

## Quad SPST CMOS Analog Switches

### FEATURES

- Low On-Resistance: 50  $\Omega$
- Low Leakage: 80 pA
- Low Power Consumption: 22 nW
- Fast Switching Action— $t_{ON}$ : 120 ns
- Low Charge Injection
- DG211/DG212 Upgrades
- TTL/CMOS Logic Compatible

### BENEFITS

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

### APPLICATIONS

- Audio Switching
- Battery Powered Systems
- Data Acquisition
- Sample-and-Hold Circuits
- Telecommunication Systems
- Automatic Test Equipment
- Single Supply Circuits
- Hard Disk Drives

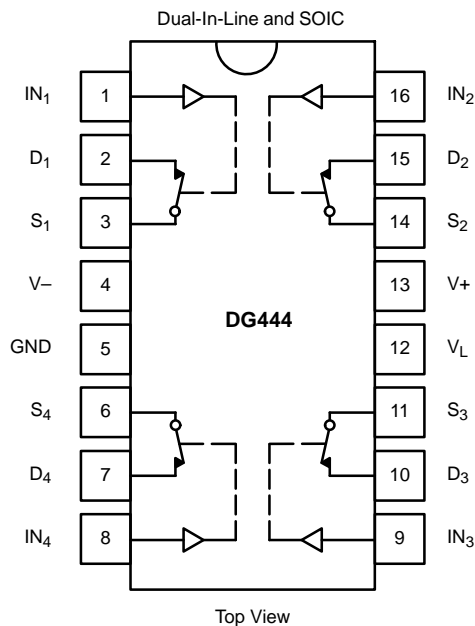
### DESCRIPTION

The DG444/DG445 monolithic quad analog switches are designed to provide high speed, low error switching of analog signals. The DG444 has a normally closed function. The DG445 has a normally open function. Combining low power (22 nW, typ) with high speed ( $t_{ON}$ : 120 ns, typ), the DG444/DG445 are ideally suited for upgrading DG211/212 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 DG444/DG445 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	DG444	DG445
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°C to 85°C	16-Pin Plastic DIP	DG444DJ
		DG445DJ
	16-Pin Narrow SOIC	DG444DY
		DG445DY



### ABSOLUTE MAXIMUM RATINGS

V+ to V-	44 V
GND to V-	25 V
V <sub>L</sub>	(GND -0.3 V) to (V+) + 0.3 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	-65 to 125°C

Power Dissipation (Package) <sup>b</sup>	
16-Pin Plastic DIP <sup>c</sup>	450 mW
16-Pin Narrow Body SOIC <sup>d</sup>	640 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 8 mW/°C above 75°C

SPECIFICATIONS FOR DUAL SUPPLIES									
Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V- = -15 V V <sub>L</sub> = 5 V, V <sub>IN</sub> = 2.4 V, 0.8 V <sup>e</sup>	Temp <sup>a</sup>	D Suffix -40 to 85°C			Unit		
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>			
<b>Analog Switch</b>									
Analog Signal Range <sup>d</sup>	V <sub>ANALOG</sub>		Full	-15		15	V		
Drain-Source On-Resistance	r <sub>DS(on)</sub>	I <sub>S</sub> = -10 mA, V <sub>D</sub> = ±8.5 V V+ = 13.5 V, V- = -13.5 V	Room Full		50	85 100	Ω		
Switch Off Leakage Current	I <sub>S(off)</sub>	V+ = 16.5 V, V- = -16.5 V V <sub>D</sub> = ±15.5 V, V <sub>S</sub> = ∓15.5 V	Room Full	-0.5 -5	±0.01	0.5 5	nA		
	I <sub>D(off)</sub>		Room Full	-0.5 -5	±0.01	0.5 5			
Channel On Leakage Current	I <sub>D(on)</sub>	V+ = 16.5 V, V- = -16.5 V V <sub>S</sub> = V <sub>D</sub> = ±15.5 V	Room Full	-0.5 -10	±0.08	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	-500	-0.01	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	-500	0.01	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			120	250	ns	
Turn-Off Time	t <sub>OFF</sub>		DG444	Room			110		140
			DG445	Room			160		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) <sup>d</sup>	X <sub>TALK</sub>		Room			100			
Source Off Capacitance	C <sub>S(off)</sub>	f = 1 MHz	Room			4		pF	
Drain Off Capacitance	C <sub>D(off)</sub>		Room			4			
Channel On Capacitance	C <sub>D(on)</sub>		V <sub>ANALOG</sub> = 0 V	Room			16		
<b>Power Supplies</b>									
Positive Supply Current	I+	V+ = 16.5 V, V- = -16.5 V V <sub>IN</sub> = 0 or 5 V	Room Full			0.001	1 5	μA	
Negative Supply Current	I-		Room Full	-1 -5		-0.0001			
Logic Supply Current	I <sub>L</sub>		Room Full			0.001	1 5		
Ground Current	I <sub>GND</sub>		Room Full	-1 -5		-0.001			



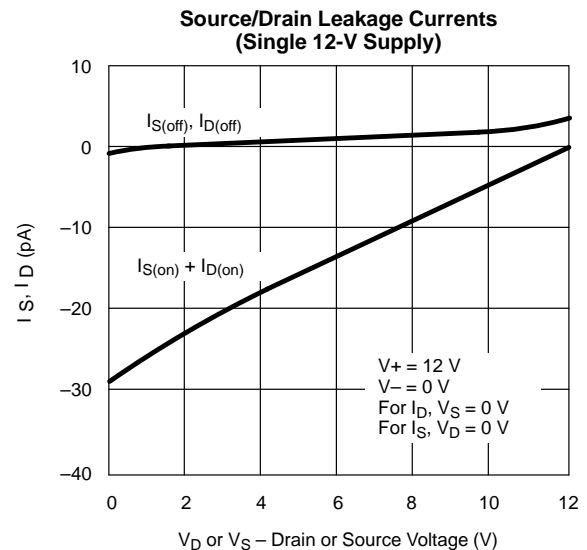
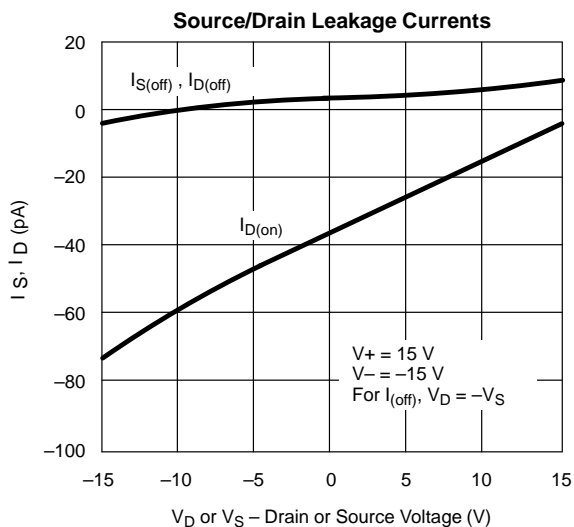
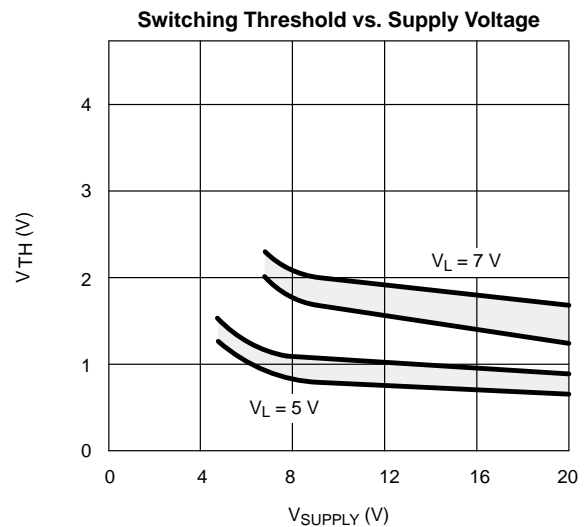
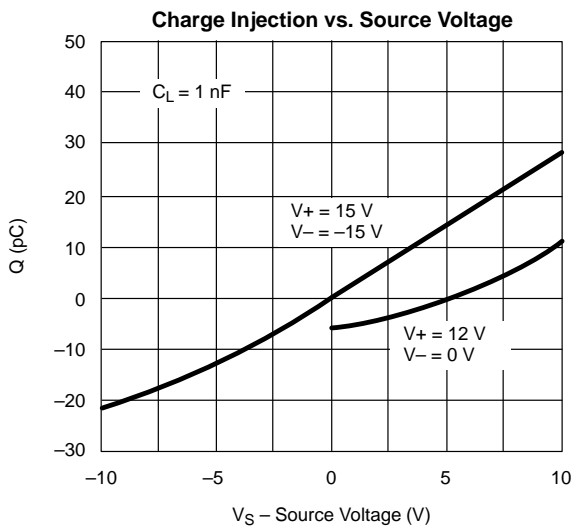
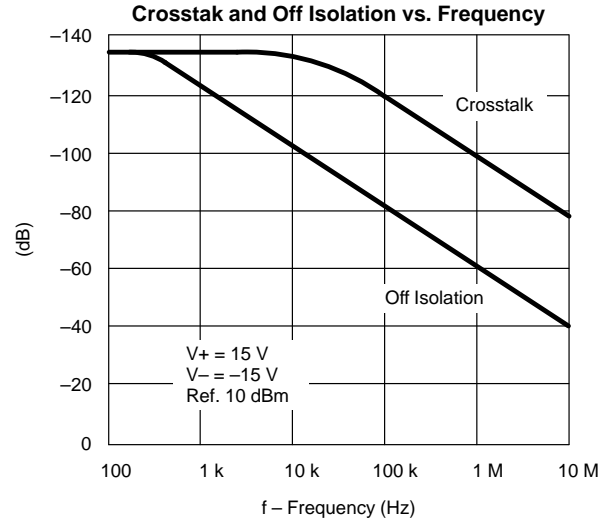
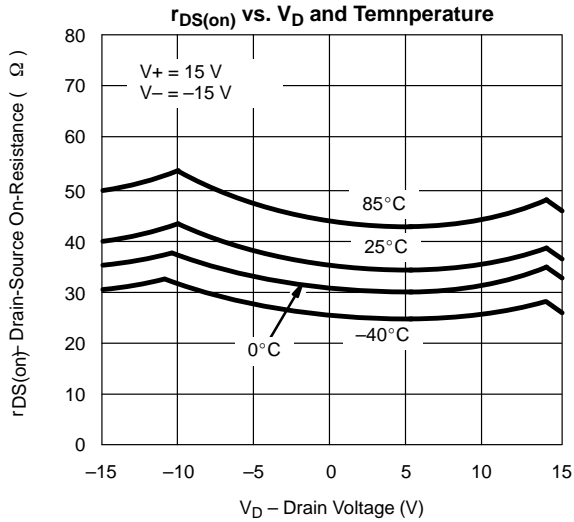
SPECIFICATIONS FOR UNIPOLAR SUPPLIES							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 12\text{ V}$ , $V_- = 0\text{ V}$ $V_L = 5\text{ V}$ , $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^e$	Temp <sup>a</sup>	D Suffix -40 to 85°C			Unit
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	$V_{ANALOG}$		Full	0		12	V
Drain-Source On-Resistance <sup>d</sup>	$r_{DS(on)}$	$I_S = -10\text{ mA}$ , $V_D = 3\text{ V}$ , $8\text{ V}$ $V_+ = 10.8\text{ V}$ , $V_L = 5.25\text{ V}$	Room Full		100	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	ns
Turn-Off Time	$t_{OFF}$		Room		60	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	$I_+$	$V_+ = 13.2\text{ V}$ , $V_{IN} = 0\text{ or }5\text{ V}$	Room Full		0.001	1 5	$\mu\text{A}$
Negative Supply Current	$I_-$	$V_{IN} = 0\text{ or }5\text{ V}$	Room Full	-1 -5	-0.0001		
Logic Supply Current	$I_L$	$V_L = 5.25\text{ V}$ , $V_{IN} = 0\text{ or }5\text{ V}$	Room Full		0.001	1 5	
Ground Current	$I_{GND}$	$V_{IN} = 0\text{ or }5\text{ V}$	Room Full	-1 -5	-0.001		

Notes:

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

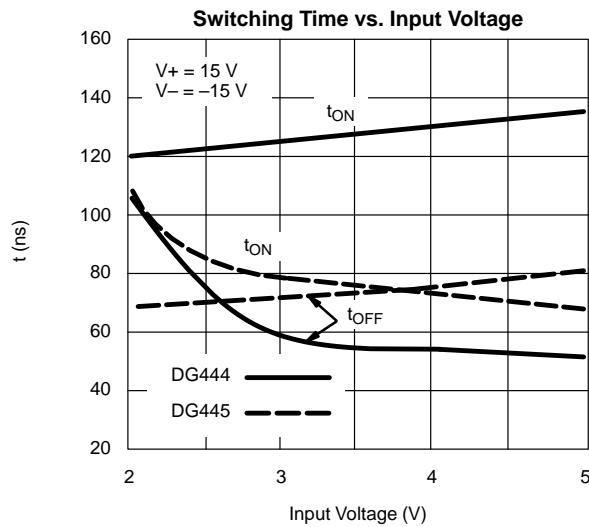
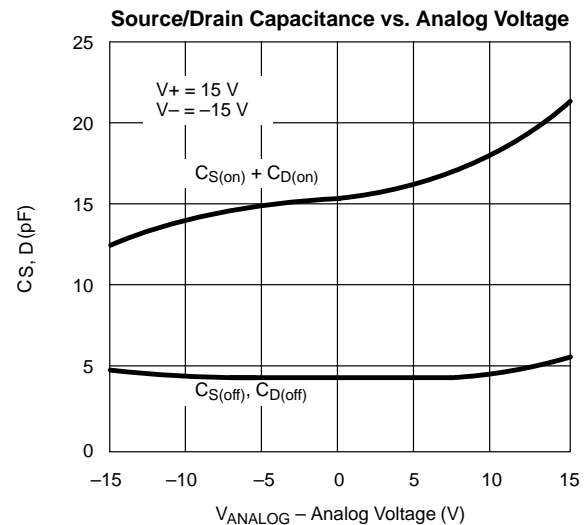
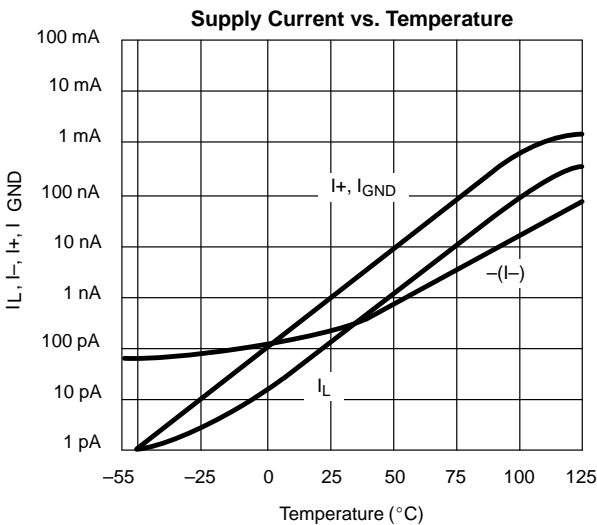
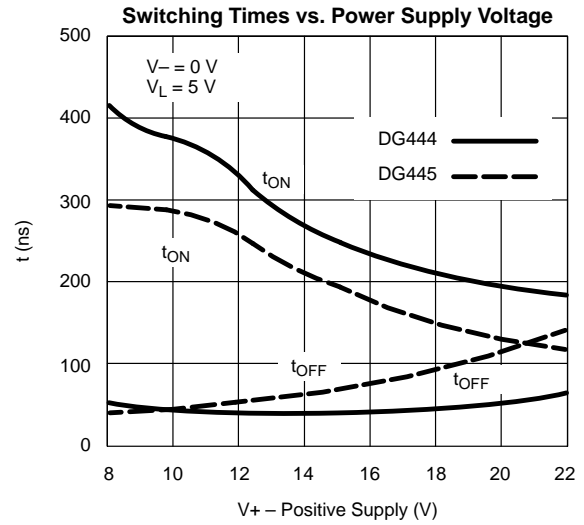
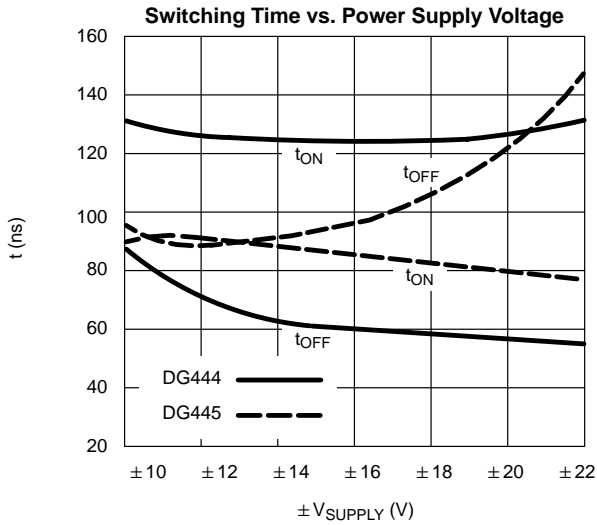


**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**





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



**SCHEMATIC DIAGRAM (TYPICAL CHANNEL)**

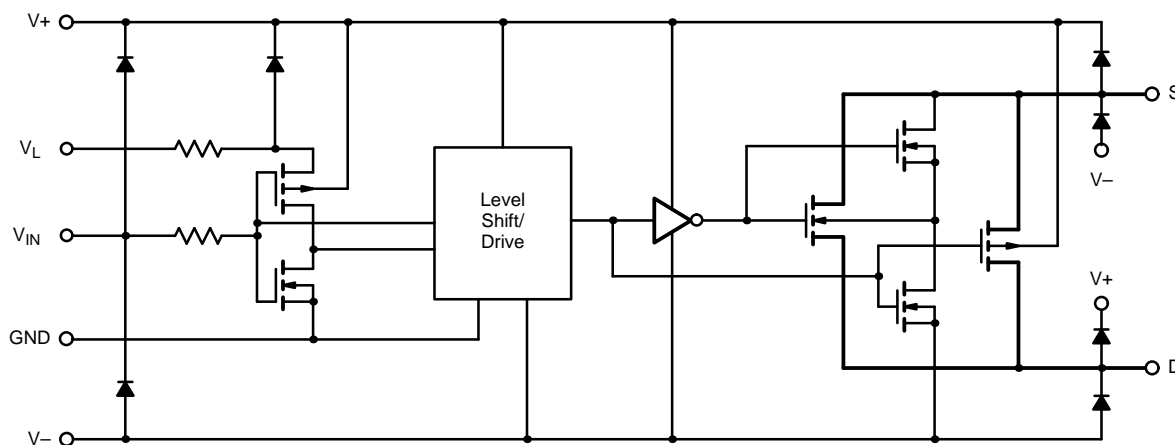
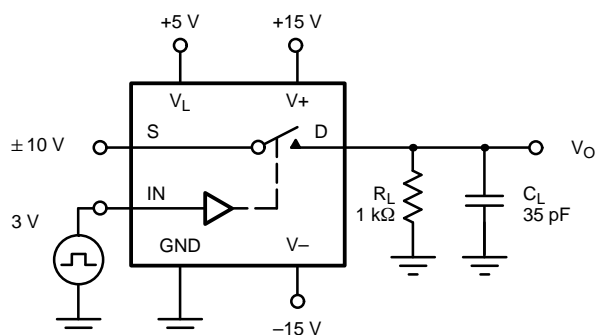
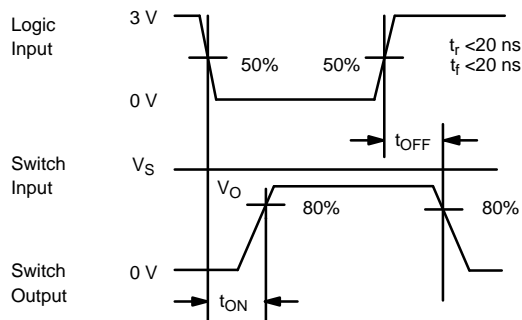


FIGURE 1.

**TEST CIRCUITS**



$C_L$  (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG445.

FIGURE 2. Switching Time

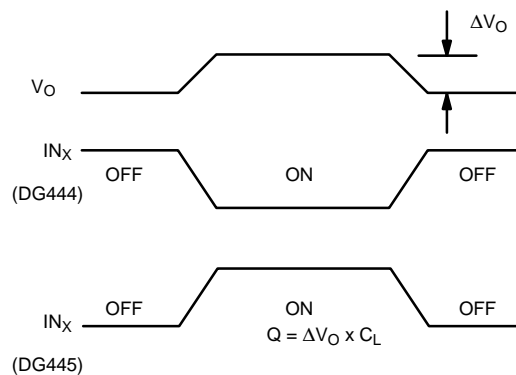
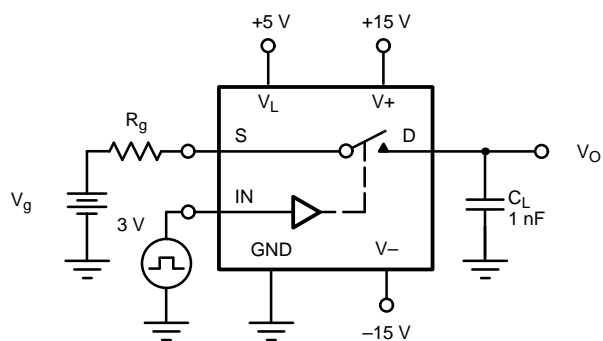
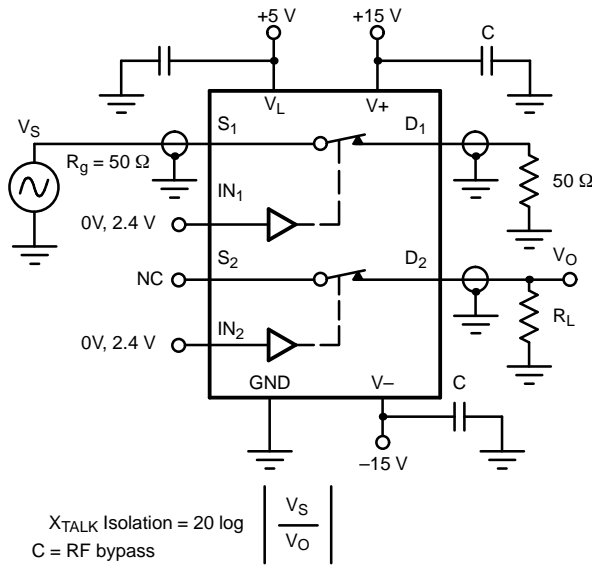


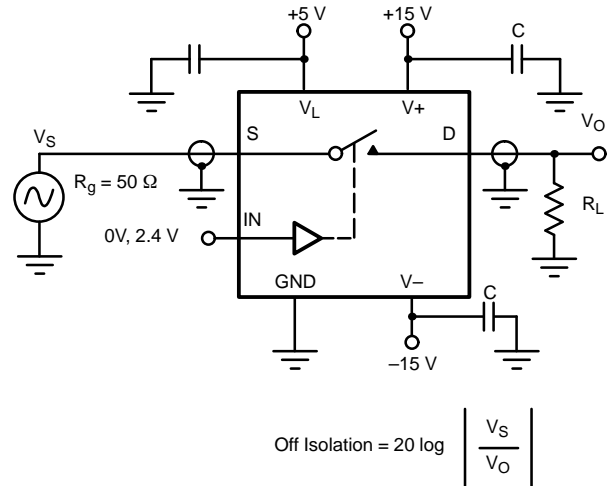
FIGURE 3. Charge Injection

**TEST CIRCUITS**

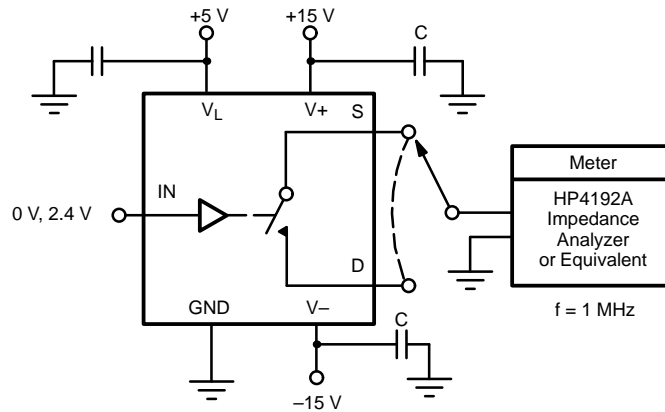
C = 1 mF tantalum in parallel with 0.01 mF ceramic



**FIGURE 4.** Crosstalk

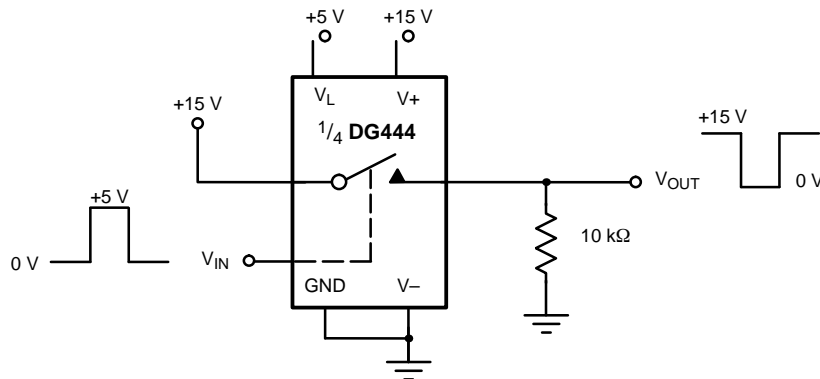


**FIGURE 5.** Off Isolation



**FIGURE 6.** Source/Drain Capacitances

**APPLICATIONS**



**FIGURE 7.** Level Shifter

**APPLICATIONS**

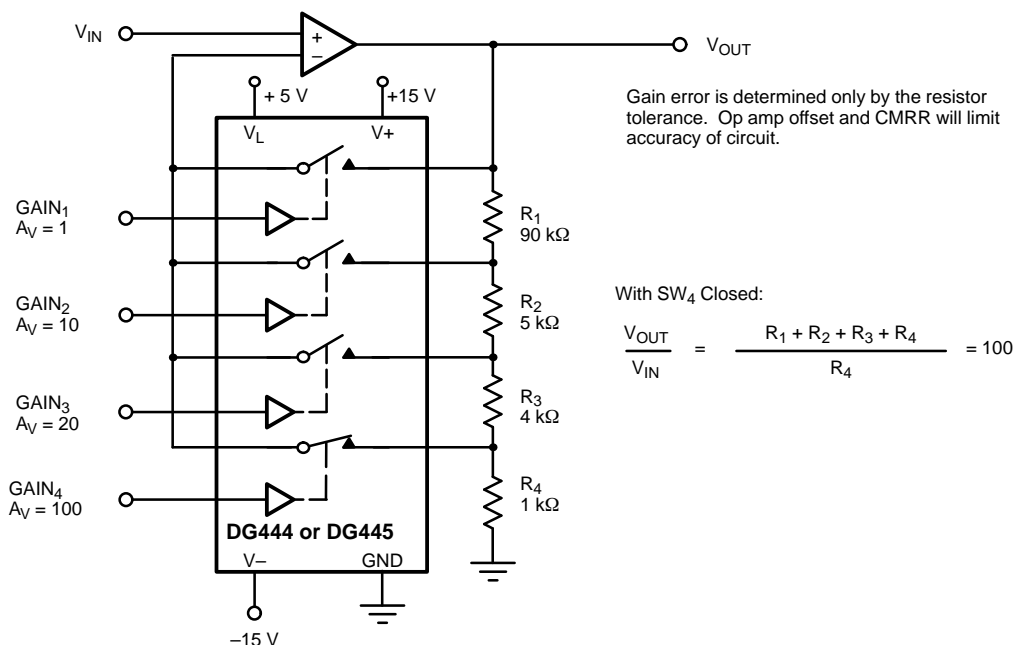


FIGURE 8. Precision-Weighted Resistor Programmable-Gain Amplifier

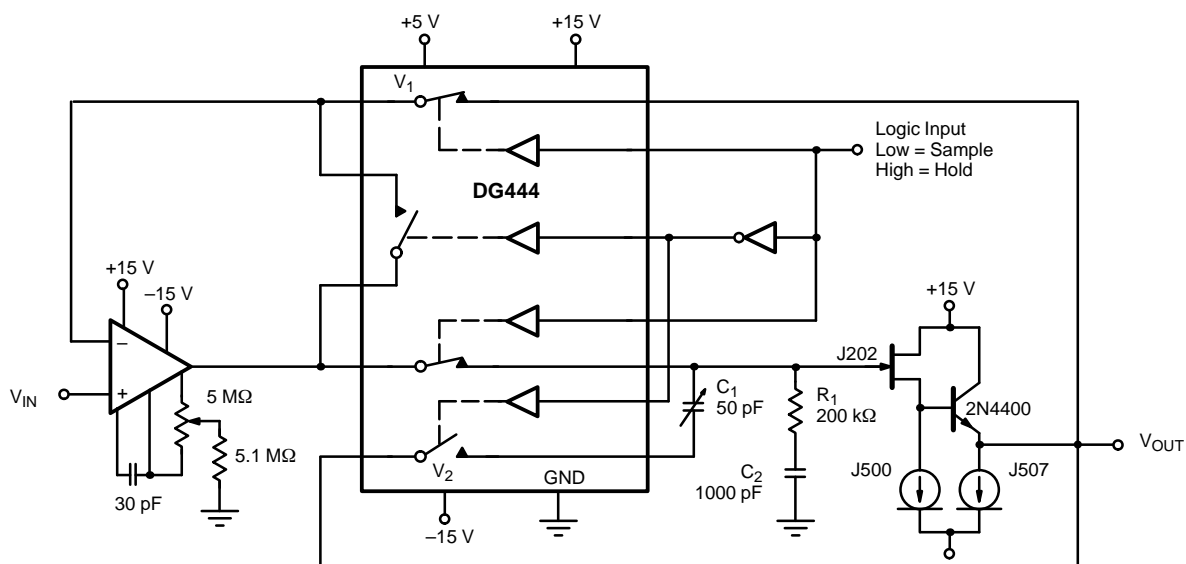


FIGURE 9. Precision Sample-and-Hold





## Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.