

## 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

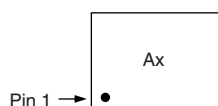
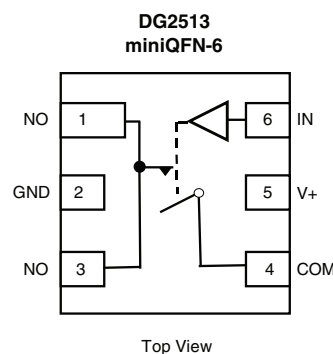
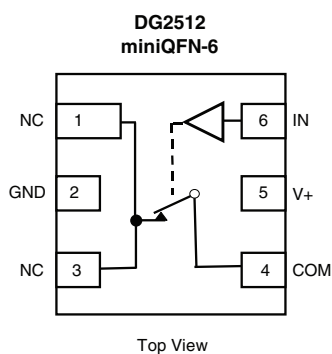
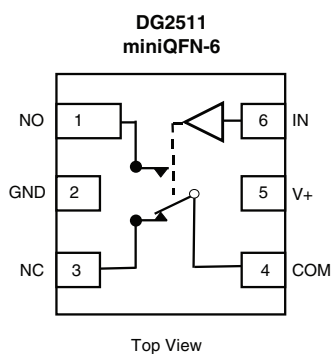
### BENEFITS

- 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 Lead (Pb)-free with Tape and Reel	DG2511DN-T1-E4 DG2512DN-T1-E4 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	°C
Power Dissipation (Packages) <sup>b</sup>	miniQFN-6 <sup>c</sup>	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>	
Analog Switch							
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 Full		1.4	1.7 1.9	Ω
R <sub>ON</sub> Match	ΔR <sub>ON</sub>		Room			0.15	
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 Full	- 2 - 20		2 20	nA
	I <sub>COM(off)</sub>		Room Full	- 2 - 20		2 20	
Channel-On Leakage Current <sup>f</sup>	I <sub>COM(on)</sub>	V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V/3 V	Room Full	- 2 - 20		2 20	
Digital Control							
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
Dynamic Characteristics							
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 Full		18	43 49	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		7	32 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		
Power Supply							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	V <sub>IN</sub> = 0 or V+			0.01	1	μA



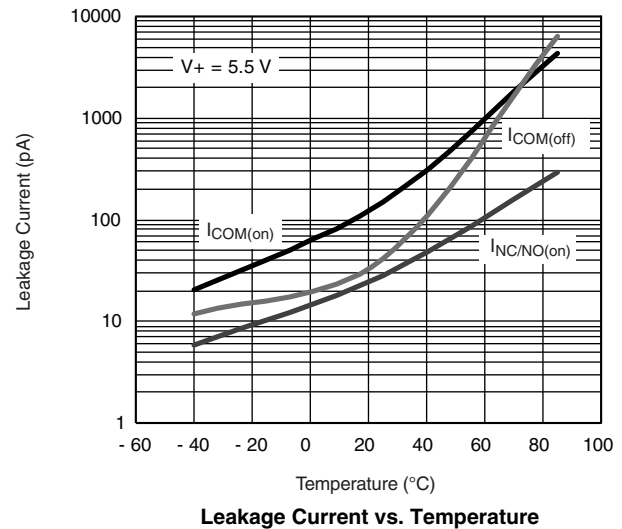
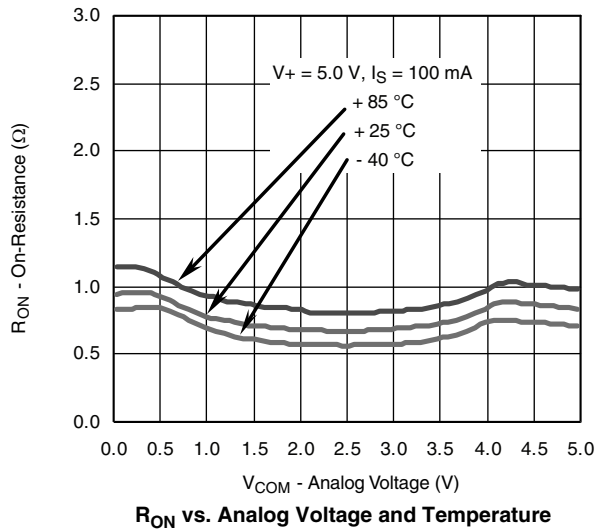
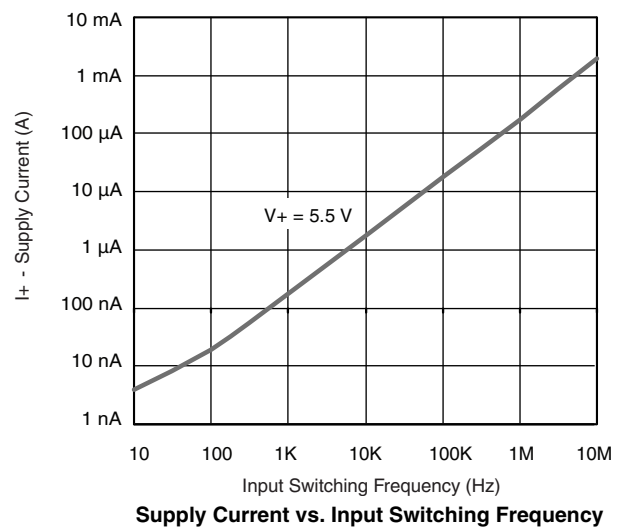
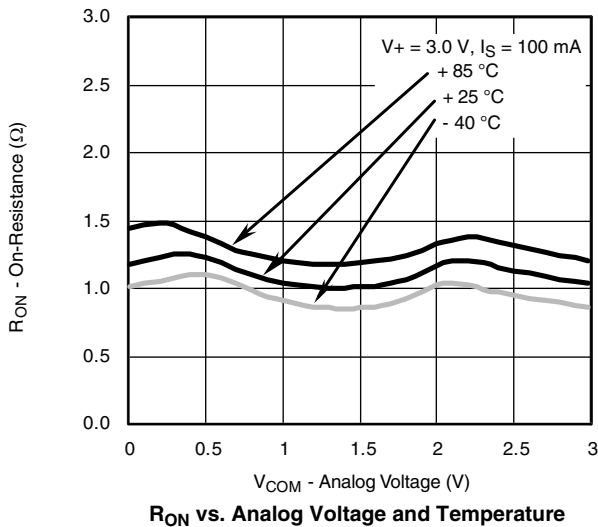
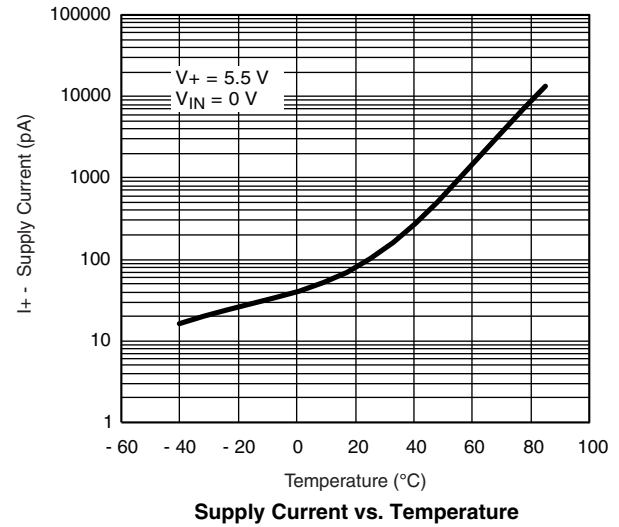
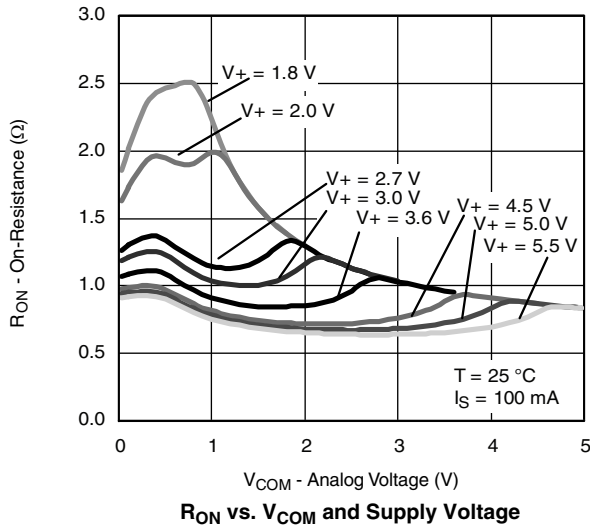
SPECIFICATIONS (V+ = 5 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5 V, ± 10 %, VIN = 0.6 V or 1.8 V <sup>e</sup>	Temp. <sup>a</sup>	Limits - 40 °C to 85 °C			Unit
				Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
Analog Switch							
Analog Signal Range <sup>d</sup>	VNO, VNC, VCOM		Full	0		V+	V
On-Resistance	RON	V+ = 4.5 V, VCOM = 0.5 V/2.5 V, INO, INC = 100 mA	Room Full		1	1.3 1.45	Ω
RON Match	ΔRON		Room			0.15	
RON Flatness	RON Flatness		Room		0.3	0.4	
Switch Off Leakage Current	INO(off) INC(off)	V+ = 5.5 V, VNO, VNC = 1 V/4.5 V, VCOM = 4.5 V/1 V	Room Full	- 2 - 20		2 20	nA
	ICOM(off)		Room Full	- 2 - 20		2 20	
Channel-On Leakage Current	ICOM(on)	V+ = 5.5 V, VNO, VNC = VCOM = 1 V/4.5 V	Room Full	- 2 - 20		2 20	
Digital Control							
Input High Voltage	VINH		Full	1.8			V
Input Low Voltage	VINL		Full			0.6	
Input Capacitance	Cin		Full		4		pF
Input Current	IINL or IINH	VIN = 0 or V+	Full	1		1	μA
Dynamic Characteristics							
Turn-On Time	tON	VNO or VNC = 2.5 V, RL = 50 Ω, CL = 35 pF	Room Full		11	35 39	ns
Turn-Off Time	tOFF		Room Full		6	31 33	
Break-Before-Make Time	tBBM		Room	1	5		
Charge Injection <sup>d</sup>	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room		14		pC
Off-Isolation <sup>d</sup>	OIRR	RL = 50 Ω, CL = 5 pF, f = 1 MHz	Room		- 58		dB
Crosstalk <sup>d</sup>	XTALK		Room		- 64		
NO, NC Off Capacitance <sup>d</sup>	CNO(off) CNC(off)	VIN = 0 or V+, f = 1 MHz	Room		19		pF
Channel-On Capacitance <sup>d</sup>	CON		Room		61		
Power Supply							
Power Supply Range	V+	VIN = 0 or V+		1.8		5.5	V
Power Supply Current	I+				0.01	1	μA

Notes:

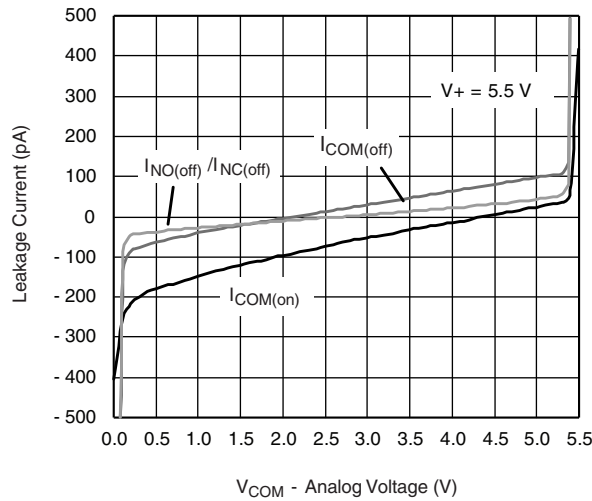
- Room = 25 °C, Full = as determined by the operating suffix.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- Typical values are for design aid only, not guaranteed nor subject to production testing.
- Guarantee by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

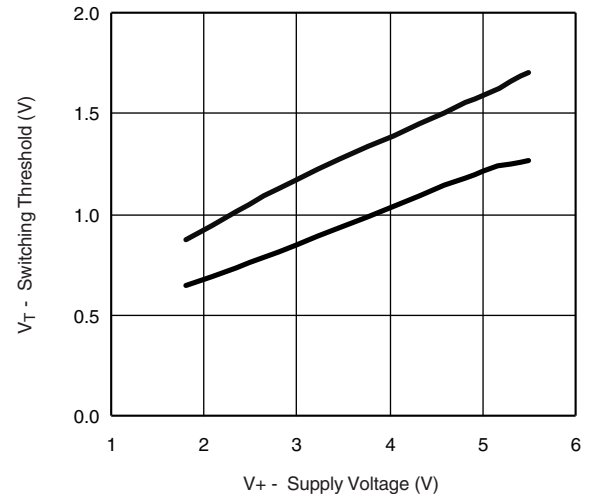
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



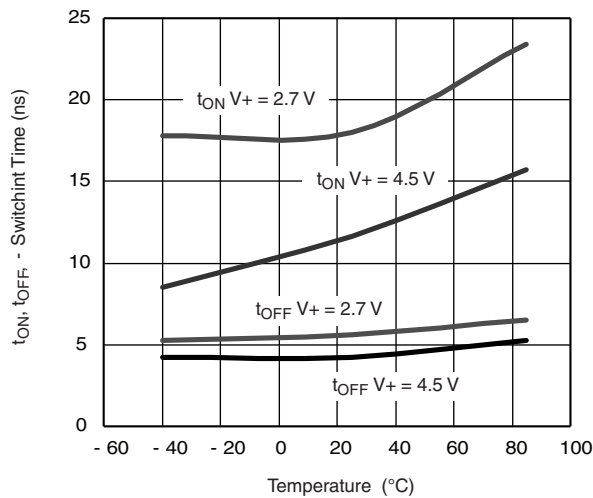
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



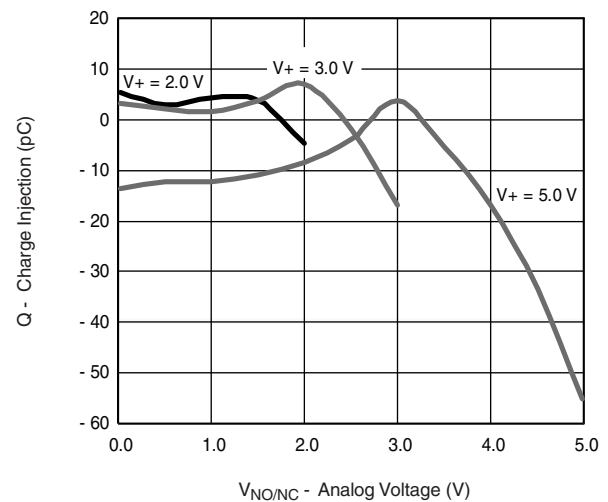
Leakage vs. Analog Voltage



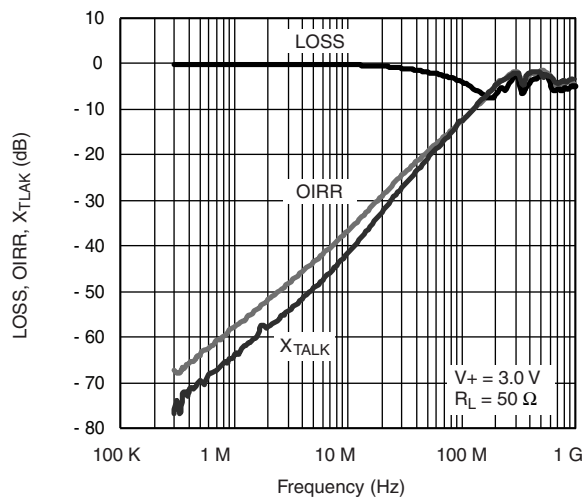
Switching Threshold vs. Supply Voltage



Switching Time vs. Temperature and Supply Voltage

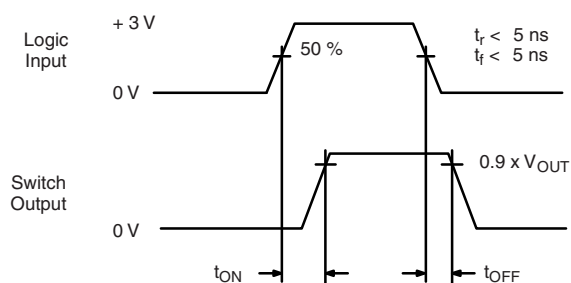
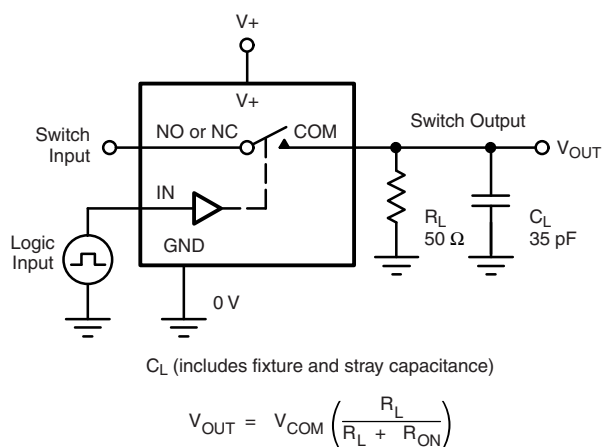


Charge Injection vs. Analog Voltage



Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

## TEST CIRCUITS



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

Figure 1. Switching Time

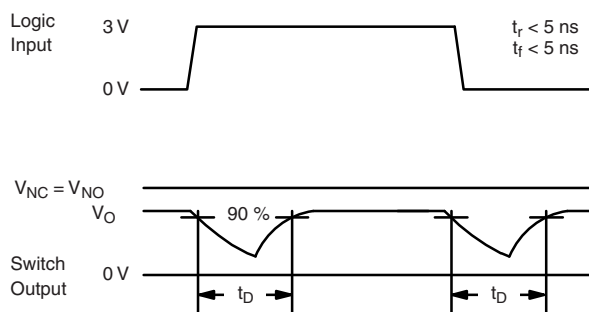
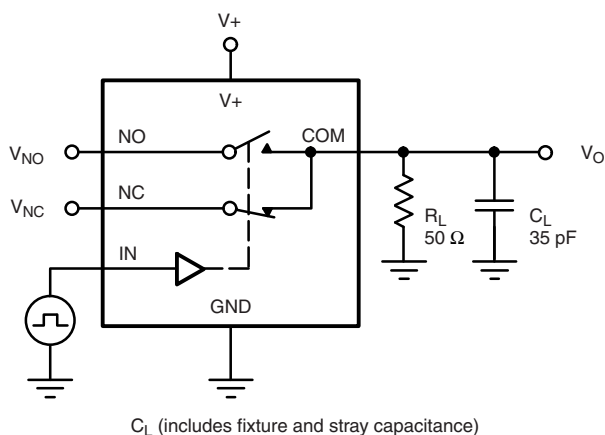
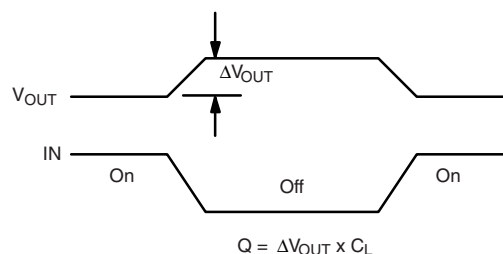
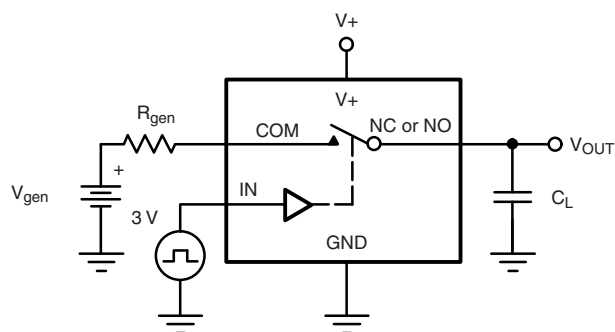


Figure 2. Break-Before-Make Interval



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

Figure 3. Charge Injection

## TEST CIRCUITS

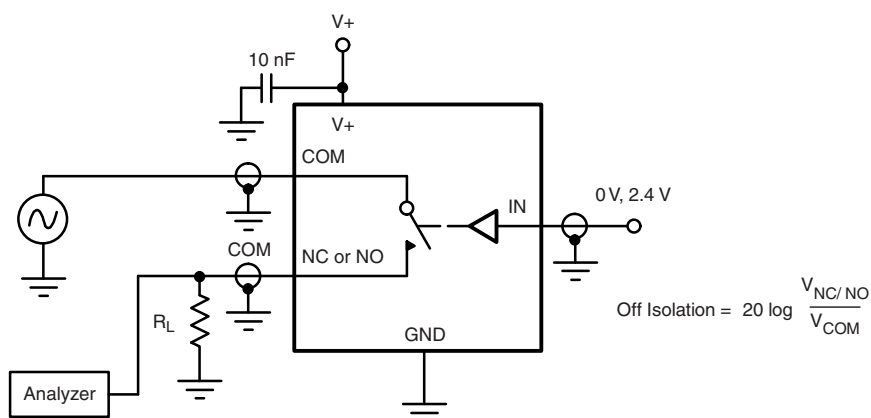


Figure 4. Off-Isolation

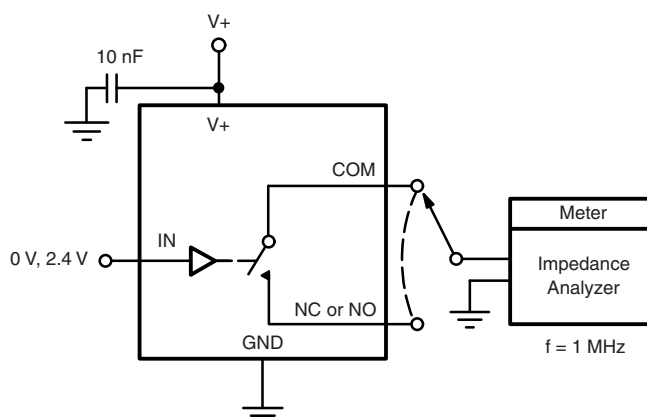
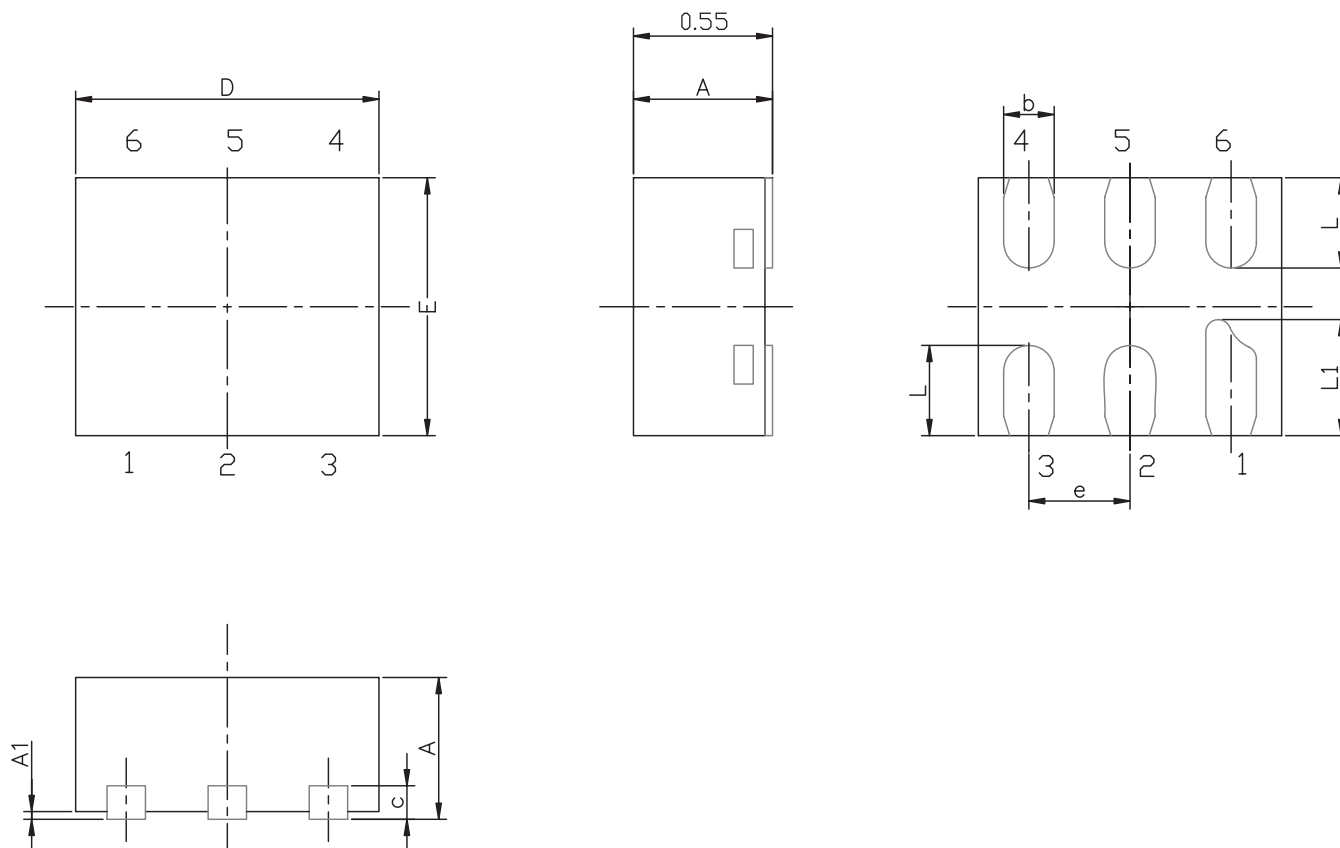


Figure 5. Channel Off/On Capacitance

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](http://www.vishay.com/ppg?74454).

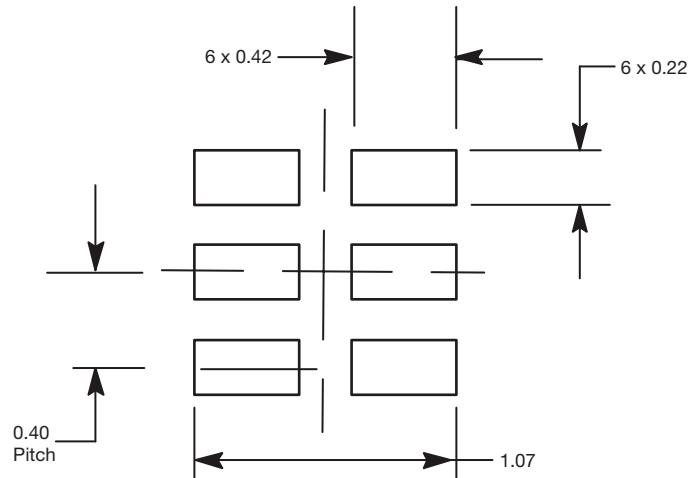
## MINI QFN-6L CASE OUTLINE



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



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**