

Low-Voltage Single SPDT Analog Switch

DESCRIPTION

The DG2012 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} : 17 ns, t_{OFF} : 13 ns), low on-resistance ($r_{DS(on)}$: 1 Ω) and small physical size (SC70), the DG2012 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG2012 is built on Vishay Siliconix's low voltage submicron CMOS process. An epitaxial layer prevents latchup. Break-before -make is guaranteed for DG2012.

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

FEATURES

- Low Voltage Operation (1.8 V to 5.5 V)
- Low On-Resistance - $r_{DS(on)}$: 1 Ω Typ.
- Fast Switching - t_{ON} : 17 ns, t_{OFF} : 13 ns
- Low Leakage
- TTL/CMOS Compatible
- 6-Pin SC-70 Package



RoHS*
COMPLIANT

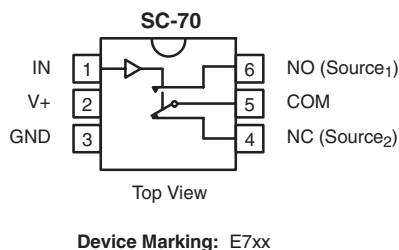
BENEFITS

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

APPLICATIONS

- Cellular Phones
- Communication Systems
- Portable Test Equipment
- Battery Operated Systems
- Sample and Hold Circuits

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE

Logic	NC	NO
0	ON	OFF
1	OFF	ON

ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 to 85 °C	SC70-6	DG2012DL-T1 DG2012DL-T1-E3

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

ABSOLUTE MAXIMUM RATINGS

Parameter	Limit	Unit
Referenced V+ to GND	- 0.3 to + 6	V
IN, COM, NC, NO ^a	- 0.3 to (V+ + 0.3)	
Continuous Current (NO, NC and COM Pins)	± 100	mA
Peak Current (Pulsed at 1 ms, 10 % duty cycle)	± 300	
Storage Temperature (D Suffix)	- 65 to 150	°C
Power Dissipation (Packages) ^b	6-Pin SO70 ^c	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. All leads welded or soldered to PC Board.

c. 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} = 0.2 V/0.9 V I _{NO} , I _{NC} = 10 mA	Room Full ^d		2.7 2.7	5.3 5.3	Ω
r _{ON} Flatness ^d	r _{ON} Flatness	V+ = 1.8 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 10 mA	Room			3	
r _{ON} Match ^d	Δr _{ON}		Room			0.25	
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	- 0.5 - 5.0		0.5 5.0	nA
	I _{COM(off)}		Room Full ^d	- 0.5 - 5.0		0.5 5.0	
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	- 0.5 - 5.0		0.5 5.0	
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		3		pF
Input Current ^f	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} = 1.5 V, R _L = 300 Ω, C _L = 35 pF Figures 1 and 2	Room Full ^d		43	63 65	ns
Turn-Off Time ^d	t _{OFF}		Room Full ^d		23	45 46	
Break-Before-Make Time ^d	t _d		Room	2			
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 3	Room		7		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 63		dB
Crosstalk ^d	X _{TALK}		Room		- 64		
N _O , N _C Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		22		pF
Channel-On Capacitance ^d	C _{ON}		Room		58		



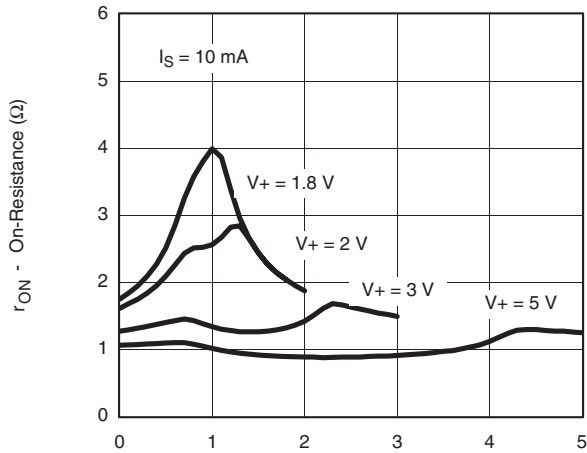
SPECIFICATIONS (V+ = 3.0 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, V _{IN} = 0.6 or 2.0 V ^e	Temp ^a	Limits - 40 to 85 °C			Unit
				Min ^b	Typ ^c	Max ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} V _{COM}		Full	0		V+	V
On-Resistance	r _{ON}	V+ = 2.7 V, V _{COM} = 0.2 V/1.5 V, I _{NO} I _{NC} = 10 mA	Room Full		1.4 1.6	2.1 2.3	Ω
r _{ON} Flatness	r _{ON} Flatness	V+ = 2.7 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 10 mA	Room			0.85	
r _{ON} MatchFlat	Δr _{ON}		Room			0.25	
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	- 0.5 - 5.0		0.5 5.0	nA
	I _{COM(off)}		Room Full	- 0.5 - 5.0		0.5 5.0	
Channel-On Leakage Current ^f	I _{COM(on)}	V+ = 3.3 V, V _{NO} , V _{NC} = V _{COM} = 1 V/3 V	Room Full	- 0.5 - 5.0		0.5 5.0	
Digital Control							
Input High Voltage	V _{INH}		Full	2			V
Input Low Voltage	V _{INL}		Full			0.6	
Input Capacitance ^d	C _{in}		Full		3		pF
Input Current ^f	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} = 2.0 V, R _L = 300 Ω, C _L = 35 pF Figures 1 and 2	Room Full		27	47 48	ns
Turn-Off Time	t _{OFF}		Room Full		17	37 38	
Break-Before-Make Time	t _d		Room	1			
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 3	Room		10		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 63		dB
Crosstalk ^d	X _{TALK}		Room		- 64		
NO, NC Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		21		pF
Channel-On Capacitance ^d	C _{ON}		Room		57		
Power Supply							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	V _{IN} = 0 or V+			0.01	1.0	μA

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			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} = 0.5 V/2.5 V I _{NO} , I _{NC} = 10 mA	Room Full		1.0 1.2	1.8 1.9	Ω
r _{ON} Flatness ^d	r _{ON} Flatness	V+ = 4.5 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 10 mA	Room			0.55	
r _{ON} Match ^d	Δr _{ON}		Room			0.25	
Switch Off Leakage Current	I _{NO(off)} I _{NC(off)}	V+ = 5.0 V V _{NO} , V _{NC} = 0.5 V/4.5 V, V _{COM} = 4.5 V/0.5 V	Room Full	- 0.5 - 5.0		0.5 5.0	nA
	I _{COM(off)}		Room Full	- 0.5 - 5.0		0.5 5.0	
Channel-On Leakage Current	I _{COM(on)}	V+ = 5.0 V, V _{NO} , V _{NC} = V _{COM} = 0.5 V/4.5 V	Room Full	- 0.5 - 5.0		0.5 5.0	
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 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		17	38 39	ns
Turn-Off Time ^d	t _{OFF}		Room Full		13	32 33	
Break-Before-Make Time ^d	t _d		Room	1			
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 3	Room		20		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room		- 63		dB
Crosstalk ^d	X _{TALK}		Room		- 64		
Source-Off Capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 or V+, f = 1 MHz	Room		20		pF
Channel-On Capacitance ^d	C _{ON}		Room		56		

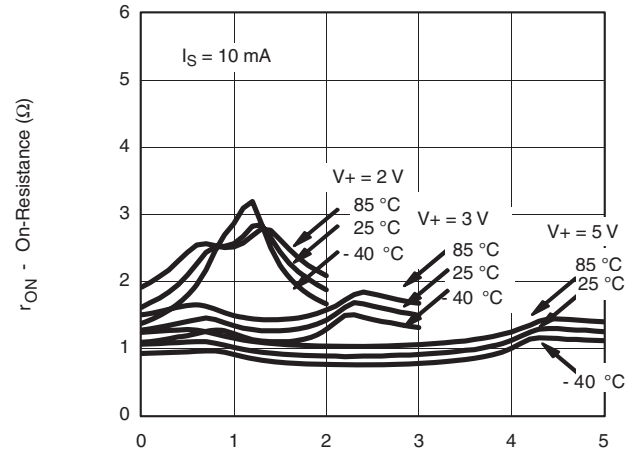
Notes:

- Room = 25 °C, Full = as determined by the operating suffix.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Typical values are for design aid only, not guaranteed nor subject to production testing.
- Guarantee by design, nor subjected to production test.
- V_{IN} = input voltage to perform proper function.
- Guaranteed by 5 V leakage testing, not production tested.

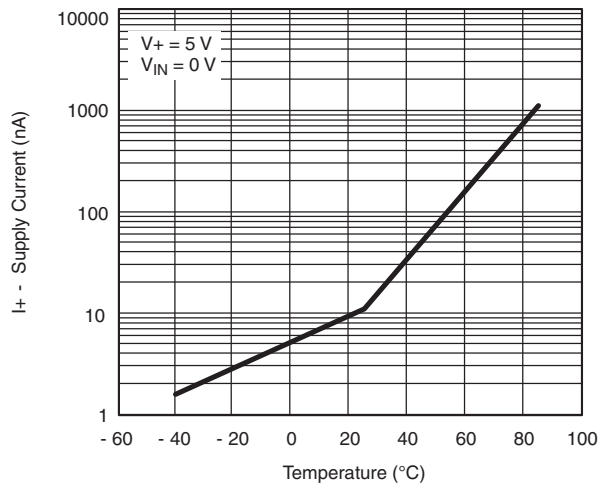
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


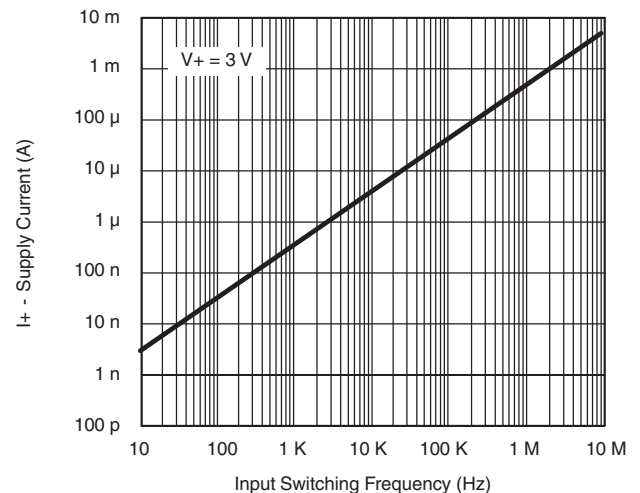
r_{ON} vs. V_{COM} and Supply Voltage



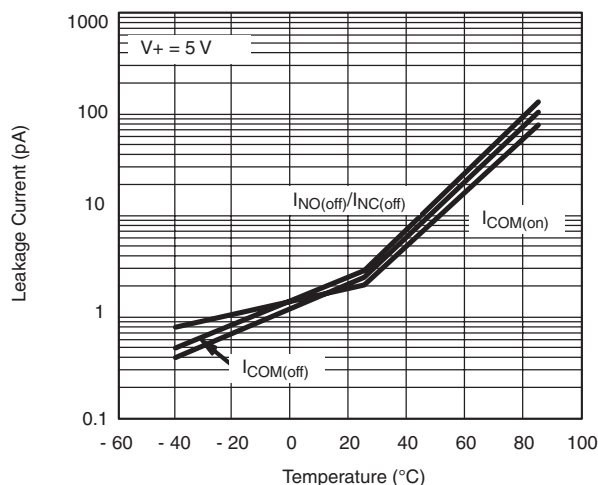
r_{ON} vs. Analog Voltage and Temperature



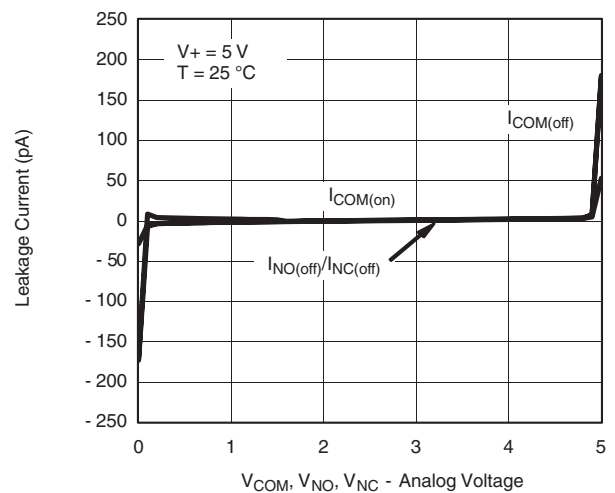
Supply Current vs. Temperature



Supply Current vs. Input Switching Frequency

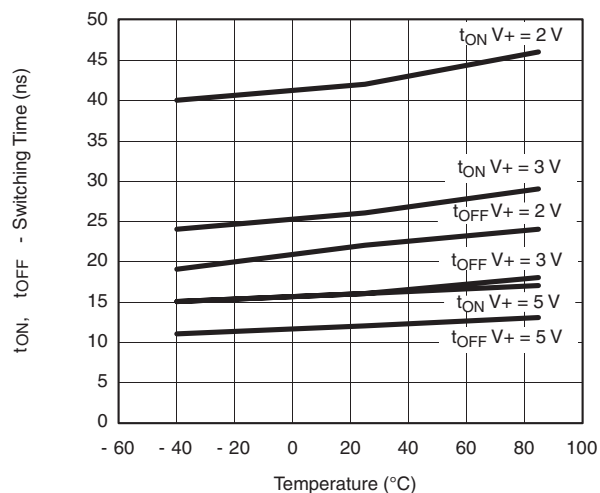


Leakage Current vs. Temperature

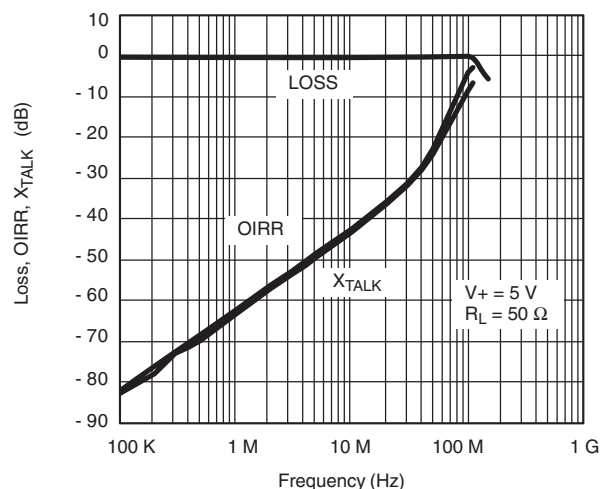


Leakage vs. Analog Voltage

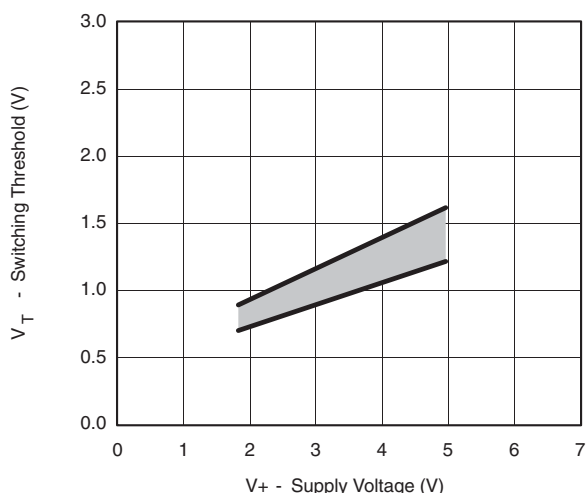
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



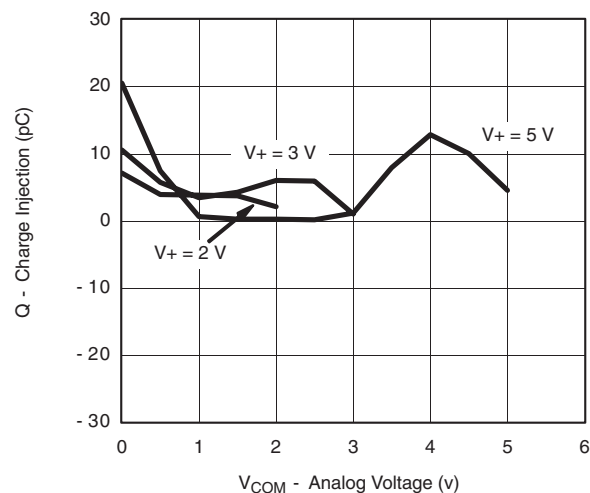
Switching Time vs. Temperature and Supply Voltage



Insertion Loss, Off-Isolation Crosstalk vs. Frequency



Switching Threshold vs. Supply Voltage



Charge Injection vs. Analog Voltage

TEST CIRCUITS

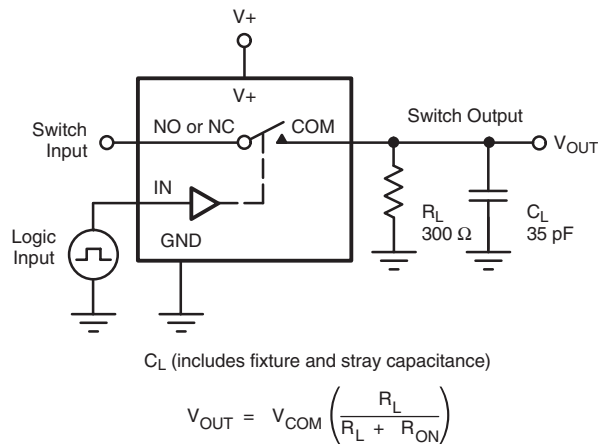


Figure 1. Switching Time

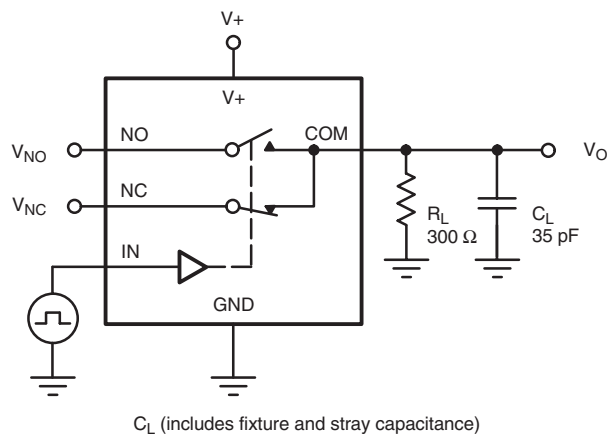


Figure 2. Break-Before-Make Interval

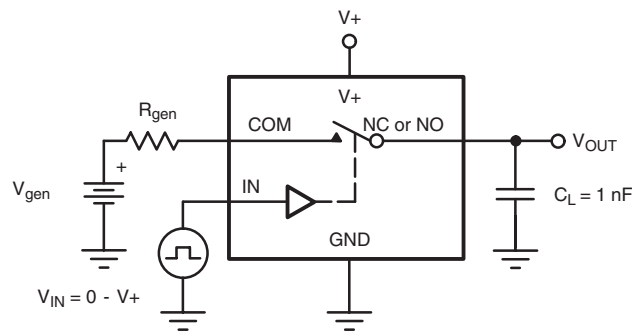


Figure 3. Charge Injection

TEST CIRCUITS

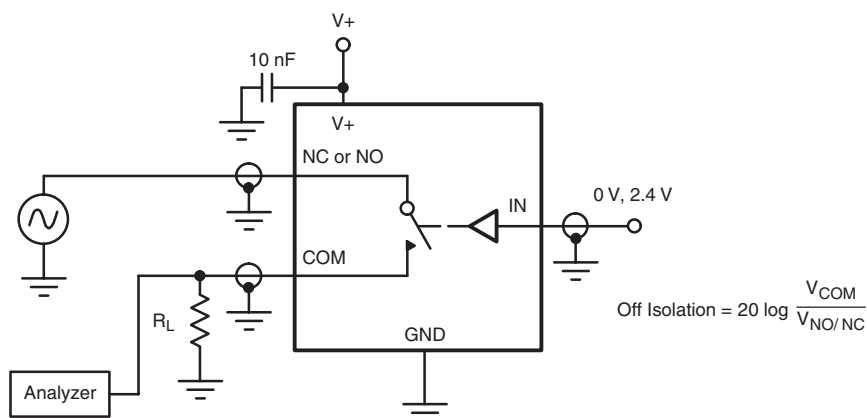


Figure 4. Off-Isolation

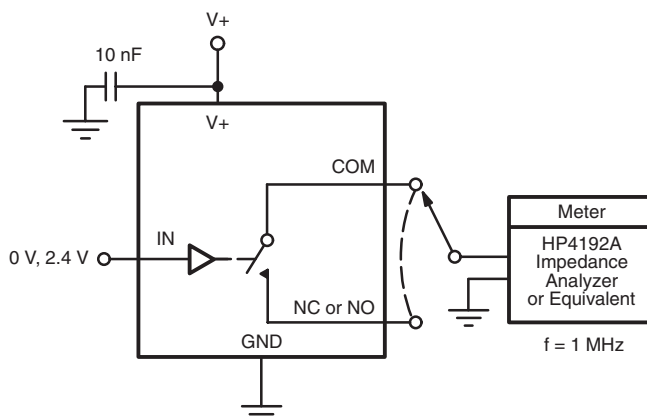


Figure 5. Channel Off/On Capacitance

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?72176>.



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.