

Quad SPST CMOS Analog Switches

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, DG212 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.

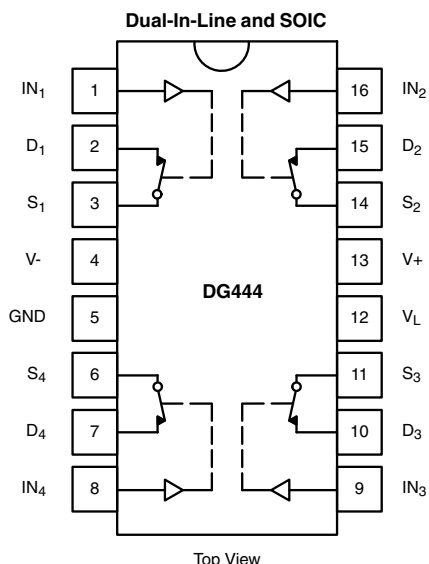
FEATURES

- Low on-resistance: 50 Ω
- 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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE		
Logic	DG444	DG445
0	On	Off
1	Off	On

Logic "0" ≤ 0.8 V

Logic "1" ≥ 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 ($T_A = 25^\circ\text{C}$, unless otherwise noted)			
Parameter		Limit	Unit
V_+ to V_-		44	V
GND to V_-		25	
V_L		(GND - 0.3) to (V_+) + 0.3	
Digital Inputs ^a , V_S , V_D		(V_-) - 2 to (V_+) + 2 or 30 mA, whichever occurs first	
Continuous Current (Any Terminal)		30	mA
Current, S or D (Pulsed at 1 ms, 10 % Duty Cycle)		100	
Storage Temperature		- 65 to 125	$^\circ\text{C}$
Power Dissipation (Package) ^b	16-Pin Plastic DIP ^c	450	mW
	16-Pin Narrow Body SOIC ^d	640	

Notes:

a. 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.

b. All leads welded or soldered to PC board.

c. Derate 6 mW/ $^\circ\text{C}$ above 75°C .d. Derate 8 mW/ $^\circ\text{C}$ above 75°C .

SPECIFICATIONS for Dual Supplies								
Parameter	Symbol	Test Conditions Unless Otherwise Specified V ₊ = 15 V, V ₋ = - 15 V V _L = 5 V, V _{IN} = 2.4 V, 0.8 V ^e	Temp. ^a	D Suffix - 40 °C °C to 85 °C			Unit	
				Min. ^b	Typ. ^c	Max. ^b		
Analog Switch								
Analog Signal Range ^d	V _{ANALOG}		Full	- 15		15	V	
Drain-Source On-Resistance	R _{DS(on)}	I _S = - 10 mA, V _D = ± 8.5 V V ₊ = 13.5 V V ₋ = - 13.5 V	Room Full		50	85 100	Ω	
Switch Off Leakage Current	I _{S(off)}	V ₊ = 16.5, V ₋ = - 16.5 V V _D = ± 15.5 V, V _S = ± 15.5 V	Room Full	- 0.5 - 5	± 0.01	0.5 5	nA	
	I _{D(off)}		Room Full	- 0.5 - 5	± 0.01	0.5 5		
Channel On Leakage Current	I _{D(on)}	V ₊ = 16.5 V, V ₋ = - 16.5 V V _S = V _D = ± 15.5 V	Room Full	- 0.5 - 10	± 0.08	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	- 500	- 0.01	500	nA	
Input Current V _{IN} High	I _{IH}	V _{IN} under test = 2.4 V All Other = 0.8 V	Full	- 500	0.01	500		
Dynamic Characteristics								
Turn-On Time	t _{ON}	R _L = 1 kΩ, C _L = 35 pF V _S = ± 10 V, See Figure 2	Room		120	250	ns	
Turn-Off Time	t _{OFF}		DG444	Room		110		140
			DG445	Room		160		210
Charge Injection ^e	Q	C _L = 1 nF, V _S = 0 V V _{gen} = 0 V, R _{gen} = 0 Ω	Room		- 1		pC	
Off Isolation ^e	OIRR	R _L = 50 Ω , C _L = 5 pF, f =1 MHz	Room		60		dB	
Crosstalk (Channel-to-Channel) ^d	X _{TALK}		Room		100			
Source Off Capacitance	C _{S(off)}	f = 1 MHz	Room		4		pF	
Drain Off Capacitance	C _{D(off)}		Room		4			
Channel On Capacitance	C _{D(on)}	V _{ANALOG} = 0 V	Room		16			

**SPECIFICATIONS for Dual Supplies**

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V- = - 15 V VL = 5 V, VIN = 2.4 V, 0.8 V ^e	Temp. ^a	D Suffix - 40 °C °C to 85 °C			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Power Supplies							
Positive Supply Current	I+	V+ = 16.5 V, V- = - 16.5 V VIN = 0 or 5 V	Room Full		0.001	1 5	μA
Negative Supply Current	I-		Room Full	- 1 - 5	- 0.0001		
Logic Supply Current	IL		Room Full		0.001	1 5	
Ground Current	IGND		Room Full	- 1 - 5	- 0.001		

SPECIFICATIONS for Unipolar Supplies

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 12 V, V- = 0 V VL = 5 V, VIN = 2.4 V, 0.8 V ^e	Temp. ^a	Limits - 40 °C °C to 85 °C			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Analog Switch							
Analog Signal Range ^d	V _{ANALOG}		Full	0		12	V
Drain-Source On-Resistance ^d	R _{DS(on)}	IS = - 10 mA, VD = 3 V, 8 V V+ = 10.8 V, VL = 5.25 V	Room Full		100	160 200	Ω
Dynamic Characteristics							
Turn-On Time	t _{ON}	RL = 1 kΩ, CL = 35 pF, VS = 8 V See Figure 2	Room		300	450	ns
Turn-Off Time	t _{OFF}		Room		60	200	
Charge Injection	Q	CL = 1 nF, Vgen = 6 V, Rgen = 0 Ω	Room		2		pC
Power Supplies							
Positive Supply Current	I+	V+ = 13.2 V, VIN = 0 or 5 V	Room Full		0.001	1 5	μA
Negative Supply Current	I-	VIN = 0 or 5 V	Room Full	- 1 - 5	- 0.0001		
Logic Supply Current	IL	VL = 5.25 V, VIN = 0 or 5 V	Room Full		0.001	1 5	
Ground Current	IGND	VIN = 0 or 5 V	Full	- 1 - 5	- 0.001		

Notes:

a. Room = 25 °C, Full = as determined by the operating temperature suffix.

b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.

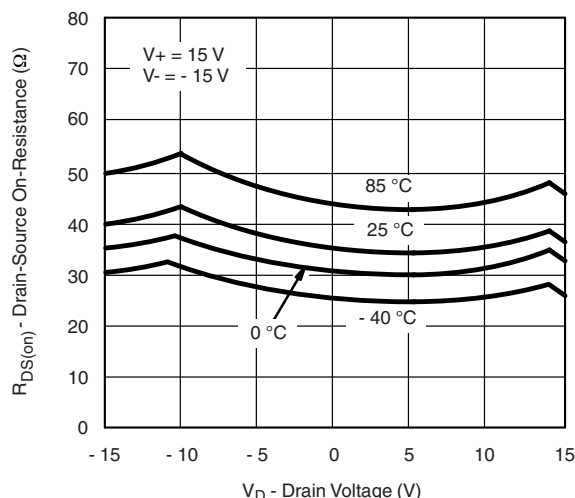
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

d. Guaranteed by design, not subject to production test.

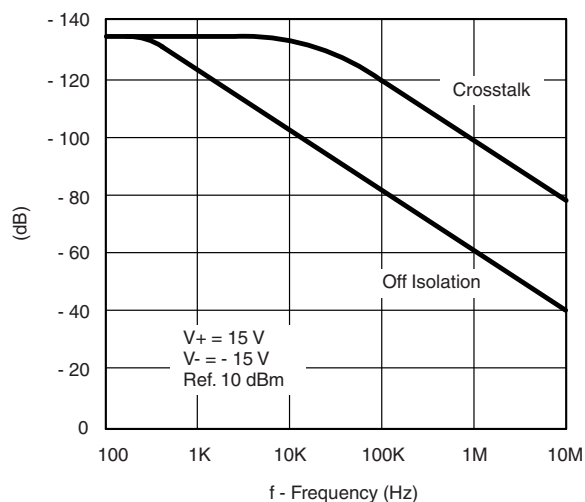
e. V_{IN} = input voltage to perform proper function.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

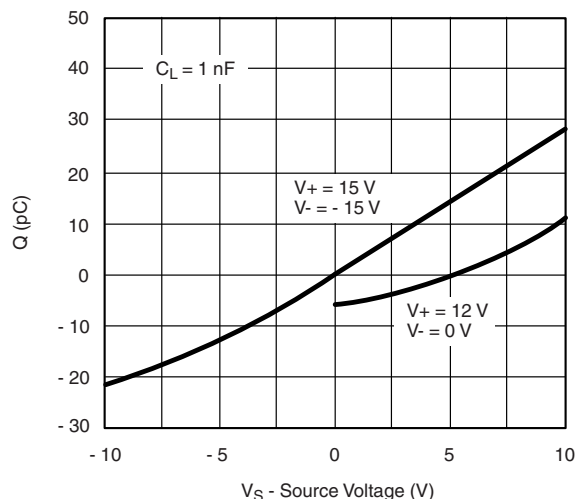
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



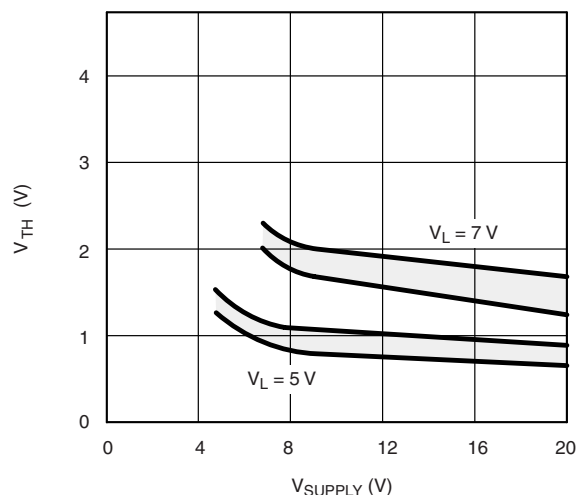
$R_{DS(on)}$ vs. V_D and Temperature



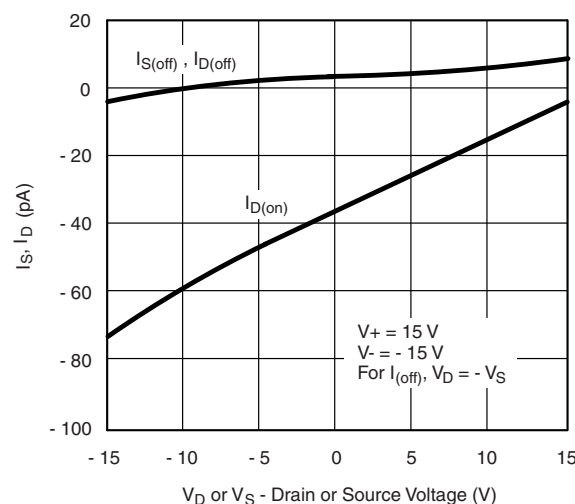
Crosstalk and Off Isolation vs. Frequency



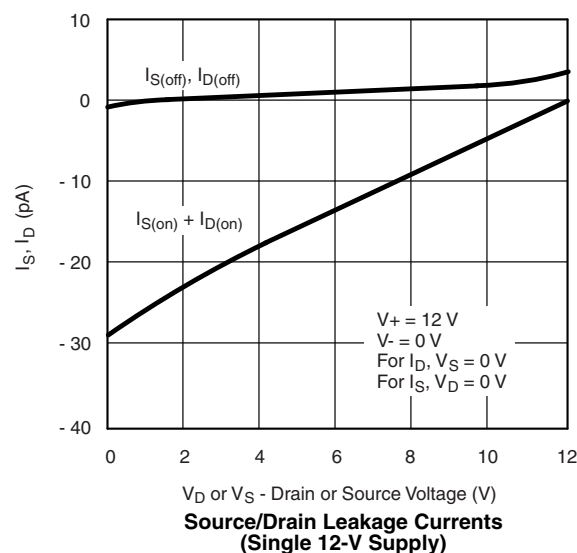
Charge Injection vs. Source Voltage



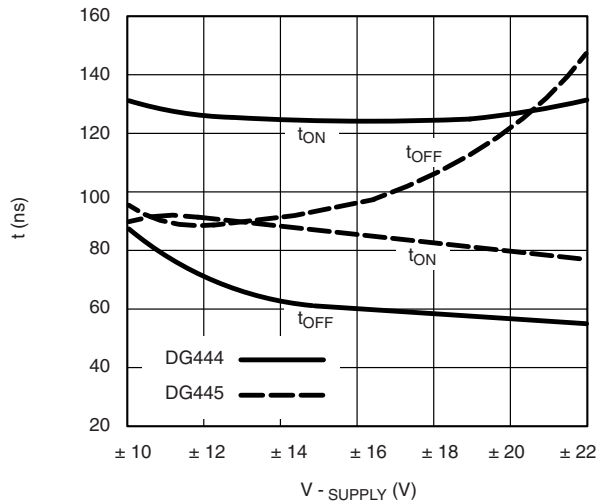
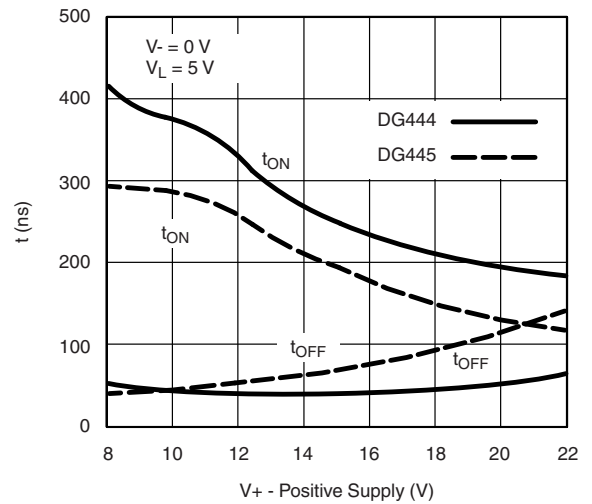
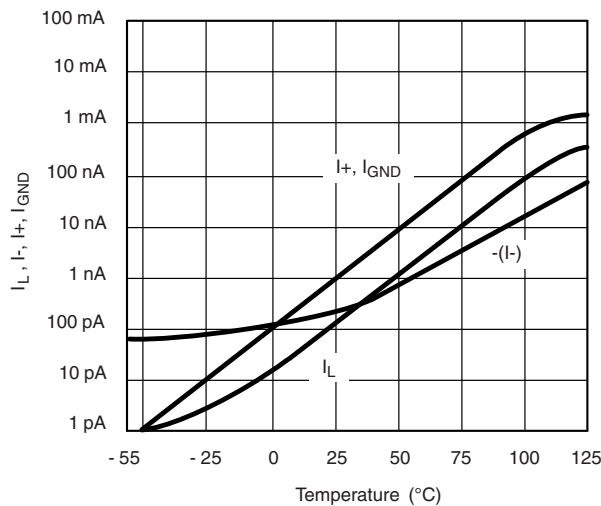
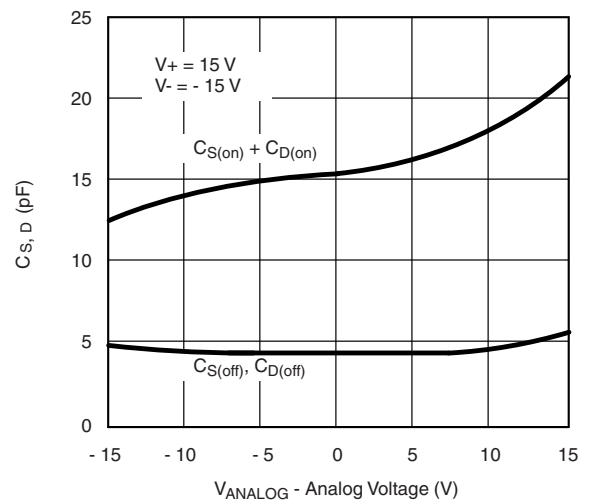
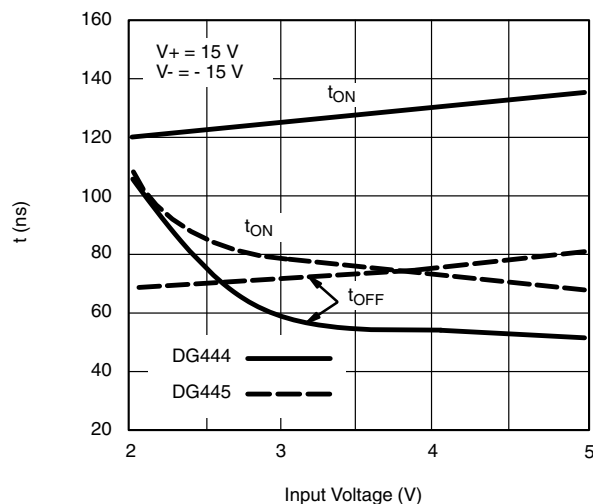
Switching Threshold vs. Supply Voltage



Source/Drain Leakage Currents



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

**TYPICAL CHARACTERISTICS** ($T_A = 25^\circ\text{C}$, unless otherwise noted)**Switching Time vs. Power Supply Voltage****Switching Times vs. Power Supply Voltage****Supply Current vs. Temperature****Source/Drain Capacitance vs. Analog Voltage****Switching Time vs. Input Voltage**

SCHEMATIC DIAGRAM Typical Channel

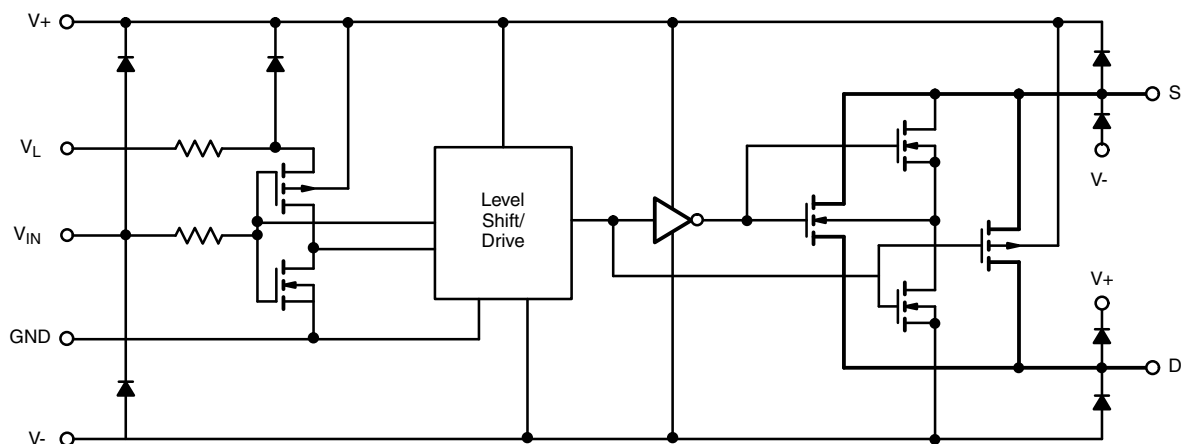
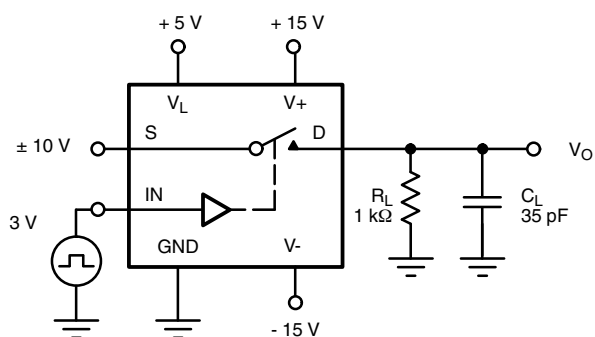
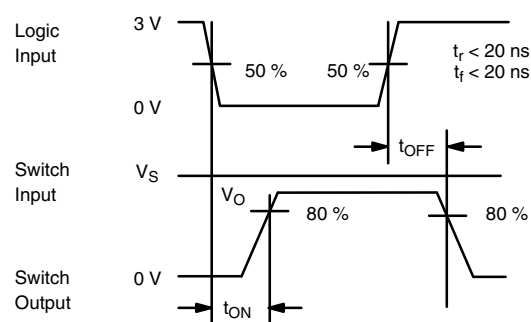


Figure 1.

TEST CIRCUITS



C_L (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG445.

Figure 2. Switching Time

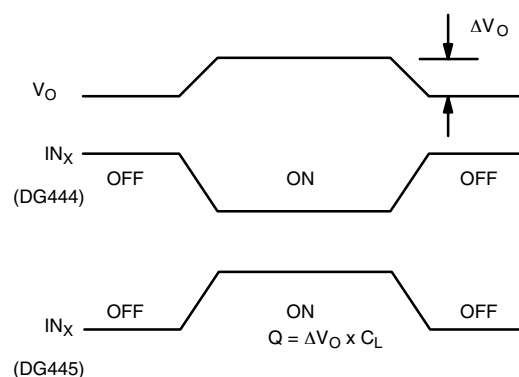
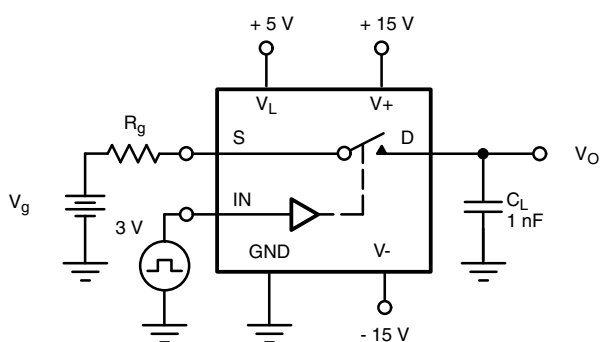


Figure 3. Charge Injection

TEST CIRCUITS

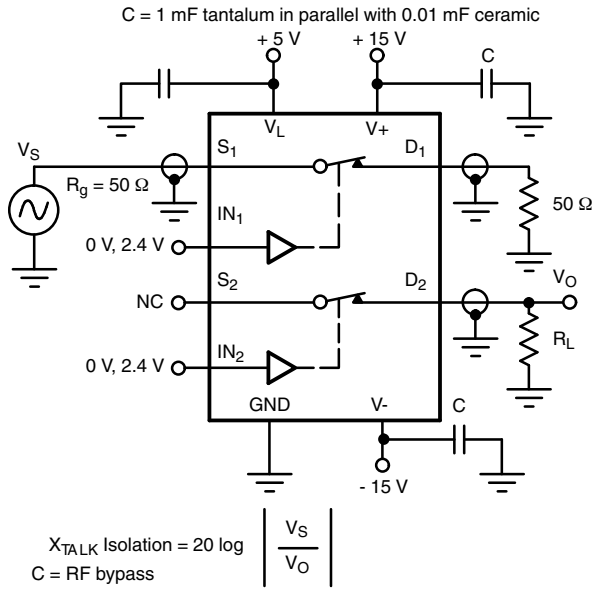


Figure 4. Crosstalk

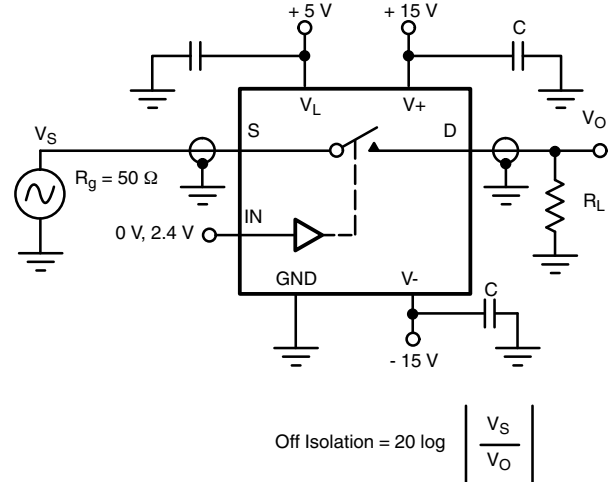


Figure 5. Off Isolation

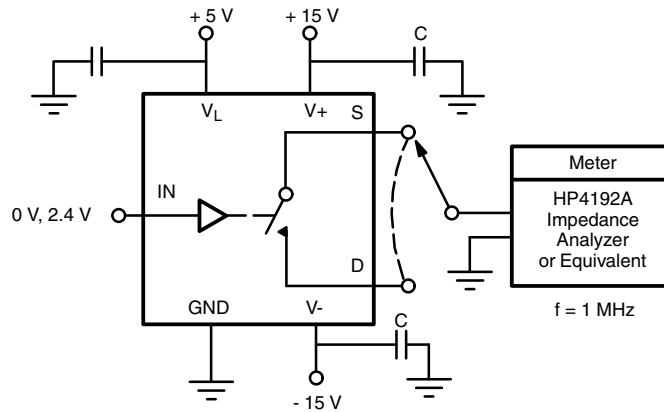


Figure 6. Source/Drain Capacitances

APPLICATIONS

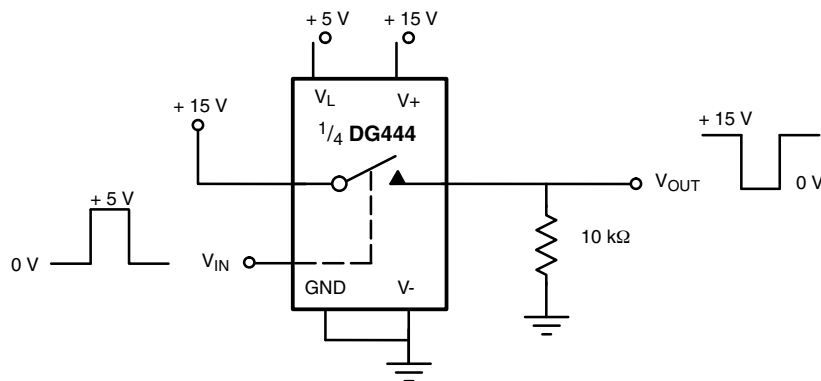


Figure 7. Level Shifter

APPLICATIONS

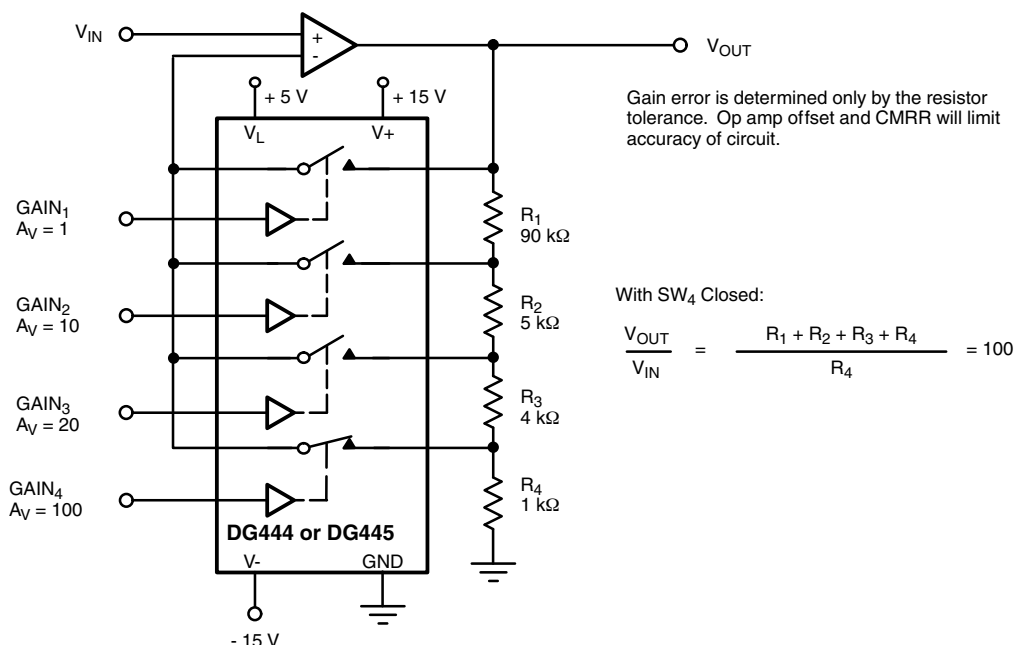


Figure 8. Precision-Weighted Resistor Programmable-Gain Amplifier

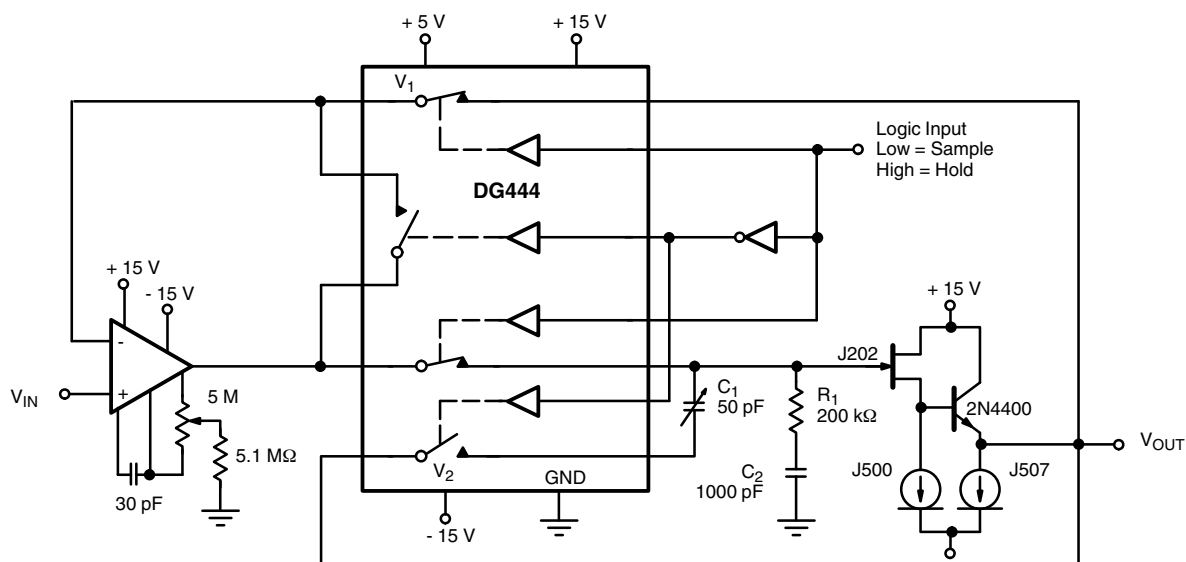


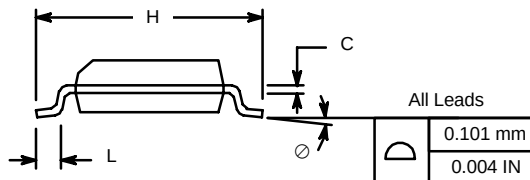
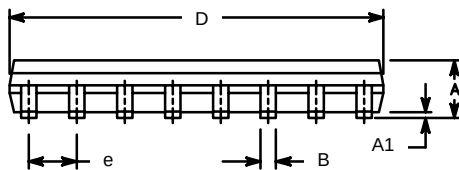
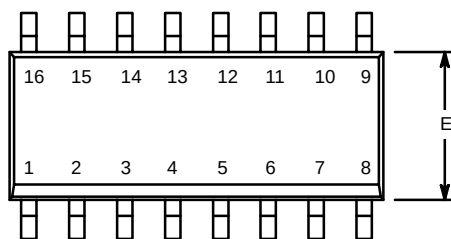
Figure 9. Precision Sample-and-Hold

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?70054.



SOIC (NARROW): 16-LEAD

JEDEC Part Number: MS-012

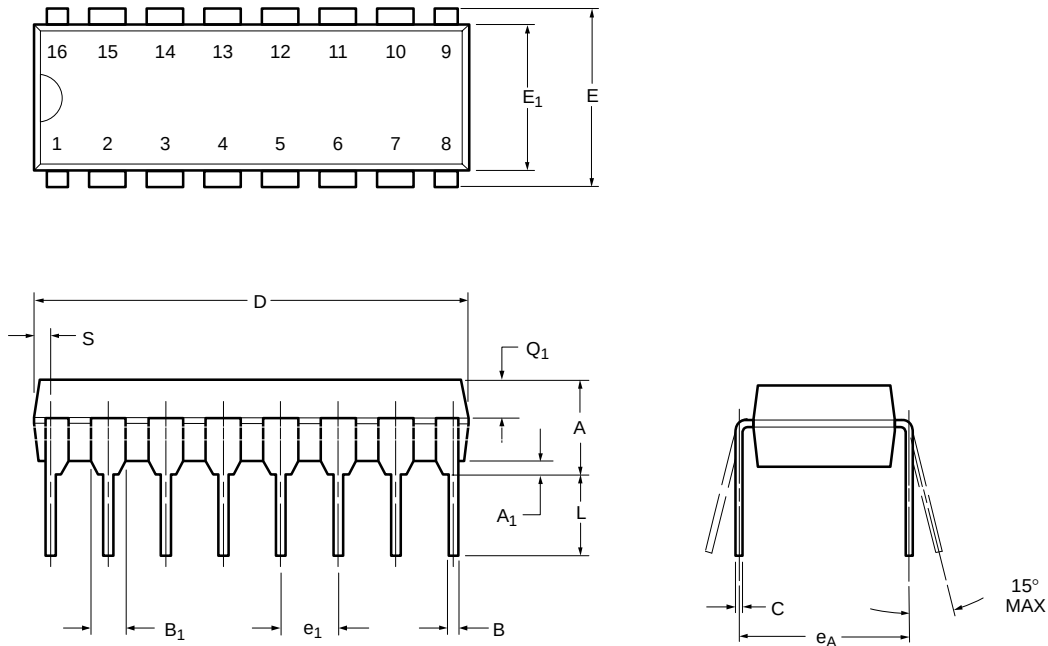


Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A ₁	0.10	0.20	0.004	0.008
B	0.38	0.51	0.015	0.020
C	0.18	0.23	0.007	0.009
D	9.80	10.00	0.385	0.393
E	3.80	4.00	0.149	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
L	0.50	0.93	0.020	0.037
Ø	0°	8°	0°	8°

ECN: S-03946—Rev. F, 09-Jul-01
DWG: 5300

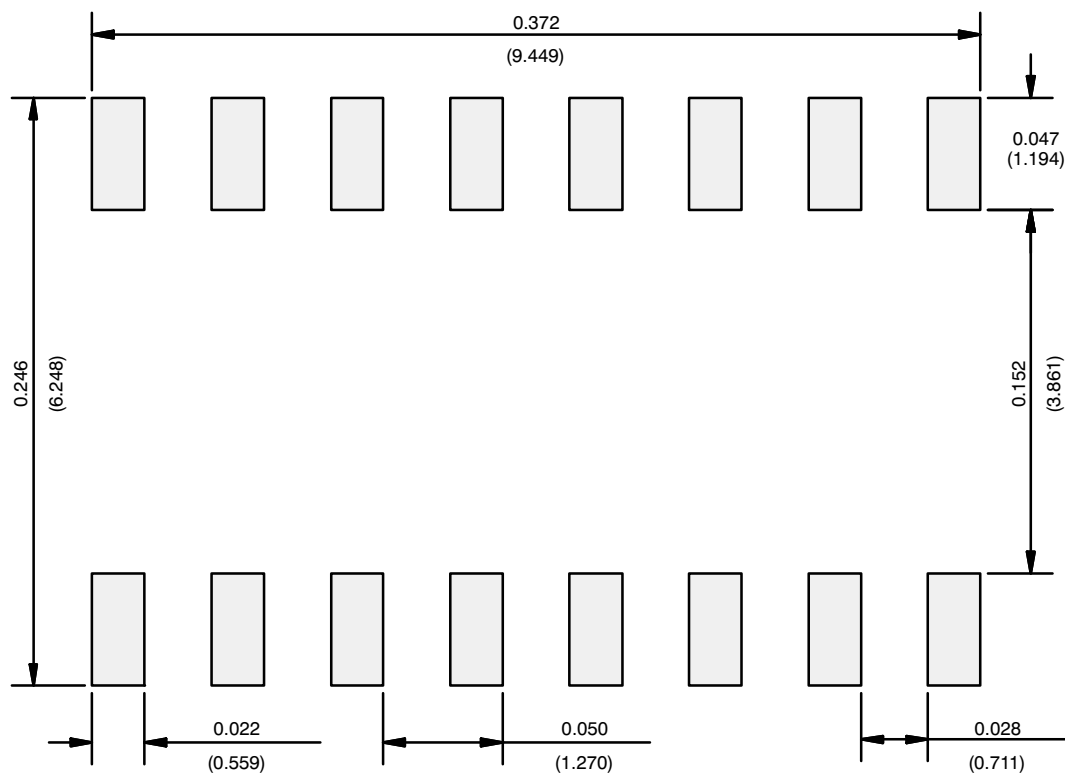


PDIP: 16-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	3.81	5.08	0.150	0.200
A₁	0.38	1.27	0.015	0.050
B	0.38	0.51	0.015	0.020
B₁	0.89	1.65	0.035	0.065
C	0.20	0.30	0.008	0.012
D	18.93	21.33	0.745	0.840
E	7.62	8.26	0.300	0.325
E₁	5.59	7.11	0.220	0.280
e₁	2.29	2.79	0.090	0.110
e_A	7.37	7.87	0.290	0.310
L	2.79	3.81	0.110	0.150
Q₁	1.27	2.03	0.050	0.080
S	0.38	1.52	.015	0.060
ECN: S-03946—Rev. D, 09-Jul-01 DWG: 5482				

RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads
Dimensions in Inches/(mm)

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