

## 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 ( $1.3 \Omega$  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 -  $R_{ON}$ :  $1.3 \Omega$  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](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

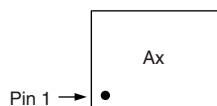
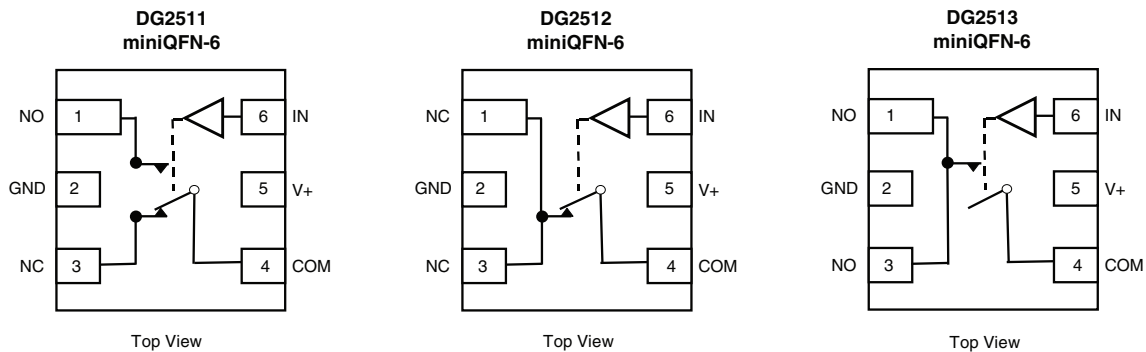
### BENEFITS

- 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 <sup>a</sup>		- 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) <sup>b</sup>	miniQFN-6 <sup>c</sup>	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 <sub>IN</sub> = 0.4 V or 2 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>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		Full	0		V+	V
On-Resistance	R <sub>ON</sub>	V+ = 2.7 V, V <sub>COM</sub> = 0.5 V/1.5 V I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room		1.4	1.7	Ω
R <sub>ON</sub> Match	ΔR <sub>ON</sub>		Full			1.9	
R <sub>ON</sub> Flatness	R <sub>ON</sub> Flatness		Room		0.3	0.4	
Switch Off Leakage Current <sup>f</sup>	I <sub>NO(off)</sub> I <sub>NC(off)</sub>	V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = 1 V/3 V, V <sub>COM</sub> = 3 V/1 V	Room	- 2		2	nA
	I <sub>COM(off)</sub>		Full	- 20		20	
Channel-On Leakage Current <sup>f</sup>		I <sub>COM(on)</sub>	Room	- 2		2	
		V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V/3 V	Full	- 20		20	
<b>Digital Control</b>							
Input High Voltage	V <sub>INH</sub>		Full	1.6			V
Input Low Voltage	V <sub>INL</sub>		Full			0.4	
Input Capacitance	C <sub>in</sub>		Full		4		pF
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 or V+	Full	1		1	μA
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V+ = 2.7 V, V <sub>NO</sub> or V <sub>NC</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	Room		18	43	ns
Turn-Off Time	t <sub>OFF</sub>		Full		7	32	
			Full			34	
Break-Before-Make Time	t <sub>BBM</sub>		Room	1	12		
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 0 V, R <sub>GEN</sub> = 0 Ω	Room		3		pC
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room		- 58		dB
Crosstalk <sup>d</sup>	X <sub>TALK</sub>		Room		- 64		
N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup>	C <sub>NO(off)</sub> C <sub>NC(off)</sub>	V <sub>IN</sub> = 0 or V+, f = 1 MHz	Room		21		pF
	Channel-On Capacitance <sup>d</sup>		C <sub>ON</sub>	Room		61	
<b>Power Supply</b>							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	V <sub>IN</sub> = 0 or V+			0.01	1	μA



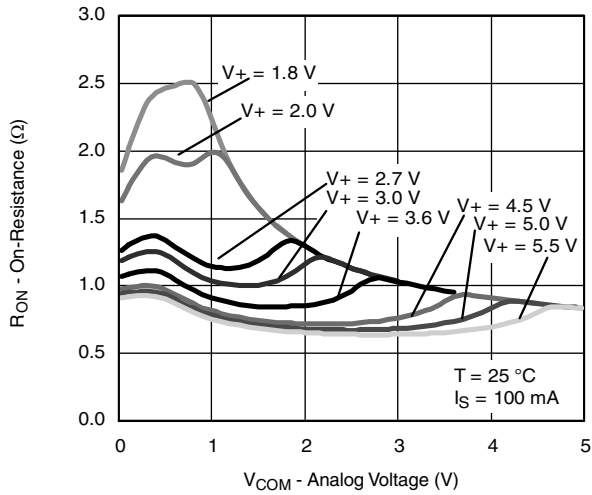
SPECIFICATIONS (V <sub>+</sub> = 5 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V <sub>+</sub> = 5 V, ± 10 %, V <sub>IN</sub> = 0.6 V or 1.8 V <sup>e</sup>	Temp. <sup>a</sup>	Limits - 40 °C to 85 °C			Unit
				Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
<b>Analog Switch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

Notes:

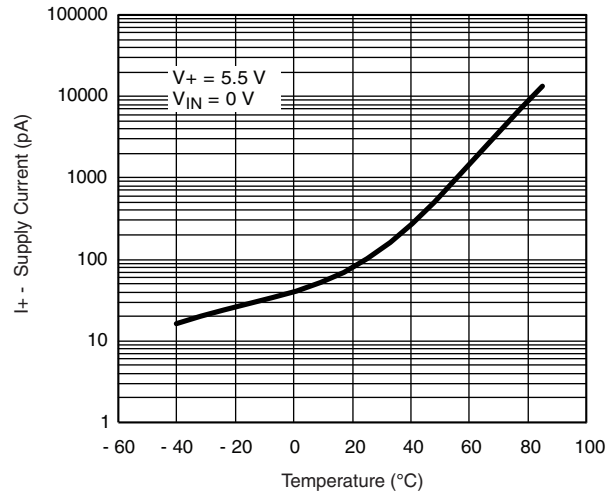
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- c. Typical values are for design aid only, not guaranteed nor subject to production testing.
- d. Guarantee by design, nor subjected to production test.
- e. V<sub>IN</sub> = 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.

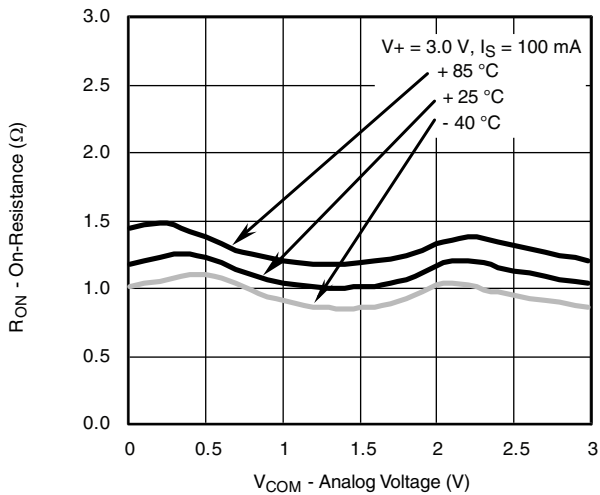
### TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



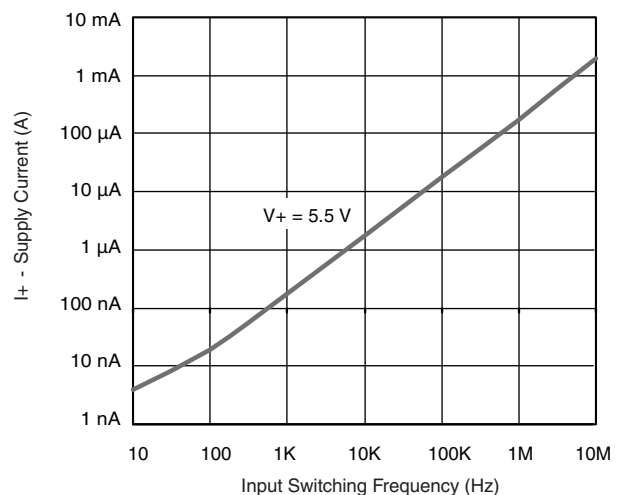
**$R_{ON}$  vs.  $V_{COM}$  and Supply Voltage**



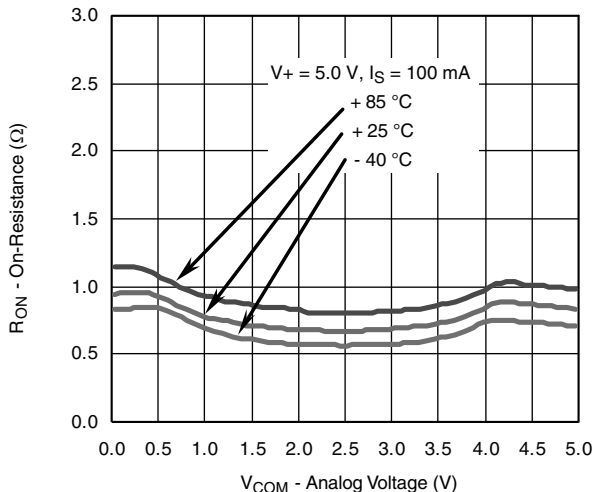
**Supply Current vs. Temperature**



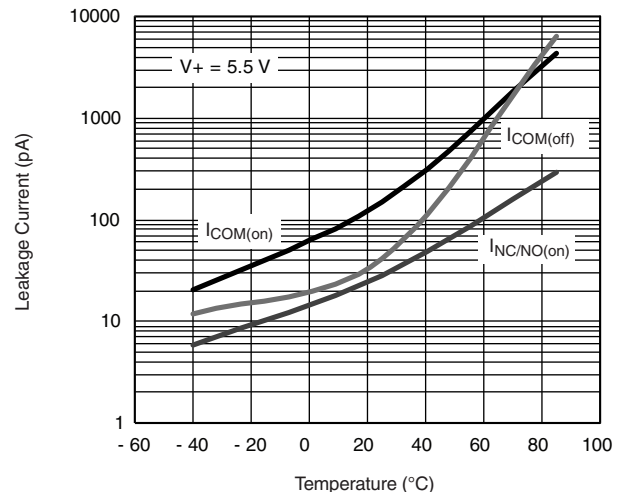
**$R_{ON}$  vs. Analog Voltage and Temperature**



**Supply Current vs. Input Switching Frequency**

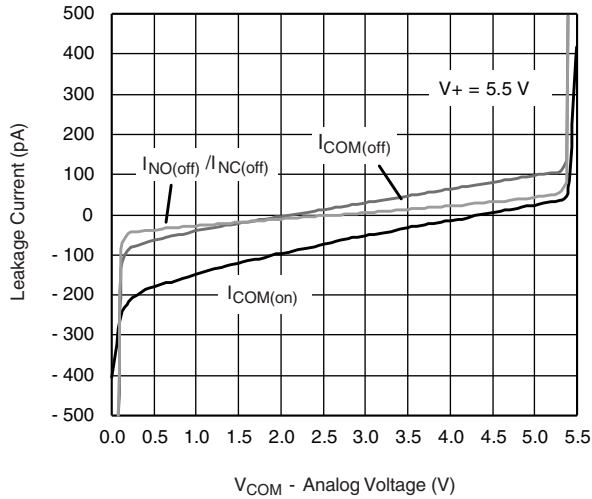


**$R_{ON}$  vs. Analog Voltage and Temperature**

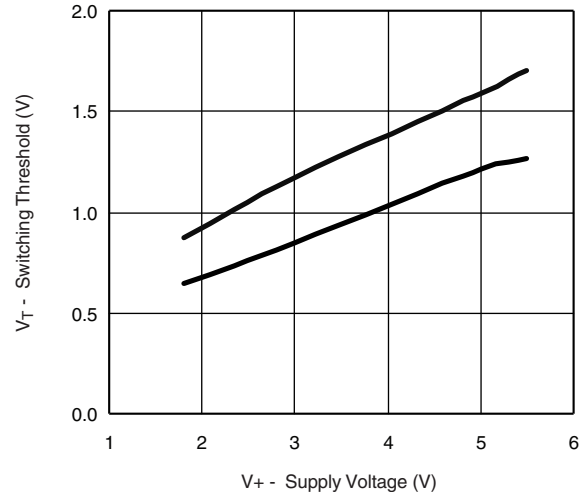


**Leakage Current vs. Temperature**

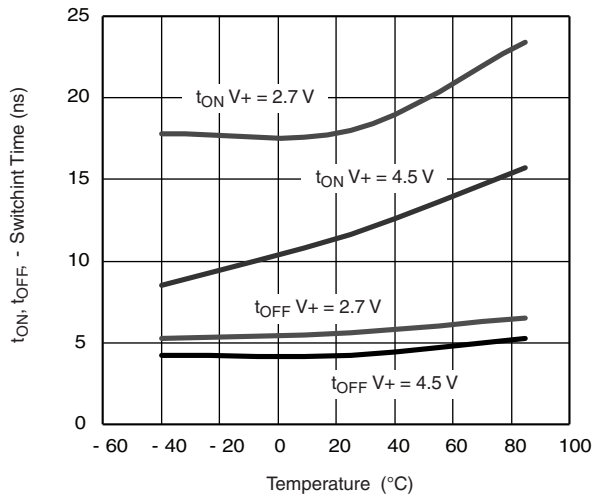
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



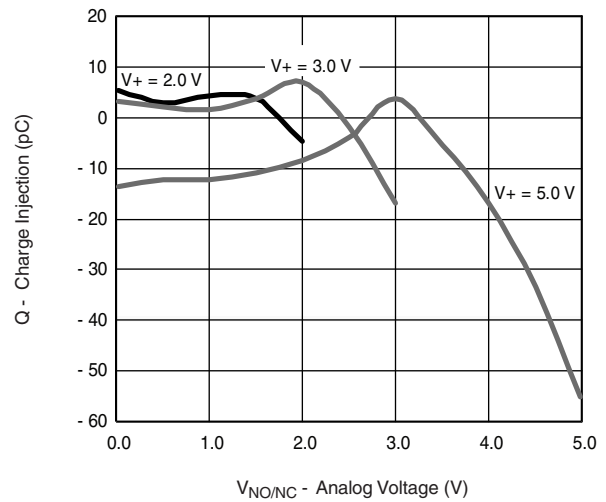
Leakage vs. Analog Voltage



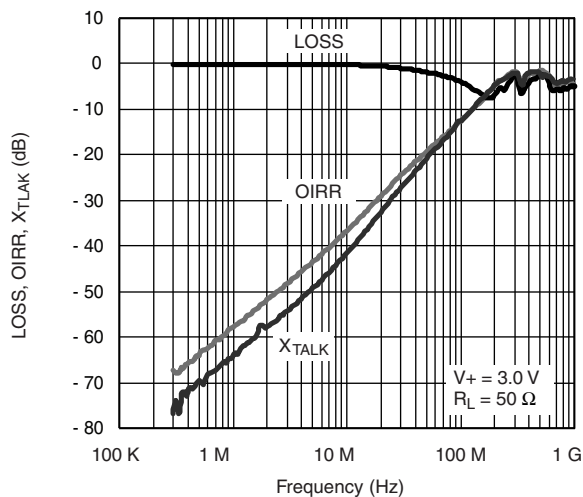
Switching Threshold vs. Supply Voltage



Switching Time vs. Temperature and Supply Voltage

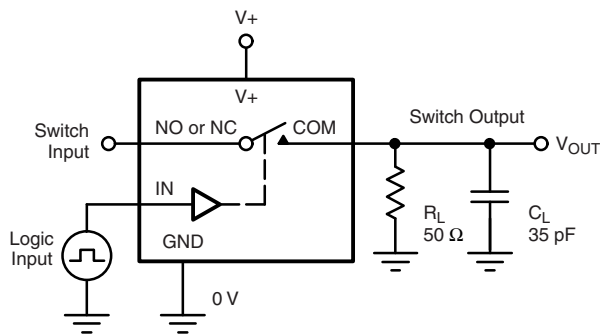


Charge Injection vs. Analog Voltage



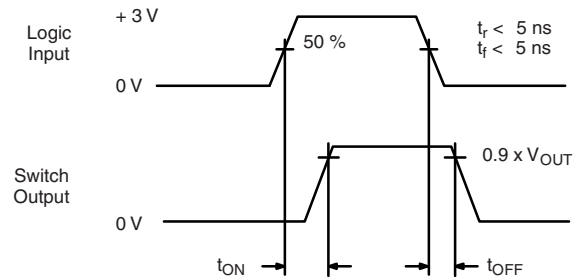
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

## TEST CIRCUITS



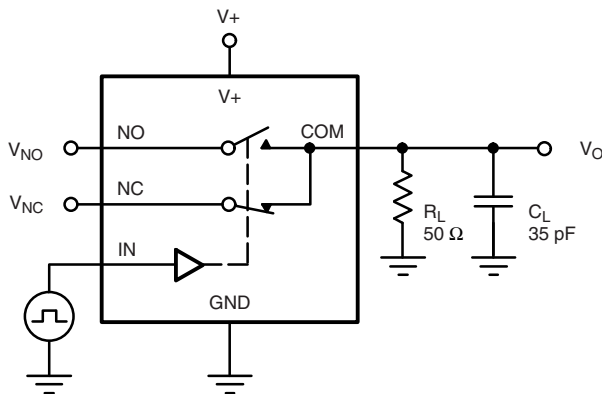
$C_L$  (includes fixture and stray capacitance)

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



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)

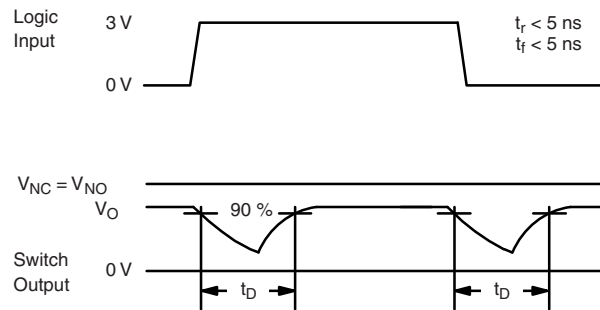
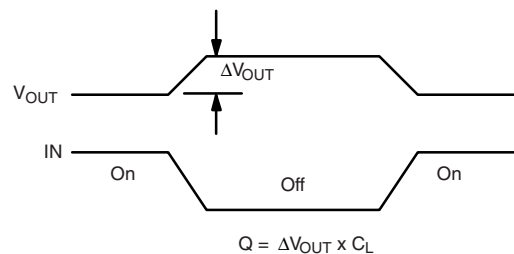
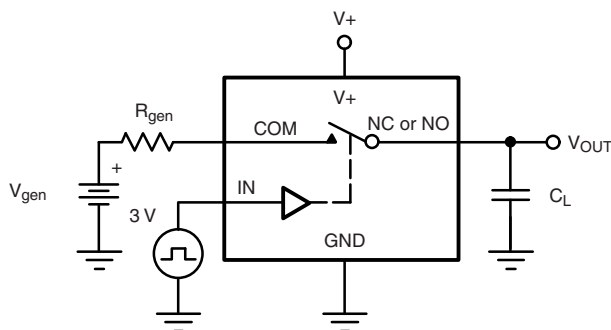


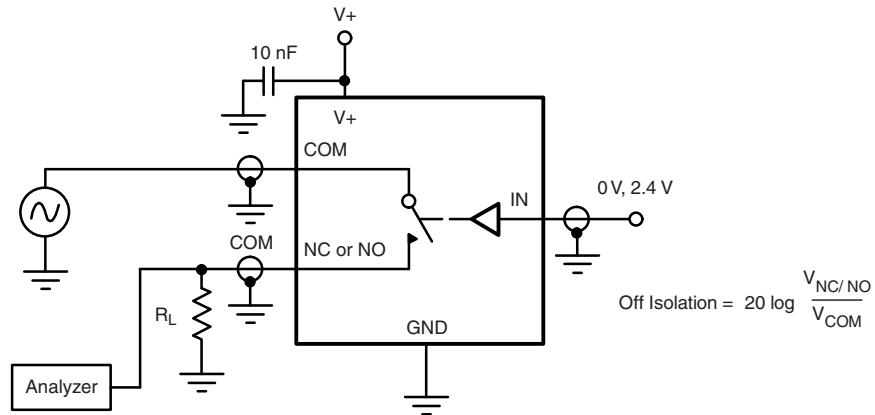
Figure 2. Break-Before-Make Interval



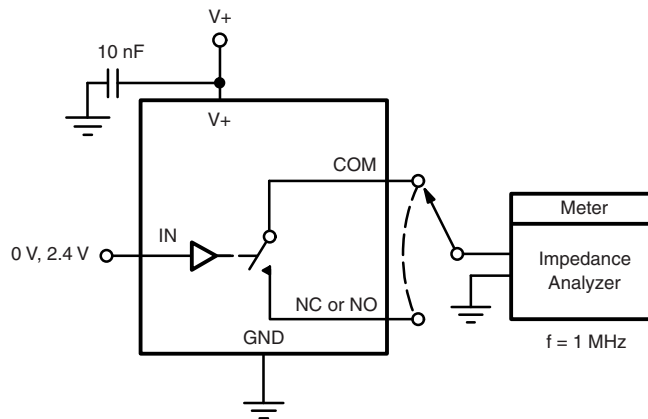
IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection

## TEST CIRCUITS



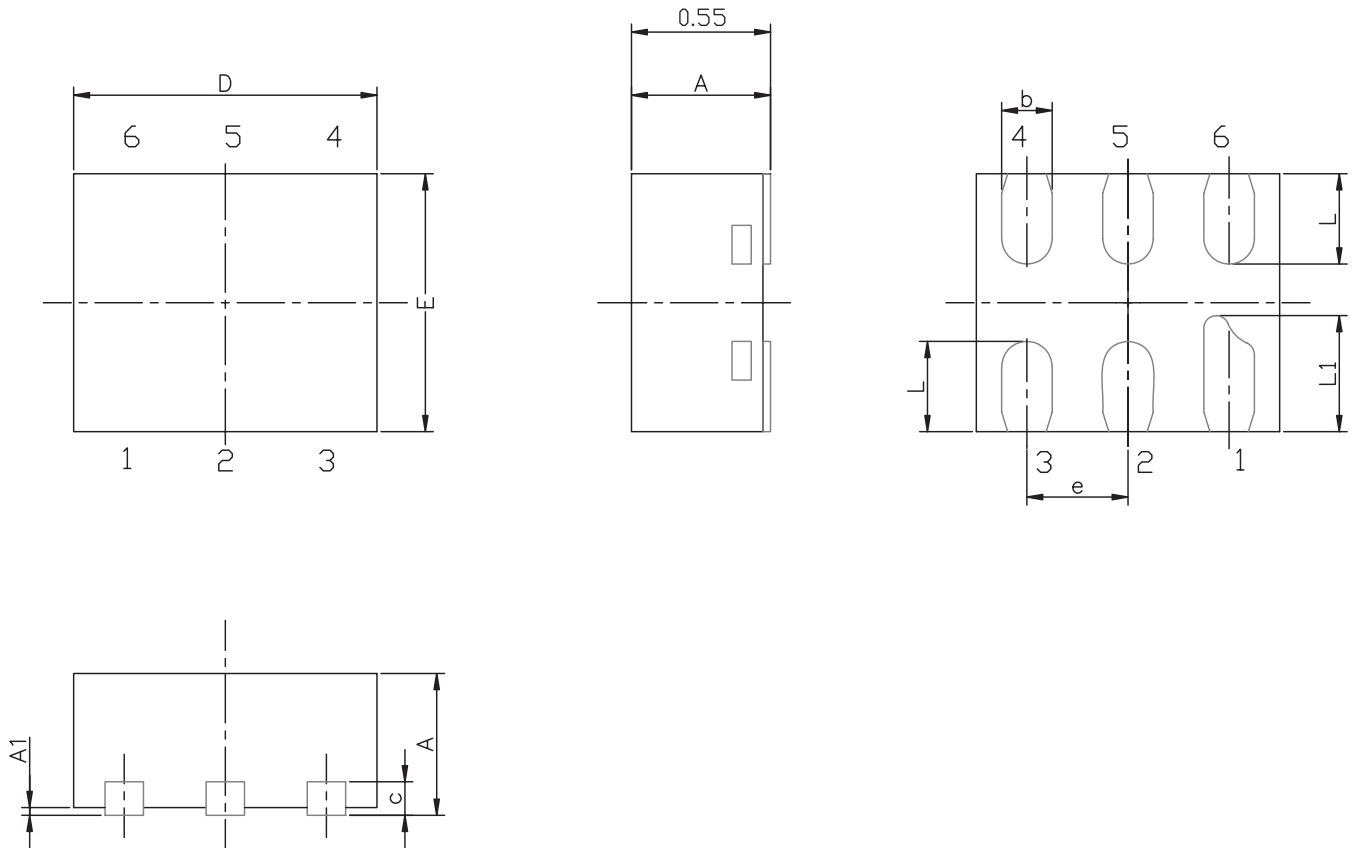
**Figure 4. Off-Isolation**



**Figure 5. Channel Off/On Capacitance**

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## MINI QFN-6L CASE OUTLINE

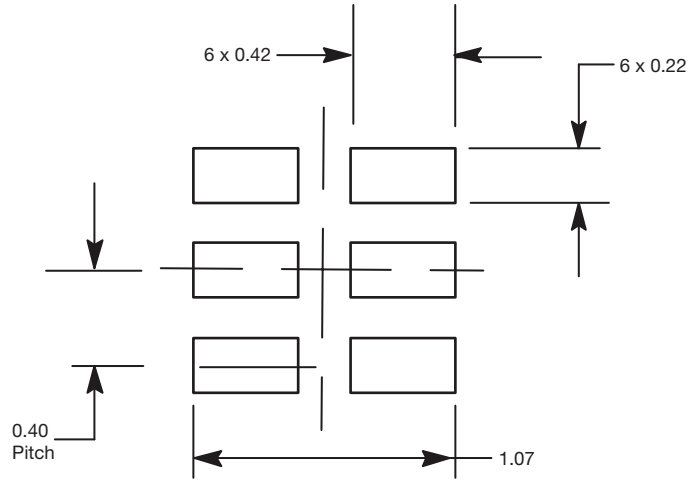


DIM	MILLIMETERS			INCHES		
	MIN.	NAM.	MAX.	MIN.	NAM.	MAX.
A	0.50	0.55	0.60	0.0197	0.0217	0.0236
A1	0.00	-	0.05	0.000	-	0.002
b	0.15	0.20	0.25	0.006	0.008	0.010
c	0.15 REF			0.006 REF		
D	1.15	1.20	1.25	0.045	0.047	0.049
E	0.95	1.00	1.05	0.037	0.039	0.041
e	0.40 BSC			0.016 BSC		
L	0.30	0.35	0.40	0.012	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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