Precision Monolithic Quad SPST CMOS Analog Switches

DESCRIPTION

The DG417B/418B/419B monolithic CMOS analog switches were designed to provide high performance switching of analog signals. Combining low power, low leakages, high speed, low on-resistance and small physical size, the DG417B series is ideally suited for portable and battery powered industrial and military applications requiring high performance and efficient use of board space.

To achieve high-voltage ratings and superior switching performance, the DG417B series is built on Vishay Siliconix's high voltage silicon gate (HVSG) process. Break-before-make is guaranteed for the DG419B, which is an SPDT configuration. An epitaxial layer prevents latchup.

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

The DG417B and DG418B respond to opposite control logic levels as shown in the Truth Table.

FEATURES

- ± 15 V Analog Signal Range
- On-Resistance - $r_{DS(on)}$: 15 Ω
- Fast Switching Action - t_{ON}: 110 ns
- TTL and CMOS Compatible
- MSOP-8 and SOIC-8 Package

Pb-free Available

RoHS* COMPLIANT

BENEFITS

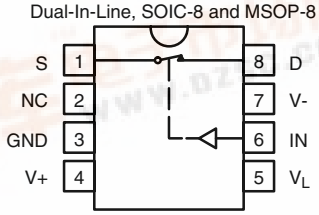
- Widest Dynamic Range
- Low Signal Errors and Distortion
- Break-Before-Make Switching Action
- Simple Interfacing
- Reduced Board Space
- Improved Reliability

APPLICATIONS

- Precision Test Equipment
- Precision Instrumentation
- Battery Powered Systems
- Sample-and-Hold Circuits
- Military Radios
- Guidance and Control Systems
- Hard Disk Drivers

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG417B
Dual-In-Line, SOIC-8 and MSOP-8

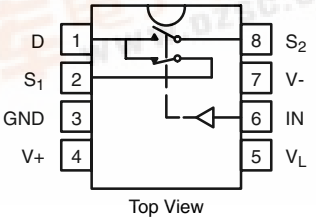


Top View

TRUTH TABLE		
Logic	DG417B	DG418B
0	ON	OFF
1	OFF	ON

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

DG419B
Dual-In-Line, SOIC-8 and MSOP-8



Top View

TRUTH TABLE - DG419B		
Logic	SW_1	SW_2
0	ON	OFF
1	OFF	ON

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

* Pb containing terminations are not RoHS compliant, exemptions may apply

ORDERING INFORMATION

Temp Range	Package	Part Number
DG417B/418B		
- 40 to 85 °C	8-Pin Plastic MiniDIP	DG417BDJ DG417BDJ-E3
		DG418BDJ DG418BDJ-E3
	8-Pin Narrow SOIC	DG417BDY DG417BDY-E3 DG417BDY-T1 DG417BDY-T1-E3
		DG418BDY DG418BDY-E3 DG418BDY-T1 DG418BDY-T1-E3
	8-Pin MSOP	DG417BDQ-T1-E3
		DG418BDQ-T1-E3
DG419B		
- 40 to 85 °C	8-Pin Plastic MiniDIP	DG419BDJ DG419BDJ-E3
	8-Pin Narrow SOIC	DG419BDY DG419BDY-E3 DG419BDY-T1 DG419BDY-T1-E3
	8-Pin MSOP	DG419BDQ-T1-E3

ABSOLUTE MAXIMUM RATINGS

Parameter		Limit	Unit
V-		- 20	V
V+		20	
GND		25	
V_L		(GND - 0.3 V) to (V+) + 0.3	
Digital Inputs[a], V_S, V_D		(V-) - 2 V to (V+) + 2 or 30 mA, whichever occurs first	
Current, (Any Terminal) Continuous		30	mA
Current (S or D) Pulsed at 1 ms, 10 % duty cycle		100	
Storage Temperature		- 65 to 150	°C
Power Dissipation (Package)[b]	8-Pin Plastic MiniDIP[c]	400	mW
	8-Pin Narrow SOIC[c]	400	
	8-Pin MSOP[d]	400	
	8-Pin CerDIP[e]	600	

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.

c. Derate 5.3 mW/°C above 75 °C.

d. Derate 4 mW/°C above 70 °C.

e. Derate 8 mW/°C above 75 °C.

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

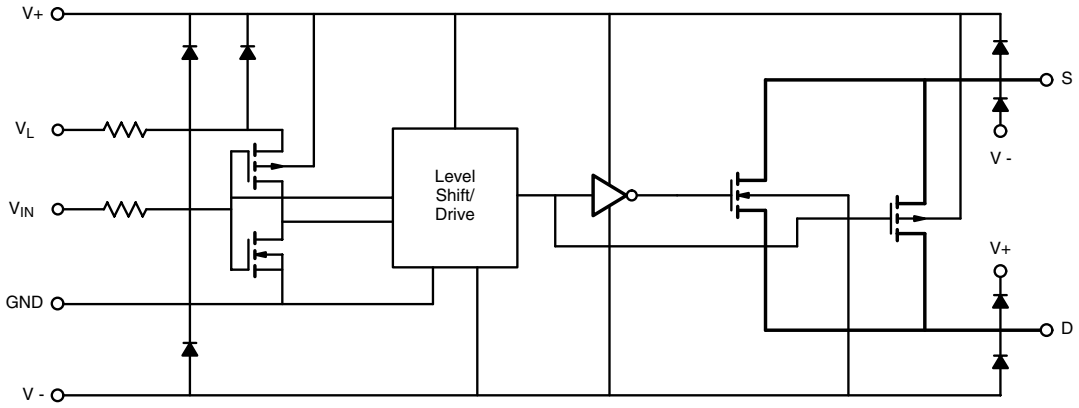


Figure 1.

SPECIFICATIONS[a]

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V- = - 15 V, V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]		Temp[b]	Typ[c]	A Suffix - 55 to 125 °C Min[d]	A Suffix - 55 to 125 °C Max[d]	D Suffix - 40 to 85 °C Min[d]	D Suffix - 40 to 85 °C Max[d]	Unit
Analog Switch										
Analog Signal Range[e]	V_{ANALOG}			Full		- 15	15	- 15	15	V
Drain-Source On-Resistance	$r_{DS(on)}$	I_S = - 10 mA, V_D = ± 12.5 V V+ = 13.5 V, V- = - 13.5 V		Room Full	15		25 34		25 29	Ω
Switch Off Leakage Current	$I_{S(off)}$	V+ = 16.5, V- = - 16.5 V V_D = ± 15.5 V, V_S = ± 15.5 V		Room Full	- 0.1	- 0.25 - 20	0.25 20	- 0.25 - 5	0.25 5	nA
	$I_{D(off)}$		DG417B DG418B	Room Full	- 0.1	- 0.25 - 20	0.25 20	- 0.25 - 5	0.25 5	
			DG419B	Room Full	- 0.1	- 0.75 - 60	0.75 60	- 0.75 - 12	0.75 12	
Channel On Leakage Current	$I_{D(on)}$	V+ = 16.5 V, V- = - 16.5 V V_S = V_D = ± 15.5 V	DG417B DG418B	Room Full	- 0.4	- 0.4 - 40	0.4 40	- 0.4 - 10	0.4 10	
			DG419B	Room Full	- 0.4	- 0.75 - 60	0.75 60	- 0.75 - 12	0.75 12	
Digital Control										
Input Current, V_{IN} Low	I_{IL}			Full		- 0.5	0.5	- 0.5	0.5	µA
Input Current, V_{IN} High	I_{IH}			Full		- 0.5	0.5	- 0.5	0.5	
Dynamic Characteristics										
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = ± 10 V, See Switching Time Test Circuit	DG417B DG418B	Room Full	62		89 106		89 99	ns
Turn-Off Time	t_{OFF}		DG417B DG418B	Room Full	53		80 88		80 86	
Transition Time	t_{TRANS}	R_L = 300 Ω, C_L = 35 pF V_{S1} = ± 10 V, V_{S2} = ± 10 V	DG419B	Room Full	60		87 96		87 93	
Break-Before-Make Time Delay	t_D	R_L = 300 Ω, C_L = 35 pF V_{S1} = V_{S2} = ± 10 V	DG419B	Room	16	3		3		
Charge Injection	Q	C_L = 10 nF V_{gen} = 0 V, R_{gen} = 0 Ω		Room	4					pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz		Room	- 86					dB
Channel-to-Channel Crosstalk[e]	X_{TALK}		DG419B	Room	- 87					

SPECIFICATIONS[a]

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V- = - 15 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]		Temp[b]	Typ[c]	A Suffix - 55 to 125 °C Min[d]	A Suffix - 55 to 125 °C Max[d]	D Suffix - 40 to 85 °C Min[d]	D Suffix - 40 to 85 °C Max[d]	Unit
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz, V_S = 0 V		Room	12					pF
Drain Off Capacitance[e]	$C_{D(off)}$		DG417B DG418B	Room	12					
Channel On Capacitance[e]	$C_{D(on)}$	f = 1 MHz, V_S = 0 V	DG417B DG418B	Room	50					
			DG419B	Room	57					
Power Supplies										
Positive Supply Current	I+	V+ = 16.5 V, V- = - 16.5 V V_{IN} = 0 or 5 V		Room Full	0.001		1 5		1 5	µA
Negative Supply Current	I-			Room Full	- 0.001	- 1 - 5		- 1 - 5		
Logic Supply Current	I_L			Room Full	0.001		1 5		1 5	
Ground Current	I_{GND}			Room Full	- 0.001	- 1 - 5		- 1 - 5		

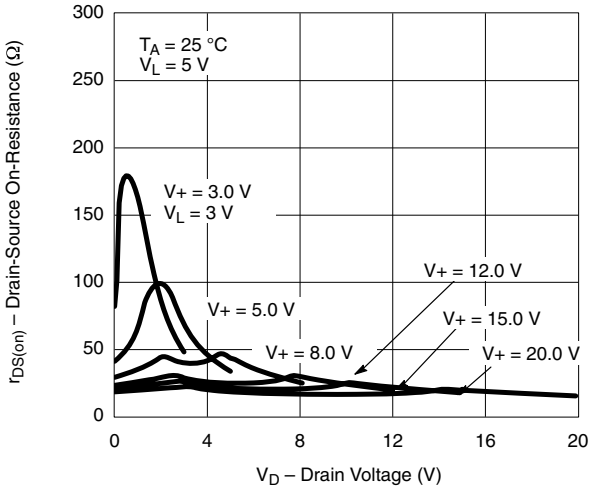
SPECIFICATIONS[a]

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 12 V, V- = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]		Temp[b]	Typ[c]	A Suffix - 55 to 125 °C Min[d]	A Suffix - 55 to 125 °C Max[d]	D Suffix - 40 to 85 °C Min[d]	D Suffix - 40 to 85 °C Max[d]	Unit
Analog Switch										
Analog Signal Range[e]	V_{ANALOG}			Full		0	12	0	12	V
Drain-Source On-Resistance	$r_{DS(on)}$	I_S = - 10 mA, V_D = 3.8 V V+ = 10.8 V,		Room Full	26		35 52		35 45	Ω
Dynamic Characteristics										
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = 8 V, See Switching Time Test Circuit		Room Full	100		125 155		125 143	ns
Turn-Off Time	t_{OFF}			Room Full	38		66 73		66 69	
Break-Before-Make Time Delay	t_D	R_L = 300 Ω, C_L = 35 pF	DG419B	Room	62	25		25		
Transition Time	t_{TRANS}	R_L = 300 Ω, C_L = 35 pF V_{S1} = 0 V, 8 V, V_{S2} = 8 V, 0 V		Room Full	95		119 153		119 141	
Charge Injection	Q	C_L = 10 nF, V_{gen} = 0 V, R_{gen} = 0 Ω		Room	3					pC
Power Supplies										
Positive Supply Current	I+	V+ = 13.2 V, V_L = 5.25 V V_{IN} = 0 or 5 V		Room Full	0.001		1 5		1 5	µA
Negative Supply Current	I-			Room	- 0.001	- 1 - 5		- 1 - 5		
Logic Supply Current	I_L			Room	0.001		1 5		1 5	
Ground Current	I_{GND}			Room	- 0.001	- 1 - 5		-1 - 5		

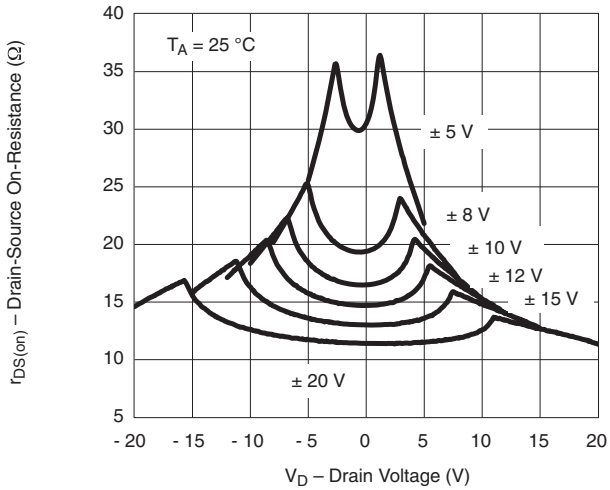
Notes:
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
e. Guaranteed by design, not subject to production test.
f. 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.

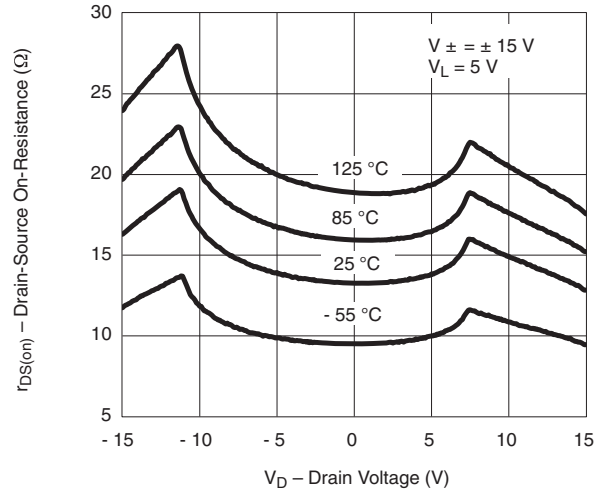
TYPICAL CHARACTERISTICS T_A = 25 °C, unless otherwise noted



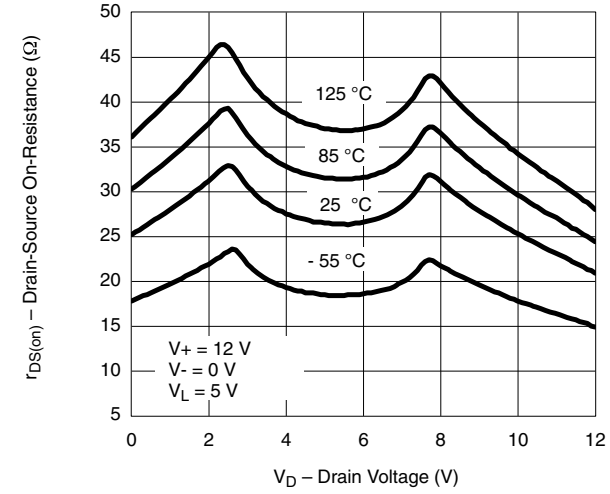
On-Resistance vs. V_D and Unipolar Power Supply Voltage



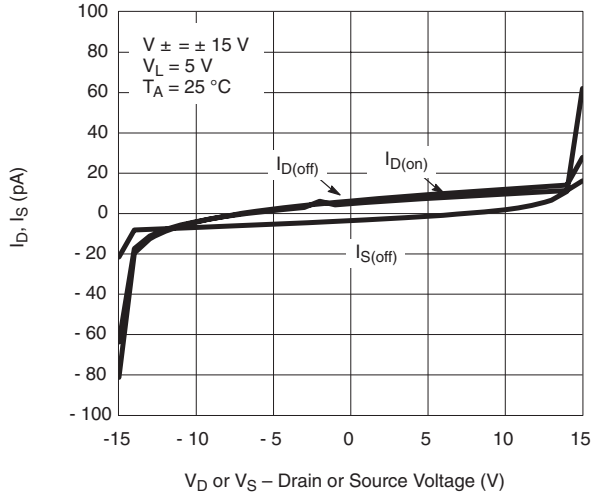
On-Resistance vs. V_D and Dual Supply Voltage



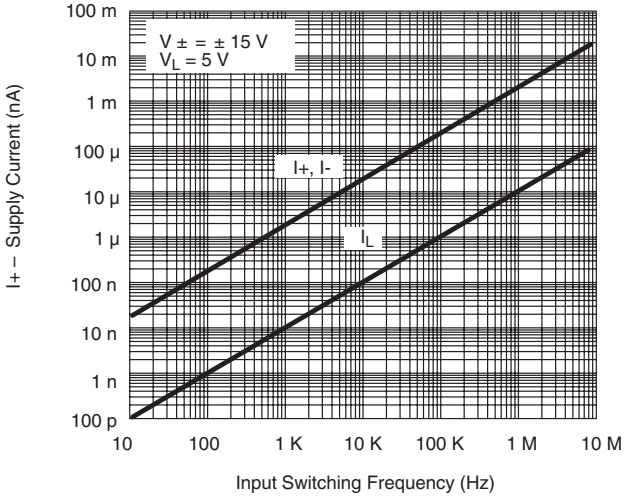
On-Resistance vs. V_D and Temperature



On-Resistance vs. V_D and Temperature

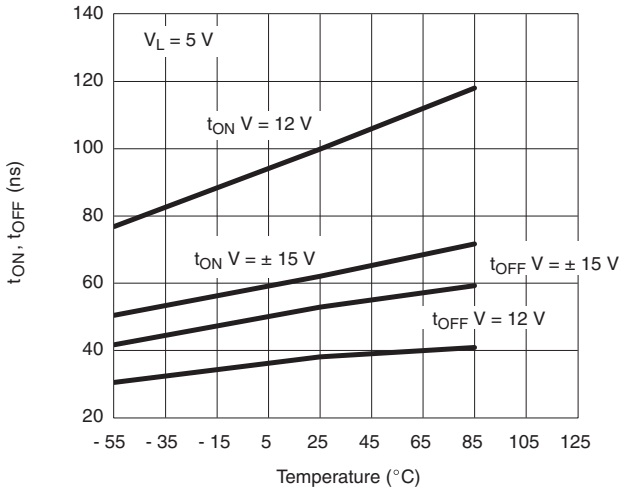


Leakage vs. Analog Voltage

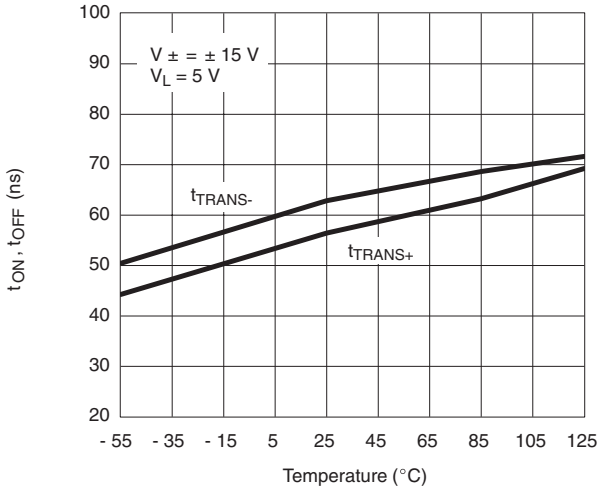


Supply Current vs. Input Switching Frequency

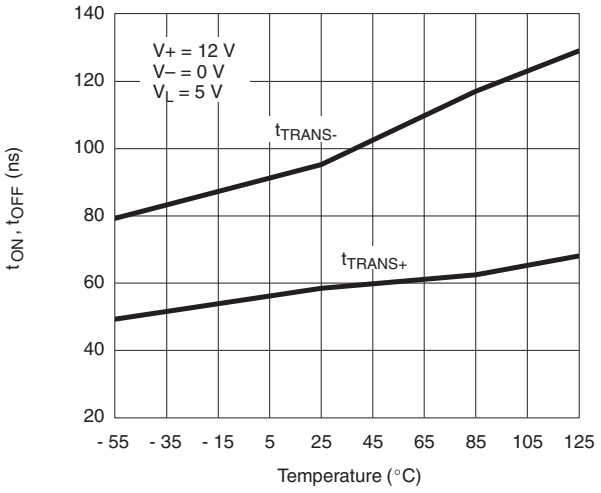
TYPICAL CHARACTERISTICS T_A = 25 °C, unless otherwise noted



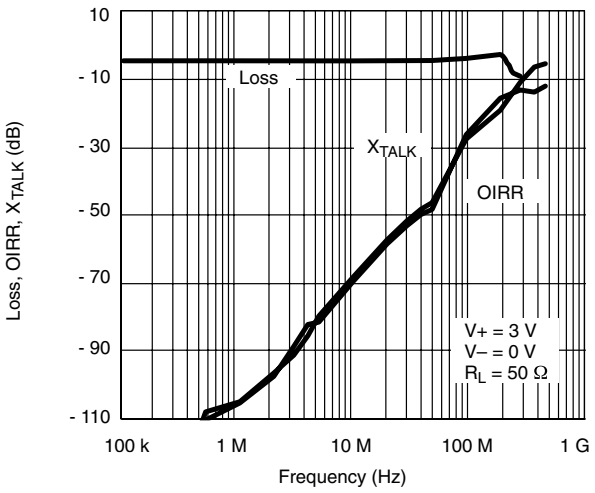
Switching Time vs. Temperature



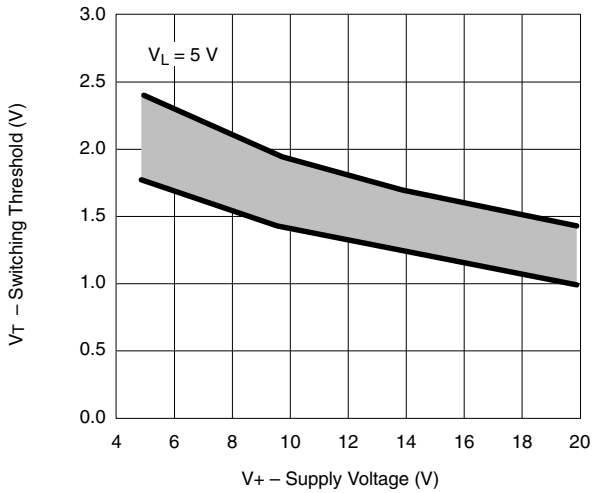
Transition Time vs. Temperature



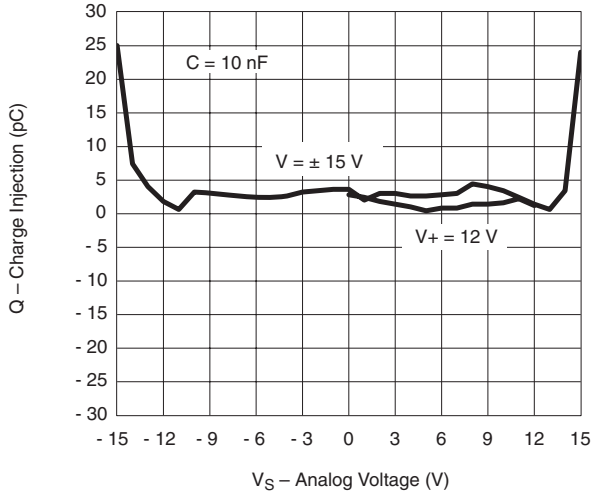
Transition Time vs. Temperature



Insertation Loss, Off -Isolation Crosstalk vs. Frequency



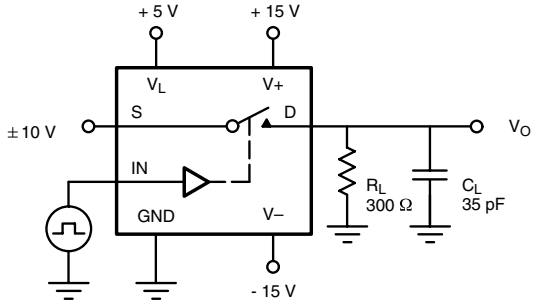
Switching Threshold vs. Supply Voltage



Charge Injection vs. Analog Voltage

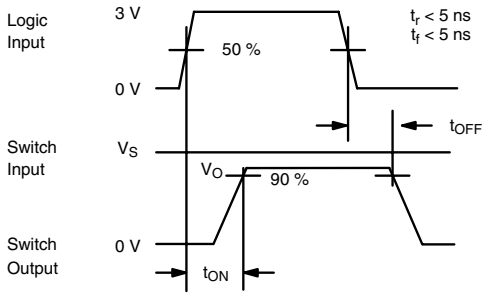
TEST CIRCUITS

V_O is the steady state output with the switch on.



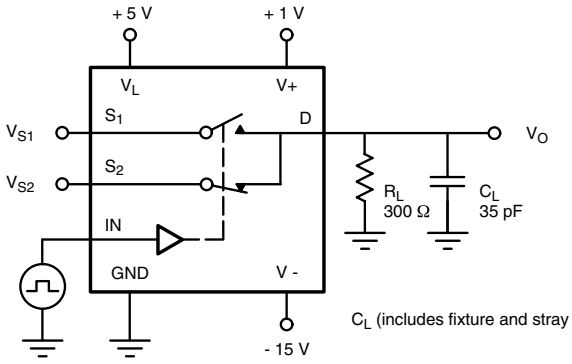
C_L (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$



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

Figure 2. Switching Time (DG417B/418B)



C_L (includes fixture and stray capacitance)

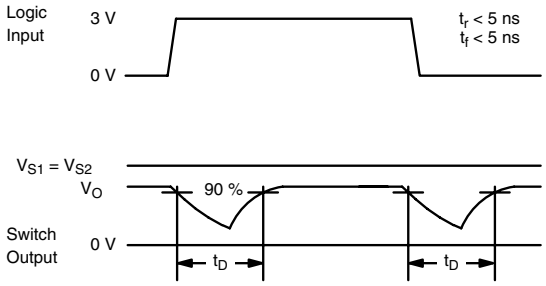
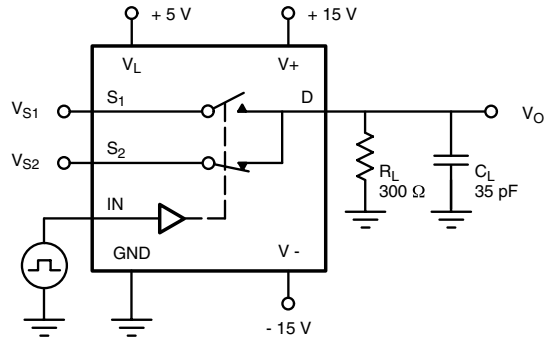


Figure 3. Break-Before-Make (DG419B)



C_L (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

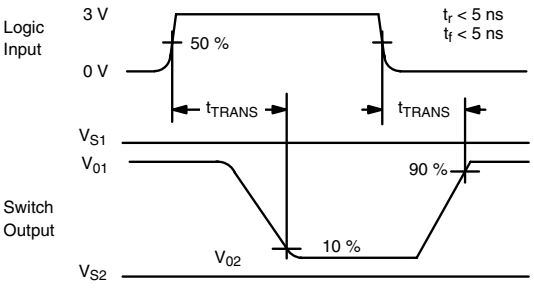
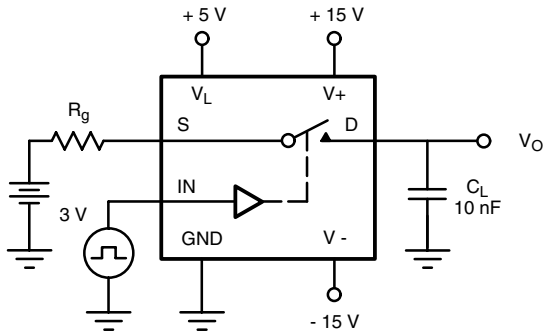


Figure 4. Transition Time (DG419B)

TEST CIRCUITS



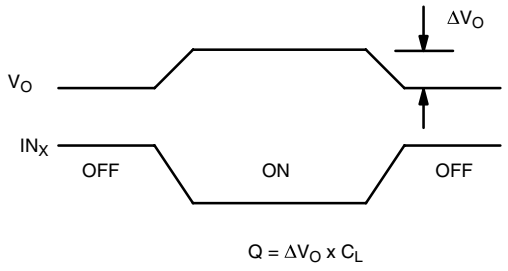


Figure 5. Charge Injection

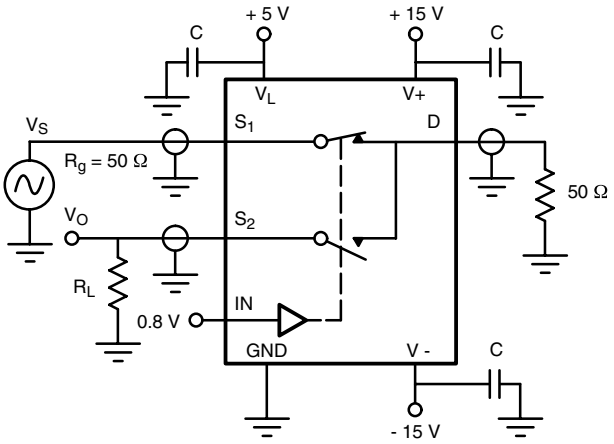


Figure 6. Crosstalk

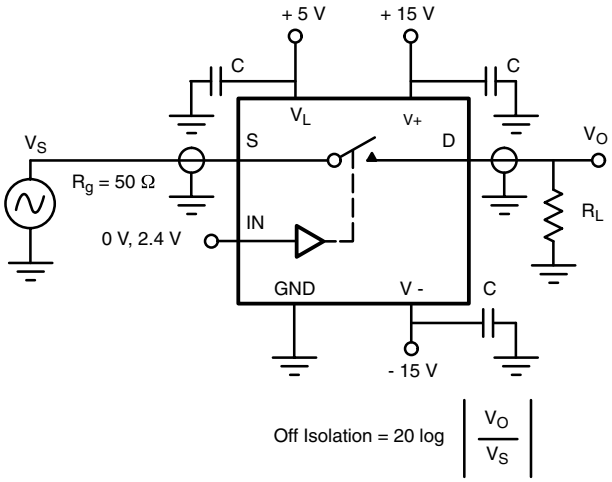


Figure 7. Off isolation

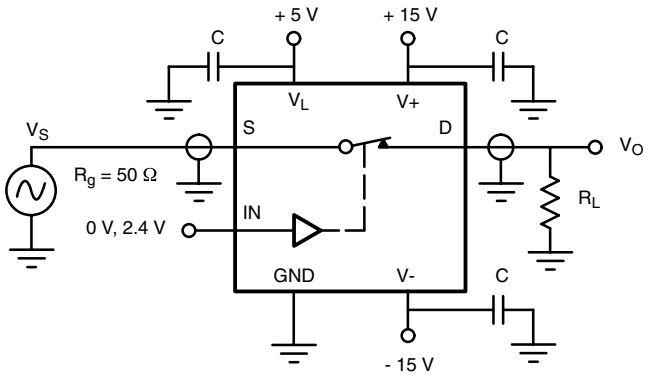


Figure 8. Insertion Loss

TEST CIRCUITS

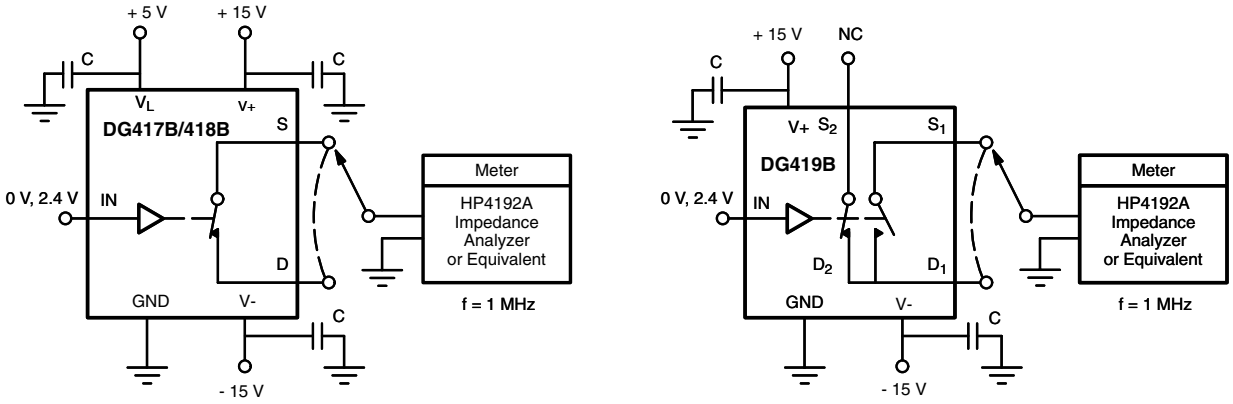


Figure 9. Source/Drain Capacitances

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