

6 Ω On-Resistance, +12 V, ± 5 V, +5 V, +3 V, SPST and SPDT Switches

DESCRIPTION

DG417LE, DG418LE, DG419LE analog switches are designed to operate from +3 V to +16 V single supply or ± 3 V to ± 8 V dual supply and are fully specified at +12 V, ± 5 V, +5 V, and +3 V.

The DG417LE, DG418LE, DG419LE are lower voltage pin-for-pin compatible companion devices to the industry standard DG417, DG418, and DG419. Each switch conducts equally well in both directions when on, blocks input voltages up to the supply level when off, and exhibits break before switching action.

Fabricated with advanced CMOS technology, the parts provide low on resistance and fast switching speed with low power dissipation.

The DG417LE, DG418LE, DG419LE operating temperature range is -40 °C to +85 °C and devices are available in 8 lead TSSOP and SOIC packages.

FEATURES

- +3 V to +16 V single supply, or ± 3 V to ± 8 V dual supply
- On resistance: 6 Ω for DG417LE, DG418LE
11 Ω for DG419LE
- Fast switching speeds: $t_{ON} = 20$ ns, $t_{OFF} = 15$ ns
- Break-before-make switching for DG419LE
- Fully specified at +12 V, ± 5 V, +5 V, and +3 V
- V+ to V- analog signal range
- CMOS / TTL compatible
- Control logic input can be over V+
- 8 pin TSSOP and 8 pin SOIC packages
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



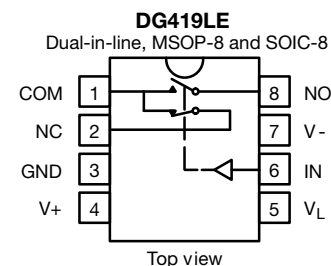
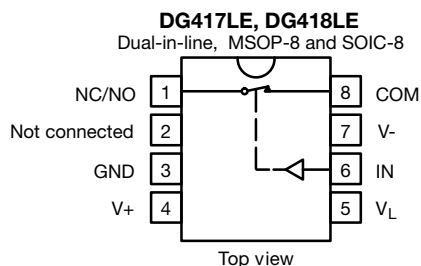
Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

APPLICATIONS

- Data acquisition systems
- Medical instruments
- Precision instruments
- Communications systems
- Automated test equipment
- Sample and hold circuit
- Audio and video signal routing

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE (DG417LE, DG418LE)		
LOGIC	DG417LE	DG418LE
0	On	Off
1	Off	On

ORDERING INFORMATION (DG417LE, DG418LE)		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	8-pin narrow SOIC	DG417LEDY-T1-GE4
		DG418LEDY-T1-GE4
	8-pin MSOP	DG417LEDQ-T1-GE3
		DG418LEDQ-T1-GE3

TRUTH TABLE (DG419LE)		
LOGIC	NC	NO
0	On	Off
1	Off	On

ORDERING INFORMATION (DG419LE)		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	8-pin narrow SOIC	DG419LEDY-T1-GE4
	8-pin MSOP	DG419LEDQ-T1-GE3



ABSOLUTE MAXIMUM RATINGS			
PARAMETER		LIMIT	UNIT
V+, V _L , IN reference to V-		-0.3 to 18	V
V+ reference to GND		-0.3 to 18	
GND reference to V-		-0.3 to 18	
COM, NC, NO reference to V- ^a		-0.3 to (V+ + 0.3) or 30 mA, whichever occurs first	
Continuous current (any terminal)		30	mA
Peak current, S or D (pulsed 1 ms, 10 % duty cycle)		100	
Storage temperature	(DQ, DY suffix)	-65 to +150	°C
Power dissipation (packages) ^b	8-pin MSOP ^c	320	mW
	8-pin SOIC ^c	400	
ESD / HBM	JS-001	2000	V
ESD / CDM	JS-002	2000	
Latch up	JESD78	300	mA

Notes

- a. Signals on NC, NO, or COM 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 6.5 mW/°C above 25 °C

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.



SPECIFICATIONS (Single supply 12 V)							
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	D SUFFIX LIMITS -40 °C to +85 °C		UNIT
					MIN. ^d	MAX. ^d	
Analog Switch							
Analog signal range ^e	V _{ANALOG}		Full	-	0	12	V
Drain-source on-resistance	R _{D_{S(on)}}	V+ = 10.8 V, V- = 0 V I _{NO} , I _{NC} = 5 mA, V _{COM} = 2 V / 9 V, DG417LE, DG418LE only	Room	6	-	7	Ω
			Full	-	-	9	
		V+ = 10.8 V, V- = 0 V I _{NO} , I _{NC} = 5 mA, V _{COM} = 2 V / 9 V, DG419LE only	Room	11	-	14	
			Full	-	-	18	
Switch off leakage current	I _{NO(off)} I _{NC(off)}	V _{COM} = 1 V / 11 V V _{NO} , V _{NC} = 11 V / 1 V	Room	± 0.002	-2	2	nA
			Full	-	-10	10	
	I _{COM(off)}		Room	± 0.003	-2	2	
			Full	-	-10	10	
Switch on leakage current	I _{COM(on)}	V _{NO} , V _{NC} = V _{COM} = 11 V / 1 V	Room	± 0.006	-2	2	
			Full	-	-10	10	
Digital Control							
Input current	I _{INL} or I _{INH}		Full	0.02	-1	1	μA
Dynamic Characteristics							
Turn-on time	t _{ON}	R _L = 300 Ω, C _L = 35 pF V _{NO} , V _{NC} = 5 V	Room	20	-	38	ns
			Full	-	-	40	
Turn-off time	t _{OFF}		Room	15	-	32	
			Full	-	-	35	
Break-before-make time	t _{BBM}	DG419LE only, V _{NC} , V _{NO} = 5 V R _L = 300 Ω, C _L = 35 pF	Room	7	-	-	
Charge injection ^e	Q _{INJ}	V _{GEN} = 0 V, R _{GEN} = 0 Ω, C _L = 1 nF	Room	26	-	-	pC
Off-isolation ^e	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room	-68	-	-	dB
Channel-to-channel crosstalk ^e	X _{TALK}		Room	-72	-	-	
Source off capacitance ^e	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 V or V+, f = 1 MHz, DG417LE, DG418LE only	Room	11	-	-	pF
Drain-on capacitance ^e	C _{ON}		Room	32	-	-	
Source off capacitance ^e	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 V or V+, f = 1 MHz, DG419LE only	Room	6	-	-	
Drain-on capacitance ^e	C _{ON}		Room	20	-	-	
Power Supplies							
Positive supply current	I+	V _{IN} = 0 V or V _L	Room	0.00009	-	1	μA
			Full	-	-	5	
Negative supply current	I-		Room	-0.00009	-1	-	
			Full	-	-5	-	
Logic supply current	I _L		Room	0.00002	-	1	
			Full	-	-	5	
Ground current	I _{GND}		Room	-0.00002	-1	-	
			Full	-	-5	-	



SPECIFICATIONS (Dual supply ± 5 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 5$ V, $V_- = -5$ V $V_L = 5$ V, $V_{IN} = 2.4$ V, 0.8 V ^f	TEMP. ^b	TYP. ^c	D SUFFIX LIMITS -40 °C to +85 °C		UNIT
					MIN. ^d	MAX. ^d	
Analog Switch							
Analog signal range ^e	V_{ANALOG}		Full	-	-5	5	V
Drain-source on-resistance	$R_{DS(on)}$	$V_+ = 5$ V, $V_- = -5$ V $I_{NO}, I_{NC} = 5$ mA, $V_{COM} = \pm 3.5$ V DG417LE / DG418LE only	Room	6	-	8	Ω
			Full	-	-	10	
		$V_+ = 5$ V, $V_- = -5$ V $I_{NO}, I_{NC} = 5$ mA, $V_{COM} = \pm 3.5$ V DG419LE only	Room	12	-	15	
			Full	-	-	21	
Switch off leakage current ^a	$I_{NO(off)}$ $I_{NC(off)}$	$V_+ = 5.5$ V, $V_- = -5.5$ V $V_{COM} = \pm 4.5$ V $V_{NO}, V_{NC} = \pm 4.5$ V	Room	± 0.001	-2	2	nA
			Full	-	-10	10	
	$I_{COM(off)}$		Room	± 0.002	-2	2	
			Full	-	-10	10	
Channel on leakage current ^a	$I_{COM(on)}$	$V_+ = 5.5$ V, $V_- = -5.5$ V $V_{NO}, V_{NC} = V_{COM} = \pm 4.5$ V	Room	± 0.003	-2	2	
			Full	-	-10	10	
Digital Control							
Input current ^a	I_{INL} or I_{INH}		Full	0.02	-1	1	μ A
Dynamic Characteristics							
Turn-on time ^e	t_{ON}	$R_L = 300 \Omega$, $C_L = 35$ pF $V_{NO}, V_{NC} = \pm 3.5$ V	Room	21	-	38	ns
			Full	-	-	40	
Turn-off time ^e	t_{OFF}		Room	20	-	45	
			Full	-	-	50	
Break-before-make time ^e	t_{BBM}	DG419LE only, $V_{NO}, V_{NC} = 3.5$ V $R_L = 300 \Omega$, $C_L = 35$ pF	Room	7	-	-	
Transition time	t_{TRANS}	$R_L = 300 \Omega$, $C_L = 35$ pF $V_{S1} = \pm 3.5$ V, $V_{S2} = \pm 3.5$ V	Room	21	-	-	
Charge injection ^e	Q_{INJ}	$V_{GEN} = 0$ V, $R_{GEN} = 0 \Omega$, $C_L = 1$ nF	Room	-17	-	-	pC
Off-isolation ^e	OIRR	$R_L = 50 \Omega$, $C_L = 5$ pF, $f = 1$ MHz	Room	-69	-	-	dB
Channel-to-channel crosstalk ^e	X_{TALK}		Room	-73	-	-	
Source off capacitance ^e	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0$ V or V_+ , $f = 1$ MHz DG417LE / DG418LE only	Room	11	-	-	pF
Drain-on capacitance ^e	C_{ON}		Room	33	-	-	
Source off capacitance ^e	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0$ V or V_+ , $f = 1$ MHz DG419LE only	Room	6	-	-	
Drain-on capacitance ^e	C_{ON}		Room	20	-	-	
Power Supplies							
Positive supply current ^e	I_+	$V_{IN} = 0$ V or V_L	Room	0.00007	-	1	μ A
			Full	-	-	5	
Negative supply current ^e	I_-		Room	-0.00009	-1	-	
			Full	-	-5	-	
Logic supply current ^e	I_L		Room	0.00002	-	1	
			Full	-	-	5	
Ground current ^e	I_{GND}		Room	-0.00003	-1	-	
			Full	-	-5	-	



SPECIFICATIONS (Single supply 5 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 5 V, V- = 0 V V _L = 5 V, V _{IN} = 2.4 V, 0.8 V ^f	TEMP. ^b	TYP. ^c	D SUFFIX LIMITS -40 °C to +85 °C		UNIT
					MIN. ^d	MAX. ^d	
Analog Switch							
Analog signal range ^e	V _{ANALOG}		Full	-	0	5	V
Drain-source on-resistance ^e	R _{DS(on)}	V+ = 4.5 V, I _{NO} , I _{NC} = 5 mA V _{COM} = 1 V, 3.5 V DG417LE / DG418LE only	Room	12	-	16	Ω
			Full	-	-	18	
		V+ = 4.5 V, I _{NO} , I _{NC} = 5 mA V _{COM} = 1 V, 3.5 V DG419LE only	Room	24	-	35	
			Full	-	-	37	
Switch off leakage current ^a	I _{NO(off)} I _{NC(off)}	V+ = 5.5 V, V- = 0 V V _{COM} = 1 V / 4.5 V V _{NO} , V _{NC} = 4.5 V / 1 V	Room	± 0.002	-1	1	nA
			Full	-	-10	10	
	I _{COM(off)}		Room	± 0.001	-1	1	
			Full	-	-10	10	
Switch on leakage current ^a	I _{COM(on)}	V+ = 5.5 V, V- = 0 V V _{NO} , V _{NC} = V _{COM} = 1 V / 4.5 V	Room	± 0.003	-1	1	
			Full	-	-10	10	
Digital Control							
Input current ^a	I _{INL} or I _{INH}		Full	0.02	-1	1	μA
Dynamic Characteristics							
Turn-on time ^e	t _{ON}	R _L = 300 Ω, C _L = 35 pF V _{NO} , V _{NC} = 3.5 V	Room	29	-	46	ns
			Full	-	-	49	
Turn-off time ^e	t _{OFF}		Room	16	-	28	
			Full	-	-	32	
Break-before-make time ^e	t _{BBM}	DG419LE only, V _{NO} , V _{NC} = 3.5 V R _L = 300 Ω, C _L = 35 pF	Room	16	-	-	
Charge injection ^e	Q _{INJ}	V _{GEN} = 0 V, R _{GEN} = 0 Ω, C _L = 1 nF	Room	10	-	-	pC
Off-isolation ^e	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 1 MHz	Room	-68	-	-	dB
Channel-to-channel crosstalk ^e	X _{TALK}		Room	-72	-	-	
Source off capacitance ^e	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 V or V+, f = 1 MHz DG417LE / DG418LE only	Room	13	-	-	pF
Drain-on capacitance ^e	C _{ON}		Room	34	-	-	
Source off capacitance ^e	C _{NO(off)} C _{NC(off)}	V _{IN} = 0 V or V+, f = 1 MHz DG419LE only	Room	7	-	-	pF
Drain-on capacitance ^e	C _{ON}		Room	22	-	-	
Power Supplies							
Positive supply current ^e	I+	V _{IN} = 0 V or V _L	Room	0.00006	-	1	μA
			Full	-	-	5	
Negative supply current ^e	I-		Room	-0.00006	-1	-	
			Full	-	-5	-	
Logic supply current ^e	I _L		Room	0.00002	-	1	
			Full	-	-	5	
Ground current ^e	I _{GND}		Room	-0.00002	-1	-	
			Full	-	-5	-	



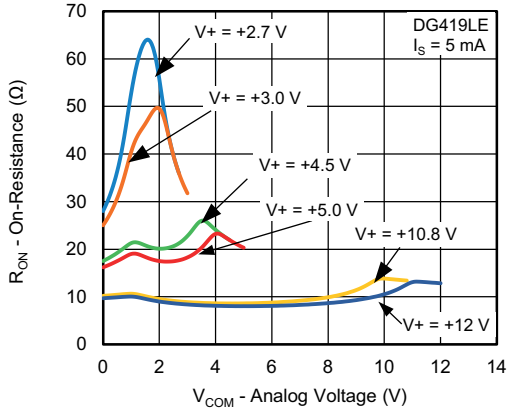
SPECIFICATIONS (Single supply 3 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 3\text{ V}$, $V_- = 0\text{ V}$ $V_L = 3\text{ V}$, $V_{IN} = 2\text{ V}$, 0.4 V^f	TEMP. ^b	TYP. ^c	D SUFFIX LIMITS -40 °C to +85 °C		UNIT
					MIN. ^d	MAX. ^d	
Analog Switch							
Analog signal range ^e	V_{ANALOG}		Full	-	0	3	V
Drain-source on-resistance	$R_{DS(on)}$	$V_+ = 2.7\text{ V}$, $V_- = 0\text{ V}$ I_{NO} , $I_{NC} = 5\text{ mA}$, $V_{COM} = 0.5\text{ V}$, 2.2 V DG417LE / DG418LE only	Room	22	-	34	Ω
			Full	-	-	38	
			Room	43	-	68	
			Full	-	-	75	
Switch off leakage current ^a	$I_{NO(off)}$ $I_{NC(off)}$	$V_+ = 3.3\text{ V}$, $V_- = 0\text{ V}$ $V_{COM} = 1\text{ V}$, 2 V , V_{NO} , $V_{NC} = 2\text{ V}$, 1 V	Room	± 0.002	-1	1	nA
			Full	-	-10	10	
	Room		± 0.001	-1	1		
	Full		-	-10	10		
Channel on leakage current ^a	$I_{COM(on)}$	$V_+ = 3.3\text{ V}$, $V_- = 0\text{ V}$ V_{NO} , $V_{NC} = V_{COM} = 1\text{ V}$, 2 V	Room	± 0.002	-1	1	
			Full	-	-10	10	
Digital Control							
Input current ^a	I_{INL} or I_{INH}		Full	0.02	-1	1	μA
Dynamic Characteristics							
Turn-on time	t_{ON}	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ V_{NO} , $V_{NC} = 1.5\text{ V}$	Room	59	-	77	ns
			Full	-	-	81	
Turn-off time	t_{OFF}		Room	33	-	54	
			Full	-	-	69	
Break-before-make time ^e	t_{BBM}	DG419LE only, V_{NO} , $V_{NC} = 1.5\text{ V}$ $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$	Room	31	-	-	
Charge injection ^e	Q_{INJ}	$V_{GEN} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, $C_L = 10\text{ nF}$	Room	6	-	-	pC
Off-isolation ^e	OIRR	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$	Room	-68	-	-	dB
Channel-to-channel crosstalk ^e	X_{TALK}		Room	-71	-	-	
Source off capacitance ^e	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0\text{ V}$ or V_+ , $f = 1\text{ MHz}$ DG417LE / DG418LE only	Room	14	-	-	pF
Channel on capacitance ^e	$C_{D(on)}$		Room	35	-	-	
Source off capacitance ^e	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0\text{ V}$ or V_+ , $f = 1\text{ MHz}$ DG419LE only	Room	8	-	-	
Channel on capacitance ^e	$C_{D(on)}$		Room	23	-	-	
Power Supplies							
Positive supply current ^e	I_+	$V_{IN} = 0\text{ V}$ or V_L	Room	0.00005	-	1	μA
			Full	-	-	5	
Negative supply current ^e	I_-		Room	-0.00007	-1	-	
			Full	-	-5	-	
Logic supply current ^e	I_L		Room	0.00002	-	1	
			Full	-	-	5	
Ground current ^e	I_{GND}		Room	-0.00002	-1	-	
			Full	-	-5	-	

Notes

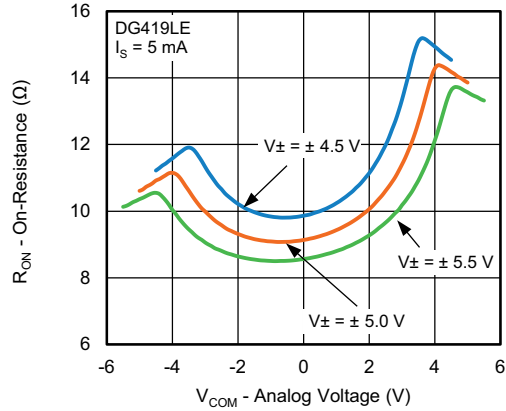
- a. Leakage parameters are guaranteed by worst case test condition and not subject to production test
- b. Room = 25 °C, full = as determined by the operating temperature suffix
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
- d. The algebraic convention 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



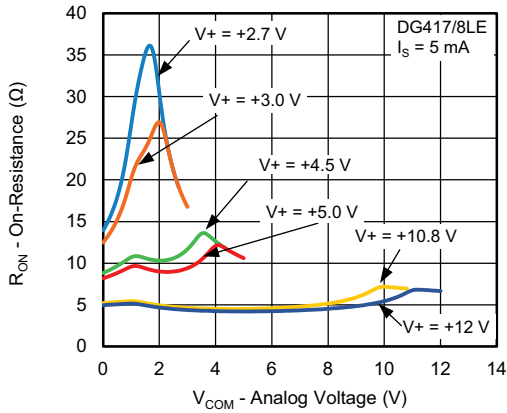
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



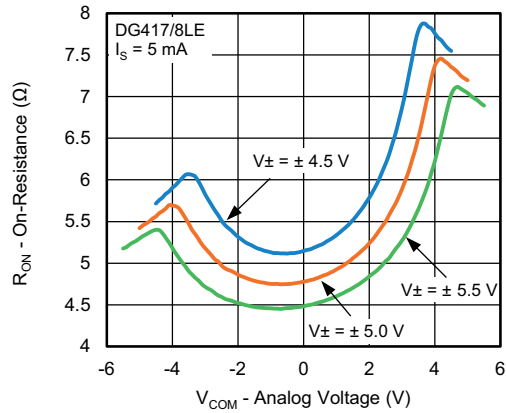
R_{DS(on)} vs. V_{COM} and Supply Voltage



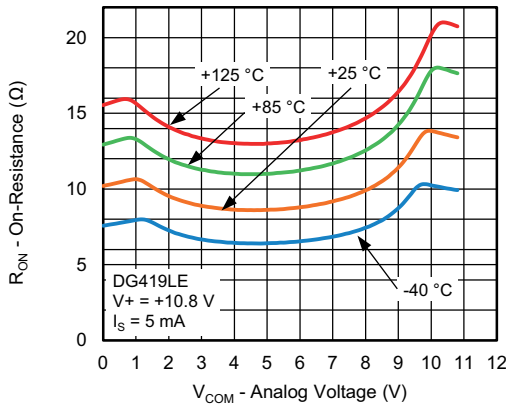
R_{DS(on)} vs. V_{COM} and Supply Voltage



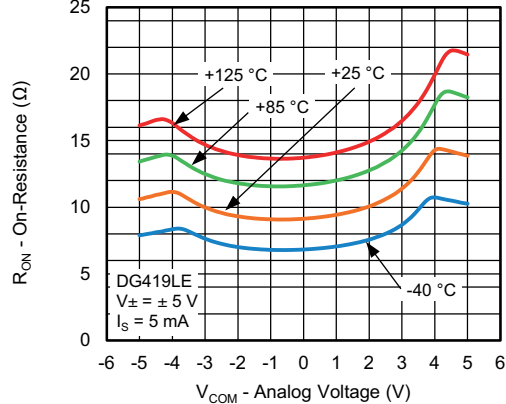
R_{DS(on)} vs. V_{COM} and Supply Voltage



R_{DS(on)} vs. V_{COM} and Supply Voltage



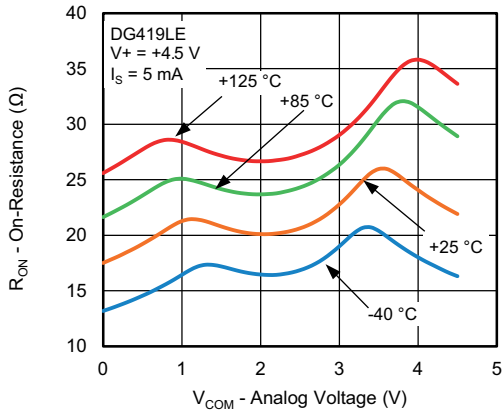
R_{DS(on)} vs. Analog Voltage and Temperature



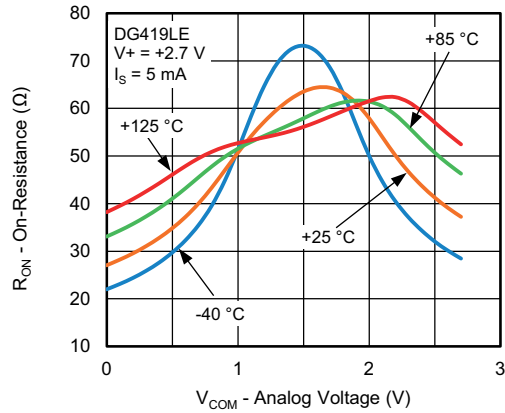
R_{DS(on)} vs. Analog Voltage and Temperature



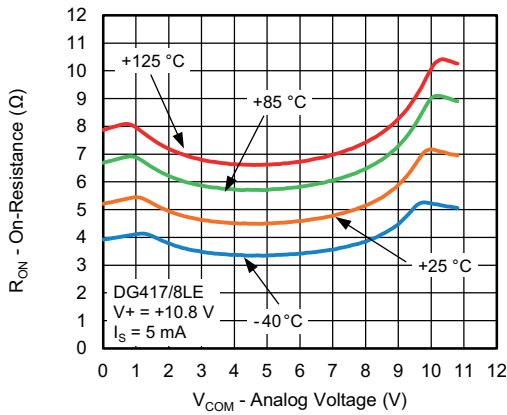
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



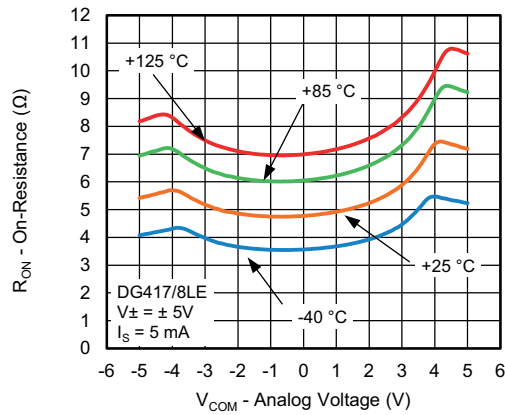
R_{DS(on)} vs. Analog Voltage and Temperature



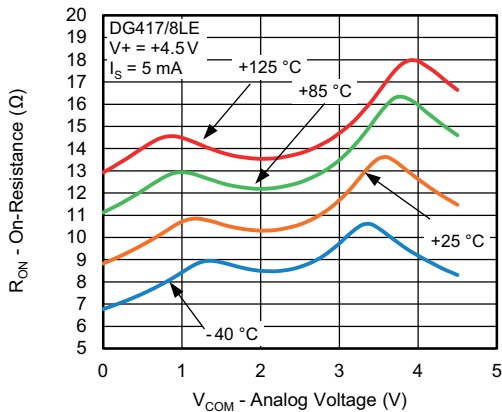
R_{DS(on)} vs. Analog Voltage and Temperature



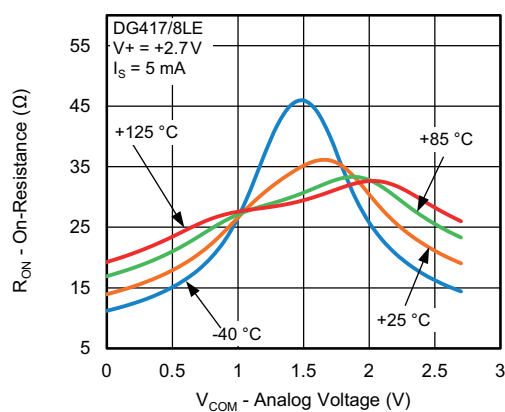
R_{DS(on)} vs. Analog Voltage and Temperature



R_{DS(on)} vs. Analog Voltage and Temperature



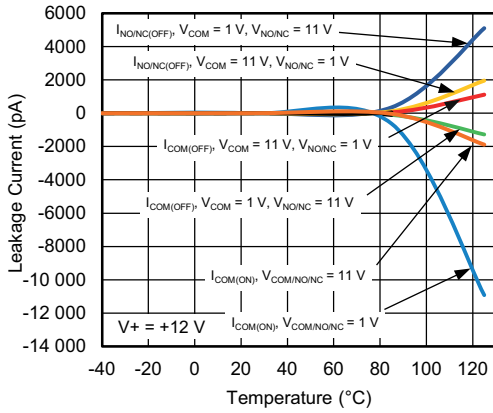
R_{DS(on)} vs. Analog Voltage and Temperature



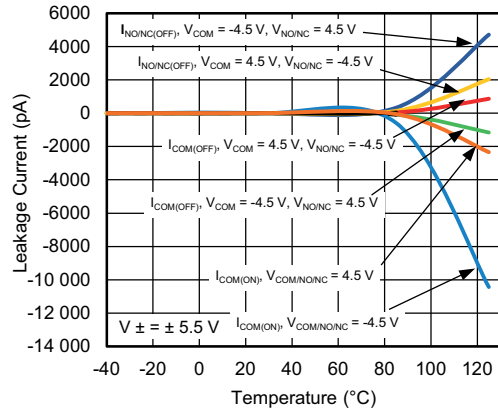
R_{DS(on)} vs. Analog Voltage and Temperature



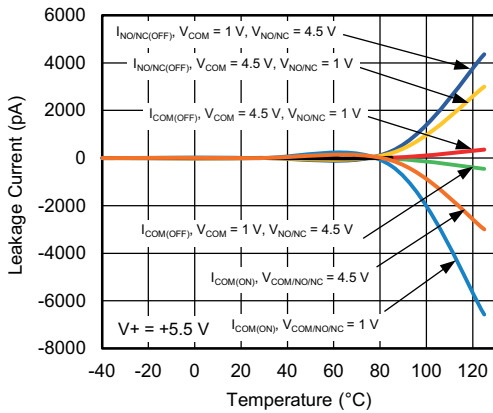
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



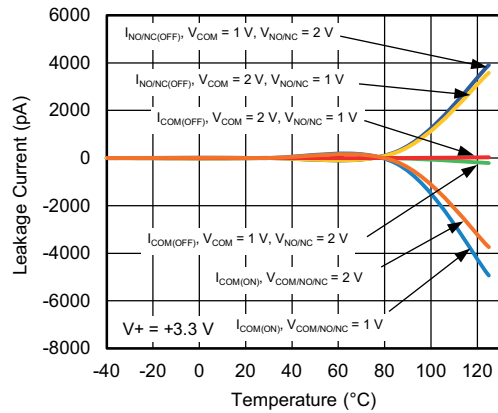
Leakage Current vs. Temperature



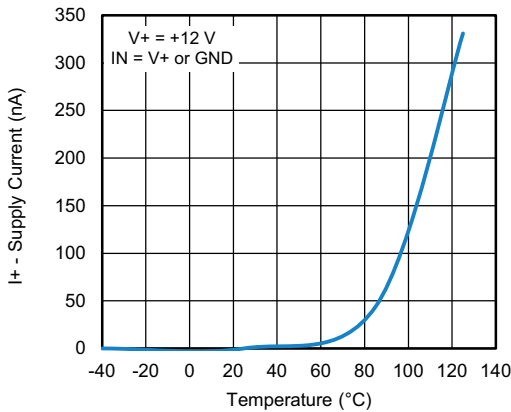
Leakage Current vs. Temperature



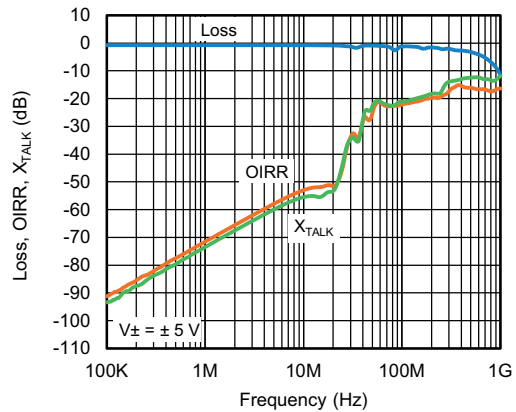
Leakage Current vs. Temperature



Leakage Current vs. Temperature



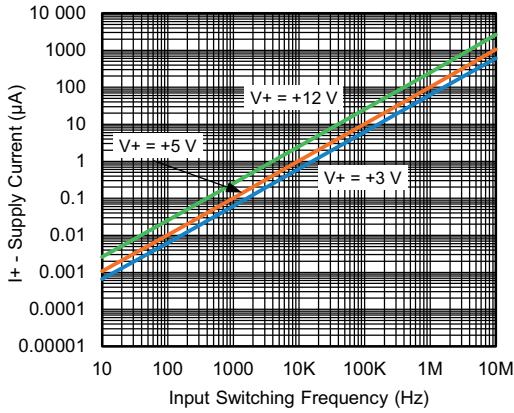
Supply Current vs. Temperature



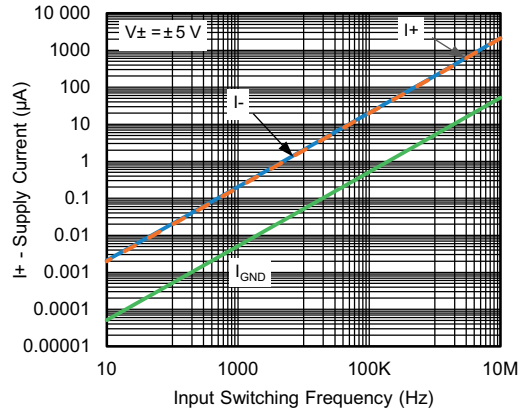
Insertion Loss, Off-Isolation Crosstalk vs. Frequency



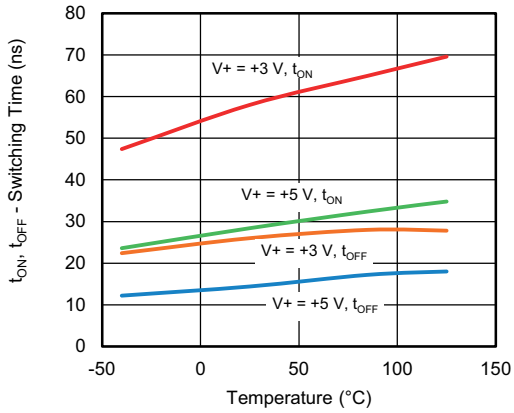
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



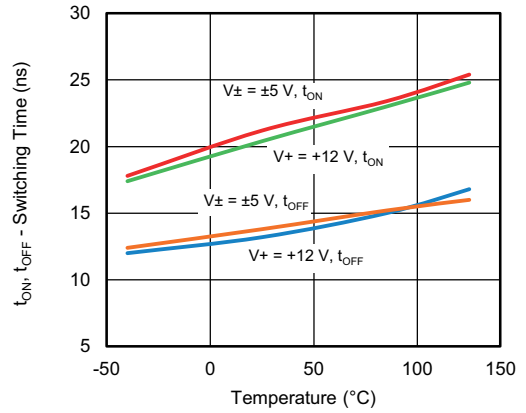
Supply Current vs. Input Switching Frequency



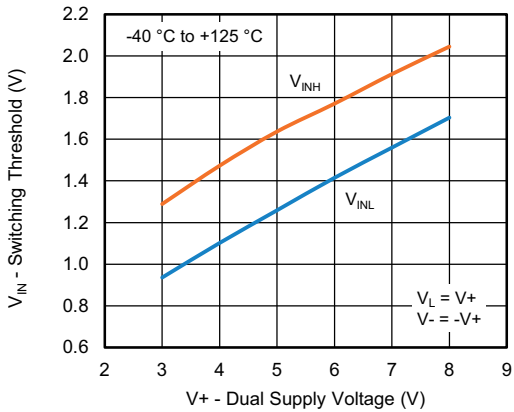
Supply Current vs. Input Switching Frequency



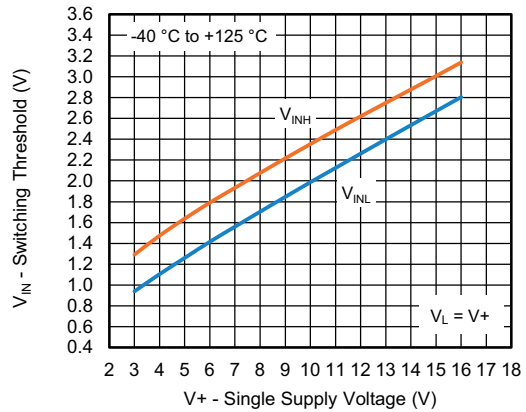
Switching Time vs. Temperature



Switching Time vs. Temperature



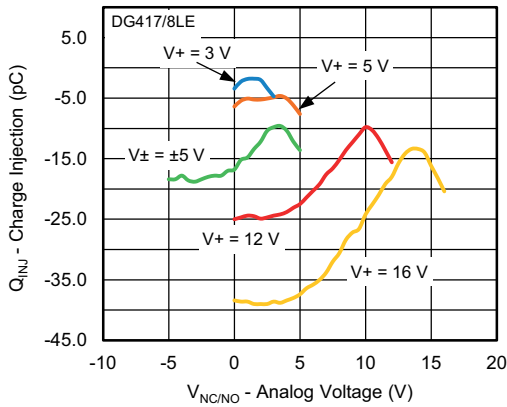
Switching Threshold vs. Dual Supply Voltage



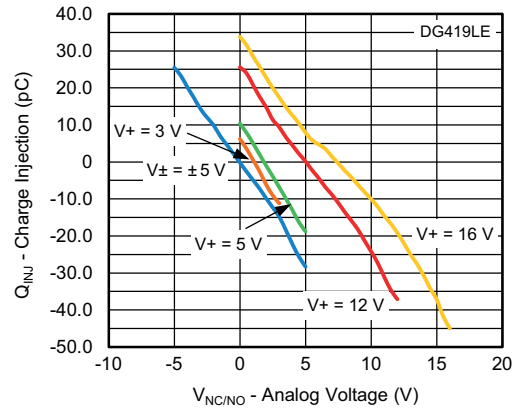
Switching Threshold vs. Single Supply Voltage



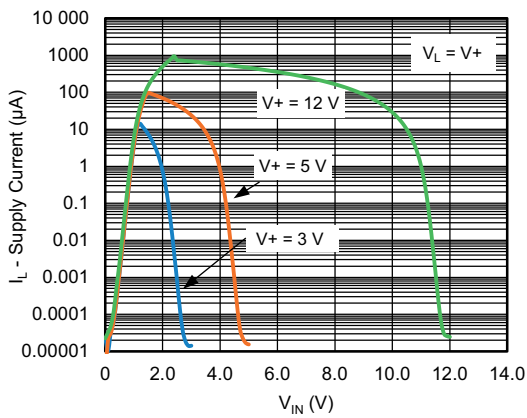
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Charge Injection vs. Analog Voltage

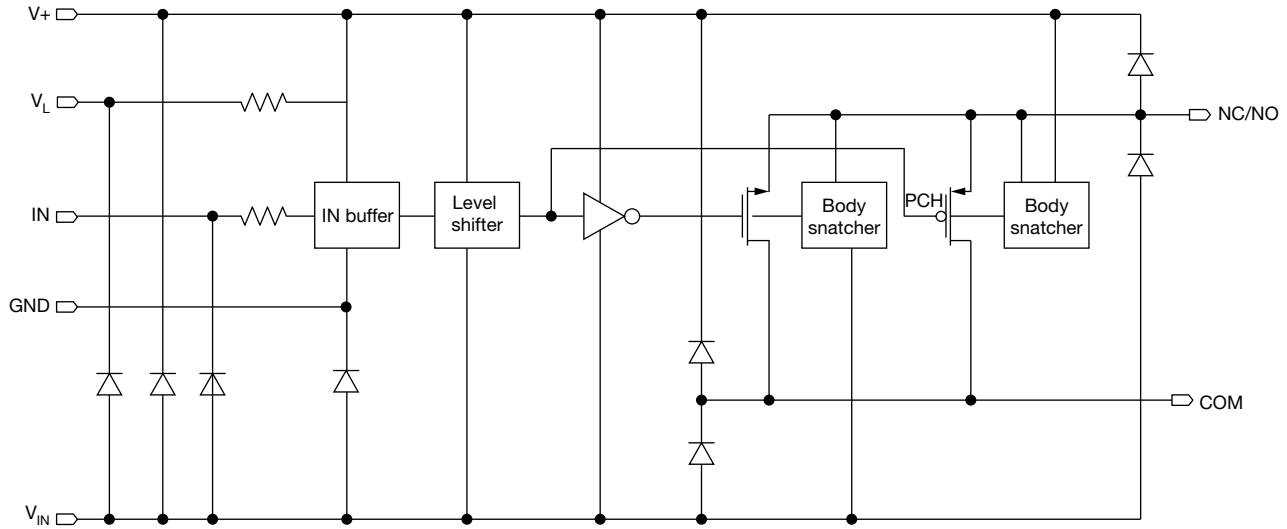


Charge Injection vs. Analog Voltage

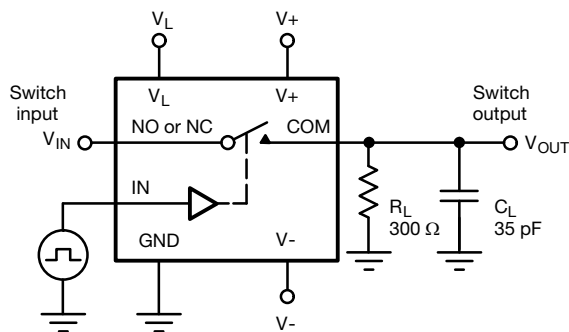


Supply Current vs. Enable Input Voltage

SCHEMATIC DIAGRAM (Typical channel)

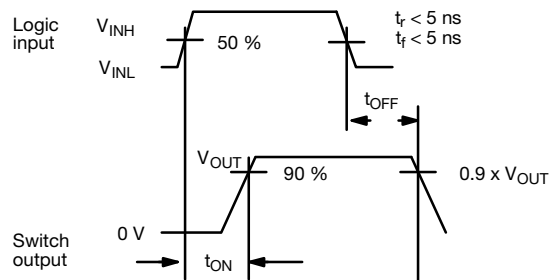


TEST CIRCUITS



C_L (includes fixture and stray capacitance)

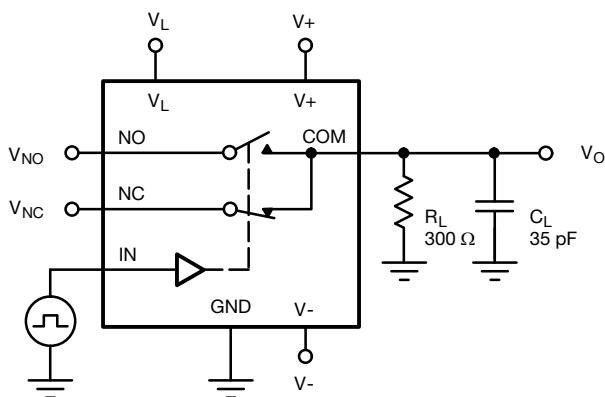
$$V_{OUT} = V_{IN} \frac{R_L}{R_L + R_{ON}}$$



Note

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

Fig. 1 - Switching Time



C_L (includes fixture and stray capacitance)

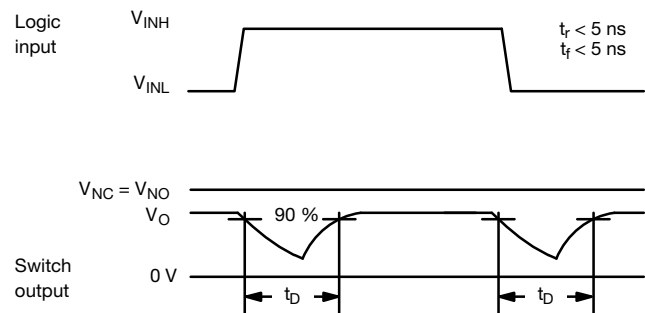
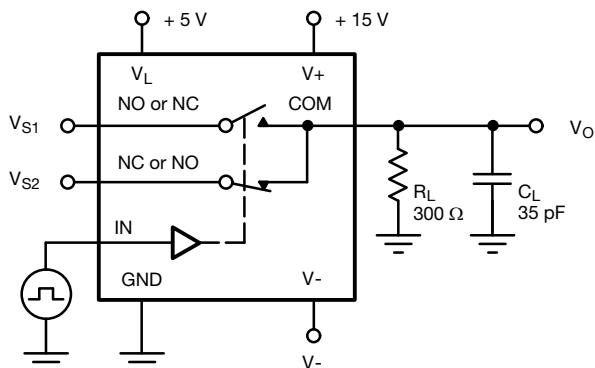


Fig. 2 - Break-Before-Make (DG419LE)

TEST CIRCUITS



C_L (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + R_{ON}}$$

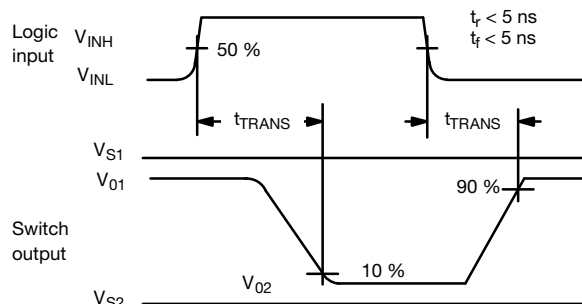
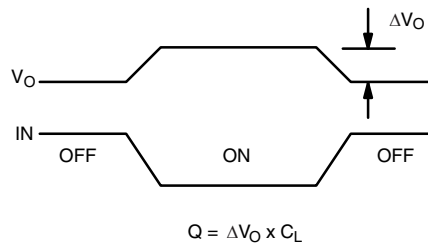
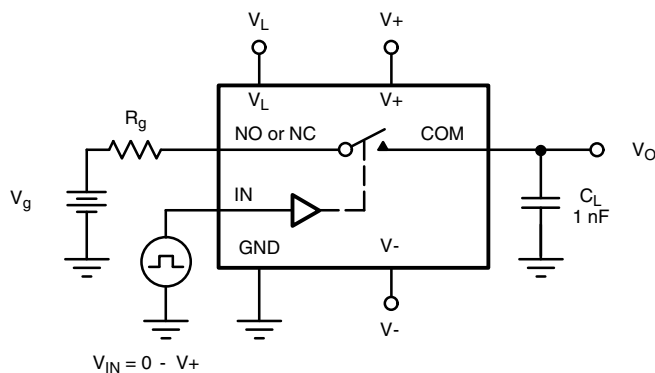
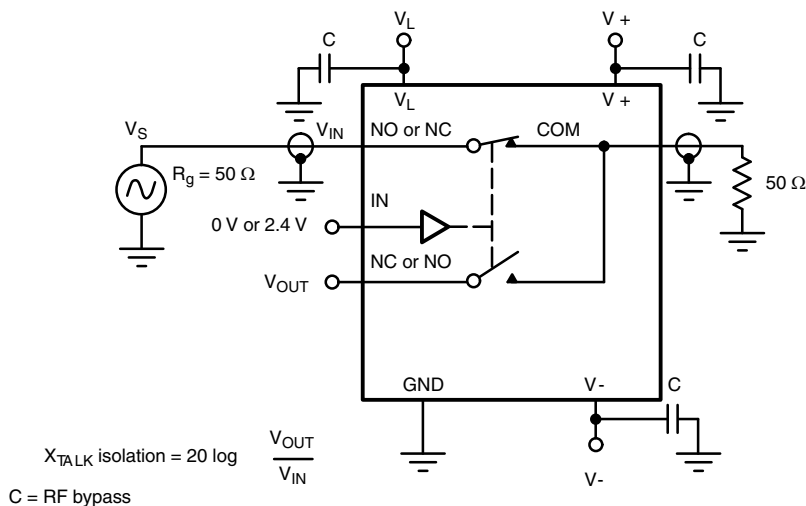


Fig. 3 - Transition Time (DG419LE)



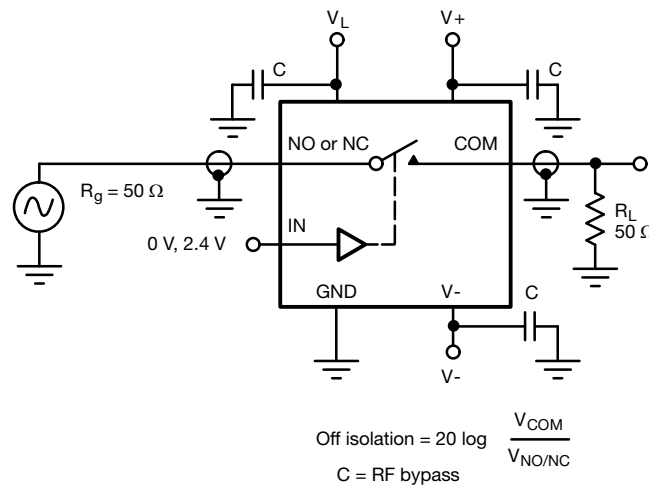
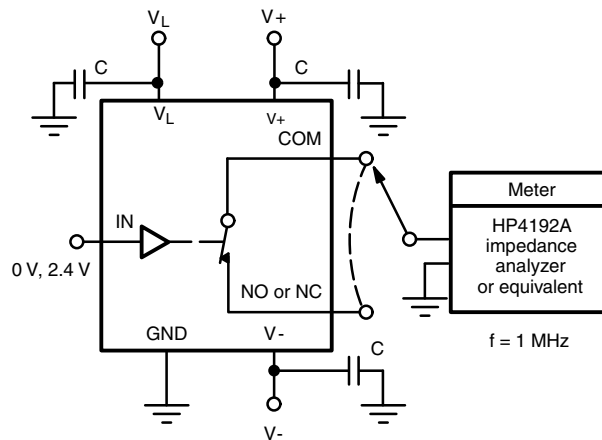
IN dependent on switch configuration input polarity determined by sense of switch.

Fig. 4 - Charge Injection



$X_{TALK} \text{ isolation} = 20 \log \frac{V_{OUT}}{V_{IN}}$
 $C = \text{RF bypass}$

Fig. 5 - Crosstalk (DG419LE)

TEST CIRCUITS

Fig. 6 - Off Isolation

Fig. 7 - Channel Capacitances

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