

## Quad SPST CMOS Analog Switches

### DESCRIPTION

The DG441, DG442 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, DG442 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, DG442 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.

### BENEFITS

- Less signal errors and distortion
- Reduced power supply requirements
- Faster throughput
- Improved reliability
- Reduced pedestal errors
- Simplifies retrofit
- Simple interfacing

### 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
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

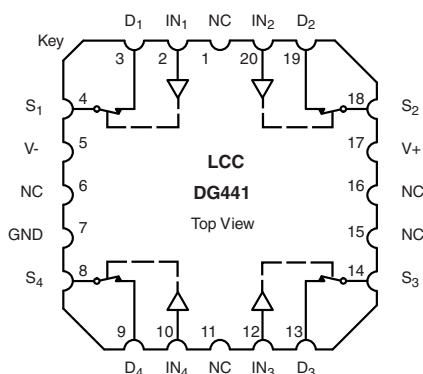
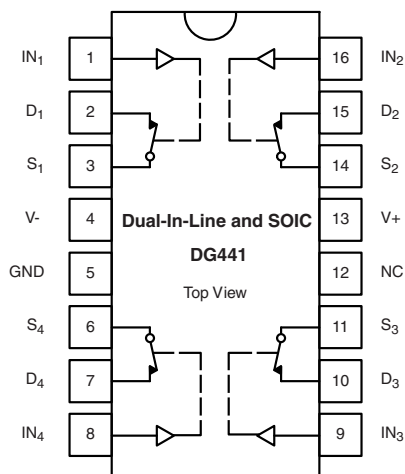


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

- Audio switching
- Battery powered systems
- Data acquisition
- Hi-Rel systems
- Sample-and-hold circuits
- Communication systems
- Automatic test equipment
- Medical instruments

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



| TRUTH TABLE |       |       |
|-------------|-------|-------|
| LOGIC       | DG441 | DG442 |
| 0           | On    | Off   |
| 1           | Off   | On    |

#### Note

- Logic "0"  $\leq 0.8\ V$   
Logic "1"  $\geq 2.4\ V$

**ORDERING INFORMATION**

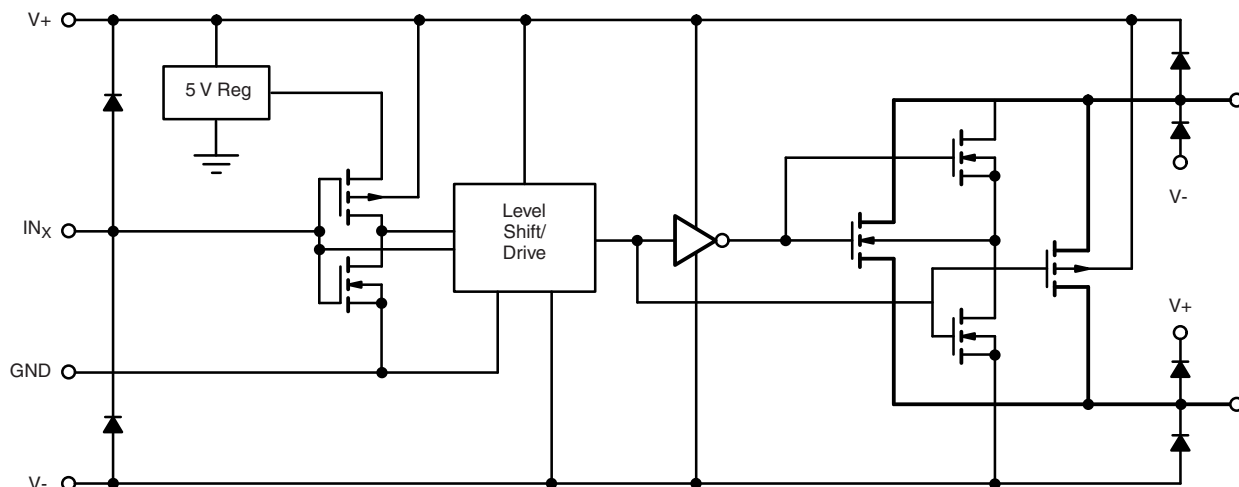
| TEMP. RANGE      | PACKAGE            | PART NUMBER                                          |
|------------------|--------------------|------------------------------------------------------|
| -40 °C to +85 °C | 16-pin plastic DIP | DG441DJ<br>DG441DJ-E3                                |
|                  |                    | DG442DJ<br>DG442DJ-E3                                |
|                  | 16-pin narrow SOIC | DG441DY<br>DG441DY-E3<br>DG441DY-T1<br>DG441DY-T1-E3 |
|                  |                    | DG442DY<br>DG442DY-E3<br>DG442DY-T1<br>DG442DY-T1-E3 |

**ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                                     |                                 | LIMIT                                                    | UNIT |
|---------------------------------------------------------------|---------------------------------|----------------------------------------------------------|------|
| Voltages referenced, V+ to V-                                 |                                 | 44                                                       | V    |
| GND to V-                                                     |                                 | 25                                                       |      |
| Digital inputs <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub> |                                 | (V-) - 2 to (V+) + 2<br>or 30 mA, whichever occurs first |      |
| Current (any terminal)                                        |                                 | 30                                                       | mA   |
| Peak current, S or D (pulsed at 1 ms, 10 % duty cycle max.)   |                                 | 100                                                      |      |
| 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                                                      |      |
|                                                               | 16-pin narrow SOIC <sup>d</sup> | 900                                                      |      |
|                                                               | LCC-20 <sup>d</sup>             | 1200                                                     |      |

**Notes**

- Signals on SX, DX, or INX 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 75 °C

**SCHEMATIC DIAGRAM** (typical channel)

**Fig. 1**



| SPECIFICATIONS <sup>a</sup> (dual supplies)       |                      |                                                                                                                                                  |                    |                   |                               |                   |                              |                   |      |
|---------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-------------------------------|-------------------|------------------------------|-------------------|------|
| PARAMETER                                         | SYMBOL               | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V<br>V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup> | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | A SUFFIX<br>-55 °C TO +125 °C |                   | D SUFFIX<br>-40 °C TO +85 °C |                   | UNIT |
|                                                   |                      |                                                                                                                                                  |                    |                   | MIN. <sup>d</sup>             | MAX. <sup>d</sup> | MIN. <sup>d</sup>            | MAX. <sup>d</sup> |      |
| Analog Switch                                     |                      |                                                                                                                                                  |                    |                   |                               |                   |                              |                   |      |
| Analog signal range <sup>e</sup>                  | V <sub>ANALOG</sub>  |                                                                                                                                                  | Full               | -                 | -15                           | 15                | -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               | 50                | -                             | 85                | -                            | 85                | Ω    |
|                                                   |                      |                                                                                                                                                  | Full               | -                 | -                             | 100               | -                            | 100               |      |
| On-resistance match between channels <sup>e</sup> | ΔR <sub>DS(on)</sub> | I <sub>S</sub> = -10 mA, V <sub>D</sub> = ± 10 V,<br>V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V                                               | Room               | -                 | -                             | 4                 | -                            | 4                 |      |
|                                                   |                      |                                                                                                                                                  | Full               | -                 | -                             | 5                 | -                            | 5                 |      |
| 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               | ± 0.01            | -0.5                          | 0.5               | -0.5                         | 0.5               | nA   |
|                                                   |                      |                                                                                                                                                  | Full               | -                 | -20                           | 20                | -5                           | 5                 |      |
|                                                   | I <sub>D(off)</sub>  |                                                                                                                                                  | Room               | ± 0.01            | -0.5                          | 0.5               | -0.5                         | 0.5               |      |
|                                                   |                      |                                                                                                                                                  | Full               | -                 | -20                           | 20                | -5                           | 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               | ± 0.08            | -0.5                          | 0.5               | -0.5                         | 0.5               |      |
|                                                   |                      |                                                                                                                                                  | Full               | -                 | -40                           | 40                | -10                          | 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               | -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,<br>all other = 0.8 V                                                                                         | Full               | 0.01              | -500                          | 500               | -500                         | 500               |      |
| Dynamic Characteristics                           |                      |                                                                                                                                                  |                    |                   |                               |                   |                              |                   |      |
| Turn-on time                                      |                      | R <sub>L</sub> = 1 kW, C <sub>L</sub> = 35 pF,<br>V <sub>S</sub> = ± 10 V,<br>see Fig. 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                                                                                                                                                | Room               | -1                | -                             | -                 | -                            | -                 | pC   |
| Off Isolation <sup>e</sup>                        |                      | OIRR                                                                                                                                             | Room               | 60                | -                             | -                 | -                            | -                 | dB   |
| Crosstalk<br>(channel-to-channel)                 |                      | X <sub>TALK</sub>                                                                                                                                | Room               | 100               | -                             | -                 | -                            | -                 |      |
| Source off capacitance <sup>e</sup>               |                      | C <sub>S(off)</sub>                                                                                                                              | 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>                                                                                                                               | Room               | 16                | -                             | -                 | -                            | -                 |      |
| Power Supplies                                    |                      |                                                                                                                                                  |                    |                   |                               |                   |                              |                   |      |
| Positive supply current                           | I <sub>+</sub>       | V <sub>+</sub> = 16.5 V, V <sub>-</sub> = -16.5 V,<br>V <sub>IN</sub> = 0 V or 5 V                                                               | Full               | 15                | -                             | 100               | -                            | 100               | μA   |
| Negative supply current                           | I <sub>-</sub>       |                                                                                                                                                  | Room               | -0.0001           | -1                            | -                 | -1                           | -                 |      |
|                                                   |                      |                                                                                                                                                  | Full               | -                 | -5                            | -                 | 5                            | -                 |      |
| Ground current                                    | I <sub>GND</sub>     |                                                                                                                                                  | Full               | -15               | -100                          | -                 | -100                         | -                 |      |



| SPECIFICATIONS <sup>a</sup> (single supply) |                     |                                                                                                                                                 |                    |                   |                               |                   |                               |                   |      |
|---------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-------------------------------|-------------------|-------------------------------|-------------------|------|
| PARAMETER                                   | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 12 V, V <sub>-</sub> = 0 V,<br>V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup> | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | A SUFFIX<br>-55 °C TO +125 °C |                   | D SUFFIX<br>- 40 °C TO +85 °C |                   | UNIT |
|                                             |                     |                                                                                                                                                 |                    |                   | MIN. <sup>d</sup>             | MAX. <sup>d</sup> | MIN. <sup>d</sup>             | MAX. <sup>d</sup> |      |
| Analog Switch                               |                     |                                                                                                                                                 |                    |                   |                               |                   |                               |                   |      |
| Analog signal range <sup>e</sup>            | V <sub>ANALOG</sub> |                                                                                                                                                 | Full               | -                 | 0                             | 12                | 0                             | 12                | V    |
| Drain-source<br>on-resistance               | R <sub>DS(on)</sub> | I <sub>S</sub> = -10 mA, V <sub>D</sub> = 3 V, 8 V,<br>V <sub>+</sub> = 10.8 V                                                                  | Room               | 100               | -                             | 160               | -                             | 160               | Ω    |
|                                             |                     |                                                                                                                                                 | Full               | -                 | -                             | 200               | -                             | 200               |      |
| 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> = 8 V, See Fig. 2                                                               | Room               | 300               | -                             | 450               | -                             | 450               | ns   |
| Turn-off time                               | t <sub>off</sub>    |                                                                                                                                                 | Room               | 60                | -                             | 200               | -                             | 200               |      |
| Charge injection                            | Q                   | C <sub>L</sub> = 1nF, V <sub>gen</sub> = 6 V,<br>R <sub>gen</sub> = 0 Ω                                                                         | Room               | 2                 | -                             | -                 | -                             | -                 | pC   |
| Power Supplies                              |                     |                                                                                                                                                 |                    |                   |                               |                   |                               |                   |      |
| Positive supply current                     | I <sub>+</sub>      | V <sub>+</sub> = 13.2 V, V <sub>-</sub> = 0 V,<br>V <sub>IN</sub> = 0 or 5 V                                                                    | Full               | 15                | -                             | 100               | -                             | 100               | μA   |
| Negative supply current                     | I <sub>-</sub>      |                                                                                                                                                 | Room               | -0.0001           | -1                            | -                 | -1                            | -                 |      |
|                                             |                     |                                                                                                                                                 | Full               | -                 | -100                          | -                 | -100                          | -                 |      |
| Ground current                              | I <sub>GND</sub>    |                                                                                                                                                 | Full               | -15               | -100                          | -                 | -100                          | -                 |      |

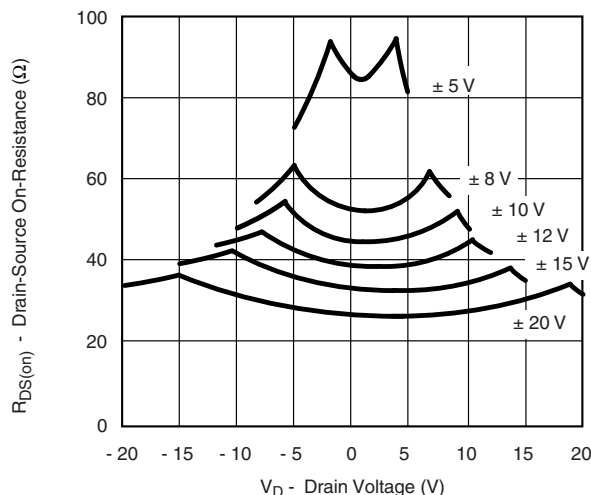
**Notes**

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

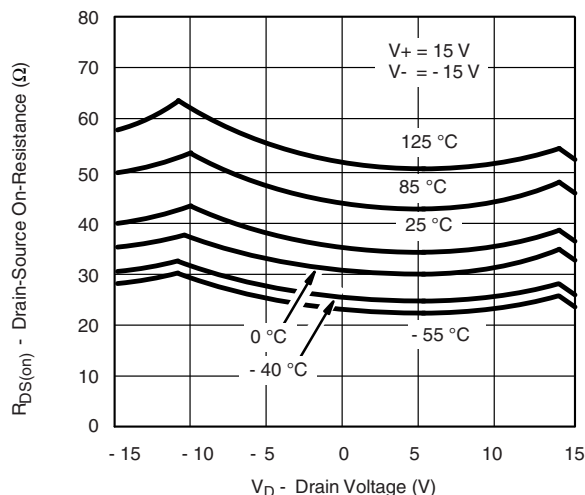
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



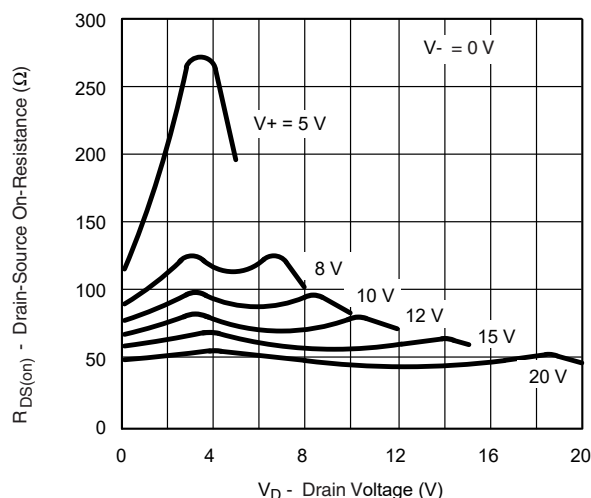
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



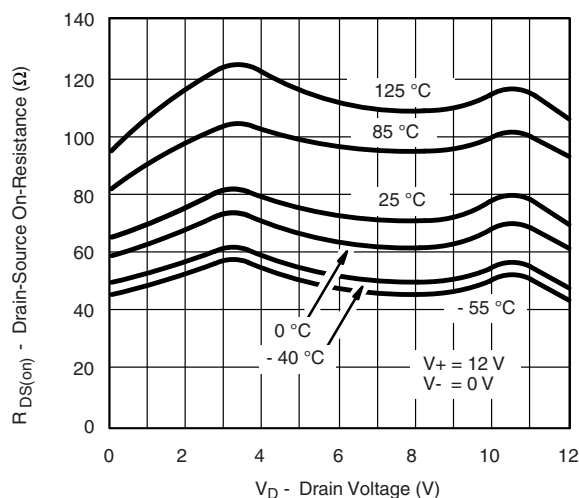
**R<sub>DS(on)</sub> vs. V<sub>D</sub> and Power Supply Voltage**



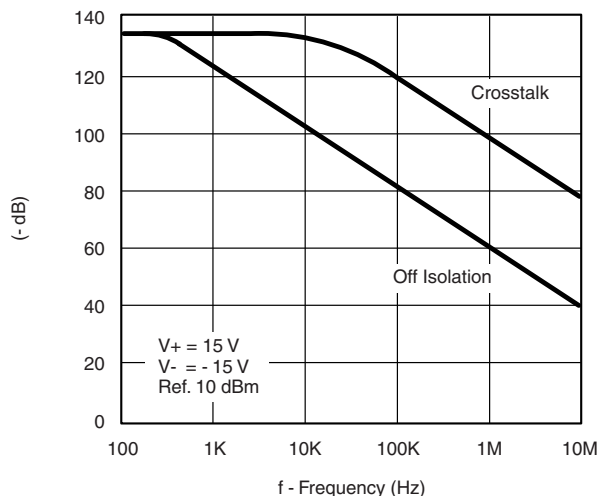
**R<sub>DS(on)</sub> vs. V<sub>D</sub> and Temperature**



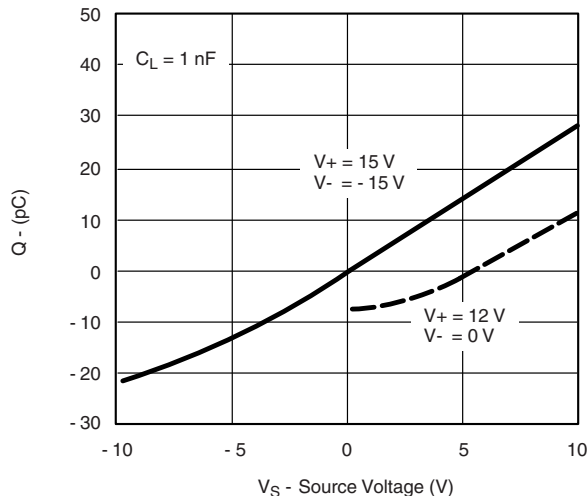
**R<sub>DS(on)</sub> vs. V<sub>D</sub> and Unipolar Power Supply Voltage**



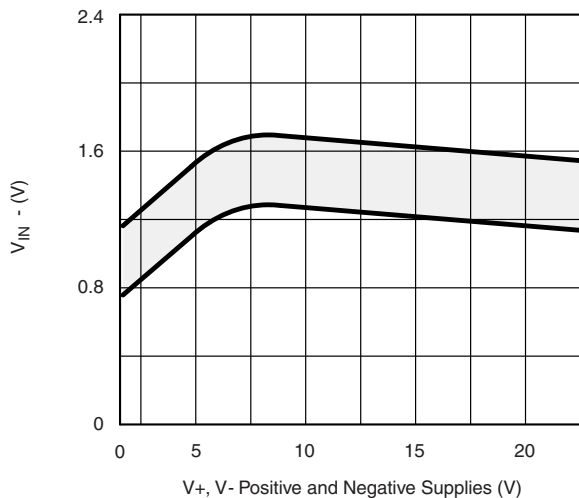
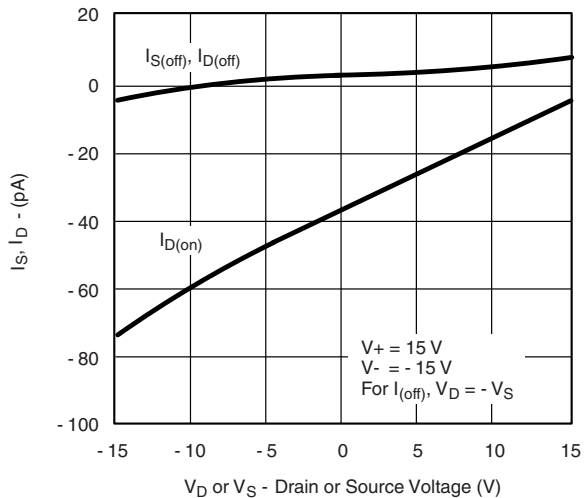
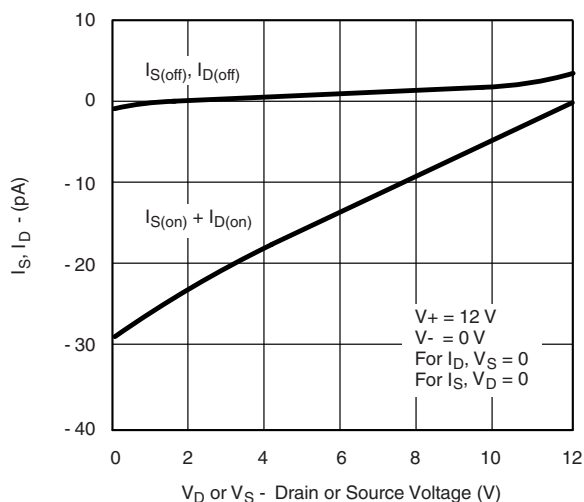
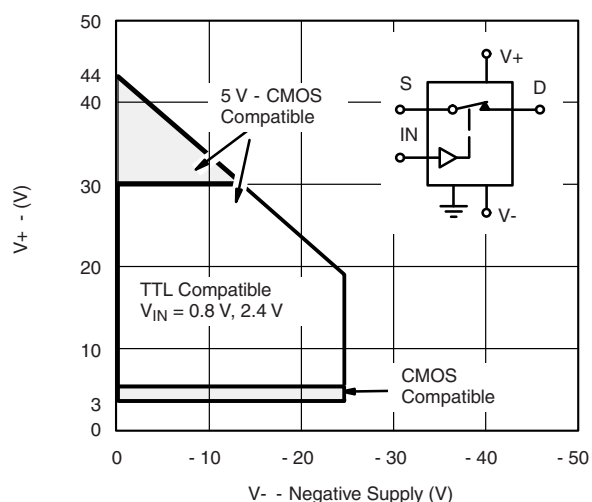
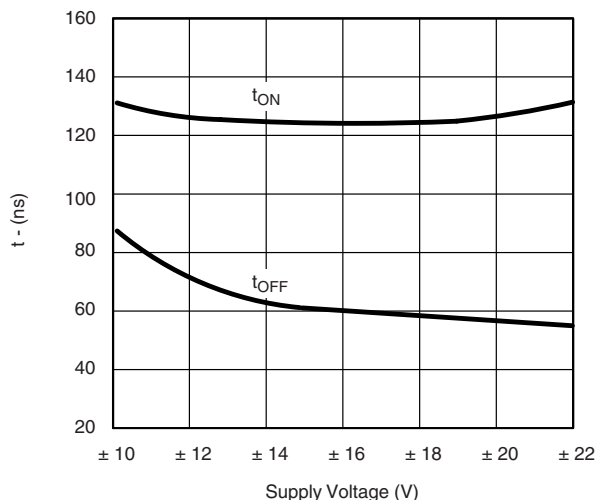
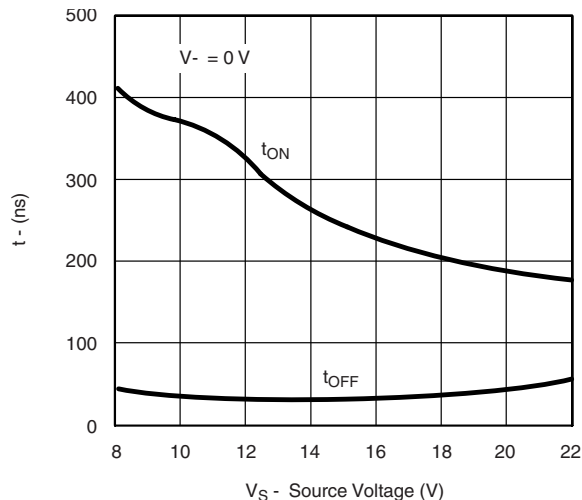
**R<sub>DS(on)</sub> vs. V<sub>D</sub> and Temperature (Single 12-V Supply)**

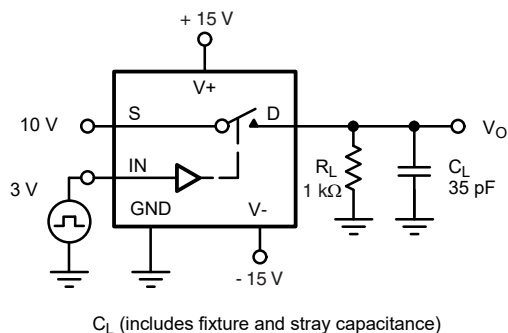
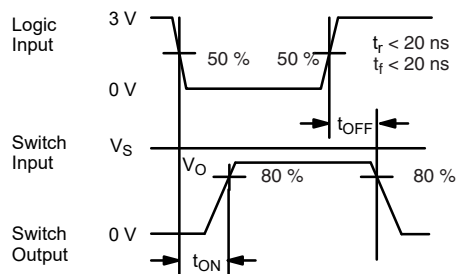


**Crosstalk and Off Isolation vs. Frequency**

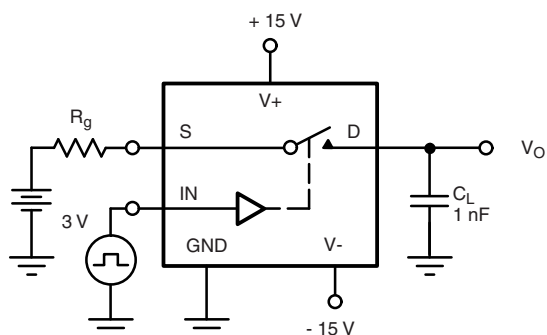
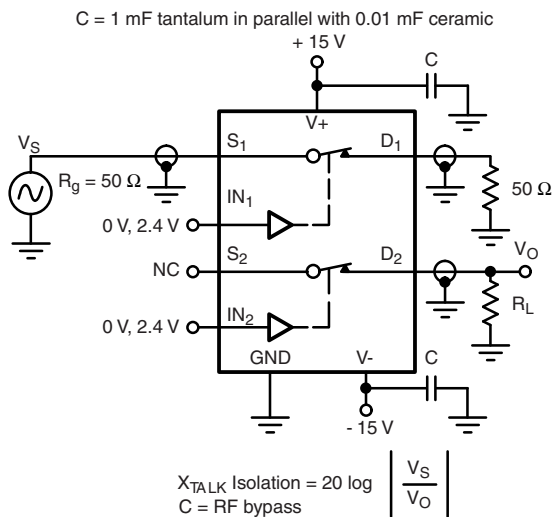
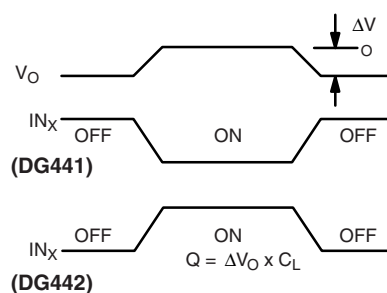
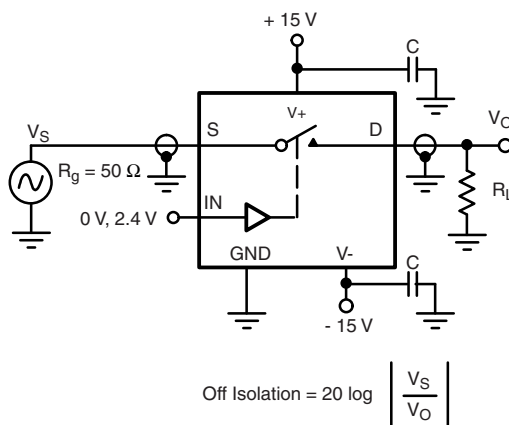


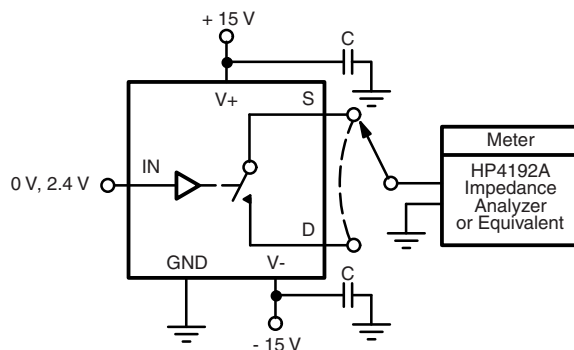
**Charge Injection vs. Source Voltage**

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Switching Threshold vs. Supply Voltage**

**Source/Drain Leakage Currents**

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

**Operating Voltage**

**Switching Time vs. Power Supply Voltage**

**Switching Time vs. Power Supply Voltage**

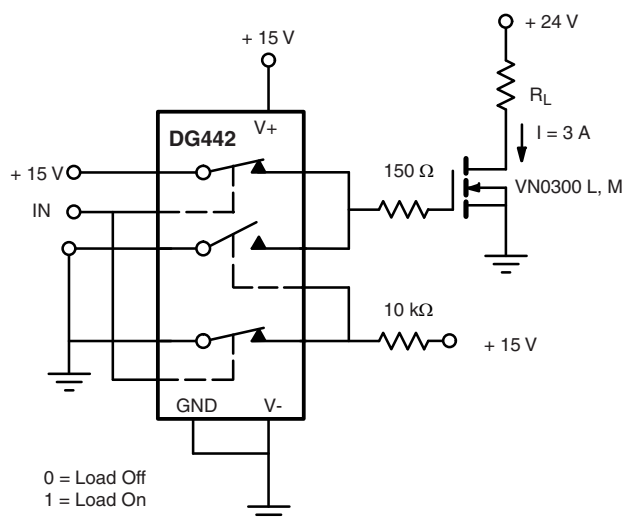
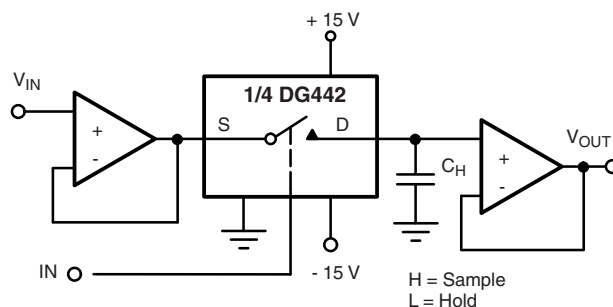
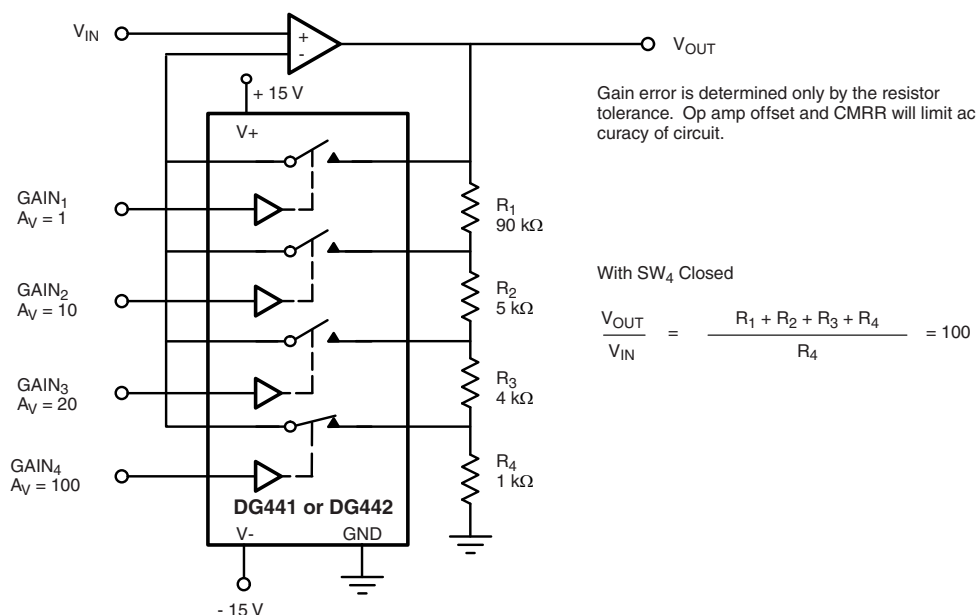
**TEST CIRCUITS**

**Fig. 2 - Switching Time**


Note: Logic input waveform is inverted for DG442.


**Fig. 3 - Charge Injection**

**Fig. 4 - Crosstalk**

**Fig. 5 - Off Isolation**


**Fig. 6 - Source/Drain Capacitances**

## APPLICATIONS


**Fig. 7 - Power MOSFET Driver**

**Fig. 8 - Open Loop Sample-and-Hold**

**Fig. 9 - Precision-Weighted Resistor Programmable-Gain Amplifier**



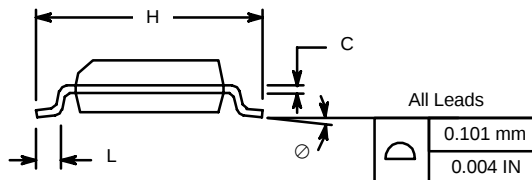
| PRODUCT SUMMARY                   |                                                              |                                                              |                                                              |                                                              |
|-----------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| Part number                       | DG441                                                        | DG441                                                        | DG442                                                        | DG442                                                        |
| Status code                       | 2                                                            | 2                                                            | 2                                                            | 2                                                            |
| Configuration                     | SPST x 4, NC                                                 | SPST x 4, NC                                                 | SPST x 4, NO                                                 | SPST x 4, NO                                                 |
| Single supply min. (V)            | 5                                                            | 5                                                            | 5                                                            | 5                                                            |
| Single supply max. (V)            | 36                                                           | 36                                                           | 36                                                           | 36                                                           |
| Dual supply min. (V)              | 5                                                            | 5                                                            | 5                                                            | 5                                                            |
| Dual supply max. (V)              | 22                                                           | 22                                                           | 22                                                           | 22                                                           |
| On-resistance ( $\Omega$ )        | 50                                                           | 50                                                           | 50                                                           | 50                                                           |
| Charge injection (pC)             | 1                                                            | 1                                                            | 1                                                            | 1                                                            |
| Source on capacitance (pF)        | 16                                                           | 16                                                           | 16                                                           | 16                                                           |
| Source off capacitance (pF)       | 4                                                            | 4                                                            | 4                                                            | 4                                                            |
| Leakage switch on typ. (nA)       | 0.08                                                         | 0.08                                                         | 0.08                                                         | 0.08                                                         |
| Leakage switch off max. (nA)      | 0.5                                                          | 0.5                                                          | 0.5                                                          | 0.5                                                          |
| -3 dB bandwidth (MHz)             | -                                                            | -                                                            | -                                                            | -                                                            |
| Package                           | SO-16 (narrow) AS                                            | Plastic DIP-16                                               | SO-16 (narrow) AS                                            | Plastic DIP-16                                               |
| Functional circuit / applications | Multi purpose,<br>instrumentation, medical<br>and healthcare | Multi purpose,<br>instrumentation, medical<br>and healthcare | Multi purpose,<br>instrumentation, medical<br>and healthcare | Multi purpose,<br>instrumentation, medical<br>and healthcare |
| Interface                         | Parallel                                                     | Parallel                                                     | Parallel                                                     | Parallel                                                     |
| Single supply operation           | Yes                                                          | Yes                                                          | Yes                                                          | Yes                                                          |
| Dual supply operation             | Yes                                                          | Yes                                                          | Yes                                                          | Yes                                                          |
| Turn on time max. (ns)            | 250                                                          | 250                                                          | 250                                                          | 250                                                          |
| Crosstalk and off isolation       | -60                                                          | -60                                                          | -60                                                          | -60                                                          |

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?70053](http://www.vishay.com/ppg?70053).



### 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°    |

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DWG: 5300



**PDIP: 16-LEAD**



| Dim            | MILLIMETERS |       | INCHES |       |
|----------------|-------------|-------|--------|-------|
|                | Min         | Max   | Min    | Max   |
| A              | 3.81        | 5.08  | 0.150  | 0.200 |
| A <sub>1</sub> | 0.38        | 1.27  | 0.015  | 0.050 |
| B              | 0.38        | 0.51  | 0.015  | 0.020 |
| B <sub>1</sub> | 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 |
| E <sub>1</sub> | 5.59        | 7.11  | 0.220  | 0.280 |
| e <sub>1</sub> | 2.29        | 2.79  | 0.090  | 0.110 |
| e <sub>A</sub> | 7.37        | 7.87  | 0.290  | 0.310 |
| L              | 2.79        | 3.81  | 0.110  | 0.150 |
| Q <sub>1</sub> | 1.27        | 2.03  | 0.050  | 0.080 |
| S              | 0.38        | 1.52  | .015   | 0.060 |

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DWG: 5482

## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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