Sub-Ω, Low Voltage, SPDT Analog Switches with Over Current Protection

DESCRIPTION

The DG2520/DG2521 are low-voltage single single-pole/ double-throw monolithic CMOS analog switches. Designed to operate from 1.8 V to 5.5 V power supply, the DG2520/ DG2521 provide low on-resistance (0.8 Ω), excellent on-resistance matching (0.06 Ω) and flatness (0.2 Ω) over the entire signal range.

The DG2520/DG2521 offers the advantage of high linearity that reduces signal distortion, making ideal for audio, video, and USB signal routing applications. Additionally, the DG2520/DG2521 are 1.6 V logic compatible within the full operation voltage range.

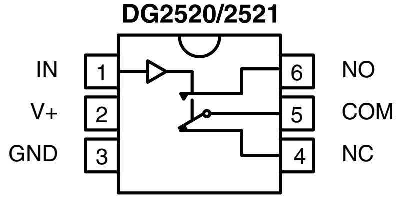
The DG2520/DG2521 offer over current protection. The protection circuitry activates when voltage drop across switch reaches 0.6 V typical. A direct/sustained short circuit will cause the switch to pulse on for typically less than 1 µs, then turn off. The switch turns on after 5 ms. If the short circuit condition remains, the switch turns off and on to produce a pulsed output. The current limiting circuitry is not instantaneous, and therefore will not activate when the output charges a small 0.1 µF capacitor.

Built on Vishay Siliconix's proprietary sub-micron high-density process, the DG2520/DG2521 brings low power consumption at the same time as reduces PCB spacing with the TSOP6 package

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. For analog switching products manufactured with 100 % matte tin device termination, the lead (Pb)-free "- E3" suffix is being used as a designator.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG2520/2521



Top View

FEATURES

- 1.8 to 5.5 V Single Supply Operation
- Low Ron: Typical 0.4 Ω at 4.5 V
- + 1.6 V Logic Compatible
- Over Current Protection

Pb-free
RoHS
COMPLIANT

BENEFITS

- High Linearity
- Low Power Consumption
- High Bandwidth
- Full Rail Signal Swing Range

APPLICATIONS

- USB/UART Signal Switching
- Audio/Video Switching
- Cellular Phone
- Media Players
- Modems
- Hard Drives
- PCMCIA

TRUTH TABLE

Logic	NC	NO
0	ON	OFF
1	OFF	ON

ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 to 85 °C	TSOP-6	DG2520DV-T1-E3
		DG2521DV-T1-E3

DEVICE MARKING:

DG2520DV = F9xxx
DG2521DV = F0xxx

ABSOLUTE MAXIMUM RATINGS

Reference to GND		Limit	Unit
V+		- 0.3 to + 6	V
IN, COM, NC, NO[a]		- 0.3 to (V+ + 0.3)	
Continuous Current (Any terminal)		± 50	mA
Peak Current (Pulsed at 1 ms, 10 % duty cycle)		± 200	
Storage Temperature (D Suffix)		- 65 to 150	°C
Power Dissipation (Packages)[b]	TSOP-6[c]	570	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 7 mW/°C above 70 °C.

SPECIFICATIONS (V+ = 3 V)

Parameter	Symbol	Test Conditions Otherwise Unless Specified $V+ = 3$ V, ± 10 %, $V_{IN} = 0.4$ or 1.8 V[e]		Temp[a]	Limits - 40 to 85 °C Min[c]	Typ[b]	Max[c]	Unit
Analog Switch								
Analog Signal Range[d]	V_{NO}, V_{NC}, V_{COM}			Full	0		V+	V
On-Resistance	r_{ON}	V+ = 2.7 V, $V_{COM} = 1.5$ V, $I_{NO/NC} = 100$ mA		Room Full		0.6	1.0 1.2	Ω
r_{ON} Flatness	r_{ON} Flatness	V+ = 2.7 V, $V_{COM} = 0, 0.75, 1.5$ V, $I_{NO/NC} = 100$ mA		Room Full		0.12	0.16 0.18	
r_{ON} Match Between Channels	Δr_{ON}	V+ = 2.7 V, $V_{COM} = 1.5$ V, $I_{NO/NC} = 100$ mA		Full			0.06	
Digital Control								
Input High Voltage[d]	V_{INH}			Full	1.8			V
Input Low Voltage	V_{INL}			Full			0.4	
Input Capacitance	C_{IN}			Full		7		pF
Input Current	I_{INL} or I_{INH}			Full	- 1		1	µA
Dynamic Characteristics								
Turn-On Time DG2520	t_{ON}	V+ = 2.7 V, V_{NO} or $V_{NC} = 1.5$ V, $R_L = 50\ \Omega$, $C_L = 35$ pF		Room Full		30	45 60	ns
Turn-Off Time DG2520	t_{OFF}			Room Full		10	17 22	
Break-Before-Make Time DG2520	t_{bbm}	V_{NO} or $V_{NC} = 1.5$ V, $R_L = 50\ \Omega$, $C_L = 35$ pF		Full	1	25		
Turn-On Time DG2521	t_{ON}	V+ = 2.7 V, V_{NO} or $V_{NC} = 1.5$ V, $R_L = 50\ \Omega$, $C_L = 35$ pF		Room Full		18	25 40	
Turn-Off Time DG2521	t_{OFF}			Room Full		25	45 55	
Make-Before-Break Time DG2521	t_{mbb}	V_{NO} or $V_{NC} = 1.5$ V, $R_L = 50\ \Omega$, $C_L = 35$ pF		Full	1	10		
Charge Injection[d]	Q	$C_L = 1$ nF, $V_{GEN} = 0$ V, $R_{GEN} = 0\ \Omega$		Room		115		pC
- 3 dB Bandwidth	BW	0 dBm, $C_L = 5$ pF, $R_L = 50\ \Omega$		Room		40		MHz
Off-Isolation[d]	OIRR	$R_L = 50\ \Omega$, $C_L = 5$ pF	f = 1 MHz	Room		- 51		dB
Crosstalk[d]	X_{TALK}		f = 1 MHz	Room		- 57		
N_O, N_C Off Capacitance[d]	$C_{NO(off)}$	$V_{IN} = 0$ or V+, f = 1 MHz		Room		50		pF
	$C_{NC(off)}$			Room		50		
Channel On Capacitance[d]	$C_{NO(on)}$			Room		160		
	$C_{NC(on)}$			Room		160		
Power Supply								
Power Supply Current	I+	$V_{IN} = 0$ or V+		Full			20	µA

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

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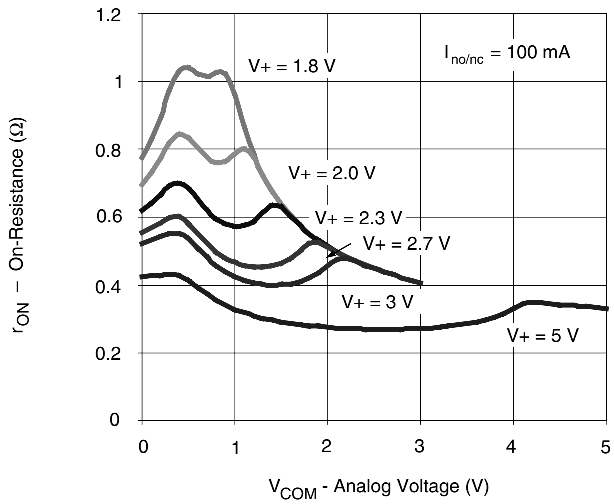
SPECIFICATIONS (V+ = 5 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5 V, ± 10 %, V_{IN} = 0.8 or 2.4 V[e]	Temp[a]	Limits - 40 to 85 °C Min[c]	Typ[b]	Max[c]	Unit
Analog Switch							
Analog Signal Range[d]	V_{NO}, V_{NC}, V_{COM}		Full	0		V+	V
On-Resistance	r_{ON}	V+ = 4.5 V, V_{COM} = 3.5 V, $I_{NO/NC}$ = 100 mA	Room Full		0.4	0.8 1.0	Ω
r_{ON} Flatness	r_{ON} Flatness	V+ = 4.5 V, V_{COM} = 0, 1, 2 V, $I_{NO/NC}$ = 100 mA	Room Full		0.15	0.2 0.22	Ω
r_{ON} Match Between Channels	Δr_{ON}	V+ = 4.5 V, V_{COM} = 3.5 V $I_{NO/NC}$ = 100 mA	Full			0.06	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	- 2 - 20		2 20	nA
	$I_{COM(off)}$		Room Full	- 2 - 20		2 20	nA
Channel On Leakage Current	$I_{COM(on)}$	V+ = 5.5 V, V_{NO}, V_{NC} = V_{COM} = 1 V/4.5 V	Room Full	- 2 - 20		2 20	nA
Digital Control							
Input High Voltage[d]	V_{INH}		Full	2.4			V
Input Low Voltage	V_{INL}		Full			0.8	V
Input Capacitance	C_{IN}		Full		10		pF
Input Current	I_{INL} or I_{INH}		Full	- 1		1	µA
Overcurrent-Protection Current Threshold			Room		1.7		A
Dynamic Characteristics							
Turn-On Time DG2520	t_{ON}	V+ = 4.5 V, V_{NO} or V_{NC} = 3 V R_L = 50 Ω, C_L = 35 pF	Room Full		25	35 40	ns
Turn-Off Time DG2520	t_{OFF}		Room Full		8	15 20	ns
Break-Before-Make Time DG2520	t_{bbm}	V_{NO} or V_{NC} = 3 V, R_L = 50 Ω, C_L = 35 pF	Full	1	15		ns
Turn-On Time DG2521	t_{ON}	V+ = 4.5 V, V_{NO} or V_{NC} = 3 V R_L = 50 Ω, C_L = 35 pF	Room Full		12	25 35	ns
Turn-Off Time DG2521	t_{OFF}		Room Full		20	35 45	ns
Make-Before-Break Time DG2521	t_{mbb}	V_{NO} or V_{NC} = 3 V, R_L = 50 Ω, C_L = 35 pF	Full	1	12		ns
Charge Injection[d]	Q	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω	Room		224		pC
- 3 dB Bandwidth	BW	0 dBm, C_L = 5 pF, R_L = 50 Ω	Room		40		MH
Off-Isolation[d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		- 51		dB
Crosstalk[d]	X_{TALK}	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		- 57		dB
Source Off Capacitance[d]	$C_{NO(off)}$	f = 1 MHz	Room		50		pF
	$C_{NC(off)}$		Room		50		pF
Channel On Capacitance[d]	$C_{NO(on)}$		Room		160		pF
	$C_{NC(on)}$		Room		160		pF
Power Supply							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	V_{IN} = 0 or V+	Full			22	µA

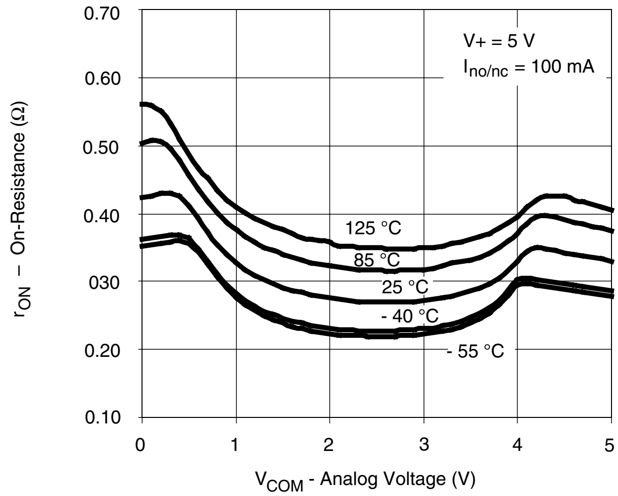
Notes:
a. Room = 25 °C, Full = as determined by the operating suffix.
b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet
d. Guarantee by design, nor subject to production test.
e. V_{IN} = input voltage to perform proper function.
f. 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.

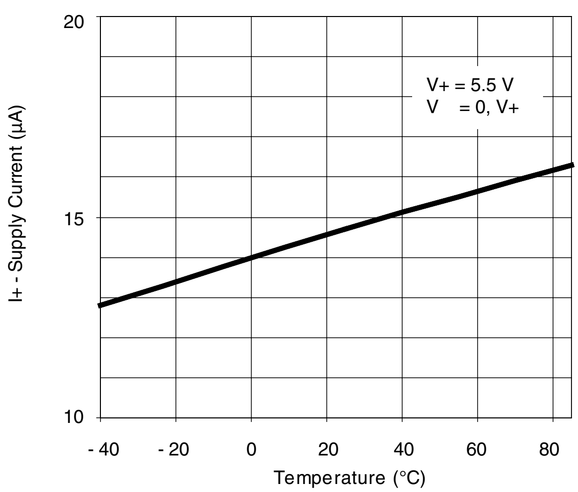
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



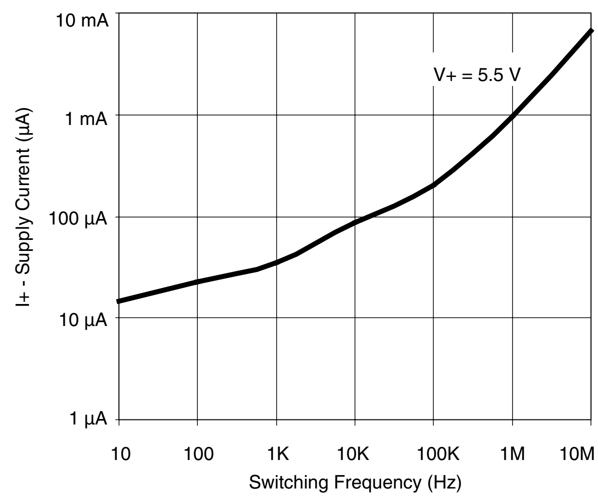
r_{ON} vs. V_{COM} and Supply Voltage



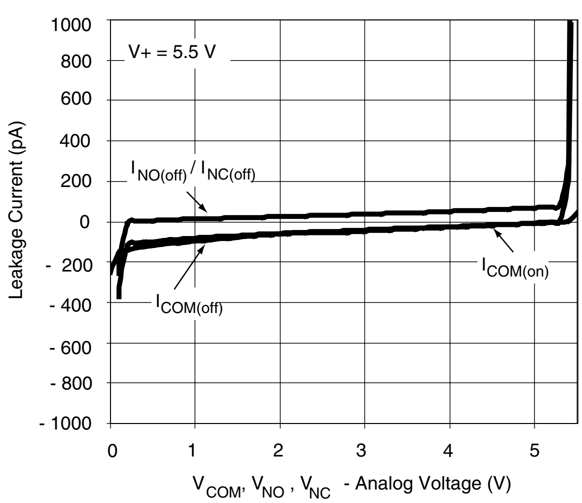
r_{ON} vs. Analog Voltage and Temperature



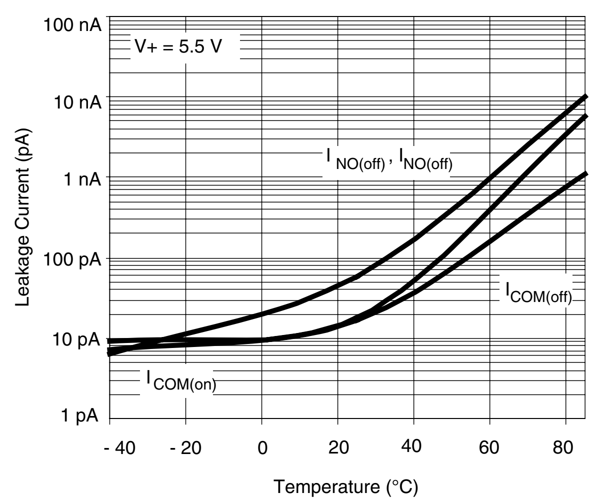
Supply Current vs. Temperature



Supply Current vs. Input Switching Frequency

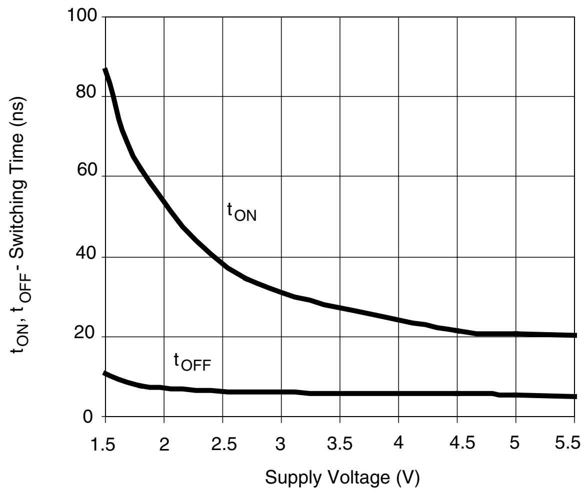


Leakage vs. Analog Voltage

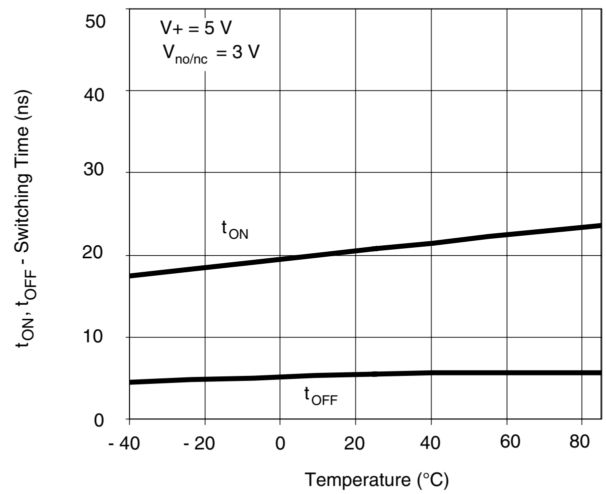


Leakage Current vs. Temperature

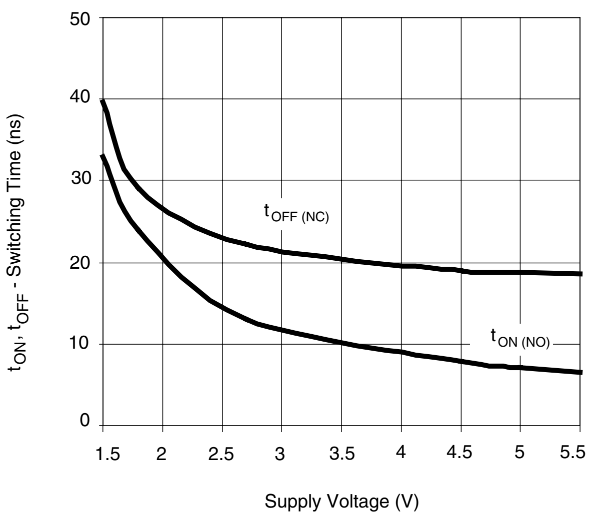
TYPICAL CHARACTERISTICS T_A = 25 °C, unless otherwise noted



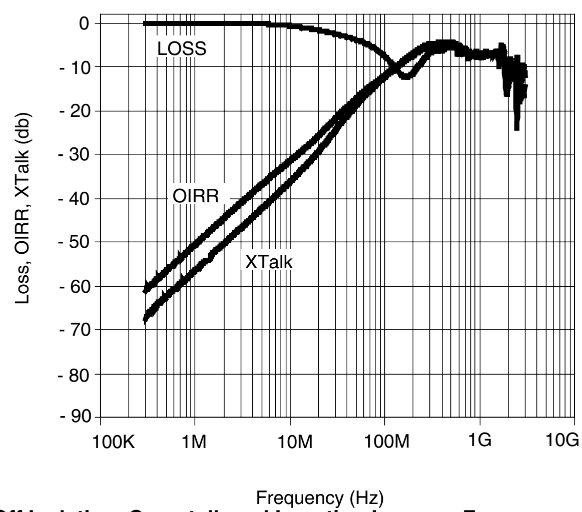
Switching Time vs. Supply Voltage, DG2520



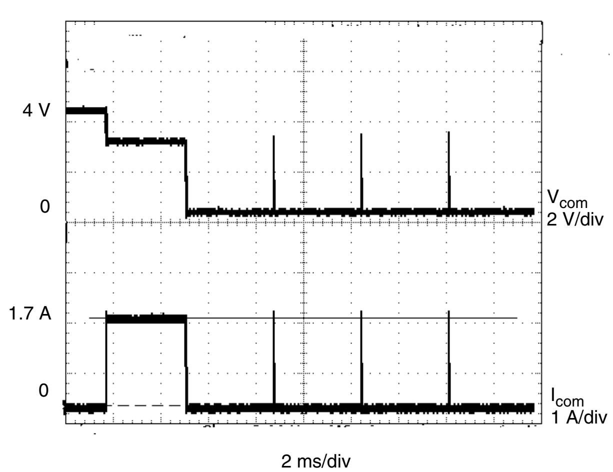
Switching Time vs. Temperature, DG2520



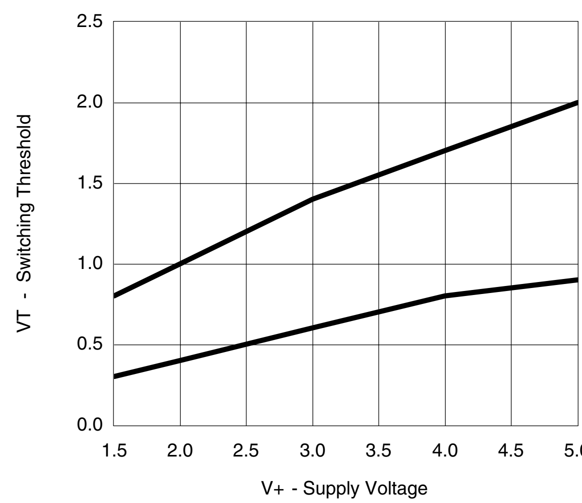
Switching Time vs. Supply Voltage, DG2521



Off Isolation, Crosstalk and Insertion Loss vs. Frequency

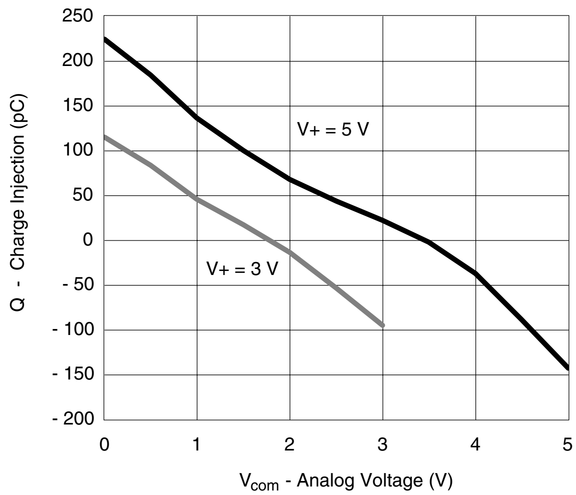


Overcurrent Response

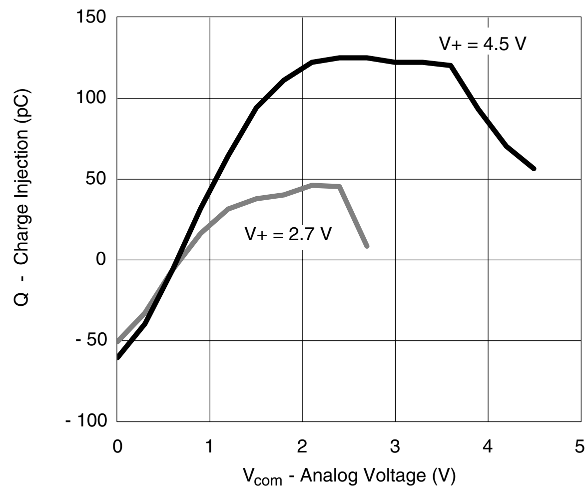


Switching Threshold vs. Supply Voltage

TYPICAL CHARACTERISTICS T_A = 25 °C, unless otherwise noted

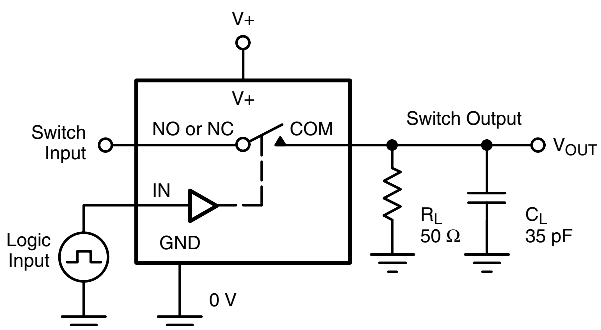


Charge Injection vs. Analog Voltage, DG2520



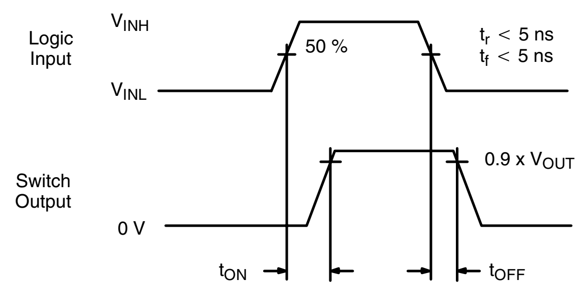
Charge Injection vs. Analog Voltage, DG2521

TEST CIRCUITS



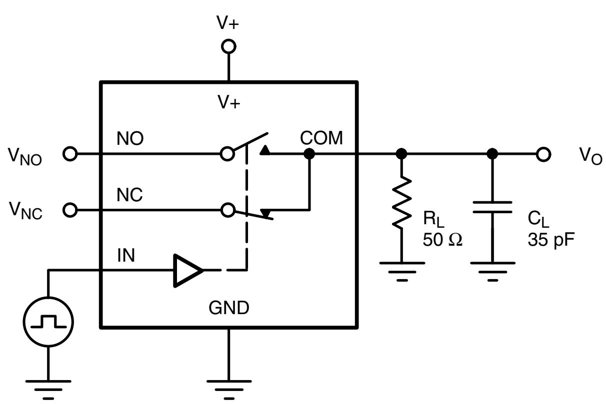
C_L (includes fixture and stray capacitance)

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



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)

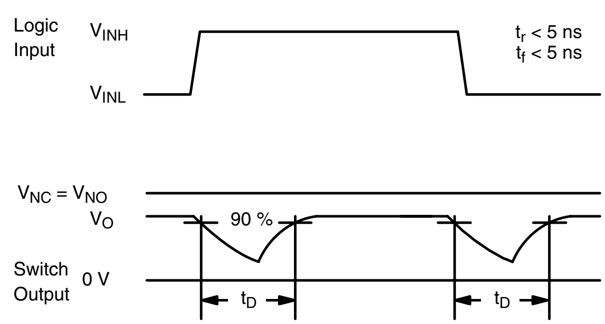


Figure 2. Break-Before-Make Interval

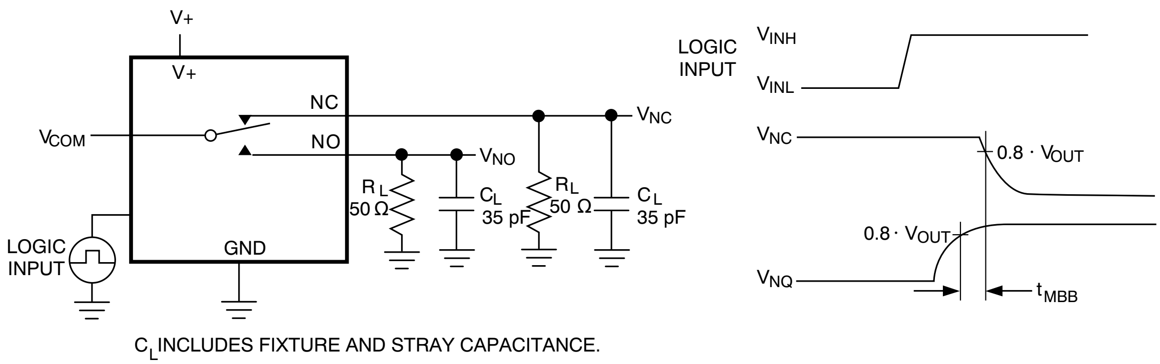


Figure 3. Make-Before-Break Interval

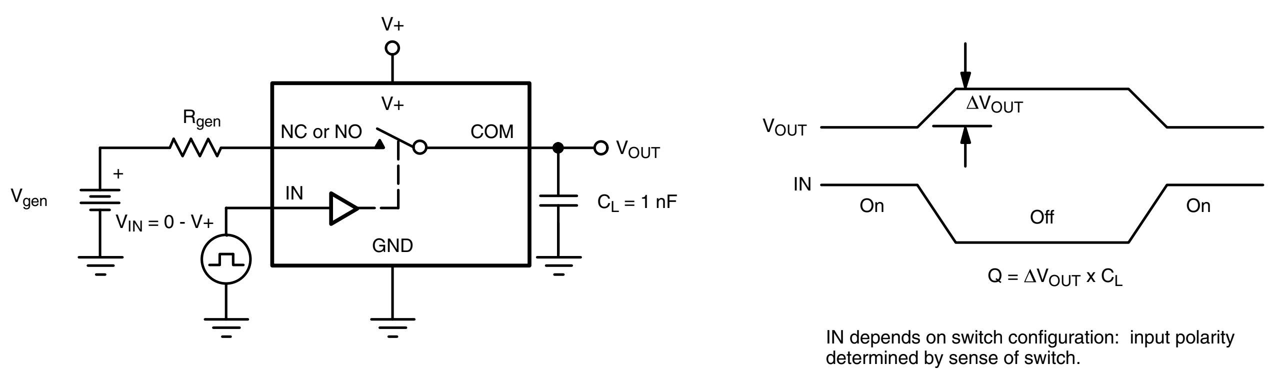


Figure 4. Charge Injection

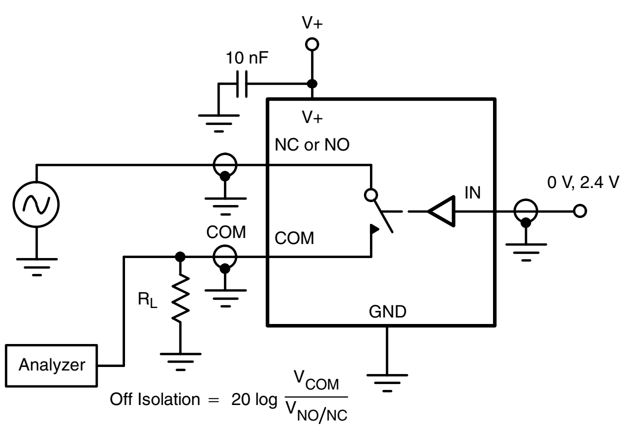


Figure 5. Off-Isolation

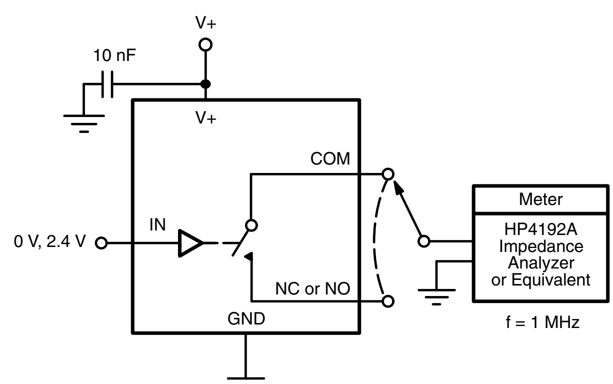


Figure 6. Channel Off/On Capacitance

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