

Low Voltage, Low On-Resistance, Dual DPDT Analog Switch

DESCRIPTION

The DG2799 is a dual double-pole/double-throw monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low power, high speed, low on-resistance and small physical size, the DG2799 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG2799 is built on Vishay Siliconix's low voltage process. An epitaxial layer prevents latchup. Break-before-make is guaranteed.

The switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

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 in QFN packages, the lead (Pb)-free "-E3/E4" only suffix is being used as a designator. Lead (Pb)-free QFN products purchased at any time will have either a nickel-palladium-gold device termination or a 100 % matte tin device termination. The different lead (Pb)-free materials are interchangeable and meet all JEDEC standards for reflow and MSL rating.

FEATURES

- Low Voltage Operation (1.65 V to 4.3 V)
- Low On-Resistance - r_{ON} : 0.25 Ω @ 2.7 V
- Fast Switching: t_{ON} = 28 ns
 t_{OFF} = 17 ns
- QFN-16 (3 x 3) Package
- Latch-Up Current > 300 mA (JESD78)

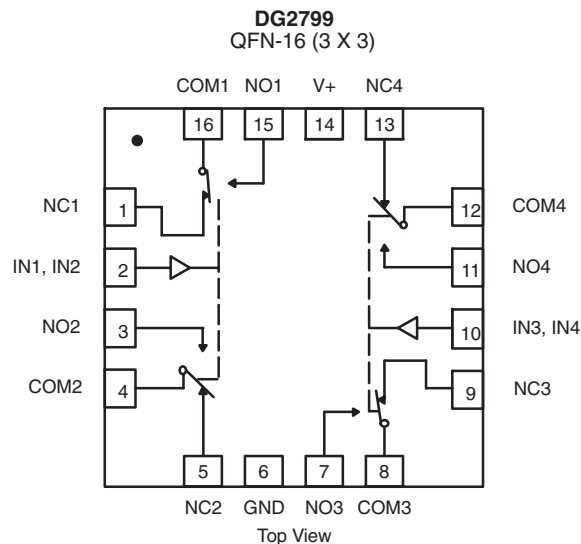
BENEFITS

- Reduced Power Consumption
- High Accuracy
- Reduce Board Space
- TTL/1.8-V Logic Compatible
- High Bandwidth

APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



NOTE:

Underside exposed pad has no device electrical connection. It is recommended that no electrical connection is made to it.

TRUTH TABLE		
Logic	NC1, 2, 3 and 4	NO1, 2, 3 and 4
0	ON	OFF
1	OFF	ON

ORDERING INFORMATION		
Temp Range	Package	Part Number
-40 to 85°C	16-Pin QFN (3 x 3 mm) Variation 2	DG2799DN-T1—E4

ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$, 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)			± 300	
Peak Current (Pulsed at 1 ms, 10 % duty cycle)			± 500	
Storage Temperature (D Suffix)			-65 to 150	$^\circ\text{C}$
Package Solder Reflow Conditions ^d	16-Pin QFN (3 x 3 mm)		250	
Power Dissipation (Packages) ^b	QFN-16 ^c		1385	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 17.3 mW/ $^\circ\text{C}$ above 70°C

d. 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, VIN = 0.4 or 1.1 V ^e	Temp ^a	Limits −40 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+ = 1.8 V, VCOM = 0.2 V, INO, INC = 100 mA	Room		0.35	1.3	Ω
		V+ = 1.8 V, VCOM = 0.9 V, INO, INC = 100 mA			0.45		
			Full			1.4	
Digital Control							
Input High Voltage	VINH		Full	1.1			V
Input Low Voltage	VINL		Full			0.4	
Input Capacitance	Cin		Full		6		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	Romm Full		62	94 97	ns
Turn-Off Time	tOFF		Room Full		24	52 55	
Break-Before-Make Time	td		Full	8			
Charge Injection ^d	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room		66		pC
Off-Isolation ^d	OIRR	RL = 50 Ω, CL = 5 pF, f = 100 kHz	Room		−74		dB
Crosstalk ^d	XTALK		Room		−74		
NO, NC Off Capacitance ^d	CNO(off)	VIN = 0 or V+, f = 1 MHz	Room		108		pF
	CNC(off)		Room		108		
Channel-On Capacitance ^d	CNO(on)		Room		240		
	CNC(on)		Room		240		
Power Supply							
Power Supply Current	I+	VIN = 0 or V+	Full			1.0	μA



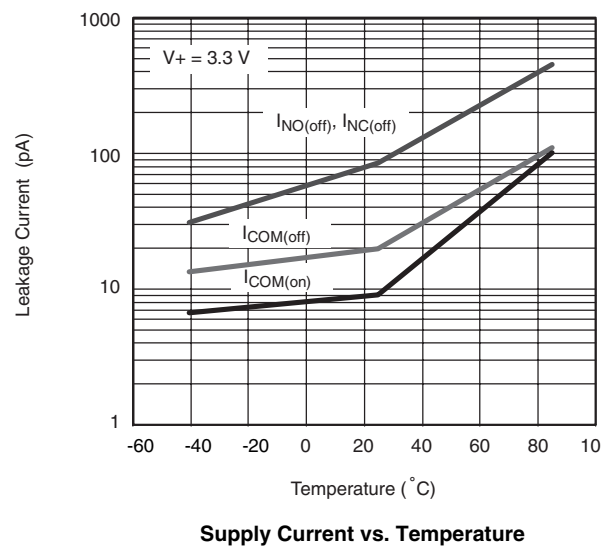
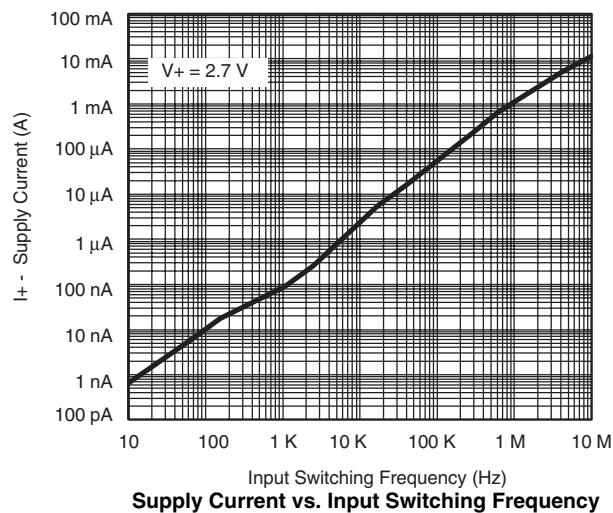
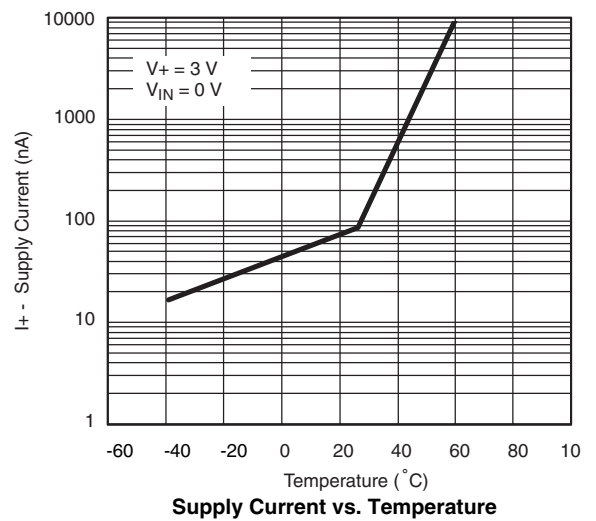
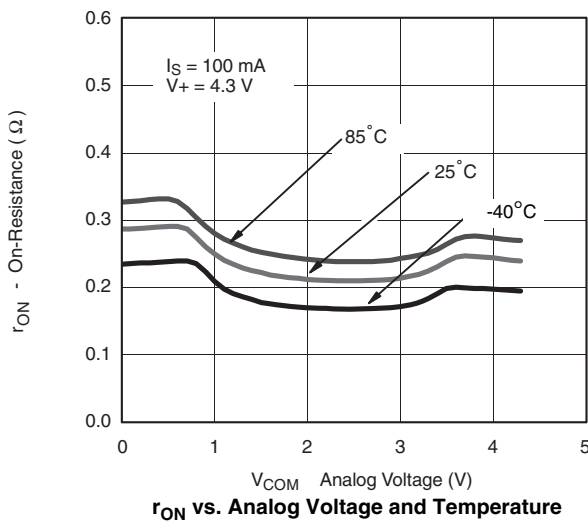
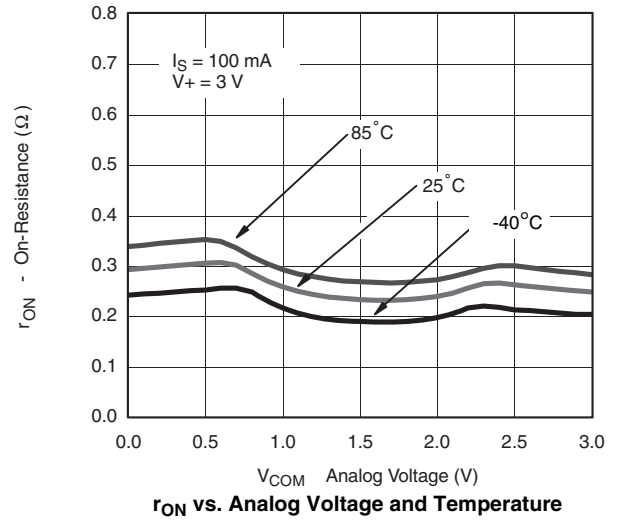
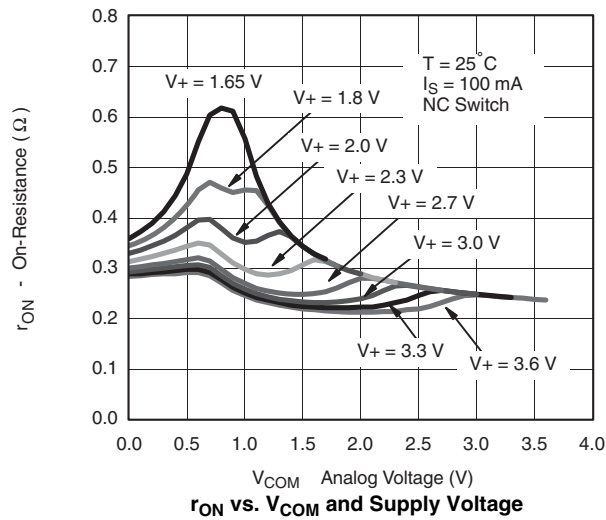
SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Condition Otherwise Unless Specified V+ = 3 V, ±10 %, V _{IN} = 0.5 or 1.4 V ^e	Temp ^a	Limits –40 to 85°C			Unit
				Min ^b	Typ ^c	Max ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} , V _{COM}		Full	0		V+	V
On-Resistance	r _{ON}	V+ = 2.7 V, V _{COM} = 0.2 V, I _{NO} , I _{NC} = 100 mA	Room		0.3	0.45	Ω
		V+ = 2.7 V, V _{COM} = 1.5 V, I _{NO} , I _{NC} = 100 mA			0.25		
			Full			0.55	
r _{ON} Flatness ^d	r _{ON} Flatness	V+ = 2.7 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 100 mA	Room		0.07	0.15	
r _{ON} Match ^d	Δr _{ON}		Room		0.05		
Switch Off Leakage Current	I _{NO(off)} , I _{NC(off)}	V+ = 3.3 V, V _{NO} , V _{NC} = 0.3 V / 3.0 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} = 0.3 V / 3.0 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		6		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 _{NO} or V _{NC} = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Romm Full		28	57 60	ns
Turn-Off Time	t _{OFF}		Room Full		17	45 47	
Break-Before-Make Time	t _d		Full	1			
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room		160		pC
Off-Isolation ^d	OIRR	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		102		pF
	C _{NC(off)}		Room		102		
Channel-On Capacitance ^d	C _{NO(on)}		Room		234		
	C _{NC(on)}		Room		234		
Power Supply							
Power Supply Range	V+			2.7		3.3	V
Power Supply Current	I+	V _{IN} = 0 or V+	Full			1.0	μA

SPECIFICATIONS (V+ = 4.3 V)								
Parameter	Symbol	Test Condition Otherwise Unless Specified V+ = 4.3 V, VIN = 0.5 or 1.6 V ^e	Temp ^a	Limits –40 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+ = 4.3 V, VCOM = 0.5 V, INO, INC = 100 mA	Room		0.29	0.43	Ω	
		V+ = 4.3 V, VCOM = 2.1 V, INO, INC = 100 mA			0.21			
			Full			0.53		
rON Flatness ^d	rON Flatness	V+ = 4.3 V, VCOM = 0 to V+, INO, INC = 100 mA	Room		0.07	0.15		
rON Match ^d	ΔrON		Room		0.05			
Switch Off Leakage Current ^d	INO(off), INC(off)	V+ = 4.3 V, VNO, VNC = 0.3 V / 4.0 V, VCOM = 4.0 V / 0.3 V	Room Full	–10 –100		10 100	nA	
	ICOM(off)		Room Full	–10 –100		10 100		
Channel-On Leakage Current ^d	ICOM(on)	V+ = 4.3 V, VNO, VNC = VCOM = 3.0 V / 4.0 V	Room Full	–10 –100		10 100		
Digital Control								
Input High Voltage	VINH		Full	1.6			V	
Input Low Voltage	VINL		Full			0.5		
Input Capacitance	Cin		Full		6		pF	
Input Current	ILINL or IINH	VIN = 0 or V+	Full	–1		1	μA	
Dynamic Characteristics								
Charge Injection ^d	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room		320		pC	
Off-Isolation ^d	OIRR	RL = 50 Ω, CL = 5 pF, f = 100 kHz	Room		–73		dB	
Crosstalk ^d	XTALK		Room		–73			
NO, NC Off Capacitance ^d	CNO(off)	VIN = 0 or V+, f = 1 MHz	Room		100		pF	
	CNC(off)		Room		100			
Channel-On Capacitance ^d	CNO(on)		Room		230			
	CNC(on)		Room		230			
Power Supply								
Power Supply Range	V+					4.3	V	
Power Supply Current	I+	VIN = 0 or V+	Full			1.0	μA	

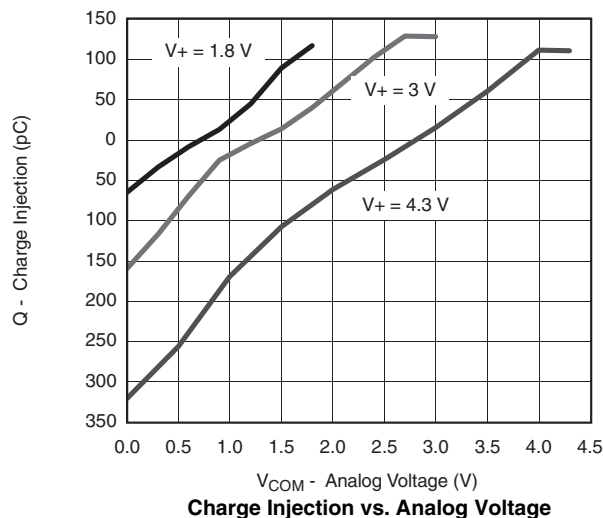
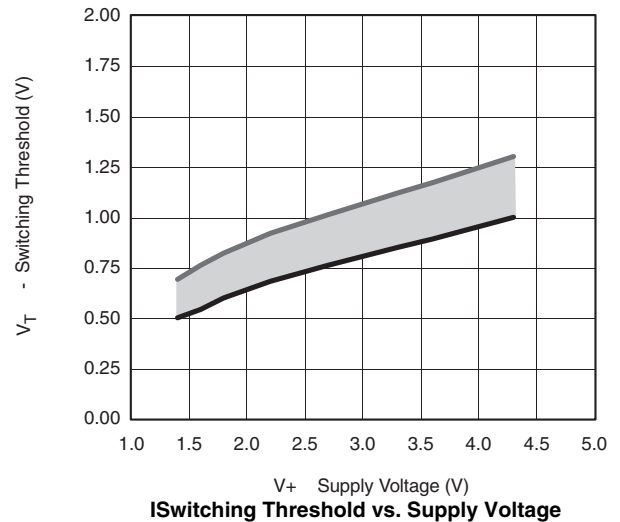
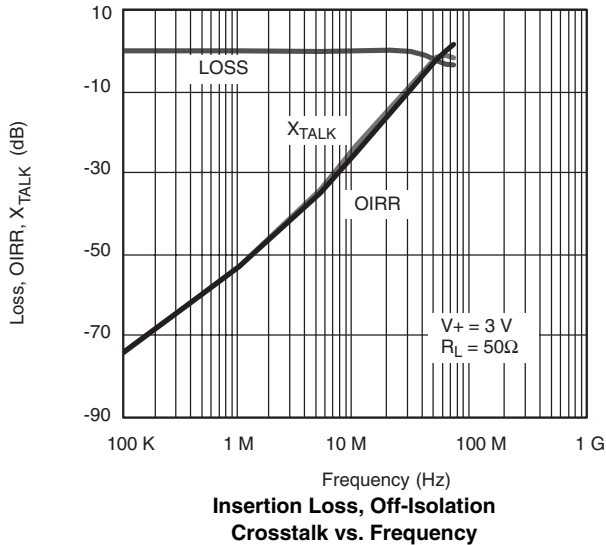
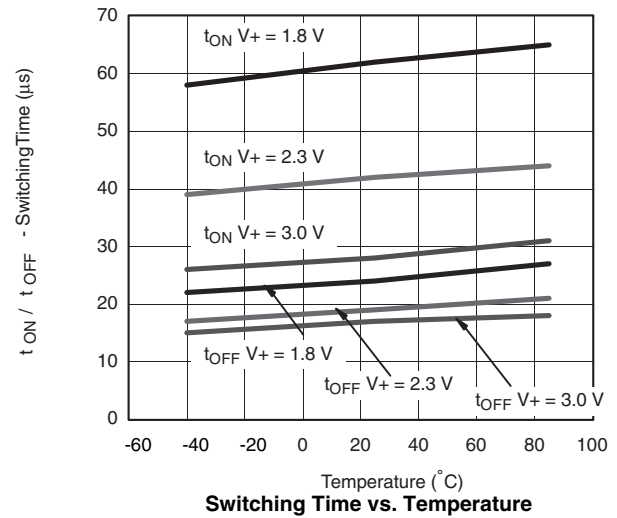
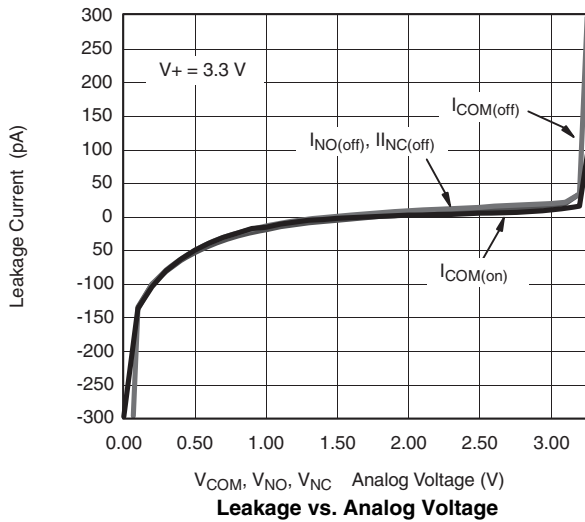
Notes

- 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.

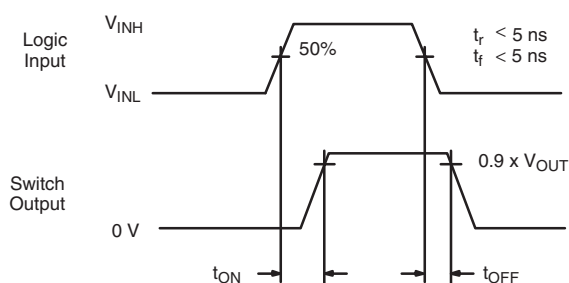
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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


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The diagram shows a 74VHC14 inverter. The input is connected to a square wave pulse source through a 50 Ω resistor. The output is connected to a load consisting of a 50 Ω resistor and a 35 pF capacitor in parallel. The input and output waveforms are shown as square waves. The input signal is labeled 'Switch Input' and the output is labeled 'Switch Output'. The input signal is a square wave with a period of 10 ns and a pulse width of 5 ns. The output signal is a square wave with a period of 10 ns and a pulse width of 5 ns. The input signal is labeled 'Switch Input' and the output is labeled 'Switch Output'. The input signal is a square wave with a period of 10 ns and a pulse width of 5 ns. The output signal is a square wave with a period of 10 ns and a pulse width of 5 ns.

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


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

Logic Input

V_{IH}

V_{IL}

$t_r < 5 \text{ ns}$

$t_f < 5 \text{ ns}$

$V_{NC} = V_{NO}$

V_O

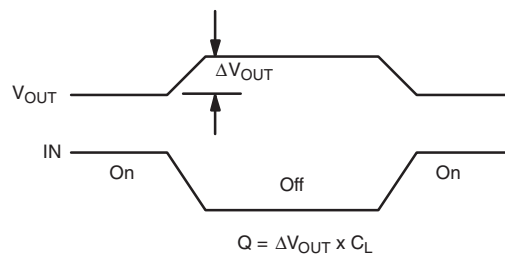
90%

Switch Output

0 V

t_D

The diagram shows a 1-bit DAC circuit. An analog multiplexer (MUX) is used to select between different input voltages. The select input 'IN' is driven by a square wave. The common output 'COM' is connected to a load capacitor $C_L = 1 \text{ nF}$. The normally closed input 'NC or NO' is connected to a resistor R_{gen} and a voltage source V_{gen} . The output voltage is V_{OUT} . The MUX is also connected to V_+ and GND.



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

Figure 3. Charge Injection

TEST CIRCUITS

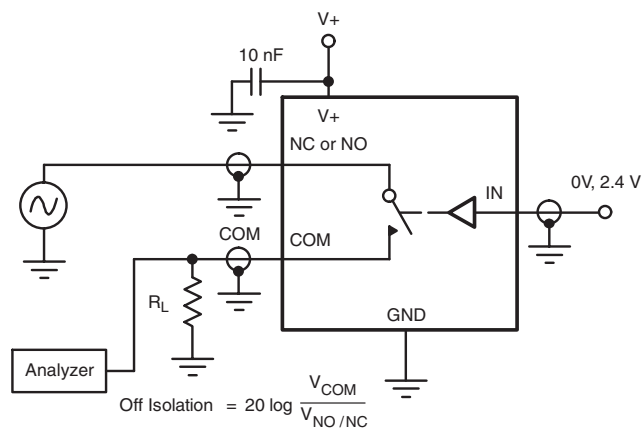


Figure 4. Off-Isolation

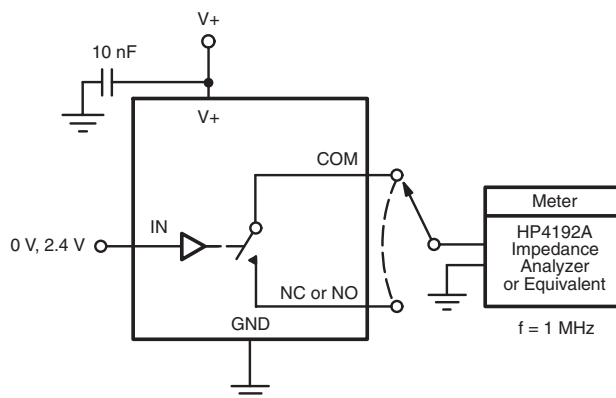


Figure 5. Channel Off/On Capacitance

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