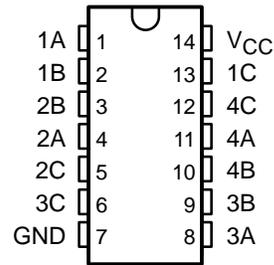


# SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

SCLS325A – MARCH 1996 – REVISED JULY 1996

- High Degree of Linearity
- High On-Off Output Voltage Ratio
- Low Crosstalk Between Switches
- Low On-State Impedance —  
Typically, 50 Ω at V<sub>CC</sub> = 6 V
- Individual Switch Controls
- Extremely Low Input Current
- Package Options Include Plastic Small-Outline (D), Plastic Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, and Standard Plastic (N) 300-mil DIPs

D, DB, PW, OR N PACKAGE  
(TOP VIEW)



## description

The SN74HC4066 is a silicon-gate CMOS quadruple analog switch designed to handle both analog and digital signals. Each switch permits signals with amplitudes of up to 6 V (peak) to be transmitted in either direction.

Each switch section has its own enable input control (C). A high-level voltage applied to C turns on the associated switch section.

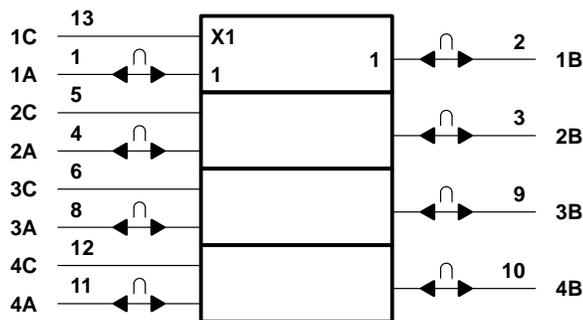
Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

The SN74HC4066 is characterized for operation from -40°C to 85°C.

FUNCTION TABLE  
(each switch)

INPUT CONTROL (C)	SWITCH
L	OFF
H	ON

## logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.



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**TEXAS  
INSTRUMENTS**

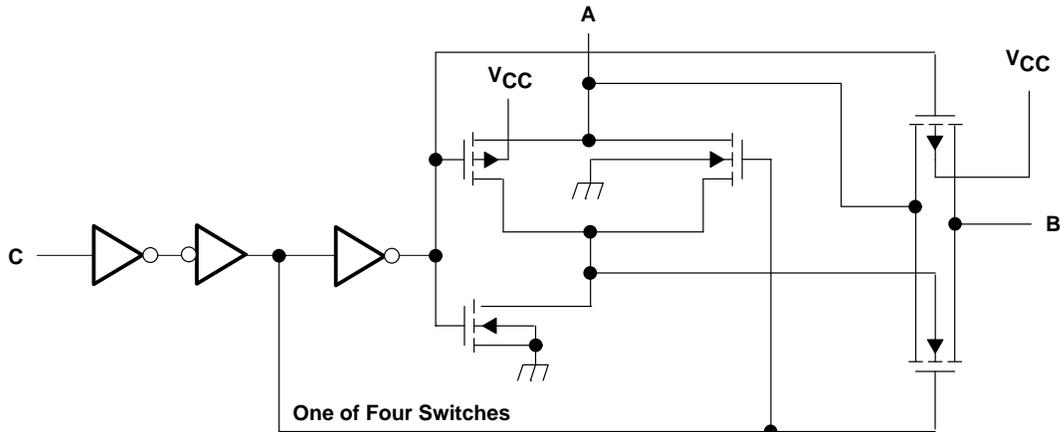
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# SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

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## logic diagram, each switch (positive logic)



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

Supply voltage range, $V_{CC}$ (see Note 1)	.....	-0.5 V to 7 V
Control-input diode current, $I_I$ ( $V_I < 0$ or $V_I > V_{CC}$ )	.....	$\pm 20$ mA
I/O port diode current, $I_I$ ( $V_I < 0$ or $V_{I/O} < V_{CC}$ )	.....	$\pm 20$ mA
On-state switch current ( $V_{I/O} = 0$ to $V_{CC}$ )	.....	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND	.....	$\pm 50$ mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2):	D package	1.25 W
	DB or PW package	0.5 W
	N package	1.1 W
Storage temperature range, $T_{stg}$	.....	$-65^\circ\text{C}$ to $150^\circ\text{C}$

† 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. All voltages are with respect to ground unless otherwise specified.  
2. The maximum power dissipation is calculated using a junction temperature of  $150^\circ\text{C}$  and a board trace length of 750 mils, except for the N package, which has a trace length of zero.

## recommended operating conditions

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	2‡	5	6	V
$V_{I/O}$	I/O port voltage	0		$V_{CC}$	V
$V_{IH}$	High-level input voltage, control inputs	$V_{CC} = 2\text{ V}$	1.5	$V_{CC}$	V
		$V_{CC} = 4.5\text{ V}$	3.15	$V_{CC}$	
		$V_{CC} = 6\text{ V}$	4.2	$V_{CC}$	
$V_{IL}$	Low-level input voltage, control inputs	$V_{CC} = 2\text{ V}$	0	0.3	V
		$V_{CC} = 4.5\text{ V}$	0	0.9	
		$V_{CC} = 6\text{ V}$	0	1.2	
$t_t$	Input rise/fall time	$V_{CC} = 2\text{ V}$		1000	ns
		$V_{CC} = 4.5\text{ V}$		500	
		$V_{CC} = 6\text{ V}$		400	
$T_A$	Operating free-air temperature	-40		85	$^\circ\text{C}$

‡ 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.



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# SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

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**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> = -1 mA, V <sub>I</sub> = 0 to V <sub>CC</sub> , V <sub>C</sub> = V <sub>IH</sub> , (see Figure 1)	2 V	150					Ω
			4.5 V	50	85	106			
			6 V	30					
R <sub>on(p)</sub>	Peak on resistance	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>C</sub> = V <sub>IH</sub> , I <sub>T</sub> = -1 mA	2 V	320					Ω
			4.5 V	70	170	215			
			6 V	50					
I <sub>I</sub>	Control input current	V <sub>C</sub> = 0 or V <sub>CC</sub>	6 V	±0.1	±100	±1000		nA	
I <sub>soff</sub>	Off-state switch leakage current	V <sub>I</sub> = V <sub>CC</sub> or 0, V <sub>O</sub> = V <sub>CC</sub> or 0, V <sub>C</sub> = V <sub>IL</sub> , (see Figure 2)	6 V				±0.1	±5	μA
I <sub>son</sub>	On-state switch leakage current	V <sub>I</sub> = V <sub>CC</sub> or 0, V <sub>C</sub> = V <sub>IH</sub> , (see Figure 3)	6 V				±0.1	±5	μA
I <sub>CC</sub>	Supply current	V <sub>I</sub> = 0 or V <sub>CC</sub> , I <sub>O</sub> = 0	6 V				2	20	μA
C <sub>i</sub>	Input capacitance	A or B C	5 V	9					pF
				3			10	10	
C <sub>f</sub>	Feedthrough capacitance	A to B	V <sub>I</sub> = 0	0.5					pF
C <sub>o</sub>	Output capacitance	A or B	5 V	9					pF

**switching characteristics over recommended operating free-air temperature range**

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
						MIN	TYP	MAX			
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation delay time	A or B	B or A	C <sub>L</sub> = 50 pF, (see Figure 4)	2 V	10			60	75	ns
					4.5 V	4			12	15	
					6 V	3			10	13	
t <sub>PZH</sub> , t <sub>PZL</sub>	Switch turn-on time	C	A or B	R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 50 pF, (see Figure 5)	2 V	70	180	225		ns	
					4.5 V	21	36	45			
					6 V	18	31	38			
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Switch turn-off time	C	A or B	R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 50 pF, (see Figure 5)	2 V	50	200	250		ns	
					4.5 V	25	40	50			
					6 V	22	34	43			
f <sub>I</sub>	Control input frequency	C	A or B	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 kΩ, V <sub>C</sub> = V <sub>CC</sub> or GND, V <sub>O</sub> = V <sub>CC</sub> /2, (see Figure 6)	2 V	15				MHz	
					4.5 V	30					
					6 V	30					
Control feedthrough noise	C	A or B	C <sub>L</sub> = 50 pF, R <sub>in</sub> = R <sub>L</sub> = 600 Ω, V <sub>C</sub> = V <sub>CC</sub> or GND, f <sub>in</sub> = 1 MHz, (see Figure 7)	4.5 V	15				mV (rms)		
				6 V	20						



# SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

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## operating characteristics, $V_{CC} = 4.5\text{ V}$ , $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance per gate	$C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$	45	pF
Minimum through bandwidth, A to B or B to A† [20 log (V <sub>O</sub> /V <sub>I</sub> )] = -3 dB	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $V_C = V_{CC}$ , (see Figure 8)	30	MHz
Crosstalk between any switches‡	$C_L = 10\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = 1\text{ MHz}$ , (see Figure 9)	45	dB
Feedthrough, switch off, A to B or B to A‡	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ , (see Figure 10)	42	dB
Amplitude distortion rate, A to B or B to A	$C_L = 50\text{ pF}$ , $R_L = 10\text{ k}\Omega$ , $f_{in} = 1\text{ kHz}$ , (see Figure 11)	0.05%	

† Adjust the input amplitude for output = 0 dBm at f = 10 kHz. Input signal must be a sine wave.

‡ Adjust the input amplitude for output = 0 dBm at f = 1 MHz. Input signal must be a sine wave.

## PARAMETER MEASUREMENT INFORMATION

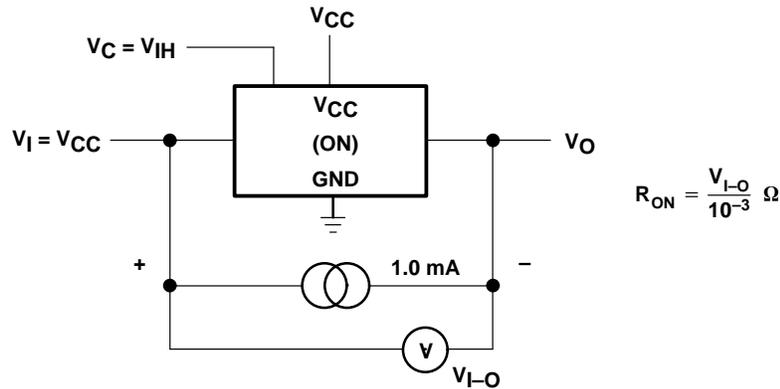
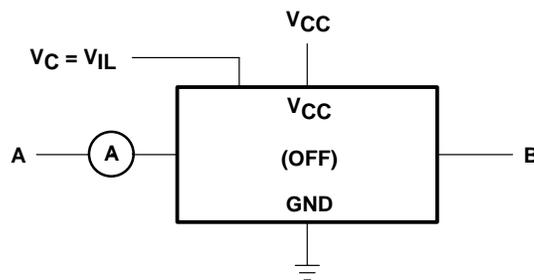


Figure 1. On-State Resistance Test Circuit



$V_S = V_A - V_B$   
 CONDITION 1:  $V_A = 0$ ,  $V_B = V_{CC}$   
 CONDITION 2:  $V_A = V_{CC}$ ,  $V_B = 0$

Figure 2. Off-State Switch Leakage Current Test Circuit

PARAMETER MEASUREMENT INFORMATION

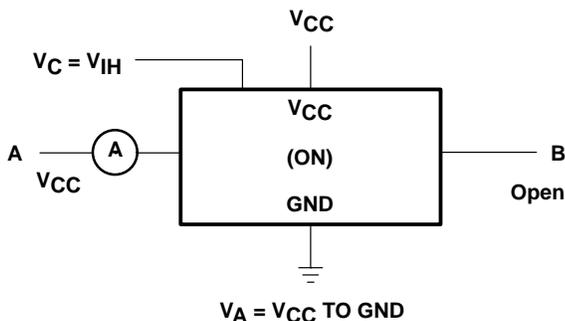


Figure 3. On-State Leakage Current Test Circuit

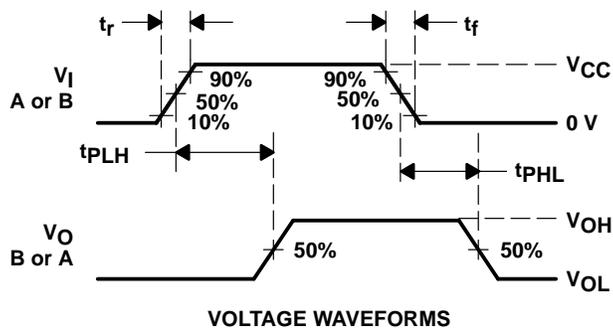
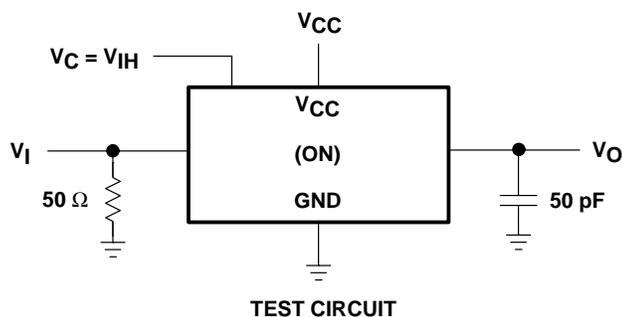
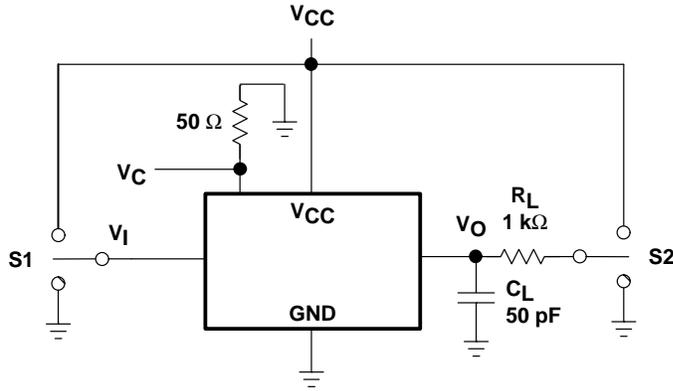


Figure 4. Propagation Delay Time, Signal Input to Signal Output

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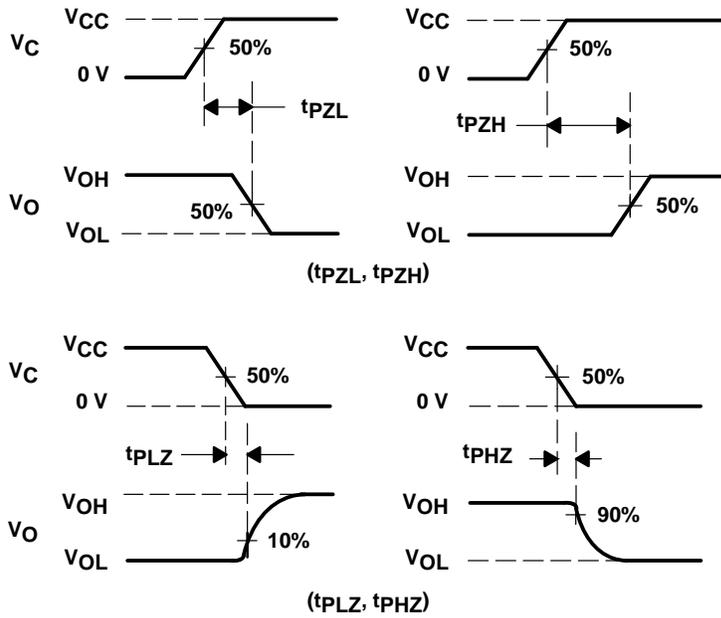
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## PARAMETER MEASUREMENT INFORMATION



TEST	S1	S2
tPZL	GND	VCC
tPZH	VCC	GND
tPLZ	GND	VCC
tPHZ	VCC	GND

TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 5. Switching Time (tPZL, tPLZ, tPZH, tPHZ), Control to Signal Output

PARAMETER MEASUREMENT INFORMATION

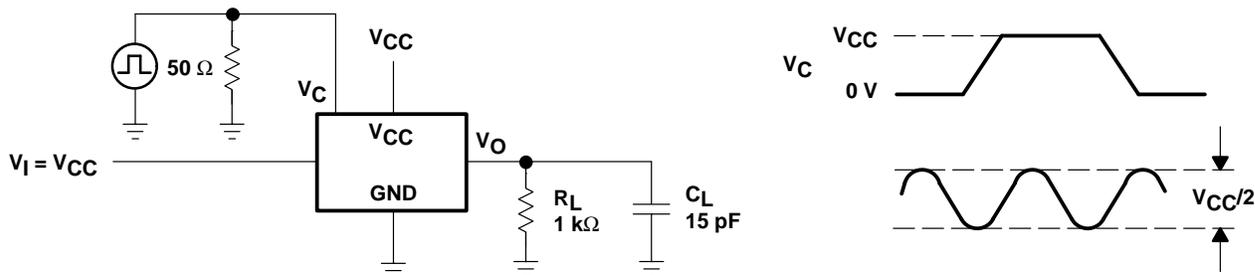


Figure 6. Control Input Frequency

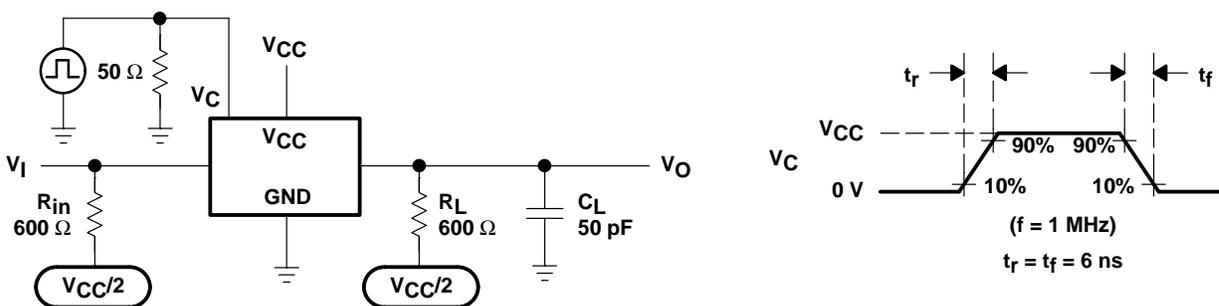


Figure 7. Control Feedthrough Noise

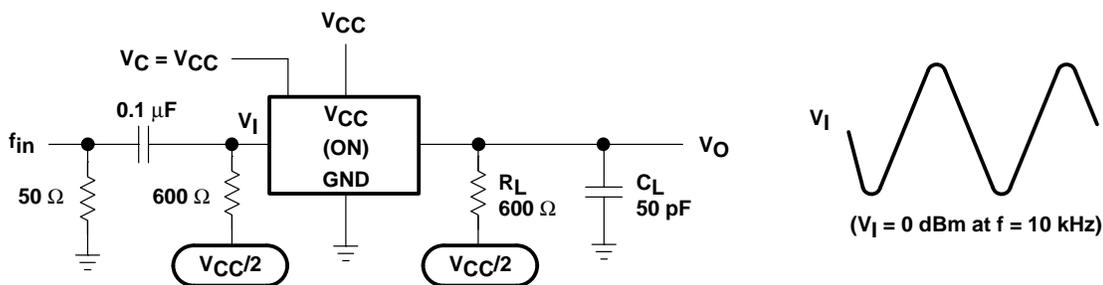


Figure 8. Minimum Through Bandwidth

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## PARAMETER MEASUREMENT INFORMATION

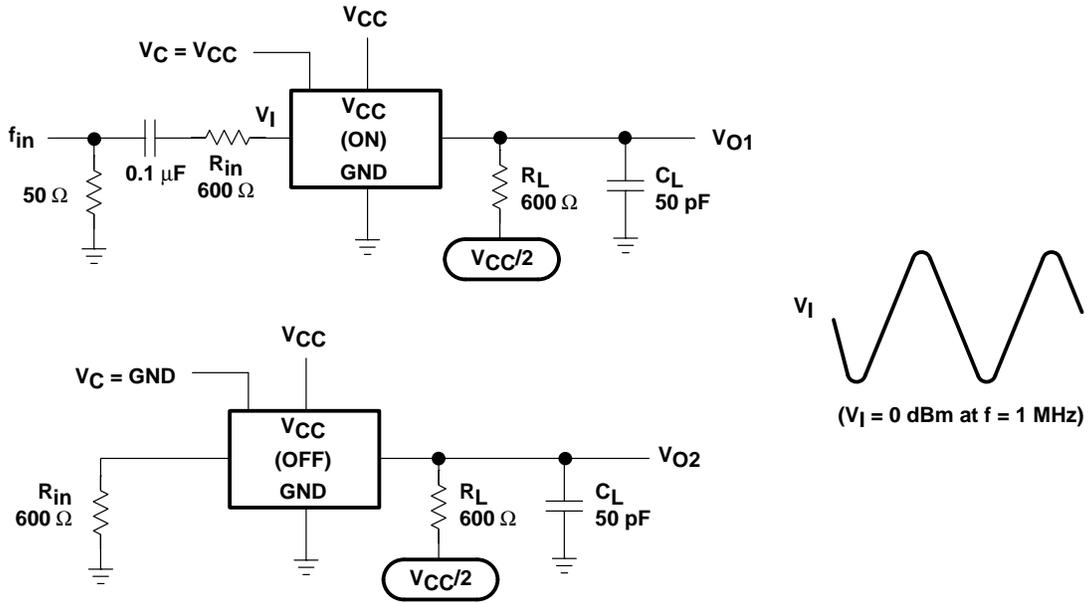


Figure 9. Crosstalk Between Any Two Switches

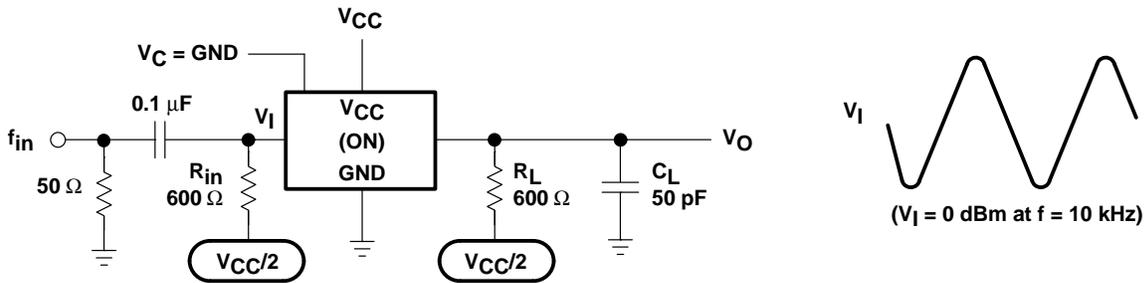


Figure 10. Feedthrough, Switch Off

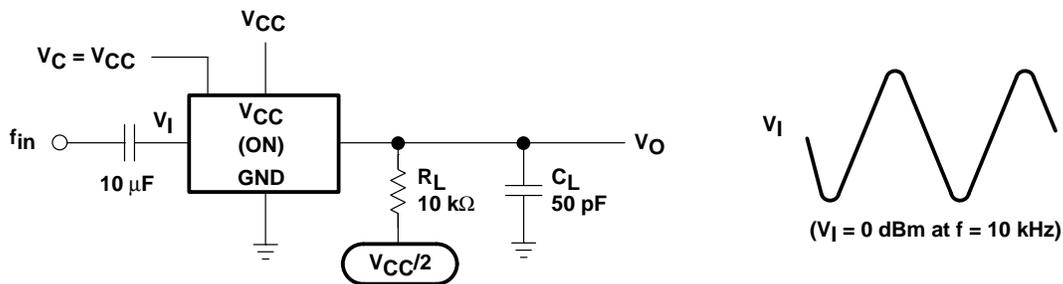


Figure 11. Amplitude Distortion Rate

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