

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

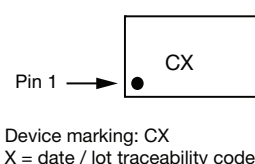
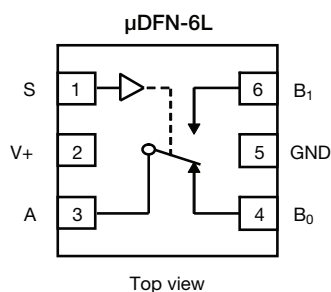
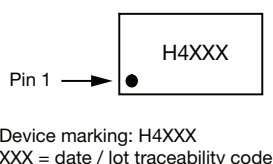
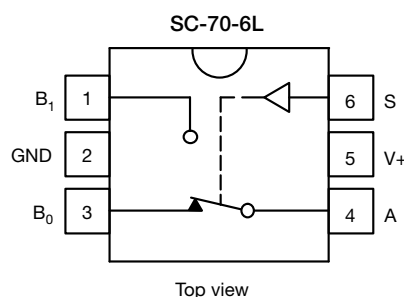


RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



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	-			
			Room	-	0.05	0.3			
		V+ = 4.5 V, B ₀ or B ₁ = 1 V, 3.5 V, I _O = 100 mA	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
Room	-	0.004				0.12			
V+ = 4.5 V, B ₀ or B ₁ = 3.5 V, I _O = 100 mA	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
Full			-20	-		20			
Switch on leakage current			I _{ON}	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		



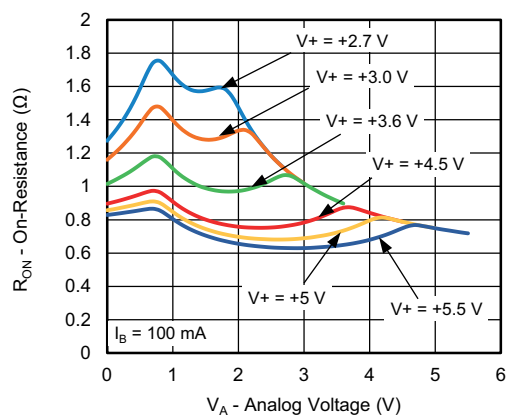
SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 3 V, VS = 0 V or V+ ^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT
				MIN. ^b	TYP. ^c	MAX. ^b	
AC Characteristics							
Turn-on time ^d	t _{ON}	V+ = 2.7 V, B ₀ or B ₁ = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room	-	27	42	ns
			Full	-	-	47	
		V+ = 4.5 V, B ₀ or B ₁ = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room	-	17	32	
			Full	-	-	35	
Turn-off time ^d	t _{OFF}	V+ = 2.7 V, B ₀ or B ₁ = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room	-	16	32	
			Full	-	-	35	
		V+ = 4.5 V, B ₀ or B ₁ = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room	-	11	28	
			Full	-	-	30	
Break-before-make time ^d	t _{BBM}	V+ = 2.7 V, B ₀ = B ₁ = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room	1	13	-	
		V+ = 4.5 V, B ₀ = B ₁ = 1.5 V, R _L = 50 Ω, C _L = 35 pF		1	8	-	
Charge injection ^d	Q	C _L = 1 nF, R _{GEN} = 0 Ω, V _{GEN} = 0 V	Room	-	-5	-	pC
Off isolation ^d	OIRR	R _L = 50 Ω, f = 1 MHz	Room	-	-64	-	dB
		R _L = 50 Ω, f = 10 MHz		-	-41	-	
Crosstalk ^d	X _{TALK}	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room	-	-64	-	
		R _L = 50 Ω, C _L = 5 pF, f = 10 MHz		-	-41	-	
Bandwidth ^d	BW	R _L = 50 Ω	Room	-	152	-	MHz
Total harmonic distortion ^d	THD	R _L = 600 Ω, V _{SIGNAL} = 0.5 V, f = 20 Hz to 20 kHz	Room	-	0.0055	-	%
Capacitance							
BX port off capacitance ^d	C _{B(OFF)}	R _L = 50 Ω, C _L = 5 pF, f = 1 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 V, VS = 0 V, 5.5 V	Room	-	0.0004	0.8	μA
			Full	-	-	1	

Notes

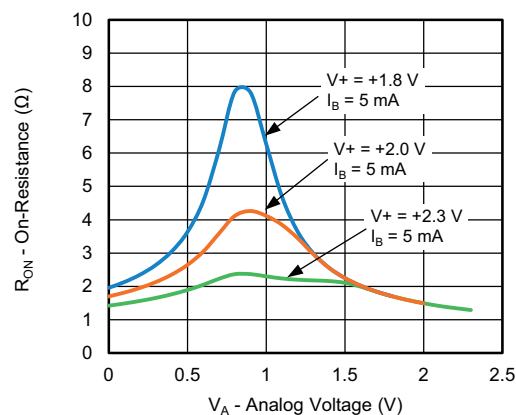
- a. Room = 25 °C, full = as determined by the operating suffix
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
c. Typical values are for design aid only, not guaranteed nor subject to production testing
d. Guarantee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



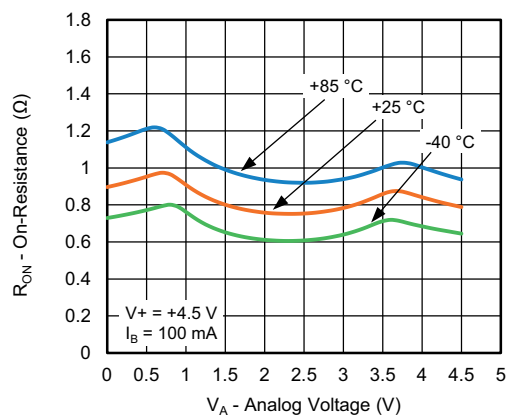
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



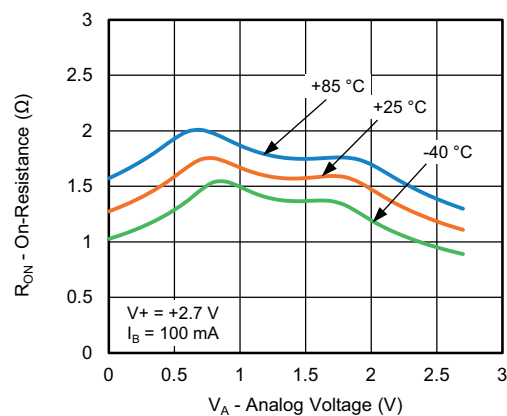
R_{ON} vs. V_A and Supply Voltage



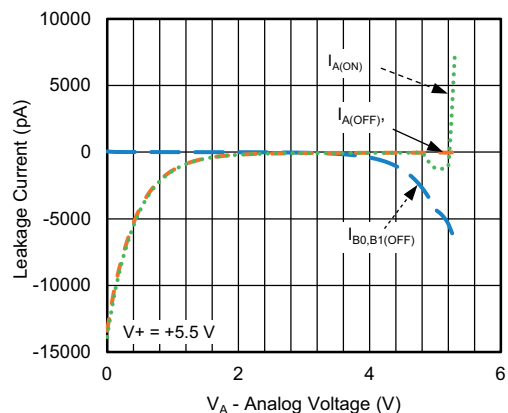
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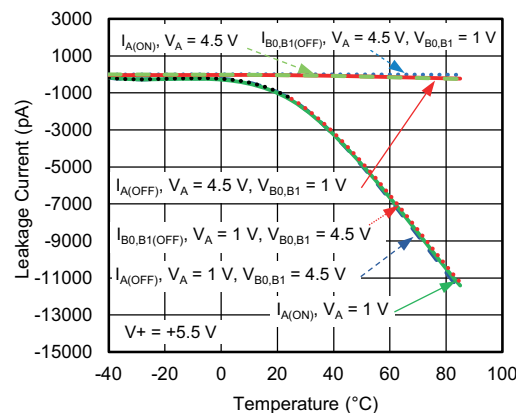
R_{ON} vs. V_A and Temperature



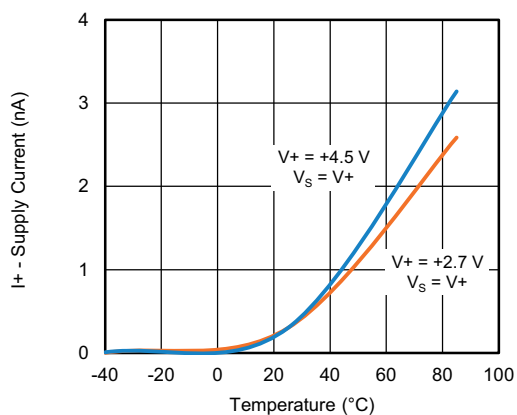
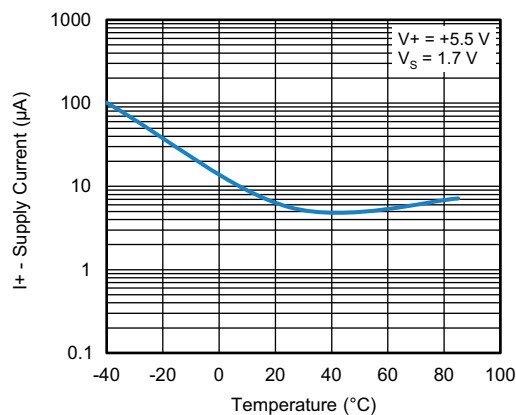
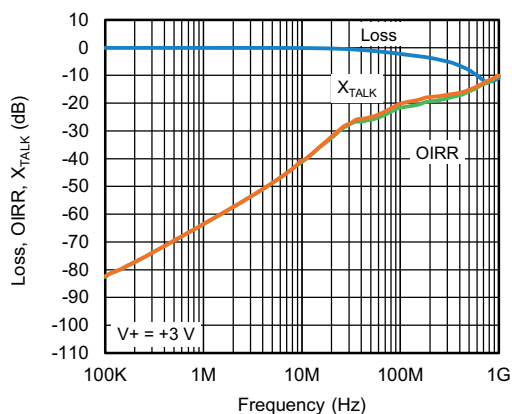
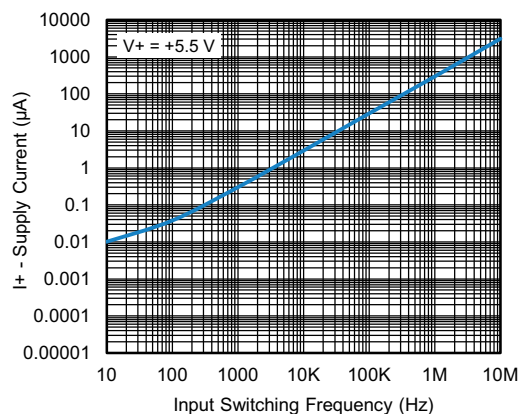
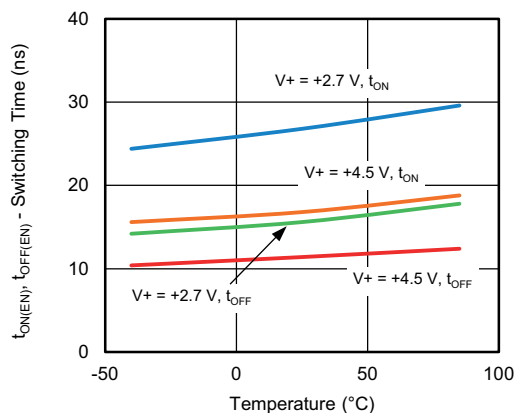
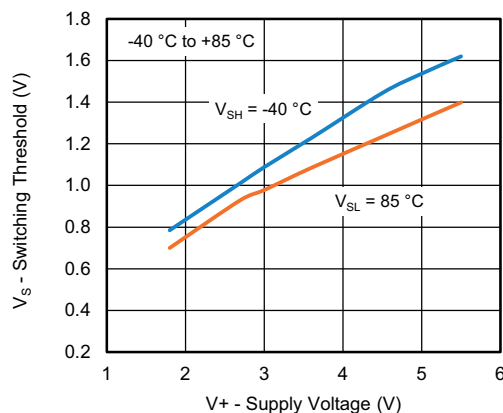
R_{ON} vs. V_A and Temperature

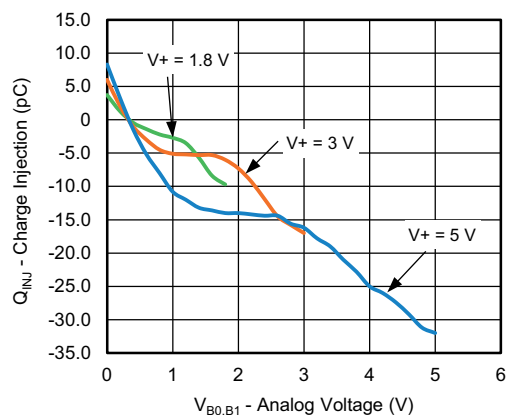
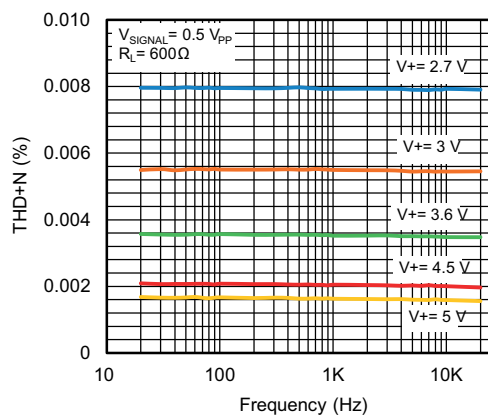
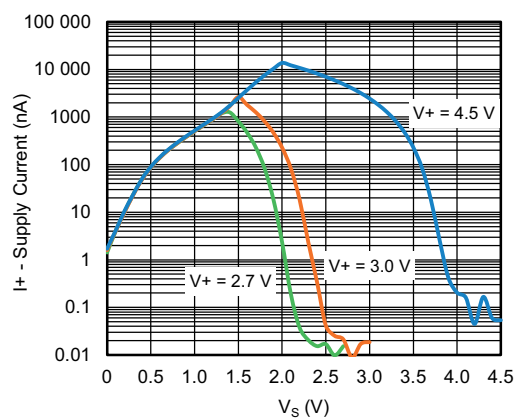
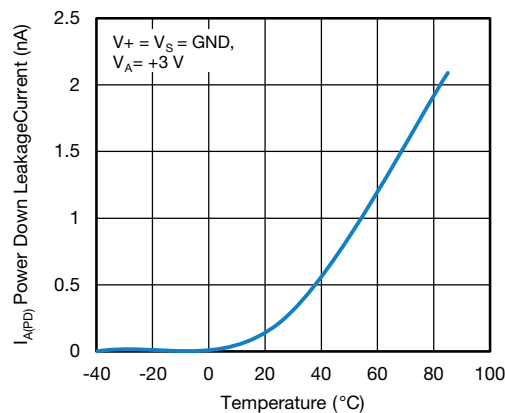
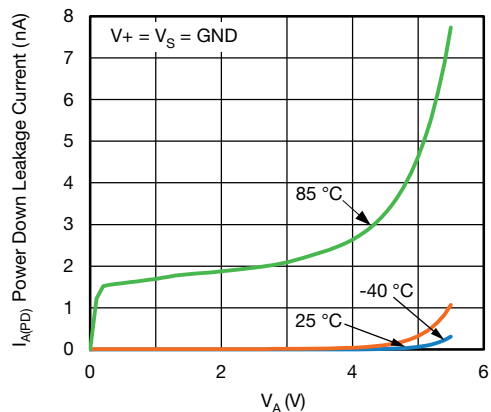


Leakage Current vs. Analog Voltage

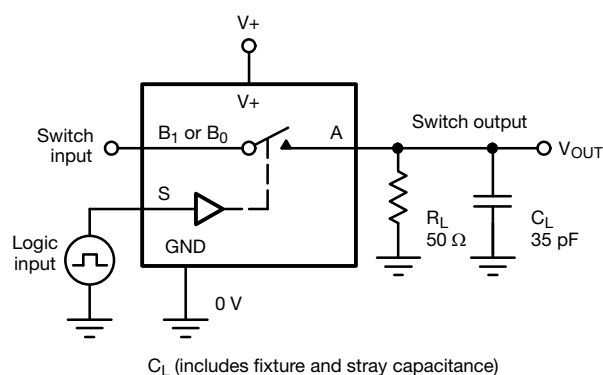


Leakage Current vs. Temperature

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



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

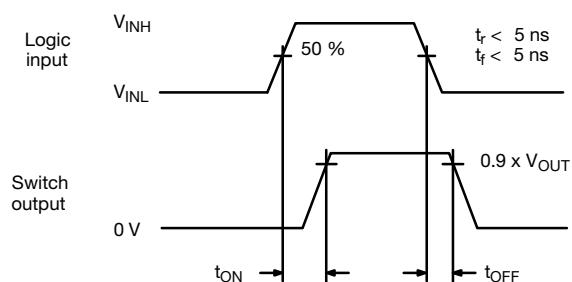


Fig. 1 - Switching Time

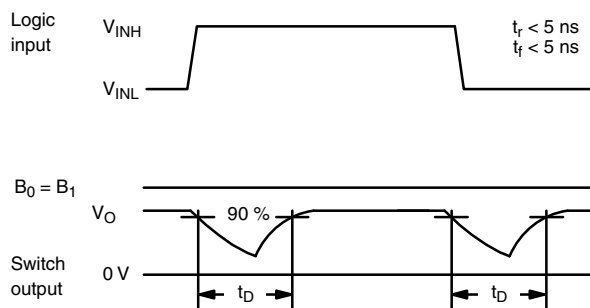
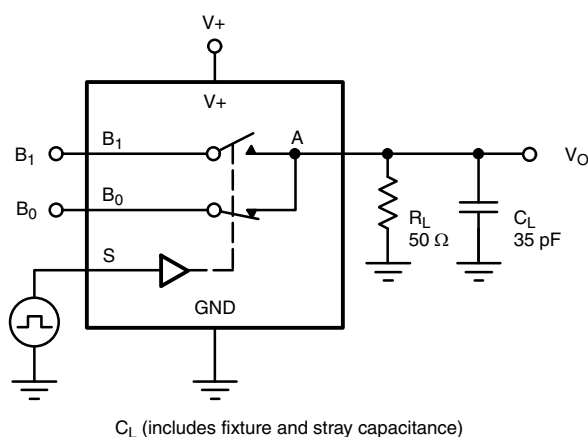
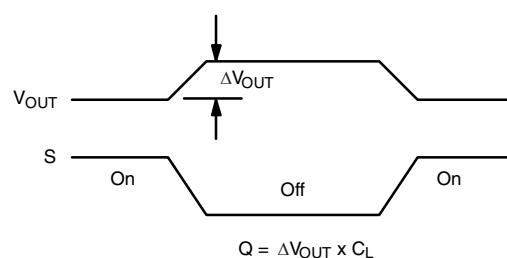
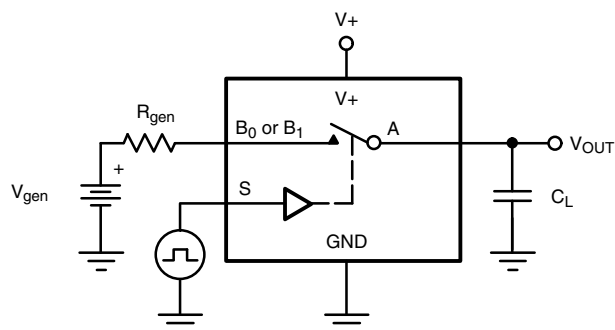
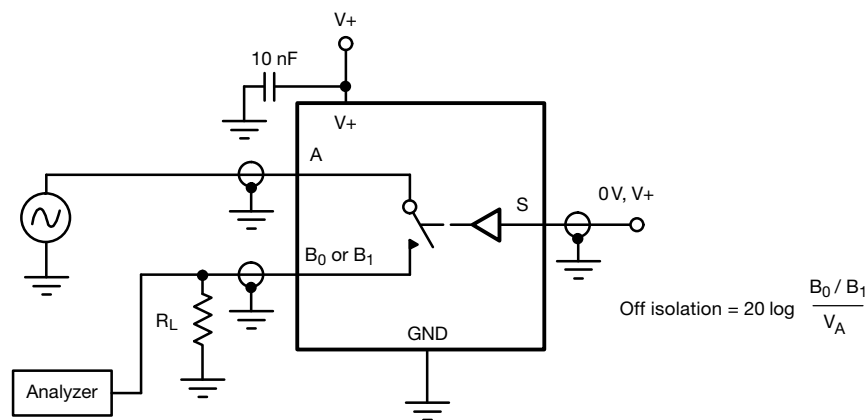
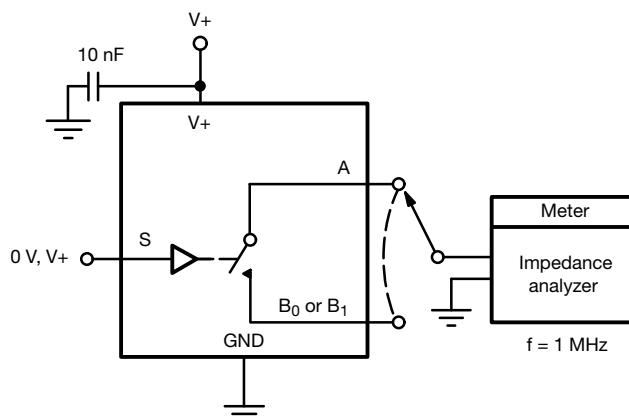


Fig. 2 - Break-Before-Make Interval



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

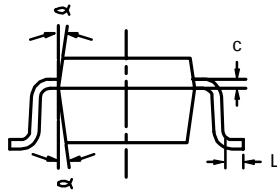
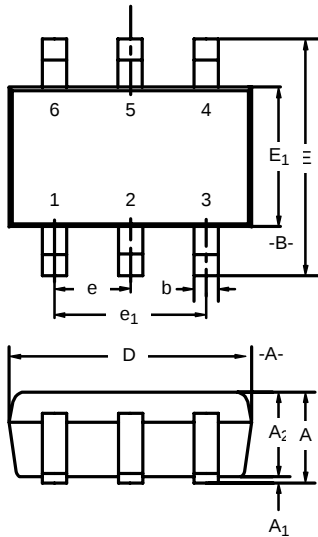


PRODUCT SUMMARY		
Part number	DG4157E	DG4157E
Status code	2	2
Configuration	SPDT x 2	SPDT x 2
Single supply min. (V)	1.65	1.65
Single supply max. (V)	5.5	5.5
Dual supply min. (V)	-	-
Dual supply max. (V)	-	-
On-resistance (Ω)	0.86	0.86
Charge injection (pC)	-5	-5
Source on capacitance (pF)	52	52
Source off capacitance (pF)	13	13
Leakage switch on typ. (nA)	1.4	1.4
Leakage switch off max. (nA)	3	3
-3 dB bandwidth (MHz)	152	152
Package	SC-70-6	μ DFN-6
Functional circuit / applications	Multi Purpose, instrumentation, medical and healthcare, portable	Multi Purpose, instrumentation, medical and healthcare, portable
Interface	Parallel	Parallel
Single supply operation	Yes	Yes
Dual supply operation	-	-
Turn on time max. (ns)	47	47
Crosstalk and off isolation	-41	-41

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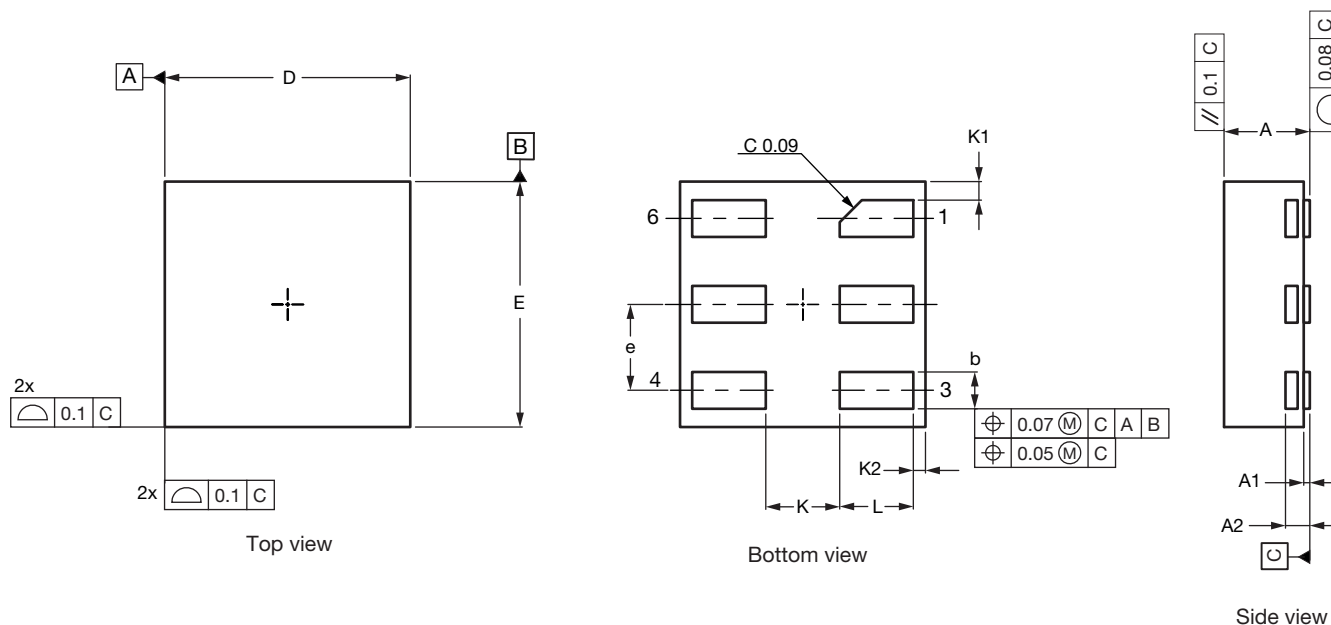
SC-70: 6-LEADS



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

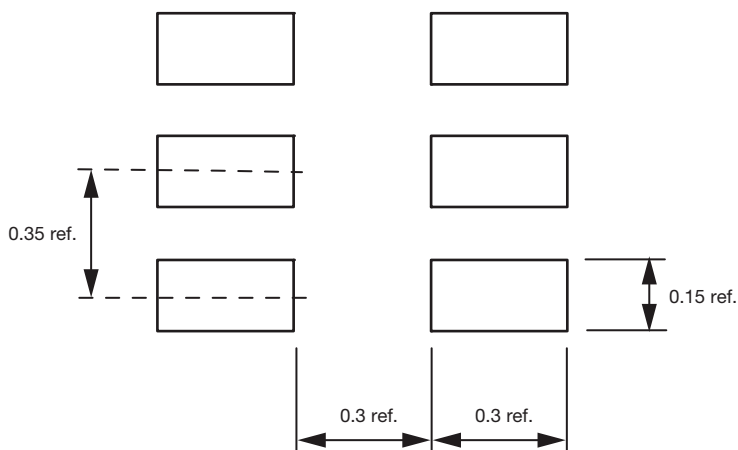


DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.32	0.35	0.38	0.013	0.014	0.015
A1	0.00	-	0.05	0.000	-	0.002
A2	0.10 Ref.			0.004 Ref.		
b	0.12	0.15	0.18	0.005	0.006	0.007
D	0.95	1.00	1.05	0.037	0.039	0.041
E	0.95	1.00	1.05	0.037	0.039	0.041
e	0.35 BSC			0.014 BSC		
K	0.30 Ref.			0.012 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
ECN: E23-0309-Rev. B, 28-Aug-2023						
DWG: 6053						

Notes

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

Recommended Minimum PADs for μ DFN 6L



Mounting Footprint
Dimensions in mm



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