

## Power Down Fault Protected, 1.8 V to 5.5 V, 2.5 Ω, 4-Channel (4:1) Multiplexer

### DESCRIPTION

The DG2034E is a four-channel multiplexer that operates with a single 1.8 V to 5.5 V power supply. It features power down fault protection that prevents excessive current flow when V+ is to ground.

The device's low power dissipation and wide voltage range make it ideal for use in battery powered products. The ultra low capacitance and charge injection of the switch make it an ideal solution for data acquisition and sample and hold applications, where low glitch and fast settling are required. Low switch resistance and fast switching speeds, together with high signal bandwidth, make the DG2034E suitable for video signal switching.

The DG2034E switches one of four inputs to a common output as determined by the 3-bit binary address lines: A0, A1, and EN. Each switch conducts equally well in both directions when on, blocks input voltages up to the supply level when off, and exhibits break before make switching action.

The device's high ESD and latch-up current capability make it more reliable in designs where the part sits close to the interface.

The DG2034E is available in MSOP10 and QFN12 3 mm x 3 mm packages.

### FEATURES

- 2.5 Ω switch on-resistance
- 7 pF source-off capacitance
- 27 pF comm-off capacitance
- 33 pF comm-on capacitance
- 13 ns turn-on time
- -2 pC charge injection
- -67 dB off-isolation at 1 MHz
- -71 dB crosstalk at 1 MHz
- 166 MHz bandwidth
- 8 kV ESD / HBM
- 400 mA latch-up current

### BENEFITS

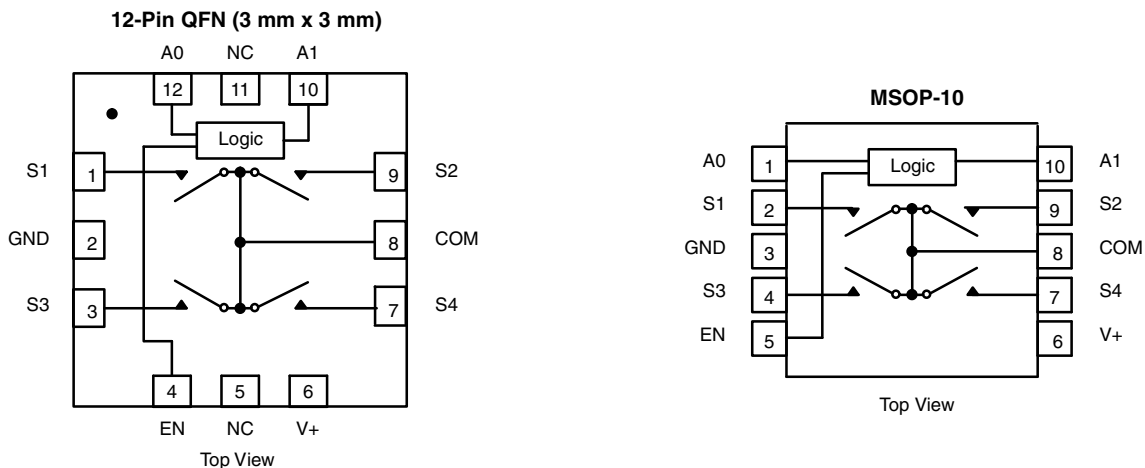
- Power down fault protection
- Low parasitic and charge injection
- Wide operation voltage range
- High ESD tolerance

### APPLICATIONS

- Automatic test equipment
- Process control and automation
- Data acquisition systems
- Meters and instruments
- Medical and healthcare systems
- Communication systems
- Audio and video switching
- Relay replacements


**RoHS**  
COMPLIANT

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION





TRUTH TABLE			
A1	A0	EN	ON SWITCH
X	X	0	None
0	0	1	S1
0	1	1	S2
1	0	1	S3
1	1	1	S4

ORDERING INFORMATION		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	MSOP-10	DG2034EDQ-T1-GE3
	12-pin QFN (3 mm x 3 mm)	DG2034EDN-T1-GE4

ABSOLUTE MAXIMUM RATINGS			
PARAMETER		LIMIT	UNIT
Referenced V+ to GND		-0.3 to +6	V
A <sub>x</sub> , EN, S <sub>x</sub> , COM <sup>a</sup>		-0.3 to (V+ + 0.3)	
Continuous current (any terminal)		± 50	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)		± 100	
Power dissipation (package) <sup>b</sup>	QFN-12 (3 mm x 3 mm) <sup>c</sup>	1295	mW
	MSOP-10 <sup>d</sup>	320	
Storage temperature (D suffix)		-65 to +150	°C
ESD / HBM	EIA / JESD22-A114-A	8k	V
ESD / CDM	EIA / JESD22-C101-A	2k	
Latch up	JESD78	400	mA

Notes

- a. Signals on S<sub>x</sub>, COM, EN or A<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 16.2 mW/°C above 70 °C
- d. Derate 4 mW/°C above 70 °C



SPECIFICATIONS (V+ = 3 V)								
PARAMETER	SYMBOL	TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 3 V, ± 10 %, V <sub>AL</sub> = 0.5 V, V <sub>AH</sub> = 1.5 V <sup>e</sup>	TEMP. <sup>a</sup>	LIMITS -40 to +85 °C			UNIT	
				MIN. <sup>c</sup>	TYP. <sup>b</sup>	MAX. <sup>c</sup>		
<b>Analog Switch</b>								
Analog signal range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0	-	V+	V	
Drain-source On-resistance	R <sub>DS(on)</sub>	V+ = 1.8 V, V <sub>S</sub> = 0.4 V / V+, I <sub>S</sub> = 8 mA	Room	-	7	10	Ω	
			Full	-	-	11		
		V+ = 2.7 V, V <sub>COM</sub> = 0.8 V / 1.8 V I <sub>COM</sub> = 10 mA	Room	-	4.6	5.3		
			Full	-	-	5.9		
On-resistance matching	ΔR <sub>DS(on)</sub>	V+ = 2.7 V, V <sub>COM</sub> = 0.8 V / 1.4 V / 1.8 V I <sub>COM</sub> = 10 mA	Room	-	0.02	0.27	Ω	
On-resistance flatness <sup>d, f</sup>	R <sub>flat(on)</sub>		Full	-	-	0.41		
			Room	-	0.62	1		
			Full	-	-	1.3		
Off leakage current <sup>g</sup>	I <sub>S(off)</sub>	V+ = 3.3 V, V <sub>S</sub> = 1 V / 3 V V <sub>COM</sub> = 3 V / 1 V, V <sub>EN</sub> = 0 V	Room	-2	0.01	2	nA	
COM off leakage current <sup>g</sup>	I <sub>COM(off)</sub>		Full	-5	-	5		
			Room	-2	0.01	2		
			Full	-5	-	5		
Channel-on leakage current <sup>g</sup>	I <sub>COM(on)</sub>	V+ = 3.3 V V <sub>COM</sub> = V <sub>S</sub> = 1 V / 3 V	Room	-2	0.01	2	nA	
			Full	-5	-	5		
<b>Digital Control</b>								
Input current <sup>d</sup>	I <sub>A</sub> or I <sub>EN</sub>	V <sub>A/EN</sub> = 0 V or V+, see truth table	Full	-1	0.05	1	μA	
Input high voltage <sup>d</sup>	V <sub>AH</sub> or V <sub>ENH</sub>		Full	1.5	1.25	-	V	
Input low voltage <sup>d</sup>	V <sub>AL</sub> or V <sub>ENL</sub>		Full	-	1	0.5		
Digital input capacitance <sup>d</sup>	C <sub>IN</sub>		Room	-	3	-	pF	
<b>Dynamic Characteristics</b>								
Turn-on time	t <sub>ON</sub>	V <sub>S</sub> = 1.5 V, C <sub>L</sub> = 35 pF, R <sub>L</sub> = 300 Ω	Room	-	19	29	ns	
			Full	-	-	39		
Turn-off time	t <sub>OFF</sub>		Room	-	16	26		
			Full	-	-	36		
Break-before-make time <sup>d</sup>	t <sub>BBM</sub>		Room	7	12	-		
			Full	5	-	-		
Transition time	t <sub>trans</sub>	V <sub>S</sub> = 1.5 V / 0 V, V <sub>S</sub> = 0 V / 1.5 V, R <sub>L</sub> = 300 Ω	Room	-	26	41		
			Full	-	-	51		
Charge injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>gen</sub> = 1.5 V, R <sub>gen</sub> = 0 Ω	Room	-	-2	-	pC	
Bandwidth <sup>d</sup>	BW	C <sub>L</sub> = 5 pF (set up capacitance)	Room	-	166	-	MHz	
Off-isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-67	-	dB
			f = 10 MHz	Room	-	-52	-	
Channel-to-channel crosstalk <sup>d</sup>	X <sub>TALK</sub>	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-71	-	
			f = 10 MHz	Room	-	-55	-	
Off capacitance <sup>d</sup>	C <sub>S(off)</sub>	V+ = 2.7 V, f = 1 MHz	Room	-	7	-	pF	
COM off capacitance <sup>d</sup>	C <sub>COM(off)</sub>		Room	-	27	-		
COM on capacitance <sup>d</sup>	C <sub>COM(on)</sub>		Room	-	33	-		
<b>Power Supply</b>								
Power supply range	V+		Full	2.7	-	3.3	V	
Power supply current <sup>d</sup>	I+	V+ = 2.7 V, V <sub>A/EN</sub> = 0 V or 2.7 V, see truth table	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 whereby 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<sub>A</sub>, EN = input voltage to perform proper function
- f. Difference of min. and max. values
- g. Guaranteed by 5 V testing



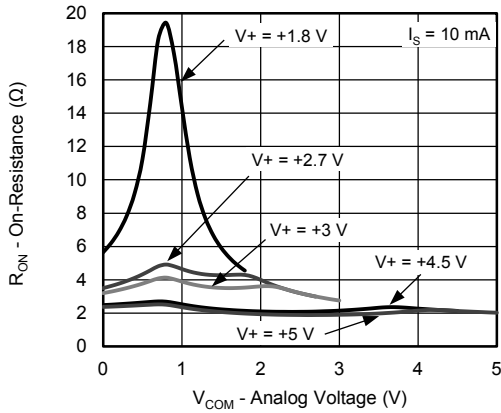
SPECIFICATIONS (V+ = 5 V)								
PARAMETER	SYMBOL	TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 5 V, ± 10 %, V <sub>AL</sub> = 0.5 V, V <sub>AH</sub> = 2 V <sup>e</sup>	TEMP. <sup>a</sup>	LIMITS -40 to +85 °C			UNIT	
				MIN. <sup>c</sup>	TYP. <sup>b</sup>	MAX. <sup>c</sup>		
<b>Analog Switch</b>								
Analog signal range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0	-	V+	V	
Drain-source On-resistance	R <sub>DS(on)</sub>	V+ = 4.5 V, V <sub>COM</sub> = 0.8 V / 3.5 V I <sub>COM</sub> = 10 mA	Room	-	2.5	3.1	Ω	
			Full	-	-	4		
On-resistance matching	ΔR <sub>DS(on)</sub>	V+ = 4.5 V, V <sub>COM</sub> = 0.8 V / 2.5 V / 3.5 V I <sub>COM</sub> = 10 mA	Room	-	0.02	0.29		
			Full	-	-	0.42		
On-resistance flatness <sup>d, f</sup>	R <sub>flat(on)</sub>		Room	-	0.6	0.9		
			Full	-	-	1.2		
Off leakage current <sup>g</sup>	I <sub>S(off)</sub>	V+ = 5.5 V, V <sub>S</sub> = 1 V / 4.5 V V <sub>COM</sub> = 4.5 V / 1 V, V <sub>EN</sub> = 0 V	Room	-2	0.17	2	nA	
COM off leakage current <sup>g</sup>	I <sub>COM(off)</sub>		Full	-8	-	8		
		Channel-on leakage current <sup>g</sup>	I <sub>COM(on)</sub>	Room	-5	0.77		5
Full	-15			-	15			
Power down leakage <sup>d</sup>	I <sub>PD</sub>	V+ = 0 V, V <sub>D</sub> = 5.5 V, S <sub>X</sub> open	Room	-5	0.61	5	μA	
		V+ = 0 V, V <sub>S</sub> = 5.5 V, COM, open	Full	-15	-	15		
<b>Digital Control</b>								
Input current <sup>d</sup>	I <sub>A</sub> or I <sub>EN</sub>	V <sub>A/EN</sub> = 0 V or V+, see truth table	Full	-	0.01	1	μA	
Input high voltage <sup>d</sup>	V <sub>AH</sub> or V <sub>ENH</sub>		Full	2	1.76	-	V	
Input low voltage <sup>d</sup>	V <sub>AL</sub> or V <sub>ENL</sub>		Full	-	1.3	0.5		
Digital input capacitance <sup>d</sup>	C <sub>IN</sub>		Room	-	3	-	pF	
<b>Dynamic Characteristics</b>								
Turn-on time	t <sub>ON</sub>	V <sub>S</sub> = 3 V, C <sub>L</sub> = 35 pF, R <sub>L</sub> = 300 Ω	Room	-	13	25	ns	
			Full	-	-	35		
Turn-off time	t <sub>OFF</sub>		Room	-	12	20		
			Full	-	-	30		
Break-before-make time <sup>d</sup>	t <sub>BBM</sub>		Room	4	10	-		
			Full	3	-	-		
Transition time	t <sub>trans</sub>	V <sub>S</sub> = 3 V / 0 V, V <sub>S</sub> = 0 V / 3 V, R <sub>L</sub> = 300 Ω	Room	-	17	32		
			Full	-	-	42		
Propagation delay <sup>d</sup>	t <sub>PD</sub>	V+ = 5 V, no R <sub>LOAD</sub>	Room	-	537	-	ps	
Charge injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>gen</sub> = 2.5 V, R <sub>gen</sub> = 0 Ω	Room	-	-2.6	-	pC	
Bandwidth <sup>d</sup>	BW	C <sub>L</sub> = 5 pF (set up capacitance)	Room	-	166	-	MHz	
Off-isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-67	-	dB
			f = 10 MHz	Room	-	-52	-	
Channel-to-channel crosstalk <sup>d</sup>	X <sub>TALK</sub>	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room	-	-71	-	
			f = 10 MHz	Room	-	-55	-	
Off capacitance <sup>d</sup>	C <sub>S(off)</sub>	V+ = 5 V, f = 1 MHz	Room	-	7	-	pF	
COM off capacitance <sup>d</sup>	C <sub>COM(off)</sub>		Room	-	27	-		
COM on capacitance <sup>d</sup>	C <sub>COM(on)</sub>		Room	-	36	-		
<b>Power Supply</b>								
Power supply range	V+		Full	4.5	-	5.5	V	
Power supply current <sup>d</sup>	I+	V+ = 5.5 V, V <sub>A/EN</sub> = 0 V or 5.5 V, see truth table	Full	-	-	1	μA	

**Notes**

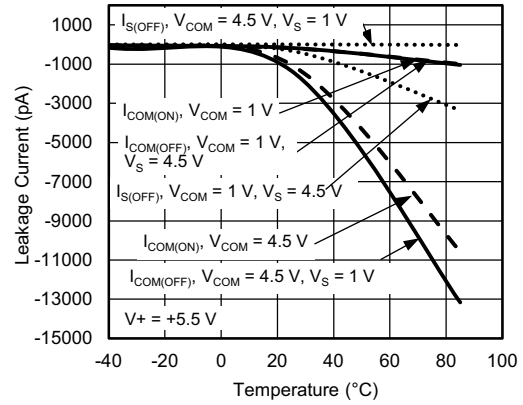
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- d. Guarantee by design, not subjected to production test
- e. V<sub>A</sub>, EN = input voltage to perform proper function
- f. Difference of min. and max. values
- g. Guaranteed by 5 V testing

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.

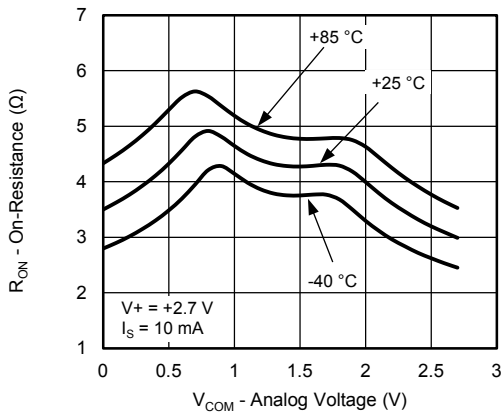
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



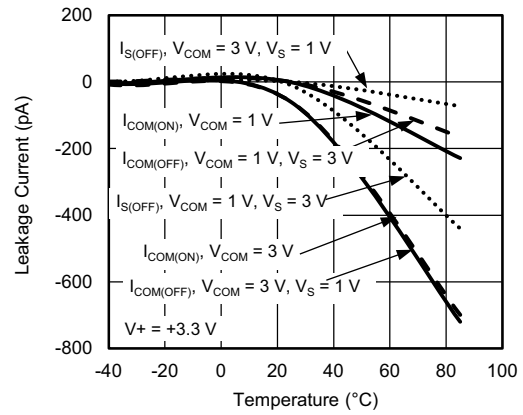
**On-Resistance vs. Analog Voltage**



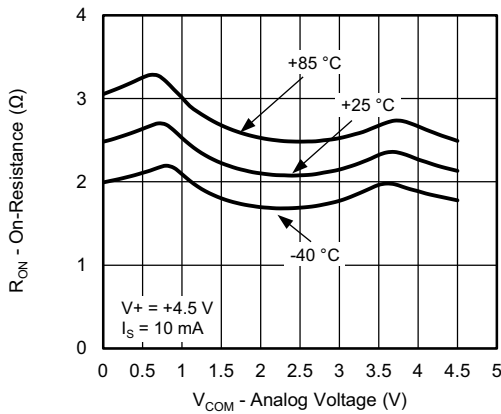
**Leakage Current vs. Temperature**



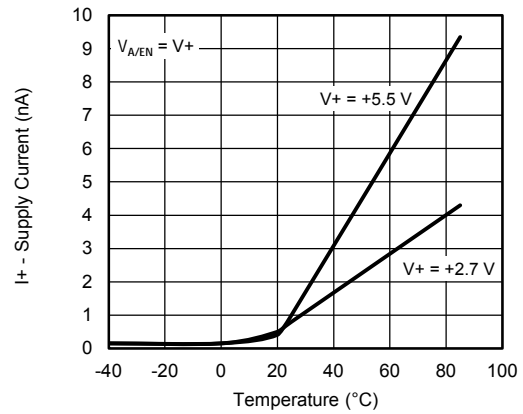
**On-Resistance vs. Analog Voltage**



**Leakage Current vs. Temperature**

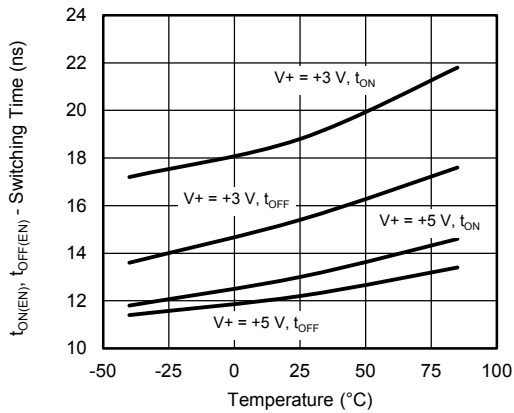


**On-Resistance vs. Analog Voltage**

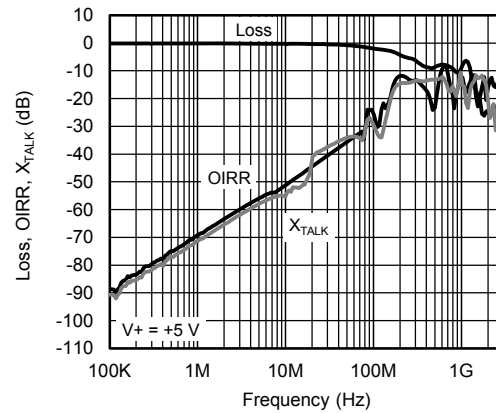


**Supply Current vs. Temperature**

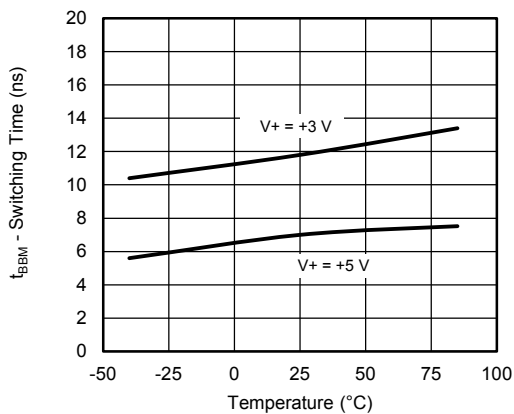
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



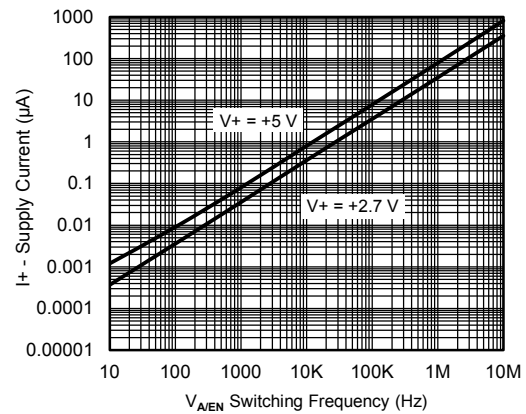
**Switching Time vs. Temperature**



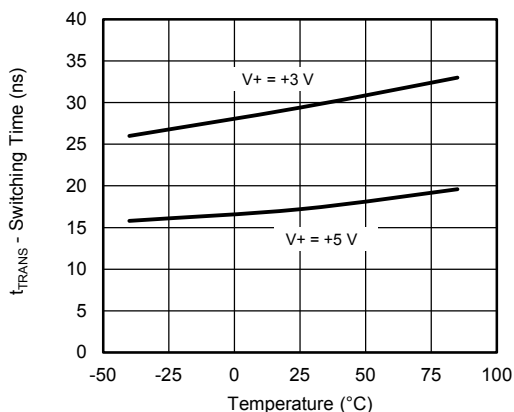
**Loss, OIRR,  $X_{TALK}$  vs. Frequency**



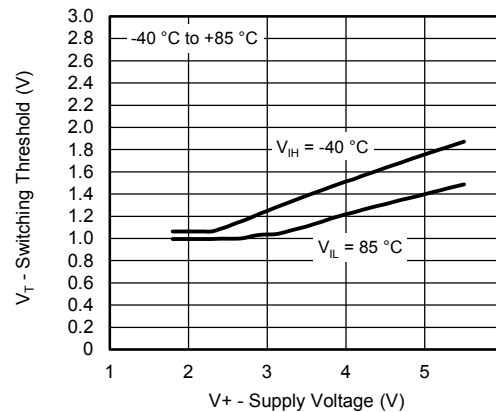
**Switching Time vs. Temperature**



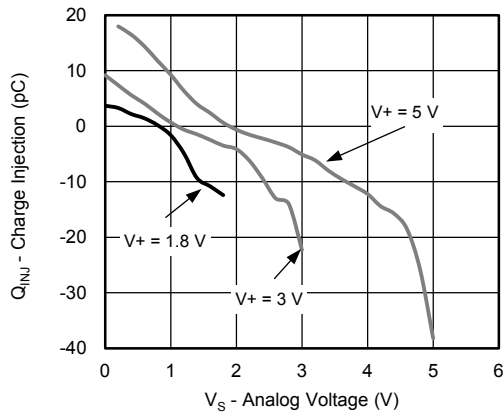
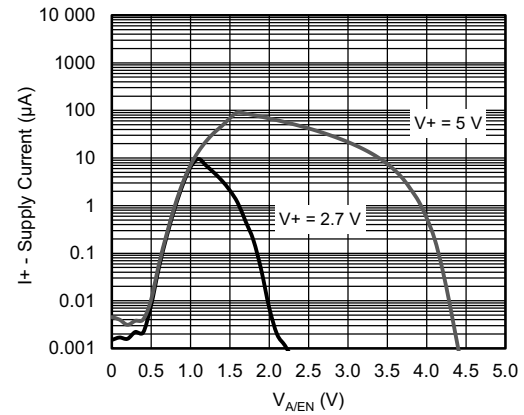
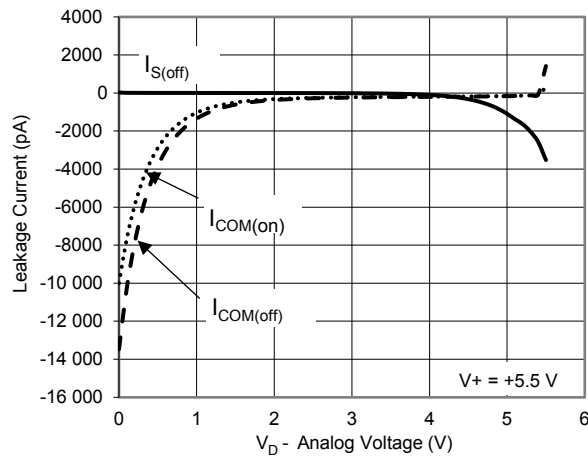
**Positive Supply Current vs. Switching Frequency**



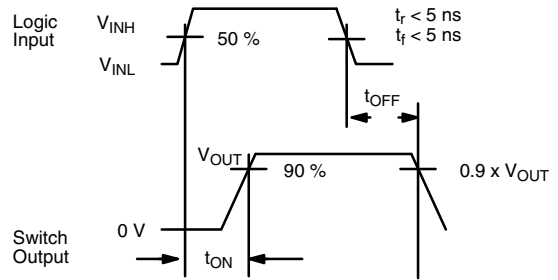
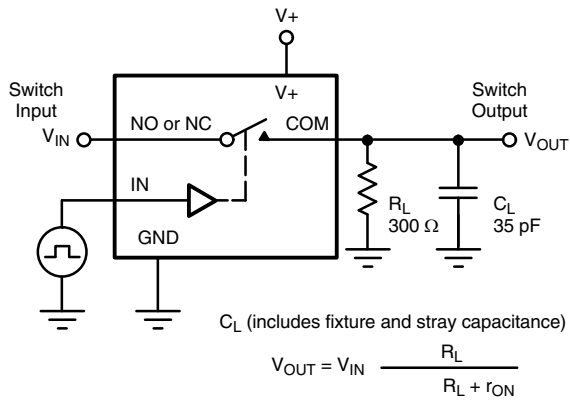
**Switching Time vs. Temperature**



**Switching Threshold vs. Supply Voltage**

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

**Charge Injection vs. Source Voltage**

**Positive Supply Current vs. Logic Voltage**

**Leakage Current vs. Analog Voltage**

TEST CIRCUITS



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

Fig. 1 - Switching Time

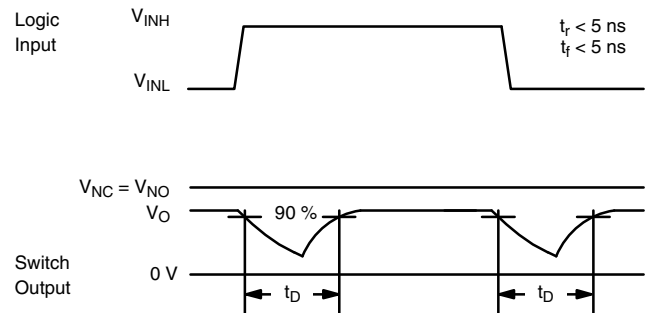
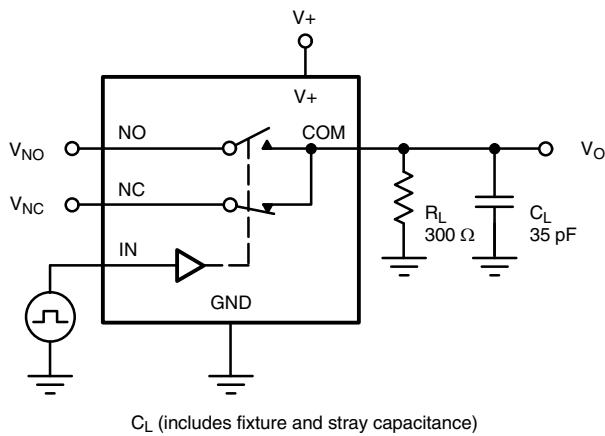


Fig. 2 - Break-Before-Make

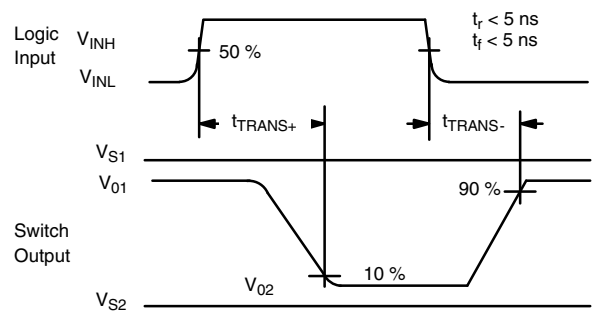
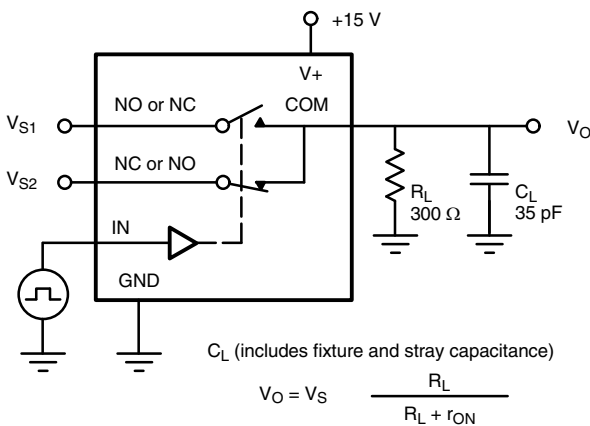
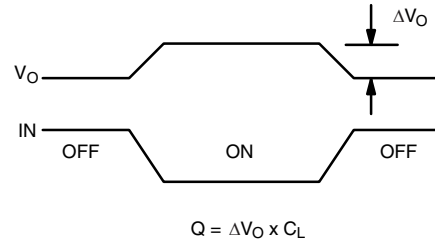
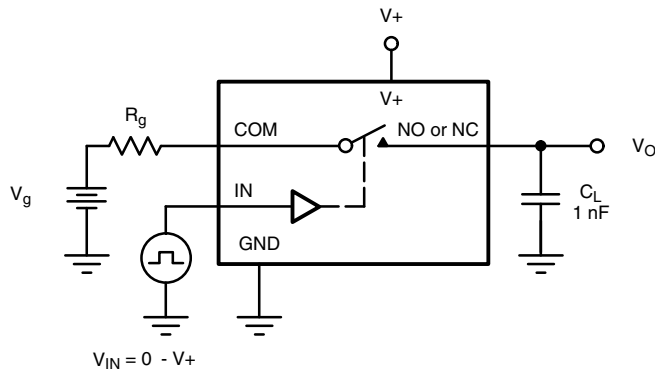


Fig. 3 - Transition Time

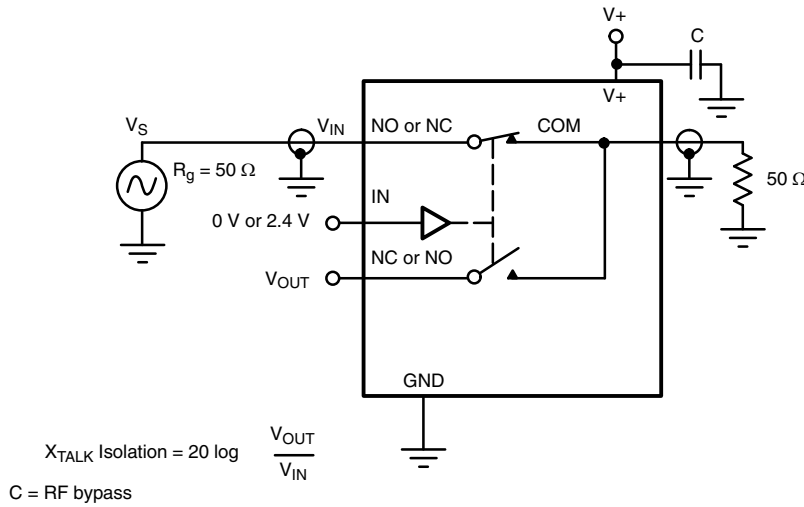


TEST CIRCUITS



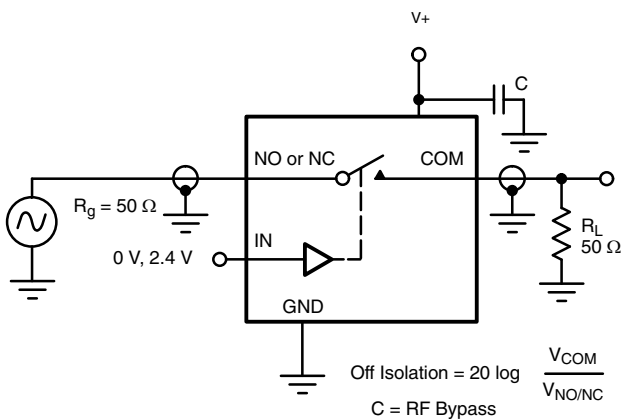
IN dependent on switch configuration Input polarity determined by sense of switch.

Fig. 4 - Charge Injection



$X_{TALK} \text{ Isolation} = 20 \log \frac{V_{OUT}}{V_{IN}}$   
C = RF bypass

Fig. 5 - Crosstalk



$\text{Off Isolation} = 20 \log \frac{V_{COM}}{V_{NO/NC}}$   
C = RF Bypass

Fig. 6 - Off Isolation

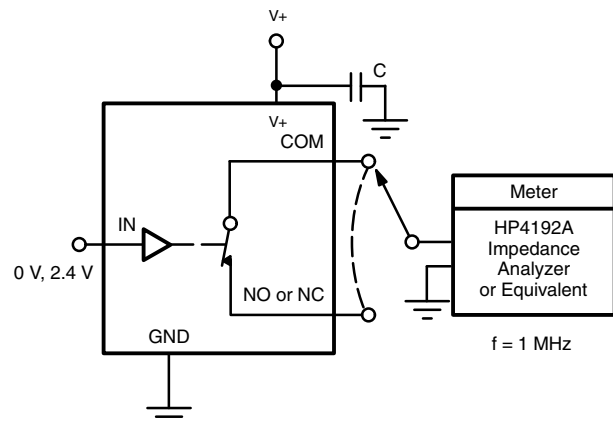
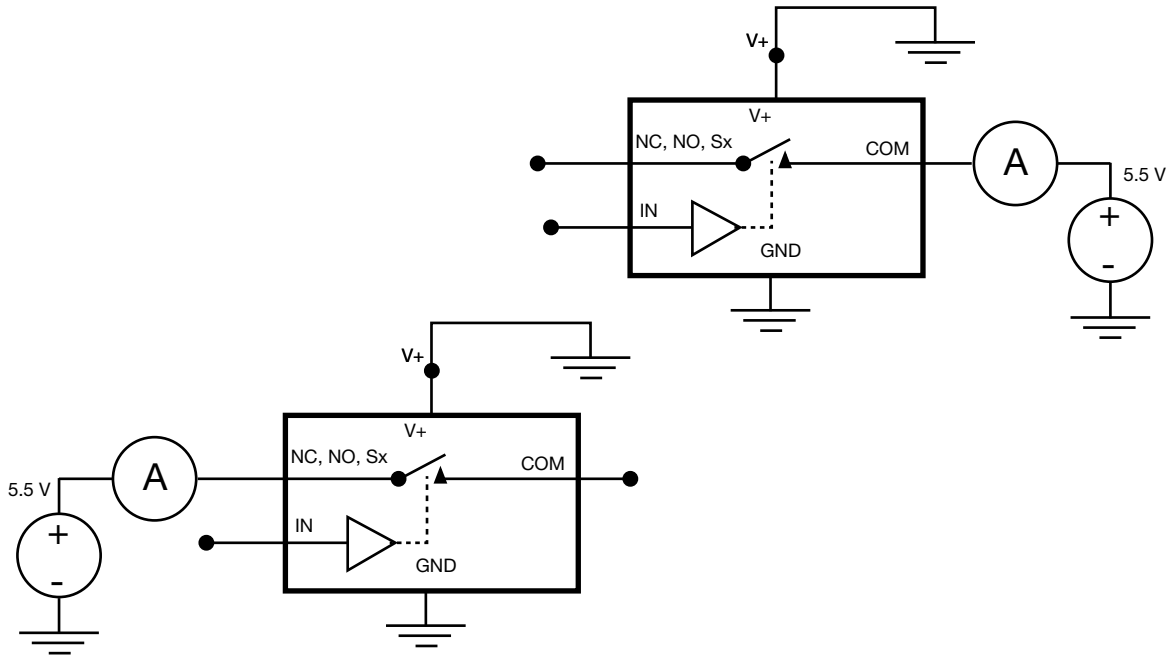


Fig. 7 - Source / Drain Capacitances

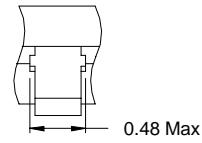
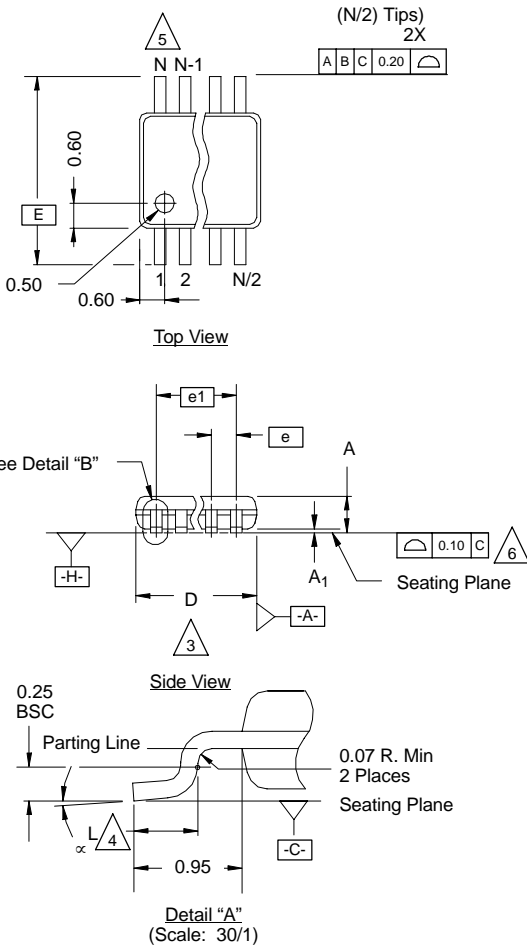
**TEST CIRCUITS**

**Fig. 8 - Source / Drain Power Down Leakage**

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?73172](http://www.vishay.com/ppg?73172).

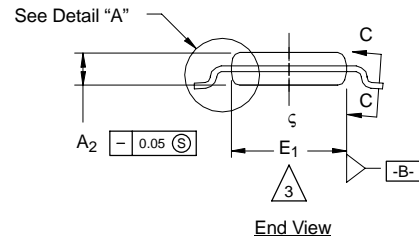
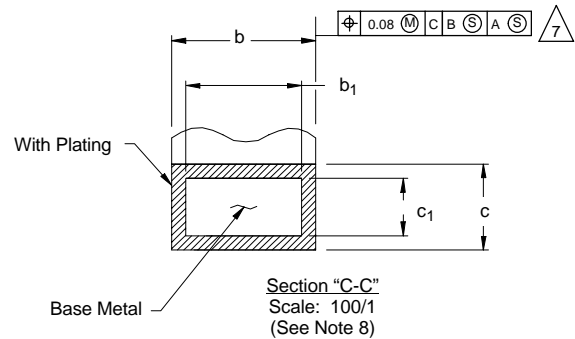


**MSOP: 10-LEADS**

JEDEC Part Number: MO-187, (Variation AA and BA)



Detail "B"  
(Scale: 30/1)  
Dambar Protrusion



NOTES:

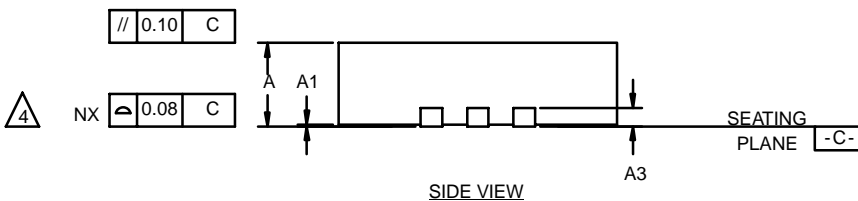
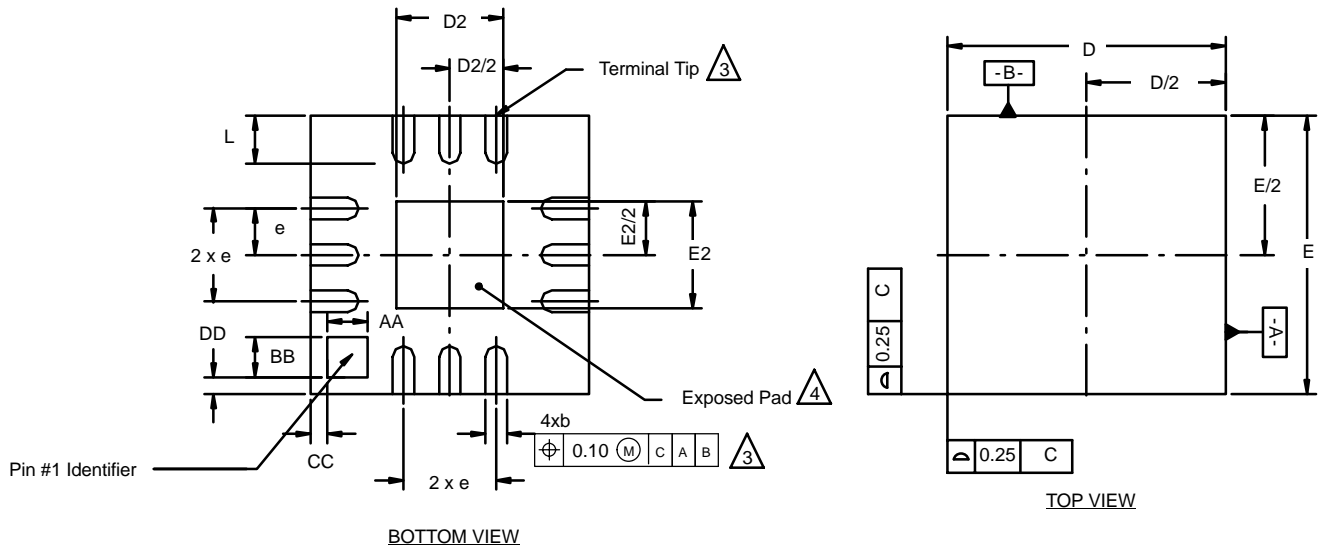
1. Die thickness allowable is  $0.203 \pm 0.0127$ .
2. Dimensioning and tolerances per ANSI.Y14.5M-1994.
3. Dimensions "D" and "E<sub>1</sub>" do not include mold flash or protrusions, and are measured at Datum plane  $\square\text{-H}\square$ , mold flash or protrusions shall not exceed 0.15 mm per side.
4. Dimension is the length of terminal for soldering to a substrate.
5. Terminal positions are shown for reference only.
6. Formed leads shall be planar with respect to one another within 0.10 mm at seating plane.
7. The lead width dimension does not include Dambar protrusion. Allowable Dambar protrusion shall be 0.08 mm total in excess of the lead width dimension at maximum material condition. Dambar cannot be located on the lower radius or the lead foot. Minimum space between protrusions and an adjacent lead to be 0.14 mm. See detail "B" and Section "C-C".
8. Section "C-C" to be determined at 0.10 mm to 0.25 mm from the lead tip.
9. Controlling dimension: millimeters.
10. This part is compliant with JEDEC registration MO-187, variation AA and BA.
11. Datums  $\square\text{-A}\square$  and  $\square\text{-B}\square$  to be determined Datum plane  $\square\text{-H}\square$ .
12. Exposed pad area in bottom side is the same as teh leadframe pad size.

**N = 10L**

Dim	MILLIMETERS			Note
	Min	Nom	Max	
A	-	-	1.10	
A <sub>1</sub>	0.05	0.10	0.15	
A <sub>2</sub>	0.75	0.85	0.95	
b	0.17	-	0.27	8
b <sub>1</sub>	0.17	0.20	0.23	8
c	0.13	-	0.23	
c <sub>1</sub>	0.13	0.15	0.18	
D	3.00 BSC			3
E	4.90 BSC			
E <sub>1</sub>	2.90	3.00	3.10	3
e	0.50 BSC			
e <sub>1</sub>	2.00 BSC			
L	0.40	0.55	0.70	4
N	10			5
α	0°	4°	6°	
ECN: T-02080—Rev. C, 15-Jul-02 DWG: 5867				



**QFN-12 LEAD (3 X 3)**



NOTES:

1. All dimensions are in millimeters.
2. N is the total number of terminals.
3. Dimension b applies to metallized terminal and is measured between 0.25 and 0.30 mm from terminal tip.
4. Coplanarity applies to the exposed heat sink slug as well as the terminal.
5. The pin #1 identifier may be either a mold or marked feature, it must be located within the zone indicated.

Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.80	0.90	1.00	0.032	0.035	0.039
<b>b</b>	0.18	0.23	0.30	0.007	0.009	0.012
<b>D</b>	3.00 BSC			0.118 BSC		
<b>D2</b>	1.00	1.15	1.25	0.039	0.045	0.049
<b>E</b>	3.00 BSC			0.118 BSC		
<b>E2</b>	1.00	1.15	1.25	0.039	0.045	0.049
<b>e</b>	0.50 BSC			0.02 BSC		
<b>L</b>	0.45	0.55	0.65	0.018	0.022	0.026
<b>AA</b>	0.435			0.017		
<b>BB</b>	0.435			0.017		
<b>CC</b>	0.18			0.007		
<b>DD</b>	0.18			0.007		
ECN: C-03092—Rev. A, 14-Apr-03 DWG: 5898						



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