



## Low-Voltage, Low $r_{ON}$ , Single SPDT Analog Switch In SC-89 Package

### FEATURES

- Low Voltage Operation (1.8 V to 5.5 V)
- Low On-Resistance -  $r_{ON}$ : 1.8  $\Omega$  @ 2.7 V
- Low Charge Injection
- Low Voltage Logic Compatible
- SC-89 Package (1.6 x 1.6 mm)

### BENEFITS

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space
- Guaranteed 2-V Operation

### APPLICATIONS

- Cellular Phones
- Communication Systems
- Portable Test Equipment
- Battery Operated Systems
- Sample and Hold Circuits
- ADC and DAC Applications
- Low Voltage Data Acquisition Systems

### DESCRIPTION

The DG2011 is a low on-resistance, single-pole/double-throw monolithic CMOS analog switch. It is designed for low voltage applications with guaranteed operation at 2 V. The DG2011 is ideal for portable and battery powered equipment, requiring high performance and efficient use of board space. In addition to the low on-resistance (1.8  $\Omega$  @ 2.7 V), charge injection is less than 10 pC over the entire analog range.

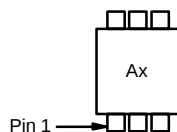
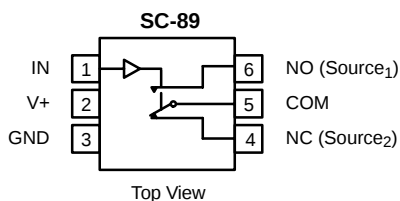
The switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

The DG2011 is built on Vishay Siliconix's low voltage J12 process. An epitaxial layer prevents latchup.

Break-before-make is guaranteed.

The DG2011 represents a breakthrough in packaging development for analog switching products. The SC-89 package (1.6 x 1.6 mm<sup>2</sup>) – also known as SOT-666 in the industry – reduces board spacing by approximately 40% while obtaining performance comparable to SC-70 analog switch devices available today.

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: Ax  
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 | SC-89 (SOT-666) | DG2011DX    |



## 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 pins)         | ±150 mA              |
| Peak Current (Pulsed at 1 ms, 10% duty cycle) | ±300 mA              |
| Storage Temperature (D Suffix)                | -65 to 150°C         |

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

|                    |        |
|--------------------|--------|
| SC-89 <sup>c</sup> | 172 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 2.15 mW/°C above 70°C

| SPECIFICATIONS (V+ = 2.0 V)                                  |                                                         |                                                                                                              |                   |                       |                  |                  |      |
|--------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|------------------|------------------|------|
| Parameter                                                    | Symbol                                                  | Test Conditions<br>Otherwise Unless Specified<br><br>V+ = 2.0 V, V <sub>IN</sub> = 0.4 or 1.6 V <sup>e</sup> | Temp <sup>a</sup> | Limits<br>-40 to 85°C |                  |                  | Unit |
|                                                              |                                                         |                                                                                                              |                   | Min <sup>b</sup>      | Typ <sup>c</sup> | Max <sup>b</sup> |      |
| Analog Switch                                                |                                                         |                                                                                                              |                   |                       |                  |                  |      |
| Analog Signal Range <sup>d</sup>                             | V <sub>NO</sub> , V <sub>NC</sub> ,<br>V <sub>COM</sub> |                                                                                                              | Full              | 0                     |                  | V+               | V    |
| On-Resistance                                                | r <sub>ON</sub>                                         | V+ = 2.0 V, V <sub>COM</sub> = 0.2 V/0.9 V<br>I <sub>NO</sub> , I <sub>NC</sub> = 20 mA                      | Room<br>Full      |                       | 3.5              | 5.5<br>5.5       | Ω    |
| Switch Off Leakage Current <sup>f</sup>                      | I <sub>NO(off)</sub> ,<br>I <sub>NC(off)</sub>          | V+ = 2.2 V<br>V <sub>NO</sub> , V <sub>NC</sub> = 0.5 V/1.5 V, V <sub>COM</sub> = 1.5 V/0.5 V                | Room<br>Full      | -1<br>-10             |                  | 1<br>10          | nA   |
|                                                              | I <sub>COM(off)</sub>                                   |                                                                                                              | Room<br>Full      | -1<br>-10             |                  | 1<br>10          |      |
| Channel-On Leakage Current <sup>f</sup>                      | I <sub>COM(on)</sub>                                    | V+ = 2.2 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.5 V/1.5 V                               | Room<br>Full      | -1<br>-10             |                  | 1<br>10          |      |
| Digital Control                                              |                                                         |                                                                                                              |                   |                       |                  |                  |      |
| Input High Voltage                                           | V <sub>INH</sub>                                        |                                                                                                              | Full              | 1.5                   |                  |                  | V    |
| Input Low Voltage                                            | V <sub>INL</sub>                                        |                                                                                                              | Full              |                       |                  | 0.4              |      |
| Input Capacitance                                            | C <sub>in</sub>                                         |                                                                                                              | Full              |                       | 4                |                  | pF   |
| Input Current                                                | I <sub>INL</sub> or I <sub>INH</sub>                    | V <sub>IN</sub> = 0 or V+                                                                                    | Full              | 1                     |                  | 1                | μA   |
| Dynamic Characteristics                                      |                                                         |                                                                                                              |                   |                       |                  |                  |      |
| Turn-On Time                                                 | t <sub>ON</sub>                                         | V <sub>NO</sub> or V <sub>NC</sub> = 1.5 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                   | Room<br>Full      |                       | 75               | 110<br>113       | ns   |
| Turn-Off Time                                                | t <sub>OFF</sub>                                        |                                                                                                              | Room<br>Full      |                       | 37               | 71<br>76         |      |
| Break-Before-Make Time                                       | t <sub>BBM</sub>                                        |                                                                                                              | Room              | 1                     | 37               |                  |      |
| 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              |                       | 7                |                  | pC   |
| Off-Isolation <sup>d</sup>                                   | OIRR                                                    | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                                      | Room              |                       | -62              |                  | dB   |
| Crosstalk <sup>d</sup>                                       | X <sub>TALK</sub>                                       |                                                                                                              | Room              |                       | -69              |                  |      |
| N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup> | C <sub>NO(off)</sub> ,<br>C <sub>NC(off)</sub>          | V <sub>IN</sub> = 0 or V+, f = 1 MHz                                                                         | Room              |                       | 29               |                  | pF   |
| Channel-On Capacitance <sup>d</sup>                          | C <sub>ON</sub>                                         |                                                                                                              | Room              |                       | 85               |                  |      |
| Power Supply                                                 |                                                         |                                                                                                              |                   |                       |                  |                  |      |
| Power Supply Range                                           | V+                                                      |                                                                                                              |                   | 1.8                   |                  | 5.5              | V    |
| Power Supply Current                                         | I+                                                      | V <sub>IN</sub> = 0 or V+                                                                                    |                   |                       | 0.01             | 1.0              | μA   |



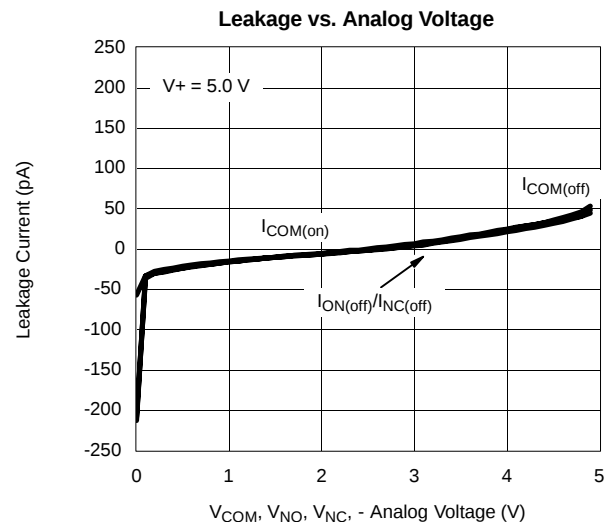
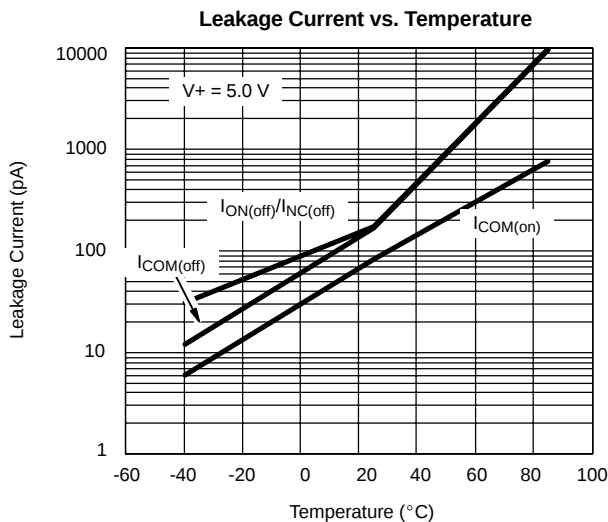
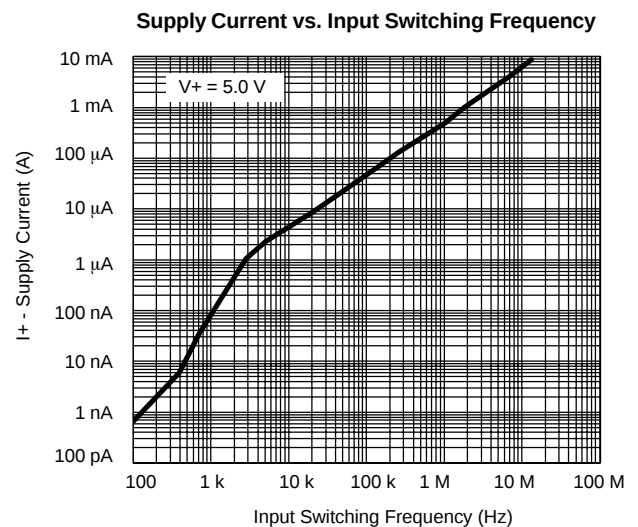
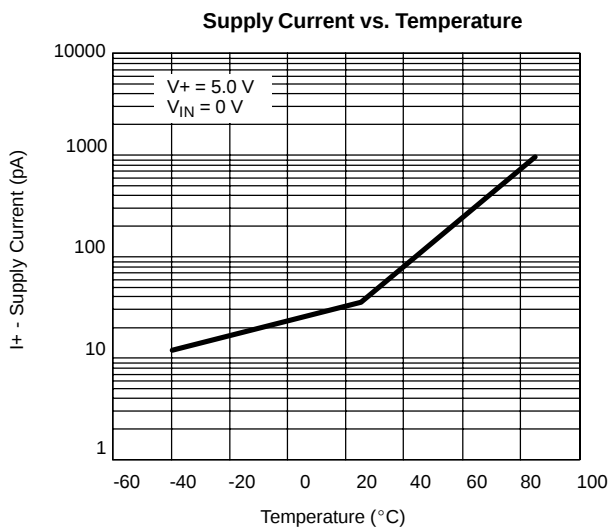
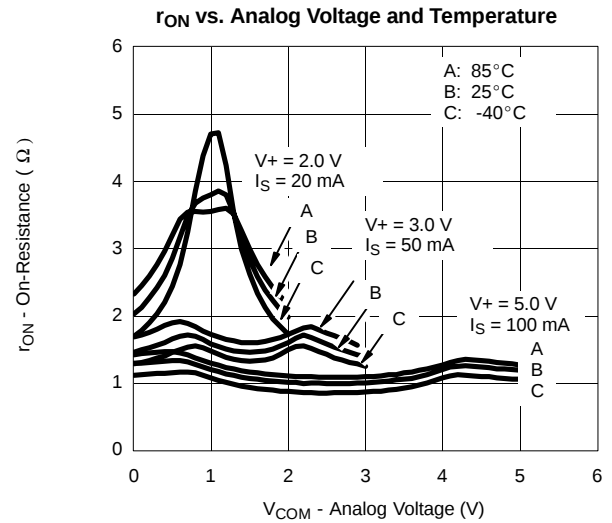
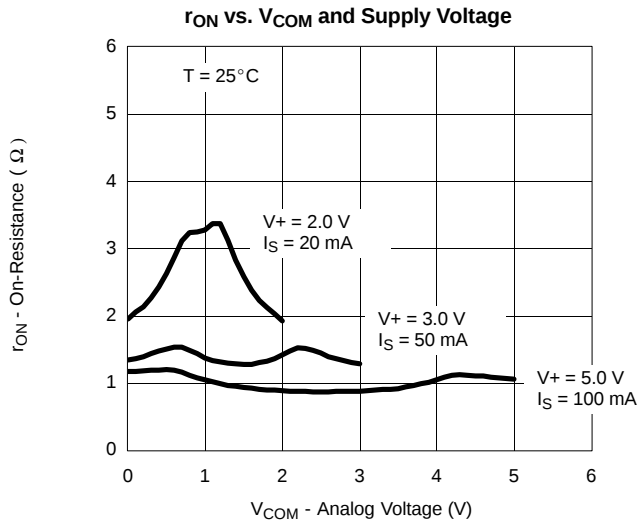
| SPECIFICATIONS (V+ = 3 V)                                    |                                                         |                                                                                                      |                   |                       |                  |                  |      |
|--------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------|-----------------------|------------------|------------------|------|
| Parameter                                                    | Symbol                                                  | Test Conditions<br>Otherwise Unless Specified<br><br>V+ = 3 V, ±10%, VIN = 0.4 or 2.0 V <sup>e</sup> | Temp <sup>a</sup> | Limits<br>-40 to 85°C |                  |                  | Unit |
|                                                              |                                                         |                                                                                                      |                   | Min <sup>b</sup>      | Typ <sup>c</sup> | Max <sup>b</sup> |      |
| Analog Switch                                                |                                                         |                                                                                                      |                   |                       |                  |                  |      |
| Analog Signal Ranged <sup>d</sup>                            | V <sub>NO</sub> , V <sub>NC</sub> ,<br>V <sub>COM</sub> |                                                                                                      | Full              | 0                     |                  | V+               | V    |
| On-Resistance                                                | r <sub>ON</sub>                                         | V+ = 2.7 V, V <sub>COM</sub> = 0.9 V/1.5 V<br>I <sub>NO</sub> , I <sub>NC</sub> = 50 mA              | Room<br>Full      |                       | 1.8              | 2.7<br>2.9       | Ω    |
| r <sub>ON</sub> Match                                        | Δr <sub>ON</sub>                                        |                                                                                                      | Room              |                       |                  | 0.2              |      |
| r <sub>ON</sub> Flatness                                     | r <sub>ON</sub><br>Flatness                             |                                                                                                      | Room              |                       | 0.2              | 0.5              |      |
| Switch Off Leakage Current <sup>f</sup>                      | I <sub>NO(off)</sub> ,<br>I <sub>NC(off)</sub>          | V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = 1 V/3 V<br>V <sub>COM</sub> = 3 V/1 V                | Room<br>Full      | -1<br>-10             |                  | 1<br>10          | nA   |
|                                                              | I <sub>COM(off)</sub>                                   |                                                                                                      | Room<br>Full      | -1<br>-10             |                  | 1<br>10          |      |
| Channel-On Leakage Current <sup>f</sup>                      | I <sub>COM(on)</sub>                                    | V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V/3 V                           | Room<br>Full      | -1<br>-10             |                  | 1<br>10          |      |
| Digital Control                                              |                                                         |                                                                                                      |                   |                       |                  |                  |      |
| Input High Voltage                                           | 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              |                       | 4                |                  | pF   |
| Input Current                                                | I <sub>INL</sub> or I <sub>INH</sub>                    | V <sub>IN</sub> = 0 or V+                                                                            | Full              | 1                     |                  | 1                | μA   |
| Dynamic Characteristics                                      |                                                         |                                                                                                      |                   |                       |                  |                  |      |
| Turn-On Time                                                 | t <sub>ON</sub>                                         | V <sub>NO</sub> or V <sub>NC</sub> = 2.0 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF           | Room<br>Full      |                       | 45               | 75<br>77         | ns   |
| Turn-Off Time                                                | t <sub>OFF</sub>                                        |                                                                                                      | Room<br>Full      |                       | 29               | 59<br>62         |      |
| Break-Before-Make Time                                       | t <sub>BBM</sub>                                        |                                                                                                      | Room              | 1                     | 16               |                  |      |
| 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                |                  | pC   |
| Off-Isolation <sup>d</sup>                                   | OIRR                                                    | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                              | Room              |                       | -62              |                  | dB   |
| Crosstalk <sup>d</sup>                                       | X <sub>TALK</sub>                                       |                                                                                                      | Room              |                       | -68              |                  |      |
| N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup> | C <sub>NO(off)</sub> ,<br>C <sub>NC(off)</sub>          | V <sub>IN</sub> = 0 or V+, f = 1 MHz                                                                 | Room              |                       | 28               |                  | pF   |
| Channel-On Capacitance <sup>d</sup>                          | C <sub>ON</sub>                                         |                                                                                                      | Room              |                       | 84               |                  |      |
| Power Supply                                                 |                                                         |                                                                                                      |                   |                       |                  |                  |      |
| Power Supply Range                                           | V+                                                      |                                                                                                      |                   | 1.8                   |                  | 5.5              | V    |
| Power Supply Current                                         | I+                                                      | V <sub>IN</sub> = 0 or V+                                                                            |                   |                       | 0.01             | 1.0              | μA   |
| Power Consumption                                            | P <sub>C</sub>                                          |                                                                                                      |                   |                       |                  |                  | 3.3  |

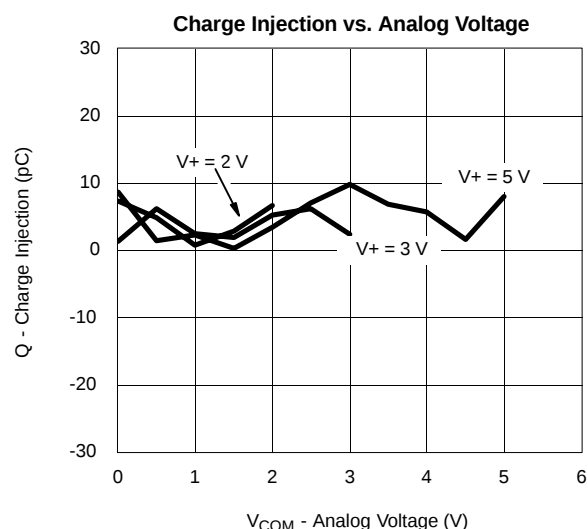
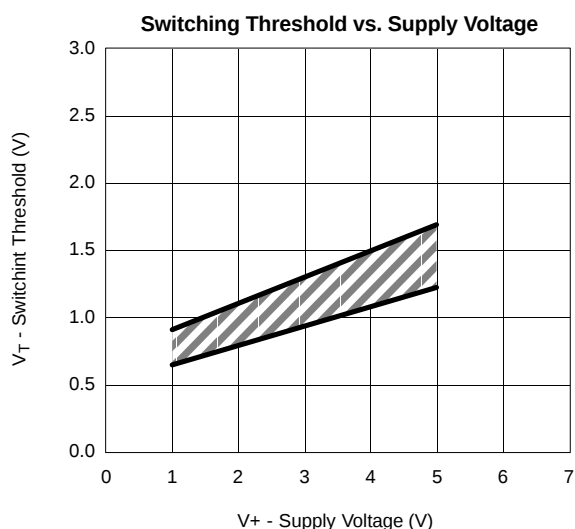
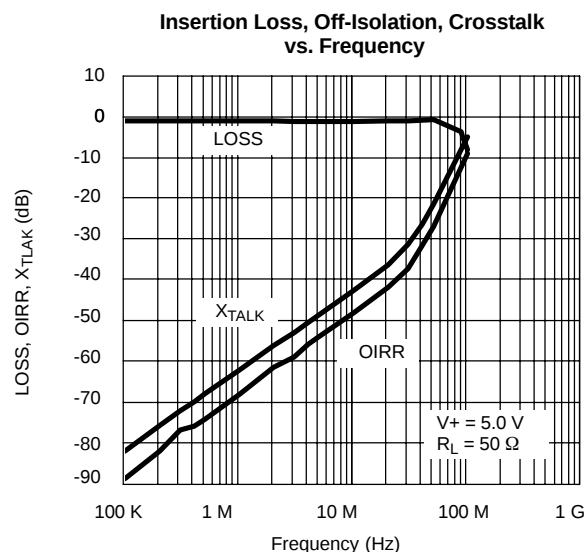
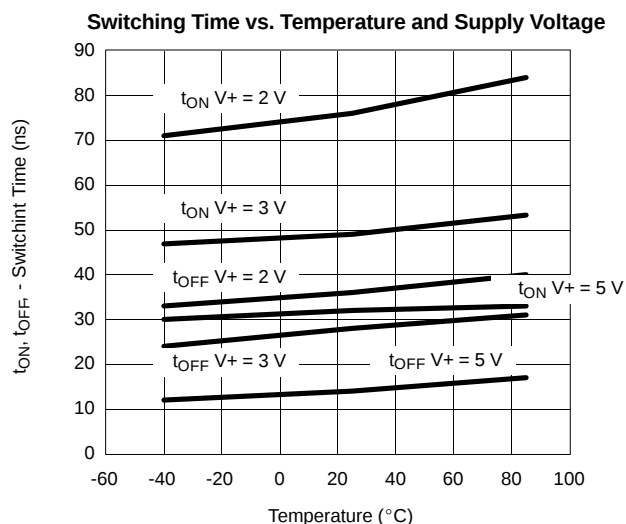
| SPECIFICATIONS (V+ = 5 V)           |                                                         |                                                                                                       |                   |                       |                  |                  |      |
|-------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------|-----------------------|------------------|------------------|------|
| 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> | Limits<br>-40 to 85°C |                  |                  | Unit |
|                                     |                                                         |                                                                                                       |                   | Min <sup>b</sup>      | Typ <sup>c</sup> | Max <sup>b</sup> |      |
| Analog Switch                       |                                                         |                                                                                                       |                   |                       |                  |                  |      |
| Analog Signal Range <sup>d</sup>    | V <sub>NO</sub> , V <sub>NC</sub> ,<br>V <sub>COM</sub> |                                                                                                       | Full              | 0                     |                  | V+               | V    |
| On-Resistance                       | r <sub>ON</sub>                                         | V+ = 4.5 V, V <sub>COM</sub> = 2.5 V<br>I <sub>NO</sub> , I <sub>NC</sub> = 100 mA                    | Room<br>Full      |                       | 1.3              | 2.0<br>2.1       | Ω    |
| r <sub>ON</sub> Match               | Δr <sub>ON</sub>                                        |                                                                                                       | Room              |                       |                  | 0.15             |      |
| Switch Off Leakage Current          | I <sub>NO(off)</sub> ,<br>I <sub>NC(off)</sub>          | V+ = 5.5 V<br>V <sub>NO</sub> , V <sub>NC</sub> = 1 V/4.5 V, V <sub>COM</sub> = 4.5 V/1 V             | Room<br>Full      | -1<br>-10             |                  | 1<br>10          | nA   |
|                                     | I <sub>COM(off)</sub>                                   |                                                                                                       | Room<br>Full      | -1<br>-10             |                  | 1<br>10          |      |
| Channel-On Leakage Current          | I <sub>COM(on)</sub>                                    | V+ = 5.5 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V/4.5 V                          | Room<br>Full      | -1<br>-10             |                  | 1<br>10          |      |
| Digital Control                     |                                                         |                                                                                                       |                   |                       |                  |                  |      |
| Input High Voltage                  | V <sub>INH</sub>                                        |                                                                                                       | Full              | 2                     |                  |                  | V    |
| Input Low Voltage                   | V <sub>INL</sub>                                        |                                                                                                       | Full              |                       |                  | 0.8              |      |
| Input Capacitance                   | C <sub>in</sub>                                         |                                                                                                       | Full              |                       | 4                |                  | pF   |
| Input Current                       | I <sub>INL</sub> or I <sub>INH</sub>                    | V <sub>IN</sub> = 0 or V+                                                                             | Full              | 1                     |                  | 1                | μA   |
| Dynamic Characteristics             |                                                         |                                                                                                       |                   |                       |                  |                  |      |
| Turn-On Time                        | t <sub>ON</sub>                                         | V <sub>NO</sub> or V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF              | Room<br>Full      |                       | 45               | 75<br>76         | ns   |
| Turn-Off Time                       | t <sub>OFF</sub>                                        |                                                                                                       | Room<br>Full      |                       | 20               | 47<br>48         |      |
| Break-Before-Make Time              | t <sub>BBM</sub>                                        |                                                                                                       | Room              | 1                     | 19               |                  |      |
| 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              |                       | 9                |                  | pC   |
| Off-Isolation <sup>d</sup>          | OIRR                                                    | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                               | Room              |                       | -62              |                  | dB   |
| Crosstalk <sup>d</sup>              | X <sub>TALK</sub>                                       |                                                                                                       | Room              |                       | -68              |                  |      |
| Source-Off Capacitance <sup>d</sup> | C <sub>NO(off)</sub> ,<br>C <sub>NC(off)</sub>          | V <sub>IN</sub> = 0 or V+, f = 1 MHz                                                                  | Room              |                       | 27               |                  | pF   |
| Channel-On Capacitance <sup>d</sup> | C <sub>ON</sub>                                         |                                                                                                       | Room              |                       | 82               |                  |      |
| Power Supply                        |                                                         |                                                                                                       |                   |                       |                  |                  |      |
| Power Supply Range                  | V+                                                      |                                                                                                       |                   | 1.8                   |                  | 5.5              | V    |
| Power Supply Current                | I+                                                      | V <sub>IN</sub> = 0 or V+                                                                             |                   |                       | 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.
- Guaranteed by 5-V leakage testing, not production tested.

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



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


TEST CIRCUITS

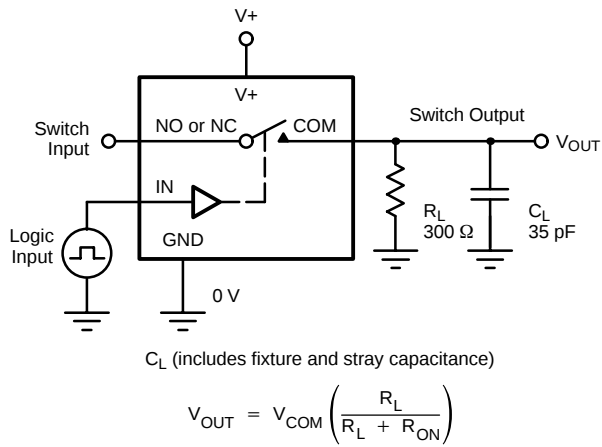
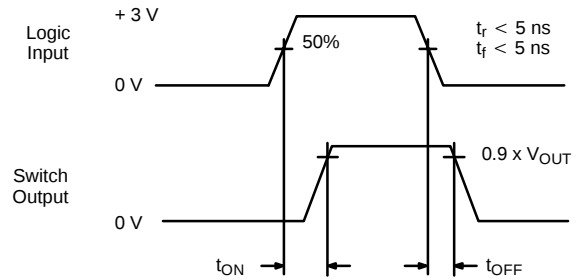


FIGURE 1. Switching Time



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

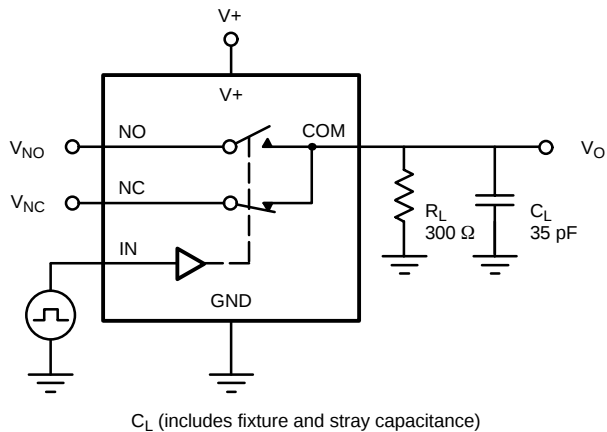
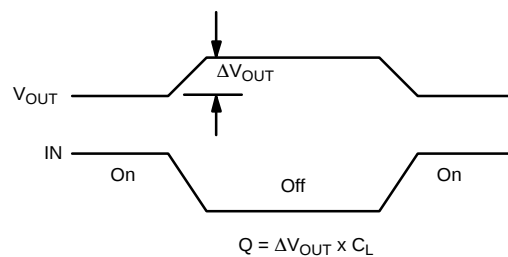
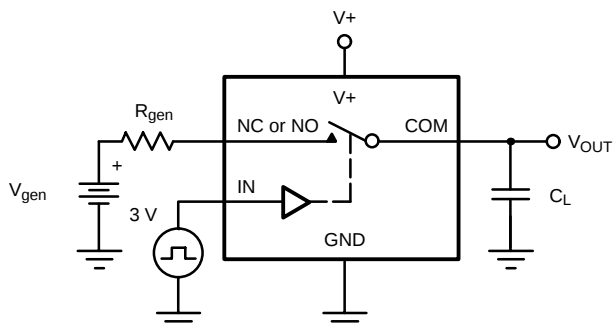
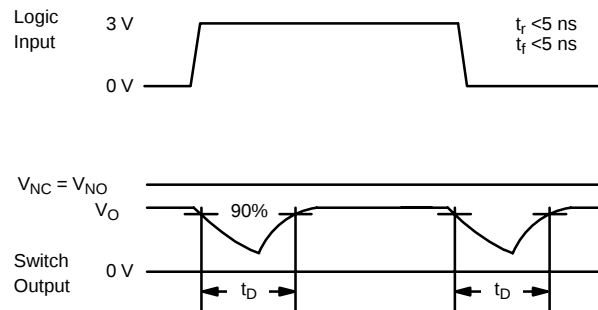
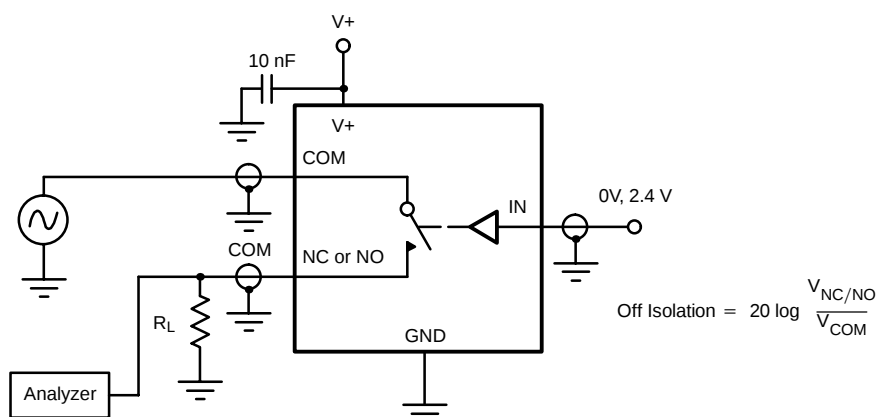
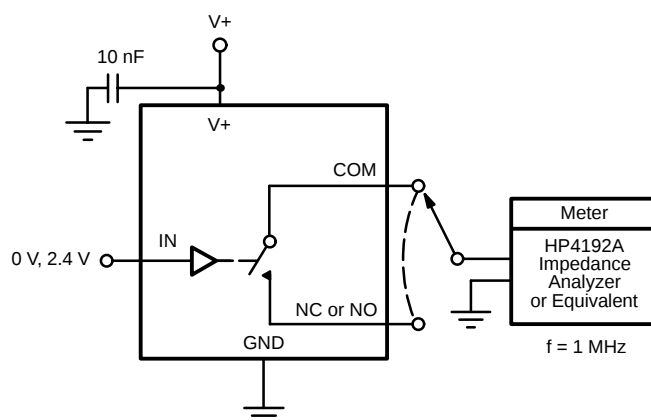


FIGURE 2. Break-Before-Make Interval



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