Low-Voltage Single SPDT MICRO FOOT™ Analog Switch

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

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

DESCRIPTION

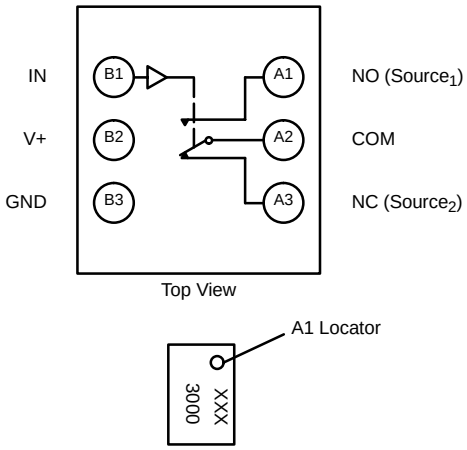
The DG3000 is a single-pole/double-throw monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low power, high speed (t_{ON}: 24 ns, t_{OFF}: 9 ns), low on-resistance ($r_{DS(on)}$: 1.4 Ω) and small physical size (MICRO FOOT, 6-bump), the DG3000 is ideal for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

The DG3000 is built on Vishay Siliconix's low voltage JI2 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.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

MICRO FOOT (6-Bump)



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 (2 x 3, 0.5-mm Pitch)	DG3000DB

ABSOLUTE MAXIMUM RATINGS

Reference to GND
V+ ..... -0.3 to +6 V
IN, COM, NC, NO[a] ..... -0.3 to (V+ + 0.3 V)
Continuous Current (Any terminal) ..... ±50 mA
Peak Current ..... ±200 mA
(Pulsed at 1 ms, 10% duty cycle)
Storage Temperature (D Suffix) ..... -65 to 150°C

Package Reflow Conditions[b]
VPR ..... 215°C
IR/Convection ..... 220°C

Power Dissipation (Packages)[c]
6-Bump, 2 x 3 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 6.5 mW/°C above 25°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 Min[b]	Typ[c]	Max[b]	Unit
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+			1.8		2.2	V
Power Supply Current[d]	I+	V_{IN} = 0 or V+			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%, V_{IN} = 0.4 or 2.0 V[e]	Temp[a]	Limits -40 to 85°C Min[b]	Typ[c]	Max[b]	Unit
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		Ω
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	V
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 Figure 1 and 2	Room Full		34	49 52	ns
Turn-Off Time[d]	t_{OFF}		Room Full		12	30 33	ns
Break-Before-Make Time[d]	t_d		Room	1	23		ns
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		dB
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		pF
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	µW

SPECIFICATIONS (V+ = 5.0 V)

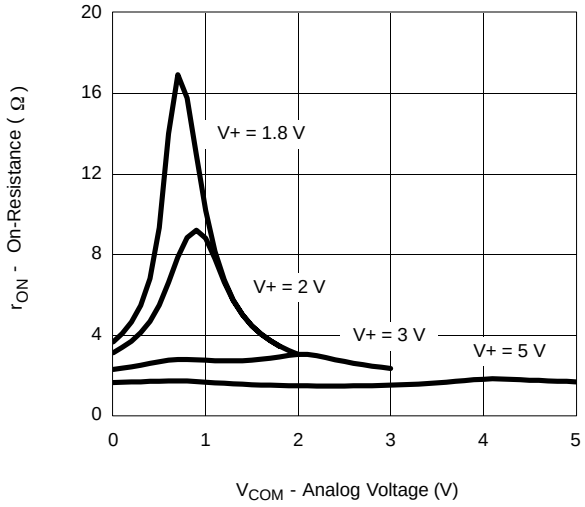
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5 V, ±10%, V_{IN} = 0.8 or 2.4 V[e]	Temp[a]	Limits -40 to 85°C Min[b]	Typ[c]	Max[b]	Unit
Analog Switch							
Analog Signal Range[d]	V_{NO}, V_{NC}, V_{COM}		Full	0		V+	V
On-Resistance	r_{ON}	V+ = 4.5 V, V_{COM} = 3 V, I_{NO}, I_{NC} = 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		Ω
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	nA
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	nA
Digital Control							
Input High Voltage	V_{INH}		Full	2.4			V
Input Low Voltage	V_{INL}		Full			0.8	V
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 Figure 1 and 2	Room Full		24	36 39	ns
Turn-Off Time[d]	t_{OFF}		Room Full		9	22 25	ns
Break-Before-Make Time[d]	t_d		Room	1	15		ns
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		dB
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		pF
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	µW

Notes:

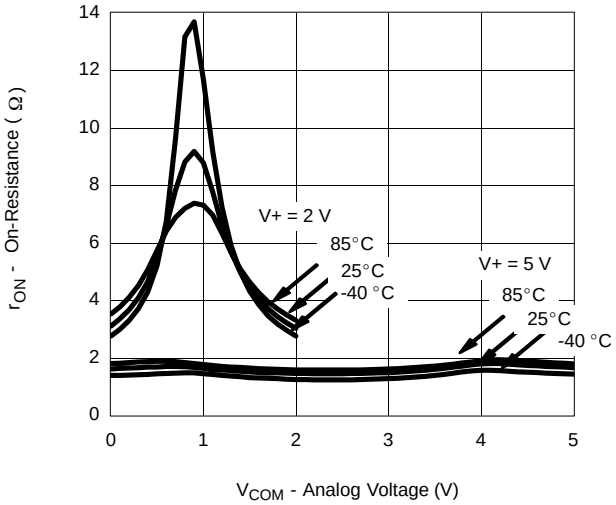
a. Room = 25°C, Full = as determined by the operating suffix.
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c. Typical values are for design aid only, not guaranteed nor subject to production testing.
d. Guarantee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

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

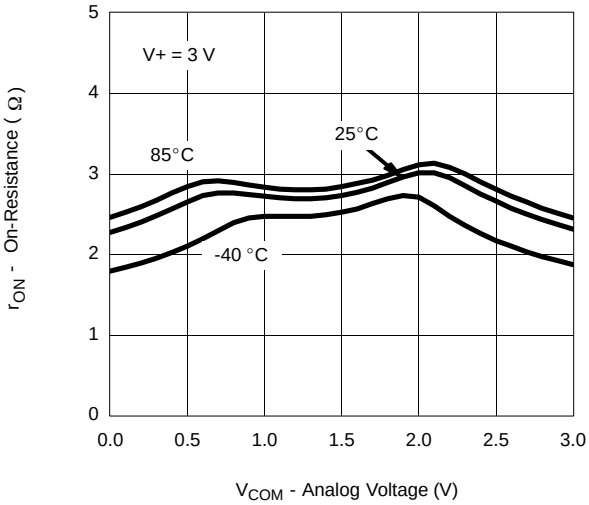
r_{ON} vs. V_{COM} and Supply Voltage



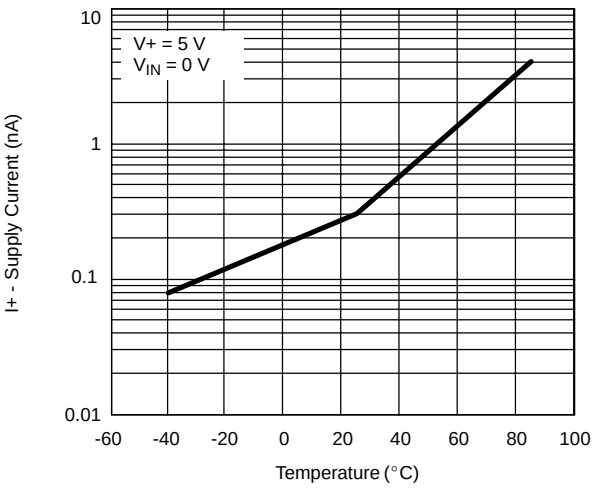
r_{ON} vs. Analog Voltage and Temperature



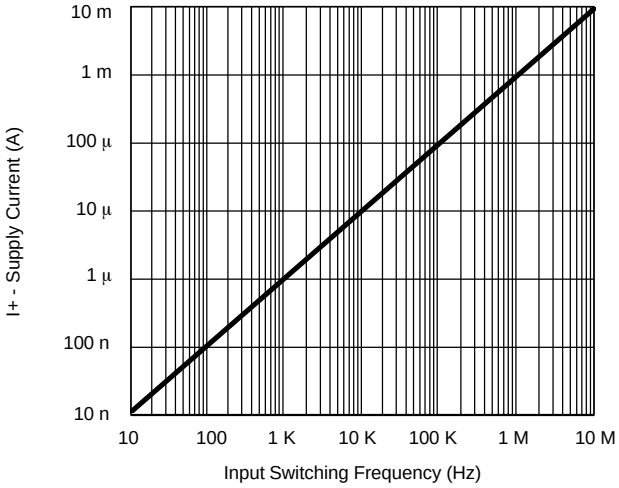
r_{ON} vs. Analog Voltage and Temperature



Supply Current vs. Temperature

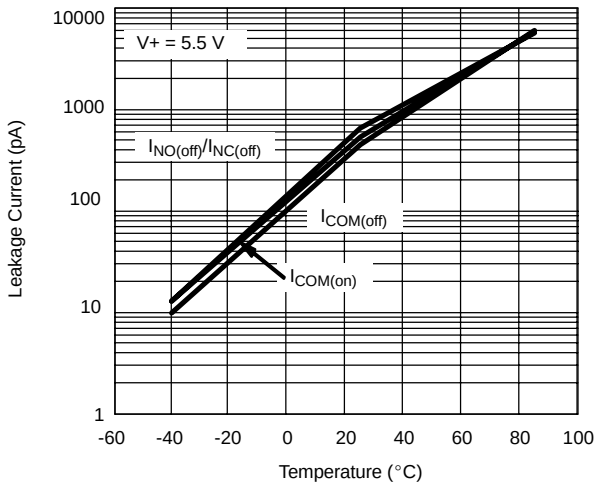


Supply Current vs. Input Switching Frequency

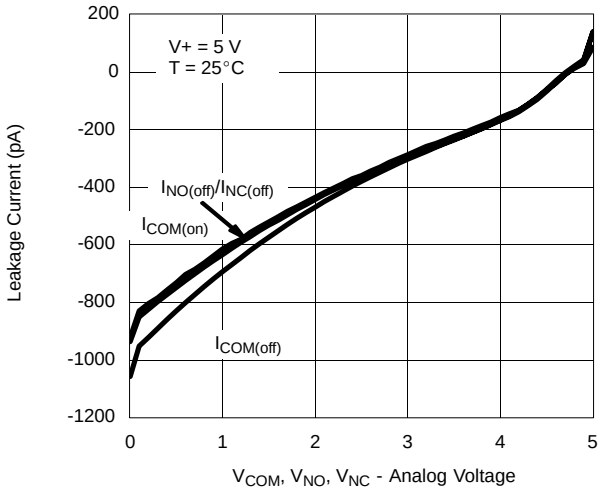


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

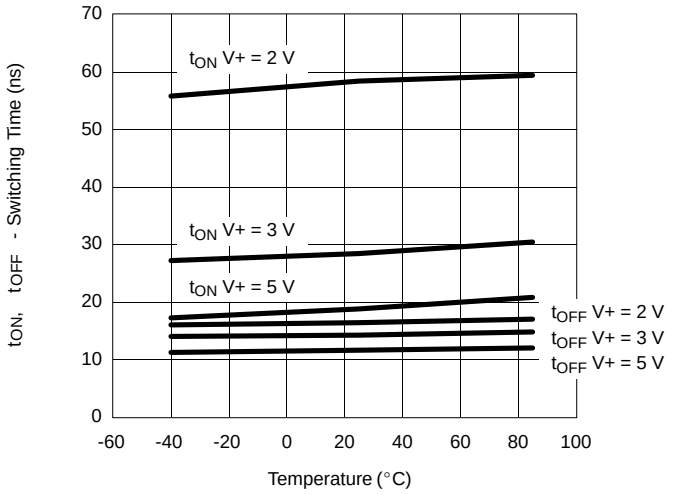
Leakage Current vs. Temperature



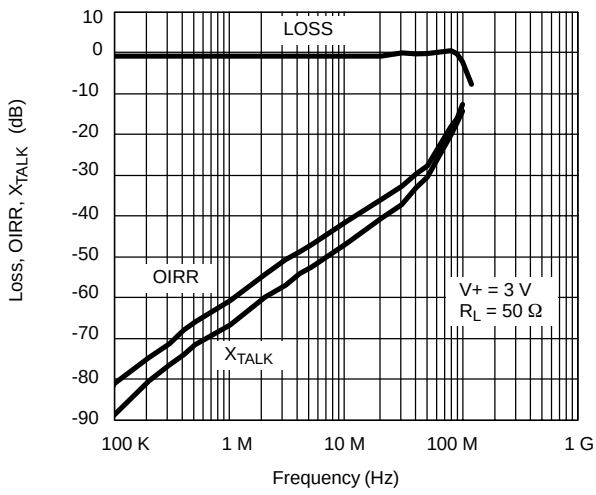
Leakage vs. Analog Voltage



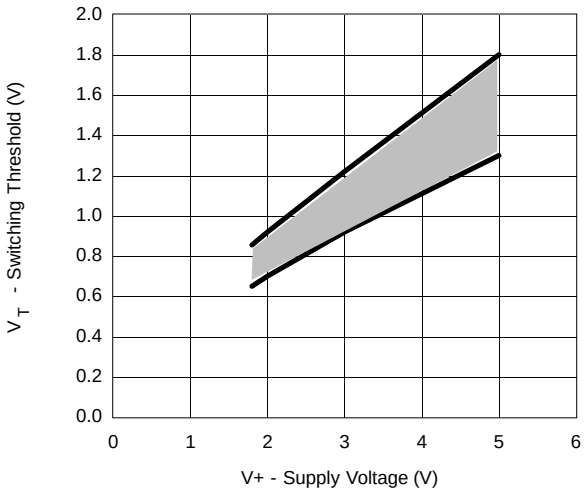
Switching Time vs. Temperature and Supply Voltage



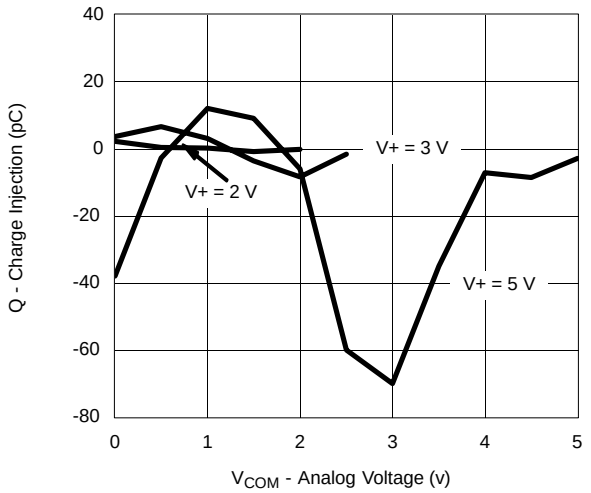
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



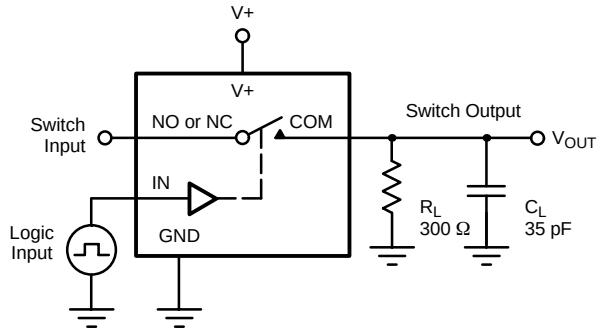
Switching Threshold vs. Supply Voltage



Charge Injection vs. Analog Voltage

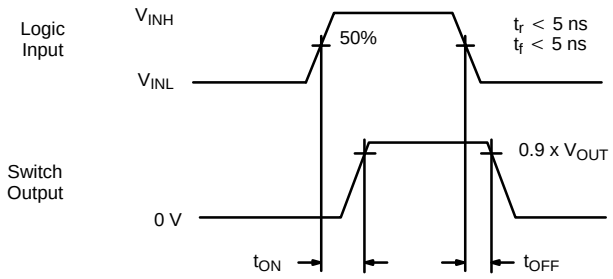


TEST CIRCUITS



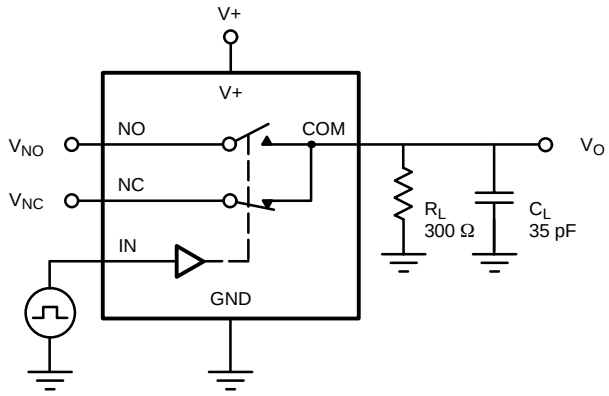
C_L (includes fixture and stray capacitance)

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



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)

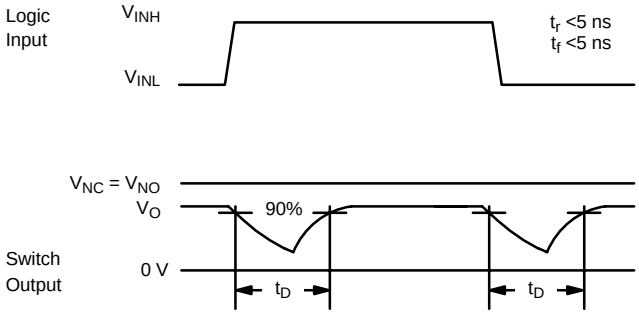
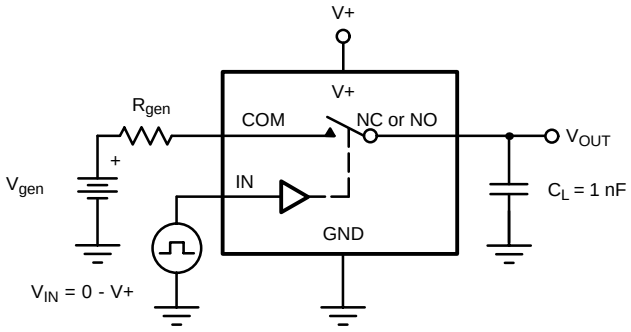
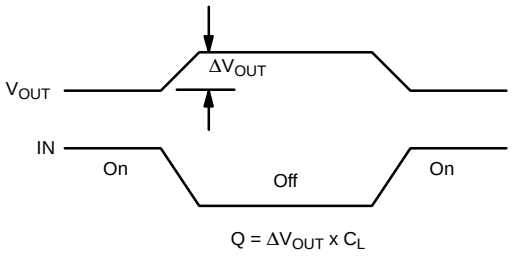


FIGURE 2. Break-Before-Make Interval





$Q = \Delta V_{OUT} \times C_L$

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

FIGURE 3. Charge Injection

TEST CIRCUITS

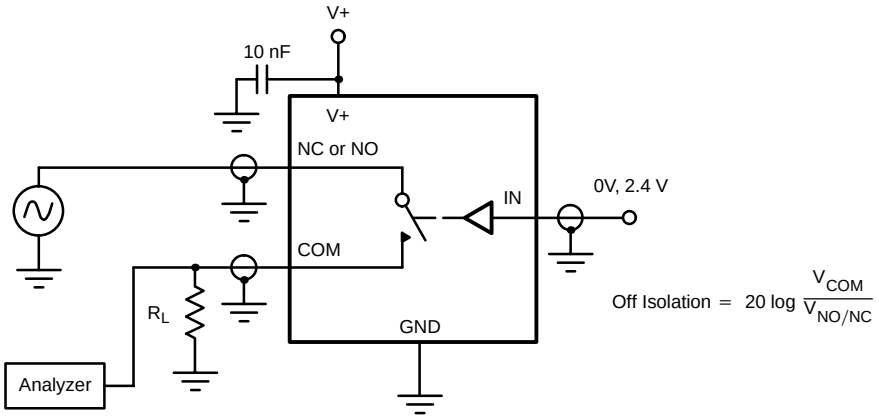


FIGURE 4. Off-Isolation

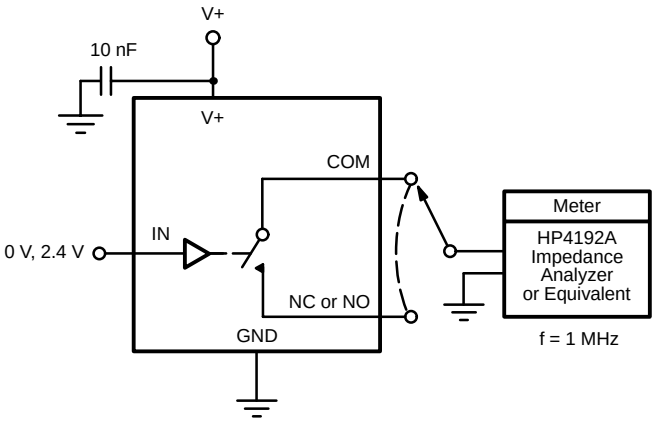
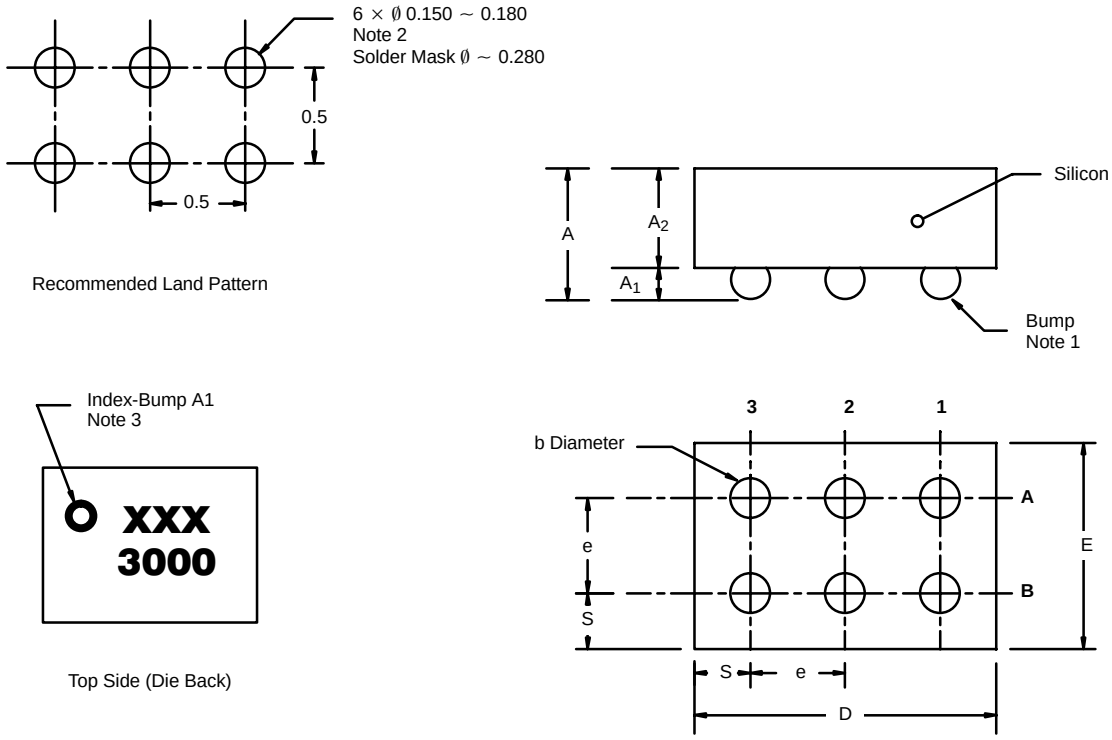


FIGURE 5. Channel Off/On Capacitance

PACKAGE OUTLINE

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



NOTES (Unless Otherwise Specified):

1. Bump is Eutectic 63/57 Sn/Pb.
2. Non-solder mask defined copper landing pad.
3. Laser Mark on silicon die back; no coating. Shown is not actual marking; sample only.

Dim	MILLIMETERS*		INCHES	
	Min	Max	Min	Max
A	0.615	0.715	0.0242	0.0281
A_1	0.140	0.190	0.0055	0.0075
A_2	0.475	0.525	0.0187	0.0207
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

* Use millimeters as the primary measurement.