

## 3- $\Omega$ , High Bandwidth, Dual SPDT Analog Switch

### DESCRIPTION

The DG2517, DG2518 are low-voltage dual single-pole/double-throw monolithic CMOS analog switches. Designed to operate from 1.8 V to 5.5 V power supply, the DG2517, DG2518 achieves a bandwidth of 242 MHz while providing low on-resistance ( $3\ \Omega$ ), excellent on-resistance matching ( $0.2\ \Omega$ ) and flatness ( $1\ \Omega$ ) over the entire signal range.

The DG2517, DG2518 offers the advantage of high linearity that reduces signal distortion, making ideal for audio, video, and USB signal routing applications. Additionally, the DG2517, DG2518 are 1.6 V logic compatible within the full operation voltage range.

Built on Vishay Siliconix's proprietary sub-micron high-density process, the DG2517, DG2518 brings low power consumption at the same time as reduces PCB spacing with the MSOP10 and DFN10 packages.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. The DFN package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-E4" suffix. The MSOP package uses 100 % matte Tin device termination and is represented by the lead (Pb)- free "-E3" suffix. Both the matte Tin and nickel-palladium-gold device terminations meet all JEDEC standards for reflow and MSL ratings.

### FEATURES

- 1.8 V to 5.5 V single supply operation
- Low  $R_{ON}$ :  $3\ \Omega$  at 4.2 V
- 242 MHz, - 3 dB bandwidth
- Low off-isolation, - 51 dB at 10 MHz
- + 1.6 V logic compatible


**RoHS**  
COMPLIANT

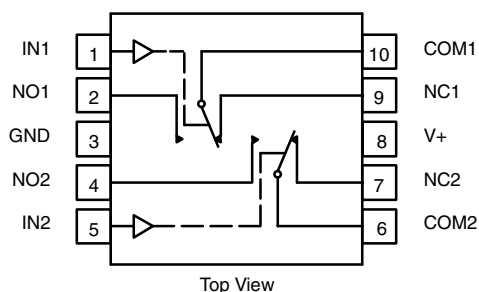
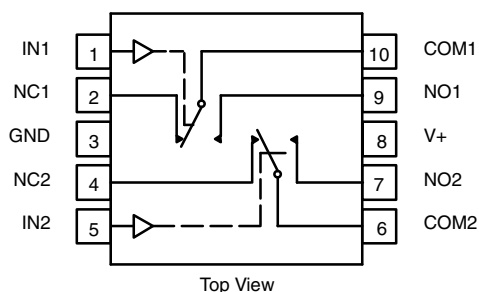
### BENEFITS

- High linearity
- Low power consumption
- High bandwidth
- Full rail signal swing range

### APPLICATIONS

- USB/UART signal switching
- Audio/video switching
- Cellular phone
- Media players
- Modems
- Hard drives
- PCMCIA

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

**DG2517**

**DG2518**


### TRUTH TABLE

| Logic | NC1 and NC2 | NO1 and NO2 |
|-------|-------------|-------------|
| 0     | ON          | OFF         |
| 1     | OFF         | ON          |

### ORDERING INFORMATION

| Temp. Range      | Package | Part Number    |
|------------------|---------|----------------|
| - 40 °C to 85 °C | MSOP-10 | DG2517DQ-T1-E3 |
|                  |         | DG2518DQ-T1-E3 |
|                  | DFN-10  | DG2517DN-T1-E4 |
|                  |         | DG2518DN-T1-E4 |

**ABSOLUTE MAXIMUM RATINGS**

| Parameter                                      |                      | Limit               | Unit |
|------------------------------------------------|----------------------|---------------------|------|
| Reference to GND                               |                      |                     |      |
| V+                                             |                      | - 0.3 to + 6        | V    |
| IN, COM, NC, NO <sup>a</sup>                   |                      | - 0.3 to (V+ + 0.3) |      |
| Continuous Current (Any terminal)              |                      | ± 50                | mA   |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle) |                      | ± 200               |      |
| Storage Temperature (D Suffix)                 |                      | - 65 to 150         | °C   |
| Power Dissipation (Packages) <sup>b</sup>      | MSOP-10 <sup>c</sup> | 320                 | mW   |
|                                                | DFN-10 <sup>d</sup>  | 1191                |      |

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 4.0 mW/°C above 70 °C.

d. Derate 14.9 mW/°C above 70 °C.

**SPECIFICATIONS (V+ = 3 V)**

| Parameter                                                    | Symbol                                                  | Test Conditions<br>Otherwise Unless Specified<br>V+ = 3 V, ± 10 %, V <sub>IN</sub> = 0.5 or 1.4 V <sup>e</sup> | Temp. <sup>a</sup> | Limits<br>- 40 °C 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+ = 2.7 V, V <sub>COM</sub> = 1.5 V<br>I <sub>NO/NC</sub> = 10 mA                                             | Room<br>Full       |                            | 3.2               | 4.5<br>5.0        | Ω    |
| R <sub>ON</sub> Flatness                                     | R <sub>ON</sub><br>Flatness                             | V+ = 2.7 V, V <sub>COM</sub> = 1.5, 2 V<br>I <sub>NO/NC</sub> = 10 mA                                          | Room<br>Full       |                            | 1.0               | 1.4<br>16         |      |
| R <sub>ON</sub> Match Between Channels                       | ΔR <sub>ON</sub>                                        | V+ = 2.7 V, V <sub>COM</sub> = 1.5 V<br>I <sub>NO/NC</sub> = 10 mA                                             | Room<br>Full       |                            | 0.1               | 0.3<br>0.4        |      |
| Switch Off Leakage Current <sup>f</sup>                      | I <sub>NO(off)</sub> ,<br>I <sub>NC(off)</sub>          | V+ = 3.6 V, V <sub>NO</sub> , V <sub>NC</sub> = 0.3 V/ 3 V<br>V <sub>COM</sub> = 3 V/0.3 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+ = 3.6 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.3 V/3 V                                   | Room<br>Full       | - 1<br>- 10                |                   | 1<br>10           |      |
| Digital Control                                              |                                                         |                                                                                                                |                    |                            |                   |                   |      |
| Input High Voltage <sup>d</sup>                              | V <sub>INH</sub>                                        |                                                                                                                | Full               | 1.4                        |                   |                   | V    |
| Input Low Voltage                                            | V <sub>INL</sub>                                        |                                                                                                                | Full               |                            |                   | 0.5               |      |
| Input Capacitance                                            | C <sub>in</sub>                                         |                                                                                                                | Full               |                            | 4                 |                   | pF   |
| Input Current                                                | I <sub>INL</sub> or I <sub>INH</sub>                    |                                                                                                                | Full               | 1                          |                   | 1                 | μA   |
| Dynamic Characteristics                                      |                                                         |                                                                                                                |                    |                            |                   |                   |      |
| Turn-On Time                                                 | t <sub>ON</sub>                                         | V+ = 2.7 V, V <sub>NO</sub> or V <sub>NC</sub> = 1.5 V<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF       | Room<br>Full       |                            | 15                | 30<br>50          | ns   |
| Turn-Off Time                                                | t <sub>OFF</sub>                                        |                                                                                                                | Room<br>Full       |                            | 10                | 25<br>35          |      |
| Break-Before-Make Time                                       | t <sub>d</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                     | Full               | 1                          |                   |                   |      |
| 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               |                            | 1                 |                   | pC   |
| - 3 dB Bandwidth                                             | BW                                                      | 0 dBm, C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω                                                            | Room               |                            | 242               |                   | MHz  |
| Off-Isolation <sup>d</sup>                                   | OIRR                                                    | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF                                                                   | f = 1 MHz          | Room                       | - 71              |                   | dB   |
|                                                              |                                                         |                                                                                                                | f = 10 MHz         | Room                       | - 51              |                   |      |
| Crosstalk <sup>d</sup>                                       | X <sub>TALK</sub>                                       | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF                                                                   | f = 1 MHz          | Room                       | - 73              |                   |      |
|                                                              |                                                         |                                                                                                                | f = 10 MHz         | Room                       | - 55              |                   |      |
| 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               |                            | 8                 |                   | pF   |
|                                                              | C <sub>NC(off)</sub>                                    |                                                                                                                | Room               |                            | 8                 |                   |      |
| Channel-On Capacitance <sup>d</sup>                          | C <sub>NO(on)</sub>                                     |                                                                                                                | Room               |                            | 35                |                   |      |
|                                                              | C <sub>NC(on)</sub>                                     |                                                                                                                | Room               |                            | 35                |                   |      |
| Power Supply                                                 |                                                         |                                                                                                                |                    |                            |                   |                   |      |
| Power Supply Current                                         | I+                                                      | V <sub>IN</sub> = 0 or V+                                                                                      | Full               |                            | 0.01              | 1.0               | μA   |

Notes:

a. Room = 25 °C, Full = as determined by the operating suffix.

b. Typical values are for design aid only, not guaranteed nor subject to production testing.

c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

d. Guarantee by design, nor subjected to production test.

e. V<sub>IN</sub> = input voltage to perform proper function.

f. Guaranteed by 5 V leakage testing, not production tested.



| SPECIFICATIONS (V+ = 5 V)              |                                                         |                                                                                                                |            |                    |                            |                   |                   |      |
|----------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------|--------------------|----------------------------|-------------------|-------------------|------|
| Parameter                              | Symbol                                                  | Test Conditions<br>Otherwise Unless Specified<br>V+ = 5 V, ± 10 %, V <sub>IN</sub> = 0.8 or 2.0 V <sup>e</sup> |            | Temp. <sup>a</sup> | Limits<br>- 40 °C 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+ = 4.2 V, V <sub>COM</sub> = 3.5 V, I <sub>NO/NC</sub> = 10 mA                                               |            | Room<br>Full       |                            | 3                 | 4.0<br>4.3        | Ω    |
| R <sub>ON</sub> Flatness               | R <sub>ON</sub><br>Flatness                             | V+ = 4.2 V, V <sub>COM</sub> = 1, 2, 3.5 V<br>I <sub>NO/NC</sub> = 10 mA                                       |            | Room<br>Full       |                            | 1.1               | 1.4<br>1.6        |      |
| R <sub>ON</sub> Match Between Channels | ΔR <sub>ON</sub>                                        | V+ = 4.2 V, V <sub>COM</sub> = 3.5 V, I <sub>NO/NC</sub> = 10 mA                                               |            | Room<br>Full       |                            | 0.1               | 0.3<br>0.4        |      |
| 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>COM</sub> = V <sub>NO</sub> , V <sub>NC</sub> = 1 V/4.5 V                                   |            | Room<br>Full       | - 1<br>- 10                |                   | 1<br>10           |      |
| Digital Control                        |                                                         |                                                                                                                |            |                    |                            |                   |                   |      |
| Input High Voltage <sup>d</sup>        | V <sub>INH</sub>                                        |                                                                                                                |            | Full               | 2.0                        |                   |                   | 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 V or V+                                                                                    |            | Full               | 1                          |                   | 1                 | μA   |
| Dynamic Characteristics                |                                                         |                                                                                                                |            |                    |                            |                   |                   |      |
| Turn-On Time                           | t <sub>ON</sub>                                         | V+ = 4.2 V, V <sub>NO</sub> or V <sub>NC</sub> = 3 V<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF         |            | Room<br>Full       |                            | 12                | 25<br>45          | ns   |
| Turn-Off Time                          | t <sub>OFF</sub>                                        |                                                                                                                |            | Room<br>Full       |                            | 8                 | 20<br>30          |      |
| Break-Before-Make Time                 | t <sub>d</sub>                                          | V <sub>NO</sub> or V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                       |            | Full               | 1                          |                   |                   |      |
| Charge Injection <sup>d</sup>          | Q <sub>INJ</sub>                                        | C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 2.5 V, R <sub>GEN</sub> = 0 Ω                                        |            | Room               |                            | 2                 |                   | pC   |
| - 3 dB Bandwidth                       | BW                                                      | 0 dBm, C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω                                                            |            | Room               |                            | 242               |                   | MHz  |
| Off-Isolation <sup>d</sup>             | OIRR                                                    | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF                                                                   | f = 1 MHz  | Room               |                            | - 71              |                   | dB   |
|                                        |                                                         |                                                                                                                | f = 10 MHz | Room               |                            | - 51              |                   |      |
| Crosstalk <sup>d</sup>                 | X <sub>TALK</sub>                                       | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF                                                                   | f = 1 MHz  | Room               |                            | - 73              |                   |      |
|                                        |                                                         |                                                                                                                | f = 10 MHz | Room               |                            | - 55              |                   |      |
| Source-Off Capacitance <sup>d</sup>    | C <sub>NO(off)</sub>                                    | V <sub>IN</sub> = 0 or V+, f = 1 MHz                                                                           |            | Room               |                            | 8                 |                   | pF   |
|                                        | C <sub>NC(off)</sub>                                    |                                                                                                                |            | Room               |                            | 8                 |                   |      |
| Channel-On Capacitance <sup>d</sup>    | C <sub>NO(on)</sub>                                     |                                                                                                                |            | Room               |                            | 35                |                   |      |
|                                        | C <sub>NC(on)</sub>                                     |                                                                                                                |            | Room               |                            | 35                |                   |      |
| Power Supply                           |                                                         |                                                                                                                |            |                    |                            |                   |                   |      |
| 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:

a. Room = 25 °C, Full = as determined by the operating suffix.

b. Typical values are for design aid only, not guaranteed nor subject to production testing.

c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

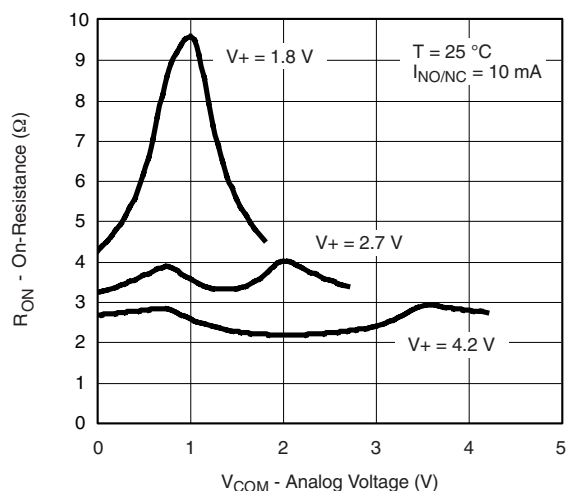
d. Guarantee by design, nor subjected to production test.

e. V<sub>IN</sub> = input voltage to perform proper function.

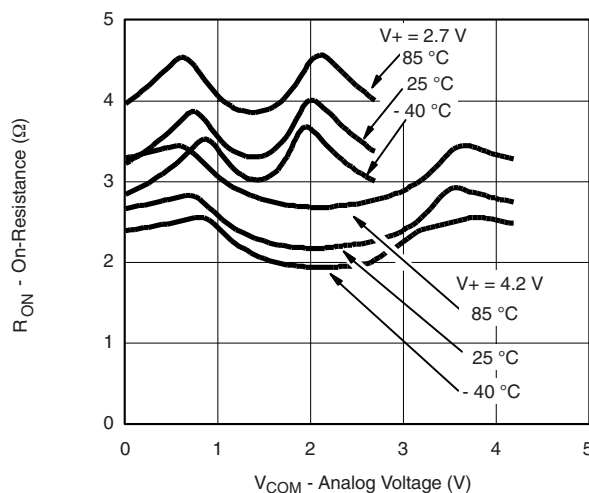
f. Guaranteed by 5 V leakage testing, not production tested.

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.

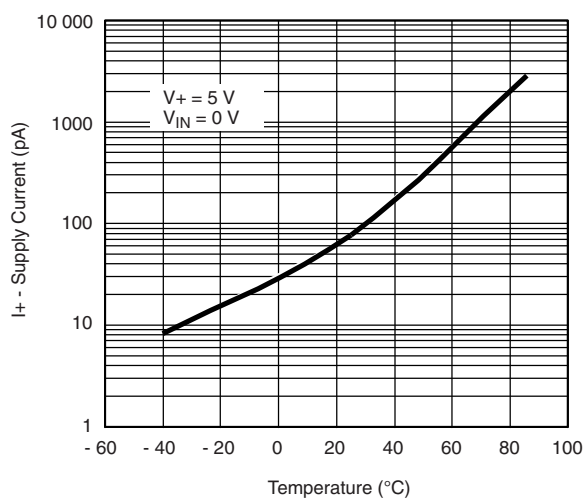
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



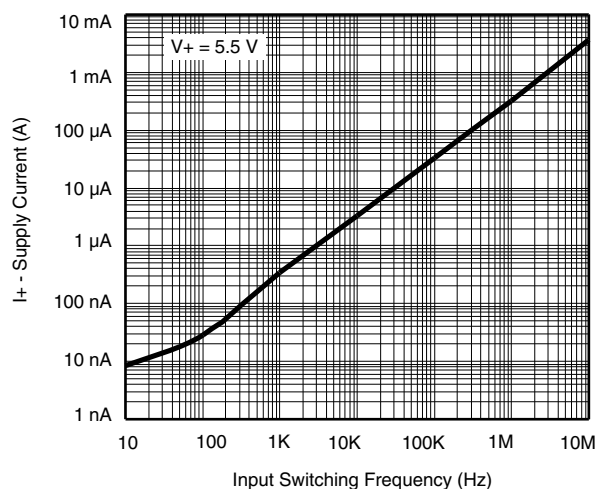
$R_{ON}$  vs.  $V_{COM}$  and Supply Voltage



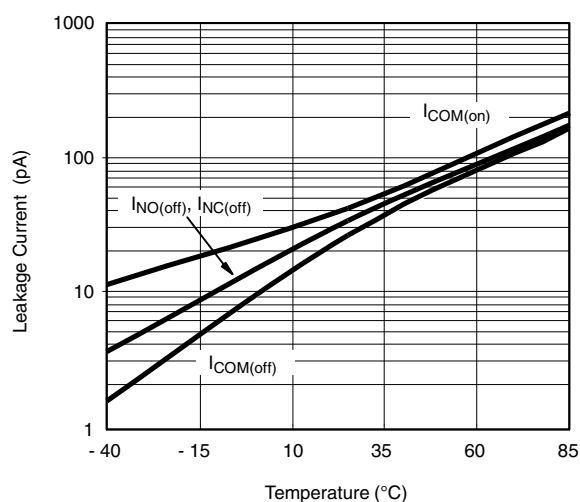
$R_{ON}$  vs. Analog Voltage and Temperature



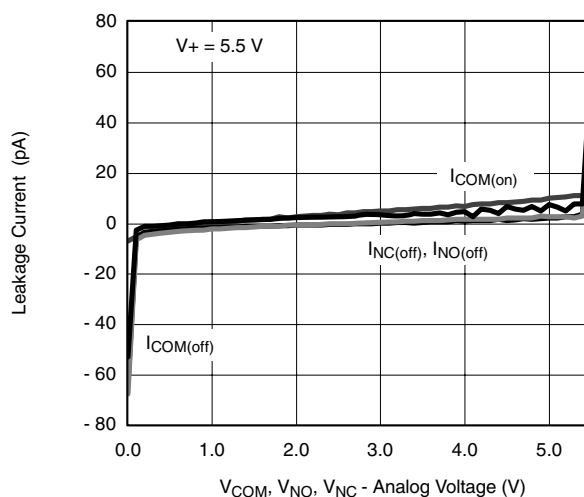
Supply Current vs. Temperature



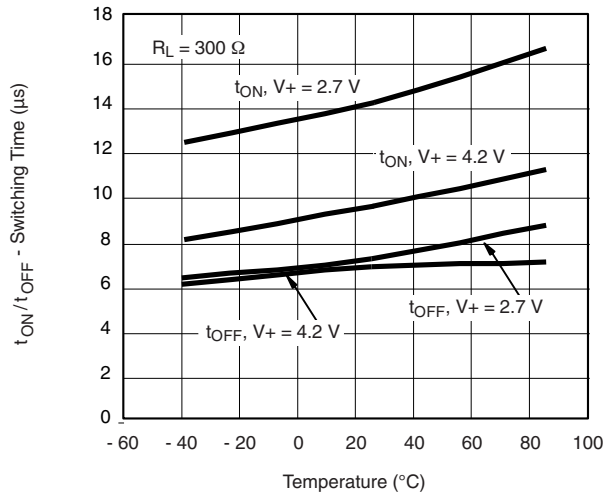
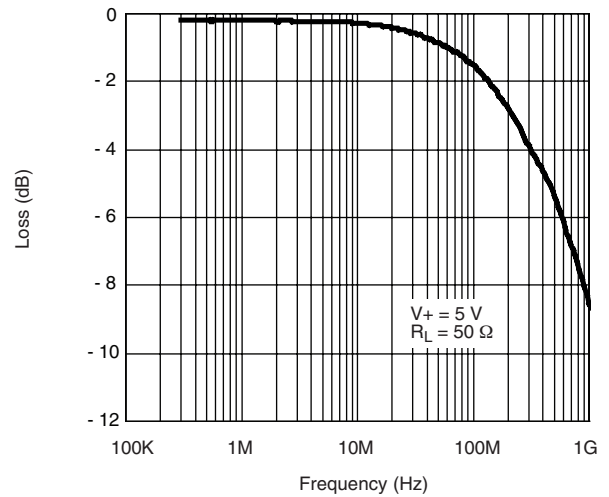
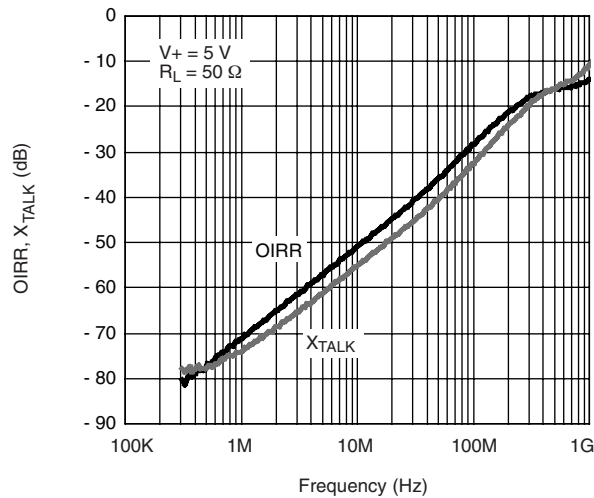
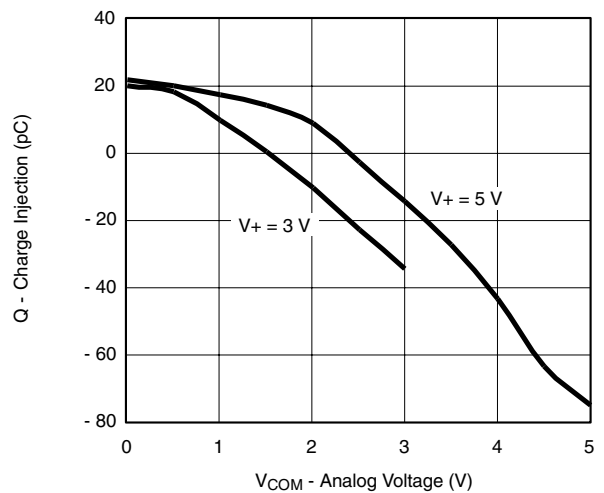
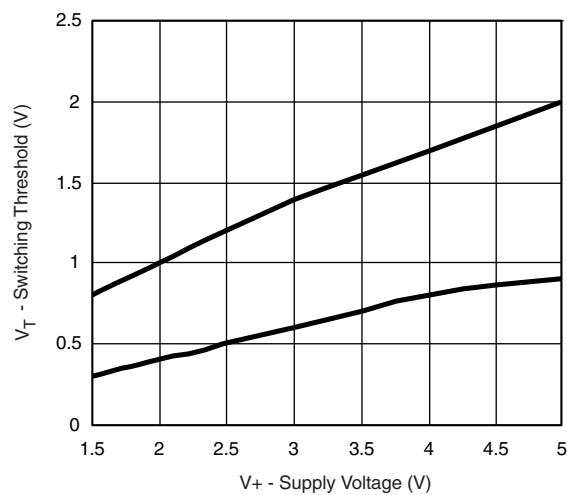
Supply Current vs. Input Switching Frequency



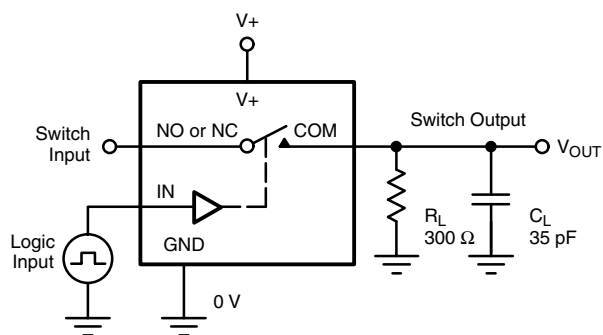
Leakage Current vs. Temperature



Leakage vs. Analog Voltage

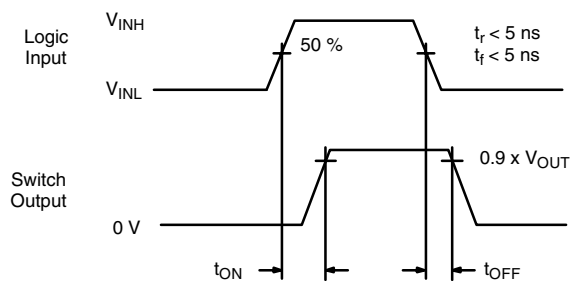
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

**Switching Time vs. Temperature**

**Insertion Loss vs. Frequency**

**Off-Isolation and Crosstalk vs. Frequency**

**Charge Injection vs. Analog Voltage**

**Switching Threshold vs. Supply Voltage**

## TEST CIRCUITS



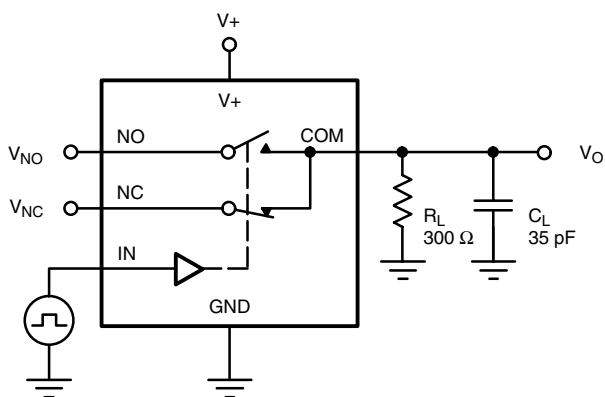
$C_L$  (includes fixture and stray capacitance)

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



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)

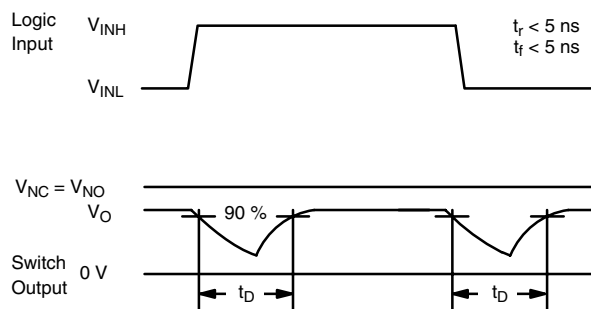
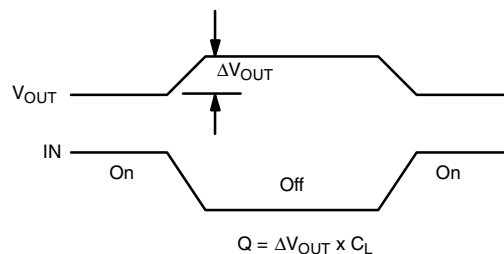
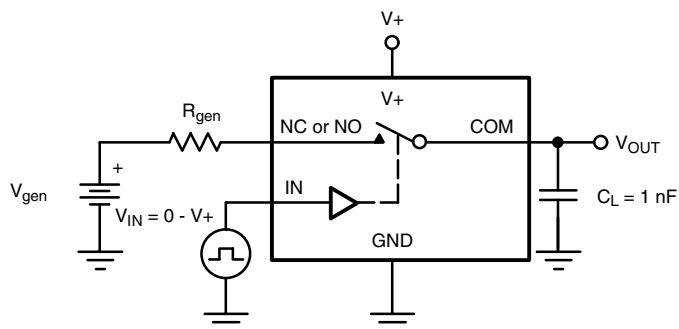
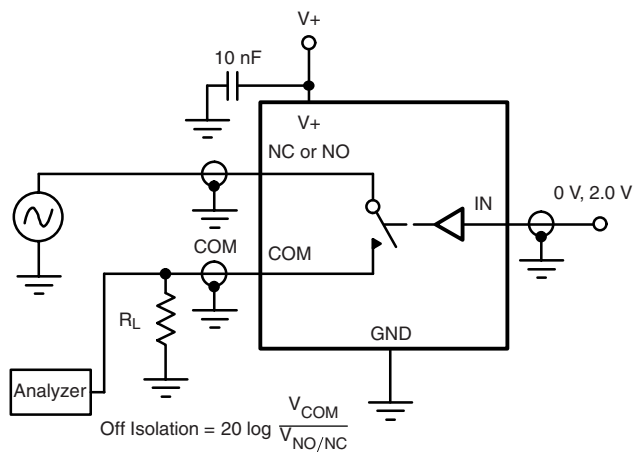
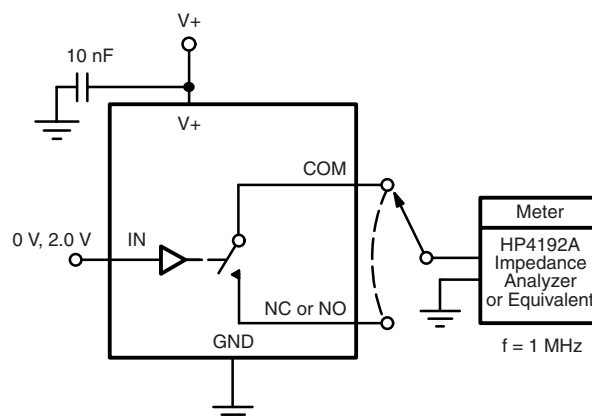


Figure 2. Break-Before-Make Interval



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

Figure 3. Charge Injection

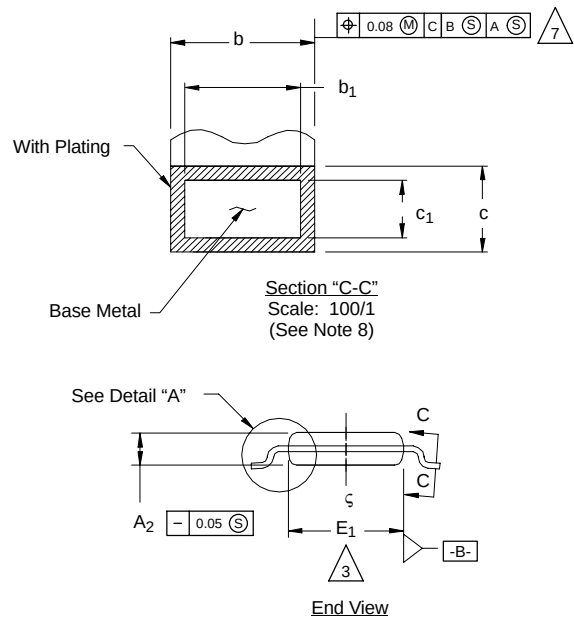
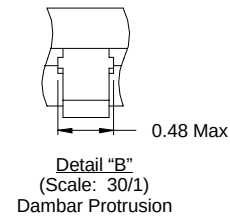
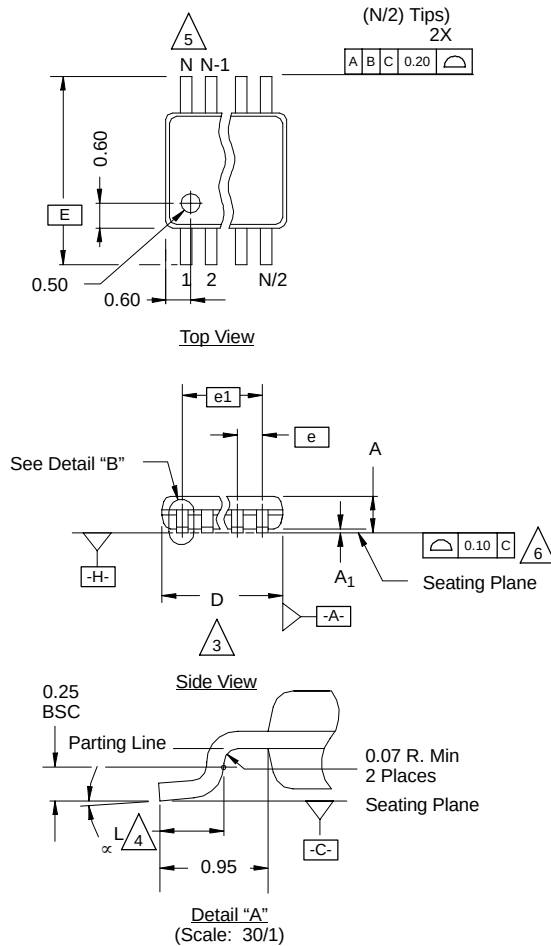
**TEST CIRCUITS**

**Figure 4. Off-Isolation**

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

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see <http://www.vishay.com/ppg?74333>.



### MSOP: 10-LEADS

JEDEC Part Number: MO-187, (Variation AA and BA)



#### NOTES:

- Die thickness allowable is  $0.203 \pm 0.0127$ .
- Dimensioning and tolerances per ANSI.Y14.5M-1994.
- Dimensions "D" and "E<sub>1</sub>" do not include mold flash or protrusions, and are measured at Datum plane  $\square H$ , mold flash or protrusions shall not exceed 0.15 mm per side.
- Dimension is the length of terminal for soldering to a substrate.
- Terminal positions are shown for reference only.
- Formed leads shall be planar with respect to one another within 0.10 mm at seating plane.
- The lead width dimension does not include Dambar protrusion. Allowable Dambar protrusion shall be 0.08 mm total in excess of the lead width dimension at maximum material condition. Dambar cannot be located on the lower radius or the lead foot. Minimum space between protrusions and an adjacent lead to be 0.14 mm. See detail "B" and Section "C-C".
- Section "C-C" to be determined at 0.10 mm to 0.25 mm from the lead tip.
- Controlling dimension: millimeters.
- This part is compliant with JEDEC registration MO-187, variation AA and BA.
- Datums  $\square A$  and  $\square B$  to be determined Datum plane  $\square H$ .
- Exposed pad area in bottom side is the same as the leadframe pad size.

**N = 10L**

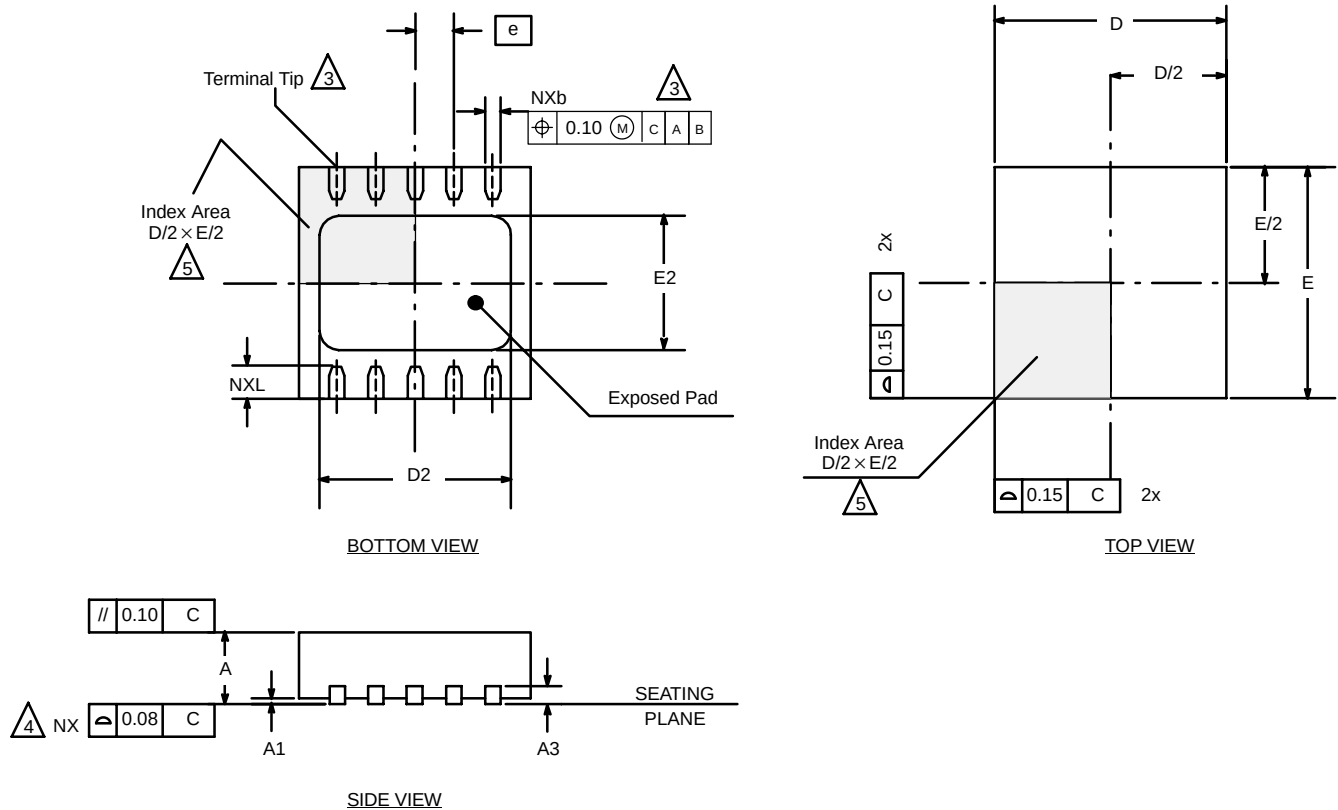
| Dim            | MILLIMETERS |      |      | Note |
|----------------|-------------|------|------|------|
|                | Min         | Nom  | Max  |      |
| A              | -           | -    | 1.10 |      |
| A <sub>1</sub> | 0.05        | 0.10 | 0.15 |      |
| A <sub>2</sub> | 0.75        | 0.85 | 0.95 |      |
| b              | 0.17        | -    | 0.27 | 8    |
| b <sub>1</sub> | 0.17        | 0.20 | 0.23 | 8    |
| c              | 0.13        | -    | 0.23 |      |
| c <sub>1</sub> | 0.13        | 0.15 | 0.18 |      |
| D              | 3.00 BSC    |      |      | 3    |
| E              | 4.90 BSC    |      |      |      |
| E <sub>1</sub> | 2.90        | 3.00 | 3.10 | 3    |
| e              | 0.50 BSC    |      |      |      |
| e <sub>1</sub> | 2.00 BSC    |      |      |      |
| L              | 0.40        | 0.55 | 0.70 | 4    |
| N              | 10          |      |      | 5    |
| α              | 0°          | 4°   | 6°   |      |

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DWG: 5867





DFN-10 LEAD (3 X 3)



NOTES:

1. All dimensions are in millimeters and inches.

2. N is the total number of terminals.

3. Dimension b applies to metallized terminal and is measured between 0.15 and 0.30 mm from terminal tip.

4. Coplanarity applies to the exposed heat sink slug as well as the terminal.

5. The pin #1 identifier may be either a mold or marked feature, it must be located within the zone indicated.

| Dim                                          | MILLIMETERS |      |      | INCHES    |       |       |
|----------------------------------------------|-------------|------|------|-----------|-------|-------|
|                                              | Min         | Nom  | Max  | Min       | Nom   | Max   |
| A                                            | 0.80        | 0.90 | 1.00 | 0.031     | 0.035 | 0.039 |
| A1                                           | 0.00        | 0.02 | 0.05 | 0.000     | 0.001 | 0.002 |
| A3                                           | 0.20 BSC    |      |      | 0.008 BSC |       |       |
| b                                            | 0.18        | 0.23 | 0.30 | 0.007     | 0.009 | 0.012 |
| D                                            | 3.00 BSC    |      |      | 0.118 BSC |       |       |
| D2                                           | 2.20        | 2.38 | 2.48 | 0.087     | 0.094 | 0.098 |
| E                                            | 3.00 BSC    |      |      | 0.118 BSC |       |       |
| E2                                           | 1.49        | 1.64 | 1.74 | 0.059     | 0.065 | 0.069 |
| e                                            | 0.50 BSC    |      |      | 0.020 BSC |       |       |
| L                                            | 0.30        | 0.40 | 0.50 | 0.012     | 0.016 | 0.020 |
| *Use millimeters as the primary measurement. |             |      |      |           |       |       |
| ECN: S-42134—Rev. A, 29-Nov-04               |             |      |      |           |       |       |
| DWG: 5943                                    |             |      |      |           |       |       |



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