

## Low Voltage, 0.7 $\Omega$ , Triple SPDT Analog Switch

### DESCRIPTION

The DG2753 is a low voltage, low on-resistance, triple single-pole/double-throw (SPDT) monolithic CMOS analog switch. The device is designed for operation from 1.65 V to 4.3 V single supply. The device is 1.8 V logic compatible within the full operation voltage range to interface with low voltage DSP or MCU control logic. These traits make it ideal for one cell Li-ion battery direct power in portable applications.

The DG2753 fully guarantees operation when  $V_+$  is as low as 1.8 V. When powered from a 3 V power supply, it has a 0.9  $\Omega$  on-resistance, with 0.1  $\Omega$   $R_{ON}$  matching between channels, and 0.2  $\Omega$  (Max)  $R_{ON}$  flatness.

Each switch conducts signals across power rails equally well in both directions when on, and blocks up to the power supply level when off. It offers 30 nS  $T_{on}$  and 10 nS  $T_{off}$ . Break-before-make is guaranteed.

The DG2753 is built on Vishay Siliconix's low voltage process. An epitaxial layer prevents latchup.

It is available in QFN16 3 x 3 mm and TSSOP16 packages. As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device terminations. For analog switching products manufactured in QFN packages, the lead (Pb)-free "-E4" suffix is being used as a designator for nickel-palladium-gold. The TSSOP-16 package is offered in lead (Pb)-free with 100 % matte Tin terminations. The "-E3" suffix is the designator. Both the 100 % matte Tin and nickel-palladium gold device terminations meet all JEDEC standards for reflow and MSL ratings.

### FEATURES

- Low Voltage Operation (1.65 to 4.3 V)
- Low On-Resistance -  $r_{ON}$ : 0.9  $\Omega$  at 2.7 V
- Fast Switching:  $T_{ON}$  = 30 ns
- $T_{OFF}$  = 10 ns
- QFN-16 (3 x 3) Package
- Latch-Up Current > 300 mA (JESD78)

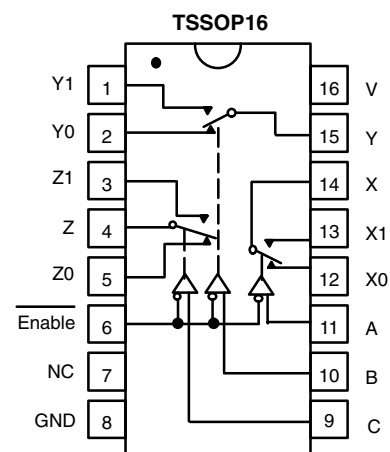
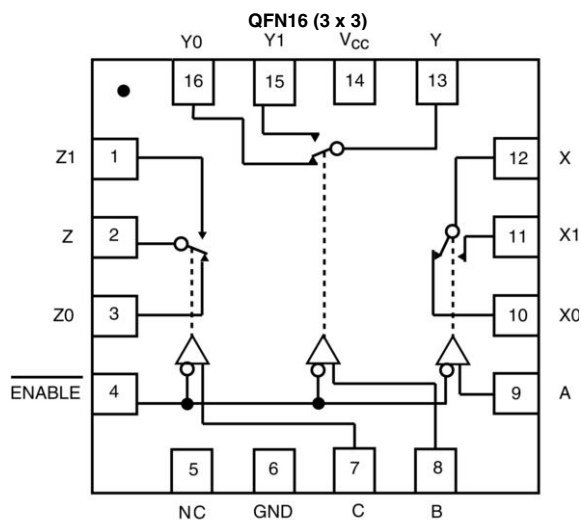
### BENEFITS

- Reduced Power Consumption
- High Accuracy
- Reduce Board Space
- TTL/1.8 V Logic Compatible

### APPLICATIONS

- Cellular Phones
- Speaker Headset Switching
- Audio and Video Signal Routing
- PCMCIA Cards
- Battery Operated Systems

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



### ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 to 85 °C	TSSOP-16	DG2753DQ-T1-E3
	16-Pin QFN (3 mm x 3 mm) Variation 2	DG2753DN-T1-E4



TRUTH TABLE					
Enable Input	Select Inputs			ON Switches	
	C	B	A	DG2753	
H	X	X	X	All switches open	
L	X	X	L	X - X0	
L	X	X	H	X - X1	
L	X	L	X	Y - Y0	
L	X	H	X	Y - Y1	
L	L	X	X	Z - Z0	
L	H	X	X	Z - Z1	

X = Do not care

ABSOLUTE MAXIMUM RATINGS $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted			
Parameter		Limit	Unit
Reference to GND	V+	- 0.3 to 5.0	V
	IN, COM, NC, NO <sup>a</sup>	- 0.3 to (V+ + 0.3)	
Current (Any terminal except NO, NC or COM)		30	mA
Continuous Current (NO, NC, or COM)		± 300	
Peak Current (Pulsed at 1 ms, 10 % duty cycle)		± 500	
Storage Temperature (D Suffix)		- 65 to 150	°C
Package Solder Reflow Conditions <sup>d</sup>	16-Pin QFN (3 x 3 mm)	250	
Power Dissipation (Packages) <sup>b</sup>	QFN-16 <sup>c</sup>	1385	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 17.3 mW/°C above 70 °C.
- d. Manual soldering with iron is not recommended for leadless components. The QFN is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper lip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

SPECIFICATIONS							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+, ± 10 %, V <sub>IN</sub> = 0.4 or 1.8 V <sup>e</sup>	Temp <sup>a</sup>	Limits - 40 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>DS(on)</sub>	V+ = 2.7 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 1.7 V	Room		0.9	1.3	Ω
		V+ = 2.7 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 1.7 V	Full			1.5	
		V+ = 4.2 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 2.1 V	Room		0.7	1.2	
		V+ = 4.2 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 2.1 V	Full			1.4	
r <sub>ON</sub> Match	Δr <sub>(on)</sub>	V+ = 2.7 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 1.7 V	Room			0.4	
		V+ = 4.3 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 2.1 V	Room			0.6	
r <sub>ON</sub> Resistance Flatness	r <sub>(on)</sub> Flatness	V+ = 2.7 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 1.7 V	Room			0.2	
Switch Off Leakage Current	I <sub>NO(off)</sub>	V+ = 4.3 V, V <sub>NO</sub> , V <sub>NC</sub> = 4 V/0.3 V, V <sub>COM</sub> = 0.3 V/4 V	Room	- 2		2	nA
	I <sub>COM(off)</sub>		Full	- 25		25	
Channel-On Leakage Current	I <sub>COM(on)</sub>	V+ = 4.3 V, V <sub>COM</sub> = V <sub>NO</sub> , V <sub>NC</sub> = 0.3 V/4 V	Room	- 2		2	
			Full	- 10		10	



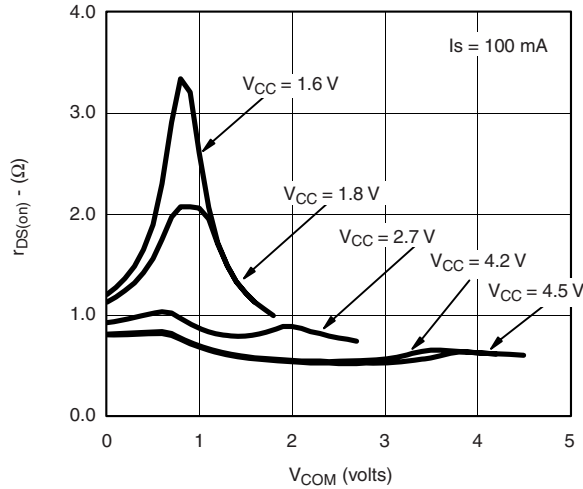
SPECIFICATIONS								
Parameter	Symbol	Test Conditions Otherwise Unless Specified $V_{+}, \pm 10\%, V_{IN} = 0.4 \text{ or } 1.8 \text{ V}^e$	Temp <sup>a</sup>	Limits - 40 to 85 °C			Unit	
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>		
<b>Digital Control</b>								
Input High Voltage	$V_{INH}$	$V_{+} = 1.8 \text{ V}$	Full	1			V	
		$V_{+} = 3 \text{ V}$	Full	1.4				
		$V_{+} = 4.3 \text{ V}$	Full	1.8				
Input Low Voltage	$V_{INL}$	$V_{+} = 1.8 \text{ V}$	Full			0.4		
		$V_{+} = 3 \text{ V}$	Full			0.5		
		$V_{+} = 4.3 \text{ V}$	Full			0.5		
Input Current	$I_{INL}, I_{INH}$	$V_{IN} = 0 \text{ V or } V_{+}$	Full	- 1		1	µA	
<b>Dynamic Characteristics</b>								
Turn-On Time	$t_{ON}$	$V_{+} = 2.7 \text{ V}$ $V_{NO}, V_{NC} = 1.5 \text{ V}, R_L = 50 \Omega, C_L = 35 \text{ pF}$	Room		30	60	ns	
Turn-Off Time	$t_{OFF}$		Full		10	30		
Break-Before-Make	$t_{OPEN}$	$V_{+} = 2.7 \text{ V}$	Full	5	30	40		
Address Transition Time	$t_{TRANS}$	$V_{NO}, V_{NC} = 1.5 \text{ V}, R_L = 50 \Omega, C_L = 35 \text{ pF}$	Full		40	80	pC	
Charge Injection <sup>d</sup>	$Q_{INJ}$	$V_{+} = 2.7 \text{ V}, C_L = 1 \text{ nF}, R_{GEN} = 0 \Omega, f = 500 \text{ kHz}$ $V_{NC}, V_{NO} = 2 \text{ V (test at COM side)}$	Room		- 25			
Off-Isolation <sup>d</sup>	$O_{IRR}$	$V_{+} = 2.7 \text{ V}, C_L = 1 \text{ nF}, R_{GEN} = 0 \Omega, f = 500 \text{ kHz}$ $V_{NC}, V_{NO} = 2 \text{ V (test at COM side)}$	Room		- 90			
Crosstalk <sup>d</sup>	$X_{TALK}$	$V_{+} = 2.7 \text{ V}, C_L = 1 \text{ nF}, R_{GEN} = 0 \Omega$ $V_{NC}, V_{NO} = 2 \text{ V (test at COM side)}$	Room		- 90		dB	
$N_O, N_C$ Off Capacitance <sup>d</sup>	$C_{NO(off)}$	$V_{IN} = 0 \text{ or } V_{+}, f = 1 \text{ MHz}$	Room		35			
	$C_{NC(off)}$		Room		35			
Channel/On Capacitance <sup>d</sup>	$C_{NO(on)}$		Room		80			
	$C_{NC(on)}$		Room		80			
<b>Power Supply</b>								
Power Supply Current	$I_{+}$		$V_{IN} = 0 \text{ or } V_{+}$	Full			1	µA

Notes:

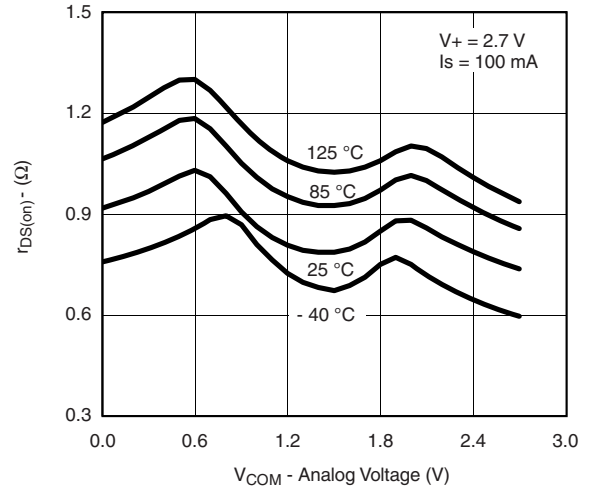
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
- c. The algebraic convention where by the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- d.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

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.

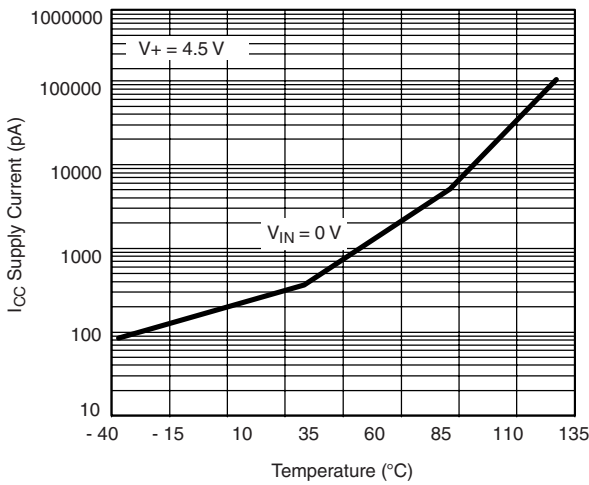
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



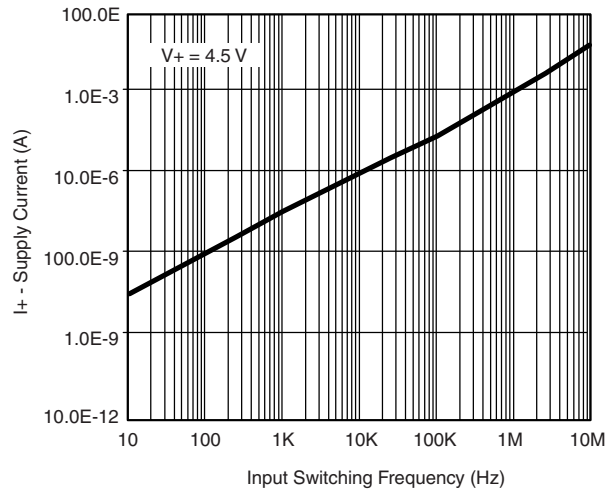
**$r_{DS(on)}$  vs.  $V_{COM}$  and Supply Voltage**



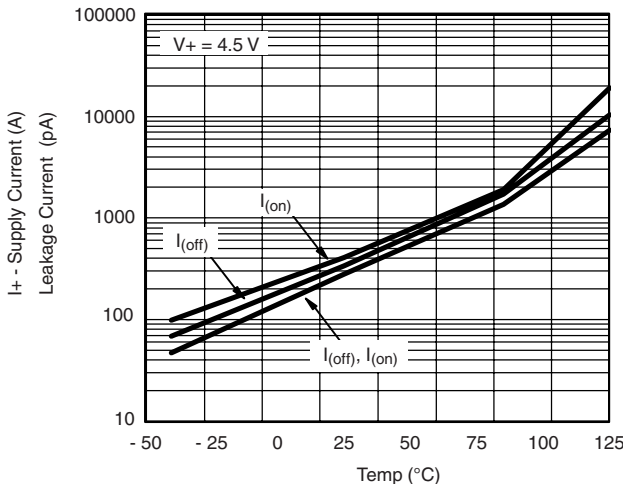
**$r_{DS(on)}$  vs. Analog Voltage and Temperature**



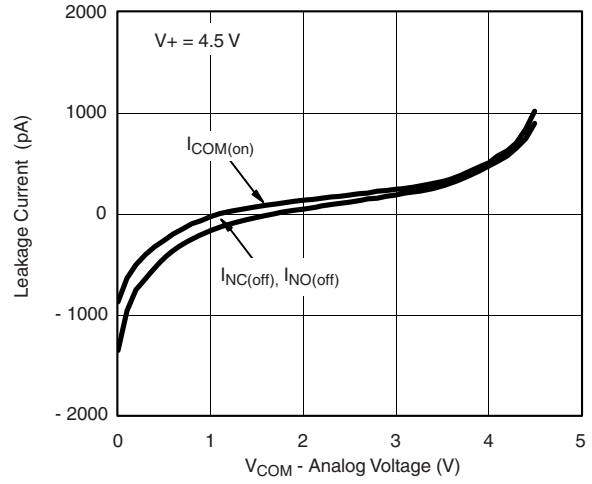
**Supply Current vs. Temperature**



**Supply Current vs. Input Switching Frequency**

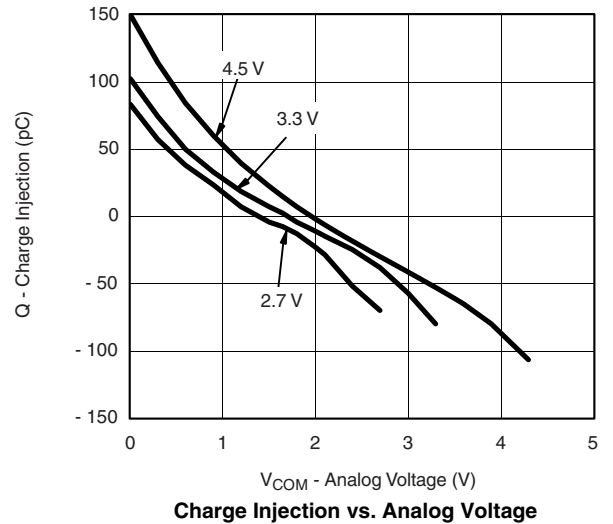
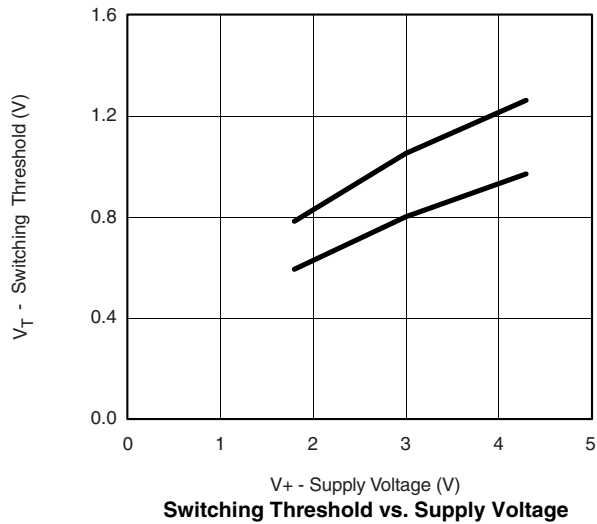
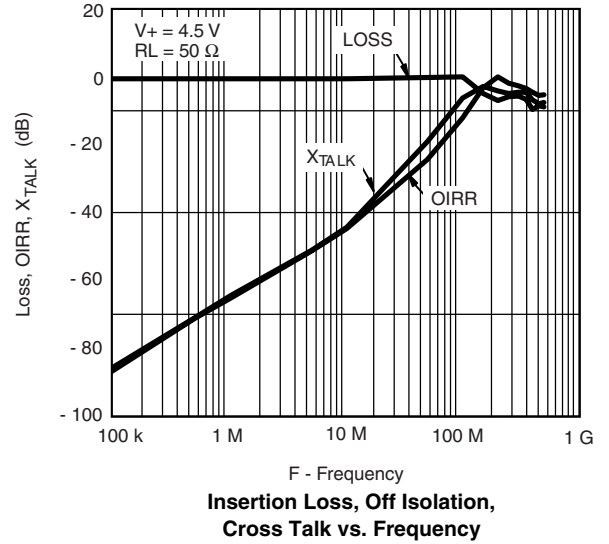
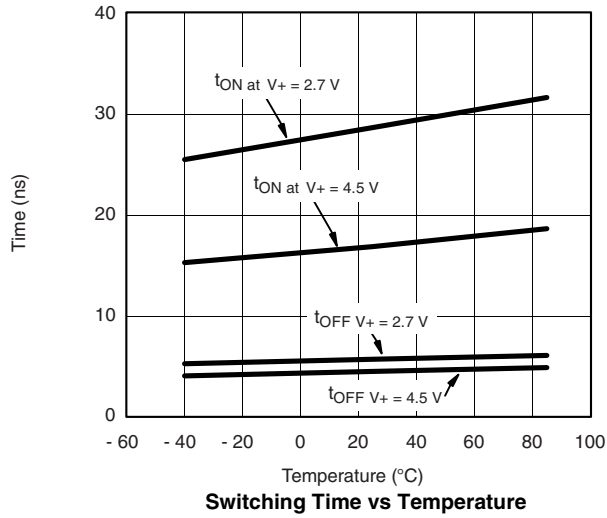


**Leakage Current vs. Temperature**

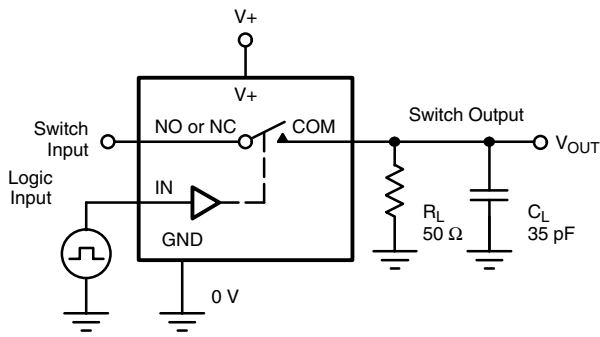


**Leakage Current vs. Analog Voltage**

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

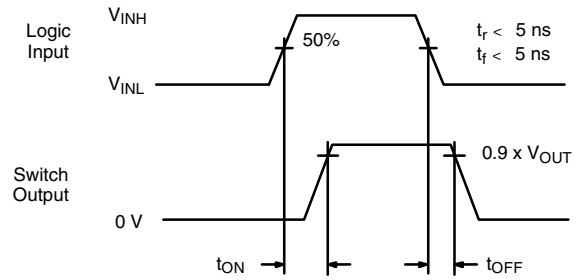


TEST CIRCUITS



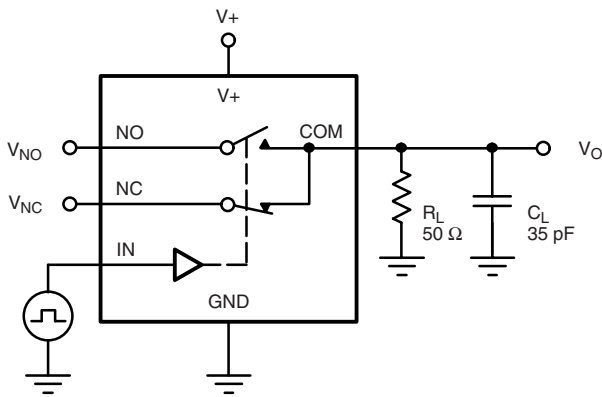
$C_L$  (includes fixture and stray capacitance)

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



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)

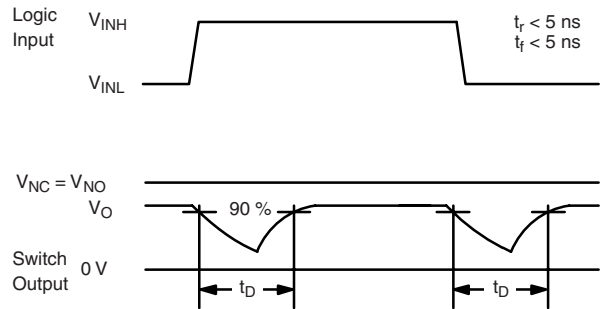
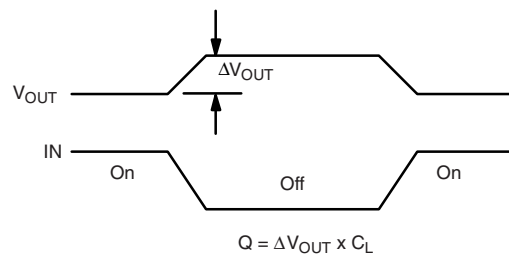
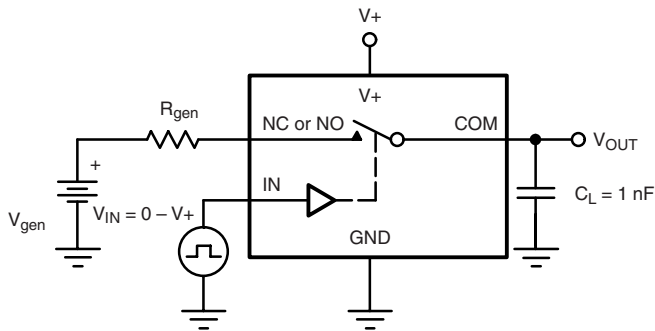


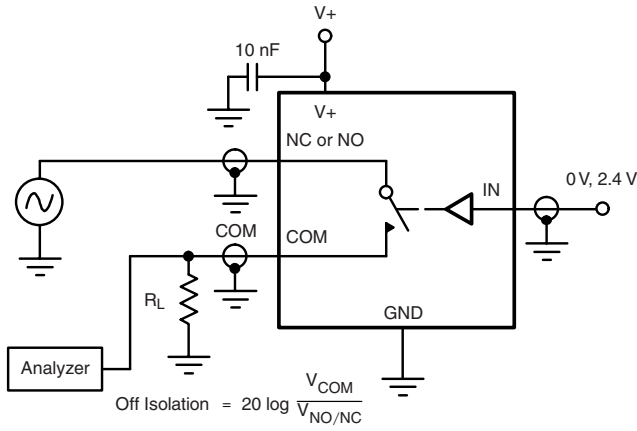
Figure 2. Break-Before-Make Interval



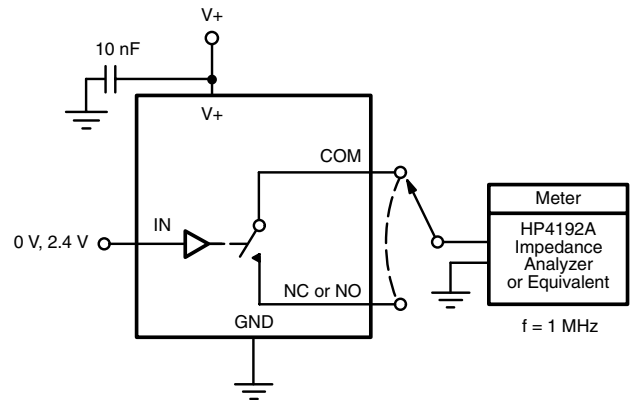
IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection

**TEST CIRCUITS**



**Figure 4. Off-Isolation**



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

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