

# 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.

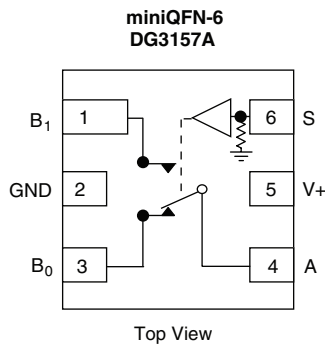
### FEATURES

- 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:  $V_{th}(high) = 1.2 V$  at  $V_+ = 3.3 V$
- 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

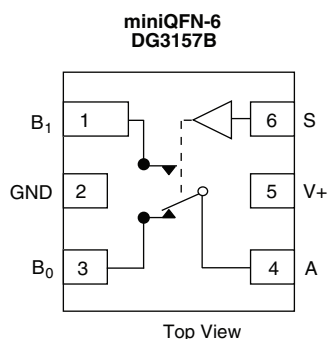


Available  
**RoHS\***  
COMPLIANT

### 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 <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>	miniQFN-6 <sup>c</sup>	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 <sub>SL</sub> = 0.5 V, V <sub>SH</sub> = 2.0 V <sup>e</sup>		Temp. <sup>a</sup>	Limits - 40 °C to 85 °C			Unit
					Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
<b>DC Characteristics</b>								
High Level Input Voltage	V <sub>SH</sub>	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 <sub>SL</sub>	V+ = 1.65 to 1.95 V		Full		0.3	V	
		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 <sub>ON</sub>	V+ = 4.5 V	V <sub>BN</sub> = 0 V, I <sub>A</sub> = 30 mA	Full	4.8	7	Ω	
			V <sub>BN</sub> = 2.4 V, I <sub>A</sub> = - 30 mA		5.7	12		
			V <sub>BN</sub> = 4.5 V, I <sub>A</sub> = - 30 mA		10.3	15		
		V+ = 3.0 V	V <sub>BN</sub> = 0 V, I <sub>A</sub> = 24 mA		5.9	9		
			V <sub>BN</sub> = 3.0 V, I <sub>A</sub> = - 24 mA		13.7	20		
		V+ = 2.3 V	V <sub>BN</sub> = 0 V, I <sub>A</sub> = 8 mA		7	12		
			V <sub>BN</sub> = 2.3 V, I <sub>A</sub> = - 8 mA		16.2	30		
		V+ = 1.65 V	V <sub>BN</sub> = 0 V, I <sub>A</sub> = 4 mA		9.2	20		
V <sub>BN</sub> = 1.65 V, I <sub>A</sub> = - 4 mA	24		50					
On-Resistance Flatness	R <sub>FLAT</sub>	0 < V <sub>BN</sub> < V+		Room	8		Ω	
					V+ = 4.5 V, I <sub>A</sub> = - 30 mA	13		
					V+ = 3.0 V, I <sub>A</sub> = - 24 mA	24		
					V+ = 2.3 V, I <sub>A</sub> = - 8 mA	89		
On-Resistance Matching Between Channels	ΔR <sub>ON</sub>	V+ = 4.5 V, V <sub>BN</sub> = 3.15 V, I <sub>A</sub> = - 30 mA		Room	0.8		Ω	
		V+ = 3.0 V, V <sub>BN</sub> = 2.1 V, I <sub>A</sub> = - 24 mA			0.1			
		V+ = 2.3 V, V <sub>BN</sub> = 1.6 V, I <sub>A</sub> = - 8 mA			0.2			
		V+ = 1.65 V, V <sub>BN</sub> = 1.15 V, I <sub>A</sub> = - 4 mA			0.9			
Input Leakage Current	I <sub>S</sub>	V+ = 5.5 V, V <sub>A</sub> = 5.5 V, V <sub>S</sub> = 0.8 V, 2.4 V	DG3157B	Full	- 1.0		1.0	
			DG3157A		- 1.0	2.5	7.0	
Off Stage Switch Leakage	I <sub>BN(off)</sub>	V+ = 5.5 V, V <sub>A</sub> /V <sub>B</sub> = 0 V/5.5 V		Room Full	- 0.1 - 1.0		0.1 1.0	
On State Switch Leakage	I <sub>BN(on)</sub>	V+ = 5.5 V, V <sub>A</sub> /V <sub>B</sub> = 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. <sup>a</sup>	Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>			
<b>Power Supply</b>								
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	$\mu\text{A}$	
<b>AC Electrical Characteristic</b>								
Prop Delay Time <sup>f</sup>	$t_{PHL}/t_{PLH}$	$V_A = 0\text{ V}$	$V_+ = 1.65\text{ to }1.95\text{ V}$	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 <sup>f</sup>	$t_{PZL}/t_{PZH}$	$V_{LOAD} = 2 \times V_+$ 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 <sup>f</sup>	$t_{PLZ}/t_{PHZ}$	$V_{LOAD} = 2 \times V_+$ 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 <sup>d</sup>	$t_{BBM}$		$V_+ = 1.65\text{ to }1.95\text{ V}$	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 <sup>d</sup>	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 <sup>d</sup>	OIRR	$R_L = 50\ \Omega$ , $f = 10\text{ MHz}$		Room		- 57	dB	
Crosstalk <sup>d</sup>	$X_{TALK}$			Room		- 64		
- 3 dB Bandwidth <sup>d</sup>	BW	$R_L = 50\ \Omega$		Room		300	MHz	
Total Harmonic Distortion <sup>d</sup>	THD	$R_L = 600\ \Omega$ , $0.5\text{ V}_{p-p}$ $f = 600\text{ Hz} - 20\text{ kHz}$		Room		0.016	%	
<b>Capacitance</b>								
Control Pin Capacitance <sup>d</sup>	$C_S$	$V_+ = 0\text{ V}$		Room		3.7	pF	
B Port Off Capacitance <sup>d</sup>	$C_{IO-B}$	$V_+ = 5\text{ V}$		Room		7		
A Port Capacitance When Switch Enable <sup>d</sup>	$C_{IO-A(on)}$			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

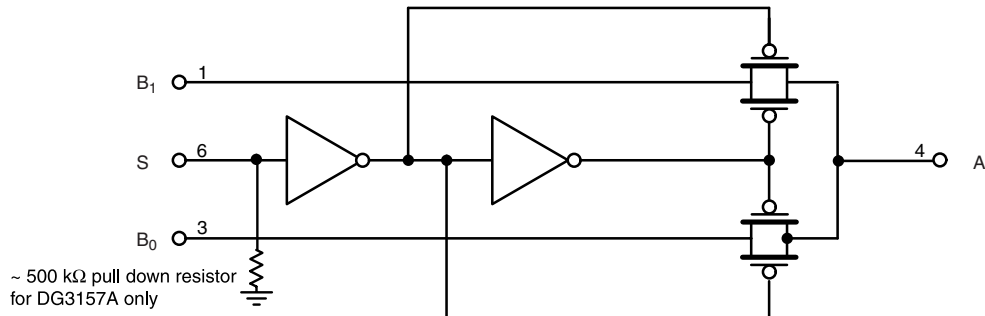


Figure 1.

### AC LOADING AND WAVEFORMS

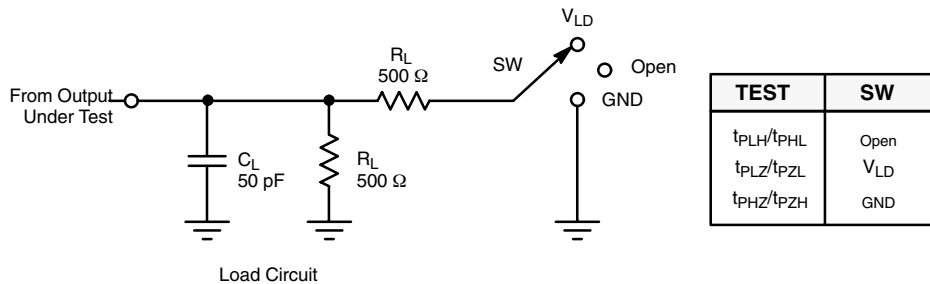


Figure 2. AC Test Circuit

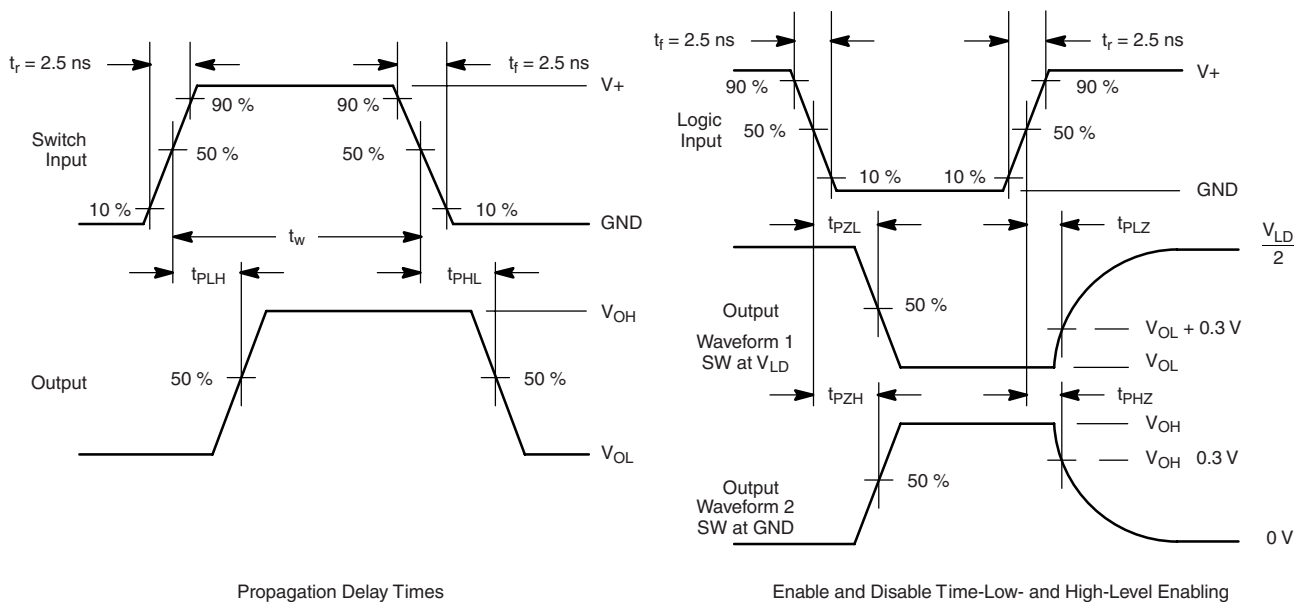
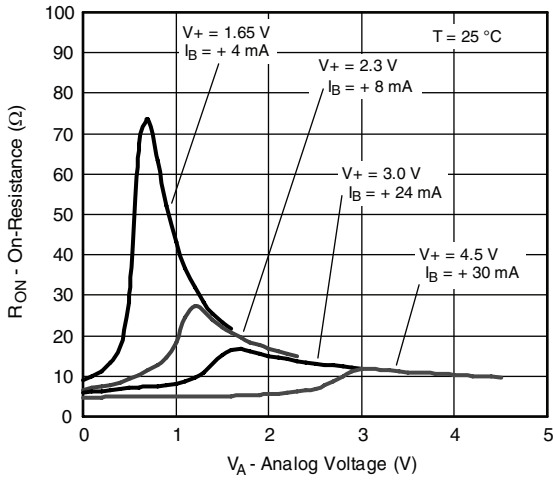


Figure 3. AC Waveforms

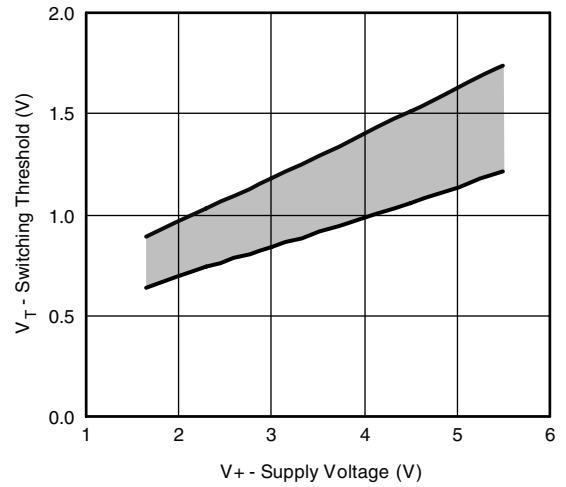
**Notes:**

- $C_L$  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.
- $V_{LD} = 2 V_+$ .

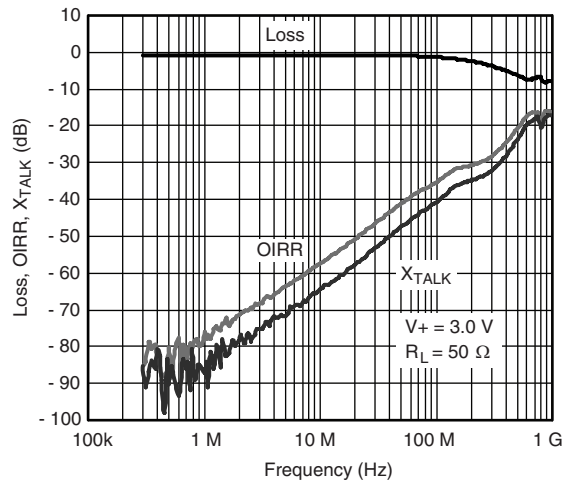
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



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

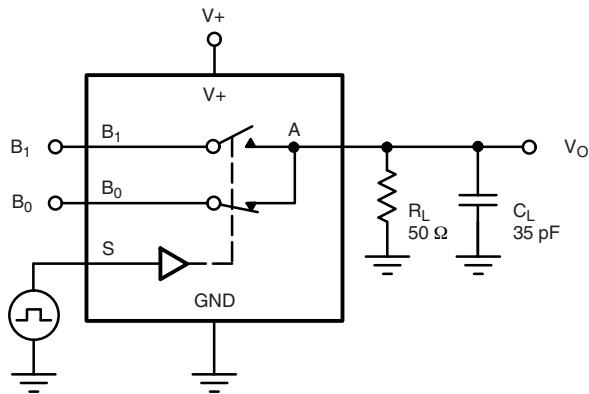


**Switching Threshold vs. Supply Voltage**



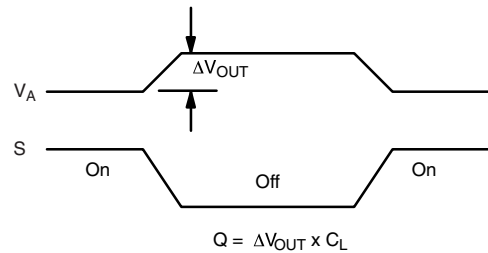
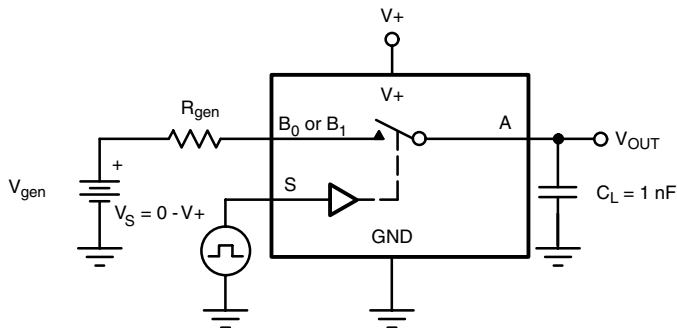
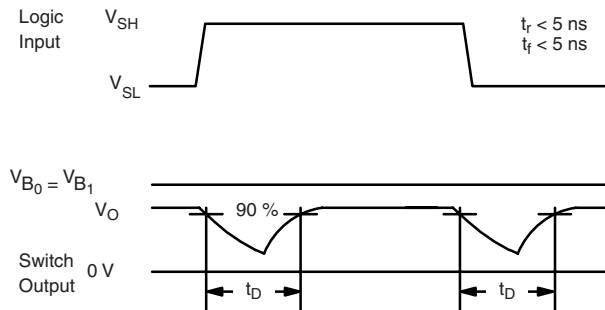
**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**

### TEST CIRCUITS



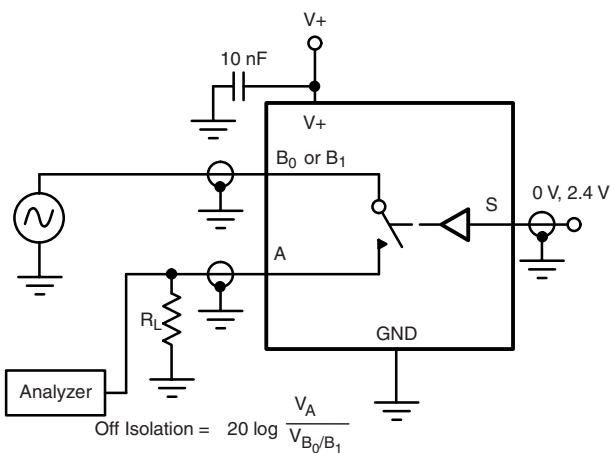
$C_L$  (includes fixture and stray capacitance)

**Figure 4. Break-Before-Make Interval**



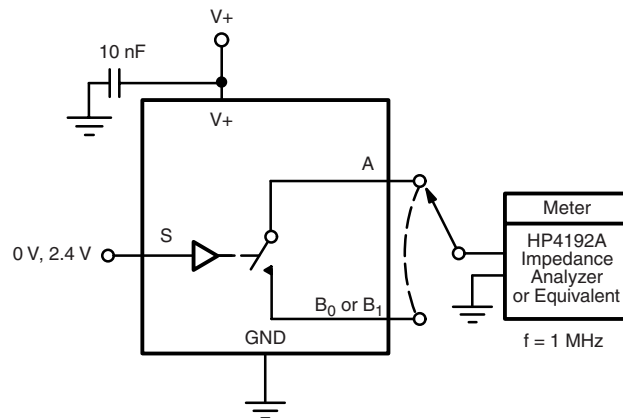
IN depends on switch configuration: input polarity determined by sense of switch.

**Figure 5. Charge Injection**



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

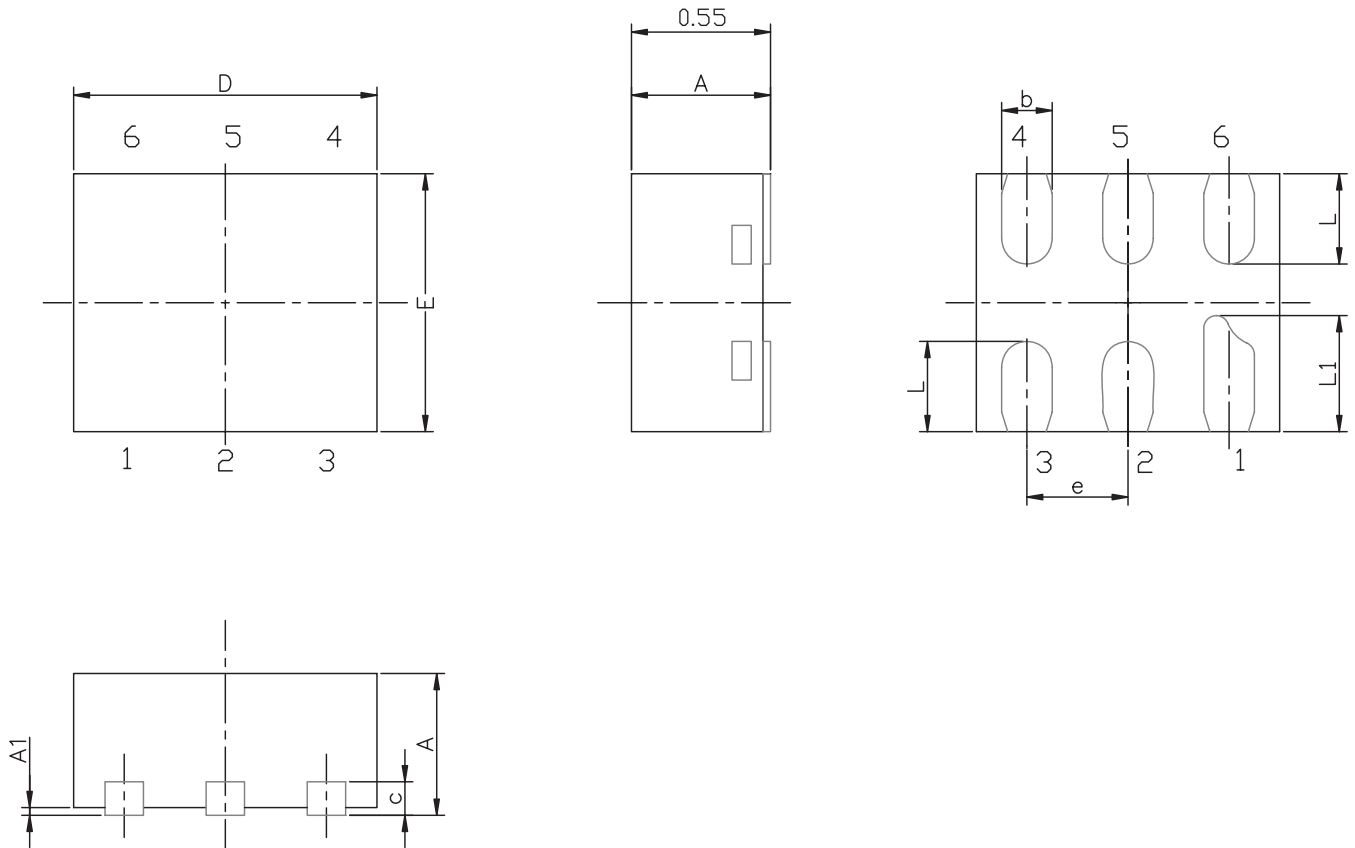
**Figure 6. Off-Isolation**



**Figure 7. Channel Off/On Capacitance**

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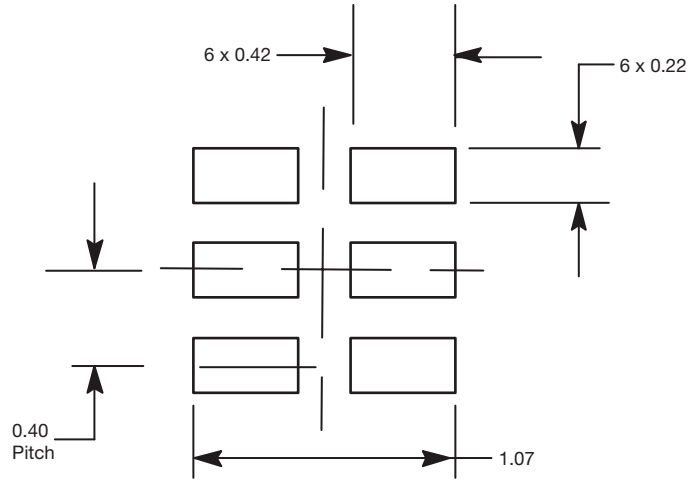
## MINI QFN-6L CASE OUTLINE



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

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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