High Voltage, Single and Dual Supply SPDT Analog Switch with Enable Pin

DESCRIPTION

The DG469/470 are high voltage SPDT switches, with a typical on resistance of 3.6 Ω and typical flatness of 0.4 Ω. The DG469 and DG470 are identical, except the DG470 provides an enable input. When the enable input is activated, both sides of the switch are in a high impedance mode (Off), maintaining a "Safe State" at power up. This function can also be used as a quick "disconnect" in the event of a fault condition. For audio switching, the enable pin provides a mute function. These are high voltage switches that are fully specified with dual supplies at ± 4.5 V and ± 15 V and a single supply of 12 V over an operating temperature range from - 40 °C to + 125 °C. Fast switching speeds coupled with high signal bandwidth makes these parts suitable for video switching applications. All digital inputs have 0.8 V and 2.4 V logic thresholds ensuring low voltage TTL/CMOS compatibility. Each switch conducts equally well in both directions when on and can handle an input signal range that extends to the supply voltage rails. They exhibit break-before-make switching action to prevent momentary shorting when switching between channels. The DG469 and DG470 are offered in a MSOP 8 and SOIC 8 package.

FEATURES

- Low on resistance (3.6 Ω typical)
- On resistance flatness (0.4 Ω typical)
- 44 V supply maximum rating
- ± 15 V analog signal range
- Fully specified at supply voltages of ± 4.5 V, 12 V and ± 15 V
- TTL/CMOS compatible
- Break before make switching guaranteed
- Total harmonic distortion 0.0145 %

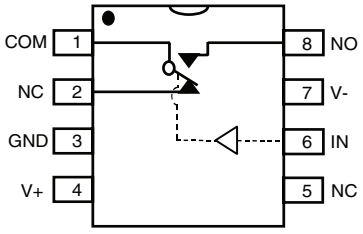
Pb-free
RoHS COMPLIANT

APPLICATIONS

- Audio and video signal switching
- Precision automatic test equipment
- Precision data acquisition
- Relay replacement
- Communications systems
- Automotive applications
- Sample and hold systems
- Power routing applications
- Telecom signal switching
- Medical equipment
- Portable and battery power systems

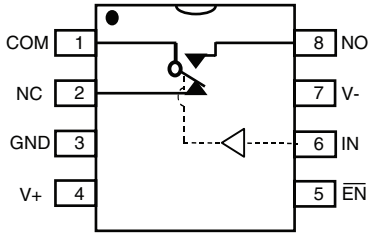
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG469
MSOP 8 and SOIC 8



TOP VIEW

DG470
MSOP 8 and SOIC 8



TOP VIEW

TRUTH TABLE: DG469		
Logic	**NC**	**NO**
0	ON	OFF
1	OFF	ON

TRUTH TABLE: DG470			
ENABLE	**Logic**	**NC**	**NO**
0	0	ON	OFF
0	1	OFF	ON
1	X	OFF	OFF

ORDERING INFORMATION

Temp Range	Package	Part Number
DG469/470		
- 40 °C to 125 °C[a]	8-Pin MSOP	DG469EQ-T1-E3 DG470EQ-T1-E3
	8-Pin Narrow SOIC	DG469EY-T1-E3 DG470EY-T1-E3

Notes:
a. - 40 °C to 85 °C datasheet limits apply.

ABSOLUTE MAXIMUM RATINGS T_A = 25 °C, unless otherwise noted

Parameter		Limit	Unit
V+ to V-		44	V
GND to V-		25	
Digital Inputs[a], V_S, V_D		(V-) - 2 to (V+) + 2 or 30 mA, whichever occurs first	
Continuous Current (NO, NC, or COM)		120	mA
Current (Any terminal except NO, NC, or COM)		30	
Peak Current, (Pulsed 1 ms, 10 % Duty Cycle)		200	
Storage Temperature		- 65 to 150	°C
Power Dissipation (Package)[b]	8-Pin MSOP[c]	320	mW
	8-Pin Narrow SOIC[d]	400	

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 4.0 mW/°C above 70 °C.
d. Derate 5.0 mW/°C above 70 °C.

SPECIFICATIONS FOR DUAL SUPPLIES

Parameter	Symbol	Test Conditions Unless Specified V+ = 15 V, V- = - 15 V V_{IN} = 2.4 V, 0.8 V[a]	Temp[b]	Typ[c]	- 40 to 125 °C Min[d]	- 40 to 125 °C Max[d]	- 40 to 85 °C Min[d]	- 40 to 85 °C Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		- 15	15	- 15	15	V
On-Resistance	r_{ON}	I_S = 50 mA, V_D = - 10 V to + 10 V	Room Full	3.6		6 8		6 7	Ω
On-Resistance Match	Δr_{ON}	I_S = 50 mA, V_D = ± 10 V	Room Full	0.12		0.4 0.9		0.4 0.5	
On-Resistance Flatness	$r_{FLATNESS}$	I_S = 50 mA, V_D = - 5 V, 0 V, + 5 V	Room Full	0.4		0.5 0.9		0.5 0.8	
Switch Off Leakage Current	$I_{S(off)}$	V_D = ± 14 V, V_S = ± 14 V	Room Full	± 0.1	- 0.5 - 20	0.5 20	- 0.5 - 2.5	0.5 2.5	nA
	$I_{D(off)}$		Room Full	± 0.1	- 0.5 - 20	0.5 20	- 0.5 - 2.5	0.5 2.5	
Channel On Leakage Current	$I_{D(on)}$	V_S = V_D = ± 14 V	Room Full	± 0.2	- 0.5 - 20	0.5 20	- 0.5 - 5	0.5 5	
Digital Control									
Input Current, V_{IN} Low	I_{IL}	V_{IN} Under Test = 0.8 V	Full	0.05	- 1	1	- 1	1	µA
Input Current, V_{IN} High	I_{IH}	V_{IN} Under Test = 2.4 V	Full	0.05	- 1	1	- 1	1	
Input Capacitance[e]	C_{IN}	f = 1 MHz	Room	3.7					pF

SPECIFICATIONS FOR DUAL SUPPLIES

Parameter	Symbol	Test Conditions Unless Specified V+ = 15 V, V- = - 15 V V_{IN} = 2.4 V, 0.8 V[a]	Temp[b]	Typ[c]	- 40 to 125 °C Min[d]	- 40 to 125 °C Max[d]	- 40 to 85 °C Min[d]	- 40 to 85 °C Max[d]	Unit
Dynamic Characteristics									
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = ± 10 V	Room Full	129		166 200		166 185	ns
Turn-Off Time	t_{OFF}		Room Full	80		108 135		108 120	
Break-Before-Make Time Delay	t_D	V_S = 10 V R_L = 300 Ω, C_L = 35 pF	Room	15					
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	58					pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF f = 1 MHz	Room	- 57					dB
Channel-to-Channel Crosstalk[e]	X_{TALK}		Room	- 63					
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	37					pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room	85					
Channel On Capacitance[e]	$C_{D(on)}$		Room	125					
Power Supplies									
Power Supply Current	I+	V+ = 16.5 V, V- = - 16.5 V V_{IN} = 0 or 5 V	Room Full	3.0		6 7		6 7	µA
Negative Supply Current	I-		Room Full	- 0.4	- 0.5 - 4.5		- 0.5 - 4.5		
Ground Current	I_{GND}		Room Full	- 3.0	- 6 - 7		- 6 - 7		

SPECIFICATIONS FOR DUAL SUPPLIES

Parameter	Symbol	Test Conditions Unless Specified V+ = 4.5 V, V- = - 4.5 V V_{IN} = 2.4 V, 0.8 V[a]	Temp[b]	Typ[c]	- 45 to 125 °C Min[d]	- 45 to 125 °C Max[d]	- 40 to 85 °C Min[d]	- 40 to 85 °C Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		- 4.5	4.5	- 4.5	4.5	V
On-Resistance[e]	r_{ON}	I_S = 50 mA, V_D = - 2 V to + 2 V	Room Full	8		11 16		11 15	Ω
On-Resistance Match[e]	Δr_{ON}	I_S = 50 mA, V_D = ± 2 V	Room Full	0.6		0.7 0.9		0.7 0.8	
Dynamic Characteristics									
Turn-On Time[e]	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = 2 V	Room Full	245		265 340		65 310	ns
Turn-Off Time[e]	t_{OFF}		Room Full	145		163 200		163 185	
Break-Before-Make[e] Time Delay	t_D	V_S = 2 V R_L = 300 Ω, C_L = 35 pF	Room Full	15					
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Full	58					pC
Power Supplies									
Power Supply Current[e]	I+	V_{IN} = 0 or 4.5 V	Room Full	3.0		6 7		6 7	µA
Negative Supply Current[e]	I-		Room Full	- 0.4	- 0.5 - 4.5		- 0.5 - 4.5		
Ground Current[e]	I_{GND}		Room Full	3.0	- 6 - 7		- 6 - 7		

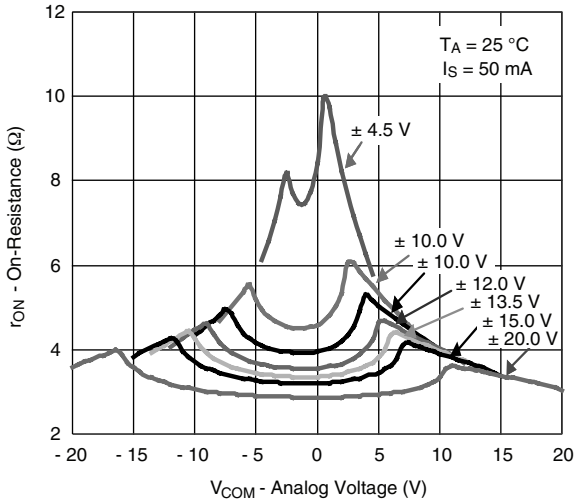
SPECIFICATIONS FOR UNIPOLAR SUPPLIES

Parameter	Symbol	Test Conditions Unless Specified V+ = 12 V, V- = 0 V V_{IN} = 2.4 V, 0.8 V[a]	Temp[b]	Typ[c]	- 40 to 125 °C Min[d]	- 40 to 125 °C Max[d]	- 40 to 85 °C Min[d]	- 40 to 85 °C Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full			12		12	V
On-Resistance	r_{ON}	I_S = 25 mA, V_D = 0 V to + 10 V	Room Full	7.5		8.5 14		8.5 11.3	Ω
On-Resistance Match	Δr_{ON}	I_S = 25 mA, V_D = + 10 V	Room Full	0.4		0.45 0.9		0.45 0.5	Ω
On-Resistance Flatness	$r_{FLATNESS}$	I_S = 25 mA, V_D = 0 V, + 5 V, + 10 V	Room Full	2.5		2.6 2.9		2.6 2.8	Ω
Dynamic Characteristics									
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = 10 V	Room Full	190		200 255		200 240	ns
Turn-Off Time	t_{OFF}		Room Full	100		110 135		110 120	ns
Break-Before-Make Time Delay	t_D	V_S = 10 V R_L = 300 Ω, C_L = 35 pF	Room	50					ns
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	2.4					pC
Power Supplies									
Power Supply Current	I+	V_{IN} = 0 or 5 V	Room Full	3.0		6 7		6 7	µA
Negative Supply Current	I-		Room Full	- 0.4	- 0.5 - 4.5		- 0.5 - 4.5		µA
Ground Current	I_{GND}		Room Full	- 3.0	- 6 - 7		- 6 - 7		µA

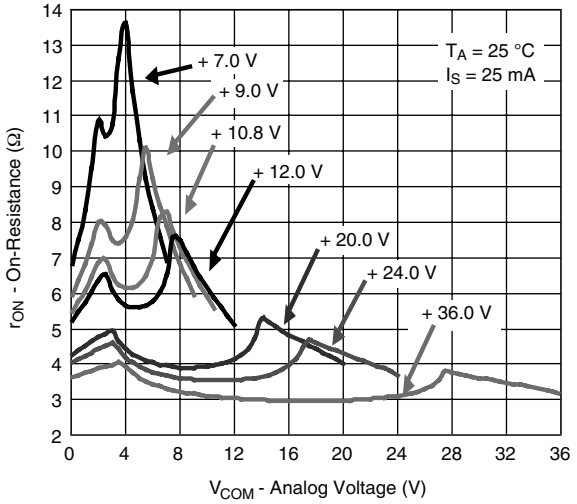
Notes:
a. V_{IN} = input voltage to perform proper function.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum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

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.

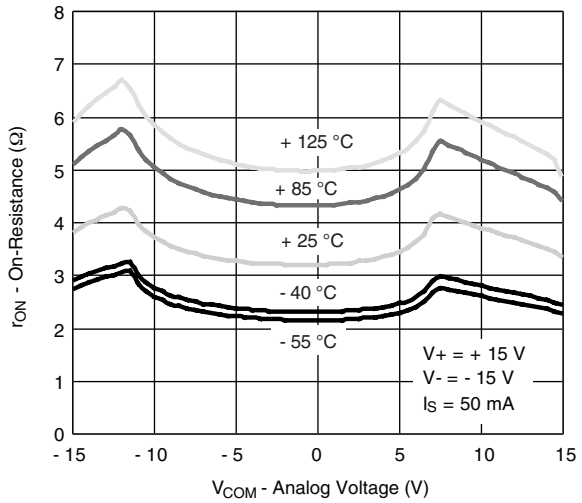
TYPICAL CHARACTERISTICS



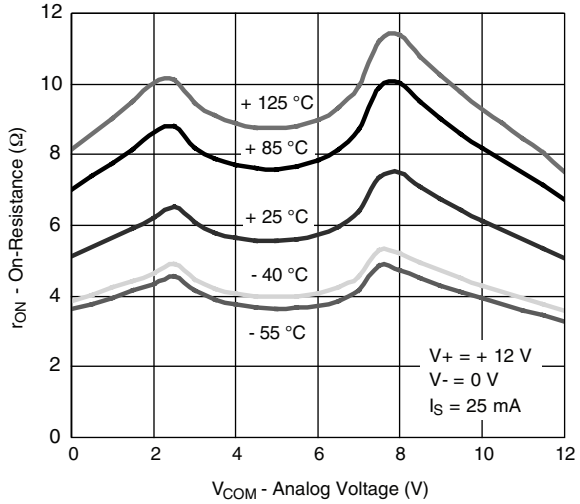
On-Resistance vs. V_D and Dual Supply Voltage



On-Resistance vs. V_D and Single Supply Voltage



On-Resistance vs. V_D and Temperature



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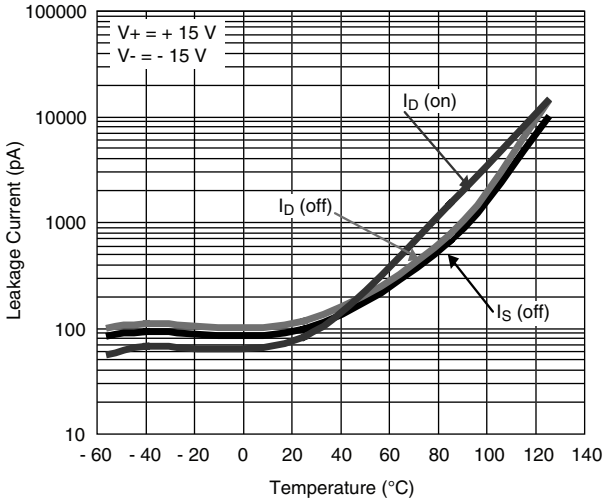
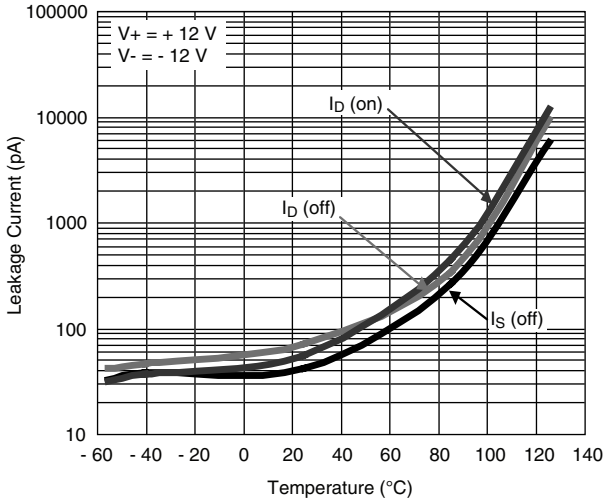
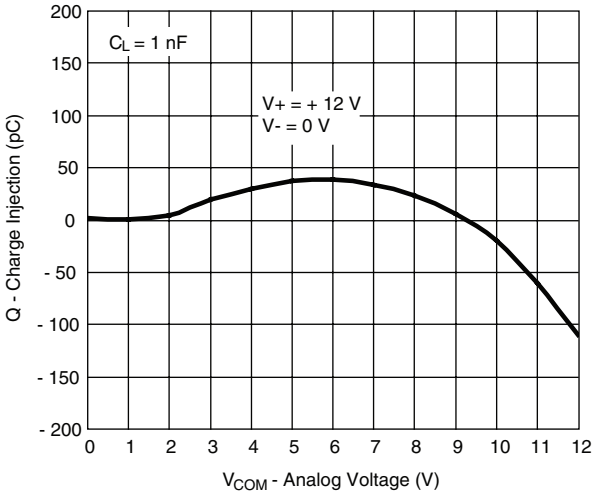


Leakage Current vs. Temperature

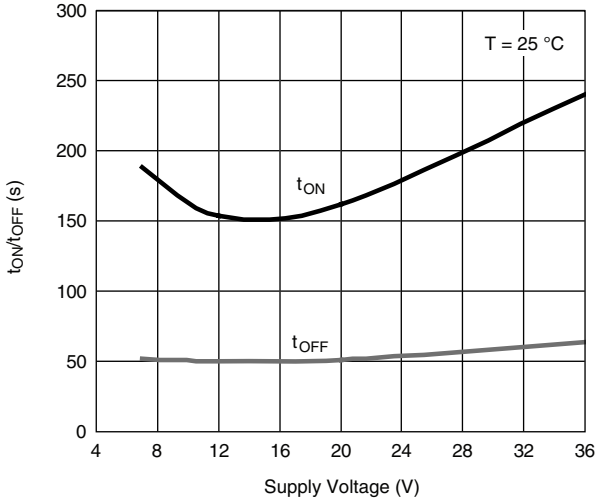


Leakage Current vs. Temperature

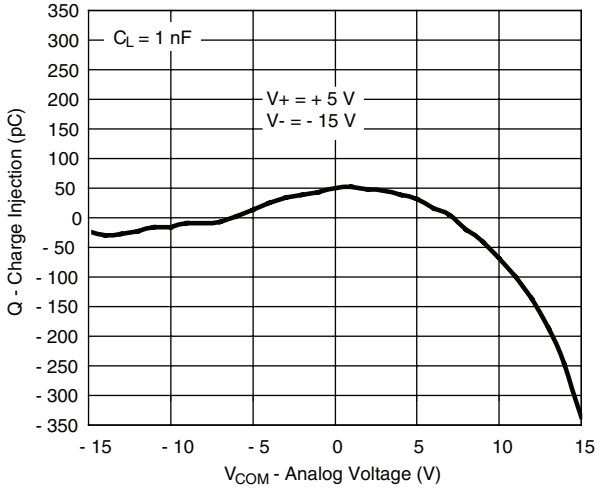
TYPICAL CHARACTERISTICS



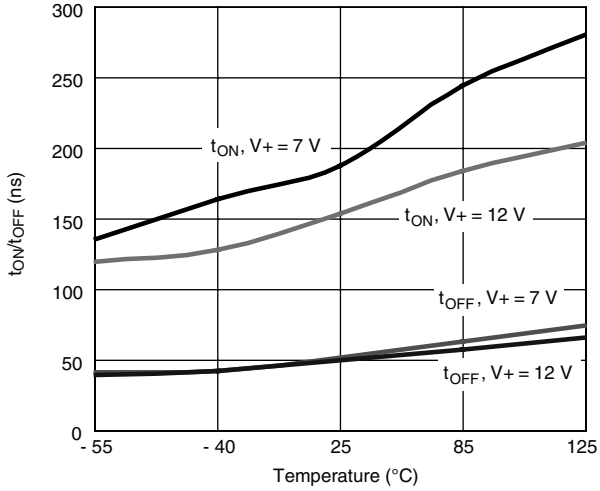
Charge Injection vs. Analog Voltage



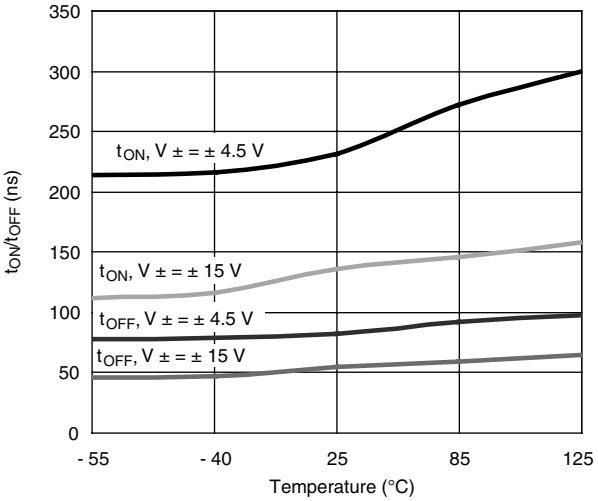
Switching Time vs. Single Supply Voltage



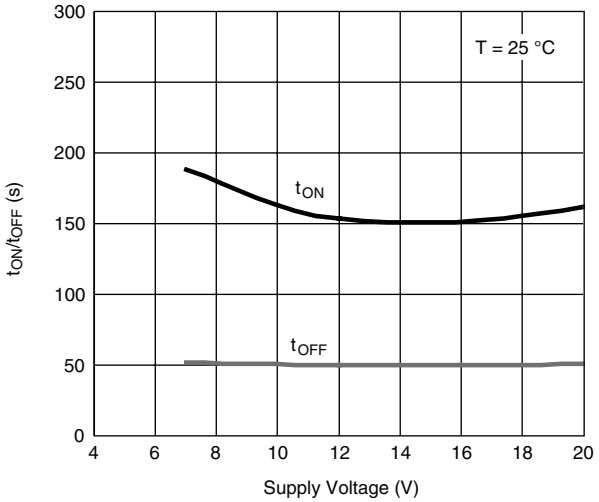
Charge Injection vs. Analog Voltage



Switching Time vs. Temperature and Single Supply Voltage

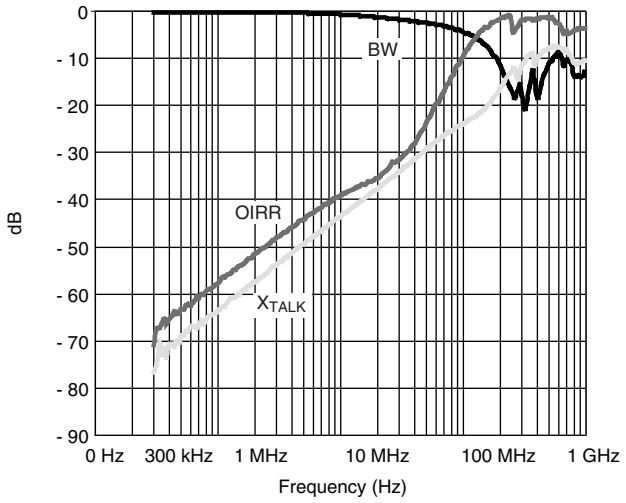


Switching Time vs. Temperature and Dual Supply Voltage

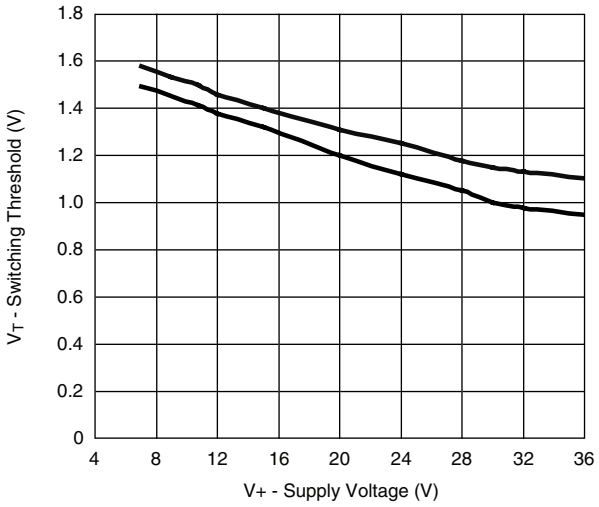


Switching Time vs. Dual Supply Voltage

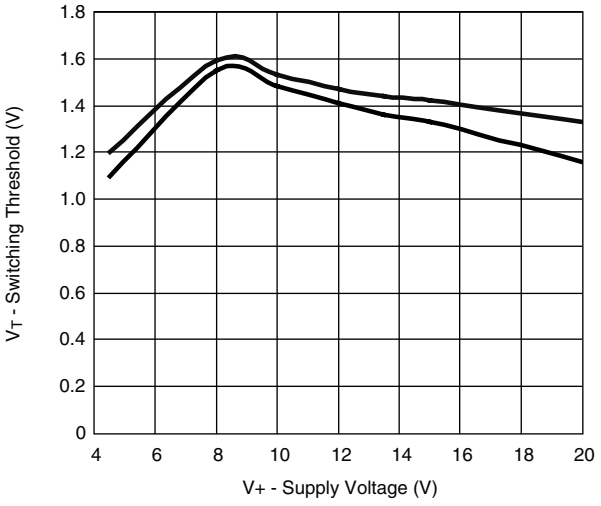
TYPICAL CHARACTERISTICS



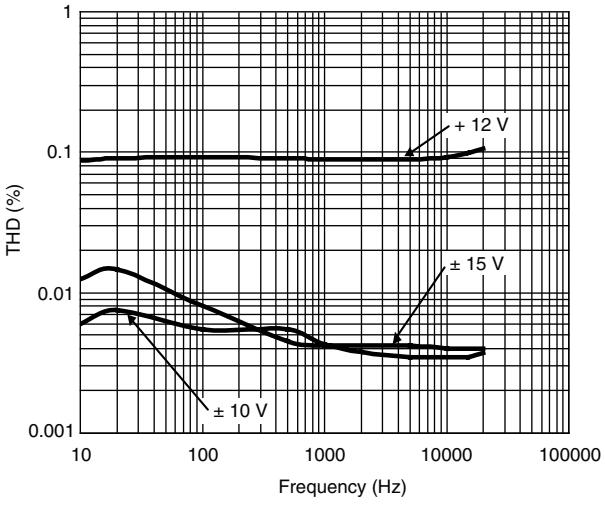
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



Switching Threshold vs. Signal Supply Voltage

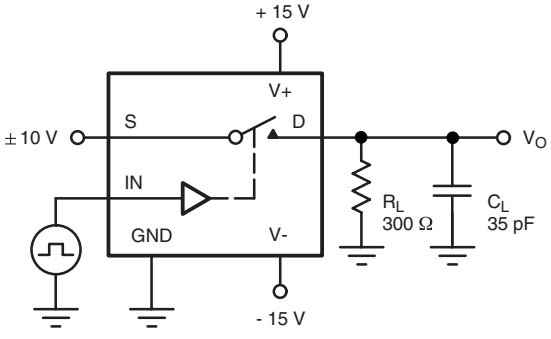


Switching Threshold vs. Dual Supply Voltage



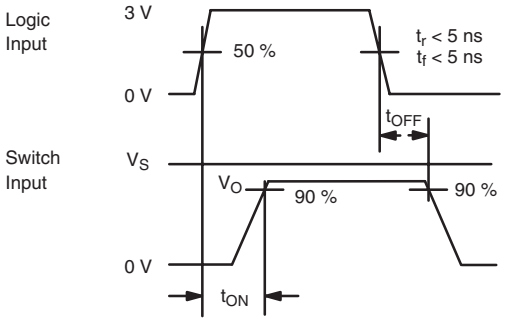
DG469, DG470 Total Harmonic Distortion

TEST CIRCUITS



C_L (includes fixture and stray capacitance)

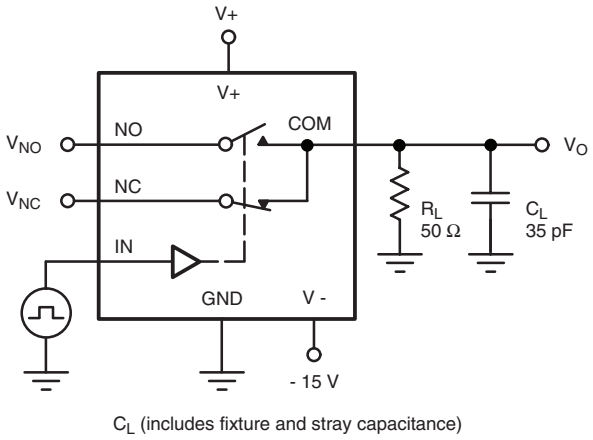
$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$



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

Figure 1. Switching Time

TEST CIRCUITS



C_L (includes fixture and stray capacitance)

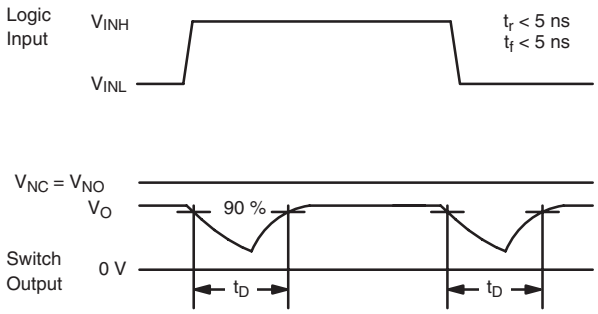
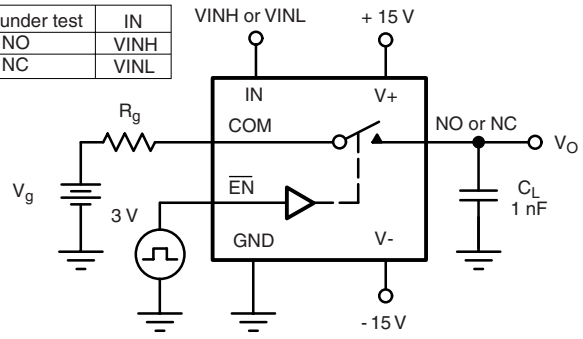


Figure 2. Break-Before-Make

Switch under test	IN
NO	VINH
NC	VINL



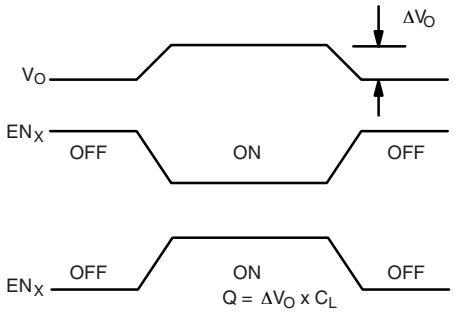


Figure 3. Charge Injection

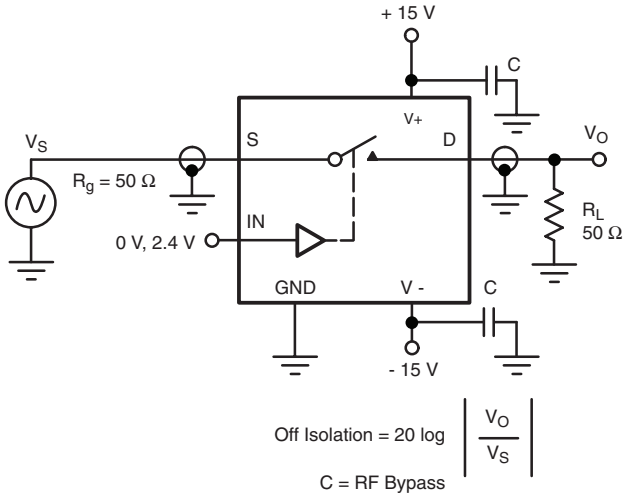


Figure 4. Off-Isolation

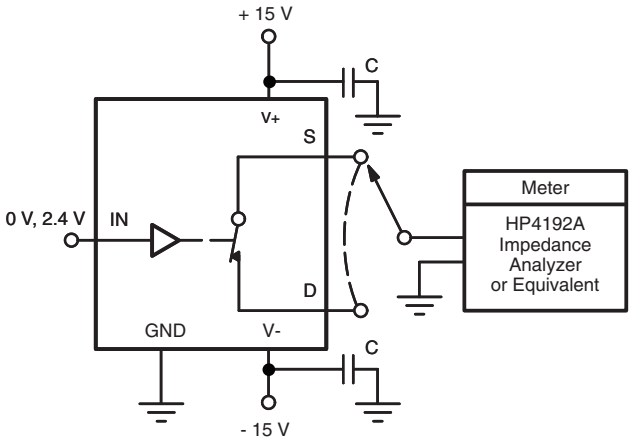


Figure 5. Source/Drain Capacitances

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