Single 4 x 1 and Dual 2 x 1 Multiplexers

FEATURES

- Low Voltage Operation (+2.7 to +12 V)
- Low On-Resistance - $r_{DS(on)}$: 14 Ω
- Low Power Consumption
- TTL Compatible
- ESD Protection >2000 V (Method 3015.7)
- Available in TSSOP-10 (aka MSOP-10)

BENEFITS

- High Accuracy
- Simple Logic Interface
- Reduce Board Space

APPLICATIONS

- Battery Operated Systems
- Portable Test Equipment
- Sample and Hold Circuits
- Cellular Phones
- Communication Systems
- Networking Equipment

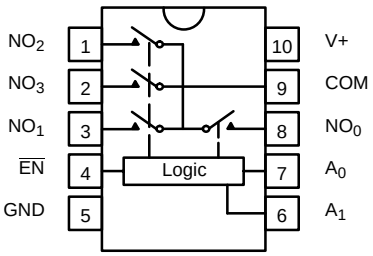
DESCRIPTION

The DG9414, a single 4 to 1 multiplexer, and the DG9415, a dual 2 x 1 multiplexer, are monolithic CMOS analog devices designed for high performance low voltage operation. Combining low power, high speed, low on-resistance and small physical size, the DG9414 and DG9415 are ideal for portable and battery powered applications requiring high performance and efficient use of board space.

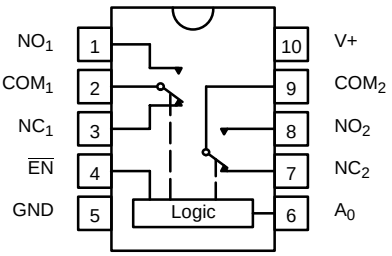
Both the DG9414 and DG9415 are built on Vishay Siliconix's low voltage BCD-15 process. Minimum ESD protection, per Method 3015.7, is 2000 volts. An epitaxial layer prevents latchup. Break-before-make is guaranteed for DG9415.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG9414DQ



DG9415DQ



EN	A_1	A_0	ON SWITCH
1	X	X	None
0	0	0	NO_0
0	0	1	NO_1
0	1	0	NO_2
0	1	1	NO_3

X = Don't Care

EN	A_0	ON SWITCH
1	X	None
0	0	NC_1 NC_2
0	1	NO_1 NO_2

X = Don't Care

ORDERING INFORMATION		
Temp Range	**Package**	**Part Number**
-40 to 85°C	MSOP-10	DG9414DQ
		DG9415DQ

ABSOLUTE MAXIMUM RATINGS

Reference to GND
V+ ..... -0.3 to +13 V
IN, COM, NC, NO[a] ..... -0.3 to (V+ + 0.3 V)
Continuous Current (Any terminal) ..... ±20 mA
Peak Current ..... ±40 mA
(Pulsed at 1ms, 10% duty cycle)

ESD (Method 3015.7) ..... > 2000 V
Storage Temperature (D Suffix) ..... -65 to 150°C
Notes:
a. Signals on S_X, D_X, or IN_X exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
b. All leads welded or soldered to PC Board.

SPECIFICATIONS (V+ = 3 V)

Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ±10%, V_{IN} = 0.4 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_{ANALOG}			Full	0		V+	V
On-Resistance	r_{ON}	V+ = 2.7 V, V_{COM} = 1.0 V/1.5 V/2.0 V I_{NO} or I_{NC} = 5 mA		Room Full		63	97 101	Ω
r_{ON} Match[d]	Δr_{ON}			Room		3	11	
r_{ON} Flatness[d, f]	r_{ON} Flatness			Room		14	33	
NO or NC Off Leakage Current[g]	$I_{NO/NC(off)}$	V+ = 3.3 V, V_{NO} or V_{NC} = 0.3 V / 3 V V_{COM} = 3 V / 0.3 V		Room Full	-1 -10		1 10	nA
COM Off Leakage Current[g]	$I_{COM(off)}$			Room Full	-1 -10		1 10	
Channel-On Leakage Current[g]	$I_{COM(on)}$	V+ = 3.3 V V_{COM} = V_{NO} or V_{NC} = 0.3 V / 3 V		Room Full	-1 -10		1 10	
Digital Control								
Input Current[g]	I_{INL} or I_{INH}	V_{IN} = 0 or V+		Full	-1.0		1.0	µA
Input High Voltage[d]	V_{INH}			Full	1.6			V
Input Low Voltage[d]	V_{INL}			Full			0.4	
Dynamic Characteristics								
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 1.5 V		Room Full		102	125 142	ns
Turn-Off Time	t_{OFF}			Room Full		45	68 75	
Break-Before-Make Time	t_D			Room	7	78		
Transition Time	t_{trans}	V_{NO} = 1.5 V/0 V, V_{NC} = 0 V/1.5 V		Room Full		81	128 144	
Charge Injection[d]	Q_{INJ}	C_L = 1 nF, Vgen = 0 V, Rgen = 0 Ω		Room		3		pC
Off-Isolation	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz		Room		-58		dB
Channel-to-Channel Crosstalk (DG9415)	X_{TALK}	R_L = 50 Ω, f = 1 MHz		Room		-64		
NO, NC Off Capacitance	$C_{NO(off)}$, $C_{NC(off)}$	f = 1 MHz	DG9414	Room		11		pF
			DG9415	Room		10		
COM Off Capacitance	$C_{COM(off)}$		DG9414	Room		26		
			DG9415	Room		13		
COM On Capacitance	$C_{COM(on)}$		DG9414	Room		43		
			DG9415	Room		25		
Power Supply								
Power Supply Range	V+				2.7		3.3	V
Power Supply Current[h]	I+	V+ = 3.3 V, V_{IN} = 0 or 3.3 V		Full			1.0	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. Difference of min and max values.
g. Guaranteed by 12-V leakage testing, not production tested.
h. Guaranteed by worst case test conditions and not subject to test.

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_{ANALOG}			Full	0		V+	V
On-Resistance	r_{ON}	V+ = 4.5 V, V_{COM} = 1.5 V/2.5 V/3.5 V, I_{NO} or I_{NC} = 10 mA		Room Full		33	56 60	Ω
r_{ON} Match	Δr_{ON}			Room		2	10	
r_{ON} Flatness[f]	r_{ON} Flatness			Room		10	20	
NO or NC Off Leakage Current[g]	$I_{NO/NC(off)}$	V+ = 5.5 V, V_{NO} or V_{NC} = 1 V / 4.5 V, V_{COM} = 4.5 V / 1 V		Room Full	-1 -10		1 10	nA
COM Off Leakage Current[g]	$I_{COM(off)}$			Room Full	-1 -10		1 10	
Channel-On Leakage Current[g]	$I_{COM(on)}$	V+ = 5.5 V, V_{COM} = V_{NO} or V_{NC} = 1 V / 4.5 V		Room Full	-1 -10		1 10	
Digital Control								
Input Current[h]	I_{INL} or I_{INH}	V_{IN} = 0 or V+		Full	-1.0		1.0	µA
Input High Voltage[d]	V_{INH}			Full	1.8			V
Input Low Voltage[d]	V_{INL}			Full			0.6	
Dynamic Characteristics								
Turn-On Time[h]	t_{ON}	V_{NO} or V_{NC} = 3.0 V		Room Full		56	77 86	ns
Turn-Off Time[h]	t_{OFF}			Room Full		25	46 50	
Break-Before-Make Time[h]	t_D			Room	7	34		
Transition Time	t_{trans}	V_{NO} = 3 V/0 V, V_{NC} = 0 V/3 V		Room Full		47	77 84	ns
Off-Isolation	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz		Room		-58		dB
Channel-to-Channel Crosstalk (DG9415)	X_{TALK}	R_L = 50 Ω, f = 1 MHz		Room		-64		
Charge Injection[d]	Q_{INJ}	C_L = 1 nF, V_{gen} = 0 V, R_{gen} = 0 Ω		Room		6		pC
NO, NC Off Capacitance	$C_{NO(off)}$, $C_{NC(off)}$	f = 1 MHz	DG9414	Room		11		pF
			DG9415	Room		10		
COM Off Capacitance	$C_{COM(off)}$		DG9414	Room		25		
			DG9415	Room		13		
COM On Capacitance	$C_{COM(on)}$		DG9414	Room		42		
			DG9415	Room		24		
Power Supply								
Power Supply Range	V+				4.5		5.5	V
Power Supply Current[h]	I+	V+ = 5.5 V, V_{IN} = 0 or 5.5 V		Full			1.0	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. Difference of min and max values.
g. Guaranteed by 12-V leakage testing, not production tested.
h. Guaranteed by worst case test conditions and not subject to test.

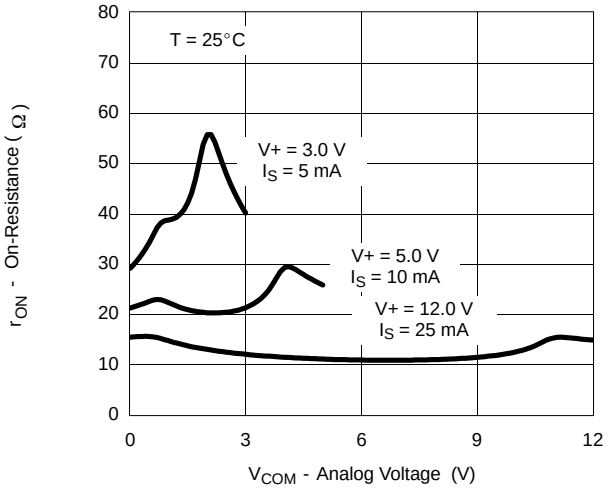
SPECIFICATIONS (V+ = 12 V)

Parameter	Symbol	Test Conditions Unless Specified V+ = 12 V, V_{IN} = 0.8 V, 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_{ANALOG}			Full	0		12	V
r_{ON} Match	Δr_{ON}			Room		1	9	Ω
r_{ON} Flatness[d, f]	r_{ON} Flatness			Room		1	10	Ω
On-Resistance	r_{ON}	V+ = 10.8 V, I_{NO}, I_{NC} = 25 mA, V_{COM} = 2/9 V		Room Full		14	17 19	Ω
Switch Off Leakage Current	$I_{NO(off)}$, $I_{NC(off)}$	V_{COM} = 1/11 V V_{NO}, V_{NC} = 11/1 V		Room Full	-1 -10		1 10	nA
	$I_{COM(off)}$			Room Full	-1 -10		1 10	nA
Channel On Leakage Current	$I_{COM(on)}$	V_{NO}, V_{NC} = V_{COM} = 11/1 V		Room Full	-1 -10		1 10	nA
Digital Control								
Input Current	I_{INL} or I_{INH}	V_{IN} = 0 or V+		Full	-1		1	µA
Input High Voltage[d]	V_{INH}			Full	2.4			V
Input Low Voltage[d]	V_{INL}			Full			0.8	V
Dynamic Characteristics								
Turn-On Time[h]	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_{NO}, V_{NC} = 5 V See Figure 2		Room Full		33	55 59	ns
Turn-Off Time[h]	t_{OFF}			Room Full		17	40 41	ns
Break-Before-Make Time Delay[h]	t_D	DG419L Only, V_{NC}, V_{NO} = 5 V R_L = 300 Ω, C_L = 35 pF		Room	2	24		ns
Transition Time	t_{trans}	V_{NO} = 5 V/0 V, V_{NC} = 0 V/5 V		Room Full		29	56 59	ns
Charge Injection[d]	Q_{INJ}	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF		Room		13		pC
Off Isolation[d]	OIRR	R_L = 50 Ω, C_L = 5 pF f = 1 MHz		Room		-58		dB
Channel-to-Channel Crosstalk[d]	X_{TALK}			Room		-64		dB
NO, NC Off Capacitance[d]	$C_{NO(off)}$, $C_{NC(off)}$	V_{IN} = 0 or V+, f = 1 MHz	DG9414	Room		10		pF
			DG9415	Room		10		pF
COM Off Capacitance	$C_{COM(off)}$		DG9414	Room		24		pF
			DG9415	Room		13		pF
COM On Capacitance[d]	$C_{COM(on)}$		DG9414	Room		40		pF
			DG9415	Room		23		pF
Power Supplies								
Positive Supply Current	I+	V_{IN} = 0 or 12 V		Full			1	µA

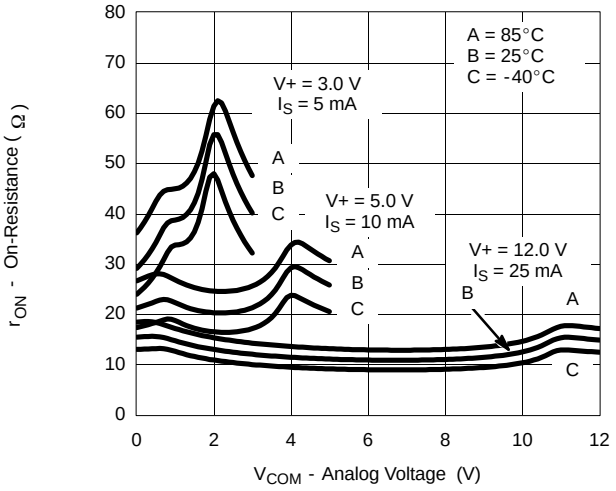
Notes:
a. Room = 25°C, Full = as determined by the operating suffix.
b. Typical values are for design aid only, not guaranteed nor subject to production testing.
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e. V_{IN} = input voltage to perform proper function.
f. Difference of min and max values.
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TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

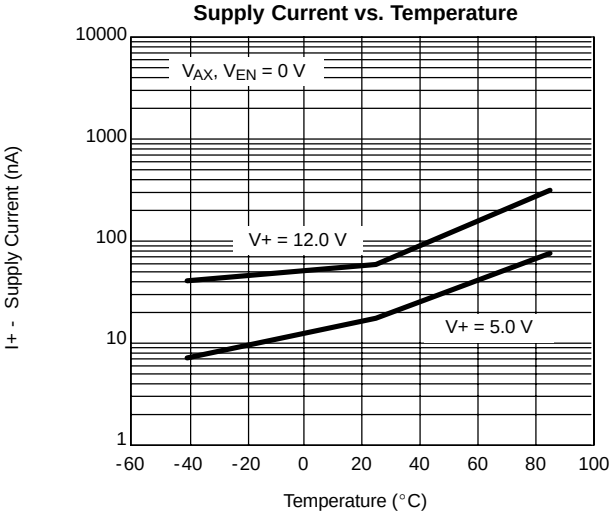
r_{ON} vs. V_{COM} and Supply Voltage



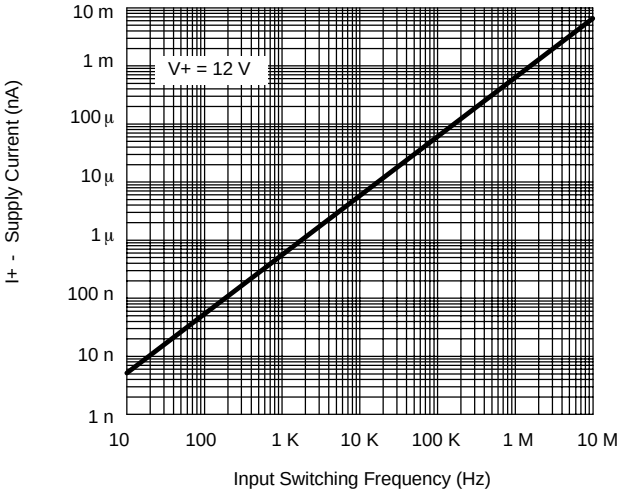
r_{ON} vs. Analog Voltage and Temperature



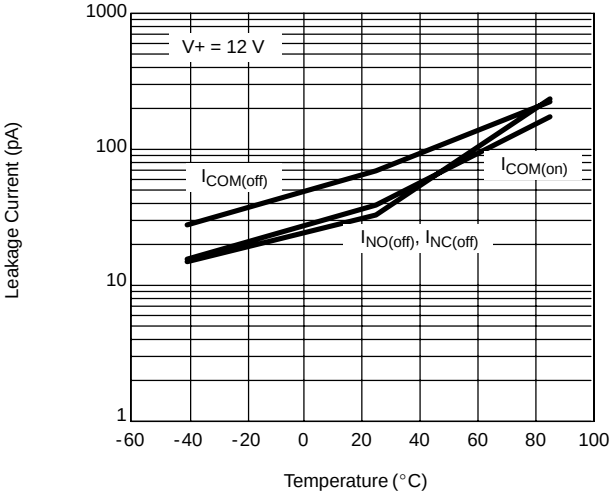
Supply Current vs. Temperature



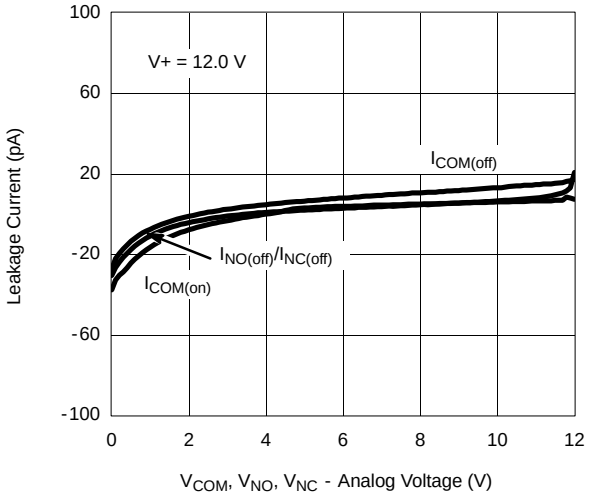
Supply Current vs. Input Switching Frequency



Leakage Current vs. Temperature

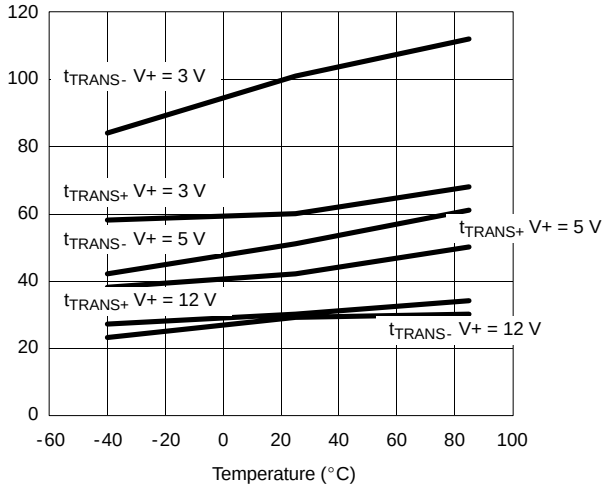


Leakage vs. Analog Voltage

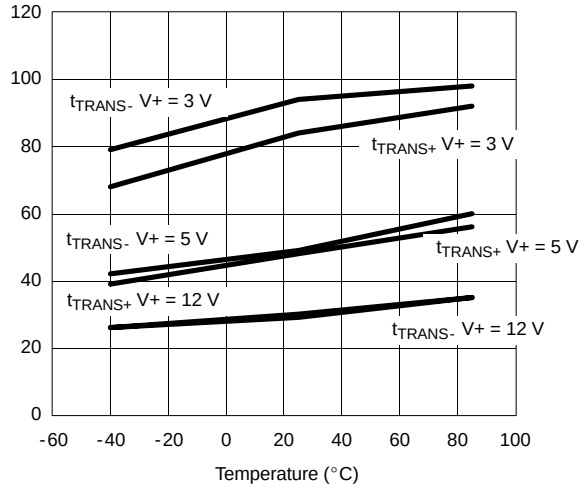


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

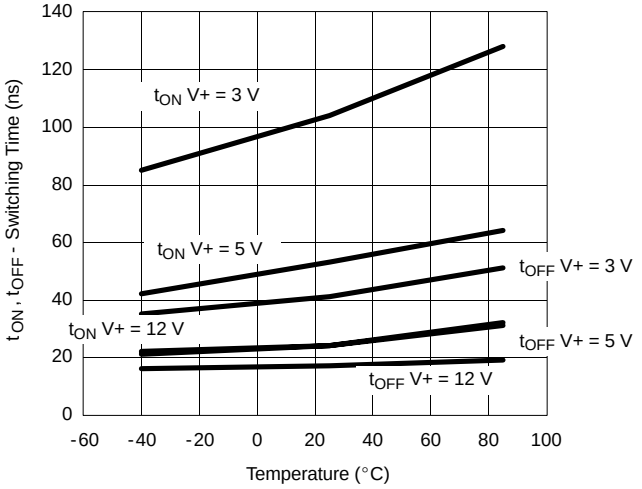
Transistion Time vs. Temperature (DG9414)



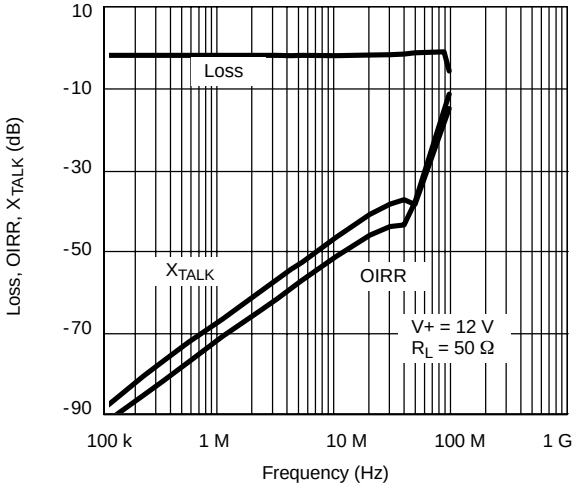
Transistion Time vs. Temperature (DG9415)



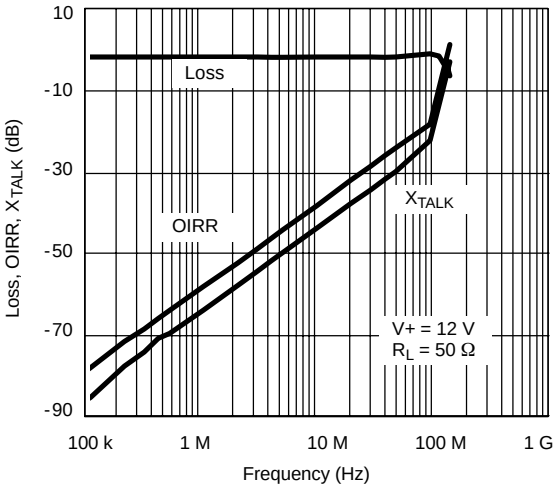
Switching Time vs. Temperature



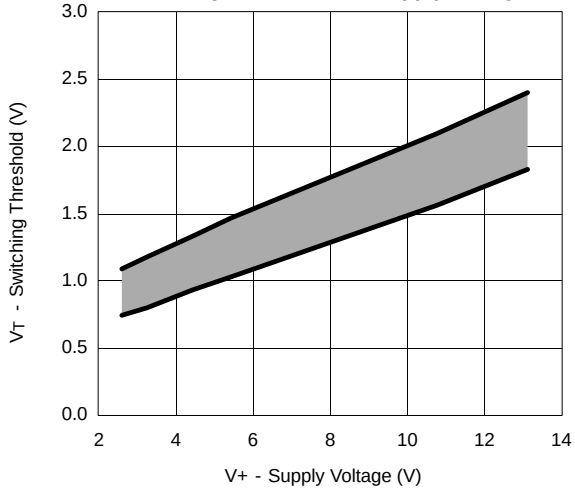
Insertion Loss, Off -Isolation Crosstalk vs. Frequency (DG9414)



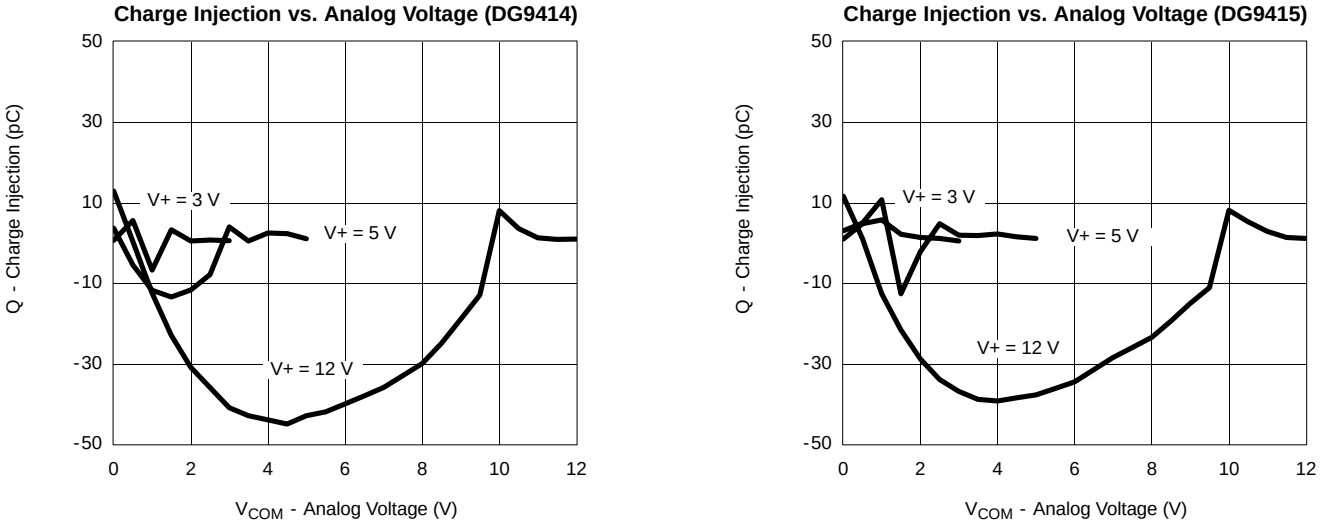
Insertion Loss, Off -Isolation Crosstalk vs. Frequency (DG9415)



Switching Threshold vs. Supply Voltage



TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

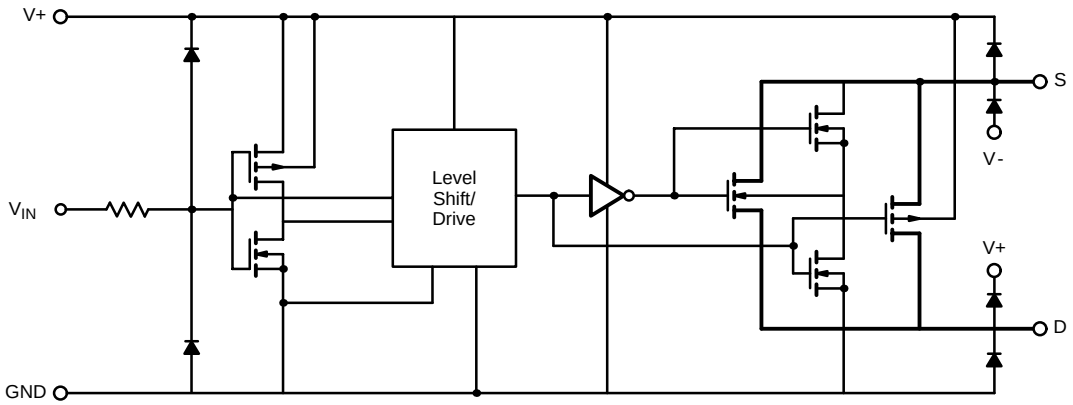
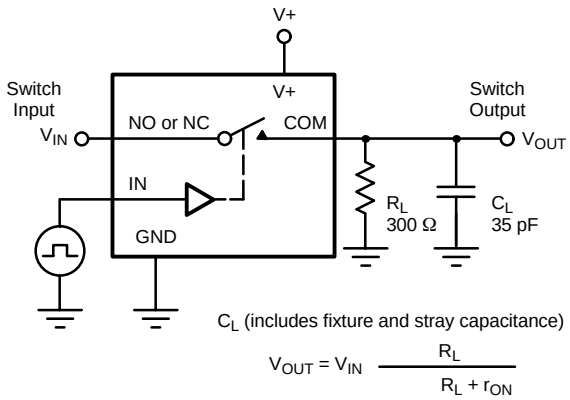
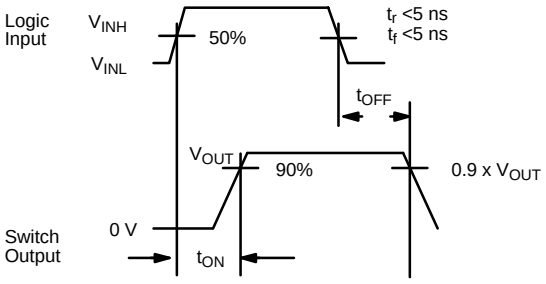


Figure 1.

TEST CIRCUITS

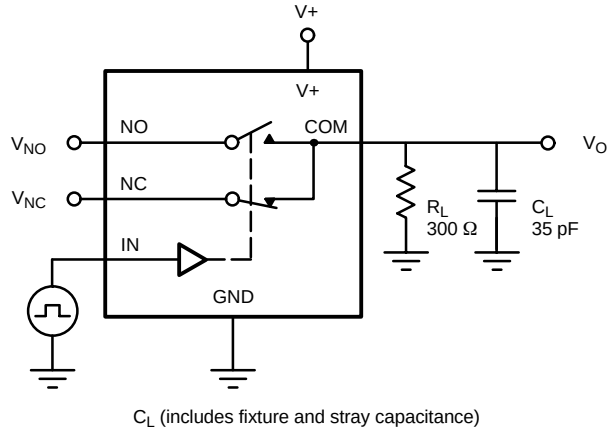




Note: Logic input waveform is inverted for switches that have the opposite logic sense control

Figure 2. Switching Time

TEST CIRCUITS



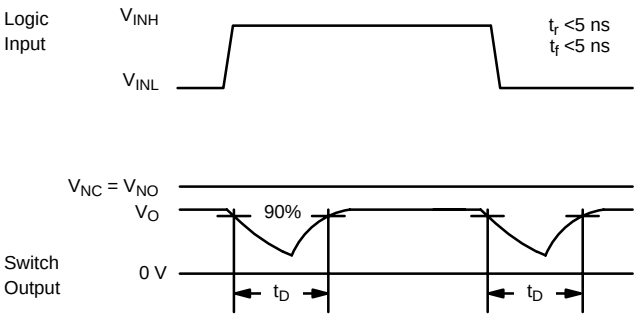
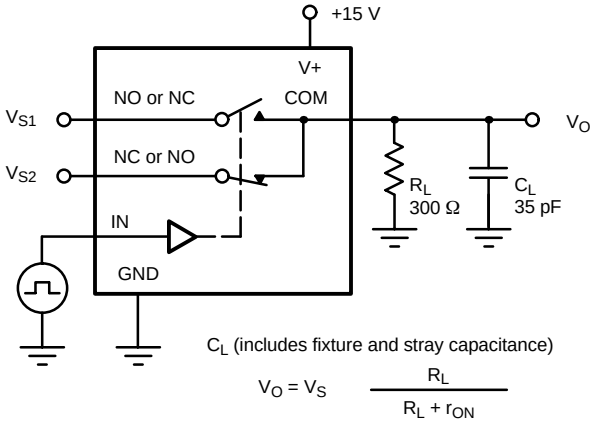


Figure 3. Break-Before-Make



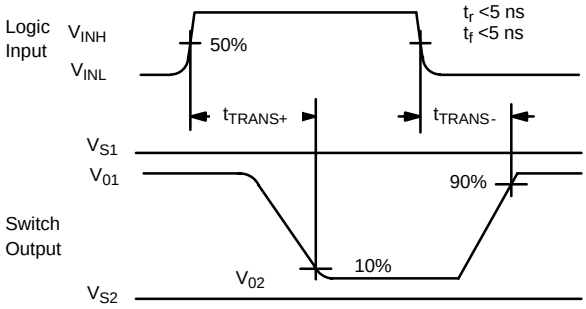
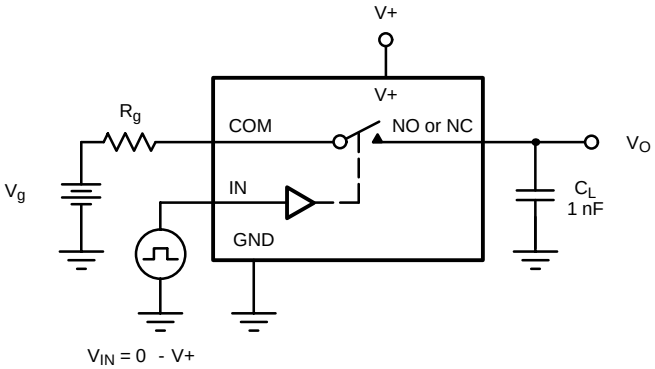
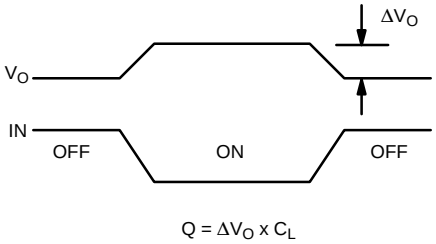


Figure 4. Transition Time





$Q = \Delta V_O \times C_L$

IN dependent on switch configuration Input polarity determined by sense of switch.

Figure 5. Charge Injection

TEST CIRCUITS

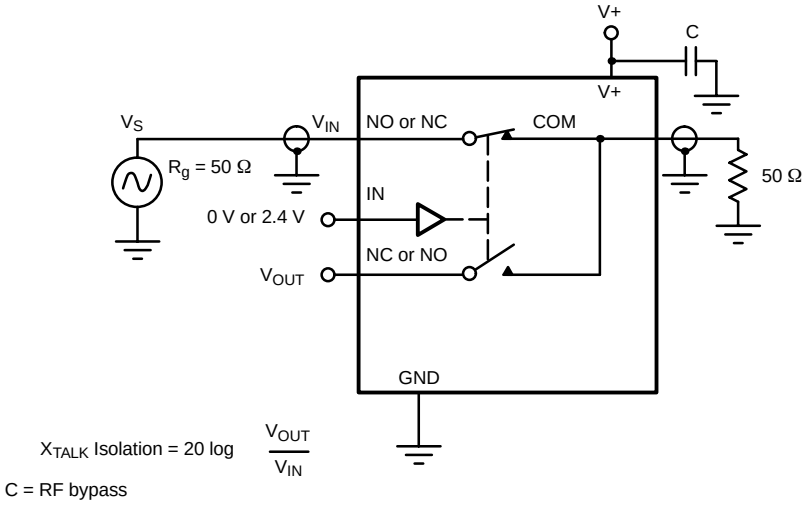


Figure 6. Crosstalk

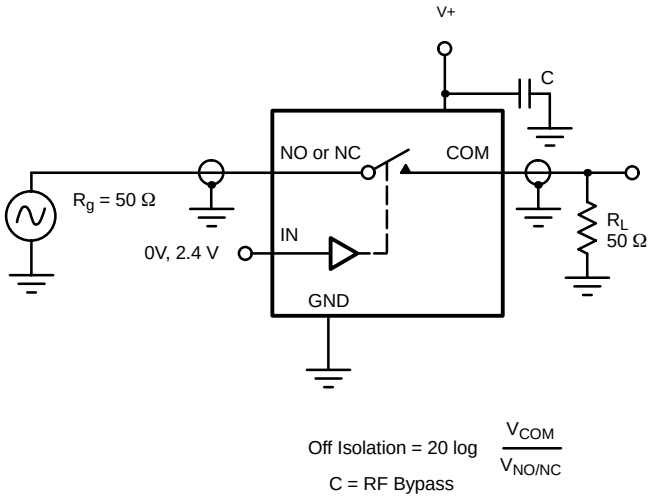


Figure 7. Off Isolation

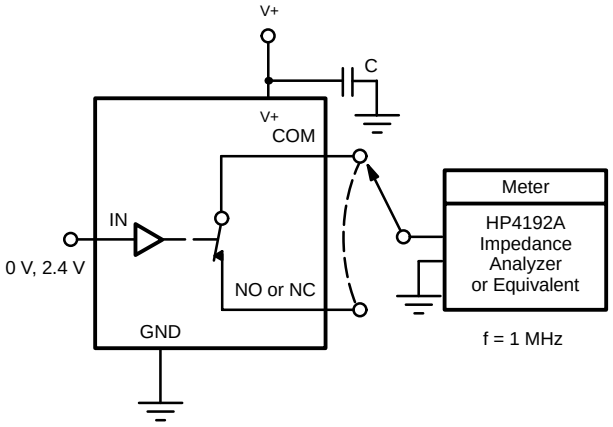


Figure 8. Source/Drain Capacitances