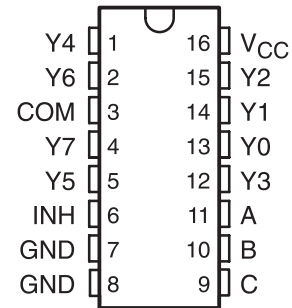


## 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

 Check for Samples: [SN74LV4051A-Q1](#)

### FEATURES

- Qualified for Automotive Applications
- 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)**


### DESCRIPTION

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<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	SN74LV4051ATDRQ1	L4051AQ
	SOIC – DW	Tape and reel	SN74LV4051ATDWRQ1	L4051AQ
	TSSOP – PW	Tape and reel	SN74LV4051ATPWRQ1	L4051AQ
–40°C to 125°C	TSSOP – PW	Tape and reel	SN74LV4051AQPWRQ1	4051AQ1

(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).

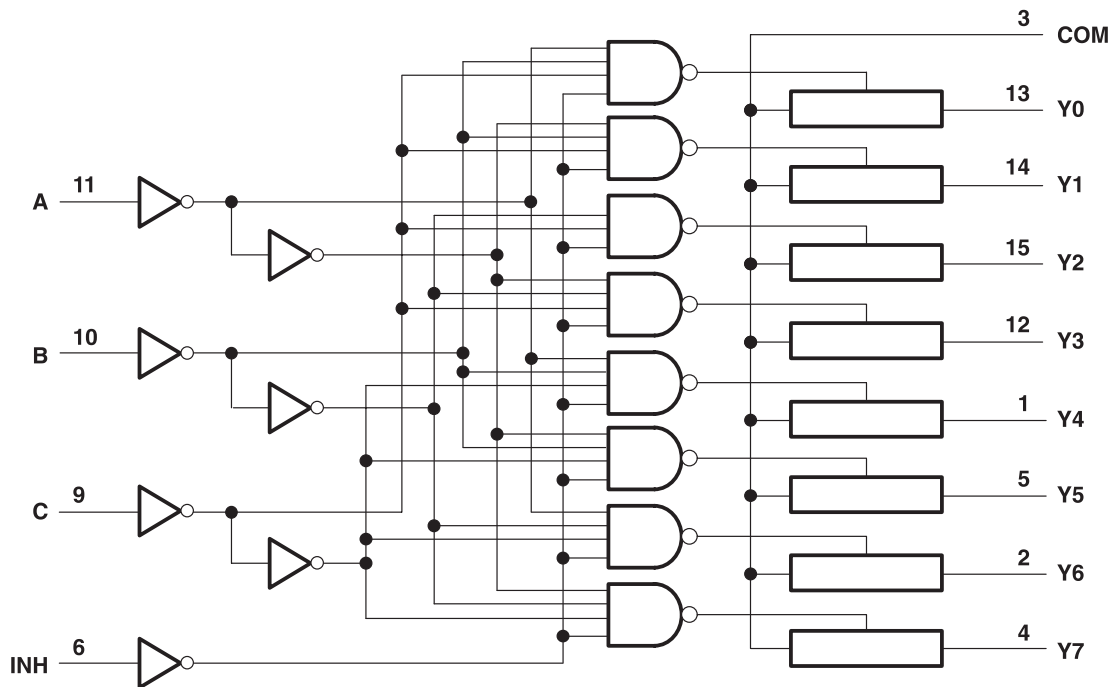
### FUNCTION TABLE

INPUTS				ON CHANNEL
INH	C	B	A	
L	L	L	L	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



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, junction to free air <sup>(4)</sup>	D package	95°C/W
		DW package	75°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 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
$V_{CC}$	Supply voltage		2 <sup>(2)</sup>	5.5	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ 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	$V_{CC} = 2$ 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	SN74LV4051ATDRQ1, SN74LV4051ATDWRQ1	–40	105	°C
		SN74LV4051ATPWRQ1			
$T_A$	Operating free-air temperature	SN74LV4051AQPWRQ1	–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		38	180		225		225	Ω
		3 V		30	150		190		190	
		4.5 V		22	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		113	500		600		600	Ω
		3 V		54	180		225		225	
		4.5 V		31	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		2.1	30		40		40	Ω
		3 V		1.4	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			23.4					pF
C <sub>OS</sub> Switch terminal capacitance		3.3 V			5.7					pF
C <sub>F</sub> Feedthrough capacitance					0.5					pF

## SWITCHING CHARACTERISTICS

 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ , 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)		2.5	9		12		14	ns
$t_{PZH}$ Enable delay time $t_{PZL}$	INH	COM or Yn	$C_L = 50\text{ pF}$ (see Figure 5)		5.5	20		25		25	ns
$t_{PHZ}$ Disable delay time $t_{PLZ}$	INH	COM or Yn	$C_L = 50\text{ pF}$ (see Figure 5)		8.8	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)		1.5	6		8		10	ns
$t_{PZH}$ Enable delay time $t_{PZL}$	INH	COM or Yn	$C_L = 50\text{ pF}$ (see Figure 5)		4	14		18		18	ns
$t_{PHZ}$ Disable delay time $t_{PLZ}$	INH	COM or Yn	$C_L = 50\text{ pF}$ (see Figure 5)		6.2	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	20			MHz	
				3 V	25				
				4.5 V	35				
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 7)	2.3 V	20			mV	
				3 V	35				
				4.5 V	60				
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 8)	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 9)	$V_I = 2\text{ Vp-p}$	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.

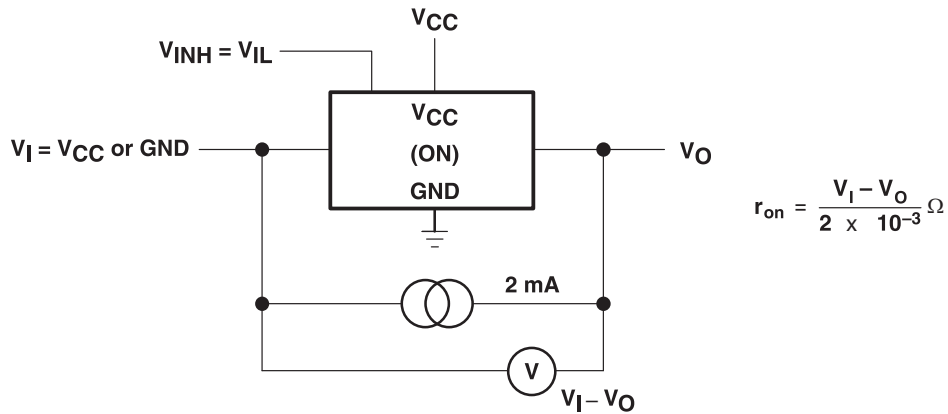
(2) Adjust  $f_{in}$  voltage to obtain 0-dBm input.

## OPERATING CHARACTERISTICS

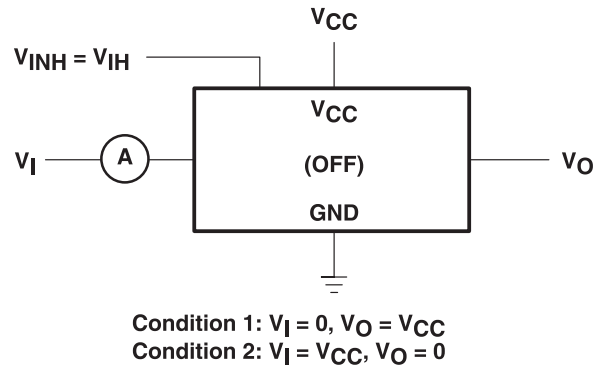
 $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	$C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$	5.9	pF

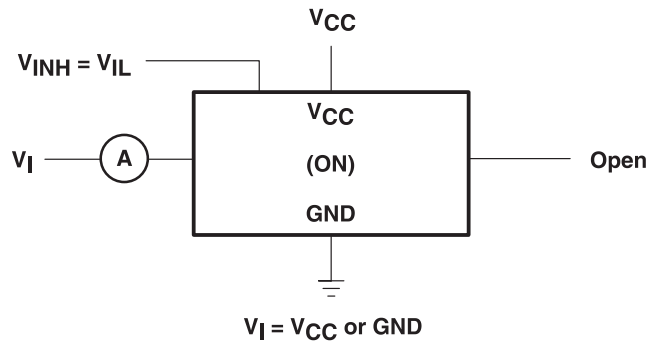
**PARAMETER MEASUREMENT INFORMATION**



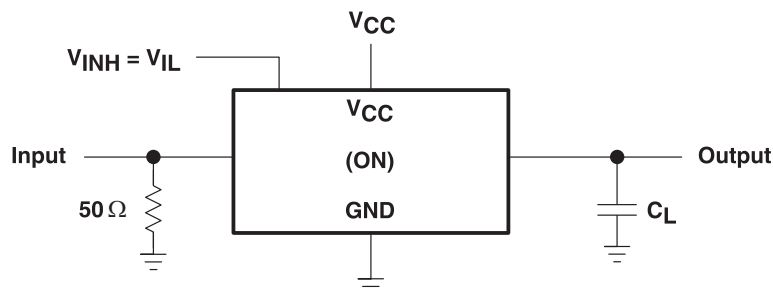
**Figure 1. On-State Resistance Test Circuit**



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

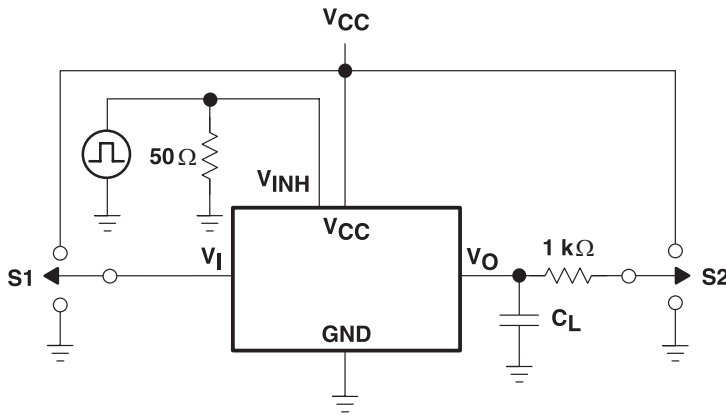


**Figure 3. On-State Switch Leakage-Current Test Circuit**



**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

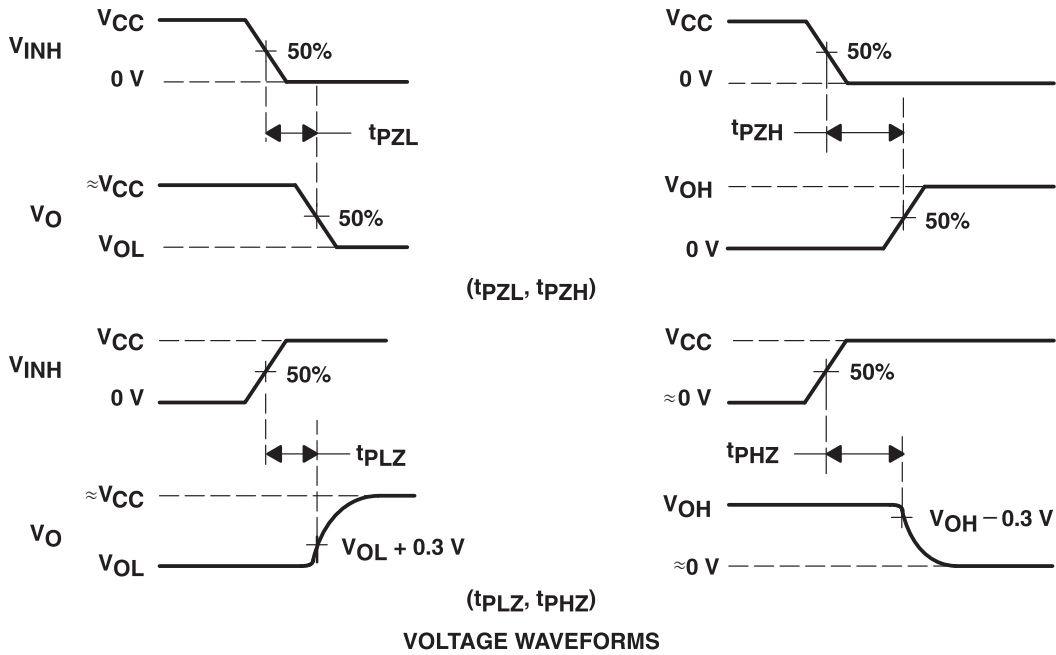
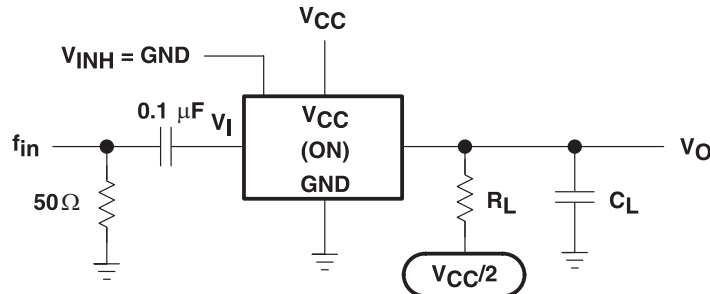


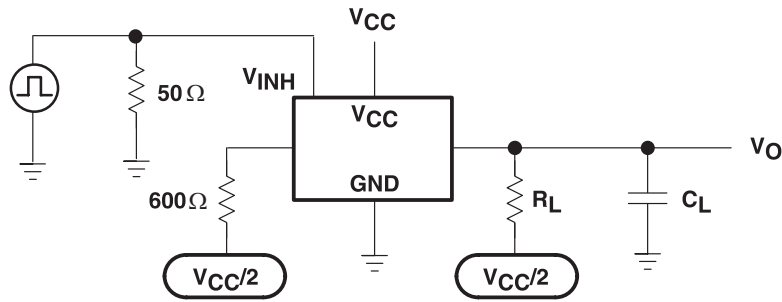
Figure 5. Switching Time ( $t_{PZL}$ ,  $t_{PLZ}$ ,  $t_{PZH}$ ,  $t_{PHZ}$ ), Control to Signal Output



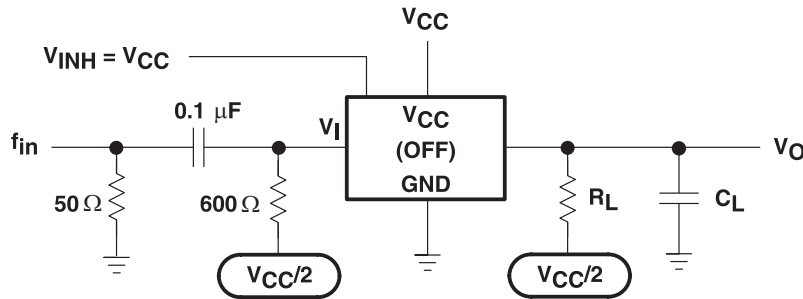
NOTE A:  $f_{in}$  is a sine wave.

Figure 6. Frequency Response (Switch On)

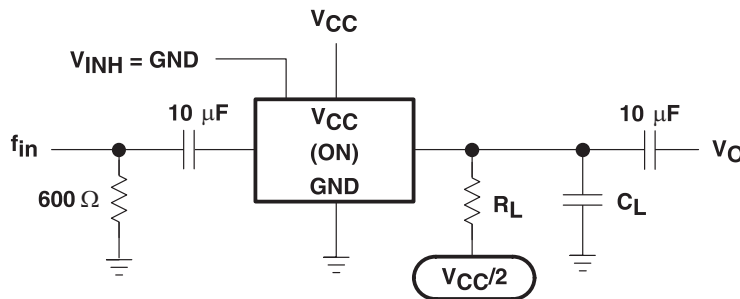
**PARAMETER MEASUREMENT INFORMATION (continued)**



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



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



**Figure 9. 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)	Op Temp (°C)	Top-Side Markings (4)	Samples
CLV4051ATDWRG4Q1	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4051AQ	<a href="#">Samples</a>
CLV4051ATPWRG4Q1	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4051AQ	<a href="#">Samples</a>
SN74LV4051AQPWRQ1	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	4051AQ1	<a href="#">Samples</a>
SN74LV4051ATDRQ1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4051AQ	<a href="#">Samples</a>
SN74LV4051ATDWRQ1	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4051AQ	<a href="#">Samples</a>
SN74LV4051ATPWRQ1	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 105	L4051AQ	<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) 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.

(4) Only one of markings shown within the brackets will appear on the physical device.

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**OTHER QUALIFIED VERSIONS OF SN74LV4051A-Q1 :**

- Catalog: [SN74LV4051A](#)
- Enhanced Product: [SN74LV4051A-EP](#)

NOTE: Qualified Version Definitions:

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

**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
CLV4051ATPWRG4Q1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV4051AQPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV4051ATPWRQ1	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)
CLV4051ATPWRG4Q1	TSSOP	PW	16	2000	367.0	367.0	35.0
SN74LV4051AQPWRQ1	TSSOP	PW	16	2000	367.0	367.0	35.0
SN74LV4051ATPWRQ1	TSSOP	PW	16	2000	367.0	367.0	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.

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040064-4/G 02/11

- 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.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (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.

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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.



DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4209202-2/E 07/11

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - 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.

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