

## Quad SPST CMOS Analog Switches

### FEATURES

- Low On-Resistance: 50  $\Omega$
- 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

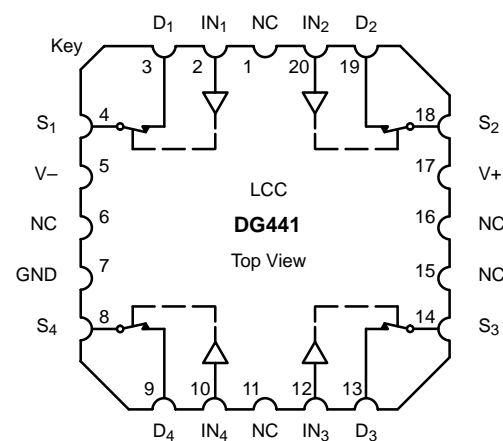
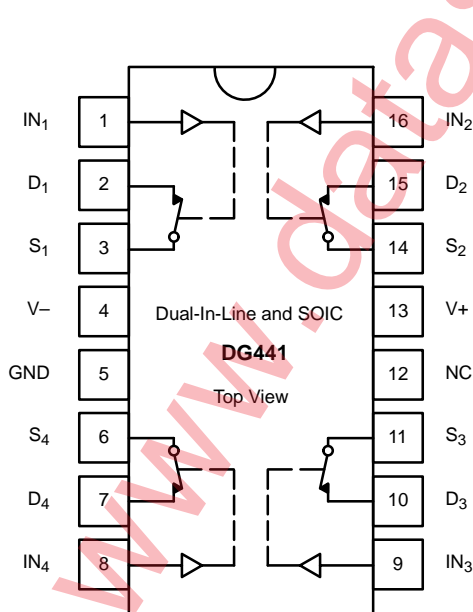
### DESCRIPTION

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  $\Omega$ , 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"  $\leq$  0.8 V  
Logic "1"  $\geq$  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 <sup>a</sup> V <sub>S</sub> , V <sub>D</sub>	(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) <sup>b</sup>	
16-Pin Plastic DIP <sup>c</sup>	450 mW
16-Pin CerDIP <sup>d</sup>	900 mW
16-Pin Narrow Body SOIC <sup>d</sup>	900 mW
LCC-20 <sup>d</sup>	1200 mW

- Notes:
- Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> 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)**

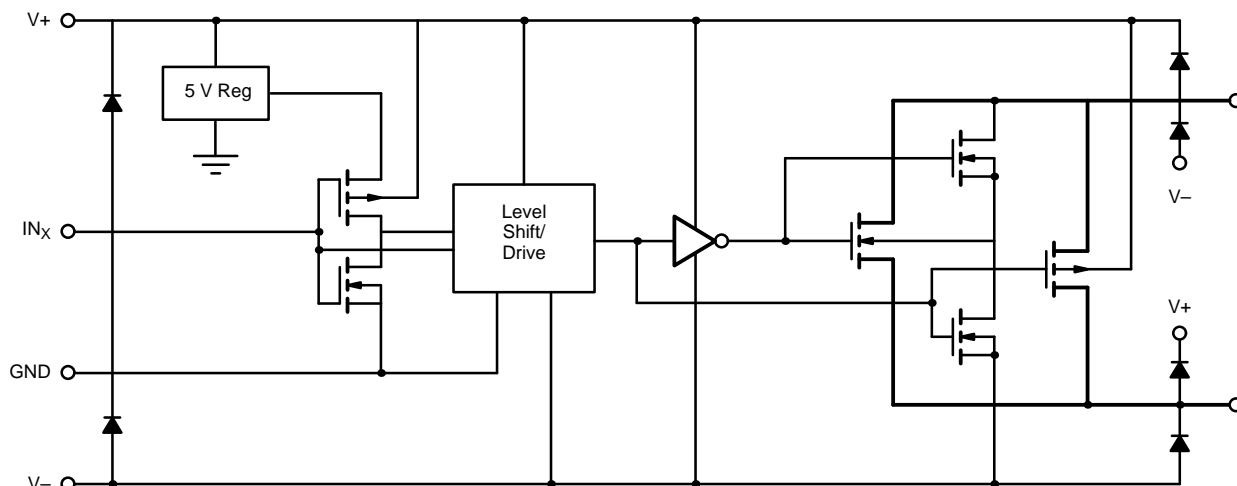


FIGURE 1.



SPECIFICATIONS <sup>a</sup> 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 <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit	
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>		
<b>Analog Switch</b>										
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		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	$\Omega$	
On-Resistance Match Between Channels <sup>e</sup>	$\Delta r_{DS(on)}$	$I_S = -10\text{ mA}, V_D = \pm 10\text{ V}$ $V_+ = 15\text{ V}, V_- = -15\text{ V}$	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	$\pm 0.01$	-0.5 -20	0.5 20	-0.5 -5	0.5 5	nA	
	$I_{D(off)}$		Room Full	$\pm 0.01$	-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	$\pm 0.08$	-0.5 -40	0.5 40	-0.5 -10	0.5 10		
<b>Digital Control</b>										
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		
<b>Dynamic Characteristics</b>										
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 <sup>e</sup>	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 <sup>e</sup>	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 <sup>e</sup>	$C_{S(off)}$	$f = 1\text{ MHz}$	Room	4					pF	
Drain Off Capacitance <sup>e</sup>	$C_{D(off)}$		Room	4						
Channel On Capacitance <sup>e</sup>	$C_{D(on)}$	$V_{ANALOG} = 0\text{ V}$	Room	16						
<b>Power Supplies</b>										
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	$\mu\text{A}$	
Negative Supply Current	$I_-$		Room Full	-0.000 1	-1 -5		-1 -5			
Ground Current	$I_{GND}$		Full	-15	-100		-100			

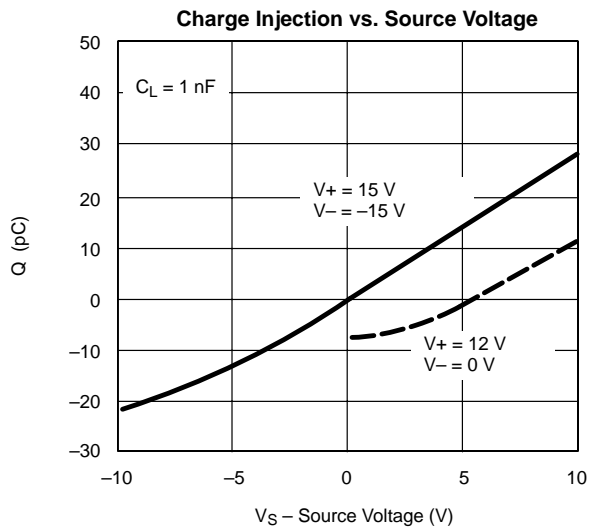
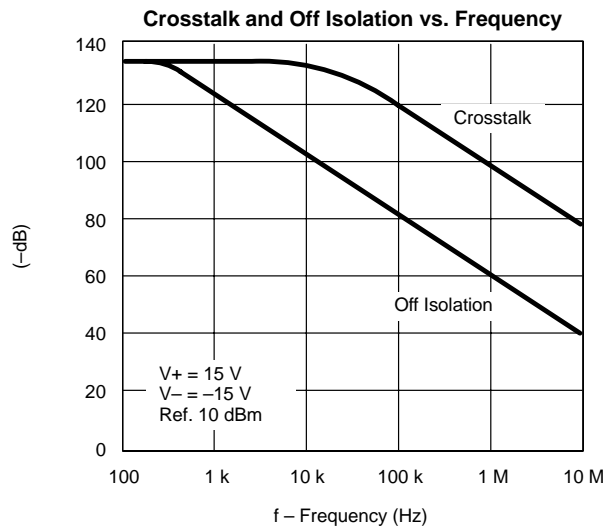
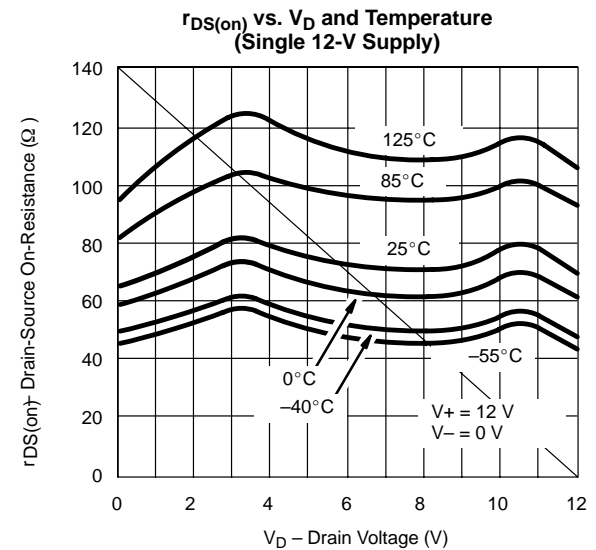
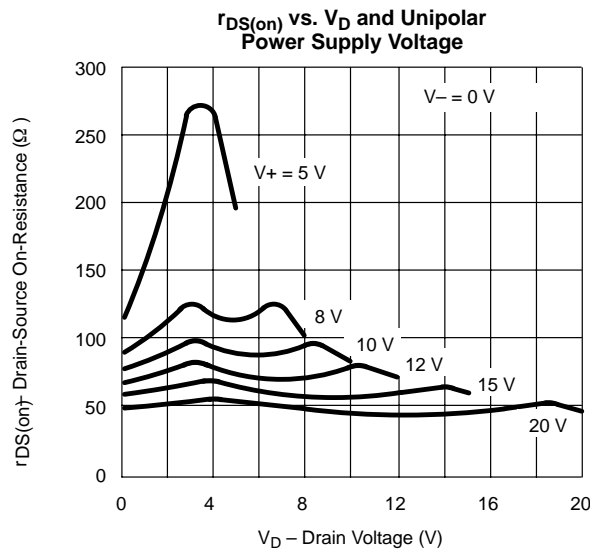
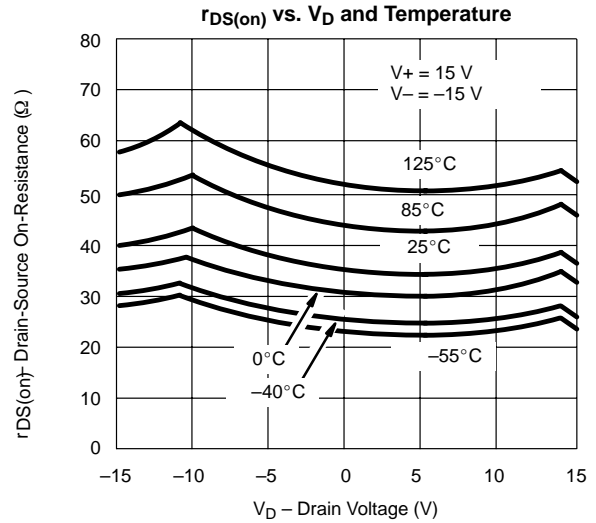
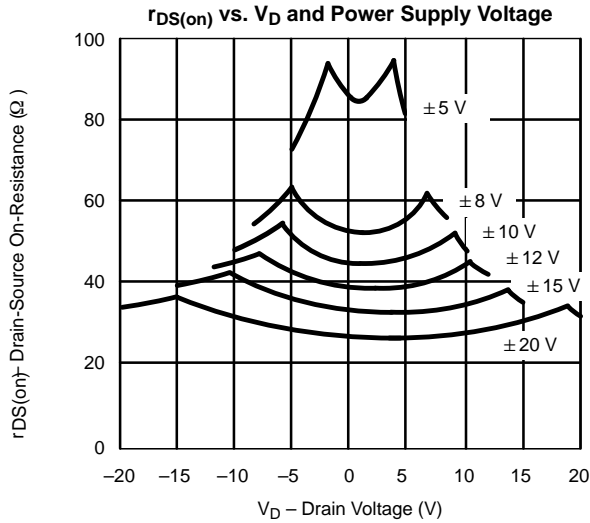


SPECIFICATIONS <sup>a</sup> FOR SINGLE SUPPLY									
Parameter	Symbol	Test Conditions Otherwise Unless Specified $V_+ = 12\text{ V}$ , $V_- = 0\text{ V}$ , $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^f$	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full		0	12	0	12	V
Drain-Source On-Resistance	$r_{DS(on)}$	$I_S = -10\text{ mA}$ , $V_D = 3\text{ V}$ , $8\text{ V}$ $V_+ = 10.8\text{ V}$	Room Full	100		160 200		160 200	$\Omega$
<b>Dynamic Characteristics</b>									
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
<b>Power Supplies</b>									
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	$\mu\text{A}$
Negative Supply Current	I-		Room Full	-0.0001	-1 -100		-1 -100		
Ground Current	$I_{GND}$		Full	-15	-100		-100		

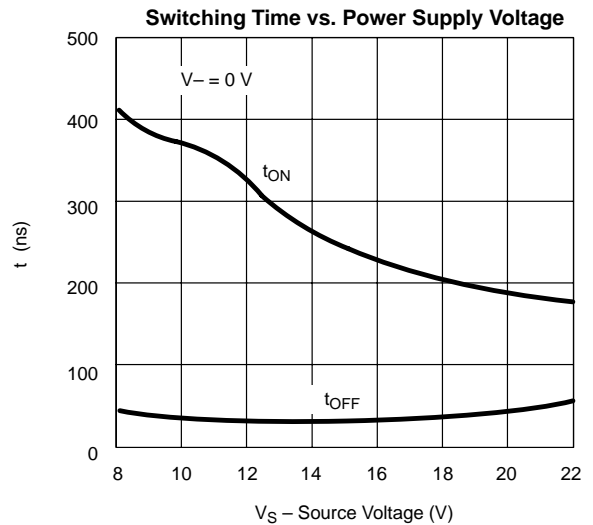
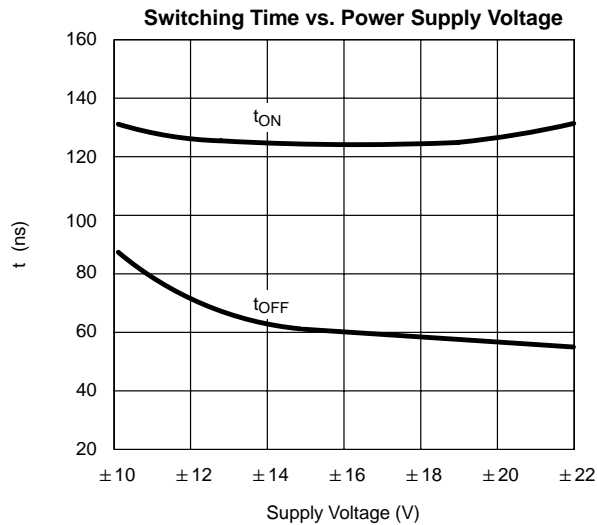
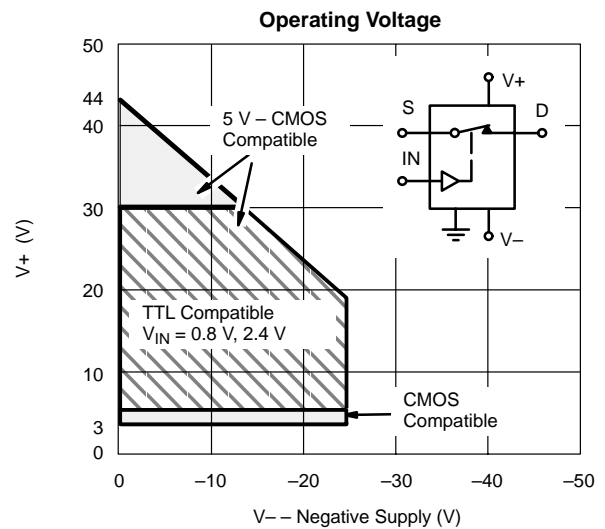
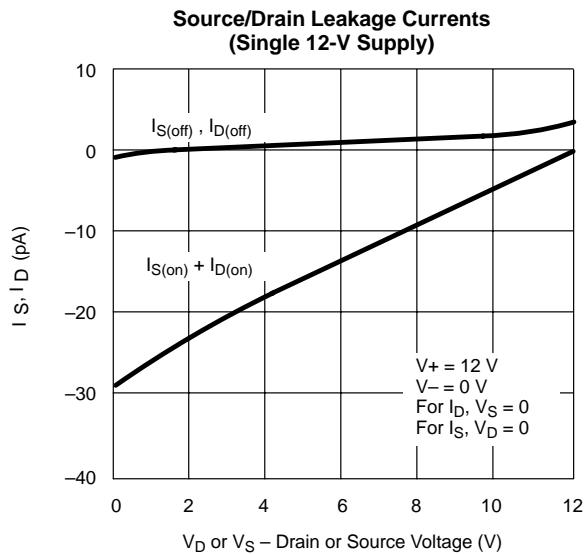
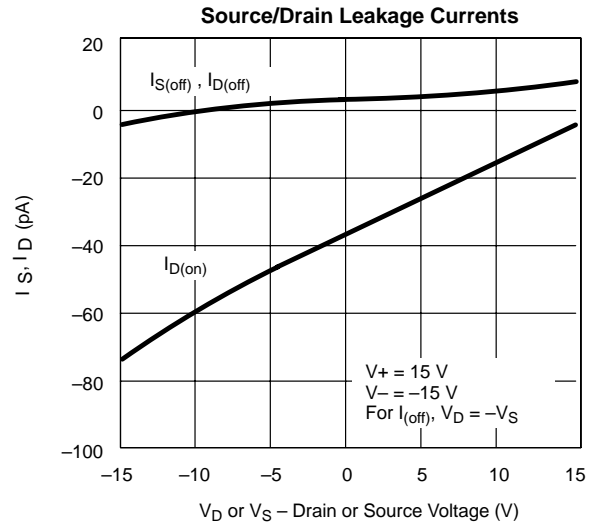
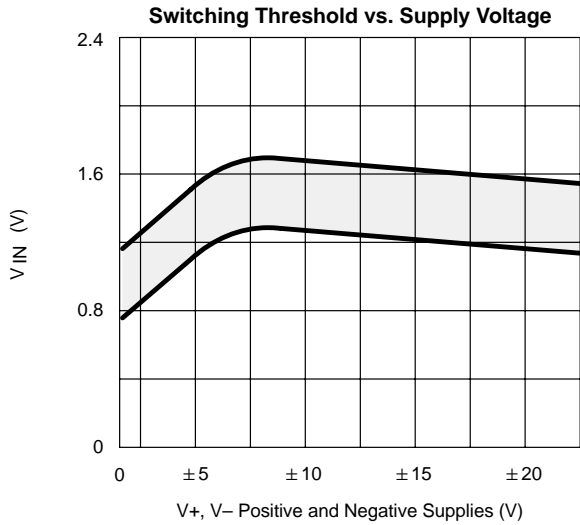
Notes:

- 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.

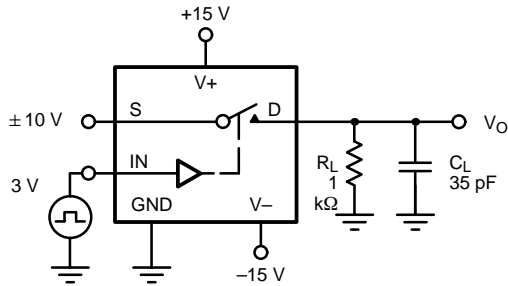
**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



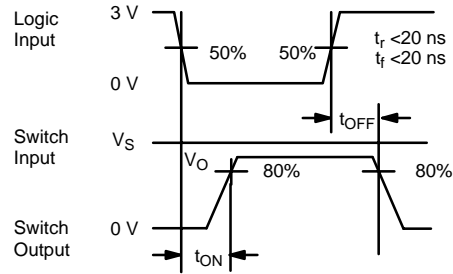
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**TEST CIRCUITS**

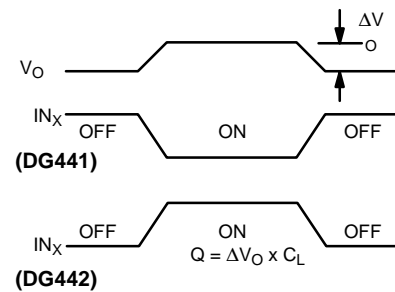
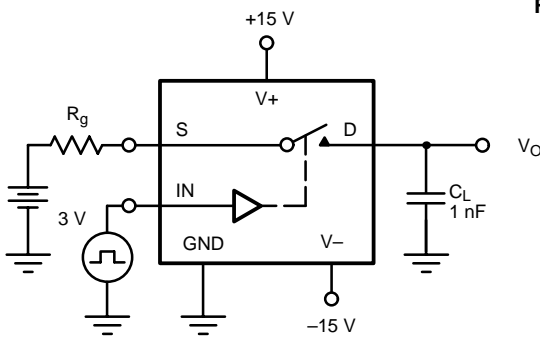


$C_L$  (includes fixture and stray capacitance)

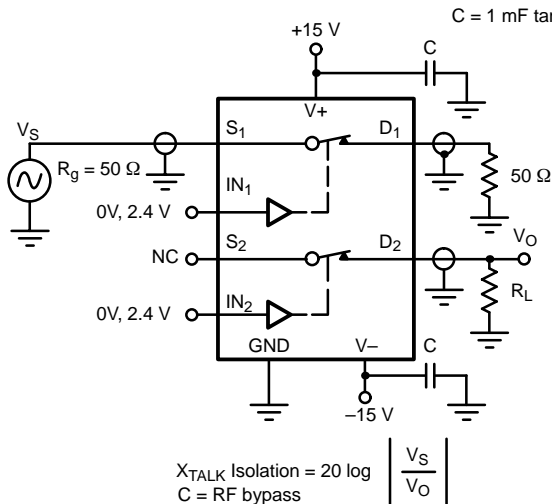


Note: Logic input waveform is inverted for DG442.

**FIGURE 2. Switching Time**



**FIGURE 3. Charge Injection**

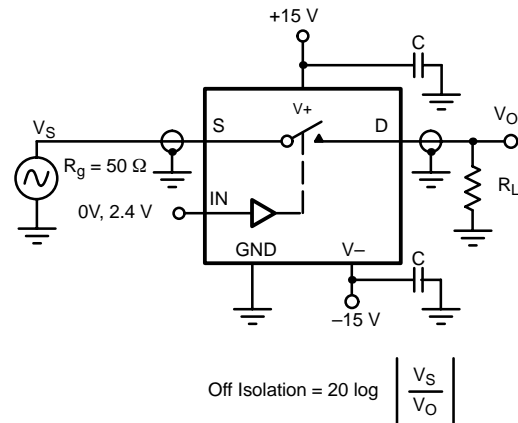


$C = 1 \text{ mF}$  tantalum in parallel with  $0.01 \text{ mF}$  ceramic

**FIGURE 4. Crosstalk**

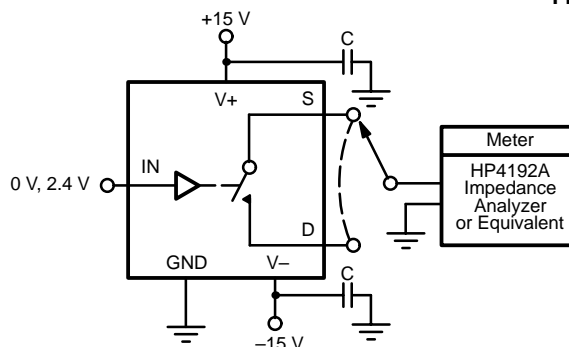
$$X_{\text{TALK Isolation}} = 20 \log \left| \frac{V_S}{V_O} \right|$$

$C = \text{RF bypass}$



**FIGURE 5. Off Isolation**

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



**FIGURE 6. Source/Drain Capacitances**

**APPLICATIONS**

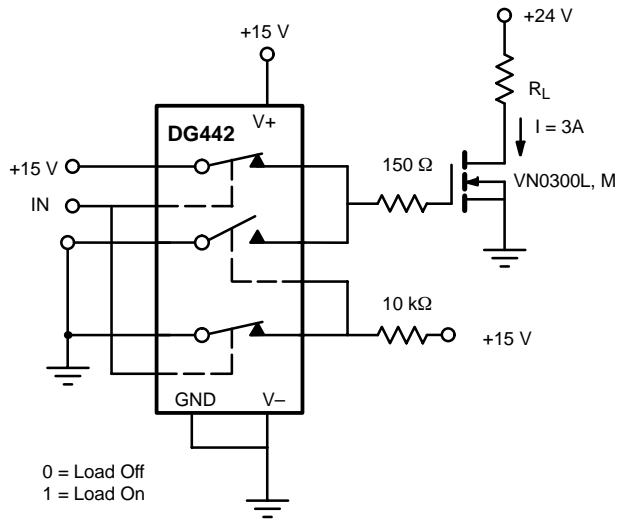


FIGURE 7. Power MOSFET Driver

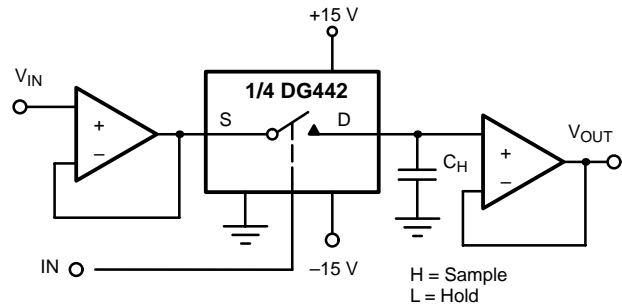
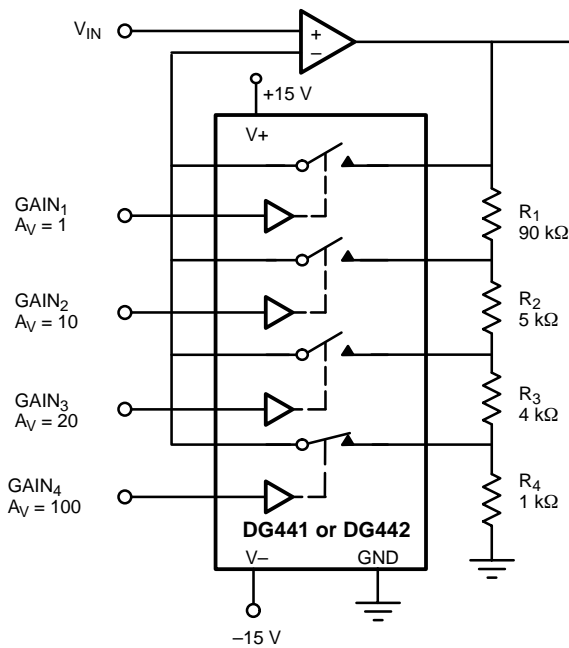


FIGURE 8. Open Loop Sample-and-Hold



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

With SW<sub>4</sub> 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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