

## Low-Voltage, 0.4 $\Omega$ $R_{ON}$ , Single SPST Analog Switch

### DESCRIPTION

The DG2715, DG2716 are low voltage, single supply, dual SPST analog switches. Designed for high performance switching of analog signals, the DG2715/2716 provide low on-resistance (0.4  $\Omega$  at + 2.7 V), fast speed ( $t_{ON}$ ,  $t_{OFF}$  at 17 ns and 14 ns) and the ability to handle signals over the entire analog voltage range.

When operated on a + 3 V supply, control pins are compatible with 1.8 V digital logic. Additionally, on-resistance flatness and matching (0.05  $\Omega$  and 0.1  $\Omega$ ) offer high accuracy between channels.

Built on Vishay Siliconix's low voltage submicron CMOS process, the DG2715, DG2716 were designed to offer solutions that extend beyond audio/video functions, to providing the performance required for today's demanding mixed-signal switching in portable applications.

The DG2715 contains a normally open (NO) switch, and the DG2716 contains a normally closed switch. An epitaxial layer prevents latch-up. All switches conduct equally well in both directions when on, and block up to the power supply level when off.

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 100 % matte tin device terminations, the lead (Pb)-free "-E3" suffix is being used as a designator.

### FEATURES

- Low voltage operation (1.6 V to 3.6 V)
- Low on-resistance -  $R_{DS(on)}$ : 0.4  $\Omega$  at 2.7 V
- Off-isolation: - 57 dB at 1 MHz
- Fast switching: 25 ns  $t_{ON}$
- Low charge injection -  $Q_{INJ}$ : 9 pC
- Low power consumption: < 1  $\mu$ W
- SC-70 5-lead package


**RoHS**  
COMPLIANT

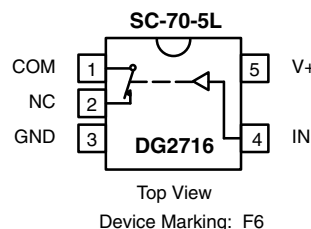
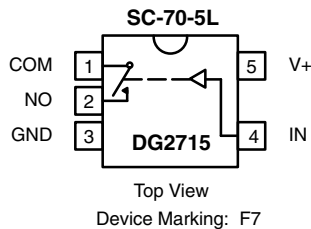
### BENEFITS

- High accuracy
- High bandwidth
- TTL and low voltage logic compatibility
- Low power consumption
- Reduced PCB space

### APPLICATIONS

- Mixed signal routing
- Portable and battery operated systems
- Low voltage data acquisition
- Modems
- PCMCIA cards

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION


**TRUTH TABLE (DG2715)**

Logic	Switch
0	OFF
1	ON

**TRUTH TABLE (DG2716)**

Logic	Switch
0	ON
1	OFF

**ORDERING INFORMATION**

Temp. Range	Package	Part Number
- 40 °C to 85 °C	SC70-5	DG2715DL-T1-E3
		DG2716DL-T1-E3

ABSOLUTE MAXIMUM RATINGS			
Parameter		Limit	Unit
Reference V+ to GND		- 0.3 to + 4	V
IN, COM, NC, NO <sup>a</sup>		- 0.3 to (V+ + 0.3 V)	
Continuous Current (NO, NC and COM Pins)		± 200	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>	5-Pin SC-70 <sup>c</sup>	250	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 3.1 mW/°C above 70 °C.

SPECIFICATIONS (V+ = 1.8 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 1.8 V, ± 10 %, V <sub>IN</sub> = 0.4 V or 1.0 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+ = 1.8 V, V <sub>COM</sub> = 0.9 V I <sub>NO</sub> , I <sub>NC</sub> = 10 mA	Room Full <sup>d</sup>		0.7	1.5 2.0	Ω
Switch Off Leakage Current <sup>f</sup>	I <sub>NO(off)</sub> I <sub>NC(off)</sub>	V+ = 2.0 V, V <sub>NO</sub> , V <sub>NC</sub> = 0.2 V/1.8 V, V <sub>COM</sub> = 1.8 V/0.2 V	Room Full <sup>d</sup>	- 1 - 10		1 10	nA
	I <sub>COM(off)</sub>		Room Full <sup>d</sup>	- 1 - 10		1 10	
Channel-On Leakage Current <sup>f</sup>	I <sub>COM(on)</sub>	V+ = 2.0 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.2 V/1.8 V	Room Full <sup>d</sup>	- 1 - 10		1 10	
<b>Digital Control</b>							
Input High Voltage	V <sub>INH</sub>		Full	1.0			V
Input Low Voltage	V <sub>INL</sub>		Full			0.4	
Input Capacitance <sup>d</sup>	C <sub>in</sub>		Full		4		pF
Input Current <sup>f</sup>	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 <sup>d</sup>	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF figures 1 and 2	Room Full <sup>d</sup>		24	36	ns
Turn-Off Time <sup>d</sup>	t <sub>OFF</sub>		Room Full <sup>d</sup>		21	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, figure 3	Room		13		pC
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room		- 57		dB
NO, NC 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		78		pF
	Channel-On Capacitance <sup>d</sup>		C <sub>ON</sub>	Room		93	



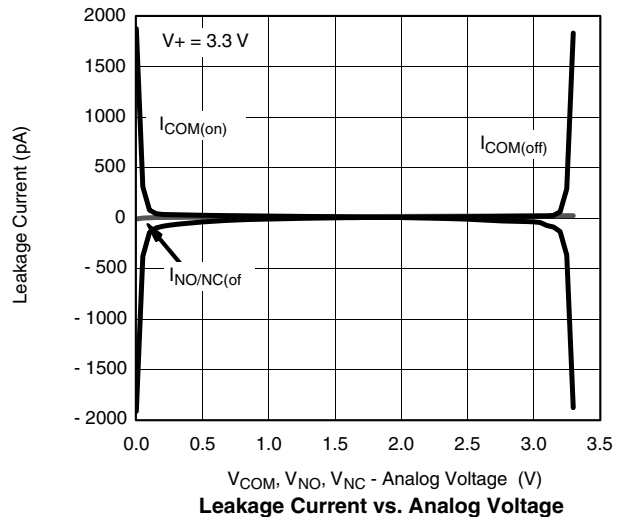
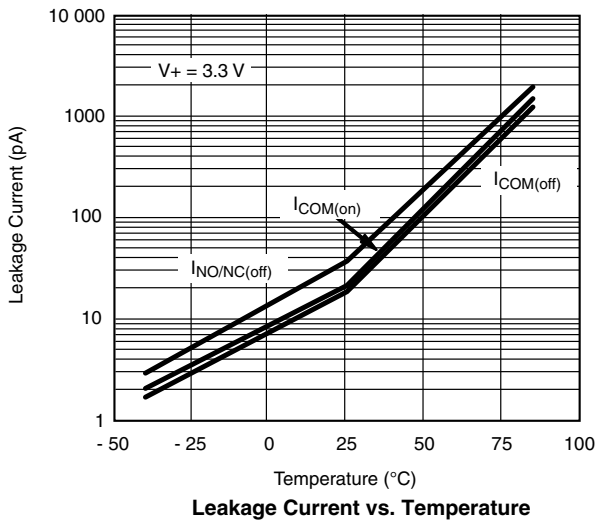
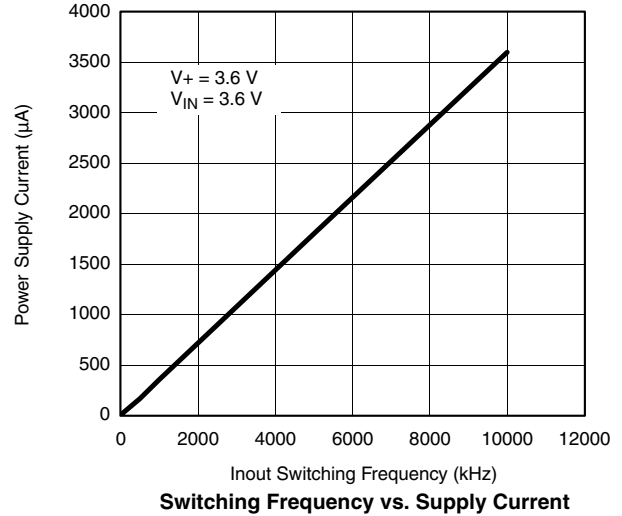
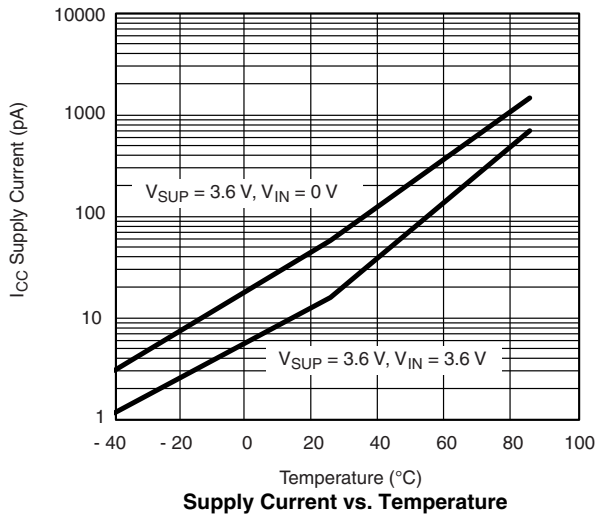
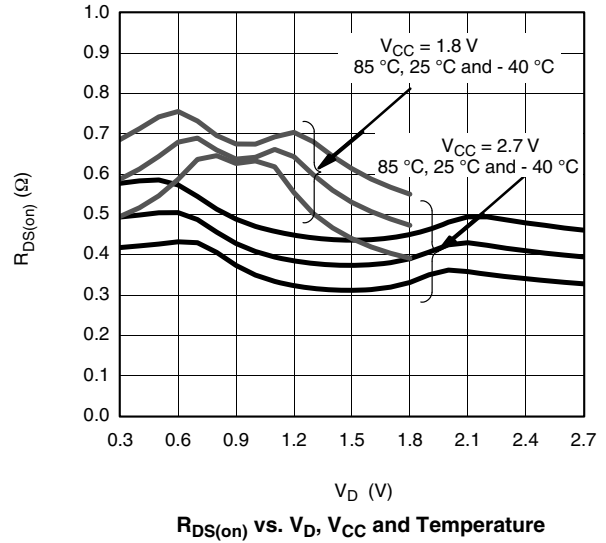
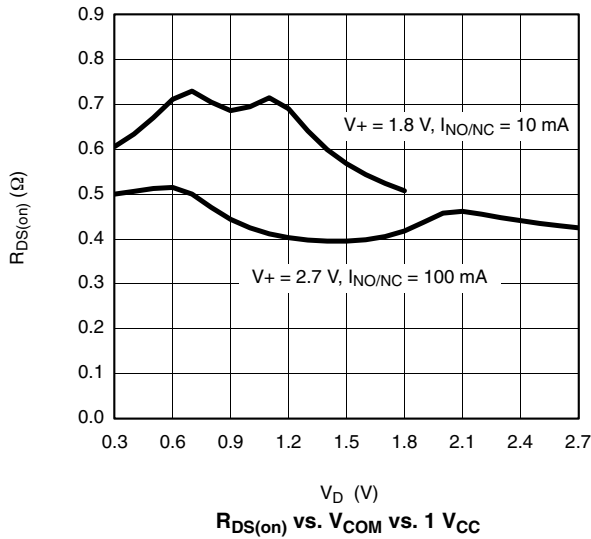
SPECIFICATIONS (V <sub>+</sub> = 3.0 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V <sub>+</sub> = 3 V, ± 10 %, V <sub>IN</sub> = 0.5 V or 1.4 V <sup>e</sup>	Temp. <sup>a</sup>	Limits - 40 °C to 85 °C			Unit
				Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
<b>Analog 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> = 2.7 V, V <sub>COM</sub> = 1.5 V I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room Full		0.4	0.6	Ω
R <sub>ON</sub> Flatness	R <sub>ON</sub> Flatness	V <sub>+</sub> = 2.7 V, V <sub>COM</sub> = 0.6 V, 1.5 V, 2.1 V I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room		0.1	0.2	
Switch Off Leakage Current	I <sub>NO(off)</sub> I <sub>NC(off)</sub>	V <sub>+</sub> = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = 0.3 V/3 V, V <sub>COM</sub> = 3 V/0.3 V	Room Full	- 1 - 10		1 10	nA
	I <sub>COM(off)</sub>		Room Full	- 1 - 10		1 10	
Channel-On Leakage Current	I <sub>COM(on)</sub>	V <sub>+</sub> = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.3 V/3 V	Room Full	- 1 - 10		1 10	
<b>Digital Control</b>							
Input High Voltage	V <sub>INH</sub>		Full	1.4			V
Input Low Voltage	V <sub>INL</sub>		Full			0.5	
Input Capacitance <sup>d</sup>	C <sub>in</sub>		Full		5		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> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF Figure 1	Room Full		17	29	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		14	26	
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, figure 3	Room		9		pC
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room		- 57		dB
NO, NC 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		72		pF
	Channel-On Capacitance <sup>d</sup>		C <sub>ON</sub>	Room		92	
<b>Power Supply</b>							
Power Supply Range	V <sub>+</sub>			1.5		3.6	V
Power Supply Current	I <sub>+</sub>	V <sub>+</sub> = 3.6 V, V <sub>IN</sub> = 0 or V <sub>+</sub>			0.01	1.0	μA

Notes:

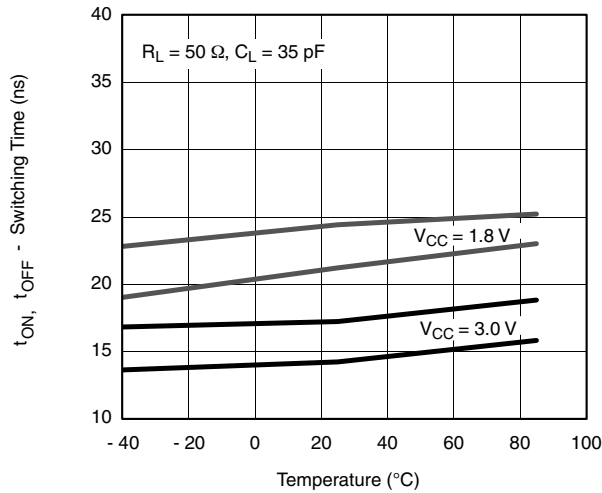
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- c. Typical values are for design aid only, not guaranteed nor subject to production testing.
- d. Guarantee by design, nor subjected to production test.
- e. V<sub>IN</sub> = input voltage to perform proper function.
- f. Guaranteed by 3 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.

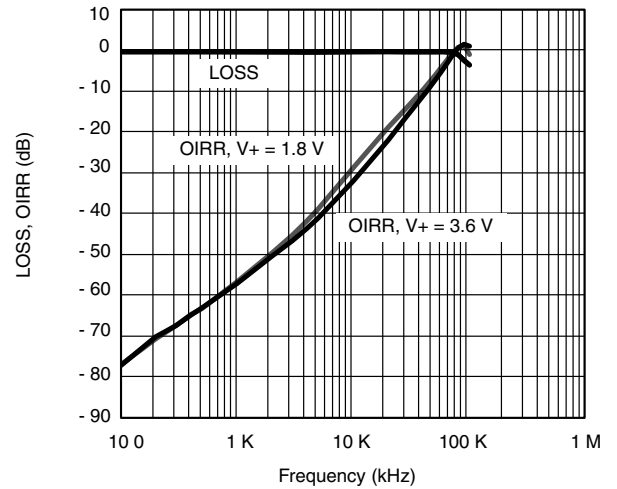
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



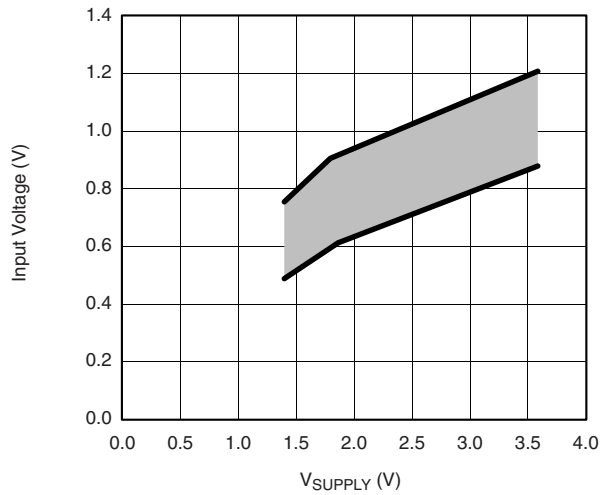
## TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



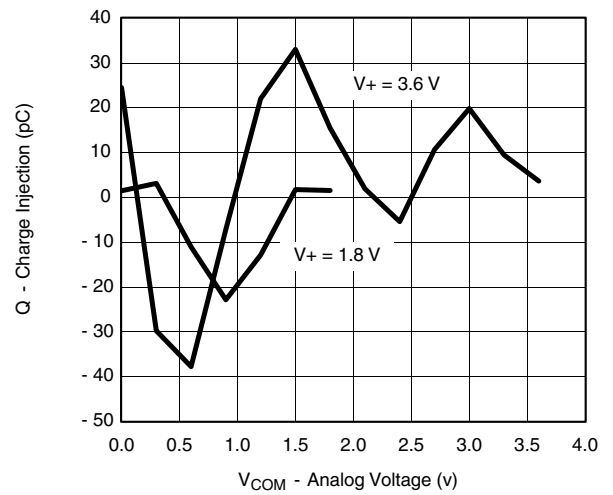
Switching Time vs. V<sub>CC</sub> and Temperature



Insertion Loss, Off-Isolation vs. Frequency

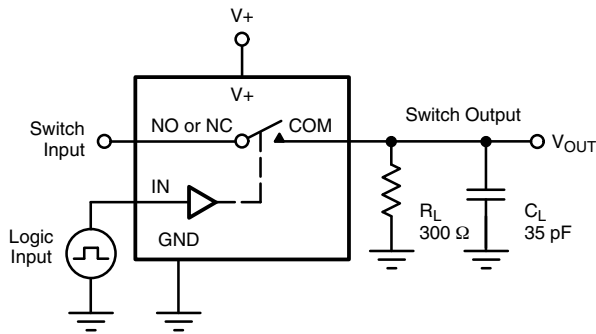


Threshold vs. Supply Voltage



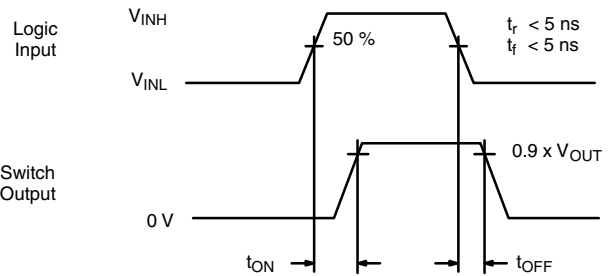
Charge Injection vs. Analog Voltage

### TEST CIRCUITS



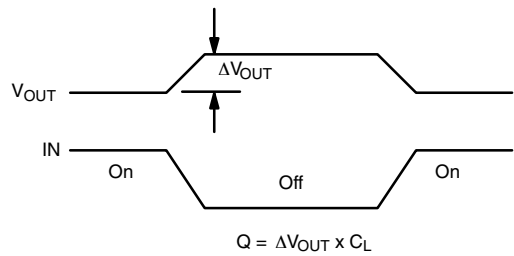
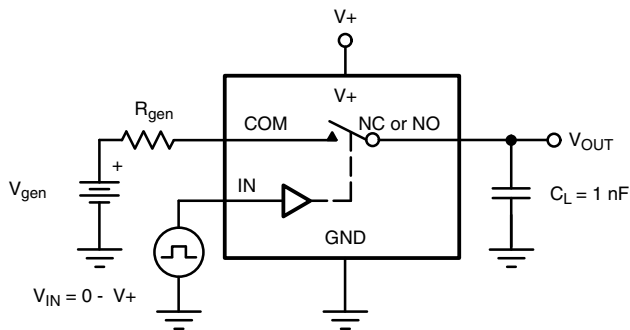
$C_L$  (includes fixture and stray capacitance)

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



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

Figure 1. Switching Time



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

Figure 2. Charge Injection

TEST CIRCUITS

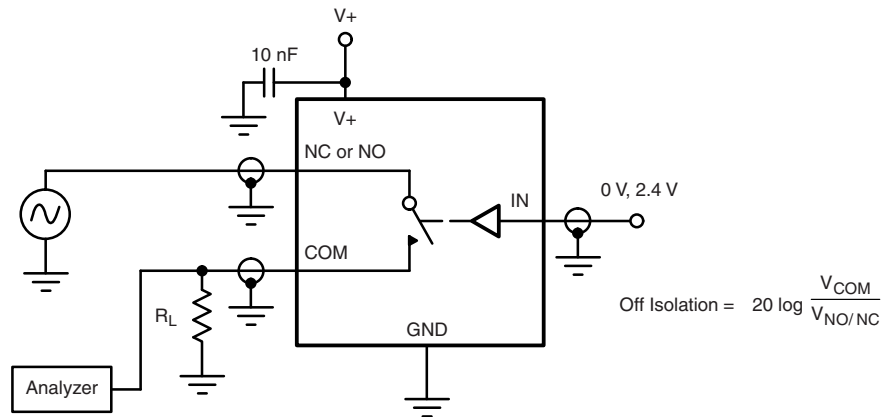


Figure 3. Off-Isolation

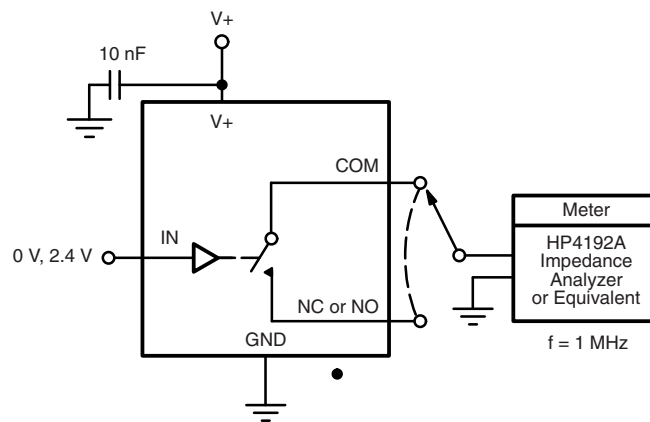
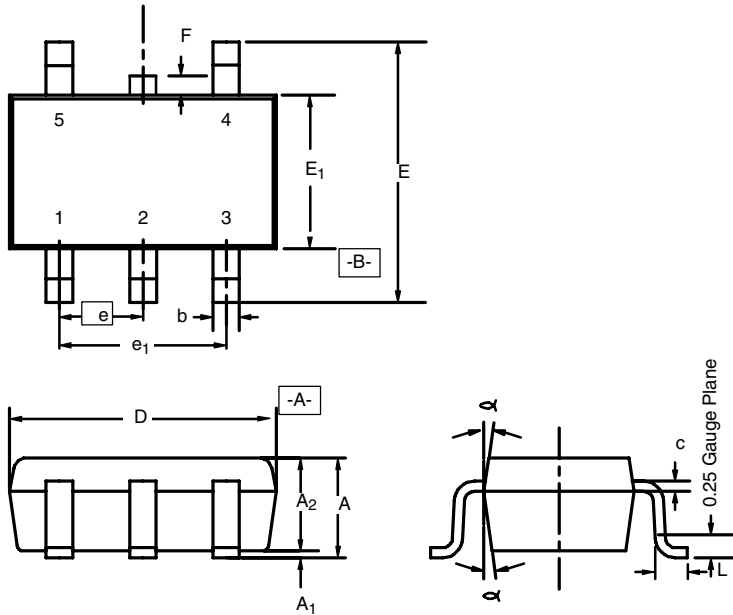


Figure 4. Channel Off/On Capacitance

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?72740](http://www.vishay.com/ppg?72740).

### SC-70: 5-LEAD



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.90	-	1.10	0.035	-	0.043
<b>A<sub>1</sub></b>	-	-	0.10	-	-	0.004
<b>A<sub>2</sub></b>	0.80	-	1.00	0.031	-	0.039
<b>b</b>	0.15	-	0.30	0.006	-	0.012
<b>c</b>	0.10	-	0.25	0.004	-	0.010
<b>D</b>	1.80	2.00	2.20	0.071	0.079	0.087
<b>E</b>	1.80	2.10	2.40	0.071	0.083	0.094
<b>E<sub>1</sub></b>	1.15	1.25	1.35	0.045	0.049	0.053
<b>e</b>	0.65BSC			0.026BSC		
<b>e<sub>1</sub></b>	1.20	1.30	1.40	0.047	0.051	0.055
<b>F</b>	0	-	0.15	0	-	0.006
<b>L</b>	0.10	0.20	0.30	0.004	0.008	0.012
<b>α</b>	7°Nom			7°Nom		
ECN: S-60035—Rev. C, 16-Jan-06 DWG: 5861						





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