

## Single 4:1 Low $r_{ON}$ Multiplexers

### DESCRIPTION

The DG2034 is a low voltage, low  $r_{ON}$ , high bandwidth single 4 to 1 analog multiplexer designed for high performance switching of analog and video signals. Combining low power; fast switching; low on-resistance, flatness and matching; and small physical size, the DG2034 is ideal for portable and battery applications.

Built on Vishay Siliconix's low voltage CMOS process, the DG2034 has an epitaxial layer which prevents latchup. Break-before-make is guaranteed.

### FEATURES

- Low voltage operation (1.8 V to 5.5 V)
- Low on-resistance -  $r_{DS(on)}$ : 4  $\Omega$
- Off-isolation and crosstalk: - 55 dB at 10 MHz
- Fast switch - 25 ns  $t_{ON}$
- Low charge injection -  $Q_{INJ}$ : 4.7 pC
- Low power consumption - 4  $\mu$ W


**RoHS**  
COMPLIANT

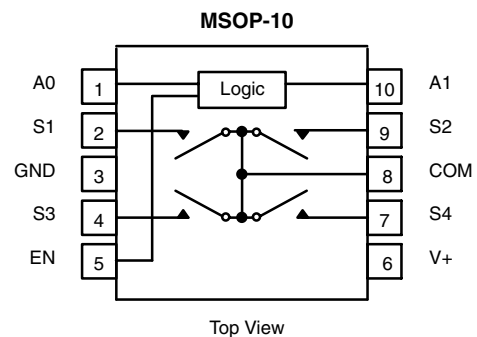
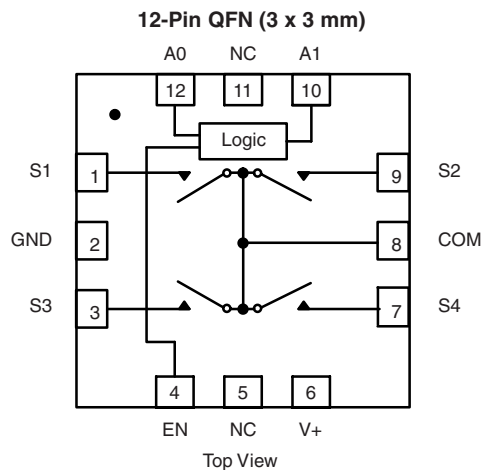
### BENEFITS

- High accuracy
- High bandwidth
- TTL and low voltage logic compatibility
- Low power consumption
- Reduced PCB space

### APPLICATIONS

- Mixed signal routing
- Portable and battery operated systems
- Low voltage data acquisition
- Modems
- PCMCIA cards

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



#### TRUTH TABLE

| A1 | A0 | EN | ON Switch |
|----|----|----|-----------|
| X  | X  | 0  | None      |
| 0  | 0  | 1  | S1        |
| 0  | 1  | 1  | S2        |
| 1  | 0  | 1  | S3        |
| 1  | 1  | 1  | S4        |

#### ORDERING INFORMATION

| Temp Range       | Package               | Part Number    |
|------------------|-----------------------|----------------|
| - 40 °C to 85 °C | MSOP-10               | DG2034DQ-T1-E3 |
|                  | 12-pin QFN (3 x 3 mm) | DG2034DN-T1-E4 |



| ABSOLUTE MAXIMUM RATINGS  |                                |                     |      |
|---|--------------------------------|---------------------|------|
| Parameter   |                                | Limit               | Unit |
| Referenced V+ to GND  |                                | - 0.3 to + 6        | V    |
| A <sub>X</sub> , E <sub>N</sub> , S <sub>X</sub> , COM <sup>a</sup> |                                | - 0.3 to (V+ + 0.3) |      |
| Continuous Current (Any Terminal)                                   |                                | ± 50                | mA   |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle)                      |                                | ± 100               |      |
| Power Dissipation (Packags) <sup>b</sup>                            | QFN-12 (3 x 3 mm) <sup>c</sup> | 1295                | mW   |
|   | MSOP-10 <sup>d</sup>           | 320                 |      |
| Storage Temperature (D Suffix)                                      |                                | - 65 to 150         | °C   |

Notes:

- a. Signals on S<sub>X</sub>, D<sub>X</sub>, EN or A<sub>X</sub> exceeding V+ or 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 16.2 mW/°C above 70 °C.
- d. Derate 4.0 mW/°C above 70 °C.

| SPECIFICATIONS (V+ = 3 V)                 |                                     |  |                    |                         |                   |                   |      |
|---|-------------------------------------|--|--------------------|-------------------------|-------------------|-------------------|------|
| Parameter                                 | Symbol                              | Test Conditions<br>Otherwise Unless Specified<br>V+ = 3 V, ± 10 %, V <sub>AL</sub> = 0.4 V, V <sub>AH</sub> = 1.5 V <sup>e</sup> | Temp. <sup>a</sup> | Limits<br>- 40 to 85 °C |                   |                   | Unit |
|   |                                     |  |                    | Min. <sup>c</sup>       | Typ. <sup>b</sup> | Max. <sup>c</sup> |      |
| <b>Analog Switch</b>                      |                                     |  |                    |                         |                   |                   |      |
| Analog Signal Range <sup>d</sup>          | V <sub>ANALOG</sub>                 |  | Full               | 0                       |                   | V+                | V    |
| On-Resistance                             | r <sub>ON</sub>                     | V+ = 2.7 V, V <sub>COM</sub> = 0.5 V/1.5 V/2.0 V<br>I <sub>S</sub> = 10 mA   | Room<br>Full       |                         | 4                 | 7<br>9            | Ω    |
| r <sub>ON</sub> Match                     | Δr <sub>ON</sub>                    |  | Room               |                         | 0.1               | 0.3               |      |
| r <sub>ON</sub> Flatness <sup>d,f</sup>   | r <sub>ON</sub><br>Flatness         |  | Room               |                         | 0.3               | 1.5               |      |
| Off Leakage Current <sup>g</sup>          | I <sub>S(off)</sub>                 | V+ = 3.3 V, V <sub>S</sub> = 1 V/3 V<br>V <sub>COM</sub> = 3 V/1 V, V <sub>EN</sub> = 0 V  | Room<br>Full       | - 1<br>- 10             | 0.3               | 1<br>10           | nA   |
| COM Off Leakage Current <sup>g</sup>      | I <sub>COM(off)</sub>               |  | Room<br>Full       | - 1<br>- 10             | 0.3               | 1<br>10           |      |
| Channel-On Leakage Current <sup>g</sup>   | I <sub>COM(on)</sub>                | V+ = 3.3 V<br>V <sub>COM</sub> = V <sub>S</sub> = 1 V/3 V  | Room<br>Full       | - 1<br>- 10             | 0.3               | 1<br>10           |      |
| <b>Digital Control</b>                    |                                     |  |                    |                         |                   |                   |      |
| Input Current <sup>d</sup>                | I <sub>A</sub> or I <sub>EN</sub>   | V <sub>A/EN</sub> = 0 or V+, See Truth Table   | Full               | - 1.0                   |                   | 1.0               | μA   |
| Input High Voltage <sup>d</sup>           | V <sub>AH</sub> or V <sub>ENH</sub> |  | Full               | 1.5                     |                   |                   | V    |
| Input Low Voltage <sup>d</sup>            | V <sub>AL</sub> or V <sub>ENL</sub> |  | Full               |                         |                   | 0.4               |      |
| <b>Dynamic Characteristics</b>            |                                     |  |                    |                         |                   |                   |      |
| Turn-On Time                              | t <sub>ON</sub>                     | V <sub>S</sub> = 1.5 V, R <sub>L</sub> = 300 Ω   | Room<br>Full       |                         | 25                | 35<br>45          | ns   |
| Turn-Off Time                             | t <sub>OFF</sub>                    |  | Room<br>Full       |                         | 15                | 25<br>35          |      |
| Break-Before-Make Time <sup>d</sup>       | t <sub>D</sub>                      |  | Room               |                         | 10.5              |                   |      |
| Transition Time                           | t <sub>trans</sub>                  | V <sub>S</sub> = 1.5 V/0 V, V <sub>S</sub> = 0 V/1.5 V, R <sub>L</sub> = 300 Ω   | Room<br>Full       |                         | 30                | 45<br>55          |      |
| 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               |                         | - 4.7             |                   | pC   |
| Off-Isolation <sup>d</sup>                | OIRR                                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF   | f = 1 MHz          | Room                    |                   | - 73              | dB   |
|   |                                     |  | f = 10 MHz         | Room                    |                   | - 54              |      |
| Channel-to-Channel Crosstalk <sup>d</sup> | X <sub>TALK</sub>                   | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF   | f = 1 MHz          | Room                    |                   | - 77              |      |
|   |                                     |  | f = 10 MHz         | Room                    |                   | - 59              |      |
| Off Capacitance <sup>d</sup>              | C <sub>S(off)</sub>                 | V+ = 2.7 V, f = 1 MHz  | Room               |                         | 14                |                   | pF   |
| COM Off Capacitance <sup>d</sup>          | C <sub>COM(off)</sub>               |  | Room               |                         | 46                |                   |      |
| COM On Capacitance <sup>d</sup>           | C <sub>COM(on)</sub>                |  | Room               |                         | 67                |                   |      |
| <b>Power Supply</b>                       |                                     |  |                    |                         |                   |                   |      |
| Power Supply Range                        | V+                                  |  |                    | 2.7                     |                   | 3.3               | V    |
| Power Supply Current <sup>d</sup>         | I+                                  | V+ = 3.3 V, V <sub>A/EN</sub> = 0 or 3.3 V, See Truth Table  | Full               |                         |                   | 1.0               | μA   |



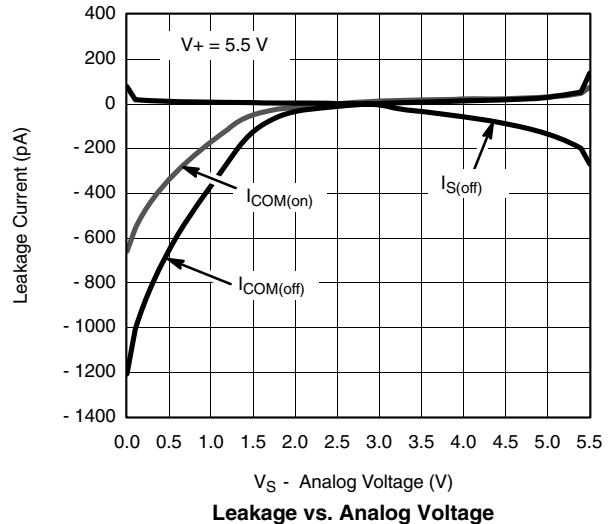
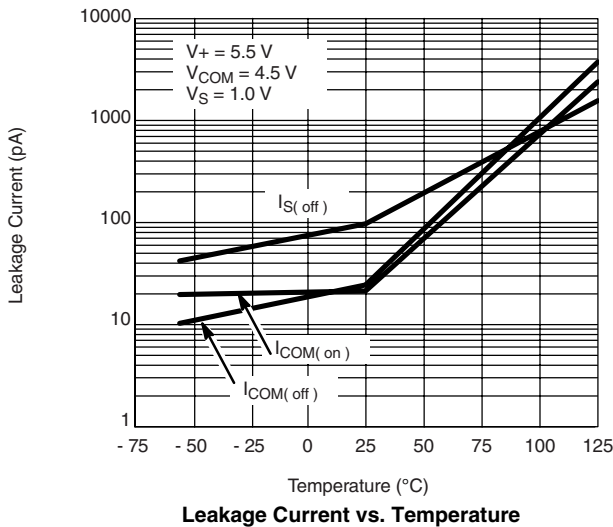
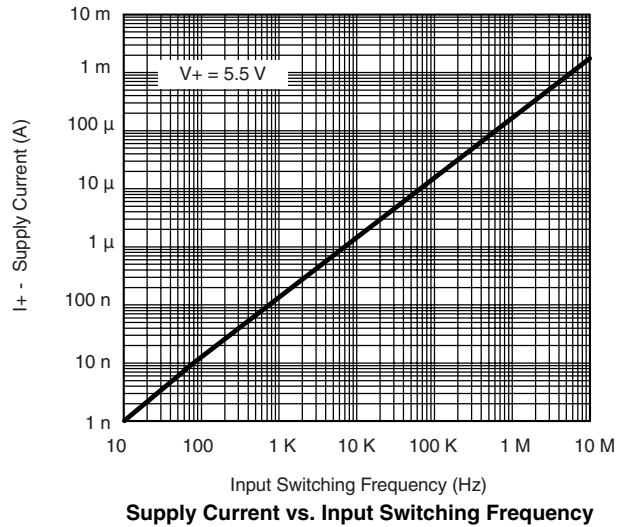
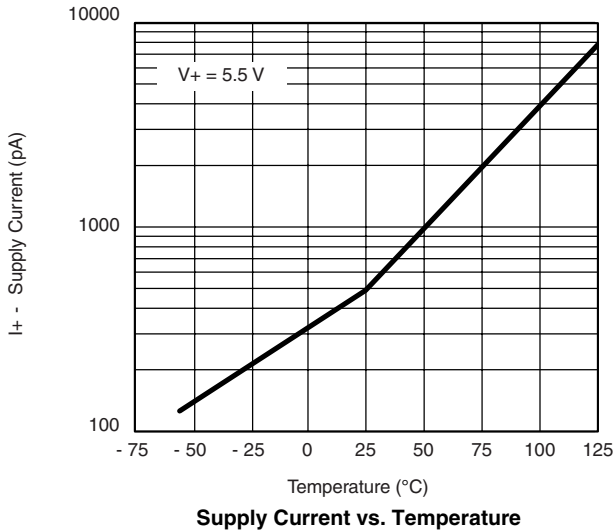
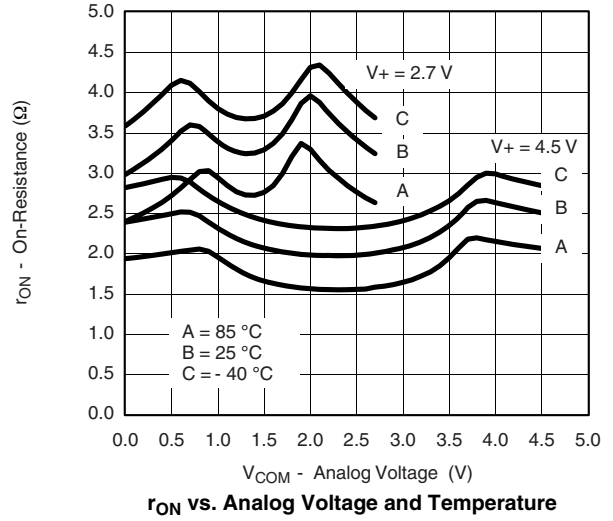
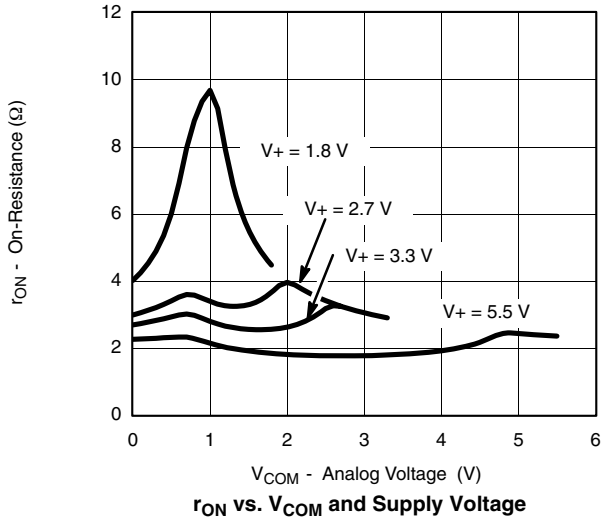
| SPECIFICATIONS (V+ = 5 V)                 |                                     |  |                    |                         |                   |                   |      |
|---|-------------------------------------|--|--------------------|-------------------------|-------------------|-------------------|------|
| Parameter                                 | Symbol                              | Test Conditions<br>Otherwise Unless Specified<br>V+ = 3 V, ± 10 %, V <sub>AL</sub> = 0.8 V or V <sub>AH</sub> = 2.4 V <sup>e</sup> | Temp. <sup>a</sup> | Limits<br>- 40 to 85 °C |                   |                   | Unit |
|   |                                     |  |                    | Min. <sup>c</sup>       | Typ. <sup>b</sup> | Max. <sup>c</sup> |      |
| <b>Analog Switch</b>                      |                                     |  |                    |                         |                   |                   |      |
| Analog Signal Range <sup>d</sup>          | V <sub>ANALOG</sub>                 |  | Full               | 0                       |                   | V+                | V    |
| On-Resistance                             | r <sub>ON</sub>                     | V+ = 4.5 V, V <sub>COM</sub> = 1.5 V/2.5 V/3.5 V<br>I <sub>S</sub> = 10 mA   | Room<br>Full       |                         | 3                 | 5.5<br>7          | Ω    |
| r <sub>ON</sub> Match                     | Δr <sub>ON</sub>                    |  | Room               |                         | 0.16              | 0.5               |      |
| r <sub>ON</sub> Flatness <sup>d,f</sup>   | r <sub>ON</sub><br>Flatness         |  | Room               |                         | 0.6               | 1.5               |      |
| Off Leakage Current                       | I <sub>S(off)</sub>                 | V+ = 5.5 V, V <sub>S</sub> = 1 V/4.5 V<br>V <sub>COM</sub> = 4.5 V/1 V, V <sub>EN</sub> = 0 V                                      | Room<br>Full       | - 1<br>- 10             | 0.5               | 1<br>10           | nA   |
| COM Off Leakage Current                   | I <sub>COM(off)</sub>               |  | Room<br>Full       | - 1<br>- 10             | 0.5               | 1<br>10           |      |
| Channel-On Leakage Current                | I <sub>COM(on)</sub>                | V+ = 5.5 V, V <sub>COM</sub> = V <sub>S</sub> = 1 V/4.5 V  | Room<br>Full       | - 1<br>- 10             | 0.5               | 1<br>10           |      |
| <b>Digital Control</b>                    |                                     |  |                    |                         |                   |                   |      |
| Input Current <sup>d</sup>                | I <sub>AH</sub> or I <sub>ENH</sub> | V <sub>A</sub> or V <sub>EN</sub> = 0 or V+, See Truth Table   | Full               | - 1.0                   |                   | 1.0               | μA   |
| Input High Voltage <sup>d</sup>           | V <sub>AH</sub> or V <sub>ENH</sub> |  | Full               | 2.4                     |                   |                   | V    |
| Input Low Voltage <sup>d</sup>            | V <sub>AL</sub> or V <sub>ENL</sub> |  | Full               |                         |                   | 0.8               |      |
| <b>Dynamic Characteristics</b>            |                                     |  |                    |                         |                   |                   |      |
| Turn-On Time                              | t <sub>ON</sub>                     | V <sub>S</sub> = 3.0 V, R <sub>L</sub> = 300 Ω   | Room<br>Full       |                         | 18                | 30<br>40          | ns   |
| Turn-Off Time                             | t <sub>OFF</sub>                    |  | Room<br>Full       |                         | 12                | 20<br>30          |      |
| Break-Before-Make Time <sup>d</sup>       | t <sub>D</sub>                      |  | Room               |                         | 10.5              |                   |      |
| Transition Time                           | t <sub>trans</sub>                  | V <sub>S</sub> = 3 V/0 V, V <sub>S</sub> = 0 V/3 V, R <sub>L</sub> = 300 Ω   | Room<br>Full       |                         | 25                | 40<br>50          |      |
| Off-Isolation <sup>d</sup>                | OIRR                                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 p  | f = 1 MHz          | Room                    |                   | - 73              | dB   |
|   |                                     |  | f = 10 MHz         | Room                    |                   | - 53.5            |      |
| Channel-to-Channel Crosstalk <sup>d</sup> | X <sub>TALK</sub>                   | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF   | f = 1 MHz          | Room                    |                   | - 77              |      |
|   |                                     |  | f = 10 MHz         | Room                    |                   | - 60.2            |      |
| 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               |                         | - 4.4             |                   | pC   |
| Off Capacitance <sup>d</sup>              | C <sub>S(off)</sub>                 | V+ = 5 V, f = 1 MHz  | Room               |                         | 13                |                   | pF   |
| COM Off Capacitance <sup>d</sup>          | C <sub>COM(off)</sub>               |  | Room               |                         | 43                |                   |      |
| COM On Capacitance <sup>d</sup>           | C <sub>COM(on)</sub>                |  | Room               |                         | 64                |                   |      |
| <b>Power Supply</b>                       |                                     |  |                    |                         |                   |                   |      |
| Power Supply Range                        | V+                                  |  |                    | 4.5                     |                   | 5.5               | V    |
| Power Supply Current                      | I+                                  | V+ = 5.5 V, V <sub>A/EN</sub> = 0 or 5.5 V, See Truth Table  | Full               |                         |                   | 1.0               | μA   |

Notes:

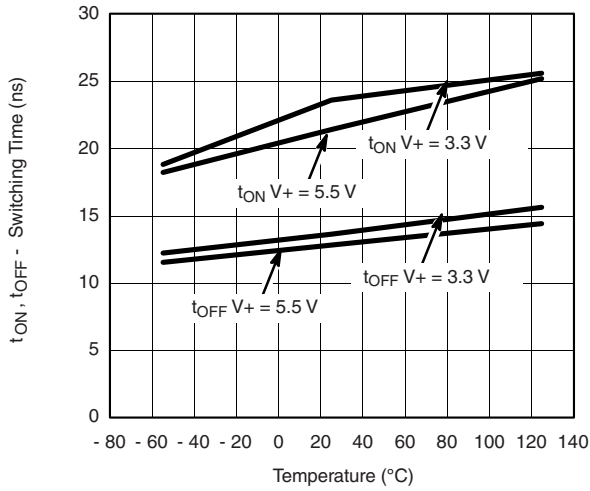
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
- c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- d. Guarantee by design, not subjected to production test.
- e. V<sub>A</sub>, E<sub>N</sub> = input voltage to perform proper function.
- f. Difference of min and max values.
- g. Guaranteed by 5 V testing.

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.

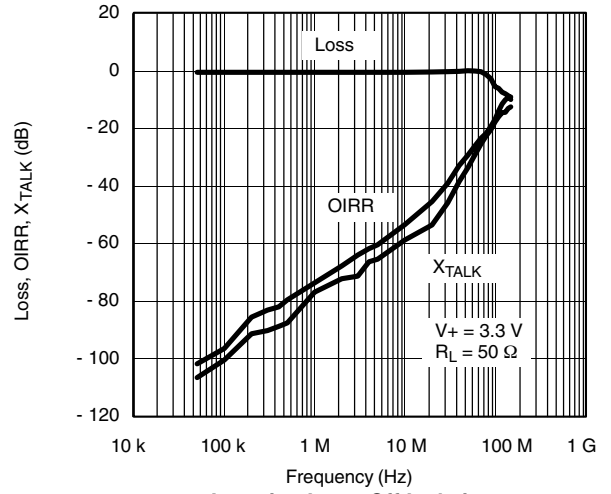
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



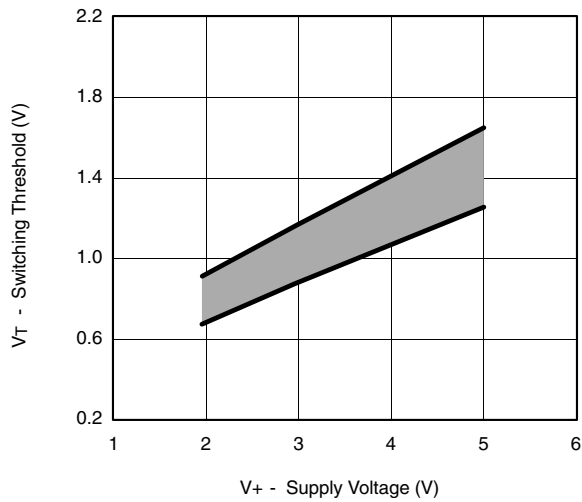
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



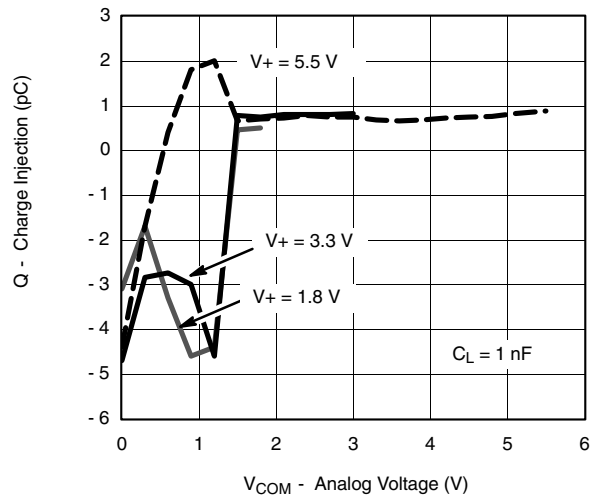
**Switching Time vs. Temperature**



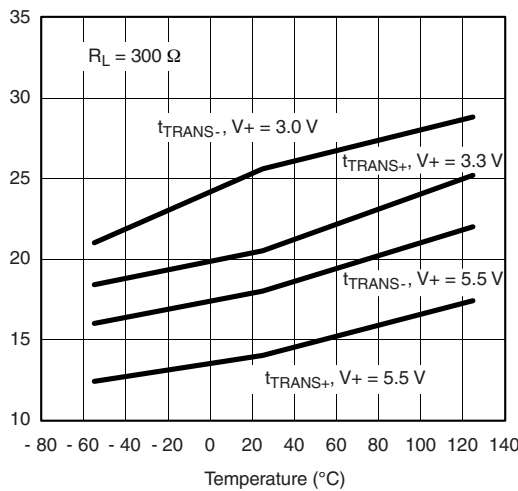
**Insertion Loss, Off-Isolation Crosstalk vs. Frequency**



**Switching Threshold vs. Supply Voltage**

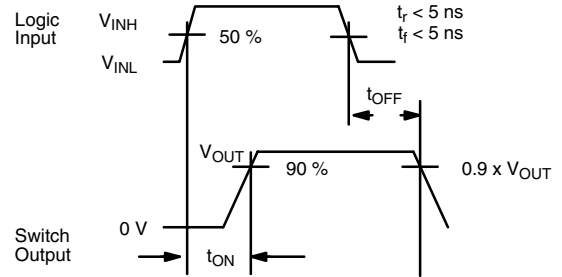
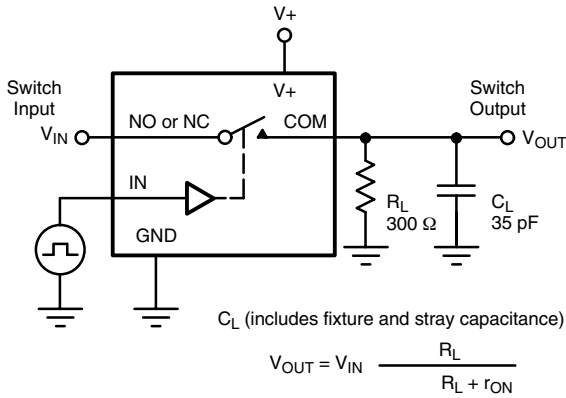


**Charge Injection vs. Analog Voltage**



**Transition Time vs. Temperature**

TEST CIRCUITS



Note: Logic input waveform is inverted for switches that have the opposite logic sense control

Figure 1. Switching Time

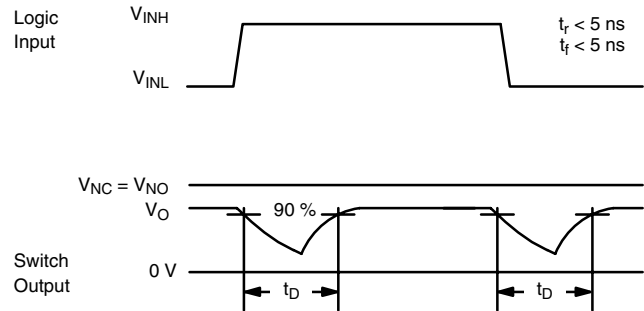
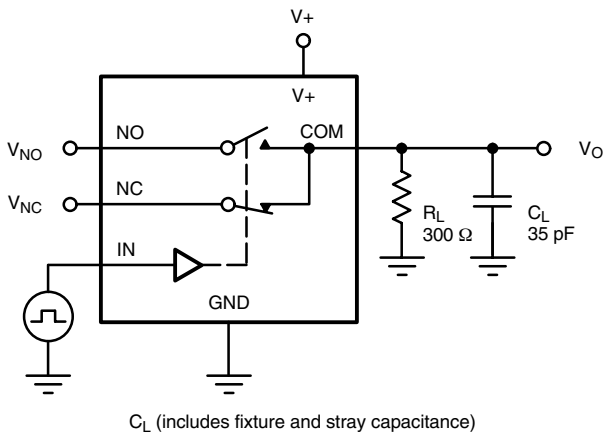


Figure 2. Break-Before-Make

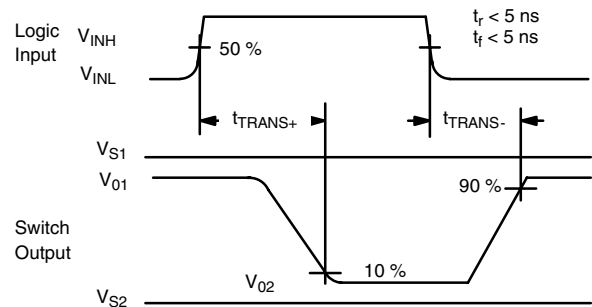
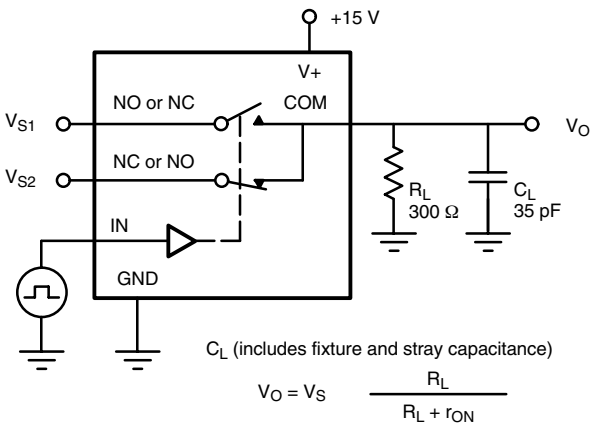
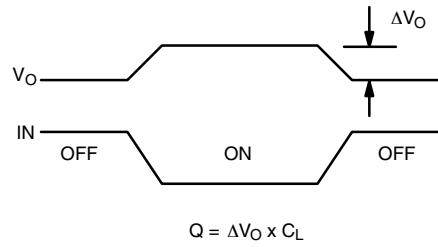
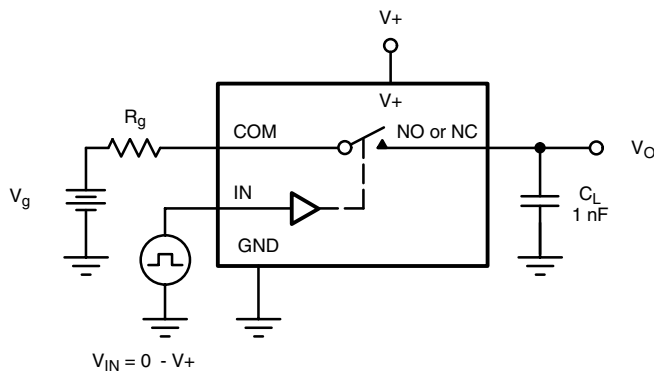


Figure 3. Transition Time

TEST CIRCUITS



IN dependent on switch configuration Input polarity determined by sense of switch.

Figure 4. Charge Injection

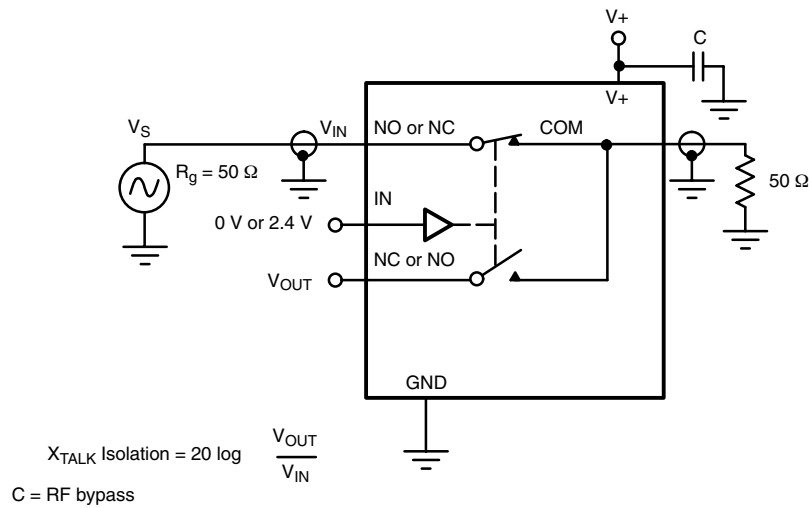


Figure 5. Crosstalk

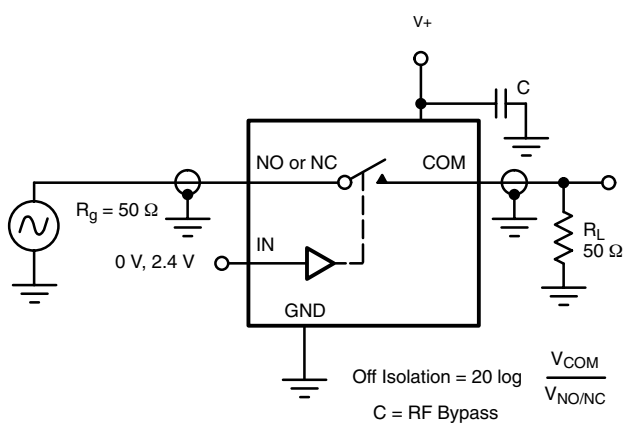


Figure 6. Off Isolation

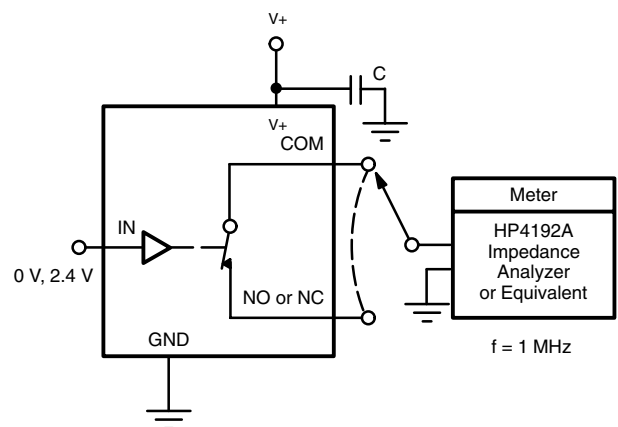


Figure 7. Source/Drain Capacitances

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?72418>.

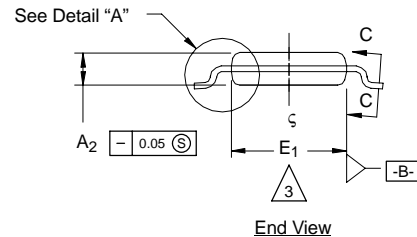
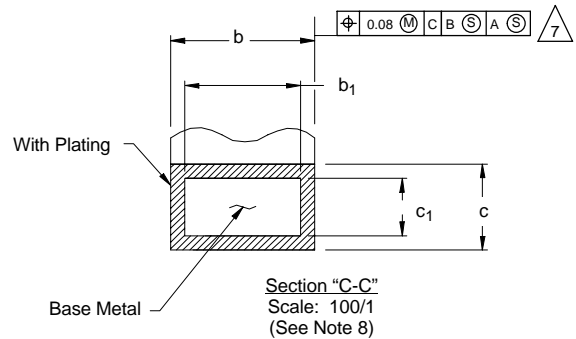


**MSOP: 10-LEADS**

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



Detail "B"  
(Scale: 30/1)  
Dambar Protrusion



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 [-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 [-A-] and [-B-] to be determined Datum plane [-H-].
- Exposed pad area in bottom side is the same as teh leadframe pad size.

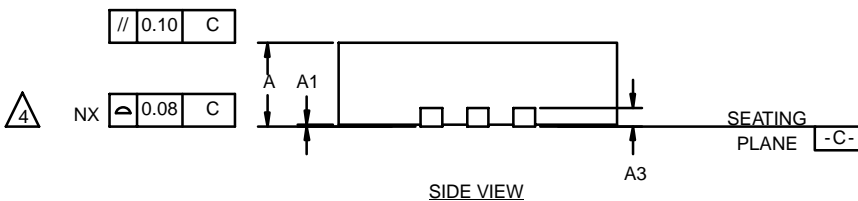
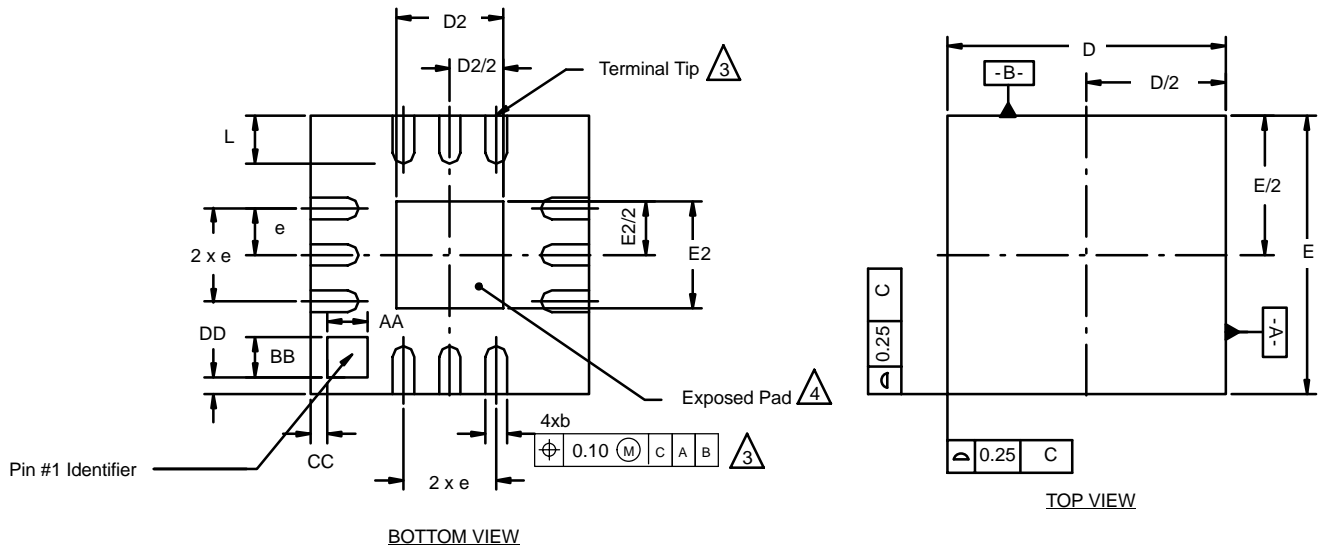
**N = 10L**

| 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°   |      |
| ECN: T-02080—Rev. C, 15-Jul-02<br>DWG: 5867 |             |      |      |      |





**QFN-12 LEAD (3 X 3)**



NOTES:

1. All dimensions are in millimeters.
2. N is the total number of terminals.
3. Dimension b applies to metallized terminal and is measured between 0.25 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   |
| <b>A</b>                                    | 0.80        | 0.90 | 1.00 | 0.032     | 0.035 | 0.039 |
| <b>b</b>                                    | 0.18        | 0.23 | 0.30 | 0.007     | 0.009 | 0.012 |
| <b>D</b>                                    | 3.00 BSC    |      |      | 0.118 BSC |       |       |
| <b>D2</b>                                   | 1.00        | 1.15 | 1.25 | 0.039     | 0.045 | 0.049 |
| <b>E</b>                                    | 3.00 BSC    |      |      | 0.118 BSC |       |       |
| <b>E2</b>                                   | 1.00        | 1.15 | 1.25 | 0.039     | 0.045 | 0.049 |
| <b>e</b>                                    | 0.50 BSC    |      |      | 0.02 BSC  |       |       |
| <b>L</b>                                    | 0.45        | 0.55 | 0.65 | 0.018     | 0.022 | 0.026 |
| <b>AA</b>                                   | 0.435       |      |      | 0.017     |       |       |
| <b>BB</b>                                   | 0.435       |      |      | 0.017     |       |       |
| <b>CC</b>                                   | 0.18        |      |      | 0.007     |       |       |
| <b>DD</b>                                   | 0.18        |      |      | 0.007     |       |       |
| ECN: C-03092—Rev. A, 14-Apr-03<br>DWG: 5898 |             |      |      |           |       |       |



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