

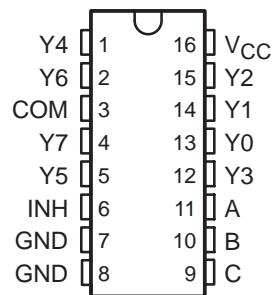
# SN74LV4051A-Q1

## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS520B – AUGUST 2003 – REVISED MAY 2004

- Qualification in Accordance With AEC-Q100†
- Qualified for Automotive Applications
- Customer-Specific Configuration Control Can Be Supported Along With Major-Change Approval
- 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 100 mA Per JESD 78, Class II

D, DW, OR PW PACKAGE  
(TOP VIEW)



† Contact factory for details. Q100 qualification data available on request.

### description/ordering information

This 8-channel CMOS analog multiplexer/demultiplexer is designed for 2-V to 5.5-V  $V_{CC}$  operation.

The SN74LV4051A 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 <sub>A</sub>	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 105°C	SOIC – D	Tape and reel	SN74LV4051ATDRQ1	L4051AQ
	SOIC – DW	Tape and reel	SN74LV4051ATDWRQ1	L4051AQ
	TSSOP – PW	Tape and reel	SN74LV4051ATPWRQ1	L4051AQ

‡ 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.

**TEXAS  
INSTRUMENTS**

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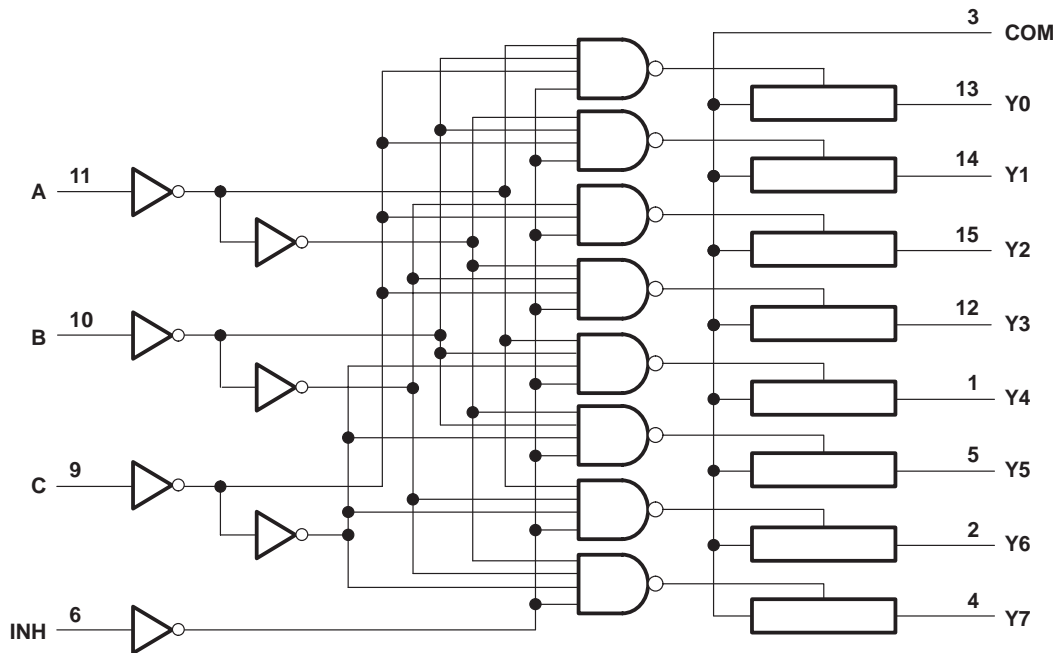
## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

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FUNCTION TABLE

INPUTS				ON CHANNEL
INH	C	B	A	
L	L	L	L	Y0
L	L	L	H	Y1
L	L	H	L	Y2
L	L	H	H	Y3
L	H	L	L	Y4
L	H	L	H	Y5
L	H	H	L	Y6
L	H	H	H	Y7
H	X	X	X	None

logic diagram (positive logic)



# SN74LV4051A-Q1

## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS520B – AUGUST 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 .....	95°C/W
DW package .....	75°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 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.



# SN74LV4051A-Q1

## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS520B – AUGUST 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		38	180		225	Ω
		3 V		30	150		190	
		4.5 V		22	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		113	500		600	Ω
		3 V		54	180		225	
		4.5 V		31	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		2.1	30		40	Ω
		3 V		1.4	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>IL</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	f = 10 MHz	3.3 V		2				pF
C <sub>IS</sub> Common terminal capacitance		3.3 V		23.4				pF
C <sub>OS</sub> Switch terminal capacitance		3.3 V		5.7				pF
C <sub>F</sub> Feedthrough capacitance		3.3 V		0.5				pF



# SN74LV4051A-Q1

## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

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**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> = 50 pF, (see Figure 4)	2.5	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)	5.5	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)	8.8	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> = 50 pF, (see Figure 4)	1.5	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	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)	6.2	14		18	ns

# SN74LV4051A-Q1

## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS520B – AUGUST 2003 – REVISED MAY 2004

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

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	20			MHz	
				3 V	25				
				4.5 V	35				
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 7)	2.3 V	20			mV	
				3 V	35				
				4.5 V	60				
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 8)	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 9)	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	5.9	pF

### PARAMETER MEASUREMENT INFORMATION

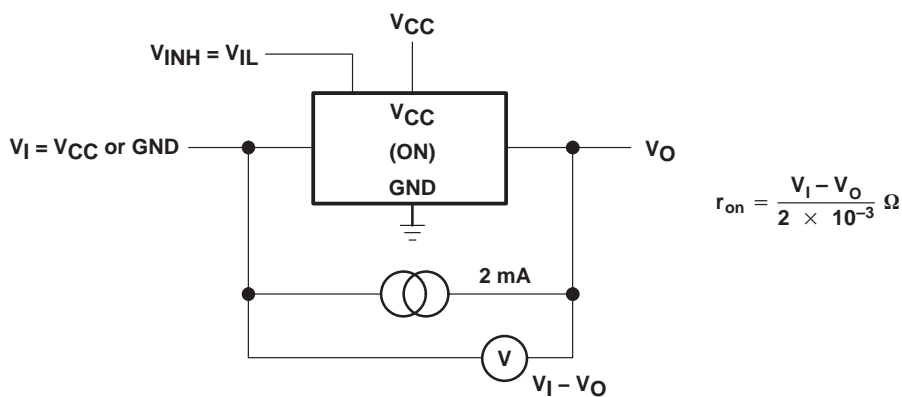
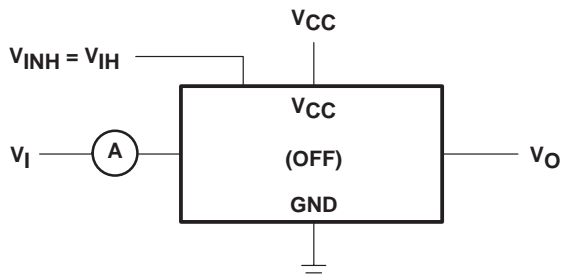


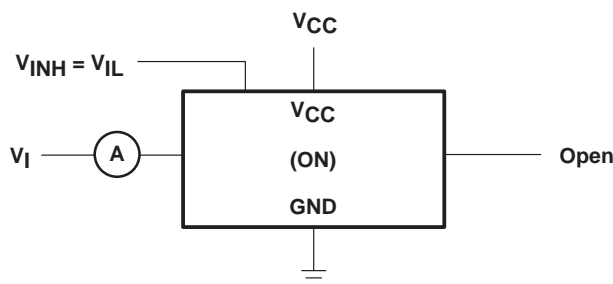
Figure 1. On-State Resistance Test Circuit

**PARAMETER MEASUREMENT INFORMATION**



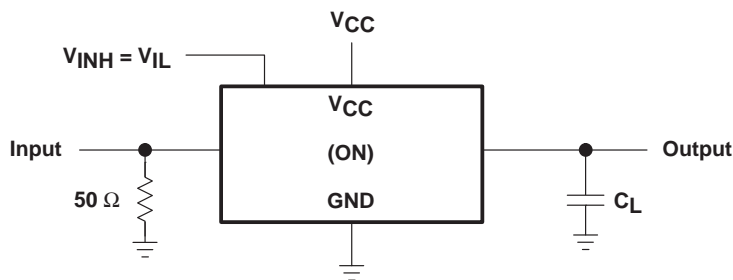
Condition 1:  $V_I = 0, V_O = V_{CC}$   
 Condition 2:  $V_I = V_{CC}, V_O = 0$

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



$V_I = V_{CC} \text{ or } GND$

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



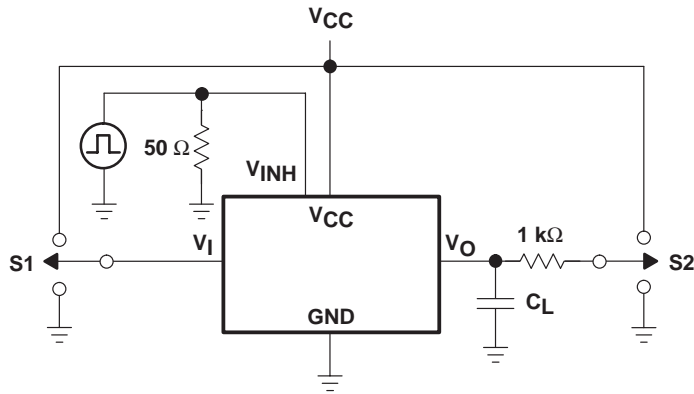
**Figure 4. Propagation Delay Time, Signal Input to Signal Output**

# SN74LV4051A-Q1

## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS520B – AUGUST 2003 – REVISED MAY 2004

### PARAMETER MEASUREMENT INFORMATION



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

TEST CIRCUIT

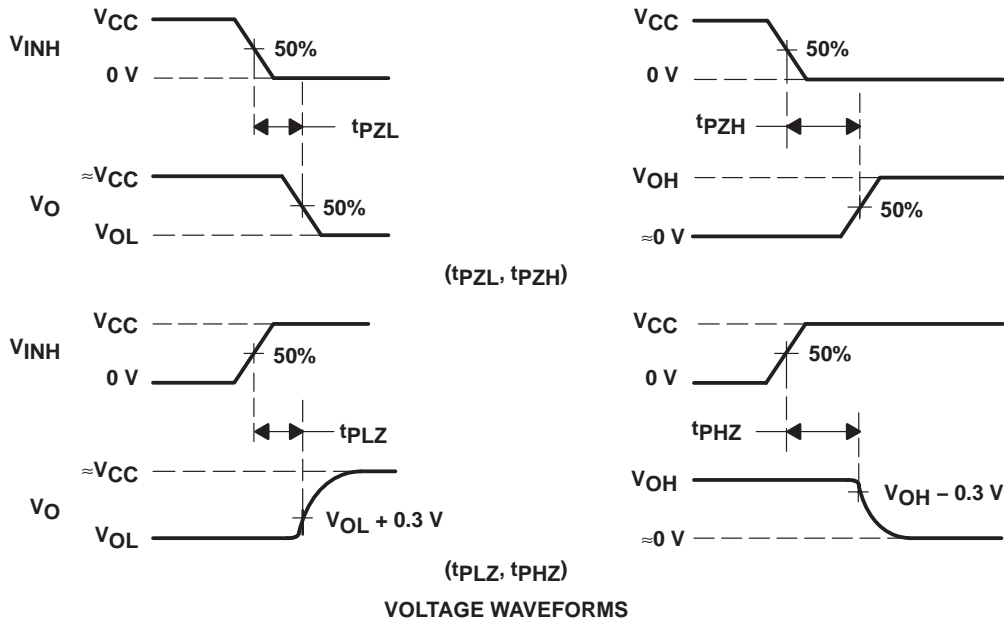
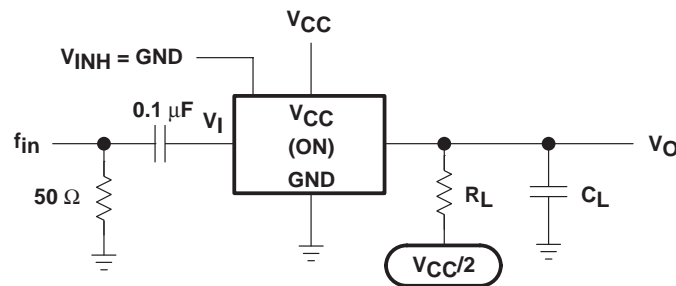


Figure 5. Switching Time (t<sub>PZL</sub>, t<sub>PLZ</sub>, t<sub>PZH</sub>, t<sub>PHZ</sub>), Control to Signal Output

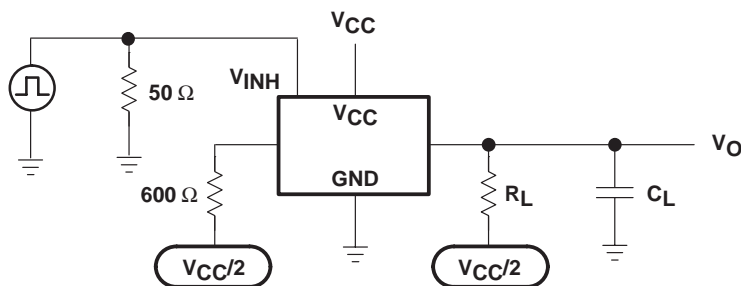


NOTE A:  $f_{in}$  is a sine wave.

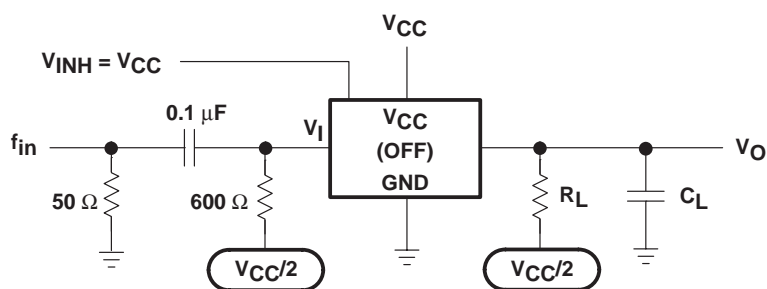
Figure 6. Frequency Response (Switch On)



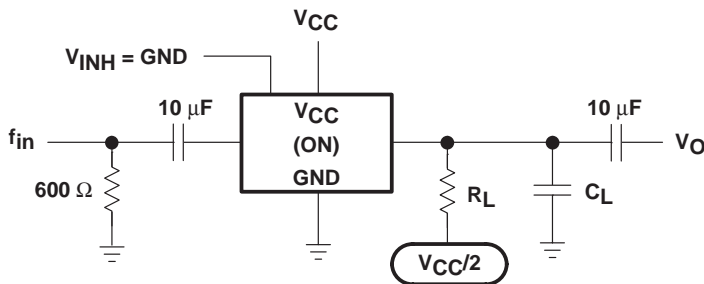
**PARAMETER MEASUREMENT INFORMATION**



**Figure 7. Crosstalk (Control Input, Switch Output)**



**Figure 8. Feedthrough Attenuation (Switch Off)**



**Figure 9. 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>
SN74LV4051ATDRQ1	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74LV4051ATDWRQ1	ACTIVE	SOIC	DW	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74LV4051ATPWRQ1	ACTIVE	TSSOP	PW	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

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**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) 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.

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<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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D (R-PDSO-G16)

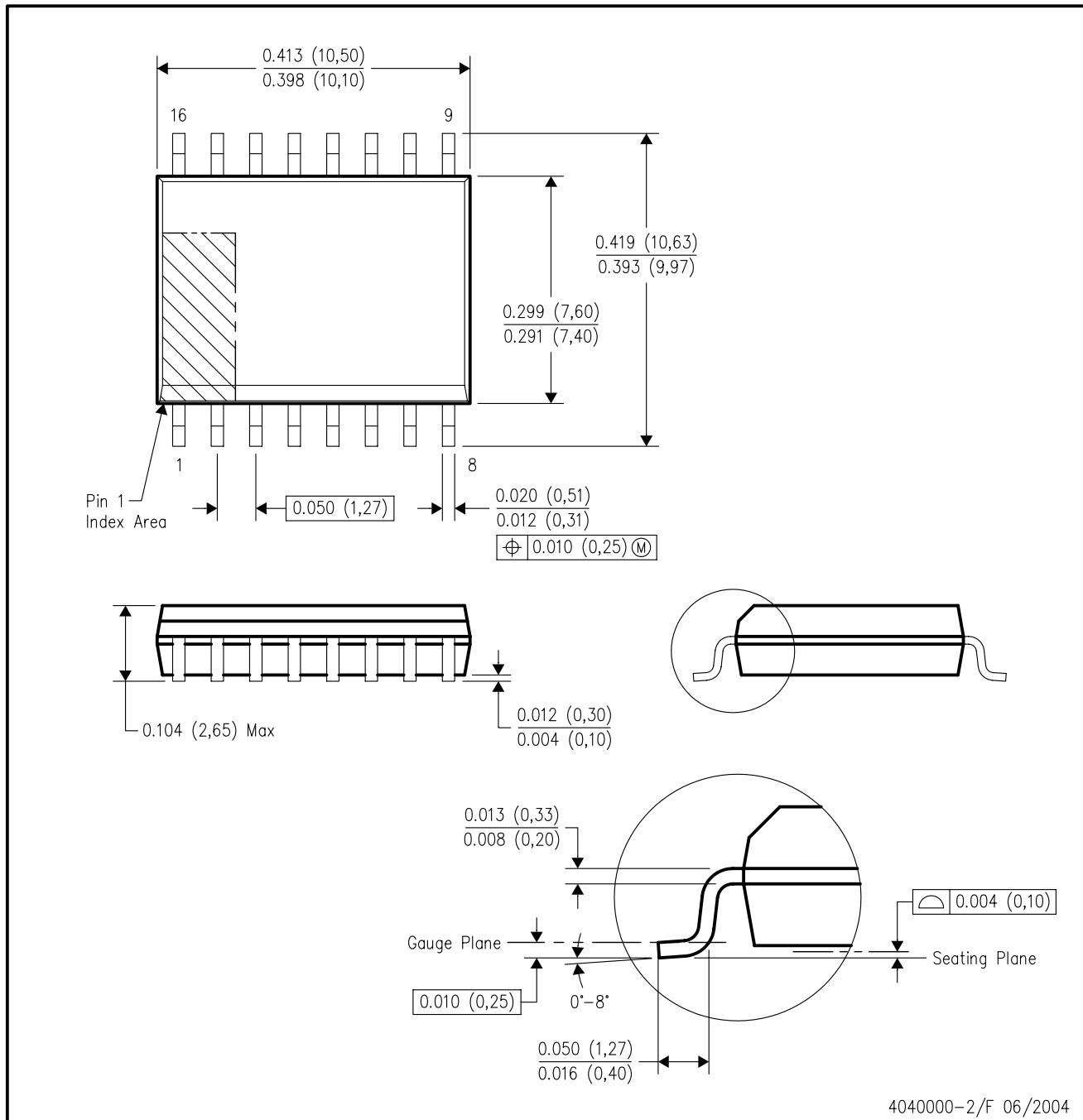
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AC.

DW (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



4040000-2/F 06/2004

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-013 variation AA.

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.  
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