



## **3.2 $\Omega$ , 8-Channel / Dual 4-Channel, $\pm 15$ V, $\pm 12$ V, $\pm 5$ V Precision Multiplexers**

### **DESCRIPTION**

The DG1408 is a precision analog multiplexer comprising eight single-ended channels. The DG1409 is a dual four single-ended channels analog multiplexer. Built on a new CMOS process, the Vishay Siliconix DG1408 and DG1409 offer low on-resistance of 3.2  $\Omega$ . The low and flat resistance over the full signal range provides excellent linearity and low signal distortion. The new CMOS platform also ensures ultra low power dissipation, minimized parasitic capacitance, and low charge injection.

The DG1408 and DG1409 can operate from either a single 4.5 V to 24 V power supply, or from dual  $\pm 4.5$  V to  $\pm 15$  V power supplies. The DG1408 connects one of eight inputs to a common output as determined by a 3-bit binary address (A0, A1, A2). The DG1409 connects one of four inputs to a common output for both multiplexers as determined by a 2-bit binary address (A0 and A1). Break-before-make switching action protects against momentary crosstalk between adjacent channels. The part does not require a VL logic supply, while all digital inputs have 0.8 V and 2 V logic thresholds to ensure low-voltage TTL / CMOS compatibility. Together with the compact package, these make the part a great fit for battery operated systems.

The DG1408 and DG1409 on channel conduct signal equally well in both directions. In the off state each channel blocks voltages up to the power supply rails. An enable (EN) function allows the user to reset the multiplexer / demultiplexer to all switches off for stacking several devices.

The advance performance of low insertion loss and low distortion make the device ideal for signal switching and relay replacement in a wide range of applications.

DG1408 and DG1409 are available in RoHS-compliant, halogen-free QFN16, 4 mm x 4 mm package.

### **FEATURES**

- 35 V supply max. rating
- 3.2  $\Omega$  typical and 4.7  $\Omega$  max. on-resistance at 25  $^{\circ}$ C
- 0.5  $\Omega$  on-resistance flatness
- Channel to channel on-resistance match: 0.2  $\Omega$
- Up to 250 mA continuous current
- Supports single and dual supply operation
- Fully specified at  $\pm 15$  V,  $\pm 12$  V, and  $\pm 5$  V
- Integrated VL supply
- Low voltage logic compatible inputs,  $V_{IH} = 2$  V,  $V_{IL} = 0.8$  V
- BBM (break-before-make switching)
- Low parasitic capacitance:  
DG1408,  $C_{S(off)} = 14$  pF,  $C_{D(on)} = 123$  pF  
DG1409,  $C_{S(off)} = 14$  pF,  $C_{D(on)} = 81$  pF
- Rail to rail signal handling
- QFN16, 4 mm x 4 mm packages
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

### **BENEFITS**

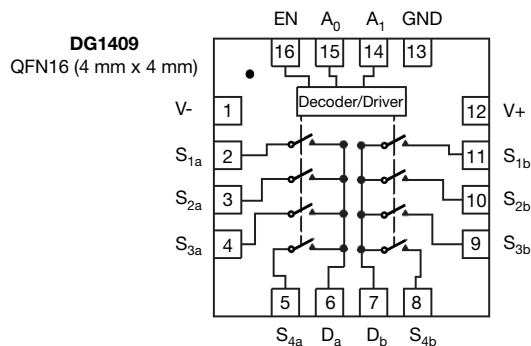
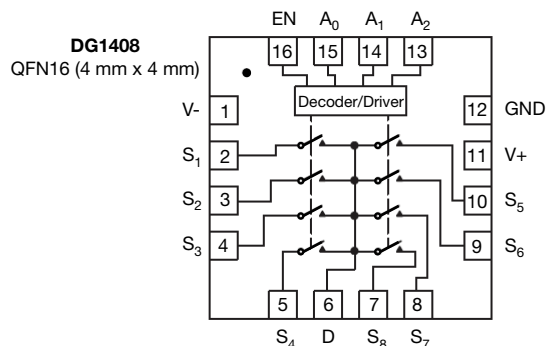
- Low insertion loss
- Low distortion
- Low power consumption
- Compact solution
- Low charge injection over the full signal range

### **APPLICATIONS**

- Medical and healthcare equipment
- Data acquisition system
- Industrial control and automation
- Test and measurement equipment
- Communication systems
- Battery powered systems
- Sample and hold circuits
- Audio and video signal switching
- Relay replacement



## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE - DG1408

| A2 | A1 | A0 | EN | ON SWITCH |
|----|----|----|----|-----------|
| X  | X  | X  | 0  | None      |
| 0  | 0  | 0  | 1  | 1         |
| 0  | 0  | 1  | 1  | 2         |
| 0  | 1  | 0  | 1  | 3         |
| 0  | 1  | 1  | 1  | 4         |
| 1  | 0  | 0  | 1  | 5         |
| 1  | 0  | 1  | 1  | 6         |
| 1  | 1  | 0  | 1  | 7         |
| 1  | 1  | 1  | 1  | 8         |

TRUTH TABLE - DG1409

| A1 | A0 | EN | ON SWITCH |
|----|----|----|-----------|
| X  | X  | 0  | None      |
| 0  | 0  | 1  | 1         |
| 0  | 1  | 1  | 2         |
| 1  | 0  | 1  | 3         |
| 1  | 1  | 1  | 4         |

## Note

- QFN exposed pad tied to V-

## ORDERING INFORMATION

| PART   | CONFIGURATION | TEMPERATURE RANGE | PACKAGE                             | ORDERING PART NUMBER |
|--------|---------------|-------------------|-------------------------------------|----------------------|
| DG1408 | 8:1 MUX       | -40 °C to +125 °C | QFN (4 mm x 4 mm) 16L (variation 2) | DG1408EN-T1-GE4      |
| DG1409 | Dual 4:1 MUX  |                   |                                     | DG1409EN-T1-GE4      |

## ABSOLUTE MAXIMUM RATINGS

| ELECTRICAL PARAMETER                | CONDITIONS                                     | LIMITS                      | UNIT |
|-------------------------------------|------------------------------------------------|-----------------------------|------|
| V+                                  | Reference to GND                               | -0.3 V to +25 V             | V    |
| V-                                  | Reference to GND                               | +0.3 V to -25 V             |      |
| V+ to V-                            |                                                | +35                         |      |
| Analog Inputs (S or D)              |                                                | V- (-0.3 V) to V+ (+0.3 V)  |      |
| Digital Inputs                      |                                                | GND (-0.3 V) to V+ (+0.3 V) |      |
| Maximum Continuous Switch Current   | QFN (4 mm x 4 mm) 16L, T <sub>A</sub> = 25 °C  | 250                         | mA   |
|                                     | QFN (4 mm x 4 mm) 16L, T <sub>A</sub> = 125 °C | 100                         |      |
| Maximum Pulse Switch Current        | Pulse at 1 ms, 10 % duty cycle                 | 500                         |      |
| Thermal Resistance                  | QFN (4 mm x 4 mm) 16L                          | 32                          | °C/W |
| <b>Temperature</b>                  |                                                |                             |      |
| Operating Temperature               |                                                | -40 to 125                  | °C   |
| Max. Operating Junction Temperature |                                                | 150                         |      |
| Storage Temperature                 |                                                | -65 to 150                  |      |

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.

## RECOMMENDED OPERATING RANGE

| ELECTRICAL                | MINIMUM | MAXIMUM | UNIT |
|---------------------------|---------|---------|------|
| Single Supply (V+)        | 4.5     | 24      | V    |
| Dual Supplies (V+ and V-) | ± 4.5   | ± 16.5  |      |



| ELECTRICAL CHARACTERISTICS    |                       |                                                                                                                                                  |  |                                  |                     |                      |                          |      |
|-------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------|---------------------|----------------------|--------------------------|------|
| PARAMETER                     | SYMBOL                | TEST CONDITIONS<br>UNLESS OTHERWISE SPECIFIED<br>V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V<br>V <sub>AX</sub> , V <sub>EN</sub> = 2 V, 0.8 V |  | +25 °C                           | -40 °C to<br>+85 °C | -40 °C to<br>+125 °C | MIN. /<br>TYP. /<br>MAX. | UNIT |
| Analog Switch                 |                       |                                                                                                                                                  |  |                                  |                     |                      |                          |      |
| Analog Signal Range           | V <sub>ANALOG</sub>   |                                                                                                                                                  |  | V <sub>-</sub> to V <sub>+</sub> |                     |                      | -                        | V    |
| Drain-Source<br>On-Resistance | R <sub>DS(on)</sub>   | V <sub>S</sub> = ± 10 V, I <sub>S</sub> = -10 mA,<br>V <sub>+</sub> = +13.5 V, V <sub>-</sub> = -13.5 V                                          |  | 3.2                              | -                   | -                    | Typ.                     | Ω    |
|                               | 4.7                   |                                                                                                                                                  |  | 5.7                              | 6.7                 | Max.                 |                          |      |
| On-Resistance Flatness        | R <sub>flat(on)</sub> |                                                                                                                                                  |  | 0.5                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | 0.7                              | 0.8                 | 0.9                  | Max.                     |      |
| On-Resistance Matching        | ΔR <sub>DS(on)</sub>  |                                                                                                                                                  |  | 0.2                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | 0.7                              | 0.8                 | 1                    | Max.                     |      |
| Source Off Leakage Current    | I <sub>S(off)</sub>   | V <sub>+</sub> = +16.5 V, V <sub>-</sub> = -16.5 V,<br>V <sub>S</sub> = ± 10 V, V <sub>D</sub> = ± 10 V                                          |  | ± 0.02                           | -                   | -                    | Typ.                     | nA   |
|                               |                       |                                                                                                                                                  |  | ± 0.2                            | ± 0.8               | ± 10                 | Max.                     |      |
| Drain Off Leakage Current     | I <sub>D(off)</sub>   |                                                                                                                                                  |  | ± 0.06                           | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | ± 0.3                            | ± 3                 | ± 20                 | Max.                     |      |
| Drain 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> = ± 10 V                                                  |  | ± 0.08                           | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | ± 1                              | ± 4                 | ± 35                 | Max.                     |      |
| Digital Control               |                       |                                                                                                                                                  |  |                                  |                     |                      |                          |      |
| Input, High Voltage           | V <sub>INH</sub>      |                                                                                                                                                  |  | -                                | -                   | 2                    | Min.                     | V    |
| Input, Low Voltage            | V <sub>INL</sub>      |                                                                                                                                                  |  | -                                | -                   | 0.8                  | Max.                     |      |
| Input Leakage                 | I <sub>IN</sub>       | V <sub>IN</sub> = V <sub>GND</sub> or V <sub>+</sub>                                                                                             |  | 0.005                            | -                   | -                    | Typ.                     | μA   |
|                               |                       |                                                                                                                                                  |  | -                                | -                   | ± 0.1                | Max.                     |      |
| Digital Input Capacitance     | C <sub>IN</sub>       |                                                                                                                                                  |  | 3.5                              | -                   | -                    | Typ.                     | pF   |
| Dynamic Characteristics       |                       |                                                                                                                                                  |  |                                  |                     |                      |                          |      |
| Transition Time               | t <sub>TRANS</sub>    | V <sub>S1</sub> = +10 V / -10 V, V <sub>S8</sub> = -10 V / +10 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                              |  | 140                              | -                   | -                    | Typ.                     | ns   |
|                               |                       |                                                                                                                                                  |  | 180                              | 220                 | 250                  | Max.                     |      |
| Break-Before-Make Time        | t <sub>OPEN</sub>     | V <sub>S1</sub> = V <sub>S8</sub> = 10 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                                                      |  | 50                               | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | -                                | -                   | 10                   | Min.                     |      |
| Enable Turn-On Time           | t <sub>ON(EN)</sub>   | V <sub>S1</sub> = 10 V, V <sub>S2</sub> - V <sub>S8</sub> = 0 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                               |  | 125                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | 150                              | 170                 | 190                  | Max.                     |      |
| Enable Turn-Off Time          | t <sub>OFF(EN)</sub>  |                                                                                                                                                  |  | 100                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | 120                              | 140                 | 160                  | Max.                     |      |
| Charge Injection              | Q <sub>INJ</sub>      | C <sub>INJ</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>S</sub> = 0 V                                                                            |  | 100                              | -                   | -                    | Typ.                     | pC   |
| Off Isolation                 | OIRR                  | C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω, 1 MHz                                                                                              |  | -60                              | -                   | -                    | Typ.                     | dB   |
| Cross Talk                    | X <sub>TALK</sub>     |                                                                                                                                                  |  | -64                              | -                   | -                    |                          |      |
| Total Harmonic Distortion     | THD                   | R <sub>L</sub> = 100 Ω, 15 V <sub>p-p</sub> ,<br>f = 20 Hz to 20 kHz                                                                             |  | 0.02                             | -                   | -                    | Typ.                     | %    |
| -3dB, Bandwidth               | BW                    | R <sub>L</sub> = 50 Ω                                                                                                                            |  | DG1408<br>46                     | -                   | -                    | Typ.                     | MHz  |
|                               |                       |                                                                                                                                                  |  | DG1409<br>68                     | -                   | -                    |                          |      |
| Source Off Capacitance        | C <sub>S(off)</sub>   | f = 1 MHz, V <sub>S</sub> = 0 V                                                                                                                  |  | 14                               | -                   | -                    | Typ.                     | pF   |
| Drain Off Capacitance         | C <sub>D(off)</sub>   |                                                                                                                                                  |  | DG1408<br>89                     | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | DG1409<br>46                     | -                   | -                    |                          |      |
| Drain On Capacitance          | C <sub>D(on)</sub>    |                                                                                                                                                  |  | DG1408<br>123                    | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | DG1409<br>81                     | -                   | -                    |                          |      |
| Power Supply                  |                       |                                                                                                                                                  |  |                                  |                     |                      |                          |      |
| Power Supply Range            |                       | GND = 0 V                                                                                                                                        |  | ± 4.5 / ± 16.5                   |                     |                      | Min. / Max.              | V    |
| Positive Supply Current       | I <sub>+</sub>        | V <sub>AX</sub> , V <sub>EN</sub> = 0 V, V <sub>+</sub> ,<br>V <sub>+</sub> = +16.5 V, V <sub>-</sub> = -16.5 V                                  |  | 17                               | 14.5                | 14                   | Typ.                     | μA   |
|                               |                       |                                                                                                                                                  |  | -                                | -                   | 30                   | Max.                     |      |
|                               |                       | V <sub>AX</sub> , V <sub>EN</sub> = 5 V,<br>V <sub>+</sub> = +16.5 V, V <sub>-</sub> = -16.5 V                                                   |  | 17                               | 14.5                | 14                   | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | -                                | -                   | 50                   | Max.                     |      |
| Negative Supply Current       | I <sub>-</sub>        | V <sub>AX</sub> , V <sub>EN</sub> = 0 V, V <sub>+</sub> ,<br>V <sub>+</sub> = +16.5 V, V <sub>-</sub> = -16.5 V                                  |  | 0.002                            | 0.22                | 0.4                  | Typ.                     |      |
|                               |                       |                                                                                                                                                  |  | -                                | -                   | 1                    | Max.                     |      |



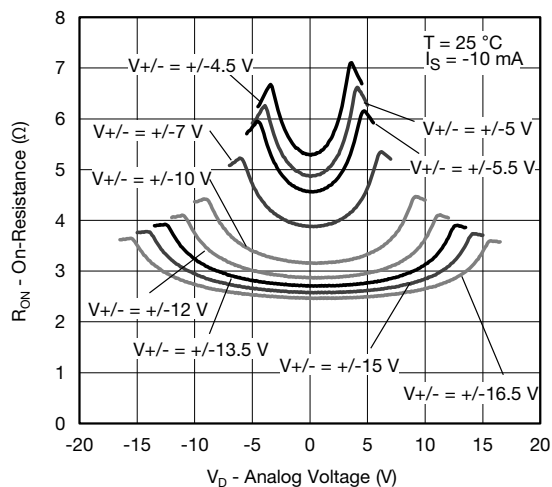
| ELECTRICAL CHARACTERISTICS    |                       |                                                                                                                                                |                     |                     |                      |                          |      |  |
|-------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|----------------------|--------------------------|------|--|
| PARAMETER                     | SYMBOL                | TEST CONDITIONS<br>UNLESS OTHERWISE SPECIFIED<br>V <sub>+</sub> = 12 V, V <sub>-</sub> = 0 V<br>V <sub>AX</sub> , V <sub>EN</sub> = 2 V, 0.8 V | +25 °C              | -40 °C to<br>+85 °C | -40 °C to<br>+125 °C | MIN. /<br>TYP. /<br>MAX. | UNIT |  |
| Analog Switch                 |                       |                                                                                                                                                |                     |                     |                      |                          |      |  |
| Analog Signal Range           | V <sub>ANALOG</sub>   |                                                                                                                                                | 0 to V <sub>+</sub> |                     |                      | -                        | V    |  |
| Drain-Source<br>On-Resistance | R <sub>DS(on)</sub>   | V <sub>S</sub> = 0 V / 10 V, I <sub>S</sub> = -10 mA,<br>V <sub>+</sub> = +10.8 V, V <sub>-</sub> = 0 V                                        | 5.5                 | -                   | -                    | Typ.                     | Ω    |  |
|                               |                       |                                                                                                                                                | 8                   | 9                   | 11                   | Max.                     |      |  |
| On-Resistance Flatness        | R <sub>flat(on)</sub> |                                                                                                                                                | 1                   | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | 2                   | 2.5                 | 3                    | Max.                     |      |  |
| On-Resistance Matching        | ΔR <sub>DS(on)</sub>  |                                                                                                                                                | 0.2                 | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | 0.7                 | 0.8                 | 1                    | Max.                     |      |  |
| Source Off Leakage Current    | I <sub>S(off)</sub>   | V <sub>+</sub> = +13.2 V, V <sub>-</sub> = 0 V,<br>V <sub>S</sub> = 1 V / 10 V, V <sub>D</sub> = 10 V / 1 V                                    | ± 0.02              | -                   | -                    | Typ.                     | nA   |  |
|                               |                       |                                                                                                                                                | ± 0.2               | ± 0.6               | ± 5                  | Max.                     |      |  |
| Drain Off Leakage Current     | I <sub>D(off)</sub>   |                                                                                                                                                | ± 0.02              | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | ± 0.3               | ± 2                 | ± 20                 | Max.                     |      |  |
| Drain On Leakage Current      | I <sub>D(on)</sub>    | V <sub>S</sub> = V <sub>D</sub> = 1 V / 10 V                                                                                                   | ± 0.05              | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | ± 0.6               | ± 3                 | ± 20                 | Max.                     |      |  |
| Digital Control               |                       |                                                                                                                                                |                     |                     |                      |                          |      |  |
| Input, High Voltage           | V <sub>INH</sub>      |                                                                                                                                                | -                   | -                   | 2                    | Min.                     | V    |  |
| Input, Low Voltage            | V <sub>INL</sub>      |                                                                                                                                                | -                   | -                   | 0.8                  | Max.                     |      |  |
| Input Leakage                 | I <sub>IN</sub>       | V <sub>IN</sub> = V <sub>GND</sub> or V <sub>+</sub>                                                                                           | 0.001               | -                   | -                    | Typ.                     | μA   |  |
|                               |                       |                                                                                                                                                | -                   | -                   | ± 0.1                | Max.                     |      |  |
| Digital Input Capacitance     | C <sub>IN</sub>       |                                                                                                                                                | 3.5                 | -                   | -                    | Typ.                     | pF   |  |
| Dynamic Characteristics       |                       |                                                                                                                                                |                     |                     |                      |                          |      |  |
| Transition Time               | t <sub>TRANS</sub>    | V <sub>S1</sub> = 8 V / 0 V, V <sub>S8</sub> = 0 V / 8 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                                    | 160                 | -                   | -                    | Typ.                     | ns   |  |
|                               |                       |                                                                                                                                                | 240                 | 290                 | 330                  | Max.                     |      |  |
| Break-Before-Make Time        | t <sub>OPEN</sub>     | V <sub>S1</sub> = V <sub>S8</sub> = 8 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                                                     | 95                  | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | -                   | -                   | 10                   | Min.                     |      |  |
| Enable Turn-On Time           | t <sub>ON(EN)</sub>   | V <sub>S1</sub> = 8 V, V <sub>S2</sub> - V <sub>S8</sub> = 0 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                              | 190                 | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | 250                 | 290                 | 330                  | Max.                     |      |  |
| Enable Turn-Off Time          | t <sub>OFF(EN)</sub>  |                                                                                                                                                | 105                 | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | 160                 | 200                 | 240                  | Max.                     |      |  |
| Charge Injection              | Q <sub>INj</sub>      | C <sub>INJ</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>S</sub> = 6 V                                                                          | 30                  | -                   | -                    | Typ.                     | pC   |  |
| Off Isolation                 | OIRR                  | C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω, 1 MHz                                                                                            | -59                 | -                   | -                    | Typ.                     | dB   |  |
| Cross Talk                    | X <sub>TALK</sub>     |                                                                                                                                                | -63                 | -                   | -                    |                          |      |  |
| Total Harmonic Distortion     | THD                   | R <sub>L</sub> = 100 Ω, 6 V <sub>p-p</sub> ,<br>f = 20 Hz to 20 kHz                                                                            | 0.05                | -                   | -                    | Typ.                     | %    |  |
| -3dB, Bandwidth               | BW                    | R <sub>L</sub> = 50 Ω                                                                                                                          | DG1408<br>41        | -                   | -                    | Typ.                     | MHz  |  |
|                               |                       |                                                                                                                                                | DG1409<br>62        | -                   | -                    |                          |      |  |
| Source Off Capacitance        | C <sub>S(off)</sub>   | f = 1 MHz, V <sub>S</sub> = 6 V                                                                                                                | 18                  | -                   | -                    | Typ.                     | pF   |  |
| Drain Off Capacitance         | C <sub>D(off)</sub>   |                                                                                                                                                | DG1408<br>113       | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | DG1409<br>59        | -                   | -                    |                          |      |  |
| Drain On Capacitance          | C <sub>D(on)</sub>    |                                                                                                                                                | DG1408<br>147       | -                   | -                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | DG1409<br>93        | -                   | -                    |                          |      |  |
| Power Supply                  |                       |                                                                                                                                                |                     |                     |                      |                          |      |  |
| Power Supply Range            |                       | GND = 0 V, V <sub>-</sub> = 0 V                                                                                                                | 4.5 / 24            |                     |                      | Min. / Max.              | V    |  |
| Positive Supply Current       | I <sub>+</sub>        | V <sub>AX</sub> , V <sub>EN</sub> = 0 V, V <sub>+</sub> ,<br>V <sub>+</sub> = +13.2 V, V <sub>-</sub> = 0 V                                    | 11                  | 9.5                 | 9                    | Typ.                     | μA   |  |
|                               |                       |                                                                                                                                                | -                   | -                   | 20                   | Max.                     |      |  |
|                               |                       | V <sub>AX</sub> , V <sub>EN</sub> = 5 V,<br>V <sub>+</sub> = 13.2 V, V <sub>-</sub> = 0 V                                                      | 11                  | 9.5                 | 9                    | Typ.                     |      |  |
|                               |                       |                                                                                                                                                | -                   | -                   | 40                   | Max.                     |      |  |

**ELECTRICAL CHARACTERISTICS**

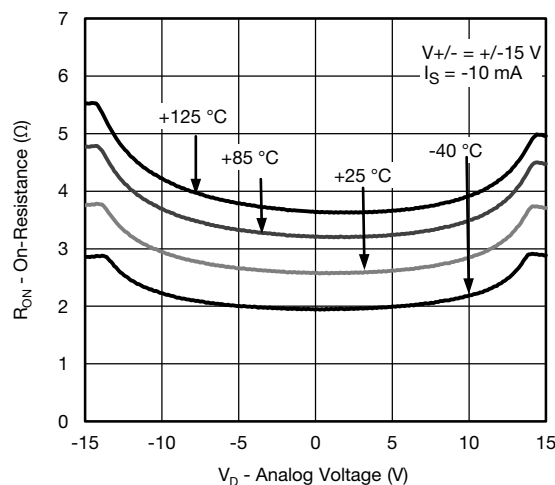
| PARAMETER                     | SYMBOL                | TEST CONDITIONS<br>UNLESS OTHERWISE SPECIFIED<br>V <sub>+</sub> = 5 V, V <sub>-</sub> = -5 V<br>V <sub>AX</sub> , V <sub>EN</sub> = 2 V, 0.8 V | +25 °C                           | -40 °C to<br>+85 °C | -40 °C to<br>+125 °C | MIN. /<br>TYP. /<br>MAX. | UNIT |
|-------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---------------------|----------------------|--------------------------|------|
| Analog Switch                 |                       |                                                                                                                                                |                                  |                     |                      |                          |      |
| Analog Signal Range           | V <sub>ANALOG</sub>   |                                                                                                                                                | V <sub>-</sub> to V <sub>+</sub> |                     |                      | -                        | V    |
| Drain-Source<br>On-Resistance | R <sub>DS(on)</sub>   | V <sub>S</sub> = ± 3.5 V, I <sub>S</sub> = -10 mA,<br>V <sub>+</sub> = +4.5 V, V <sub>-</sub> = -4.5 V                                         | 7                                | -                   | -                    | Typ.                     | Ω    |
|                               |                       |                                                                                                                                                | 9                                | 10                  | 12                   | Max.                     |      |
| On-Resistance Flatness        | R <sub>flat(on)</sub> |                                                                                                                                                | 1.5                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | 2.5                              | 3                   | 3                    | Max.                     |      |
| On-Resistance Matching        | ΔR <sub>DS(on)</sub>  |                                                                                                                                                | 0.2                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | 0.7                              | 0.8                 | 1                    | Max.                     |      |
| Source Off Leakage Current    | I <sub>S(off)</sub>   | V <sub>+</sub> = +5.5 V, V <sub>-</sub> = -5.5 V,<br>V <sub>S</sub> = ± 4.5 V, V <sub>D</sub> = ± 4.5 V                                        | ± 0.01                           | -                   | -                    | Typ.                     | nA   |
|                               |                       |                                                                                                                                                | ± 0.2                            | ± 0.8               | ± 10                 | Max.                     |      |
| Drain Off Leakage Current     | I <sub>D(off)</sub>   |                                                                                                                                                | ± 0.02                           | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | ± 0.3                            | ± 3                 | ± 20                 | Max.                     |      |
| Drain On Leakage Current      | I <sub>D(on)</sub>    | V <sub>+</sub> = +5.5 V, V <sub>-</sub> = -5.5 V,<br>V <sub>S</sub> = V <sub>D</sub> = ± 4.5 V                                                 | ± 0.05                           | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | ± 1                              | ± 4                 | ± 35                 | Max.                     |      |
| Digital Control               |                       |                                                                                                                                                |                                  |                     |                      |                          |      |
| Input, High Voltage           | V <sub>INH</sub>      |                                                                                                                                                | -                                | -                   | 2                    | Min.                     | V    |
| Input, Low Voltage            | V <sub>INL</sub>      |                                                                                                                                                | -                                | -                   | 0.8                  | Max.                     |      |
| Input Leakage                 | I <sub>IN</sub>       | V <sub>IN</sub> = V <sub>GND</sub> or V <sub>+</sub>                                                                                           | 0.001                            | -                   | -                    | Typ.                     | μA   |
|                               |                       |                                                                                                                                                | -                                | -                   | ± 0.1                | Max.                     |      |
| Digital Input Capacitance     | C <sub>IN</sub>       |                                                                                                                                                | 3.5                              | -                   | -                    | Typ.                     | pF   |
| Dynamic Characteristics       |                       |                                                                                                                                                |                                  |                     |                      |                          |      |
| Transition Time               | t <sub>TRANS</sub>    | V <sub>S1</sub> = +3 V / -3 V, V <sub>S8</sub> = -3 V / +3 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                                | 275                              | -                   | -                    | Typ.                     | ns   |
|                               |                       |                                                                                                                                                | 350                              | 400                 | 440                  | Max.                     |      |
| Break-Before-Make Time        | t <sub>OPEN</sub>     | V <sub>S1</sub> = V <sub>S8</sub> = 3 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                                                     | 110                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | -                                | -                   | 10                   | Min.                     |      |
| Enable Turn-On Time           | t <sub>ON(EN)</sub>   | V <sub>S1</sub> = 3 V, V <sub>S2</sub> - V <sub>S8</sub> = 0 V,<br>R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 35 pF                              | 245                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | 290                              | 350                 | 390                  | Max.                     |      |
| Enable Turn-Off Time          | t <sub>OFF(EN)</sub>  |                                                                                                                                                | 185                              | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | 240                              | 300                 | 340                  | Max.                     |      |
| Charge Injection              | Q <sub>INJ</sub>      | C <sub>INJ</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>S</sub> = 0 V                                                                          | 25                               | -                   | -                    | Typ.                     | pC   |
| Off Isolation                 | OIRR                  | C <sub>L</sub> = 5 pF, R <sub>L</sub> = 50 Ω, 1 MHz                                                                                            | -60                              | -                   | -                    | Typ.                     | dB   |
| Cross Talk                    | X <sub>TALK</sub>     |                                                                                                                                                | -64                              | -                   | -                    |                          |      |
| Total Harmonic Distortion     | THD                   | R <sub>L</sub> = 100 Ω, 5 V <sub>P-P</sub> , f = 20 Hz to 20 kHz                                                                               | 0.065                            | -                   | -                    | Typ.                     | %    |
| -3dB, Bandwidth               | BW                    | R <sub>L</sub> = 50 Ω                                                                                                                          | DG1408<br>40                     | -                   | -                    | Typ.                     | MHz  |
|                               |                       |                                                                                                                                                | DG1409<br>61                     | -                   | -                    |                          |      |
| Source Off Capacitance        | C <sub>S(off)</sub>   | f = 1 MHz, V <sub>S</sub> = 0 V                                                                                                                | 18                               | -                   | -                    | Typ.                     | pF   |
| Drain Off Capacitance         | C <sub>D(off)</sub>   |                                                                                                                                                | DG1408<br>118                    | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | DG1409<br>61                     | -                   | -                    |                          |      |
| Drain On Capacitance          | C <sub>D(on)</sub>    |                                                                                                                                                | DG1408<br>152                    | -                   | -                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | DG1409<br>95                     | -                   | -                    |                          |      |
| Power Supply                  |                       |                                                                                                                                                |                                  |                     |                      |                          |      |
| Power Supply Range            |                       | GND = 0 V                                                                                                                                      | ± 4.5 / ± 16.5                   |                     |                      | Min. / Max.              | V    |
| Positive Supply Current       | I <sub>+</sub>        | V <sub>AX</sub> , V <sub>EN</sub> = 0 V, V <sub>+</sub> ,<br>V <sub>+</sub> = +5.5 V, V <sub>-</sub> = -5.5 V                                  | 0.5                              | 0.7                 | 1                    | Typ.                     | μA   |
|                               |                       |                                                                                                                                                | -                                | -                   | 20                   | Max.                     |      |
|                               |                       | V <sub>AX</sub> , V <sub>EN</sub> = 3 V,<br>V <sub>+</sub> = +5.5 V, V <sub>-</sub> = -5.5 V                                                   | 0.7                              | 1.3                 | 2                    | Typ.                     |      |
|                               |                       |                                                                                                                                                | -                                | -                   | 50                   | Max.                     |      |
| Negative Supply Current       | I <sub>-</sub>        | V <sub>AX</sub> , V <sub>EN</sub> = 0 V, V <sub>+</sub> ,<br>V <sub>+</sub> = +5.5 V, V <sub>-</sub> = -5.5 V                                  | 0.0002                           | 0.013               | 0.026                | Typ.                     |      |
|                               |                       |                                                                                                                                                | -                                | -                   | 1                    | Max.                     |      |



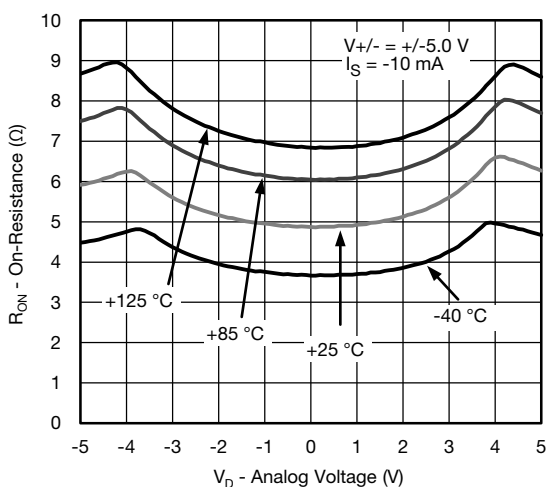
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



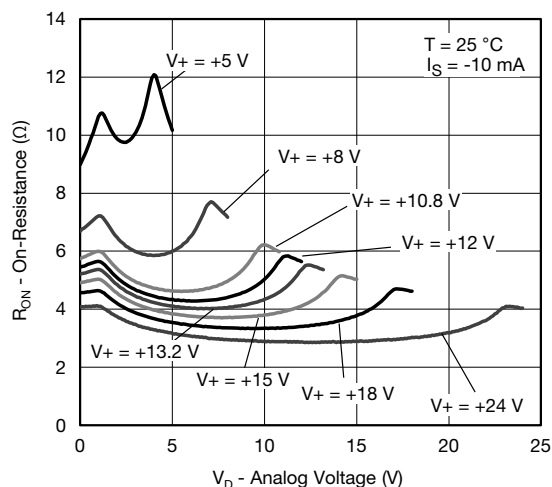
On-Resistance vs. Analog Voltage



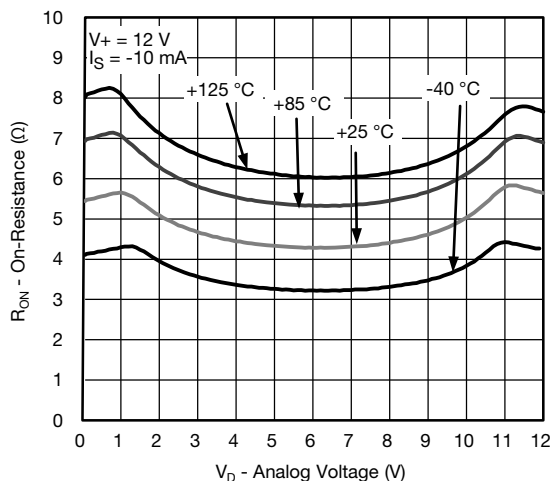
On-Resistance vs. Analog Voltage



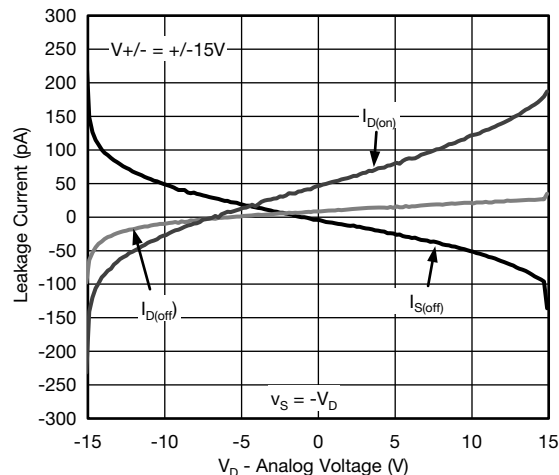
On-Resistance vs. Analog Voltage



On-Resistance vs. Analog Voltage



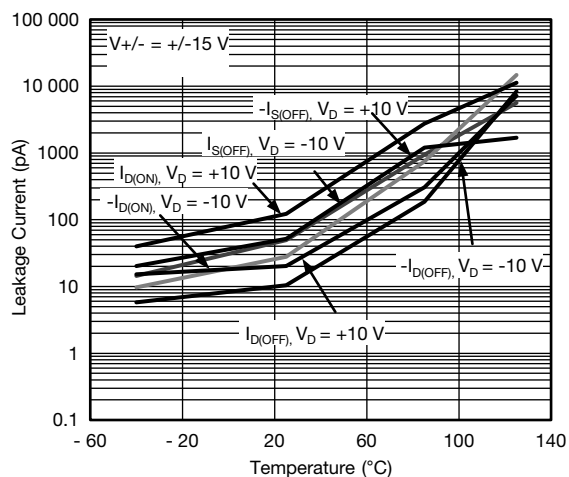
On-Resistance vs. Analog Voltage



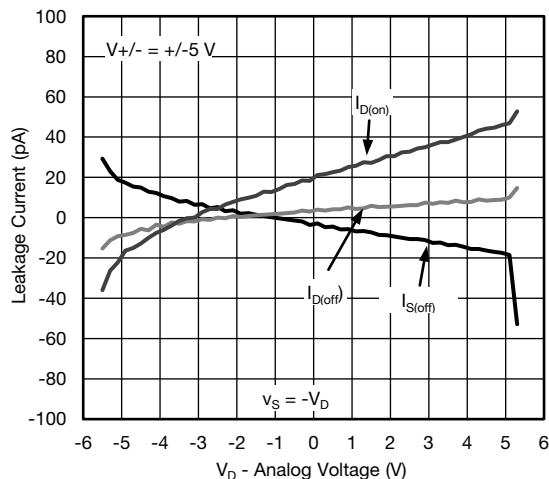
Leakage Current vs. Analog Voltage



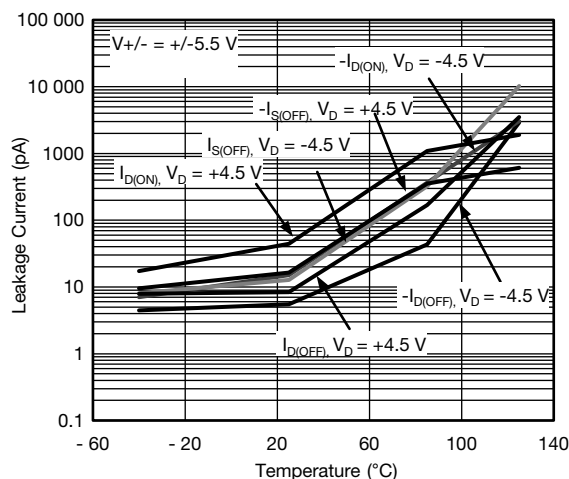
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



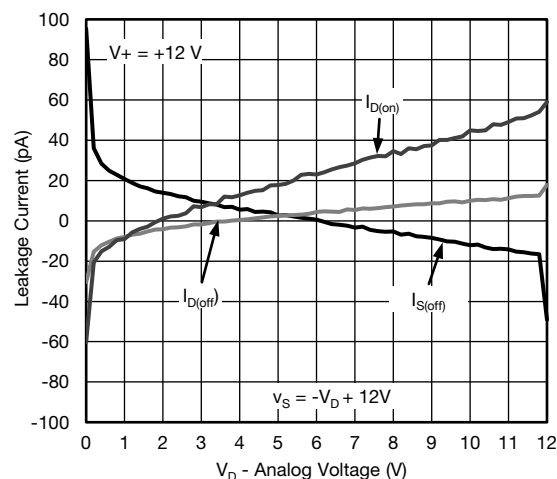
**Leakage Current vs. Temperature**



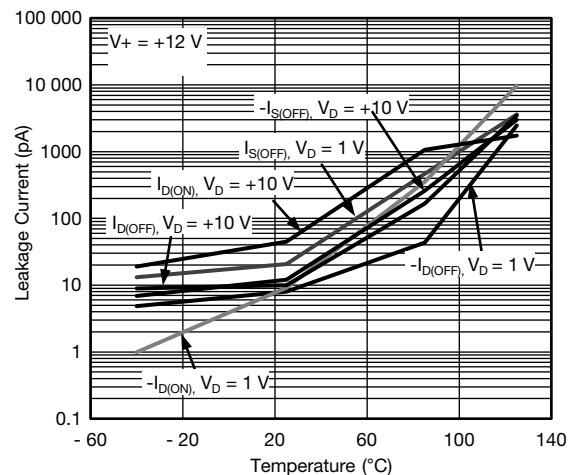
**Leakage Current vs. Temperature**



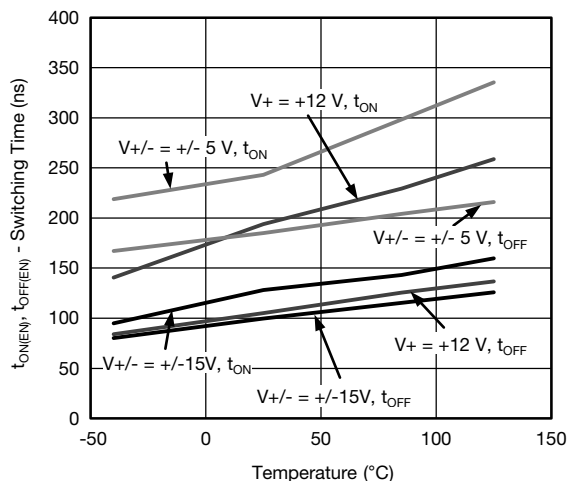
**Leakage Current vs. Temperature**



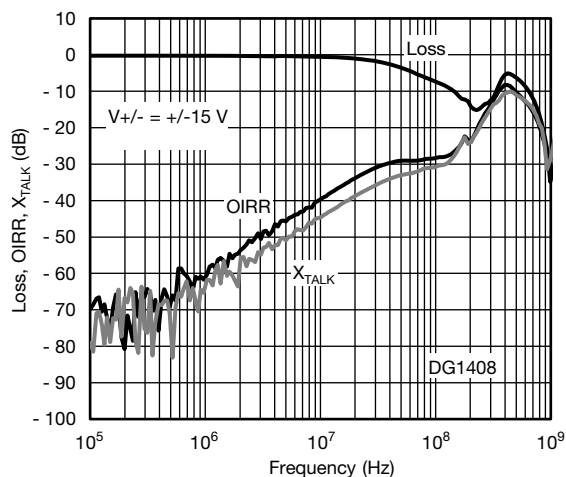
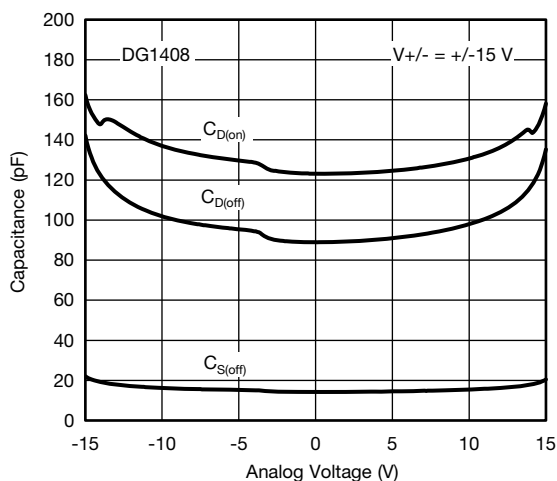
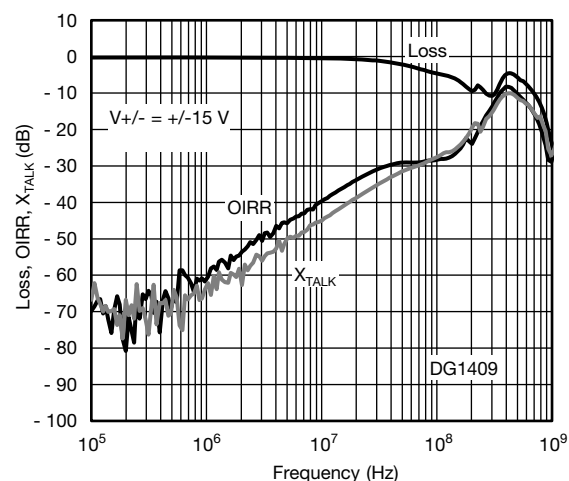
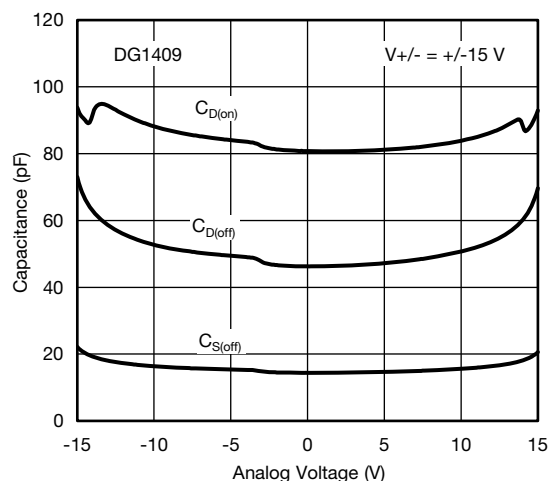
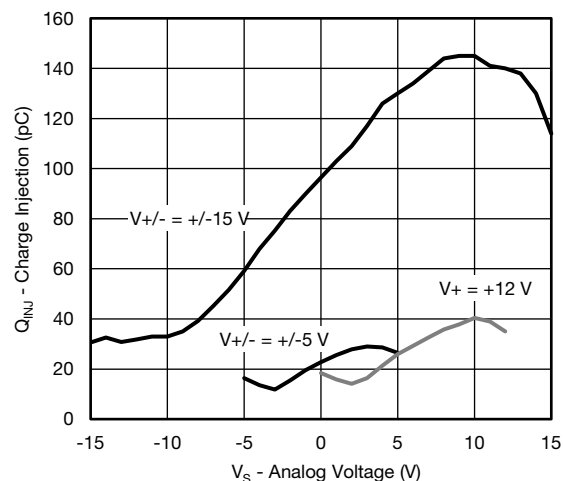
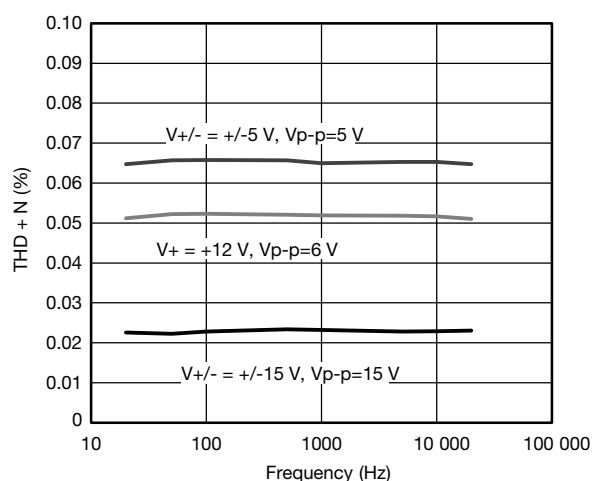
**Leakage Current vs. Analog Voltage**



**Leakage Current vs. Analog Voltage**

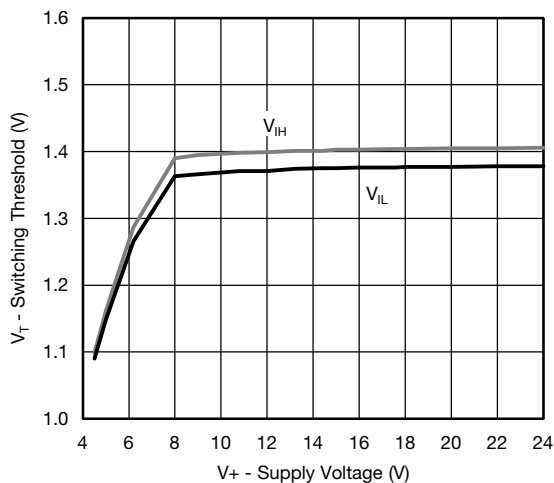


**Switching Time vs. Temperature**

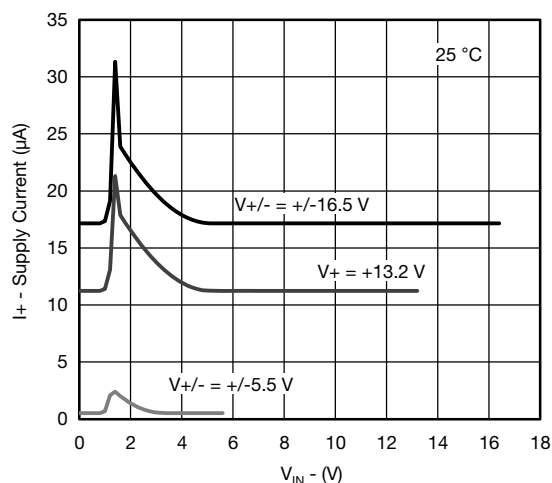
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

**Loss, OIRR,  $X_{TALK}$  vs. Frequency**

**Capacitance vs. Analog Voltage**

**Loss, OIRR,  $X_{TALK}$  vs. Frequency**

**Capacitance vs. Analog Voltage**

**Charge Injection vs. Source Voltage**

**THD vs. Frequency**



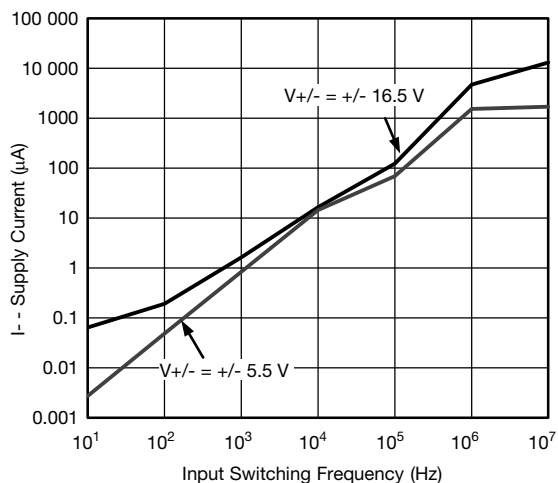
**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



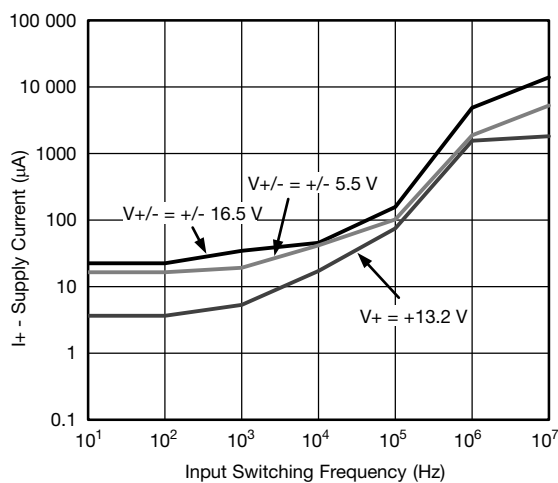
Switching Threshold vs. Supply Voltage



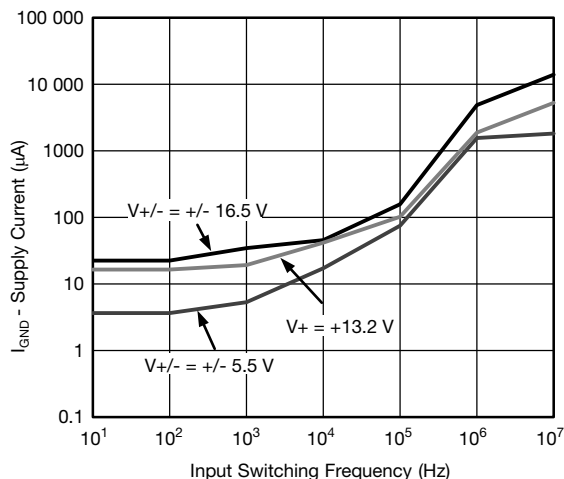
Positive Supply Current vs. Switching Frequency



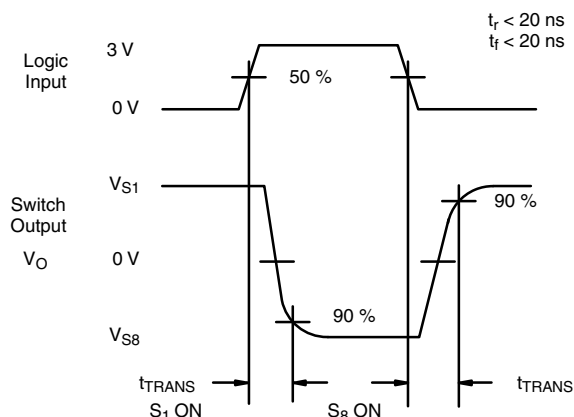
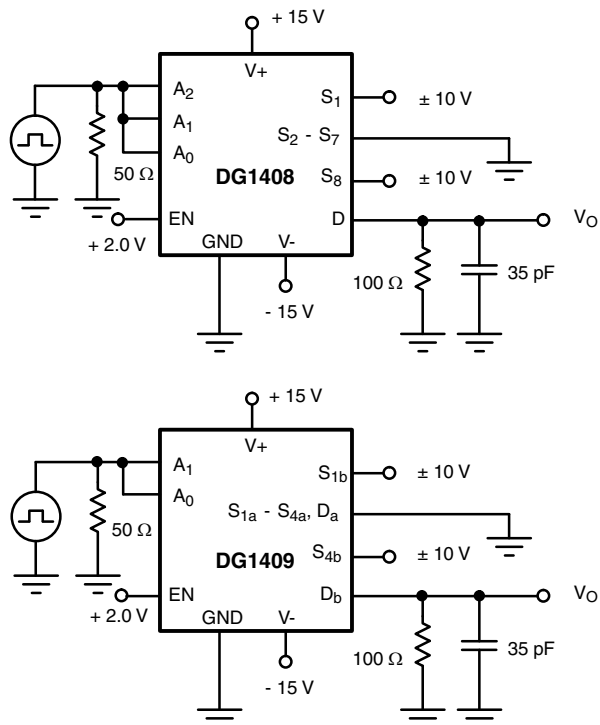
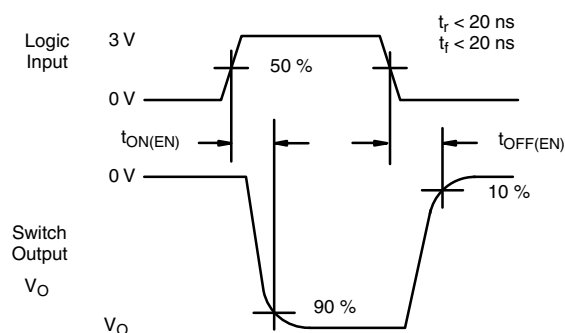
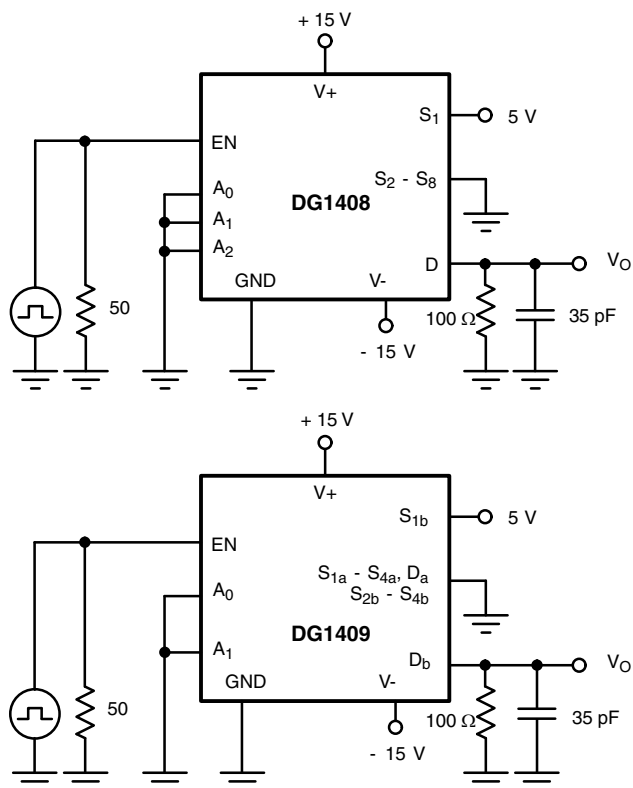
Negative Supply Current vs. Switching Frequency

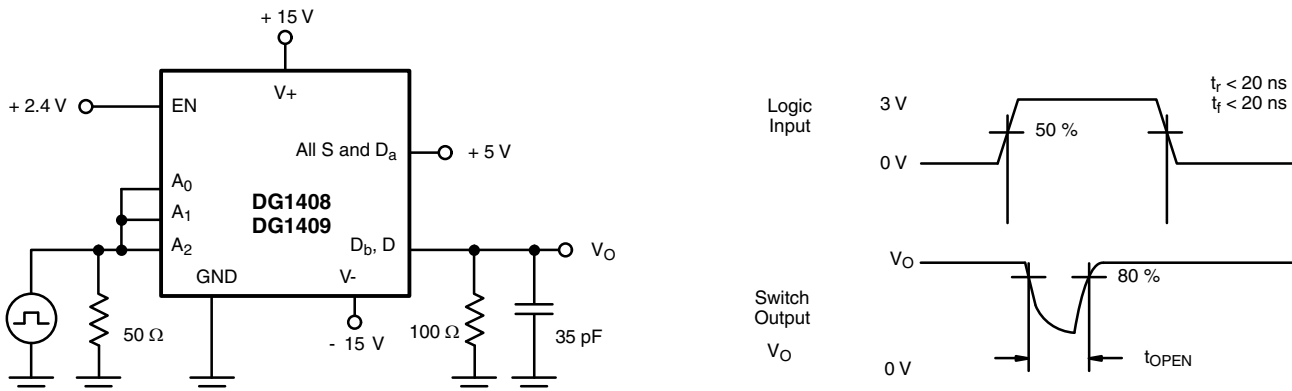
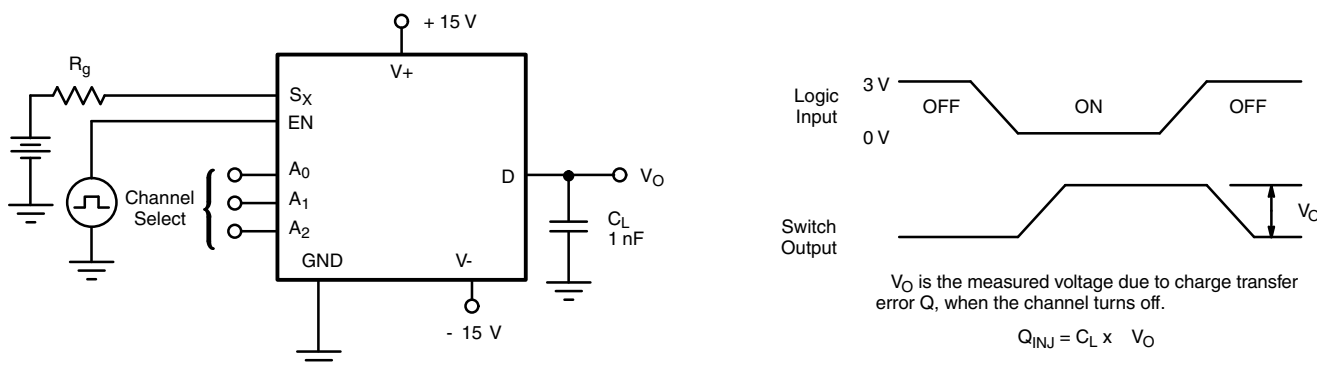
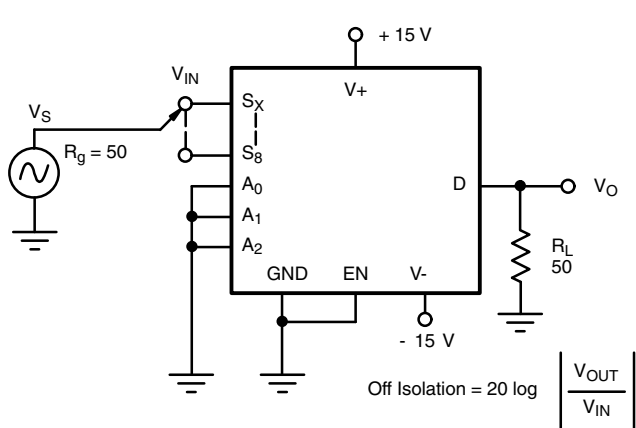
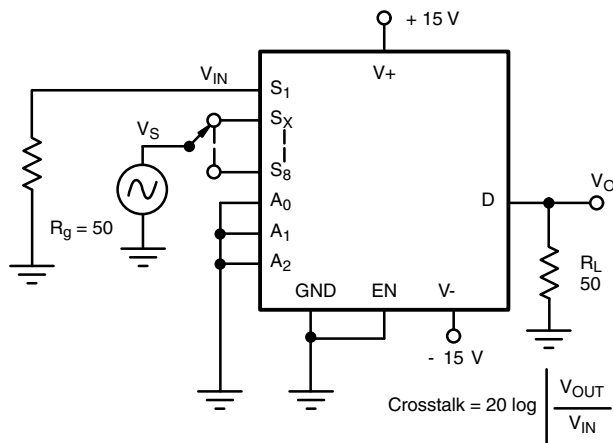


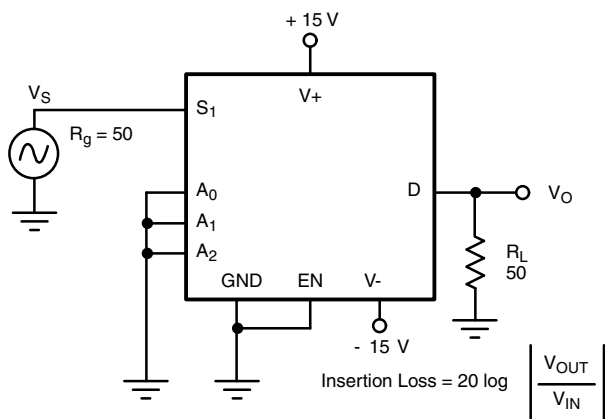
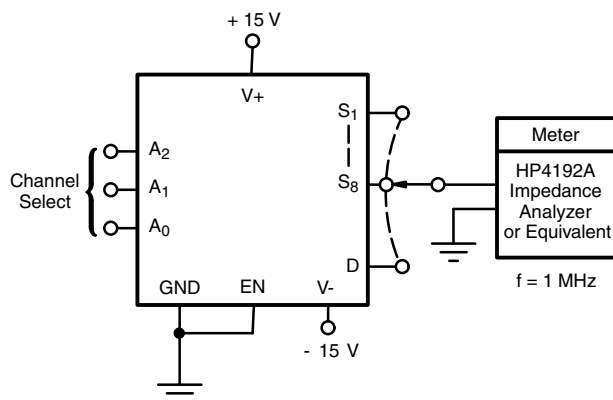
Positive Supply Current vs. Input Logic Voltage



Ground Current vs. Switching Frequency

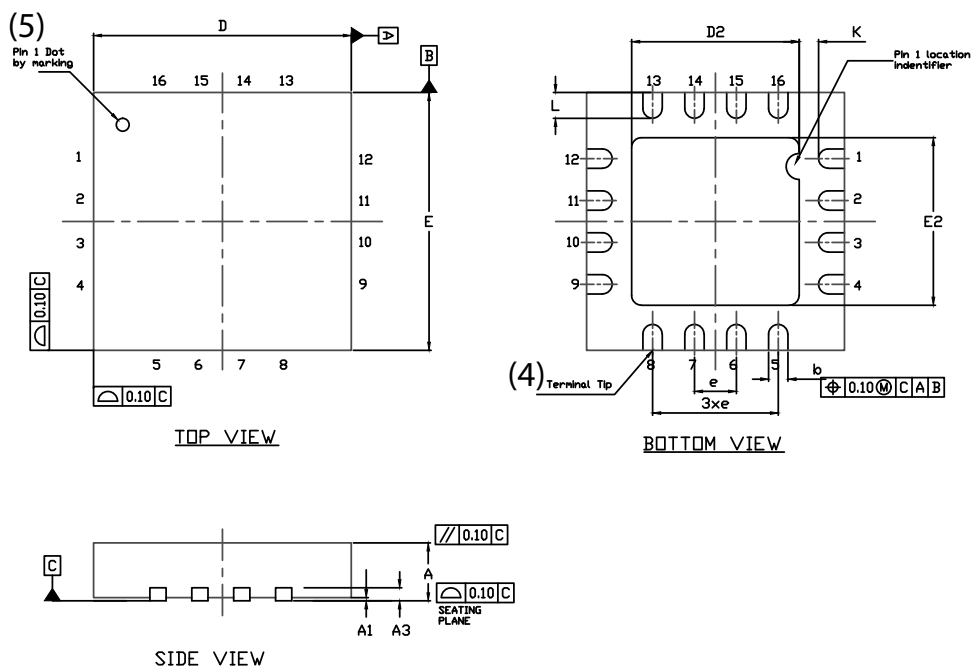
**TEST CIRCUITS**

**Fig. 1 - Transition Time**

**Fig. 2 - Enable Switching Time**


**Fig. 3 - Break-Before-Make Internal**

**Fig. 4 - Charge Injection**

**Fig. 5 - Off-Isolation**

**Fig. 6 - Crosstalk**


**Fig. 7 - Insertion Loss**

**Fig. 8 - Source Drain Capacitance**

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## QFN 4x4-16L Case Outline



| DIM               | VARIATION 1                |      |      |            |       |       | VARIATION 2                |      |      |            |       |       |
|-------------------|----------------------------|------|------|------------|-------|-------|----------------------------|------|------|------------|-------|-------|
|                   | MILLIMETERS <sup>(1)</sup> |      |      | INCHES     |       |       | MILLIMETERS <sup>(1)</sup> |      |      | INCHES     |       |       |
|                   | MIN.                       | NOM. | MAX. | MIN.       | NOM.  | MAX.  | MIN.                       | NOM. | MAX. | MIN.       | NOM.  | MAX.  |
| A                 | 0.75                       | 0.85 | 0.95 | 0.029      | 0.033 | 0.037 | 0.75                       | 0.85 | 0.95 | 0.029      | 0.033 | 0.037 |
| A1                | 0                          | -    | 0.05 | 0          | -     | 0.002 | 0                          | -    | 0.05 | 0          | -     | 0.002 |
| A3                | 0.20 ref.                  |      |      | 0.008 ref. |       |       | 0.20 ref.                  |      |      | 0.008 ref. |       |       |
| b                 | 0.25                       | 0.30 | 0.35 | 0.010      | 0.012 | 0.014 | 0.25                       | 0.30 | 0.35 | 0.010      | 0.012 | 0.014 |
| D                 | 4.00 BSC                   |      |      | 0.157 BSC  |       |       | 4.00 BSC                   |      |      | 0.157 BSC  |       |       |
| D2                | 2.0                        | 2.1  | 2.2  | 0.079      | 0.083 | 0.087 | 2.5                        | 2.6  | 2.7  | 0.098      | 0.102 | 0.106 |
| e                 | 0.65 BSC                   |      |      | 0.026 BSC  |       |       | 0.65 BSC                   |      |      | 0.026 BSC  |       |       |
| E                 | 4.00 BSC                   |      |      | 0.157 BSC  |       |       | 4.00 BSC                   |      |      | 0.157 BSC  |       |       |
| E2                | 2.0                        | 2.1  | 2.2  | 0.079      | 0.083 | 0.087 | 2.5                        | 2.6  | 2.7  | 0.098      | 0.102 | 0.106 |
| K                 | 0.20 min.                  |      |      | 0.008 min. |       |       | 0.20 min.                  |      |      | 0.008 min. |       |       |
| L                 | 0.5                        | 0.6  | 0.7  | 0.020      | 0.024 | 0.028 | 0.3                        | 0.4  | 0.5  | 0.012      | 0.016 | 0.020 |
| N <sup>(3)</sup>  | 16                         |      |      | 16         |       |       | 16                         |      |      | 16         |       |       |
| Nd <sup>(3)</sup> | 4                          |      |      | 4          |       |       | 4                          |      |      | 4          |       |       |
| Ne <sup>(3)</sup> | 4                          |      |      | 4          |       |       | 4                          |      |      | 4          |       |       |

### Notes

- (1) Use millimeters as the primary measurement.
- (2) Dimensioning and tolerances conform to ASME Y14.5M. - 1994.
- (3) N is the number of terminals. Nd and Ne is the number of terminals in each D and E site respectively.
- (4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.
- (5) The pin 1 identifier must be existed on the top surface of the package by using identification mark or other feature of package body.
- (6) Package warpage max. 0.05 mm.

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DWG: 5890



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