# Low-Voltage, 0.45-Ω, SPDT Analog Switch

## DESCRIPTION

The DG2717 is a low voltage, low on resistance, single- pole/ double-throw (SPDT) monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low-power, high speed, low on-resistance, and small package size, the DG2717 is ideal for portable and battery power applications.

The DG2717 has an operation range from 1.6 V to 4.3 V single supply, and is low voltage logic compatible within this range, allowing the easy interface with low voltage DSP or MCU control logic. These traits make it ideal for one cell Li-ion battery direct power.

The switch conducts signals within power rails equally well in both directions when on, and blocks up to the power supply level when off. Break-before-make is guaranteed.

The DG2717 is built on Vishay Siliconix's sub micron CMOS low voltage process.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device terminations. For analog switching products manufactured in SC89 package, the lead (Pb)-free "E3" suffix is being used as a designator. It has a Tin device termination that meets all JEDEC standards for reflow and MSL rating.

## FEATURES

- Low Voltage Operation (1.6 V to 4.3 V)
- Low On-Resistance - $r_{DS(on)}$: 0.45 Ω Typ.
- Fast Switching - $t_{ON}$: 22 ns, $t_{OFF}$: 8 ns
- Low Leakage
- TTL/CMOS Compatible
- SC-89 (1.6 mm x 1.6 mm) Package

Pb-free
RoHS COMPLIANT

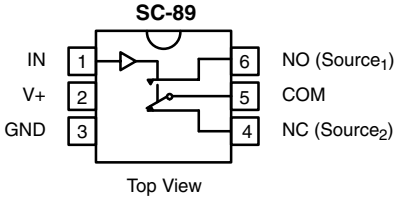
## BENEFITS

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space

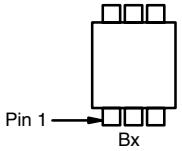
## APPLICATIONS

- Cellular Phones
- PMP/MP3
- Audio and Video Signal Routing
- Power Switch
- Reed Relay Replacement

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION




Top View




Device Marking: Bx
x = Date/Lot Traceability Code

| TRUTH TABLE | | |
|---|---|---|
| **Logic** | **NC** | **NO** |
| 0 | ON | OFF |
| 1 | OFF | ON |

| ORDERING INFORMATION | | |
|---|---|---|
| **Temp Range** | **Package** | **Part Number** |
| - 40 to 85 °C | SC89-6 | DG2717DX-T1-E3 |

## ABSOLUTE MAXIMUM RATINGS

| Parameter | | Limit | Unit |
|---|---|---|---|
| Reference V+ to GND | | - 0.3 to + 5.0 | V |
| IN, COM, NC, NO[a] | | - 0.3 to (V+ + 0.3) | |
| Continuous Current (NO, NC and COM Pins) | | ± 200 | mA |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle) | | ± 300 | |
| Storage Temperature (D Suffix) | | - 65 to 150 | °C |
| Power Dissipation (Packages)[b] | 6-Pin SC89 | 172 | mW |

Notes:
a. Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
b. All leads welded or soldered to PC Board.
c. Derate 2.15 mW/°C above 70 °C.

## SPECIFICATIONS (V+ = 1.8 V)

| Parameter | Symbol | Test Condition Otherwise Unless Specified V+ = 1.8 V, ± 10 %, $V_{IN}$ = 0.4 or 1.0 V[e] | Temp[a] | Limits - 40 to 85 °C Min[b] | Typ[c] | Max[b] | Unit |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[d] | $V_{NO}$, $V_{NC}$, $V_{COM}$ | | Full | 0 | | V+ | V |
| On-Resistance | $r_{ON}$ | V+ = 1.8 V, $V_{COM}$ = 0.2 V, $I_{NO/NC}$ = 100 mA | Room<br>Full | | 1.0 | 2.0<br>2.1 | Ω |
| **Digital Control** | | | | | | | |
| Input High Voltage | $V_{INH}$ | | Full | 1.0 | | | V |
| Input Low Voltage | $V_{INL}$ | | Full | | | 0.4 | |
| Input Capacitance[d] | $C_{in}$ | | Full | | 7 | | pF |
| Input Current[f] | $I_{INL}$ or $I_{INH}$ | $V_{IN}$ = 0 V or V+ | Full | - 1 | | 1 | µA |
| **Dynamic Characteristics** | | | | | | | |
| Turn-On Time[d] | $t_{ON}$ | $V_{NO}$ or $V_{NC}$ = 1.5 V, $R_L$ = 50 Ω, $C_L$ = 35 pF Figures 1 and 2 | Room<br>Full[d] | | 54 | 74<br>81 | ns |
| Turn-Off Time[d] | $t_{OFF}$ | | Room<br>Full[d] | | 14 | 34<br>35 | |
| Break-Before-Make Time[d] | $t_d$ | | Room | 8 | | | |
| Charge Injection[d] | $Q_{INJ}$ | $C_L$ = 1 nF, $V_{GEN}$ = 0 V, $R_{GEN}$ = 0 Ω, Figure 3 | Room | | 26 | | pC |
| Off-Isolation[d] | $O_{IRR}$ | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 1 MHz | Room | | - 54 | | dB |
| Crosstalk[d] | $X_{TALK}$ | | Room | | - 60 | | |
| NO, NC Off Capacitance[d] | $C_{NO(off)}$, $C_{NC(off)}$ | $V_{IN}$ = 0 or V+, f = 1 MHz | Room | | 80 | | pF |
| Channel-On Capacitance[d] | $C_{ON}$ | | Room | | 180 | | |

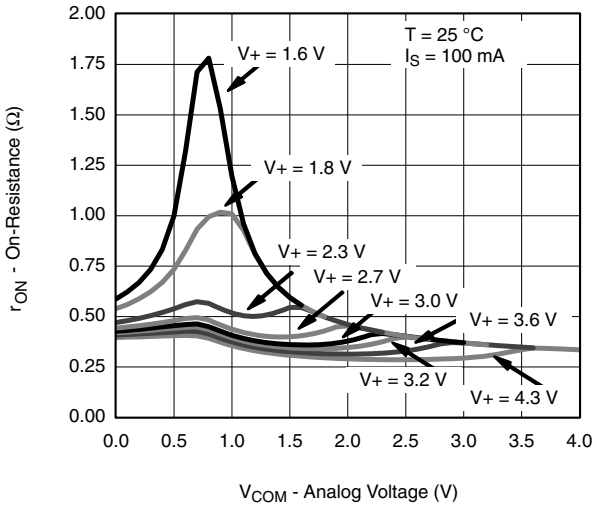
## SPECIFICATIONS (V+ = 3.0 V)

| Parameter | Symbol | Test Condition Otherwise Unless Specified V+ = 2.7 V to 3.6 V, $V_{IN}$ = 0.5 or 1.4 V[e] | Temp[a] | Limits - 40 to 85 °C Min[b] | Typ[c] | Max[b] | Unit |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[d] | $V_{NO}$, $V_{NC}$, $V_{COM}$ | | Full | 0 | | V+ | V |
| On-Resistance | $r_{ON}$ | V+ = 2.7 V, $V_{COM}$ = 1.5 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room<br>Full | | 0.5 | 0.7<br>0.8 | Ω |
| | | V+ = 3.6 V, $V_{COM}$ = 0.5 V, 2.0 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room<br>Full | | 0.45 | 0.65<br>0.75 | |
| $r_{ON}$ Flatness[d] | $r_{ON}$ Flatness | V+ = 2.7 V, $V_{COM}$ = 0.6 V, 2.1 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room | | | 0.2 | |
| $r_{ON}$ Match[d] | $\Delta r_{ON}$ | V+ = 2.7 V, $V_{COM}$ = 1.5 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room | | | 0.6 | |
| Switch Off Leakage Current | $I_{NO(off)}$, $I_{NC(off)}$ | V+ = 4.3 V, $V_{NO}$, $V_{NC}$ = 0.3 V / 4 V, $V_{COM}$ = 4 V / 0.3 V | Room<br>Full | - 10<br>- 100 | | 10<br>100 | nA |
| | $I_{COM(off)}$ | | Room<br>Full | - 10<br>- 100 | | 10<br>100 | |
| Channel-On Leakage Current | $I_{COM(on)}$ | V+ = 4.3 V, $V_{NO}$, $V_{NC}$ = $V_{COM}$ = 0.3 V / 4 V | Room<br>Full | - 10<br>- 100 | | 10<br>100 | |
| **Digital Control** | | | | | | | |
| Input High Voltage | $V_{INH}$ | | Full | 1.4 | | | V |
| Input Low Voltage | $V_{INL}$ | | Full | | | 0.5 | |
| Input Capacitance[d] | $C_{in}$ | | Full | | 7 | | pF |
| Input Current[f] | $I_{INL}$ or $I_{INH}$ | $V_{IN}$ = 0 V or V+ | Full | - 1 | | 1 | µA |
| **Dynamic Characteristics** | | | | | | | |
| Turn-On Time | $t_{ON}$ | V+ = 3.0 V, $V_{NO}$ or $V_{NC}$ = 1.5 V, $R_L$ = 300 Ω, $C_L$ = 35 pF, Figure 1 and 2 | Room<br>Full | | 22 | 44<br>48 | ns |
| Turn-Off Time | $t_{OFF}$ | | Room<br>Full | | 8 | 29<br>30 | |
| Break-Before-Make Time | $t_d$ | | Room | 1 | | | |
| Charge Injection[d] | $Q_{INJ}$ | $C_L$ = 1 nF, $V_{GEN}$ = 0 V, $R_{GEN}$ = 0 Ω, Figure 3 | Room | | 28 | | pC |
| Off-Isolation[d] | $O_{IRR}$ | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 1 MHz | Room | | - 54 | | dB |
| Crosstalk[d] | $X_{TALK}$ | | Room | | - 57 | | |
| NO, NC Off Capacitance[d] | $C_{NO(off)}$, $C_{NC(off)}$ | $V_{IN}$ = 0 or V+, f = 1 MHz | Room | | 76 | | pF |
| Channel-On Capacitance[d] | $C_{ON}$ | | Room | | 178 | | |
| **Power Supply** | | | | | | | |
| Power Supply Range | V+ | | | 1.6 | | 4.3 | V |
| Power Supply Current | I+ | V+ = 3.6 V, $V_{IN}$ = 0 or V+ | | | 0.01 | 1.0 | µA |

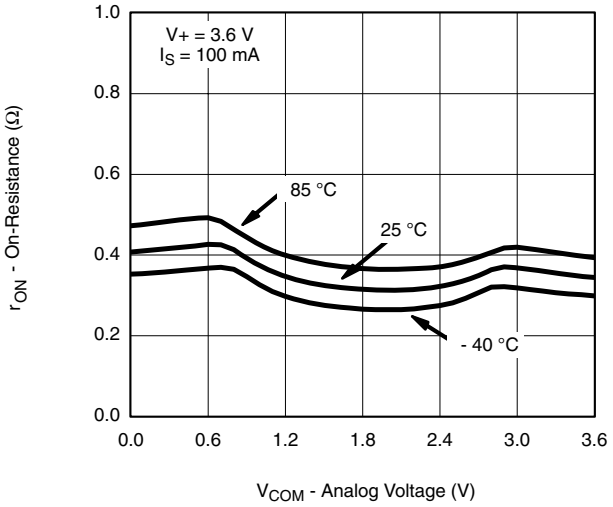
Notes:
a. Room = 25 °C, Full = as determined by the operating suffix.
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c. Typical values are for design aid only, not guaranteed nor subject to production testing.
d. Guarantee by design, nor subjected to production test.
e. $V_{IN}$ = input voltage to perform proper function.

*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.*

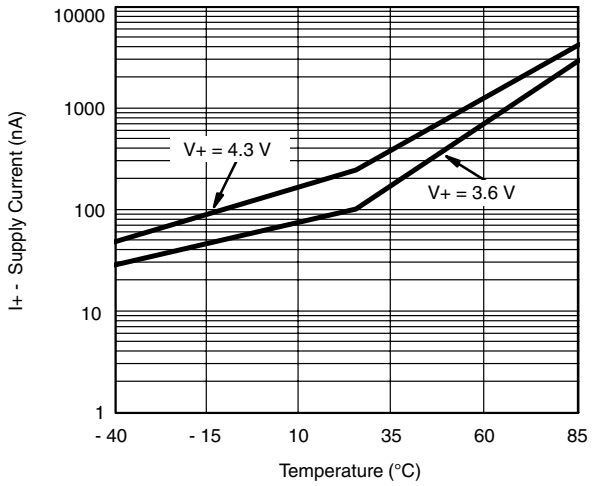
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



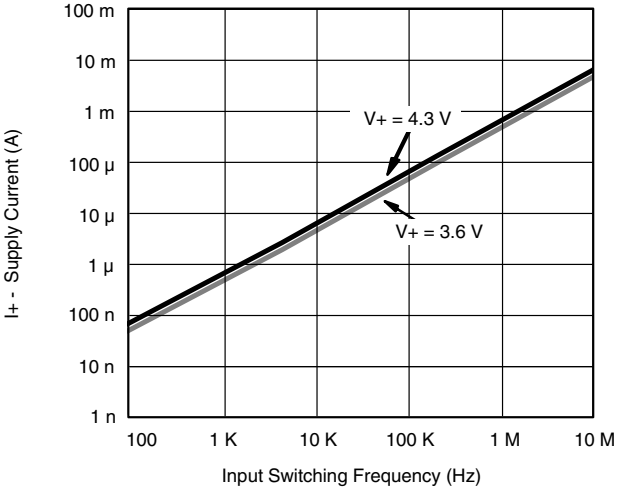

**$r_{ON}$ vs. $V_{COM}$ and Single Supply Voltage**



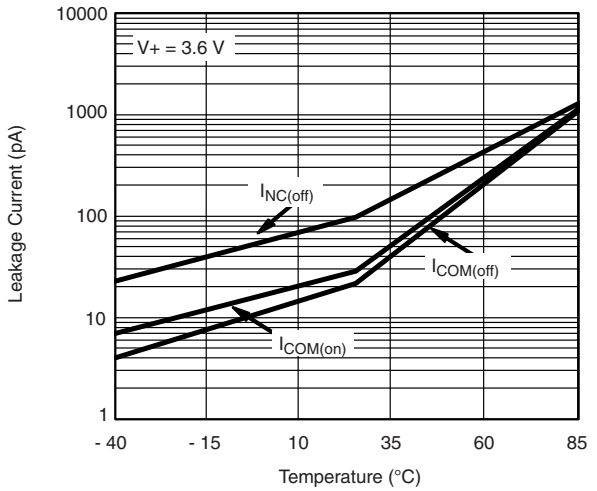

**$r_{ON}$ vs. Analog Voltage and Temperature**



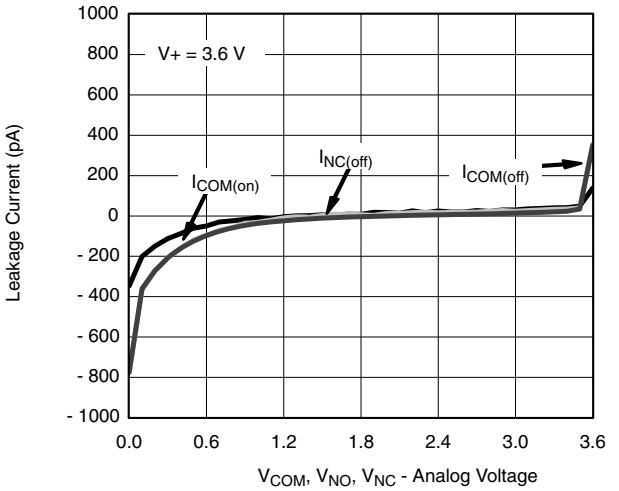

**Supply Current vs. Temperature**




**Supply Current vs. Input Switching Frequency**

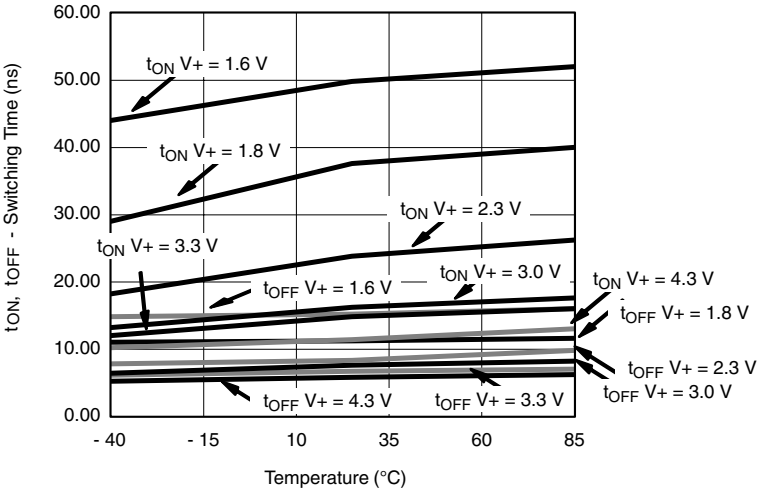



**Leakage Current vs. Temperature**

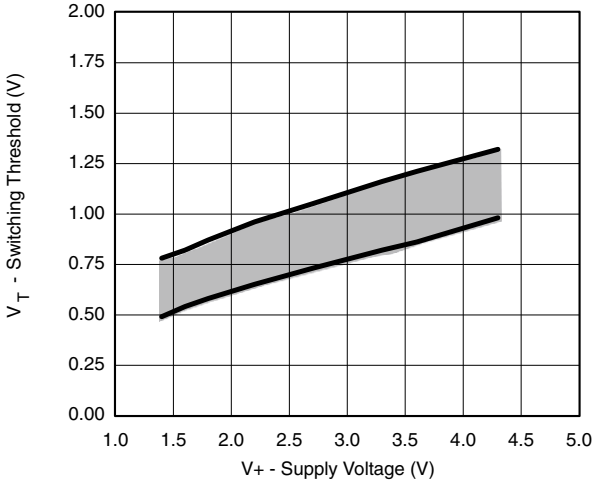



**Leakage vs. Analog Voltage**

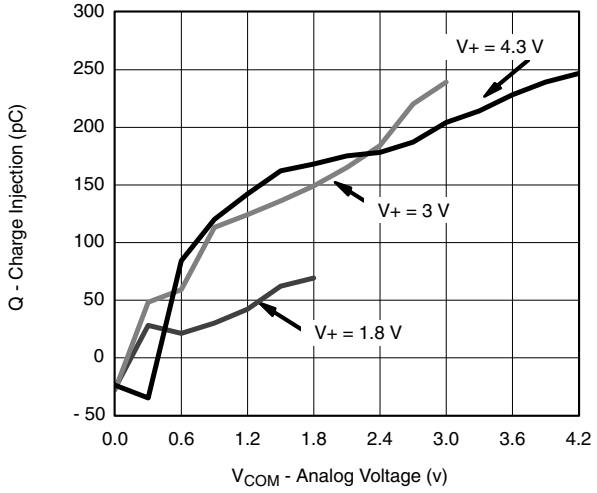
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



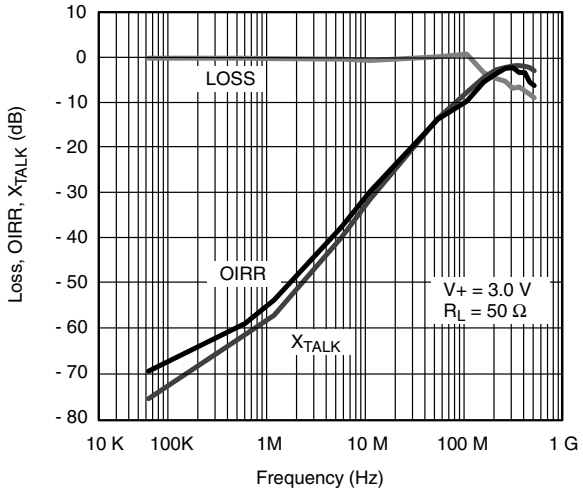

**Switching Time vs. Temperature**




**Switching Threshold vs. Supply Voltage**

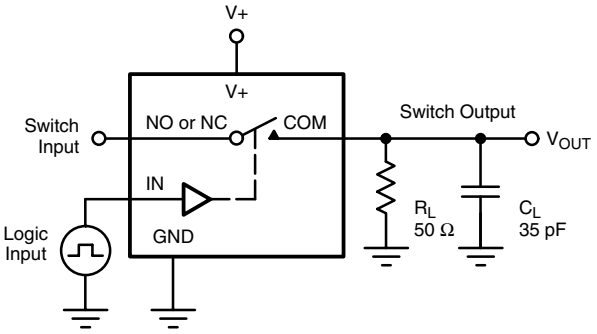



**Charge Injection vs. Analog Voltage**



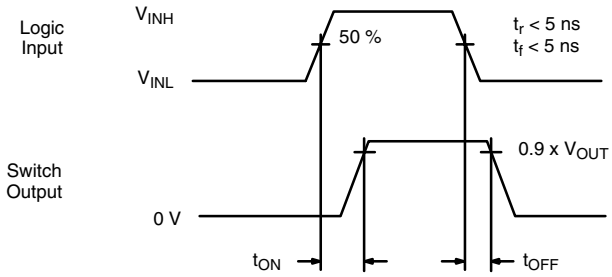

**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**

## TEST CIRCUITS



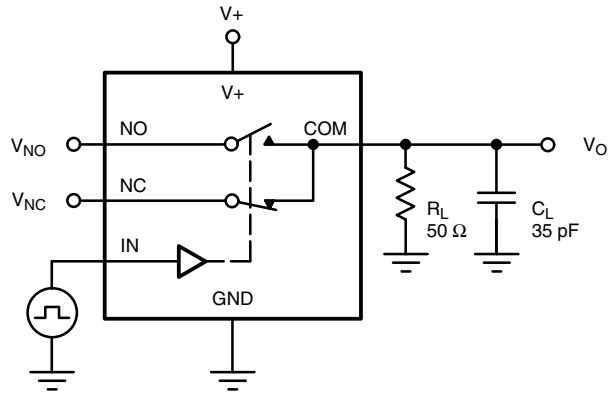

$C_L$ (includes fixture and stray capacitance)

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




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)

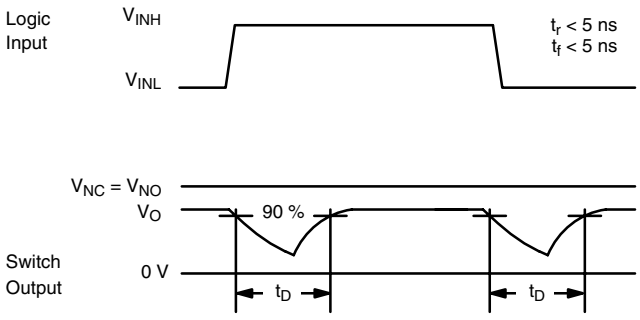
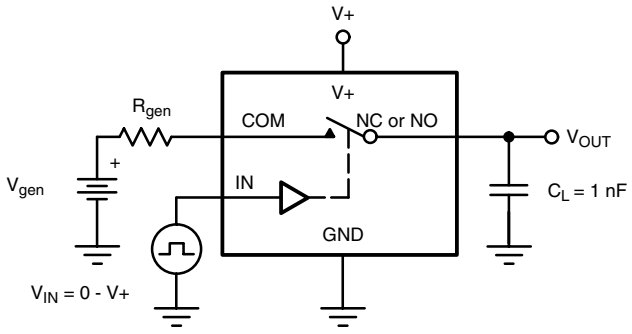
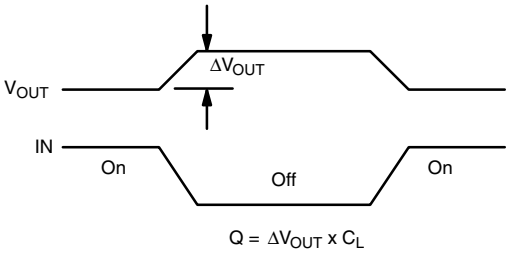



**Figure 2. Break-Before-Make Interval**




Q = $\Delta V_{OUT}$ x $C_L$

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

**Figure 3. Charge Injection**

## TEST CIRCUITS

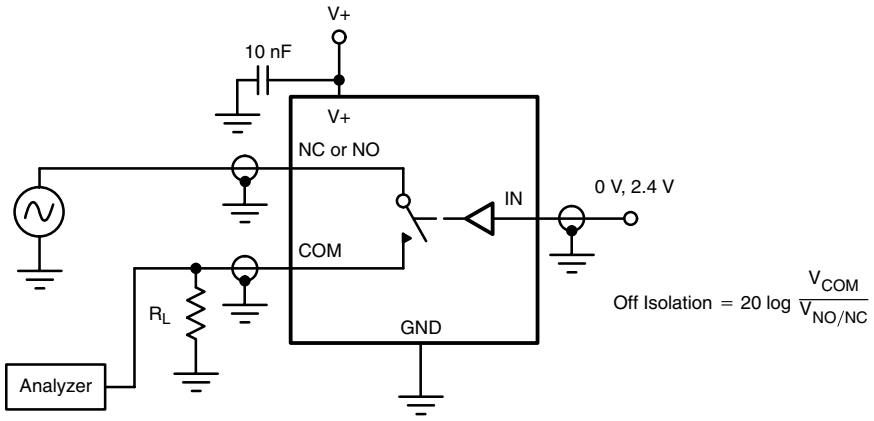



**Figure 4. Off-Isolation**

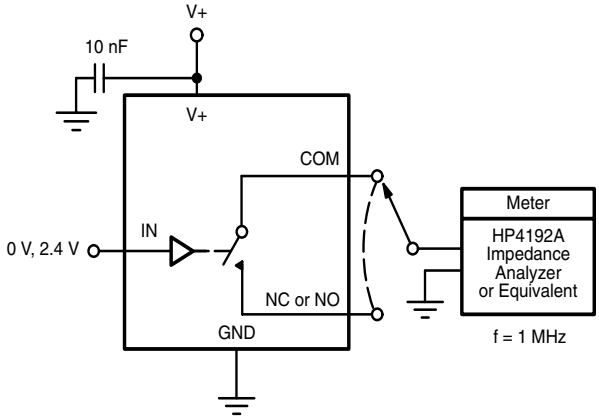



**Figure 5. Channel Off/On Capacitance**

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