

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

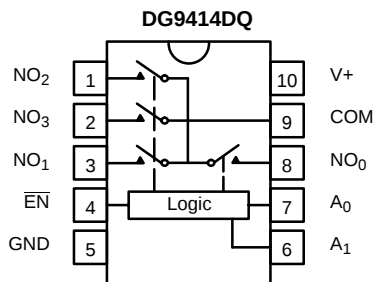
- Battery Operated Systems
- Portable Test Equipment
- Sample and Hold Circuits
- Cellular Phones
- Communication Systems
- Networking Equipment

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.

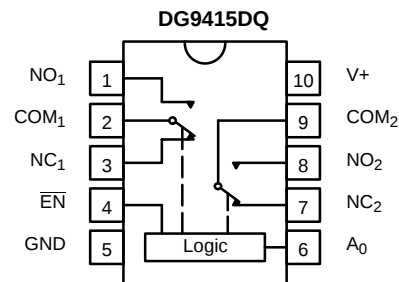
Both the DG9414 and DG9415 are built on Vishay Siliconix's low voltage BCD-15 process. Minimum ESD protection, per Method 3015.7, is 2000 volts. An epitaxial layer prevents latchup. Break-before-make is guaranteed for DG9415.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



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%, VIN = 0.4 or 2.4 V ^e	Temp ^a	Limits -40 to 85°C			Unit	
				Min ^c	Typ ^b	Max ^c		
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, V _{gen} = 0 V, R _{gen} = 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, VIN = 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%, VIN = 0.8 or 2.4 V ^e	Temp ^a	Limits -40 to 85°C			Unit
				Min ^c	Typ ^b	Max ^c	
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:

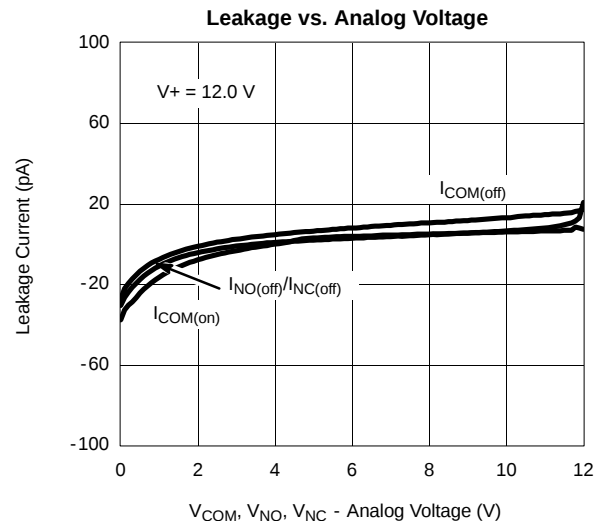
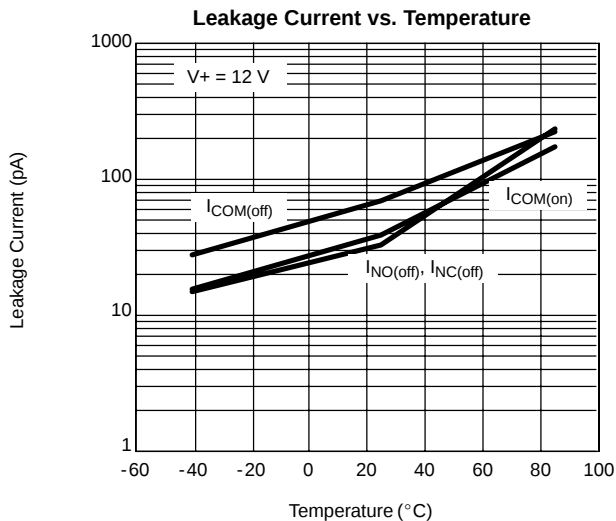
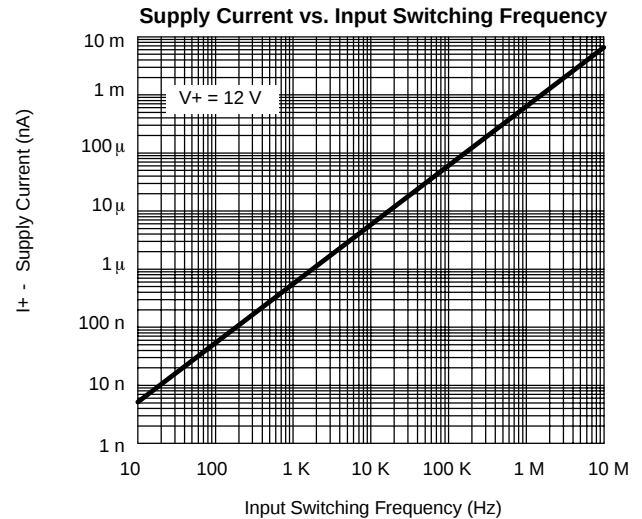
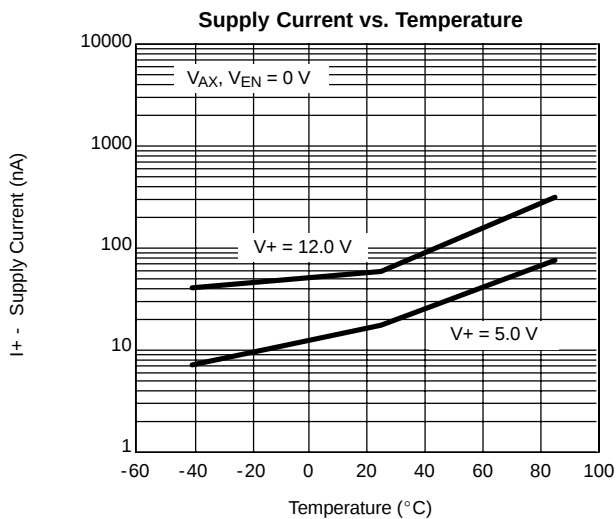
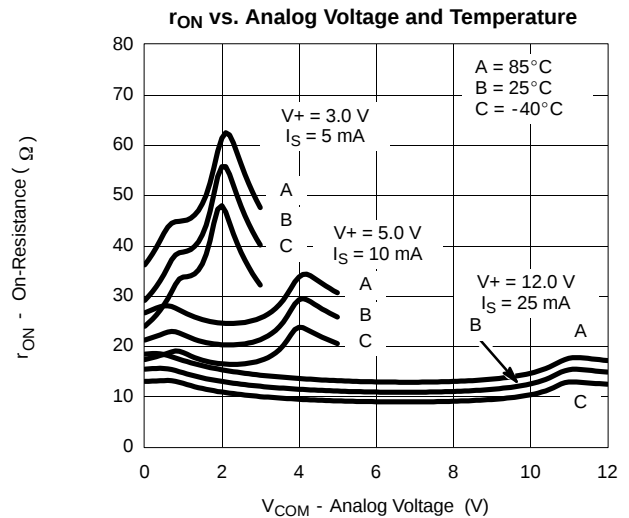
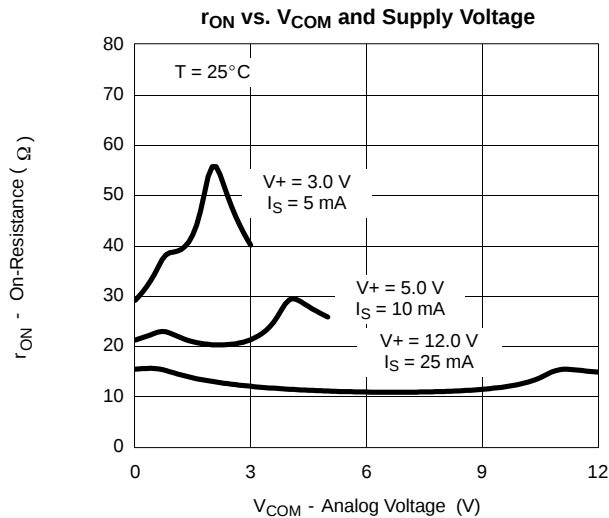
- Room = 25°C, Full = as determined by the operating suffix.
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- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guarantee by design, nor subjected to production test.
- V_{IN} = input voltage to perform proper function.
- Difference of min and max values.
- Guaranteed by 12-V leakage testing, not production tested.
- Guaranteed by worst case test conditions and not subject to test.

SPECIFICATIONS (V+ = 12 V)										
Parameter	Symbol	Test Conditions Unless Specified V+ = 12 V, VIN = 0.8 V, 2.4 V ^e	Temp ^a	Limits -40 to 85°C			Unit			
				Min ^c	Typ ^b	Max ^c				
Analog Switch										
Analog Signal Range ^d	VANALOG		Full	0		12	V			
rON Match	ΔrON		Room		1	9	Ω			
rON Flatness ^{d, f}	rON Flatness		Room		1	10				
On-Resistance	rON	V+ = 10.8 V, INO, INC = 25 mA, VCOM = 2/9 V	Room Full		14	17 19				
Switch Off Leakage Current	INO(off), INC(off)	VCOM = 1/11 V VNO, VNC = 11/1 V	Room Full	-1 -10		1 10	nA			
	ICOM(off)		Room Full	-1 -10		1 10				
Channel On Leakage Current	ICOM(on)	VNO, VNC = VCOM = 11/1 V	Room Full	-1 -10		1 10				
Digital Control										
Input Current	IINL or IINH	VIN = 0 or V+	Full	-1		1	μA			
Input High Voltage ^d	VINH		Full	2.4			V			
Input Low Voltage ^d	VINL		Full			0.8				
Dynamic Characteristics										
Turn-On Time ^h	tON	RL = 300 Ω, CL = 35 pF VNO, VNC = 5 V See Figure 2	Room Full		33	55 59	ns			
Turn-Off Time ^h	tOFF		Room Full		17	40 41				
Break-Before-Make Time Delay ^h	tD	DG419L Only, VNC, VNO = 5 V RL = 300 Ω, CL = 35 pF	Room	2	24					
Transition Time	ttrans	VNO = 5 V/0 V, VNC = 0 V/5 V	Room Full		29	56 59				
Charge Injection ^d	QINJ	Vg = 0 V, Rg = 0 Ω, CL = 1 nF	Room		13		pC			
Off Isolation ^d	OIRR	RL = 50 Ω, CL = 5 pF f = 1 MHz	Room		-58		dB			
Channel-to-Channel Crosstalk ^d	XTALK		Room		-64					
NO, NC Off Capacitance ^d	CNO(off), CNC(off)	VIN = 0 or V+, f = 1 MHz	DG9414	Room	10		pF			
			DG9415	Room	10					
COM Off Capacitance	CCOM(off)		DG9414	Room	24					
			DG9415	Room	13					
COM On Capacitance ^d	CCOM(on)		DG9414	Room	40					
			DG9415	Room	23					
Power Supplies										
Positive Supply Current	I+		VIN = 0 or 12 V	Full				1	μA	

Notes:

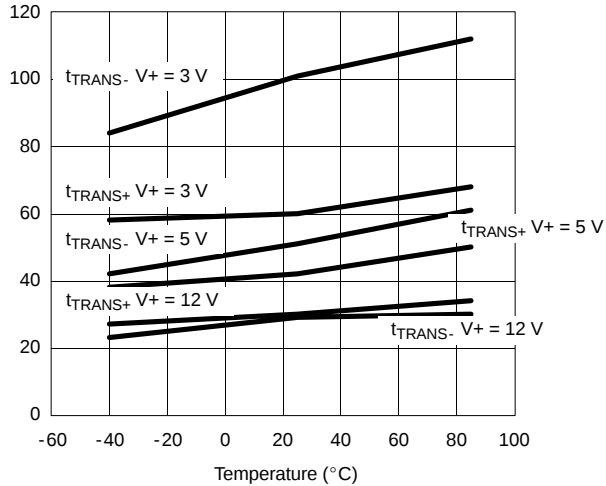
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TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

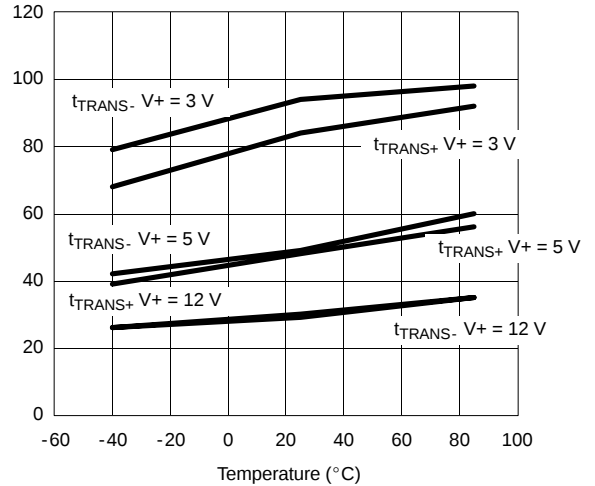


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

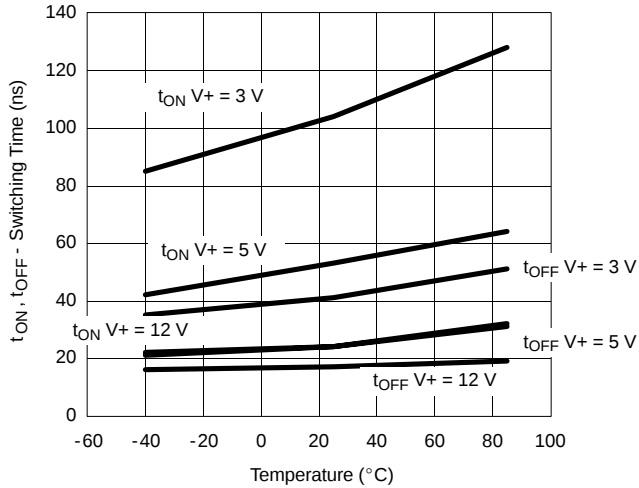
Transistion Time vs. Temperature (DG9414)



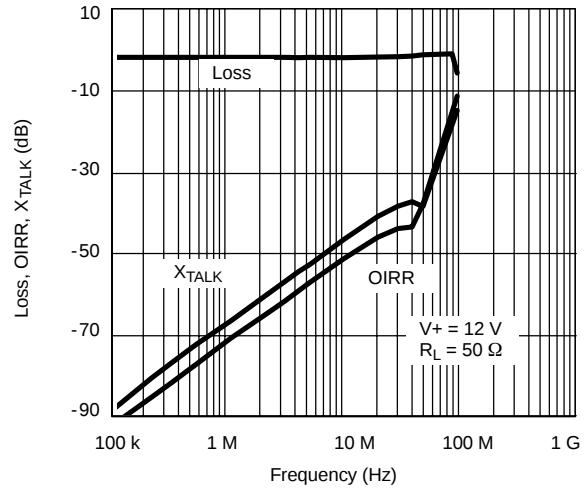
Transistion Time vs. Temperature (DG9415)



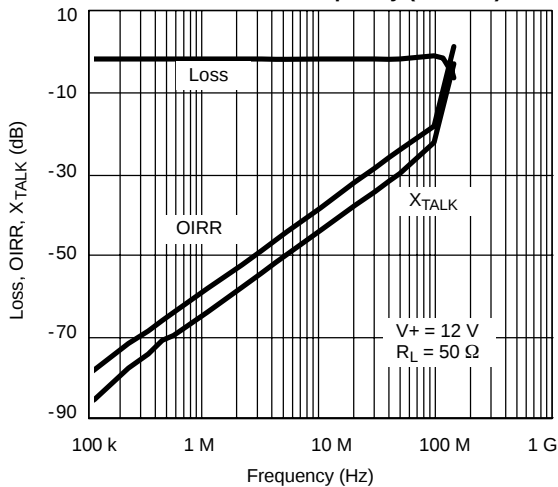
Switching Time vs. Temperature



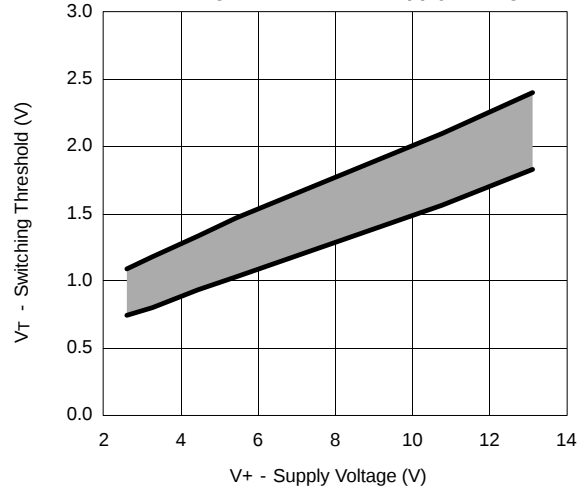
Insertion Loss, Off -Isolation Crosstalk vs. Frequency (DG9414)



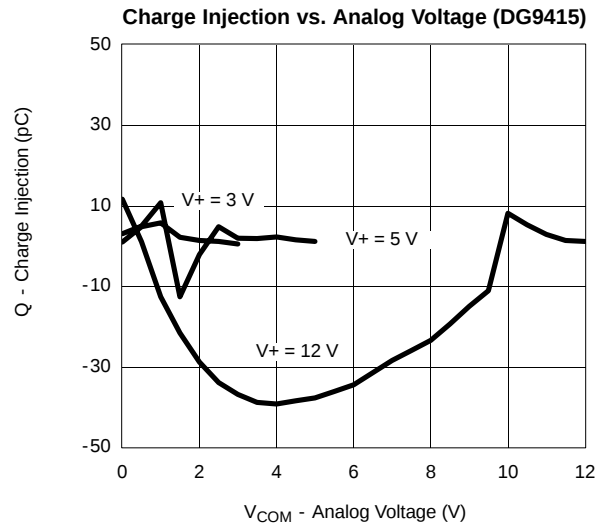
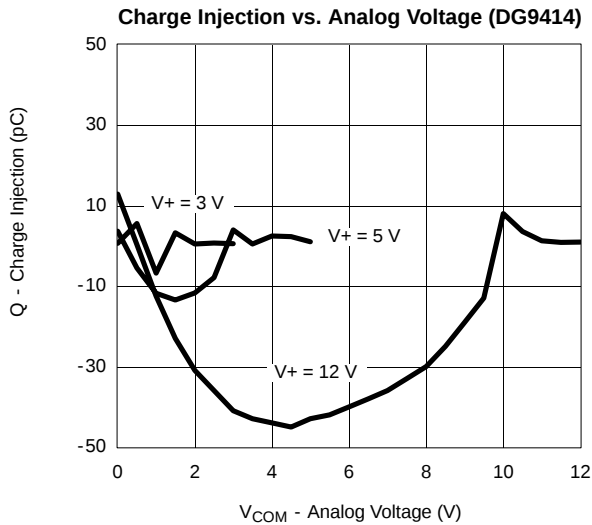
Insertion Loss, Off -Isolation Crosstalk vs. Frequency (DG9415)



Switching Threshold vs. Supply Voltage



TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

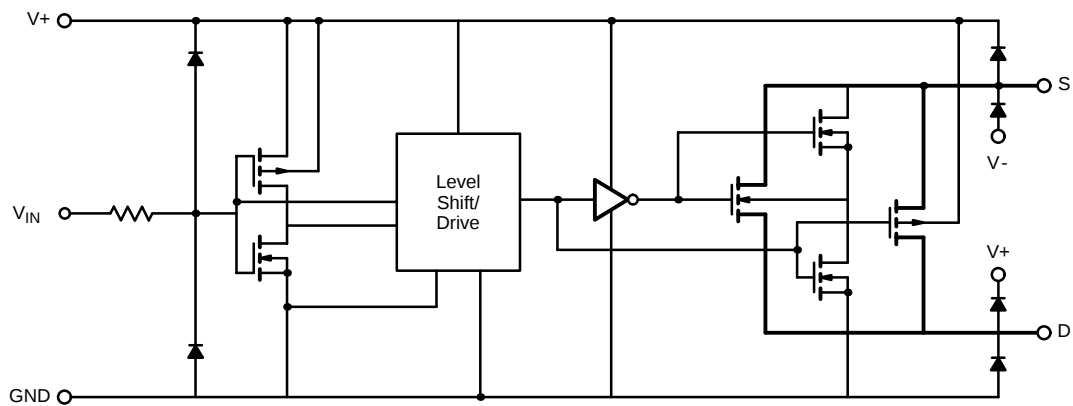
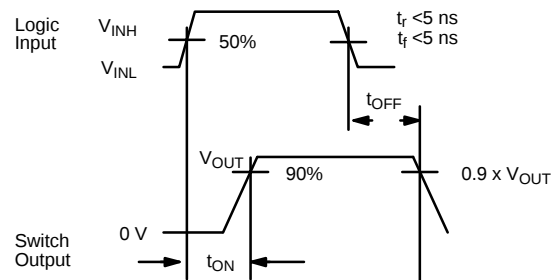
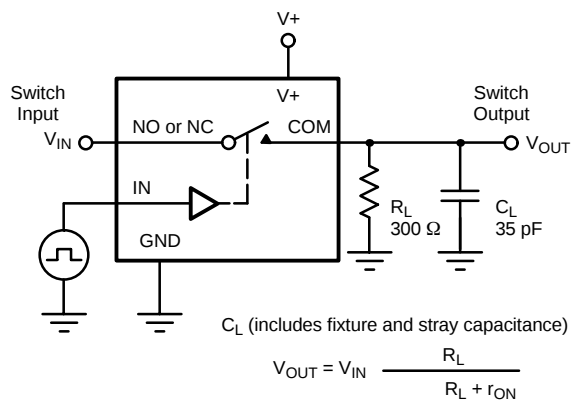


Figure 1.

TEST CIRCUITS



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

Figure 2. Switching Time

TEST CIRCUITS

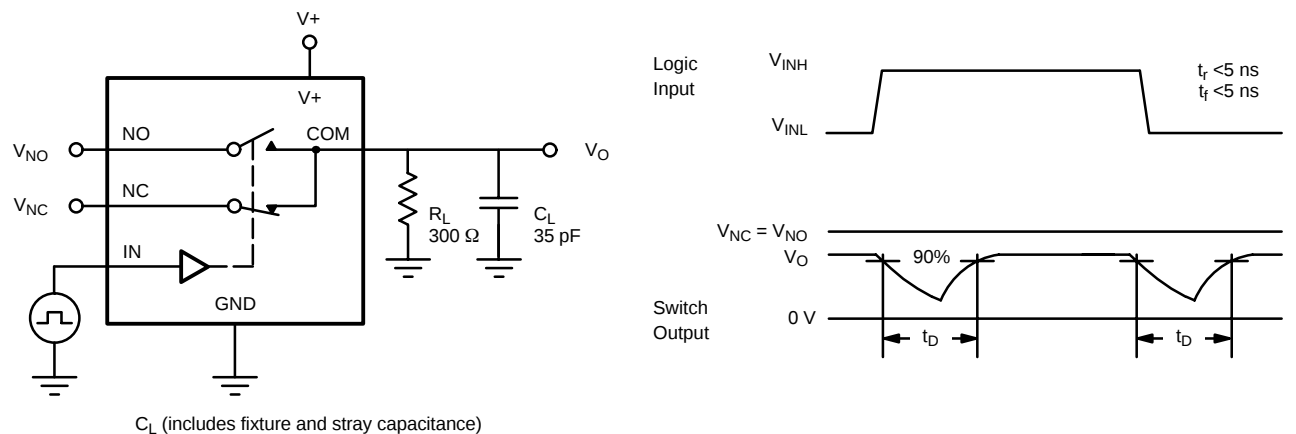


Figure 3. Break-Before-Make

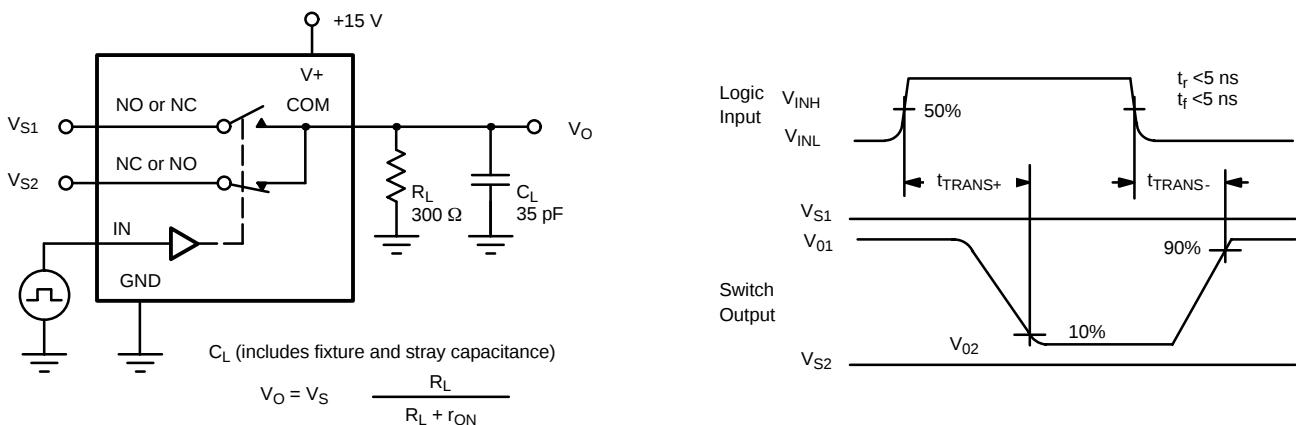


Figure 4. Transition Time

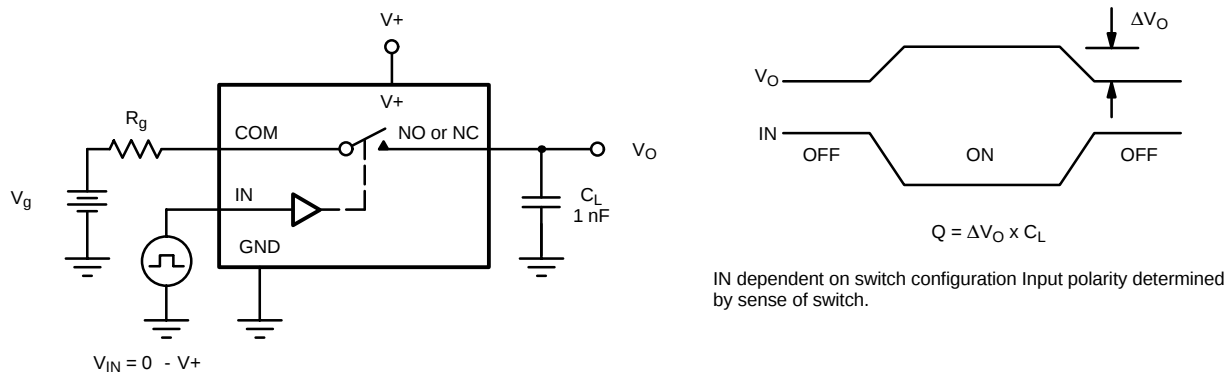


Figure 5. Charge Injection

V_S
 $R_g = 50 \Omega$
 V_{IN}
 $0 \text{ V or } 2.4 \text{ V}$
 V_{OUT}
 GND
 $V+$
 C
 50Ω
 $X_{TALK} \text{ Isolation} = 20 \log \frac{V_{OUT}}{V_{IN}}$
 $C = \text{RF bypass}$

Off Isolation = $20 \log \frac{V_{COM}}{V_{NO/NC}}$

C = RF Bypass

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