Power-off Isolation, 6 Ω, 1.8 V to 5.5 V, SPDT Analog Switch (2:1 Multiplexer)

DESCRIPTION

The DG4599E is a high performance single-pole, double-throw (SPDT) analog switch designed for 1.8 V to 5.5 V operation with a single power rail.

Fabricated with high density CMOS technology, the device achieves low on resistance of 6 Ω and switch off capacitance of 7 pF at a 5 V power supply and low power consumption, and fast switching speeds.

The DG4599E features break before make switching performance. It can handle both analog and digital signals and permits signals with amplitudes of up to V+ to be transmitted in either direction.

A power-off protection circuit is built into the switch to prevent an abnormal current path through the signal pins during the power-off condition. The part can withstand greater than 7 kV ESD (human body model). The DG4599E is available in the compact SC-70-6L package.

FEATURES

Pb-free Available

RoHS* Available

- Low switch on-resistance (6 Ω)
- +1.8 V to +5.5 V single supply operation
- Isolation in powered-off mode
- Low voltage logic control
- Control logic inputs can go over V+
- Low parasitic capacitance
- Break before make switching
- Latch-up performance exceeds 200 mA per JESD 78
- High ESD rating
  - 7000 V human body model (JS-001)
  - 1000 V charge device model (JS-002)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note

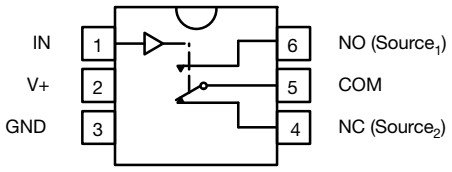
* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

APPLICATIONS

- Battery powered devices
- Consumer and computing
- Instrumentation
- Medical equipment
- Control and automation

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

SC-70



Top view

Device marking

● H8

TRUTH TABLE		
LOGIC	NC	NO
0	On	Off
1	Off	On

Notes

- Logic “0” ≤ 0.8 V
- Logic “1” ≥ 2.4 V

ORDERING INFORMATION		
TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	SC-70-6	DG4599EDL-T1-GE3

ABSOLUTE MAXIMUM RATINGS

PARAMETER		LIMIT	UNIT
V+, COM, NC, NO, IN reference to GND		-0.3 to 6	V
Continuous current (any terminal)		± 50	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)		± 200	
Storage temperature		-65 to +150	°C
Power dissipation (packages) [a]	6-pin SC-70 [b]	250	mW
ESD / HBM	JS-001	7000	V
ESD / CDM	JS-002	1000	
Latch up	Per JESD78 with 1.5 x voltage clamp	200	mA

Notes
a. All leads welded or soldered to PC board
b. Derate 3.1 mW/°C above 70 °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 (V+ = 5 V)

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 5 V, ± 10 % V_{IN} = 0.8 V or 2.4 V [e]	TEMP. [a]	LIMITS -40 °C to +85 °C MIN. [b]	TYP. [c]	MAX. [b]	UNIT
Analog Switch							
Analog signal range [d]	V_{NO}, V_{NC} V_{COM}		Full	0	-	V+	V
Drain-source on-resistance [d]	$R_{DS(on)}$	V+ = 4.5 V, V_{COM} = 3 V, I_{NO}, I_{NC} = 10 mA	Room	-	6	60	Ω
			Full	-	8	65	
$R_{DS(on)}$ flatness [d]	$R_{DS(on)}$ flatness	V+ = 5 V, V_{COM} = 1.5 V, 3.5 V, I_{NO}, I_{NC} = 10 mA	Room	-	0.4	-	
$R_{DS(on)}$ match [d]	$\Delta R_{DS(on)}$	V+ = 4.5 V, V_{COM} = 3 V, I_{NO}, I_{NC} = 10 mA	Room	-	0.04	2	
Switch-off leakage current [f]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 5.5 V, V_{NO}, V_{NC} = 1 V / 4.5 V, V_{COM} = 4.5 V / 1 V	Room	-1.5	-	1.5	nA
			Full	-4	-	4	
	$I_{COM(off)}$		Room	-1	-	1	
			Full	-4	-	4	
Channel-on leakage current [f]	$I_{COM(on)}$	V+ = 5.5 V, V_{NO}, V_{NC} = V_{COM} = 1 V / 4.5 V	Room	-1	-	1	
			Full	-4	-	4	
Power-down leakage	I_{PD}	V+ = 0 V, V_{COM} = 5 V, NO/NC open, V_{IN} = GND	Full	-	-	5	µA
		V+ = 0 V, V_{NO}, V_{NC} = 5 V, COM open, V_{IN} = GND	Full	-	-	5	
Digital Control							
Input high voltage	V_{INH}		Full	2.4	-	-	V
Input low voltage	V_{INL}		Full	-	-	0.8	
Input capacitance [d]	C_{IN}		Full	-	6	-	pF
Input current	I_{INL} or I_{INH}	V_{IN} = 0 V or V+	Full	-1	-	1	µA
Dynamic Characteristics							
Turn-on time [d]	t_{ON}	V_{NO} or V_{NC} = 3 V, R_L = 300 Ω, C_L = 35 pF	Room	-	10	30	ns
			Full	-	-	40	
Turn-off time [d]	t_{OFF}		Room	-	8	25	
			Full	-	-	30	
Break-before-make time [d]	t_{BBM}		Room	1	-	-	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, V_{NO}, V_{NC} = 0 V, R_{GEN} = 0 Ω	Room	-	1	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-78	-	dB
Crosstalk [d]	X_{TALK}		Room	-	-77	-	
NO, NC off capacitance [d]	$C_{NO(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	7	-	pF
	$C_{NC(off)}$		Room	-	7	-	
Channel-on capacitance [d]	C_{ON}		Room	-	13	-	
Power Supply							
Power supply current [d]	I+	V_{IN} = 0 V or V+	Full	-	0.004	1	µA

SPECIFICATIONS (V+ = 3 V)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED** V+ = 3 V, ± 10 % V_{IN} = 0.4 V or 2 V [e]	**TEMP.** [a]	**LIMITS** -40 °C to +85 °C			**UNIT**
				MIN. [b]	**TYP.** [c]	**MAX.** [b]	
Analog Switch							
Analog signal range [d]	V_{NO}, V_{NC} V_{COM}		Full	0	-	V+	V
Drain-source on-resistance [d]	$R_{DS(on)}$	V+ = 2.7 V, V_{COM} = 1.5 V, I_{NO}, I_{NC} = 10 mA	Room	-	13	95	Ω
			Full	-	15	105	
$R_{DS(on)}$ flatness [d]	$R_{DS(on)}$ flatness	V+ = 3 V, V_{COM} = 0 V to V+, I_{NO}, I_{NC} = 10 mA	Room	-	1.4	-	
$R_{DS(on)}$ match [d]	$\Delta R_{DS(on)}$	V+ = 2.7 V, V_{COM} = 1.5 V, I_{NO}, I_{NC} = 10 mA	Room	-	0.03	2	
Switch-off leakage current [f]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 3.3 V, V_{NO}, V_{NC} = 1 V / 3 V, V_{COM} = 3 V / 1 V	Room	-400	-	400	pA
			Full	-4	-	4	nA
	$I_{COM(off)}$		Room	-800	-	800	pA
			Full	-8	-	8	nA
Channel-on leakage current [f]	$I_{COM(on)}$	V+ = 3.3 V, V_{NO}, V_{NC} = V_{COM} = 1 V / 3 V	Room	-800	-	800	pA
			Full	-8	-	8	nA
Digital Control							
Input high voltage	V_{INH}		Full	2	-	-	V
Input low voltage	V_{INL}		Full	-	-	0.4	
Input capacitance [d]	C_{IN}		Full	-	6	-	pF
Input current	I_{INL} or I_{INH}	V_{IN} = 0 V or V+	Full	-1	-	1	µA
Dynamic Characteristics							
Turn-on time [d]	t_{ON}	V_{NO} or V_{NC} = 2 V, R_L = 300 Ω, C_L = 35 pF	Room	-	13	45	ns
			Full	-	-	55	
Turn-off time [d]	t_{OFF}		Room	-	9	35	
			Full	-	-	40	
Break-before-make time [d]	t_{BBM}		Room	1	-	-	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, V_{NO}, V_{NC} = 0 V, R_{GEN} = 0 Ω	Room	-	0.9	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-78	-	dB
Crosstalk [d]	X_{TALK}		Room	-	-77	-	
NO, NC off capacitance [d]	$C_{NO(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	7	-	pF
	$C_{NC(off)}$		Room	-	7	-	
Channel-on capacitance [d]	C_{ON}		Room	-	14	-	
Power Supply							
Power supply current [d]	I+	V_{IN} = 0 V or V+	Full	-	0.002	1	µA

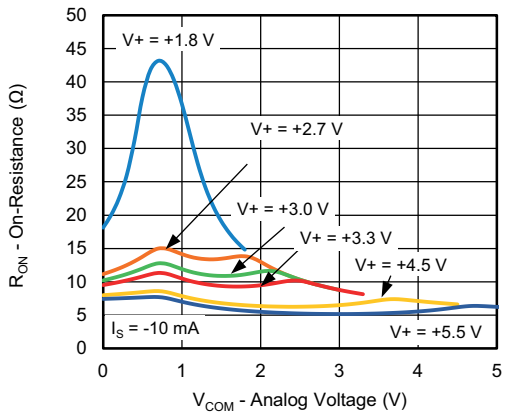
SPECIFICATIONS (V+ = 2.5 V)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED** V+ = 2.5 V, ± 10 % V_{IN} = 0.4 V or 2 V [e]	**TEMP.** [a]	**LIMITS** -40 °C to +85 °C			**UNIT**
				MIN. [b]	**TYP.** [c]	**MAX.** [b]	
Analog Switch							
Analog signal range [d]	V_{NO}, V_{NC} V_{COM}		Full	0	-	V+	V
Drain-source on-resistance [d]	$R_{DS(on)}$	V+ = 2.2 V, V_{COM} = 1 V, I_{NO}, I_{NC} = 10 mA	Room	-	23	110	Ω
			Full [d]	-	24	120	
$R_{DS(on)}$ flatness [d]	$R_{DS(on)}$ flatness	V+ = 2.5 V, V_{COM} = 0 V to V+, I_{NO}, I_{NC} = 10 mA	Room	-	1.7	-	
$R_{DS(on)}$ match [d]	$\Delta R_{DS(on)}$	V+ = 2.2 V, V_{COM} = 1.2 V, I_{NO}, I_{NC} = 10 mA	Room	-	0.1	2	
Switch-off leakage current [f]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 2.7 V, V_{NO}, V_{NC} = 0.5 V / 1.5 V, V_{COM} = 1.5 V / 0.5 V	Room	-200	-	200	pA
			Full [d]	-3	-	3	nA
	$I_{COM(off)}$		Room	-200	-	200	pA
			Full [d]	-3	-	3	nA
Channel-on leakage current [f]	$I_{COM(on)}$	V+ = 2.7 V, V_{NO}, V_{NC} = V_{COM} = 0.5 V / 1.5 V	Room	-200	-	200	pA
			Full [d]	-3	-	3	nA
Digital Control							
Input high voltage	V_{INH}		Full	2	-	-	V
Input low voltage	V_{INL}		Full	-	-	0.4	
Input capacitance [d]	C_{IN}		Full	-	6	-	pF
Input current	I_{INL} or I_{INH}	V_{IN} = 0 V or V+	Full	-1	-	1	µA
Dynamic Characteristics							
Turn-on time [d]	t_{ON}	V_{NO} or V_{NC} = 1.5 V, R_L = 300 Ω, C_L = 35 pF	Room	-	16	50	ns
			Full [d]	-	-	60	
Turn-off time [d]	t_{OFF}		Room	-	10	35	
			Full	-	-	45	
Break-before-make time [d]	t_{BBM}		Room [d]	1	-	-	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, V_{NO}, V_{NC} = 0 V, R_{GEN} = 0 Ω	Room	-	0.9	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-78	-	dB
Crosstalk [d]	X_{TALK}		Room	-	-77	-	
NO, NC off capacitance [d]	$C_{NO(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	7	-	pF
	$C_{NC(off)}$		Room	-	7	-	
Channel-on capacitance [d]	C_{ON}		Room	-	14	-	
Power Supply							
Power supply current [d]	I+	V_{IN} = 0 V or V+	Full	-	-	1	µA

SPECIFICATIONS (V+ = 2 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 2 V, ± 10 % V_{IN} = 0.4 V or 1.6 V [e]	TEMP. [a]	LIMITS -40 °C to +85 °C MIN. [b]	TYP. [c]	MAX. [b]	UNIT
Analog Switch							
Analog signal range [d]	V_{NO}, V_{NC} V_{COM}		Full	0	-	V+	V
Drain-source on-resistance [d]	$R_{DS(on)}$	V+ = 1.8 V, V_{COM} = 1 V, I_{NO}, I_{NC} = 10 mA	Room	-	37	110	Ω
			Full [d]	-	36	120	
$R_{DS(on)}$ flatness [d]	$R_{DS(on)}$ flatness	V+ = 2 V, V_{COM} = 0 V to V+, I_{NO}, I_{NC} = 10 mA	Room	-	3	-	
$R_{DS(on)}$ match [d]	$\Delta R_{DS(on)}$	V+ = 1.8 V, V_{COM} = 1 V, I_{NO}, I_{NC} = 10 mA	Room	-	0.04	2	
Switch-off leakage current [f]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 2.2 V, V_{NO}, V_{NC} = 0.5 V / 1.5 V, V_{COM} = 1.5 V / 0.5 V	Room	-200	-	200	pA
			Full [d]	-3	-	3	nA
	$I_{COM(off)}$		Room	-200	-	200	pA
			Full [d]	-3	-	3	nA
Channel-on leakage current [f]	$I_{COM(on)}$	V+ = 2.2 V, V_{NO}, V_{NC} = V_{COM} = 0.5 V / 1.5 V	Room	-200	-	200	pA
			Full [d]	-3	-	3	nA
Digital Control							
Input high voltage	V_{INH}		Full	1.6	-	-	V
Input low voltage	V_{INL}		Full	-	-	0.4	
Input capacitance [d]	C_{IN}		Full	-	6	-	pF
Input current	I_{INL} or I_{INH}	V_{IN} = 0 V or V+	Full	-1	-	1	µA
Dynamic Characteristics							
Turn-on time [d]	t_{ON}	V_{NO} or V_{NC} = 1.5 V, R_L = 300 Ω, C_L = 35 pF	Room	-	21	50	ns
			Full [d]	-	-	60	
Turn-off time [d]	t_{OFF}		Room	-	13	35	
			Full [d]	-	-	45	
Break-before-make time [d]	t_{BBM}		Room	1	-	-	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, V_{NO}, V_{NC} = 0 V, R_{GEN} = 0 Ω	Room	-	0.8	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-78	-	dB
Crosstalk [d]	X_{TALK}		Room	-	-77	-	
NO, NC off capacitance [d]	$C_{NO(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	7	-	pF
	$C_{NC(off)}$		Room	-	7	-	
Channel-on capacitance [d]	C_{ON}		Room	-	14	-	
Power Supply							
Power supply current [d]	I+	V_{IN} = 0 V or V+	Full	-	-	1	µA

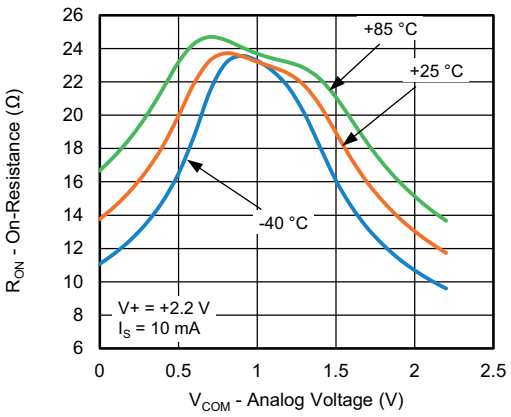
Notes

a. Room = 25 °C, full = as determined by the operating suffix
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
c. Typical values are for design aid only, not guaranteed nor subject to production testing
d. Guarantee by design, nor subjected to production test
e. V_{IN} = input voltage to perform proper function
f. Guaranteed by 5 V leakage testing, not production tested

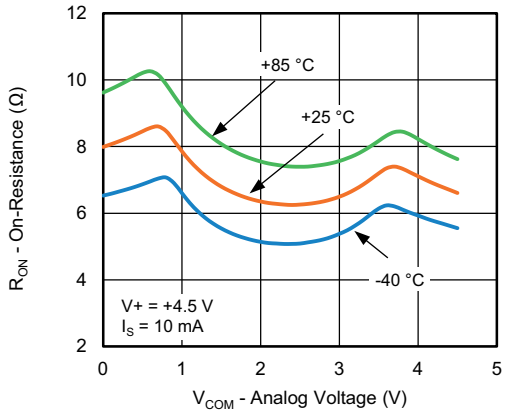
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



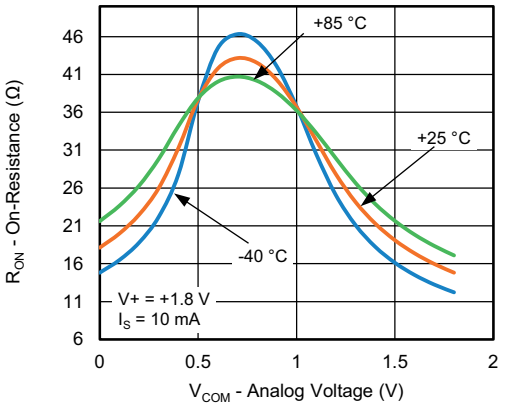
$R_{DS(on)}$ vs. V_{COM} and Supply Voltage



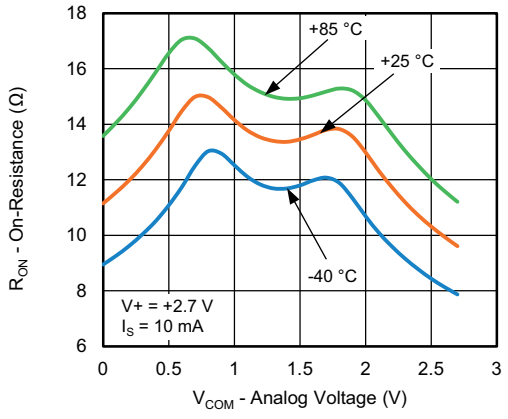
$R_{DS(on)}$ vs. Analog Voltage and Temperature



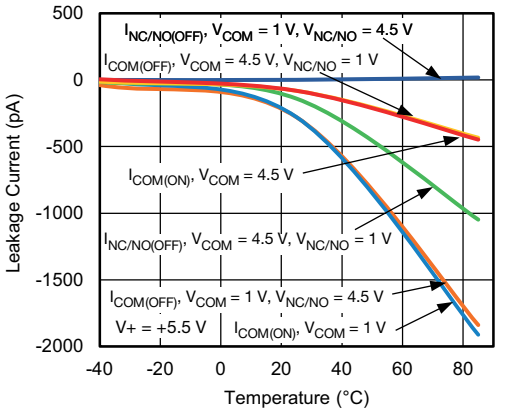
$R_{DS(on)}$ vs. Analog Voltage and Temperature



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

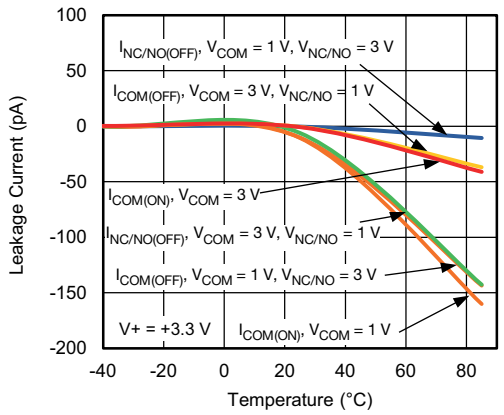


$R_{DS(on)}$ vs. Analog Voltage and Temperature

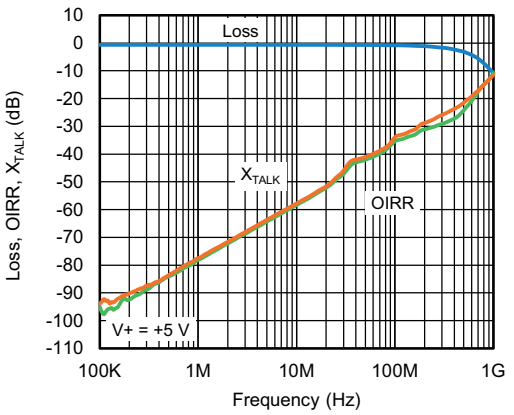


Leakage Current vs. Temperature

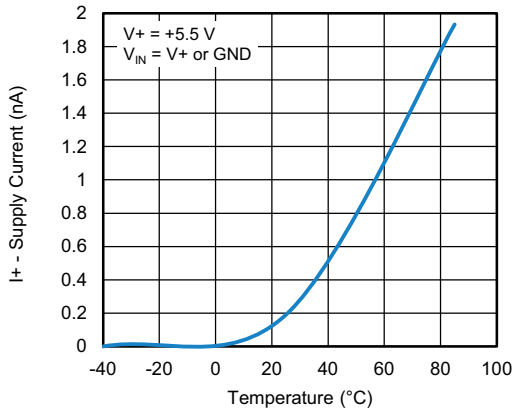
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



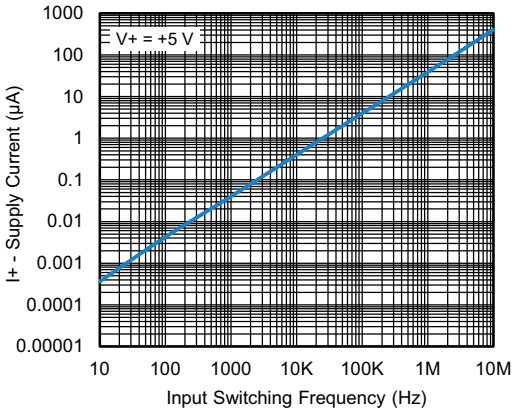
Leakage Current vs. Temperature



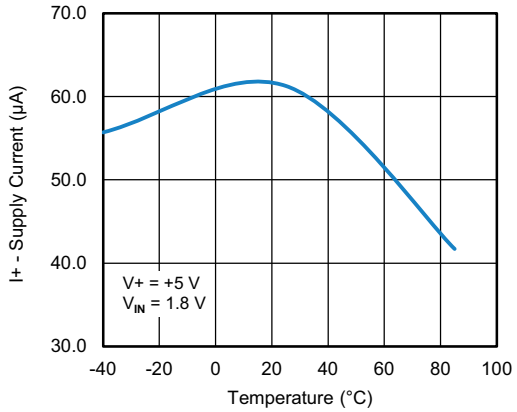
Insertion Loss, Off-Isolation Crosstalk vs. Frequency



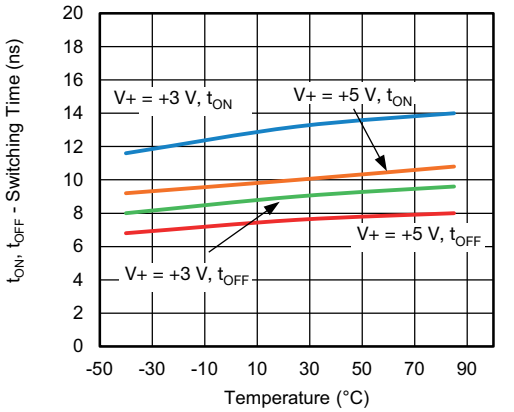
Supply Current vs. Temperature



Supply Current vs. Input Switching Frequency

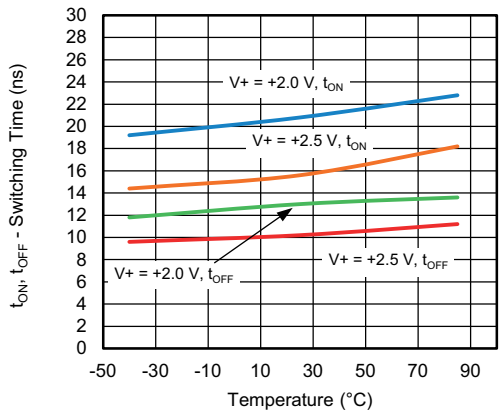


Supply Current vs. Temperature

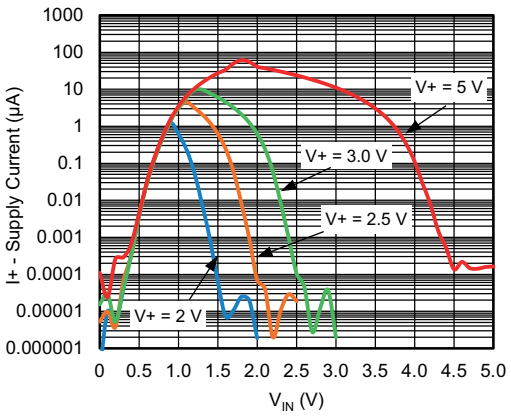


Switching Time vs. Temperature

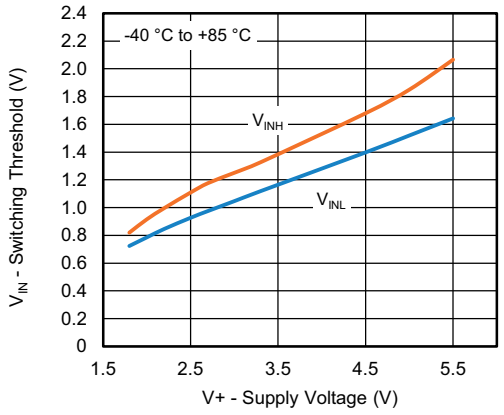
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



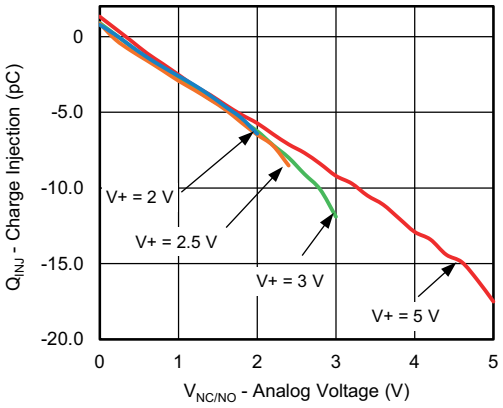
Switching Time vs. Temperature



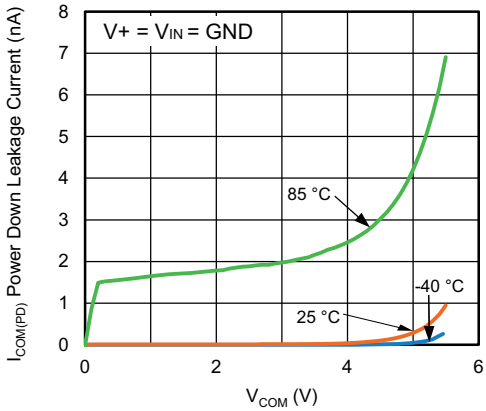
Supply Current vs. Enable Input Voltage



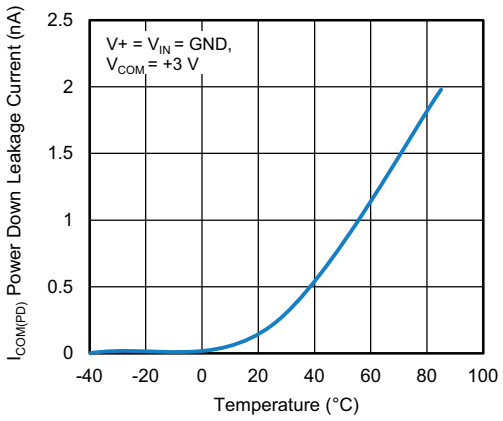
Switching Threshold vs. Supply Voltage



Charge Injection vs. Analog Voltage

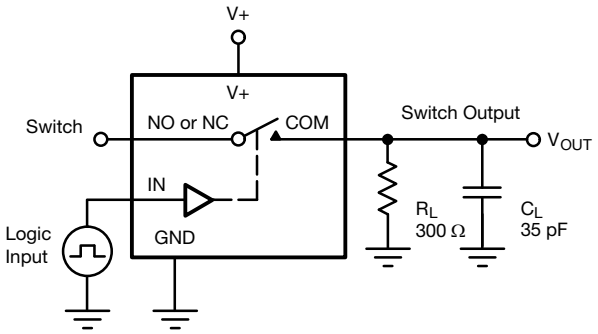


Power Down Leakage Current vs. V_{COM}



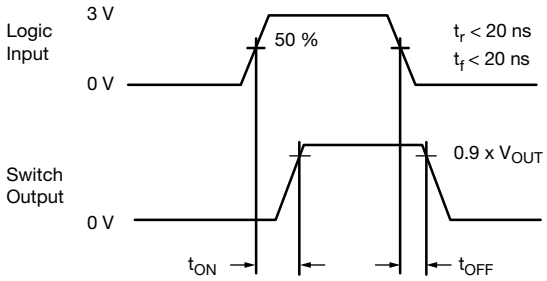
Power Down Leakage Current vs. Temperature

TEST CIRCUITS



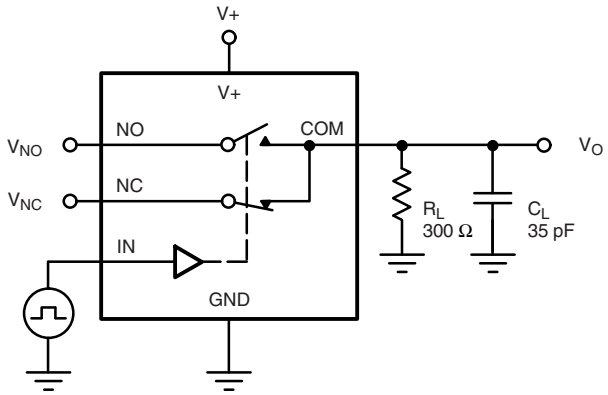
C_L (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM}\left(\frac{R_L}{R_L + R_{ON}}\right)$$



Logic "1" = switch on
Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time



C_L (includes fixture and stray capacitance)

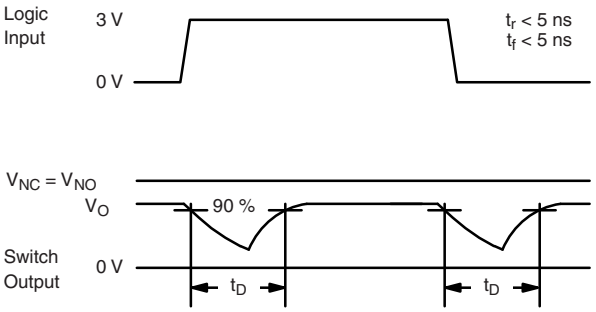
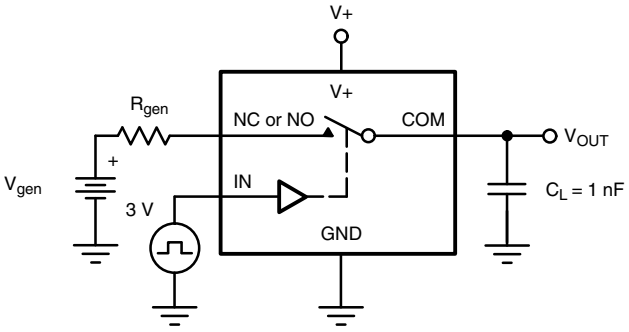
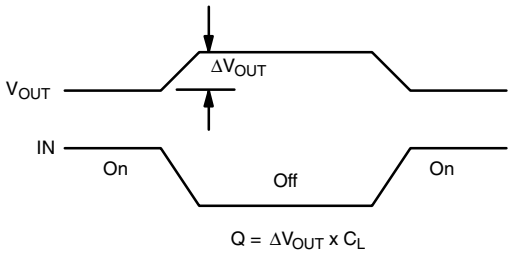


Fig. 2 - Break-Before-Make Interval





$Q = \Delta V_{OUT} \times C_L$

IN depends on switch configuration: input polarity determined by sense of switch.

Fig. 3 - Charge Injection

TEST CIRCUITS

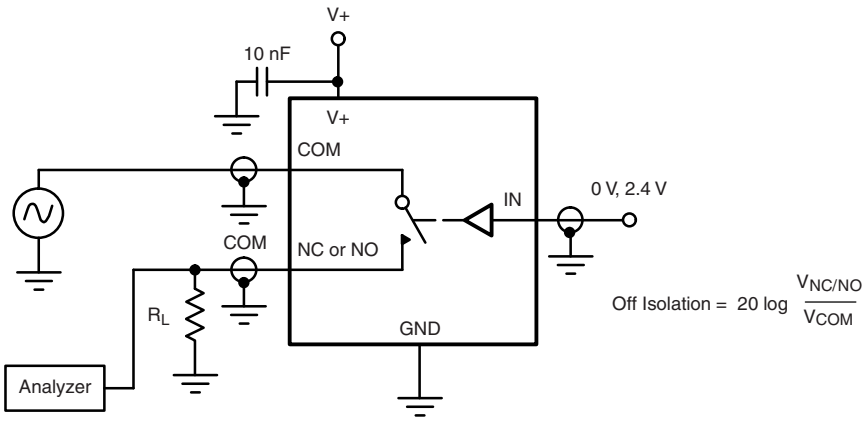


Fig. 4 - Off-Isolation

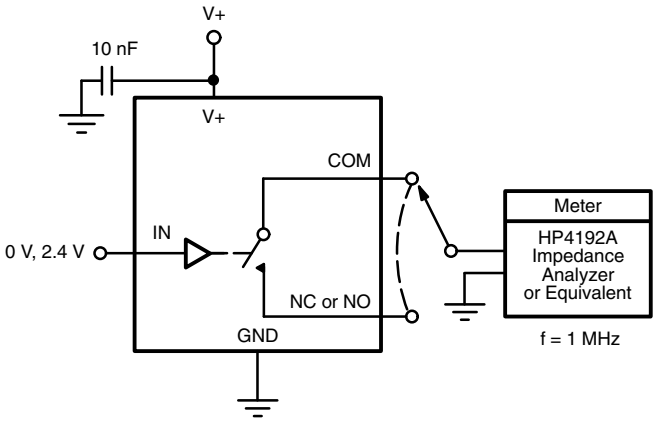


Fig. 5 - Channel Off / On Capacitance

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