

## 200 Ω, Low Leakage, Low Parasitic and Low Charge Injection, Quad SPST Analog Switches

### DESCRIPTION

The DG2501, DG2502, and DG2503 are monolithic quad single-pole single-throw (SPST) analog switches that operate from a single 1.8 V to 5.5 V power supply.

These switches are fully specified at 3 V and 5 V. The parts feature low parasitic capacitance, low charge injection, and low leakage performance over the full operating temperature range of -40 °C to +85 °C. Their ESD/HBM tolerance is over 8 kV.

The DG2501, DG2502, and DG2503 each feature four independently selectable SPST switches with closely matched channel resistance. The DG2501 is normally closed, while the DG2502 is normally open.

The DG2503 has two normally open and two normally closed switches. All parts are guaranteed break-before-make operation for use in multiplexer applications. The parts have a guaranteed control logic high of 1.4 V when V+ is 3 V and 1.8 V when V+ is 5 V.

Each switch conducts equally well in both directions when on, and each has an input signal range that extends to the supplies.

The DG2501, DG2502, and DG2503 are ideal for portable healthcare, instrument, and communication devices.

The DG2501, DG2502, and DG2503 are available in wafer level CSP package with top side lamination.

The package has a 4 x 4 bump array, 0.35 mm pitch, and 1.44 mm x 1.44 mm length and width.

### FEATURES

- 1.8 V to 5.5 V single supply operation
- Low leakage, 1 nA / max. at 85 °C
- Low switch off capacitance
- Rail-to-rail signal handling
- Latch up current > 800 mA (JESD78)
- ESD: 8000 V/HBM, 500 V/CDM
- Typical power consumption (< 0.01 μW)
- TTL/CMOS compatible
- Compact WCSP16 1.44 mm x 1.44 mm
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

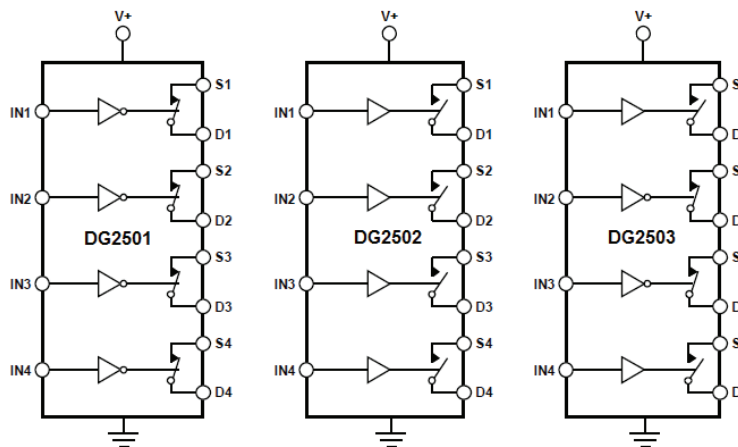


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

### APPLICATIONS

- Analog front end signal switching
- Sample-and-hold circuits
- Battery-powered systems
- Portable meters
- Automatic test equipment
- Medical and healthcare equipment
- Communication systems

### FUNCTIONAL BLOCK DIAGRAM



Switches are shown for a Logic 0 Input

TRUTH TABLE						
DG2501		DG2502		DG2503		
LOGIC	SWITCH	LOGIC	SWITCH	LOGIC	SW1, SW4	SW2, SW3
0	ON	0	OFF	0	OFF	ON
1	OFF	1	ON	1	ON	OFF

ORDERING INFORMATION					
PART NUMBER	CONFIGURATION	SWITCH FUNCTION	TEMPERATURE RANGE	PACKAGE	REEL QUANTITY
DG2501DB-T2-GE1	Quad SPST	NC	-40 °C to +85 °C	WCSP16, 1.44 mm x 1.44 mm	3000
DG2501DB-T4-GE1	Quad SPST	NC	-40 °C to +85 °C	WCSP16, 1.44 mm x 1.44 mm	10 000
DG2502DB-T2-GE1	Quad SPST	NO	-40 °C to +85 °C	WCSP16, 1.44 mm x 1.44 mm	3000
DG2502DB-T4-GE1	Quad SPST	NO	-40 °C to +85 °C	WCSP16, 1.44 mm x 1.44 mm	10 000
DG2503DB-T2-GE1	Quad SPST	NC/NO	-40 °C to +85 °C	WCSP16, 1.44 mm x 1.44 mm	3000
DG2503DB-T4-GE1	Quad SPST	NC/NO	-40 °C to +85 °C	WCSP16, 1.44 mm x 1.44 mm	10 000

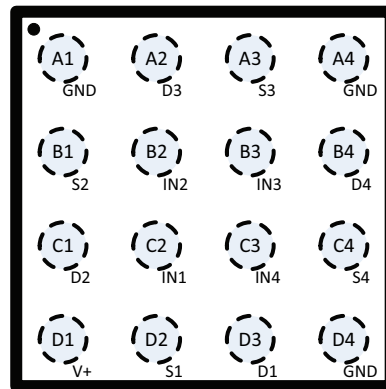
**PACKAGE OUTLINE**

 Top View  
(Bump Side Down)

Fig. 1 - Package Outline for WCSP16, 1.44 mm x 1.44 mm, 0.35 mm Pitch

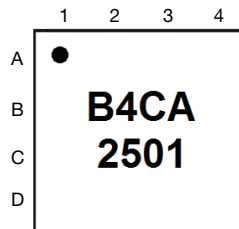
**DEVICE MARKING**

 Row 1 Dot = Pin A1 Locator  
 Row 2 B = Fab, 4 = Year, C = Week Code, A = Lot Code  
 Row 3 2501 = Part Code

Fig. 2 - Device Marking

ABSOLUTE MAXIMUM RATINGS			
ELECTRICAL PARAMETERS	CONDITIONS	LIMITS	UNIT
V+, INx	Reference to GND	-0.3 to 6	V
Sx, Dx	Reference to GND	-0.3 to (V+) +0.3	
Maximum Continuous Switch Current		5	mA
Maximum Peak Current (Pulsed 1 ms, 10 % Duty Cycle)		20	
Thermal Resistance		80	°C/W
Latch Up Current	JESD78	> 800	mA
ESD - HBM	ANSI / ESDA / JEDEC® JS-001	> 8000	V
ESD - CDM	JESD22-C101	> 500	
Temperature			
Operating Temperature		-40 to 85	°C
Storage Temperature		-65 to 150	

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.



ELECTRICAL CHARACTERISTICS 3 V Supply							
PARAMETER	SYMBOL	TEST CONDITION UNLESS OTHERWISE SPECIFIED, V+ = 3 V VINH = 1.4 V, VINL = 0.8 V <sup>a</sup>	TEMP. <sup>b</sup>	TYP. <sup>c</sup>	-40 °C to 85 °C		UNIT
					MIN. <sup>d</sup>	MAX. <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full	-	0	3	V
Drain-Source On Resistance	R <sub>DS(on)</sub>	V <sub>S</sub> = 1.5 V, I <sub>S</sub> = -1 mA	Room	133	-	200	Ω
			Full	-	-	250	
On-Resistance Matching	ΔR <sub>on</sub>		Room	0.83	-	10	Ω
			Full	-	-	13	
Switch Off Leakage Current	I <sub>S</sub> /I <sub>D(off)</sub>	V+ = 3.3 V, V <sub>S</sub> = 0.3 V/3 V, V <sub>D</sub> = 3 V/0.3 V	Room	± 0.016	-0.4	+0.4	nA
			Full	-	-1	+1	
Channel On Leakage Current	I <sub>D(on)</sub>	V+ = 3.3 V, V <sub>D</sub> = 0.3 V/3 V	Room	± 0.009	-0.4	+0.4	nA
			Full	-	-1	+1	
<b>Digital Control</b>							
Input, High Voltage	V <sub>INH</sub>		Full	-	1.4	-	V
Input, Low Voltage	V <sub>INL</sub>		Full	-	-	0.4	
Input Leakage	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>GND</sub> or V+	Room	± 0.001	-	-	μA
			Full	-	-0.1	+0.1	
Digital Input Capacitance <sup>e</sup>	C <sub>IN</sub>	f = 1 MHz	Room	2	-	-	pF
<b>Dynamic Characteristics</b>							
Break-Before Make Time	t <sub>BBM</sub>	DG2503 only, V <sub>S1</sub> = V <sub>S2</sub> = 1.5 V, R <sub>L</sub> = 300 Ω C <sub>L</sub> = 35 pF	Room	47	10	-	ns
			Full	-	10	-	
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 1.5 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room	175	-	220	ns
			Full	-	-	250	
Turn-Off Time	t <sub>OFF</sub>		Room	77	-	100	ns
			Full	-	-	120	
Charge Injection <sup>e</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>S</sub> = 1.5 V	Room	-0.7	-	-	pC
Off Isolation <sup>e</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1MHz	Room	-83	-	-	dB
Cross Talk <sup>e</sup>	X Talk		Room	-85	-	-	
3 dB Bandwidth <sup>e</sup>	BW	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	Room	510	-	-	MHz
Source Off Capacitance <sup>e</sup>	C <sub>S(off)</sub>	f = 1 MHz, V <sub>S</sub> = 1.5 V	Room	2.9	-	-	pF
Drain Off Capacitance <sup>e</sup>	C <sub>D(off)</sub>		Room	2.8	-	-	
Drain On Capacitance <sup>e</sup>	C <sub>D(on)</sub>		Room	7.8	-	-	
<b>Power Requirements</b>							
Power Supply Current	I+	Digital Input 0 or V+	Room	0.001	-	-	μA
			Full	-	-	1	



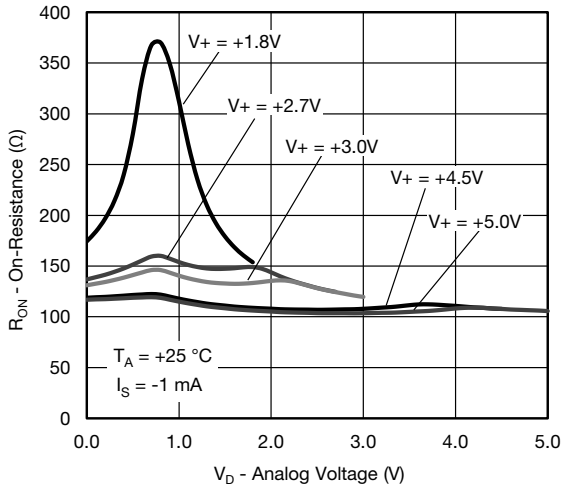
ELECTRICAL CHARACTERISTICS 5 V Supply							
PARAMETER	SYMBOL	TEST CONDITION UNLESS OTHERWISE SPECIFIED, V <sub>+</sub> = 5 V V <sub>INH</sub> = 1.8 V, V <sub>INL</sub> = 0.5 V <sup>a</sup>	TEMP. <sup>b</sup>	TYP. <sup>c</sup>	-40 °C to 85 °C		UNIT
					MIN. <sup>d</sup>	MAX. <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full	-	0	5	V
Drain-Source On Resistance	R <sub>DS(on)</sub>	V <sub>S</sub> = 2.5 V, I <sub>S</sub> = -1 mA	Room	104	-	150	Ω
On-Resistance Matching	ΔR <sub>on</sub>		Full	-	-	200	
			Room	0.39	-	8	
			Full	-	-	10	
Switch Off Leakage Current	I <sub>S</sub> /I <sub>D(off)</sub>	V <sub>+</sub> = 5.5 V, V <sub>S</sub> = 1 V/4.5 V, V <sub>D</sub> = 4.5 V/1 V	Room	± 0.022	-0.4	+0.4	nA
			Full	-	-1	+1	
Channel On Leakage Current	I <sub>D(on)</sub>	V <sub>+</sub> = 5.5 V, V <sub>D</sub> = 4.5 V/1 V	Room	± 0.017	-0.4	+0.4	nA
			Full	-	-1	+1	
<b>Digital Control</b>							
Input, High Voltage	V <sub>INH</sub>		Full	-	1.8	-	V
Input, Low Voltage	V <sub>INL</sub>		Full	-	-	0.5	
Input Leakage	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>GND</sub> or V <sub>+</sub>	Room	± 0.001	-	-	μA
			Full	-	-1	+1	
Digital Input Capacitance <sup>e</sup>	C <sub>IN</sub>	f = 1 MHz	Room	2	-	-	pF
<b>Dynamic Characteristics</b>							
Break-Before Make Time	t <sub>BBM</sub>	DG2503 only, V <sub>S1</sub> = V <sub>S2</sub> = 3 V, R <sub>L</sub> = 300 Ω C <sub>L</sub> = 35 pF	Room	25	10	-	ns
			Full	-	10	-	
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 3 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room	64	-	100	ns
			Full	-	-	150	
Turn-Off Time	t <sub>OFF</sub>		Room	38	-	60	ns
			Full	-	-	100	
Charge Injection <sup>e</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>S</sub> = 3 V	Room	-2	-	-	pC
Off Isolation <sup>e</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1MHz	Room	-84	-	-	dB
Cross Talk <sup>e</sup>	X Talk		Room	-83	-	-	
3 dB Bandwidth <sup>e</sup>	BW	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF	Room	550	-	-	MHz
Source Off Capacitance <sup>e</sup>	C <sub>S(off)</sub>	f = 1 MHz, V <sub>S</sub> = 3 V	Room	2.7	-	-	pF
Drain Off Capacitance <sup>e</sup>	C <sub>D(off)</sub>		Room	2.6	-	-	
Drain On Capacitance <sup>e</sup>	C <sub>D(on)</sub>		Room	7.6	-	-	
<b>Power Requirements</b>							
Power Supply Current	I <sub>+</sub>	Digital Input = 1.8 V, at one channel V <sub>+</sub> = 5 V	Room	4.6	-	-	μA
			Full	-	-	30	
		Digital Input 0 or V <sub>+</sub>	Room	0.001	-	-	
			Full	-	-	2	

**Notes**

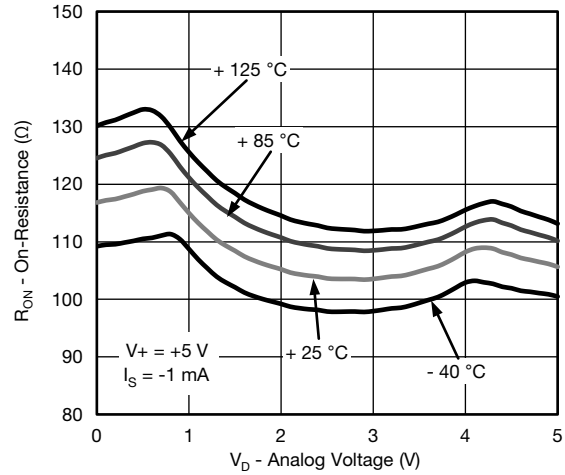
- a. V<sub>IN</sub> = input voltage to perform proper function.
- b. Room = 25 °C, Full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The convention where the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- e. Guaranteed by design, not subject to production test.



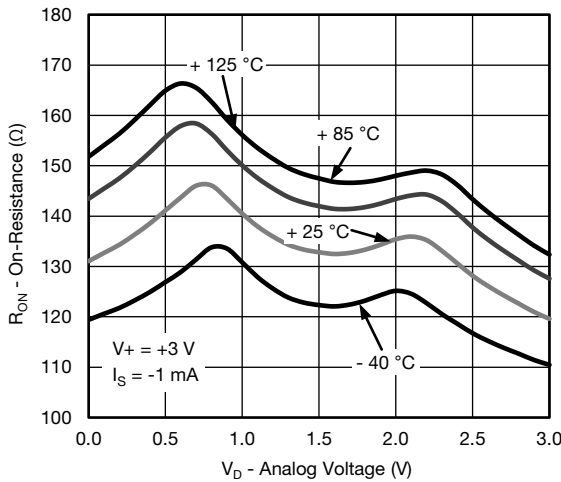
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



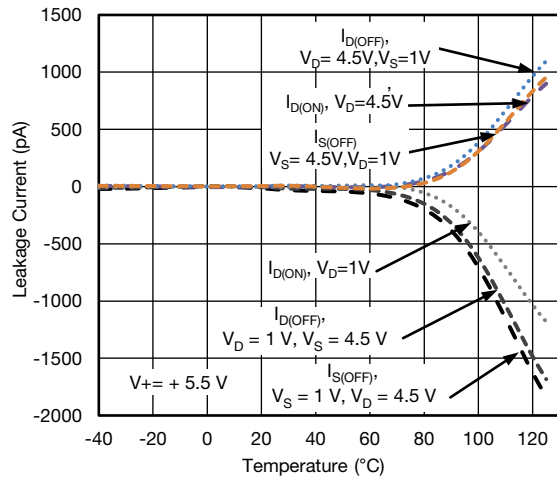
**On-Resistance vs. Analog Voltage**



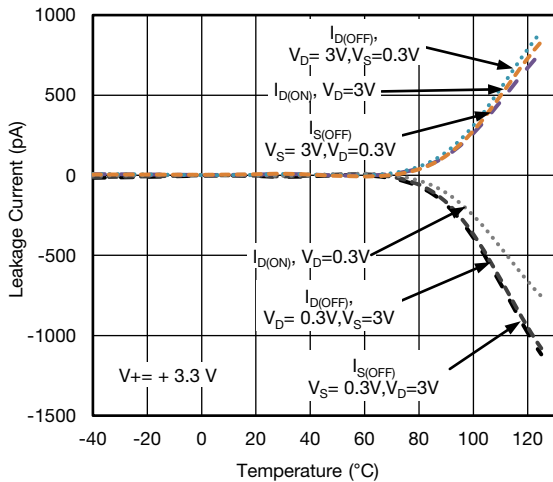
**On-Resistance vs. Analog Voltage**



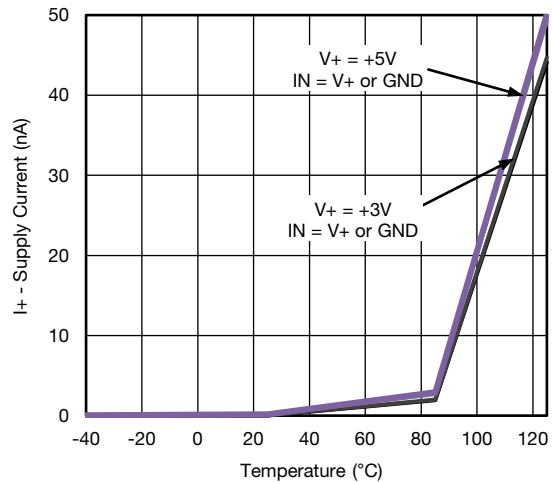
**On-Resistance vs. Analog Voltage**



**Leakage Current vs. Temperature**



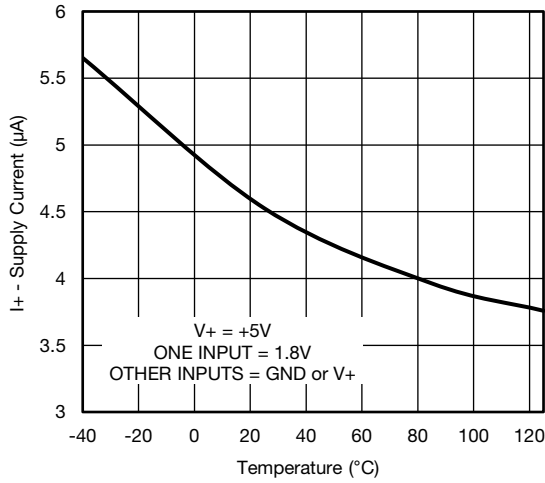
**Leakage Current vs. Temperature**



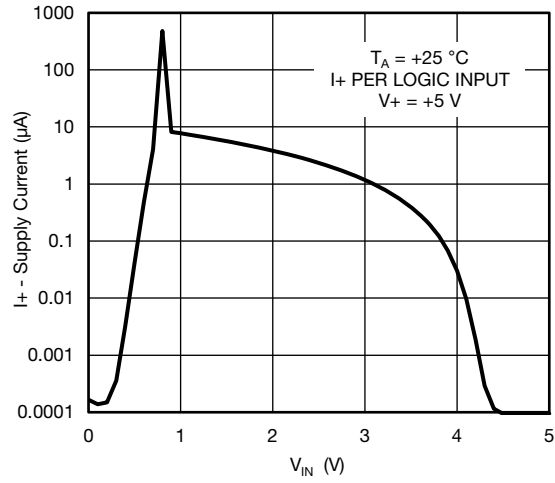
**Supply Current vs. Temperature**



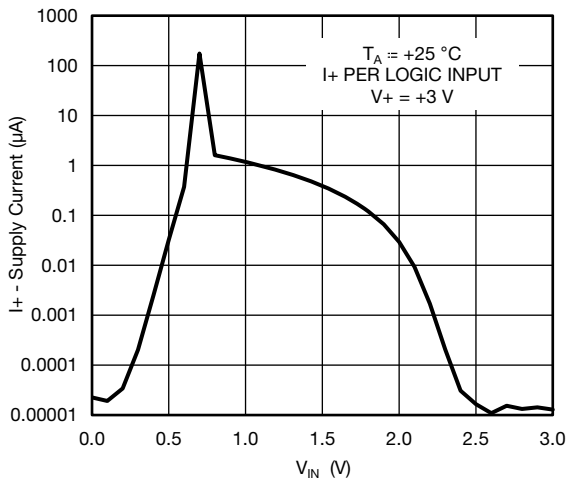
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



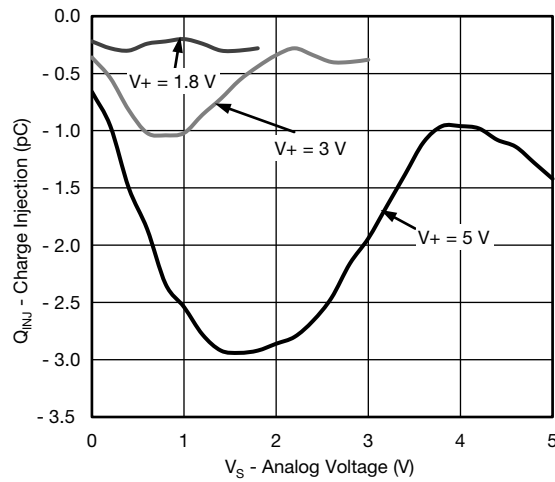
Supply Current vs. Temperature



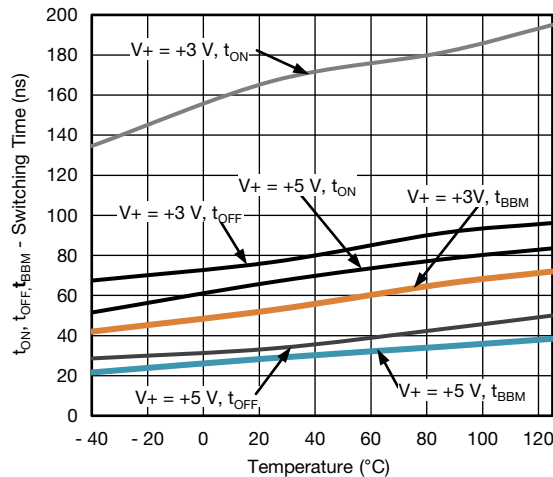
Supply Current vs.  $V_{IN}$



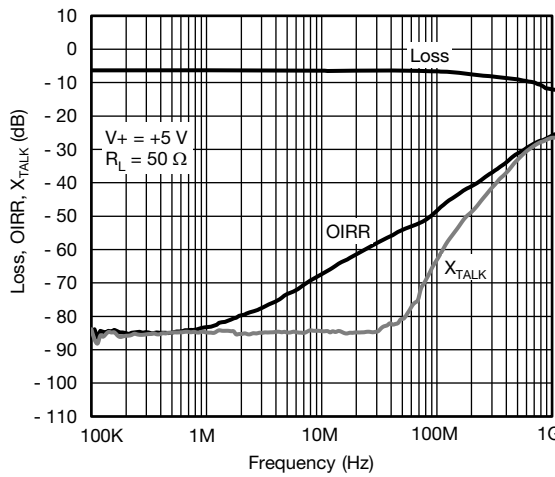
Supply Current vs.  $V_{IN}$



Charge Injection vs. Analog Voltage



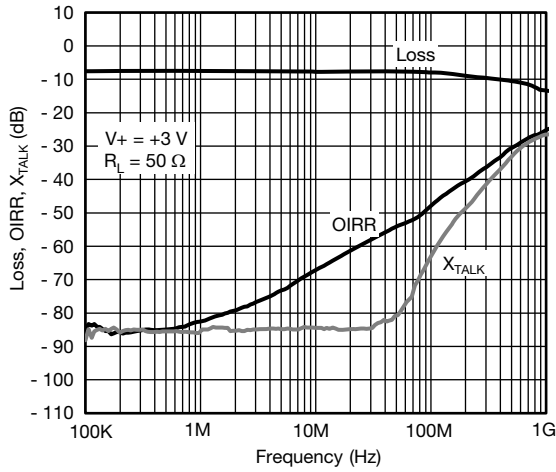
Switching Time vs. Temperature



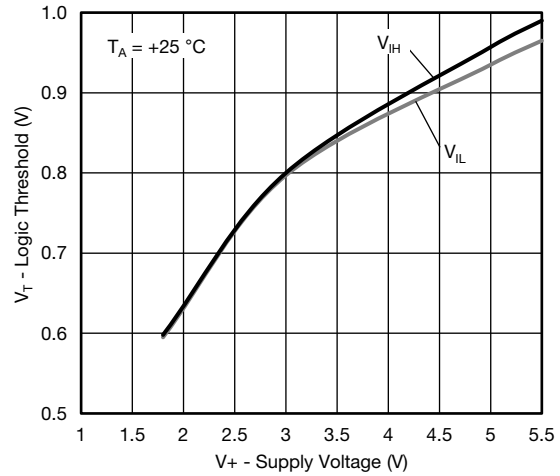
Loss, OIRR,  $X_{TALK}$  vs. Frequency



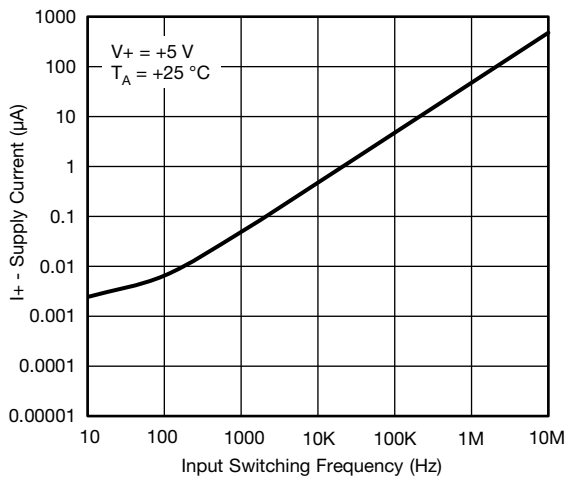
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



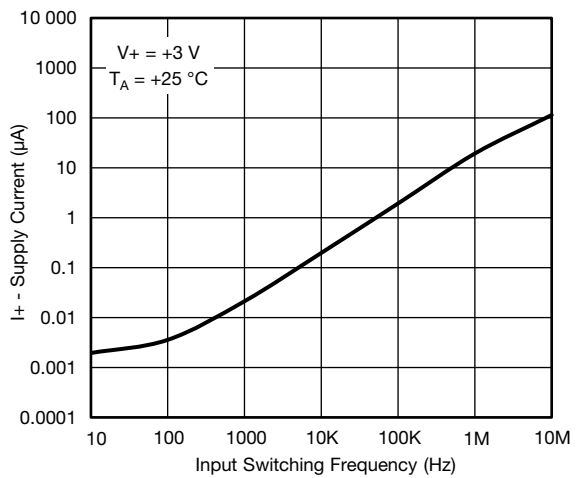
**Loss, OIRR,  $X_{TALK}$  vs. Frequency**



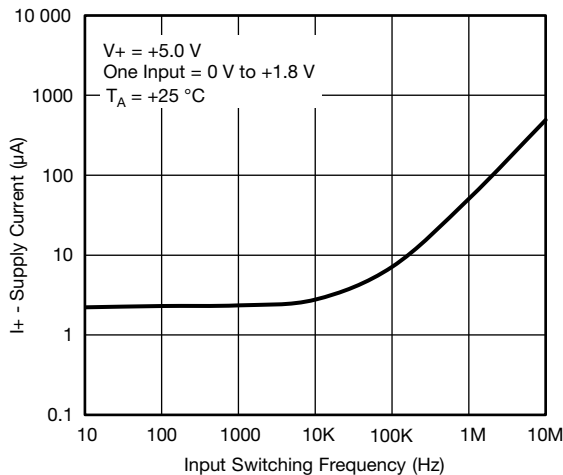
**Logic Threshold vs. Supply Voltage**



**Supply Current vs. Input Switching Frequency**

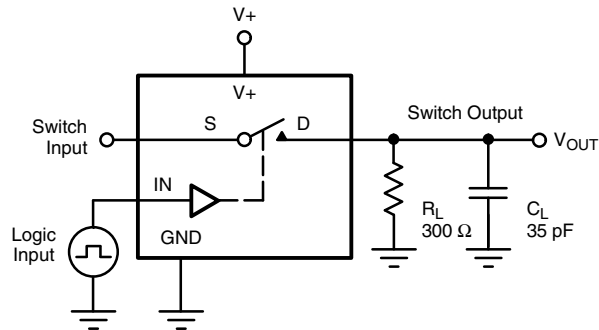


**Supply Current vs. Input Switching Frequency**



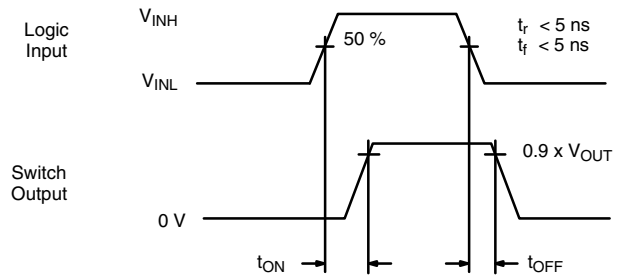
**Supply Current vs. Input Switching Frequency**

**TEST CIRCUIT**



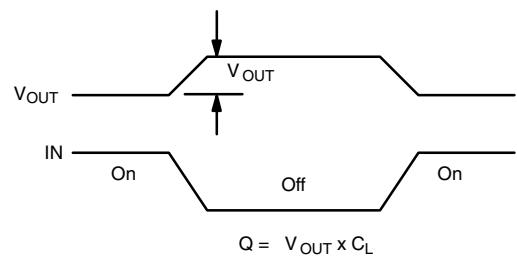
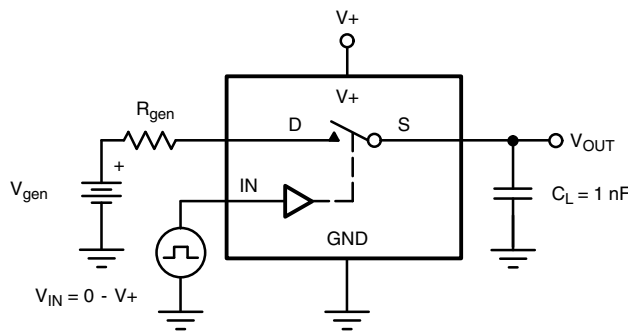
$C_L$  (includes fixture and stray capacitance)

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



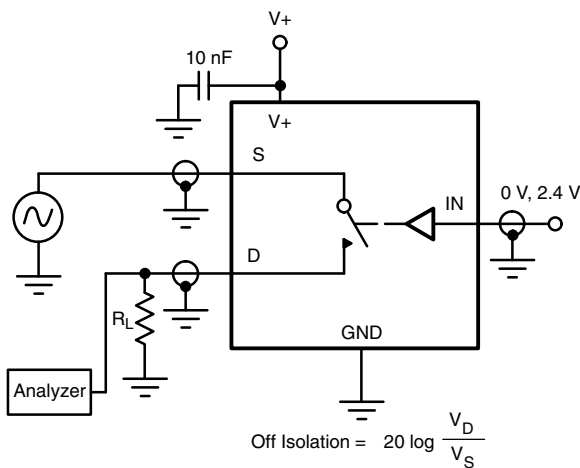
Logic "1" = Switch On  
 Logic input waveforms inverted for switches that have the opposite logic sense.

**Fig. 3 - Switching Time**

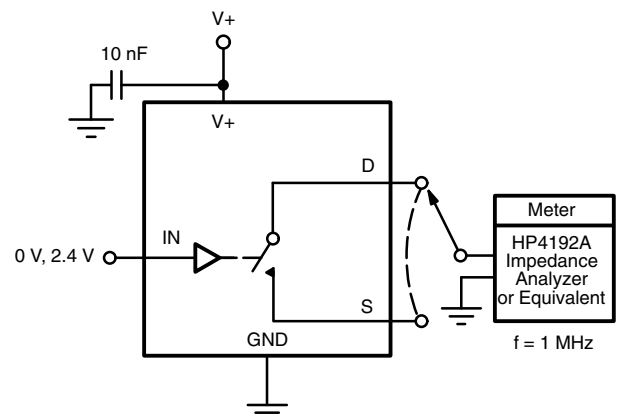


IN depends on switch configuration: input polarity determined by sense of switch.

**Fig. 4 - Charge Injection**



**Fig. 5 - Off-Isolation**



**Fig. 6 - 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 [www.vishay.com/ppg?62962](http://www.vishay.com/ppg?62962).





## 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.

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.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А