

## 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.

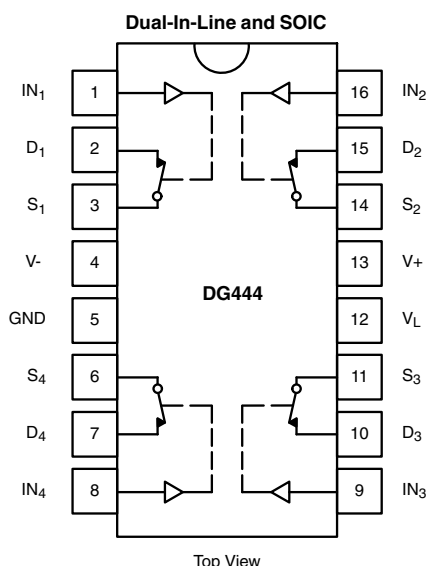
### FEATURES

- Low on-resistance: 50  $\Omega$
- 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

### 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 ( $T_A = 25^\circ\text{C}$ , 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 <sup>a</sup> , $V_S$ , $V_D$                                   |                                      | ( $V_-$ ) - 2 to ( $V_+$ ) + 2<br>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) <sup>b</sup>                                      | 16-Pin Plastic DIP <sup>c</sup>      | 450                                                                | mW               |
|                                                                               | 16-Pin Narrow Body SOIC <sup>d</sup> | 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  $75^\circ\text{C}$ .d. Derate 8 mW/ $^\circ\text{C}$  above  $75^\circ\text{C}$ .

| SPECIFICATIONS for Dual Supplies            |                     |                                                                                                                                                                      |                    |                                 |                   |                   |      |     |
|---------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------|-------------------|-------------------|------|-----|
| Parameter                                   | Symbol              | Test Conditions<br>Unless Otherwise Specified<br>V <sub>+</sub> = 15 V, V <sub>-</sub> = - 15 V<br>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<br>- 40 °C °C to 85 °C |                   |                   | Unit |     |
|                                             |                     |                                                                                                                                                                      |                    | Min. <sup>b</sup>               | Typ. <sup>c</sup> | Max. <sup>b</sup> |      |     |
| Analog Switch                               |                     |                                                                                                                                                                      |                    |                                 |                   |                   |      |     |
| 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<br>V <sub>+</sub> = 13.5 V V <sub>-</sub> = - 13.5 V                                                              | Room<br>Full       |                                 | 50                | 85<br>100         | Ω    |     |
| Switch Off Leakage Current                  | I <sub>S(off)</sub> | V <sub>+</sub> = 16.5, V <sub>-</sub> = - 16.5 V<br>V <sub>D</sub> = ± 15.5 V, V <sub>S</sub> = ± 15.5 V                                                             | Room<br>Full       | - 0.5<br>- 5                    | ± 0.01            | 0.5<br>5          | nA   |     |
|                                             | I <sub>D(off)</sub> |                                                                                                                                                                      | Room<br>Full       | - 0.5<br>- 5                    | ± 0.01            | 0.5<br>5          |      |     |
| Channel On Leakage Current                  | I <sub>D(on)</sub>  | V <sub>+</sub> = 16.5 V, V <sub>-</sub> = - 16.5 V<br>V <sub>S</sub> = V <sub>D</sub> = ± 15.5 V                                                                     | Room<br>Full       | - 0.5<br>- 10                   | ± 0.08            | 0.5<br>10         |      |     |
| Digital Control                             |                     |                                                                                                                                                                      |                    |                                 |                   |                   |      |     |
| Input Current V <sub>IN</sub> Low           | I <sub>IL</sub>     | V <sub>IN</sub> under test = 0.8 V<br>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<br>All Other = 0.8 V                                                                                                              | Full               | - 500                           | 0.01              | 500               |      |     |
| Dynamic Characteristics                     |                     |                                                                                                                                                                      |                    |                                 |                   |                   |      |     |
| Turn-On Time                                | t <sub>ON</sub>     | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 35 pF<br>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<br>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                |                   |      |     |

**SPECIFICATIONS for Dual Supplies**

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

**SPECIFICATIONS for Unipolar Supplies**

| Parameter                                  | Symbol              | Test Conditions<br>Unless Otherwise Specified<br>V+ = 12 V, V- = 0 V<br>V <sub>L</sub> = 5 V, V <sub>IN</sub> = 2.4 V, 0.8 V <sup>e</sup> | Temp. <sup>a</sup> | Limits<br>- 40 °C °C to 85 °C |                   |                   | Unit |
|--------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------|-------------------|-------------------|------|
|                                            |                     |                                                                                                                                           |                    | Min. <sup>b</sup>             | Typ. <sup>c</sup> | Max. <sup>b</sup> |      |
| Analog Switch                              |                     |                                                                                                                                           |                    |                               |                   |                   |      |
| Analog Signal Range <sup>d</sup>           | V <sub>ANALOG</sub> |                                                                                                                                           | Full               | 0                             |                   | 12                | V    |
| Drain-Source<br>On-Resistance <sup>d</sup> | R <sub>DS(on)</sub> | I <sub>S</sub> = - 10 mA, V <sub>D</sub> = 3 V, 8 V<br>V+ = 10.8 V, V <sub>L</sub> = 5.25 V                                               | Room<br>Full       |                               | 100               | 160<br>200        | Ω    |
| Dynamic Characteristics                    |                     |                                                                                                                                           |                    |                               |                   |                   |      |
| Turn-On Time                               | t <sub>ON</sub>     | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 35 pF, V <sub>S</sub> = 8 V<br>See Figure 2                                                       | Room               |                               | 300               | 450               | ns   |
| Turn-Off Time                              | t <sub>OFF</sub>    |                                                                                                                                           | Room               |                               | 60                | 200               |      |
| Charge Injection                           | Q                   | C <sub>L</sub> = 1 nF, V <sub>gen</sub> = 6 V, R <sub>gen</sub> = 0 Ω                                                                     | Room               |                               | 2                 |                   | pC   |
| Power Supplies                             |                     |                                                                                                                                           |                    |                               |                   |                   |      |
| Positive Supply Current                    | I+                  | V+ = 13.2 V, V <sub>IN</sub> = 0 or 5 V                                                                                                   | Room<br>Full       |                               | 0.001             | 1<br>5            | μA   |
| Negative Supply Current                    | I-                  | V <sub>IN</sub> = 0 or 5 V                                                                                                                | Room<br>Full       | - 1<br>- 5                    | - 0.0001          |                   |      |
| Logic Supply Current                       | I <sub>L</sub>      | V <sub>L</sub> = 5.25 V, V <sub>IN</sub> = 0 or 5 V                                                                                       | Room<br>Full       |                               | 0.001             | 1<br>5            |      |
| Ground Current                             | I <sub>GND</sub>    | V <sub>IN</sub> = 0 or 5 V                                                                                                                | Full               | - 1<br>- 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.

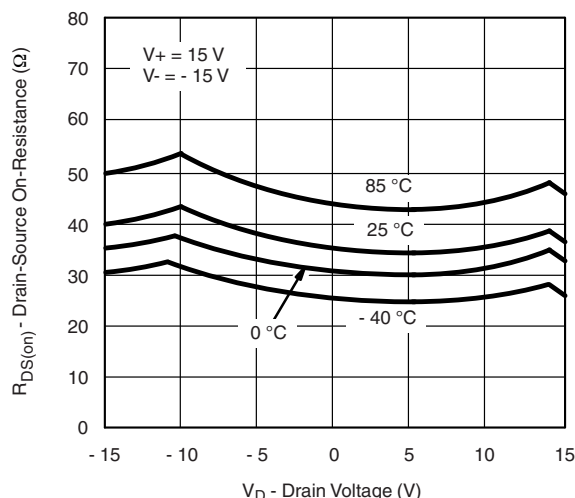
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

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

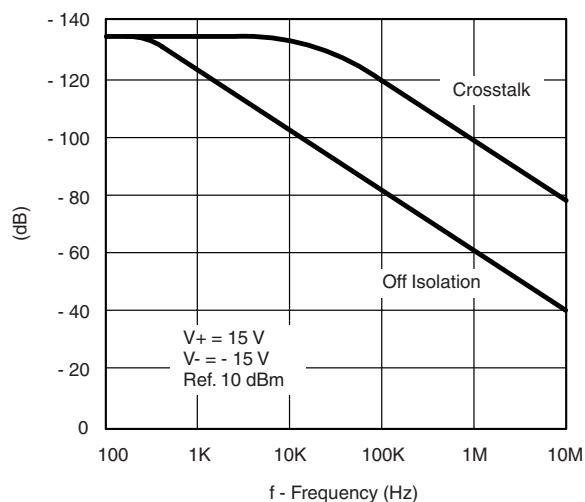
e.  $V_{IN}$  = input voltage to perform proper function.

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.

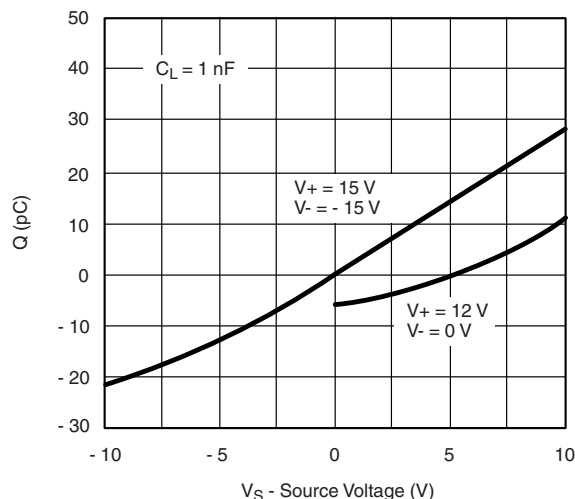
## TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



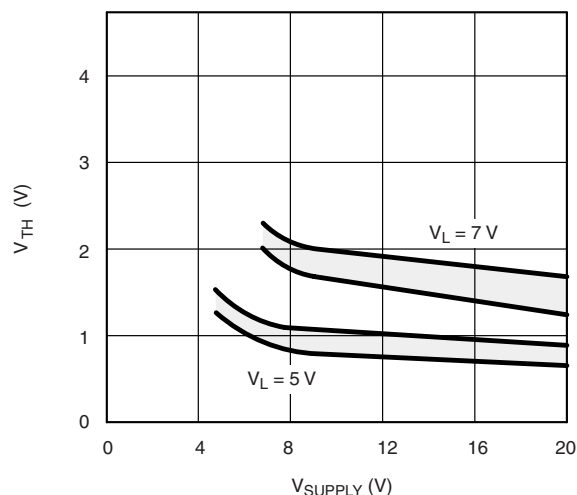
$R_{DS(on)}$  vs.  $V_D$  and Temperature



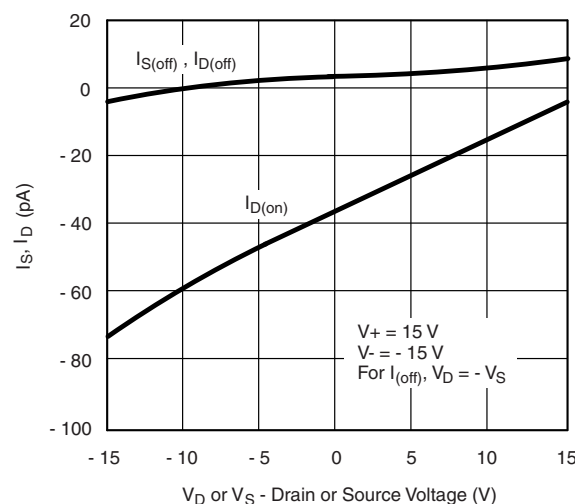
Crosstalk and Off Isolation vs. Frequency



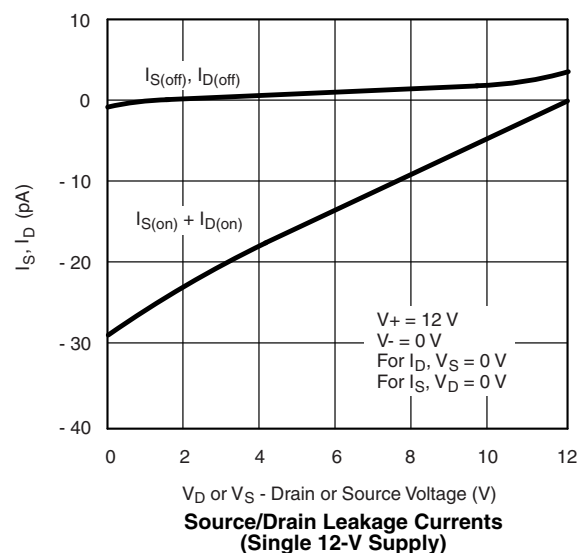
Charge Injection vs. Source Voltage



Switching Threshold vs. Supply Voltage

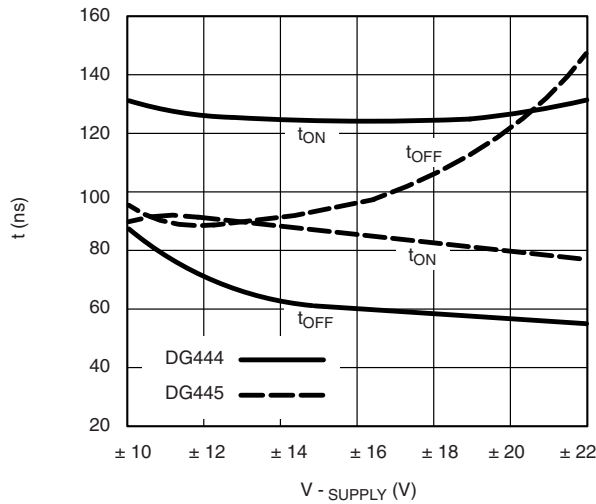


Source/Drain Leakage Currents

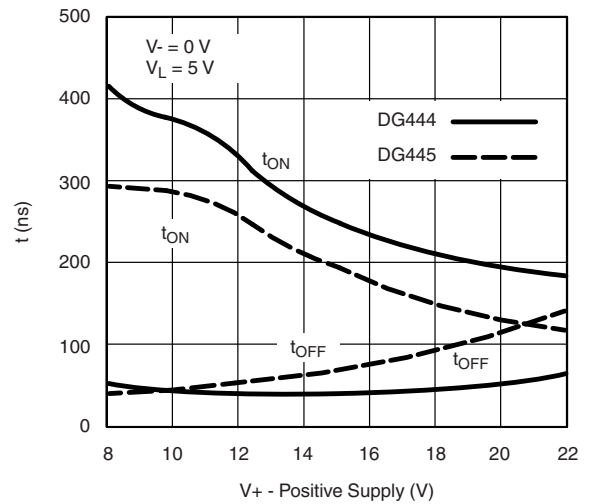


Source/Drain Leakage Currents (Single 12-V Supply)

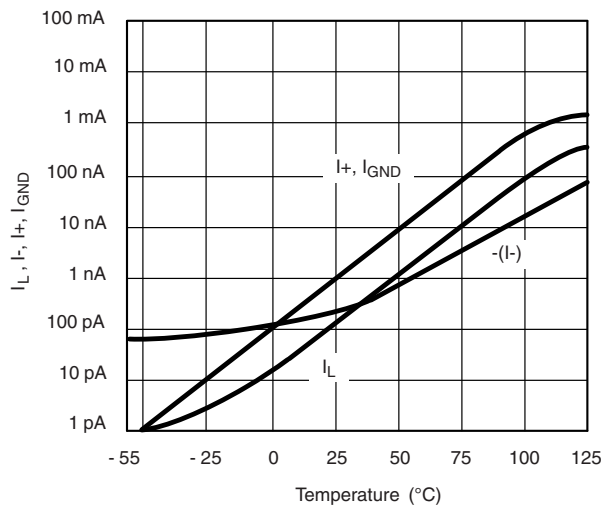
## TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



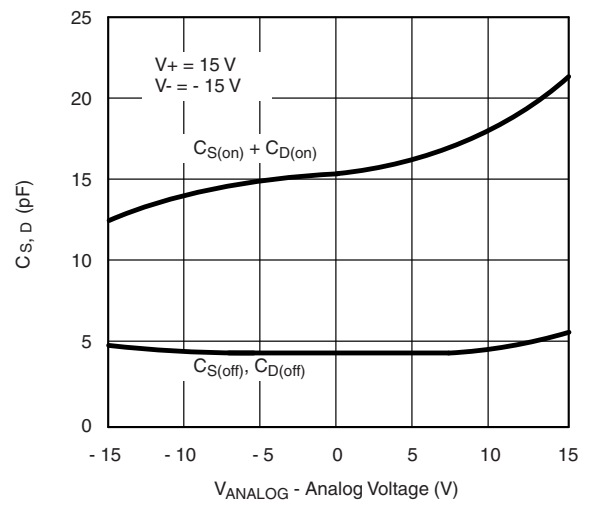
Switching Time vs. Power Supply Voltage



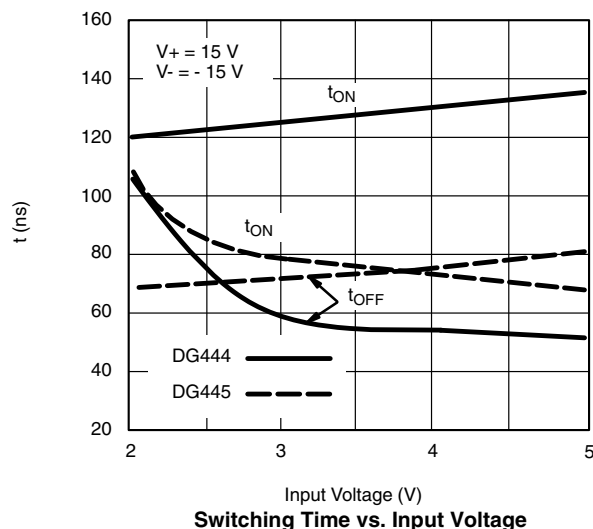
Switching Times vs. Power Supply Voltage



Supply Current vs. Temperature



Source/Drain Capacitance vs. Analog Voltage



Switching Time vs. Input Voltage

## SCHEMATIC DIAGRAM Typical Channel

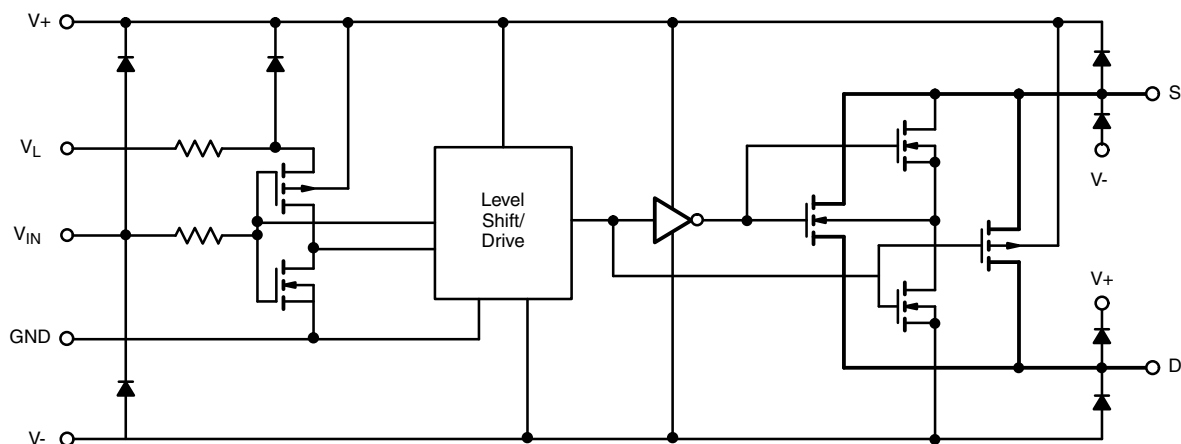
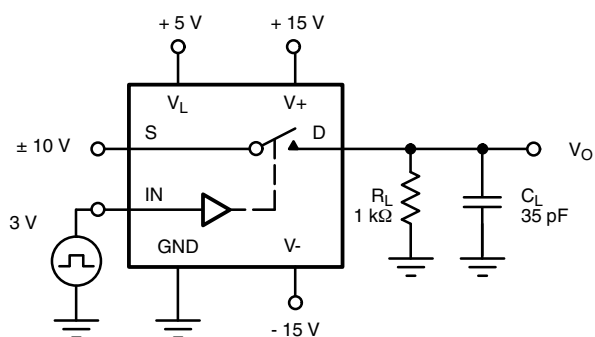
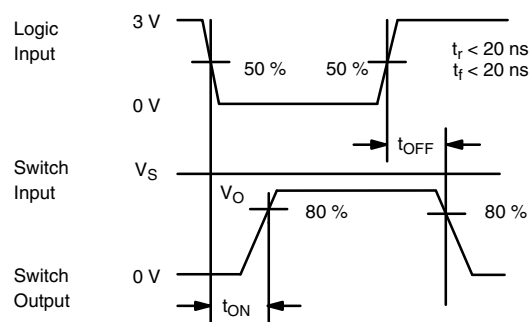


Figure 1.

## TEST CIRCUITS



$C_L$  (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG445.

Figure 2. Switching Time

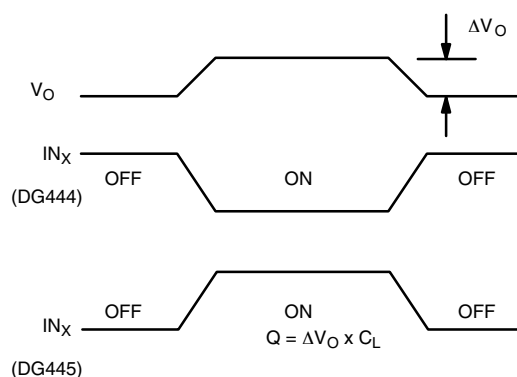
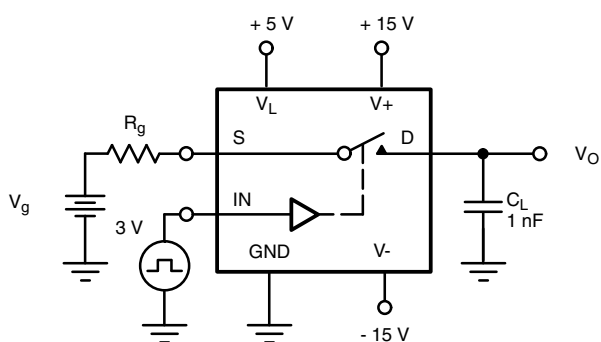


Figure 3. Charge Injection

## TEST CIRCUITS

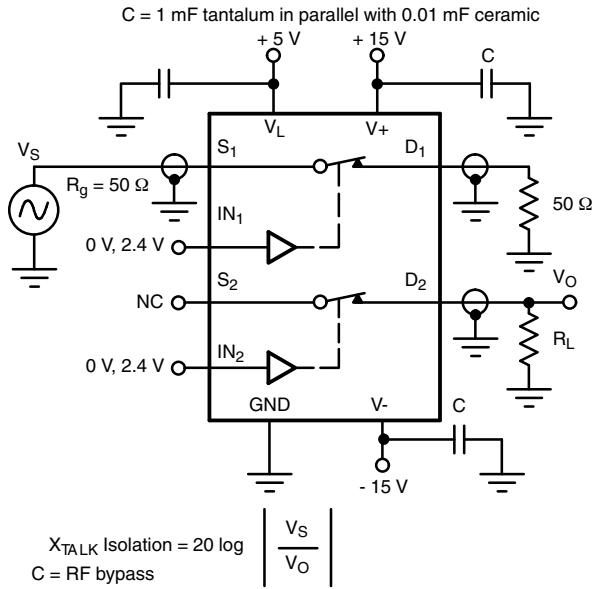


Figure 4. Crosstalk

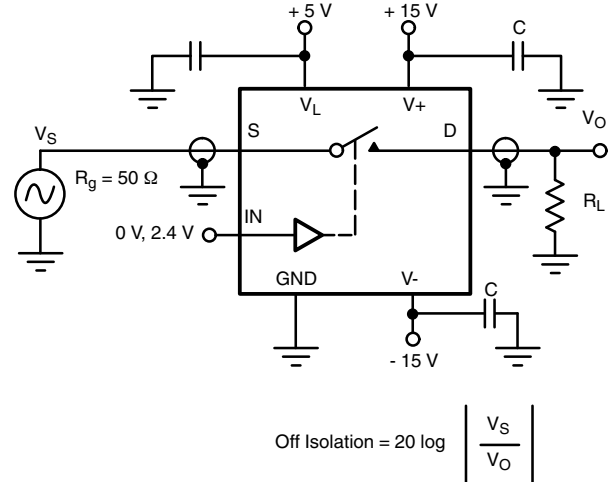


Figure 5. Off Isolation

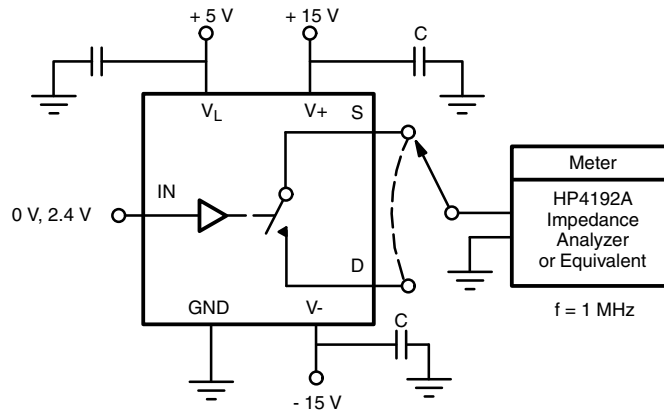


Figure 6. Source/Drain Capacitances

## APPLICATIONS

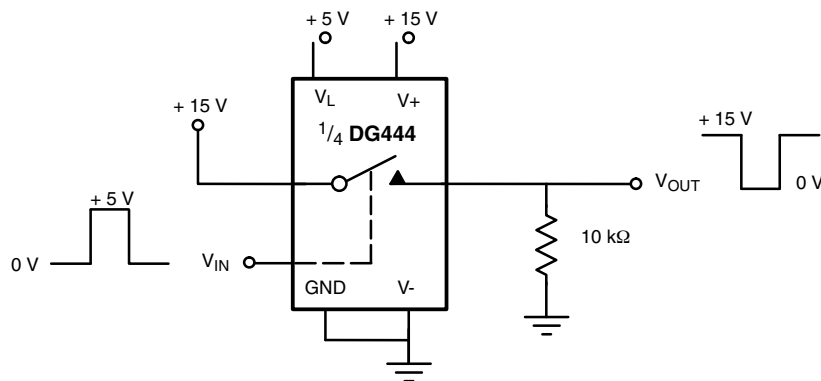


Figure 7. Level Shifter

### APPLICATIONS

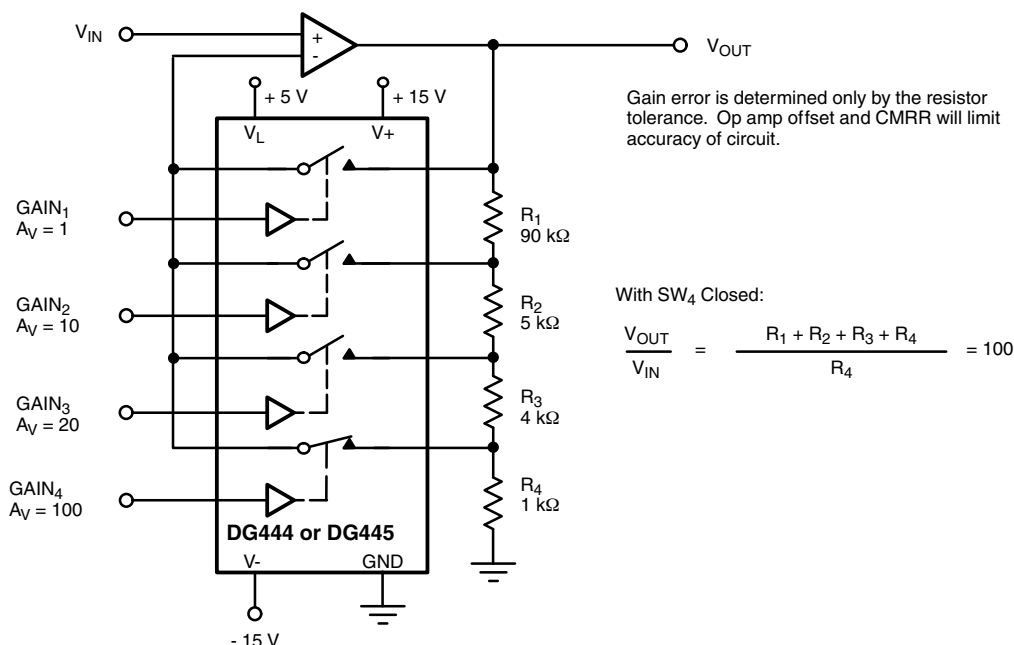


Figure 8. Precision-Weighted Resistor Programmable-Gain Amplifier

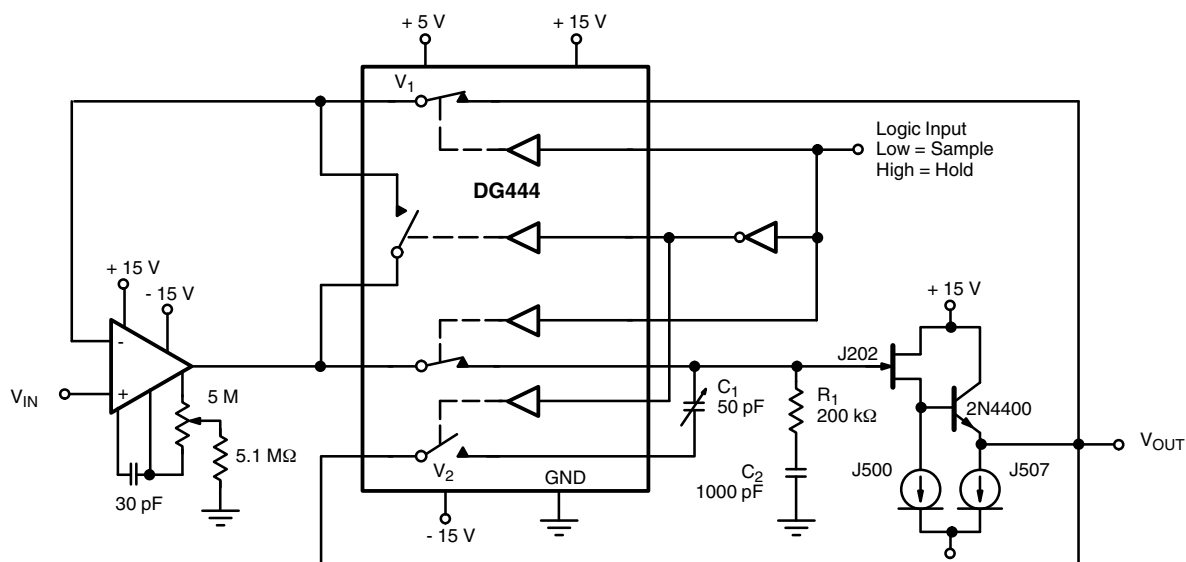


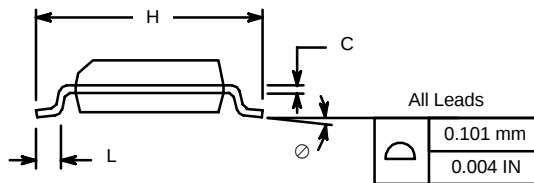
Figure 9. Precision Sample-and-Hold

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](http://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 <sub>1</sub> | 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

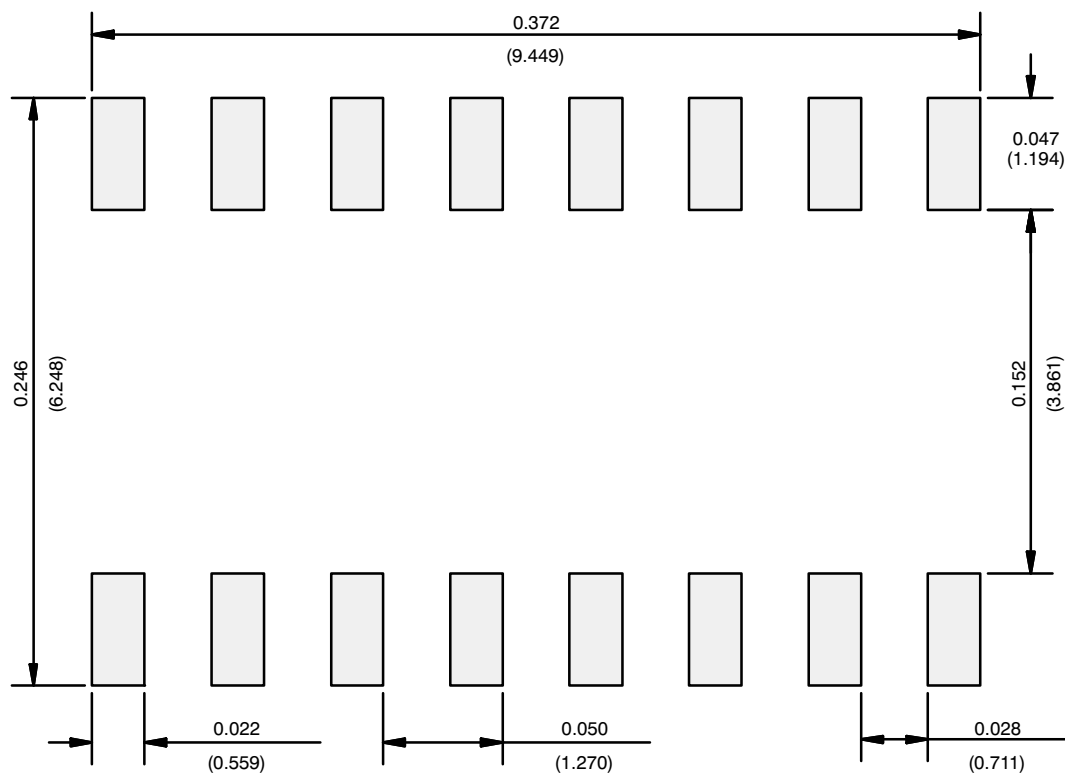


**PDIP: 16-LEAD**



| Dim                                         | MILLIMETERS |       | INCHES |       |
|---------------------------------------------|-------------|-------|--------|-------|
|                                             | Min         | Max   | Min    | Max   |
| <b>A</b>                                    | 3.81        | 5.08  | 0.150  | 0.200 |
| <b>A<sub>1</sub></b>                        | 0.38        | 1.27  | 0.015  | 0.050 |
| <b>B</b>                                    | 0.38        | 0.51  | 0.015  | 0.020 |
| <b>B<sub>1</sub></b>                        | 0.89        | 1.65  | 0.035  | 0.065 |
| <b>C</b>                                    | 0.20        | 0.30  | 0.008  | 0.012 |
| <b>D</b>                                    | 18.93       | 21.33 | 0.745  | 0.840 |
| <b>E</b>                                    | 7.62        | 8.26  | 0.300  | 0.325 |
| <b>E<sub>1</sub></b>                        | 5.59        | 7.11  | 0.220  | 0.280 |
| <b>e<sub>1</sub></b>                        | 2.29        | 2.79  | 0.090  | 0.110 |
| <b>e<sub>A</sub></b>                        | 7.37        | 7.87  | 0.290  | 0.310 |
| <b>L</b>                                    | 2.79        | 3.81  | 0.110  | 0.150 |
| <b>Q<sub>1</sub></b>                        | 1.27        | 2.03  | 0.050  | 0.080 |
| <b>S</b>                                    | 0.38        | 1.52  | .015   | 0.060 |
| ECN: S-03946—Rev. D, 09-Jul-01<br>DWG: 5482 |             |       |        |       |

## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**

## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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