Precision Monolithic Quad SPST CMOS Analog Switches

DESCRIPTION

The DG417B, DG418B, DG419B 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 switcing action - t_{ON}: 110 ns
- TTL and CMOS compatible
- 8-pin CerDIP package

BENEFITS

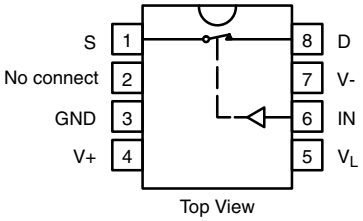
- Widest dynamic ranges
- Low signal errors and distortion
- Break-before-make switching action
- Simple interfacing
- Reduced board space
- Improved reliability

APPLICATIONS

- Precision test equipment
- Precision instrumentation
- Battery powered systems
- Sample-and-hold circuits
- Military radios
- Hi-Rel systems
- Guidance and control systems
- Hard disk drivers

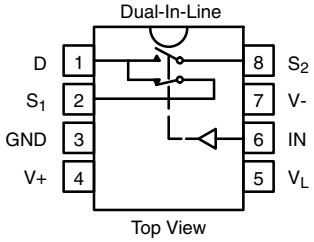
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG417B, DG418B
Dual-In-Line



Top View

DG419B
Dual-In-Line



Top View

TRUTH TABLE		
LOGIC	**DG417B**	**DG418B**
0	On	Off
1	Off	On

Notes
- Logic "0" ≤ 0.8 V
- Logic "1" ≥ 2.4 V

TRUTH TABLE (DG419B)		
LOGIC	**SW_1**	**SW_2**
0	On	Off
1	Off	On

Notes
- Logic "0" ≤ 0.8 V
- Logic "1" ≥ 2.4 V

ORDERING INFORMATION

PART	CONFIGURATION	TEMP. RANGE	PACKAGE	ORDERING PART	GENERIC	DSCC NUMBER
DG417B	SPST x 1, NC	- 55 °C to 125 °C	8-pin CerDIP	9073704PA	DG417BAK/883	5962-9073704MPA
				DG417BAK	DG417BAK	-
				DG417BAK-E3	DG417BAK-E3	-
DG418B	SPST x 1, NO			9073705PA	DG418BAK/883	5962-9073705MPA
				DG418BAK	DG418BAK	-
				DG418BAK-E3	DG418BAK-E3	-
DG419B	SPDT x 1			9073706PA	DG419BAK/883	5962-9073706MPA
				DG419BAK	DG419BAK	-
				DG419BAK-E3	DG419BAK-E3	-

ABSOLUTE MAXIMUM RATINGS

PARAMETER		LIMIT	UNIT
Voltages Referenced to V-	V+	44	V
	GND	25	
V_L		(GND - 0.3) 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 CerDIP[c]	600	mW

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 soldered or welded to PC board.
c. Derate 8 mW/°C above 75 °C.

SCHEMATIC DIAGRAM (Typical Channel)

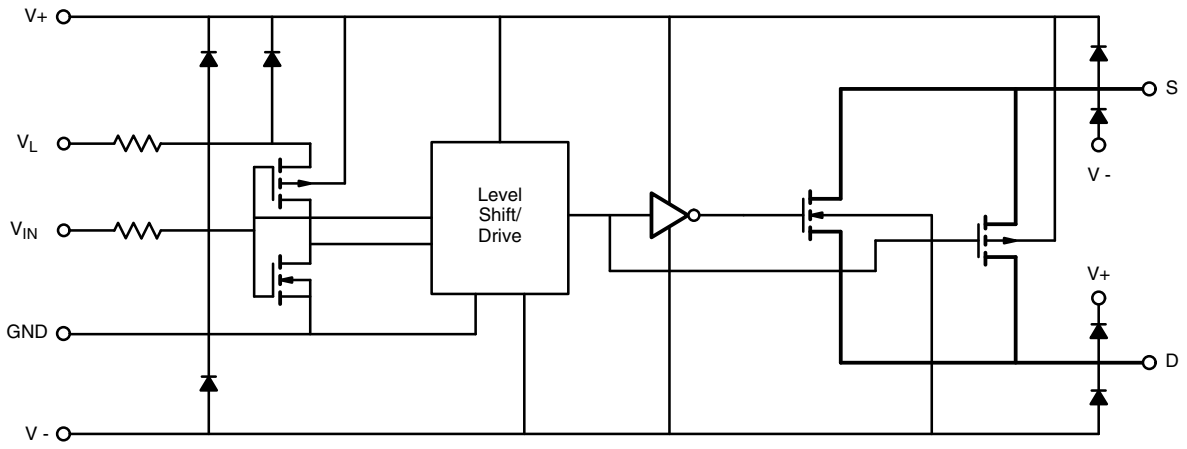


Fig. 1

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 °C to 125 °C MIN.[d]	A SUFFIX - 55 °C to 125 °C MAX.[d]	UNIT
Analog Switch								
Analog Signal Range[e]	V_{ANALOG}			Full		- 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	15		25	Ω
				Full	15		34	
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	- 0.1	- 0.25	0.25	nA
				Full	- 0.1	- 20	20	
	$I_{D(off)}$		DG417B	Room	- 0.1	- 0.25	0.25	
				Full	- 0.1	- 20	20	
			DG418B	Room	- 0.1	- 0.25	0.25	
				Full	- 0.1	- 20	20	
			DG419B	Room	- 0.1	- 0.75	0.75	
				Full	- 0.1	- 60	60	
Channel On Leakage Current	$I_{D(on)}$	V+ = 16.5 V, V - = - 16.5 V V_S = V_D = ± 15.5 V	DG417B	Room	- 0.4	- 0.4	0.4	
				Full	- 0.4	- 40	40	
			DG418B	Room	- 0.4	- 0.4	0.4	
				Full	- 0.4	- 40	40	
			DG419B	Room	- 0.4	- 0.75	0.75	
				Full	- 0.4	- 60	60	
Digital Control								
Input Current, V_{IN} Low	I_{IL}			Full		- 0.5	0.5	µA
Input Current, V_{IN} High	I_{IH}			Full		- 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	Room	62		89	ns
				Full	62		106	
			DG418B	Room	62		89	
				Full	62		106	
Turn-Off Time	t_{OFF}		DG417B	Room	53		80	
				Full	53		88	
			DG418B	Room	53		80	
				Full	53		88	
Transition Time	t_{TRANS}	R_L = 300 Ω, C_L = 35 pF V_{S1} = ± 10 V, V_{S2} = ± 10 V	DG419B	Room	60		87	
				Full	60		96	
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		
Charge Injection	Q	C_L = 10 nF, V_{gen} = 0 V, R_{gen} = 0 Ω		Room	38			pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz		Room	- 82			dB
Channel-to-Channel Crosstalk[e]	X_{TALK}		DG419B	Room	- 88			
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	Room	12			
			DG418B	Room	12			
Channel On Capacitance[e]	$C_{D(on)}$	f = 1 MHz, V_S = 0 V	DG417B	Room	50			
			DG418B	Room	50			
			DG419B	Room	57			

SPECIFICATIONS[a]

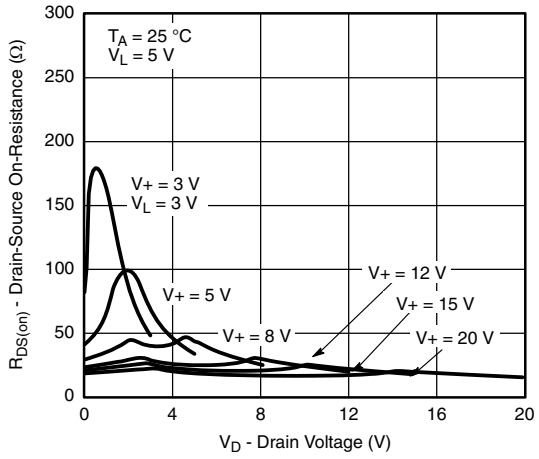
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 12 V, V- = - 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]		TEMP.[b]	TYP.[c]	A SUFFIX - 55 °C to 125 °C MIN.[d]	A SUFFIX - 55 °C to 125 °C MAX.[d]	UNIT
Power Supplies								
Positive Supply Current	I+	V+ = 16.5 V, V- = - 16.5 V V_{IN} = 0 V or 5 V		Room	0.001		1	µA
				Full			5	
Negative Supply Current	I-			Room	- 0.001	- 1		
				Full		- 5		
Logic Supply Current	I_L			Room	0.001		1	
				Full			5	
Ground Current	I_{GND}			Room	- 0.001	- 1		
				Full		- 5		
Analog Switch								
Analog Signal Range[e]	V_{ANALOG}			Full		0	12	V
Drain-Source On-Resistance	$R_{DS(on)}$	I_S = - 10 mA, V_D = 3.8 V V+ = 10.8 V		Room	26		35	Ω
				Full	26		52	
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	100		125	ns
				Full	100		155	
Turn-Off Time	t_{OFF}			Room	38		66	
				Full	38		69	
Break-Before-Make Time Delay	t_D	R_L = 300 Ω, C_L = 35 pF	DG419B	Room	62	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	95		119	
				Full	95		153	
Charge Injection	Q	C_L = 10 nF, V_{gen} = 0 V, R_{gen} = 0 Ω		Room	18			pC
Power Supplies								
Positive Supply Current	I+	V+ = 13.2 V, V_L = 5.25 V V_{IN} = 0 V or 5 V		Room	0.001		1	µA
				Full	0.001		5	
Negative Supply Current	I-			Room	- 0.001	- 1 - 5		
Logic Supply Current	I_L			Room	0.001		1 5	
Ground Current	I_{GND}			Room	- 0.001	- 1 - 5		

Notes

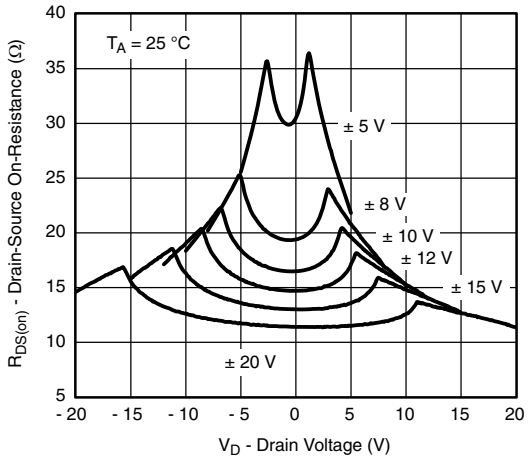
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25 °C, full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive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

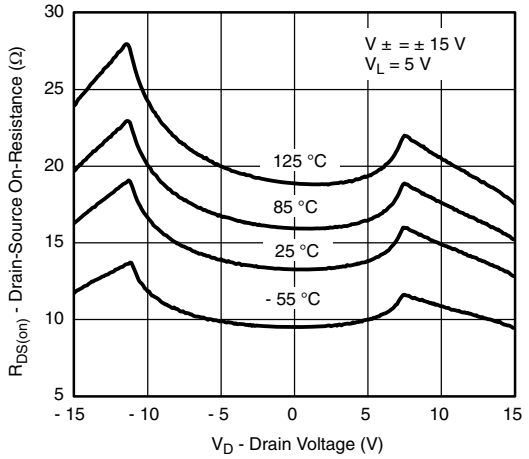
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



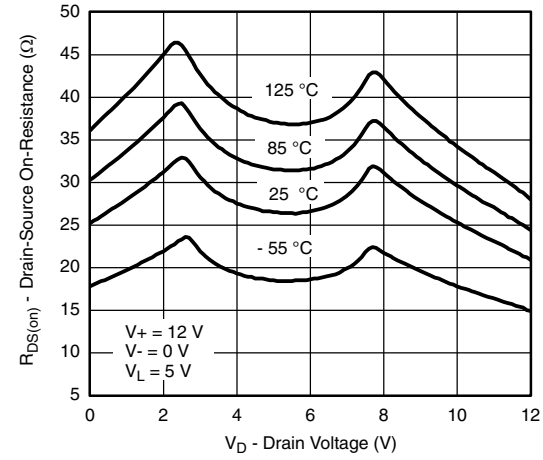
On-Resistance vs. V_D and Unipolar Power Supply Voltage



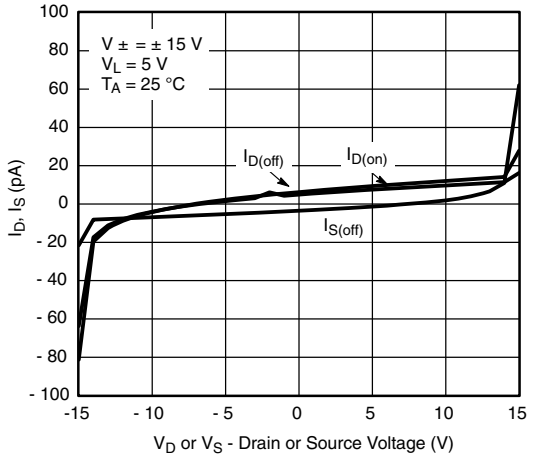
On-Resistance vs. V_D and Dual Supply Voltage



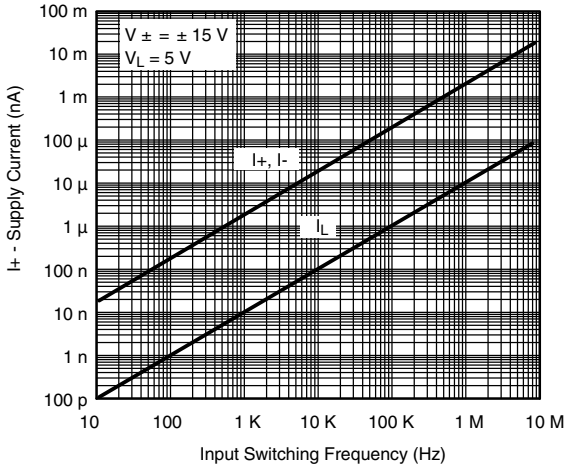
On-Resistance vs. V_D and Temperature



On-Resistance vs. V_D and Temperature

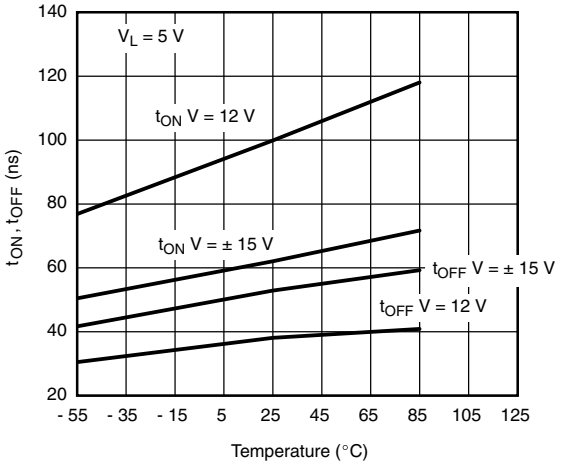


Leakage vs. Analog Voltage

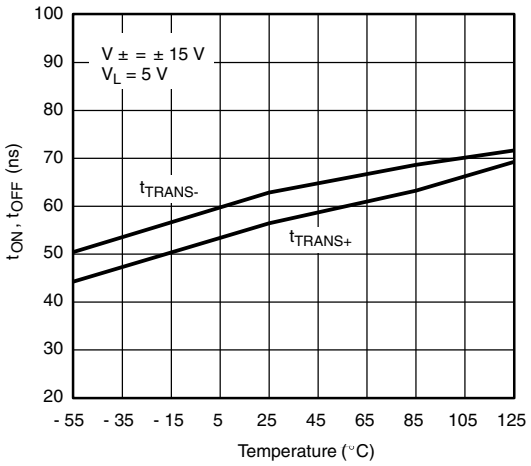


Supply current vs. Input Switching Frequency

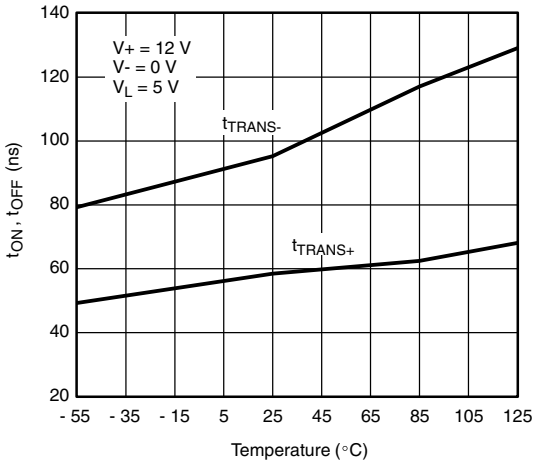
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



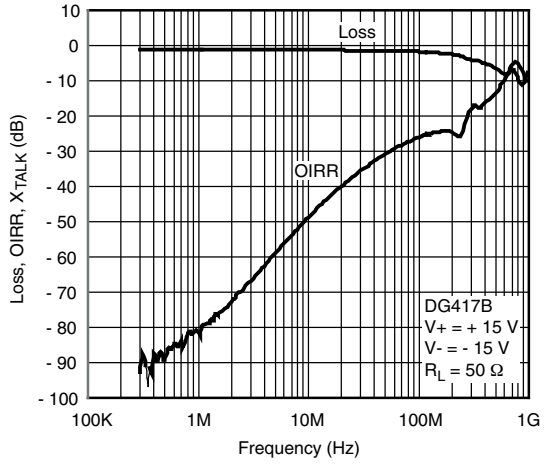
Switching Time vs. Temperature



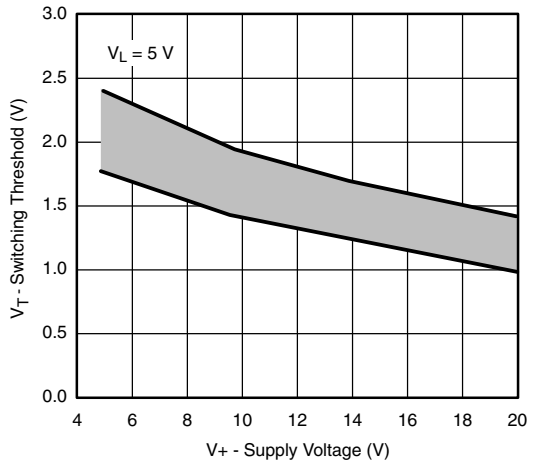
Transition Time vs. Temperature



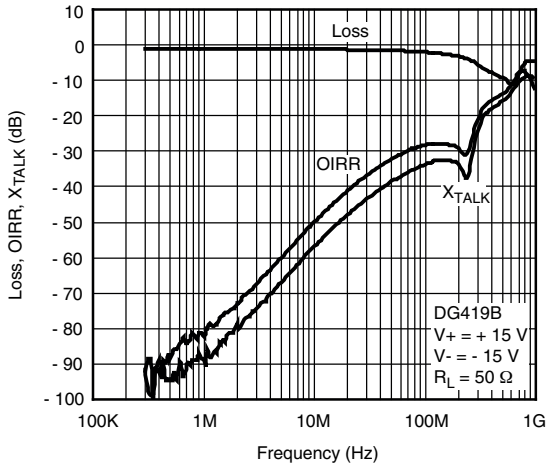
Transition Time vs. Temperature



Insertion Loss, Off-Isolation Crosstalk vs. Frequency

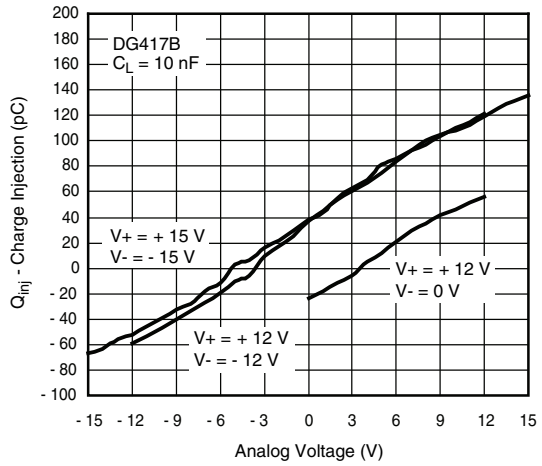


Switching Threshold vs. Supply Voltage

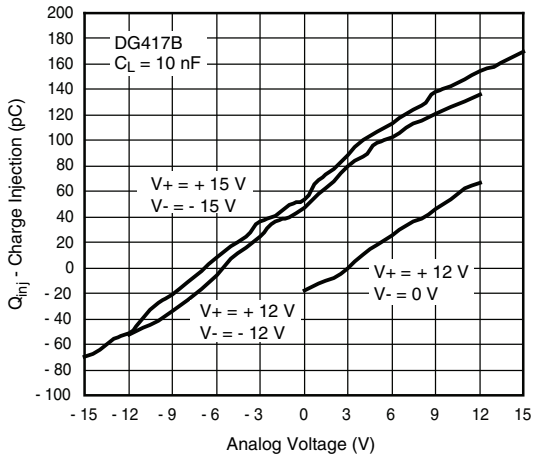


Insertion Loss, Off-Isolation Crosstalk vs. Frequency

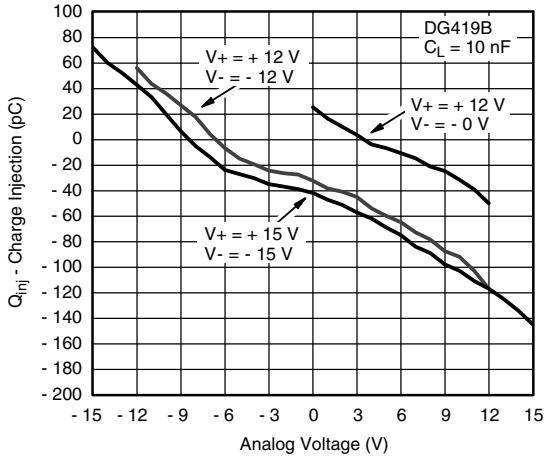
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



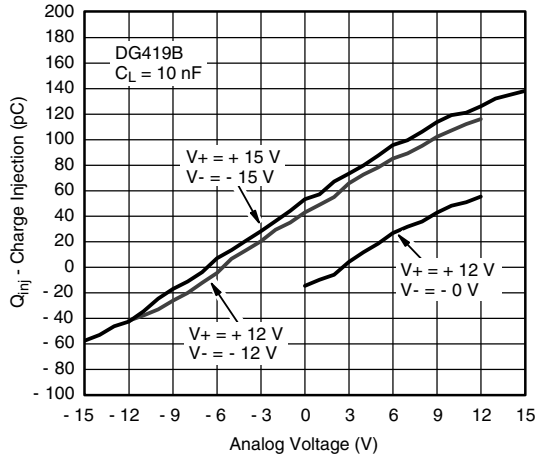
Charge Injection vs. Analog Voltage (Measured at drain pin)



Charge Injection vs. Analog Voltage (Measured at source pin)



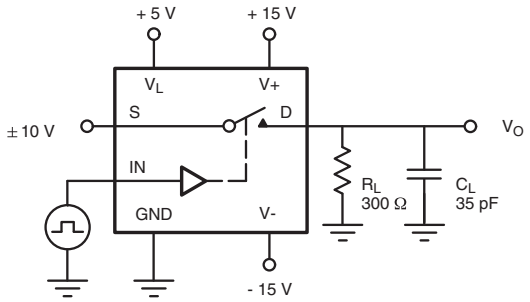
Charge Injection vs. Analog Voltage (Measured at drain pin)



Charge Injection vs. Analog Voltage (Measured at source pin)

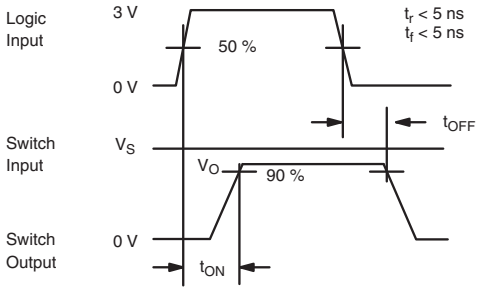
TEST CIRCUITS

V_O is the steady state output with the switch on.



C_L (includes fixture and stray capacitance)

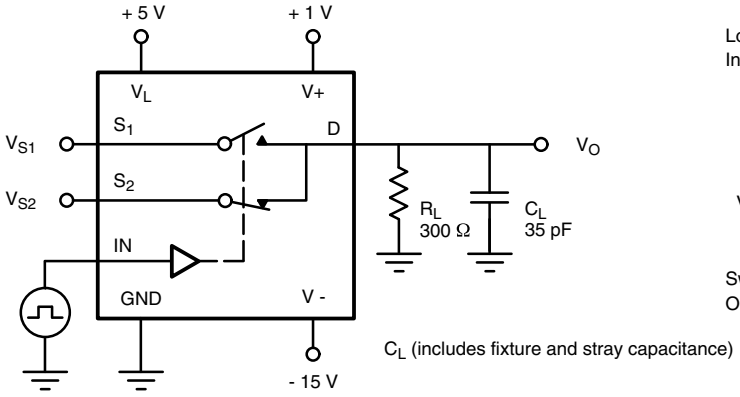
$$V_O = V_S \frac{R_L}{R_L + R_{DS(on)}}$$



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

Fig. 2 - Switching Time (DG417B, DG418B)

TEST CIRCUITS



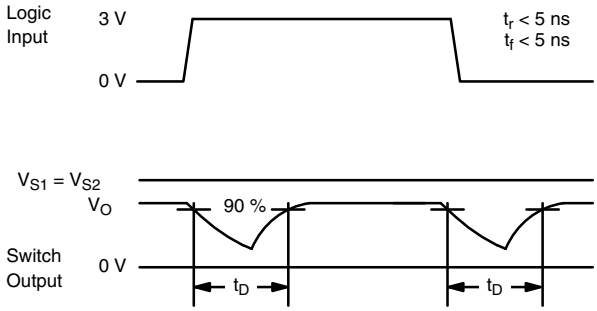
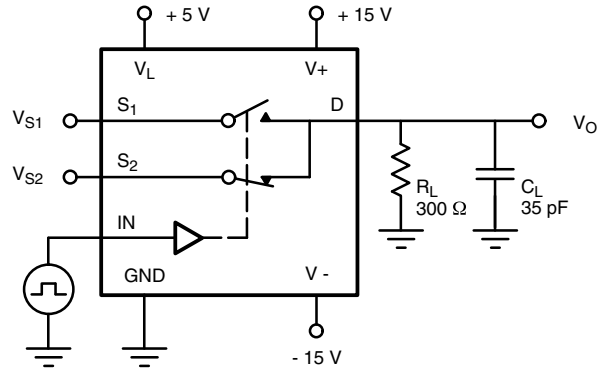


Fig. 3 - Break-Before-Mak (DG419B)



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

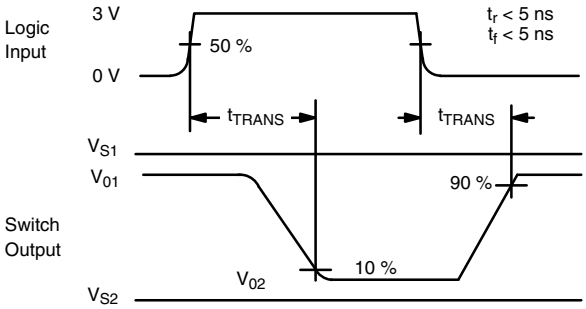
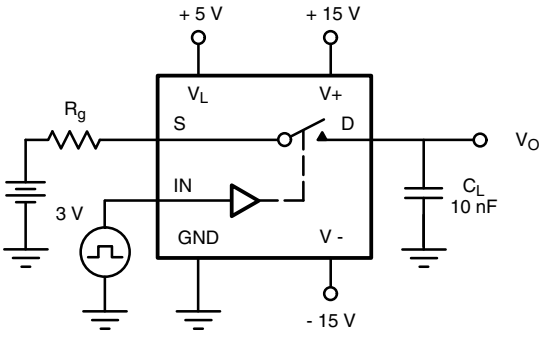


Fig. 4 - Transition Time (DG419B)



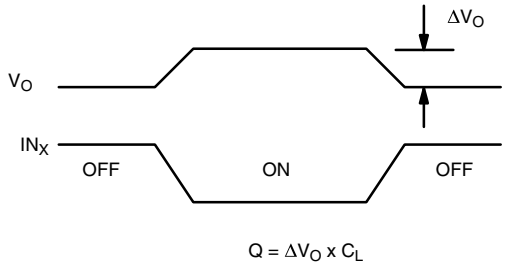


Fig. 5 - Charge Injection

TEST CIRCUITS

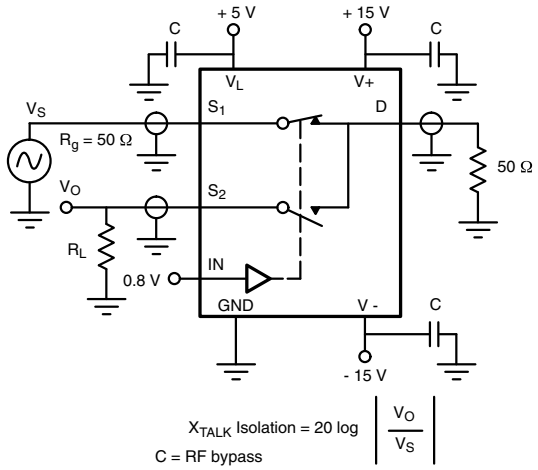


Fig. 6 - Crosstalk

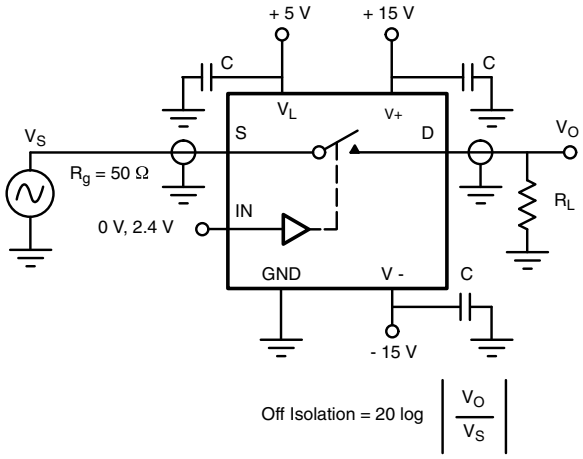


Fig. 7 - Off Isolation

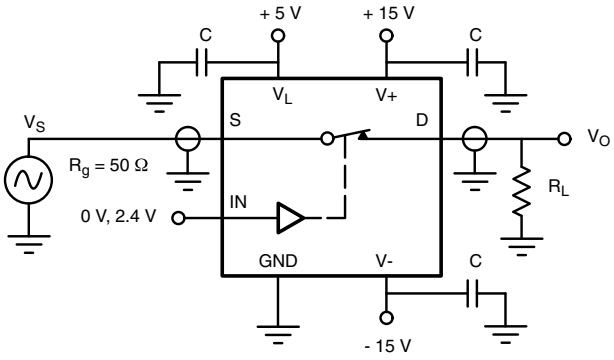


Fig. 8 - Insertion Loss

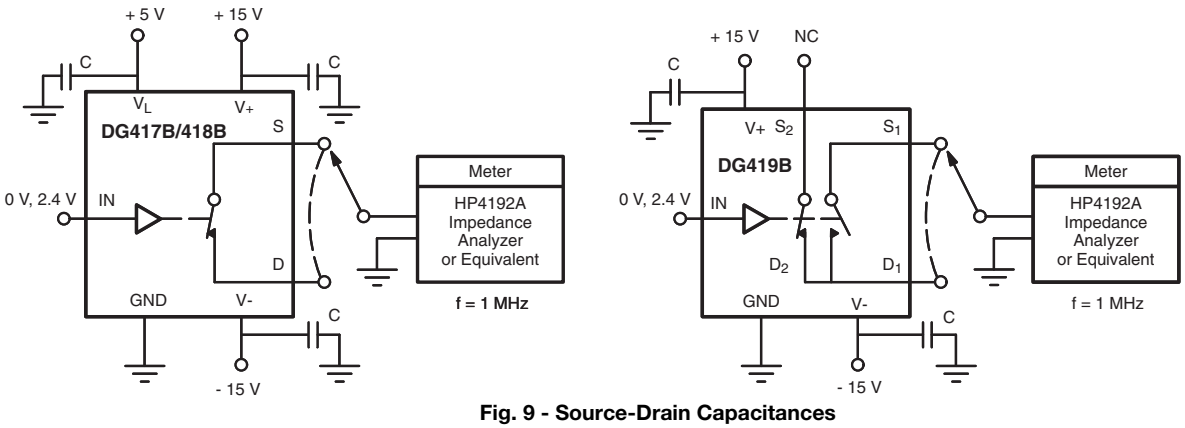
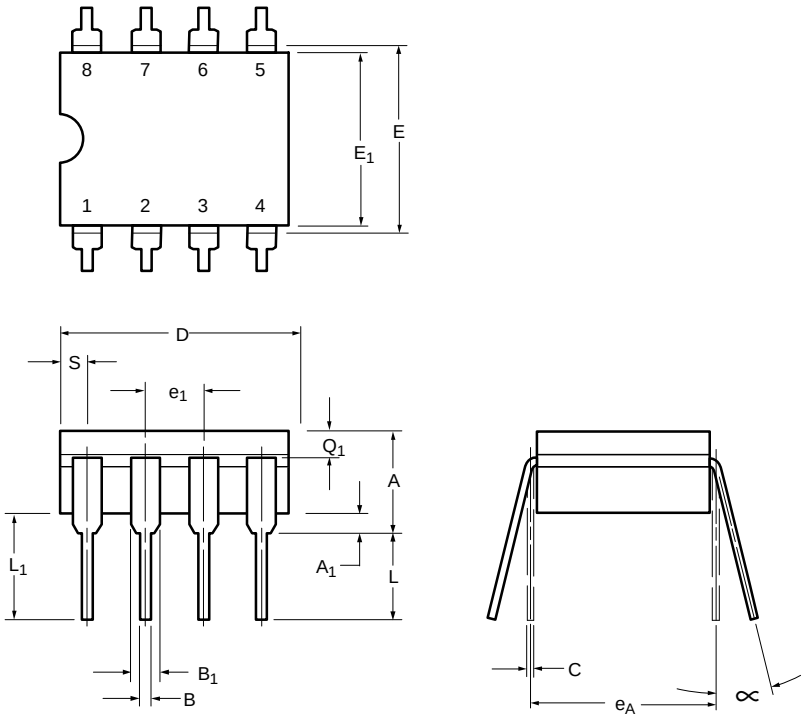


Fig. 9 - Source-Drain Capacitances

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?63275.

CERDIP: 8-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	4.06	5.08	0.160	0.200
A_1	0.51	1.14	0.020	0.045
B	0.38	0.51	0.015	0.020
B_1	1.14	1.65	0.045	0.065
C	0.20	0.30	0.008	0.012
D	9.40	10.16	0.370	0.400
E	7.62	8.26	0.300	0.325
E_1	6.60	7.62	0.260	0.300
e_1	2.54 BSC		0.100 BSC	
e_A	7.62 BSC		0.300 BSC	
L	3.18	3.81	0.125	0.150
L_1	3.18	5.08	0.150	0.200
Q_1	1.27	2.16	0.050	0.085
S	0.64	1.52	0.025	0.060
∝	0°	15°	0°	15°

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