

Low Voltage, 300-MHz - 3 dB Bandwidth, SPDT Analog Switch with Power Down Protection

(2:1 Multiplexer/Demultiplexer Bus Switch)

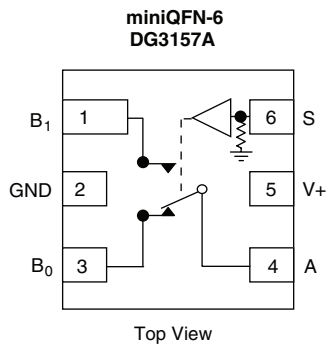
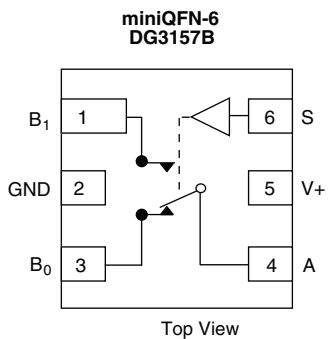
DESCRIPTION

The DG3157A, DG3157B are high-speed single-pole double-throw, low voltage switch. Using sub-micro CMOS technology, the DG3157A, DG3157B achieves low on-resistance and negligible propagation delay. The DG3157A, DG3157B can handle both analog and digital signals and permits signals with amplitudes of up to V_{CC} to be transmitted in either direction. Select pin of control logic input can be over the V_+ . When the select pin is low, B_0 is connected to the output A pin. When the select pin is high, B_1 is connected to the output A pin. The path that is open will have a high-impedance state with respect to the output A pin. Break before make is guaranteed. The DG3157A has an internal pull down resistor on the control pin S, while the DG3157B does not.

FEATURES

- Ultra small miniQFN6 package of 1 mm x 1.2 mm
- Wide operation voltage range: 1.8 V to 5.5 V
- Useful in both analog and digital signal switching
- 300 MHz - 3 dB bandwidth
- Power down safe design
- Low voltage logic threshold: $V_{th}(high) = 1.2\text{ V}$ at $V_+ = 3.3\text{ V}$
- Minimal propagation delay
- Break-before-make switching
- Zero bounce in flow-through mode
- > 300 mA latch up current per JESD78
- > 8 kV ESD/HBM
- DG3157A version has internal pull down resistor on control pin S


 Available
RoHS*
 COMPLIANT

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

Device Marking: E

Device Marking: D
TRUTH TABLE

| Logic Input (S) | Function |
|-----------------|----------------------|
| 0 | B_0 Connected to A |
| 1 | B_1 Connected to A |

ORDERING INFORMATION

| Temp. Range | Package | Part Number |
|------------------|-----------|-----------------|
| - 40 °C to 85 °C | miniQFN-6 | DG3157ADN-T1-E4 |
| | | DG3157BDN-T1-E4 |

* Pb containing terminations are not RoHS compliant, exemptions may apply.

| ABSOLUTE MAXIMUM RATINGS | | | |
|--|------------------------|---------------------|------|
| Parameter | | Limit | Unit |
| Reference V+ to GND | | - 0.3 to + 6 | V |
| S, A, B ^a | | - 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) ^b | miniQFN-6 ^c | 160 | mW |

Notes:

- a. Signals on A, or B or S 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 2.0 mW/°C above 70 °C.

| SPECIFICATIONS | | | | | | | | |
|---|----------------------|--|---|--------------------|--------------------------------------|-------------------|-------------------|------|
| Parameter | Symbol | Test Conditions Unless Otherwise Specified V+ = 3.0 V, V _{SL} = 0.5 V, V _{SH} = 2.0 V ^e | | Temp. ^a | Limits - 40 °C to 85 °C | | | Unit |
| | | | | | Min. ^b | Typ. ^c | Max. ^b | |
| DC Characteristics | | | | | | | | |
| High Level Input Voltage | V _{SH} | V+ = 1.65 to 1.95 V | | Full | 1.2 | | V | |
| | | V+ = 2.0 to 2.6 V | | | 1.4 | | | |
| | | V+ = 2.7 to 3.6 V | | | 2.0 | | | |
| | | V+ = 4.5 to 5.5 V | | | 2.4 | | | |
| Low Level Input Voltage | V _{SL} | V+ = 1.65 to 1.95 V | | | | | | 0.3 |
| | | V+ = 2.0 to 2.6 V | | | | | | 0.4 |
| | | V+ = 2.7 to 3.6 V | | | | | | 0.5 |
| | | V+ = 4.5 to 5.5 V | | | | | | 0.8 |
| On-Resistance | R _{ON} | V+ = 4.5 V | V _{BN} = 0 V, I _A = 30 mA | Full | 4.8 | 7 | Ω | |
| | | | V _{BN} = 2.4 V, I _A = - 30 mA | | 5.7 | 12 | | |
| | | | V _{BN} = 4.5 V, I _A = - 30 mA | | 10.3 | 15 | | |
| | | V+ = 3.0 V | V _{BN} = 0 V, I _A = 24 mA | | 5.9 | 9 | | |
| | | | V _{BN} = 3.0 V, I _A = - 24 mA | | 13.7 | 20 | | |
| | | V+ = 2.3 V | V _{BN} = 0 V, I _A = 8 mA | | 7 | 12 | | |
| | | | V _{BN} = 2.3 V, I _A = - 8 mA | | 16.2 | 30 | | |
| | | V+ = 1.65 V | V _{BN} = 0 V, I _A = 4 mA | | 9.2 | 20 | | |
| V _{BN} = 1.65 V, I _A = - 4 mA | 24 | | 50 | | | | | |
| On-Resistance Flatness | R _{FLAT} | 0 < V _{BN} < V+ | | Room | 8 | | | |
| | | | | | V+ = 4.5 V, I _A = - 30 mA | 13 | | |
| | | | | | V+ = 3.0 V, I _A = - 24 mA | 24 | | |
| | | | | | V+ = 2.3 V, I _A = - 8 mA | 89 | | |
| On-Resistance Matching Between Channels | ΔR _{ON} | V+ = 4.5 V, V _{BN} = 3.15 V, I _A = - 30 mA | | | 0.8 | | | |
| | | V+ = 3.0 V, V _{BN} = 2.1 V, I _A = - 24 mA | | | 0.1 | | | |
| | | V+ = 2.3 V, V _{BN} = 1.6 V, I _A = - 8 mA | | | 0.2 | | | |
| | | V+ = 1.65 V, V _{BN} = 1.15 V, I _A = - 4 mA | | | 0.9 | | | |
| Input Leakage Current | I _S | V+ = 5.5 V, V _A = 5.5 V, V _S = 0.8 V, 2.4 V | DG3157B | Full | - 1.0 | | 1.0 | |
| | | | DG3157A | | - 1.0 | 2.5 | 7.0 | |
| Off Stage Switch Leakage | I _{BN(off)} | V+ = 5.5 V, V _A /V _B = 0 V/5.5 V | | Room Full | - 0.1 - 1.0 | | 0.1 1.0 | |
| On State Switch Leakage | I _{BN(on)} | V+ = 5.5 V, V _A /V _B = 0 V/5.5 V | | Room Full | - 0.1 - 1.0 | | 0.1 1.0 | |



| SPECIFICATIONS | | | | | | | | |
|--|-------------------|---|--------------------------------------|-------------------|----------------------------|----------|---------------|------|
| Parameter | Symbol | Test Conditions Unless Otherwise Specified $V_+ = 3.0\text{ V}$, $V_{SL} = 0.5\text{ V}$, $V_{SH} = 2.0\text{ V}^e$ | | | Limits - 40 °C to 85 °C | | | Unit |
| | | Temp. ^a | Min. ^b | Typ. ^c | Max. ^b | | | |
| Power Supply | | | | | | | | |
| Power Supply Range | V_+ | | Full | 1.65 | | 5.5 | V | |
| Quiescent Supply Current | I_+ | $V_+ = 5.5\text{ V}$, $V_A = V_+$ or GND | Room Full | | | 1 10 | μA | |
| AC Electrical Characteristic | | | | | | | | |
| Prop Delay Time ^f | t_{PHL}/t_{PLH} | $V_A = 0\text{ V}$ | $V_+ = 1.65\text{ to }1.95\text{ V}$ | Full | | 1.5 | ns | |
| | | | $V_+ = 2.3\text{ to }2.7\text{ V}$ | Full | | 0.8 | | |
| | | | $V_+ = 3.0\text{ to }3.6\text{ V}$ | Full | | 0.4 | | |
| | | | $V_+ = 4.5\text{ to }5.5\text{ V}$ | Full | | 0.3 | | |
| Output Enable Time ^f | t_{PZL}/t_{PZH} | $V_{LOAD} = 2 \times V_+$ for t_{PZL} $V_{LOAD} = 0\text{ V}$ for t_{PZH} | $V_+ = 1.65\text{ to }1.95\text{ V}$ | Room Full | | 27 50 | ns | |
| | | | $V_+ = 2.3\text{ to }2.7\text{ V}$ | Room Full | | 15 45 | | |
| | | | $V_+ = 3.0\text{ to }3.6\text{ V}$ | Room Full | | 10 30 | | |
| | | | $V_+ = 4.5\text{ to }5.5\text{ V}$ | Room Full | | 7 25 | | |
| Output Disable Time ^f | t_{PLZ}/t_{PHZ} | $V_{LOAD} = 2 \times V_+$ for t_{PLZ} $V_{LOAD} = 0\text{ V}$ for t_{PHZ} | $V_+ = 1.65\text{ to }1.95\text{ V}$ | Room Full | | 16 45 | ns | |
| | | | $V_+ = 2.3\text{ to }2.7\text{ V}$ | Room Full | | 10 40 | | |
| | | | $V_+ = 3.0\text{ to }3.6\text{ V}$ | Room Full | | 8 35 | | |
| | | | $V_+ = 4.5\text{ to }5.5\text{ V}$ | Room Full | | 6 21 | | |
| Break-Before-Make Time ^d | t_{BBM} | $V_+ = 1.65\text{ to }1.95\text{ V}$ | | Full | 0.5 | 11 | pC | |
| | | $V_+ = 2.3\text{ to }2.7\text{ V}$ | | Full | 0.5 | 6 | | |
| | | $V_+ = 3.0\text{ to }3.65\text{ V}$ | | Full | 0.5 | 4 | | |
| | | $V_+ = 4.5\text{ to }5.5\text{ V}$ | | Full | 0.5 | 3 | | |
| Charge Injection ^d | Q | $C_L = 1\text{ nF}$, $V_{GEN} = 0\text{ V}$ $R_{GEN} = 0\ \Omega$ | $V_+ = 5\text{ V}$ | Room | | 7 | pC | |
| | | | $V_+ = 3.3\text{ V}$ | Room | | 5 | | |
| Off Isolation ^d | OIRR | $R_L = 50\ \Omega$, $f = 10\text{ MHz}$ | | Room | | - 57 | dB | |
| Crosstalk ^d | X_{TALK} | | | Room | | - 64 | | |
| - 3 dB Bandwidth ^d | BW | $R_L = 50\ \Omega$ | | Room | | 300 | MHz | |
| Total Harmonic Distortion ^d | THD | $R_L = 600\ \Omega$, 0.5 V_{p-p} $f = 600\text{ Hz} - 20\text{ kHz}$ | | Room | | 0.016 | % | |
| Capacitance | | | | | | | | |
| Control Pin Capacitance ^d | C_S | $V_+ = 0\text{ V}$ | | Room | | 3.7 | pF | |
| B Port Off Capacitance ^d | C_{IO-B} | $V_+ = 5\text{ V}$ | | Room | | 7 | | |
| A Port Capacitance When Switch Enable ^d | $C_{IO-A(on)}$ | | | Room | | 19 | | |

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_S = input voltage to perform proper function.
- f. Guaranteed by design and not production tested. The bus switch propagation delay is a function of the RC time constant contributed by the on-resistance and the specified load capacitance with an ideal voltage source (zero output impedance) driving the switch.

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.

LOGIC DIAGRAM Positive Logic

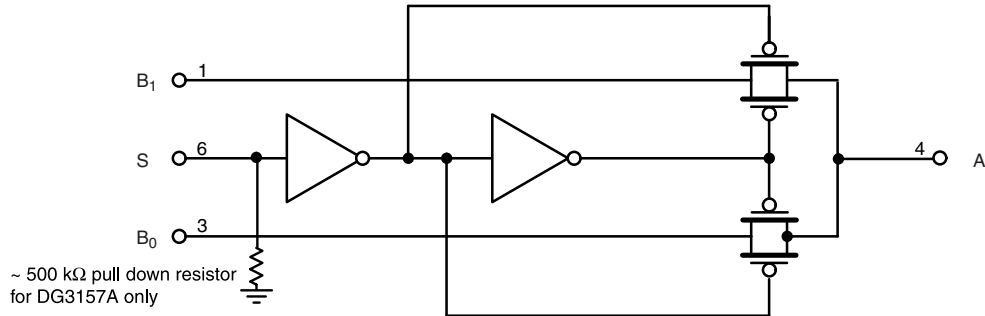


Figure 1.

AC LOADING AND WAVEFORMS

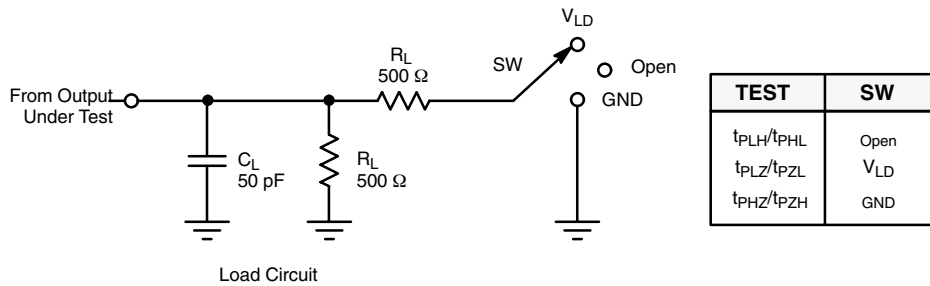


Figure 2. AC Test Circuit

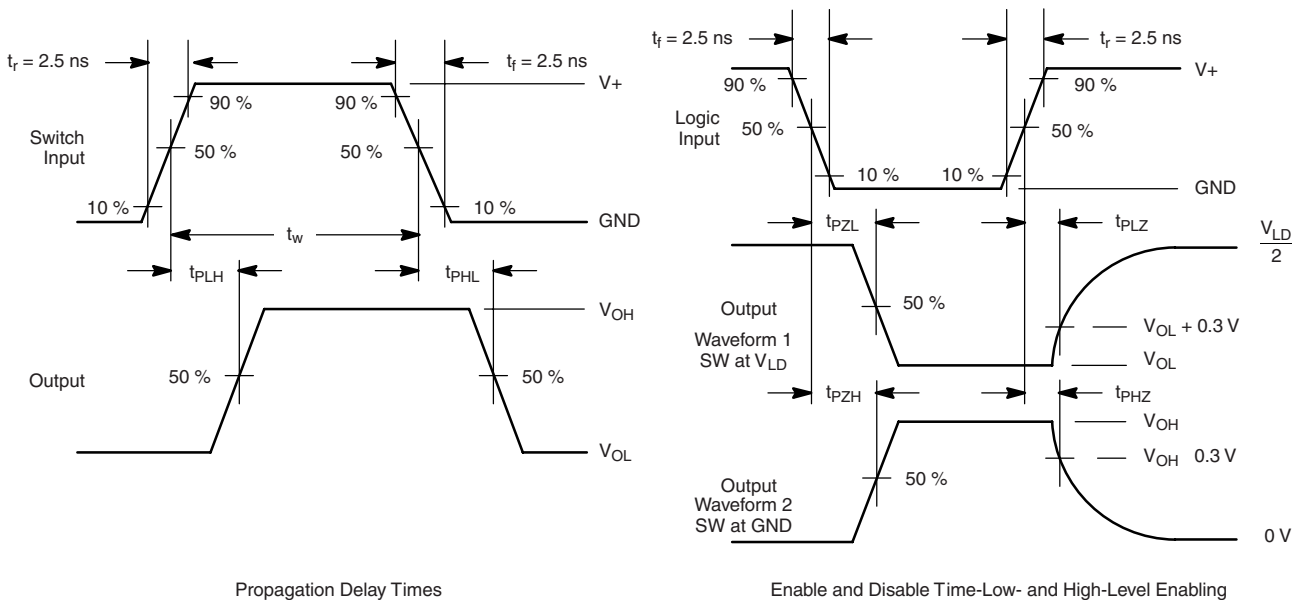
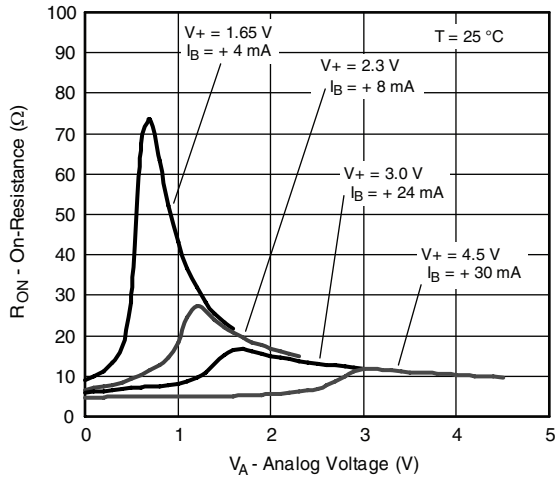


Figure 3. AC Waveforms

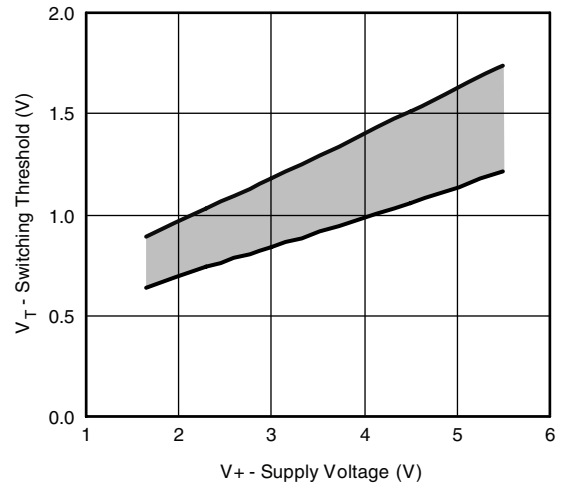
Notes:

- C_L includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
- Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: Input PRR = 1.0 MHz, $t_w = 500$ ns.
- The outputs are measured one at a time with one transition per measurement.
- $V_{LD} = 2 V_+$.

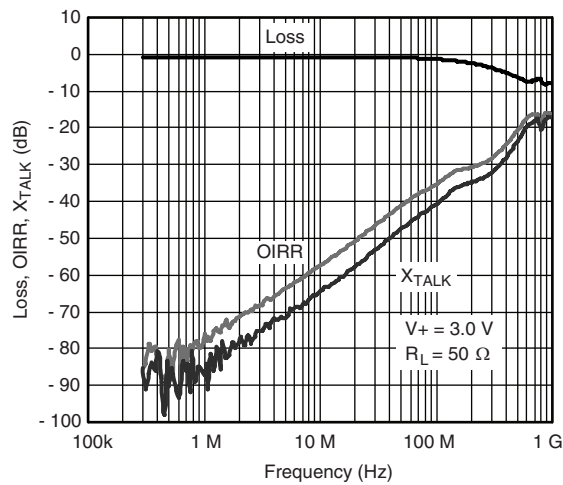
TYPICAL CHARACTERISTICS $T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted



R_{ON} vs. V_A and Supply Voltage

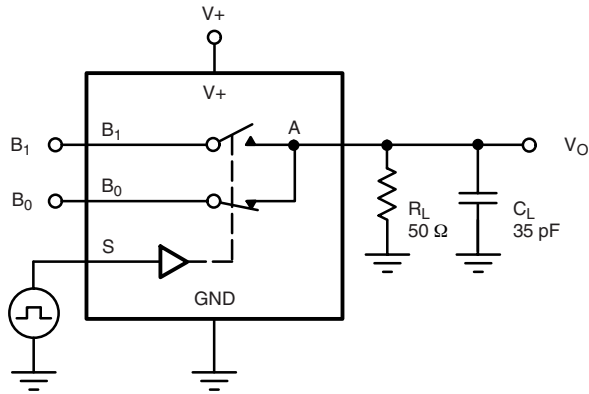


Switching Threshold vs. Supply Voltage



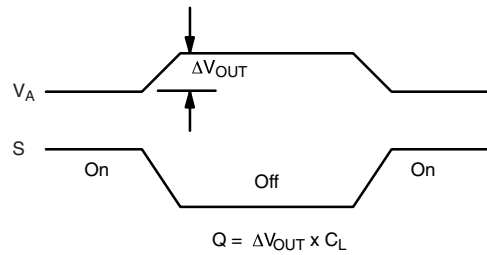
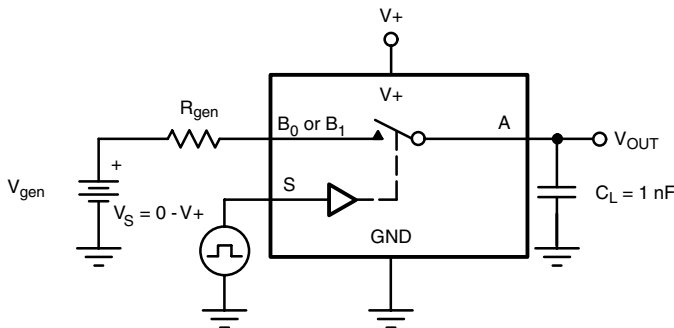
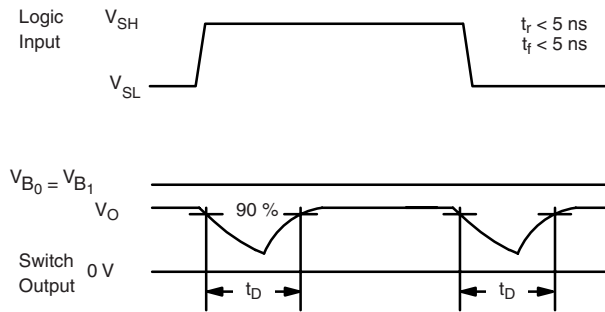
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

TEST CIRCUITS



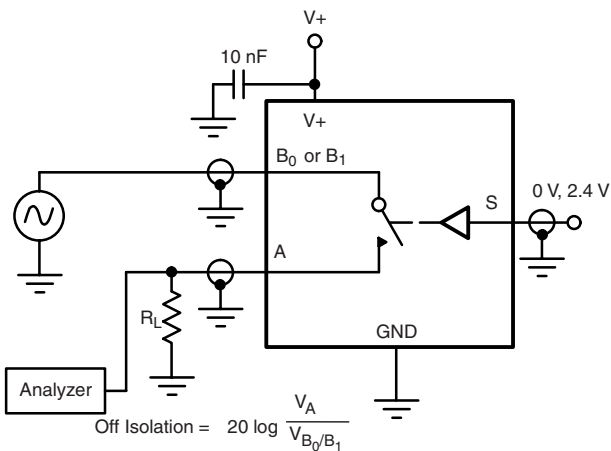
C_L (includes fixture and stray capacitance)

Figure 4. Break-Before-Make Interval



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

Figure 5. Charge Injection



$$\text{Off Isolation} = 20 \log \frac{V_A}{V_{B_0/B_1}}$$

Figure 6. Off-Isolation

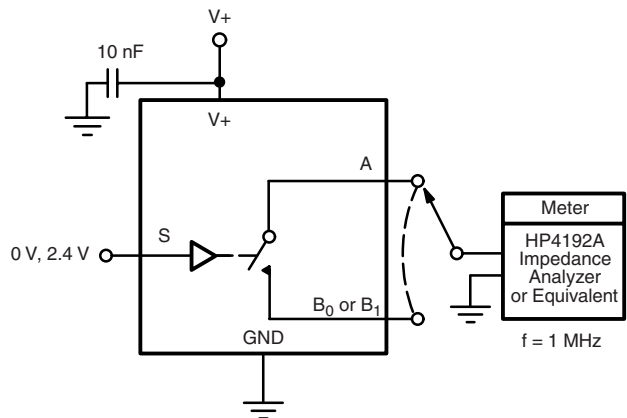
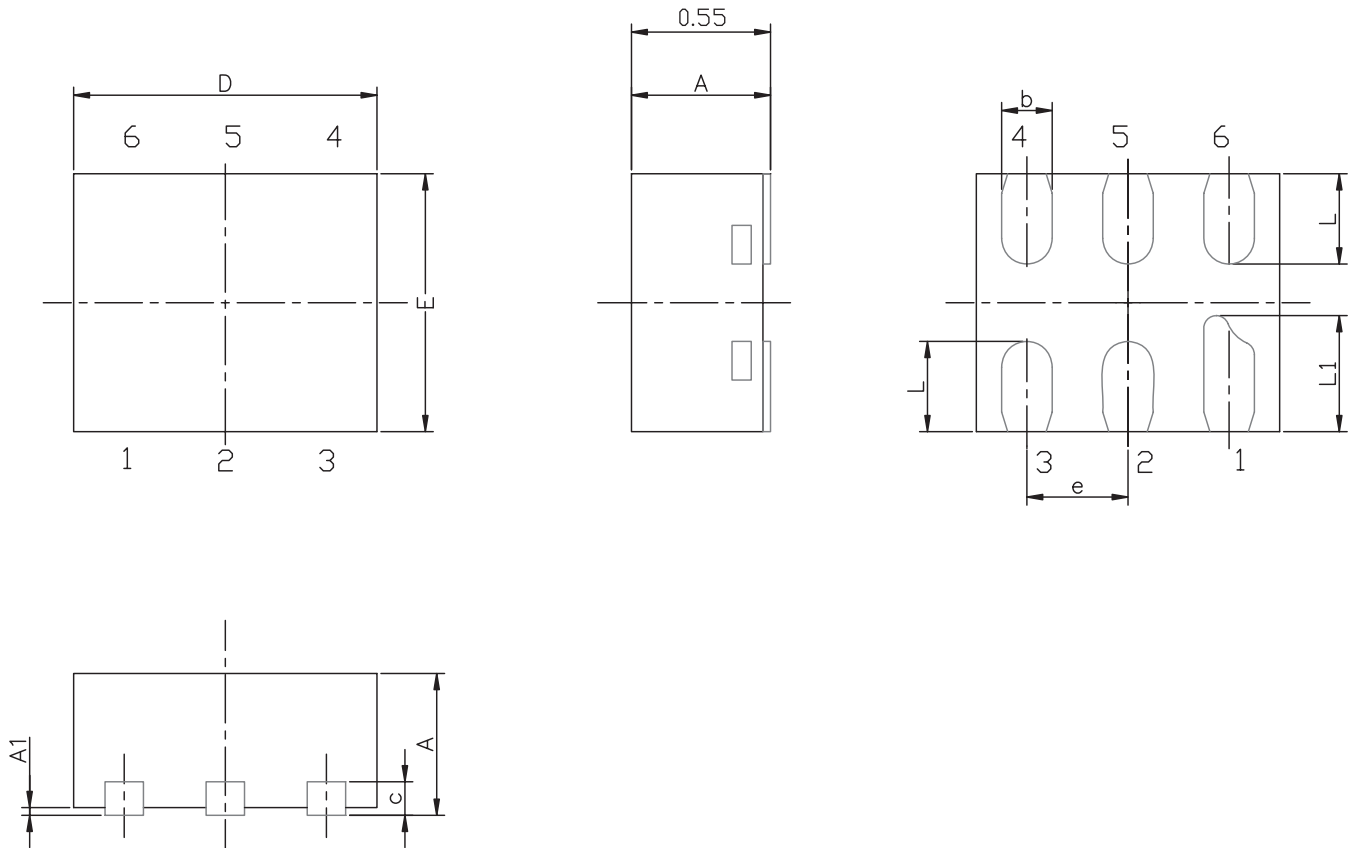


Figure 7. Channel Off/On Capacitance

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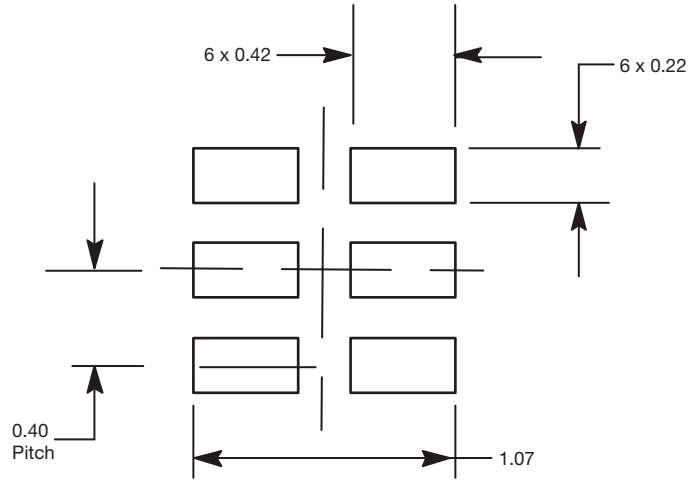
MINI QFN-6L CASE OUTLINE



| 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 |

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 DWG: 5958

RECOMMENDED MINIMUM PADS FOR MINI QFN 6L



Mounting Footprint
Dimensions in mm



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