

Low-Voltage Single SPDT MICRO FOOT[®] Analog Switch

DESCRIPTION

The DG3000 is a single-pole/double-throw monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low power, high speed (t_{ON} : 24 ns, t_{OFF} : 9 ns), low on-resistance ($r_{DS(on)}$: 1.4 Ω) and small physical size (MICRO FOOT, 6-bump), the DG3000 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG3000 is built on Vishay Siliconix's low voltage J12 process. An epitaxial layer prevents latchup. Break-before-make is guaranteed for DG3000.

Each switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. For MICRO FOOT analog switching products manufactured with tin/silver/copper (Sn/Ag/Cu) device terminations, the lead (Pb)-free "-E1" suffix is being used as a designator.

FEATURES

- MICRO FOOT[®] Chip Scale Package (1.07 x 1.57 mm)
- Low Voltage Operation (1.8 V to 5.5 V)
- Low On-Resistance - $r_{DS(on)}$: 1.4 Ω
- Fast Switching - t_{ON} : 24 ns, t_{OFF} : 9 ns
- Low Power Consumption
- TTL/CMOS Compatible



Available
RoHS*
COMPLIANT

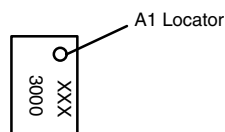
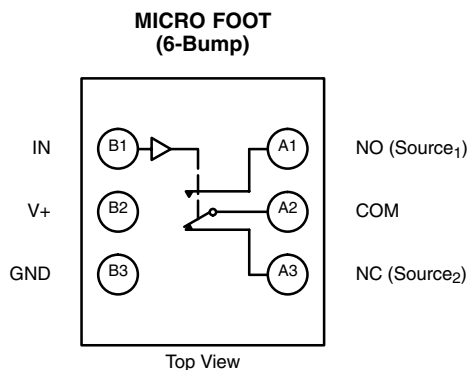
BENEFITS

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space

APPLICATIONS

- Cellular Phones
- Communication Systems
- Portable Test Equipment
- Battery Operated Systems
- PCM Cards
- PDA

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: 3000
xxx = Date/Lot Traceability Code

TRUTH TABLE

Logic	NC	NO
0	ON	OFF
1	OFF	ON

ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 to 85 °C	MICRO FOOT: 6-Bump 3 x 2, 0.5 mm Pitch 165 μ m nom. bump height (Eutectic, SnPb)	DG3000DB-T1
	MICRO FOOT: 6-Bump 3 x 2, 0.5 mm pitch, 238 μ m nom. bump height (Lead (Pb)-free, Sn/Ag/Cu)	DG3000DB-T1-E1

* Pb containing terminations are not RoHS compliant, exemptions may apply.



ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$, unless otherwise noted			
Parameter	Limit		Unit
Referenced V_+ to GND	- 0.3 to + 6 V		V
IN, COM, NC, NO ^a	- 0.3 V to ($V_+ + 0.3$ V)		
Continuous Current (Any Terminal)	± 50		mA
Peak Current (Pulsed at 1 ms, 10 % duty cycle)	± 200		
Storage Temperature (D Suffix)	- 65 to 150		°C
Package Reflow Conditions^b			
VPR (Eutectic)	215		°C
IR/Convection (Eutectic)	220		
IR/Convection (Lead (Pb)-free)	250		
Power Dissipation (Packages) ^c	6-Bump, 3 x 2 MICRO FOOT ^d	250	mW

Notes:

- a. Signals on NC, NO, or COM or IN exceeding V_+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- b. Refer to IPC/JEDEC (J-STD-020A). No hand/manual solder rework recommended.
- c. All bumps soldered to PC Board.
- d. Derate 3.1 mW/°C above 70 °C.

SPECIFICATIONS ($V_+ = 2.0$ V)								
Parameter	Symbol	Test Conditions Otherwise Unless Specified $V_+ = 2.0$ V, ± 10 %, $V_{IN} = 0.4$ or 1.6 V ^e	Temp ^a	Limits - 40 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, $V_{COM} = 1.0$ V, $I_{NO}, I_{NC} = 10$ mA	Room Full ^d		17	20 22.5	Ω	
r_{ON} Flatness ^d	r_{ON} Flatness	$V_+ = 1.8$ V, $V_{COM} = 0$ to V_+ , $I_{NO}, I_{NC} = 10$ mA	Room		14			
Switch Off Leakage Current ^f	$I_{NO(off)}$ $I_{NC(off)}$	$V_+ = 2.2$ V $V_{NO}, V_{NC} = 0.5$ V/1.5 V, $V_{COM} = 1.5$ V/0.5 V	Room Full ^d	- 700 - 11		700 11	pA nA	
	$I_{COM(off)}$		Room Full ^d	- 700 - 11		700 11	pA nA	
Channel-On Leakage Current ^f	$I_{COM(on)}$	$V_+ = 2.2$ V, $V_{NO}, V_{NC} = V_{COM} = 0.5$ V/1.5 V	Room Full ^d	- 700 - 11		700 11	pA nA	
Digital Control								
Input High Voltage	V_{INH}		Full	1.6			V	
Input Low Voltage	V_{INL}		Full			0.4		
Input Capacitance ^d	C_{in}		Full		5		pF	
Input Current ^d	I_{INL} or I_{INH}	$V_{IN} = 0$ 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 Figures 1 and 2	Room Full ^d		61	76 79	ns	
Turn-Off Time	t_{OFF}		Room Full ^d		17	33 36		
Break-Before-Make Time	t_d		Room	1	45			
Charge Injection ^d	Q_{INJ}	$C_L = 1$ nF, $V_{GEN} = 0$ V, $R_{GEN} = 0$ Ω, Figure 3	Room		2		pC	
Off-Isolation ^d	OIRR	$R_L = 50$ Ω, $C_L = 5$ pF, $f = 1$ MHz	Room		- 61		dB	
Crosstalk ^d	X_{TALK}		Room		- 67			
NO, NC Off Capacitance ^d	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0$ or V_+ , $f = 1$ MHz	Room		31		pF	
Channel-On Capacitance ^d	C_{ON}		Room		98			
Power Supply								
Power Supply Range	V_+	$V_{IN} = 0$ or V_+		1.8		2.2	V	
Power Supply Current ^d	I_+				0.1		1.0	μA
Power Consumption	P_C						2.2	μW



SPECIFICATIONS (V+ = 3.0 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, VIN = 0.4 or 2.0 V ^e	Temp ^a	Limits - 40 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 ^d	r _{ON}	V+ = 2.7 V, V _{COM} = 1.5 V, I _{NO} , I _{NC} = 10 mA	Room Full		3.3 3.4	4.1 4.2	Ω
r _{ON} Flatness ^d	r _{ON} Flatness	V+ = 2.7 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 10 mA	Room		1.3		
Switch Off Leakage Current ^f	I _{NO(off)} I _{NC(off)}	V+ = 3.3 V V _{NO} , V _{NC} = 1 V/3 V, V _{COM} = 3 V/1 V	Room Full	- 800 - 13		800 13	pA nA
	I _{COM(off)}		Room Full	- 800 - 13		800 13	pA nA
Channel-On Leakage Current ^f	I _{COM(on)}	V+ = 3.3 V, V _{NO} , V _{NC} = V _{COM} = 1 V/3 V	Room Full	- 800 - 13		800 13	pA nA
Digital Control							
Input High Voltage	V _{INH}		Full	2			V
Input Low Voltage	V _{INL}		Full			0.4	
Input Capacitance ^d	C _{in}		Full		5		pF
Input Current ^d	I _{INL} or I _{INH}	V _{IN} = 0 or V+	Full	- 1		1	μA
Dynamic Characteristics							
Turn-On Time ^d	t _{ON}	V _{NO} or V _{NC} = 2.0 V, R _L = 300 Ω, C _L = 35 pF Figures 1 and 2	Room Full		34	49 52	ns
Turn-Off Time ^d	t _{OFF}		Room Full		12	30 33	
Break-Before-Make Time ^d	t _d		Room	1	23		
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 3	Room		4		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 61		dB
Crosstalk ^d	X _{TALK}		Room		- 67		
NO, NC Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		31		pF
Channel-On Capacitance ^d	C _{ON}		Room		47		
Power Supply							
Power Supply Range	V+			2.7		3.3	V
Power Supply Current ^d	I+	V _{IN} = 0 or V+			0.1	1.0	μA
Power Consumption	P _C						3.3



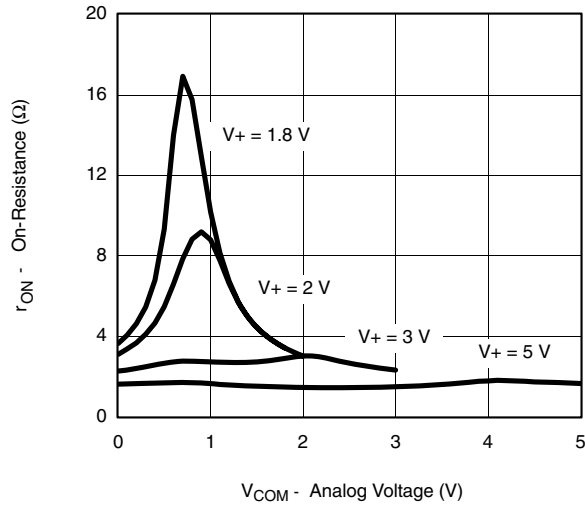
SPECIFICATIONS (V+ = 5.0 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5 V, ± 10 %, VIN = 0.8 or 2.4 V ^e	Temp ^a	Limits - 40 to 85 °C			Unit
				Min ^b	Typ ^c	Max ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} V _{COM}		Full	0		V+	V
On- Resistance	r _{ON}	V+ = 4.5 V, V _{COM} = 3 V, I _{NO} , I _{NC} = 10 mA	Room Full		1.4 1.6	2.3 2.8	Ω
r _{ON} Flatness ^d	r _{ON} Flatness	V+ = 4.5 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 10 mA	Room		0.5		
Switch Off Leakage Current	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 Full	- 1.2 - 21		1.2 21	nA
	I _{COM(off)}		Room Full	- 1.2 - 21		1.2 21	
Channel-On Leakage Current	I _{COM(on)}	V+ = 5.5 V, V+ = 5.5 V V _{NO} , V _{NC} = V _{COM} = 1 V/4.5 V	Room Full	- 1.2 - 21		1.2 21	
Digital Control							
Input High Voltage	V _{INH}		Full	2.4			V
Input Low Voltage	V _{INL}		Full			0.8	
Input Capacitance	C _{in}		Full		5		pF
Input Current	I _{INL} or I _{INH}	V _{IN} = 0 or V+	Full	- 1		1	μA
Dynamic Characteristics							
Turn-On Time ^d	t _{ON}	V _{NO} or V _{NC} = 3 V, R _L = 300 Ω, C _L = 35 pF Figures 1 and 2	Room Full		24	36 39	ns
Turn-Off Time ^d	t _{OFF}		Room Full		9	22 25	
Break-Before-Make Time ^d	t _d		Room	1	15		
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 3	Room		38		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 61		dB
Crosstalk ^d	X _{TALK}		Room		- 67		
Source-Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		30		pF
Channel-On Capacitance ^d	C _{ON}		Room		96		
Power Supply							
Power Supply Range	V+			4.5		5.5	V
Power Supply Current	I+	V _{IN} = 0 or V+			0.1	1.0	μA
Power Consumption	P _C						5.5

Notes:

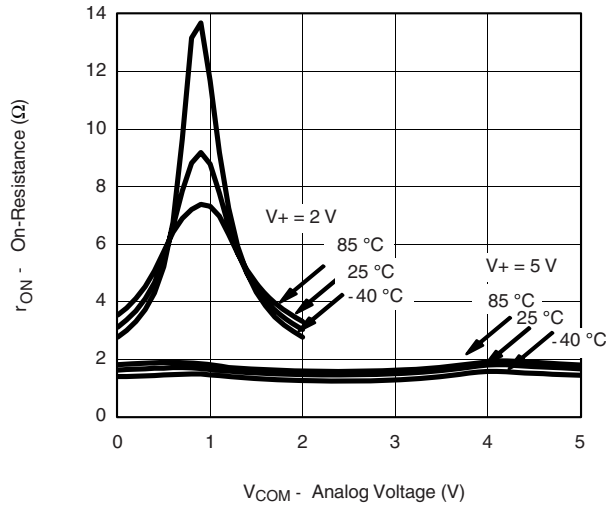
- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- c. Typical values are for design aid only, not guaranteed nor subject to production testing.
- d.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

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.

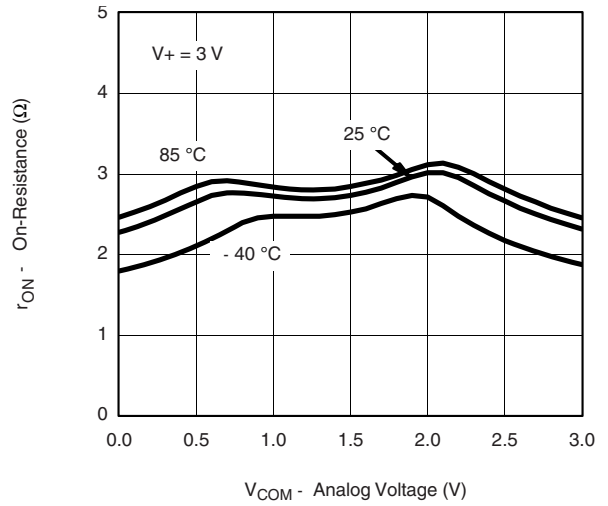
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



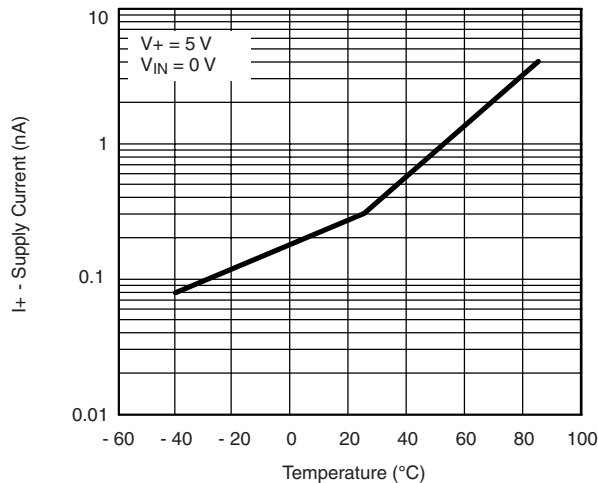
r_{ON} vs. V_{COM} and Supply Voltage



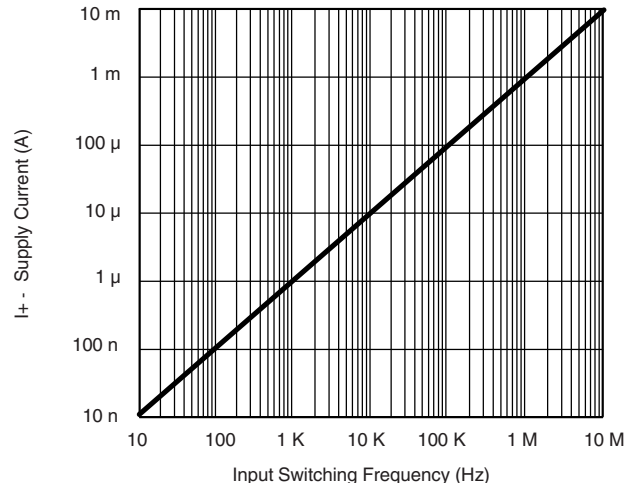
r_{ON} vs. Analog Voltage and Temperature



r_{ON} vs. Analog Voltage and Temperature

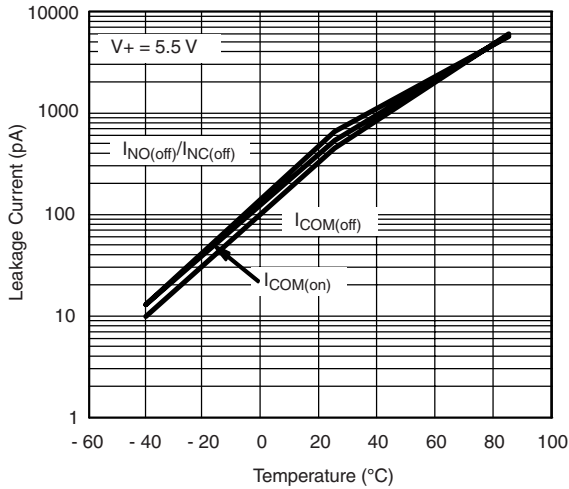


Supply Current vs. Temperature

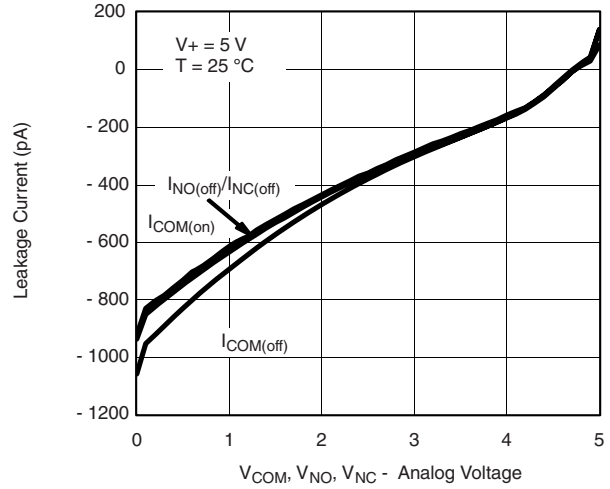


Supply Current vs. Input Switching Frequency

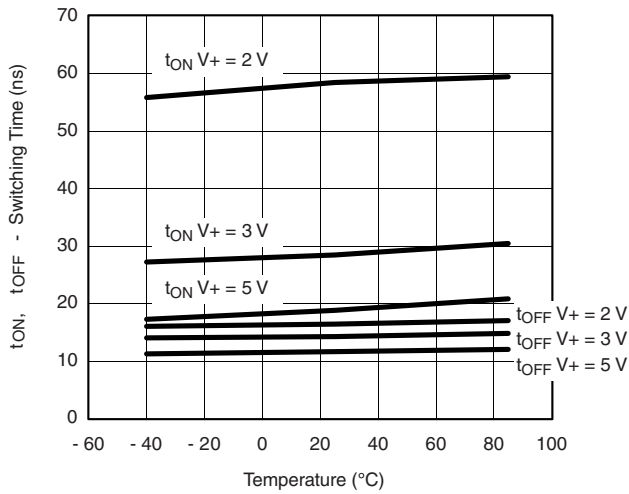
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



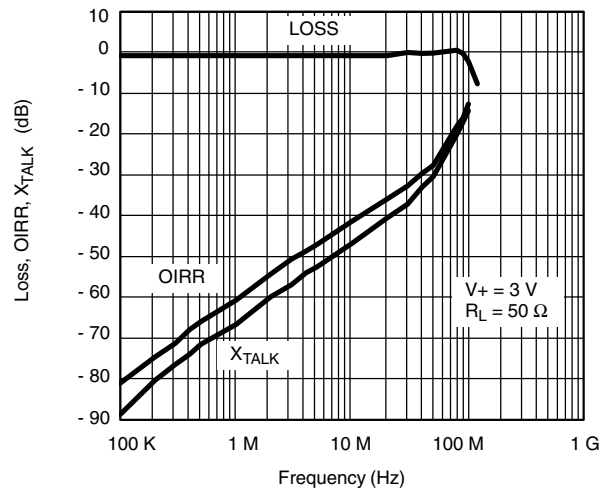
Leakage Current vs. Temperature



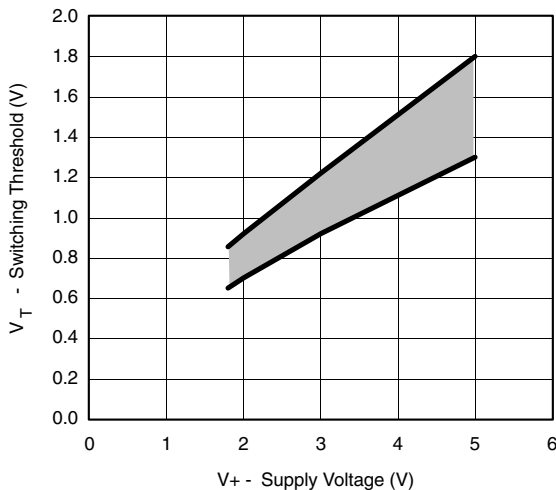
Leakage vs. Analog Voltage



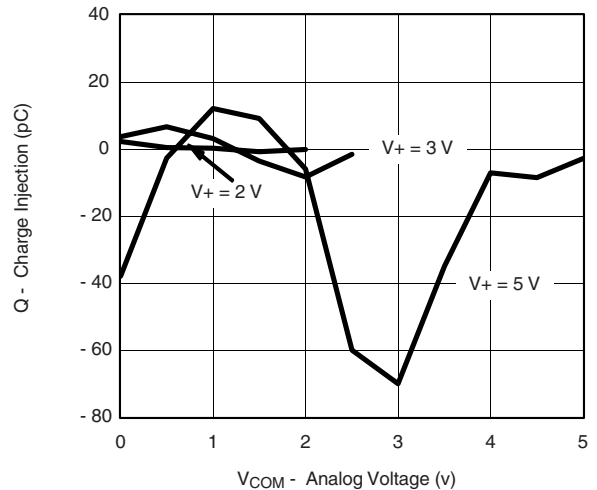
Switching Time vs. Temperature and Supply Voltage



Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

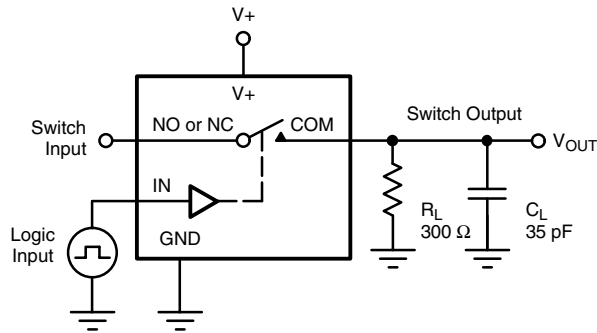


Switching Threshold vs. Supply Voltage



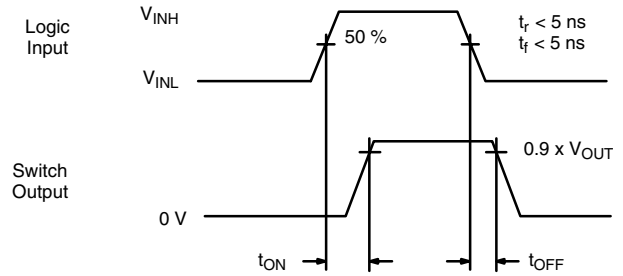
Charge Injection vs. Analog Voltage

TEST CIRCUITS



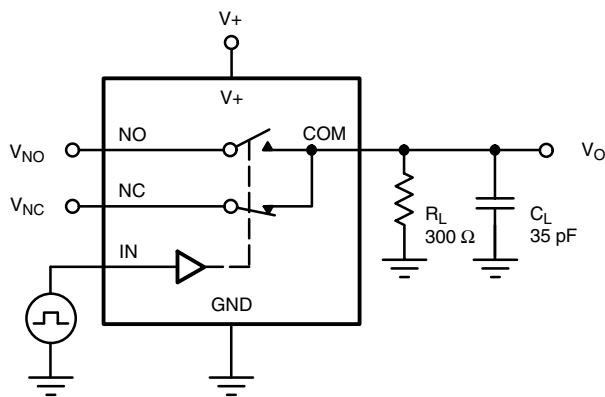
C_L (includes fixture and stray capacitance)

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



Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 1. Switching Time



C_L (includes fixture and stray capacitance)

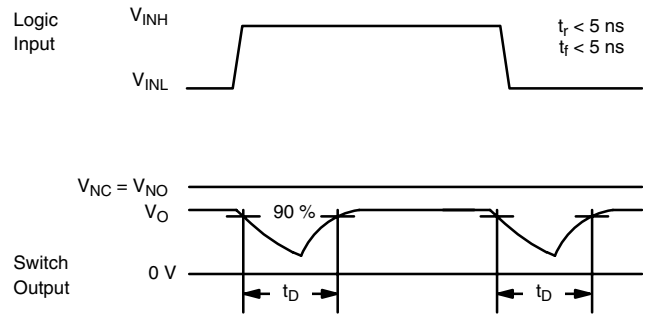
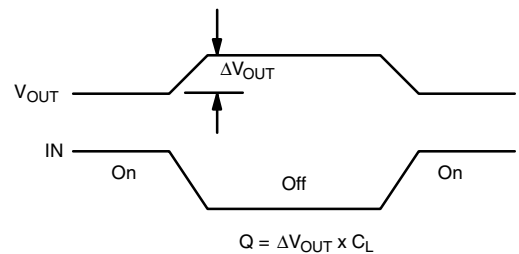
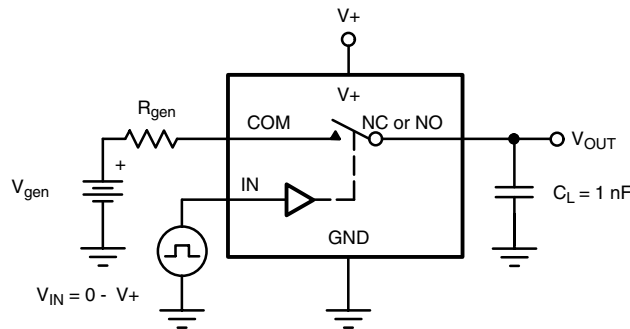


Figure 2. Break-Before-Make Interval



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

Figure 3. Charge Injection

TEST CIRCUITS

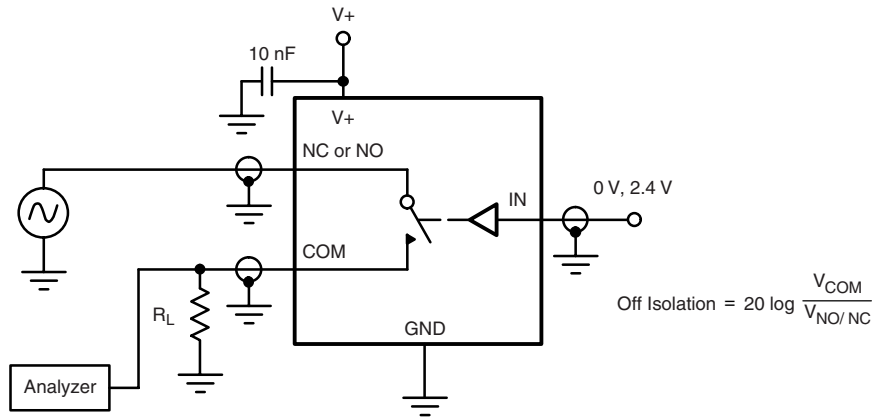


Figure 4. Off-Isolation

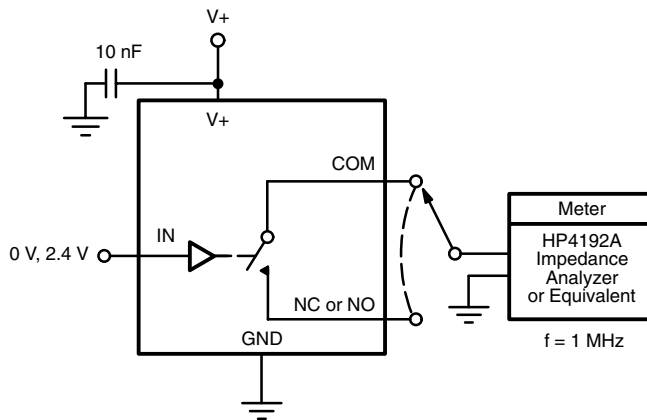
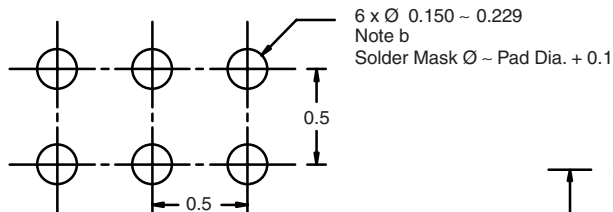


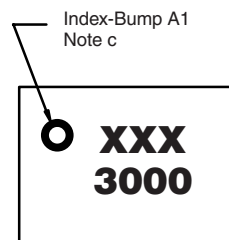
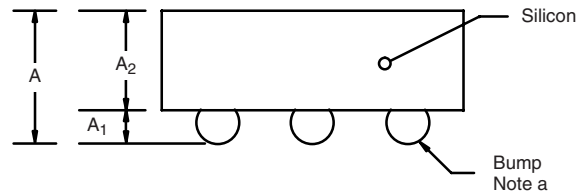
Figure 5. Channel Off/On Capacitance

PACKAGE OUTLINE

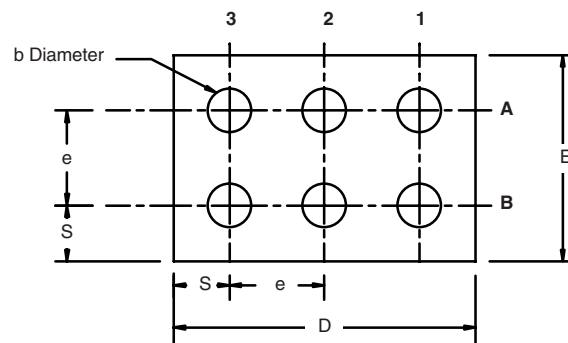
MICRO FOOT: 6-BUMP (3 x 2, 0.5 mm PITCH)



Recommended Land Pattern



Top Side (Die Back)



Notes (Unless Otherwise Specified):

- a. Bump is Eutectic 63/57 Sn/Pb or Lead (Pb)-free Sn/Ag/Cu.
- b. Non-solder mask defined copper landing pad.
- c. Laser Mark on silicon die back; no coating. Shown is not actual marking; sample only.

EUTECTIC (Sn/Pb)				
Dim	Millimeters ^a		Inches	
	Min	Max	Min	Max
A	0.615	0.715	0.0242	0.0281
A₁	0.140	0.190	0.0055	0.0075
A₂	0.470	0.495	0.0185	0.0195
b	0.180	0.250	0.0071	0.0098
D	1.555	1.585	0.0612	0.0624
E	1.055	1.085	0.0415	0.0427
e	0.5 BASIC		0.0197 BASIC	
S	0.278	0.293	0.0109	0.0115

Notes:

- a. Use millimeters as the primary measurement.

LEAD (Pb)-FREE (Sn/Ag/Cu)				
Dim	Millimeters ^a		Inches	
	Min	Max	Min	Max
A	0.688	0.753	0.0271	0.0296
A₁	0.218	0.258	0.0086	0.0102
A₂	0.470	0.495	0.0185	0.0195
b	0.306	0.346	0.0120	0.0136
D	1.555	1.585	0.0612	0.0624
E	1.055	1.085	0.0415	0.0427
e	0.5 BASIC		0.0197 BASIC	
S	0.278	0.293	0.0109	0.0115

Notes:

- a. Use millimeters as the primary measurement.

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?71742>.



Disclaimer

All product specifications and data are subject to change without notice.

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 herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

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.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.