



**THE DATASHEET OF  
DG2515DQ-T1-E3**



## 3-Ω, 235-MHz Bandwidth, Dual SPDT Analog Switch

### DESCRIPTION

The DG2515, DG2516 are low-voltage dual single-pole/double-throw monolithic CMOS analog switches. Designed to operate from 1.8 V to 5.5 V power supply, the DG2515, DG2516 achieves a bandwidth of 235 MHz while providing low on-resistance (3 Ω), excellent on-resistance matching (0.2 Ω) and flatness (1 Ω) over the entire signal range.

The DG2515, DG2516 offers the advantage of high linearity that reduces signal distortion, making ideal for audio, video, and USB signal routing applications. Additionally, the DG2515, DG2516 are 1.6 V logic compatible within the full operation voltage range.

Built on Vishay Siliconix's proprietary sub-micron high-density process, the DG2515, DG2516 brings low power consumption at the same time as reduces PCB spacing with the MSOP10 package.

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 termination, the lead (Pb)-free "- E3" suffix is being used as a designator.

### FEATURES

- 1.8 V to 5.5 V single supply operation
- Low  $R_{ON}$ : 3 Ω at 4.2 V
- 235 MHz, - 3 dB bandwidth
- Low off-isolation, - 51 dB at 10 MHz
- + 1.6 V logic compatible



RoHS  
COMPLIANT

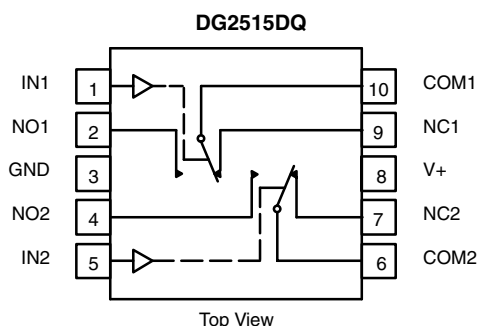
### BENEFITS

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

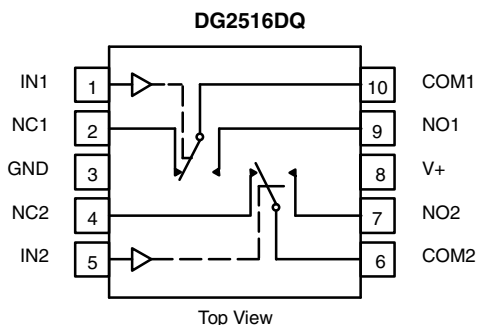
### APPLICATIONS

- 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	MSOP-10	DG2515DQ-T1-E3
		DG2516DQ-T1-E3



ABSOLUTE MAXIMUM RATINGS			
Parameter		Limit	Unit
Reference to GND			
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>	MSOP-10 <sup>c</sup>	320	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 4.0 mW/°C above 70 °C.

SPECIFICATIONS V+ = 3 V							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, V <sub>IN</sub> = 0.5 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+	V
On-Resistance	R <sub>ON</sub>	V+ = 2.7 V, V <sub>COM</sub> = 1.5 V I <sub>NO/NC</sub> = 10 mA	Room Full		3.2	4.5 5.0	Ω
R <sub>ON</sub> Flatness	R <sub>ON</sub> Flatness	V+ = 2.7 V, V <sub>COM</sub> = 1.5, 2 V I <sub>NO/NC</sub> = 10 mA	Room Full		1.0	1.4 16	
R <sub>ON</sub> Match Between Channels	ΔR <sub>ON</sub>	V+ = 2.7 V, V <sub>COM</sub> = 1.5 V I <sub>NO/NC</sub> = 10 mA	Room Full		0.1	0.3 0.4	
Switch Off Leakage Current <sup>f</sup>	I <sub>NO(off)</sub> , I <sub>NC(off)</sub>	V+ = 3.6 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 <sup>f</sup>	I <sub>COM(on)</sub>	V+ = 3.6 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 <sup>d</sup>	V <sub>INH</sub>		Full	1.4			V
Input Low Voltage	V <sub>INL</sub>		Full			0.5	
Input Capacitance	C <sub>in</sub>		Full		12		pF
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 V 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> = 300 Ω, C <sub>L</sub> = 35 pF	Room Full		30	70 100	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		25	50 70	
Break-Before-Make Time	t <sub>d</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 1.5 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Full	1			
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		24		pC
- 3 dB Bandwidth	BW	0 dBm, C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω	Room		235		MHz
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room		- 71	dB
			f = 10 MHz	Room		- 51	
Crosstalk <sup>d</sup>	X <sub>TALK</sub>	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room		- 74	
			f = 10 MHz	Room		- 52	
N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup>	C <sub>NO(off)</sub>	V <sub>IN</sub> = 0 or V+, f = 1 MHz	Room		17		pF
	C <sub>NC(off)</sub>		Room		17		
Channel-On Capacitance <sup>d</sup>	C <sub>NO(on)</sub>		Room		40		
	C <sub>NC(on)</sub>		Room		40		
<b>Power Supply</b>							
Power Supply Current	I+	V <sub>IN</sub> = 0 or V+	Full		0.01	1.0	μA



SPECIFICATIONS $V_+ = 5\text{ V}$									
Parameter	Symbol	Test Conditions Otherwise Unless Specified $V_+ = 5\text{ V}, \pm 10\%, V_{IN} = 0.8\text{ or }2.0\text{ V}^e$	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>	$V_{NO}, V_{NC}, V_{COM}$		Full	0		$V_+$	V		
On-Resistance	$R_{ON}$	$V_+ = 4.2\text{ V}, V_{COM} = 3.5\text{ V}, I_{NO/NC} = 10\text{ mA}$	Room Full		3	4.0 4.3	$\Omega$		
$R_{ON}$ Flatness	$R_{ON}$ Flatness	$V_+ = 4.2\text{ V}, V_{COM} = 1, 2, 3.5\text{ V}$ $I_{NO/NC} = 10\text{ mA}$	Room Full		1.1	1.4 1.6			
$R_{ON}$ Match Between Channels	$\Delta R_{ON}$	$V_+ = 4.2\text{ V}, V_{COM} = 3.5\text{ V}, I_{NO/NC} = 10\text{ mA}$	Room Full		0.1	0.3 0.4			
Switch Off Leakage Current	$I_{NO(off)}, I_{NC(off)}$	$V_+ = 5.5\text{ V}$ $V_{NO}, V_{NC} = 1\text{ V}/4.5\text{ V}, V_{COM} = 4.5\text{ V}/1\text{ V}$	Room Full	- 1 - 10		1 10	nA		
	$I_{COM(off)}$		Room Full	- 1 - 10		1 10			
Channel-On Leakage Current	$I_{COM(on)}$	$V_+ = 5.5\text{ V}, V_{NO}, V_{NC} = V_{COM} = 1\text{ V}/4.5\text{ V}$	Room Full	- 1 - 10		1 10			
<b>Digital Control</b>									
Input High Voltage <sup>d</sup>	$V_{INH}$		Full	2.0			V		
Input Low Voltage	$V_{INL}$		Full			0.8			
Input Capacitance	$C_{in}$		Full		12		pF		
Input Current	$I_{INL}$ or $I_{INH}$	$V_{IN} = 0\text{ V or }V_+$	Full	1		1	$\mu\text{A}$		
<b>Dynamic Characteristics</b>									
Turn-On Time	$t_{ON}$	$V_+ = 4.2\text{ V}, V_{NO}$ or $V_{NC} = 3\text{ V}$ $R_L = 300\ \Omega, C_L = 35\text{ pF}$	Room Full		25	50 70	ns		
Turn-Off Time	$t_{OFF}$		Room Full		20	40 50			
Break-Before-Make Time	$t_d$	$V_{NO}$ or $V_{NC} = 3\text{ V}, R_L = 300\ \Omega, C_L = 35\text{ pF}$	Full	1					
Charge Injection <sup>d</sup>	$Q_{INJ}$	$C_L = 1\text{ nF}, V_{GEN} = 0\text{ V}, R_{GEN} = 0\ \Omega$	Room		49		pC		
- 3 dB Bandwidth	BW	0 dBm, $C_L = 5\text{ pF}, R_L = 50\ \Omega$	Room		235		MHz		
Off-Isolation <sup>d</sup>	OIRR	$R_L = 50\ \Omega, C_L = 5\text{ pF}$	f = 1 MHz	Room		- 71	dB		
			f = 10 MHz	Room		- 51			
Crosstalk <sup>d</sup>	$X_{TALK}$	$R_L = 50\ \Omega, C_L = 5\text{ pF}$	f = 1 MHz	Room		- 74			
			f = 10 MHz	Room		- 52			
Source Off Capacitance <sup>d</sup>	$C_{NO(off)}$	$V_{IN} = 0\text{ or }V_+, f = 1\text{ MHz}$	Room		17		pF		
	$C_{NC(off)}$		Room		17				
Channel-On Capacitance <sup>d</sup>	$C_{NO(on)}$		Room		40				
	$C_{NC(on)}$		Room		40				
<b>Power Supply</b>									
Power Supply Range	$V_+$				1.8			5.5	V
Power Supply Current	$I_+$	$V_{IN} = 0\text{ or }V_+$	Full		0.01	1.0	$\mu\text{A}$		

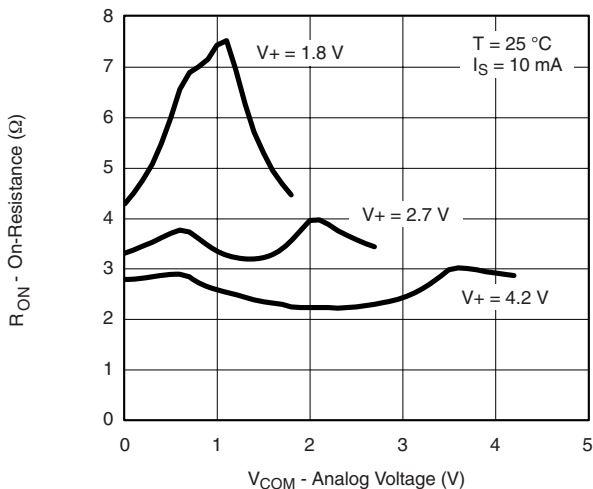
Notes:

- 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 data sheet.
- 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.

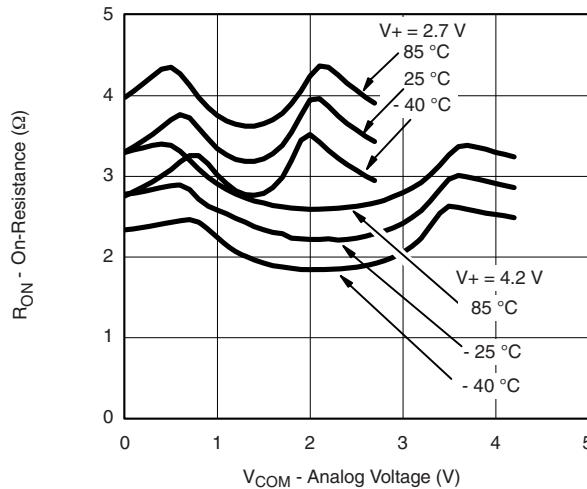
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



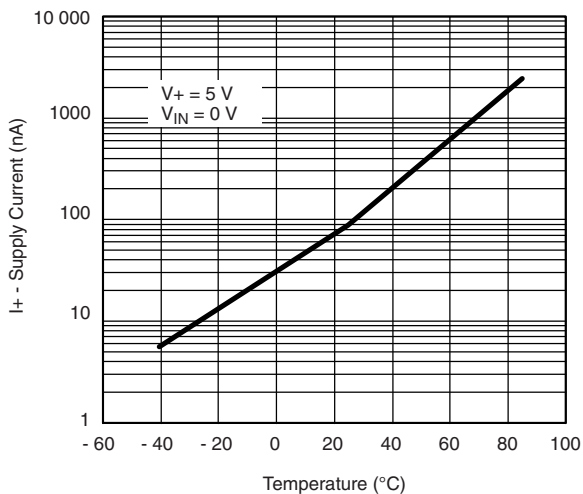
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



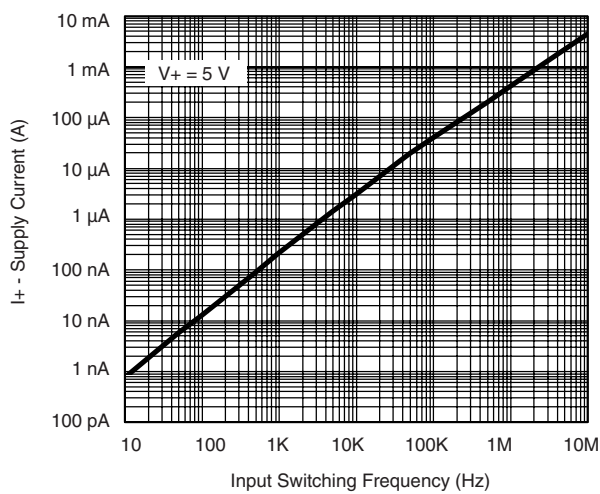
**RON vs. VCOM and Supply Voltage**



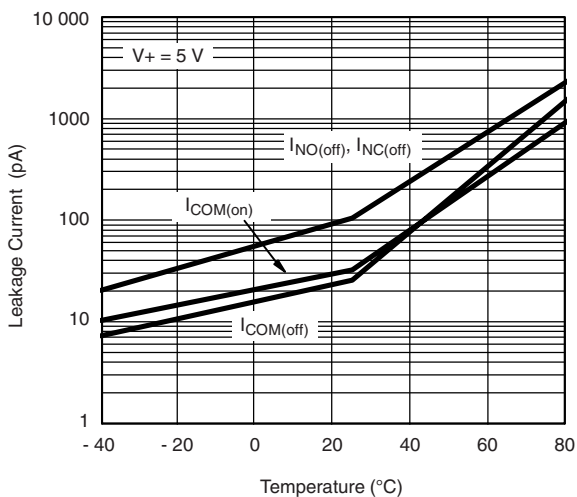
**RON vs. Analog Voltage and Temperature**



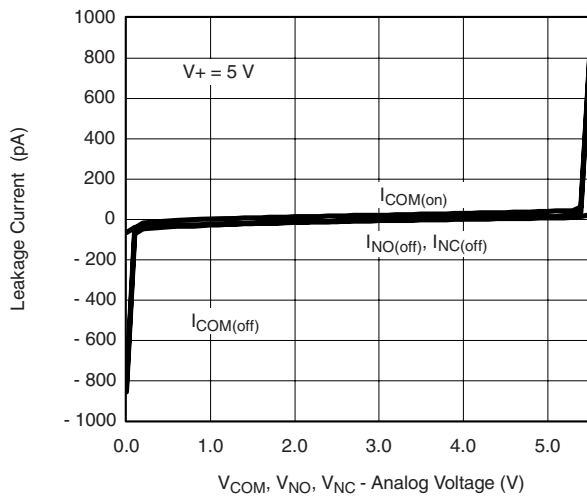
**Supply Current vs. Temperature**



**Supply Current vs. Input Switching Frequency**

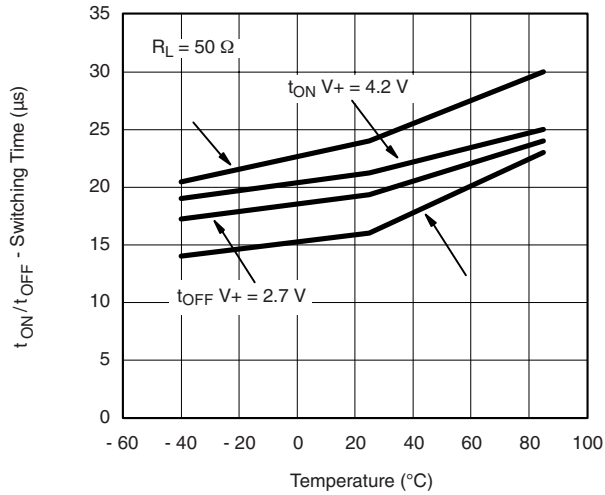


**Leakage Current vs. Temperature**

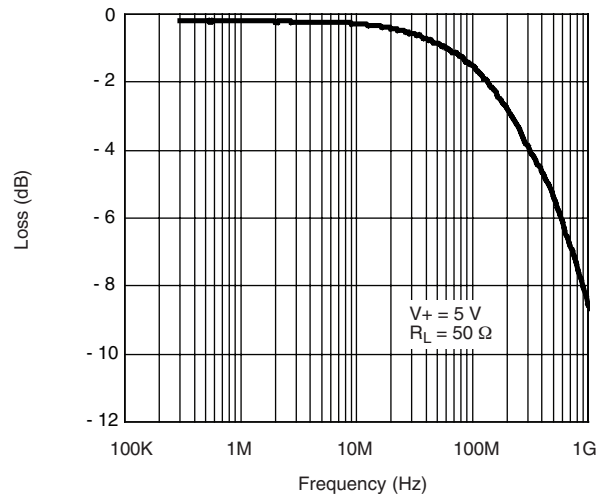


**Leakage vs. Analog Voltage**

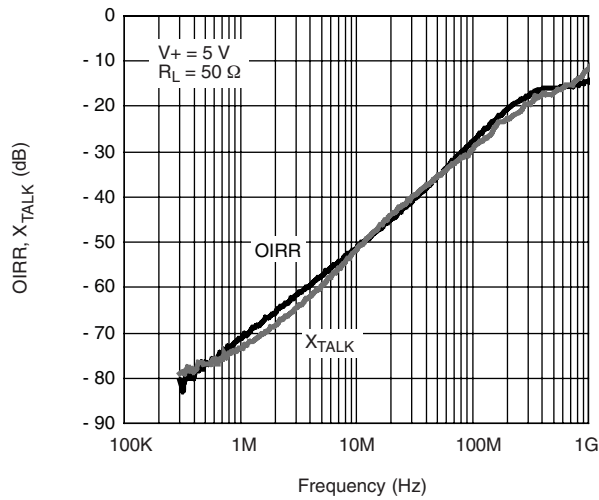
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



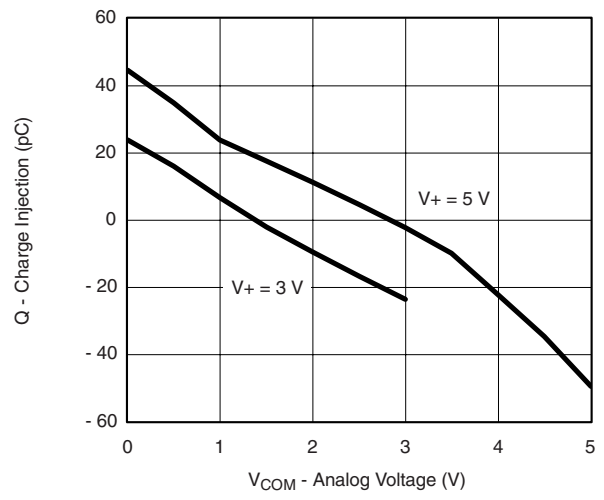
**Switching Time vs. Temperature**



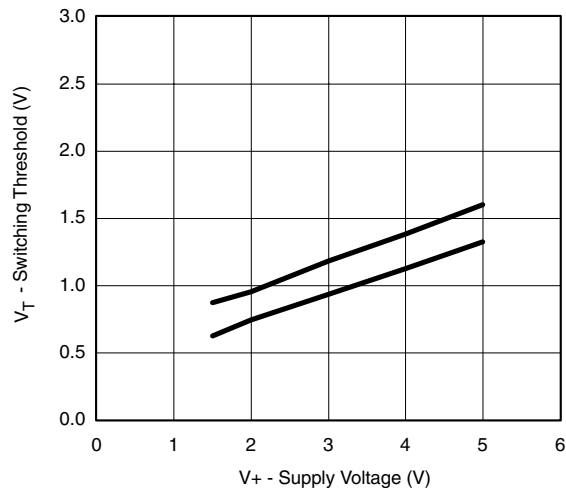
**Insertion Loss vs. Frequency**



**Off-Isolation and Crosstalk vs. Frequency**

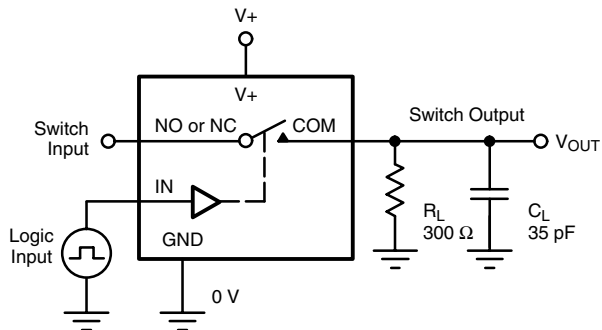


**Charge Injection vs. Analog Voltage**



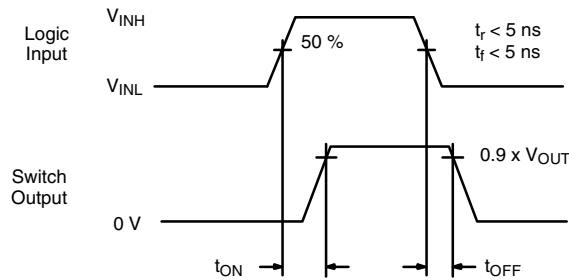
**Switching Threshold vs. Supply Voltage**

TEST CIRCUITS



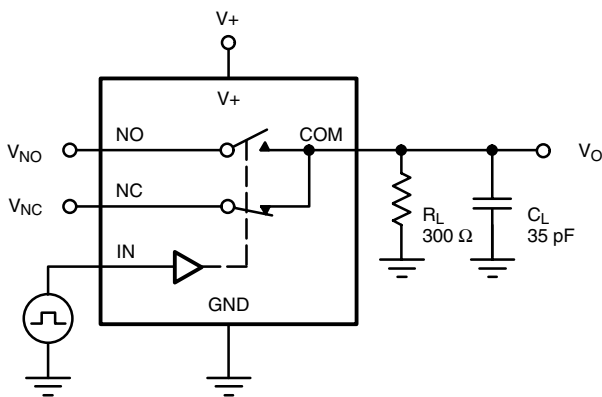
$C_L$  (includes fixture and stray capacitance)

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



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

Figure 1. Switching Time



$C_L$  (includes fixture and stray capacitance)

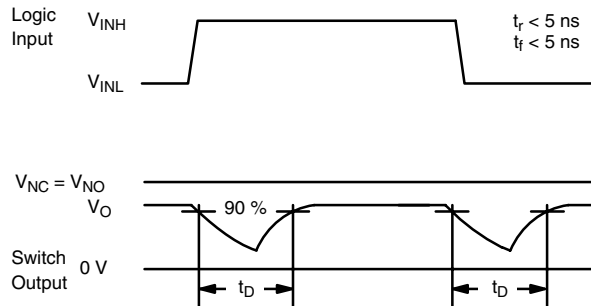
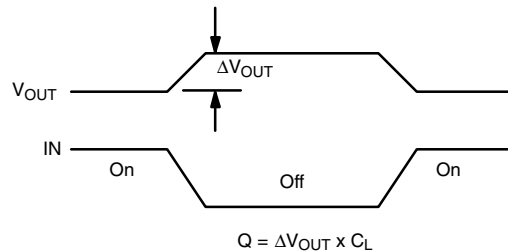
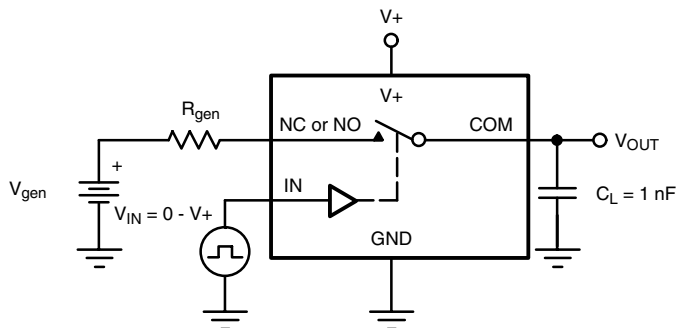


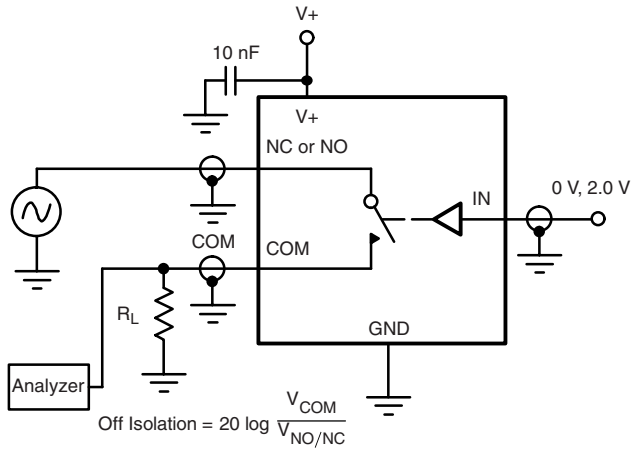
Figure 2. Break-Before-Make Interval



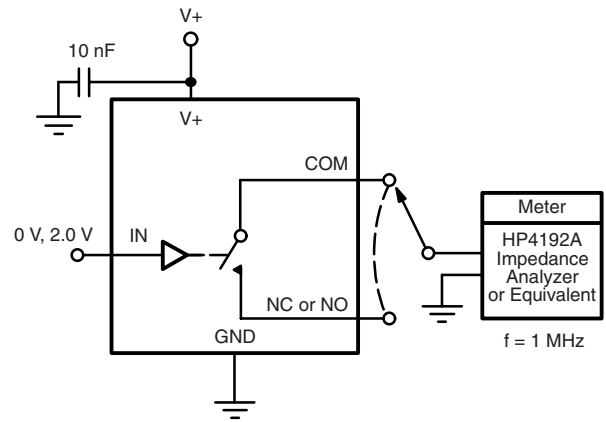
IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection

**TEST CIRCUITS**



**Figure 4. Off-Isolation**



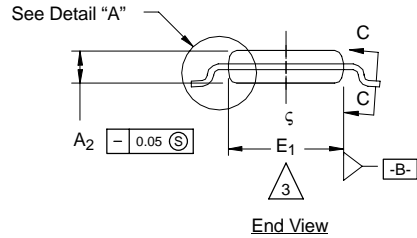
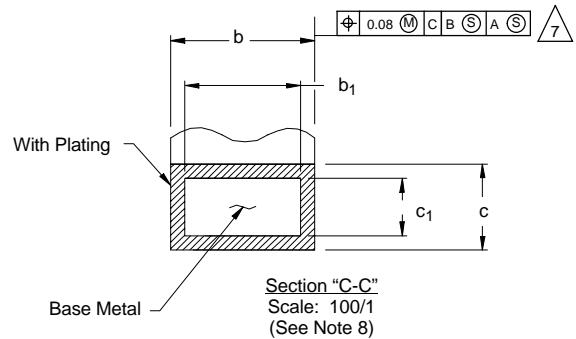
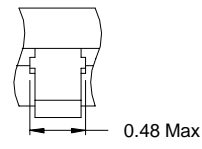
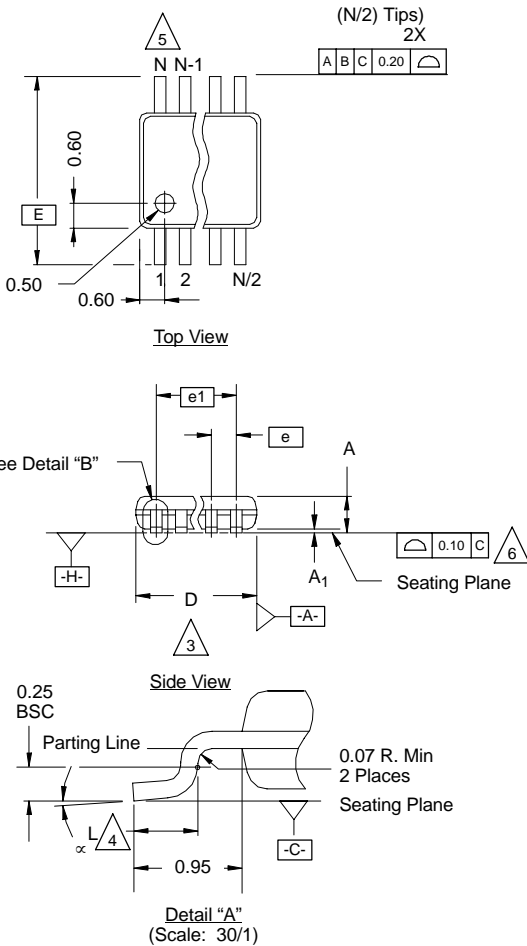
**Figure 5. Channel Off/On Capacitance**

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 <http://www.vishay.com/ppg?73453>.



**MSOP: 10-LEADS**

JEDEC Part Number: MO-187, (Variation AA and BA)



NOTES:

- Die thickness allowable is  $0.203 \pm 0.0127$ .
- Dimensioning and tolerances per ANSI.Y14.5M-1994.
- Dimensions "D" and "E<sub>1</sub>" do not include mold flash or protrusions, and are measured at Datum plane [-H-], mold flash or protrusions shall not exceed 0.15 mm per side.
- Dimension is the length of terminal for soldering to a substrate.
- Terminal positions are shown for reference only.
- Formed leads shall be planar with respect to one another within 0.10 mm at seating plane.
- The lead width dimension does not include Dambar protrusion. Allowable Dambar protrusion shall be 0.08 mm total in excess of the lead width dimension at maximum material condition. Dambar cannot be located on the lower radius or the lead foot. Minimum space between protrusions and an adjacent lead to be 0.14 mm. See detail "B" and Section "C-C".
- Section "C-C" to be determined at 0.10 mm to 0.25 mm from the lead tip.
- Controlling dimension: millimeters.
- This part is compliant with JEDEC registration MO-187, variation AA and BA.
- Datums [-A-] and [-B-] to be determined Datum plane [-H-].
- Exposed pad area in bottom side is the same as teh leadframe pad size.

**N = 10L**

Dim	MILLIMETERS			Note
	Min	Nom	Max	
A	-	-	1.10	
A <sub>1</sub>	0.05	0.10	0.15	
A <sub>2</sub>	0.75	0.85	0.95	
b	0.17	-	0.27	8
b <sub>1</sub>	0.17	0.20	0.23	8
c	0.13	-	0.23	
c <sub>1</sub>	0.13	0.15	0.18	
D	3.00 BSC			3
E	4.90 BSC			
E <sub>1</sub>	2.90	3.00	3.10	3
e	0.50 BSC			
e <sub>1</sub>	2.00 BSC			
L	0.40	0.55	0.70	4
N	10			5
α	0°	4°	6°	
ECN: T-02080—Rev. C, 15-Jul-02 DWG: 5867				



## Disclaimer

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**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.**

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-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management