0.39 Ω, Low-R_{ON}, Ultra-Low Distortion, Compact DPDT Analog Switch

DESCRIPTION

The DG2751 is a compact, low resistance, ultra-low distortion double pole double throw (DPST) analog switch.

The DG2751 features a flat 0.39 Ω ON resistance over the analog signal range from (V+) - 5.5 V to V+, supporting bi-directional negative signal swing. The design brings superior signal fidelity by eliminating the distortion caused by double hump switch resistance character of conventional analog switches.

The DG2751 operates over a voltage range from 3 V to 5.5 V. Because of its low current consumption, it can be powered directly by a GPIO. When V+ power is off, all switch pins are of high impedance mode.

Shunt switches are integrated at normally close (NOn) channels to discharge the AC-coupling capacitance at the terminals.

The part is controlled by a single bit, S, which can interface with 1.2 V low voltage I/O. Switch ON/OFF is of break-before-make (BBM).

The DG2751 is available in ultra-compact 1.2 mm x 1.2 mm, 9-bump WCSP package, and operate over the -40 °C to +85 °C extended temperature range.

FEATURES

- 2.3 V to 5.5 V single supply operation
- Low resistance: 0.39 Ω / typ. at 2.7 V
- Highly flat and matched R_{ON}
- Low parasitic capacitance, C_{ON} = 31 pF, C_{OFF} = 30 pF
- High bandwidth: 290 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: > 8 kV
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

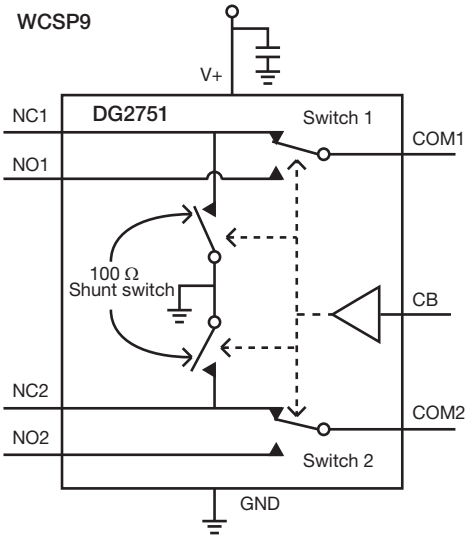
APPLICATIONS

- Applications
- Smart phones
- Tablets
- Portable media players
- Headphones
- Audio / video equipment
- Low-distortion signal switches
- Digital cameras
- Docking devices

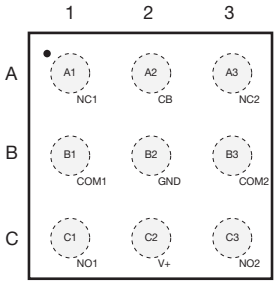
BENEFITS

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

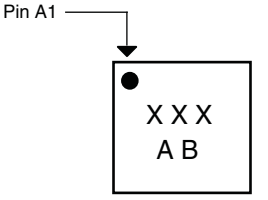
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Top view (solder bumps on bottom)



WCSP9, 1.25 mm x 1.25 mm
Top view (solder bumps on bottom)



Device marking: AB for DG2751
x = date / lot traceability code

TRUTH TABLE

CB	FUNCTION
0	COMx is connected to NCx
1	COMx is connected to NOx, NCx is connected to shunt resistor

ORDERING INFORMATION

PART NUMBER	PACKAGE	MARKING CODE	TEMPERATURE RANGE	STANDARD PACKAGING QUANTITY
DG2751DB-T2-GE1	WCSP9	AB	-40 °C to +85 °C lead (Pb)-free	Tape and reel 3000 units

PIN DESCRIPTION

PIN	NAME	FUNCTION
A1	NC1	Normally close terminal for switch 1
A2	CB	Logic control input. Drive CB low to connect COMx to NCx. Drive CB high to connect COMx to NOx.
A3	NC2	Normally closed terminal for switch 2
B1	COM1	Common terminal for switch 1
B2	GND	Ground
B3	COM2	Common terminal for switch 2
C1	NO1	Normally open terminal for switch 1
C2	V+	Device power supply input. Bypass V+ to GND with a 0.1 µ capacitor as close to the pin as possible
C3	NO2	Normally open terminal for switch 2

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)

PARAMETER		LIMIT	UNIT
Reference to GND	V+, IN	-0.3 to 6	V
	COM, NO, NC [a]	(V+) - 5.5 to (V+ + 0.3)	
Current (any terminal except COM, NO, NC, IN)		30	mA
Continuous Current (COM, NO, NC, IN)		± 250	
Peak Current (pulsed at 1 ms, 10 % duty cycle)		± 500	
Storage Temperature (D suffix)		-65 to +150	°C
Power Dissipation (packages) [b]	WCSP9-40 [c]	963	mW
Junction-to-Ambient Thermal Resistance (θ_{JA})		83	°C/W
ESD (human body model) I/O to GND		8	kV
Latch-Up (per JESD78)		400	mA

Notes

a. Signals on COM, NO, NC, 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 12 mW/°C above 70 °C.
d. Package thermal resistances were obtained using the method described in JEDEC® specification JESD51-7.

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.

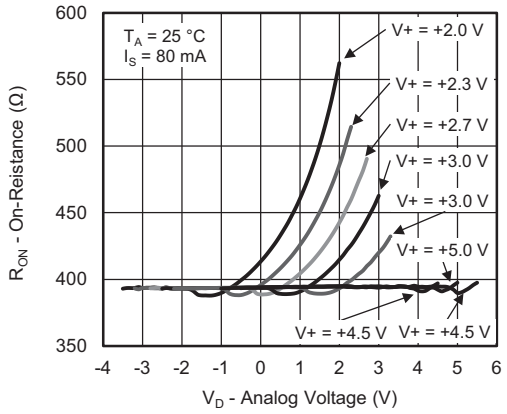
SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS unless otherwise specified, V+ = 3.3 V, T_A = -40 °C to +85 °C control logic are either at 0 V or V+, typical values are at 25 °C with V+	TEMP. [a]	LIMITS -40 °C to +85 °C MIN. [b]	TYP. [c]	MAX. [b]	UNIT
Analog Switch							
Analog Signal Range [d]	V_{ANALOG}		Full	(V+) - 5.5	-	V+	V
On-Resistance	$R_{DS(on)}$	V+ = 3.3 V, V_S = 0 V, ± 1.8 V, I_S = 80 mA	Room	-	0.390	0.600	Ω
			Full	-	0.470	0.800	
On-Resistance Match	ΔR_{ON}		Room	-	0.002	0.050	
On-Resistance Flatness	R_{ON} Flatness		Room	-	0.020	0.050	
Pull Down Resistance	R_{PD}	I = 80 mA, V_{SW} = ± 1.8 V, V+ = 3 V	Room	-	118	130	
			Full	-	130	150	
Switch Off Leakage Current	$I_{NO(off)}$	V+ = 3.3 V, V_{NO} = ± 2 V, V_{NC} = ∓ 2 V	Room	-50	10	50	µA
			Full	-50	11	50	
	$I_{COM(off)}$	V+ = 3.3 V, V_{COM} = ± 2 V, V_{NO} or V_{NC} = ∓ 2 V	Room	-100	31	100	
			Full	-100	33	100	
	$I_{NC(off)}$ [g]	V+ = 3.3 V, V_{NC} = ± 2 V, V_{NO} = ∓ 2 V	Room	-30	20	30	mA
			Full	-30	21	30	
Channel On Leakage Current	$I_{COM(on)}$	V+ = 3.3 V, V_{COM} = +2 V or -2 V	Room	-100	31	100	µA
			Full	-100	33	100	
Digital Control							
Input Voltage High	V_{INH}	V+ = 2.3 V to 5.5 V	Full	1.2	-	-	V
Input Voltage Low	V_{INL}		Full	-	-	0.3	
Input Capacitance	C_{IN}		Room	-	3	-	pF
Input Current	I_{INL} or I_{INH}	V+ = 5 V, V_{IN} = 0 or V+	Full	-1	0.02	1	µA
Dynamic Characteristics							
Break-Before-Make Time [e, d]	t_{BBM}	V+ = 2.7 V, V_S = 1.5 V, R_L = 50 Ω, C_L = 35 pF	Room	3	41	90	µs
			Full	2	-	-	
Switch Turn-On Time [e, d]	t_{ON}		Room	-	44	95	
			Full	-	51	95	
Switch Turn-Off Time [e, d]	t_{OFF}		Room	-	0.72	1.5	
			Full	-	0.72	1.5	
Power ON Delay	T_{ON_DLY}		Room	-	108	184	
			Full	-	134	213	
Switch On Rise Time	TR		Room	-	20	31	
			Full	-	24	35	
Charge Injection [d]	Q_{INJ}	C_L = 1 nF, R_{GEN} = 0 Ω, V_{GEN} = 0 V	Room	-	18.9	-	pC
Total Harmonic Distortion Plus Noise	THD+N	f = 1 kHz, V+ = 3 V, A-weighted filter, R_L = 20 kΩ, V_{SW} = 2 V_{RMS}		-	-106	-	dB
		f = 1 kHz, V+ = 3 V, A-weighted filter, R_L = 20 kΩ, V_{SW} = 1.5 V_{RMS}		-	-103	-	
		f = 1 kHz, V+ = 3 V, A-weighted filter, R_L = 20 kΩ, V_{SW} = 1 V_{RMS}		-	-101	-	
		f = 1 kHz, V+ = 3 V, A-weighted filter, R_L = 20 kΩ, V_{SW} = 0.7 V_{RMS}		-	-100	-	
		f = 1 kHz, V+ = 3.3 V, A-weighted filter, R_L = 32 Ω, V_{SW} = 1 V_{RMS}		-	-111	-	
		f = 1 kHz, V+ = 3.3 V, A-weighted filter, R_L = 32 Ω, V_{SW} = 0.7 V_{RMS}		-	-114	-	
		f = 1 kHz, V+ = 3.3 V, A-weighted filter, R_L = 32 Ω, V_{SW} = 0.5 V_{RMS}		-	-113	-	
		f = 1 kHz, V+ = 3.3 V, A-weighted filter, R_L = 32 Ω, V_{SW} = 0.3 V_{RMS}		-	-110	-	
Off-Isolation [d]	OIRR	V+ = 3.3 V, R_L = 50 Ω, C_L = 5 pF, f = 20 kHz, PSRR at 3.3 V		-	-106	-	
Crosstalk [d]	X_{TALK}			-	-107	-	
Bandwidth [d]	BW	V+ = 3.3 V, R_L = 50 Ω, -3 dB		-	290	-	MHz
Channel-Off Capacitance [d]	$C_{NC/NO(off)}$	V+ = 3.3 V, R_L = 50 Ω, C_L = 5 pF		-	30	-	pF
Channel-On Capacitance [d]	$C_{COM/NC/NO(on)}$			-	31	-	
Power Supply							
Power Supply Range	V+			2.3	-	5.5	V
Power Supply Current	I+	V+ = 3.3 V, V_{IN} = 0 V, or 1.8 V	Full	-	18	29	µA
Power Supply Rejection Ratio	PSRR	R_{COM} = 50 Ω, f = 1 kHz, V+ = 3.3 V	Room	-	-104	-	dB
		R_{COM} = 50 Ω, f = 217 Hz, V+ = 3.3 V	Room	-	-106	-	

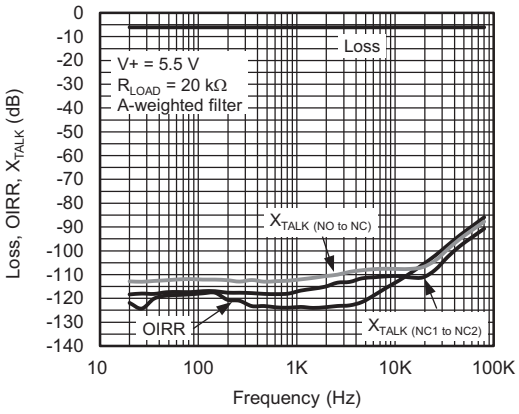
Notes

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 data sheet.
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.
g. When NC is off, NC is connected to the 100 Ω shunt resistor.

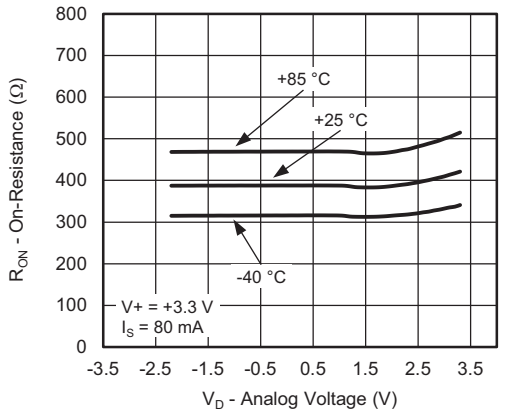
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



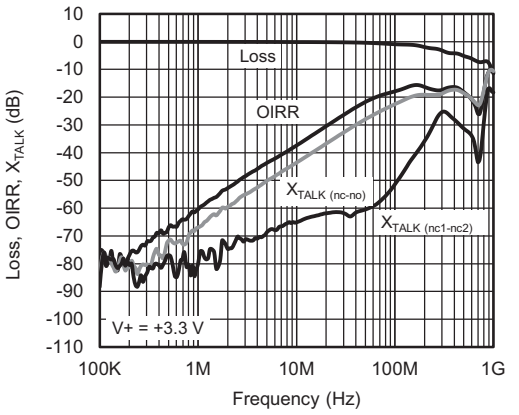
On-Resistance vs. V_D and Supply Voltage



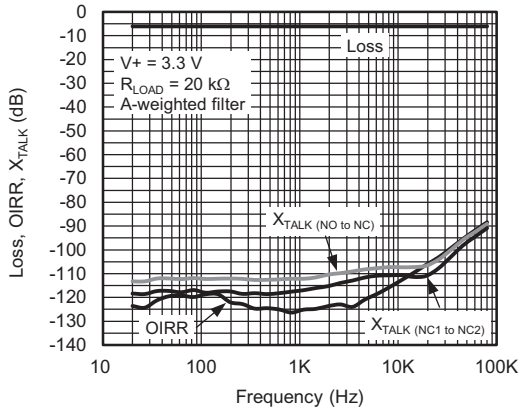
Loss, Off-Isolation, Crosstalk vs. Audio Frequency
V+ = 5.5 V



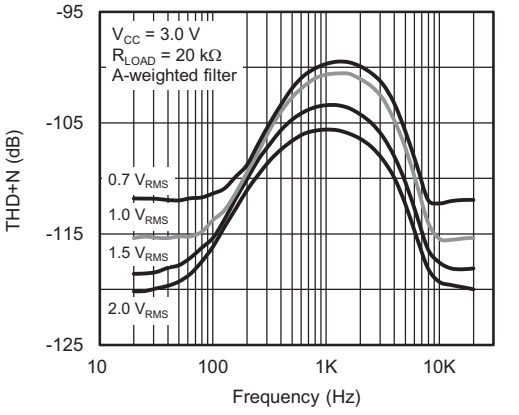
On-Resistance vs. Analog Voltage and Temperature



Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

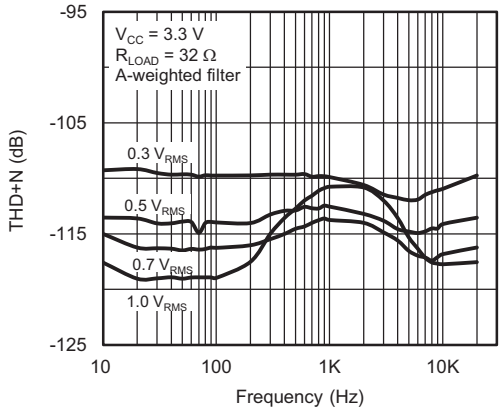


Loss, Off-Isolation, Crosstalk vs. Audio Frequency
V+ = 3.3 V

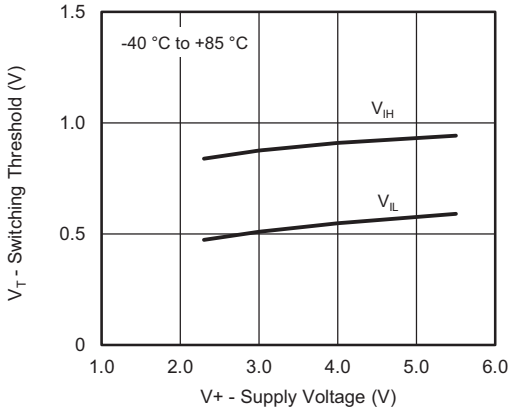


THD+N vs. Frequency

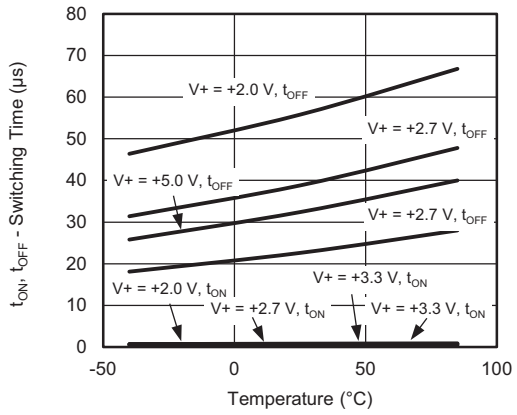
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



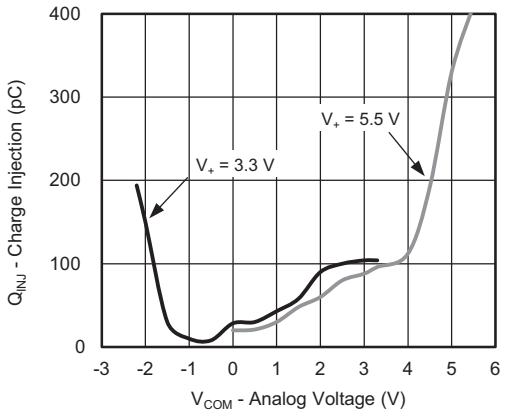
THD+N vs. Frequency



Switching Threshold vs. Supply Voltage

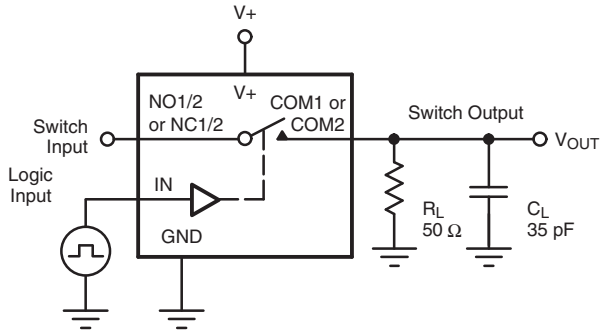


Switching Time vs. Temperature and Supply Voltage



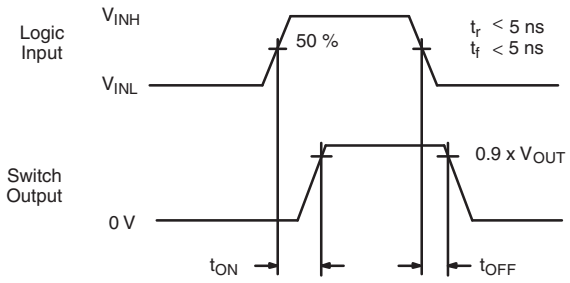
Charge Injection vs. Analog Voltage

TEST CIRCUITS



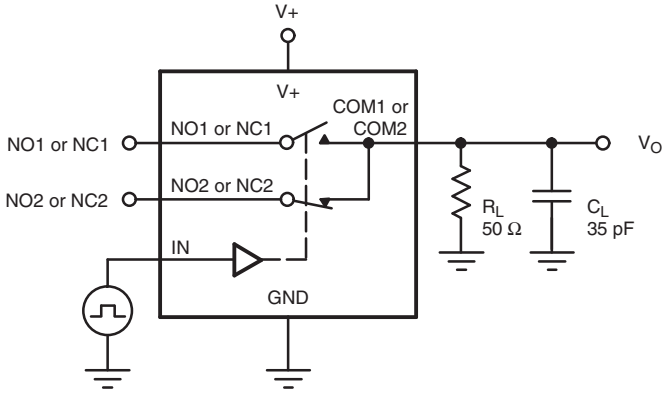
C_L (includes fixture and stray capacitance)

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



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)

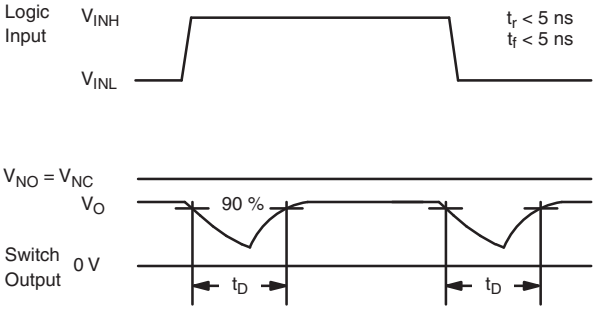
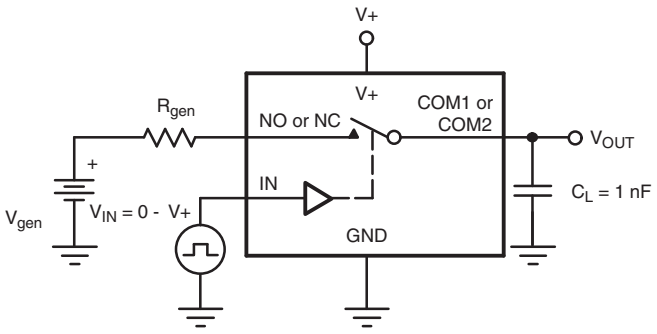
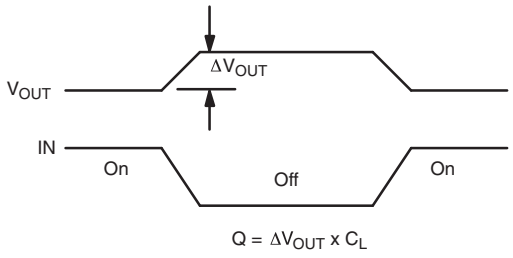


Fig. 2 - Break-Before-Make Interval





Q = ΔV$_{OUT}$ x C_L

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

Fig. 3 - Charge Injection

TEST CIRCUITS

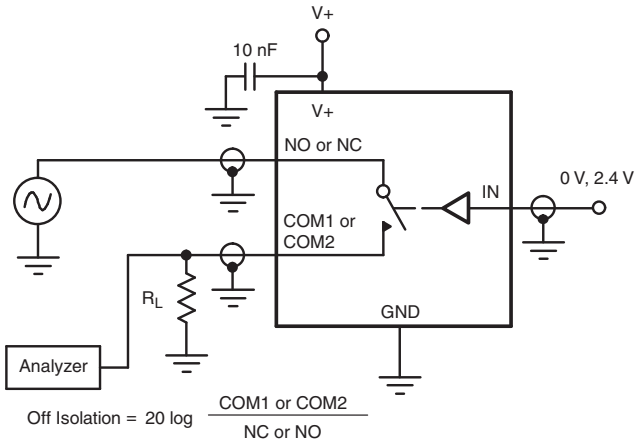


Fig. 4 - Off-Isolation

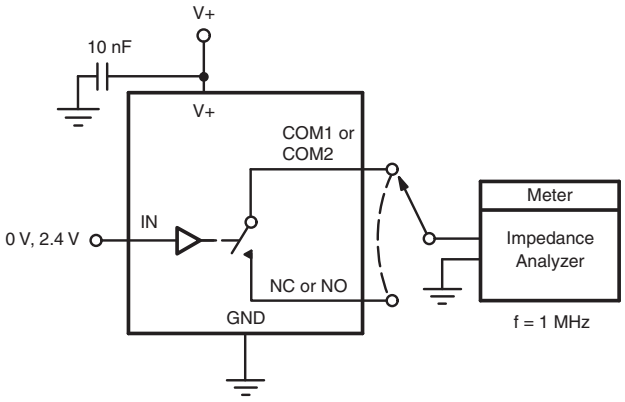


Fig. 5 - Channel Off/On Capacitance

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