

## Low-Voltage Dual SPST Analog Switch

### FEATURES

- Low Voltage Operation (+2.7 to +5 V)
- Low On-Resistance -  $r_{DS(on)}$ : 20  $\Omega$
- Fast Switching -  $t_{ON}$ : 35 ns,  $t_{OFF}$ : 20 ns
- Low Leakage -  $I_{COM(on)}$ : 200-pA max
- Low Charge Injection -  $Q_{INJ}$ : 1 pC
- Low Power Consumption
- TTL/CMOS Compatible
- ESD Protection > 2000 V (Method 3015.7)
- Available in MSOP-8 and SOIC-8

### BENEFITS

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

### APPLICATIONS

- Battery Operated Systems
- Portable Test Equipment
- Sample and Hold Circuits
- Cellular Phones
- Communication Systems
- Military Radio
- PBX, PABX Guidance and Control Systems

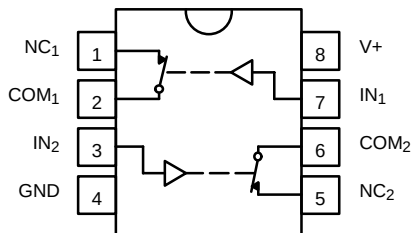
### DESCRIPTION

The DG9232/9233 is a single-pole/single-throw monolithic CMOS analog device designed for high performance switching of analog signals. Combining low power, high speed ( $t_{ON}$ : 35 ns,  $t_{OFF}$ : 20 ns), low on-resistance ( $r_{DS(on)}$ : 20  $\Omega$ ) and small physical size, the DG9232/9233 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

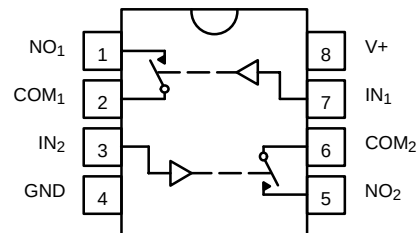
The DG9232/9233 is built on Vishay Siliconix's low voltage BCD-15 process. Minimum ESD protection, per Method 3015.7 is 2000 V. An epitaxial layer prevents latchup. Break-before -make is guaranteed for DG9232/9233.

Each switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Top View



Top View

| TRUTH TABLE - DG9232 |        |
|----------------------|--------|
| Logic                | Switch |
| 0                    | On     |
| 1                    | Off    |

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 2.4$  V

| TRUTH TABLE - DG9233 |        |
|----------------------|--------|
| Logic                | Switch |
| 0                    | Off    |
| 1                    | On     |

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 2.4$  V

| ORDERING INFORMATION |         |             |
|----------------------|---------|-------------|
| Temp Range           | Package | Part Number |
| -40 to 85°C          | SOIC-8  | DG9232DY    |
|                      |         | DG9233DY    |
|                      | MSOP-8  | DG9232DQ    |
|                      |         | DG9233DQ    |

## ABSOLUTE MAXIMUM RATINGS

Reference to GND

V+ ..... -0.3 to +13 V

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

Continuous Current (Any terminal) ..... ± 20 mA

Peak Current ..... ± 40 mA

(Pulsed at 1ms, 10% duty cycle)

ESD (Method 3015.7) ..... &gt; 2000 V

Storage Temperature (D Suffix) ..... -65 to 125°C

Power Dissipation (Packages)<sup>b</sup>8-Pin Narrow Body SOIC<sup>c</sup> ..... 400 mW

Notes:

- Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC Board.
- Derate 6.5 mW/°C above 75°C

| SPECIFICATIONS (V+ = 3 V)                 |                     |                                                                                                   |                   |                         |                  |                  |      |
|-------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------|-------------------|-------------------------|------------------|------------------|------|
| Parameter                                 | Symbol              | Test Conditions<br>Otherwise Unless Specified<br>V+ = 3 V, ± 10%, VIN = 0.8 or 2.4 V <sup>e</sup> | Temp <sup>a</sup> | D Suffix<br>−40 to 85°C |                  |                  | Unit |
|                                           |                     |                                                                                                   |                   | Min <sup>c</sup>        | Typ <sup>b</sup> | Max <sup>c</sup> |      |
| Analog Switch                             |                     |                                                                                                   |                   |                         |                  |                  |      |
| Analog Signal Range <sup>d</sup>          | VANALOG             |                                                                                                   | Full              | 0                       |                  | 3                | V    |
| Drain-Source On-Resistance                | rDS(on)             | VNO or VNC = 1.5 V, V+ = 2.7 V<br>ICOM = 5 mA                                                     | Room<br>Full      |                         | 30               | 50<br>80         | Ω    |
| rDS(on) Match <sup>d</sup>                | ΔrDS(on)            | VNO or VNC = 1.5 V                                                                                | Room              |                         | 0.4              | 2                |      |
| rDS(on) Flatness <sup>d</sup>             | rDS(on)<br>Flatness | VNO or VNC = 1 and 2 V                                                                            | Room              |                         | 4                | 8                |      |
| NO or NC Off Leakage Current <sup>g</sup> | INO/NC(off)         | VNO or VNC = 1 V / 2 V, VCOM = 2 V / 1 V                                                          | Room<br>Full      | −100<br>−5000           | 5                | 100<br>5000      | pA   |
| COM Off Leakage Current <sup>g</sup>      | ICOM(off)           | VCOM = 1 V / 2 V, VNO or VNC = 2 V / 1 V                                                          | Room<br>Full      | −100<br>−5000           | 5                | 100<br>5000      |      |
| Channel-On Leakage Current <sup>g</sup>   | ICOM(on)            | VCOM = VNO or VNC = 1 V / 2 V                                                                     | Room<br>Full      | −200<br>−10000          | 10               | 200<br>10000     |      |
| Digital Control                           |                     |                                                                                                   |                   |                         |                  |                  |      |
| Input Current                             | IINL or IINH        |                                                                                                   | Full              |                         | 1                |                  | μA   |
| Dynamic Characteristics                   |                     |                                                                                                   |                   |                         |                  |                  |      |
| Turn-On Time                              | tON                 | VNO or VNC = 1.5 V                                                                                | Room<br>Full      |                         | 50               | 120<br>200       | ns   |
| Turn-Off Time                             | tOFF                |                                                                                                   | Room<br>Full      |                         | 20               | 50<br>120        |      |
| Charge Injection <sup>d</sup>             | QINJ                | CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω                                                                 | Room              |                         | 1                | 5                | pC   |
| Off-Isolation                             | OIRR                | RL = 50 Ω, CL = 5 pF, f = 1 MHz                                                                   | Room              |                         | −74              |                  | dB   |
| Crosstalk                                 | XTALK               |                                                                                                   | Room              |                         | −90              |                  |      |
| NC and NO Capacitance                     | C(off)              | f = 1 MHz                                                                                         | Room              |                         | 7                |                  | pF   |
| Channel-On Capacitance                    | CCOM(on)            |                                                                                                   | Room              |                         | 20               |                  |      |
| Com-Off Capacitance                       | CCOM(off)           |                                                                                                   | Room              |                         | 13               |                  |      |
| Power Supply                              |                     |                                                                                                   |                   |                         |                  |                  |      |
| Power Supply Range                        | V+                  |                                                                                                   |                   | 2.7                     |                  | 12               | V    |
| Power Supply Current                      | I+                  | V+ = 3.3 V, VIN = 0 or 3.3 V                                                                      |                   |                         |                  | 1                | 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.
- Difference of min and max values.
- Guaranteed by 5-V leakage tests, not production tested.

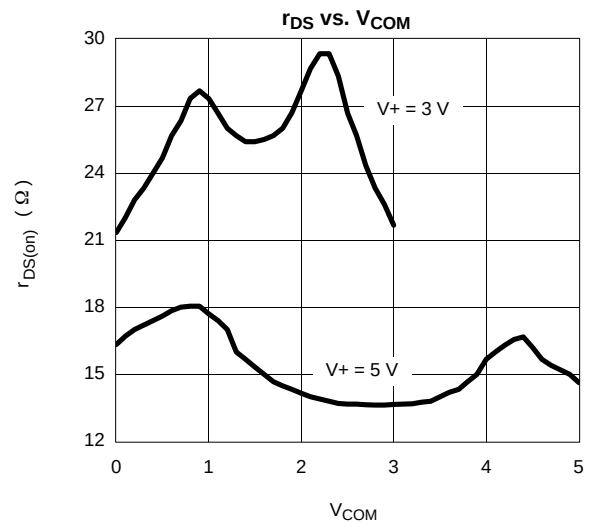
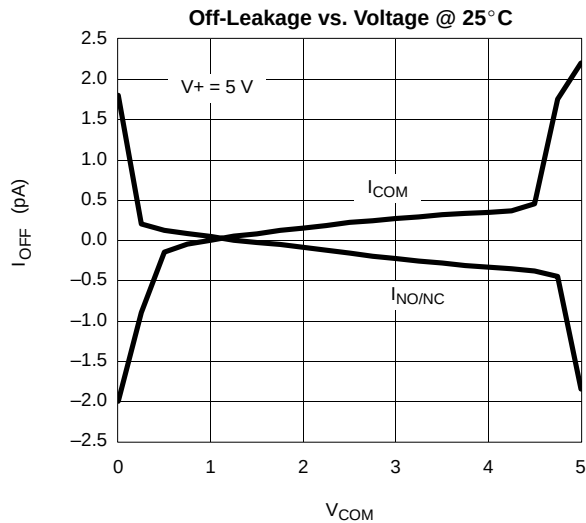
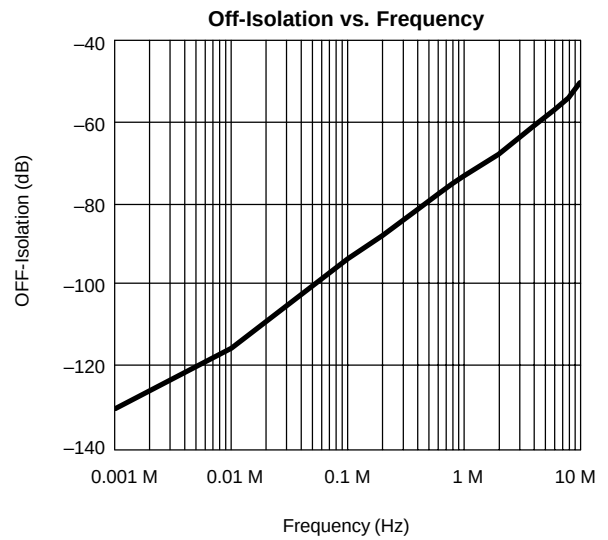
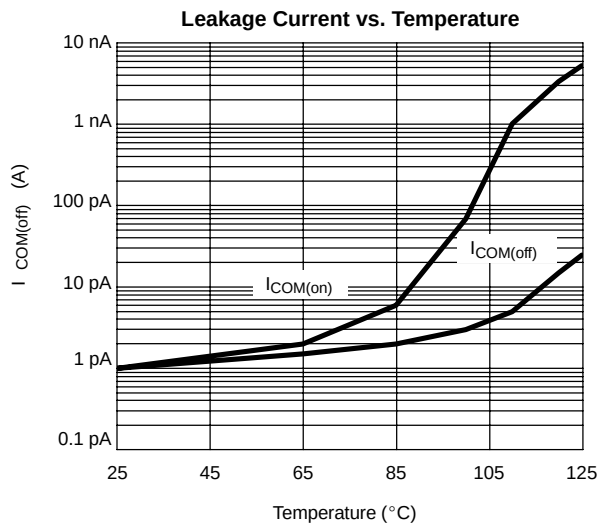
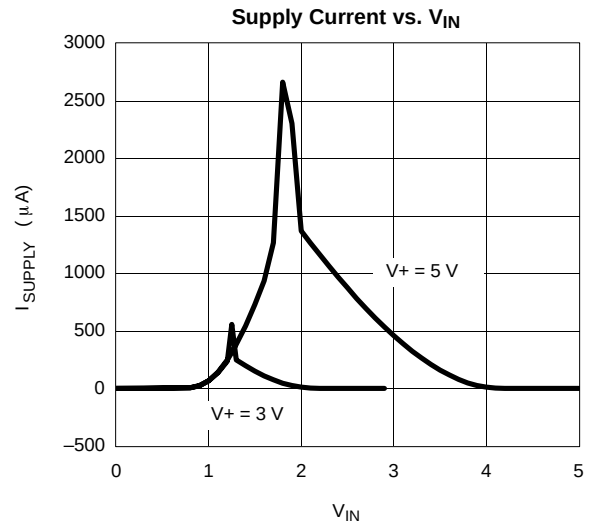
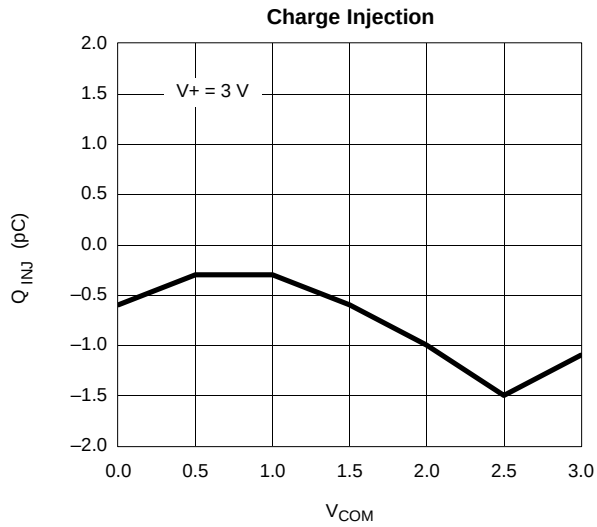


| SPECIFICATIONS (V+ = 5 V)                 |                                      |                                                                                                      |                   |                         |                  |                  |      |
|-------------------------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------|-------------------|-------------------------|------------------|------------------|------|
| Parameter                                 | Symbol                               | Test Conditions<br>Otherwise Unless Specified<br><br>V+ = 5 V, ±10%, VIN = 0.8 or 2.4 V <sup>e</sup> | Temp <sup>a</sup> | D Suffix<br>–40 to 85°C |                  |                  | Unit |
|                                           |                                      |                                                                                                      |                   | Min <sup>c</sup>        | Typ <sup>b</sup> | Max <sup>c</sup> |      |
| Analog Switch                             |                                      |                                                                                                      |                   |                         |                  |                  |      |
| Analog Signal Range <sup>d</sup>          | V <sub>ANALOG</sub>                  |                                                                                                      | Full              | 0                       |                  | 5                | V    |
| Drain-Source On-Resistance                | r <sub>DS(on)</sub>                  | V <sub>NO</sub> or V <sub>NC</sub> = 3.5 V, V+ = 4.5 V<br>I <sub>COM</sub> = 5 mA                    | Room<br>Full      |                         | 20               | 30<br>50         | Ω    |
| r <sub>DS(on)</sub> Match <sup>d</sup>    | Δr <sub>DS(on)</sub>                 | V <sub>NO</sub> or V <sub>NC</sub> = 3.5 V                                                           | Room              |                         | 0.4              | 2                |      |
| r <sub>DS(on)</sub> Flatness <sup>d</sup> | r <sub>DS(on)</sub><br>Flatness      | V <sub>NO</sub> or V <sub>NC</sub> = 1, 2, and 3 V                                                   | Room              |                         | 2                | 6                |      |
| NO or NC Off Leakage Current              | I <sub>NO/NC(off)</sub>              | V <sub>NO</sub> or V <sub>NC</sub> = 1 V / 4 V, V <sub>COM</sub> = 4 V / 1 V                         | Room<br>Full      | –100<br>–5000           | 10               | 100<br>5000      | pA   |
| COM Off Leakage Current                   | I <sub>COM(off)</sub>                | V <sub>COM</sub> = 1 V / 4 V, V <sub>NO</sub> or V <sub>NC</sub> = 4 V / 1 V                         | Room<br>Full      | –100<br>–5000           | 10               | 100<br>5000      |      |
| Channel-On Leakage Current                | I <sub>COM(on)</sub>                 | V <sub>COM</sub> = V <sub>NO</sub> or V <sub>NC</sub> = 1 V / 4 V                                    | Room<br>Full      | –200<br>–10000          |                  | 200<br>10000     |      |
| Digital Control                           |                                      |                                                                                                      |                   |                         |                  |                  |      |
| Input Current                             | I <sub>INL</sub> or I <sub>INH</sub> |                                                                                                      | Full              |                         | 1                |                  | μA   |
| Dynamic Characteristics                   |                                      |                                                                                                      |                   |                         |                  |                  |      |
| Turn-On Time                              | t <sub>ON</sub>                      | V <sub>NO</sub> or V <sub>NC</sub> = 3.0 V                                                           | Room<br>Full      |                         | 35               | 75<br>150        | ns   |
| Turn-Off Time                             | t <sub>OFF</sub>                     |                                                                                                      | Room<br>Full      |                         | 20               | 50<br>100        |      |
| Charge Injection <sup>d</sup>             | Q <sub>INJ</sub>                     | C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 0 V, R <sub>GEN</sub> = 0 Ω                                | Room              |                         | 2                | 5                | pC   |
| Off-Isolation                             | OIRR                                 | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                              | Room              |                         | –74              |                  | dB   |
| Crosstalk                                 | X <sub>TALK</sub>                    |                                                                                                      | Room              |                         | –90              |                  |      |
| NC and NO Capacitance                     | C <sub>(off)</sub>                   | f = 1 MHz                                                                                            | Room              |                         | 7                |                  | pF   |
| Channel-On Capacitance                    | C <sub>D(on)</sub>                   |                                                                                                      | Room              |                         | 20               |                  |      |
| Com-Off Capacitance                       | C <sub>D(off)</sub>                  |                                                                                                      | Room              |                         | 13               |                  |      |
| Power Supply                              |                                      |                                                                                                      |                   |                         |                  |                  |      |
| Power Supply Range                        | V+                                   |                                                                                                      |                   | 2.7                     |                  | 12               | V    |
| Power Supply Current                      | I+                                   | V+ = 5.5 V, VIN = 0 or 5.5 V                                                                         |                   |                         |                  | 1                | μA   |

Notes:

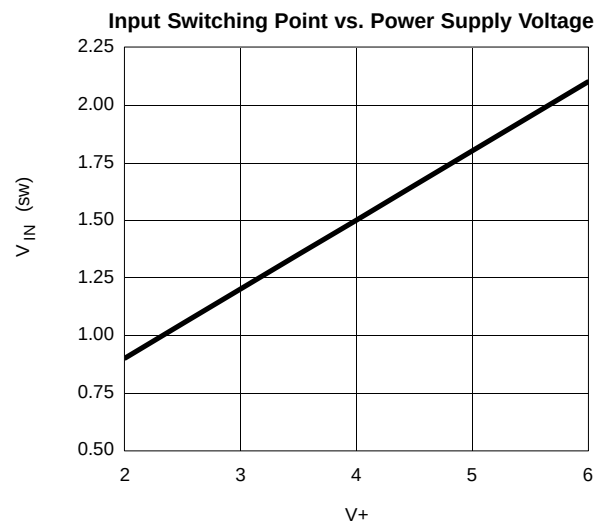
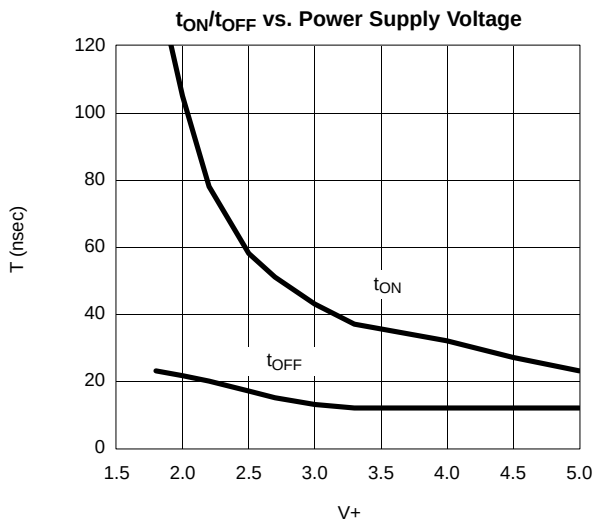
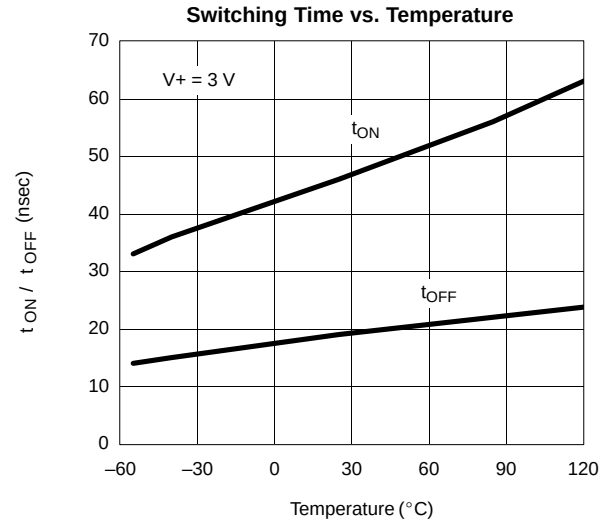
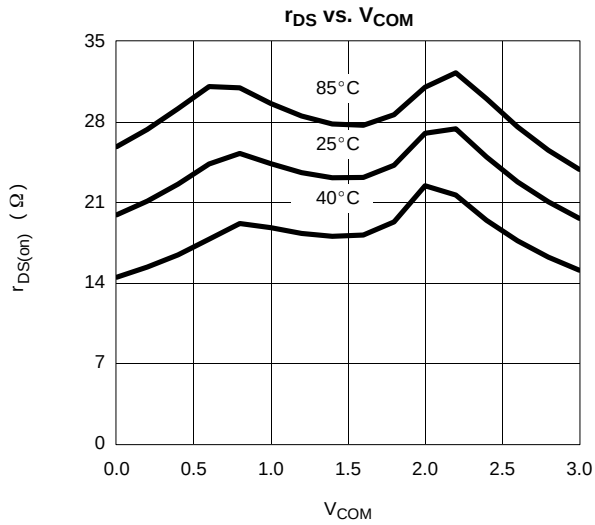
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- Difference of min and max values.

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

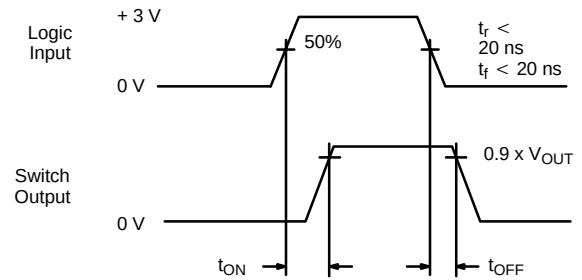
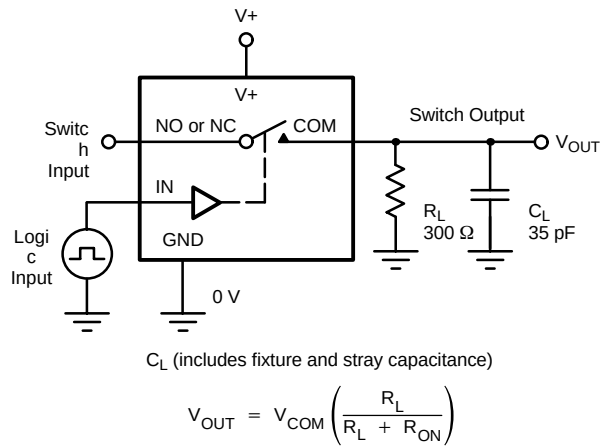




**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



TEST CIRCUITS



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

FIGURE 1. Switching Time

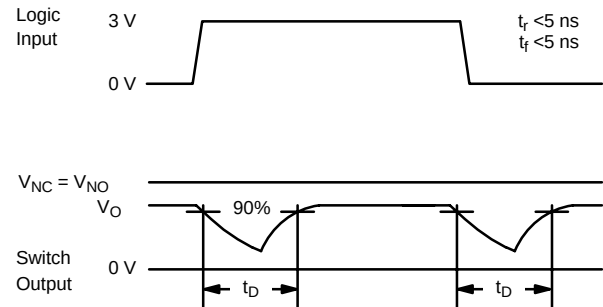
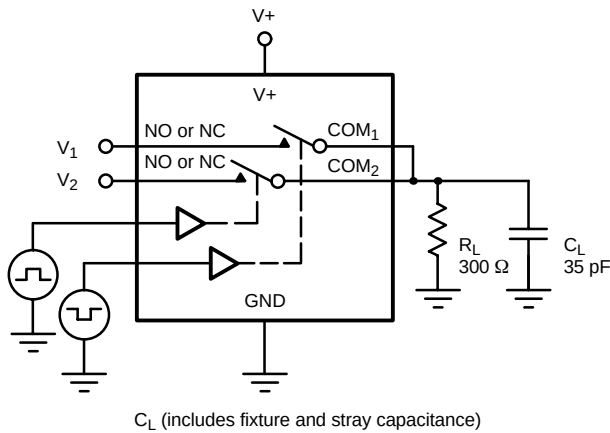
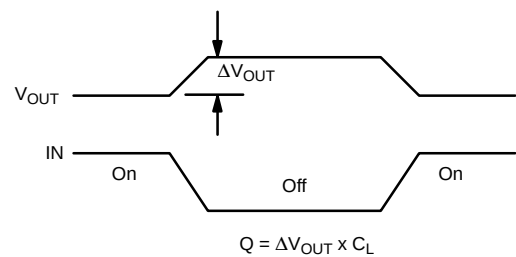
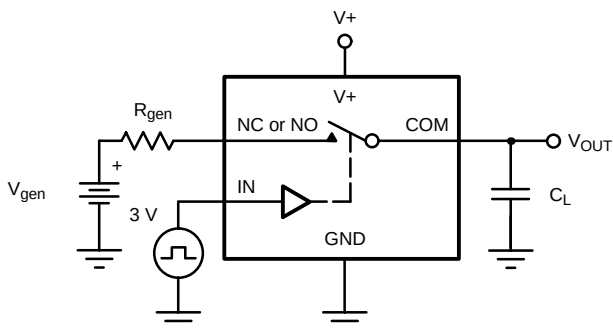


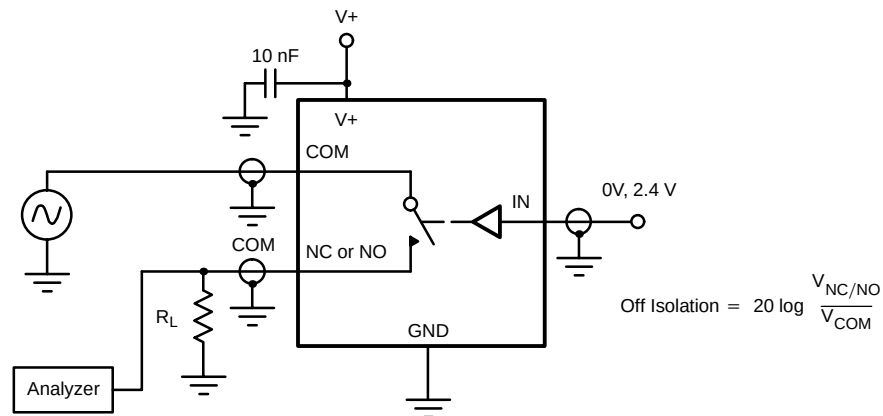
FIGURE 2. Break-Before-Make Interval



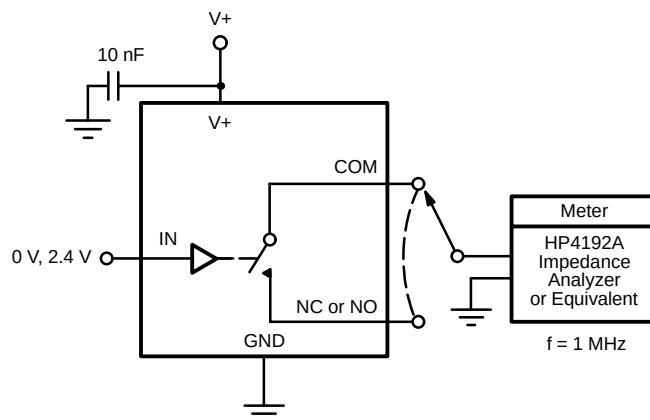
IN depends on switch configuration: input polarity determined by sense of switch.

FIGURE 3. Charge Injection

**TEST CIRCUITS**



**FIGURE 4.** Off-Isolation



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