Powered-off Protection, 0.7 Ω, 1.8 V to 5.5 V, SPST Analog Switch

DESCRIPTION

The DG2715E, DG2716E are single-pole, single-throw (SPST) analog switches 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 0.7 Ω at a 5 V power supply, fast switching speeds (t_{ON}, t_{OFF} at 13 ns and 11 ns), and low power consumption.

The DG2715E, DG2716E feature low control logic input threshold. This logic inputs can go over V+ up to 5.5 V. Additionally, on-resistance flatness (0.15 Ω) offer high accuracy between channels.

The DG2715E contains a normally open (NO) switch, and the DG2716E contains a normally closed switch. All switches conduct both analog and digital signals equally well in either directions when on, permit signals with amplitudes of up to V+, and block up to the power supply level when off. The DG2715E, DG2716E can withstand greater than 7 kV (human body model). A powered-off protection circuit is built into the switch to prevent an abnormal current flow from COM pin to V+ during the power-down condition. The powered-off protection feature plus the switch's high ESD and latch up current capabilities make it more reliable in designs where the part sits close to the interface. Operation temperature is specified from -40 °C to +85 °C. The DG2715E, DG2716E are available in the compact SC-70-5 package.

FEATURES

- Low switch on-resistance (0.7 Ω at 5 V)
- 1.8 V to 5.5 V single supply operation
- Powered-off protection
- Control logic inputs can go over V+ up to 5.5 V
- Low charge injection (7 pC)
- Latch-up performance exceeds 300 mA per JESD 78
- ESD tested
  - 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

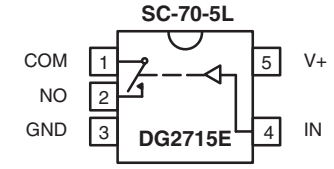
Pb-free

RoHS COMPLIANT

APPLICATIONS

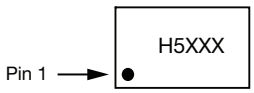
- Smartphones and tablets
- Consumer and computing
- Portable instrumentation
- Audio and video signal routing
- Medical equipment

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

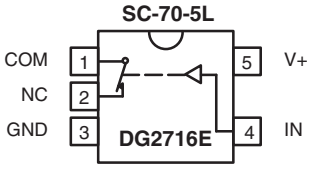


Top view

Device marking: H5

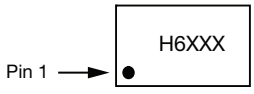


Device marking: H5XXX
XXX = date / lot traceability code



Top view

Device marking: H6



Device marking: H6XXX
XXX = date / lot traceability code

TRUTH TABLE (DG2715E)	
LOGIC	**SWITCH**
0	Off
1	On

TRUTH TABLE (DG2716E)	
LOGIC	**SWITCH**
0	On
1	Off

ORDERING INFORMATION		
TEMP. RANGE	**PACKAGE**	**PART NUMBER**
-40 °C to +85 °C	SC-70-5	DG2715EDL-T1-GE3
		DG2716EDL-T1-GE3

ABSOLUTE MAXIMUM RATINGS

PARAMETER		LIMIT	UNIT
V+, COM, NC, NO, IN reference to GND		-0.3 to 6	V
Continuous current (NO, NC, and COM pins)		± 200	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)		± 300	
Storage temperature	(D suffix)	-65 to +150	°C
Power dissipation (packages) [a]	5-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
On-resistance	R_{ON}	V+ = 4.5 V, V_{COM} = 0.5 V / 2.5 V, I_{NO}, I_{NC} = 10 mA	Room	-	0.7	1.1	Ω
			Full [d]	-	-	1.2	
R_{ON} flatness [d]	R_{ON} flatness	V+ = 4.5 V, V_{COM} = 0 V to V+, I_{NO}, I_{NC} = 10 mA	Room	-	0.11	-	
Switch off leakage current [f]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 5 V, V_{NO}, V_{NC} = 0.5 V / 4.5 V, V_{COM} = 4.5 V / 0.5 V	Room	-5	-	5	nA
			Full	-25	-	25	
	$I_{COM(off)}$		Room	-5	-	5	
			Full [d]	-25	-	25	
Channel-on leakage current [f]	$I_{COM(on)}$	V+ = 5 V, V_{NO}, V_{NC} = V_{COM} = 0.5 V / 4.5 V	Room	-5	-	5	
			Full [d]	-20	-	20	
Power down leakage	$I_{COM(PD)}$	V+ = 0 V, V_{COM} = 4.5 V, V_{IN} = GND	Full [d]	-1	-	1	µA
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	-	2	-	pF
Input current [f]	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	-	13	20	ns
			Full [d]	-	-	25	
Turn-off time [d]	t_{OFF}		Room	-	11	20	
			Full [d]	-	-	25	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω	Room	-	-7	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-57	-	dB
NO, NC off capacitance [d]	$C_{NO(off)}$, $C_{NC(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	29	-	pF
Channel-on capacitance [d]	C_{ON}		Room	-	73	-	
Power Supply							
Power supply current	I+	V_{IN} = 0 V or V+	Full	-	0.00005	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

SPECIFICATIONS (V+ = 3 V)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED** V+ = 3 V, ± 10 %, V_{IN} = 0.5 V or 1.4 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
On-resistance	R_{ON}	V+ = 2.7 V, V_{COM} = 1.5 V, I_{NO}, I_{NC} = 100 mA	Room	-	0.96	1.2	Ω
			Full	-	-	1.3	
R_{ON} flatness	R_{ON} flatness	V+ = 2.7 V, V_{COM} = 0.6 V, 1.5 V, 2.1 V, I_{NO}, I_{NC} = 100 mA	Room	-	0.15	-	
Switch off leakage current	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 3.3 V, V_{NO}, V_{NC} = 0.3 V / 3 V, V_{COM} = 3 V / 0.3 V	Room	-3	-	3	nA
			Full	-10	-	10	
	$I_{COM(off)}$		Room	-3	-	3	
			Full	-10	-	10	
Channel-on leakage current	$I_{COM(on)}$	V+ = 3.3 V, V_{NO}, V_{NC} = V_{COM} = 0.3 V / 3 V	Room	-3	-	3	
			Full	-10	-	10	
Digital Control							
Input high voltage	V_{INH}		Full	1.4	-	-	V
Input low voltage	V_{INL}		Full	-	-	0.5	
Input capacitance [d]	C_{IN}		Full	-	2	-	pF
Input current	I_{INL} or I_{INH}	V_{IN} = 0 V or V+	Full	-1	-	1	µA
Dynamic Characteristics							
Turn-on time	t_{ON}	V_{NO} or V_{NC} = 1.5 V, R_L = 50 Ω, C_L = 35 pF	Room	-	20	25	ns
			Full	-	-	30	
Turn-off time	t_{OFF}		Room	-	15	21	
			Full	-	-	28	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω	Room	-	-12	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-57	-	dB
NO, NC off capacitance [d]	$C_{NO(off)}$, $C_{NC(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	30	-	pF
Channel-on capacitance [d]	C_{ON}		Room	-	73	-	
Power Supply							
Power supply current	I+	V+ = 3.6 V, V_{IN} = 0 V or V+	Full	-	0.00003	1	µA

Notes

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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 3 V leakage testing, not production tested

SPECIFICATIONS (V+ = 1.8 V)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED** V+ = 1.8 V, ± 10 %, V_{IN} = 0.4 V or 1 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
On-resistance	R_{ON}	V+ = 1.8 V, V_{COM} = 0.9 V, I_{NO}, I_{NC} = 10 mA	Room	-	4	7	Ω
			Full [d]	-	-	11	
Switch off leakage current [f]	$I_{NO(off)}$, $I_{NC(off)}$	V+ = 2 V, V_{NO}, V_{NC} = 0.2 V / 1.8 V, V_{COM} = 1.8 V / 0.2 V	Room	-2	-	2	nA
			Full [d]	-5	-	5	
	$I_{COM(off)}$		Room	-2	-	2	
			Full [d]	-5	-	5	
Channel-on leakage current [f]	$I_{COM(on)}$	V+ = 2 V, V_{NO}, V_{NC} = V_{COM} = 0.2 V / 1.8 V	Room	-2	-	2	
			Full [d]	-5	-	5	
Digital Control							
Input high voltage	V_{INH}		Full	1	-	-	V
Input low voltage	V_{INL}		Full	-	-	0.4	
Input capacitance [d]	C_{IN}		Full	-	2	-	pF
Input current [f]	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 = 50 Ω, C_L = 35 pF	Room	-	35	40	ns
			Full [d]	-	-	43	
Turn-off time [d]	t_{OFF}		Room	-	27	40	
			Full [d]	-	-	43	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω	Room	-	-9	-	pC
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-57	-	dB
NO, NC off capacitance [d]	$C_{NO(off)}$, $C_{NC(off)}$	V_{IN} = 0 V or V+, f = 1 MHz	Room	-	31	-	pF
Channel-on capacitance [d]	C_{ON}		Room	-	70	-	

Notes

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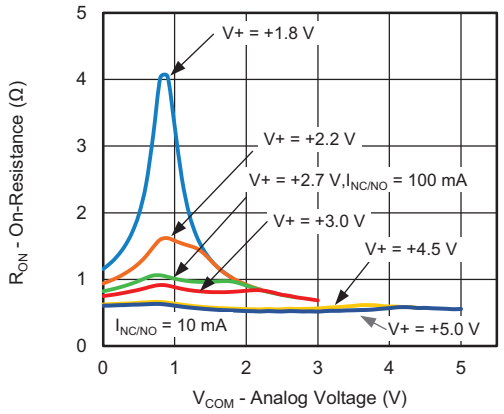
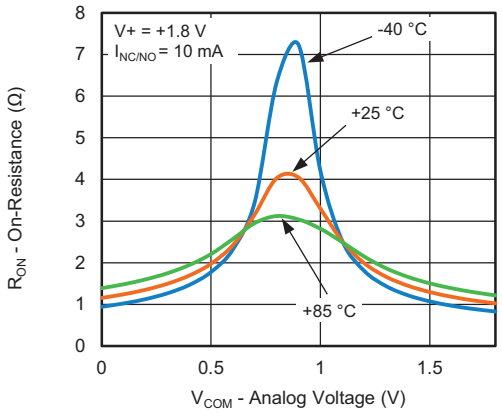
d. Guarantee by design, nor subjected to production test
e. V_{IN} = input voltage to perform proper function
f. Guaranteed by 3 V leakage testing, not production tested

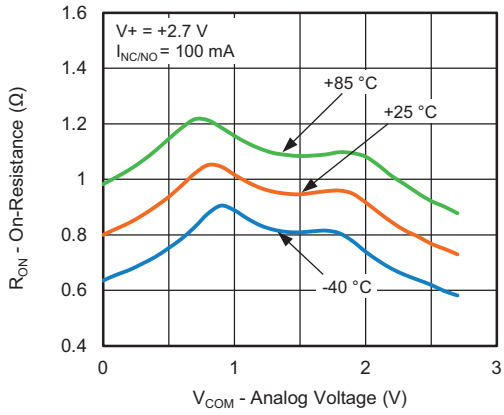
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



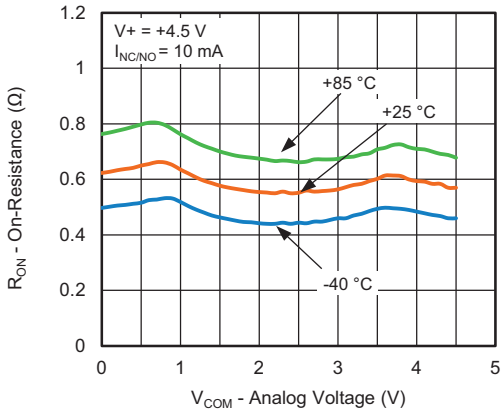
$R_{DS(on)}$ vs. V_{COM} vs. V+



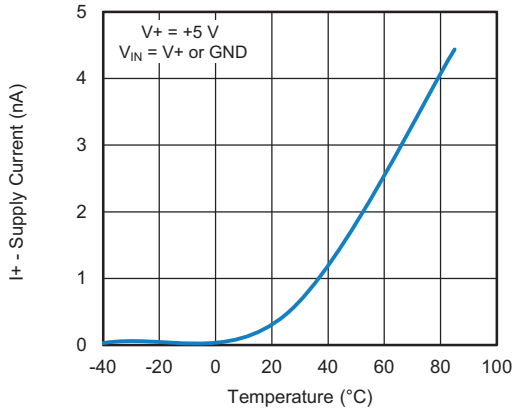
$R_{DS(on)}$ vs. V_{COM}, and Temperature



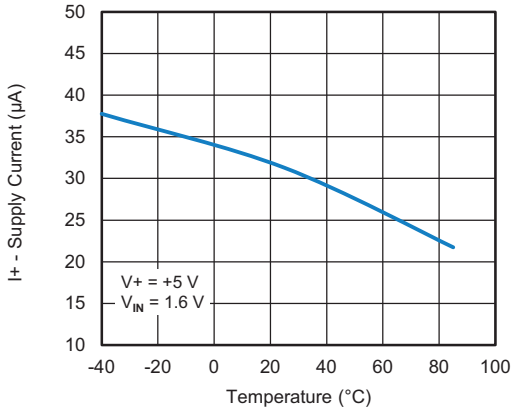
$R_{DS(on)}$ vs. V_{COM}, and Temperature



$R_{DS(on)}$ vs. V_{COM}, and Temperature

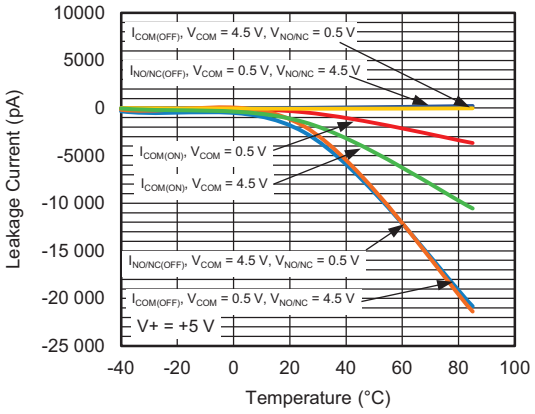


Supply Current vs. Temperature

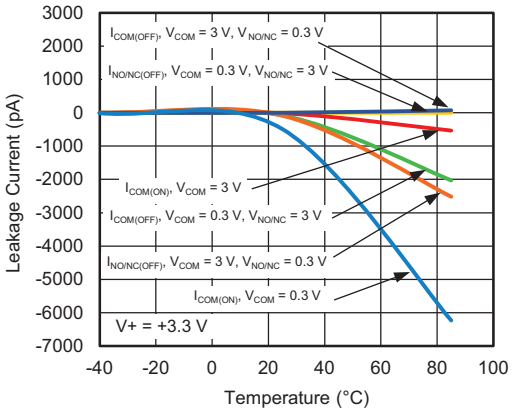


Supply Current vs. Temperature

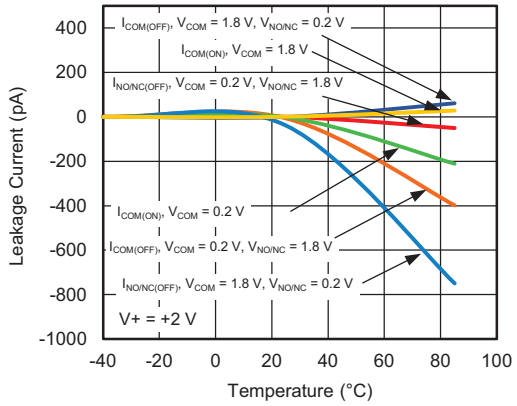
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



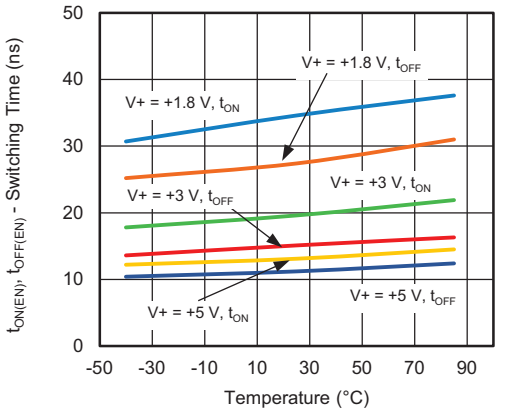
Leakage Current vs. Temperature



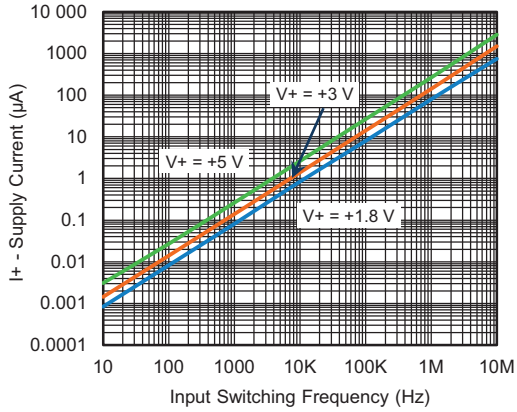
Leakage Current vs. Temperature



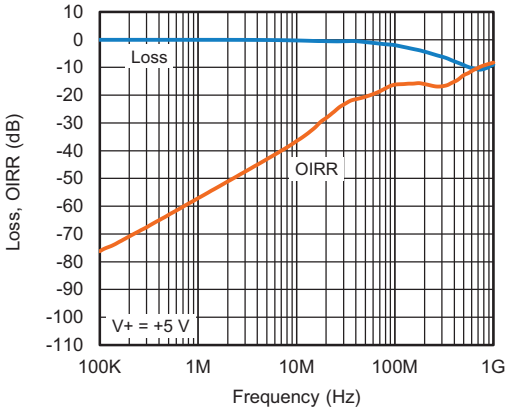
Leakage Current vs. Temperature



Switching Time vs. Temperature

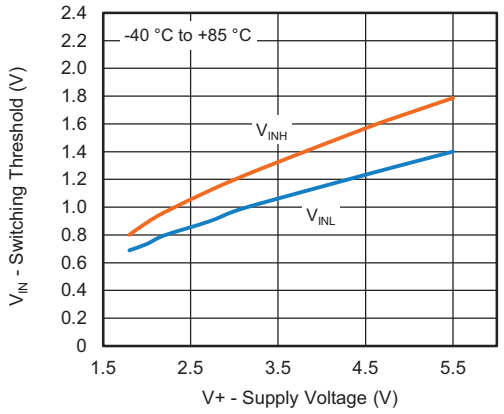


Supply Current vs. Input Switching Frequency

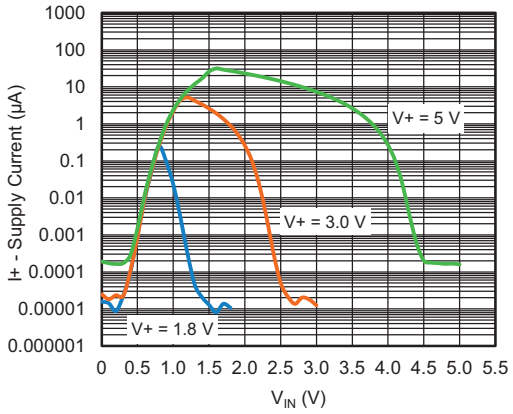


Insertion Loss, Off-Isolation vs. Frequency

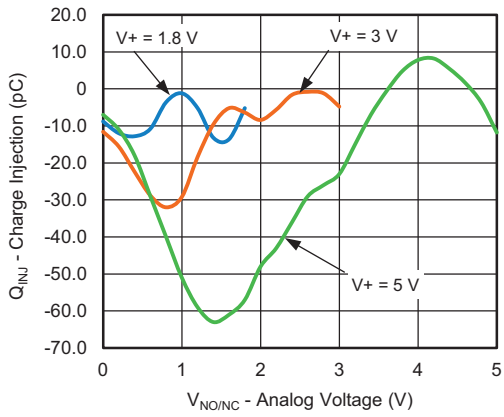
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



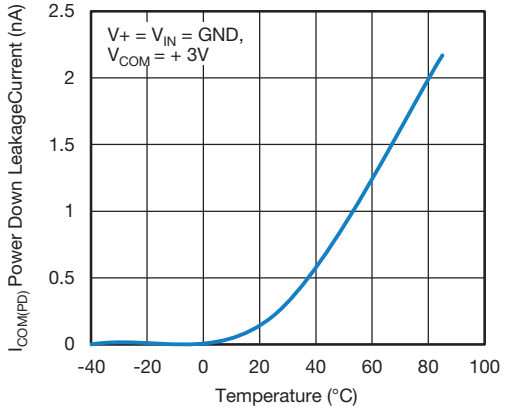
Switching Threshold vs. Supply Voltage



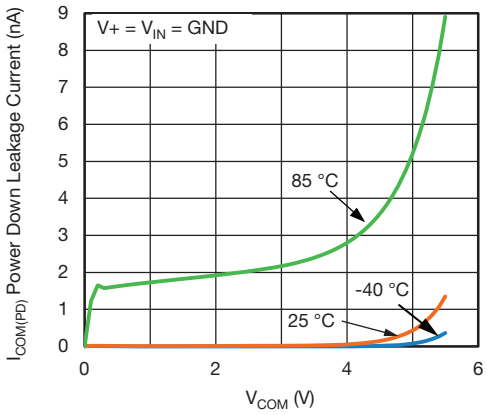
Supply Current vs V_{IN}



Charge Injection vs. Analog Voltage

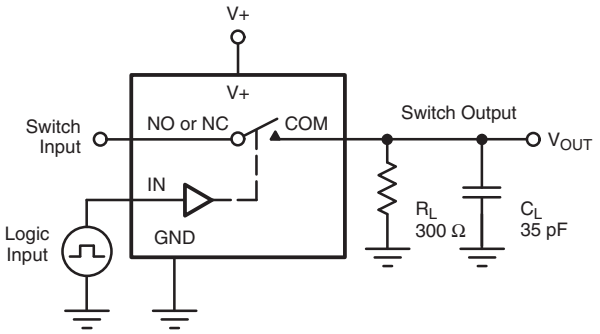


Power Down Leakage Current vs. Temperature



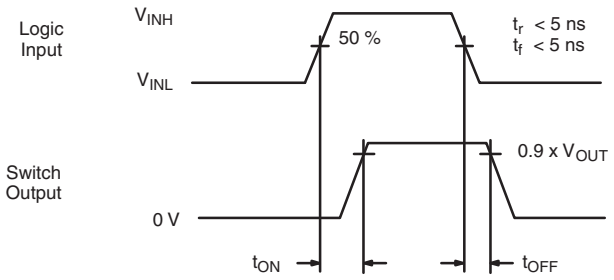
Power Down Leakage Current vs. V_{COM}

TEST CIRCUITS



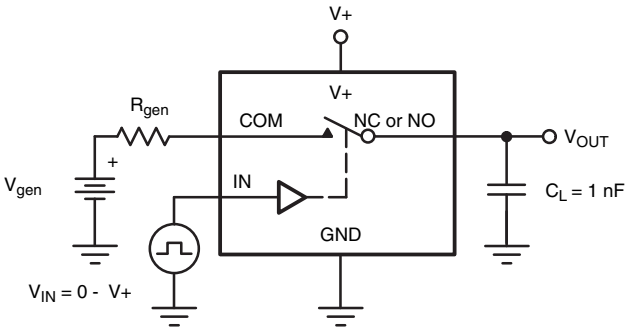
C_L (includes fixture and stray capacitance)

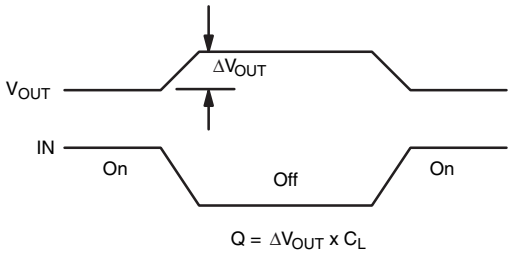
$$V_{OUT} = V_{COM}\left(\frac{R_L}{R_L + R_{ON}}\right)$$



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

Fig. 1 - Switching Time

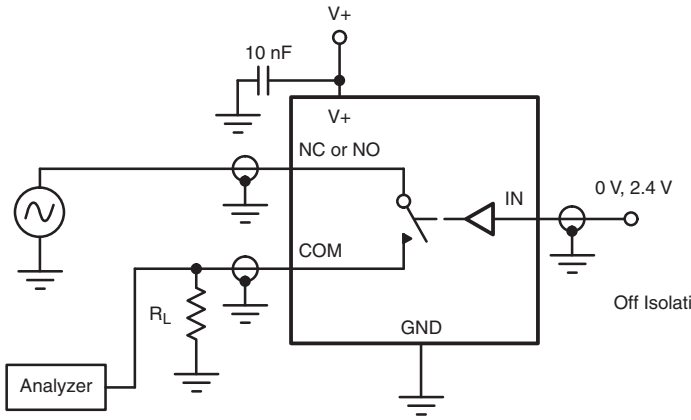




$Q = \Delta V_{OUT} \times C_L$

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

Fig. 2 - Charge Injection



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

Fig. 3 - Off-Isolation

TEST CIRCUITS

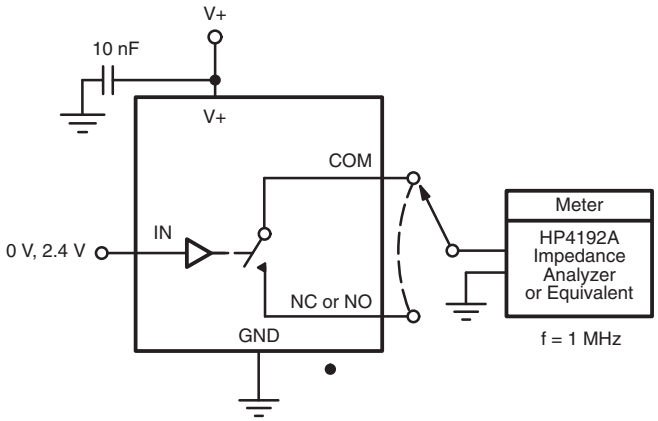


Fig. 4 - Channel Off / On Capacitance

PRODUCT SUMMARY		
Part number	DG2715E	DG2716E
Status code	2	2
Configuration	SPST x 1, NO	SPST x 1, NC
Single supply min. (V)	1.8	1.8
Single supply max. (V)	5.5	5.5
Dual supply min. (V)	-	-
Dual supply max. (V)	-	-
On-resistance (Ω)	0.7	0.7
Charge injection (pC)	-7	-7
Source on capacitance (pF)	73	73
Source off capacitance (pF)	29	29
Leakage switch on typ. (nA)	-	-
Leakage switch off max. (nA)	-5	5
-3 dB bandwidth (MHz)	-	-
Package	SC-70-5	SC-70-5
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare, portable	Multi purpose, instrumentation, medical and healthcare, portable
Interface	Parallel	Parallel
Single supply operation	Yes	Yes
Dual supply operation	-	-
Turn on time max. (ns)	25	25
Crosstalk and off isolation	-57	-57

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