

## Single 4:1 Low $r_{ON}$ Multiplexers

### DESCRIPTION

The DG2034 is a low voltage, low  $r_{ON}$ , high bandwidth single 4 to 1 analog multiplexer designed for high performance switching of analog and video signals. Combining low power; fast switching; low on-resistance, flatness and matching; and small physical size, the DG2034 is ideal for portable and battery applications.

Built on Vishay Siliconix's low voltage CMOS process, the DG2034 has an epitaxial layer which prevents latchup. Break-before-make is guaranteed.

### FEATURES

- Low voltage operation (1.8 V to 5.5 V)
- Low on-resistance -  $r_{DS(on)}$ : 4  $\Omega$
- Off-isolation and crosstalk: - 55 dB at 10 MHz
- Fast switch - 25 ns  $t_{ON}$
- Low charge injection -  $Q_{INJ}$ : 4.7 pC
- Low power consumption - 4  $\mu$ W


**RoHS**  
COMPLIANT

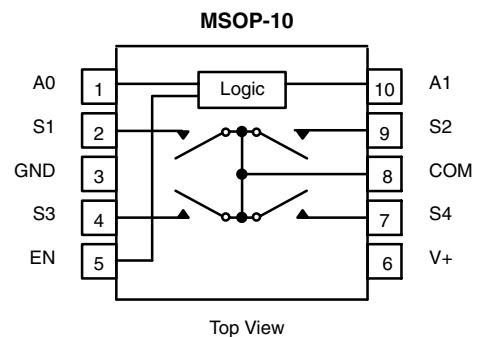
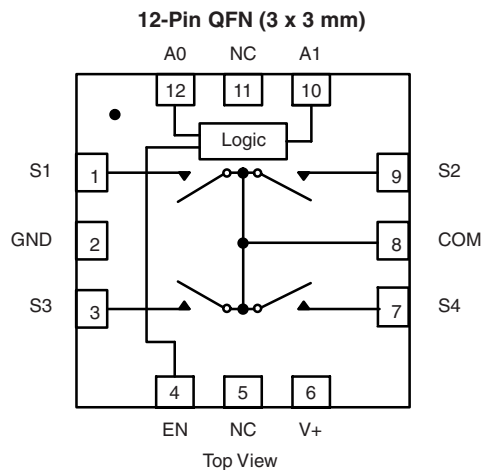
### BENEFITS

- High accuracy
- High bandwidth
- TTL and low voltage logic compatibility
- Low power consumption
- Reduced PCB space

### APPLICATIONS

- Mixed signal routing
- Portable and battery operated systems
- Low voltage data acquisition
- Modems
- PCMCIA cards

### 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	DG2034DQ-T1-E3
	12-pin QFN (3 x 3 mm)	DG2034DN-T1-E4



ABSOLUTE MAXIMUM RATINGS			
Parameter		Limit	Unit
Referenced V+ to GND		- 0.3 to + 6	V
A <sub>X</sub> , E <sub>N</sub> , 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 (Packags) <sup>b</sup>	QFN-12 (3 x 3 mm) <sup>c</sup>	1295	mW
	MSOP-10 <sup>d</sup>	320	
Storage Temperature (D Suffix)		- 65 to 150	°C

Notes:

- a. Signals on S<sub>X</sub>, D<sub>X</sub>, 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 4.0 mW/°C above 70 °C.

SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, V <sub>AL</sub> = 0.4 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
On-Resistance	r <sub>ON</sub>	V+ = 2.7 V, V <sub>COM</sub> = 0.5 V/1.5 V/2.0 V I <sub>S</sub> = 10 mA	Room Full		4	7 9	Ω
r <sub>ON</sub> Match	Δr <sub>ON</sub>		Room		0.1	0.3	
r <sub>ON</sub> Flatness <sup>d,f</sup>	r <sub>ON</sub> Flatness		Room		0.3	1.5	
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 Full	- 1 - 10	0.3	1 10	nA
COM Off Leakage Current <sup>g</sup>	I <sub>COM(off)</sub>		Room Full	- 1 - 10	0.3	1 10	
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 Full	- 1 - 10	0.3	1 10	
<b>Digital Control</b>							
Input Current <sup>d</sup>	I <sub>A</sub> or I <sub>EN</sub>	V <sub>A/EN</sub> = 0 or V+, See Truth Table	Full	- 1.0		1.0	μA
Input High Voltage <sup>d</sup>	V <sub>AH</sub> or V <sub>ENH</sub>		Full	1.5			V
Input Low Voltage <sup>d</sup>	V <sub>AL</sub> or V <sub>ENL</sub>		Full			0.4	
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 1.5 V, R <sub>L</sub> = 300 Ω	Room Full		25	35 45	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		15	25 35	
Break-Before-Make Time <sup>d</sup>	t <sub>D</sub>		Room		10.5		
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 Full		30	45 55	
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		- 4.7		pC
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	f = 1 MHz	Room		- 73	dB
			f = 10 MHz	Room		- 54	
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		- 77	
			f = 10 MHz	Room		- 59	
Off Capacitance <sup>d</sup>	C <sub>S(off)</sub>	V+ = 2.7 V, f = 1 MHz	Room		14		pF
COM Off Capacitance <sup>d</sup>	C <sub>COM(off)</sub>		Room		46		
COM On Capacitance <sup>d</sup>	C <sub>COM(on)</sub>		Room		67		
<b>Power Supply</b>							
Power Supply Range	V+			2.7		3.3	V
Power Supply Current <sup>d</sup>	I+	V+ = 3.3 V, V <sub>A/EN</sub> = 0 or 3.3 V, See Truth Table	Full			1.0	μA



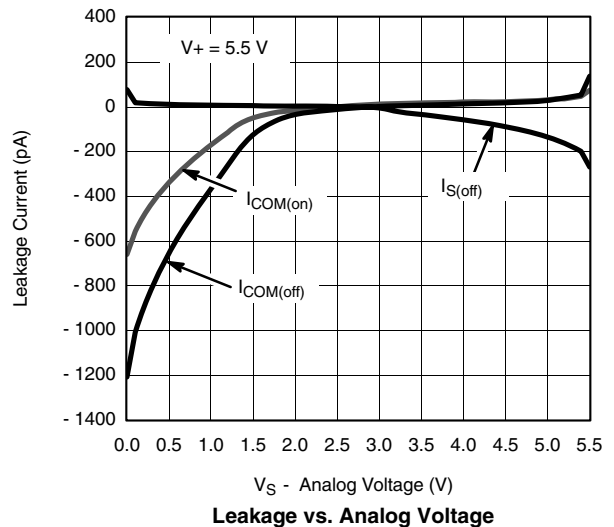
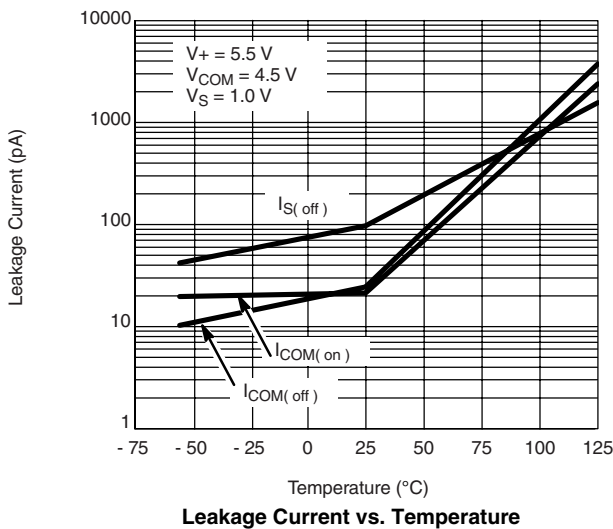
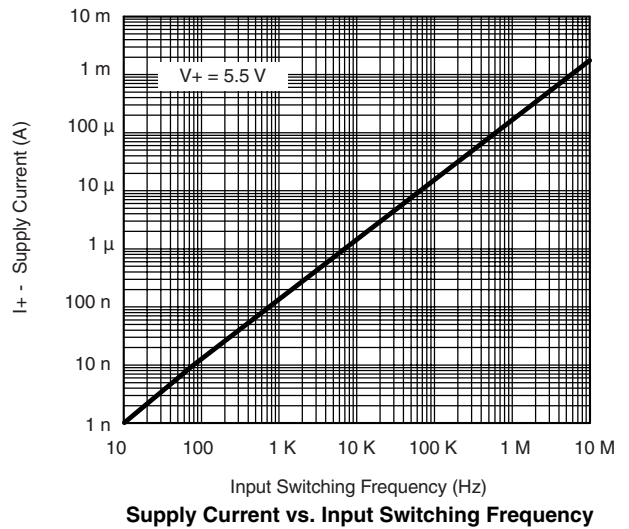
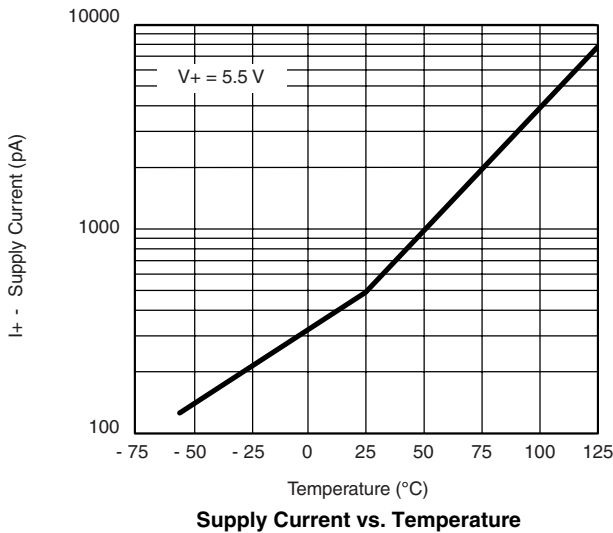
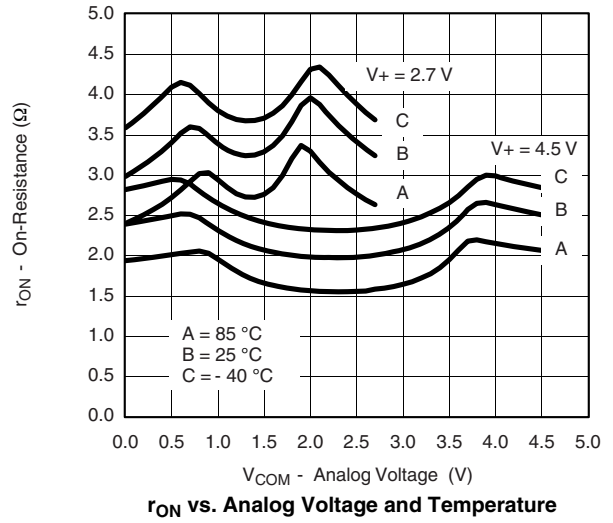
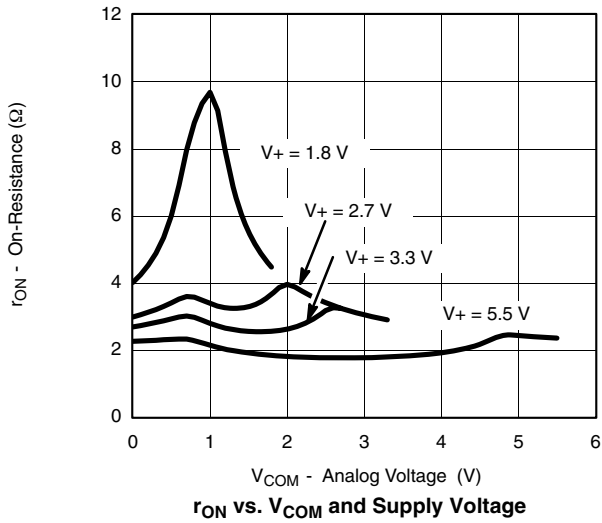
SPECIFICATIONS (V+ = 5 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, V <sub>AL</sub> = 0.8 V or V <sub>AH</sub> = 2.4 V <sup>e</sup>	Temp. <sup>a</sup>	Limits - 40 to 85 °C			Unit
				Min. <sup>c</sup>	Typ. <sup>b</sup>	Max. <sup>c</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0		V+	V
On-Resistance	r <sub>ON</sub>	V+ = 4.5 V, V <sub>COM</sub> = 1.5 V/2.5 V/3.5 V I <sub>S</sub> = 10 mA	Room Full		3	5.5 7	Ω
r <sub>ON</sub> Match	Δr <sub>ON</sub>		Room		0.16	0.5	
r <sub>ON</sub> Flatness <sup>d,f</sup>	r <sub>ON</sub> Flatness		Room		0.6	1.5	
Off Leakage Current	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 Full	- 1 - 10	0.5	1 10	nA
COM Off Leakage Current	I <sub>COM(off)</sub>		Room Full	- 1 - 10	0.5	1 10	
Channel-On Leakage Current	I <sub>COM(on)</sub>	V+ = 5.5 V, V <sub>COM</sub> = V <sub>S</sub> = 1 V/4.5 V	Room Full	- 1 - 10	0.5	1 10	
<b>Digital Control</b>							
Input Current <sup>d</sup>	I <sub>AH</sub> or I <sub>ENH</sub>	V <sub>A</sub> or V <sub>EN</sub> = 0 or V+, See Truth Table	Full	- 1.0		1.0	μA
Input High Voltage <sup>d</sup>	V <sub>AH</sub> or V <sub>ENH</sub>		Full	2.4			V
Input Low Voltage <sup>d</sup>	V <sub>AL</sub> or V <sub>ENL</sub>		Full			0.8	
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 3.0 V, R <sub>L</sub> = 300 Ω	Room Full		18	30 40	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		12	20 30	
Break-Before-Make Time <sup>d</sup>	t <sub>D</sub>		Room		10.5		
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 Full		25	40 50	
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 p	f = 1 MHz	Room		- 73	dB
			f = 10 MHz	Room		- 53.5	
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		- 77	
			f = 10 MHz	Room		- 60.2	
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		- 4.4		pC
Off Capacitance <sup>d</sup>	C <sub>S(off)</sub>	V+ = 5 V, f = 1 MHz	Room		13		pF
COM Off Capacitance <sup>d</sup>	C <sub>COM(off)</sub>		Room		43		
COM On Capacitance <sup>d</sup>	C <sub>COM(on)</sub>		Room		64		
<b>Power Supply</b>							
Power Supply Range	V+			4.5		5.5	V
Power Supply Current	I+	V+ = 5.5 V, V <sub>A/EN</sub> = 0 or 5.5 V, See Truth Table	Full			1.0	μA

Notes:

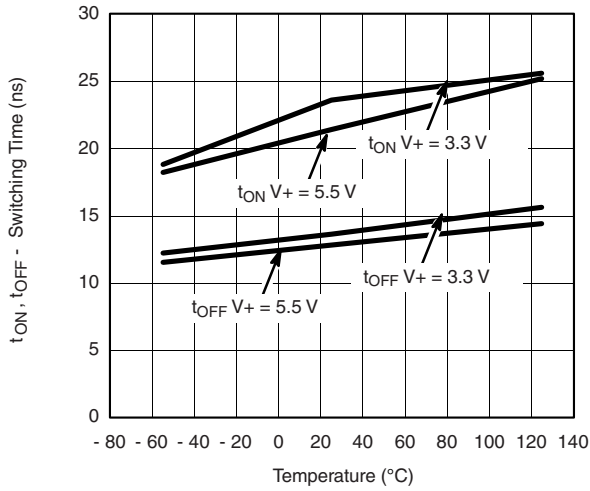
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
- c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- d. Guarantee by design, not subjected to production test.
- e. V<sub>A</sub>, E<sub>N</sub> = 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.

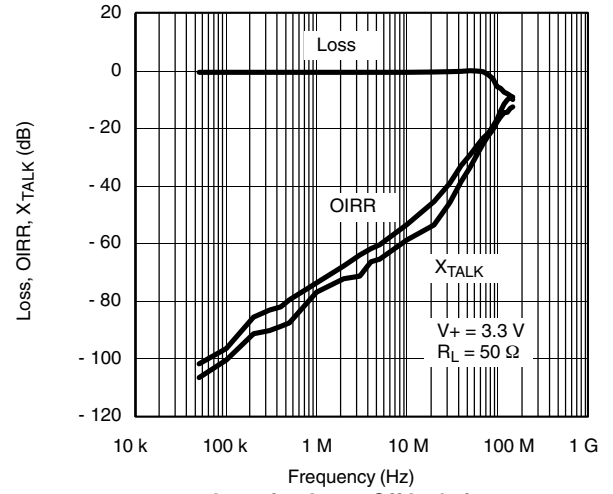
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



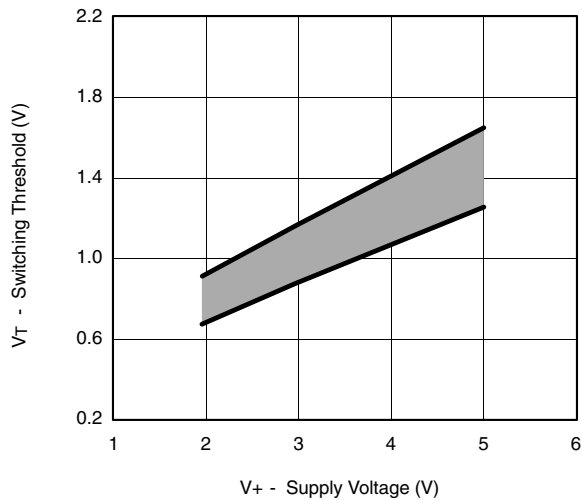
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



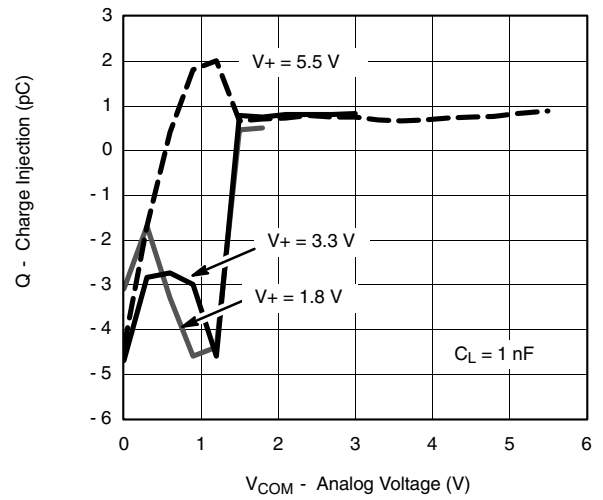
**Switching Time vs. Temperature**



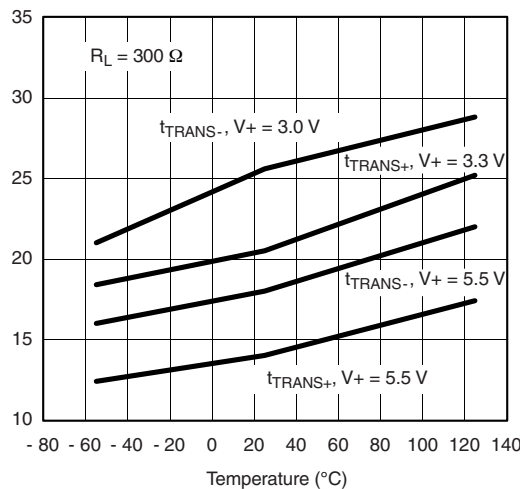
**Insertion Loss, Off-Isolation Crosstalk vs. Frequency**



**Switching Threshold vs. Supply Voltage**

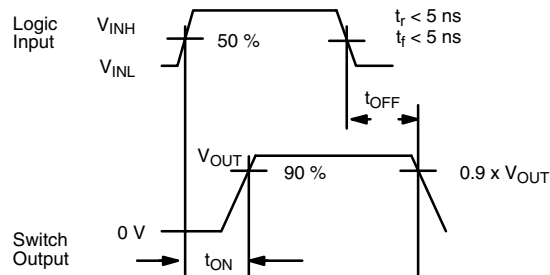
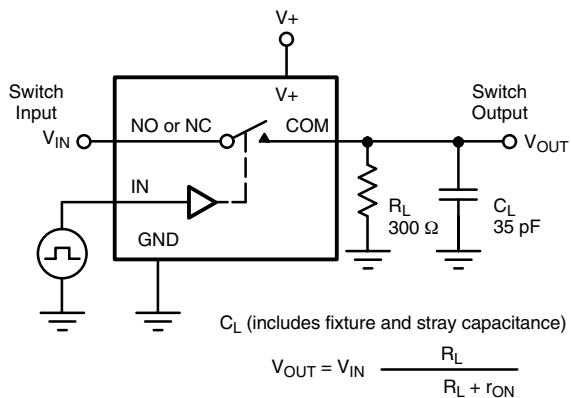


**Charge Injection vs. Analog Voltage**



**Transition Time vs. Temperature**

TEST CIRCUITS



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

Figure 1. Switching Time

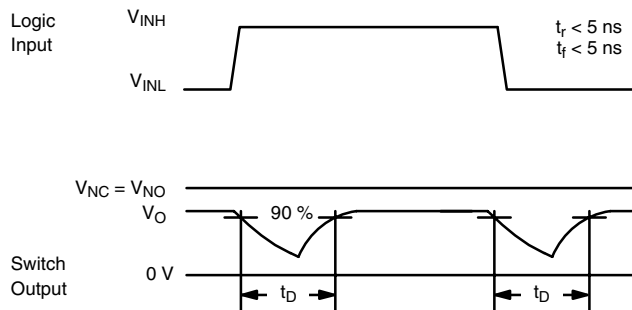
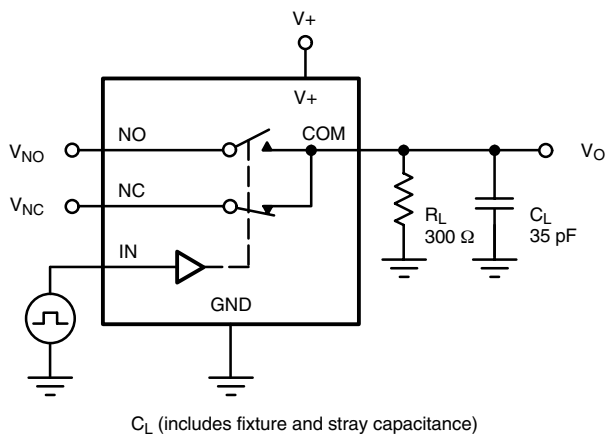


Figure 2. Break-Before-Make

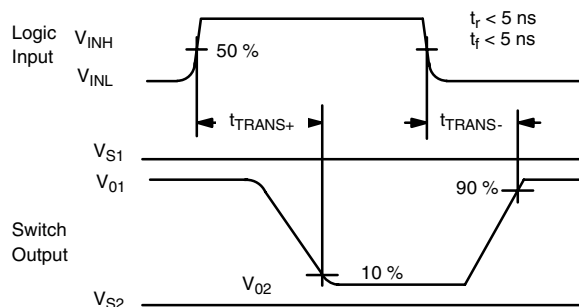
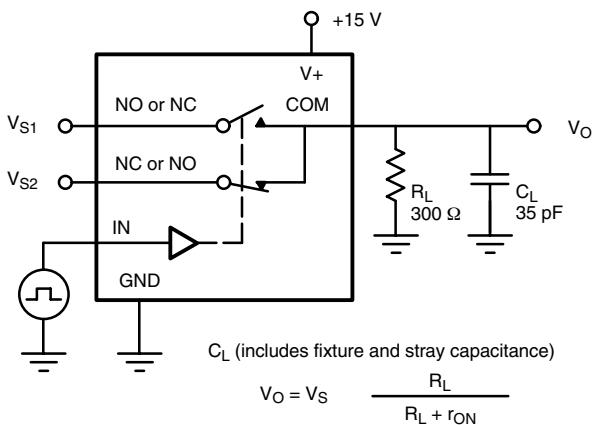


Figure 3. Transition Time

TEST CIRCUITS

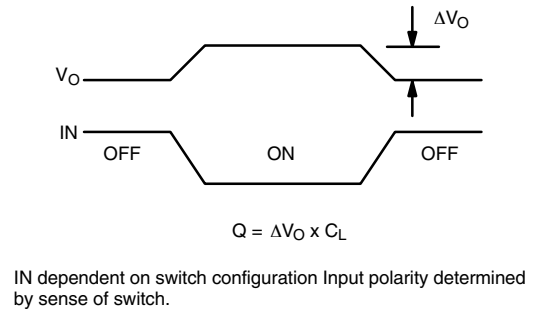
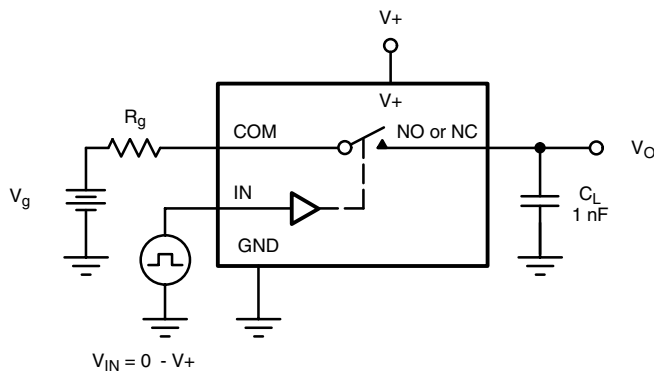


Figure 4. Charge Injection

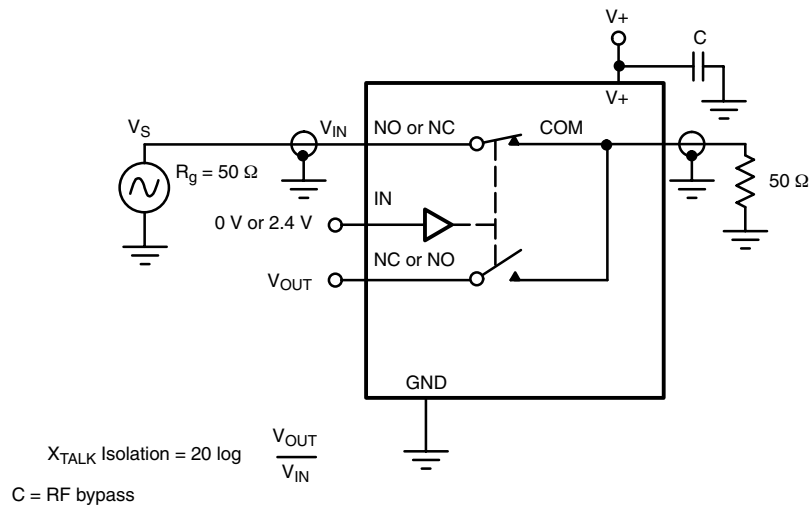


Figure 5. Crosstalk

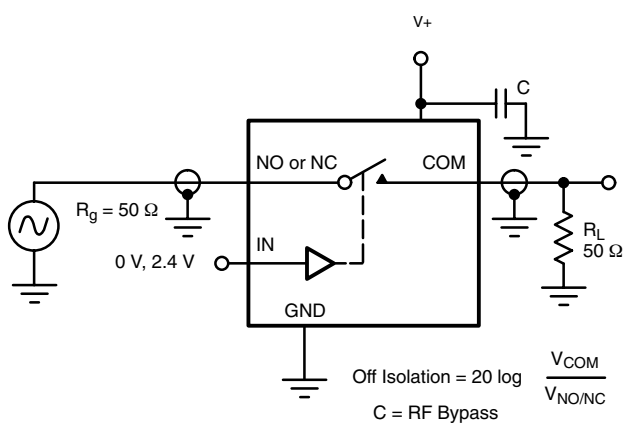


Figure 6. Off Isolation

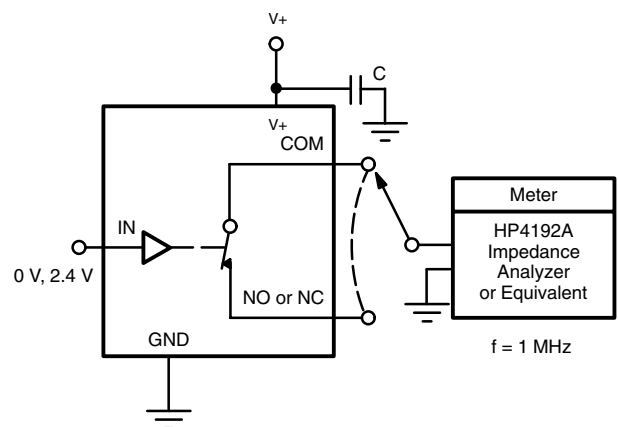


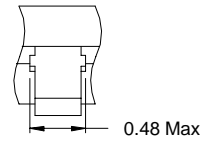
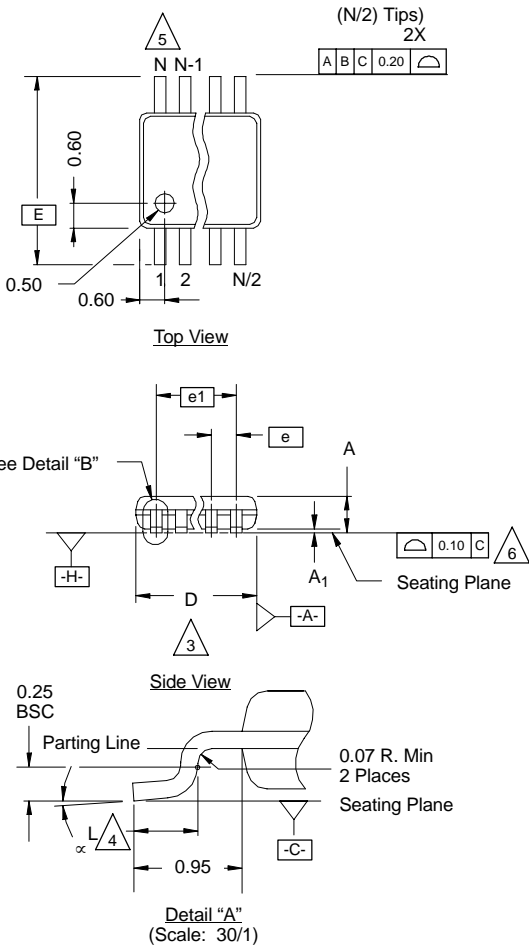
Figure 7. Source/Drain Capacitances

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 <http://www.vishay.com/ppg?72418>.

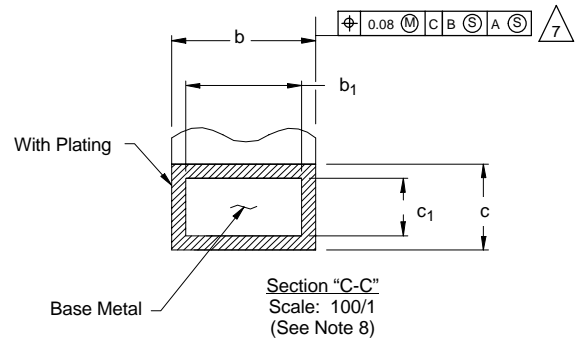


**MSOP: 10-LEADS**

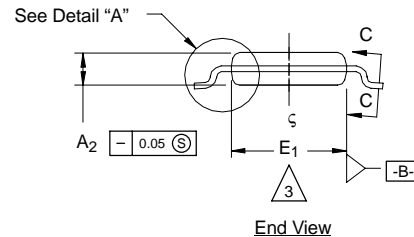
JEDEC Part Number: MO-187, (Variation AA and BA)



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



Section "C-C"  
Scale: 100/1  
(See Note 8)



End View

NOTES:

- Die thickness allowable is  $0.203 \pm 0.0127$ .
- Dimensioning and tolerances per ANSI.Y14.5M-1994.
- 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.
- Dimension is the length of terminal for soldering to a substrate.
- Terminal positions are shown for reference only.
- Formed leads shall be planar with respect to one another within 0.10 mm at seating plane.
- 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".
- Section "C-C" to be determined at 0.10 mm to 0.25 mm from the lead tip.
- Controlling dimension: millimeters.
- This part is compliant with JEDEC registration MO-187, variation AA and BA.
- Datums  $\square\text{-A}\square$  and  $\square\text{-B}\square$  to be determined Datum plane  $\square\text{-H}\square$ .
- Exposed pad area in bottom side is the same as teh leadframe pad size.

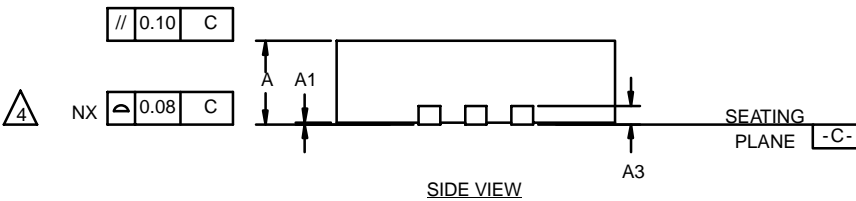
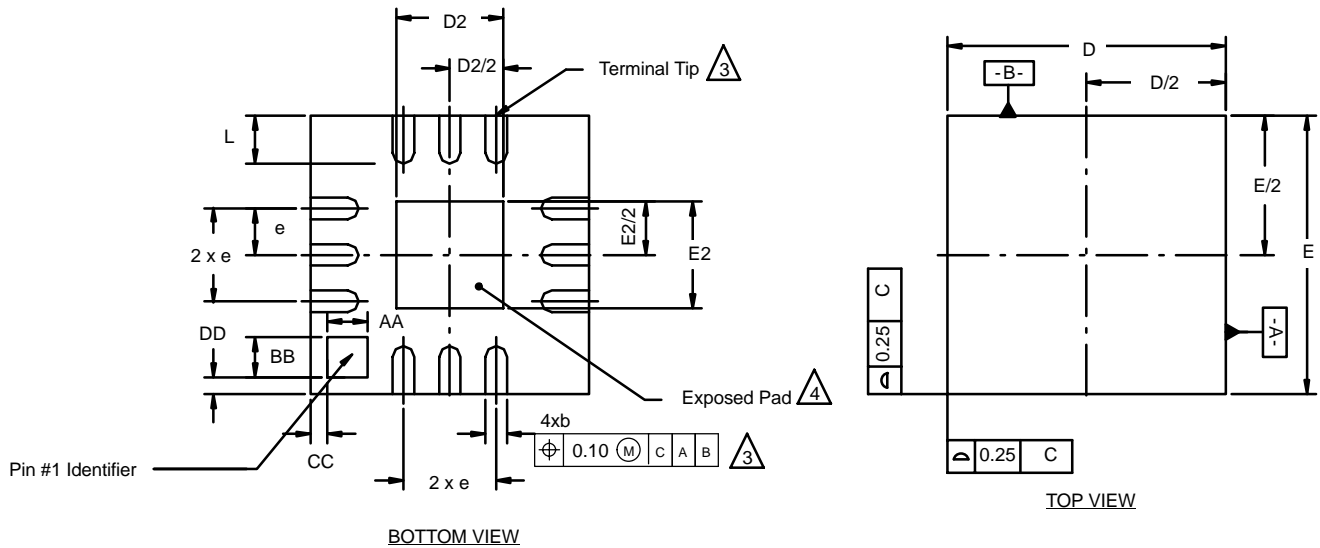
**N = 10L**

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						



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.