

0.4 Ω , Low Resistance and Capacitance, Dual DPDT / Quad SPDT Analog Switch

DESCRIPTION

The DG2523 and DG2524 are four-channel single-pole double-throw (SPDT) analog switches. The DG2523 has two control inputs that each controls a pair of single-pole double-throw (SPDT). It is also known as a two-channel double-pole double-throw (DPDT) configuration. The DG2524 has an $\overline{\text{EN}}$ pin to enable the device when the logic is low.

The parts are designed to operate from 1.8 V to 5.5 V single power rail. All switches conduct equally well in both directions, offering rail to rail signal switching and can be used both as multiplexers as well as de-multiplexers. The parts feature low control logic threshold. Break-before-make switching is guaranteed.

The DG2523 and DG2524 exhibit low parasitic capacitance, low leakage, and highly matched low and flat switch resistance over the full signal range characters that are important for precision analog designs.

The high bandwidth and excellent total harmonic distortion (THD) performance make them ideal for both analog and digital signal switching in space constrain applications requiring high performance and efficient use of board space.

The DG2523 and DG2524 come in lead (Pb)-free QFN-16 package of 3 mm x 3 mm.

BENEFITS

- Low and flat resistance
- Excellent total harmonic distortion
- Low parasitic capacitance
- Low voltage control interface

FEATURES

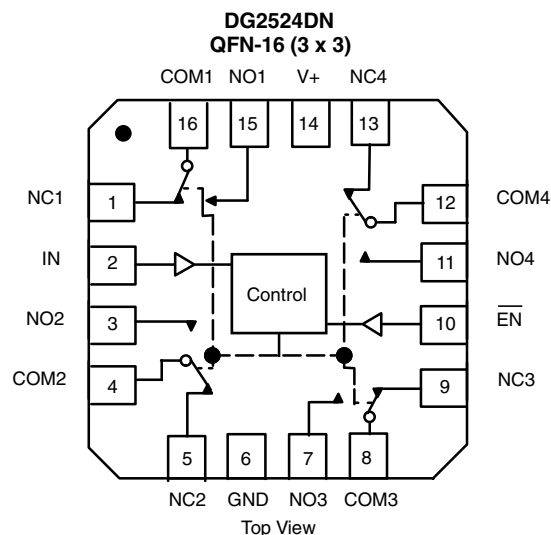
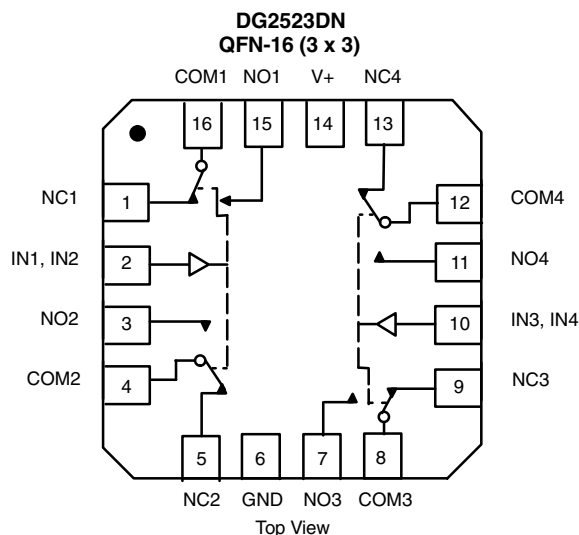
- 1.8 V to 5.5 V single supply operation
- Low resistance: 0.4 Ω / typ. at 2.7 V
- Highly flat and matched R_{on}
- Low parasitic capacitance, $C_{\text{on}} = 26$ pF, $C_{\text{off}} = 14.5$ pF
- Typical switch off leakage of 40 pA
- High bandwidth: 310 MHz
- Guaranteed logic high 1.2 V, logic low 0.3 V
- Break before make switching
- Signal swing over V_+ capable
- Power down protection
- Latch up current: 300 mA (JESD78)
- ESD/HBM: > 6 kV
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

APPLICATIONS

- Automatic test equipment
- Data acquisition systems
- Meters and instruments
- Medical and healthcare systems
- Communication systems
- Audio and video signal routing
- Battery powered systems
- Computer peripherals
- Data storage
- Relay replacement

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



**TRUTH TABLE DG2523**

INx	NC1, 2, 3, and 4	NO1, 2, 3, and 4
0	On	Off
1	Off	On

TRUTH TABLE DG2524

$\overline{\text{EN}}$	LOGIC IN	NC1, 2, 3, and 4	NO1, 2, 3, and 4
1	x	Off	Off
0	0	On	Off
0	1	Off	On

ORDERING INFORMATION

TEMPERATURE RANGE	PACKAGE	PART NUMBER	MARKING CODE	MIN. ORDER / PACK. QUANTITY
-40 °C to +85 °C lead (Pb)-free	QFN-16 (3 mm x 3 mm) variation 2	DG2523DN-T1-GE4	2523	Tape and reel, 2500 units
		DG2524DN-T1-GE4	2524	

Note

- Exposed pad has no electrical connection

ABSOLUTE MAXIMUM RATINGS ($T_A = 25\text{ °C}$, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Reference to GND	V+	-0.3 to +6	V
	IN, COM, NC, NO ^a	-0.3 to (V+ + 0.3)	
Current (any terminal except NO, NC, or COM)		30	mA
Continuous current (NO, NC, or COM)		± 300	
Peak current (pulsed at 1 ms, 10 % duty cycle)		± 500	
Storage temperature (D suffix)		-65 to +150	°C
Package solder reflow conditions ^d	QFN-16	250	
Power dissipation (packages) ^b	QFN-16 ^c	1385	mW

Notes

- Signals on NC, NO, or COM, or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings
- All leads welded or soldered to PC board
- Derate 17.3 mW/°C above 70 °C
- Manual soldering with iron is not recommended for leadless components. The miniQFN-16 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper lip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection

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.



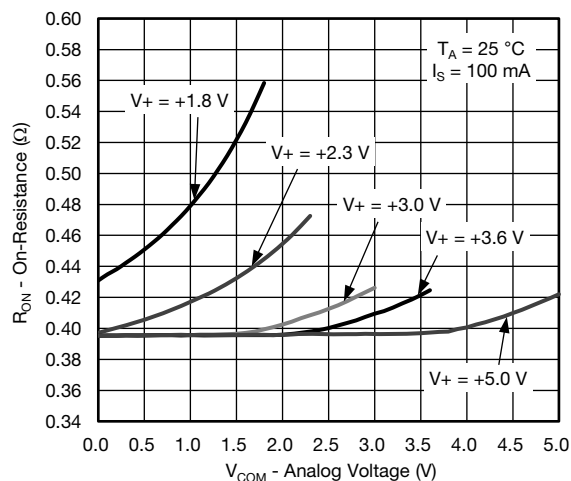
SPECIFICATIONS (V+ = 3 V)							
PARAMETER	SYMBOL	TEST CONDITIONS unless otherwise specified V+ = 3 V, ± 10 %, VIN = 0.5 V or 1.4 V ^e	TEMP. ^a	LIMITS -40 °C to +85 °C			UNIT
				MIN. ^b	TYP. ^c	MAX. ^b	
Analog Switch							
Analog signal range ^d	VNO, VNC, VCOM		Full	0	-	V+	V
On-resistance	RON	V+ = 2.7 V, VCOM = 0 to 2.7 V, INO, INC = 100 mA	Room	-	0.40	0.55	Ω
			Full	-	-	0.65	
RON flatness ^d	RON flatness	V+ = 2.7 V, VCOM = 0 to V+, INO, INC = 100 mA	Full	-	0.03	0.08	
RON match ^d	ΔRON		Room	-	0.05	-	
Switch off leakage current	INO(off), INC(off)	V+ = 5.5 V, VNO, VNC = 0.5 V / 4 V, VCOM = 4 V / 0.5 V	Room	-1	0.04	1	nA
			Full	-5	-	5	
	ICOM(off)		Room	-1	0.17	1	
			Full	-5	-	5	
Channel-on leakage current	ICOM(on)	V+ = 5.5 V, VNO, VNC = VCOM = 0.5 V / 4 V	Room	-1	0.17	1	
			Full	-5	-	5	
Digital Control							
Input high voltage	VINH		Full	1.2	-	-	V
Input low voltage	VINL			-	-	0.3	
Input capacitance	CIN		Full	-	5	-	pF
Input current	IINL or IINH	VIN = 0 or V+	Full	-1	-	1	μA
Dynamic Characteristics							
Turn-on time	tON	VNO or VNC = 1.5 V, RL = 50 Ω, CL = 35 pF	Room	-	38	60	μs
			Full	-	-	70	
Turn-off time	tOFF		Room	-	0.43	1	
			Full	-	-	3	
Break-before-make time	td		Full	1	-	-	
Charge injection ^d	QINJ	CL = 1 nF, VGEN = 1.5 V, RGEN = 0 Ω	Room	-	-19	-	pC
-3 dB bandwidth	BW	RL = 50 Ω, CL = 5 pF	Room	-	310	-	MHz
Off-isolation ^d	OIRR	RL = 50 Ω, CL = 5 pF, f = 100 kHz	Room	-	-82	-	dB
		RL = 50 Ω, CL = 5 pF, f = 1 MHz		-	-55	-	
Crosstalk ^{d, f}	XTALK	RL = 50 Ω, CL = 5 pF, f = 100 kHz		-	-89	-	
		RL = 50 Ω, CL = 5 pF, f = 1 MHz		-	-61	-	
Total harmonic distortion plus noise	THD + N	2.5 V, signal peak to peak voltage RL = 32 Ω, f = 1 kHz			-	-100	
NO, NC off capacitance ^d	CNO(off)	f = 1 MHz	Room	-	14.5	-	pF
	CNC(off)			-	14.5	-	
Channel-on capacitance ^d	CNO(on)			-	26	-	
	CNC(on)			-	26	-	
Power Supply							
Power supply range	V+			1.8	-	5.5	V
Power supply current	I+	VIN = 0 or V+	Full	-	29	60	μA

Notes

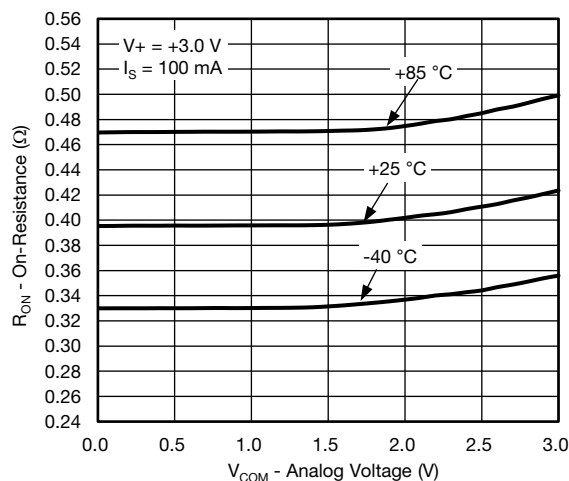
- a. Room = 25 °C, full = as determined by the operating suffix
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
c. Typical values are for design aid only, not guaranteed nor subject to production testing
d. Guarantee by design, not subjected to production test
e. V_{IN} = input voltage to perform proper function
f. Crosstalk measured between channels



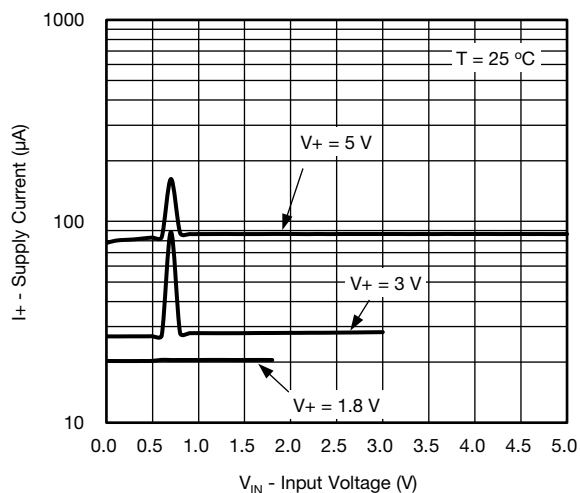
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)



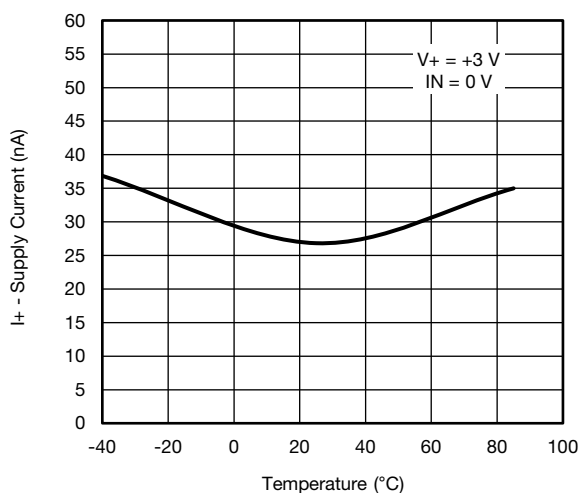
R_{ON} vs. V_{COM} and Supply Voltage



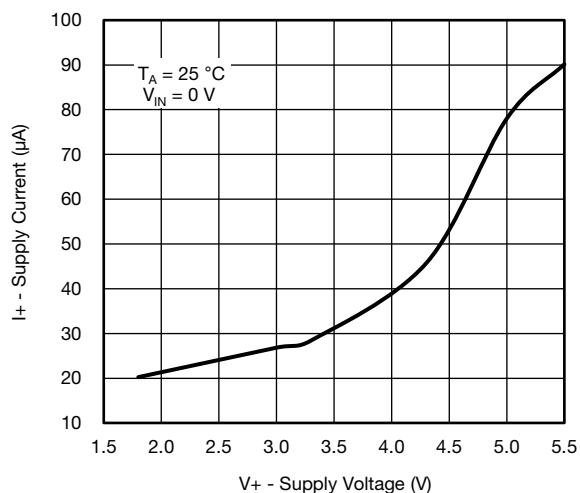
R_{ON} vs. Analog Voltage and Temperature



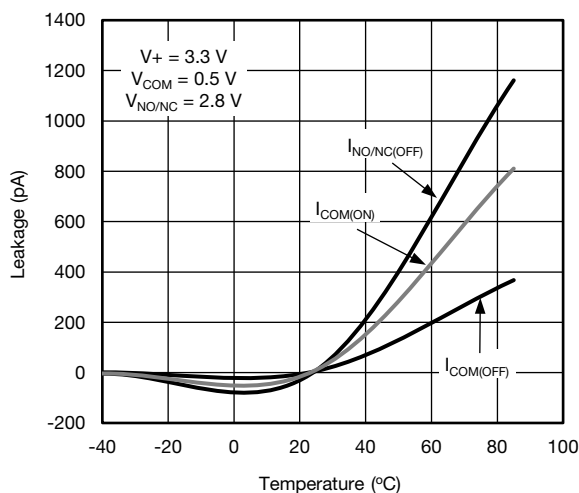
Supply Current vs. Input Voltage



Supply Current vs. Temperature



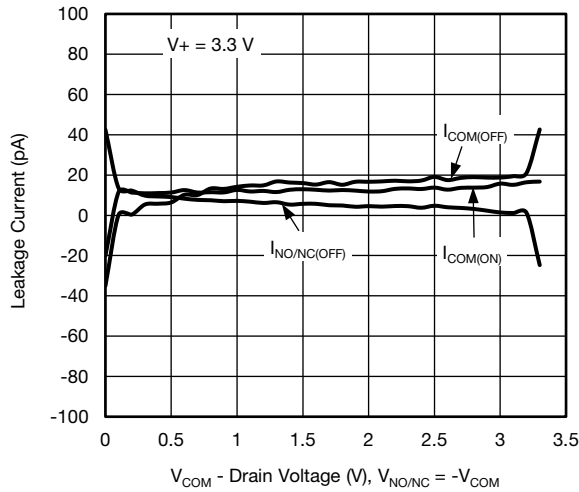
Supply Current vs. Supply Voltage



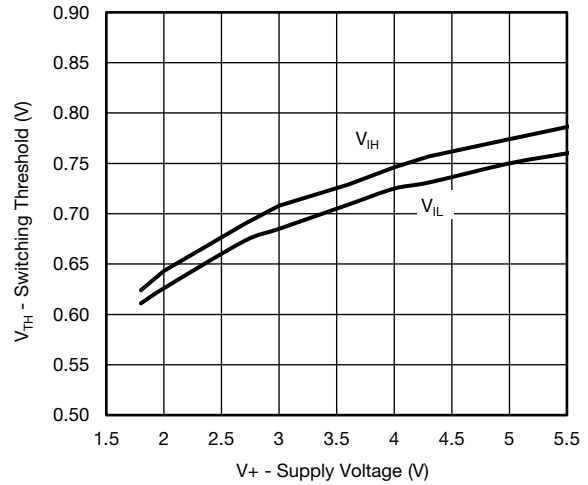
Leakage Current vs. Temperature



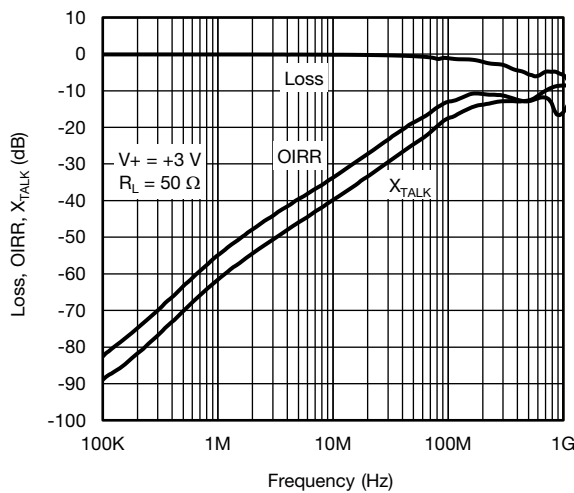
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



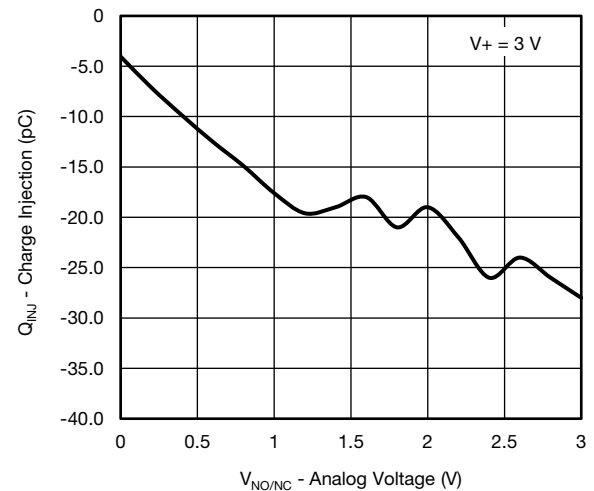
Leakage Current vs. Drain Voltage



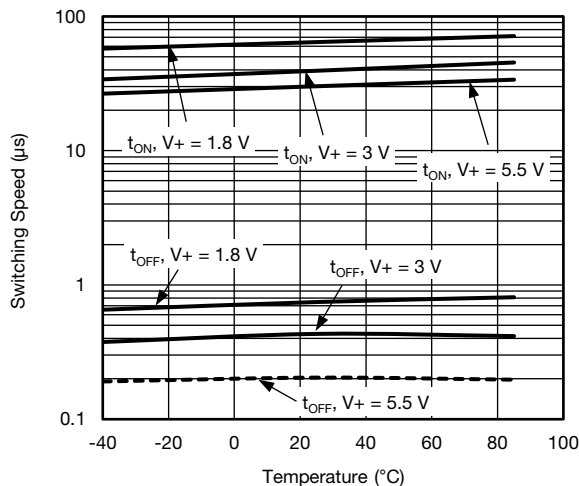
Switching Threshold vs. Supply Voltage



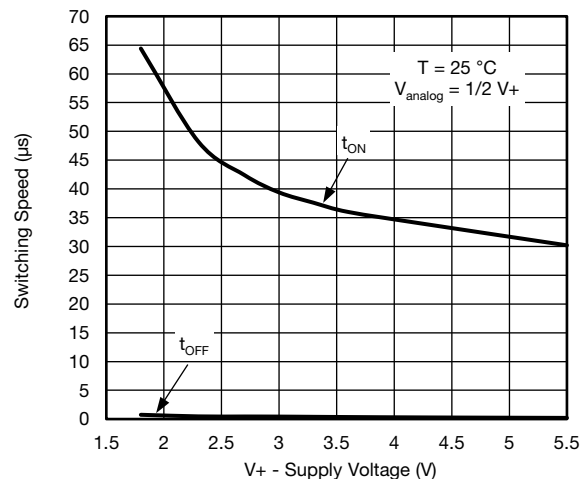
Insertion Loss, Off-Isolation Crosstalk vs. Frequency



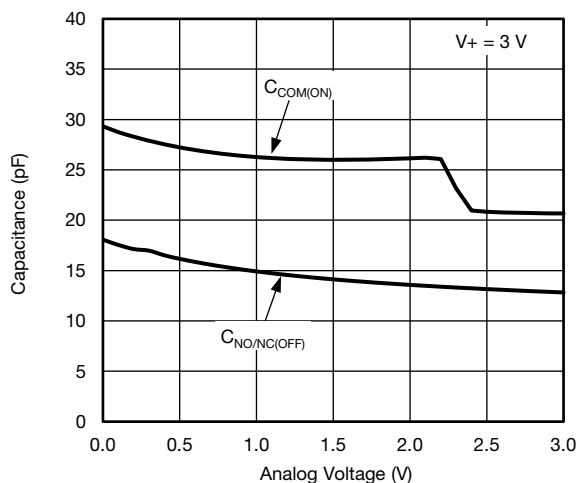
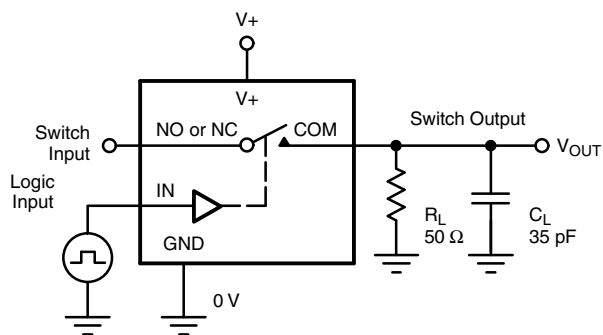
Charge Injection vs. Analog Voltage



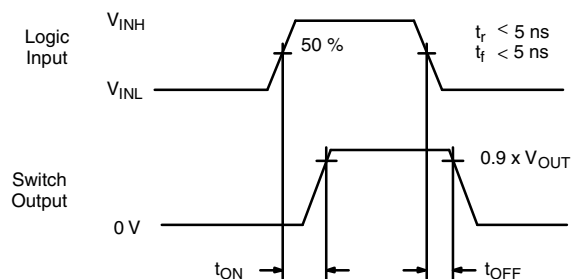
Switching Time vs. Temperature



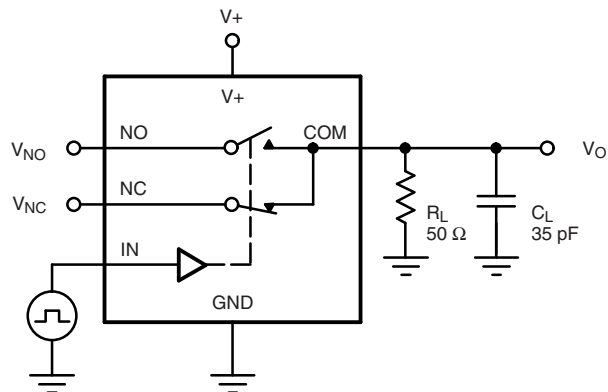
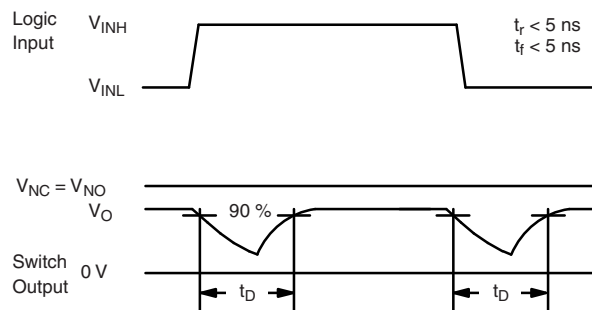
Switching Time vs. Supply Voltage

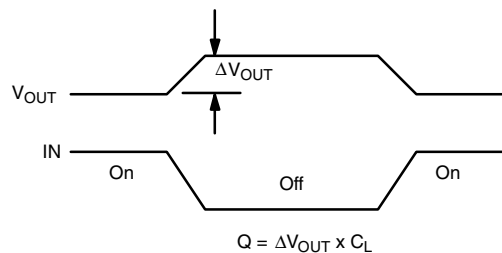
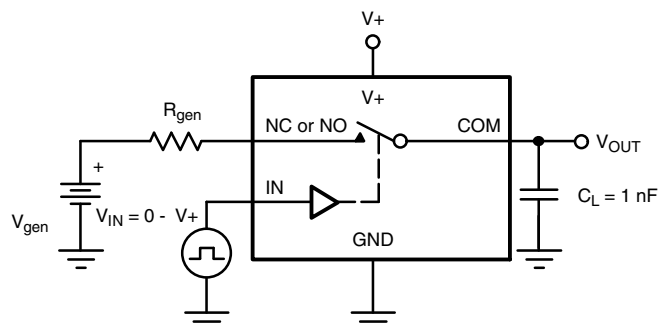
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Capacitance vs. Analog Voltage
TEST CIRCUITS

 C_L (includes fixture and stray capacitance)

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

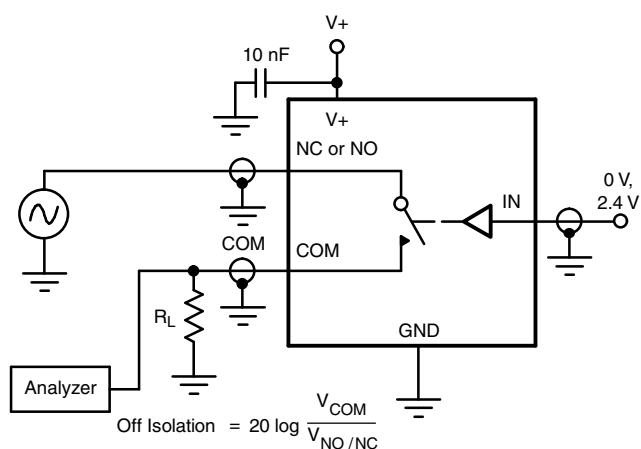
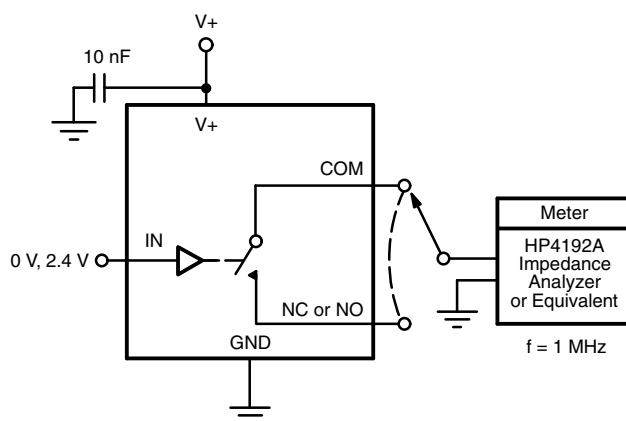


Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time

 C_L (includes fixture and stray capacitance)

Fig. 2 - Break-Before-Make Interval



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

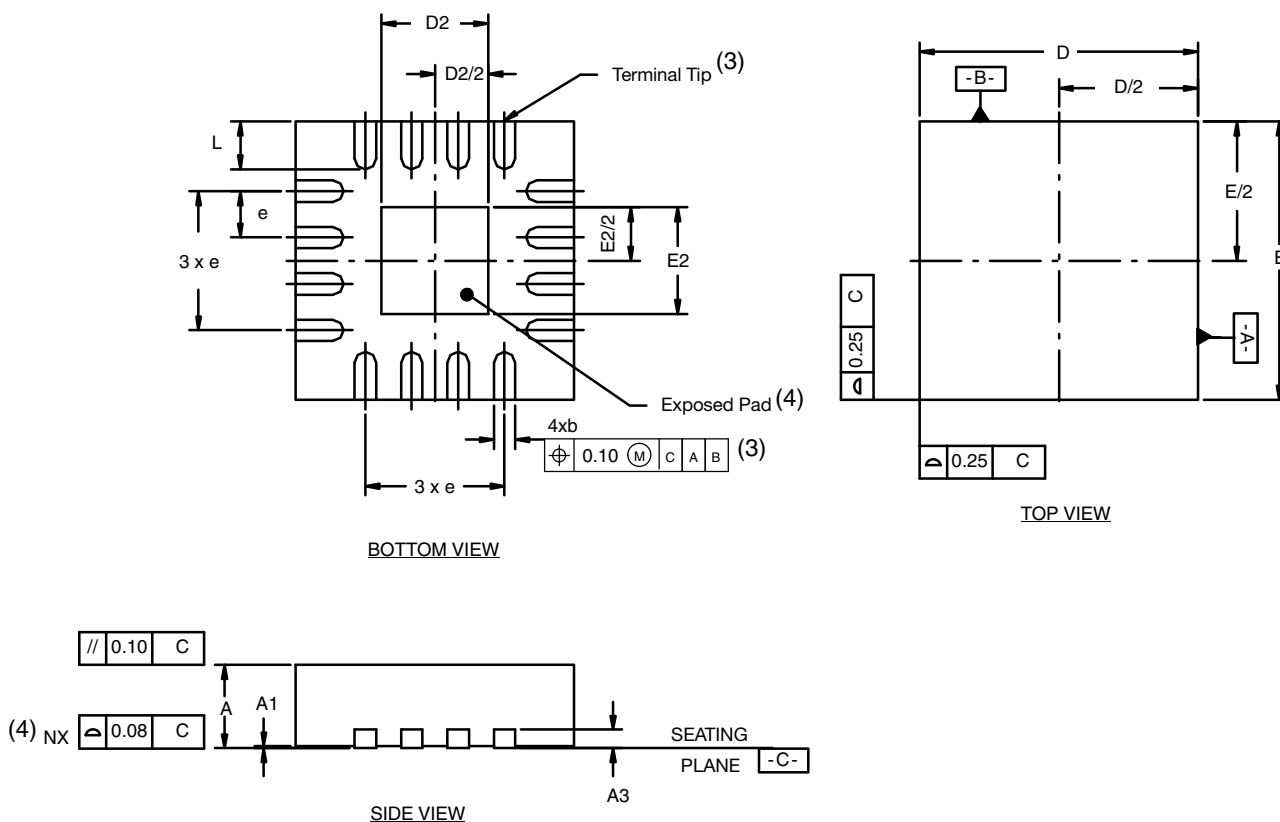
Fig. 3 - Charge Injection

Fig. 4 - Off-Isolation

Fig. 5 - Channel Off / On Capacitance



PRODUCT SUMMARY		
Part number	DG2523	DG2524
Status code	2	2
Configuration	DPDT x 2	SPDT x 4
Single supply min. (V)	1.8	1.8
Single supply max. (V)	5.5	5.5
Dual supply min. (V)	-	-
Dual supply max. (V)	-	-
On-resistance (Ω)	0.4	0.4
Charge injection (pC)	-19	-19
Source on capacitance (pF)	26	26
Source off capacitance (pF)	14.5	14.5
Leakage switch on typ. (nA)	0.17	0.17
Leakage switch off max. (nA)	1	1
-3 dB bandwidth (MHz)	310	310
Package	QFN-16 3 x 3	QFN-16 3 x 3
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare, portable	Multi purpose, instrumentation, medical and healthcare, portable
Interface	Parallel	Parallel
Single supply operation	Yes	Yes
Dual supply operation	-	-
Turn on time max. (ns)	60 000	60 000
Crosstalk and off isolation	-55	-55

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?67894.

QFN-16 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.	VARIATION 1						VARIATION 2					
	MILLIMETERS			INCHES			MILLIMETERS			INCHES		
	MIN.	NOM	MAX.	MIN.	NOM	MAX.	MIN.	NOM	MAX.	MIN.	NOM	MAX.
A	0.80	0.90	1.00	0.031	0.035	0.039	0.80	0.90	1.00	0.031	0.035	0.039
b	0.18	0.23	0.30	0.007	0.009	0.012	0.18	0.25	0.30	0.007	0.010	0.012
D	2.90	3.00	3.10	0.114	0.118	0.122	2.90	3.00	3.10	0.114	0.118	0.122
D2	1.00	1.15	1.25	0.039	0.045	0.049	1.50	1.70	1.80	0.059	0.067	0.071
E	2.90	3.00	3.10	0.114	0.118	0.122	2.90	3.00	3.10	0.114	0.118	0.122
E2	1.00	1.15	1.25	0.039	0.045	0.049	1.50	1.70	1.80	0.059	0.067	0.071
e	0.50 BSC			0.020 BSC			0.50 BSC			0.020 BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020	0.30	0.40	0.50	0.012	0.016	0.020
ECN: T16-0233-Rev. D, 09-May-16 DWG: 5899												



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.