

## Low-Voltage, Sub 1-Ω, Dual SPDT Analog Switch

### FEATURES

- Low Voltage Operation (1.8 V to 5.5 V)
- Low On-Resistance -  $r_{ON}$ : 0.45 Ω
- -71 dB OIRR @ 2.7 V, 100 kHz
- ESD Protection >2000 V
- MSOP-10 Package
- Available in Lead (Pb)-Free

### BENEFITS

- Reduced Power Consumption
- High Accuracy
- Reduce Board Space
- 1.6-V Logic Compatible
- High Bandwidth

### APPLICATIONS

- Cellular Phones
- Speaker Headset Switching
- Audio and Video Signal Routing
- PCMCIA Cards
- Battery Operated Systems
- Relay Replacement

### DESCRIPTION

The DG2031 is a sub 1-Ω (0.75 Ω @ 2.7 V) dual SPDT analog switch designed for low voltage applications.

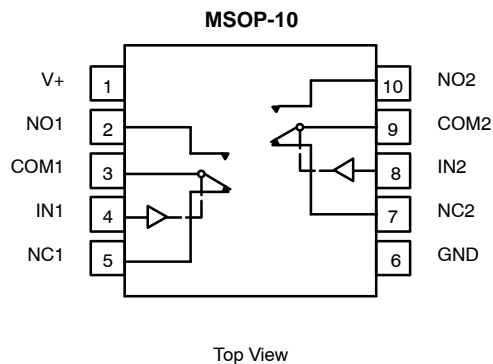
The DG2031 has on-resistance matching (less than 0.05 Ω @ 2.7 V) and flatness (less than 0.2 Ω @ 2.7 V) that are guaranteed over the entire voltage range. Additionally, low logic thresholds makes the DG2031 an ideal interface to low voltage DSP control signals.

The DG2031 has fast switching speed (on/off time @ 34 and 24 ns) with break-before-make guaranteed. In the On condition, all switching elements conduct equally in both directions. Off-isolation and crosstalk is -71 dB @ 100 kHz.

The DG2031 is built on Vishay Siliconix's high-density low voltage CMOS process. An eptiaxial layer is built in to prevent latchup. The DG2031 contains the additional benefit of 2,000-V ESD protection.

Packaged in space saving MSOP-10, the DG2031 is a high performance, low  $r_{ON}$  switch for battery powered applications. The DG2031 is available in both standard and lead (Pb)-free packaging. No lead is used in the manufacturing process, for the lead (Pb)-free version, either inside the device/package or on external terminations.

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE		
Logic	NC1 and NC2	NO1 and NO2
0	ON	OFF
1	OFF	ON

ORDERING INFORMATION			
Temp Range	Package	Standard Part Number	Lead (Pb)-Free Part Number
-40 to 85°C	MSOP-10 (with Tape and Reel)	DG2031DQ-T1	DG2031DQ-T1—E3



Vishay Siliconix

**ABSOLUTE MAXIMUM RATINGS**

Reference to GND

V+ ..... -0.3 to +6 V

IN, COM, NC, NO<sup>a</sup> ..... -0.3 to (V+ + 0.3 V)

Continuous Current (NO, NC, COM) ..... ± 300 mA

Peak Current ..... ± 500 mA  
(Pulsed at 1 ms, 10% duty cycle)

Storage Temperature (D Suffix) ..... -65 to 150°C

ESD per Method 3015.7 ..... >2 kV

Power Dissipation (Packages)<sup>b</sup>

MSOP-10<sup>c</sup> ..... 320 mW

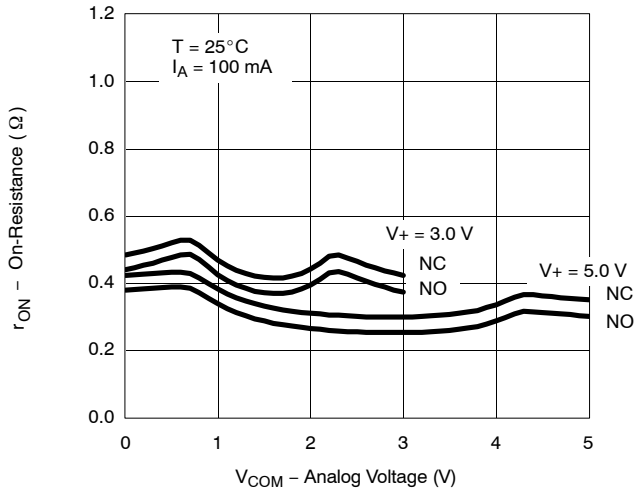
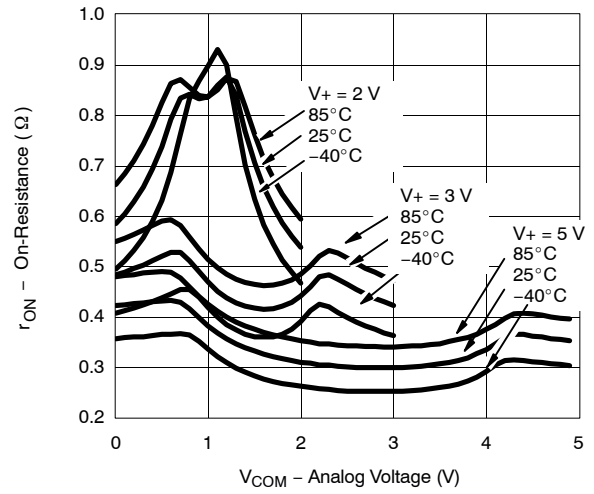
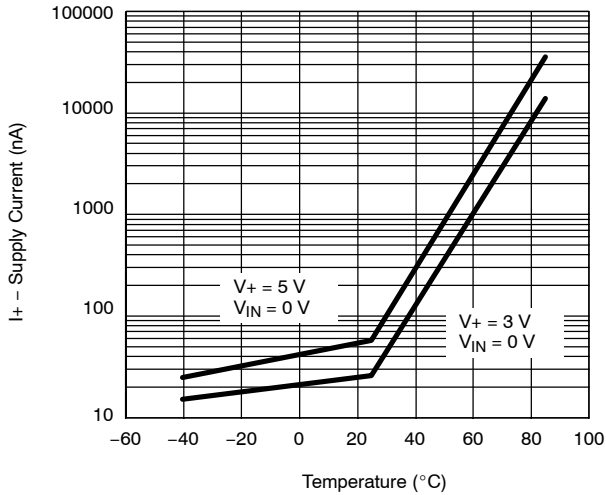
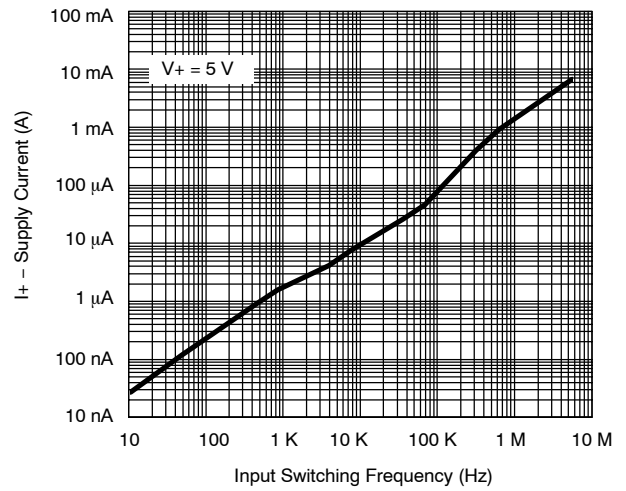
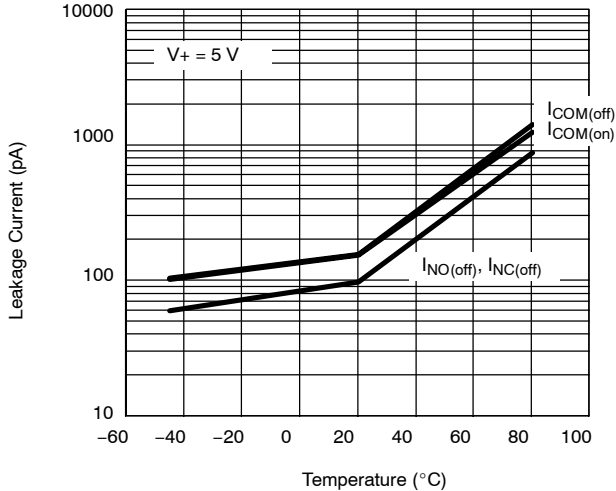
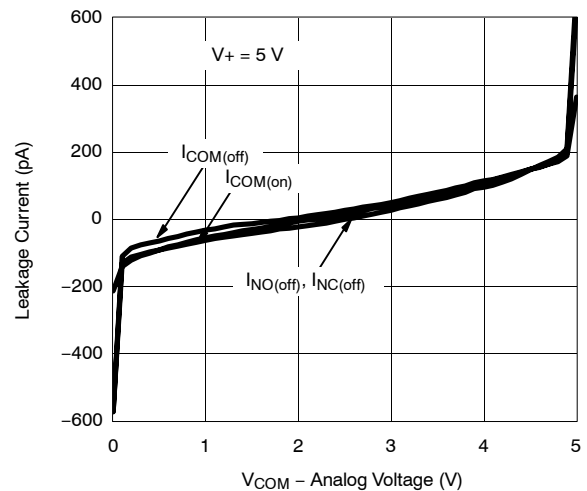
- Notes:
- Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
  - All leads welded or soldered to PC Board.
  - Derate 4.0 mW/°C above 70°C

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10%, V <sub>IN</sub> = 0.4 or 2.0 V <sup>e</sup>	Temp <sup>a</sup>	Limits -40 to 85°C			Unit
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		Full	0		V+	V
On-Resistance	r <sub>ON</sub>	V+ = 2.7 V, V <sub>COM</sub> = 0.6/1.5 V I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room Full		0.50	0.75 0.8	Ω
r <sub>ON</sub> Flatness <sup>d</sup>	r <sub>ON</sub> Flatness		Room		0.12	0.2	
On-Resistance Match Between Channels <sup>d</sup>	Δr <sub>DS(on)</sub>		Room			0.05	
Switch Off Leakage Current	I <sub>NO(off)</sub> , I <sub>NC(off)</sub>	V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = 0.3 V/3 V V <sub>COM</sub> = 3 V/0.3 V	Room Full	-1 -10		1 10	nA
	I <sub>COM(off)</sub>		Room Full	-1 -10		1 10	
Channel-On Leakage Current	I <sub>COM(on)</sub>	V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.3 V/3 V	Room Full	-1 -10		1 10	
<b>Digital Control</b>							
Input High Voltage <sup>d</sup>	V <sub>INH</sub>		Full	1.6			V
Input Low Voltage	V <sub>INL</sub>		Full			0.4	
Input Capacitance	C <sub>in</sub>		Full		9		pF
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 or V+	Full	1		1	μA
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2.0 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	Room Full		34	58 59	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		24	49 50	
Break-Before-Make Time	t <sub>d</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2.0 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	Full	2	10		
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 1.5 V, R <sub>GEN</sub> = 0 Ω	Room		4		pC
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 100 KHz	Room		-71		dB
Crosstalk <sup>d</sup>	X <sub>TALK</sub>		Room		-71		
N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup>	C <sub>NO(off)</sub>	V <sub>IN</sub> = 0 or V+, f = 1 MHz	Room		117		pF
	C <sub>NC(off)</sub>		Room		115		
Channel-On Capacitance <sup>d</sup>	C <sub>NO(on)</sub>		Room		367		
	C <sub>NC(on)</sub>		Room		368		
			Room				
<b>Power Supply</b>							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	V <sub>IN</sub> = 0 or V+	Full		0.01	1.0	μA

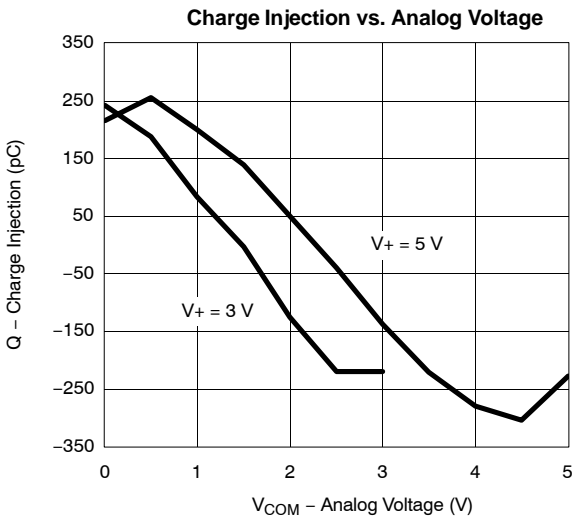
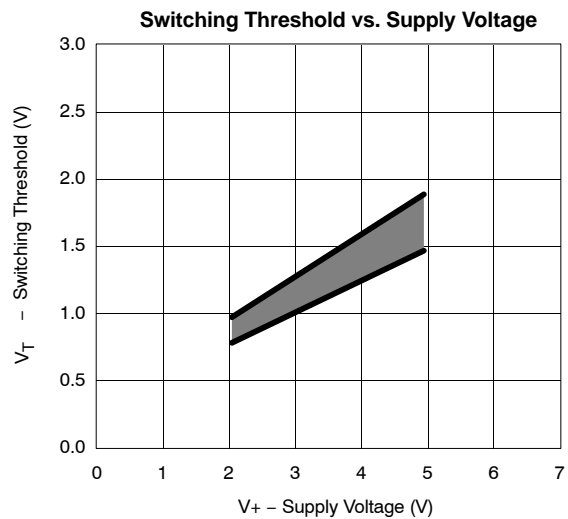
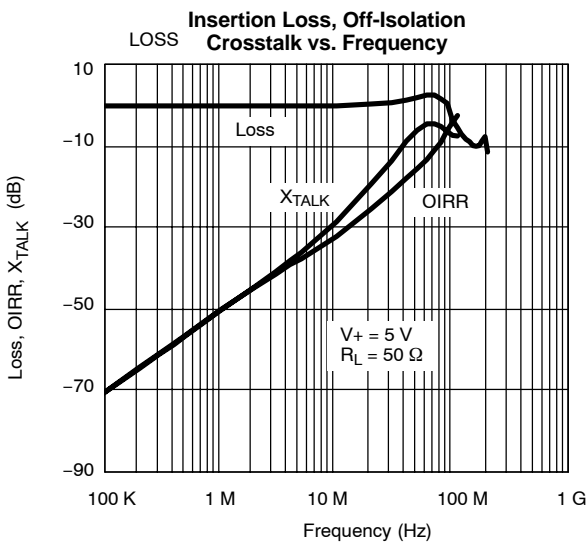
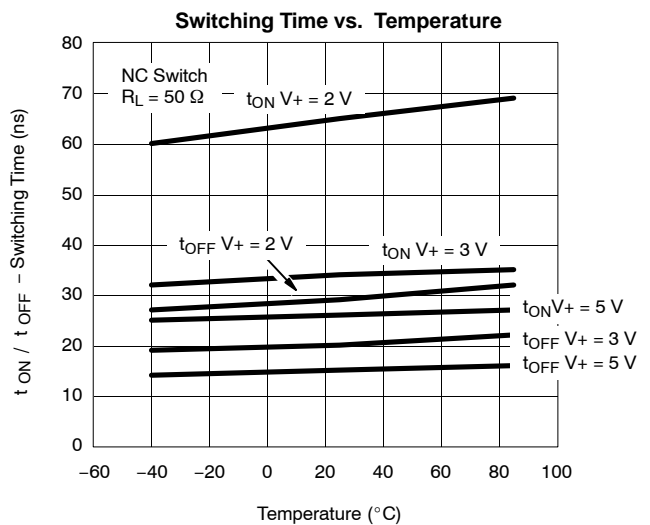
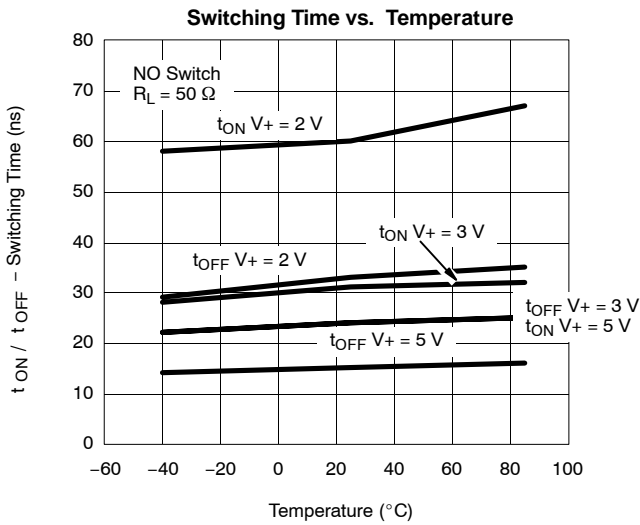
Notes:

- Room = 25°C, Full = as determined by the operating suffix.
- Typical values are for design aid only, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guarantee by design, nor subjected to production test.
- V<sub>IN</sub> = input voltage to perform proper function.

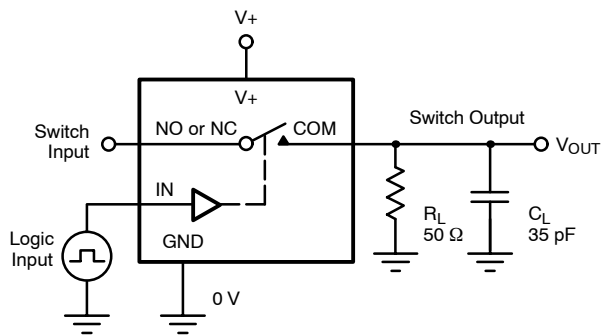
**TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)**
 **$r_{ON}$  vs.  $V_{COM}$  and Supply Voltage**

 **$r_{ON}$  vs. Analog Voltage and Temperature (NC1)**

**Supply Current vs. Temperature**

**Supply Current vs. Input Switching Frequency**

**Leakage Current vs. Temperature**

**Leakage vs. Analog Voltage**




**TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)**

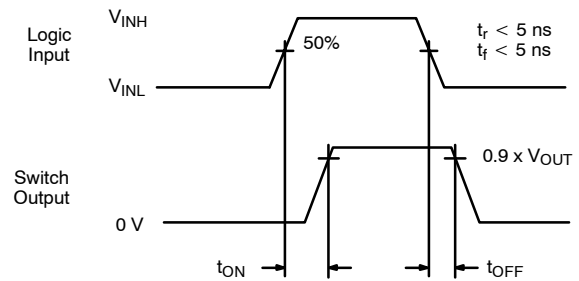


TEST CIRCUITS



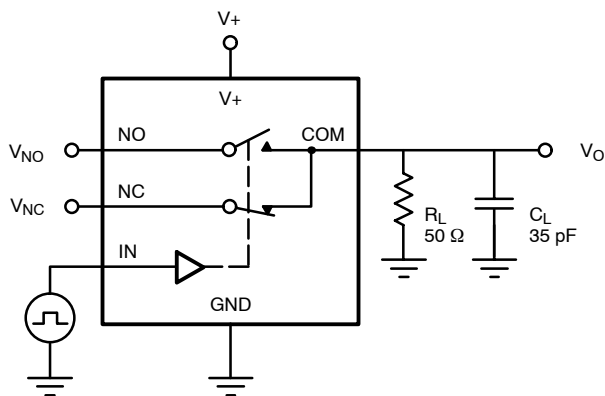
$C_L$  (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM} \left( \frac{R_L}{R_L + R_{ON}} \right)$$



Logic "1" = Switch On  
Logic input waveforms inverted for switches that have the opposite logic sense.

FIGURE 1. Switching Time



$C_L$  (includes fixture and stray capacitance)

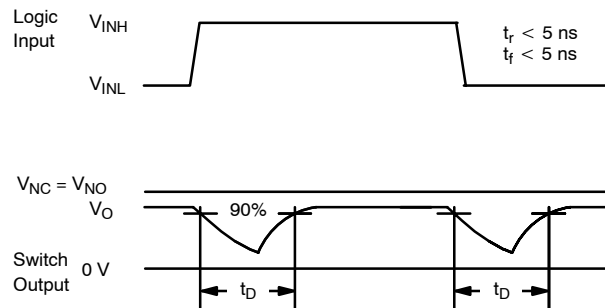
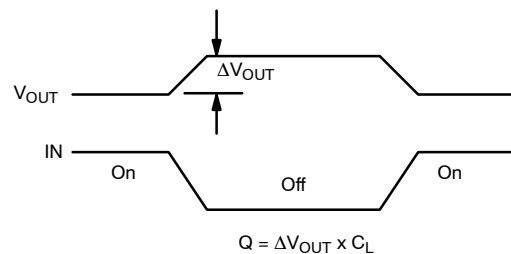
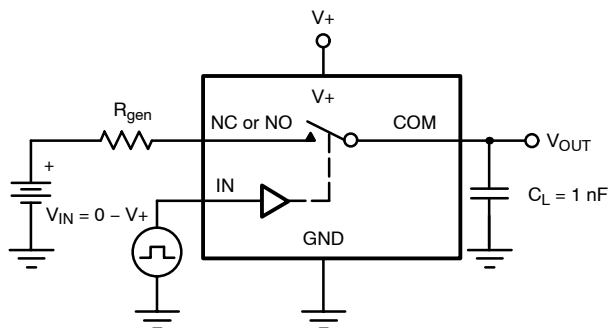


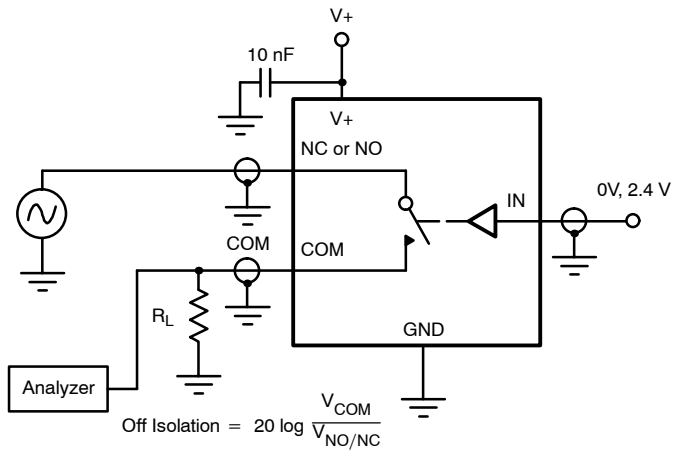
FIGURE 3. Break-Before-Make Interval



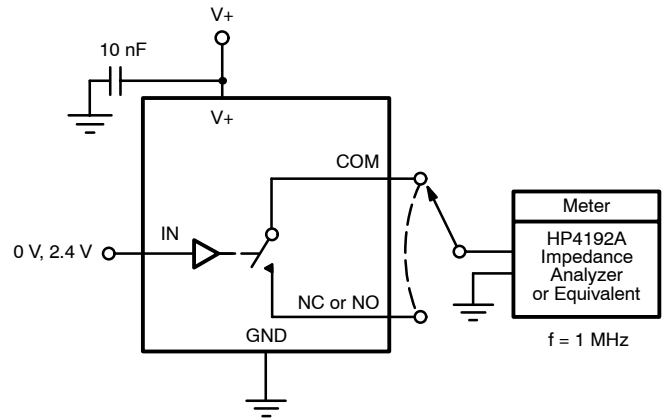
IN depends on switch configuration: input polarity determined by sense of switch.

FIGURE 2. Charge Injection

**TEST CIRCUITS**



**FIGURE 4.** Off-Isolation



**FIGURE 5.** Channel Off/On Capacitance



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