

## Powered-off Isolation, 0.86 $\Omega$ , 1.65 V to 5.5 V, SPDT Analog Switch (2:1 Multiplexer)

### DESCRIPTION

The DG4157E is a high performance single-pole, double-throw (SPDT) analog switch designed for 1.65 V to 5.5 V operation with a single power rail.

Fabricated with high density CMOS technology, the device achieves low on resistance of 0.86  $\Omega$  at a 4.5 V power supply, low power consumption, and fast switching speeds. The DG4157E can handle both analog and digital signals and permits signals with amplitudes of up to  $V_+$  to be transmitted in either direction. Its control logic inputs can go over  $V_+$  up to 5.5 V. The control logic input high threshold is guaranteed as low as 1.8 V over the power supply range up to 5.5 V. It features break before make switching performance. Its -3 dB bandwidth is typically 152 MHz.

A powered-off protection circuit is built into the switch to prevent an abnormal current flow from COM pin to  $V_+$  during the power-down condition. Each output pin can withstand greater than 7 kV (human body model).

Operation temperature is specified from -40  $^{\circ}\text{C}$  to +85  $^{\circ}\text{C}$ . The DG4157E is available in the ultra compact  $\mu\text{DFN-6L}$  and SC-70-6 packages.

### FEATURES

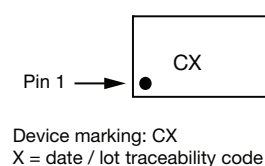
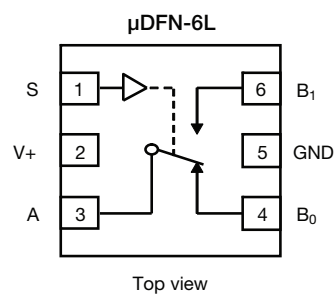
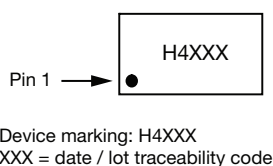
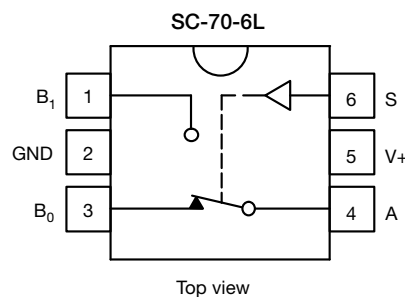
- Low switch on-resistance (0.86  $\Omega$ )
- 1.65 V to 5.5 V single supply operation
- Isolation in powered-off mode
- Guaranteed 1.8 V logic high
- Control logic inputs can go over  $V_+$
- Low charge injection (5 pC)
- Low total harmonic distortion
- Break before make switching
- Latch-up performance exceeds 300 mA per JESD 78
- ESD tested
  - 7000 V human body model (JS-001)
  - 1000 V charge device model (JS-002)
- Ultra compact  $\mu\text{DFN-6L}$  1 mm x 1 mm x 0.35 mm package
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Smartphones and tablets
- Consumer and computing
- Portable instrumentation
- Medical equipment

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



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 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$	SC-70-6L	DG4157EDL-T1-GE3
	$\mu\text{DFN-6L}$	DG4157EDN-T1-GE4



ABSOLUTE MAXIMUM RATINGS			
PARAMETER		LIMIT	UNIT
V+, A, B <sub>0</sub> , B <sub>1</sub> , S reference to GND		-0.3 to 6	V
Continuous current (any terminal)		± 200	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)		± 400	
Thermal resistance <sup>a</sup>		407	°C/W
ESD / HBM	JS-001	7000	V
ESD / CDM	JS-002	1000	
Latch up	JESD78	300	mA
Operating temperature		-40 to +85	°C
Max. operating junction temperature		150	
Operating junction temperature		125	
Storage temperature		-65 to +150	

**Note**

a. Measured on an 1" x 1" inch FR4 board, using 0.39" by 1", 2 oz. copper trace without air flow

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.

SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 3 V, V <sub>S</sub> = 0 V or 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>							
On resistance	R <sub>ON</sub>	V+ = 2.7 V, B <sub>0</sub> or B <sub>1</sub> = 1.5 V, I <sub>O</sub> = 100 mA	Room	-	1.6	2	Ω
			Full	-	-	3	
		V+ = 4.5 V, B <sub>0</sub> or B <sub>1</sub> = 3.5 V, I <sub>O</sub> = 100 mA	Room	-	0.86	1.2	
			Full	-	-	1.5	
On resistance flatness	R <sub>FLATNESS</sub>	V+ = 2.7 V, B <sub>0</sub> or B <sub>1</sub> = 0.75 V, 1.5 V, I <sub>O</sub> = 100 mA	Room	-	0.2	-	
			Full	-	-	-	
		V+ = 4.5 V, B <sub>0</sub> or B <sub>1</sub> = 1 V, 3.5 V, I <sub>O</sub> = 100 mA	Room	-	0.05	0.3	
			Full	-	-	0.4	
On resistance match	ΔR <sub>ON</sub>	V+ = 2.7 V, B <sub>0</sub> or B <sub>1</sub> = 1.5 V, I <sub>O</sub> = 100 mA	Room	-	0.003	-	
			Full	-	-	-	
		V+ = 4.5 V, B <sub>0</sub> or B <sub>1</sub> = 3.5 V, I <sub>O</sub> = 100 mA	Room	-	0.004	0.12	
			Full	-	-	0.15	
Switch off leakage current	I <sub>OFF</sub>	V+ = 5.5 V, A = 1 V, 4.5 V B <sub>0</sub> or B <sub>1</sub> = 4.5 V, 1 V or floating	Room	-3	1.36	3	nA
Switch on leakage current	I <sub>ON</sub>		Full	-20	-	20	
			Room	-4	1.4	4	
Full	-40		-	40			
Power down leakage	I <sub>A(DP)</sub>	V+ = 0 V, V <sub>A</sub> = 4.5 V, V <sub>S</sub> = GND	Full	-1	-	1	μA
<b>Digital Control</b>							
Input, high voltage	V <sub>INH</sub>	V+ = 2.7 V to 5.5 V	Full	1.8	-	-	V
Input, low voltage	V <sub>INL</sub>		Full	-	-	0.6	
Input current	I <sub>INH</sub> , I <sub>INL</sub>	V <sub>S</sub> = 0 or V+	Full	-1	-	1	μA

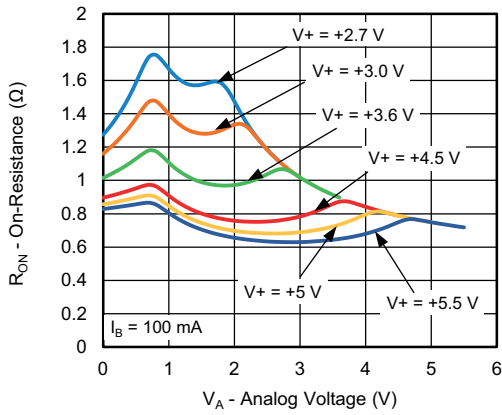


SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 3\text{ V}, V_S = 0\text{ V}$ or $V_+^e$	TEMP. <sup>a</sup>	LIMITS -40 °C to +85 °C			UNIT
				MIN. <sup>b</sup>	TYP. <sup>c</sup>	MAX. <sup>b</sup>	
<b>AC Characteristics</b>							
Turn-on time <sup>d</sup>	$t_{ON}$	$V_+ = 2.7\text{ V}, B_0$ or $B_1 = 1.5\text{ V}, R_L = 50\ \Omega,$ $C_L = 35\text{ pF}$	Room	-	27	42	ns
			Full	-	-	47	
		$V_+ = 4.5\text{ V}, B_0$ or $B_1 = 1.5\text{ V}, R_L = 50\ \Omega,$ $C_L = 35\text{ pF}$	Room	-	17	32	
			Full	-	-	35	
Turn-off time <sup>d</sup>	$t_{OFF}$	$V_+ = 2.7\text{ V}, B_0$ or $B_1 = 1.5\text{ V}, R_L = 50\ \Omega,$ $C_L = 35\text{ pF}$	Room	-	16	32	
			Full	-	-	35	
		$V_+ = 4.5\text{ V}, B_0$ or $B_1 = 1.5\text{ V}, R_L = 50\ \Omega,$ $C_L = 35\text{ pF}$	Room	-	11	28	
			Full	-	-	30	
Break-before-make time <sup>d</sup>	$t_{BBM}$	$V_+ = 2.7\text{ V}, B_0 = B_1 = 1.5\text{ V}, R_L = 50\ \Omega,$ $C_L = 35\text{ pF}$	Room	1	13	-	
				$V_+ = 4.5\text{ V}, B_0 = B_1 = 1.5\text{ V}, R_L = 50\ \Omega,$ $C_L = 35\text{ pF}$	1	8	-
Charge injection <sup>d</sup>	Q	$C_L = 1\text{ nF}, R_{GEN} = 0\ \Omega, V_{GEN} = 0\text{ V}$	Room	-	-5	-	pC
Off isolation <sup>d</sup>	OIRR	$R_L = 50\ \Omega, f = 1\text{ MHz}$	Room	-	-64	-	dB
		$R_L = 50\ \Omega, f = 10\text{ MHz}$		-	-41	-	
Crosstalk <sup>d</sup>	$X_{TALK}$	$R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$	Room	-	-64	-	
		$R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 10\text{ MHz}$		-	-41	-	
Bandwidth <sup>d</sup>	BW	$R_L = 50\ \Omega$	Room	-	152	-	MHz
Total harmonic distortion <sup>d</sup>	THD	$R_L = 600\ \Omega, V_{SIGNAL} = 0.5\text{ V},$ $f = 20\text{ Hz to } 20\text{ kHz}$	Room	-	0.0055	-	%
<b>Capacitance</b>							
BX port off capacitance <sup>d</sup>	$C_{B(OFF)}$	$R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$	Room	-	13	-	pF
A port on capacitance <sup>d</sup>	$C_{A(ON)}$			-	52	-	
Control pin capacitance <sup>d</sup>	$C_{IN}$			-	1	-	
<b>Power Supply</b>							
Quiescent supply current	I+	$V_+ = 5.5\text{ V}, V_S = 0\text{ V}, 5.5\text{ V}$	Room	-	0.0004	0.8	$\mu\text{A}$
			Full	-	-	1	

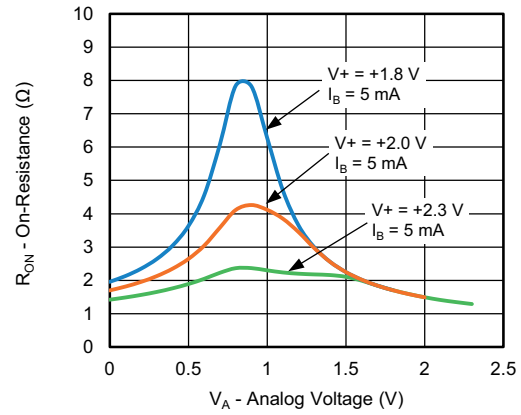
**Notes**

- 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 datasheet
- 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

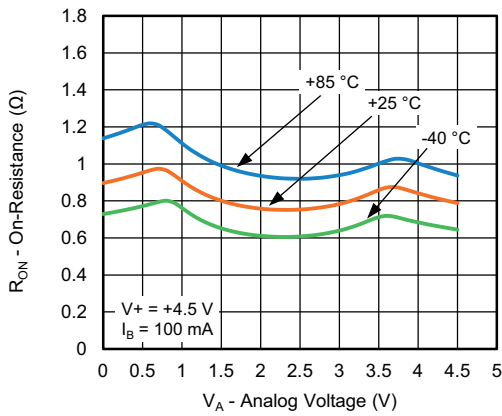
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



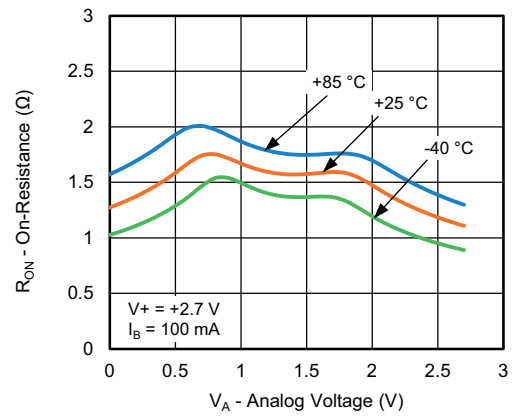
**RON vs. VA and Supply Voltage**



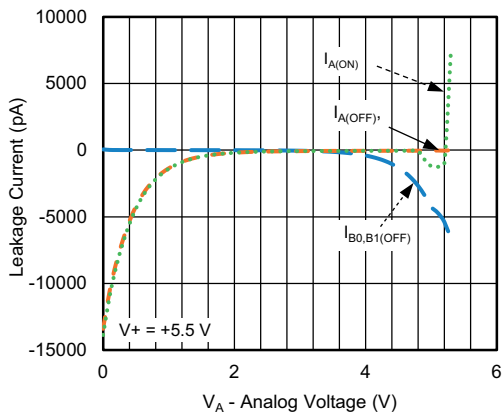
**RON vs. VA and Supply Voltage**



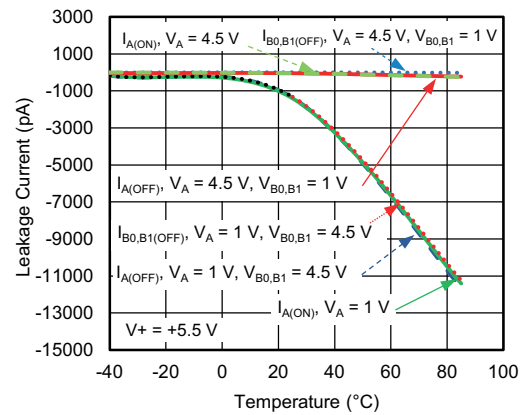
**RON vs. VA and Temperature**



**RON vs. VA and Temperature**



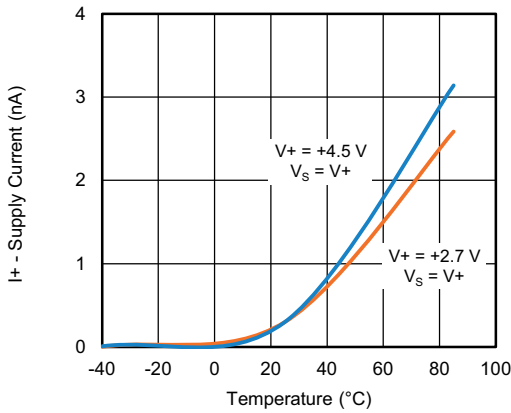
**Leakage Current vs. Analog Voltage**



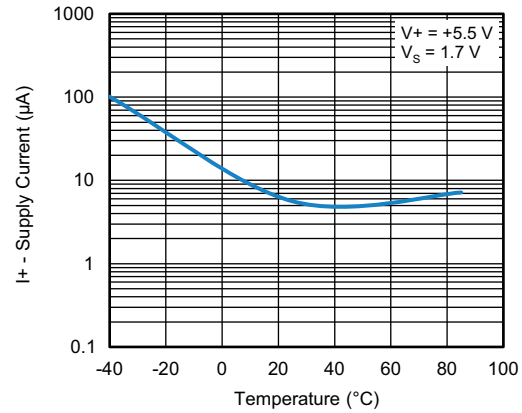
**Leakage Current vs. Temperature**



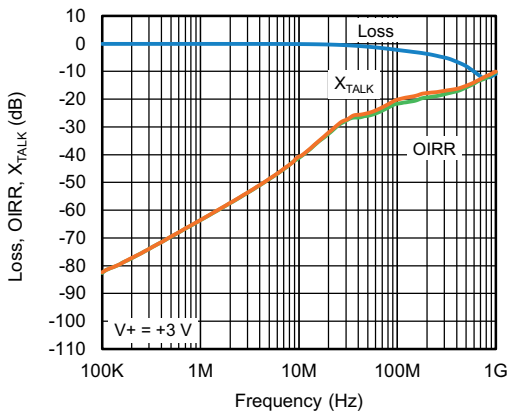
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



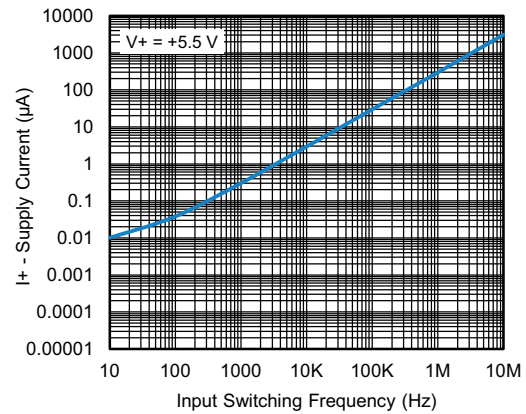
Supply Current vs. Temperature



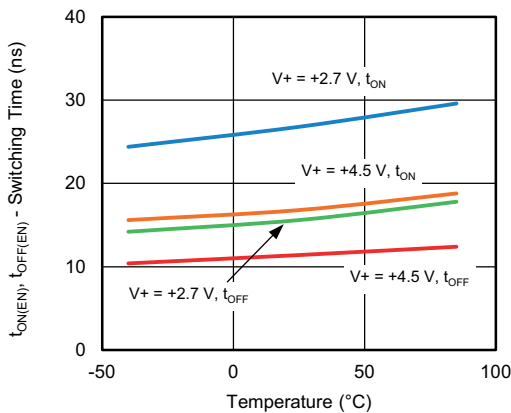
Supply Current vs. Temperature



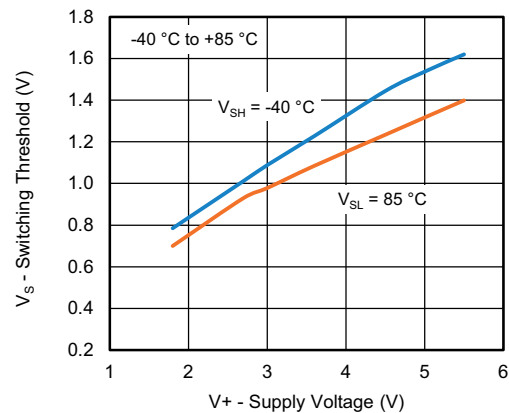
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



Supply Current vs. Switching Frequency

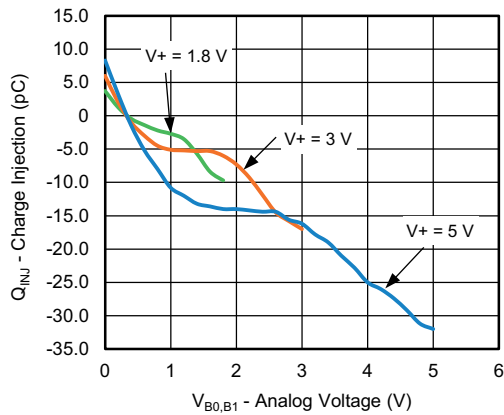


Switching Time vs. Temperature

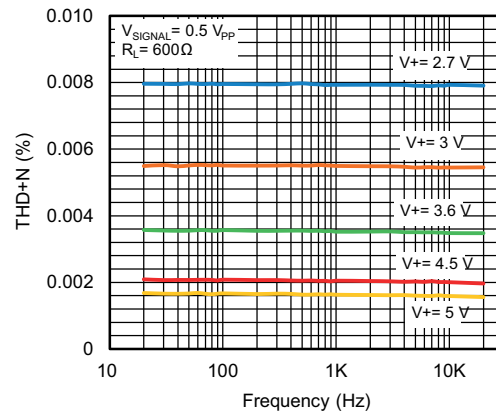


Switching Threshold vs. Supply Voltage

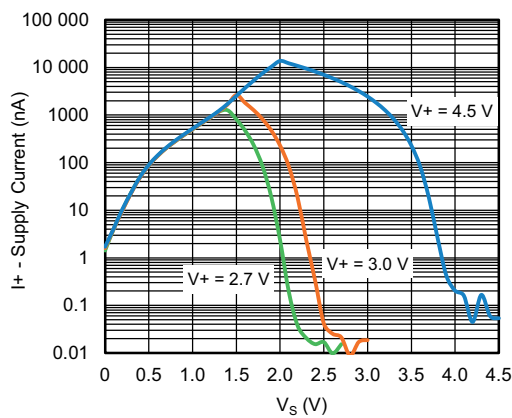
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



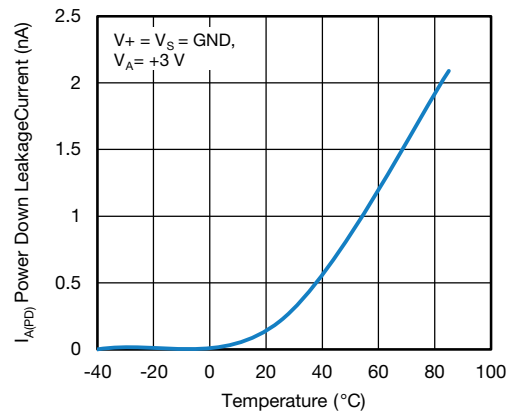
**Charge Injection vs. Source Voltage**



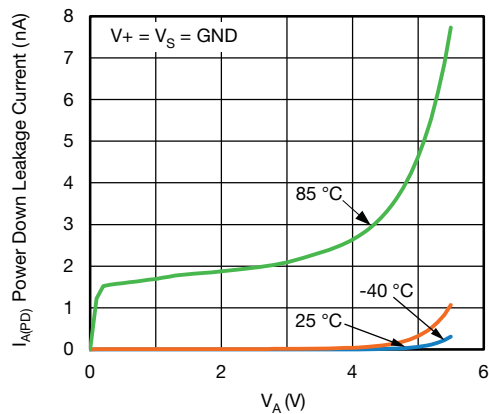
**THD+N vs. Frequency**



**Supply Current vs. Logic Voltage**

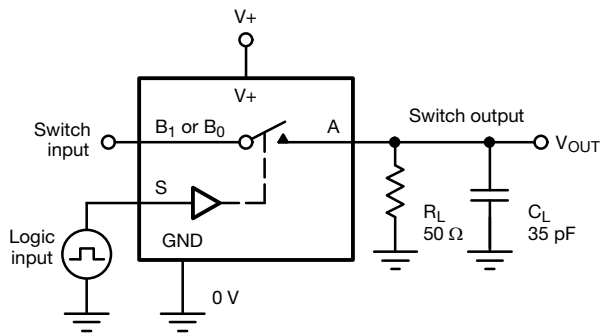


**Power Down Leakage Current vs. Temperature**



**Power Down Leakage Current vs.  $V_A$**

TEST CIRCUITS



$C_L$  (includes fixture and stray capacitance)

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

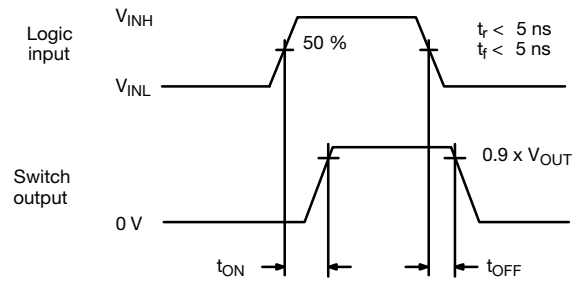
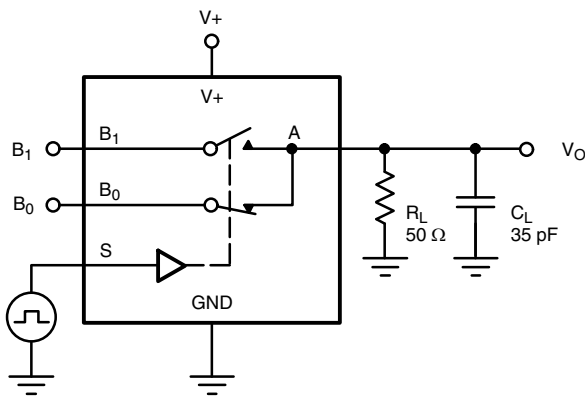


Fig. 1 - Switching Time



$C_L$  (includes fixture and stray capacitance)

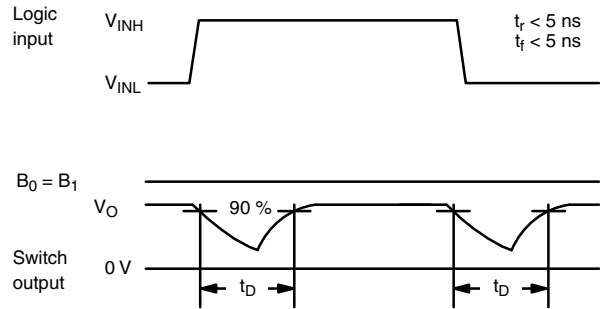
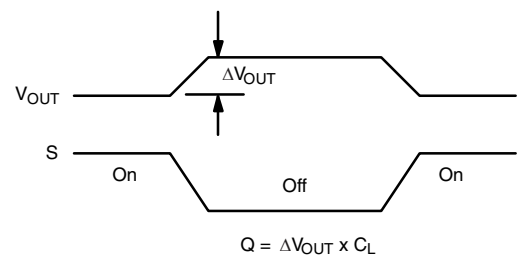
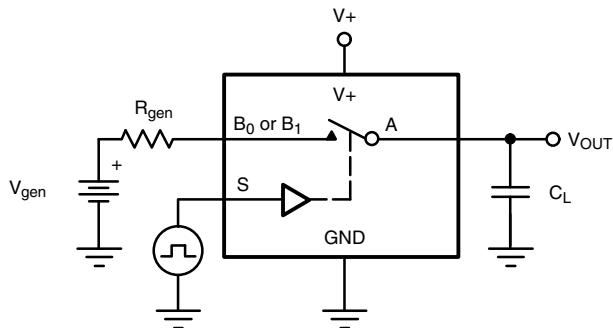
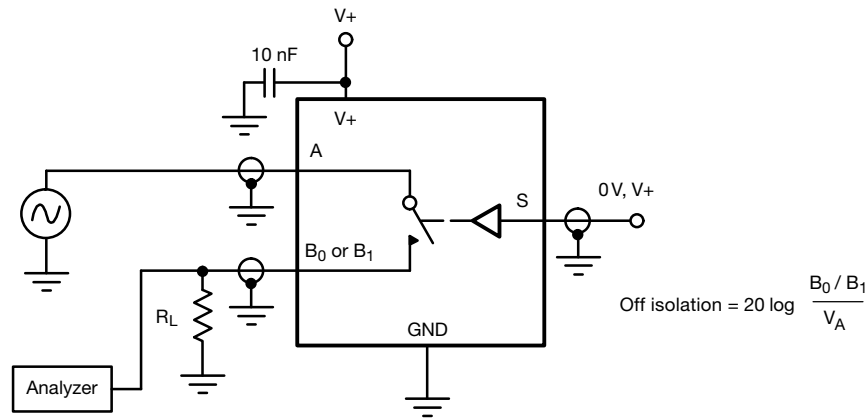
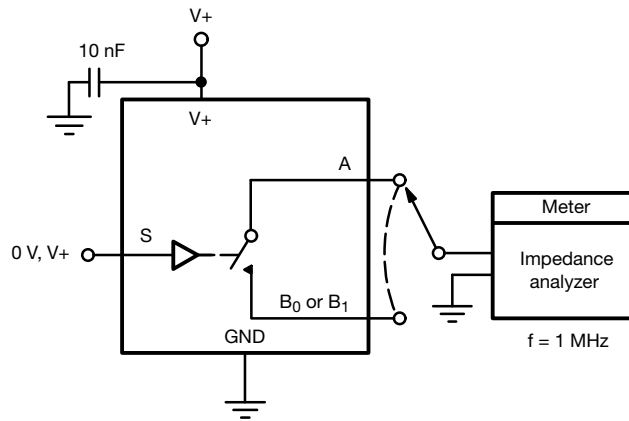


Fig. 2 - Break-Before-Make Interval



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**

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