

Precision Low-Voltage, Low-Glitch CMOS Analog Switches

FEATURES

- 2.7- thru 12-V Single Supply or ± 2.7 - thru ± 6 -Dual Supply
- Low On-Resistance— $r_{DS(on)}$: 2.0Ω @ 12 V
- Fast Switching— t_{ON} : 28 ns
— t_{OFF} : 22 ns
- TTL and Low Voltage Logic
- Low Leakage: 10 pA (typ)
- > 2000-V ESD Protection

BENEFITS

- High Accuracy
- High Speed, Low Glitch
- Single and Dual Supply Capability
- Low r_{ON} in Small TSOP Package
- Low Leakage
- Low Power Consumption

APPLICATIONS

- Automatic Test Equipment
- Data Acquisition
- XDSL and DSLAM
- PBX Systems
- Reed Relay Replacement
- Audio and Video Signal Routing

DESCRIPTION

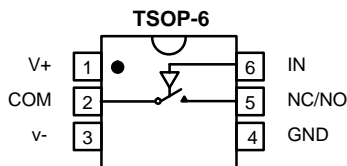
Using BiCMOS wafer fabrication technology allows the DG9421/DG9422 to operate on single and dual supplies.

Designed for optimal performance at single 5 V and dual ± 5 V, the DG9421/9422 combine low and flat on-resistance (3Ω), fast speed ($t_{ON} = 38$ ns) and low charge injection (less

than 1 pC) and is well suited for applications where signal switching accuracy, low noise and low distortion is critical.

The DG9421 and DG9422 respond to opposite control logic as shown in the Truth Table.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking:

DG9421DV = 4Exxx
DG9422DV = 4Fxxx

TRUTH TABLE

| Logic | DG9421 | DG9422 |
|-------|--------|--------|
| 0 | ON | OFF |
| 1 | OFF | ON |

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

Switches Shown for Logic "0" Input

ORDERING INFORMATION

| | | |
|-------------|------------|----------|
| -40 to 85°C | 6-Pin TSOP | DG9421DV |
| | | DG9422DV |



ABSOLUTE MAXIMUM RATINGS

| | | |
|--|-------|--|
| V+ to V- | | -0.3 TO 13 V |
| GND to V- | | 7 V |
| V _{IN} ^a , V _S , V _D | | -0.3 to (V+ +0.3 V) or 50 mA, whichever occurs first |
| Continuous Current (Any Terminal) | | 50 mA |
| Peak Current, S or D (Pulsed 1 ms, 10% Duty Cycle) | | 100 mA |
| Storage Temperature | | -65 to 150°C |

| | | |
|--|-------|--------|
| Power Dissipation (Package) ^b | | 570 mW |
| 6-Pin TSOP ^c | | 570 mW |

Notes:

- 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.
- All leads welded or soldered to PC Board.
- Derate 7 mW/°C above 25°C

| SPECIFICATIONS ^a (SINGLE SUPPLY 12 V) | | | | | | | |
|--|---------------------|--|-------------------|-----------------------|------------------|------------------|------|
| Parameter | Symbol | Test Conditions Unless Specified V+ = 12 V, V- = 0 V V _{IN} = 2.4 V, 0.8 V ^f | Temp ^b | Limits -40 to 85°C | | | Unit |
| | | | | Min ^d | Typ ^c | Max ^d | |
| Analog Switch | | | | | | | |
| Analog Signal Range ^a | V _{ANALOG} | | Full | 0 | | 12 | V |
| Drain-Source On-Resistance | r _{DS(on)} | V+ = 10.8 V, V- = 0 V I _S = 5 mA, V _D = 2/9 V | Room Full | | 2.0 | 3 3.4 | Ω |
| Switch Off Leakage Current | I _{S(off)} | V _D = 1/11 V, V _S = 11/1 V | Room Full | -1 -10 | | 1 10 | nA |
| | I _{D(off)} | | Room Full | -1 -10 | | 1 10 | |
| Channel On Leakage Current | I _{D(on)} | V _S = V _D = 11/1 V | Room Full | -1 -10 | | 1 10 | |
| Digital Control | | | | | | | |
| Input Current, V _{IN} Low | I _{IL} | V _{IN} Under Test = 0.8 V | Full | -1 | 0.02 | 1 | μA |
| Input Current, V _{IN} High | I _{IH} | V _{IN} Under Test = 2.4 V | Full | -1 | 0.02 | 1 | |
| Dynamic Characteristics | | | | | | | |
| Turn-On Time ^e | t _{ON} | R _L = 300 Ω, C _L = 35 pF V _S = 5 V See Figure 2 | Room Full | | 20 | 45 49 | ns |
| Turn-Off Time ^e | t _{OFF} | | Room Full | | 25 | 47 59 | |
| Charge Injection ^e | Q | V _g = 0 V, R _g = 0 Ω, C _L = 1 nF | Room | | 0.8 | | pC |
| Off Isolation ^e | OIRR | R _L = 50 Ω, C _L = 5 pF, f = 1 MHz | Room | | -60 | | dB |
| Source Off Capacitance ^e | C _{S(off)} | f = 1 MHz | Room | | 31 | | pF |
| Drain Off Capacitance ^e | C _{D(off)} | | Room | | 30 | | |
| Channel On Capacitance ^e | C _{D(on)} | | Room | | 71 | | |
| Power Supplies | | | | | | | |
| Positive Supply Current | I+ | V _{IN} = 0 or 12 V | Room Full | | 0.02 | 1 5 | μA |
| Negative Supply Current | I- | | Room Full | -1 -5 | -0.002 | | |
| Ground Current | I _{GND} | | Room Full | -1 -5 | -0.002 | | |



| SPECIFICATIONS ^a (DUAL SUPPLY ± 5 V) | | | | | | | |
|---|--------------|--|-------------------|-----------------------|------------------|------------------|---------------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 5\text{ V}, V_- = -5\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Limits -40 to 85°C | | | Unit |
| | | | | Min ^d | Typ ^c | Max ^d | |
| Analog Switch | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | -5 | | 5 | V |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $V_+ = 5\text{ V}, V_- = -5\text{ V}$ $I_S = 5\text{ mA}, V_D = \pm 3.5\text{ V}$ | Room Full | | 2.2 | 3.2 3.6 | Ω |
| Switch Off Leakage Current ^g | $I_{S(off)}$ | $V_+ = 5.5\text{ V}, V_- = -5.5\text{ V}$ $V_D = \pm 4.5\text{ V}, V_S = \mp 4.5\text{ V}$ | Room Full | -1 -10 | | 1 10 | nA |
| | $I_{D(off)}$ | | Room Full | -1 -10 | | 1 10 | |
| Channel On Leakage Current ^g | $I_{D(on)}$ | $V_+ = 5.5\text{ V}, V_- = -5.5\text{ V}$ $V_S = V_D = \pm 4.5\text{ V}$ | Room Full | -1 10 | | 1 10 | |
| Digital Control | | | | | | | |
| Input Current, V_{IN} Low ^e | I_{IL} | V_{IN} Under Test = 0.8 V | Full | -1 | 0.02 | 1 | μA |
| Input Current, V_{IN} High ^e | I_{IH} | V_{IN} Under Test = 2.4 V | Full | -1 | 0.02 | 1 | |
| Dynamic Characteristics | | | | | | | |
| Turn-On Time | t_{ON} | $R_L = 300\ \Omega, C_L = 35\text{ pF}$ $V_S = \pm 3.5\text{ V}$ See Figure 2 | Room Full | | 38 | 63 68 | ns |
| Turn-Off Time | t_{OFF} | | Room Full | | 45 | 83 97 | |
| Charge Injection ^e | Q | $V_g = 0\text{ V}, R_g = 0\ \Omega, C_L = 1\text{ nF}$ | Room | | 0.6 | | pC |
| Off Isolation ^e | OIRR | $R_L = 50\ \Omega, C_L = 5\text{ pF},$ $f = 1\text{ MHz}$ | Room | | -57 | | dB |
| Source Off Capacitance ^e | $C_{S(off)}$ | $f = 1\text{ MHz}$ | Room | | 32 | | pF |
| Drain Off Capacitance ^e | $C_{D(off)}$ | | Room | | 31 | | |
| Channel On Capacitance ^e | $C_{D(on)}$ | | Room | | 71 | | |
| Power Supplies | | | | | | | |
| Positive Supply Current ^e | I_+ | $V_{IN} = 0\text{ or }5\text{ V}$ | Room Full | | 0.03 | 1 5 | μA |
| Negative Supply Current ^e | I_- | | Room Full | -1 -5 | -0.002 | | |
| Ground Current ^e | I_{GND} | | Room Full | -1 -5 | -0.002 | | |

| SPECIFICATIONS ^a (SINGLE SUPPLY 5 V) | | | | | | | |
|---|--------------|---|-------------------|-----------------------|------------------|------------------|----------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 5\text{ V}, V_- = 0\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Limits -40 to 85°C | | | Unit |
| | | | | Min ^d | Typ ^c | Max ^d | |
| Analog Switch | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | 0 | | 5 | V |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $V_+ = 4.5\text{ V}, I_S = 5\text{ mA}$ $V_D = 1\text{ V}, 3.5\text{ V}$ | Room Full | | 3.6 | 6.0 6.6 | Ω |
| Dynamic Characteristics | | | | | | | |
| Turn-On Time ^e | t_{ON} | $R_L = 300\ \Omega, C_L = 35\text{ pF}$ $V_S = 3.5\text{ V}$, See Figure 2 | Room Hot | | 43 | 67 74 | ns |
| Turn-Off Time ^e | t_{OFF} | | Room Hot | | 30 | 67 80 | |
| Charge Injection ^e | Q | $V_g = 0\text{ V}, R_g = 0\ \Omega, C_L = 1\text{ nF}$ | Room | | 0.3 | | pC |



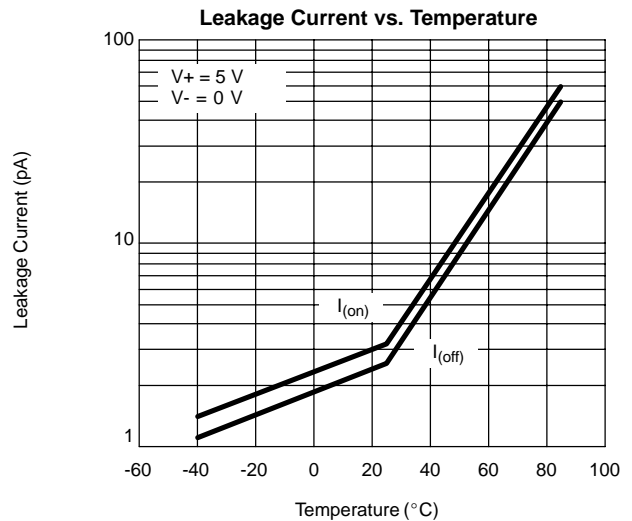
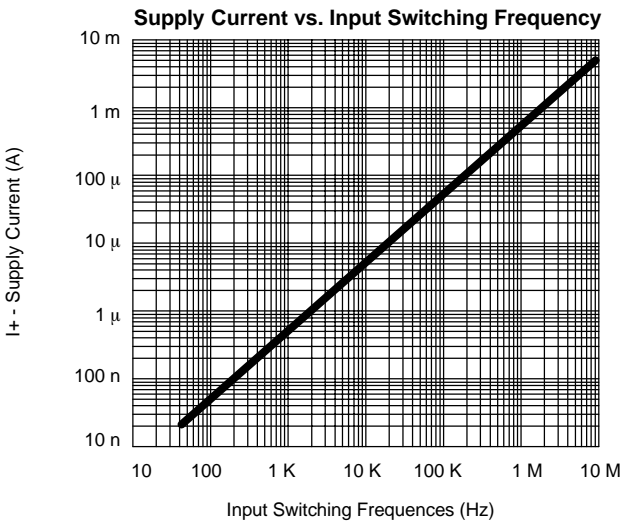
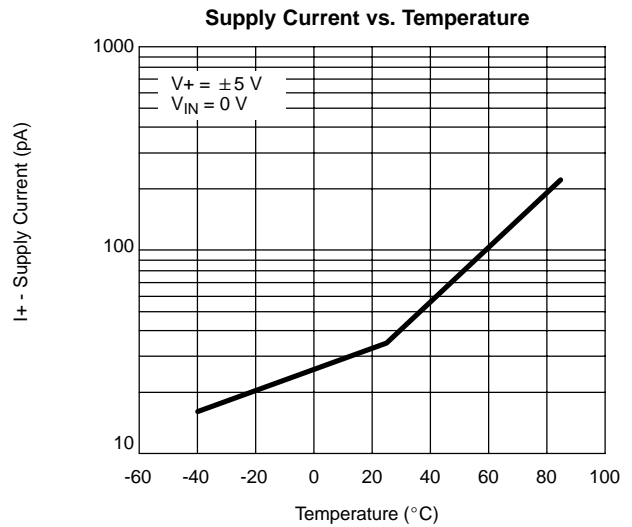
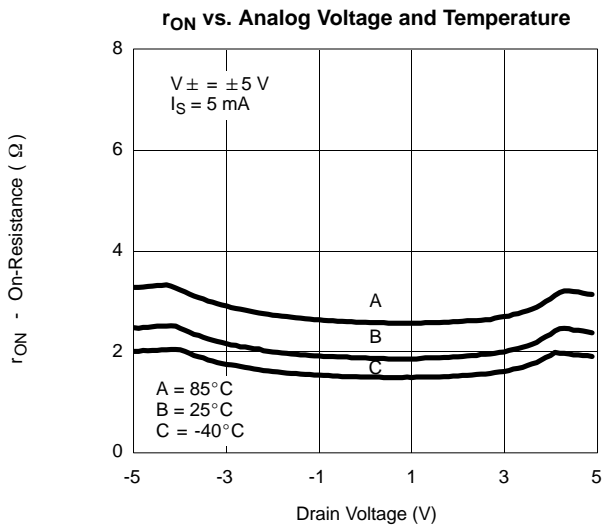
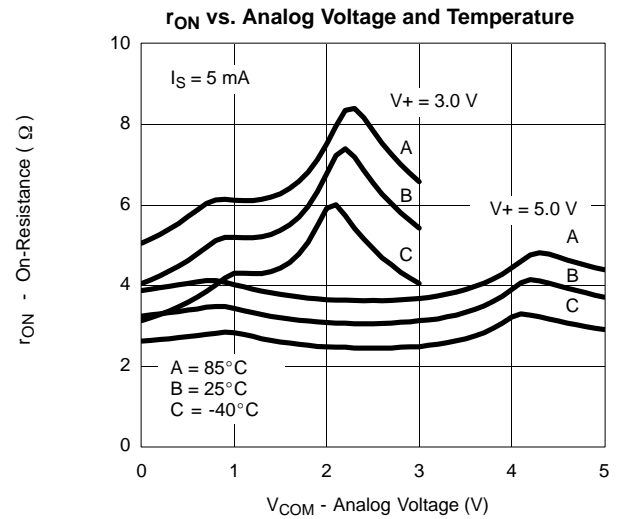
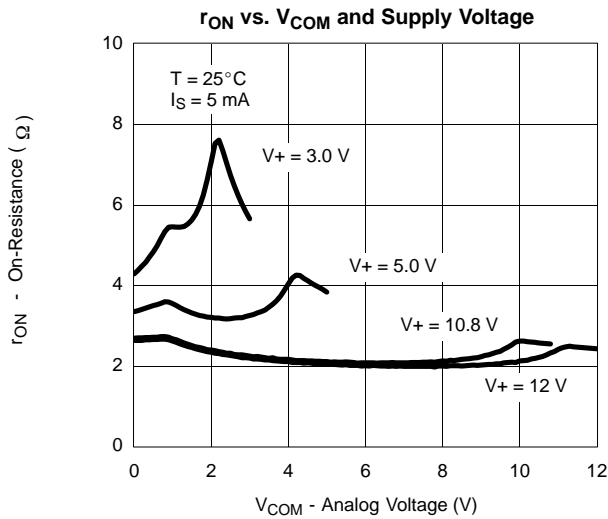
| SPECIFICATIONS ^a (SINGLE SUPPLY 5 V) | | | | | | | |
|---|------------------|---|-------------------|-----------------------|------------------|------------------|------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 5\text{ V}, V_- = 0\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Limits -40 to 85°C | | | Unit |
| | | | | Min ^d | Typ ^c | Max ^d | |
| Power Supplies | | | | | | | |
| Positive Supply Current ^e | I+ | $V_{IN} = 0\text{ or }5\text{ V}$ | Room Hot | | 0.02 | 1 5 | μA |
| Negative Supply Current ^e | I- | | Room Hot | -1 -5 | -0.002 | | |
| Ground Current ^e | I _{GND} | | Room Hot | -1 -5 | -0.002 | | |

| SPECIFICATIONS ^a (SINGLE SUPPLY 3 V) | | | | | | | |
|--|---------------------|---|-------------------|-----------------------|------------------|------------------|------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 3\text{ V}, V_- = 0\text{ V}$ $V_{IN} = 0.4\text{ V}^f$ | Temp ^b | Limits -40 to 85°C | | | Unit |
| | | | | Min ^d | Typ ^c | Max ^d | |
| Analog Switch | | | | | | | |
| Analog Signal Range ^e | V _{ANALOG} | | Full | 0 | | 3 | V |
| Drain-Source On-Resistance | r _{DS(on)} | $V_+ = 2.7\text{ V}, V_- = 0\text{ V}$ $I_S = 5\text{ mA}, V_D = 0.5, 2.2\text{ V}$ | Room Full | | 7.3 | 8.8 10.1 | Ω |
| Switch Off Leakage Current ^g | I _{S(off)} | $V_+ = 3.3\text{ V}, V_- = 0\text{ V}$ $V_D = 1, 2\text{ V}, V_S = 2, 1\text{ V}$ | Room Full | -1 -10 | | 1 10 | nA |
| | I _{D(off)} | | Room Full | -1 -10 | | 1 10 | |
| Channel On Leakage Current ^g | I _{D(on)} | $V_+ = 3.3\text{ V}, V_- = 0\text{ V}$ $V_S = V_D = 1, 2\text{ V}$ | Room Full | -1 -10 | | 1 10 | |
| Digital Control | | | | | | | |
| Input Current, V _{IN} Low ^e | I _{IL} | V _{IN} Under Test = 0.4 V | Full | -1 | 0.02 | 1 | μA |
| Input Current, V _{IN} High ^e | I _{IH} | V _{IN} Under Test = 2.4 V | Full | -1 | 0.02 | 1 | |
| Dynamic Characteristics | | | | | | | |
| Turn-On Time | t _{ON} | $R_L = 300\text{ Ω}, C_L = 35\text{ pF}$ $V_S = 1.5\text{ V}$ See Figure 2 | Room Full | | 90 | 110 125 | ns |
| Turn-Off Time | t _{OFF} | | Room Full | | 32 | 84 99 | |
| Charge Injection ^e | Q | $V_g = 0\text{ V}, R_g = 0\text{ Ω}, C_L = 1\text{ nF}$ | Room | | 0.3 | | pC |
| Off Isolation ^e | OIRR | $R_L = 50\text{ Ω}, C_L = 5\text{ pF},$ $f = 1\text{ MHz}$ | Room | | -60 | | dB |
| Source Off Capacitance ^e | C _{S(off)} | f = 1 MHz | Room | | 35 | | pF |
| Drain Off Capacitance ^e | C _{D(off)} | | Room | | 34 | | |
| Channel On Capacitance ^e | C _{D(on)} | | Room | | 77 | | |

Notes:

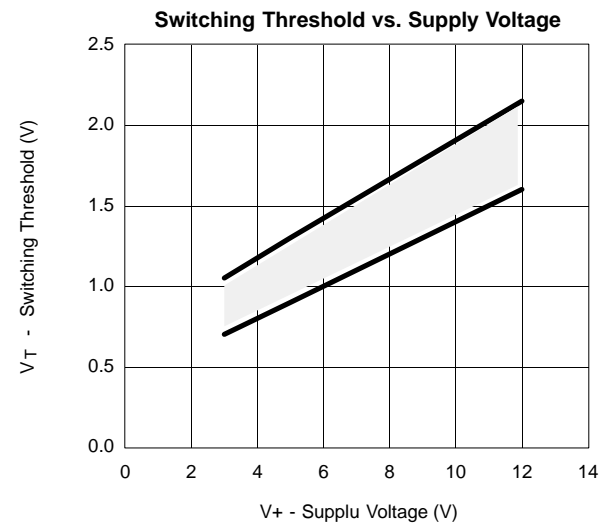
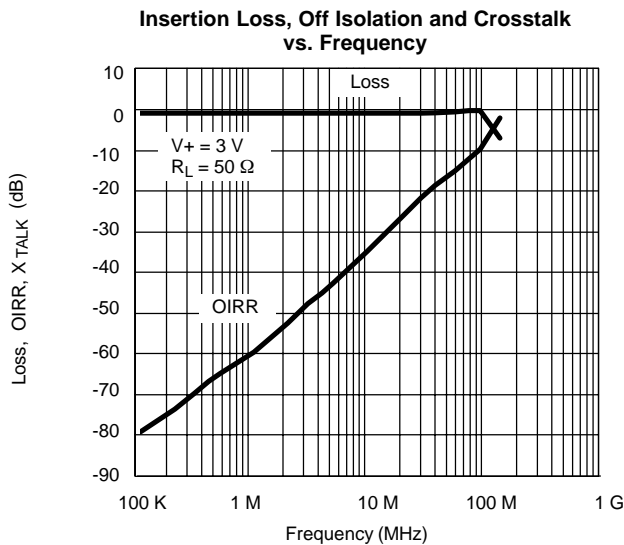
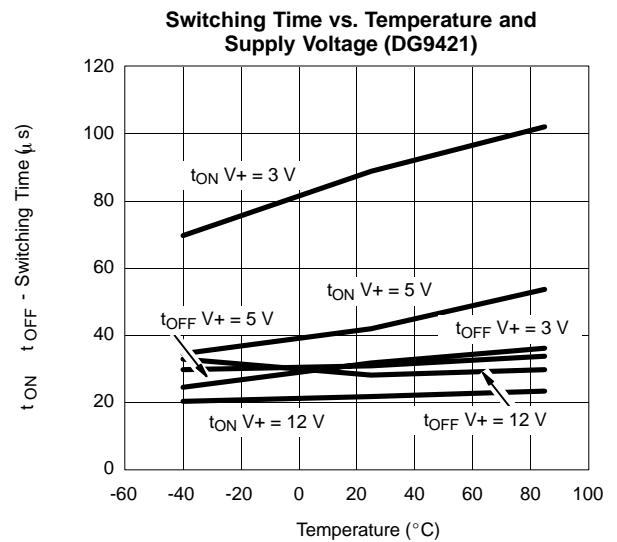
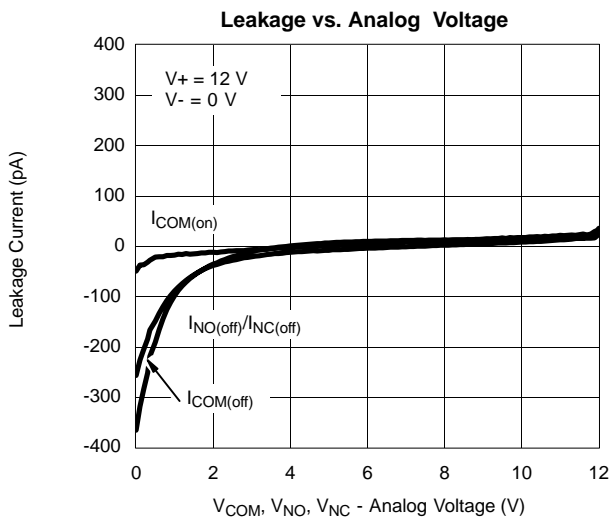
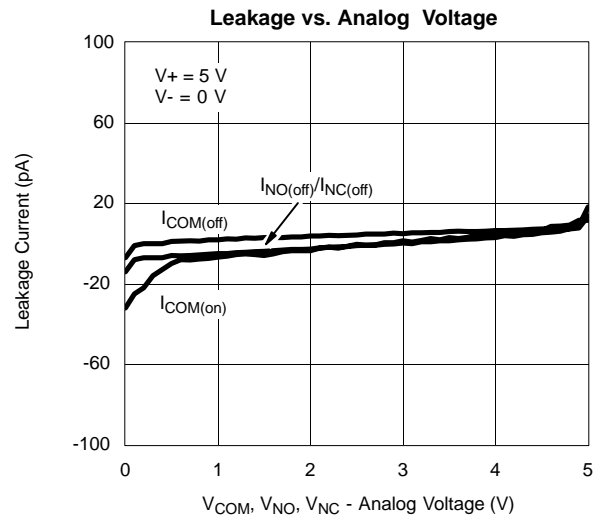
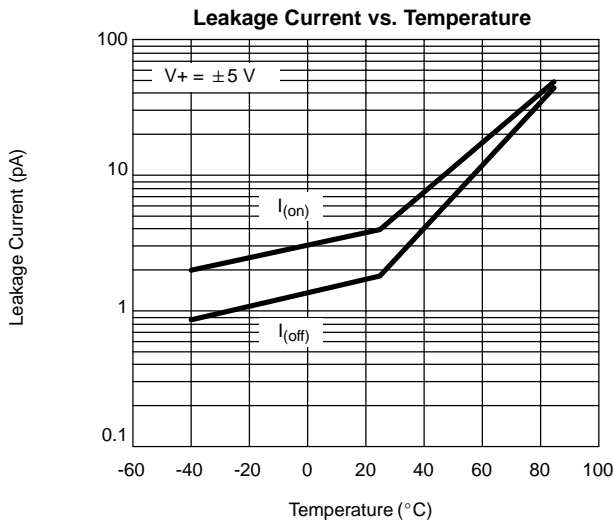
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25°C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guaranteed by design, not subject to production test.
- V_{IN} = input voltage to perform proper function.
- Leakage parameters are guaranteed by worst case test conditions and not subject to test.

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

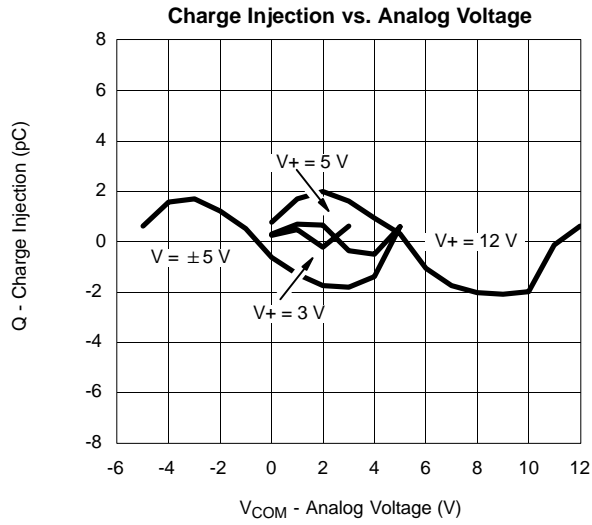




TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

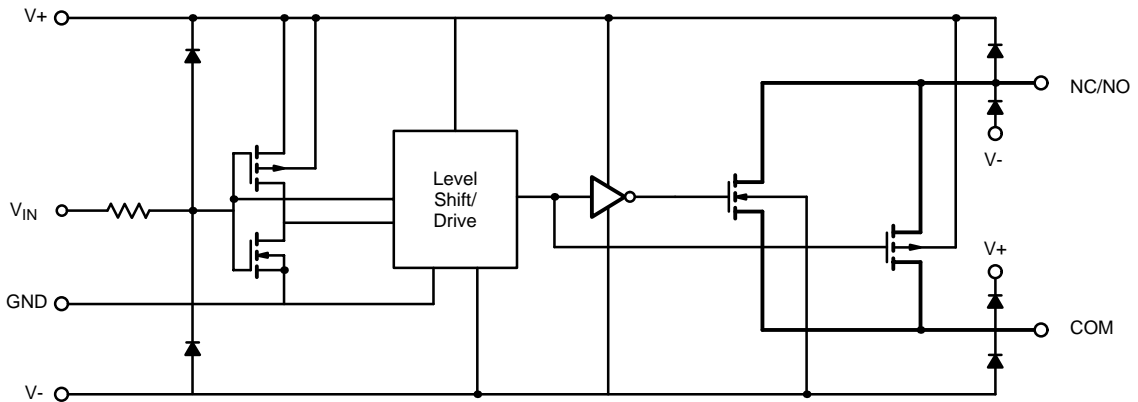
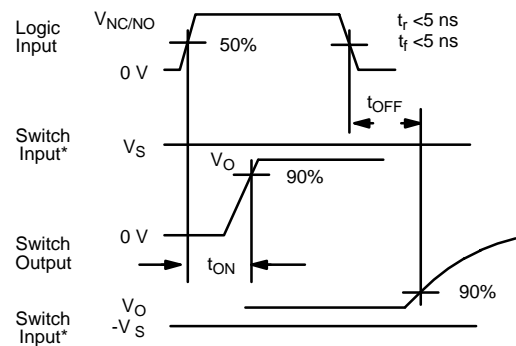
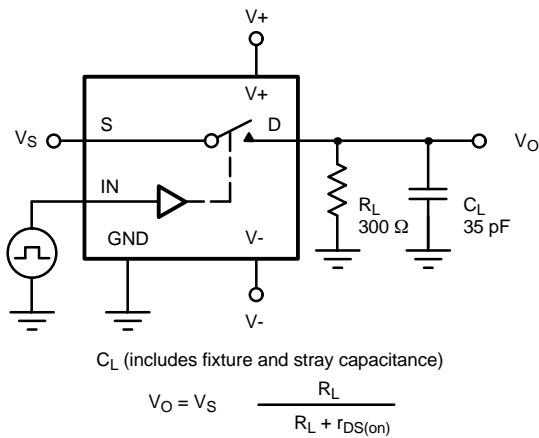


FIGURE 1.

TEST CIRCUITS



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

FIGURE 2. Switching Time

TEST CIRCUITS

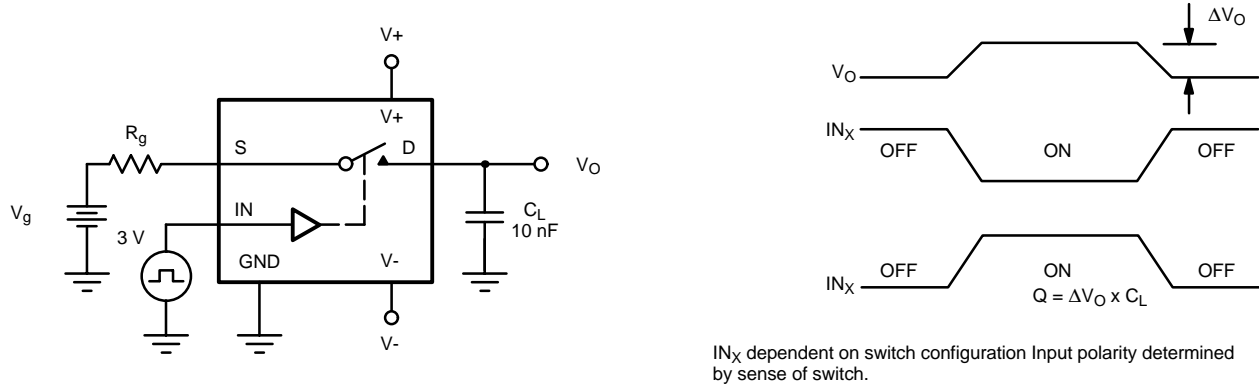


FIGURE 3. Charge Injection

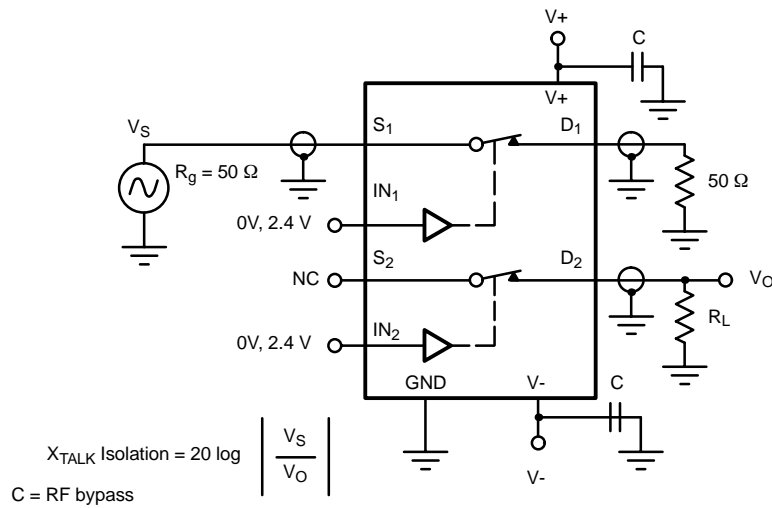


FIGURE 4. Crosstalk

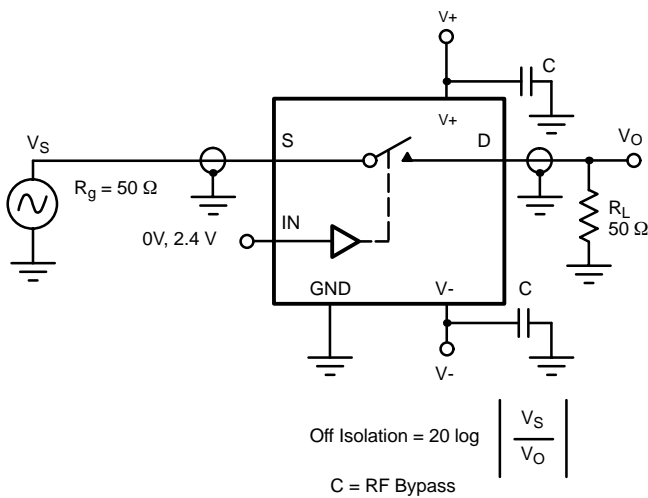


FIGURE 5. Off Isolation

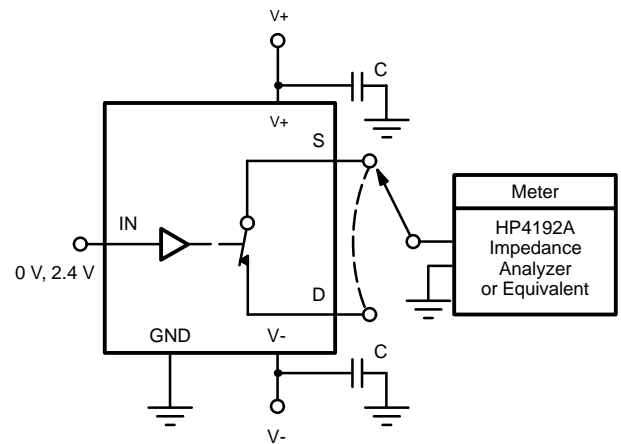


FIGURE 6. Source/Drain Capacitances



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