

## Powered-Off Protection, 0.85 $\Omega$ , 1.8 V to 5.5 V, SPDT Analog Switch (2:1 Multiplexer)

### DESCRIPTION

The DG2001E is a high performance single-pole, double-throw (SPDT) analog switch designed for 1.8 V to 5.5 V operation with a single power rail.

Fabricated with high density CMOS technology, the device achieves low on resistance of 0.85  $\Omega$  at a 5 V power supply, low power consumption, and fast switching speeds.

The DG2001E can handle both analog and digital signals and permits signals with amplitudes of up to  $V_+$  to be transmitted in either direction. Its control logic inputs can go over  $V_+$  up to 5.5 V. The control logic input high threshold is guaranteed as low as 1.8 V over the power supply range up to 5.5 V. It features break before make switching performance.

A powered-off protection circuit is built into the switch to prevent an abnormal current flow from COM pin to  $V_+$  during the power-down condition. Each output pin can withstand greater than 7 kV (human body model).

Operation temperature is specified from -40  $^{\circ}\text{C}$  to +85  $^{\circ}\text{C}$ . The DG2001E is available in TSOP-6 package.

### FEATURES

- Low switch on-resistance (0.85  $\Omega$ )
- 1.8 V to 5.5 V single supply operation
- Isolation in powered-off mode
- Guaranteed 1.8 V logic high
- Control logic inputs can go over  $V_+$
- Low charge injection (8 pC)
- Break before make switching
- Latch-up performance exceeds 300 mA per JESD 78
- ESD tested
  - 7000 V human body model (JS-001)
  - 1000 V charge device model (JS-002)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

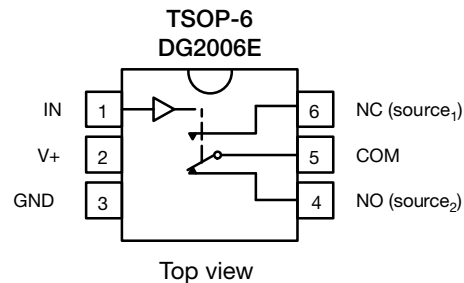
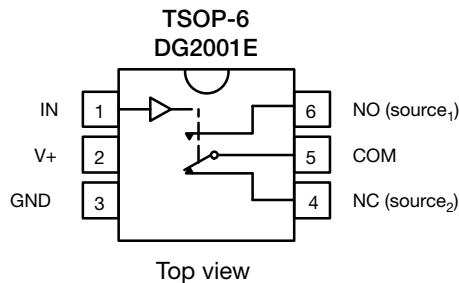


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

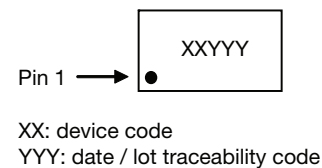
### APPLICATIONS

- Consumer and computing
- Portable instrumentation
- Medical equipment
- Battery operated systems

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE		
LOGIC	NC	NO
0	On	Off
1	Off	On



ORDERING INFORMATION			
TEMP RANGE	PACKAGE	PART NUMBER	MARKING CODE
-40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$	TSOP-6	DG2001EDV-T1-GE3	H1
		DG2006EDV-T1-GE3	I1



ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted)				
PARAMETER			LIMIT	UNIT
V+, COM, NC, NO, IN reference to GND			-0.3 to 6	V
Continuous current (any terminal)			± 50	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)			± 200	
Storage temperature (D suffix)			-65 to +125	°C
Power dissipation (packages) <sup>a</sup>	TSOP-6 <sup>b</sup>		570	mW
ESD / HBM	JS-001		7000	V
ESD / CDM	JS-002		1000	
Latch up	Per JEDEC78 with 1.5 x voltage clamp		300	mA

**Notes**

- a. All leads welded or soldered to PC board
- b. Derate 7 mW/°C above 25 °C

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.

SPECIFICATIONS (V <sub>+</sub> = 5 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V <sub>+</sub> = 5 V, ± 10 % V <sub>IN</sub> = 0.8 V or 2.4 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 <sub>+</sub>	V
On-resistance	R <sub>ON</sub>	V <sub>+</sub> = 4.5 V V <sub>COM</sub> = 3 V, I <sub>NO</sub> , I <sub>NC</sub> = 10 mA	Room	-	0.85	1.6	Ω
			Full	-	-	1.8	
R <sub>ON</sub> flatness <sup>d</sup>	R <sub>ON</sub> Flatness	V <sub>+</sub> = 4.5 V V <sub>COM</sub> = 0 V to V <sub>+</sub> , I <sub>NO</sub> , I <sub>NC</sub> = 10 mA	Room	-	0.3	-	
Switch off leakage current <sup>g</sup>	I <sub>NO(off)</sub> I <sub>NC(off)</sub>	V <sub>+</sub> = 5.5 V V <sub>NO</sub> , V <sub>NC</sub> = 1 V / 4.5 V, V <sub>COM</sub> = 4.5 V / 1 V	Room	-5	-	5	nA
			Full	-30	-	30	
	Room		-5	-	5		
	Full		-30	-	30		
Channel-on leakage current <sup>g</sup>	I <sub>COM(on)</sub>	V <sub>+</sub> = 5.5 V V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V / 4.5 V	Room	-5	-	5	
			Full	-30	-	30	
Power down leakage	I <sub>COM(PD)</sub>	V <sub>+</sub> = 0 V, V <sub>COM</sub> = 4.5 V, V <sub>IN</sub> = GND	Full <sup>d</sup>	-	-	1	μA
<b>Digital Control</b>							
Input high voltage	V <sub>INH</sub>		Full	2.4	-	-	V
Input low voltage	V <sub>INL</sub>		Full	-	-	0.8	
Input capacitance	C <sub>IN</sub>		Full	-	3	-	pF
Input current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 V or V <sub>+</sub>	Full	-1	-	1	μA
<b>Dynamic Characteristics</b>							
Turn-on time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room	-	15	32	ns
			Full	-	-	35	
Turn-off time	t <sub>OFF</sub>		Room	-	6	26	
			Full	-	-	31	
Break-before-make time	t <sub>d</sub>		Room	1	4	-	
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	-	8	-	pC
Off-isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room	-	-63	-	dB
Crosstalk <sup>d</sup>	X <sub>TALK</sub>		Room	-	-63	-	
Source-off capacitance <sup>d</sup>	C <sub>NO(off)</sub> C <sub>NC(off)</sub>	V <sub>IN</sub> = 0 V or V <sub>+</sub> , f = 1 MHz	Room	-	16	-	pF
Channel-on capacitance <sup>d</sup>	C <sub>ON</sub>		Room	-	53	-	
<b>Power Supply</b>							
Power supply current	I <sub>+</sub>	V <sub>IN</sub> = 0 V or V <sub>+</sub>	Full	-	0.0003	1	μA



SPECIFICATIONS ( $V_+ = 3\text{ V}$ )								
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 3\text{ V}, \pm 10\%$ $V_{IN} = 0.4\text{ V}$ or $2\text{ V}^e$	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	$R_{ON}$	$V_+ = 2.7\text{ V}$ $V_{COM} = 1.5\text{ V}, I_{NO}, I_{NC} = 10\text{ mA}$	Room	-	1.6	2.2	$\Omega$	
			Full	-	-	2.6		
$R_{ON}$ flatness <sup>d</sup>	$R_{ON}$ Flatness	$V_+ = 2.7\text{ V}$ $V_{COM} = 0\text{ V}$ to $V_+, I_{NO}, I_{NC} = 10\text{ mA}$	Room	-	0.6	-		
Switch off leakage current <sup>g</sup>	$I_{NO(off)}$ $I_{NC(off)}$	$V_+ = 3.3\text{ V}$ $V_{NO}, V_{NC} = 1\text{ V} / 3\text{ V}, V_{COM} = 3\text{ V} / 1\text{ V}$	Room	-5	-	5	nA	
			Full	-15	-	15		
	Room		-5	-	5			
	Full		-15	-	15			
Channel-on leakage current <sup>g</sup>	$I_{COM(on)}$	$V_+ = 3.3\text{ V}$ $V_{NO}, V_{NC} = V_{COM} = 1\text{ V} / 3\text{ V}$	Room	-5	-	5		
			Full	-15	-	15		
<b>Digital Control</b>								
Input high voltage	$V_{INH}$		Full	2	-	-	V	
Input low voltage	$V_{INL}$		Full	-	-	0.4		
Input capacitance	$C_{IN}$		Full	-	-	-	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	$t_{ON}$	$V_{NO}$ or $V_{NC} = 2\text{ V}, R_L = 300\ \Omega, C_L = 35\text{ pF}$	Room	-	21	42	ns	
			Full	-	-	47		
Turn-off time	$t_{OFF}$		Room	-	9	32		
			Full	-	-	35		
Break-before-make time	$t_d$			Room	1	7	-	
Charge injection <sup>d</sup>	$Q_{INJ}$		$C_L = 1\text{ nF}, V_{GEN} = 0\text{ V}, R_{GEN} = 0\ \Omega$	Room	-	6	-	pC
Off-isolation <sup>d</sup>	OIRR		$R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$	Room	-	-63	-	dB
Crosstalk <sup>d</sup>	$X_{TALK}$			Room	-	-63	-	
$N_O, N_C$ off capacitance <sup>d</sup>	$C_{NO(off)}$ $C_{NC(off)}$		$V_{IN} = 0\text{ V}$ or $V_+, f = 1\text{ MHz}$	Room	-	16	-	pF
Channel-on capacitance <sup>d</sup>	$C_{ON}$			Room	-	54	-	
<b>Power Supply</b>								
Power supply current	$I_+$	$V_{IN} = 0\text{ V}$ or $V_+$	Full	-	0.00002	1	$\mu\text{A}$	



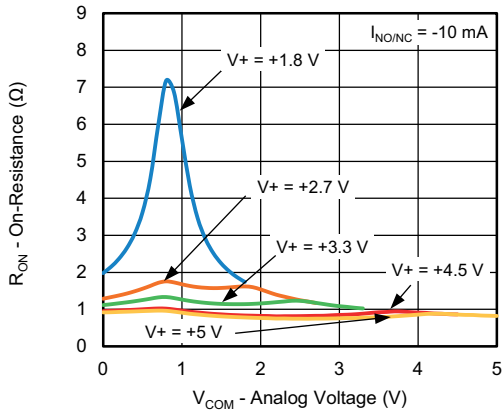
SPECIFICATIONS (V+ = 2 V)									
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 2 V, ± 10 % VIN = 0.4 V or 1.6 V <sup>e</sup>	TEMP. <sup>a</sup>	LIMITS -40 °C to +85 °C			UNIT		
				MIN. <sup>b</sup>	TYP. <sup>c</sup>	MAX. <sup>b</sup>			
<b>Analog Switch</b>									
Analog signal 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+ = 1.8 V V <sub>COM</sub> = 1 V, I <sub>NO</sub> , I <sub>NC</sub> = 10 mA	Room	-	6	8	Ω		
			Full	-	-	10			
R <sub>ON</sub> flatness <sup>d</sup>	R <sub>ON</sub> Flatness	V+ = 1.8 V V <sub>COM</sub> = 0 V to V+, I <sub>NO</sub> , I <sub>NC</sub> = 10 mA	Room	-	6	-			
Switch off leakage current <sup>g</sup>	I <sub>NO(off)</sub> I <sub>NC(off)</sub>	V+ = 2.2 V V <sub>NO</sub> , V <sub>NC</sub> = 0.5 V / 1.5 V, V <sub>COM</sub> = 1.5 V / 0.5 V	Room	-0.5	-	0.5	nA		
			Full	-5	-	5			
	Room		-0.5	-	0.5				
	Full		-5	-	5				
Channel-on leakage current <sup>g</sup>	I <sub>COM(on)</sub>	V+ = 2.2 V V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.5 V / 1.5 V	Room	-0.5	-	0.5			
			Full	-5	-	5			
<b>Digital Control</b>									
Input high voltage	V <sub>INH</sub>		Full	1.6	-	-	V		
Input low voltage	V <sub>INL</sub>		Full	-	-	0.4			
Input capacitance	C <sub>IN</sub>		Full	-	3	-	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 <sub>NO</sub> or V <sub>NC</sub> = 1.5 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room	-	36	51	ns		
			Full	-	-	62			
Turn-off time	t <sub>OFF</sub>		Room	-	16	40			
			Full	-	-	43			
Break-before-make time	t <sub>d</sub>			Room	1	16		-	
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	-	21		-	pC
Off-isolation <sup>d</sup>	OIRR		R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room	-	-63		-	dB
Crosstalk <sup>d</sup>	X <sub>TALK</sub>			Room	-	-63		-	
N <sub>O</sub> , N <sub>C</sub> off capacitance <sup>d</sup>	C <sub>NO(off)</sub> C <sub>NC(off)</sub>	V <sub>IN</sub> = 0 V or V+, f = 1 MHz	Room	-	16	-	pF		
			Channel-on capacitance <sup>d</sup>	C <sub>ON</sub>	Room	-		52	-
<b>Power Supply</b>									
Power supply current	I+	V <sub>IN</sub> = 0 V or V+	Full	-	0.00001	1	μA		

**Notes**

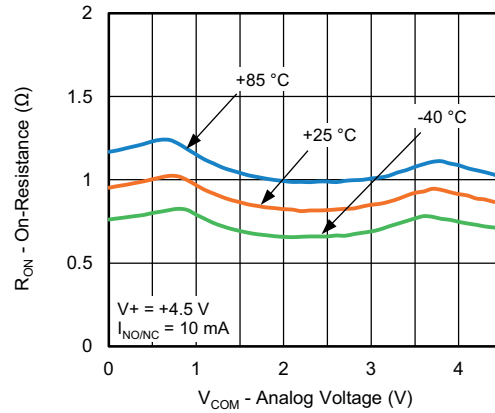
- a. Room = 25 °C, full = as determined by the operating suffix
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
- c. Typical values are for design aid only, not guaranteed nor subject to production testing
- d. Guarantee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



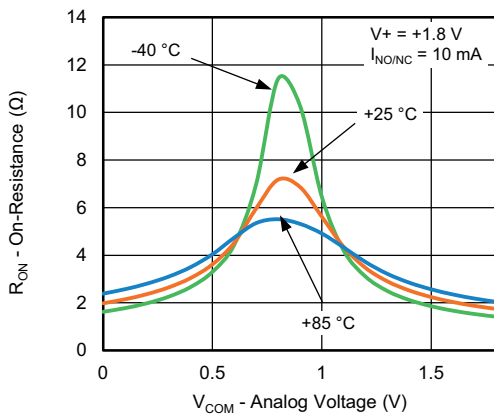
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



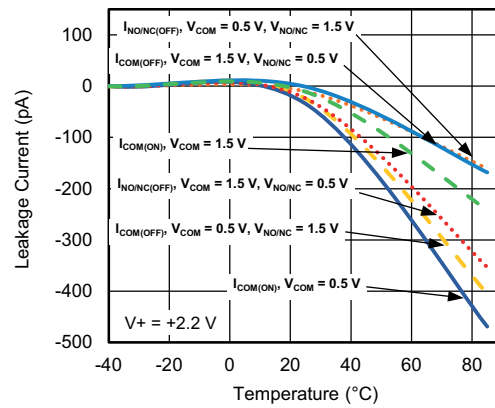
R<sub>DS(on)</sub> vs. V<sub>COM</sub> and Supply Voltage



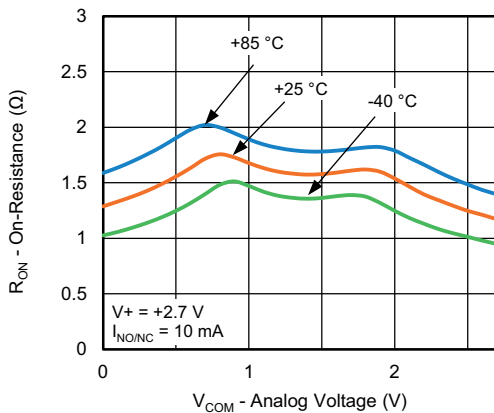
R<sub>DS(on)</sub> vs. V<sub>COM</sub> and Temperature



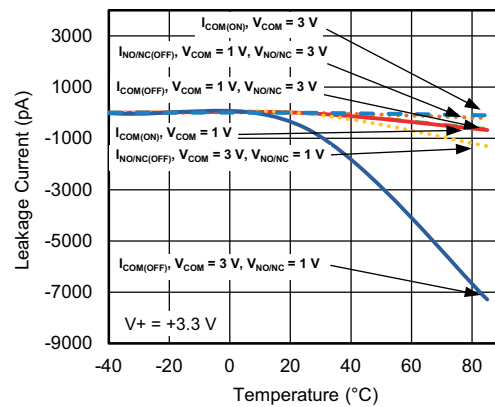
R<sub>DS(on)</sub> vs. V<sub>COM</sub> and Temperature



Leakage Current vs. Temperature



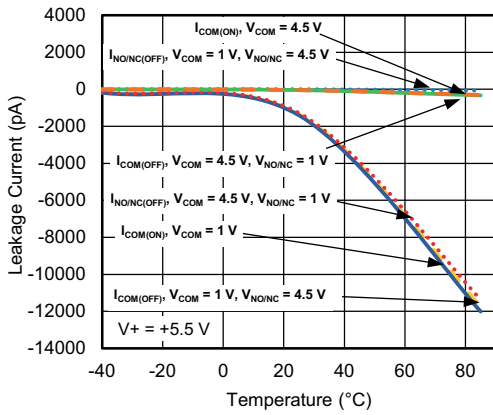
R<sub>DS(on)</sub> vs. V<sub>COM</sub> and Temperature



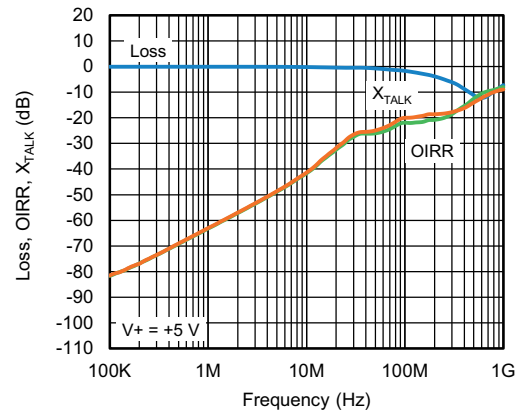
Leakage Current vs. Temperature



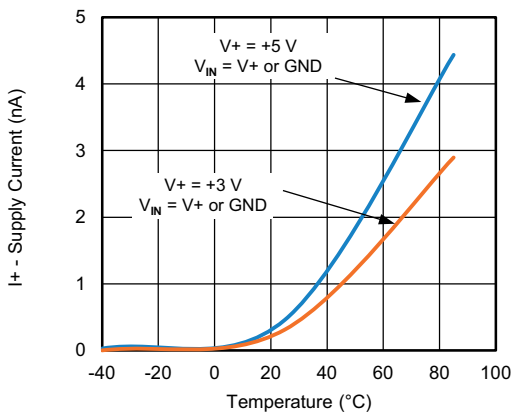
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



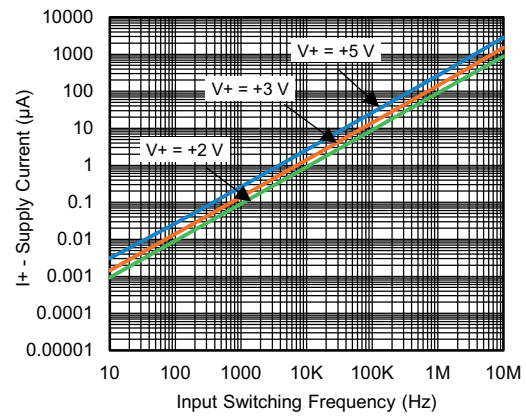
Leakage Current vs. Temperature



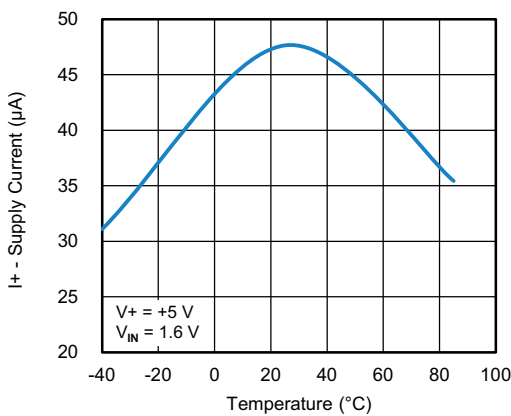
Insertion Loss, Off-Isolation Crosstalk vs. Frequency



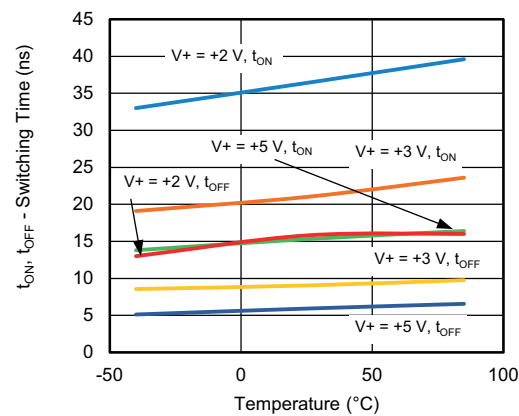
Supply Current vs. Temperature



Supply Current vs. Input Switching Frequency



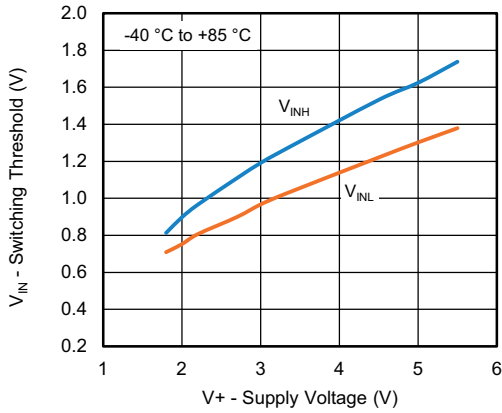
Supply Current vs. Temperature



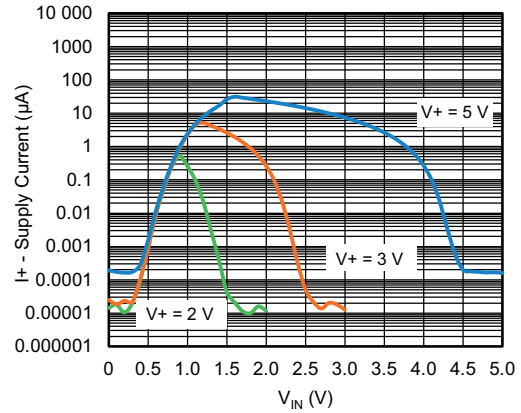
Switching Time vs. Temperature and Supply Voltage



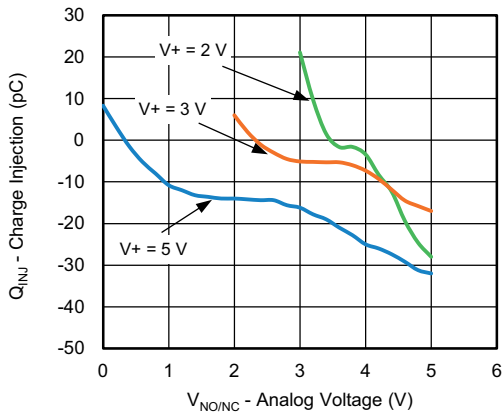
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



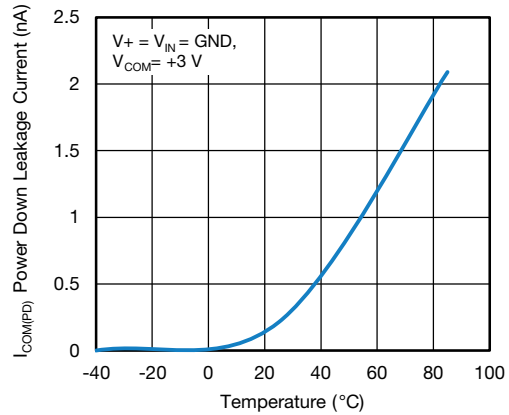
Switching Threshold vs. Supply Voltage



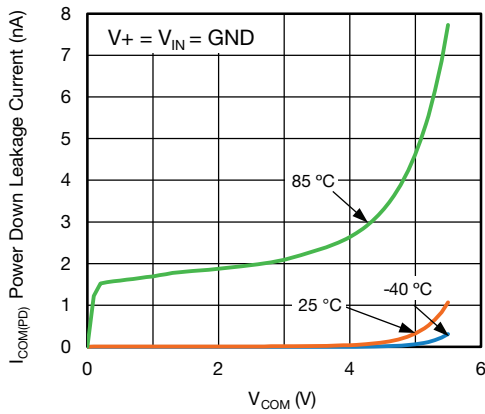
Supply Current vs. Enable Input Voltage



Charge Injection vs. Analog Voltage

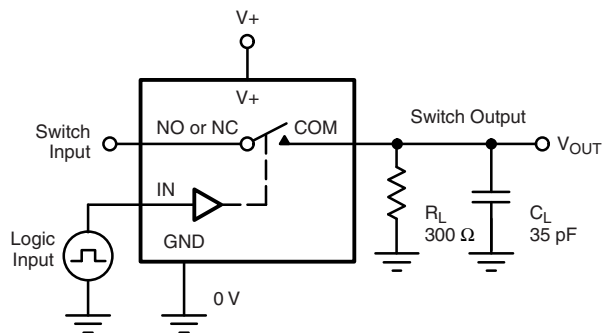


Power Down Leakage Current vs. Temperature



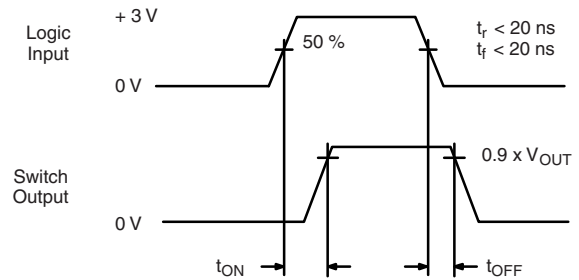
Power Down Leakage Current vs. V\_COM

TEST CIRCUITS



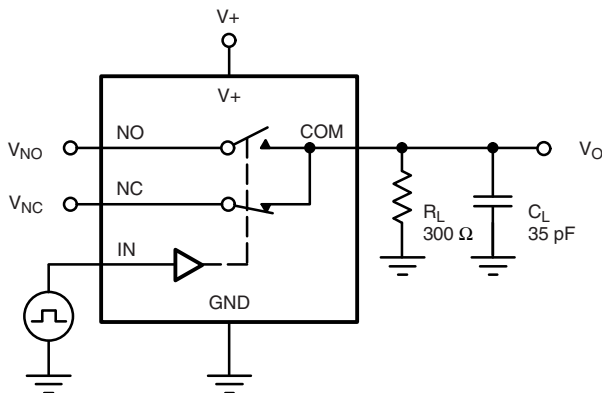
$C_L$  (includes fixture and stray capacitance)

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



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)

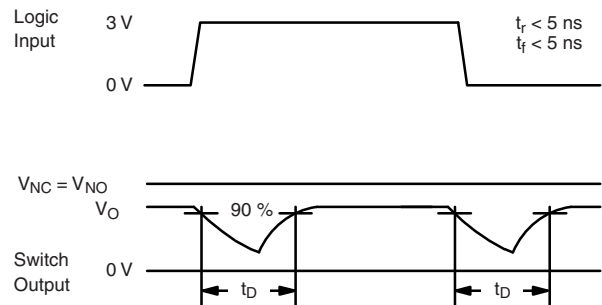
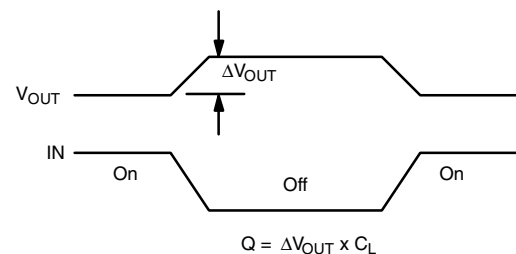
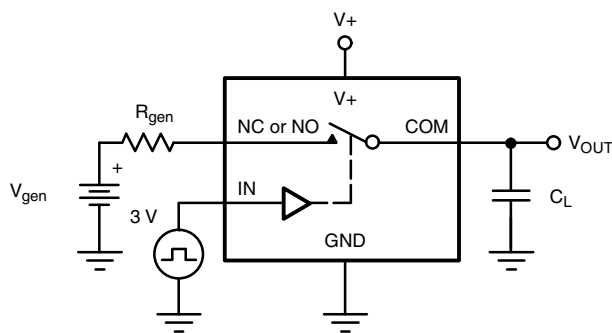


Fig. 2 - Break-Before-Make Interval



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

Fig. 3 - Charge Injection



TEST CIRCUITS

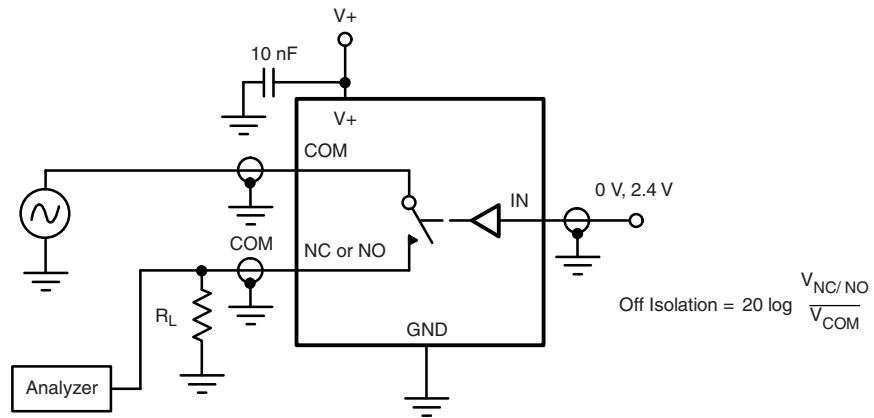


Fig. 4 - Off-Isolation

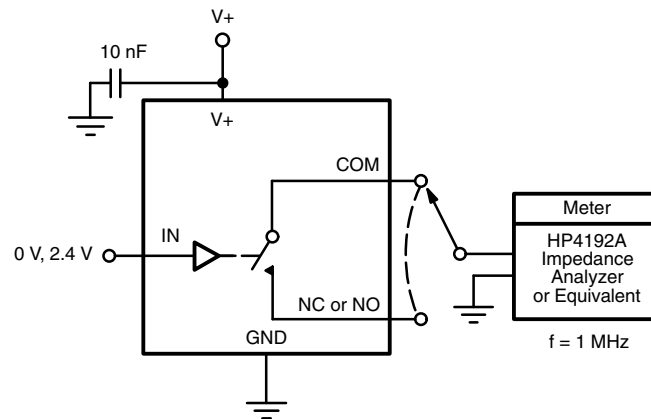


Fig. 5 - Channel Off / On Capacitance

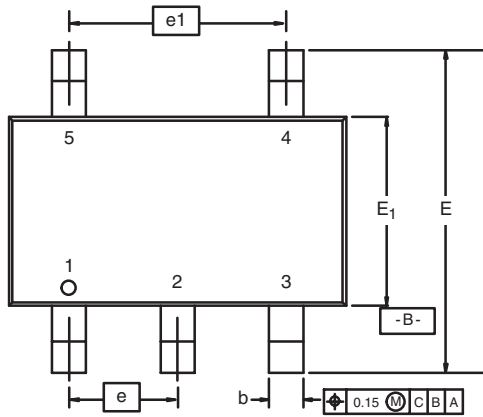


PRODUCT SUMMARY	
Part number	DG2001E
Status code	2
Configuration	SPDT x 1
Single supply min. (V)	1.8
Single supply max. (V)	5.5
Dual supply min. (V)	-
Dual supply max. (V)	-
On-resistance ( $\Omega$ )	0.85
Charge injection (pC)	8
Source on capacitance (pF)	53
Source off capacitance (pF)	16
Leakage switch on typ. (nA)	0.05
Leakage switch off max. (nA)	5
-3 dB bandwidth (MHz)	-
Package	TSOP-6
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare, portable
Interface	Binary
Single supply operation	Yes
Dual supply operation	-
Turn on time max. (ns)	32
Crosstalk and off isolation	-63

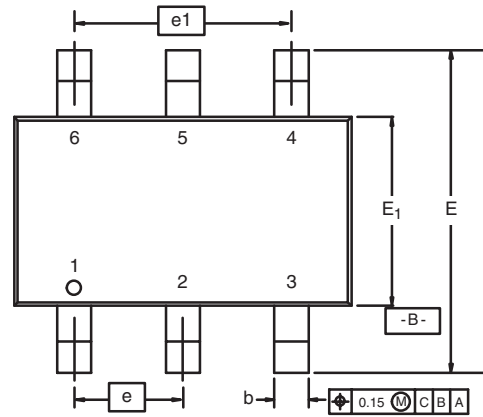
Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package / tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?76471](http://www.vishay.com/ppg?76471).

## TSOP: 5/6-LEAD

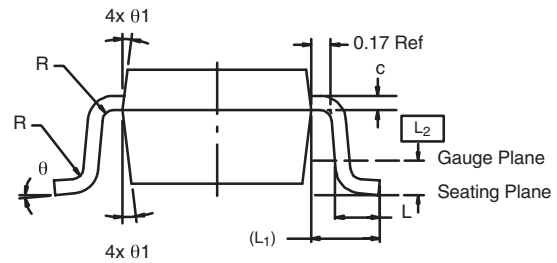
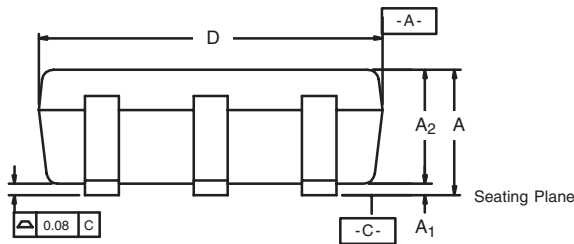
JEDEC Part Number: MO-193C



**5-LEAD TSOP**



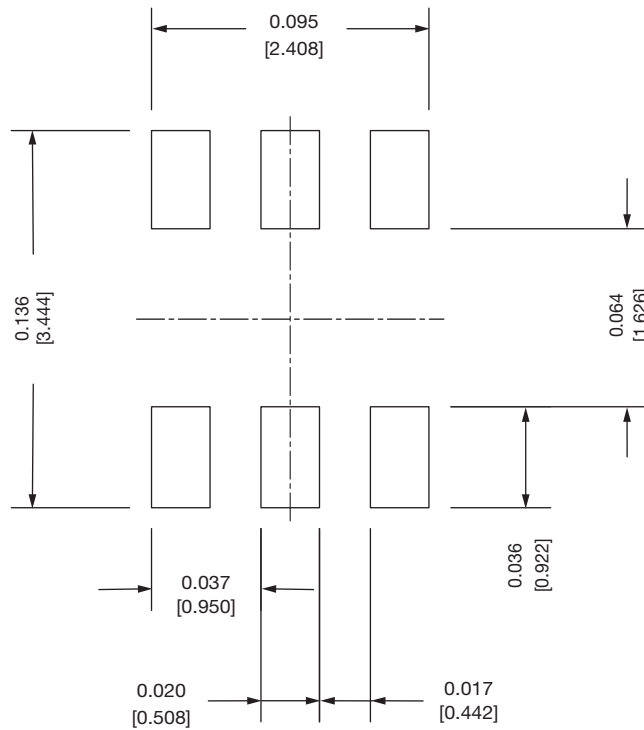
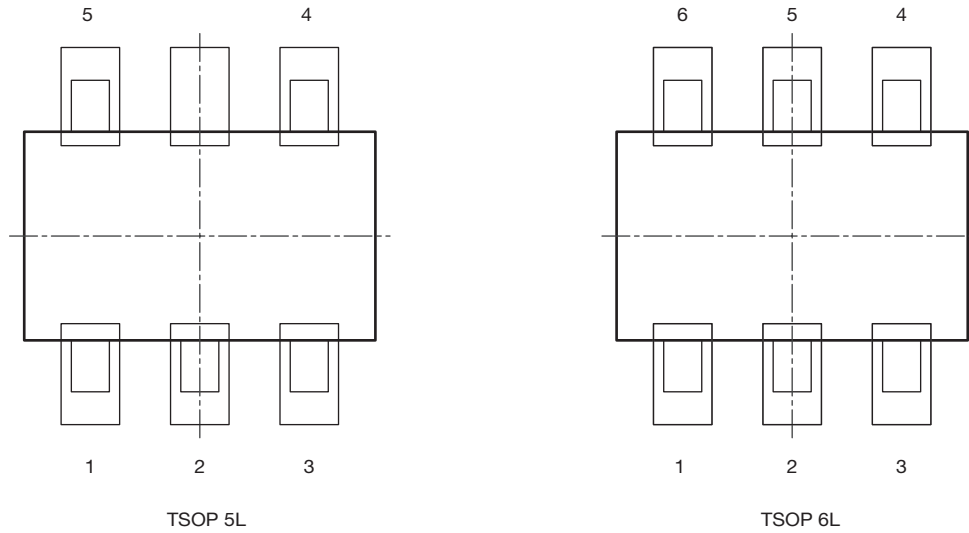
**6-LEAD TSOP**



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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