



# Precision Low-Voltage, Low-Glitch CMOS Analog Switches

## DESCRIPTION

Using BiCMOS wafer fabrication technology allows the DG9421, DG9422 to operate on single and dual supplies.

Designed for optimal performance at single 5 V and dual ± 5 V, the DG9421, DG9422 combine low and flat on-resistance (3 Ω), fast speed (t<sub>ON</sub> = 38 ns) and is well suited for applications where signal switching accuracy, low noise and low distortion is critical.

The DG9421 and DG9422 respond to opposite control logic as shown in the Truth Table.

## FEATURES

- 2.7 V thru 12 V single supply or ± 2.7 V thru ± 6 V dual supply
- Low on-resistance - R<sub>DS(on)</sub>: 2 Ω at 12 V
- Fast switching - t<sub>ON</sub>: 22 ns  
- t<sub>OFF</sub>: 28 ns
- TTL and low voltage logic
- Low leakage: 10 pA (typ.)
- > 2000 V ESD protection
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

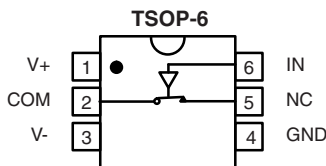
## BENEFITS

- High accuracy
- High speed, low glitch
- Single and dual supply capability
- Low R<sub>ON</sub> in small TSOP package
- Low leakage
- Low power consumption

## APPLICATIONS

- Automatic test equipment
- Data acquisition
- XDSL and DSLAM
- PBX systems
- Reed relay replacement
- Audio and video signal routing

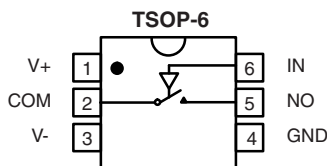
## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Top View

Device Marking:

DG9421DV = 4Exxx



Top View

Device Marking:

DG9422DV = 4Fxxx

TRUTH TABLE		
LOGIC	DG9421	DG9422
0	ON	OFF
1	OFF	ON

### Notes

- Logic "0" ≤ 0.8 V
- Logic "1" ≥ 2.4 V
- Switches shown for logic "0" input

ORDERING INFORMATION		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	6 / Pin TSOP	DG9421DV-T1 DG9421DV-T1-E3
		DG9422DV-T1 DG9422DV-T1-E3



ABSOLUTE MAXIMUM RATINGS			
PARAMETER	LIMIT		UNIT
V+ to V-	-0.3 to +13		V
GND to V-	7		
V <sub>IN</sub> <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub>	-0.3 to (V+ + 0.3) or 50 mA, whichever occurs first		V/mA
Continuous Current (any terminal)	50		mA
Peak Current, S or D (pulsed at 1 ms, 10 % duty cycle)	100		
Storage Temperature	-65 to +150		°C
Power Dissipation (Packages) <sup>b</sup>	6-Pin TSOP <sup>c</sup>	570	mW

**Notes**

- a. Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> 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 25 °C.

SPECIFICATIONS <sup>a</sup> (Single Supply 12 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 12 V, V- = 0 V, V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup>	TEMP. <sup>b</sup>	LIMITS -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>a</sup>	V <sub>ANALOG</sub>		Full	0	-	12	V
Drain-Source On-Resistance	R <sub>DS(on)</sub>	V+ = 10.8 V, V- = 0 V, I <sub>S</sub> = 5 mA, V <sub>D</sub> = 2 V/9 V	Room	-	2	3	Ω
			Full	-	2	3.4	
Switch Off Leakage Current	I <sub>S(off)</sub>	V <sub>D</sub> = 1/11 V, V <sub>S</sub> = 11 V/1 V	Room	-1	-	1	nA
			Full	-10	-	10	
	Room		-1	-	1		
	Full		-10	-	10		
Channel-On Leakage Current	I <sub>D(on)</sub>	V <sub>S</sub> = V <sub>D</sub> = 11 V/1 V	Room	-1	-	1	
			Full	-10	-	10	
<b>Digital Control</b>							
Input Current, V <sub>IN</sub> Low	I <sub>IL</sub>	V <sub>IN</sub> under test = 0.8 V	Full	-1	0.02	1	μA
Input Current, V <sub>IN</sub> High	I <sub>IH</sub>	V <sub>IN</sub> under test = 2.4 V	Full	-1	0.02	1	
<b>Dynamic Characteristics</b>							
Turn-On Time <sup>e</sup>	t <sub>ON</sub>	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF, V <sub>S</sub> = 5 V see figure 2	Room	-	20	45	ns
			Full	-	-	49	
Turn-Off Time <sup>e</sup>	t <sub>OFF</sub>		Room	-	25	47	
			Full	-	-	59	
Charge Injection <sup>e</sup>	Q	V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 1 nF	Room	-	43	-	pC
Off-Isolation <sup>e</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room	-	-60	-	dB
Source Off Capacitance <sup>e</sup>	C <sub>S(off)</sub>	f = 1 MHz	Room	-	31	-	pF
Drain Off Capacitance <sup>e</sup>	C <sub>D(off)</sub>		Room	-	30	-	
Channel On Capacitance <sup>e</sup>	C <sub>D(on)</sub>		Room	-	71	-	
<b>Power Supplies</b>							
Positive Supply Current	I+	V <sub>IN</sub> = 0 V or 12 V	Room	-	0.020	1	μA
			Full	-	-	5	
Negative Supply Current	I-		Room	-1	-0.002	-	
			Full	-5	-	-	
Ground Current	I <sub>GND</sub>		Room	-1	-0.002	-	
			Full	-5	-	-	



SPECIFICATIONS <sup>a</sup> (Dual Supply $\pm 5$ V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 5$ V, $V_- = -5$ V, $V_{IN} = 2.4$ V, $0.8$ V <sup>f</sup>	TEMP. <sup>b</sup>	LIMITS -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>	$V_{ANALOG}$		Full	-5	-	5	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_+ = 5$ V, $V_- = 5$ V $I_S = 5$ mA, $V_D = \pm 3.5$ V	Room	-	2.2	3.2	$\Omega$
			Full	-	-	3.6	
Switch Off Leakage Current <sup>g</sup>	$I_{S(off)}$	$V_+ = 5.5$ V, $V_- = 5.5$ V $V_D = \pm 4.5$ V, $V_S = \mp 4.5$ V	Room	-1	-	1	nA
			Full	-10	-	10	
	Room		-1	-	1		
	Full		-10	-	10		
Channel-On Leakage Current <sup>g</sup>	$I_{D(on)}$	$V_+ = 5.5$ V, $V_- = -5.5$ V $V_S = V_D = \pm 4.5$ V	Room	-1	-	1	nA
			Full	-10	-	10	
<b>Digital Control</b>							
Input Current, $V_{IN}$ Low <sup>e</sup>	$I_{IL}$	$V_{IN}$ under test = 0.8 V	Full	-1	0.02	1	$\mu$ A
Input Current, $V_{IN}$ High <sup>e</sup>	$I_{IH}$	$V_{IN}$ under test = 2.4 V	Full	-1	0.02	1	
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	$R_L = 300 \Omega$ , $C_L = 35$ pF, $V_S = \pm 3.5$ V see figure 2	Room	-	38	63	ns
			Full	-	-	68	
Turn-Off Time	$t_{OFF}$		Room	-	45	83	
			Full	-	-	97	
Charge Injection <sup>e</sup>	Q	$V_g = 0$ V, $R_g = 0 \Omega$ , $C_L = 1$ nF	Room	-	207	-	pC
Off-Isolation <sup>e</sup>	OIRR	$R_L = 50 \Omega$ , $C_L = 5$ pF, $f = 1$ MHz	Room	-	-57	-	dB
Source Off Capacitance <sup>e</sup>	$C_{S(off)}$	$f = 1$ MHz	Room	-	32	-	pF
Drain Off Capacitance <sup>e</sup>	$C_{D(off)}$		Room	-	31	-	
Channel On Capacitance <sup>e</sup>	$C_{D(on)}$		Room	-	71	-	
<b>Power Supplies</b>							
Positive Supply Current <sup>e</sup>	$I_+$	$V_{IN} = 0$ V or 5 V	Room	-	0.030	1	$\mu$ A
			Full	-	-	5	
Negative Supply Current <sup>e</sup>	$I_-$		Room	-1	-0.002	-	
			Full	-5	-	-	
Ground Current <sup>e</sup>	$I_{GND}$		Room	-1	-0.002	-	
			Full	-5	-	-	



SPECIFICATIONS <sup>a</sup> (Single Supply 5 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 5\text{ V}, V_- = 0\text{ V}, V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$	TEMP. <sup>b</sup>	LIMITS -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>	$V_{ANALOG}$		Full	0	-	5	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_+ = 4.5\text{ V}, I_S = 5\text{ mA}, V_D = 1\text{ V}, 3.5\text{ V}$	Room	-	3.6	6	$\Omega$
			Full	-	-	6.6	
<b>Dynamic Characteristics</b>							
Turn-On Time <sup>e</sup>	$t_{ON}$	$R_L = 300\ \Omega, C_L = 35\text{ pF}, V_S = 3.5\text{ V},$ see figure 2	Room	-	43	67	ns
			Hot	-	-	74	
Turn-Off Time <sup>e</sup>	$t_{OFF}$		Room	-	30	67	
			Hot	-	-	80	
Charge Injection <sup>e</sup>	Q	$V_g = 0\text{ V}, R_g = 0\ \Omega, C_L = 1\text{ nF}$	Room	-	25	-	pC
<b>Power Supplies</b>							
Positive Supply Current <sup>e</sup>	I+	$V_{IN} = 0\text{ V or } 5\text{ V}$	Room	-	0.020	1	$\mu\text{A}$
			Hot	-	-	5	
Negative Supply Current <sup>e</sup>	I-		Room	-1	-0.002	-	
			Hot	-5	-	-	
Ground Current <sup>e</sup>	$I_{GND}$		Room	-1	-0.002	-	
			Hot	-5	-	-	



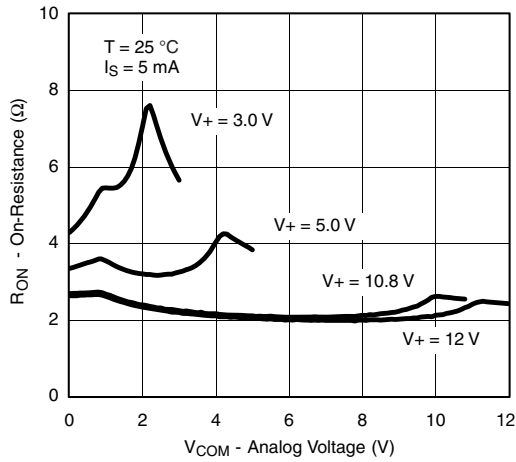
SPECIFICATIONS <sup>a</sup> (Single Supply 3 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 3\text{ V}, V_- = 0\text{ V}, V_{IN} = 0.4\text{ V}^f$	TEMP. <sup>b</sup>	LIMITS -40 °C to +85 °C			UNIT
				MIN. <sup>d</sup>	TYP. <sup>c</sup>	MAX. <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full	0	-	3	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_+ = 2.7\text{ V}, V_- = 0\text{ V}$ $I_S = 5\text{ mA}, V_D = 0.5\text{ V}, 2.2\text{ V}$	Room	-	7.3	8.8	$\Omega$
			Full	-	-	10.1	
Switch Off Leakage Current <sup>g</sup>	$I_{S(off)}$	$V_+ = 3.3\text{ V}, V_- = 0\text{ V}$ $V_S = 1, 2\text{ V}, V_D = 2\text{ V}, 1\text{ V}$	Room	-1	-	1	nA
			Full	-10	-	10	
	Room		-1	-	1		
	Full		-10	-	10		
Channel-On Leakage Current <sup>g</sup>	$I_{D(on)}$	$V_+ = 3.3\text{ V}, V_- = 0\text{ V}$ $V_D = V_S = 1\text{ V}, 2\text{ V}$	Room	-1	-	1	
			Full	-10	-	10	
<b>Digital Control</b>							
Input Current, $V_{IN}$ Low <sup>e</sup>	$I_{IL}$	$V_{IN}$ under test = 0.4 V	Full	-1	0.02	1	$\mu\text{A}$
Input Current, $V_{IN}$ High <sup>e</sup>	$I_{IH}$	$V_{IN}$ under test = 2.4 V	Full	-1	0.02	1	
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	$R_L = 300\ \Omega, C_L = 35\text{ pF}, V_S = 1.5\text{ V}$ see figure 2	Room		90	110	ns
			Full			125	
Turn-Off Time	$t_{OFF}$		Room		32	84	
			Full			99	
Charge Injection <sup>e</sup>	Q	$V_g = 0\text{ V}, R_g = 0\ \Omega, C_L = 1\text{ nF}$	Room		31		pC
Off-Isolation <sup>e</sup>	OIRR	$R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$	Room		-60		dB
Source Off Capacitance <sup>e</sup>	$C_{S(off)}$	f = 1 MHz	Room		35		pF
Drain Off Capacitance <sup>e</sup>	$C_{D(off)}$		Room		34		
Channel On Capacitance <sup>e</sup>	$C_{D(on)}$		Room		77		

**Notes**

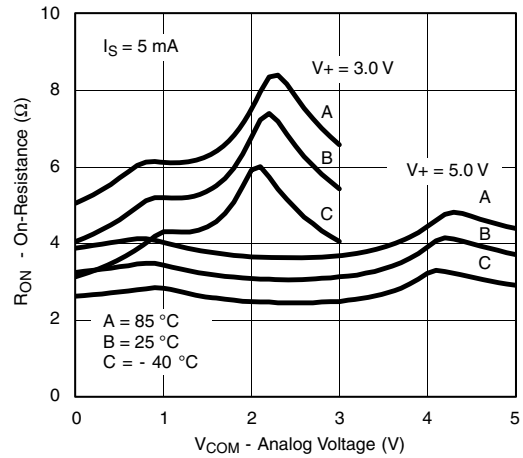
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guaranteed by design, not subject to production test.
- $V_{IN}$  = input voltage to perform proper function.
- Leakage parameters are guaranteed by worst case test conditions and not subject to test.

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.

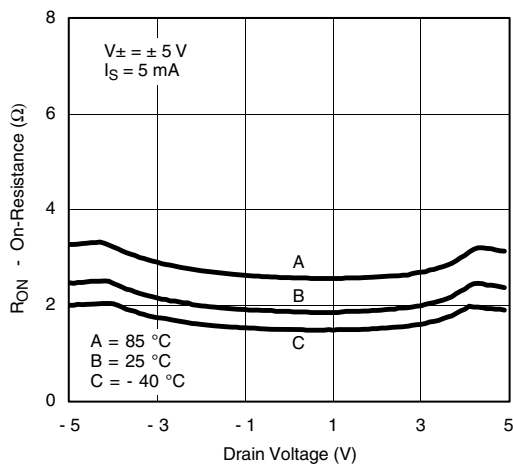
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



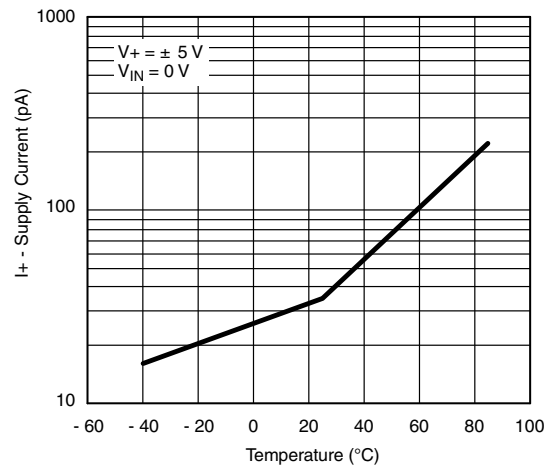
**RON vs. VCOM and Supply Voltage**



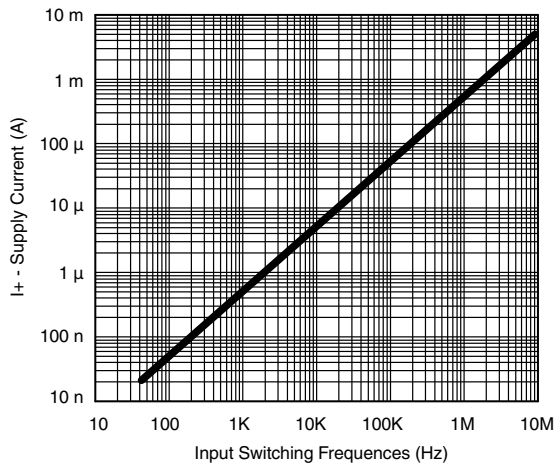
**RON vs. Analog Voltage and Temperature**



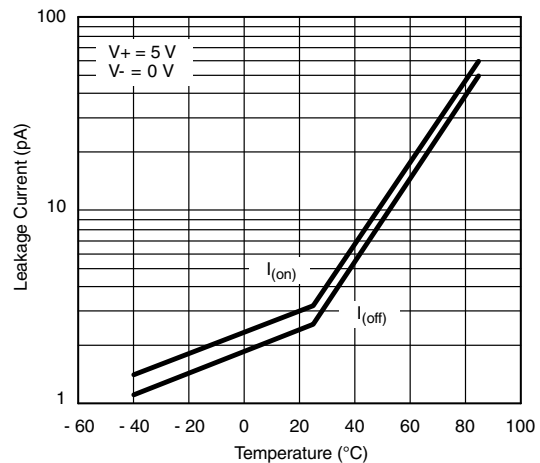
**RON vs. Analog Voltage and Temperature**



**Supply Current vs. Temperature**



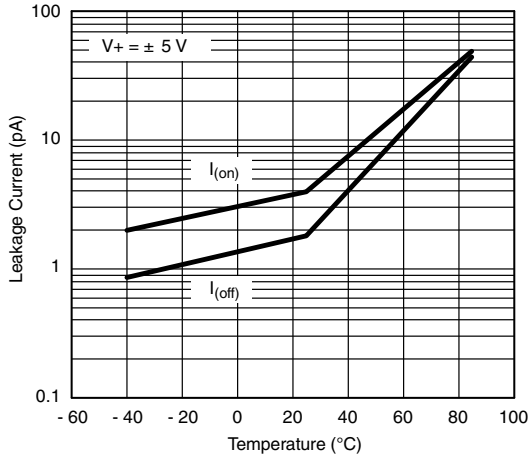
**Supply Current vs. Input Switching Frequency**



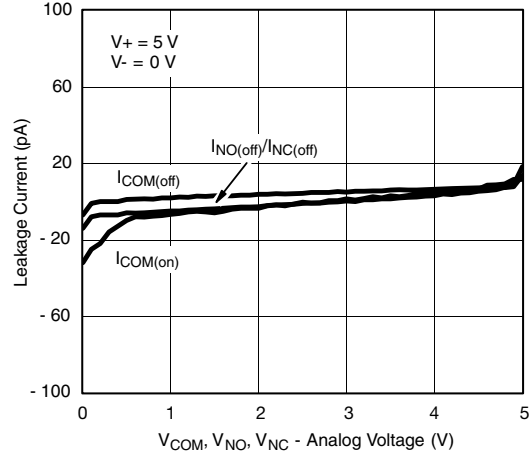
**Leakage Current vs. Temperature**



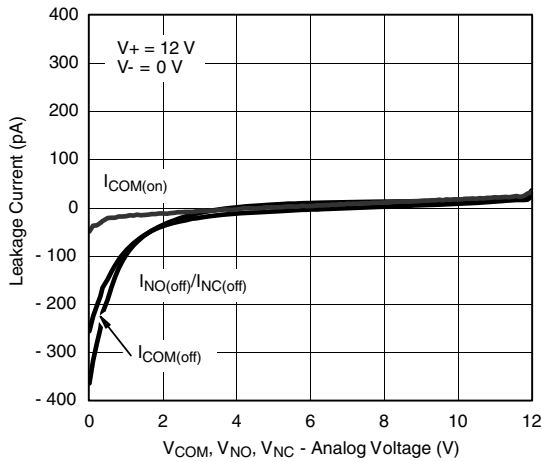
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



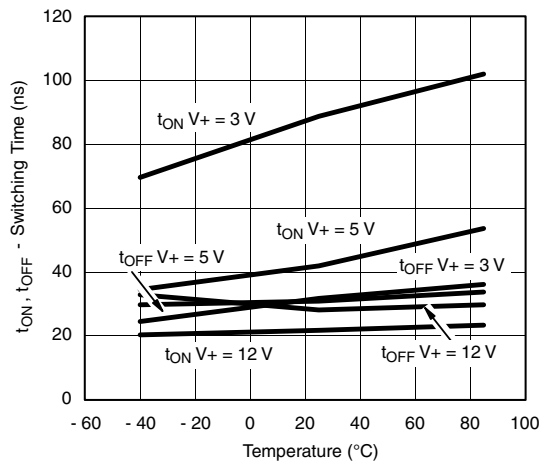
Leakage Current vs. Temperature



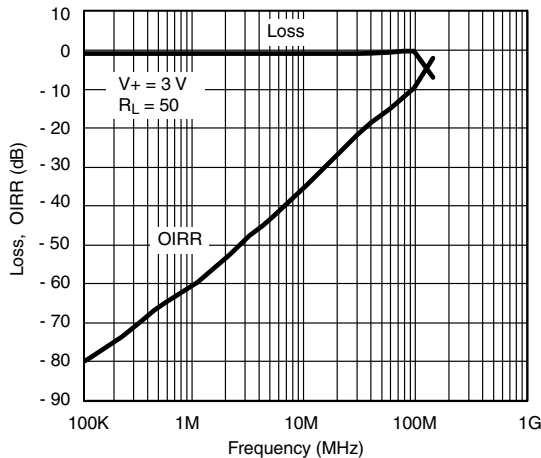
Leakage vs. Analog Voltage



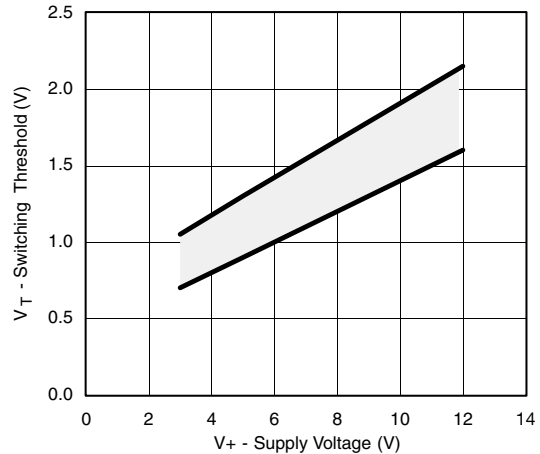
Leakage vs. Analog Voltage



Switching Time vs. Temperature and Supply Voltage (DG9421)

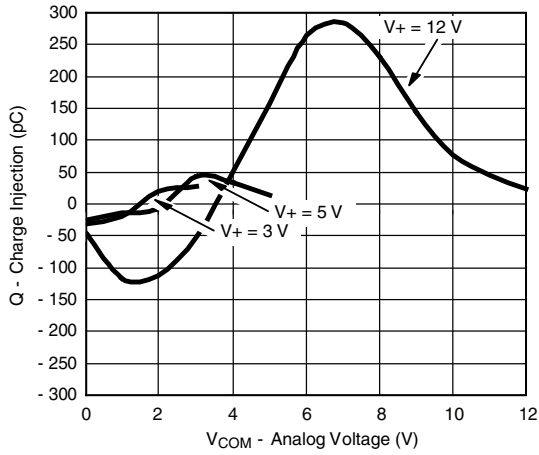


Insertion Loss, Off Isolation vs. Frequency

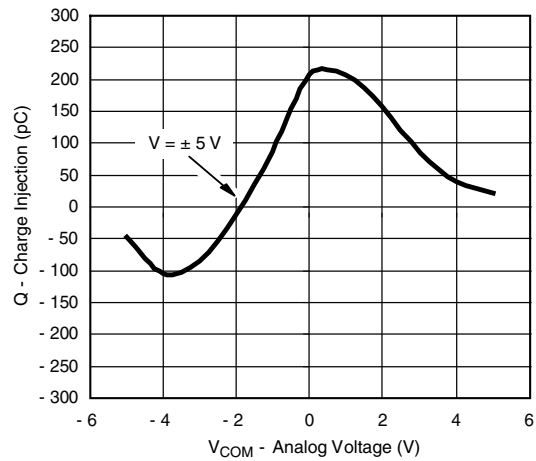


Switching Threshold vs. Supply Voltage

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



Charge Injection vs. Analog Voltage



Charge Injection vs. Analog Voltage

**SCHEMATIC DIAGRAM** (Typical Channel)

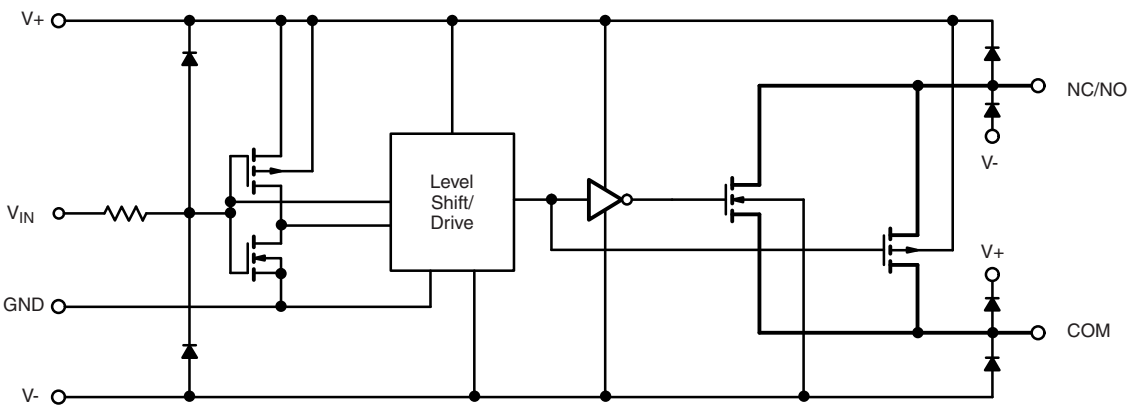
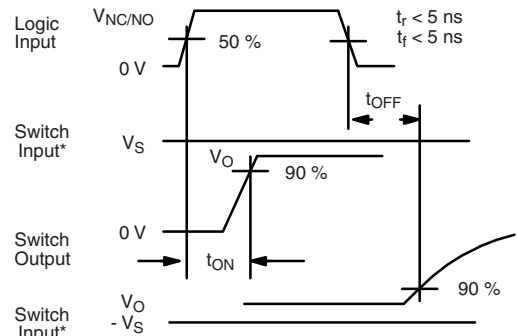
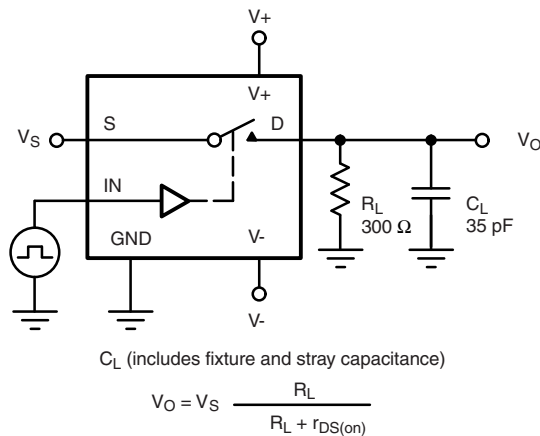


Fig. 1

**TEST CIRCUITS**

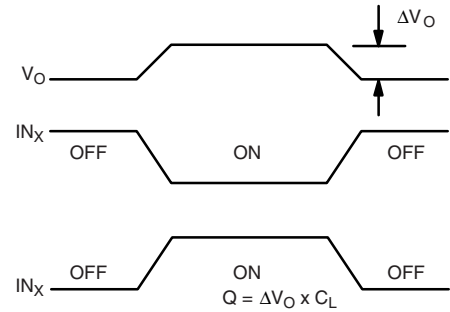
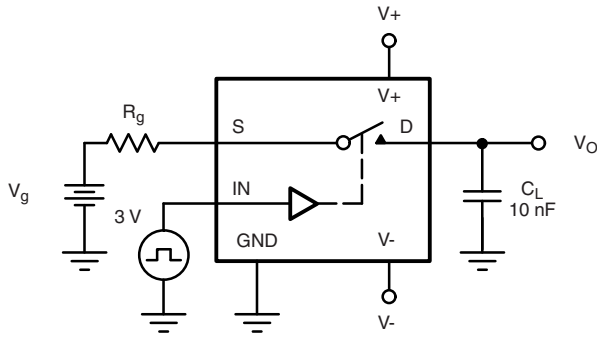


Note: \* Logic input waveform is inverted for switches that have the opposite logic sense control

Fig. 2 - Switching Time



TEST CIRCUITS



IN<sub>X</sub> dependent on switch configuration Input polarity determined by sense of switch.

Fig. 3 - Charge Injection

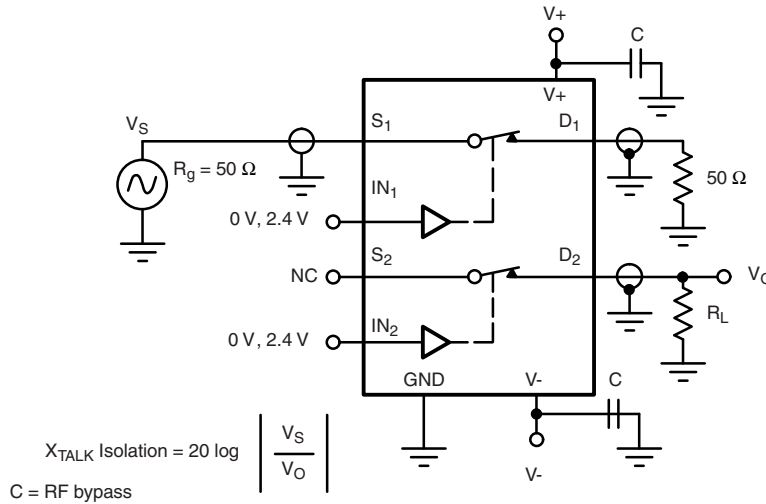


Fig. 4 - Crosstalk

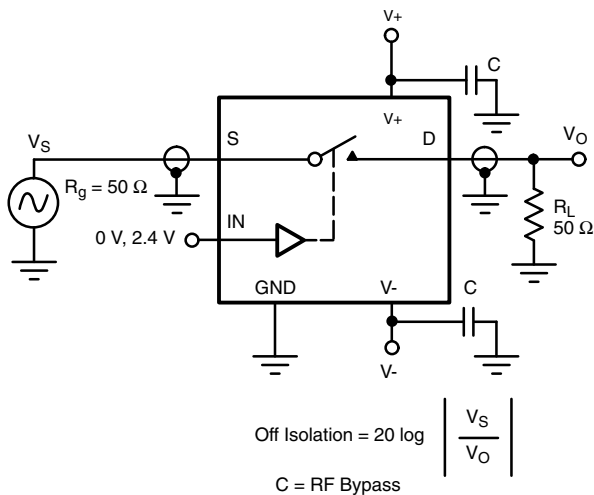


Fig. 5 - Off Isolation

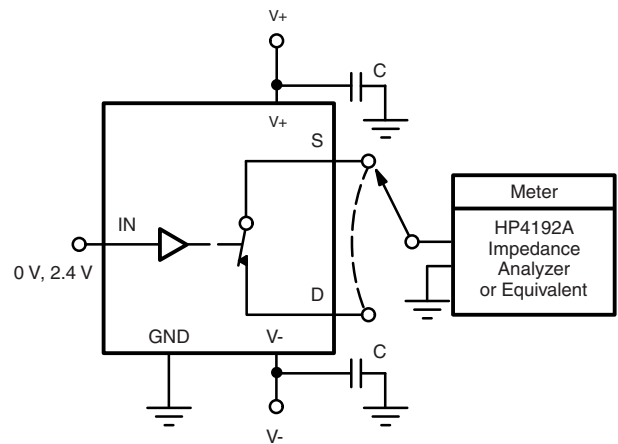
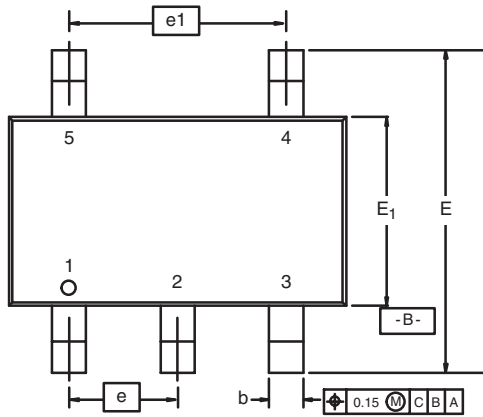


Fig. 6 - Source/Drain Capacitances

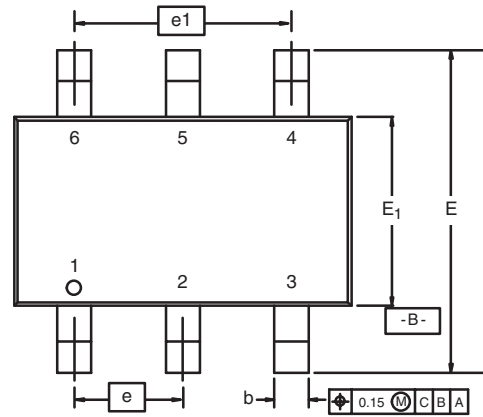
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## TSOP: 5/6-LEAD

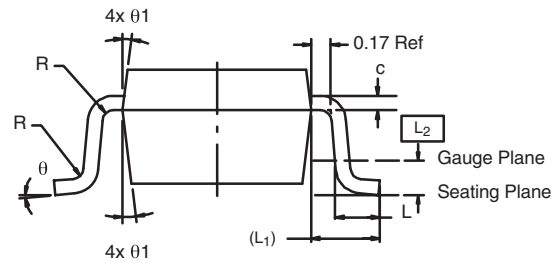
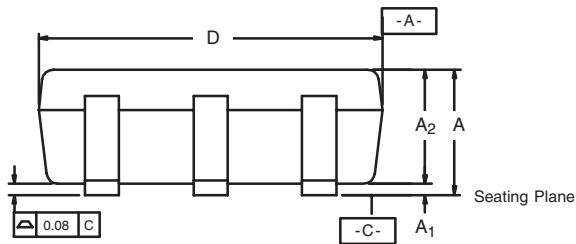
JEDEC Part Number: MO-193C



5-LEAD TSOP



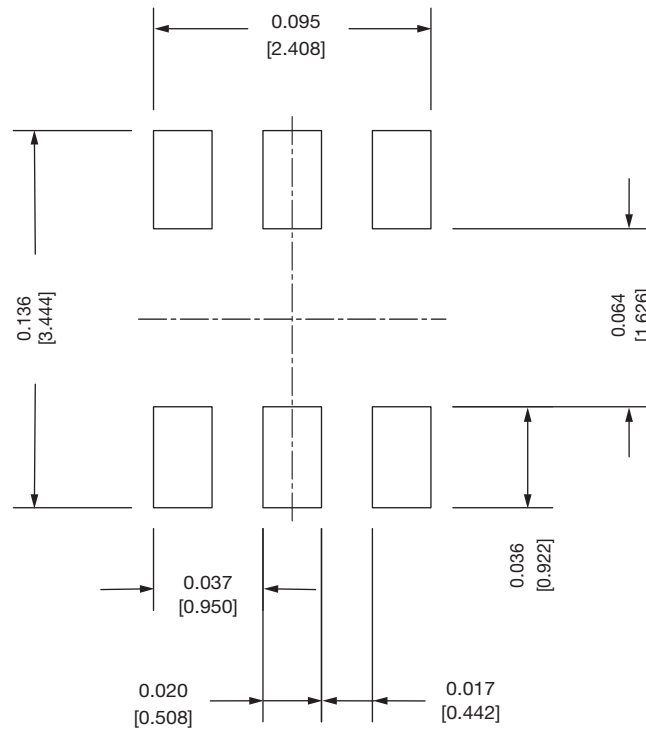
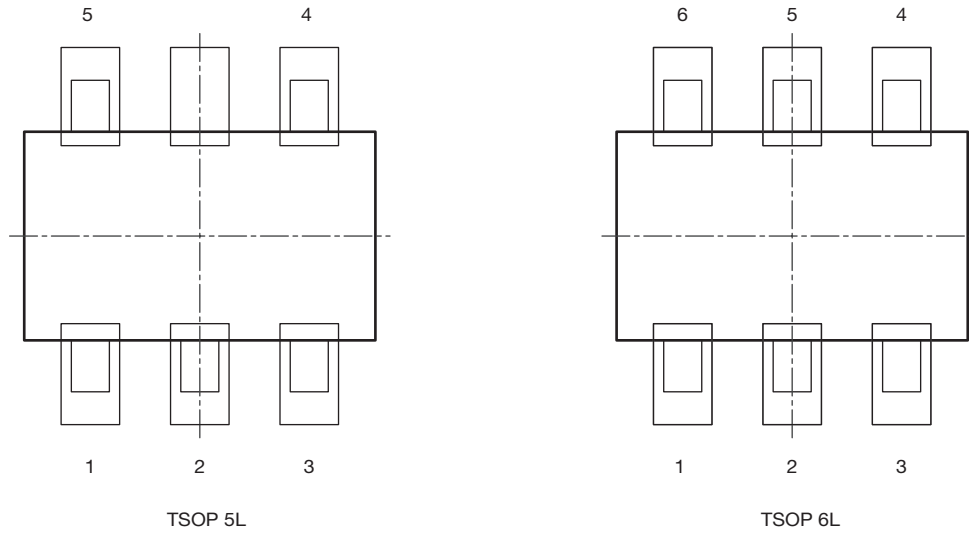
6-LEAD TSOP



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 Land Pattern For TSOP-5L / TSOP-6L



**Note**

- All dimensions are in inches (millimeter)

ECN: C22-0860-Rev. B, 24-Oct-2022  
 DWG: 3010



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