

# SN74LV4053A-EP

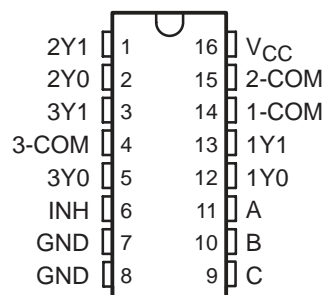
## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULPLEXER

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](http://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.



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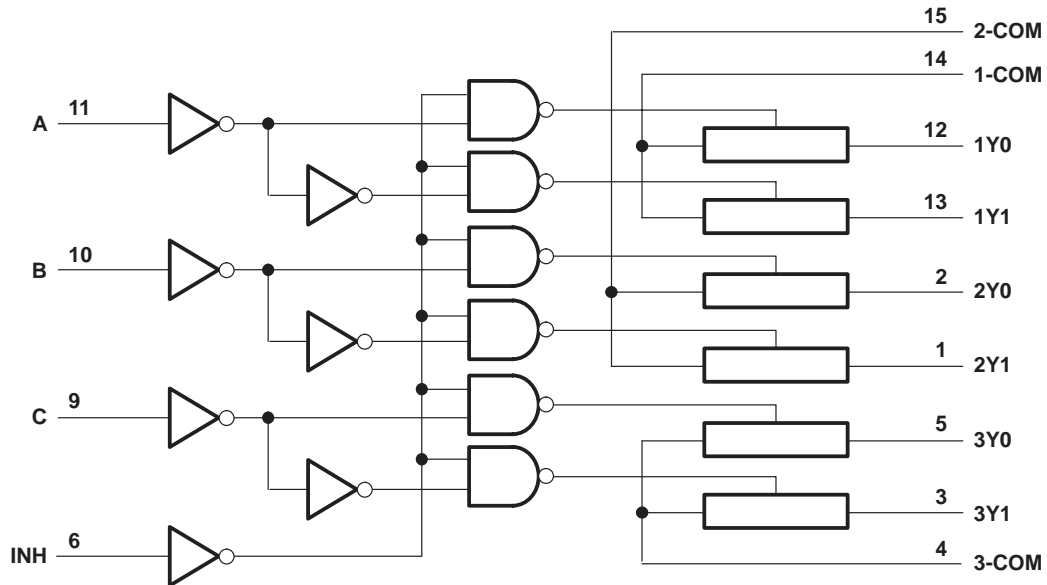
## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

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)



# SN74LV4053A-EP

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

### 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, $\theta_{JA}$ (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.



# SN74LV4053A-EP

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

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

switching characteristics over recommended operating free-air temperature range,  
V<sub>CC</sub> = 2.5 V ± 0.2 V (unless otherwise noted)

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



# SN74LV4053A-EP

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay time	COM or Y <sub>n</sub>	Y <sub>n</sub> or COM	C <sub>L</sub> = 15 pF, (see Figure 4)	1.6	6		10	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Enable delay time	INH	COM or Y <sub>n</sub>	C <sub>L</sub> = 15 pF, (see Figure 5)	5.3	12		15	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Disable delay time	INH	COM or Y <sub>n</sub>	C <sub>L</sub> = 15 pF, (see Figure 5)	6.1	12		15	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay time	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	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Enable delay time	INH	COM or Y <sub>n</sub>	C <sub>L</sub> = 50 pF, (see Figure 5)	6.1	20		25	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Disable delay time	INH	COM or Y <sub>n</sub>	C <sub>L</sub> = 50 pF, (see Figure 5)	8.9	20		25	ns

**switching characteristics over recommended operating free-air temperature range,  
V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted)**

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



# SN74LV4053A-EP

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

### analog switch characteristics

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			UNIT
					MIN	TYP	MAX	
Frequency response (switch on)	COM or Y <sub>n</sub>	Y <sub>n</sub> or COM	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = 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 <sub>n</sub>	Y <sub>n</sub> or COM	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = 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 <sub>n</sub>	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = 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 <sub>n</sub>	Y <sub>n</sub> or COM	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 600 Ω, f <sub>in</sub> = 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 <sub>n</sub>	Y <sub>n</sub> or COM	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 10 kΩ, f <sub>in</sub> = 1 kHz (sine wave) (see Figure 10)	V <sub>I</sub> = 2 V <sub>p-p</sub>	2.3 V	0.1		%
				V <sub>I</sub> = 2.5 V <sub>p-p</sub>	3 V	0.1		
				V <sub>I</sub> = 4 V <sub>p-p</sub>	4.5 V	0.1		

NOTES: 5. Adjust f<sub>in</sub> voltage to obtain 0-dBm output. Increase f<sub>in</sub> frequency until dB meter reads -3 dB.  
6. Adjust f<sub>in</sub> voltage to obtain 0-dBm input.

### operating characteristics, V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C

PARAMETER	TEST CONDITIONS	TYP	UNIT
C <sub>pd</sub> Power dissipation capacitance	C <sub>L</sub> = 50 pF, f = 10 MHz	5.3	pF

### PARAMETER MEASUREMENT INFORMATION

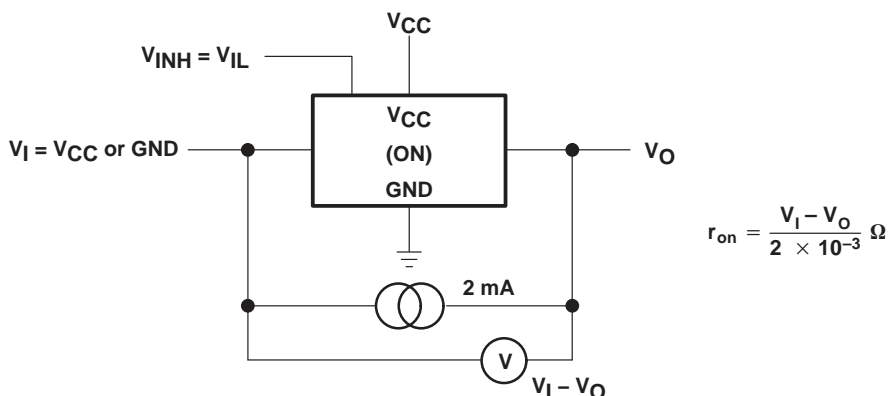
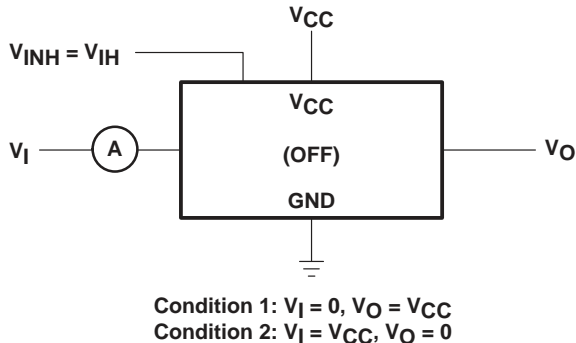
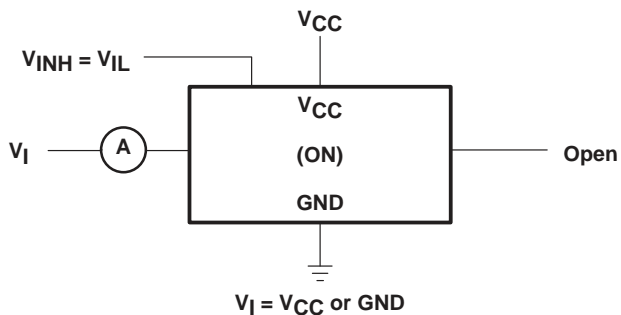


Figure 1. On-State Resistance Test Circuit

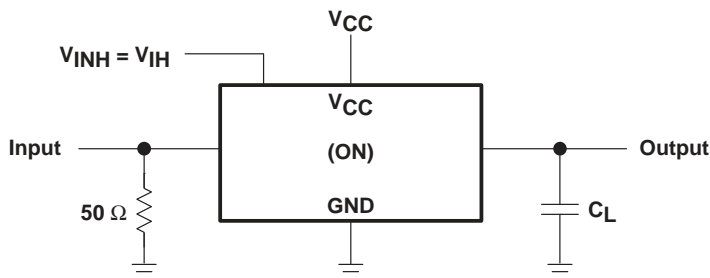
**PARAMETER MEASUREMENT INFORMATION**



**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**

# SN74LV4053A-EP TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

## PARAMETER MEASUREMENT INFORMATION

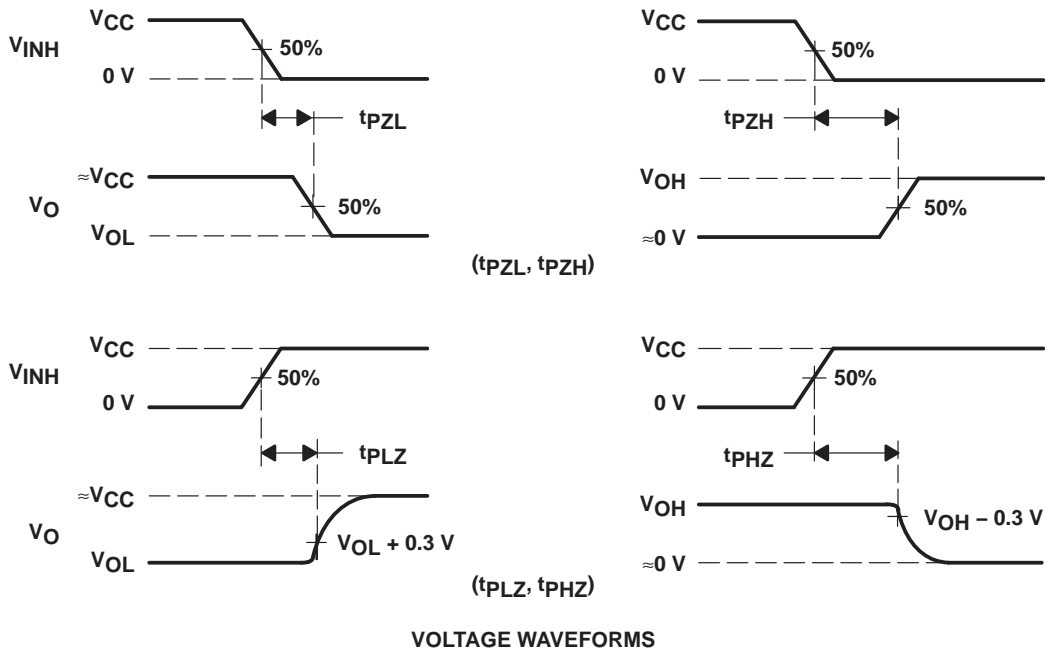
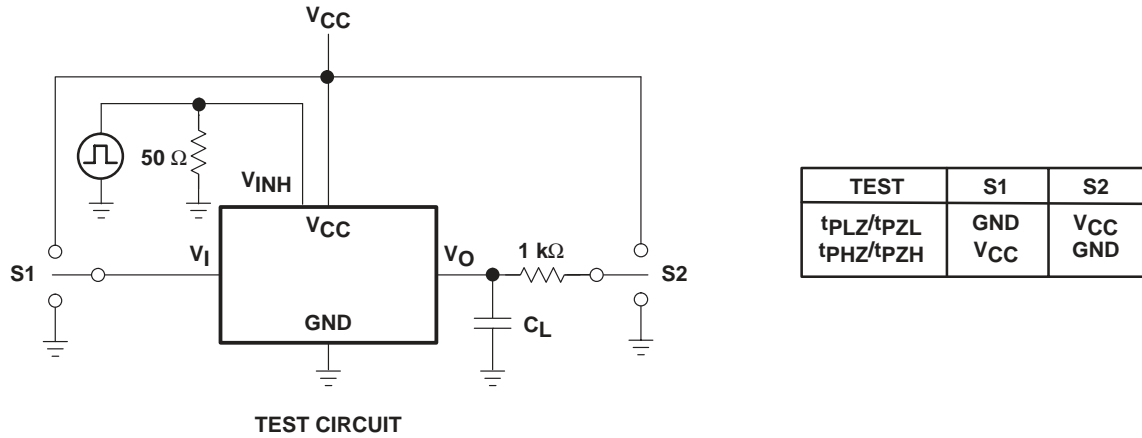
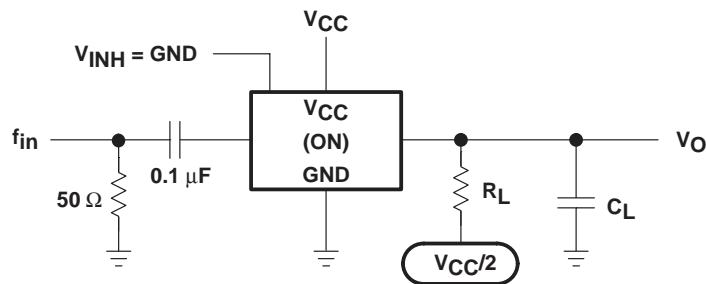


Figure 5. Switching Time ( $t_{PZL}$ ,  $t_{PLZ}$ ,  $t_{PZH}$ ,  $t_{PHZ}$ ), Control to Signal Output

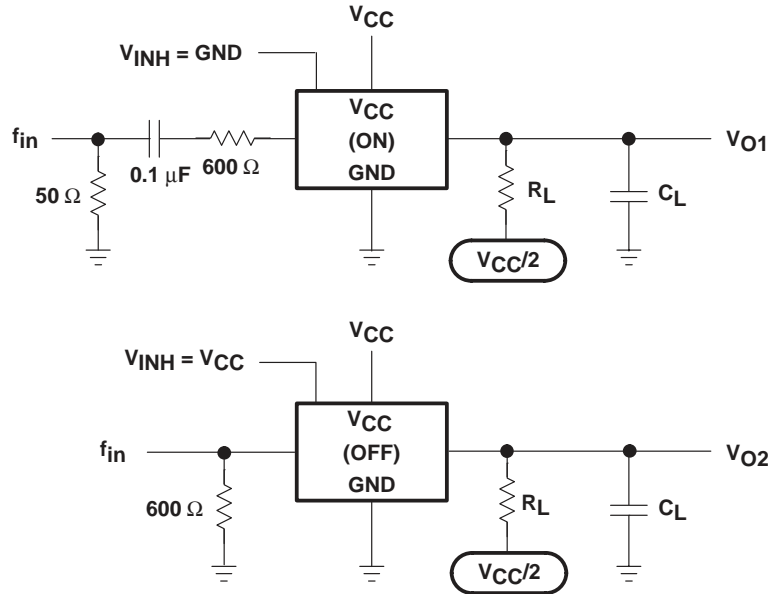


NOTE A:  $f_{in}$  is a sine wave.

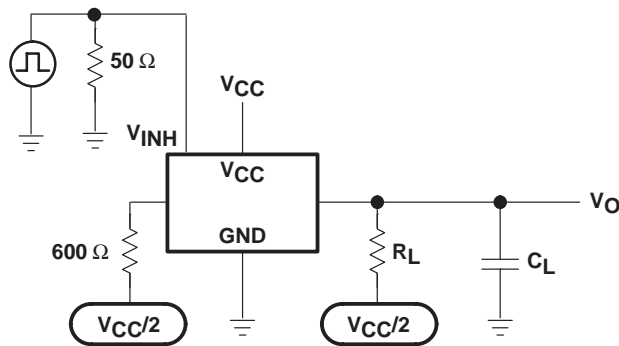
Figure 6. Frequency Response (Switch On)



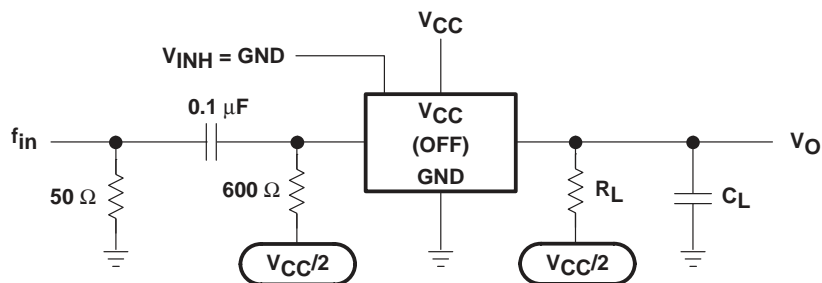
**PARAMETER MEASUREMENT INFORMATION**



**Figure 7. Crosstalk Between Any Two Switches**



**Figure 8. Crosstalk Between Control Input and Switch Output**



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

# SN74LV4053A-EP

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS503C – MAY 2003 – REVISED MAY 2004

### PARAMETER MEASUREMENT INFORMATION

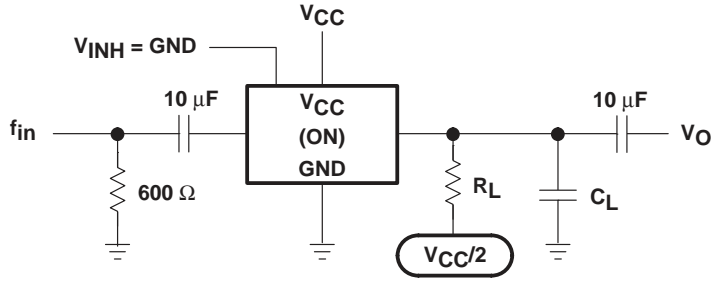


Figure 10. Sine-Wave Distortion

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LV4053ATPWREP	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4053EP	<a href="#">Samples</a>
V62/03666-01XE	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4053EP	<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) **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.

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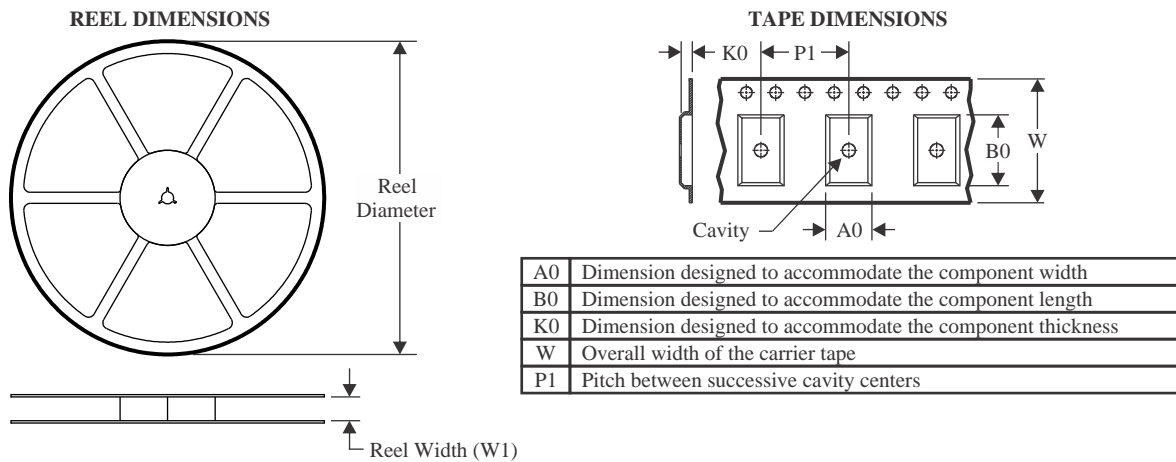
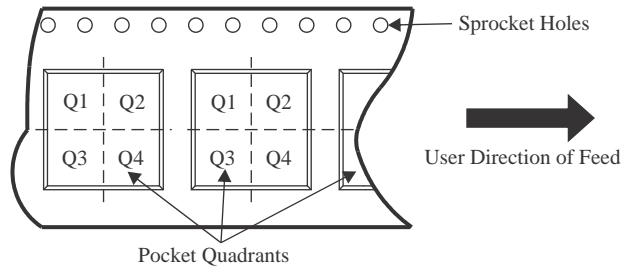
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**OTHER QUALIFIED VERSIONS OF SN74LV4053A-EP :**

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

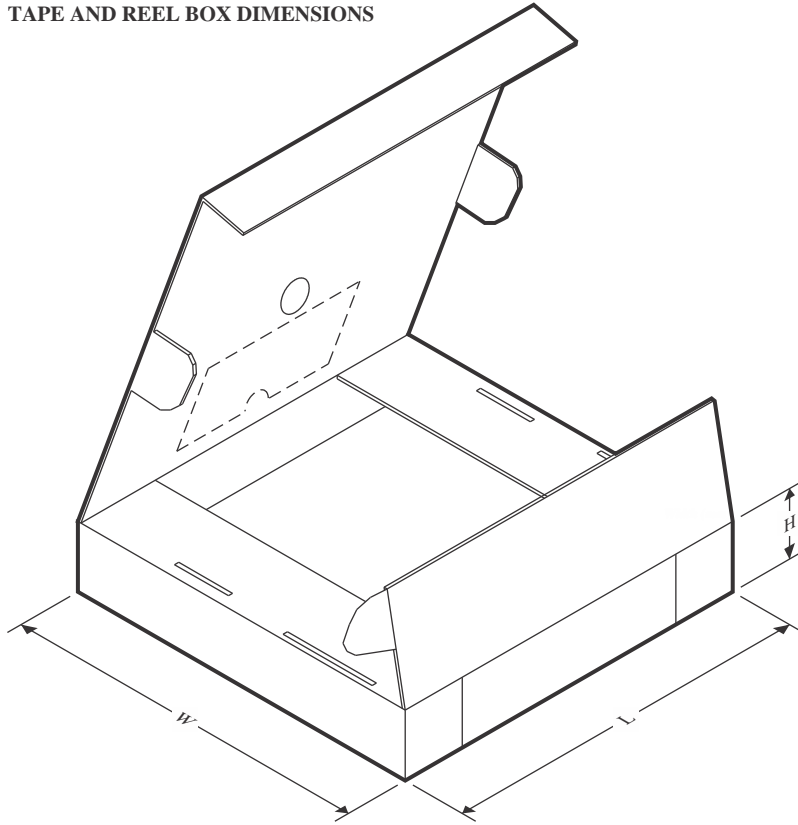
## NOTE: Qualified Version Definitions:

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

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


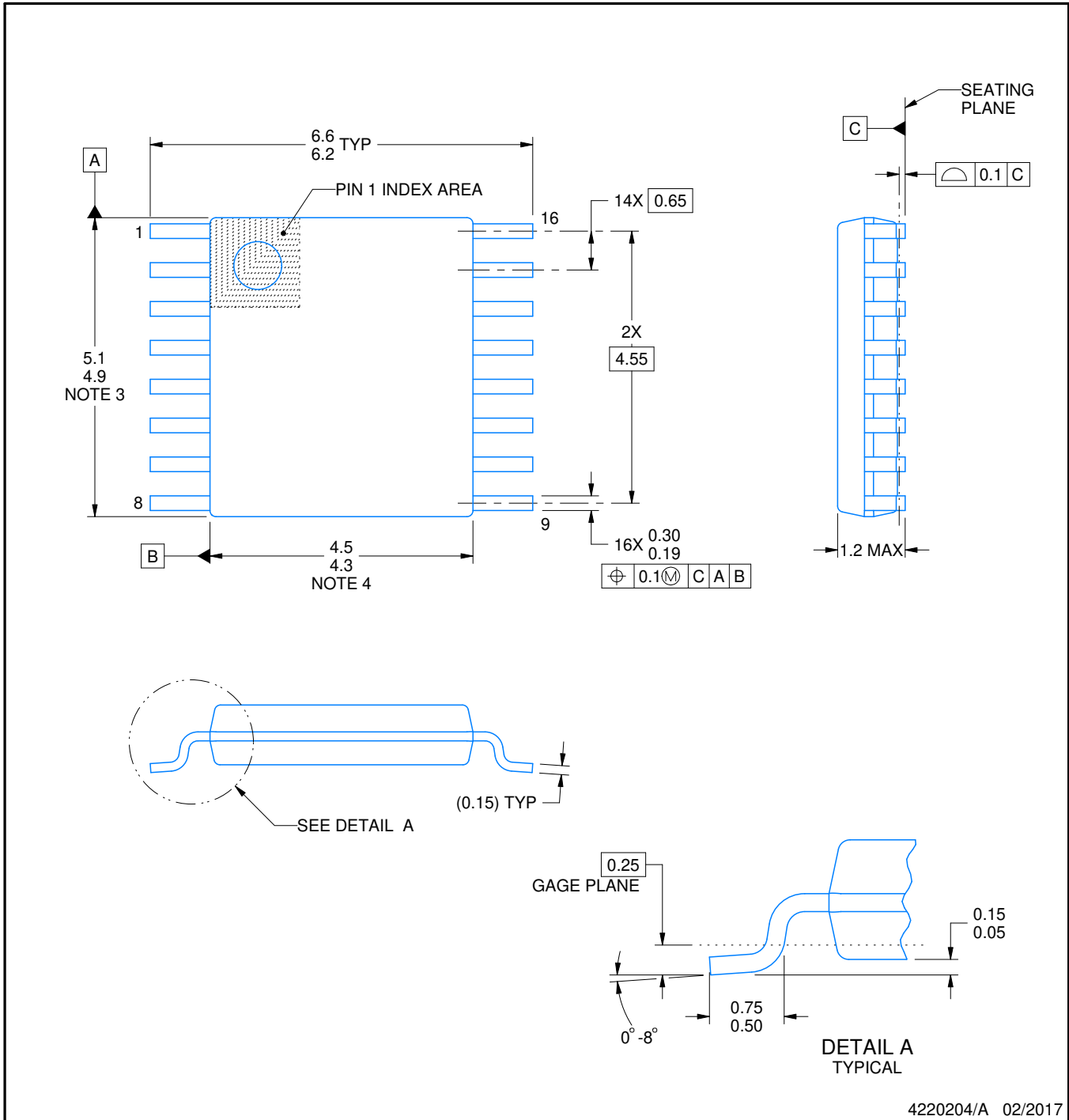
\*All dimensions are nominal

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
SN74LV4053ATPWREP	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)
SN74LV4053ATPWREP	TSSOP	PW	16	2000	356.0	356.0	35.0



4220204/A 02/2017

NOTES:

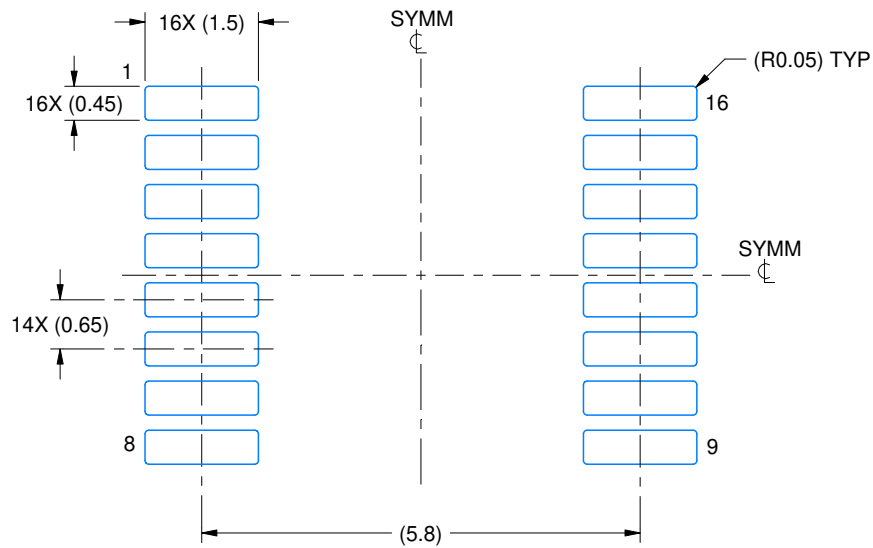
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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

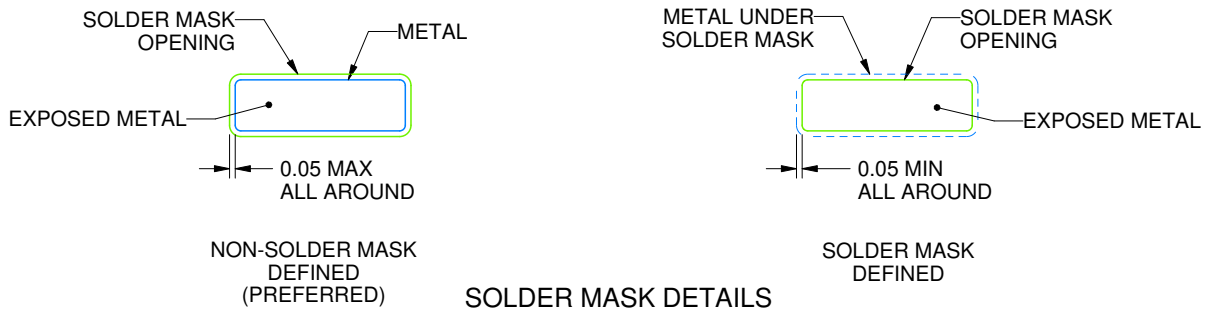
PW0016A

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.

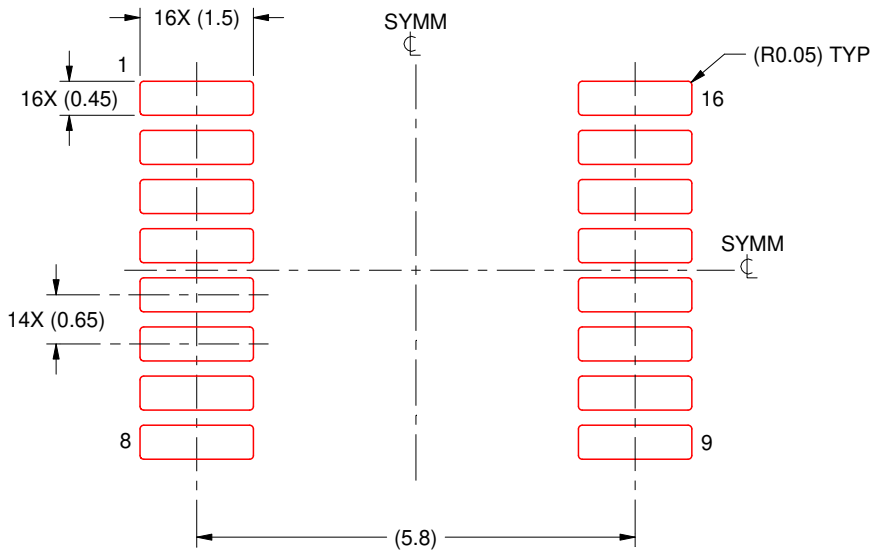


# EXAMPLE STENCIL DESIGN

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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