

## 2.5 Ω, High Bandwidth, Dual SPDT Analog Switch

### DESCRIPTION

The DG2032E is a low-voltage dual single-pole / double-throw monolithic CMOS analog switch. Designed to operate from 1.8 V to 5.5 V power supply, the DG2032E achieves a bandwidth of 221 MHz while providing low on-resistance (2.5 Ω), excellent on-resistance matching (0.3 Ω) and flatness (1 Ω) over the entire signal range.

The DG2032E offers the advantage of high linearity that reduces signal distortion, making ideal for audio, video, and USB signal routing applications.

Built on Vishay Siliconix's proprietary sub-micron high-density process, the DG2032E brings low power consumption at the same time as reduces PCB spacing with the QFN12 package.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. The QFN12 package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-GE4" suffix. The nickel-palladium-gold device terminations meet all JEDEC® standards for reflow and MSL ratings.

### FEATURES

- 1.8 V to 5.5 V single supply operation
- Low  $R_{ON}$ : 2.5 Ω at 4.5 V
- 221 MHz, -3 dB bandwidth
- Low off-isolation, -58 dB at 1 MHz
- +1.6 V logic compatible
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

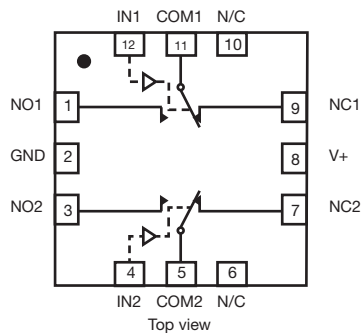
### BENEFITS

- High linearity
- Low power consumption
- High bandwidth
- Full rail signal swing range

### APPLICATIONS

- USB / UART signal switching
- Audio / video switching
- Cellular phone
- Media players
- Modems
- Hard drives
- PCMCIA

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



#### TRUTH TABLE

LOGIC	NC1 AND NC2	NO1 AND NO2
0	ON	OFF
1	OFF	ON

#### ORDERING INFORMATION

TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	12-Pin QFN (3 mm x 3 mm)	DG2032EDN-T1-GE4

### ABSOLUTE MAXIMUM RATINGS

PARAMETER	LIMIT	UNIT
<b>Reference to GND</b>		
V+	-0.3 to +6	V
IN, COM, NC, NO <sup>a</sup>	-0.3 to (V+ + 0.3)	
Continuous current (any terminal)	± 50	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)	± 200	
Storage temperature (D suffix)	-65 to +150	°C
Power dissipation (packages) <sup>b</sup>	12-Pin QFN (3 mm x 3 mm) <sup>c</sup>	1295
ESD / HBM	EIA / JESD22-A114-A	7.5k
ESD / CDM	EIA / JESD22-C101-A	1.5k
Latch up	JESD78	300
		mA

#### Notes

- Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings
- All leads welded or soldered to PC board
- Derate 4 mW/°C above 70 °C



SPECIFICATIONS (V+ = 3 V)									
PARAMETER	SYMBOL	TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 3 V, ± 10 %, VINL = 0.5 V, VINH = 1.5 V <sup>e</sup>	TEMP. <sup>a</sup>	LIMITS -40 °C to +85 °C			UNIT		
				MIN. <sup>c</sup>	TYP. <sup>b</sup>	MAX. <sup>c</sup>			
<b>Analog Switch</b>									
Analog signal range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0	-	V+	V		
Drain-source on-resistance	R <sub>DS(on)</sub>	V+ = 1.8 V, V <sub>NC/NO</sub> = 0.4 V / V+, I <sub>NC/NO</sub> = 8 mA	Room	-	7	11	Ω		
			Full	-	-	13			
		V+ = 2.7 V, V <sub>COM</sub> = 0.8 V / 1.8 V, I <sub>COM</sub> = 10 mA	Room	-	4.6	5.5			
			Full	-	-	6.5			
On-resistance matching	ΔR <sub>DS(on)</sub>	V+ = 2.7 V, V <sub>COM</sub> = 0.8 V / 1.4 V / 1.8 V, I <sub>COM</sub> = 10 mA	Room	-	0.02	0.3			
			Full	-	-	0.6			
On-resistance flatness <sup>d, f</sup>	R <sub>flat(on)</sub>		Room	-	0.62	1			
			Full	-	-	1.5			
Off leakage current <sup>g</sup>	I <sub>NC/NO(off)</sub>	V+ = 3.6 V, V <sub>NC/NO</sub> = 1 V / 3.2 V, V <sub>COM</sub> = 3.2 V / 1 V	Room	-1	0.01	1	nA		
			Full	-5	-	5			
Channel-on leakage current <sup>g</sup>	I <sub>COM(on)</sub>	V+ = 3.3 V, V <sub>COM</sub> = V <sub>NC/NO</sub> = 1 V / 3.2 V	Room	-1	0.01	1	nA		
			Full	-5	-	5			
<b>Digital Control</b>									
Input current <sup>d</sup>	I <sub>INL</sub> or I <sub>INH</sub>		Full	-1	-	1	μA		
Input high voltage <sup>d</sup>	V <sub>INH</sub>		Full	1.5	-	-	V		
Input low voltage <sup>d</sup>	V <sub>INL</sub>		Full	-	-	0.4			
Digital input capacitance <sup>d</sup>	C <sub>IN</sub>		Room	-	3	-	pF		
<b>Dynamic Characteristics</b>									
Turn-on time	t <sub>ON</sub>	V <sub>NC/NO</sub> = 3 V, C <sub>L</sub> = 35 pF, R <sub>L</sub> = 300 Ω	Room	-	19	45	ns		
			Full	-	-	50			
Turn-off time	t <sub>OFF</sub>		Room	-	9	35			
			Full	-	-	45			
Break-before-make time <sup>d</sup>	t <sub>BBM</sub>		Room	4	11	-			
			Full	3	-	-			
Charge injection <sup>d</sup>	Q <sub>INJ</sub>		C <sub>L</sub> = 1 nF, V <sub>gen</sub> = 1.5 V, R <sub>gen</sub> = 0 Ω	Room	-	-9	-	pC	
Bandwidth <sup>d</sup>	BW		C <sub>L</sub> = 5 pF (set up capacitance)	Room	-	226	-	MHz	
Off-isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-55	-	dB	
			f = 10 MHz	Room	-	-42	-		
Channel-to-channel crosstalk <sup>d</sup>	X <sub>TALK</sub>	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-61	-		
			f = 10 MHz	Room	-	-44	-		
NO, NC off capacitance <sup>d</sup>	C <sub>NO(off)</sub>	V+ = 2.7 V, f = 1 MHz	Room	-	7	-	pF		
	C <sub>NC(off)</sub>		Room	-	7	-			
Channel-on capacitance <sup>d</sup>	C <sub>NO(on)</sub>		Room	-	23	-			
	C <sub>NC(on)</sub>		Room	-	23	-			
<b>Power Supply</b>									
Power supply range	V+				2.7	-		3.3	V
Power supply current <sup>d</sup>	I+	V+ = 2.7 V, V <sub>IN</sub> = 0 V or 2.7 V	Full	-	-	1	μA		

**Notes**

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



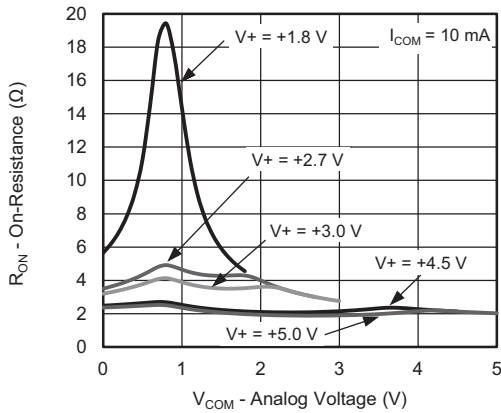
SPECIFICATIONS (V+ = 5 V)								
PARAMETER	SYMBOL	TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 5 V, ± 10 %, VINL = 0.5 V, VINH = 2 V <sup>e</sup>	TEMP. <sup>a</sup>	LIMITS -40 °C to +85 °C			UNIT	
				MIN. <sup>c</sup>	TYP. <sup>b</sup>	MAX. <sup>c</sup>		
<b>Analog Switch</b>								
Analog signal range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0	-	V+	V	
Drain-source on-resistance	R <sub>DS(on)</sub>	V+ = 4.5 V, V <sub>COM</sub> = 0.8 V / 3.5 V; I <sub>COM</sub> = 10 mA	Room	-	2.5	3.1	Ω	
			Full	-	-	4		
On-resistance matching	ΔR <sub>DS(on)</sub>	V+ = 4.5 V, V <sub>COM</sub> = 0.8 V / 2.5 V / 3.5 V, I <sub>COM</sub> = 10 mA	Room	-	0.01	0.4		
			Full	-	-	0.6		
On-resistance flatness <sup>d, f</sup>	R <sub>flat(on)</sub>		Room	-	0.61	1		
			Full	-	-	1.5		
Off leakage current <sup>g</sup>	I <sub>NC/NO(off)</sub>	V+ = 5.5 V, V <sub>NC/NO</sub> = 1 V / 4.5 V, V <sub>COM</sub> = 4.5 V / 1 V	Room	-2	0.15	2	nA	
			Full	-10	-	10		
Channel-on leakage current <sup>g</sup>	I <sub>COM(on)</sub>	V+ = 5.5 V, V <sub>COM</sub> = V <sub>NC/NO</sub> = 1 V / 4.5 V	Room	-2	0.20	2		
			Full	-10	-	10		
Power down leakage <sup>d</sup>	I <sub>PD</sub>	V+ = 0 V, V <sub>COM</sub> = 5.5 V, NC/NO open	Full	-	0.01	5	μA	
		V+ = 0 V, V <sub>NC/NO</sub> = 5.5 V, COM, open	Full	-	0.01	3	mA	
<b>Digital Control</b>								
Input current <sup>d</sup>	I <sub>INL</sub> or I <sub>INH</sub>		Full	-1	-	1	μA	
Input high voltage <sup>d</sup>	V <sub>INH</sub>		Full	2	-	-	V	
Input low voltage <sup>d</sup>	V <sub>INL</sub>		Full	-	-	0.5		
Digital input capacitance <sup>d</sup>	C <sub>IN</sub>		Room	-	3	-	pF	
<b>Dynamic Characteristics</b>								
Turn-on time	t <sub>ON</sub>	V <sub>NC/NO</sub> = 3 V, C <sub>L</sub> = 35 pF, R <sub>L</sub> = 300 Ω	Room	-	13	40	ns	
			Full	-	-	43		
Turn-off time	t <sub>OFF</sub>		Room	-	7	33		
			Full	-	-	35		
Break-before-make time <sup>d</sup>	t <sub>BBM</sub>		Room	3	6	-		
			Full	2	-	-		
Propagation delay <sup>d</sup>	tpd	V+ = 5 V, no R <sub>L</sub>	Room	-	380	-	ps	
Charge injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>gen</sub> = 2.5 V, R <sub>gen</sub> = 0 Ω	Room	-	-19.4	-	pC	
Bandwidth <sup>d</sup>	BW	C <sub>L</sub> = 5 pF (set up capacitance)	Room	-	221	-	MHz	
Off-isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-58	-	dB
			f = 10 MHz	Room	-	-43	-	
Channel-to-channel crosstalk <sup>d</sup>	X <sub>TALK</sub>		f = 1 MHz	Room	-	-62	-	
			f = 10 MHz	Room	-	-47	-	
NO, NC off capacitance <sup>d</sup>	C <sub>NO(off)</sub>		V+ = 5 V, f = 1 MHz	Room	-	7	-	pF
	C <sub>NC(off)</sub>			Room	-	7	-	
Channel-on capacitance <sup>d</sup>	C <sub>NO(on)</sub>	Room		-	23	-		
	C <sub>NC(on)</sub>	Room		-	23	-		
<b>Power Supply</b>								
Power supply range	V+				4.5	-	5.5	V
Power supply current <sup>d</sup>	I+	V+ = 5.5 V, V <sub>IN</sub> = 0 V or 5.5 V	Full	-	-	1	μA	

**Notes**

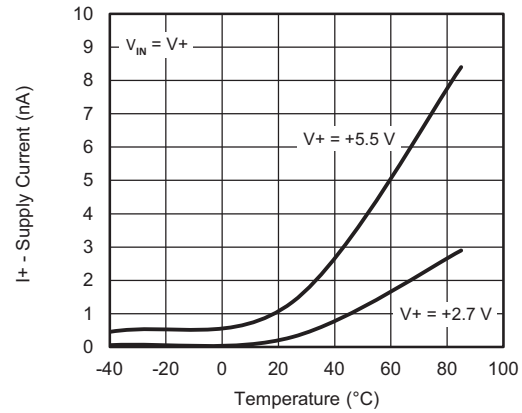
- a. Room = 25 °C, Full = as determined by the operating suffix
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- c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
- d. Guarantee by design, not subjected to production test
- e. V<sub>IN</sub> = input voltage to perform proper function
- f. Difference of min. and max. values
- g. Guaranteed by 5 V testing

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.

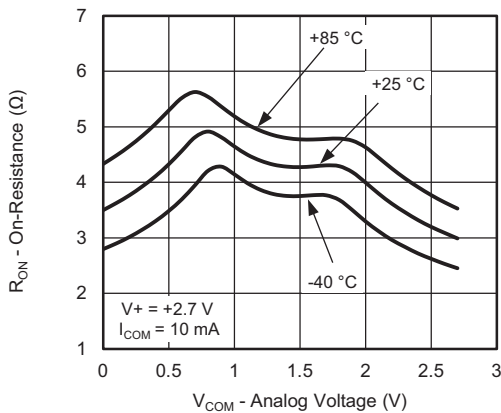
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



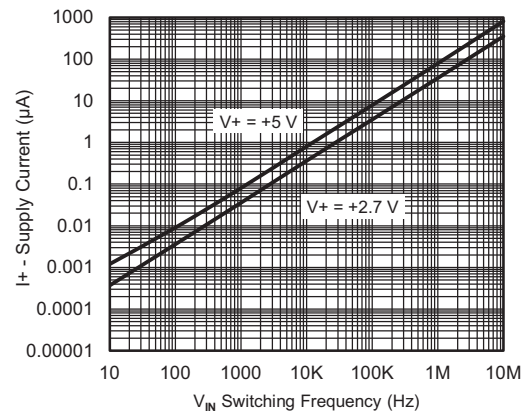
**RON vs. VCOM and Single Supply Voltage**



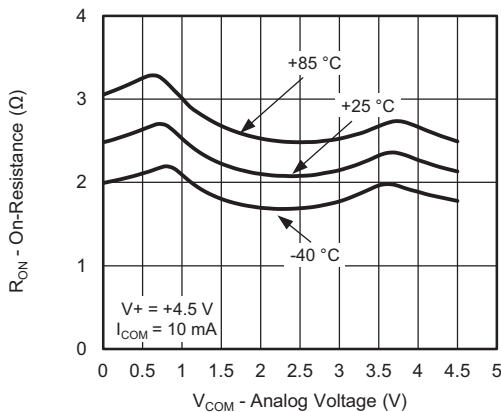
**Supply Current vs. Temperature**



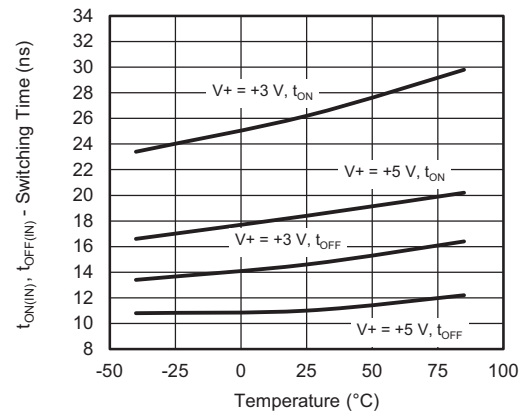
**RON vs. Analog Voltage and Temperature**



**Positive Supply Current vs. Switching Frequency**

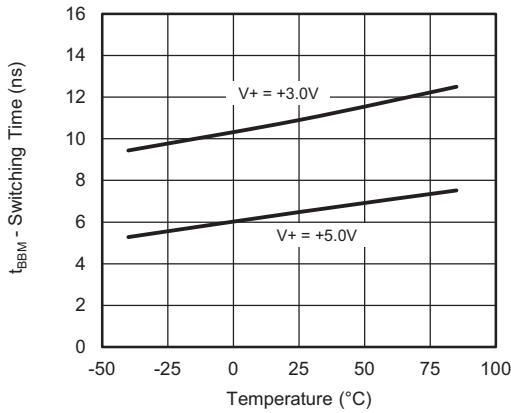


**RON vs. Analog Voltage and Temperature**

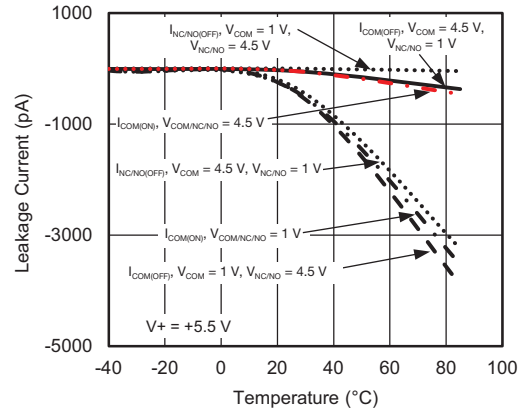


**Switching Time vs. Temperature**

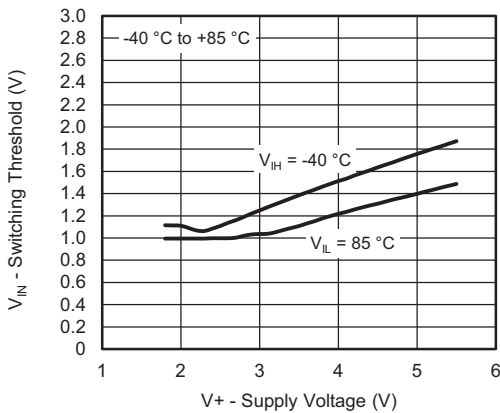
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



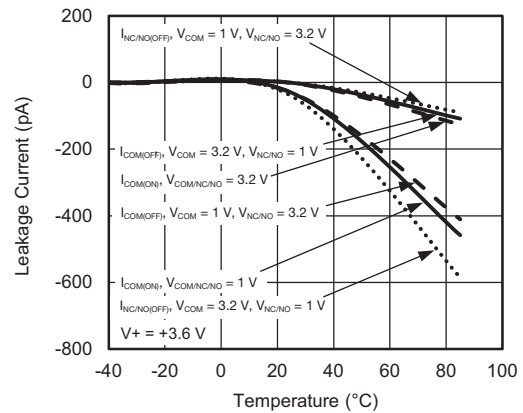
**Switching Time vs. Temperature**



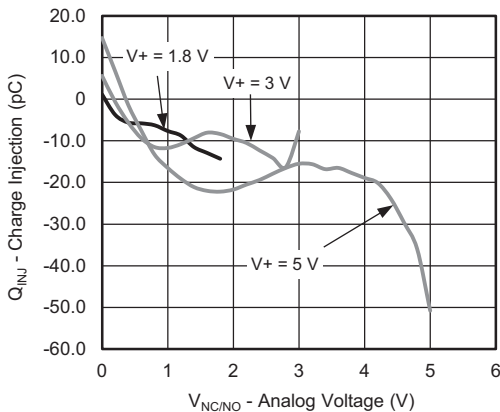
**Leakage Current vs. Temperature**



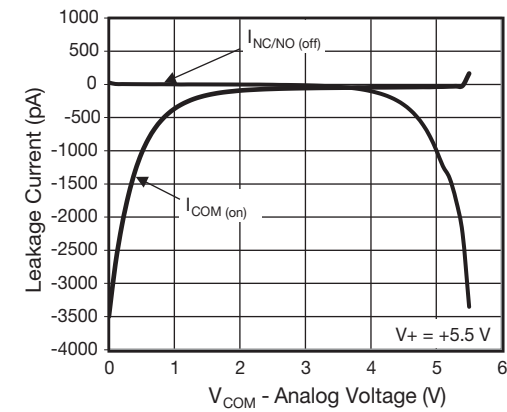
**Switching Threshold vs. Supply Voltage**



**Leakage Current vs. Temperature**

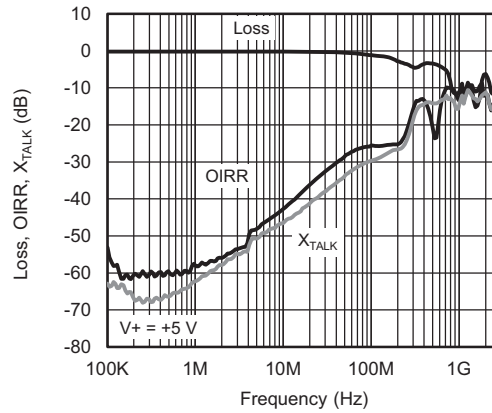


**Charge Injection vs. Source Voltage**



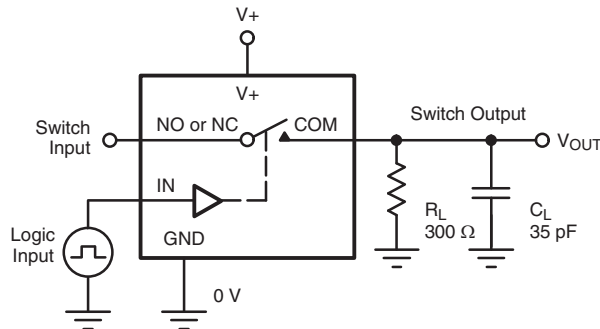
**Leakage Current vs. Analog Voltage**

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



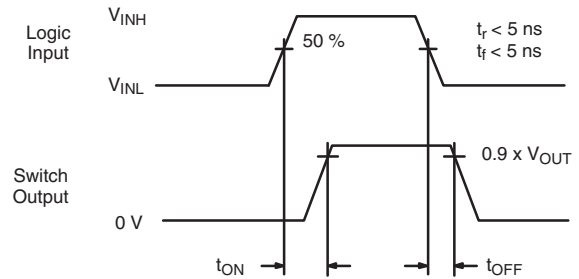
**Loss, OIRR,  $X_{TALK}$  vs. Frequency**

**TEST CIRCUITS**



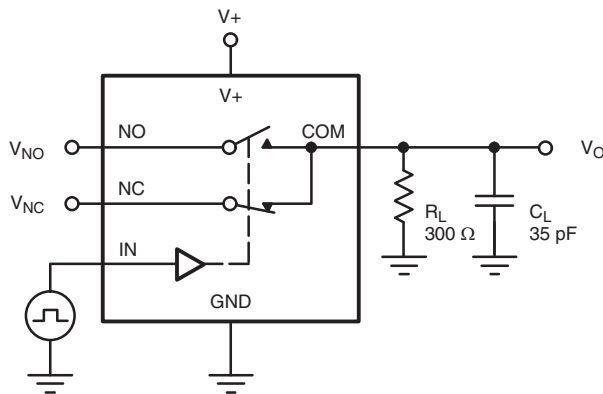
$C_L$  (includes fixture and stray capacitance)

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

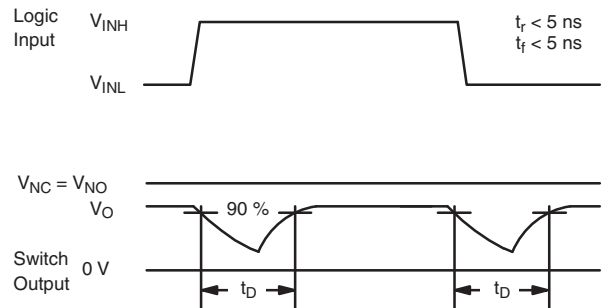


Logic "1" = Switch On  
Logic input waveforms inverted for switches that have the opposite logic sense.

**Fig. 1 - Switching Time**

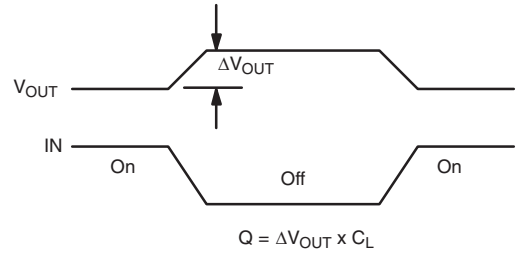
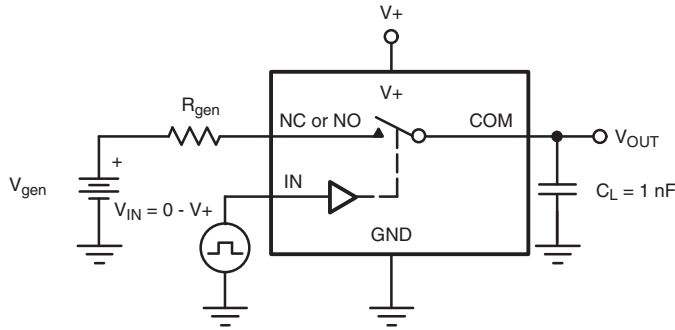


$C_L$  (includes fixture and stray capacitance)



**Fig. 2 - Break-Before-Make Interval**

TEST CIRCUITS



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

Fig. 3 - Charge Injection

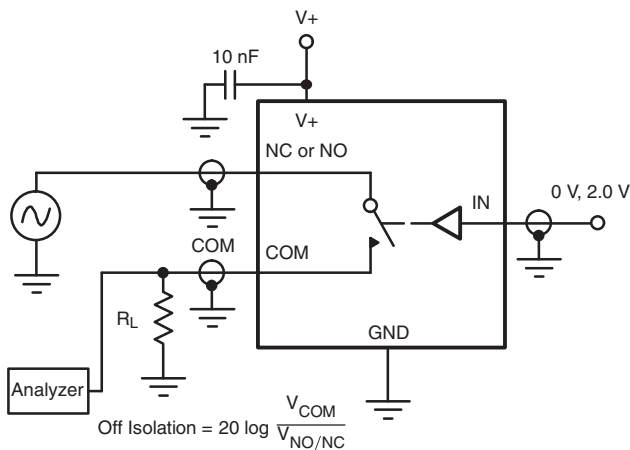


Fig. 4 - Off-Isolation

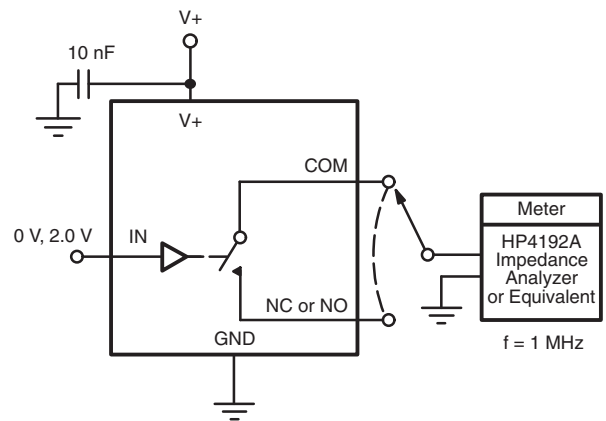


Fig. 5 - Channel Off / On Capacitance

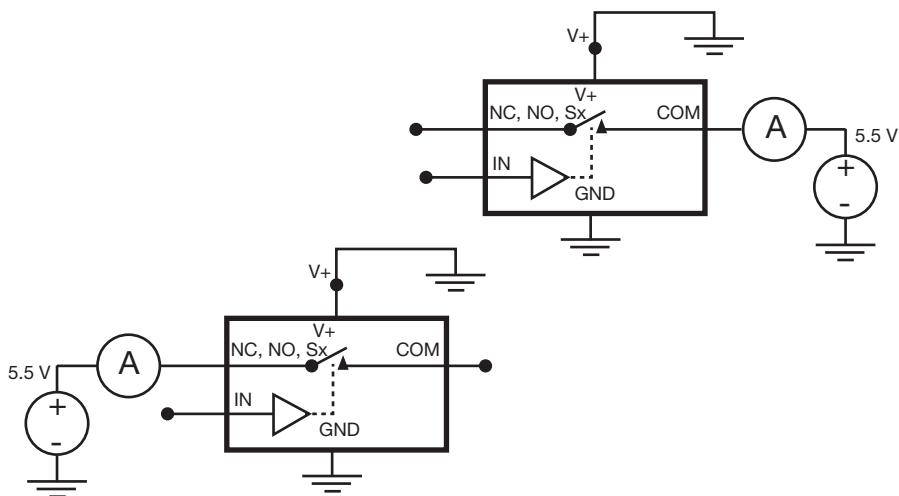
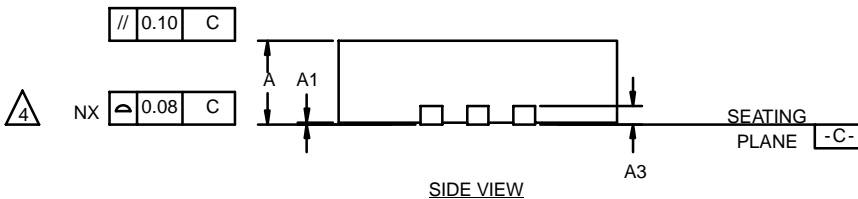
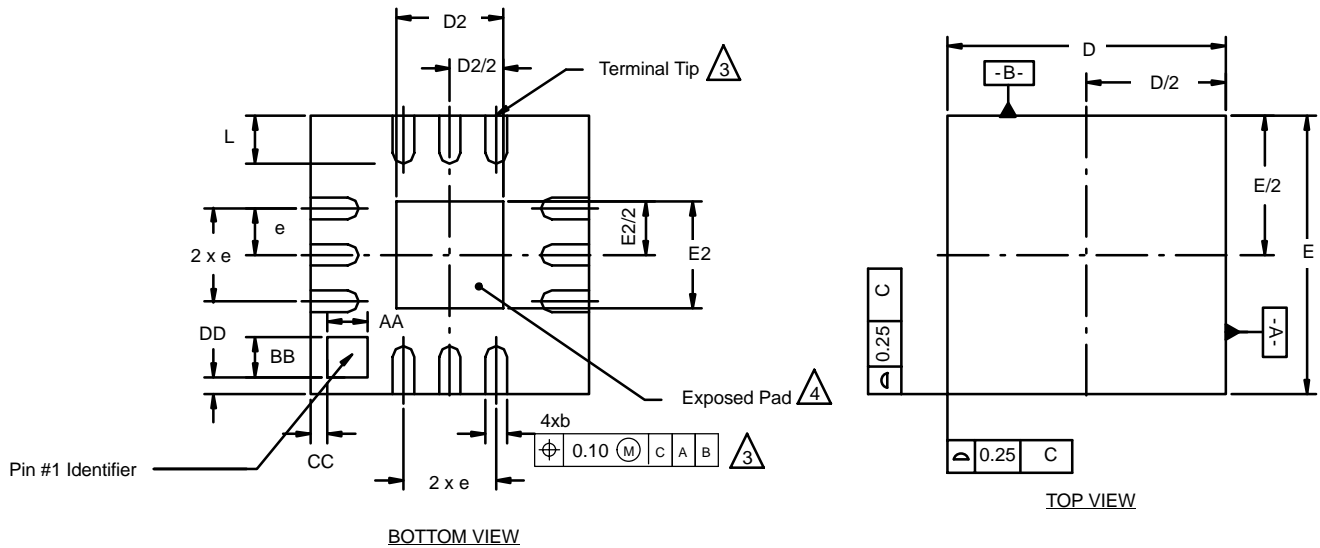


Fig. 6 - Source / Drain Power Down Leakage

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?78604](http://www.vishay.com/ppg?78604).



**QFN-12 LEAD (3 X 3)**



NOTES:

1. All dimensions are in millimeters.
2. N is the total number of terminals.
3. Dimension b applies to metallized terminal and is measured between 0.25 and 0.30 mm from terminal tip.
4. Coplanarity applies to the exposed heat sink slug as well as the terminal.
5. The pin #1 identifier may be either a mold or marked feature, it must be located within the zone indicated.

Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.80	0.90	1.00	0.032	0.035	0.039
<b>b</b>	0.18	0.23	0.30	0.007	0.009	0.012
<b>D</b>	3.00 BSC			0.118 BSC		
<b>D2</b>	1.00	1.15	1.25	0.039	0.045	0.049
<b>E</b>	3.00 BSC			0.118 BSC		
<b>E2</b>	1.00	1.15	1.25	0.039	0.045	0.049
<b>e</b>	0.50 BSC			0.02 BSC		
<b>L</b>	0.45	0.55	0.65	0.018	0.022	0.026
<b>AA</b>	0.435			0.017		
<b>BB</b>	0.435			0.017		
<b>CC</b>	0.18			0.007		
<b>DD</b>	0.18			0.007		
ECN: C-03092—Rev. A, 14-Apr-03 DWG: 5898						





## **Disclaimer**

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