

Powered-off Protection, 0.85 Ω, 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 Ω 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 °C to +85 °C. The DG2001E is available in TSOP-6 package.

FEATURES

- Low switch on-resistance (0.85 Ω)
- 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

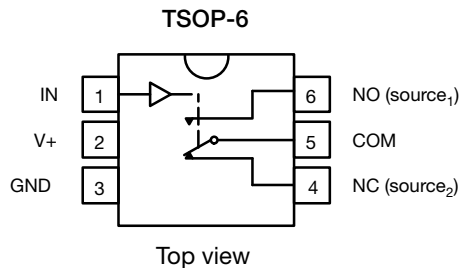


RoHS
COMPLIANT
HALOGEN
FREE

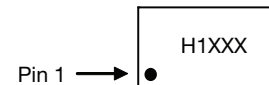
APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device marking: H1



Device marking: H1XXX
XXX = date / lot traceability code

TRUTH TABLE		
LOGIC	NC	NO
0	On	Off
1	Off	On

ORDERING INFORMATION		
TEMP RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	TSOP-6	DG2001EDV-T1-GE3



ABSOLUTE MAXIMUM RATINGS (T _A = 25 °C, unless otherwise noted)			
PARAMETER			UNIT
V+, COM, NC, NO, IN reference to GND			V
Continuous current (any terminal)			mA
Peak current (pulsed at 1 ms, 10 % duty cycle)			mA
Storage temperature (D suffix)			°C
Power dissipation (packages) ^a	TSOP-6 ^b	570	mW
ESD / HBM	JS-001	7000	V
ESD / CDM	JS-002	1000	
Latch up	Per JESD78 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 ₊ = 5 V)									
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V ₊ = 5 V, ± 10 % V _{IN} = 0.8 V or 2.4 V ^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT		
				MIN. ^b	TYP. ^c	MAX. ^b			
Analog Switch									
Analog signal range ^d	V _{NO} , V _{NC} V _{COM}		Full	0	-	V ₊	V		
On-resistance	R _{ON}	V ₊ = 4.5 V V _{COM} = 3 V, I _{NO} , I _{NC} = 10 mA	Room	-	0.85	1.6	Ω		
			Full	-	-	1.8			
R _{ON} flatness ^d	R _{ON} Flatness	V ₊ = 4.5 V V _{COM} = 0 V to V ₊ , I _{NO} , I _{NC} = 10 mA	Room	-	0.3	-			
Switch off leakage current ^g	I _{NO(off)} I _{NC(off)}	V ₊ = 5.5 V V _{NO} , V _{NC} = 1 V / 4.5 V, V _{COM} = 4.5 V / 1 V	Room	-5	-	5	nA		
			Full	-30	-	30			
	Room		-5	-	5				
	Full		-30	-	30				
Channel-on leakage current ^g	I _{COM(on)}	V ₊ = 5.5 V V _{NO} , V _{NC} = V _{COM} = 1 V / 4.5 V	Room	-5	-	5			
			Full	-30	-	30			
Power down leakage	I _{COM(PD)}	V ₊ = 0 V, V _{COM} = 4.5 V, V _{IN} = GND	Full ^d	-	-	1	μA		
Digital Control									
Input high voltage	V _{INH}		Full	2.4	-	-	V		
Input low voltage	V _{INL}		Full	-	-	0.8			
Input capacitance	C _{IN}		Full	-	3	-	pF		
Input current	I _{INL} or I _{INH}	V _{IN} = 0 V or V ₊	Full	-1	-	1	μA		
Dynamic Characteristics									
Turn-on time	t _{ON}	V _{NO} or V _{NC} = 3 V, R _L = 300 Ω, C _L = 35 pF	Room	-	15	32	ns		
			Full	-	-	35			
Turn-off time	t _{OFF}		Room	-	6	26			
			Full	-	-	31			
Break-before-make time	t _d			Room	1	4		-	
Charge injection ^d	Q _{INJ}		C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room	-	8		-	pC
Off-isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room	-	-63	-	dB		
Crosstalk ^d	X _{TALK}		Room	-	-63	-			
Source-off capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 V or V ₊ , f = 1 MHz	Room	-	16	-	pF		
Channel-on capacitance ^d	C _{ON}		Room	-	53	-			
Power Supply									
Power supply current	I ₊	V _{IN} = 0 V or V ₊	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 V^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT	
				MIN. ^b	TYP. ^c	MAX. ^b		
Analog Switch								
Analog signal range ^d	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	Ω	
			Full	-	-	2.6		
R_{ON} flatness ^d	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 ^g	$I_{NO(off)}$ $I_{NC(off)}$	$V_+ = 3.3\text{ V}$ $V_{NO}, V_{NC} = 1\text{ V} / 3\text{ V}, V_{COM} = 3\text{ V} / 1\text{ V}$	Room	-5	-	5	nA	
			Full	-15	-	15		
	Room		-5	-	5			
	Full		-15	-	15			
Channel-on leakage current ^g	$I_{COM(on)}$	$V_+ = 3.3\text{ V}$ $V_{NO}, V_{NC} = V_{COM} = 1\text{ V} / 3\text{ V}$	Room	-5	-	5		
			Full	-15	-	15		
Digital Control								
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	μA	
Dynamic Characteristics								
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 ^d	Q_{INJ}		$C_L = 1\text{ nF}, V_{GEN} = 0\text{ V}, R_{GEN} = 0\ \Omega$	Room	-	6	-	pC
Off-isolation ^d	OIRR		$R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$	Room	-	-63	-	dB
Crosstalk ^d	X_{TALK}			Room	-	-63	-	
N_O, N_C off capacitance ^d	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0\text{ V}$ or $V_+, f = 1\text{ MHz}$	Room	-	16	-	pF	
Channel-on capacitance ^d	C_{ON}		Room	-	54	-		
Power Supply								
Power supply current	I_+	$V_{IN} = 0\text{ V}$ or V_+	Full	-	0.00002	1	μA	

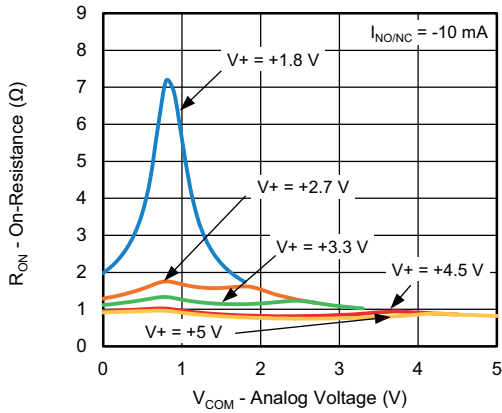


SPECIFICATIONS (V+ = 2 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 2 V, ± 10 % VIN = 0.4 V or 1.6 V ^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT
				MIN. ^b	TYP. ^c	MAX. ^b	
Analog Switch							
Analog signal range ^d	V _{NO} , V _{NC} V _{COM}		Full	0	-	V+	V
On-resistance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

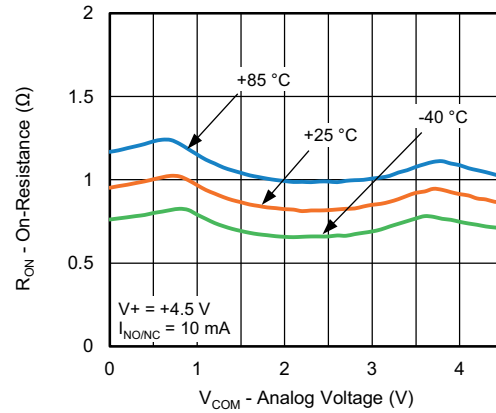
Notes

- 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_{IN} = input voltage to perform proper function
- f. Guaranteed by 5 V leakage testing, not production tested

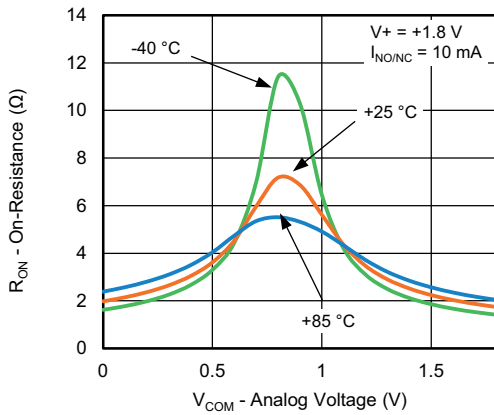
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



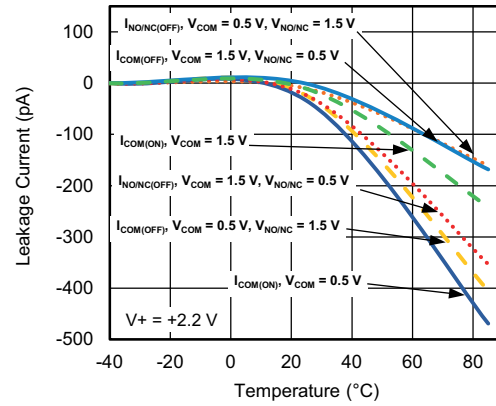
$R_{DS(on)}$ vs. V_{COM} and Supply Voltage



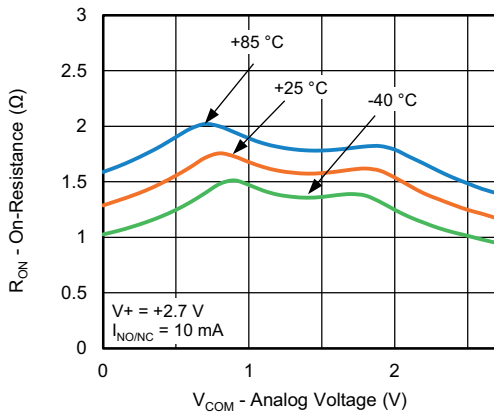
$R_{DS(on)}$ vs. V_{COM} and Temperature



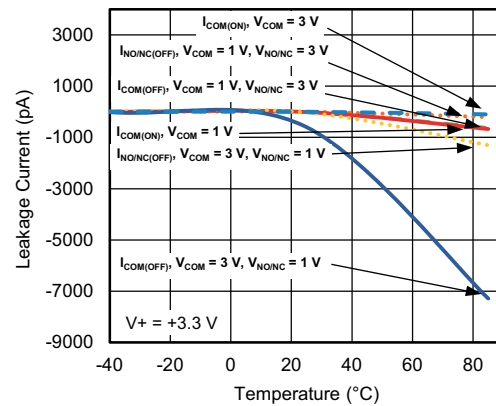
$R_{DS(on)}$ vs. V_{COM} and Temperature



Leakage Current vs. Temperature

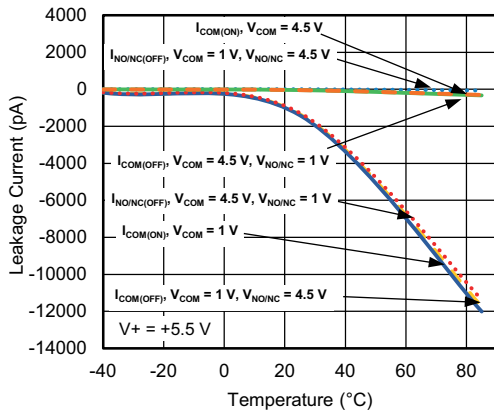


$R_{DS(on)}$ vs. V_{COM} and Temperature

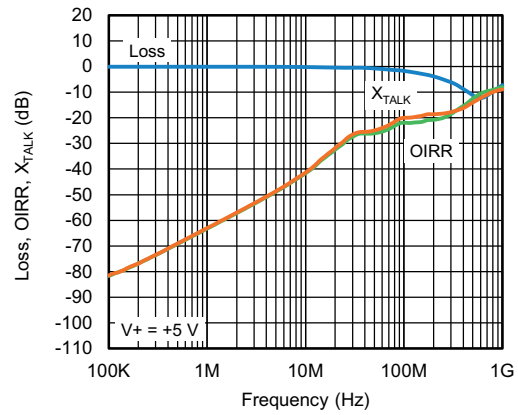


Leakage Current vs. Temperature

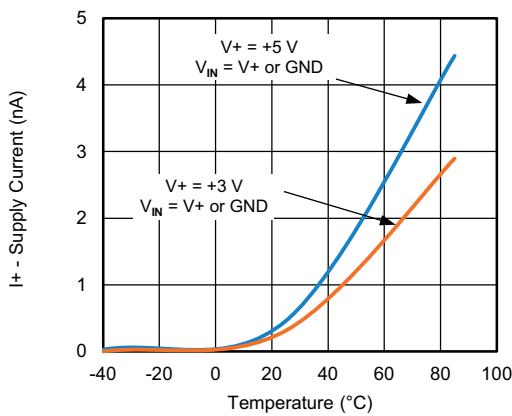
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



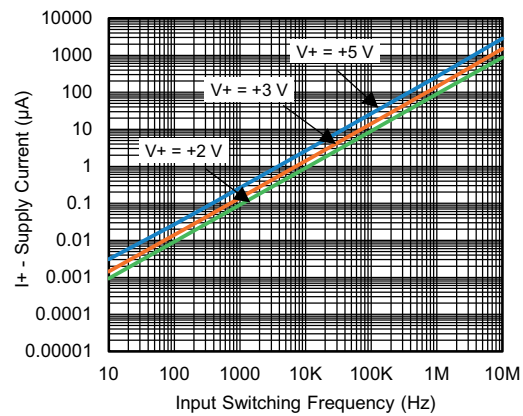
Leakage Current vs. Temperature



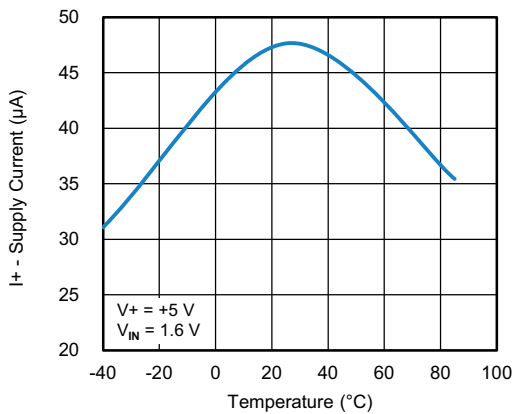
Insertion Loss, Off-Isolation Crosstalk vs. Frequency



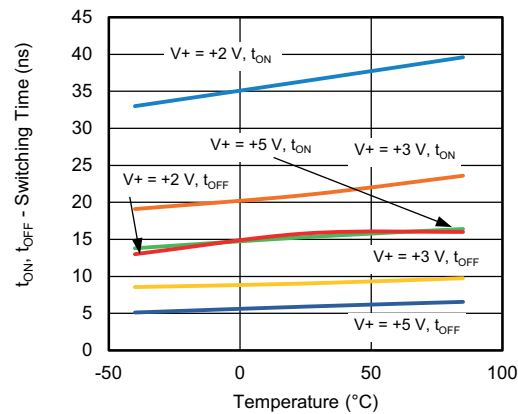
Supply Current vs. Temperature



Supply Current vs. Input Switching Frequency

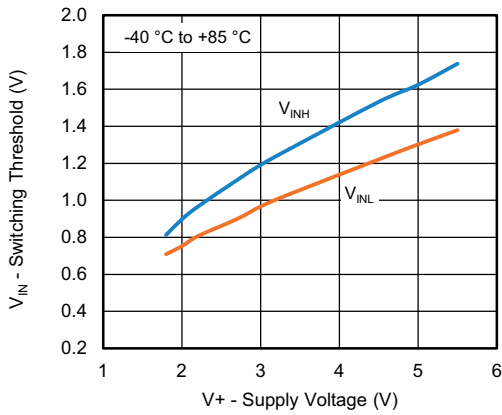


Supply Current vs. Temperature

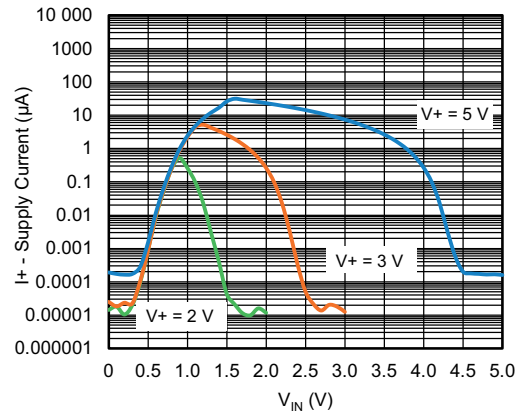


Switching Time vs. Temperature and Supply Voltage

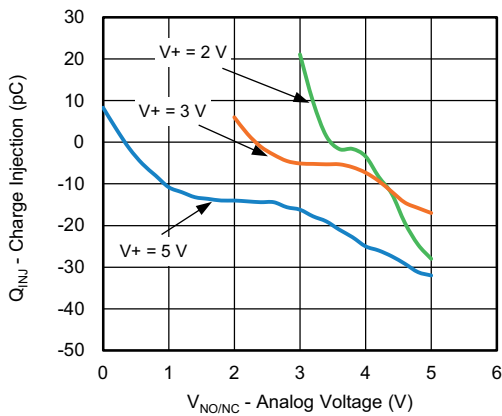
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



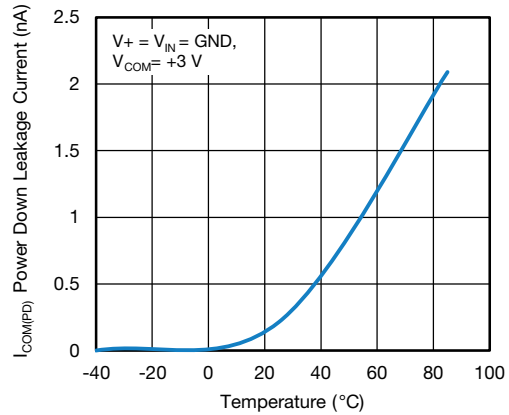
Switching Threshold vs. Supply Voltage



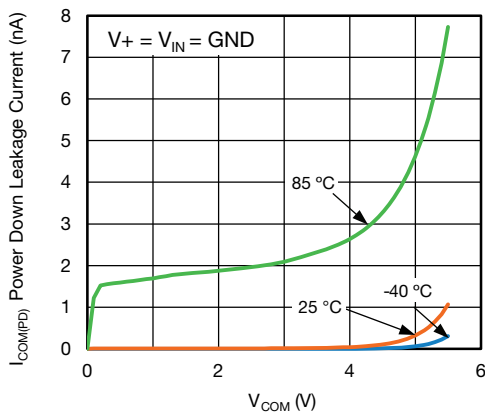
Supply Current vs. Enable Input Voltage



Charge Injection vs. Analog Voltage

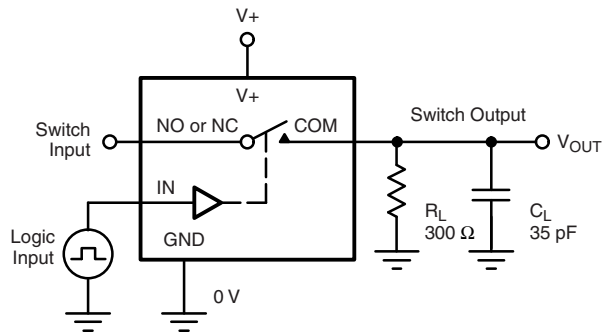


Power Down Leakage Current vs. Temperature



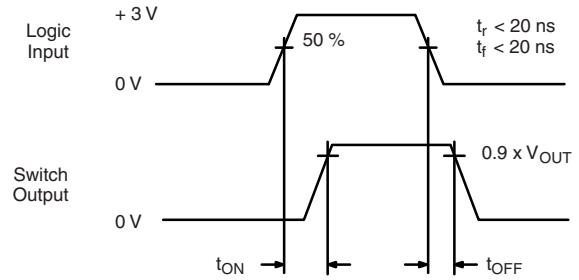
Power Down Leakage Current vs. V_{COM}

TEST CIRCUITS



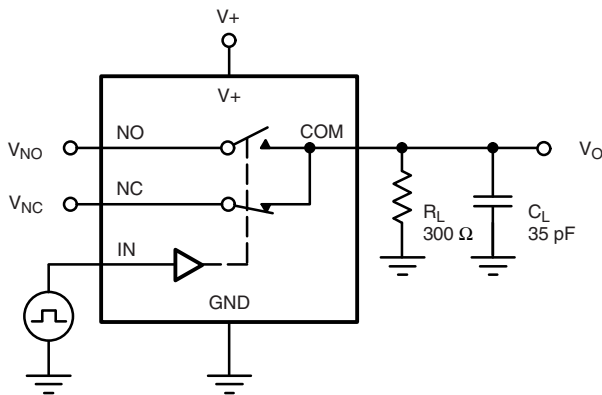
C_L (includes fixture and stray capacitance)

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



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)

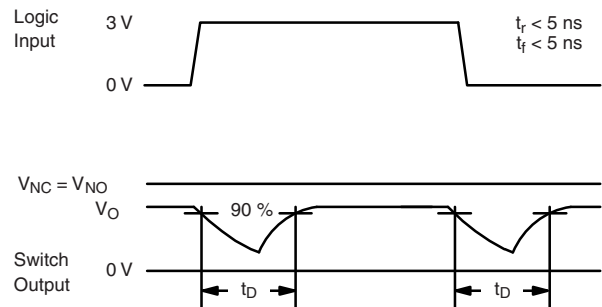
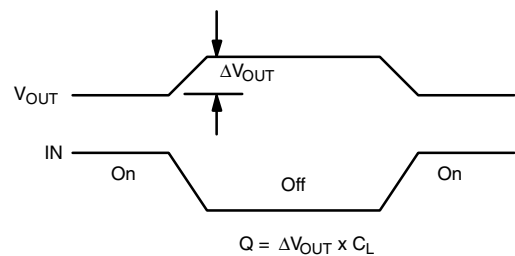
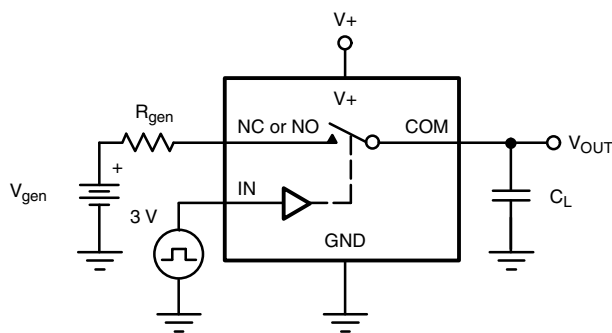
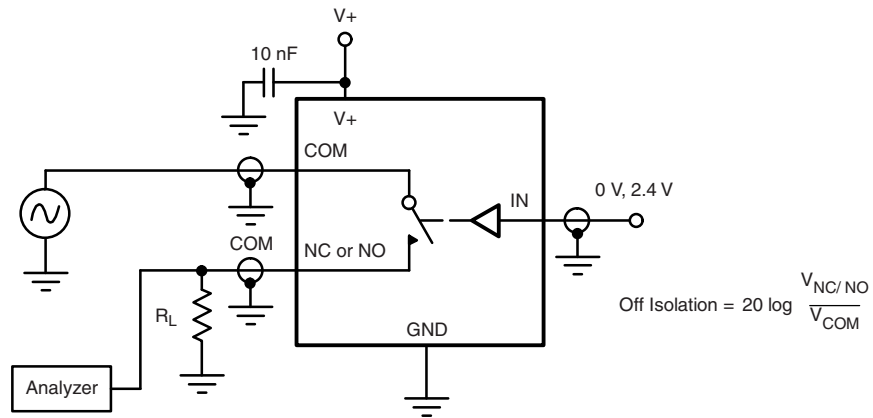
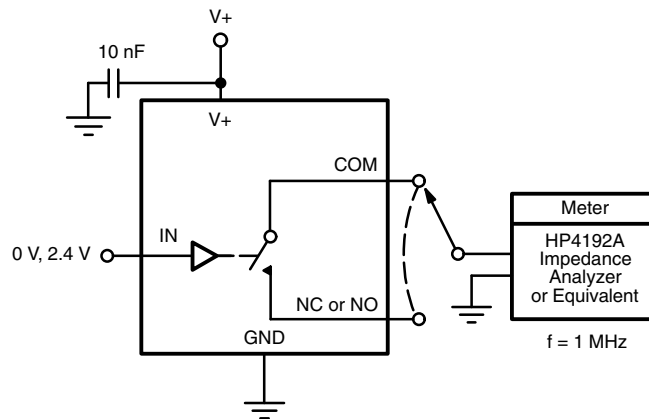


Fig. 2 - Break-Before-Make Interval



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

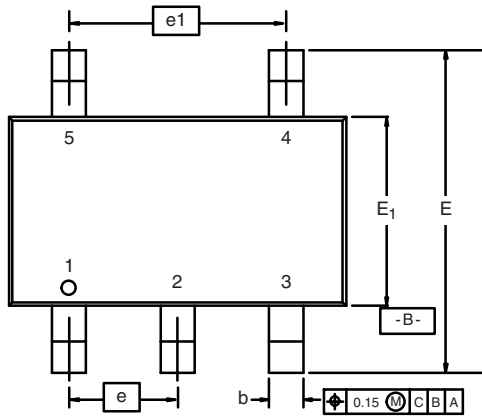
Fig. 3 - Charge Injection

TEST CIRCUITS

Fig. 4 - Off-Isolation

Fig. 5 - Channel Off/On Capacitance

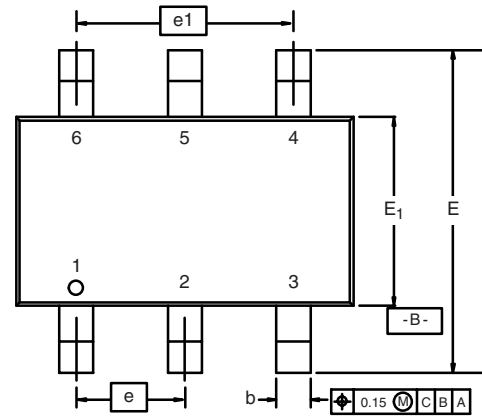
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TSOP: 5/6-LEAD

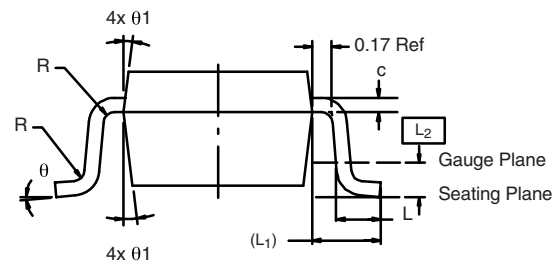
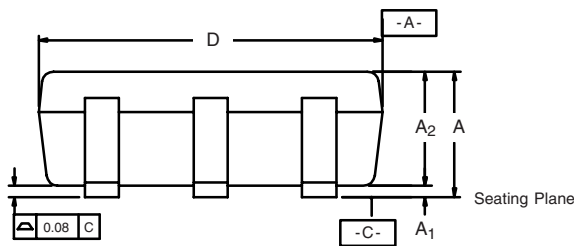
JEDEC Part Number: MO-193C



5-LEAD TSOP

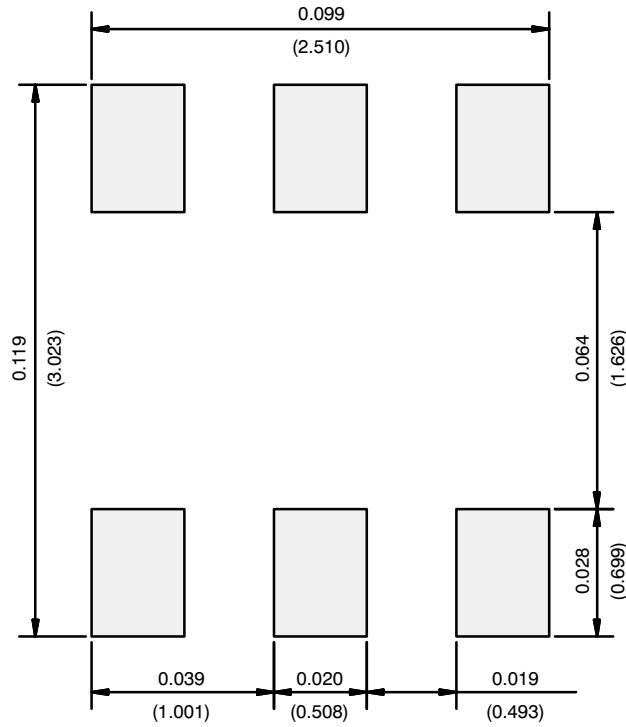


6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.91	-	1.10	0.036	-	0.043
A₁	0.01	-	0.10	0.0004	-	0.004
A₂	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
E₁	1.55	1.65	1.70	0.061	0.065	0.067
e	0.95 BSC			0.0374 BSC		
e₁	1.80	1.90	2.00	0.071	0.075	0.079
L	0.32	-	0.50	0.012	-	0.020
L₁	0.60 Ref			0.024 Ref		
L₂	0.25 BSC			0.010 BSC		
R	0.10	-	-	0.004	-	-
θ	0°	4°	8°	0°	4°	8°
θ₁	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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