

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

DESCRIPTION

The DG469, DG470 are high voltage SPDT switches, with a typical on resistance of 3.6Ω and typical flatness of 0.4Ω . The DG469, 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 $\pm 4.5 \text{ V}$ and $\pm 15 \text{ V}$ and a single supply of 12 V over an operating temperature range from $-40 \text{ }^\circ\text{C}$ to $+125 \text{ }^\circ\text{C}$. 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, DG470 are offered in a MSOP 8 and SOIC 8 package.

FEATURES

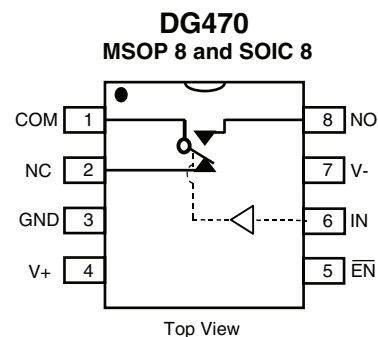
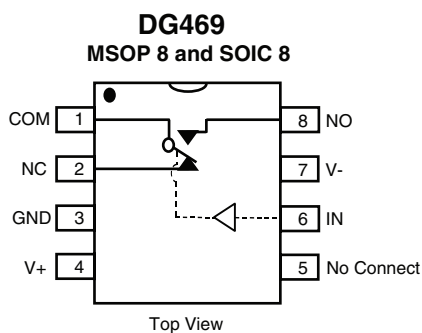
- Low on resistance (3.6Ω typical)
- On resistance flatness (0.4Ω typical)
- 44 V supply maximum rating
- $\pm 15 \text{ V}$ analog signal range
- Fully specified at supply voltages of $\pm 4.5 \text{ V}$, 12 V and $\pm 15 \text{ V}$
- TTL/CMOS compatible
- Break before make switching guaranteed
- Total harmonic distortion 0.0145%
- Compliant to RoHS Directive 2002/95/EC


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



| 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, DG470 | | |
| - 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 $T_A = 25\text{ °C}$, 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 $V_+ = 15\text{ V}$, $V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}$, 0.8 V^a | Temp. ^b | Typ. ^c | - 40 °C to 125 °C | | - 40 °C to 85 °C | | Unit |
| | | | | | Min. ^d | Max. ^d | Min. ^d | Max. ^d | |
| Analog Switch | | | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | | - 15 | 15 | - 15 | 15 | V |
| On-Resistance | R_{ON} | $I_S = 50\text{ mA}$, $V_D = -10\text{ V}$ to $+10\text{ V}$ | Room Full | 3.6 | | 6 8 | | 6 7 | Ω |
| On-Resistance Match | ΔR_{ON} | $I_S = 50\text{ mA}$, $V_D = \pm 10\text{ V}$ | Room Full | 0.12 | | 0.4 0.9 | | 0.4 0.5 | |
| On-Resistance Flatness | $R_{FLATNESS}$ | $I_S = 50\text{ mA}$, $V_D = -5\text{ V}$, 0 V , $+5\text{ V}$ | Room Full | 0.4 | | 0.5 0.9 | | 0.5 0.8 | |
| Switch Off Leakage Current | $I_{S(off)}$ | $V_D = \pm 14\text{ V}$, $V_S = \pm 14\text{ V}$ | 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 | $I_{D(on)}$ | $V_S = V_D = \pm 14\text{ V}$ | 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} | $f = 1\text{ MHz}$ | Room | 3.7 | | | | | pF |

| SPECIFICATIONS for Dual Supplies | | | | | | | | | |
|---|--------------|---|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 15\text{ V}$, $V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}$, 0.8 V^a | Temp. ^b | Typ. ^c | - 40 °C to 125 °C | | - 40 °C to 85 °C | | Unit |
| | | | | | Min. ^d | Max. ^d | Min. ^d | Max. ^d | |
| Dynamic Characteristics | | | | | | | | | |
| Turn-On Time | t_{ON} | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ $V_S = \pm 10\text{ V}$ | 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 | $V_S = 10\text{ V}$ $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | Room | 15 | | | | | |
| Charge Injection ^e | Q | $V_g = 0\text{ V}$, $R_g = 0\ \Omega$, $C_L = 1\text{ nF}$ | Room | 58 | | | | | pC |
| Off Isolation ^e | OIRR | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ | Room | - 57 | | | | | dB |
| Channel-to-Channel Crosstalk ^e | X_{TALK} | | Room | - 63 | | | | | |
| Source Off Capacitance ^e | $C_{S(off)}$ | $f = 1\text{ MHz}$ | 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_+ | $V_+ = 16.5\text{ V}$, $V_- = -16.5\text{ V}$ $V_{IN} = 0\text{ or }5\text{ V}$ | 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 $V_+ = 4.5\text{ V}$, $V_- = -4.5\text{ V}$ $V_{IN} = 2.4\text{ V}$, 0.8 V^a | Temp. ^b | Typ. ^c | - 45 °C to 125 °C | | - 40 °C to 85 °C | | Unit |
| | | | | | Min. ^d | Max. ^d | Min. ^d | Max. ^d | |
| Analog Switch | | | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | | - 4.5 | 4.5 | - 4.5 | 4.5 | V |
| On-Resistance ^e | R_{ON} | $I_S = 50\text{ mA}$, $V_D = -2\text{ V to }+2\text{ V}$ | Room Full | 8 | | 11 16 | | 11 15 | Ω |
| On-Resistance Match ^e | ΔR_{ON} | $I_S = 50\text{ mA}$, $V_D = \pm 2\text{ V}$ | Room Full | 0.6 | | 0.7 0.9 | | 0.7 0.8 | |
| Dynamic Characteristics | | | | | | | | | |
| Turn-On Time ^e | t_{ON} | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ $V_S = 2\text{ V}$ | 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 | $V_S = 2\text{ V}$ $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ | Room Full | 15 | | | | | |
| Charge Injection ^e | Q | $V_g = 0\text{ V}$, $R_g = 0\ \Omega$, $C_L = 1\text{ nF}$ | Full | 58 | | | | | pC |
| Power Supplies | | | | | | | | | |
| Power Supply Current ^e | I_+ | $V_{IN} = 0\text{ or }4.5\text{ V}$ | 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 | | |



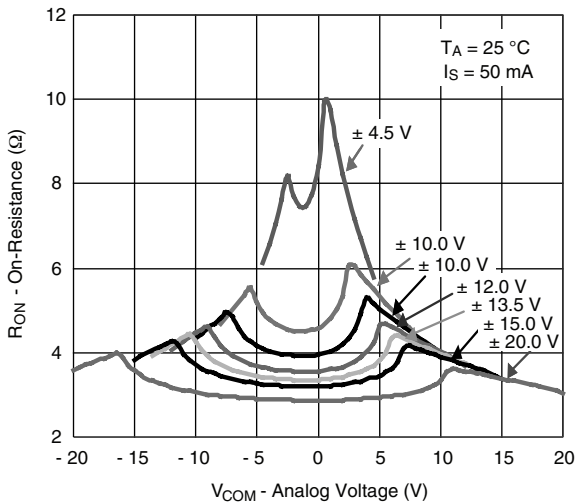
| SPECIFICATIONS for Unipolar Supplies | | | | | | | | | |
|--------------------------------------|-----------------------|---|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|
| Parameter | Symbol | Test Conditions Unless Specified V+ = 12 V, V- = 0 V V _{IN} = 2.4 V, 0.8 V ^a | Temp. ^b | Typ. ^c | - 40 °C to 125 °C | | - 40 °C to 85 °C | | Unit |
| | | | | | Min. ^d | Max. ^d | Min. ^d | Max. ^d | |
| 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 | |
| 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 | |
| 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 | |
| Break-Before-Make Time Delay | t _D | V _S = 10 V R _L = 300 Ω, C _L = 35 pF | Room | 50 | | | | | |
| 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 | | |
| Ground Current | I _{GND} | | Room Full | - 3.0 | - 6 - 7 | | - 6 - 7 | | |

Notes:

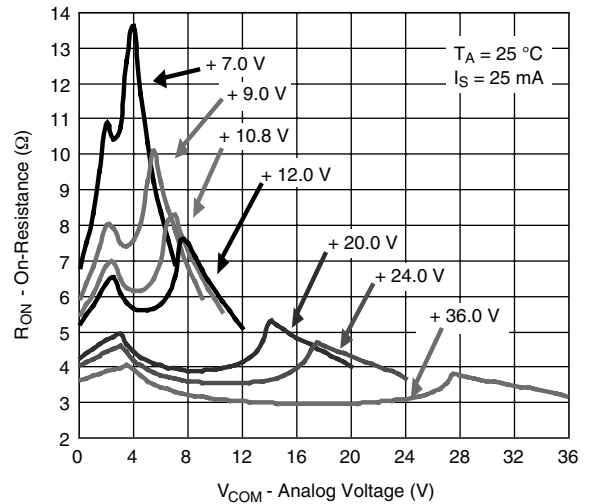
- a. V_{IN} = input voltage to perform proper function.
- b. Room = 25 °C, Full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The algebraic convention whereby the most negative value is a minimum 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.

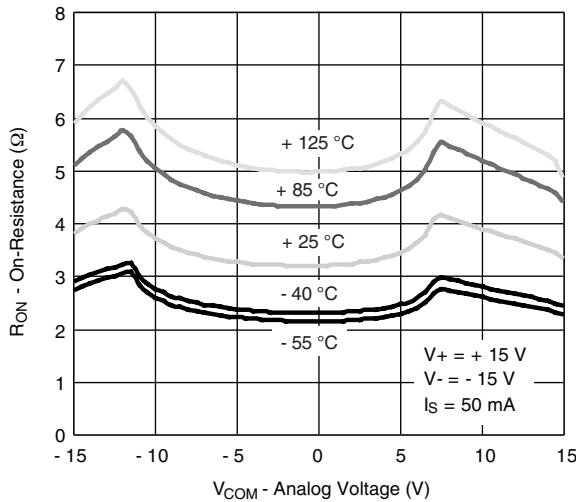
TYPICAL CHARACTERISTICS



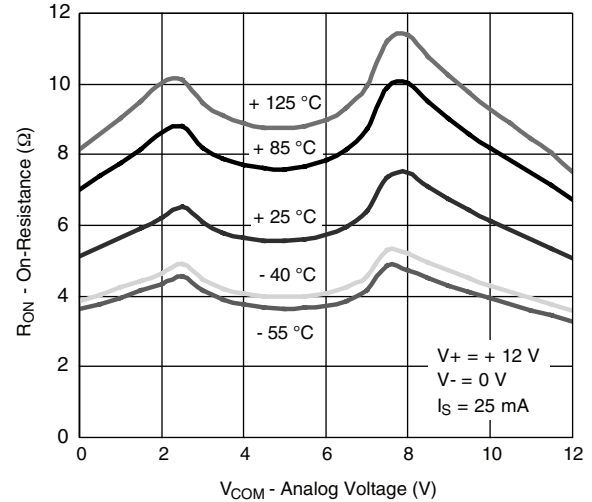
On-Resistance vs. V_D and Dual Supply Voltage



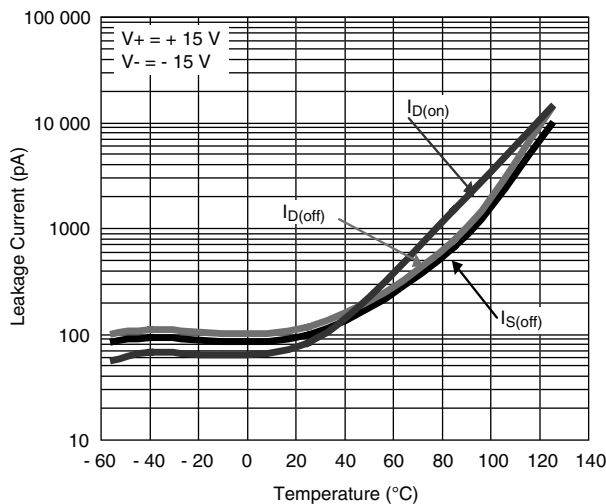
On-Resistance vs. V_D and Single Supply Voltage



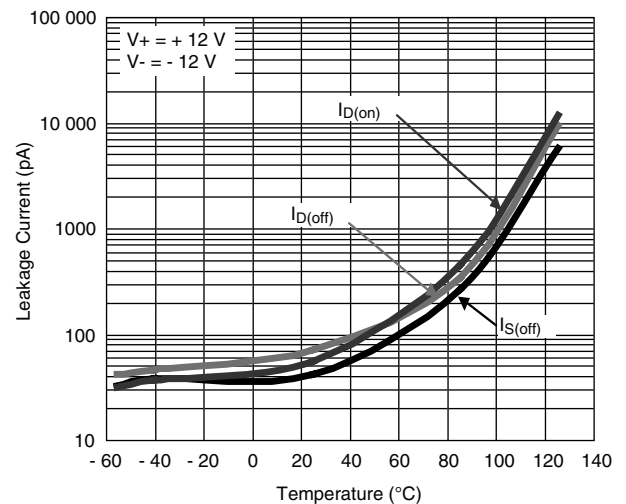
On-Resistance vs. V_D and Temperature



On-Resistance vs. V_D and Temperature

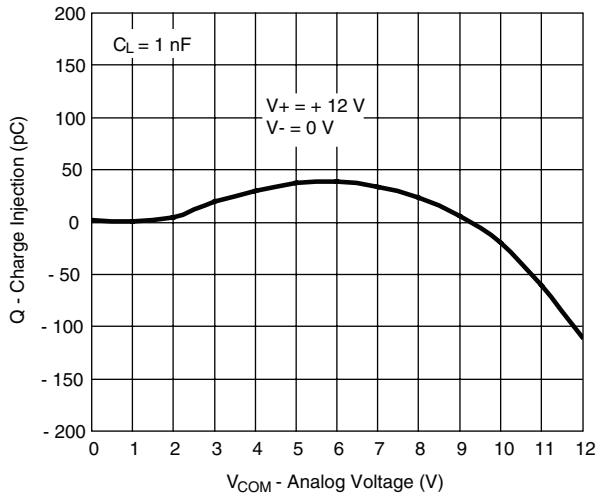


Leakage Current vs. Temperature

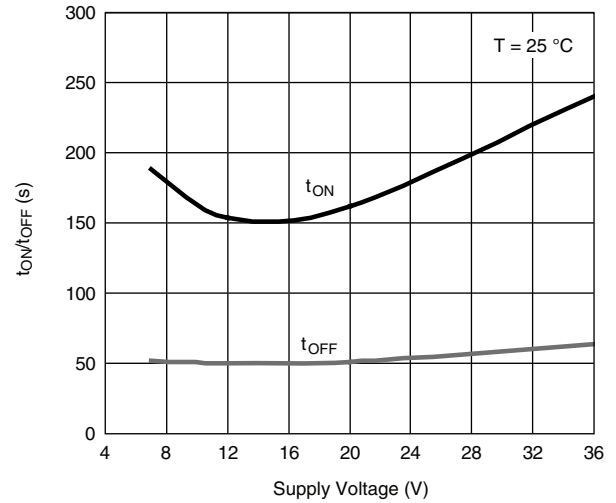


Leakage Current vs. Temperature

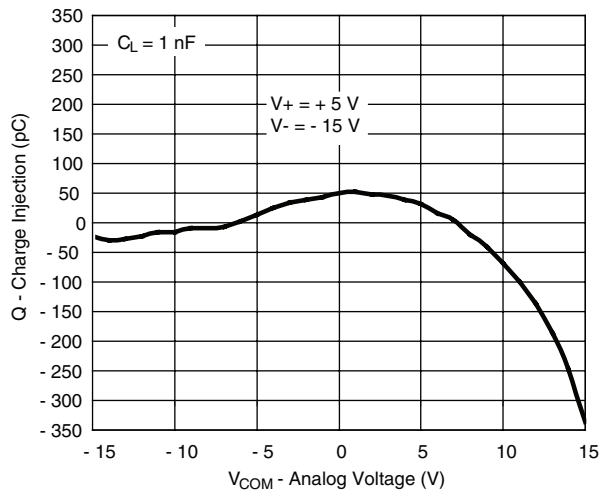
TYPICAL CHARACTERISTICS



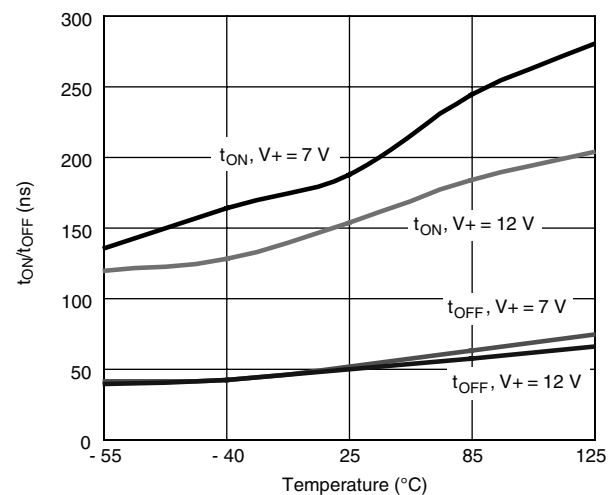
Charge Injection vs. Analog Voltage



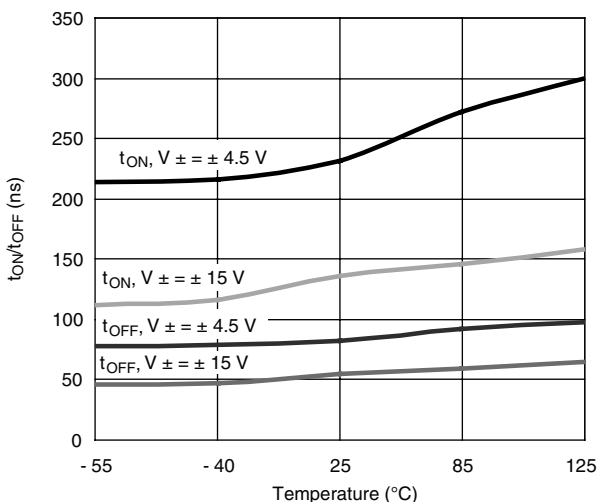
Switching Time vs. Single Supply Voltage



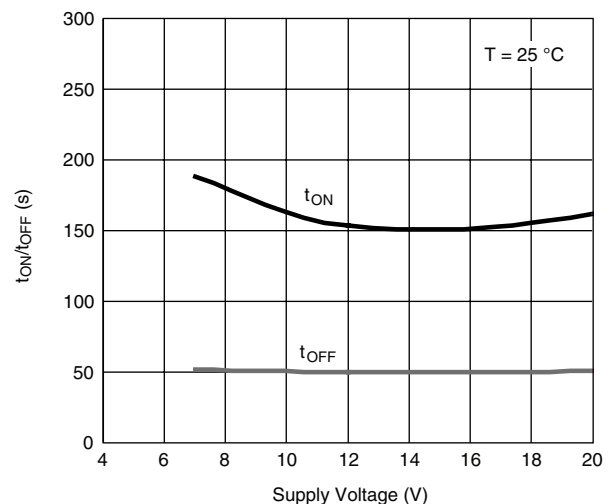
Charge Injection vs. Analog Voltage



Switching Time vs. Temperature and Single Supply Voltage

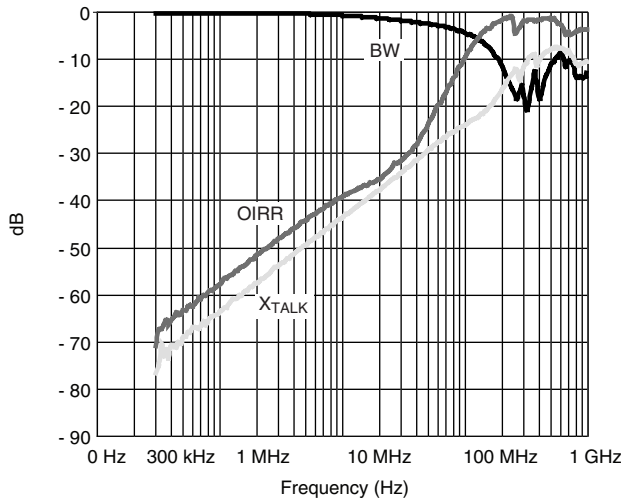


Switching Time vs. Temperature and Dual Supply Voltage

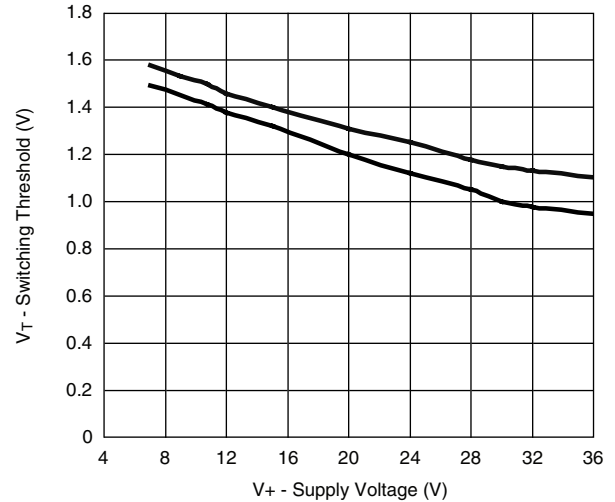


Switching Time vs. Dual Supply Voltage

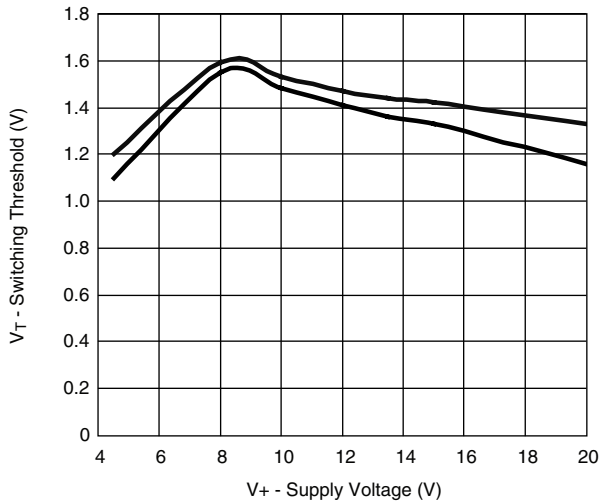
TYPICAL CHARACTERISTICS



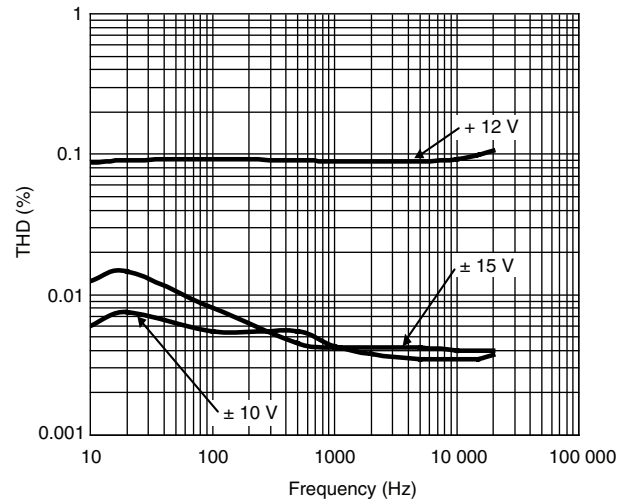
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



Switching Threshold vs. Signal Supply Voltage

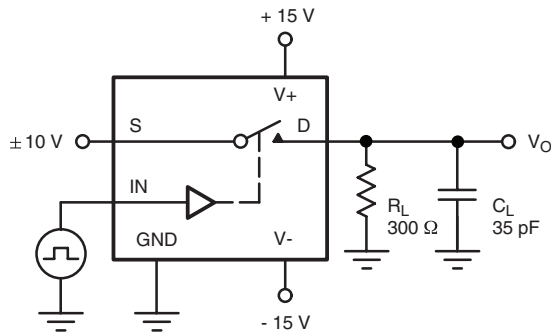


Switching Threshold vs. Dual Supply Voltage



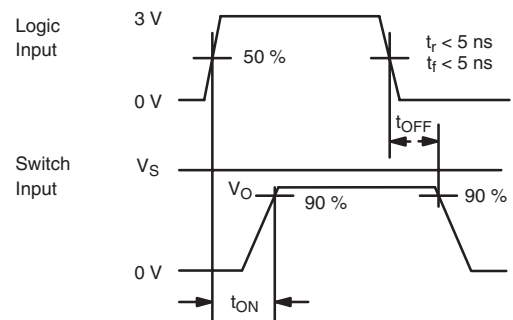
DG469, DG470 Total Harmonic Distortion

TEST CIRCUITS



C_L (includes fixture and stray capacitance)

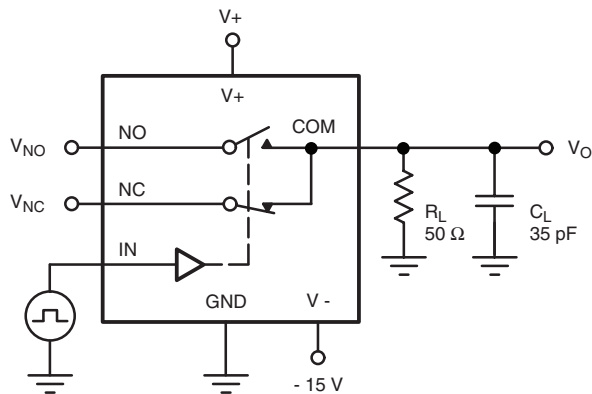
$$V_O = V_S \frac{R_L}{R_L + \tau_{DS(on)}}$$



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)

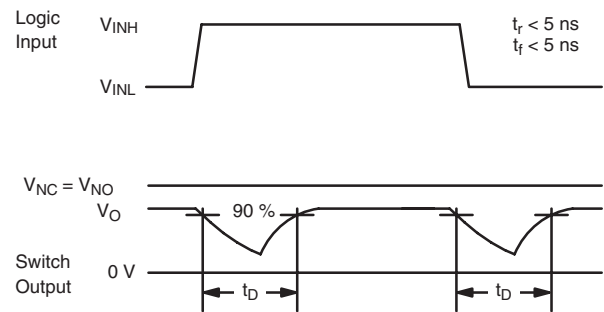


Figure 2. Break-Before-Make

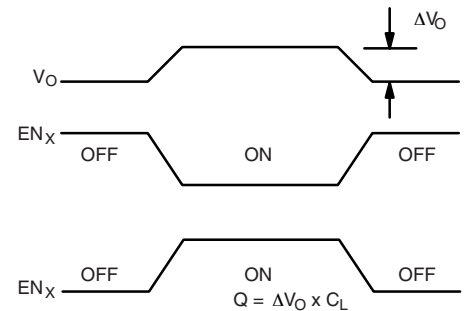
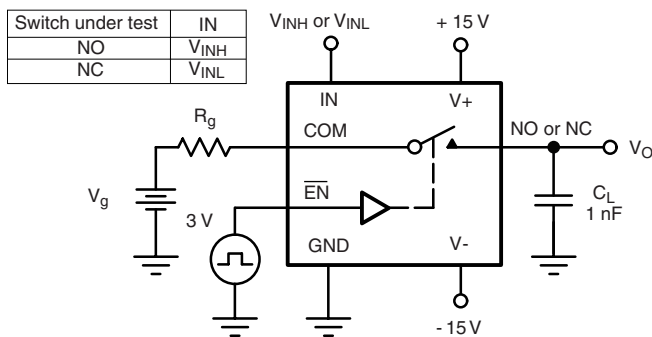


Figure 3. Charge Injection

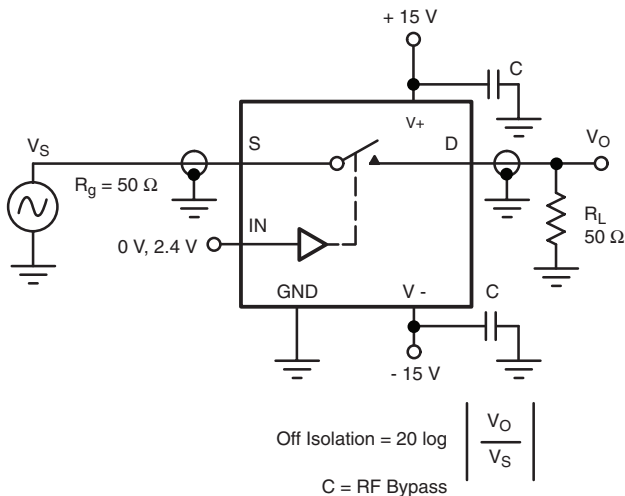


Figure 4. Off-Isolation

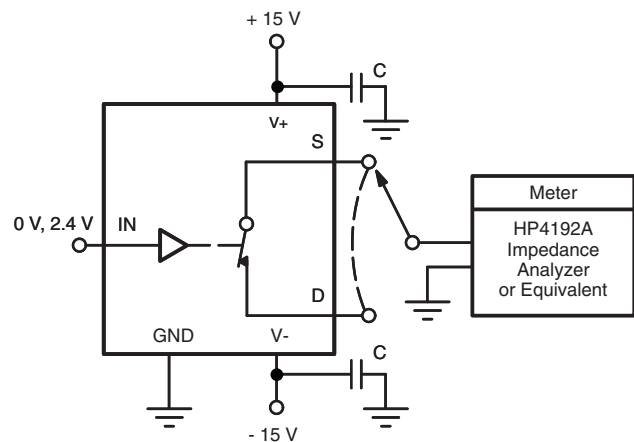


Figure 5. Source/Drain Capacitances

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