

Quad SPST CMOS Analog Switches

FEATURES

- Low On-Resistance: 50 Ω
- Low Leakage: 80 pA
- Low Power Consumption: 0.2 mW
- Fast Switching Action— t_{ON} : 150 ns
- Low Charge Injection— Q : -1 pC
- DG201A/DG202 Upgrades
- TTL/CMOS-Compatible Logic
- Single Supply Capability

BENEFITS

- Less Signal Errors and Distortion
- Reduced Power Supply Requirements
- Faster Throughput
- Improved Reliability
- Reduced Pedestal Errors
- Simplifies Retrofit
- Simple Interfacing

APPLICATIONS

- Audio Switching
- Battery Powered Systems
- Data Acquisition
- Hi-Rel Systems
- Sample-and-Hold Circuits
- Communication Systems
- Automatic Test Equipment
- Medical Instruments

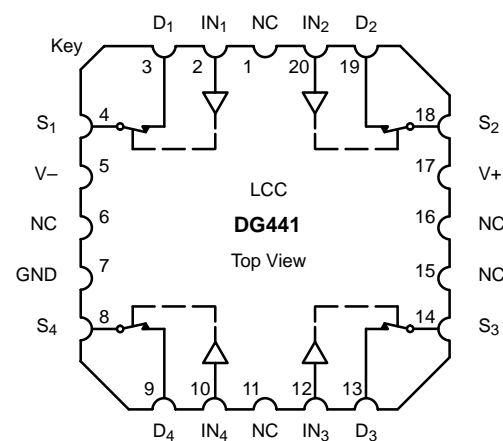
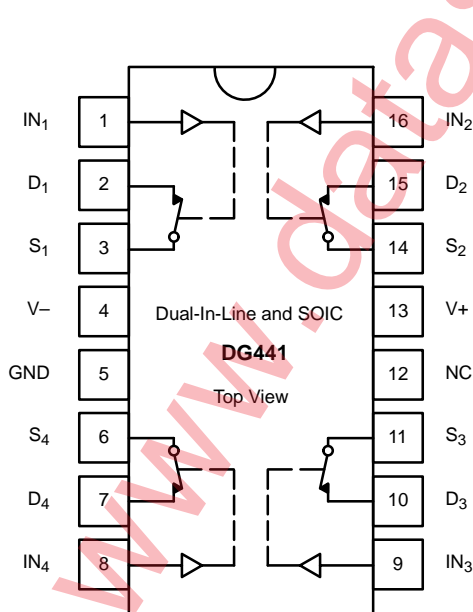
DESCRIPTION

The DG441/442 monolithic quad analog switches are designed to provide high speed, low error switching of analog and audio signals. The DG441 has a normally closed function. The DG442 has a normally open function. Combining low on-resistance (50 Ω , typ.) with high speed (t_{ON} 150 ns, typ.), the DG441/442 are ideally suited for upgrading DG201A/202 sockets. Charge injection has been minimized on the drain for use in sample-and-hold circuits.

To achieve high voltage ratings and superior switching performance, the DG441/442 are built on Vishay Siliconix's high-voltage silicon-gate process. An epitaxial layer prevents latchup.

Each switch conducts equally well in both directions when on, and blocks input voltages to the supply levels when off.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



| TRUTH TABLE | | |
|-------------|-------|-------|
| Logic | DG441 | DG442 |
| 0 | ON | OFF |
| 1 | OFF | ON |

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

| ORDERING INFORMATION | | |
|----------------------|--------------------|-----------------|
| Temp Range | Package | Part Number |
| -40 to 85°C | 16-Pin Plastic DIP | DG441DJ |
| | | DG442DJ |
| | 16-Pin Narrow SOIC | DG441DY |
| | | DG442DY |
| -55 to 125°C | 16-Pin CerDIP | DG441AK |
| | | DG441AK/883 |
| | | 5962-9204101MEA |
| | | DG442AK |
| | | DG442AK/883 |
| | | 5962-9204102MEA |
| | LCC-20 | 5962-9204101M2A |
| | | 5962-9204102M2A |

ABSOLUTE MAXIMUM RATINGS

| | |
|-------------------------------------------------------------|------------------------------------------------------------|
| V+ to V- | 44 V |
| GND to V- | 25 V |
| Digital Inputs ^a V _S , V _D | (V-) -2 V to (V+) +2 V or 30 mA, whichever occurs first |
| Continuous Current (Any Terminal) | 30 mA |
| Current, S or D (Pulsed 1 ms, 10% duty cycle) | 100 mA |
| Storage Temperature (AK Suffix) | -65 to 150°C |
| (DJ, DY Suffix) | -65 to 125°C |

| | |
|------------------------------------------|---------|
| Power Dissipation (Package) ^b | |
| 16-Pin Plastic DIP ^c | 450 mW |
| 16-Pin CerDIP ^d | 900 mW |
| 16-Pin Narrow Body SOIC ^d | 900 mW |
| LCC-20 ^d | 1200 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 6 mW/°C above 75°C
 - Derate 12 mW/°C above 25°C

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

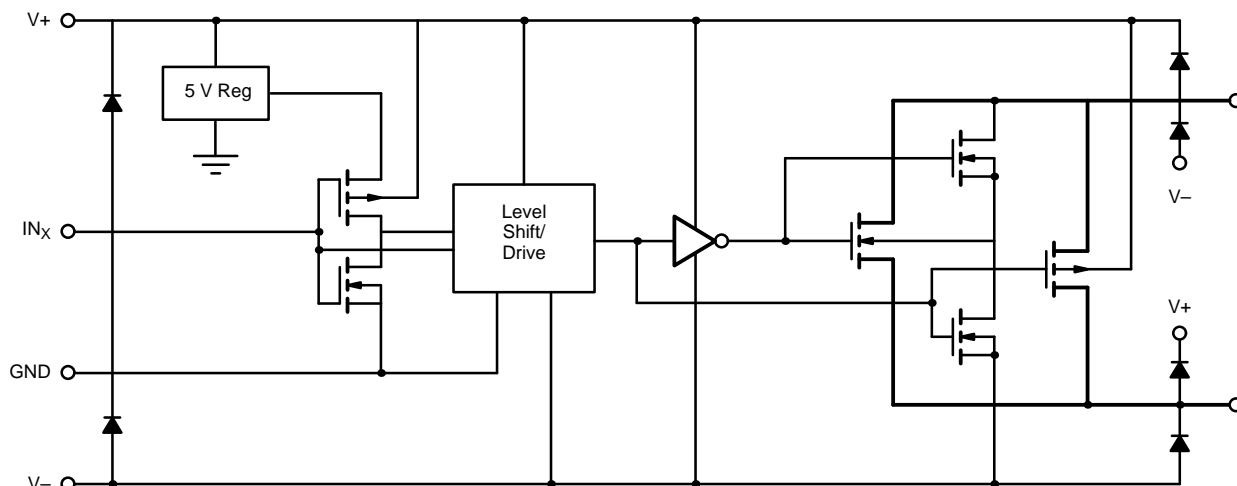


FIGURE 1.



| SPECIFICATIONS ^a FOR DUAL SUPPLIES | | | | | | | | | | |
|---------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|--|
| Parameter | Symbol | Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}, V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Typ ^c | A Suffix -55 to 125°C | | D Suffix -40 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 | |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = \pm 8.5\text{ V}$ $V_+ = 13.5\text{ V}, V_- = -13.5\text{ V}$ | Room Full | 50 | | 85 100 | | 85 100 | Ω | |
| On-Resistance Match Between Channels ^e | $\Delta r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = \pm 10\text{ V}$ $V_+ = 15\text{ V}, V_- = -15\text{ V}$ | Room Full | | | 4 5 | | 4 5 | | |
| Switch Off Leakage Current | $I_{S(off)}$ | $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$ $V_D = \pm 15.5\text{ V}, V_S = \mp 15.5\text{ V}$ | Room Full | ± 0.01 | -0.5 -20 | 0.5 20 | -0.5 -5 | 0.5 5 | nA | |
| | $I_{D(off)}$ | | Room Full | ± 0.01 | -0.5 -20 | 0.5 20 | -0.5 -5 | 0.5 5 | | |
| Channel On Leakage Current | $I_{D(on)}$ | $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$ $V_S = V_D = \pm 15.5\text{ V}$ | Room Full | ± 0.08 | -0.5 -40 | 0.5 40 | -0.5 -10 | 0.5 10 | | |
| Digital Control | | | | | | | | | | |
| Input Current V_{IN} Low | I_{IL} | V_{IN} under test = 0.8 V, All Other = 2.4 V | Full | -0.01 | -500 | 500 | -500 | 500 | nA | |
| Input Current V_{IN} High | I_{IH} | V_{IN} under test = 2.4 V, All Other = 0.8 V | Full | 0.01 | -500 | 500 | -500 | 500 | | |
| Dynamic Characteristics | | | | | | | | | | |
| Turn-On Time | t_{ON} | $R_L = 1\text{ k}\Omega, C_L = 35\text{ pF}$ $V_S = \pm 10\text{ V}$, See Figure 2 | Room | 150 | | 250 | | 250 | ns | |
| Turn-Off Time | DG441 | | Room | 90 | | 120 | | 120 | | |
| | DG442 | | Room | 110 | | 210 | | 210 | | |
| Charge Injection ^e | Q | $C_L = 1\text{ nF}, V_S = 0\text{ V}$ $V_{gen} = 0\text{ V}, R_{gen} = 0\text{ }\Omega$ | Room | -1 | | | | | pC | |
| Off Isolation ^e | OIRR | $R_L = 50\text{ }\Omega, C_L = 5\text{ pF}$ $f = 1\text{ MHz}$ | Room | 60 | | | | | dB | |
| Crosstalk (Channel-to-Channel) | X_{TALK} | | Room | 100 | | | | | | |
| Source Off Capacitance ^e | $C_{S(off)}$ | $f = 1\text{ MHz}$ | Room | 4 | | | | | pF | |
| Drain Off Capacitance ^e | $C_{D(off)}$ | | Room | 4 | | | | | | |
| Channel On Capacitance ^e | $C_{D(on)}$ | $V_{ANALOG} = 0\text{ V}$ | Room | 16 | | | | | | |
| Power Supplies | | | | | | | | | | |
| Positive Supply Current | I_+ | $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$ $V_{IN} = 0\text{ or }5\text{ V}$ | Full | 15 | | 100 | | 100 | μA | |
| Negative Supply Current | I_- | | Room Full | -0.000 1 | -1 -5 | | -1 -5 | | | |
| Ground Current | I_{GND} | | Full | -15 | -100 | | -100 | | | |

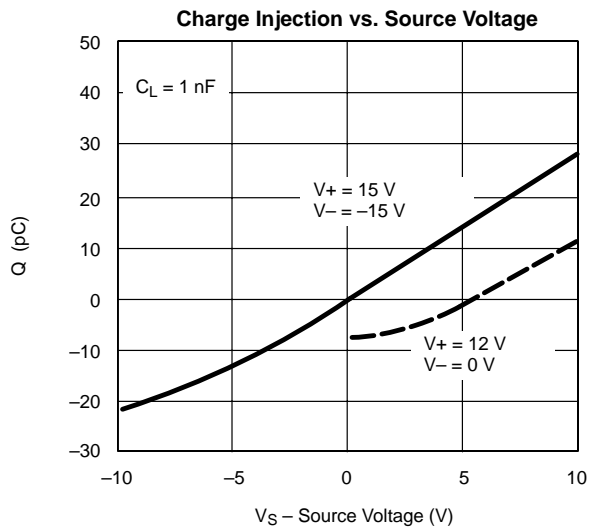
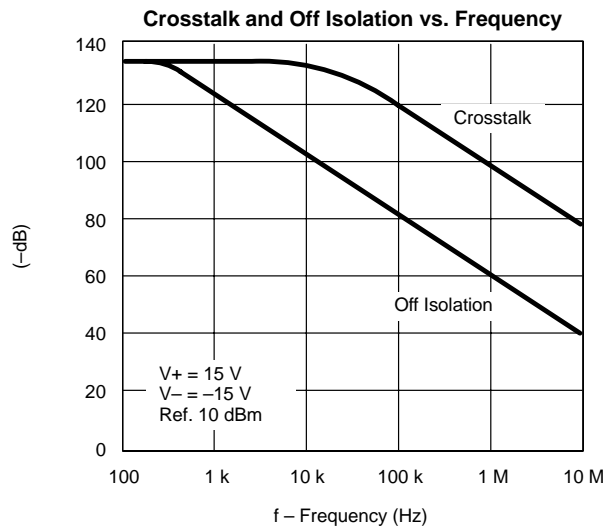
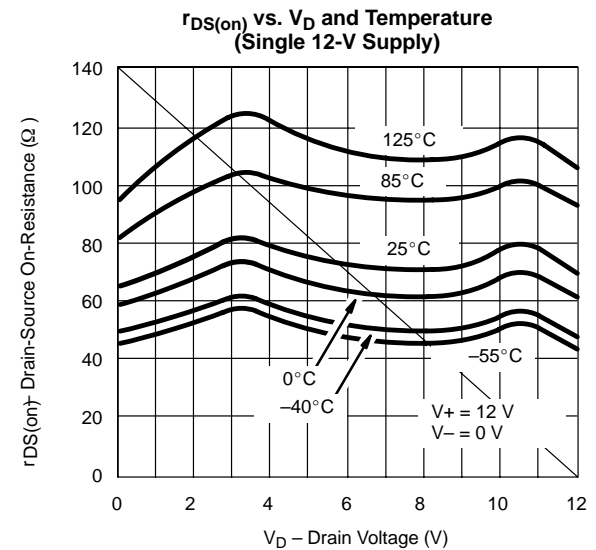
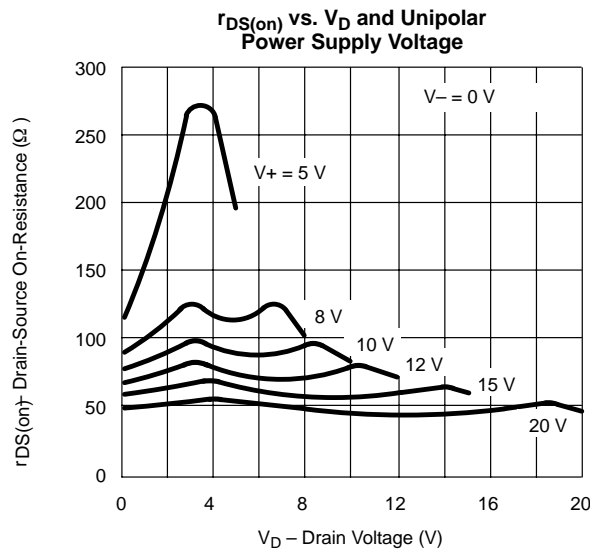
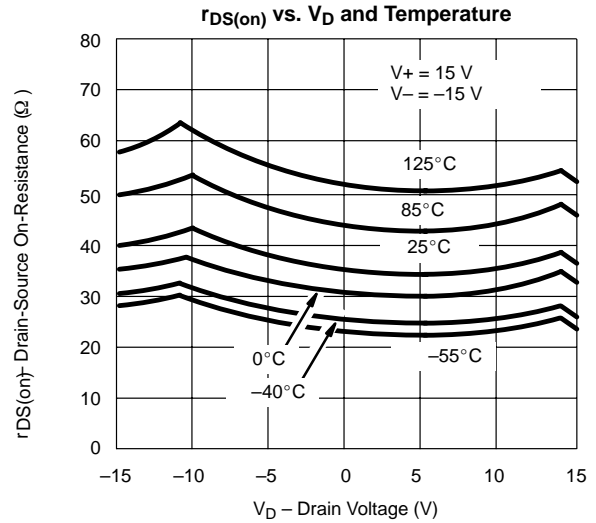
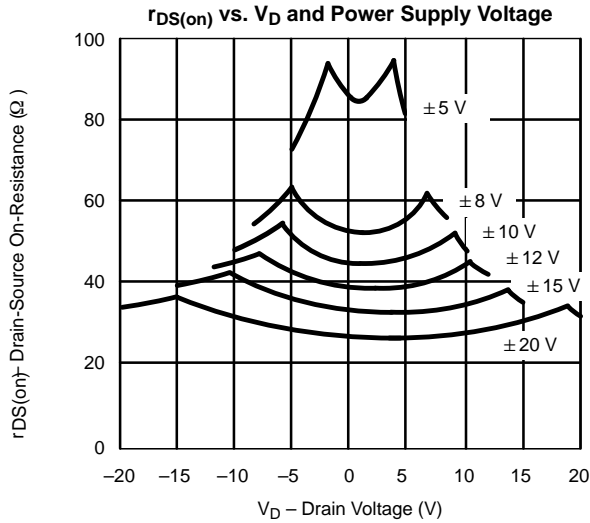


| SPECIFICATIONS ^a FOR SINGLE SUPPLY | | | | | | | | | |
|-----------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|
| Parameter | Symbol | Test Conditions Otherwise Unless Specified $V_+ = 12\text{ V}$, $V_- = 0\text{ V}$, $V_{IN} = 2.4\text{ V}$, 0.8 V^f | Temp ^b | Typ ^c | A Suffix -55 to 125°C | | D Suffix -40 to 85°C | | Unit |
| | | | | | Min ^d | Max ^d | Min ^d | Max ^d | |
| Analog Switch | | | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | | 0 | 12 | 0 | 12 | V |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $I_S = -10\text{ mA}$, $V_D = 3\text{ V}$, 8 V $V_+ = 10.8\text{ V}$ | Room Full | 100 | | 160 200 | | 160 200 | Ω |
| Dynamic Characteristics | | | | | | | | | |
| Turn-On Time | t_{ON} | $R_L = 1\text{ k}\Omega$, $C_L = 35\text{ pF}$ $V_S = 8\text{ V}$, See Figure 2 | Room | 300 | | 450 | | 450 | ns |
| Turn-Off Time | t_{OFF} | | Room | 60 | | 200 | | 200 | |
| Charge Injection | Q | $C_L = 1\text{ nF}$, $V_{gen} = 6\text{ V}$, $R_{gen} = 0\ \Omega$ | Room | 2 | | | | | pC |
| Power Supplies | | | | | | | | | |
| Positive Supply Current | I+ | $V_+ = 13.2\text{ V}$, $V_- = 0\text{ V}$ $V_{IN} = 0\text{ or }5\text{ V}$ | Full | 15 | | 100 | | 100 | μA |
| Negative Supply Current | I- | | Room Full | -0.0001 | -1 -100 | | -1 -100 | | |
| Ground Current | I_{GND} | | Full | -15 | -100 | | -100 | | |

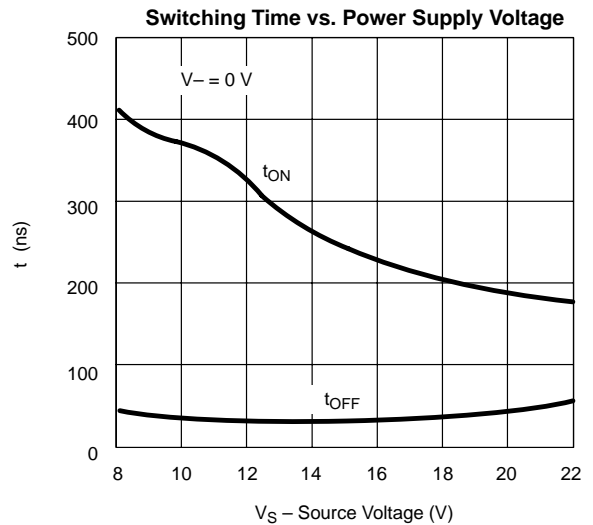
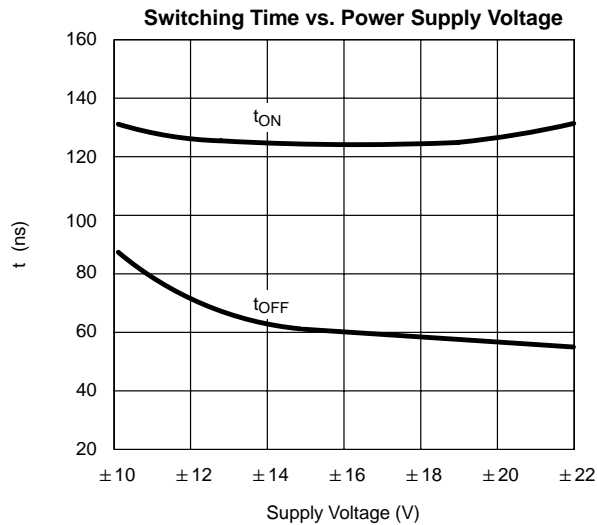
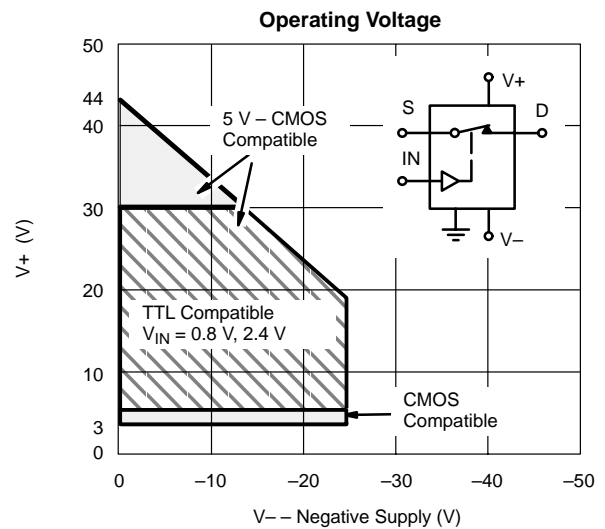
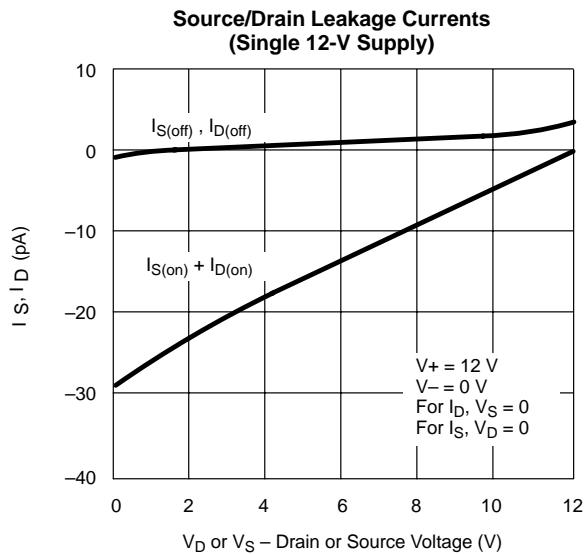
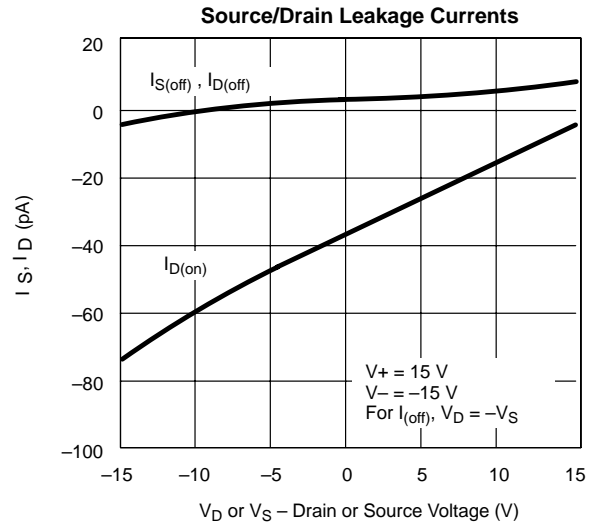
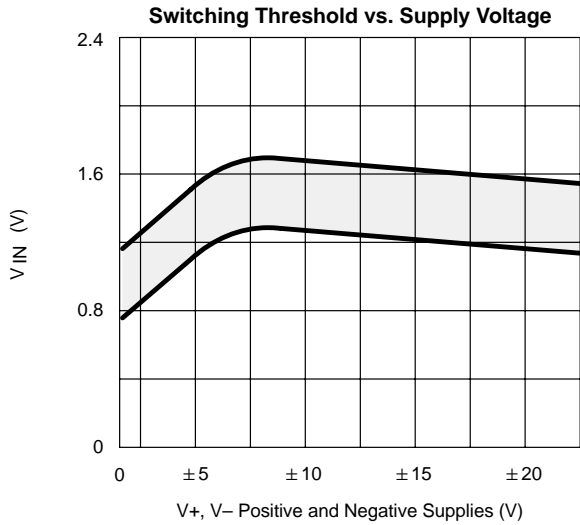
Notes:

- 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.

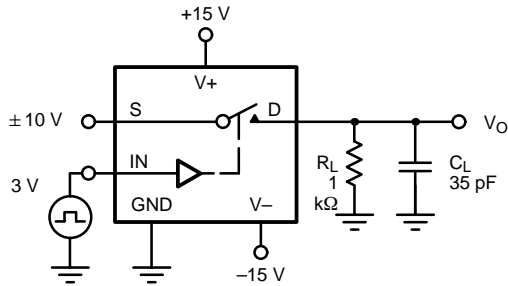
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



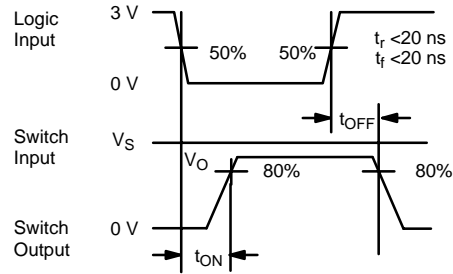
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



TEST CIRCUITS



C_L (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG442.

FIGURE 2. Switching Time

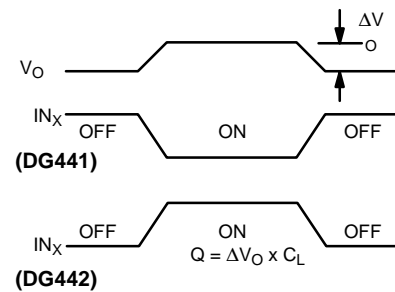
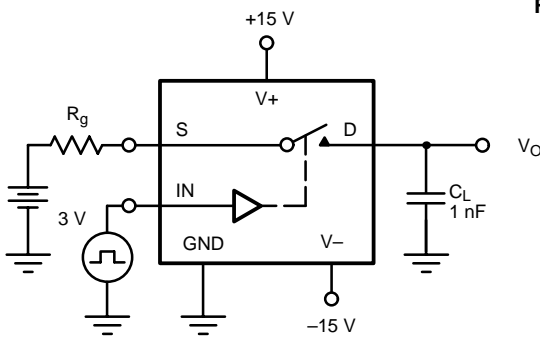
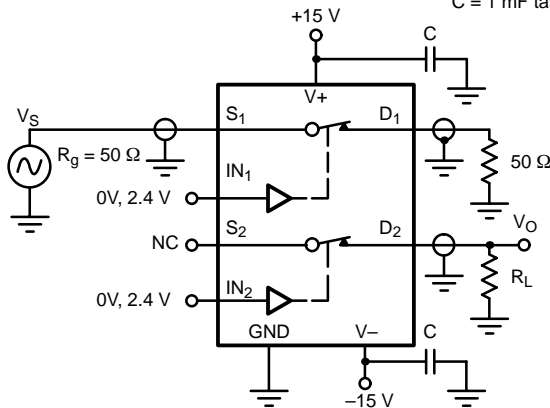


FIGURE 3. Charge Injection

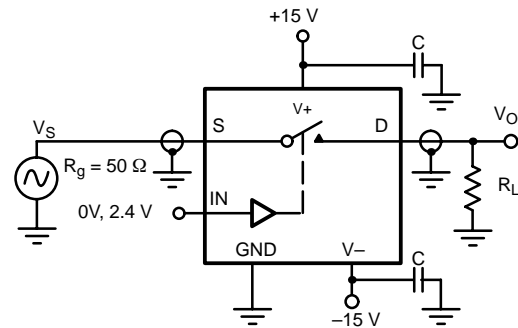
$C = 1 \text{ mF}$ tantalum in parallel with 0.01 mF ceramic



$$X_{\text{TALK Isolation}} = 20 \log \left| \frac{V_S}{V_O} \right|$$

$C = \text{RF bypass}$

FIGURE 4. Crosstalk



$$\text{Off Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

FIGURE 5. Off Isolation

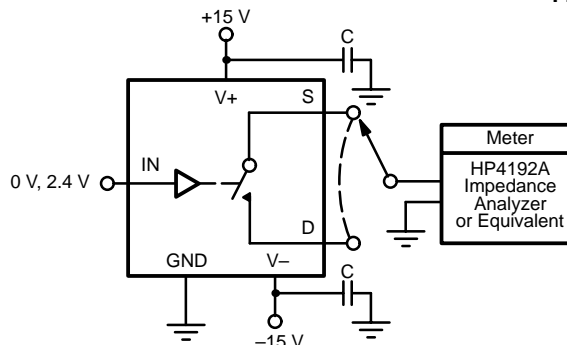


FIGURE 6. Source/Drain Capacitances

APPLICATIONS

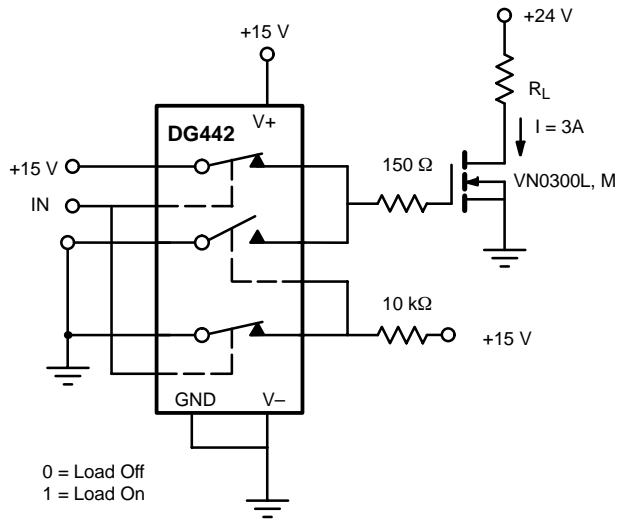


FIGURE 7. Power MOSFET Driver

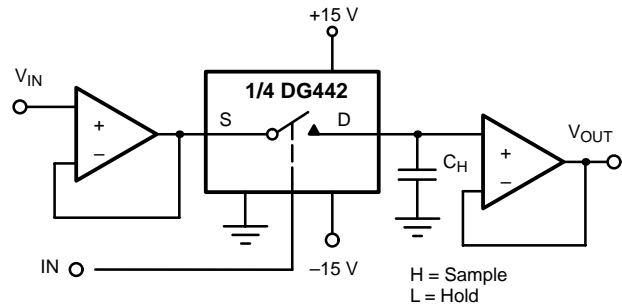
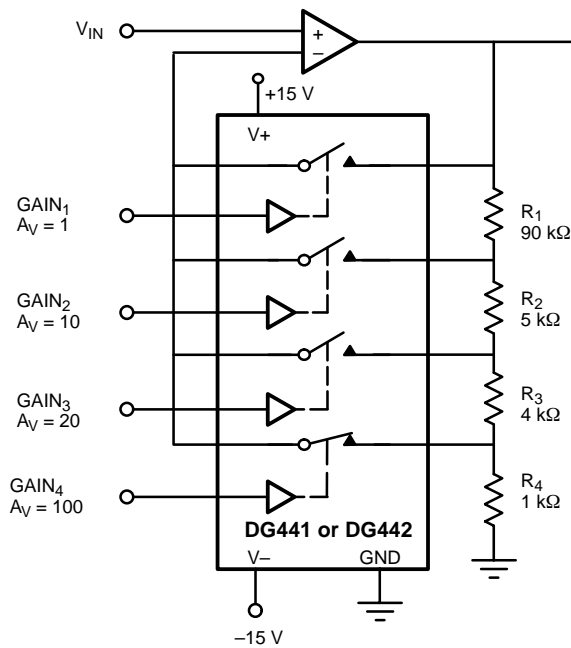


FIGURE 8. Open Loop Sample-and-Hold



Gain error is determined only by the resistor tolerance. Op amp offset and CMRR will limit accuracy of circuit.

With SW₄ Closed

$$\frac{V_{OUT}}{V_{IN}} = \frac{R_1 + R_2 + R_3 + R_4}{R_4} = 100$$

FIGURE 9. Precision-Weighted Resistor Programmable-Gain Amplifier



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