

## 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— $Q_c$ : -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

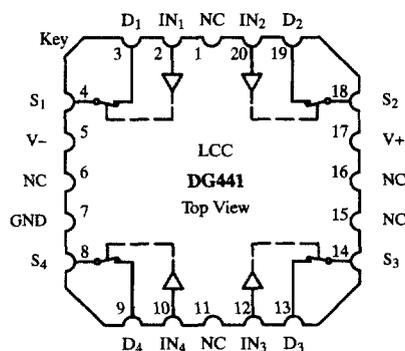
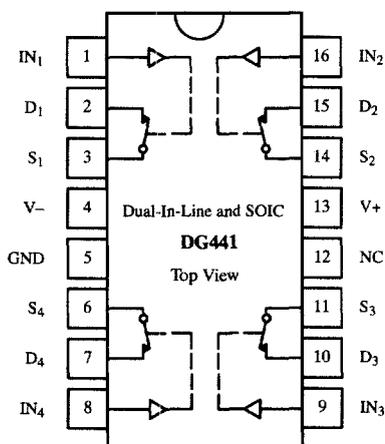
### Description

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 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

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70053.

**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 I<sub>NX</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)**

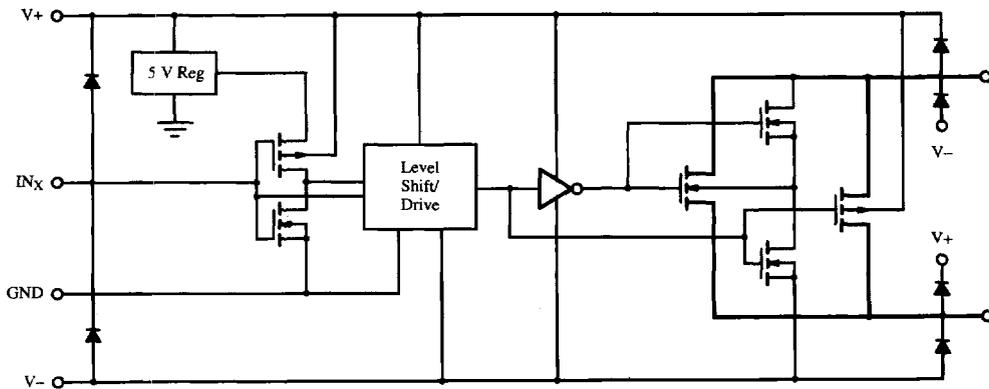


Figure 1.

## Specifications<sup>a</sup> for Dual Supplies

Parameter	Symbol	Test Conditions Unless Specified V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup>	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 <sub>ANALOG</sub>		Full		-15	15	-15	15	V	
Drain-Source On-Resistance	I <sub>DS(on)</sub>	I <sub>S</sub> = -10 mA, V <sub>D</sub> = ± 8.5 V V <sub>+</sub> = 13.5 V, V <sub>-</sub> = -13.5 V	Room Full	50		85 100		85 100	Ω	
Switch Off Leakage Current	I <sub>S(off)</sub>	V <sub>+</sub> = 16.5 V, V <sub>-</sub> = -16.5 V V <sub>D</sub> = ± 15.5 V, V <sub>S</sub> = ∓ 15.5 V	Room Full	± 0.01	-0.5 -20	0.5 20	-0.5 -5	0.5 5	nA	
	I <sub>D(off)</sub>		Room Full	± 0.01	-0.5 -20	0.5 20	-0.5 -5	0.5 5		
Channel On Leakage Current	I <sub>D(on)</sub>	V <sub>+</sub> = 16.5 V, V <sub>-</sub> = -16.5 V V <sub>S</sub> = V <sub>D</sub> = ± 15.5 V	Room Full	± 0.08	-0.5 -40	0.5 40	-0.5 -10	0.5 10		
<b>Digital Control</b>										
Input Current V <sub>IN</sub> Low	I <sub>IL</sub>	V <sub>IN</sub> under test = 0.8 V All Other = 2.4 V	Full	-0.01	-500	500	-500	500	nA	
Input Current V <sub>IN</sub> High	I <sub>IH</sub>	V <sub>IN</sub> 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 <sub>ON</sub>	R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 35 pF V <sub>S</sub> = ± 10 V, See Figure 2	Room	150		250		250	ns	
Turn-Off Time	DG441		t <sub>OFF</sub>	Room	90		120			120
	DG442		t <sub>OFF</sub>	Room	110		210			210
Charge Injection <sup>e</sup>	Q	C <sub>L</sub> = 1 nF, V <sub>S</sub> = 0 V V <sub>gen</sub> = 0 V, R <sub>gen</sub> = 0 Ω	Room	-1					pC	
Off Isolation <sup>e</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF f = 1 MHz	Room	60					dB	
Crosstalk (Channel-to-Channel)	X <sub>TALK</sub>		Room	100						
Source Off Capacitance <sup>e</sup>	C <sub>S(off)</sub>	f = 1 MHz	Room	4					pF	
Drain Off Capacitance <sup>e</sup>	C <sub>D(off)</sub>		Room	4						
Channel On Capacitance <sup>e</sup>	C <sub>D(on)</sub>		V <sub>ANALOG</sub> = 0 V	Room	16					
<b>Power Supplies</b>										
Positive Supply Current	I <sub>+</sub>	V <sub>+</sub> = 16.5 V, V <sub>-</sub> = -16.5 V V <sub>IN</sub> = 0 or 5 V	Full	15		100		100	μA	
Negative Supply Current	I <sub>-</sub>		Room	-0.0001	-1 -5		-1 -5			
			Full							
Ground Current	I <sub>GND</sub>		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.
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- V<sub>IN</sub> = input voltage to perform proper function.

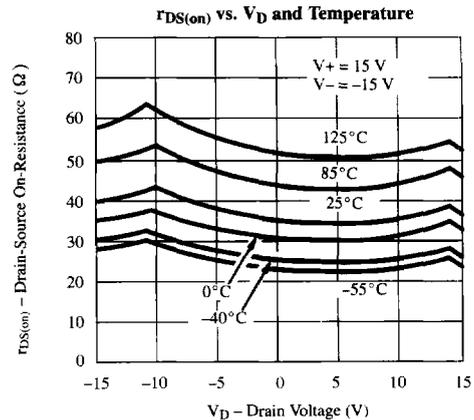
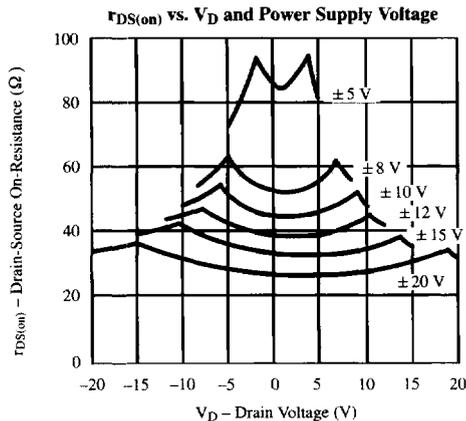
## Specifications<sup>a</sup> for Single Supply

Parameter	Symbol	Test Conditions Unless Otherwise 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+	$V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$ $V_{IN} = 0\text{ or }5\text{ V}$	Full	15		100		100	$\mu\text{A}$
Negative Supply Current	I-		Room Full	-0.0001	-1 -100		-1 -100		
Ground Current	$I_{GND}$		Full	-15	-100		-100		

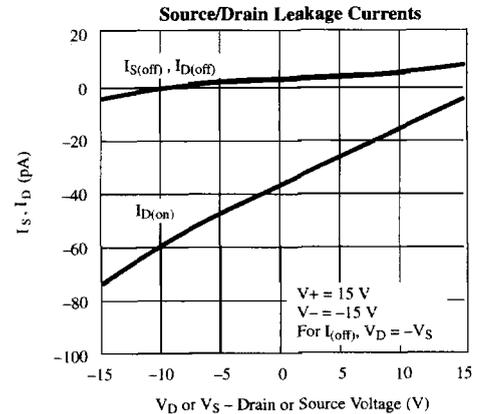
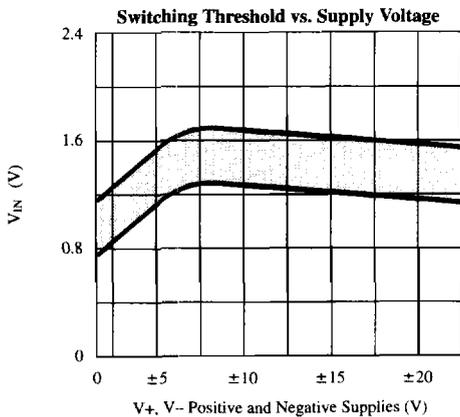
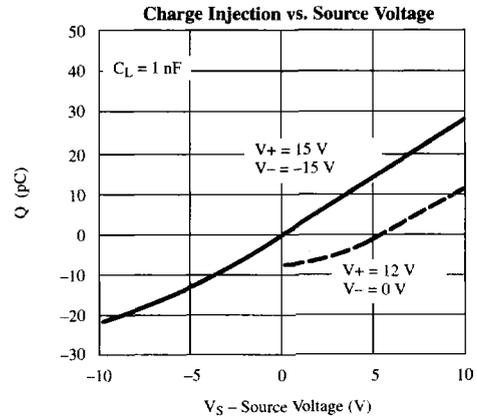
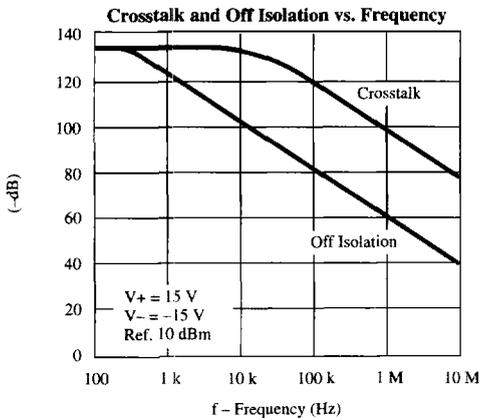
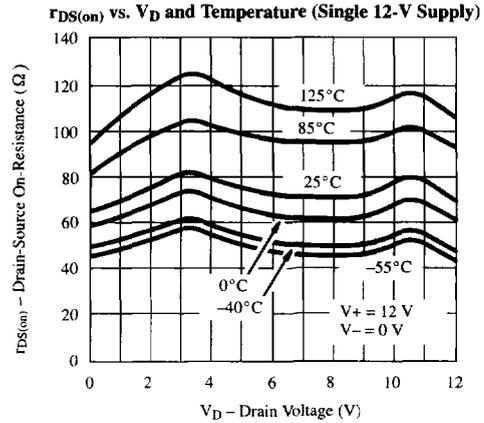
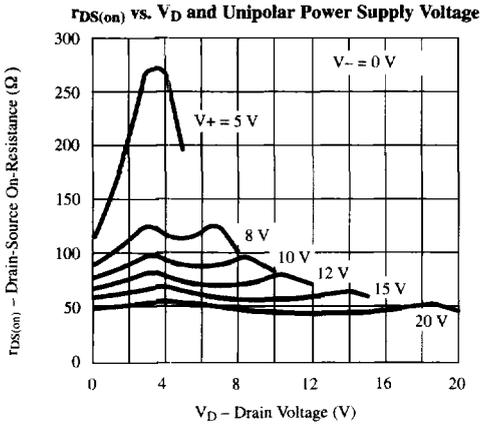
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## Typical Characteristics

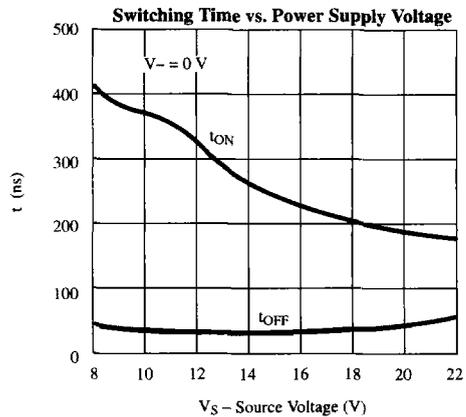
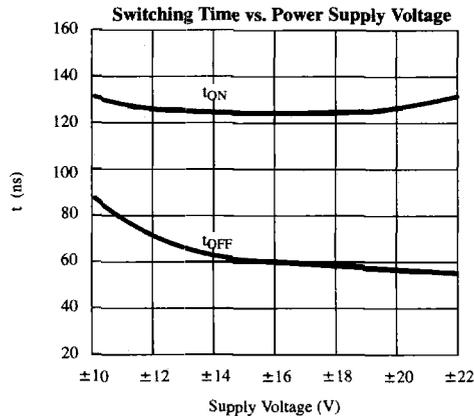
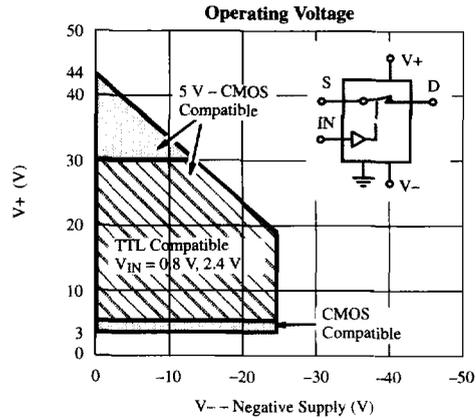
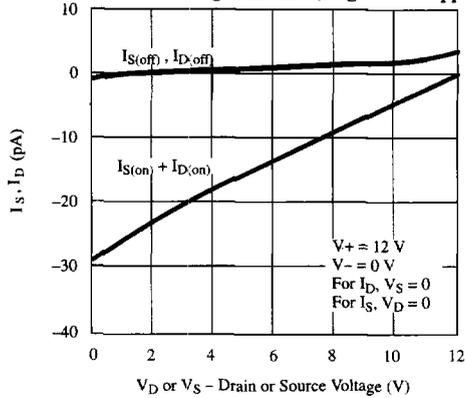


## Typical Characteristics (Cont'd)

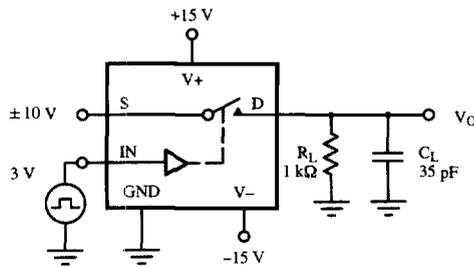


**Typical Characteristics (Cont'd)**

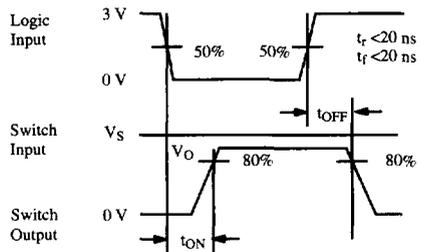
**Source/Drain Leakage Currents (Single 12-V Supply)**



**Test Circuits**



$C_L$  (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG442.

**Figure 2. Switching Time**

## Test Circuits (Cont'd)

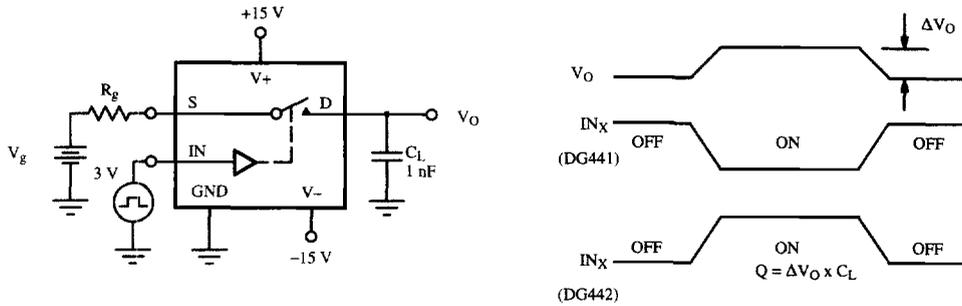


Figure 3. Charge Injection

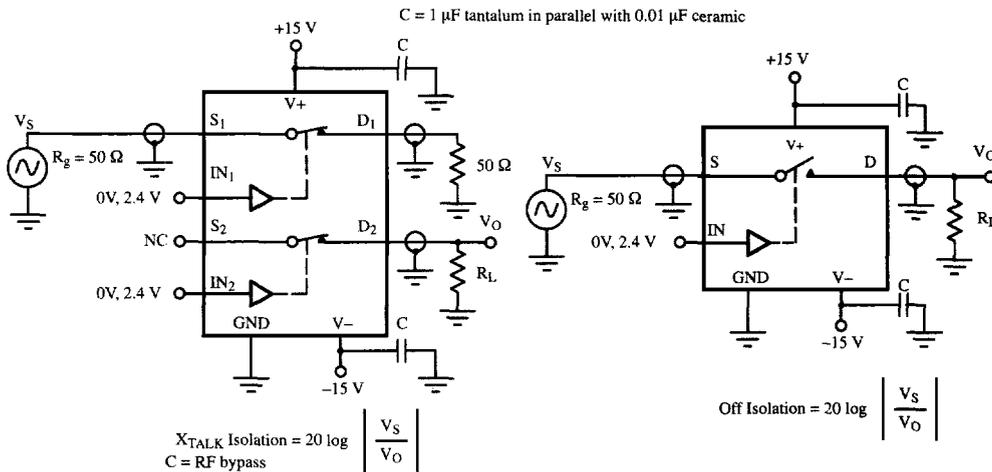


Figure 4. Crosstalk

Figure 5. Off Isolation

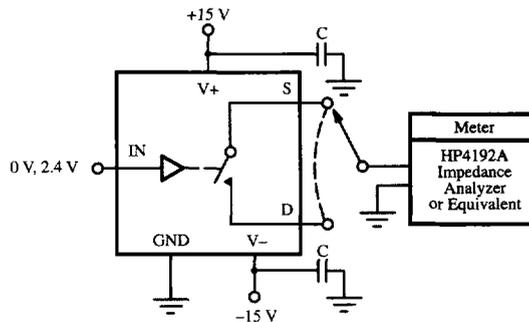
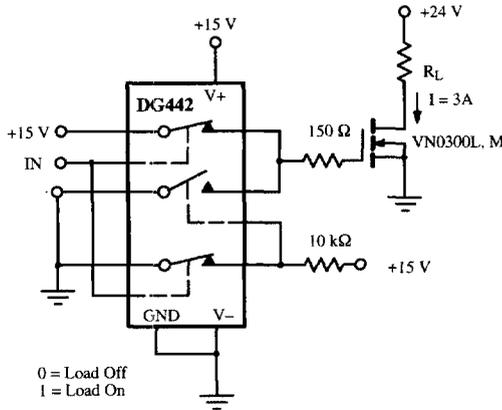
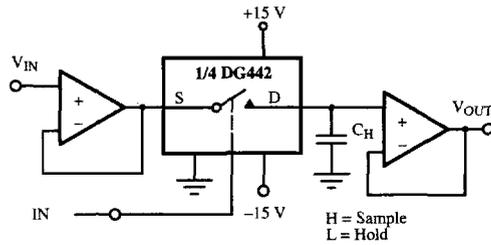


Figure 6. Source/Drain Capacitances

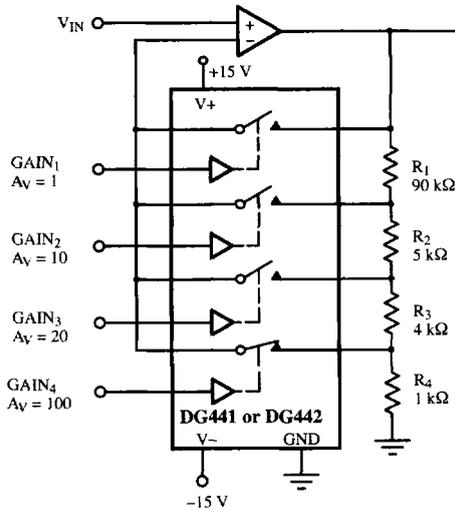
**Applications**



**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 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