

## Low Power, High Voltage SPST Analog Switches

### DESCRIPTION

The DG447, DG448 are dual supply single-pole/single-throw (SPST) switches. On resistance is 25  $\Omega$  maximum and flatness is 2.2  $\Omega$  max over the specified analog signal range. These analog switches were designed to provide high speed, low error switching of precision analog signals. The primary application areas are in the routing and switching in telecommunications and test equipment. Combining low power, low leakages, low on-resistance and small physical size, the DG477, DG448 are also ideally suited for portable and battery powered industrial and military equipment.

The DG477 has one normally closed switch, while the DG448 switch is normally open. They operate either from a single + 7 V to 36 V supply or from dual  $\pm 4.5$  V to  $\pm 20$  V supplies. They are offered in the very popular, small TSOP6 package.

### FEATURES

- $\pm 15$  V analog signal range
- On-resistance -  $R_{DS(on)}$ : 25  $\Omega$  max.
- Fast switching action -  $t_{ON}$ : 100 ns
- $V_L$  logic supply not required
- TTL CMOS input compatible
- Rail to rail signal handling
- Dual or single supply operation
- Compliant to RoHS Directive 2002/95/EC


**RoHS**  
COMPLIANT

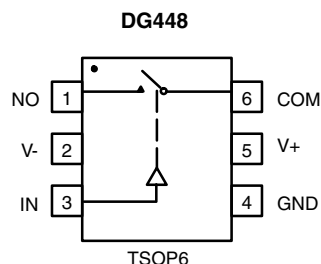
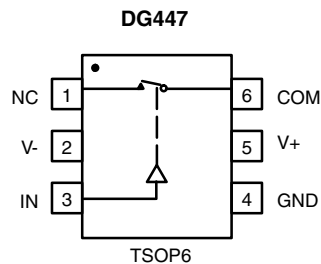
### BENEFITS

- Wide dynamic range
- Low signal errors and distortion
- Break-before-make switching action
- Simple interfacing
- Reduced board space
- Improved reliability

### APPLICATIONS

- Precision test equipment
- Precision instrumentation
- Communications systems
- PBX, PABX systems
- Audio equipment
- Redundant systems
- PC multimedia boards
- Hard disc drives

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



#### TRUTH TABLE

Logic	DG447	DG448
0	ON	OFF
1	OFF	ON

Logic "0"  $\leq 0.8$  V  
 Logic "1"  $\geq 2.4$  V

Device Marking:  
 DG447DV = G5xxx  
 DG448DV = G6xxx



### ORDERING INFORMATION

Temp. Range	Package	Part Number
<b>DG447, DG448</b>		
- 40 °C to 85 °C	6-pin TSOP	DG447DV-T1-E3
		DG448DV-T1-E3

### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C, unless otherwise noted)

Parameter Referenced to V-	Limit	Unit	
V+	44	V	
GND	25		
Digital Inputs <sup>a</sup> , V <sub>no/nc</sub> , V <sub>COM</sub>	(V-) - 2 V to (V+) + 2 V or 30 mA, whichever occurs first		
Current, (Any Terminal) Continuous	30	mA	
Current (NO or NC or COM) Pulsed at 1 ms, 10 % Duty Cycle	100		
Storage Temperature	- 65 to 150	°C	
Power Dissipation (Package) <sup>b</sup>	6-pin TSOP <sup>c</sup>	570	mW

Notes:

a. Signals on NO, NC, COM, or IN exceeding V+ or 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 7 mW/°C above 70 °C.

### SPECIFICATIONS<sup>a</sup>

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V- = - 15 V V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup>	Temp. <sup>b</sup>	D Suffix - 40 °C to 85 °C			Unit
				Min. <sup>d</sup>	Typ. <sup>c</sup>	Max. <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full	- 15		15	V
Drain-Source On-Resistance	R <sub>ON</sub>	I <sub>no/nc</sub> = 10 mA, V <sub>COM</sub> = 10 V V+ = 13.5 V, V- = - 13.5 V	Room Full		17	25 30	Ω
On-Resistance Flatness	R <sub>ON</sub> Flatness	I <sub>no/nc</sub> = 10 mA, V <sub>COM</sub> = ± 5 V, 0 V V+ = 13.5 V, V- = - 13.5 V	Room Full		0.8	2.2 3	
Switch Off Leakage Current	I <sub>no/nc(off)</sub>	V+ = 16.5, V- = - 16.5 V V <sub>COM</sub> = ± 15.5 V V <sub>no/nc</sub> = -/+ 15.5 V	Room Full	- 1 - 10	- 0.1	1 10	nA
	I <sub>COM(off)</sub>		Room Full	- 1 - 10	- 0.1	1 10	
Channel On Leakage Current	I <sub>COM(on)</sub>	V+ = 16.5 V, V- = - 16.5 V V <sub>COM</sub> = V <sub>no/nc</sub> = ± 15.5 V	Room Full	- 1 - 10	- 0.1	1 10	
<b>Digital Control</b>							
Input, High Voltage	I <sub>INH</sub>		Full	2.4			V
Input, Low Voltage	I <sub>INL</sub>		Full			0.8	
Input Capacitance <sup>e</sup>	C <sub>IN</sub>		Room		5		pF
Input Current	I <sub>IN</sub>	V <sub>IN</sub> = 0 or 5 V		- 1		1	μA
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF V <sub>no/nc</sub> = ± 10 V	Room Full		100	130 140	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		50	95 110	
Charge Injection <sup>e</sup>	Q	C <sub>L</sub> = 10 nF, V <sub>gen</sub> = 0 V, R <sub>gen</sub> = 0 Ω	Room		10		pC
Off-Isolation <sup>e</sup>	OIRR	C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω, f = 1 MHz	Room		- 72		dB
Source Off Capacitance <sup>e</sup>	C <sub>S(off)</sub>	f = 1 MHz	Room		19		pF
Drain Off Capacitance <sup>e</sup>	C <sub>D(off)</sub>		Room		8		
Channel On Capacitance <sup>e</sup>	C <sub>D(on)</sub>		Room		30		
<b>Power Supplies</b>							
Positive Supply Current	I+	V+ = 16.5 V, V- = - 16.5 V V <sub>IN</sub> = 0 or 5 V	Room Full		16	30 50	μA
Negative Supply Current	I-		Room Full	- 1 - 10	- 0.02		



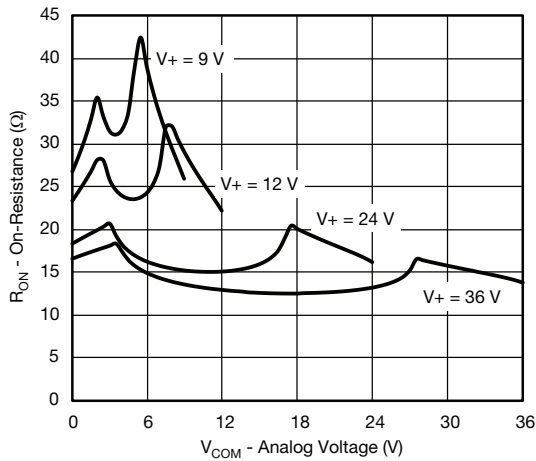
SPECIFICATIONS <sup>a</sup>							
Parameter	Symbol	Test Conditions Unless Otherwise Specified V <sub>+</sub> = 12 V, V <sub>-</sub> = 0 V V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup>	Temp. <sup>b</sup>	D Suffix - 40 °C to 85 °C			Unit
				Min. <sup>d</sup>	Typ. <sup>c</sup>	Max. <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full	0		12	V
Drain-Source On-Resistance	R <sub>ON</sub>	I <sub>no/nc</sub> = - 10 mA, V <sub>COM</sub> = 8 V V <sub>+</sub> = 10.8 V	Room Full		32	45 60	Ω
On-Resistance Flatness	R <sub>ON</sub> Flatness	I <sub>no/nc</sub> = 10 mA, V <sub>COM</sub> = 2, 6, 8 V V <sub>+</sub> = 10.8 V	Room Full		2	6 8	Ω
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>NO, NC</sub> = ± 10 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room Full		140	175 225	nS
Turn-Off Time	t <sub>OFF</sub>		Room Full		50	120 150	
Charge Injection <sup>e</sup>	Q	C <sub>L</sub> = 10 nF, V <sub>gen</sub> = 0 V, R <sub>gen</sub> = 0 Ω	Room		12		pC
<b>Power Supplies</b>							
Positive Supply Current	I <sub>+</sub>	V <sub>+</sub> = 13.2 V, V <sub>IN</sub> = 0 V, 5 V	Room Full		22	50 75	μA

Notes:

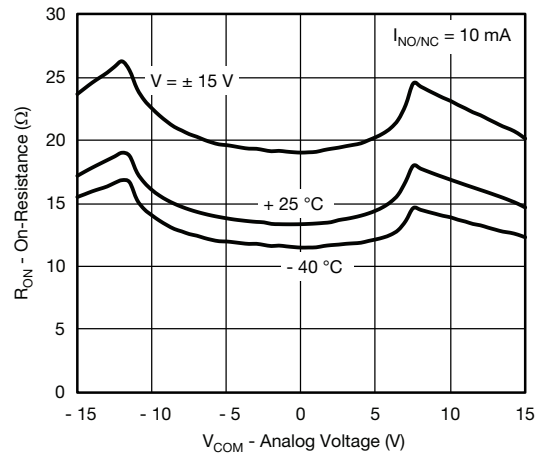
- a. Refer to PROCESS OPTION FLOWCHART.
- b. Room = 25 °C, full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- e. Guaranteed by design, not subject to production test.
- f. V<sub>IN</sub> = 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.

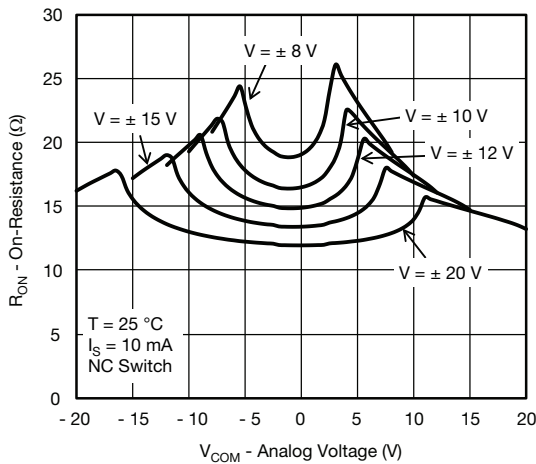
## TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



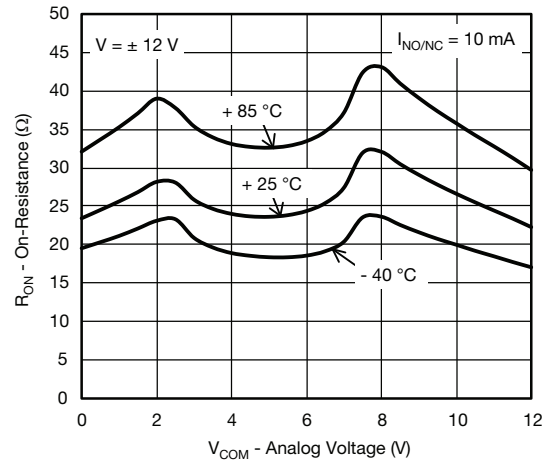
**R<sub>ON</sub> vs. V<sub>COM</sub> and Single Supply Voltage**



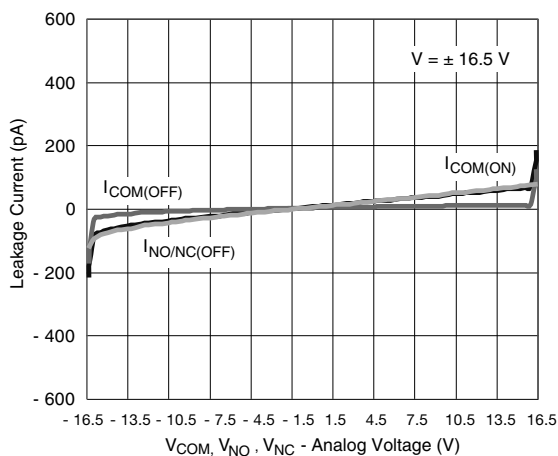
**R<sub>ON</sub> vs. Analog Voltage and Temperature**



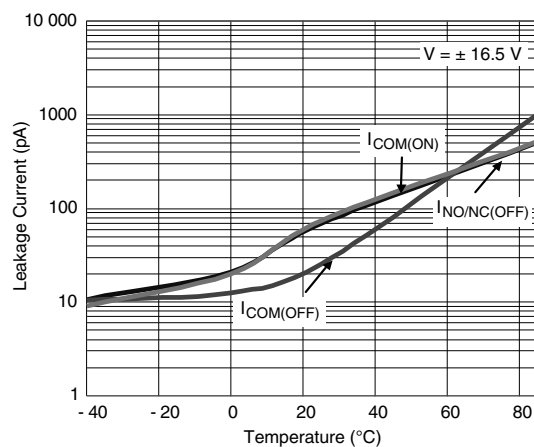
**R<sub>ON</sub> vs. V<sub>COM</sub> and Dual Supply Voltage**



**R<sub>ON</sub> vs. Analog Voltage and Temperature**

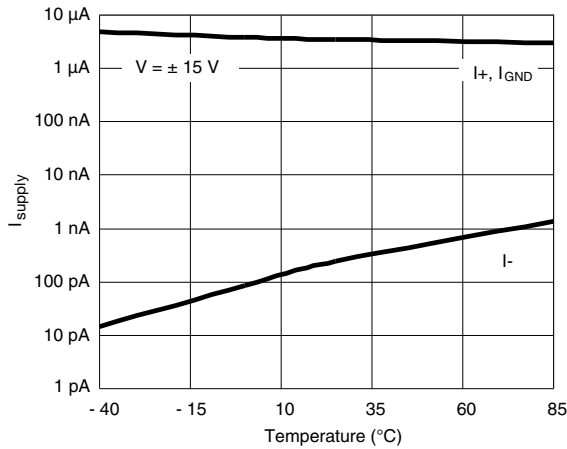


**Leakage vs. Analog Voltage**

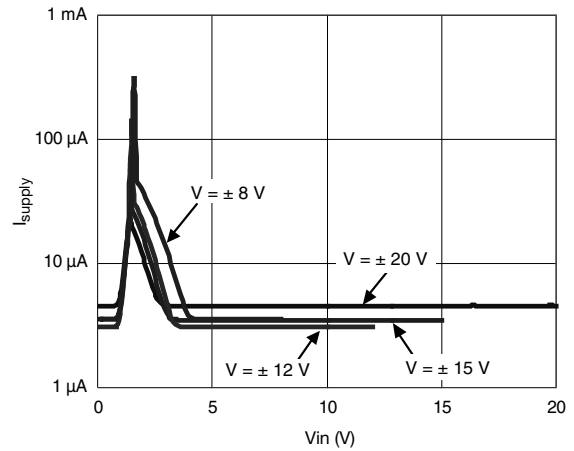


**Leakage Current vs. Temperature**

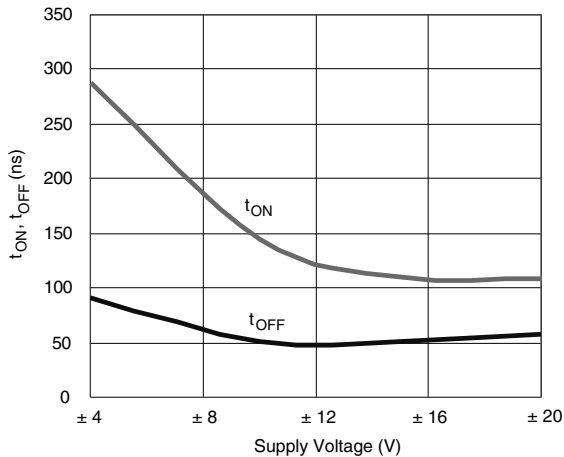
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



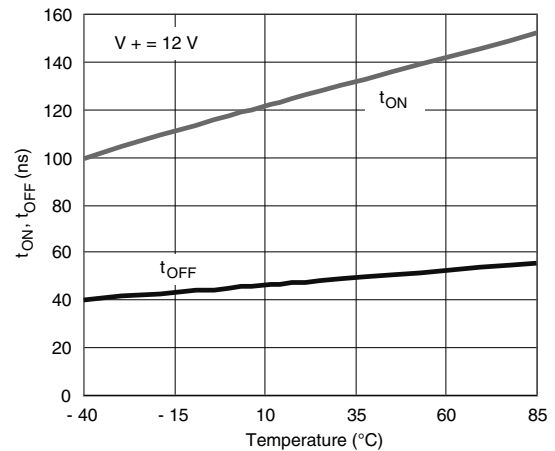
**Supply Current vs. Temperature**



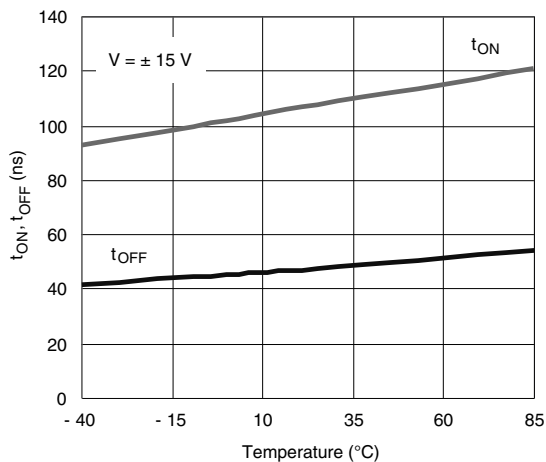
**Supply Current vs.  $V_{\text{IN}}$**



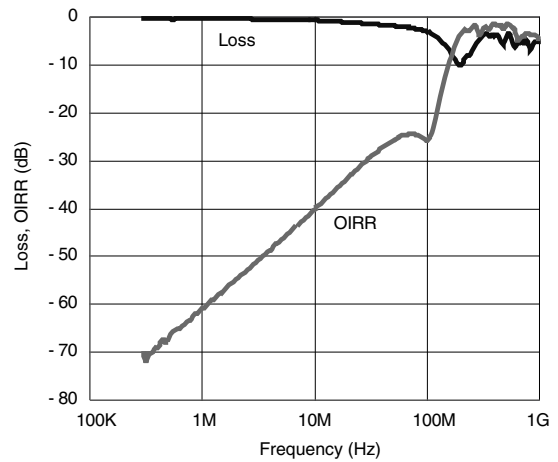
**Switching Time vs. Supply Voltages**



**Switching Time vs. Temperature**

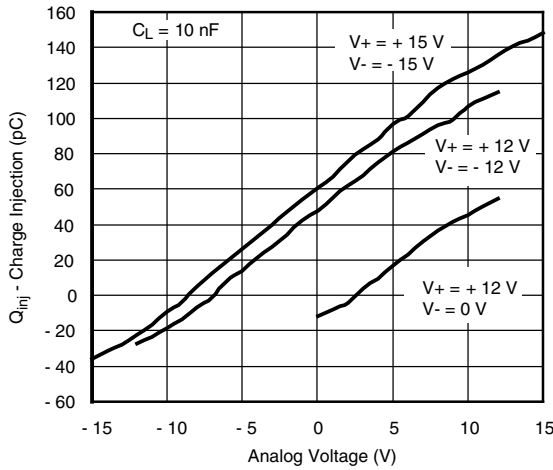


**Switching Time vs. Temperature**

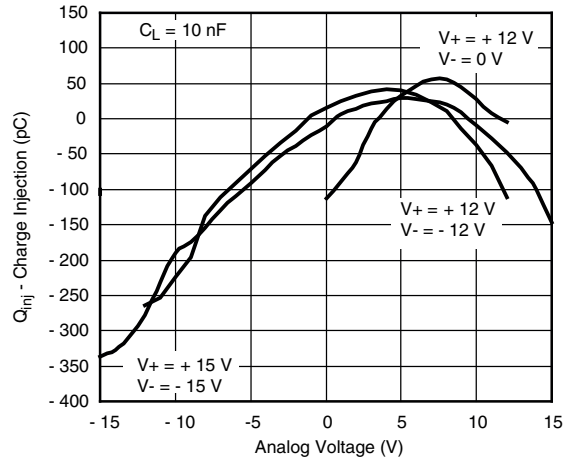


**Off Isolation and Insertion Loss vs. Frequency**

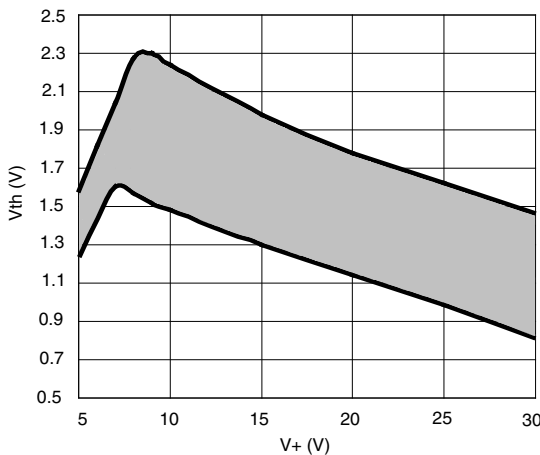
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



**Charge Injection vs. Analog Voltage  
(Measured at COM pin)**



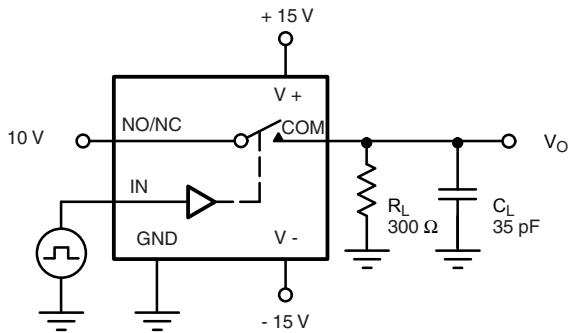
**Charge Injection vs. Analog Voltage  
(Measured at NC or NO pin)**



**Input Switching Threshold vs. Supply Voltage**

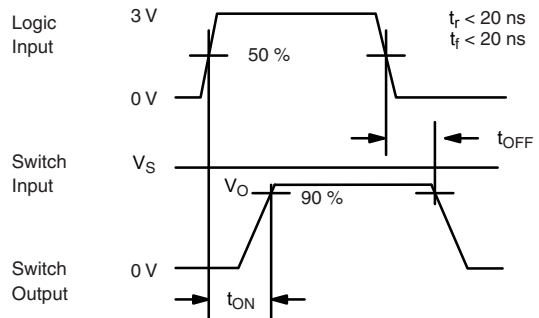
**TEST CIRCUITS**

$V_O$  is the steady state output with the switch on.



$C_L$  (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{ON}}$$

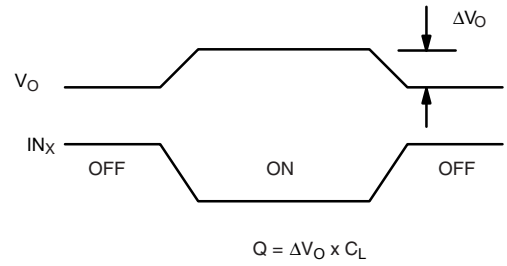
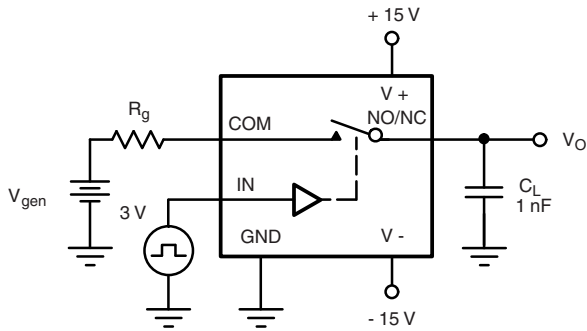


Note: Logic input waveform is inverted for switches that have the opposite logic sense.

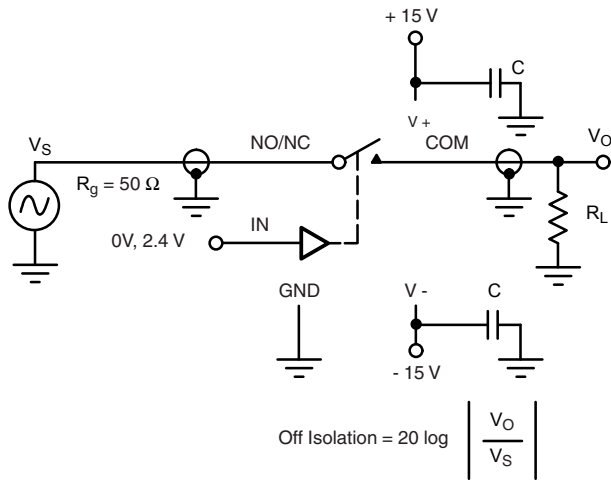
**Figure 1. Switching Time**

**TEST CIRCUITS**

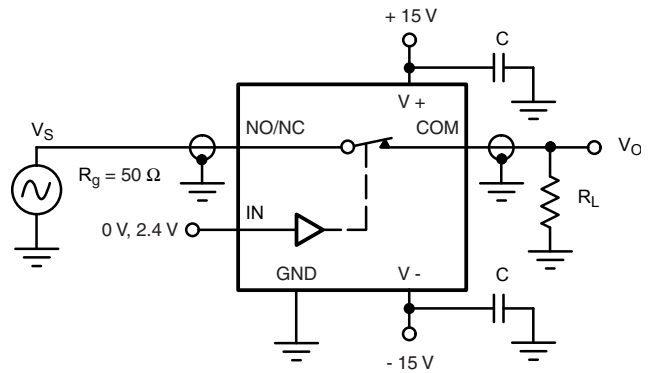
$V_O$  is the steady state output with the switch on.



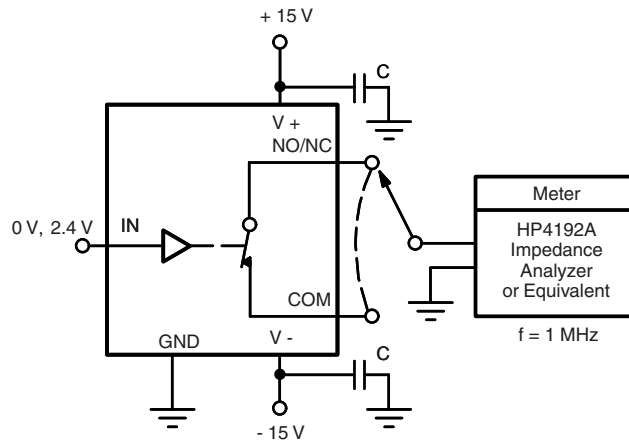
**Figure 2. Charge Injection**



**Figure 3. Off Isolation**

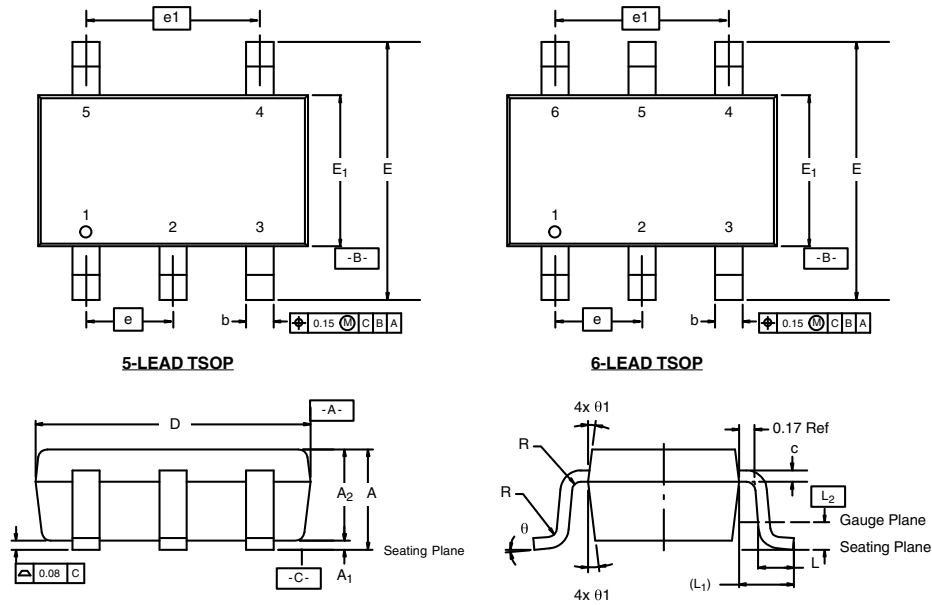


**Figure 4. Insertion Loss**



**Figure 5. Source/Drain Capacitances**

**TSOP: 5/6-LEAD**  
**JEDEC Part Number: MO-193C**



DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.91	-	1.10	0.036	-	0.043
A <sub>1</sub>	0.01	-	0.10	0.0004	-	0.004
A <sub>2</sub>	0.90	-	1.00	0.035	0.038	0.039
b	0.30	0.32	0.45	0.012	0.013	0.018
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.95	3.05	3.10	0.116	0.120	0.122
E	2.70	2.85	2.98	0.106	0.112	0.117
E <sub>1</sub>	1.55	1.65	1.70	0.061	0.065	0.067
e	0.95 BSC			0.0374 BSC		
e <sub>1</sub>	1.80	1.90	2.00	0.071	0.075	0.079
L	0.32	-	0.50	0.012	-	0.020
L <sub>1</sub>	0.60 Ref.			0.024 Ref.		
L <sub>2</sub>	0.25 BSC			0.010 BSC		
R	0.10	-	-	0.004	-	-
θ	0°	4°	8°	0°	4°	8°
θ <sub>1</sub>	7° Nom.			7° Nom.		

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## TSOP: 5/6-LEAD

JEDEC Part Number: MO-193C



5-LEAD TSOP



6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.91	-	1.10	0.036	-	0.043
<b>A<sub>1</sub></b>	0.01	-	0.10	0.0004	-	0.004
<b>A<sub>2</sub></b>	0.90	-	1.00	0.035	0.038	0.039
<b>b</b>	0.30	0.32	0.45	0.012	0.013	0.018
<b>c</b>	0.10	0.15	0.20	0.004	0.006	0.008
<b>D</b>	2.95	3.05	3.10	0.116	0.120	0.122
<b>E</b>	2.70	2.85	2.98	0.106	0.112	0.117
<b>E<sub>1</sub></b>	1.55	1.65	1.70	0.061	0.065	0.067
<b>e</b>	0.95 BSC			0.0374 BSC		
<b>e<sub>1</sub></b>	1.80	1.90	2.00	0.071	0.075	0.079
<b>L</b>	0.32	-	0.50	0.012	-	0.020
<b>L<sub>1</sub></b>	0.60 Ref			0.024 Ref		
<b>L<sub>2</sub></b>	0.25 BSC			0.010 BSC		
<b>R</b>	0.10	-	-	0.004	-	-
<b>θ</b>	0°	4°	8°	0°	4°	8°
<b>θ<sub>1</sub></b>	7° Nom			7° Nom		
ECN: C-06593-Rev. I, 18-Dec-06						
DWG: 5540						

## RECOMMENDED MINIMUM PADS FOR TSOP-6



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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