

Powered-off Protection, 1 Ω , 1.8 V to 5.5 V, SPDT Analog Switch (2:1 Multiplexer)

DESCRIPTION

The DG2012E is a high performance single-pole, double-throw (SPDT) analog switch designed for 1.8 V to 5.5 V operation with a single power rail.

Fabricated with high density CMOS technology, the device achieves low on resistance of 1 Ω at a 5 V power supply, low power consumption, and fast switching speeds.

The DG2012E can handle both analog and digital signals and permits signals with amplitudes of up to V+ to be transmitted in either direction. Its control logic inputs can go over V+ up to 5.5 V. It features break before make switching performance. Its -3 dB bandwidth is typically 160 MHz.

A powered-off protection circuit is built into the switch to prevent an abnormal current flow from COM pin to V+ during the power-down condition. Each output pin can withstand greater than 7 kV (human body model).

Operation temperature is specified from -40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$.

The DG2012E is available in SC-70-6L package.

FEATURES

- Low switch on-resistance (1 Ω)
- 1.65 V to 5.5 V single supply operation
- Isolation in powered-off mode
- Control logic inputs can go over V+
- Low charge injection (5 pC)
- Low total harmonic distortion
- Break before make switching
- Latch-up performance exceeds 300 mA per JESD 78
- ESD tested
 - 7000 V human body model (JS-001)
 - 1000 V charge device model (JS-002)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note

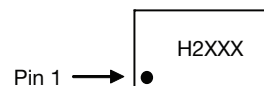
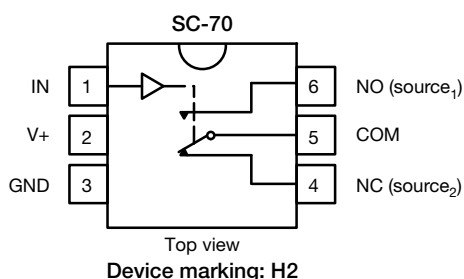
* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details



APPLICATIONS

- Smartphones and tablets
- Consumer and computing
- Portable instrumentation
- Medical equipment

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device marking: H2XXX
XXX = date / lot traceability code

TRUTH TABLE		
LOGIC	NC	NO
0	On	Off
1	Off	On

ORDERING INFORMATION		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$	SC-70-6	DG2012EDL-T1-GE3

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER		LIMIT	UNIT
V+, COM, NC, NO, IN reference to GND		-0.3 to 6	V
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) ^a	6-pin SO-70 ^b	250	mW
ESD / HBM	JS-001	7000	V
ESD / CDM	JS-002	1000	
Latch up	Per JEDEC78 with 1.5 x voltage clamp	300	mA

Notes

a. All leads welded or soldered to PC board

b. Derate 3.1 mW/°C above 70 °C

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.

SPECIFICATIONS (V+ = 5 V)

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 5 V, ± 10 %, V _{IN} = 0.8 V or 2.4 V ^e	TEMP. ^a	LIMITS -40 °C 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 ^d	- -	1 -	1.6 2	Ω
R _{ON} flatness ^d	R _{ON} flatness	V+ = 4.5 V, V _{COM} = 0 V to V+, I _{NO} , I _{NC} = 10 mA	Room	-	0.2	0.5	
R _{ON} match ^d	ΔR _{ON}		Room	-	-	0.3	
Switch off leakage current ^f	I _{NO(off)} I _{NC(off)}	V+ = 5 V V _{NO} , V _{NC} = 0.5 V / 4.5 V, V _{COM} = 4.5 V / 0.5 V	Room	-5	-	5	nA
			Full	-20	-	20	
	I _{COM(off)}		Room	-5	-	5	
			Full ^d	-20	-	20	
Channel-on leakage current ^f	I _{COM(on)}	V+ = 5 V, V _{NO} , V _{NC} = V _{COM} = 0.5 V / 4.5 V	Room	-5	-	5	
			Full ^d	-20	-	20	
Power down leakage	I _{COM(PD)}	V+ = 0 V, V _{COM} = 4.5 V, V _{IN} = GND	Full ^d	-1	-	1	μA
Digital Control							
Input high voltage	V _{INH}		Full	2.4	-	-	V
Input low voltage	V _{INL}		Full	-	-	0.8	
Input capacitance ^d	C _{IN}		Full	-	3	-	pF
Input current ^f	I _{INL} or I _{INH}	V _{IN} = 0 V 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	Room	-	15	32	ns
			Full ^d	-	-	35	
Turn-off time ^d	t _{OFF}		Room	-	7	28	
			Full ^d	-	-	30	
Break-before-make time ^d	t _d		Room	1	5	-	
Charge injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room	-	8	-	pC
Off-isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room	-	-63	-	dB
Crosstalk ^d	X _{TALK}		Room	-	-63	-	
N _O , N _C off capacitance ^d	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 V or V+, f = 1 MHz	Room	-	16	-	pF
Channel-on capacitance ^d	C _{ON}		Room	-	52	-	
Power Supply							
Power supply current	I+	V _{IN} = 0 V or V+	Full	-	0.0003	1	μA



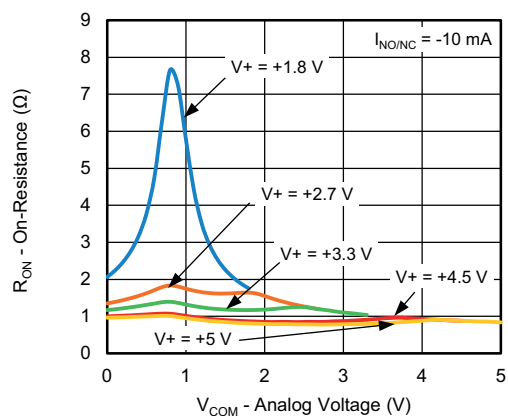
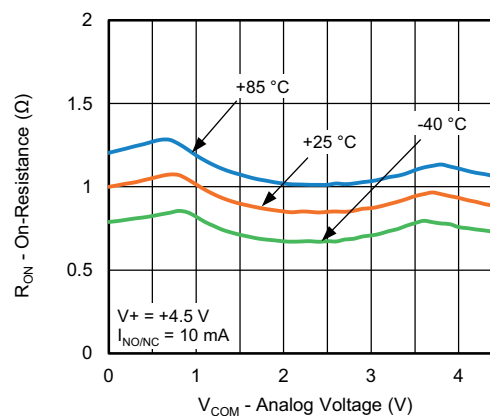
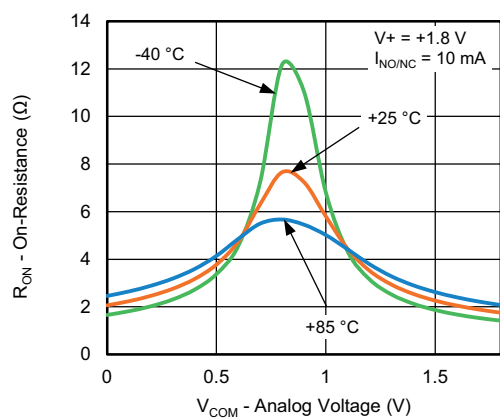
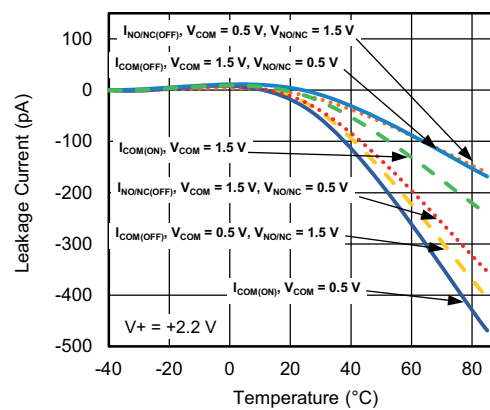
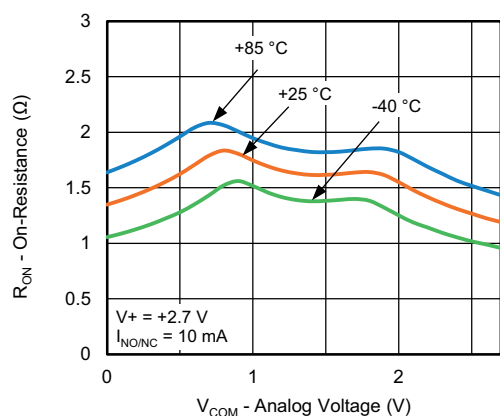
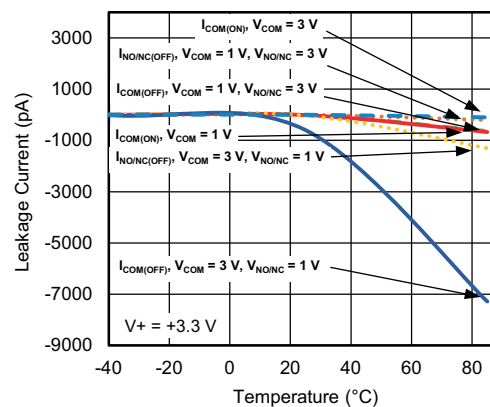
SPECIFICATIONS (V+ = 3 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 3 V, ± 10 %, VIN = 0.4 V or 1.4 V e	TEMP. a	LIMITS -40 °C to 85 °C			UNIT
				MIN. b	TYP. c	MAX. b	
Analog Switch							
Analog signal range d	VNO, VNC VCOM		Full	0	-	V+	V
On-resistance	RON	V+ = 2.7 V, VCOM = 0.2 V / 1.5 V, INO INC = 10 mA	Room Full d	- -	1.4 -	2.5 3	Ω
RON flatness d	RON flatness	V+ = 2.7 V, VCOM = 0 V to V+, INO, INC = 10 mA	Room	-	0.6	0.9	
RON match d	ΔRON		Room	-	-	0.3	nA
Switch off leakage current f	INO(off) INC(off)	V+ = 3.3 V VNO, VNC = 1 V / 3 V, VCOM = 3 V / 1 V	Room	-5	-	5	
	ICOM(off)		Full	-15	-	15	
				Room	-5	-	
Channel-on leakage current f	ICOM(on)	V+ = 3.3 V, VNO, VNC = VCOM = 1 V / 3 V	Full d	-15	-	15	
Digital Control							
Input high voltage	VINH		Full	1.4	-	-	V
Input low voltage	VINL		Full	-	-	0.4	
Input capacitance d	CIN		Full	-	3	-	pF
Input current f	INL or INH	VIN = 0 V or V+	Full	-1	-	1	μA
Dynamic Characteristics							
Turn-on time d	tON	VNO or VNC = 2 V, RL = 300 Ω, CL = 35 pF	Room Full d	- -	21 -	42 47	ns
Turn-off time d	tOFF		Room Full d	- -	16 -	32 35	
			Room	1	7	-	
Break-before-make time d	td		Room	-	6	-	
Charge injection d	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room	-	-63	-	dB
Off-isolation d	OIRR	RL = 50 Ω, CL = 5 pF, f = 1 MHz	Room	-	-63	-	
Crosstalk d	XTALK		Room	-	160	-	MHz
Bandwidth d	BW		Room	-	16	-	pF
NO, NC off capacitance d	CNO(off) CNC(off)	VIN = 0 V or V+, f = 1 MHz	Room	-	52	-	
Channel-on capacitance d	CON		Room	-			
Power Supply							
Power supply current	I+	VIN = 0 V or V+	Full	-	0.00002	1	μA

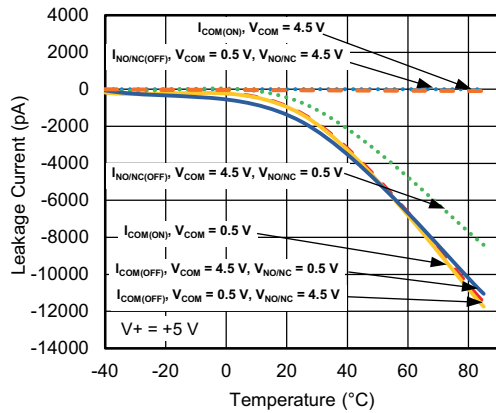
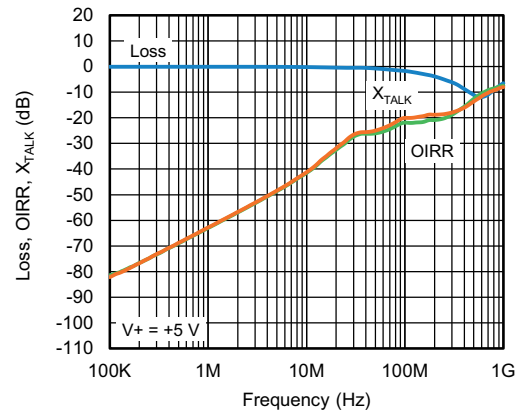
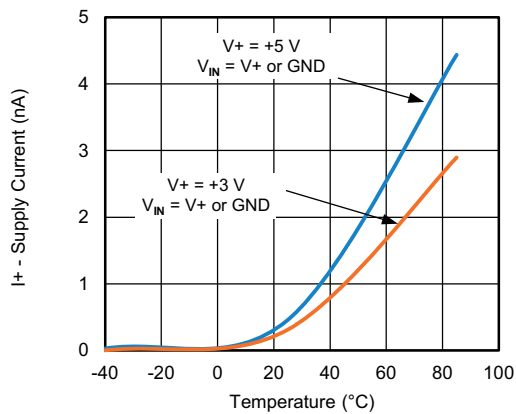
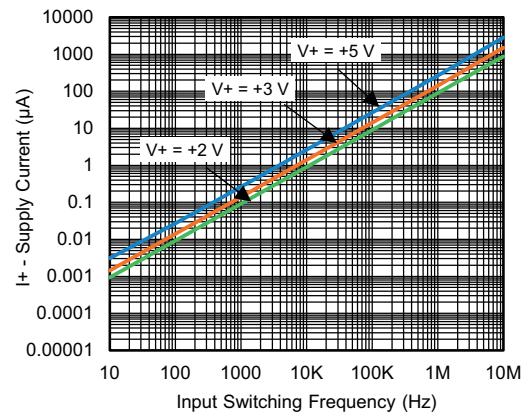
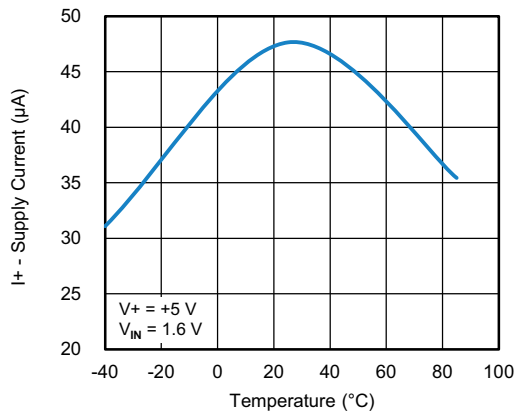
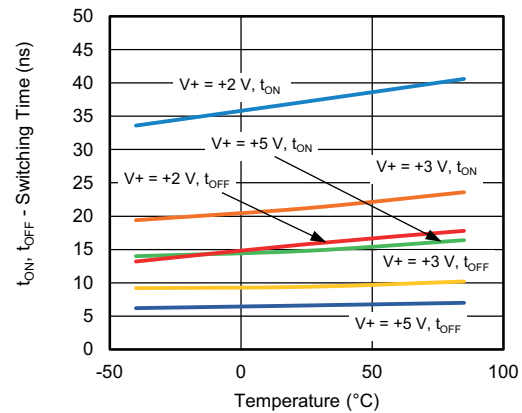


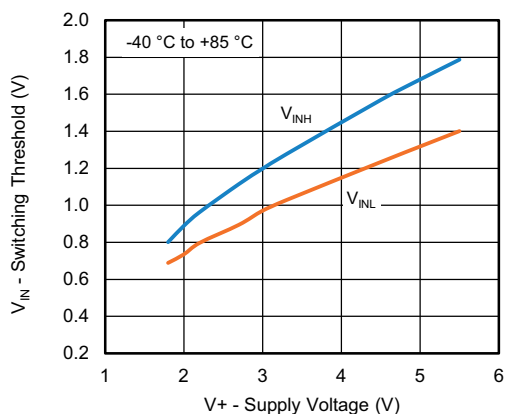
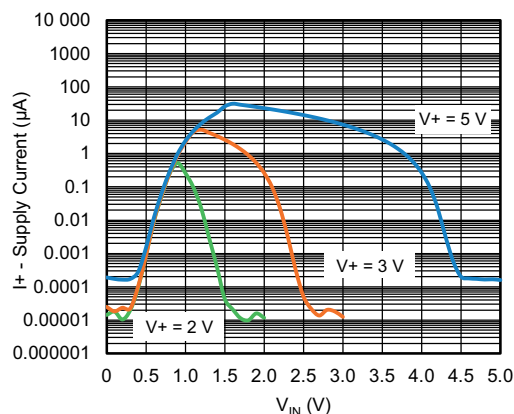
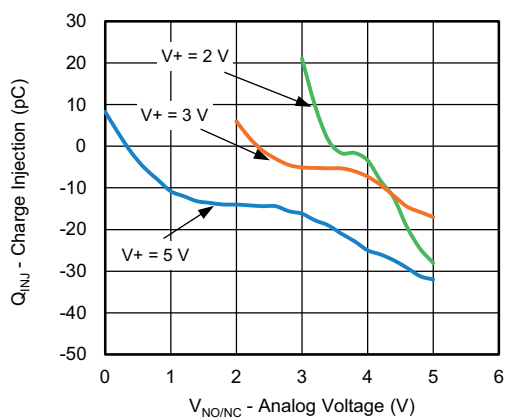
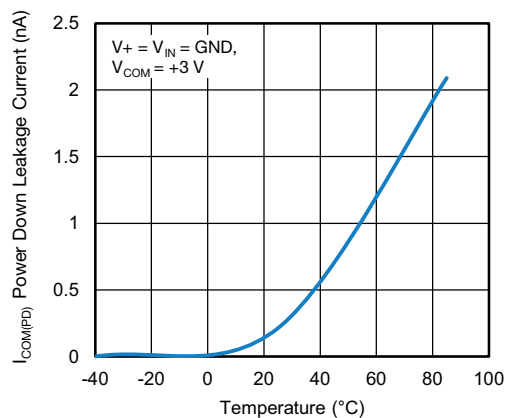
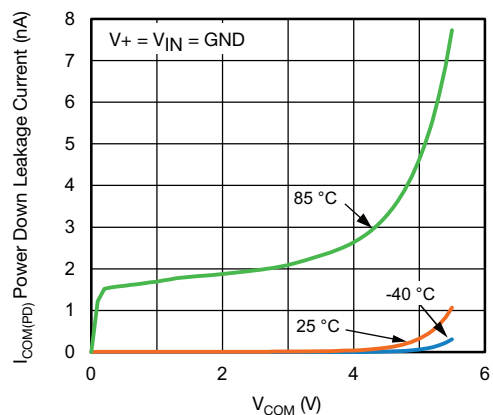
SPECIFICATIONS (V+ = 2 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 2 V, ± 10 %, VIN = 0.4 V or 1.6 V e	TEMP. a	LIMITS -40 °C to +85 °C			UNIT
				MIN. b	TYP. c	MAX. b	
Analog Switch							
Analog signal range d	VNO, VNC, VCOM		Full	0	-	V+	V
On-resistance	RON	V+ = 1.8 V, VCOM = 0.2 V / 0.9 V INO, INC = 10 mA	Room Full d	- -	5 -	10 15	Ω
RON flatness d	RON flatness	V+ = 1.8 V, VCOM = 0 V to V+, INO, INC = 10 mA	Room	-	6	9	
RON match d	ΔRON		Room	-	-	0.3	
Switch off leakage current f	INO(off) INC(off)	V+ = 2.2 V VNO, VNC = 0.5 V / 1.5 V, VCOM = 1.5 V / 0.5 V	Room	-0.5	-	0.5	nA
	ICOM(off)		Full	-5	-	5	
			Room	-0.5	-	0.5	
			Full d	-5	-	5	
Channel-on leakage current f	ICOM(on)	V+ = 2.2 V, VNO, VNC = VCOM = 0.5 V / 1.5 V	Room	-0.5	-	0.5	
			Full d	-5	-	5	
Digital Control							
Input high voltage	VINH		Full	1.6	-	-	V
Input low voltage	VINL		Full	-	-	0.4	
Input capacitance d	CIN		Full	-	3	-	pF
Input current f	IINL or IINH	VIN = 0 V or V+	Full	-1	-	1	μA
Dynamic Characteristics							
Turn-on time d	tON	VNO or VNC = 1.5 V, RL = 300 Ω, CL = 35 pF	Room	-	37	57	ns
Turn-off time d	tOFF		Full d	-	-	60	
			Room	-	26	44	
			Full d	-	-	45	
Break-before-make time d	td		Room	1	17	-	
Charge injection d	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room	-	21	-	pC
Off-isolation d	OIRR	RL = 50 Ω, CL = 5 pF, f = 1 MHz	Room	-	-63	-	dB
Crosstalk d	XTALK		Room	-	-63	-	
NO, NC off capacitance d	CNO(off) CNC(off)	VIN = 0 V or V+, f = 1 MHz	Room	-	16	-	pF
Channel-on capacitance d	CON		Room	-	51	-	
Power Supply							
Power supply current	I+	VIN = 0 V or V+	Full	-	0.00001	1	μA

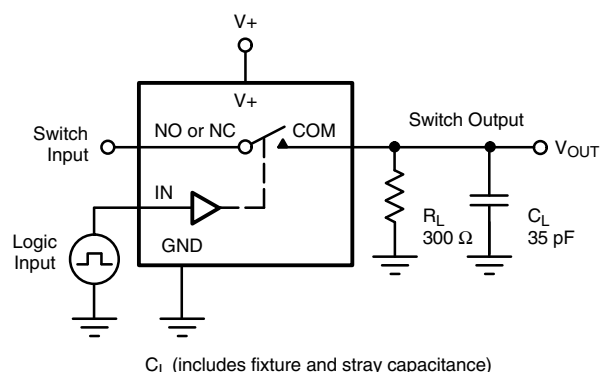
Notes

- 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 datasheet
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 otherwise noted)

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

 R_{ON} vs. V_{COM} and Temperature

 R_{ON} vs. V_{COM} and Temperature

Leakage Current vs. Temperature

 R_{ON} vs. V_{COM} and Temperature

Leakage Current vs. Temperature

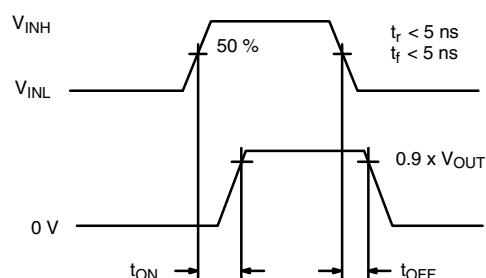
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Leakage Current vs. Temperature

Insertion Loss, Off-Isolation Crosstalk vs. Frequency

Supply Current vs. Temperature

Supply Current vs. Input Switching Frequency

Supply Current vs. Temperature

Switching Time vs. Temperature and Supply Voltage

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Switching Threshold vs. Supply Voltage

Supply Current vs. Enable Input Voltage

Charge Injection vs. Analog Voltage

Power Down Leakage Current vs. Temperature

Power Down Leakage Current vs. V_{COM}

TEST CIRCUITS

 C_L (includes fixture and stray capacitance)

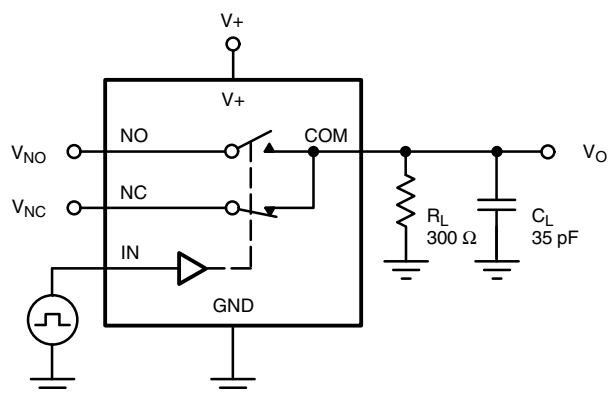
$$V_{OUT} = V_{COM} \left(\frac{R_L}{R_L + R_{ON}} \right)$$

Logic Input

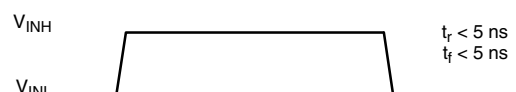


Switch Output

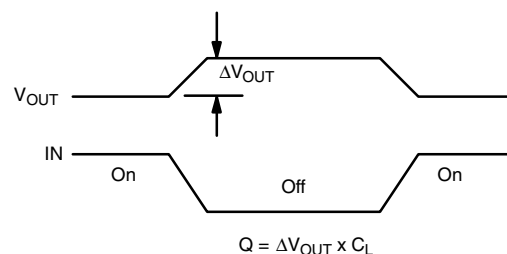
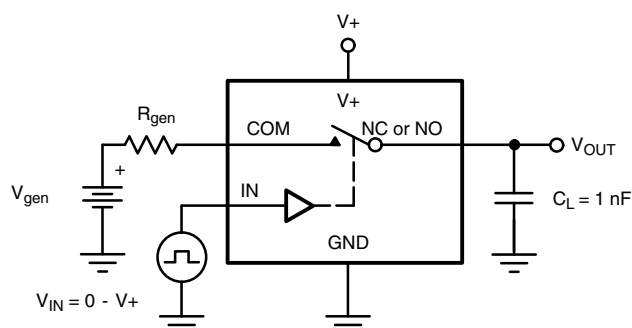
Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time

 C_L (includes fixture and stray capacitance)

Logic Input

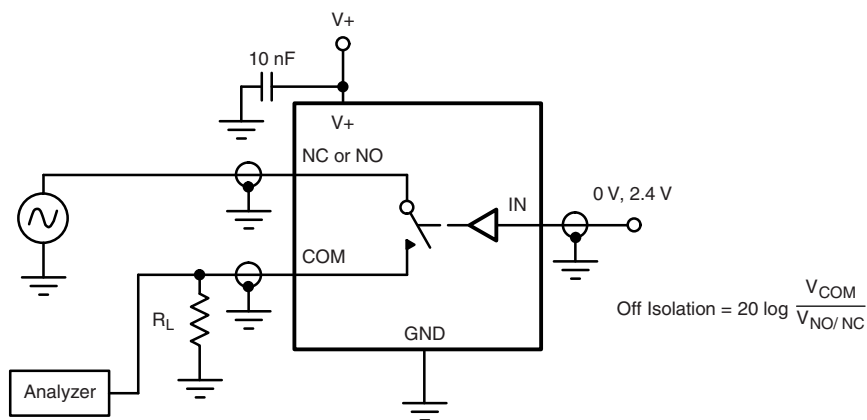
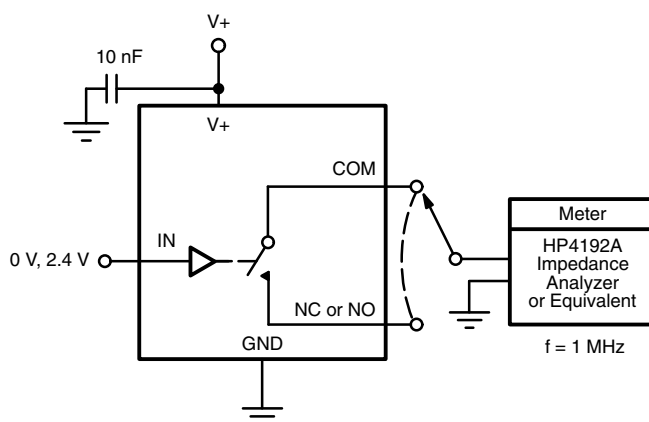


Switch Output

Fig. 2 - Break-Before-Make Interval


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

Fig. 3 - Charge Injection

TEST CIRCUITS

Fig. 4 - Off-Isolation

Fig. 5 - Channel Off / On Capacitance



PRODUCT SUMMARY	
Part number	DG2012E
Status code	2
Configuration	SPDT x 2
Single supply min. (V)	1.65
Single supply max. (V)	5.5
Dual supply min. (V)	-
Dual supply max. (V)	-
On-resistance (Ω)	1
Charge injection (pC)	8
Source on capacitance (pF)	52
Source off capacitance (pF)	16
Leakage switch on typ. (nA)	1.4
Leakage switch off max. (nA)	5
-3 dB bandwidth (MHz)	160
Package	SC-70-6
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare, portable
Interface	Parallel
Single supply operation	Yes
Dual supply operation	-
Turn on time max. (ns)	47
Crosstalk and off isolation	-41

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?75834.



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.