Low Voltage, 0.4 Ω, Dual SPDT Analog Switch

DESCRIPTION

The DG2731/2732/2733 are low voltage, low on-resistance, dual single-pole/double-throw (SPDT) monolithic CMOS analog switches designed for high performance switching of analog signals. Combining low-power, high speed, low on-resistance, and small package size, the DG2731/2732/2733 are ideal for portable and battery power applications.

The DG2731/2732/2733 have an operation range from 1.6 V to 4.3 V single supply. The DG2731 and DG2732 have two separate control pins with reverse control logic. The DG2733 has an EN pin to enable the device when the logic is high.

The DG2731/2732/2733 are 1.6-V logic compatible, allowing the easy interface with low voltage DSP or MCU control logic and ideal for one cell Li-ion battery direct power.

The switch conducts signals within power rails equally well in both directions when on, and blocks up to the power supply level when off. Break-before-make is guaranteed.

The DG2731/2732/2733 are built on Vishay Siliconix's sub micron CMOS low voltage process technology and provides greater than 300 mA latch-up protection, as tested per JESD78.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device terminations. DG2731/2732/2733 are offered in a DFN or MSOP package. The DFN package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-E4" suffix. The MSOP package uses 100% matte Tin device termination and is represented by the lead (Pb)-free "-E3" suffix. Both the matte Tin and nickel-palladium-gold device terminations meet all JEDEC standards for reflow and MSL ratings.

FEATURES

- Low Voltage Operation (1.65 V to 4.3 V)
- Low On-Resistance - r_{ON}: 0.3 Ω@ 3.6 V
- Fast Switching: T_{ON} = 50 ns @ 4.3 V
- T_{OFF} = 14 ns @ 4.3 V
- Latch-Up Current > 300 mA (JESD78)

Pb-free
RoHS COMPLIANT

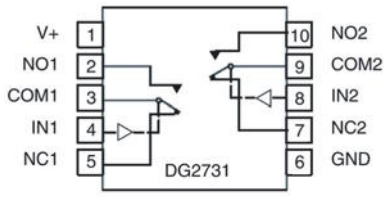
BENEFITS

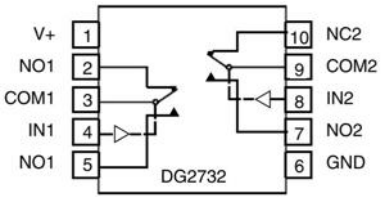
- Reduced Power Consumption
- High Accuracy
- Reduce Board Space
- TTL/1.6-V Logic Compatible

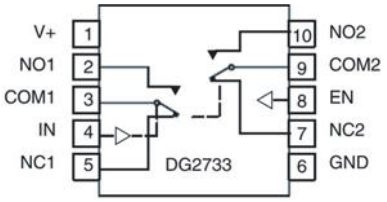
APPLICATIONS

- Cellular Phones
- Speaker Headset Switching
- Audio and Video Signal Routing
- PCMCIA Cards
- Battery Operated Systems

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION







TRUTH TABLE

Logic	EN (DG2733 only)	NC1, 2	NO1, 2
0	1	ON	OFF
1	1	OFF	ON
0	0	OFF	OFF
1	0	OFF	OFF

ORDERING INFORMATION

Temp Range	Package	Part Number
–40 to 85°C	MSOP–10	DG2731DQ–T1–E3 DG2732DQ–T1–E3 DG2733DQ–T1–E3
	DFN–10	DG2731DN–T1–E4 DG2732DN–T1–E4 DG2733DN–T1–E4

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

Parameter		Symbol	Limit	Unit
Reference to GND	V+		–0.3 to 5.0	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)			±250	
Peak Current (Pulsed at 1 ms, 10 % duty cycle)			±500	
Storage Temperature (D Suffix)			–65 to 150	°C
Package Solder Reflow Conditions[d]	10–PIN MSOP			
	10–PIN DFN			
Power Dissipation (Packages)[b]	MSOP–10[c]		320	mW
	DFN–10[d]		1191	

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 4.0 mW/C above 70°C
d. Derate 14.9 mW/C above 70°C
e. Manual soldering with iron is not recommended for leadless components. The QFN 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.

SPECIFICATIONS (V+ = 1.8 V)

Parameter	Symbol	Test Condition Otherwise Unless Specified V+ = 1.8 V, V_{IN} = 0.4 or 1.4 V[e]	Temp[a]	Limits –40 to 85°C Min[b]	Typ[c]	Max[b]	Unit
Analog Switch							
Analog Signal Range[d]	V_{NO}, V_{NC}, V_{COM}		Full	0		V+	V
On-Resistance	r_{ON}	V+ = 1.8 V, V_{COM} = 0.9 V, I_{NO}, I_{NC} = 100 mA	Room		0.7	1.0	Ω
			Full			1.2	
Digital Control							
Input High Voltage	V_{INH}		Full	1.4			V
Input Low Voltage	V_{INL}		Full			0.4	
Input Capacitance	C_{in}		Full		4		pF
Power Supply							
Power Supply Current	I+	V_{IN} = 0 or V+	Full			1.0	µA

SPECIFICATIONS (V+ = 3 V)

Parameter	Symbol	Test Condition Otherwise Unless Specified V+ = 3 V, ±10 %, V_{IN} = 0.5 or 1.4 V[e]	Temp[a]	Limits –40 to 85°C Min[b]	Typ[c]	Max[b]	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} = 0.5 V, I_{NO}, I_{NC} = 100 mA	Room		0.35	0.45	Ω
		V+ = 2.7 V, V_{COM} = 1.5 V, I_{NO}, I_{NC} = 100 mA	Room		0.3		
			Full			0.6	
r_{ON} Match[d]	Δr_{ON}	V+ = 2.7 V, V_{COM} = 0.5 to 1.5 V, I_{NO}, I_{NC} = 100 mA	Room		0.03	0.06	
Switch Off Leakage Current	$I_{NO(off)}$, $I_{NC(offF)}$	V+ = 3.3 V, V_{NO}, V_{NC} = 0.3 V / 4.0 V, V_{COM} = 3.0 V / 0.3 V	Room Full	–1 –10		1 10	nA
	$I_{COM(off)}$		Room Full	–1 –10		1 10	
Channel-On Leakage Current	$I_{COM(on)}$	V+ = 3.3 V, V_{NO}, V_{NC} = V_{COM} = 3.0 V / 0.3 V	Room Full	–1 –10		1 10	
Digital Control							
Input High Voltage	V_{INH}		Full	1.4			V
Input Low Voltage	V_{INL}		Full			0.5	
Input Capacitance	C_{in}		Full		5		pF
Input Current	I_{INL} or I_{INH}	V_{IN} = 0 or V+	Full	–1		1	µA
Dynamic Characteristics							
Turn-On Time	t_{ON}	V+ = 3.6 V V_{NO} or V_{NC} = 1.5 V, R_L = 50 Ω, C_L = 35 pF	Room Full		85	110 140	ns
Turn-Off Time	t_{OFF}		Room Full		17	30 35	
Break-Before-Make Time	t_{BBM}		Full	10			
Charge Injection[d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω	Room		9		pC
Off-Isolation[d]	O_{IRR}	R_L = 50 Ω, C_L = 5 pF, f = 100 kHz	Room		–75		dB
Crosstalk[d]	X_{TALK}		Room		–75		
N_O, N_C Off Capacitance[d]	$C_{NO(off)}$	V_{IN} = 0 or V+, f = 1 MHz	Room		104		pF
	$C_{NC(off)}$		Room		104		
Channel On Capacitance[d]	$C_{NO(on)}$		Room		230		
	$C_{NC(on)}$		Room		230		
Power Supply							
Power Supply Range	V+			2.7		3.3	V
Power Supply Current	I+	V_{IN} = 0 or V+	Full			1.0	µA
Turn-On Time DG2733 (EN)	$t_{ON(EN)}$	V+ = 3.6 V V_{NO} or V_{NC} = 1.5 V, R_L = 50 Ω, C_L = 35 pF	Room Full		79	105 135	ns
Turn-Off Time DG2733 (EN)	$t_{OFF(EN)}$		Room Full		17	29 35	

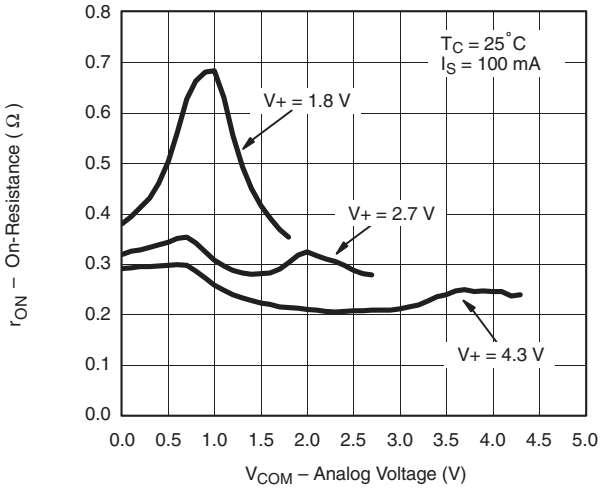
SPECIFICATIONS (V+ = 4.3 V)

Parameter	Symbol	Test Condition Otherwise Unless Specified V+ = 4.3 V, V_{IN} = 0.5 or 1.6 V[e]	Temp[a]	Limits –40 to 85°C Min[b]	Typ[c]	Max[b]	Unit
Analog Switch							
Analog Signal Range[d]	V_{NO}, V_{NC}, V_{COM}		Full	0		V+	V
On-Resistance	r_{ON}	V+ = 4.3 V, V_{COM} = 0.9 V, I_{NO}, I_{NC} = 100 mA	Room		0.29	0.4	Ω
		V+ = 4.3 V, V_{COM} = 2.5 V, I_{NO}, I_{NC} = 100 mA			0.21		
			Full			0.55	
r_{ON} Match[d]	Δr_{ON}	V+ = 4.3 V, V_{COM} = 0. 9 to 2.5 V+, I_{NO}, I_{NC} = 100 mA	Room		0.03	0.06	
Switch Off Leakage Current[d]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 4.3 V, V_{NO}, V_{NC} = 0.3 V / 4.0 V, V_{COM} = 4.0 V / 0.3 V	Full	–20		20	nA
	$I_{COM(off)}$		Full	–20		20	
Channel-On Leakage Current[d]	$I_{COM(on)}$	V+ = 4.3 V, V_{NO}, V_{NC} = V_{COM} = 3.0 V / 4.0 V	Full	–20		20	
Digital Control							
Input High Voltage	V_{IN}		Full	1.6			V
Input Low Voltage	V_{INL}		Full			0.5	
Input Capacitance	C_{in}		Full		–4		pF
Input Current	I_{INL} or I_{INH}	V_{IN} = 0 or V+	Full	–1		1	µA
Dynamic Characteristics							
Break-Before-Make Time	t_{BBM}	V_{NO} or V_{NC} = 1.5 V, R_L = 50 Ω, C_L = 35 pF	Full	5			ns
Power Supply							
Power Supply Range	V+					4.3	V
Power Supply Current	I+	V_{IN} = 0 or V+	Full			1.0	µA

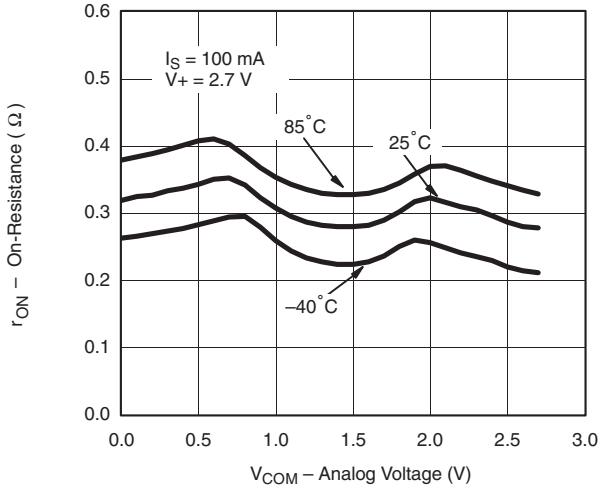
Notes
a. Room = 25°C, Full = as determined by the operating suffix.
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c. Typical values are for design aid only, not guaranteed nor subject to production testing.
d. Guarantee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

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.

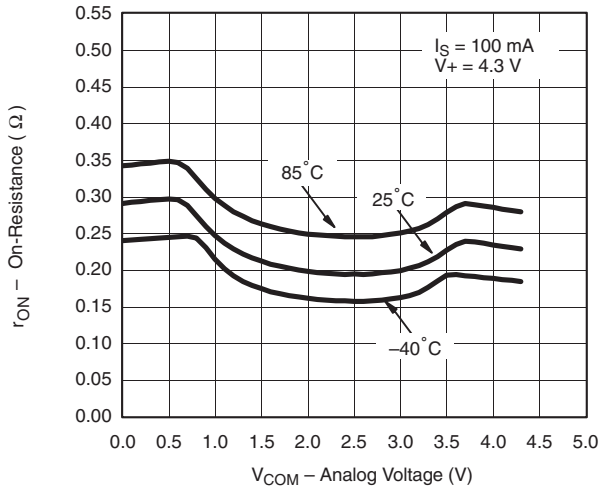
TYPICAL CHARACTERISTICS T_A = 25 °C, unless otherwise noted



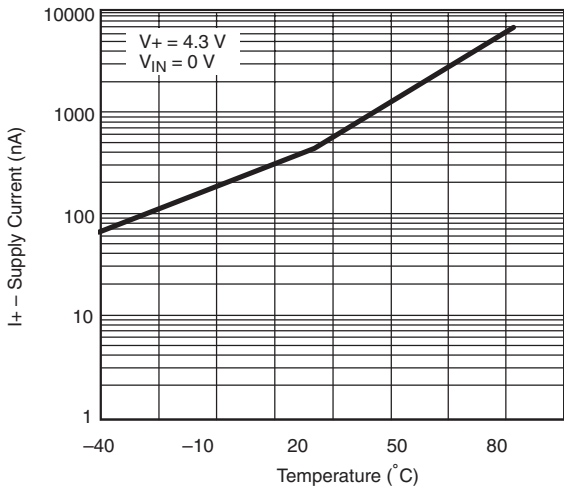
r_{ON} vs. V_{COM} and Supply Voltage



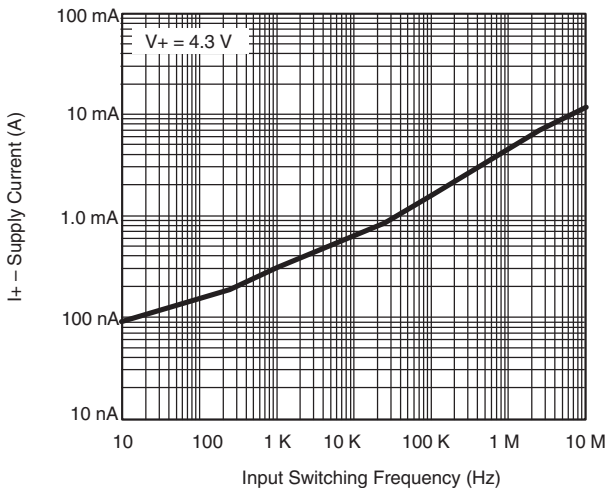
r_{ON} vs. Analog Voltage and Temperature



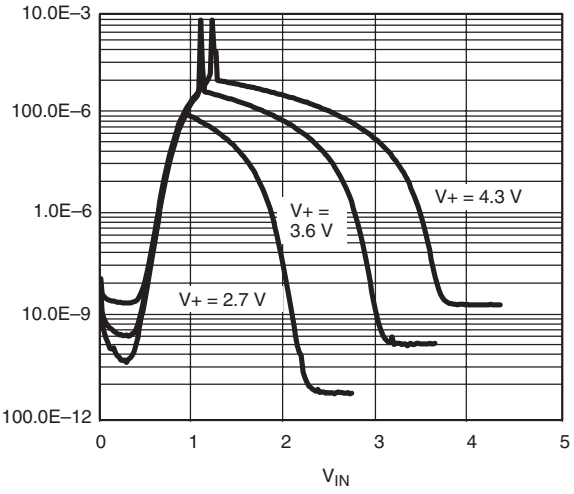
r_{ON} vs. Analog Voltage and Temperature



Supply Current vs. Temperature

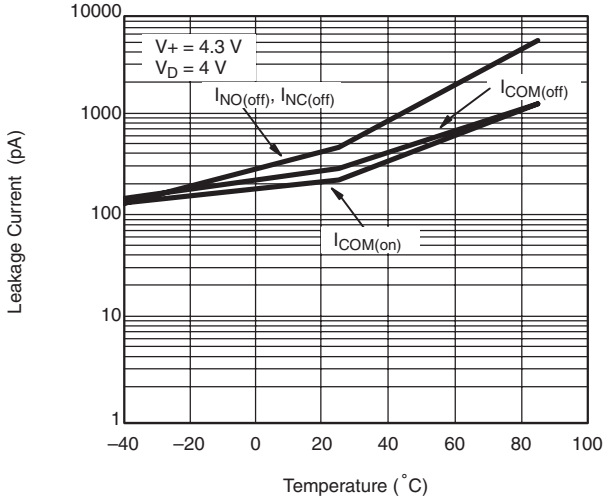


Supply Current vs. Input Switching Frequency

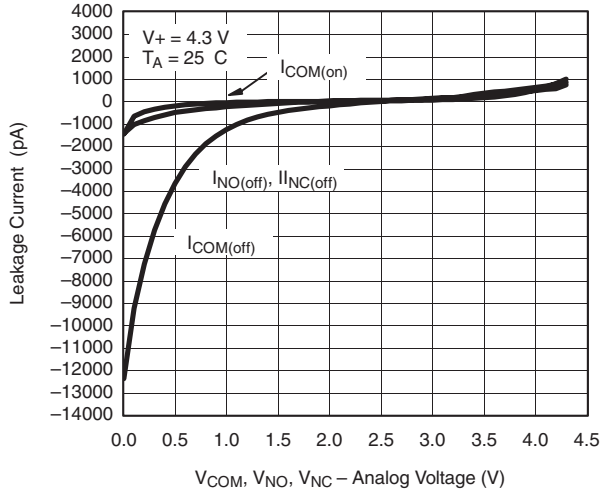


Supply Current vs. V_{IN}

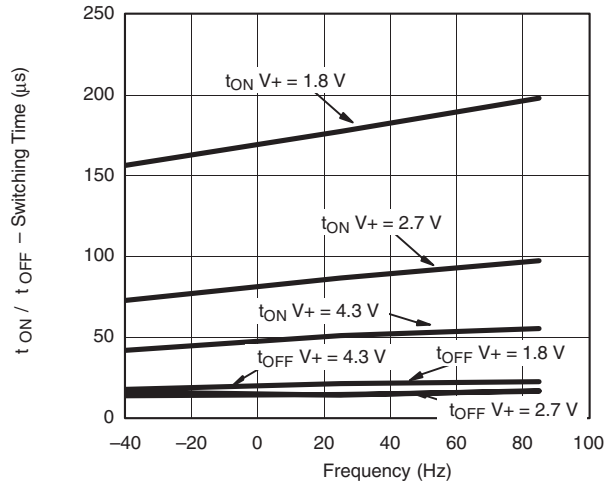
TYPICAL CHARACTERISTICS T_A = 25 °C, unless otherwise noted



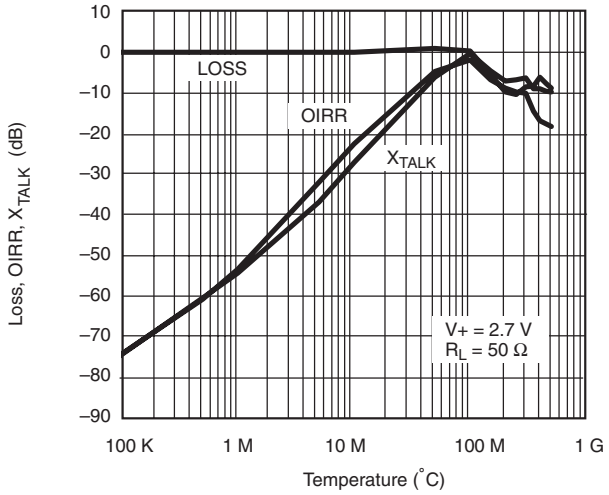
Leakage Current vs. Temperature



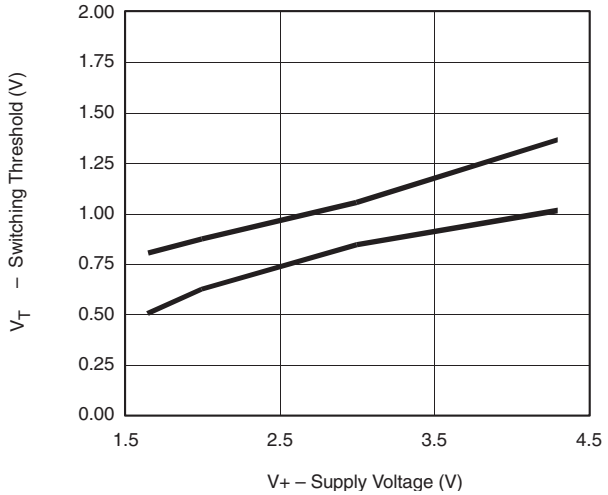
Leakage vs. Analog Voltage



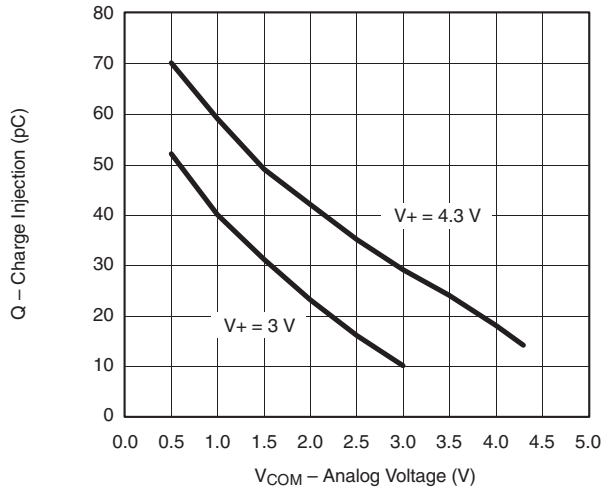
Switching Time vs. Temperature



Insertion Loss, Off-Isolation Crosstalk vs. Frequency

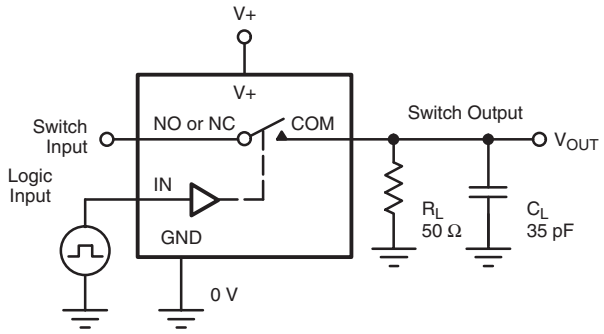


Switching Threshold vs. Supply Voltage



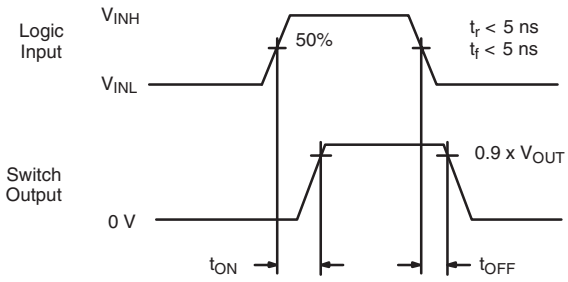
Charge Injection vs. Analog Voltage

TEST CIRCUITS



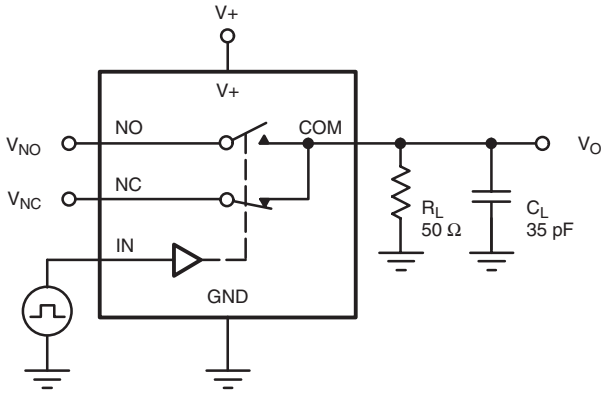
C_L (includes fixture and stray capacitance)

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



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

Figure 1. Switching Time



C_L (includes fixture and stray capacitance)

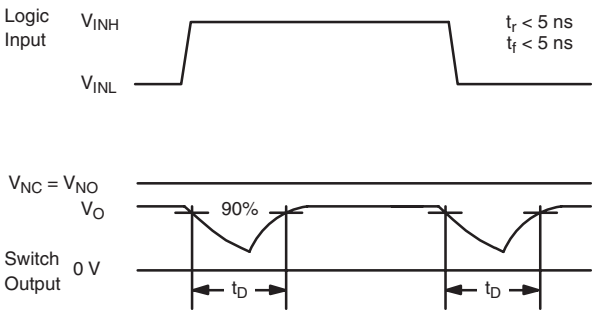
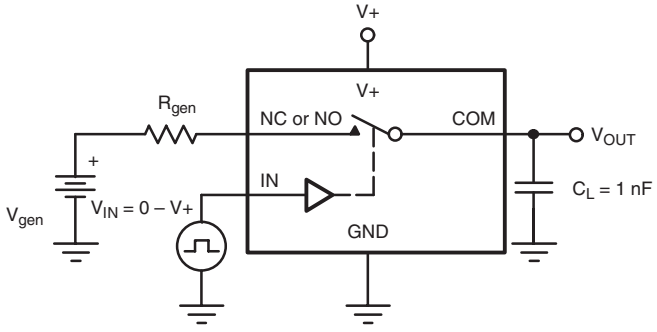
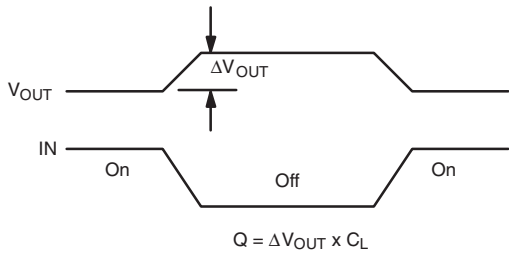


Figure 2. Break-Before-Make Interval





$Q = \Delta V_{OUT} \times C_L$

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

Figure 3. Charge Injection

TEST CIRCUITS

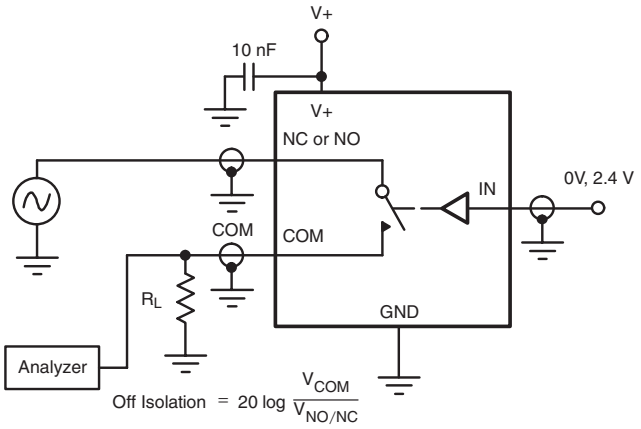


Figure 4. Off-Isolation

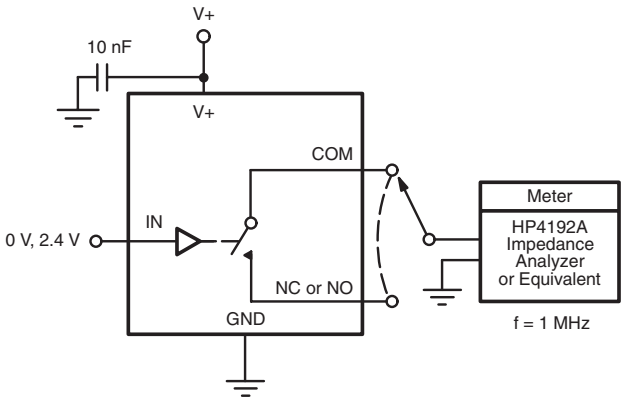


Figure 5. Channel Off/On Capacitance

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