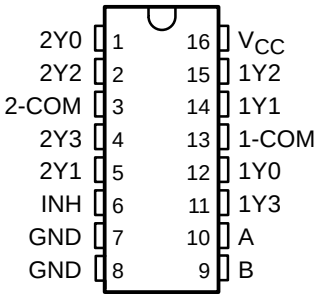
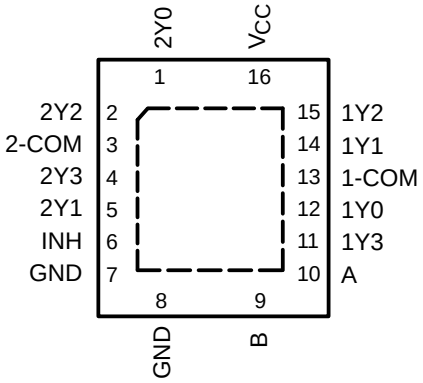
- **2-V to 5.5-V V_{CC} Operation**
- **Support Mixed-Mode Voltage Operation on All Ports**
- **Fast Switching**
- **High On-Off Output-Voltage Ratio**
- **Low Crosstalk Between Switches**
- **Extremely Low Input Current**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**

SN54LV4052A . . . J OR W PACKAGE
SN74LV4052A . . . D, DB, DGV, N, NS, OR PW PACKAGE
(TOP VIEW)



SN74LV4052A . . . RGY PACKAGE
(TOP VIEW)



description/ordering information

These dual 4-channel CMOS analog multiplexers/demultiplexers are designed for 2-V to 5.5-V V_{CC} operation.

The ’LV4052A devices handle 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 85°C	QFN – RGY	Tape and reel	SN74LV4052ARGYR	LW052A
	PDIP – N	Tube	SN74LV4052AN	SN74LV4052AN
	SOIC – D	Tube	SN74LV4052AD	LV4052A
		Tape and reel	SN74LV4052ADR	
	SOP – NS	Tape and reel	SN74LV4052ANSR	74LV4052A
	SSOP – DB	Tape and reel	SN74LV4052ADBR	LW052A
	TSSOP – PW	Tape and reel	SN74LV4052APWR	LW052A
	TVSOP – DGV	Tape and reel	SN74LV4052ADGVR	LW052A
–55°C to 125°C	CDIP – J	Tube	SNJ54LV4052AJ	SNJ54LV4052AJ
	CFP – W	Tube	SNJ54LV4052AW	SNJ54LV4052AW

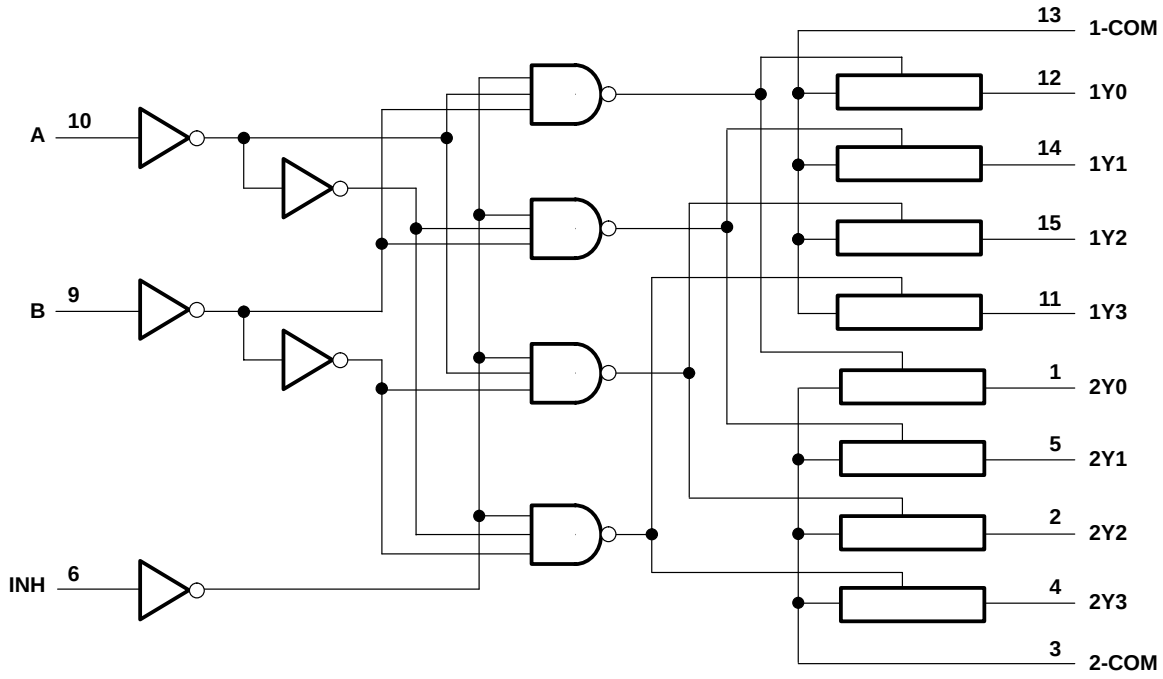
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

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.

FUNCTION TABLE

INPUTS			ON CHANNEL
INH	B	A	
L	L	L	1Y0, 2Y0
L	L	H	1Y1, 2Y1
L	H	L	1Y2, 2Y2
L	H	H	1Y3, 2Y3
H	X	X	None

logic diagram (positive logic)



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 or V_{IO} > V_{CC}) . . . . . ±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
(see Note 3): DB package . . . . . 82°C/W
(see Note 3): DGV package . . . . . 120°C/W
(see Note 3): N package . . . . . 67°C/W
(see Note 3): NS package . . . . . 64°C/W
(see Note 3): PW package . . . . . 108°C/W
(see Note 4): RGY package . . . . . 39°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 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.
4. The package thermal impedance is calculated in accordance with JESD 51-5.

recommended operating conditions (see Note 5)

			SN54LV4052A		SN74LV4052A		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2‡	5.5	2‡	5.5	V
V_{IH}	High-level input voltage, control inputs	V_{CC} = 2 V	1.5		1.5		V
		V_{CC} = 2.3 V to 2.7 V	$V_{CC} \times 0.7$		$V_{CC} \times 0.7$		
		V_{CC} = 3 V to 3.6 V	$V_{CC} \times 0.7$		$V_{CC} \times 0.7$		
		V_{CC} = 4.5 V to 5.5 V	$V_{CC} \times 0.7$		$V_{CC} \times 0.7$		
V_{IL}	Low-level input voltage, control inputs	V_{CC} = 2 V		0.5		0.5	V
		V_{CC} = 2.3 V to 2.7 V		$V_{CC} \times 0.3$		$V_{CC} \times 0.3$	
		V_{CC} = 3 V to 3.6 V		$V_{CC} \times 0.3$		$V_{CC} \times 0.3$	
		V_{CC} = 4.5 V to 5.5 V		$V_{CC} \times 0.3$		$V_{CC} \times 0.3$	
V_I	Control input voltage		0	5.5	0	5.5	V
V_{IO}	Input/output voltage		0	V_{CC}	0	V_{CC}	V
$\Delta t/\Delta v$	Input transition rise or fall rate	V_{CC} = 2.3 V to 2.7 V		200		200	ns/V
		V_{CC} = 3 V to 3.6 V		100		100	
		V_{CC} = 4.5 V to 5.5 V		20		20	
T_A	Operating free-air temperature		–55	125	–40	85	°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 5: 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.

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

PARAMETER		TEST CONDITIONS	V_{CC}	T_A = 25°C			SN54LV4052A		SN74LV4052A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	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		43	180		225		225	Ω
			3 V		34	150		190		190	
			4.5 V		25	75		100		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		133	500		600		600	Ω
			3 V		63	180		225		225	
			4.5 V		35	100		125		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		1.5	30		40		40	Ω
			3 V		1.1	20		30		30	
			4.5 V		0.7	15		20		20	
I_I	Control input current	V_I = 5.5 V or GND	0 to 5.5 V			±0.1		±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		±1	µA
$I_{S(on)}$	On-state switch leakage current	V_I = V_{CC} or GND, V_{INH} = V_{IL} (see Figure 3)	5.5 V			±0.1		±1		±1	µA
I_{CC}	Supply current	V_I = V_{CC} or GND	5.5 V					20		20	µA
C_{IC}	Control input capacitance	f = 10 MHz	3.3 V		2.1						pF
C_{IS}	Common terminal capacitance		3.3 V		13.1						pF
C_{OS}	Switch terminal capacitance		3.3 V		5.6						pF
C_F	Feed-through capacitance		3.3 V		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			SN54LV4052A		SN74LV4052A		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Y	Y or COM	C_L = 15 pF, (see Figure 4)		1.9	10		16		16	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Y	C_L = 15 pF, (see Figure 5)		8	18		23		23	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Y	C_L = 15 pF, (see Figure 5)		8.3	18		23		23	ns
t_{PLH} t_{PHL}	Propagation delay time	COM or Y	Y or COM	C_L = 50 pF, (see Figure 4)		3.8	12		18		18	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Y	C_L = 50 pF, (see Figure 5)		9.4	28		35		35	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Y	C_L = 50 pF, (see Figure 5)		12.4	28		35		35	ns

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			SN54LV4052A		SN74LV4052A		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Y	Y or COM	C_L = 15 pF, (see Figure 4)		1.2	6		10		10	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Y	C_L = 15 pF, (see Figure 5)		5.7	12		15		15	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Y	C_L = 15 pF, (see Figure 5)		6.6	12		15		15	ns
t_{PLH} t_{PHL}	Propagation delay time	COM or Y	Y or COM	C_L = 50 pF, (see Figure 4)		2.5	9		12		12	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Y	C_L = 50 pF, (see Figure 5)		6.7	20		25		25	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Y	C_L = 50 pF, (see Figure 5)		9.5	20		25		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			SN54LV4052A		SN74LV4052A		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Y	Y or COM	C_L = 15 pF, (see Figure 4)		0.7	4		7		7	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Y	C_L = 15 pF, (see Figure 5)		4	8		10		10	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Y	C_L = 15 pF, (see Figure 5)		5	8		10		10	ns
t_{PLH} t_{PHL}	Propagation delay time	COM or Y	Y or COM	C_L = 50 pF, (see Figure 4)		1.5	6		8		8	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Y	C_L = 50 pF, (see Figure 5)		4.7	14		18		18	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Y	C_L = 50 pF, (see Figure 5)		6.9	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°C			UNIT
						MIN	TYP	MAX	
Frequency response (switch on)	COM or Y	Y or COM	C_L = 50 pF, R_L = 600 Ω, f_{in} = 1 MHz (sine wave) (see Note 6 and Figure 6)		2.3 V		30		MHz
					3 V		35		
					4.5 V		50		
Crosstalk (between any switches)	COM or Y	Y or COM	C_L = 50 pF, R_L = 600 Ω, f_{in} = 1 MHz (sine wave) (see Note 7 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	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		
Feed-through attenuation (switch off)	COM or Y	Y or COM	C_L = 50 pF, R_L = 600 Ω, f_{in} = 1 MHz (sine wave) (see Note 7 and Figure 9)		2.3 V		–45		dB
					3 V		–45		
					4.5 V		–45		
Sine-wave distortion	COM or Y	Y 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: 6. Adjust f_{in} voltage to obtain 0 dBm at output. Increase f_{in} frequency until dB meter reads –3 dB.
7. Adjust f_{in} voltage to obtain 0 dBm at input.

operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance	C_L = 50 pF,	f = 10 MHz	11.8	pF

PARAMETER MEASUREMENT INFORMATION

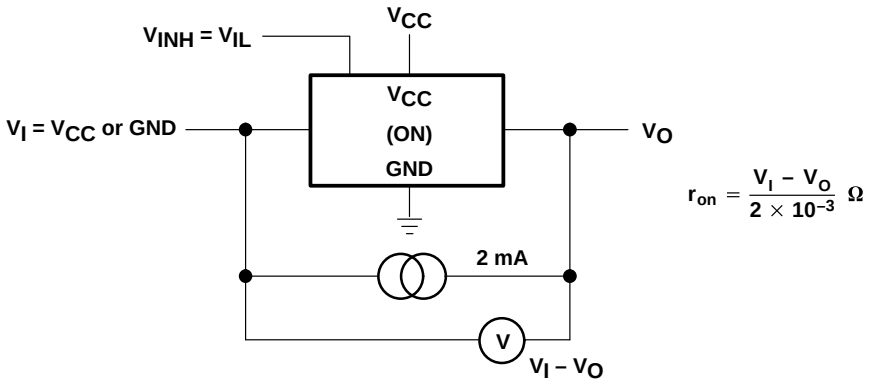
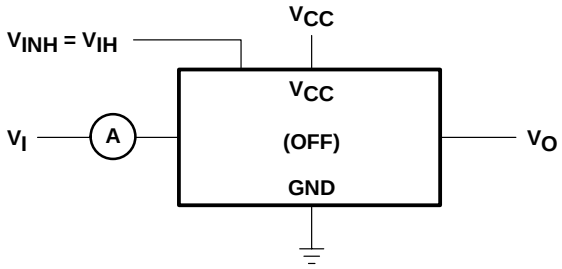


Figure 1. On-State Resistance Test Circuit



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

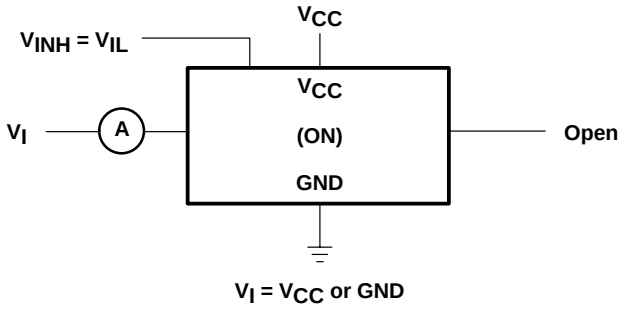


Figure 3. On-State Switch Leakage-Current Test Circuit

PARAMETER MEASUREMENT INFORMATION

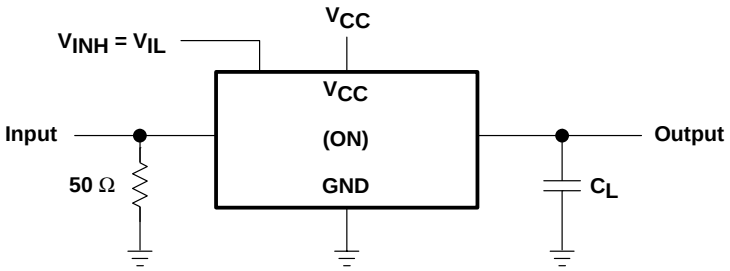
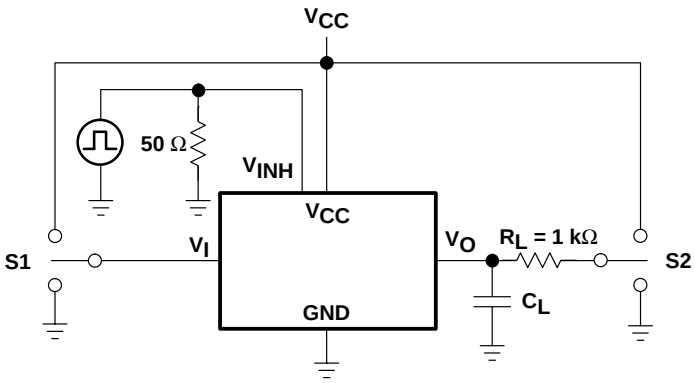
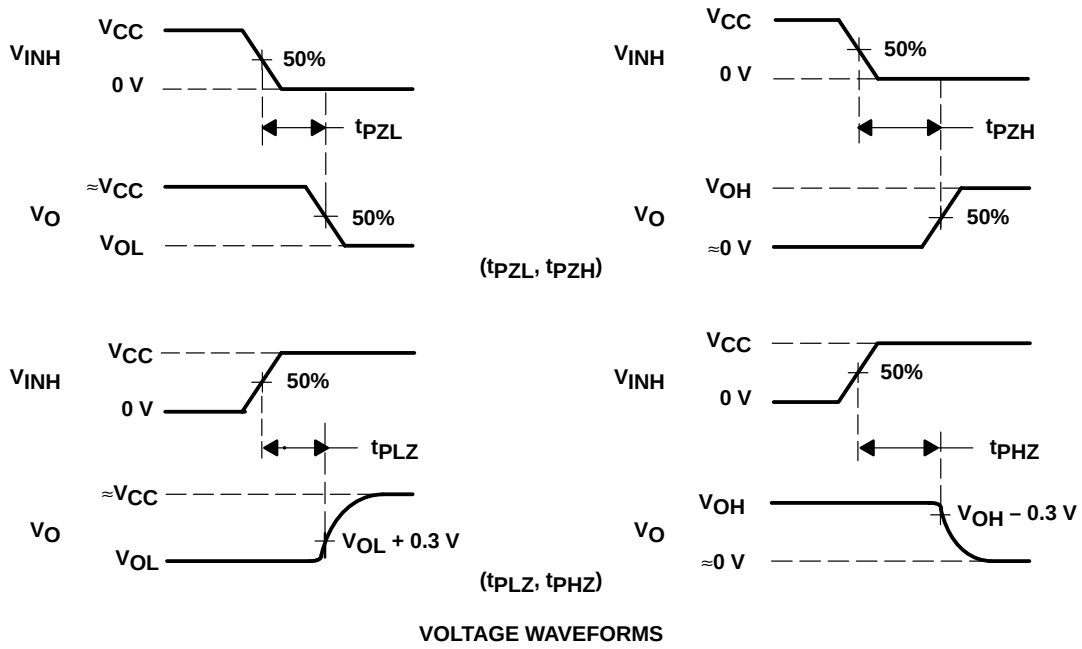


Figure 4. Propagation Delay Time, Signal Input to Signal Output



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

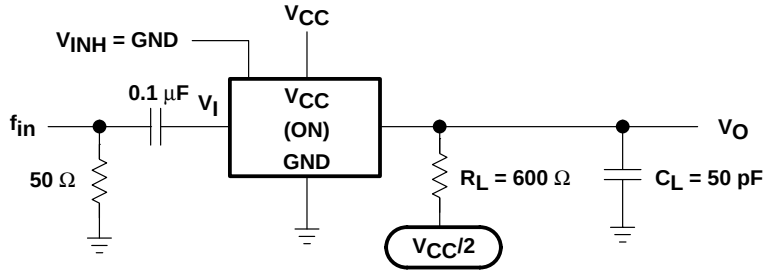
TEST CIRCUIT



VOLTAGE WAVEFORMS

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

PARAMETER MEASUREMENT INFORMATION



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

Figure 6. Frequency Response (Switch On)

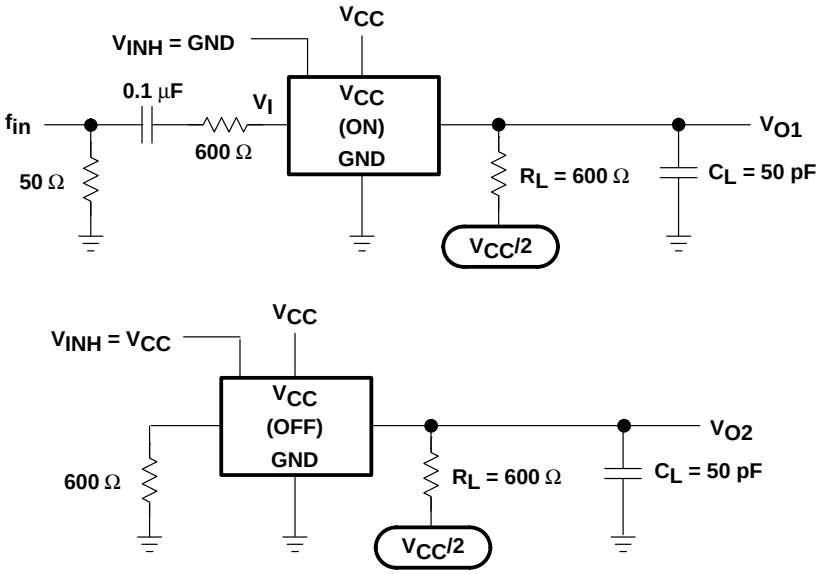


Figure 7. Crosstalk Between Any Two Switches

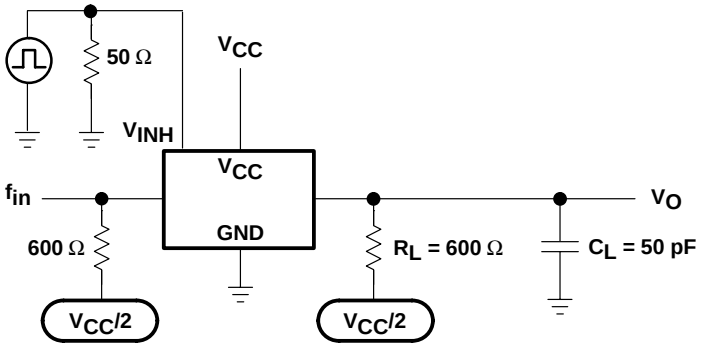


Figure 8. Crosstalk Between Control Input and Switch Output

PARAMETER MEASUREMENT INFORMATION

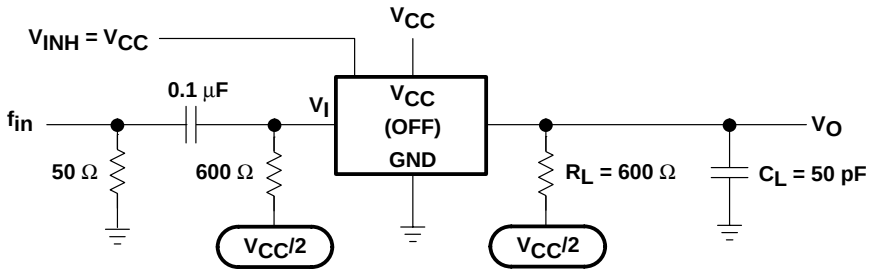


Figure 9. Feed-Through Attenuation (Switch Off)

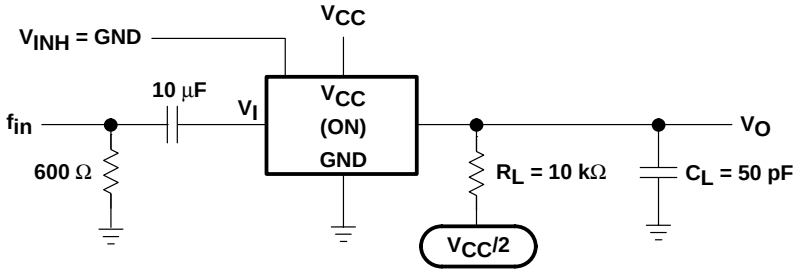


Figure 10. Sine-Wave Distortion

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