

# Low Voltage, 1 $\Omega$ Single SPDT Analog Switch (1:2 Multiplexer) with Power Down Protection

## DESCRIPTION

The DG4157 is a high performance single pole double throw analog switch designed for 1.65 V to 5.5 V operation with single power rail.

Fabricated with high density CMOS technology, the device achieves low on resistance as 1  $\Omega$  at 4.5 V power supply and fast switching speed. The - 3 dB bandwidth is typically 117 MHz.

The DG4157 features break before make switch performance, and guarantees logic high control input threshold as low as 1.4 V over the range up to 5.5 V.

It can handle both analog and digital signals and permits signals with amplitudes of up to  $V_{CC}$  to be transmitted in either direction.

Power down protection circuit is built in to prevent abnormal current path through signal pins during power down condition.

Each output pin (A, B<sub>0</sub>, or B<sub>1</sub>) can withstand greater than 8 kV (human body model).

It is available in both SC-70-6 and miniQFN6 packages.

The features make it an ideal part for the switching of audio, video, and data stream.

## FEATURES

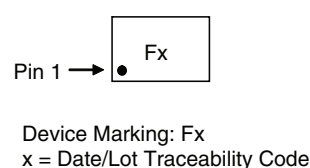
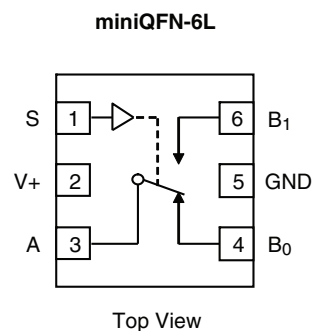
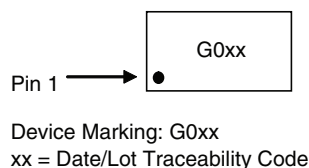
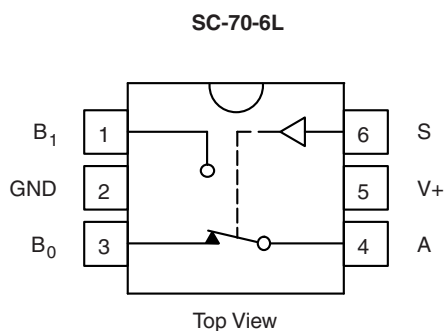
- Direct cross of industry standard xxx4157
- 1.65 V to 5.5 V operation voltage range
- Guaranteed 1.4 V logic high input threshold at  $V_{CC} = 5.5$  V
- 117 MHz, - 3 dB bandwidth
- Low on-resistance
- Power down protection
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



Available

**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



| TRUTH TABLE     |                               |
|-----------------|-------------------------------|
| LOGIC INPUT (S) | FUNCTION                      |
| 0               | B <sub>0</sub> Connected to A |
| 1               | B <sub>1</sub> Connected to A |

| ORDERING INFORMATION |            |                |
|----------------------|------------|----------------|
| TEMP. RANGE          | PACKAGE    | PART NUMBER    |
| -40 °C to +85 °C     | SC-70-6L   | DG4157DL-T1-E3 |
|                      | miniQFN-6L | DG4157DN-T1-E4 |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                      |                         | LIMIT                          | UNIT |
|------------------------------------------------|-------------------------|--------------------------------|------|
| Reference V <sub>+</sub> to GND                |                         | -0.3 to +6                     | V    |
| S, A, B <sup>a</sup>                           |                         | -0.3 to (V <sub>+</sub> + 0.3) |      |
| Continuous Current (Any terminal)              |                         | ± 200                          | mA   |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle) |                         | ± 400                          |      |
| Storage Temperature                            | D Suffix                | -65 to +150                    | °C   |
| Power Dissipation (Packages) <sup>b</sup>      | SC-70-6L <sup>c</sup>   | 250                            | mW   |
|                                                | miniQFN-6L <sup>d</sup> | 160                            |      |

**Notes**

- a. Signals on A, or B or S exceeding V<sub>+</sub> 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 3.1 mW/°C above 70 °C.  
d. Derate 2 mW/°C above 70 °C.

**SPECIFICATIONS**

| PARAMETER                                 | SYMBOL                     | TEST CONDITIONS<br>UNLESS OTHERWISE SPECIFIED<br>V+ = 3 V, VIN = 0 V or 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> |      |    |      |
| DC Characteristics                        |                            |                                                                                         |                     |                            |                                                                 |                   |      |    |      |
| On Resistance                             | RON                        | V+ = 2.7 V, B0 or B1 = 1.5 V, IO = 100 mA                                               | Room                | -                          | 1.7                                                             | 2.5               | Ω    |    |      |
|                                           |                            |                                                                                         | Full                | -                          | -                                                               | 3                 |      |    |      |
|                                           |                            | V+ = 4.5 V, B0 or B1 = 3.5 V, IO = 100 mA                                               | Room                | -                          | 0.95                                                            | 1.2               |      |    |      |
|                                           |                            |                                                                                         | Full                | -                          | -                                                               | 1.4               |      |    |      |
| On Resistance Flatness                    | RFLATNESS                  | V+ = 2.7 V, B0 or B1 = 0.75 V, 1.5 V, IO = 100 mA                                       | Room                | -                          | 0.2                                                             | -                 |      |    |      |
|                                           |                            |                                                                                         | Room                | -                          | 0.14                                                            | 0.3               |      |    |      |
|                                           |                            | V+ = 4.5 V, B0 or B1 = 1 V, 3.5 V, IO = 100 mA                                          | Full                | -                          | -                                                               | 0.4               |      |    |      |
|                                           |                            |                                                                                         | On Resistance Match | ΔRON                       | V+ = 2.7 V, B0 or B1 = 1.5 V, IO = 100 mA                       | Room              |      | -  | 0.04 |
| Room                                      | -                          | 0.05                                                                                    |                     |                            |                                                                 | 0.12              |      |    |      |
| V+ = 4.5 V, B0 or B1 = 3.5 V, IO = 100 mA | Full                       | -                                                                                       |                     |                            | -                                                               | 0.15              |      |    |      |
|                                           | Switch Off Leakage Current | IOFF                                                                                    |                     |                            | V+ = 5.5 V, A = 1 V, 4.5 V<br>B0 or B1 = 4.5 V, 1 V or floating | Room              | -2   | -  | 2    |
| Full                                      |                            |                                                                                         | -20                 | -                          |                                                                 | 20                |      |    |      |
| Switch On Leakage Current                 |                            |                                                                                         | ION                 | Room                       |                                                                 | -4                | -    | 4  |      |
|                                           |                            |                                                                                         |                     | Full                       |                                                                 | -40               | -    | 40 |      |
| Digital Control                           |                            |                                                                                         |                     |                            |                                                                 |                   |      |    |      |
| Input, High Voltage                       | VINH                       | V+ = 2.7 V to 5.5 V                                                                     | Full                | 1.4                        | -                                                               | -                 | V    |    |      |
| Input, Low Voltage                        | VINL                       |                                                                                         | Full                | -                          | -                                                               | 0.4               |      |    |      |
| Input Current                             | IINH, IINL                 | VIN = 0 or V+                                                                           | Full                | -1                         | -                                                               | 1                 | μA   |    |      |
| Power Supply                              |                            |                                                                                         |                     |                            |                                                                 |                   |      |    |      |
| Power Supply Range                        | V+                         |                                                                                         | Full                | 1.65                       | -                                                               | 5.5               | V    |    |      |
| Quiescent Supply Current                  | I+                         | V+ = 5.5 V, VIN = 0 V, 5.5 V                                                            | Room                | -                          | 0.05                                                            | 0.5               | μA   |    |      |
|                                           |                            |                                                                                         | Full                | -                          | -                                                               | 1                 |      |    |      |

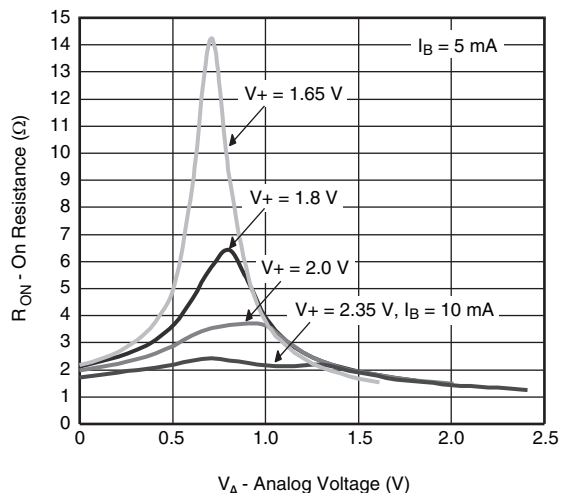
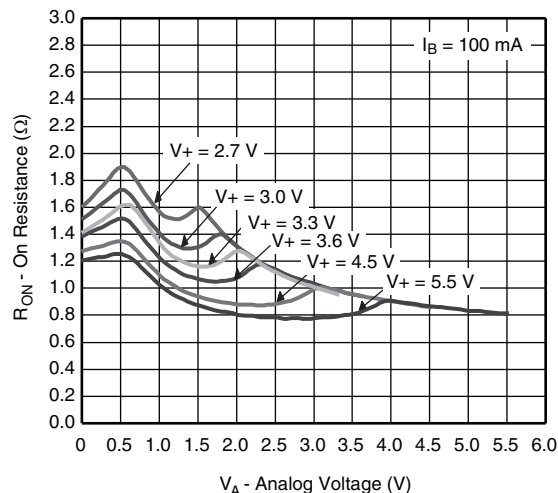
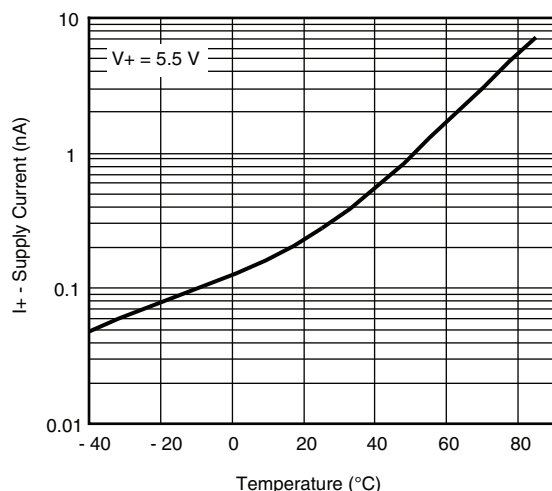
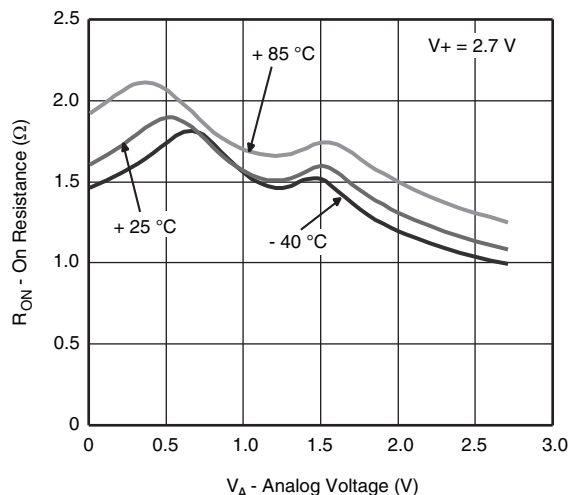
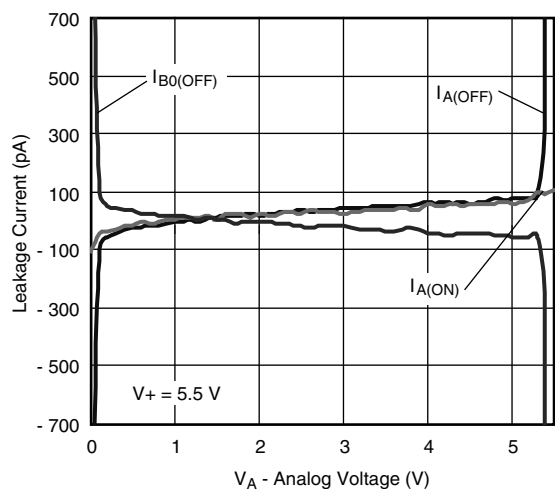
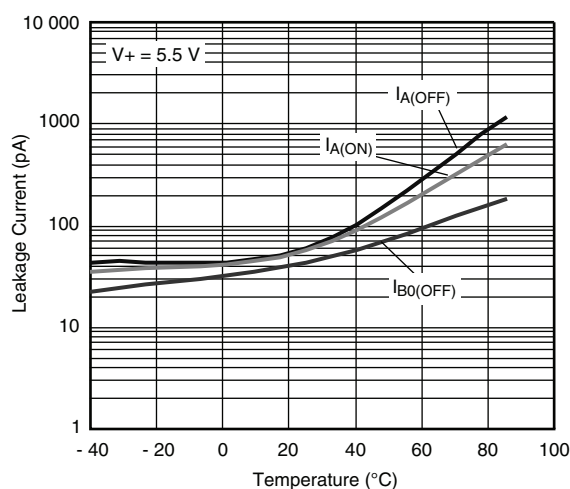


| SPECIFICATIONS                         |                     |                                                                                                     |                    |                            |                   |                   |      |
|----------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------|--------------------|----------------------------|-------------------|-------------------|------|
| PARAMETER                              | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE SPECIFIED<br>V+ = 3 V, VIN = 0 V or 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> |      |
| AC Characteristics                     |                     |                                                                                                     |                    |                            |                   |                   |      |
| Turn-On Time <sup>d</sup>              | t <sub>ON</sub>     | V+ = 2.7 V, B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF | Room               | -                          | 40                | 55                | ns   |
|                                        |                     |                                                                                                     | Full               | -                          | -                 | 60                |      |
|                                        |                     | V+ = 4.5 V, B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF | Room               | -                          | 22                | 37                |      |
|                                        |                     |                                                                                                     | Full               | -                          | -                 | 40                |      |
| Turn-Off Time <sup>d</sup>             | t <sub>OFF</sub>    | V+ = 2.7 V, B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF | Room               | -                          | 12                | 27                |      |
|                                        |                     |                                                                                                     | Full               | -                          | -                 | 30                |      |
|                                        |                     | V+ = 4.5 V, B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF | Room               | -                          | 8                 | 23                |      |
|                                        |                     |                                                                                                     | Full               | -                          | -                 | 25                |      |
| Break-Before-Make Time <sup>d</sup>    | t <sub>BBM</sub>    | V+ = 2.7 V, B <sub>0</sub> = B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF  | Room               | 1                          | 26                | -                 |      |
|                                        |                     | V+ = 4.5 V, B <sub>0</sub> = B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF  |                    | 1                          | 15                | -                 |      |
| Charge Injection <sup>d</sup>          | Q                   | C <sub>L</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>GEN</sub> = 0 V                               | Room               | -                          | 50                | -                 | pC   |
| Off Isolation <sup>d</sup>             | OIRR                | R <sub>L</sub> = 50 Ω, f = 1 MHz                                                                    | Room               | -                          | -58               | -                 | dB   |
|                                        |                     | R <sub>L</sub> = 50 Ω, f = 10 MHz                                                                   |                    | -                          | -31               | -                 |      |
| Crosstalk <sup>d</sup>                 | X <sub>TALK</sub>   | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                             | Room               | -                          | -63               | -                 |      |
|                                        |                     | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz                                            |                    | -                          | -36               | -                 |      |
| Bandwidth <sup>d</sup>                 | BW                  | R <sub>L</sub> = 50 Ω                                                                               | Room               | -                          | 117               | -                 | MHz  |
| Total Harmonic Distortion <sup>d</sup> | THD                 | R <sub>L</sub> = 600 Ω, V <sub>IN</sub> = 0.5 V, f = 20 kHz to 20 kHz                               | Room               | -                          | 0.02              | -                 | %    |
| Capacitance                            |                     |                                                                                                     |                    |                            |                   |                   |      |
| BX Port Off Capacitance <sup>d</sup>   | C <sub>B(OFF)</sub> | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                             | Room               | -                          | 20                | -                 | pF   |
| A Port On Capacitance <sup>d</sup>     | C <sub>A(ON)</sub>  |                                                                                                     |                    | -                          | 57                | -                 |      |
| Control Pin Capacitance <sup>d</sup>   | C <sub>IN</sub>     |                                                                                                     |                    | -                          | 5                 | -                 |      |

**Notes**

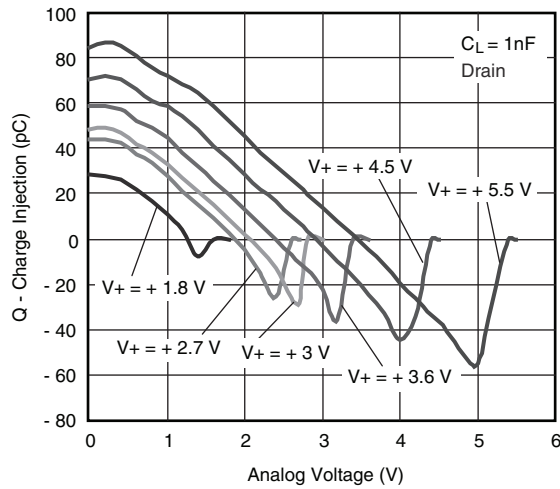
- a. Room = 25 °C, Full = as determined by the operating suffix.  
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.  
c. Typical values are for design aid only, not guaranteed nor subject to production testing.  
d.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

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

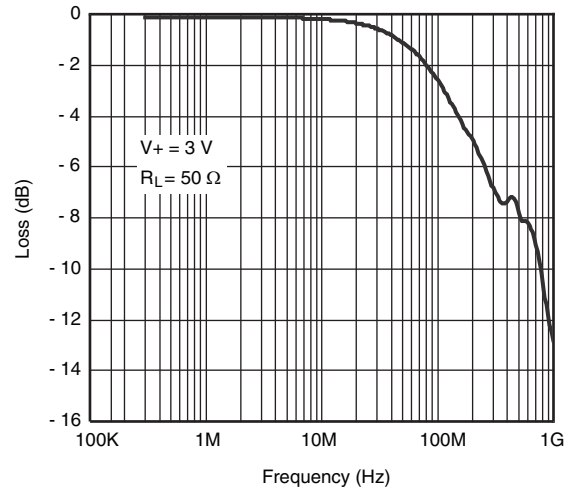
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

 **$R_{ON}$  vs.  $V_A$  and Supply Voltage**

 **$R_{ON}$  vs.  $V_A$  and Supply Voltage**

**Supply Current vs. Temperature**

 **$R_{ON}$  vs.  $V_D$  and Temperature**

**Leakage vs. Analog Voltage**

**Leakage Current vs. Temperature**



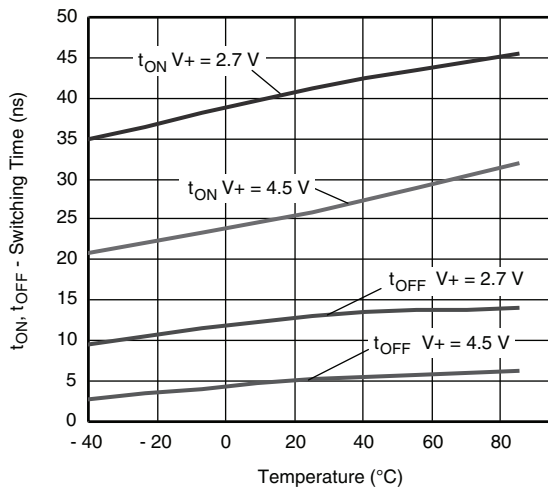
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



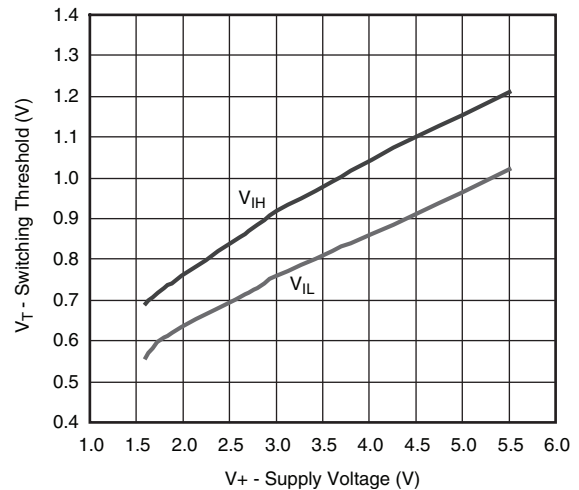
**Charge Injection vs. Analog Voltage**



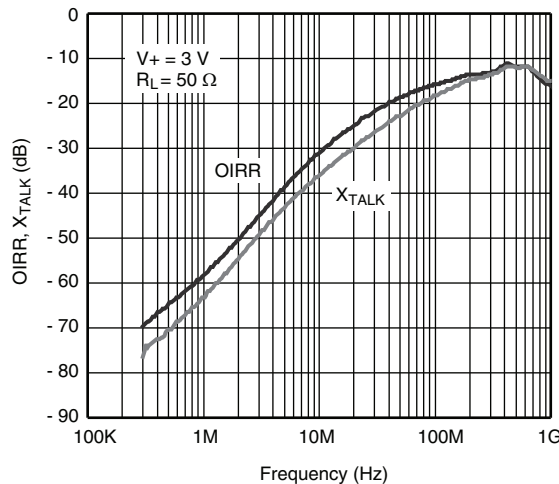
**Insertion Loss vs. Frequency**



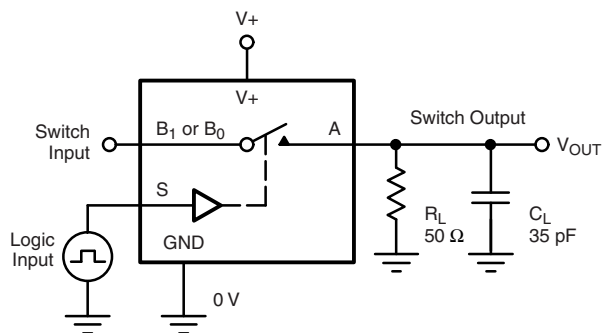
**Switching Time vs. Temperature**



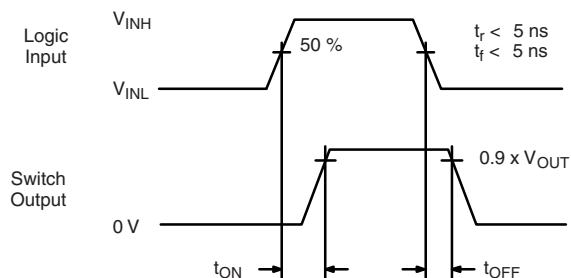
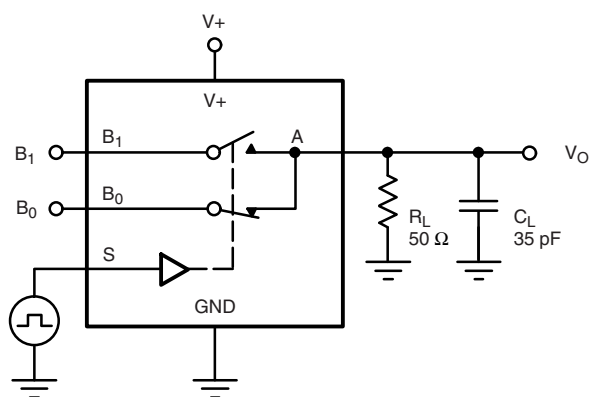
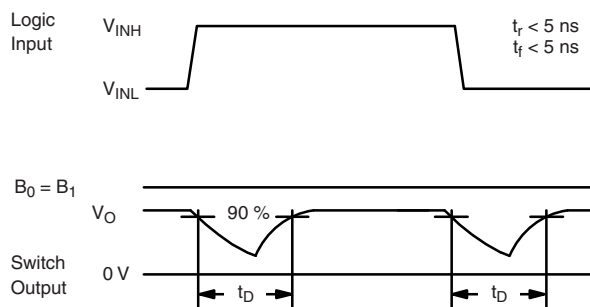
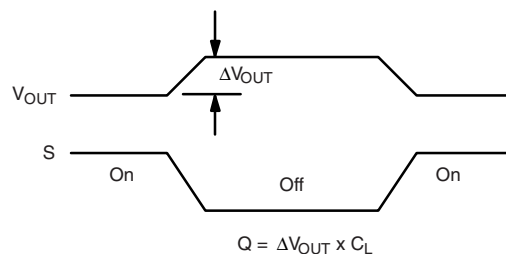
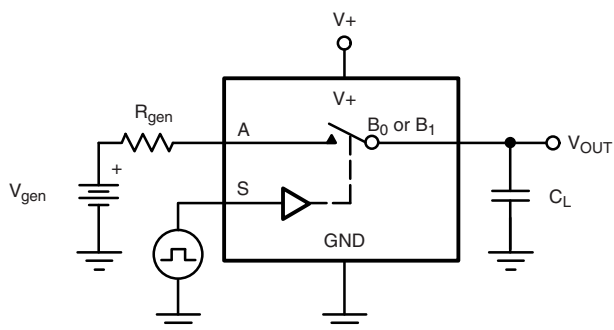
**Switching Threshold vs. Supply Voltage**



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

**TEST CIRCUITS**

 $C_L$  (includes fixture and stray capacitance)

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

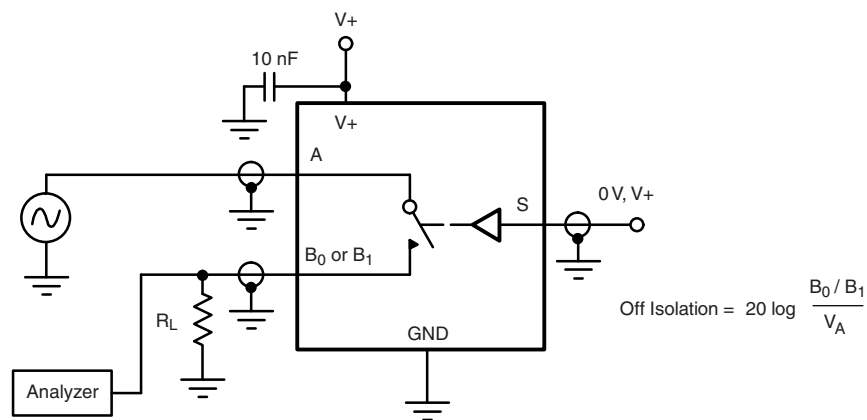

**Fig. 1 - Switching Time**

 $C_L$  (includes fixture and stray capacitance)

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


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

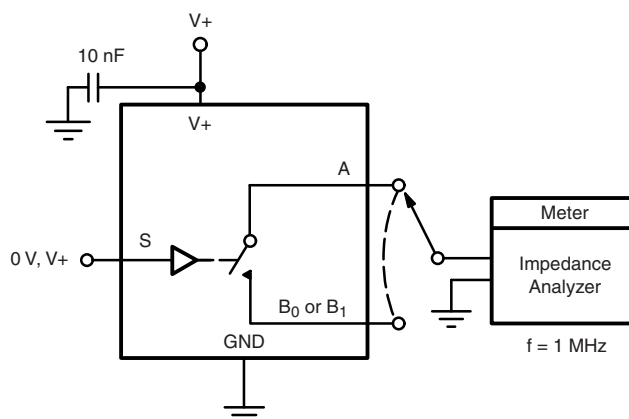
S depends on switch configuration: input polarity determined by sense of switch.

**Fig. 3 - Charge Injection**

## TEST CIRCUITS



### Fig. 4 - Off-Isolation

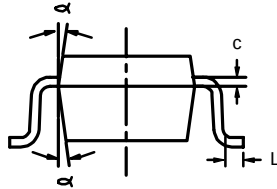
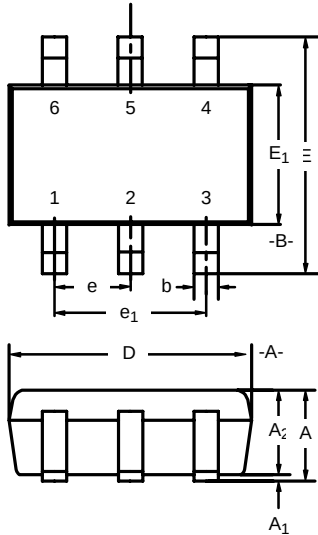


**Fig. 5 - Channel Off/On Capacitance**

*Vishay Silconix 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 [www.vishay.com/ppg?68800](http://www.vishay.com/ppg?68800).*



**SC-70: 6-LEADS**

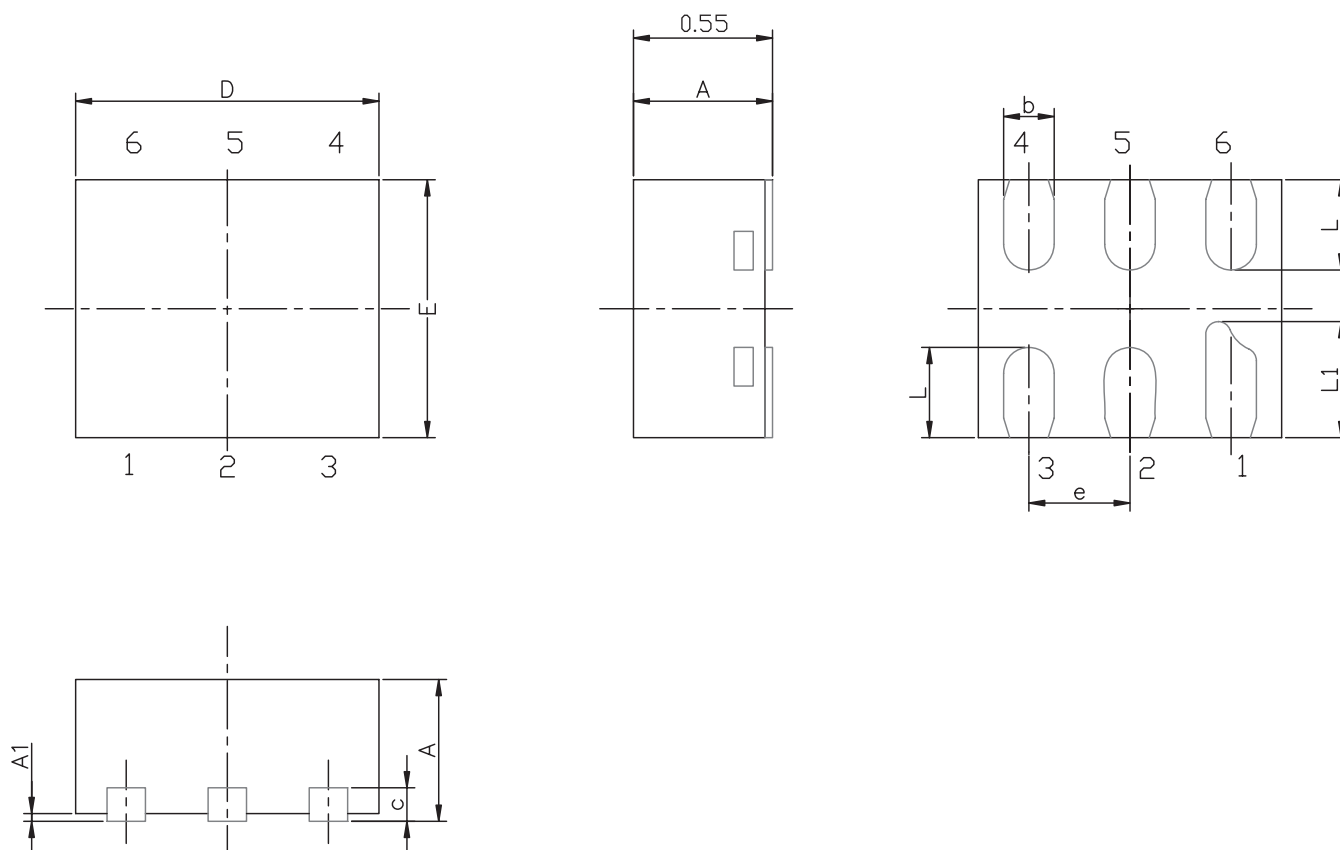


| Dim            | MILLIMETERS |      |      | INCHES   |       |       |
|----------------|-------------|------|------|----------|-------|-------|
|                | Min         | Nom  | Max  | Min      | Nom   | Max   |
| A              | 0.90        | –    | 1.10 | 0.035    | –     | 0.043 |
| A <sub>1</sub> | –           | –    | 0.10 | –        | –     | 0.004 |
| A <sub>2</sub> | 0.80        | –    | 1.00 | 0.031    | –     | 0.039 |
| b              | 0.15        | –    | 0.30 | 0.006    | –     | 0.012 |
| c              | 0.10        | –    | 0.25 | 0.004    | –     | 0.010 |
| D              | 1.80        | 2.00 | 2.20 | 0.071    | 0.079 | 0.087 |
| E              | 1.80        | 2.10 | 2.40 | 0.071    | 0.083 | 0.094 |
| E <sub>1</sub> | 1.15        | 1.25 | 1.35 | 0.045    | 0.049 | 0.053 |
| e              | 0.65BSC     |      |      | 0.026BSC |       |       |
| e <sub>1</sub> | 1.20        | 1.30 | 1.40 | 0.047    | 0.051 | 0.055 |
| L              | 0.10        | 0.20 | 0.30 | 0.004    | 0.008 | 0.012 |
| α              | 7°Nom       |      |      | 7°Nom    |       |       |

ECN: S-03946—Rev. B, 09-Jul-01  
DWG: 5550



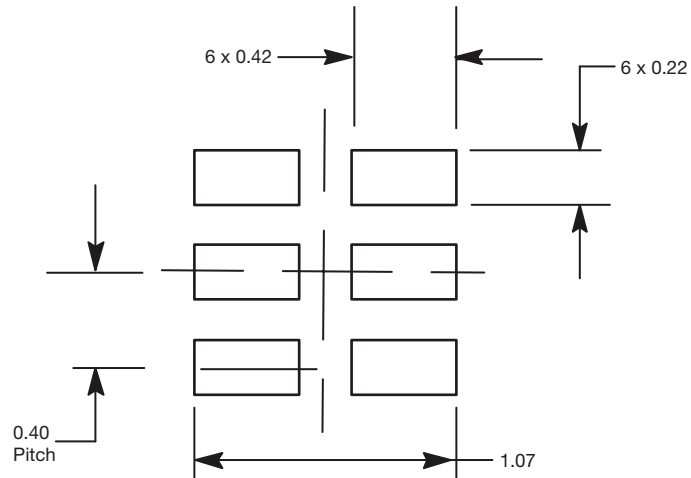
## MINI QFN-6L CASE OUTLINE



| DIM | MILLIMETERS |      |      | INCHES    |        |        |
|-----|-------------|------|------|-----------|--------|--------|
|     | MIN.        | NAM. | MAX. | MIN.      | NAM.   | MAX.   |
| A   | 0.50        | 0.55 | 0.60 | 0.0197    | 0.0217 | 0.0236 |
| A1  | 0.00        | -    | 0.05 | 0.000     | -      | 0.002  |
| b   | 0.15        | 0.20 | 0.25 | 0.006     | 0.008  | 0.010  |
| c   | 0.15 REF    |      |      | 0.006 REF |        |        |
| D   | 1.15        | 1.20 | 1.25 | 0.045     | 0.047  | 0.049  |
| E   | 0.95        | 1.00 | 1.05 | 0.037     | 0.039  | 0.041  |
| e   | 0.40 BSC    |      |      | 0.016 BSC |        |        |
| L   | 0.30        | 0.35 | 0.40 | 0.012     | 0.014  | 0.016  |
| L1  | 0.40        | 0.45 | 0.50 | 0.016     | 0.018  | 0.020  |

ECN T-07039-Rev. A, 12-Feb-07  
DWG: 5958

## RECOMMENDED MINIMUM PADS FOR MINI QFN 6L



Mounting Footprint  
Dimensions in mm



## Disclaimer

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## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**