

Powered-off Isolation, 0.86 Ω , 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 Ω 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 Ω)
- 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

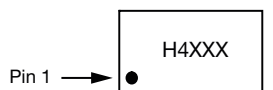
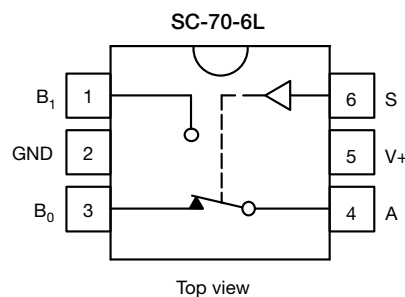


RoHS
COMPLIANT
HALOGEN
FREE

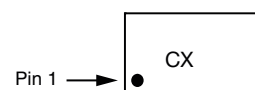
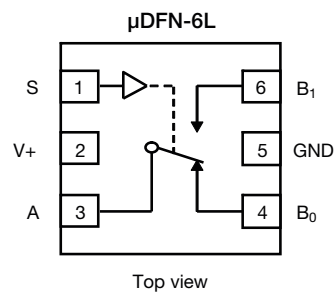
APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device marking: H4XXX
XXX = date / lot traceability code



Device marking: CX
X = date / lot traceability code

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 ₀ , B ₁ , 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 ^a		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 _S = 0 V or V+ ^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT
				MIN. ^b	TYP. ^c	MAX. ^b	
DC Characteristics							
On resistance	R _{ON}	V+ = 2.7 V, B ₀ or B ₁ = 1.5 V, I _O = 100 mA	Room	-	1.6	2	Ω
			Full	-	-	3	
		V+ = 4.5 V, B ₀ or B ₁ = 3.5 V, I _O = 100 mA	Room	-	0.86	1.2	
			Full	-	-	1.5	
On resistance flatness	R _{FLATNESS}	V+ = 2.7 V, B ₀ or B ₁ = 0.75 V, 1.5 V, I _O = 100 mA	Room	-	0.2	-	
			Full	-	-	-	
		V+ = 4.5 V, B ₀ or B ₁ = 1 V, 3.5 V, I _O = 100 mA	Room	-	0.05	0.3	
			Full	-	-	0.4	
On resistance match	ΔR _{ON}	V+ = 2.7 V, B ₀ or B ₁ = 1.5 V, I _O = 100 mA	Room	-	0.003	-	
			Full	-	-	-	
		V+ = 4.5 V, B ₀ or B ₁ = 3.5 V, I _O = 100 mA	Room	-	0.004	0.12	
			Full	-	-	0.15	
Switch off leakage current	I _{OFF}	V+ = 5.5 V, A = 1 V, 4.5 V B ₀ or B ₁ = 4.5 V, 1 V or floating	Room	-3	1.36	3	nA
Switch on leakage current	I _{ON}		Full	-20	-	20	
			Room	-4	1.4	4	
Full	-40		-	40			
Power down leakage	I _{A(DP)}	V+ = 0 V, V _A = 4.5 V, V _S = GND	Full	-1	-	1	μA
Digital Control							
Input, high voltage	V _{INH}	V+ = 2.7 V to 5.5 V	Full	1.8	-	-	V
Input, low voltage	V _{INL}		Full	-	-	0.6	
Input current	I _{INH} , I _{INL}	V _S = 0 or V+	Full	-1	-	1	μA

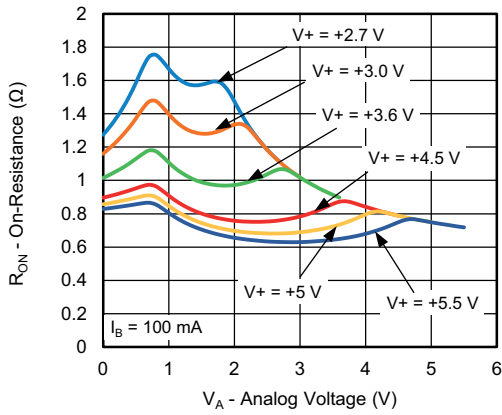


SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 3\text{ V}, V_S = 0\text{ V}$ or V_+^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT
				MIN. ^b	TYP. ^c	MAX. ^b	
AC Characteristics							
Turn-on time ^d	t_{ON}	$V_+ = 2.7\text{ V}, B_0$ or $B_1 = 1.5\text{ V}, R_L =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

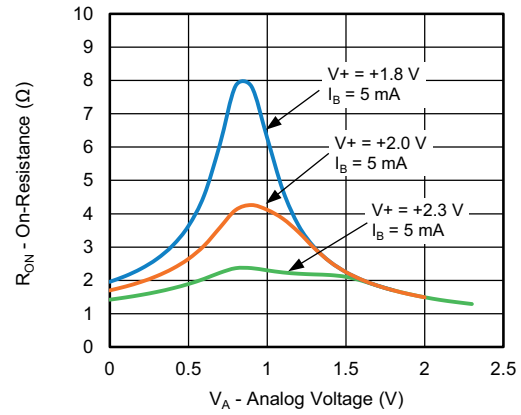
Notes

- 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

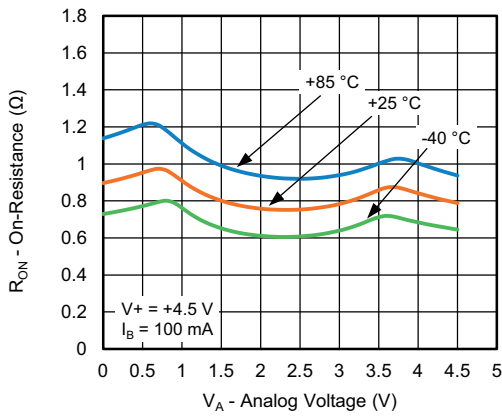
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



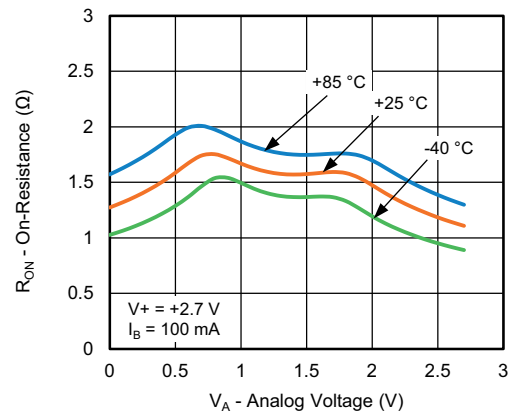
RON vs. VA and Supply Voltage



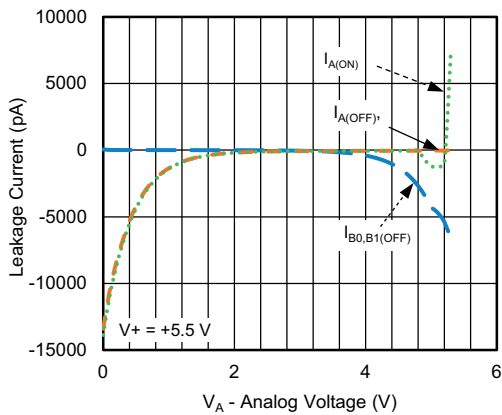
RON vs. VA and Supply Voltage



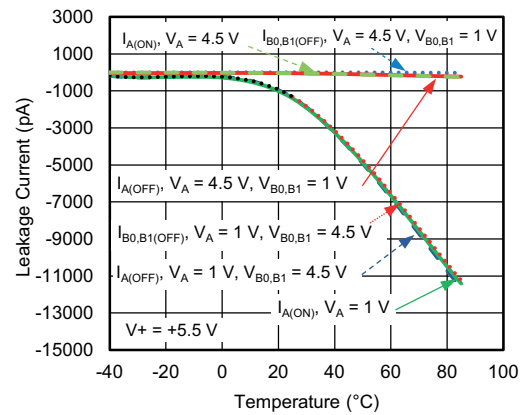
RON vs. VA and Temperature



RON vs. VA and Temperature

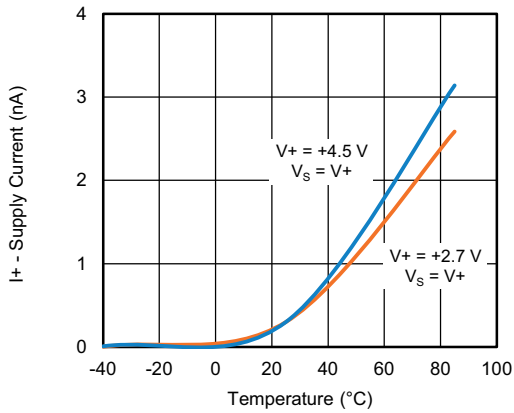


Leakage Current vs. Analog Voltage

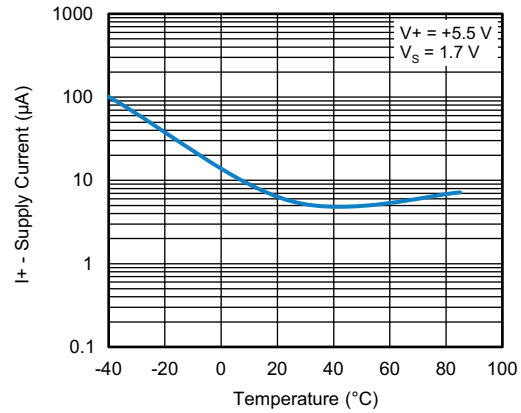


Leakage Current vs. Temperature

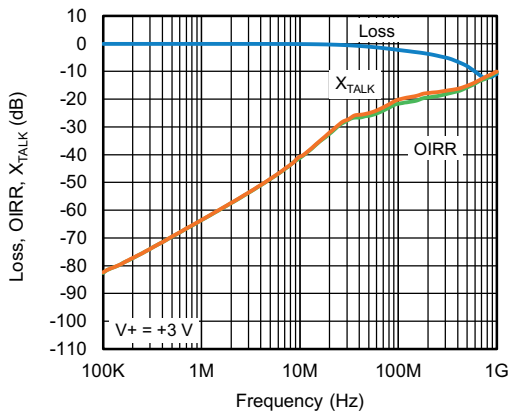
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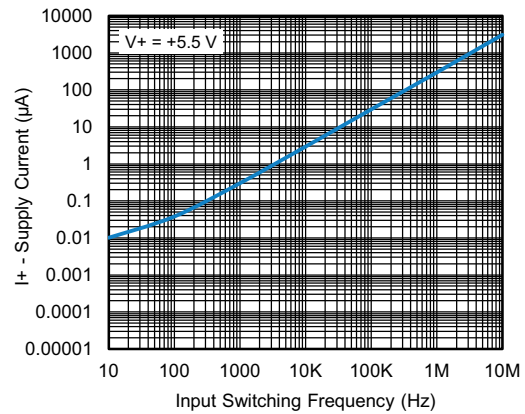
Supply Current vs. Temperature



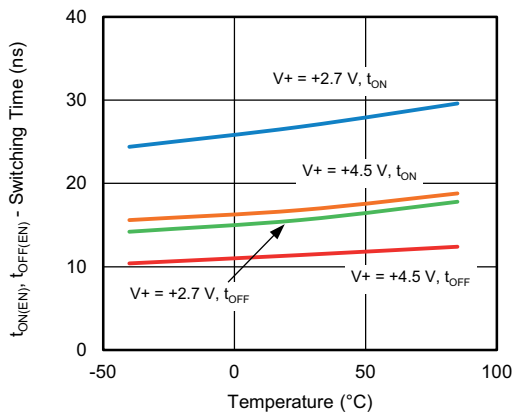
Supply Current vs. Temperature



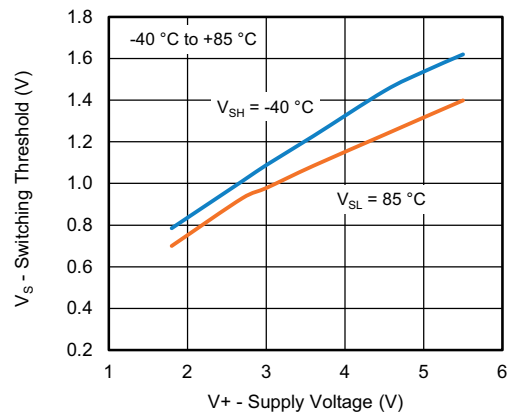
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



Supply Current vs. Switching Frequency



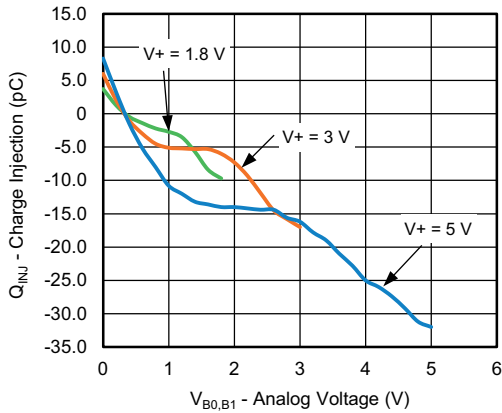
Switching Time vs. Temperature



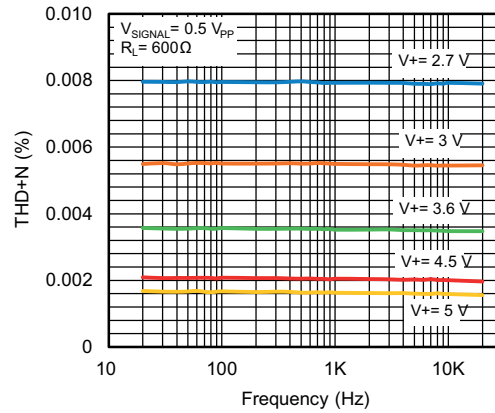
Switching Threshold vs. Supply Voltage



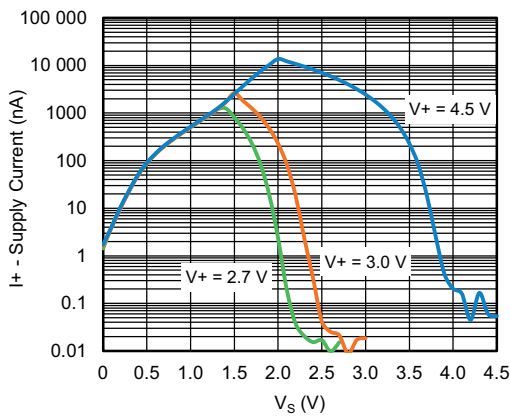
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



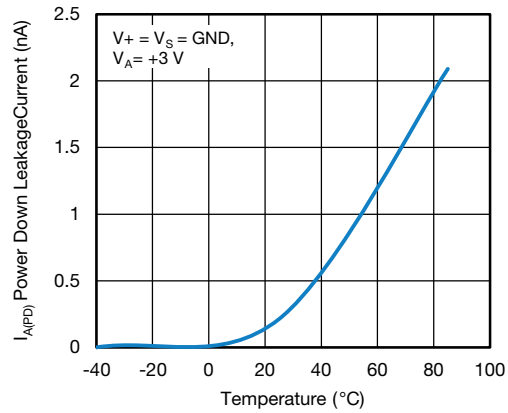
Charge Injection vs. Source Voltage



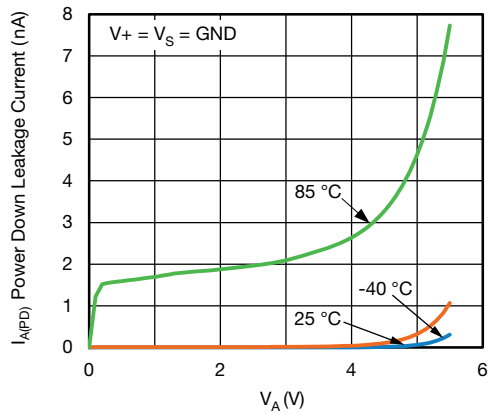
THD+N vs. Frequency



Supply Current vs. Logic Voltage

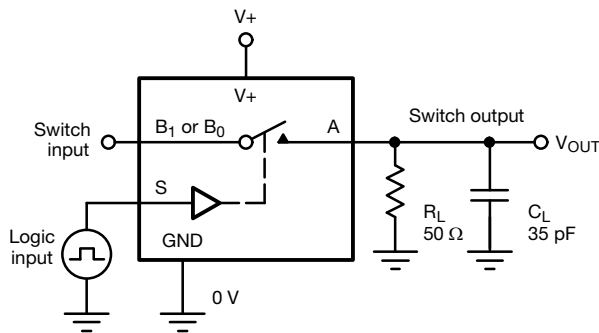


Power Down Leakage Current vs. Temperature



Power Down Leakage Current vs. V_A

TEST CIRCUITS



C_L (includes fixture and stray capacitance)

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

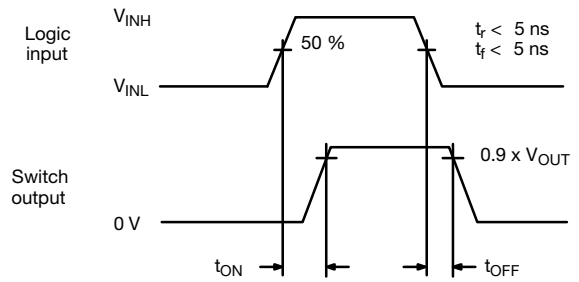
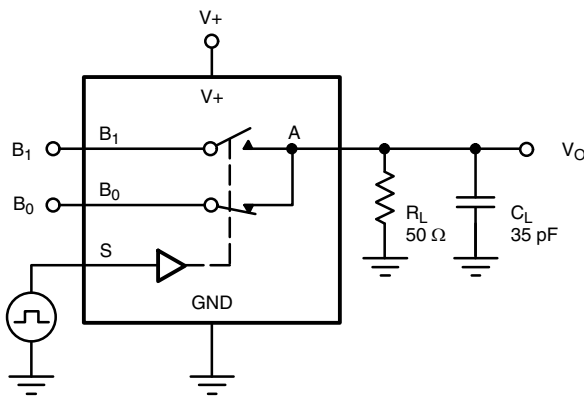


Fig. 1 - Switching Time



C_L (includes fixture and stray capacitance)

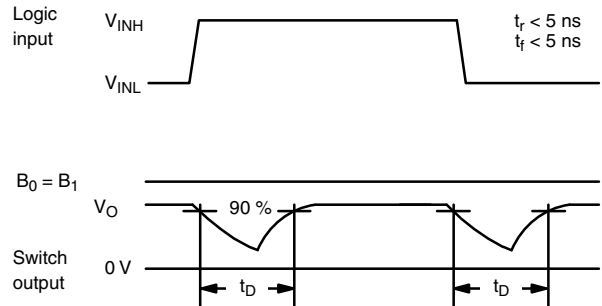
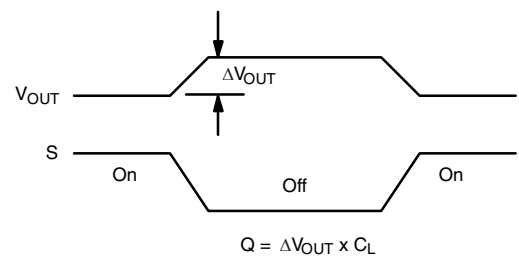
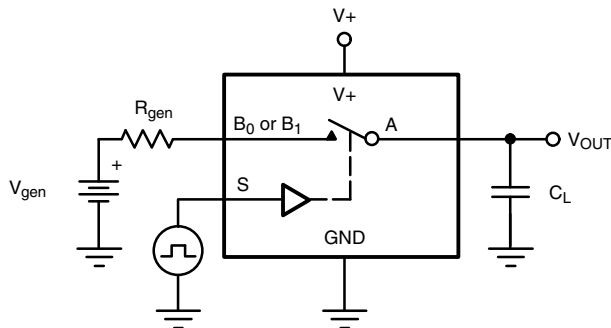
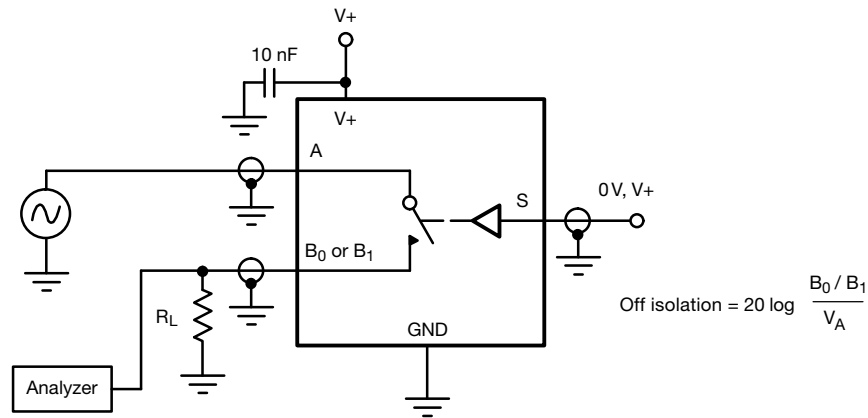
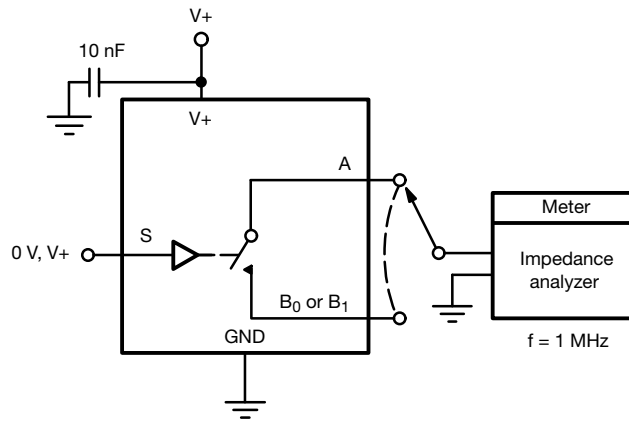


Fig. 2 - Break-Before-Make Interval



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

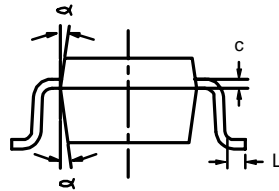
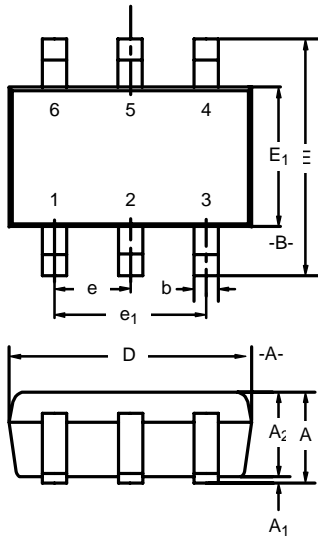
Fig. 3 - Charge Injection

TEST CIRCUITS

Fig. 4 - Off-Isolation

Fig. 5 - Channel Off/On Capacitance

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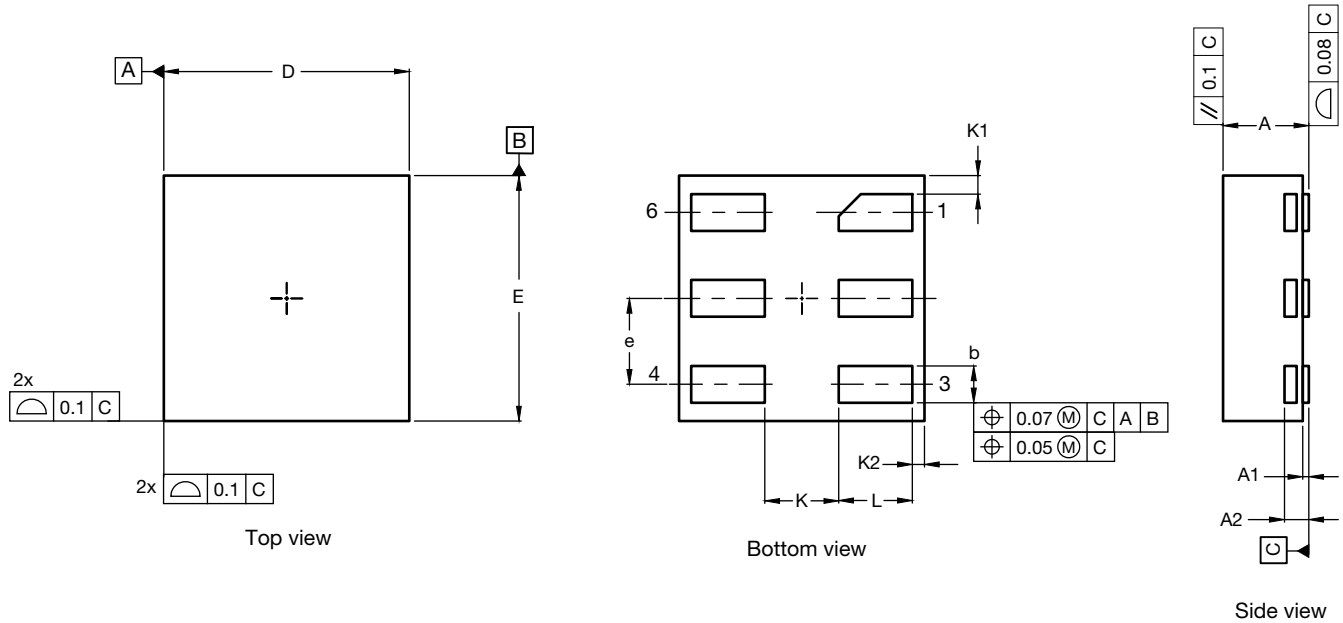
SC-70: 6-LEADS



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.90	-	1.10	0.035	-	0.043
A ₁	-	-	0.10	-	-	0.004
A ₂	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 ₁	1.15	1.25	1.35	0.045	0.049	0.053
e	0.65BSC			0.026BSC		
e ₁	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						



μDFN-6L 1 mm x 1 mm Case Outline



DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.32	0.35	0.38	0.013	0.014	0.015
A1	0.00	-	0.05	0.000	-	0.002
A2	0.10 Ref.			0.004 Ref.		
b	0.12	0.15	0.18	0.005	0.006	0.007
D	0.95	1.00	1.05	0.037	0.039	0.041
E	0.95	1.00	1.05	0.037	0.039	0.041
e	0.35 BSC			0.014 BSC		
K	0.30 Ref.			0.012 Ref.		
K1	0.075 Ref.			0.003 Ref.		
K2	0.05 Ref.			0.002 Ref.		
L	0.27	0.30	0.33	0.011	0.012	0.013

Notes

- (1) Use millimeters as the primary measurement.
- (2) Dimensioning and tolerances conform to ASME Y14.5M-1994.
- (3) N is the number of terminals.
Nd and Ne is the number of terminals in each D and E site respectively.
- (4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.
- (5) The pin 1 identifier must be existed on the top surface of the package by using indentation mark or other feature of package body.
- (6) Package warpage max. 0.05 mm.

ECN: T16-0553-Rev. A, 26-Sep-16
 DWG: 6053



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