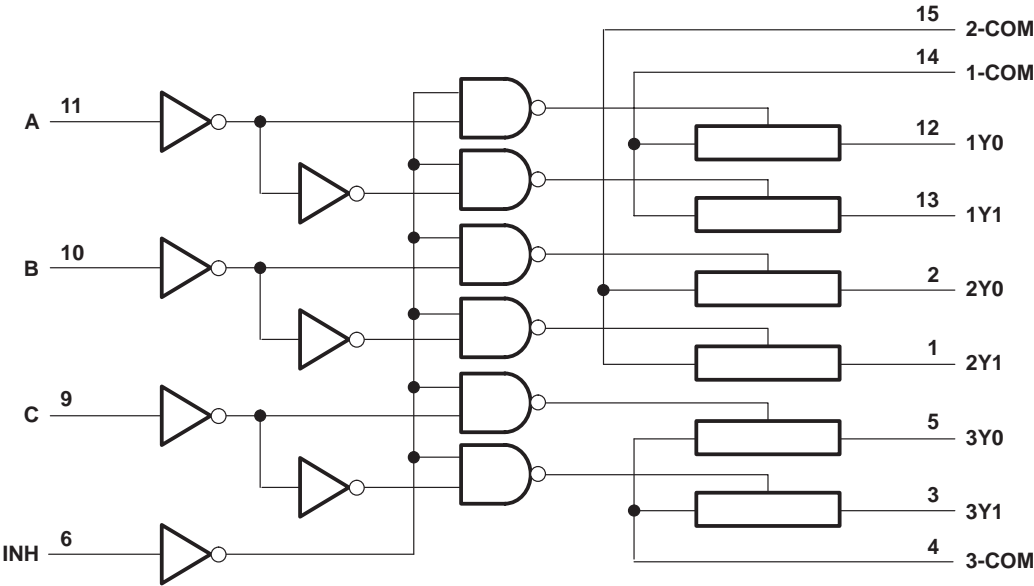
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FUNCTION TABLE

INPUTS				ON CHANNELS
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

logic diagram (positive logic)



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

Supply voltage range, V_{CC}	–0.5 V to 7.0 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7.0 V
Switch I/O voltage range, V_{IO} (see Notes 1 and 2)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–20 mA
I/O diode current, I_{IOK} ($V_{IO} < 0$)	–50 mA
Switch through current, I_T ($V_{IO} = 0$ to V_{CC})	±25 mA
Continuous current through V_{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 3): D package	73°C/W
PW package	108°C/W
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. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. This value is limited to 5.5 V maximum.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		2 [‡]	5.5	V
V_{IH}	High-level input voltage, control inputs	$V_{CC} = 2$ V	1.5		V
		$V_{CC} = 2.3$ V to 2.7 V	$V_{CC} \times 0.7$		
		$V_{CC} = 3$ V to 3.6 V	$V_{CC} \times 0.7$		
		$V_{CC} = 4.5$ V to 5.5 V	$V_{CC} \times 0.7$		
V_{IL}	Low-level input voltage, control inputs	$V_{CC} = 2$ V		0.5	V
		$V_{CC} = 2.3$ V to 2.7 V		$V_{CC} \times 0.3$	
		$V_{CC} = 3$ V to 3.6 V		$V_{CC} \times 0.3$	
		$V_{CC} = 4.5$ V to 5.5 V		$V_{CC} \times 0.3$	
V_I	Control input voltage		0	5.5	V
V_{IO}	Input/output voltage		0	V_{CC}	V
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 2.3$ V to 2.7 V		200	ns/V
		$V_{CC} = 3$ V to 3.6 V		100	
		$V_{CC} = 4.5$ V to 5.5 V		20	
T_A	Operating free-air temperature		–40	105	°C

[‡] 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.

NOTE 4: 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.



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

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			MIN	MAX	UNIT
			MIN	TYP	MAX			
r _{on} On-state switch resistance	I _T = 2 mA, V _I = V _{CC} or GND, V _{INH} = V _{IL} , (see Figure 1)	2.3 V		41	180		225	Ω
		3 V		30	150		190	
		4.5 V		23	75		100	
r _{on(p)} Peak on-state resistance	I _T = 2 mA, V _I = V _{CC} to GND, V _{INH} = V _{IL}	2.3 V		139	500		600	Ω
		3 V		63	180		225	
		4.5 V		35	100		125	
Δr _{on} Difference in on-state resistance between switches	I _T = 2 mA, V _I = V _{CC} to GND, V _{INH} = V _{IL}	2.3 V		2	30		40	Ω
		3 V		1.6	20		30	
		4.5 V		1.3	15		20	
I _I Control input current	V _I = 5.5 V or GND	0 to 5.5 V			±0.1		±1	μA
I _{S(off)} Off-state switch leakage current	V _I = V _{CC} and V _O = GND, or V _I = GND and V _O = V _{CC} , V _{INH} = V _{IH} , (see Figure 2)	5.5 V			±0.1		±1	μA
I _{S(on)} On-state switch leakage current	V _I = V _{CC} or GND, V _{INH} = V _{IH} (see Figure 3)	5.5 V			±0.1		±1	μA
I _{CC} Supply current	V _I = V _{CC} or GND	5.5 V					20	μA
C _{IC} Control input capacitance				2				pF
C _{IS} Common terminal capacitance				8.2				pF
C _{OS} Switch terminal capacitance				5.6				pF
C _F Feedthrough capacitance				0.5				pF

switching characteristics over recommended operating free-air temperature range, V_{CC} = 2.5 V ± 0.2 V (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T _A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t _{PLH} t _{PHL} Propagation delay time	COM or Y _n	Y _n or COM	C _L = 15 pF, (see Figure 4)		2.5	10		16	ns
t _{PZH} t _{PZL} Enable delay time	INH	COM or Y _n	C _L = 15 pF, (see Figure 5)		7.6	18		23	ns
t _{PHZ} t _{PLZ} Disable delay time	INH	COM or Y _n	C _L = 15 pF, (see Figure 5)		7.7	18		23	ns
t _{PLH} t _{PHL} Propagation delay time	COM or Y _n	Y _n or COM	C _L = 50 pF, (see Figure 4)		4.4	12		18	ns
t _{PZH} t _{PZL} Enable delay time	INH	COM or Y _n	C _L = 50 pF, (see Figure 5)		8.8	28		35	ns
t _{PHZ} t _{PLZ} Disable delay time	INH	COM or Y _n	C _L = 50 pF, (see Figure 5)		11.7	28		35	ns



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**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T _A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t _{PLH} t _{PHL}	Propagation delay time	COM or Y _n	Y _n or COM (see Figure 4)	C _L = 15 pF,	1.6	6		10	ns
t _{PZH} t _{PZL}	Enable delay time	INH	COM or Y _n (see Figure 5)	C _L = 15 pF,	5.3	12		15	ns
t _{PHZ} t _{PLZ}	Disable delay time	INH	COM or Y _n (see Figure 5)	C _L = 15 pF,	6.1	12		15	ns
t _{PLH} t _{PHL}	Propagation delay time	COM or Y _n	Y _n or COM (see Figure 4)	C _L = 50 pF,	2.9	9		12	ns
t _{PZH} t _{PZL}	Enable delay time	INH	COM or Y _n (see Figure 5)	C _L = 50 pF,	6.1	20		25	ns
t _{PHZ} t _{PLZ}	Disable delay time	INH	COM or Y _n (see Figure 5)	C _L = 50 pF,	8.9	20		25	ns

**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 5 V ± 0.5 V (unless otherwise noted)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T _A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t _{PLH} t _{PHL}	Propagation delay time	COM or Y _n	Y _n or COM (see Figure 4)	C _L = 15 pF,	0.9	4		7	ns
t _{PZH} t _{PZL}	Enable delay time	INH	COM or Y _n (see Figure 5)	C _L = 15 pF,	3.8	8		10	ns
t _{PHZ} t _{PLZ}	Disable delay time	INH	COM or Y _n (see Figure 5)	C _L = 15 pF,	4.6	8		10	ns
t _{PLH} t _{PHL}	Propagation delay time	COM or Y _n	Y _n or COM (see Figure 4)	C _L = 50 pF,	1.8	6		8	ns
t _{PZH} t _{PZL}	Enable delay time	INH	COM or Y _n (see Figure 5)	C _L = 50 pF,	4.3	14		18	ns
t _{PHZ} t _{PLZ}	Disable delay time	INH	COM or Y _n (see Figure 5)	C _L = 50 pF,	6.3	14		18	ns



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analog switch characteristics

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V _{CC}	T _A = 25°C			UNIT
					MIN	TYP	MAX	
Frequency response (switch on)	COM or Y _n	Y _n or COM	C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (sine wave) (see Note 5 and Figure 6)	2.3 V		30		MHz
				3 V		35		
				4.5 V		50		
Crosstalk (between any switches)	COM or Y _n	Y _n or COM	C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (sine wave) (see Note 6 and Figure 7)	2.3 V		–45		dB
				3 V		–45		
				4.5 V		–45		
Crosstalk (control input to signal output)	INH	COM or Y _n	C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (square wave) (see Figure 8)	2.3 V		20		mV
				3 V		35		
				4.5 V		65		
Feedthrough attenuation (switch off)	COM or Y _n	Y _n or COM	C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (see Note 6 and Figure 9)	2.3 V		–45		dB
				3 V		–45		
				4.5 V		–45		
Sine-wave distortion	COM or Y _n	Y _n or COM	C _L = 50 pF, R _L = 10 kΩ, f _{in} = 1 kHz (sine wave) (see Figure 10)	V _I = 2 V _{p-p}	2.3 V		0.1	%
				V _I = 2.5 V _{p-p}	3 V		0.1	
				V _I = 4 V _{p-p}	4.5 V		0.1	

NOTES: 5. Adjust f_{in} voltage to obtain 0-dBm output. Increase f_{in} frequency until dB meter reads –3 dB.
6. Adjust f_{in} voltage to obtain 0-dBm input.

operating characteristics, V_{CC} = 3.3 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C _{pd}	Power dissipation capacitance	C _L = 50 pF, f = 10 MHz	5.3	pF

PARAMETER MEASUREMENT INFORMATION

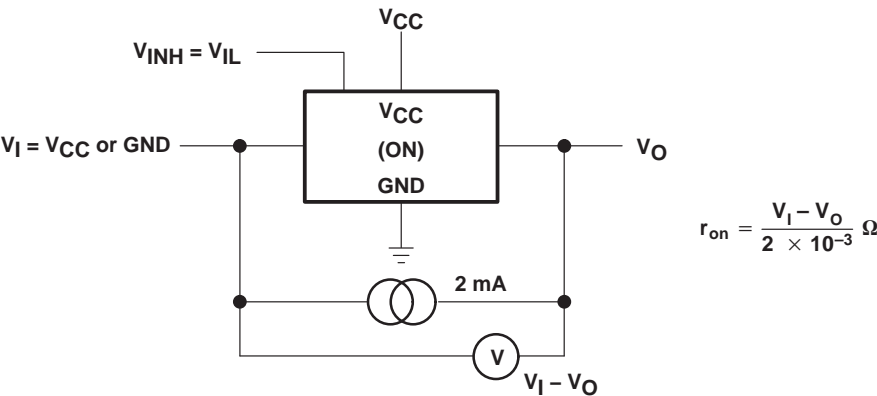


Figure 1. On-State Resistance Test Circuit

PARAMETER MEASUREMENT INFORMATION

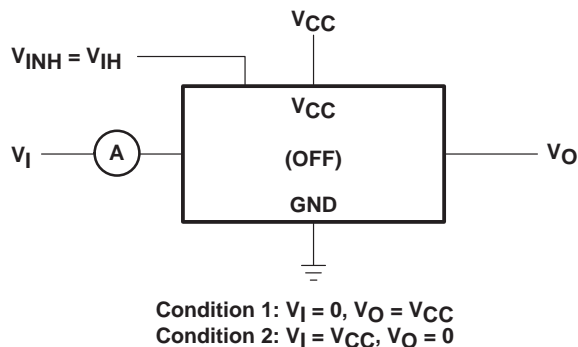


Figure 2. Off-State Switch Leakage-Current Test Circuit

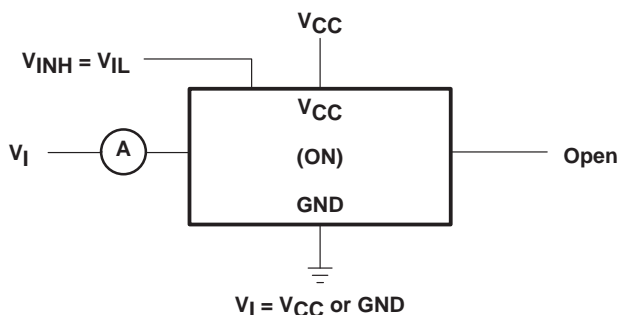


Figure 3. On-State Switch Leakage-Current Test Circuit

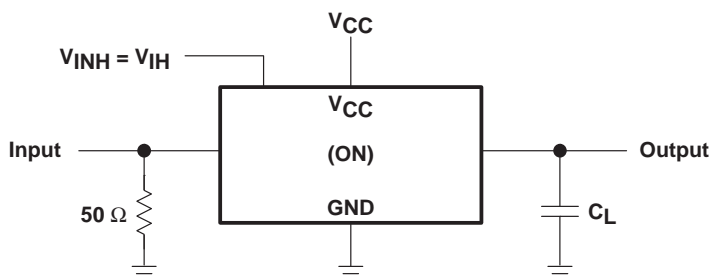


Figure 4. Propagation Delay Time, Signal Input to Signal Output

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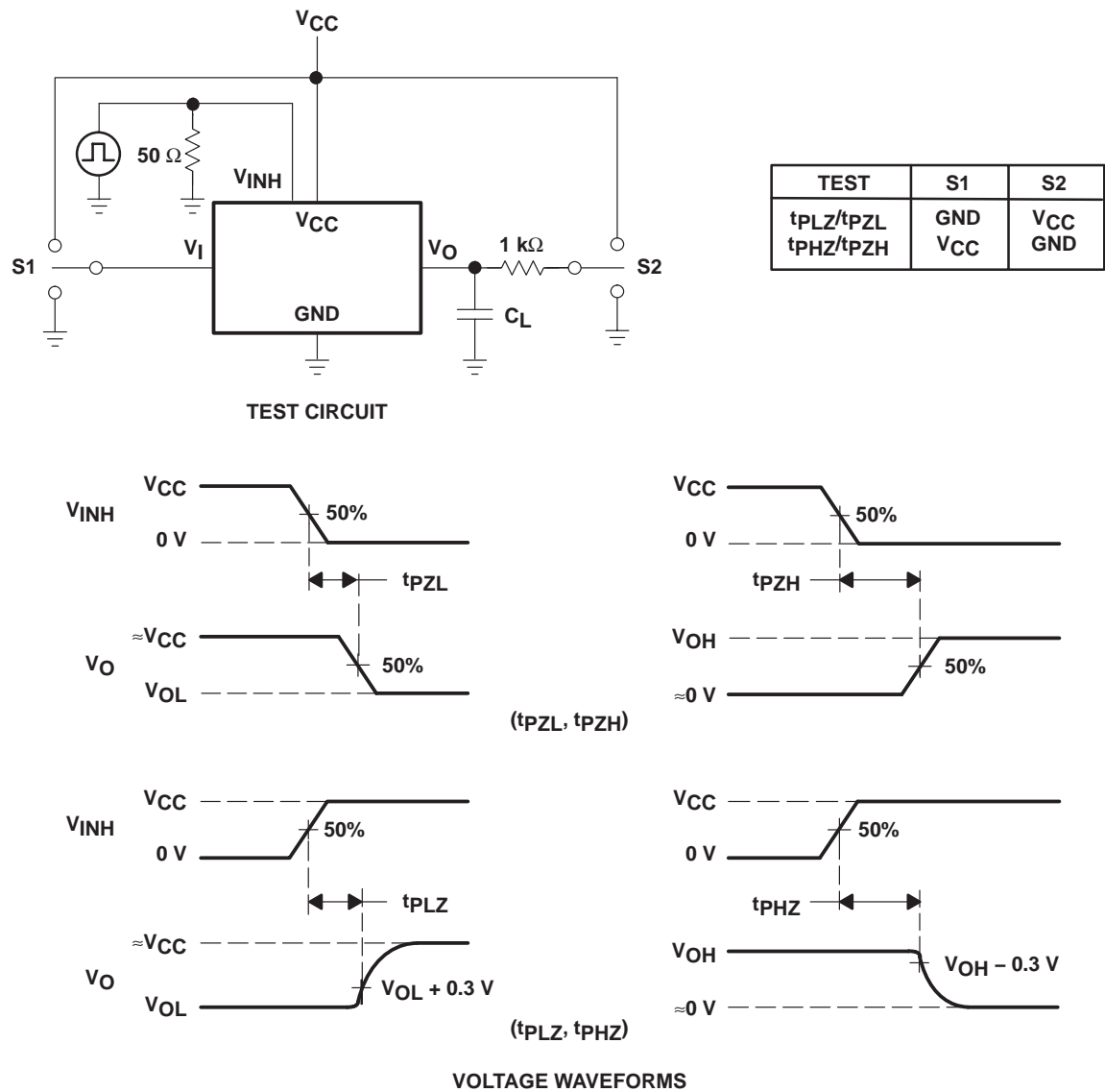


Figure 5. Switching Time (tpZL, tpLZ, tpZH, tpHZ), Control to Signal Output

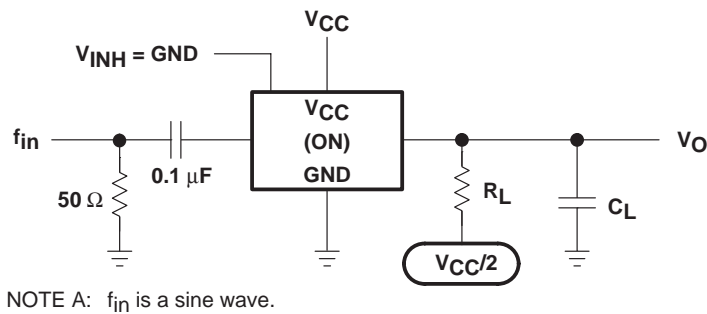


Figure 6. Frequency Response (Switch On)

PARAMETER MEASUREMENT INFORMATION

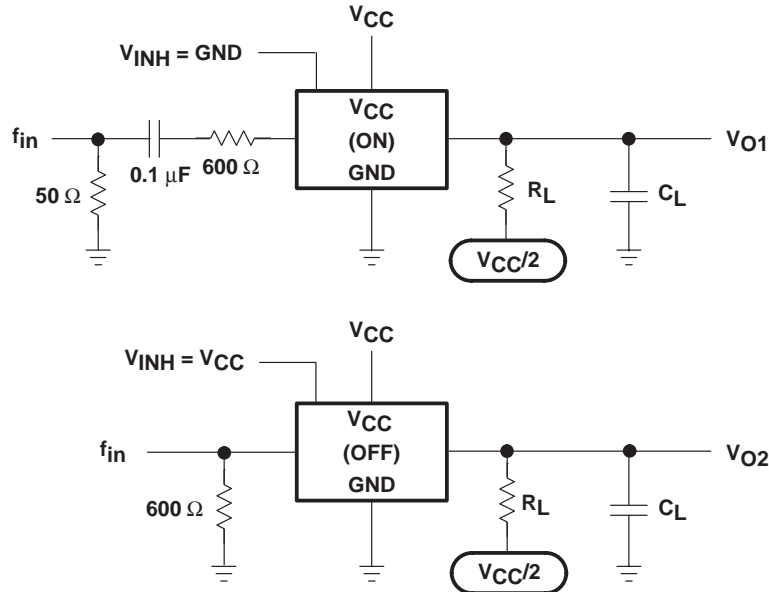


Figure 7. Crosstalk Between Any Two Switches

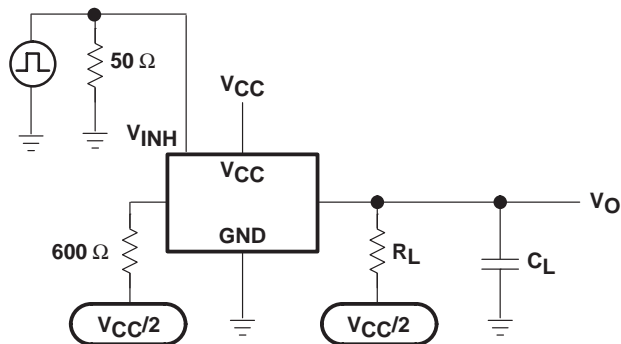


Figure 8. Crosstalk Between Control Input and Switch Output

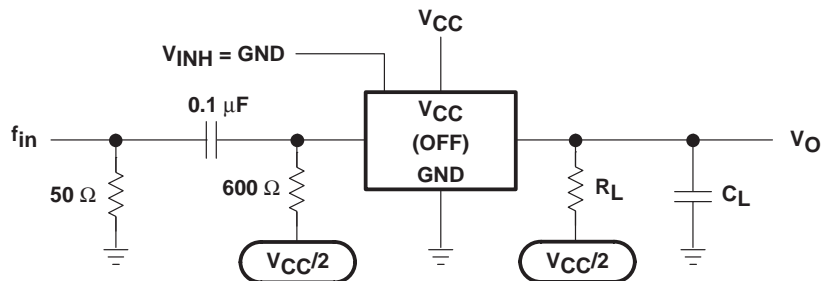


Figure 9. Feedthrough Attenuation (Switch Off)

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PARAMETER MEASUREMENT INFORMATION

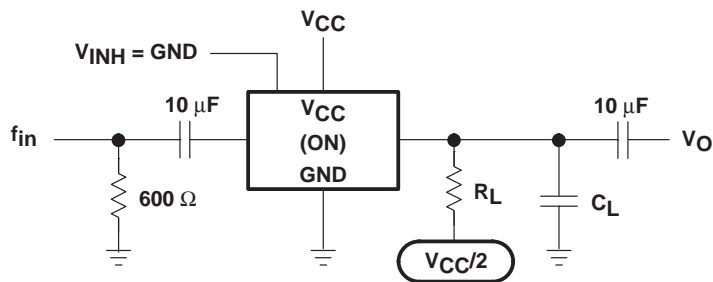


Figure 10. Sine-Wave Distortion

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74LV4053ATDREP	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4053ATPWREP	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/03666-01XE	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/03666-01YE	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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.

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OTHER QUALIFIED VERSIONS OF SN74LV4053A-EP :

- Catalog: [SN74LV4053A](#)
- Automotive: [SN74LV4053A-Q1](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

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
SN74LV4053ATDREP	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74LV4053ATPWREP	TSSOP	PW	16	2000	330.0	12.4	7.0	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)
SN74LV4053ATDREP	SOIC	D	16	2500	333.2	345.9	28.6
SN74LV4053ATPWREP	TSSOP	PW	16	2000	346.0	346.0	29.0

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