

Low-Voltage, Low R_{ON} , Single Analog Switch In miniQFN-6 Package

DESCRIPTION

The DG2511, DG2512, DG2513 are low on-resistance, single-pole/double-throw or single-pole/single-throw monolithic CMOS analog switch. It is designed for low voltage applications. The DG2511, DG2512, DG2513 are ideal for portable and battery powered equipment, requiring high performance and efficient use of board space. In addition to the low on-resistance (1.3Ω at 2.7 V).

The DG2511 is an SPDT and the DG2512, DG2513 are SPST. The switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

The DG2511, DG2512, DG2513 are built on Vishay Siliconix's low voltage J15L process. An epitaxial layer prevents latchup.

Break-before-make is guaranteed.

The DG2511, DG2512, DG2513 represents a breakthrough in packaging development for analog switching products. The miniQFN-6 package (1.2 x 1 mm).

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. For analog switching products manufactured with NiPdAu device terminations, the lead (Pb)-free "-E4" suffix is being used as a designator.

FEATURES

- Low voltage operation (1.8 V to 5.5 V)
- Low on-resistance - R_{ON} : 1.3Ω at 2.7 V
- Low charge injection
- Latch-up current > 300 mA (JESD78A)
- miniQFN-6 package (1.2 x 1 mm)
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

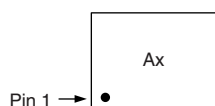
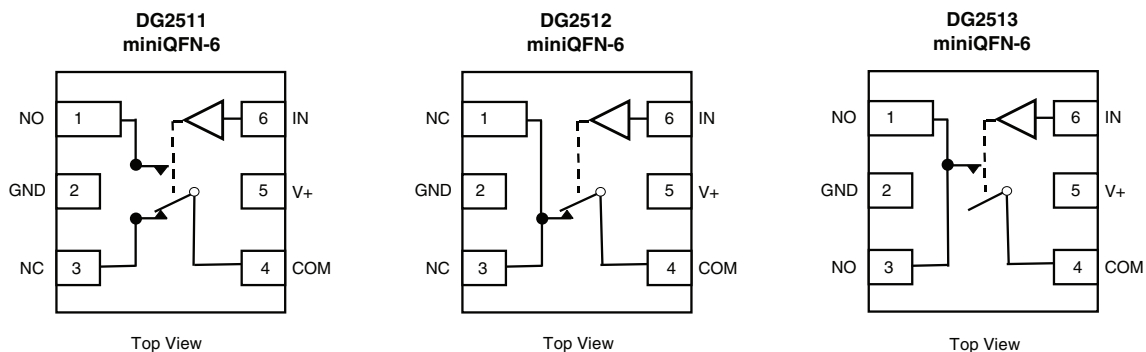
BENEFITS

- Reduced power consumption
- Simple logic interface
- High accuracy
- Reduce board space
- Guaranteed 2 V operation

APPLICATIONS

- Cellular phones
- Communication systems
- Portable test equipment
- Battery operated systems
- Sample and hold circuits
- ADC and DAC applications
- Low voltage data acquisition systems

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: Ax for DG2511
 Bx for DG2512
 Cx for DG2513
 x = Date/Lot Traceability Code
 Note: Pin 1 has long lead

TRUTH TABLE

Logic	NC	NO
0	On	Off
1	Off	On

COMMERCIAL ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 °C to 85 °C	miniQFN-6	DG2511DN-T1-E4
	Lead (Pb)-free	DG2512DN-T1-E4
	with Tape and Reel	DG2513DN-T1-E4

ABSOLUTE MAXIMUM RATINGS			
Parameter		Limit	Unit
Reference V+ to GND		- 0.3 to + 6	V
IN, COM, NC, NO ^a		- 0.3 to (V+ + 0.3)	
Continuous Current (NO, NC, COM pins)		± 150	mA
Peak Current (Pulsed at 1 ms, 10 % duty cycle)		± 300	
Storage Temperature	D Suffix	- 65 to 150	°C
Power Dissipation (Packages) ^b	miniQFN-6 ^c	160	mW

Notes:

- a. Signals on NC, NO, or COM or IN 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 mW/°C above 70 °C.

SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, V _{IN} = 0.4 V or 2 V ^e	Temp. ^a	Limits - 40 °C to 85 °C			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} , V _{COM}		Full	0		V+	V
On-Resistance	R _{ON}	V+ = 2.7 V, V _{COM} = 0.5 V/1.5 V I _{NO} , I _{NC} = 100 mA	Room		1.4	1.7	Ω
R _{ON} Match	ΔR _{ON}		Full			1.9	
R _{ON} Flatness	R _{ON} Flatness		Room		0.3	0.4	
Switch Off Leakage Current ^f	I _{NO(off)} I _{NC(off)}	V+ = 3.3 V, V _{NO} , V _{NC} = 1 V/3 V, V _{COM} = 3 V/1 V	Room	- 2		2	nA
	I _{COM(off)}		Full	- 20		20	
Channel-On Leakage Current ^f		I _{COM(on)}	Room	- 2		2	
		V+ = 3.3 V, V _{NO} , V _{NC} = V _{COM} = 1 V/3 V	Full	- 20		20	
Digital Control							
Input High Voltage	V _{INH}		Full	1.6			V
Input Low Voltage	V _{INL}		Full			0.4	
Input Capacitance	C _{in}		Full		4		pF
Input Current	I _{INL} or I _{INH}	V _{IN} = 0 or V+	Full	1		1	μA
Dynamic Characteristics							
Turn-On Time	t _{ON}	V+ = 2.7 V, V _{NO} or V _{NC} = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room		18	43	ns
Turn-Off Time	t _{OFF}		Full		7	32	
			Full			34	
Break-Before-Make Time	t _{BBM}		Room	1	12		
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room		3		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 58		dB
Crosstalk ^d	X _{TALK}		Room		- 64		
N _O , N _C Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		21		pF
	Channel-On Capacitance ^d		C _{ON}	Room		61	
Power Supply							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	V _{IN} = 0 or V+			0.01	1	μA



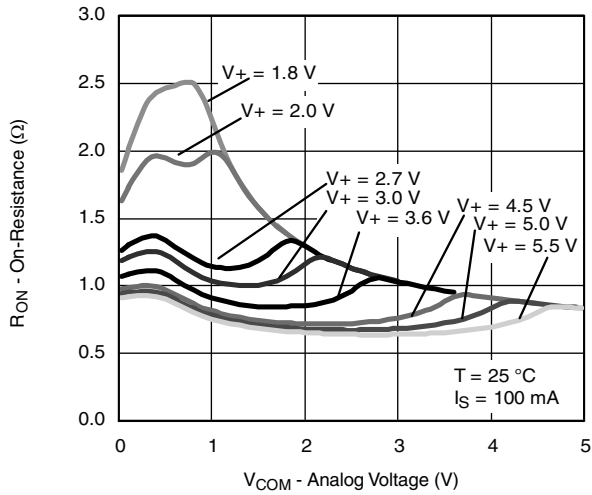
SPECIFICATIONS (V+ = 5 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5 V, ± 10 %, VIN = 0.6 V or 1.8 V ^e	Temp. ^a	Limits - 40 °C to 85 °C			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} , V _{COM}		Full	0		V+	V
On-Resistance	R _{ON}	V+ = 4.5 V, V _{COM} = 0.5 V/2.5 V, I _{NO} , I _{NC} = 100 mA	Room		1	1.3	Ω
R _{ON} Match	ΔR _{ON}		Full			1.45	
R _{ON} Flatness	R _{ON} Flatness		Room		0.3	0.4	
Switch Off Leakage Current	I _{NO(off)}	V+ = 5.5 V, V _{NO} , V _{NC} = 1 V/4.5 V, V _{COM} = 4.5 V/1 V	Room	- 2		2	nA
	I _{NC(off)}		Full	- 20		20	
	I _{COM(off)}		Room	- 2		2	
Channel-On Leakage Current	I _{COM(on)}	V+ = 5.5 V, V _{NO} , V _{NC} = V _{COM} = 1 V/4.5 V	Room	- 2		2	
Full			Full	- 20		20	
Digital Control							
Input High Voltage	V _{INH}		Full	1.8			V
Input Low Voltage	V _{INL}		Full			0.6	
Input Capacitance	C _{in}		Full		4		pF
Input Current	I _{INL} or I _{INH}	V _{IN} = 0 or V+	Full	1		1	μA
Dynamic Characteristics							
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = 2.5 V, R _L = 50 Ω, C _L = 35 pF	Room		11	35	ns
Turn-Off Time	t _{OFF}		Full		6	31	
Break-Before-Make Time	t _{BBM}		Room	1	5	33	
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room		14		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 58		dB
Crosstalk ^d	X _{TALK}		Room		- 64		
N _O , N _C Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		19		pF
Channel-On Capacitance ^d	C _{ON}		Room		61		
Power Supply							
Power Supply Range	V+	V _{IN} = 0 or V+		1.8		5.5	V
Power Supply Current	I+				0.01		1

Notes:

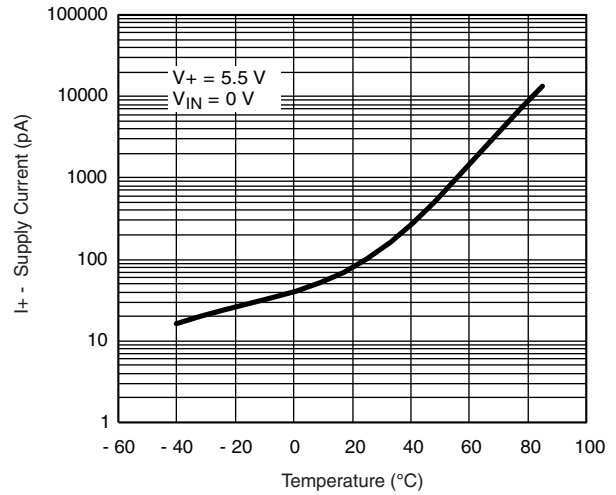
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- c. Typical values are for design aid only, not guaranteed nor subject to production testing.
- d. Guarantee by design, nor subjected to production test.
- e. V_{IN} = input voltage to perform proper function.
- f. Guaranteed by 5 V leakage testing, not production tested.

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.

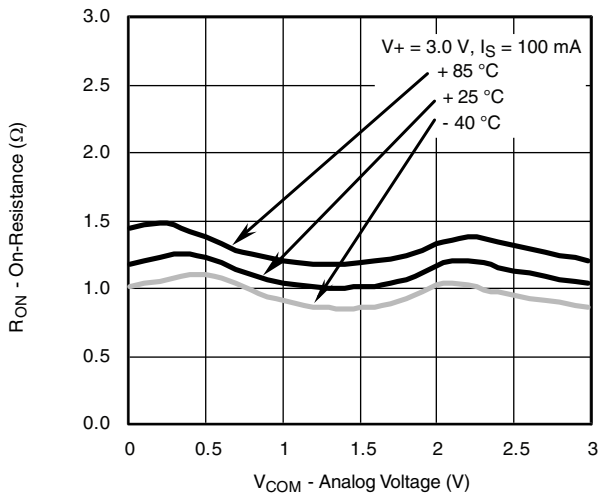
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



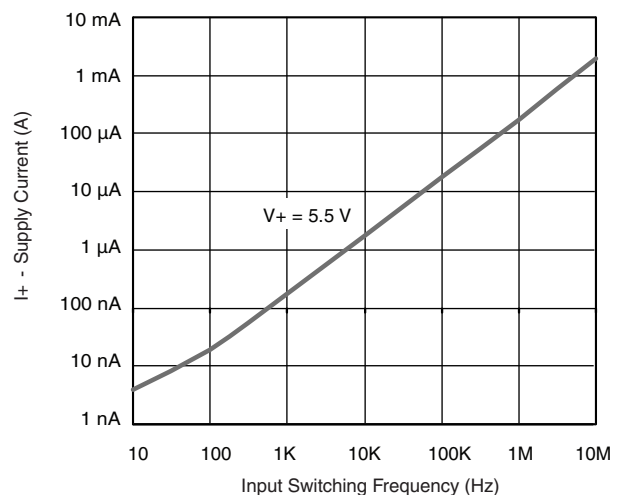
R_{ON} vs. V_{COM} and Supply Voltage



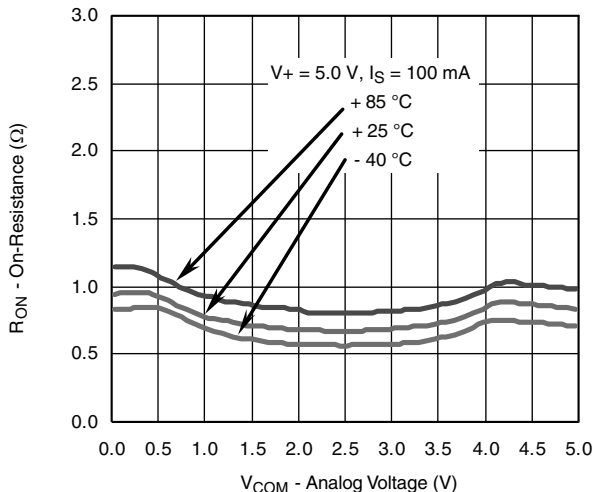
Supply Current vs. Temperature



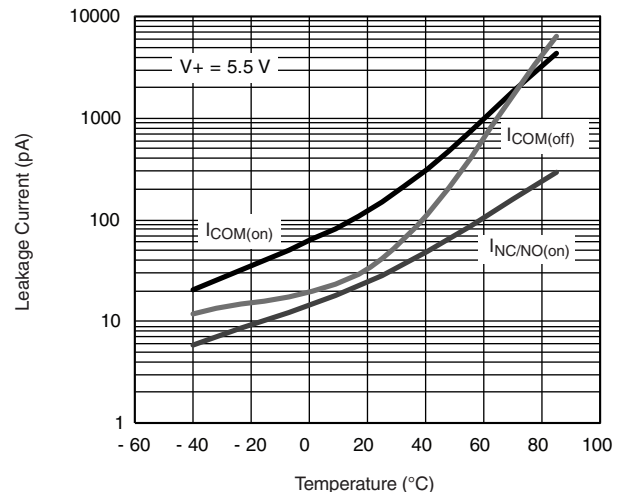
R_{ON} vs. Analog Voltage and Temperature



Supply Current vs. Input Switching Frequency

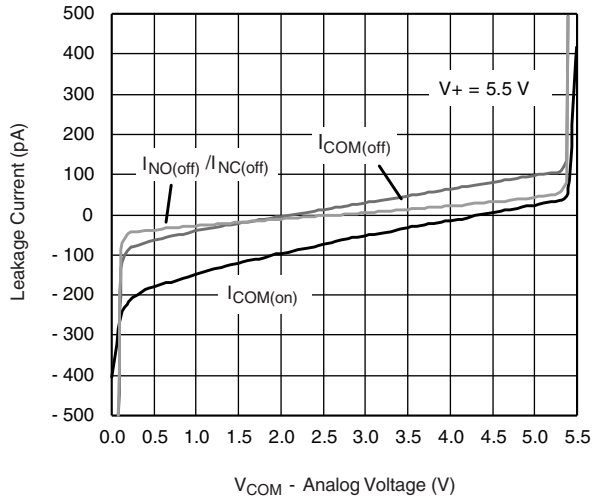


R_{ON} vs. Analog Voltage and Temperature

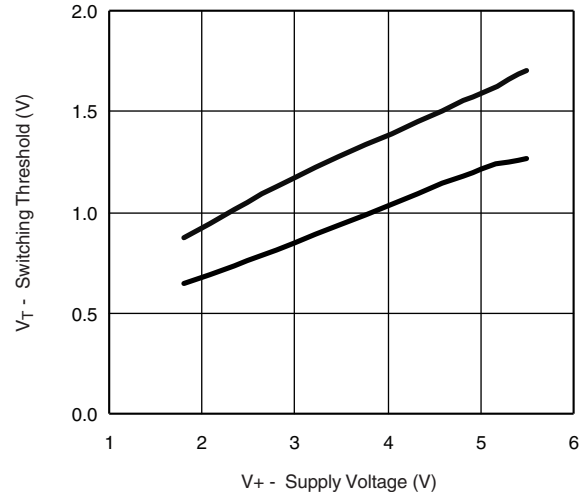


Leakage Current vs. Temperature

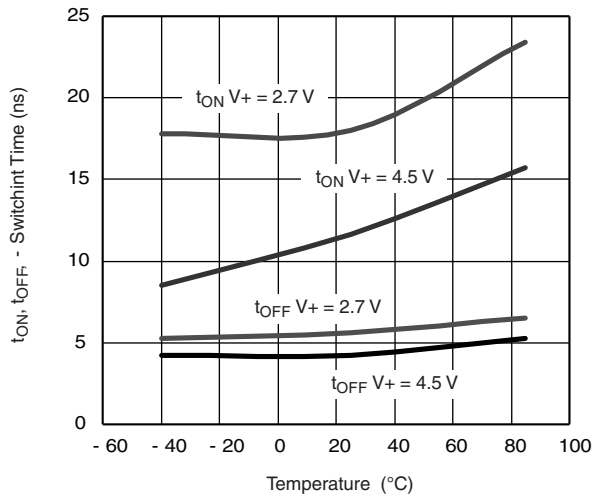
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



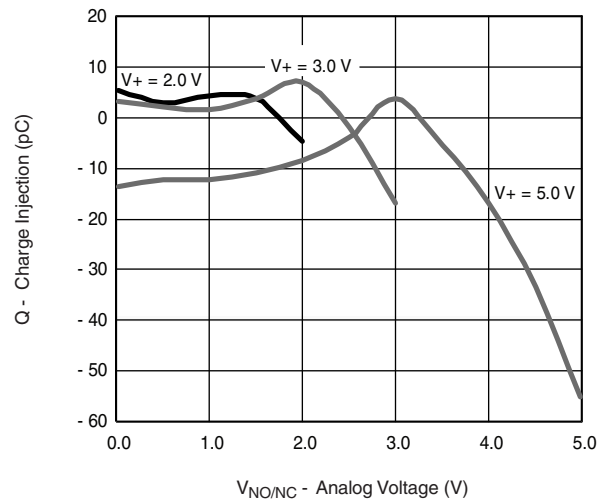
Leakage vs. Analog Voltage



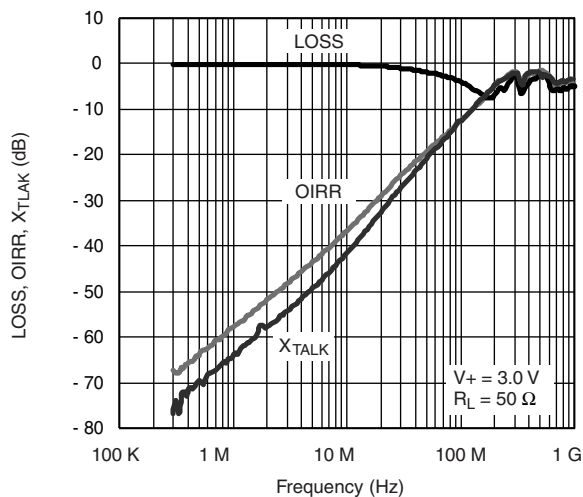
Switching Threshold vs. Supply Voltage



Switching Time vs. Temperature and Supply Voltage

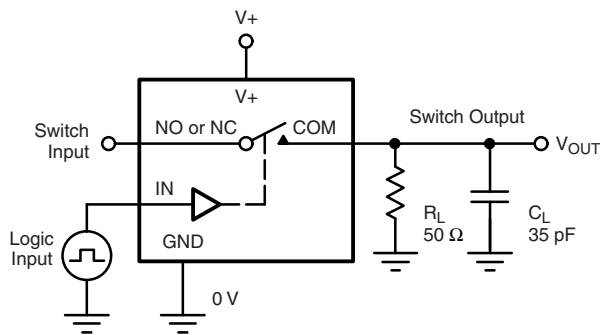


Charge Injection vs. Analog Voltage



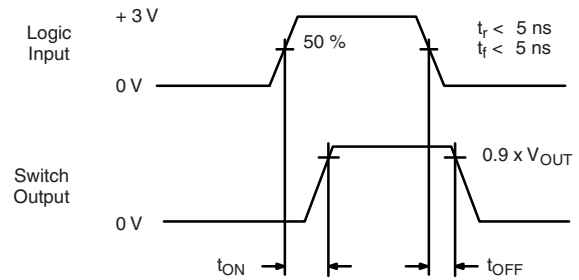
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

TEST CIRCUITS



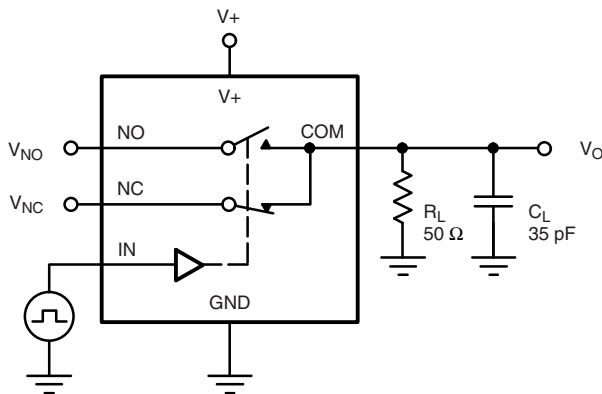
C_L (includes fixture and stray capacitance)

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



Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 1. Switching Time



C_L (includes fixture and stray capacitance)

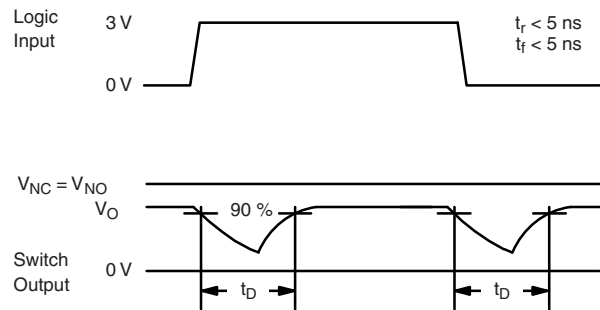
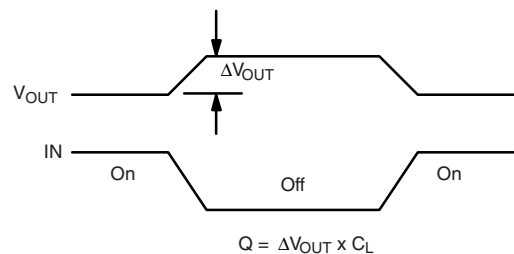
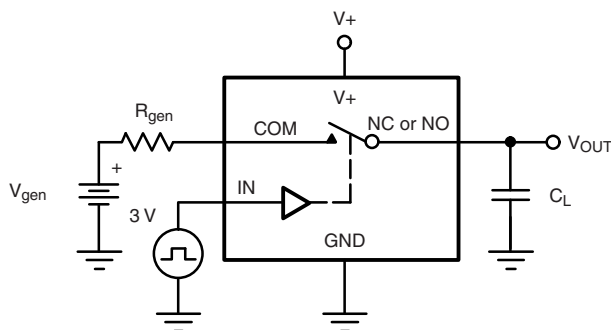


Figure 2. Break-Before-Make Interval



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

Figure 3. Charge Injection

TEST CIRCUITS

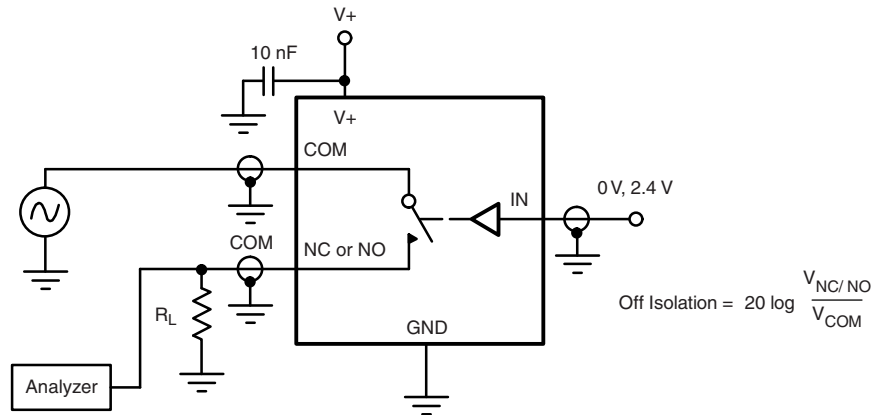


Figure 4. Off-Isolation

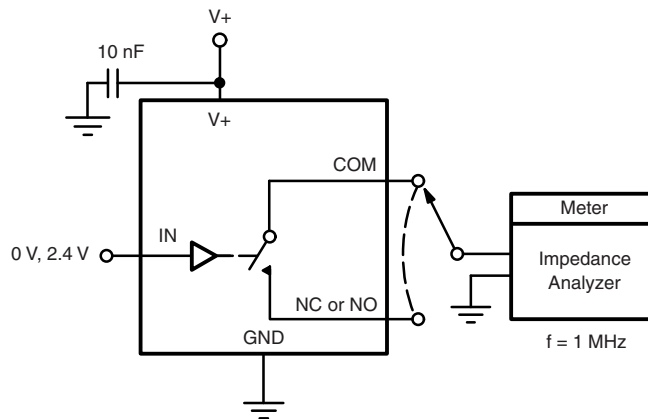
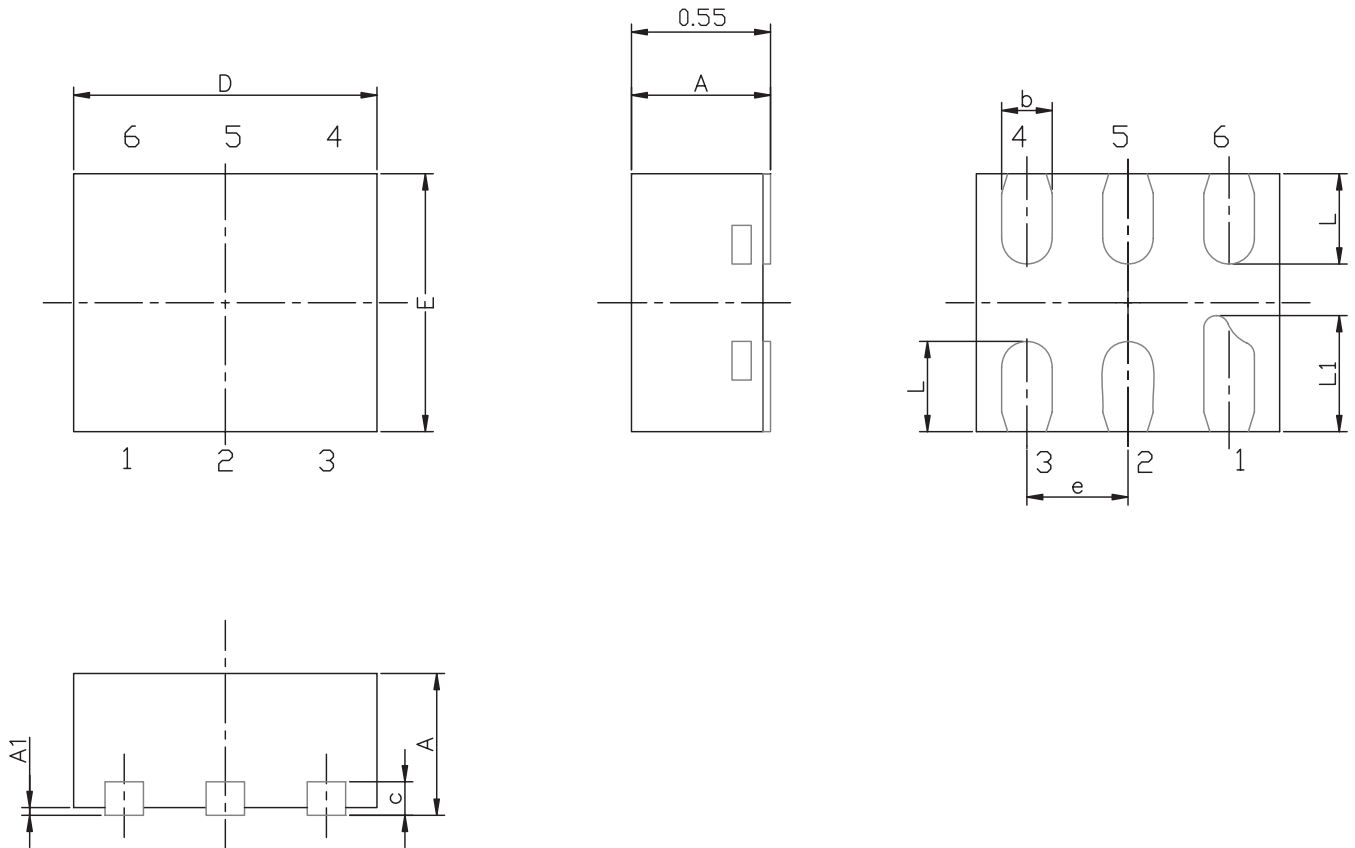


Figure 5. Channel Off/On Capacitance

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?74454.

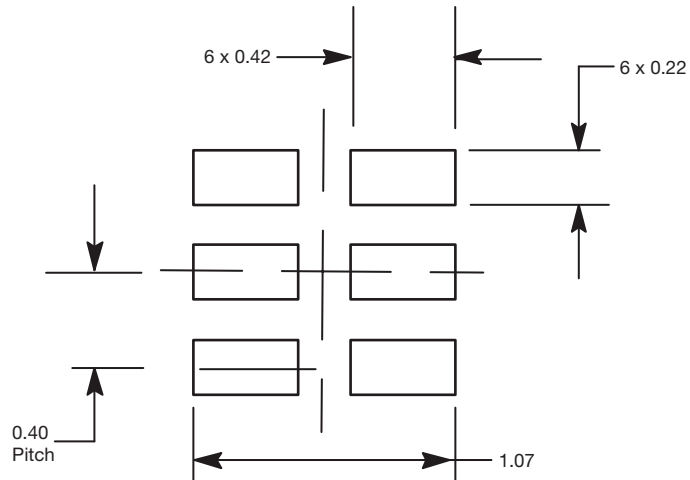
MINI QFN-6L CASE OUTLINE



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



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