

**TRUTH TABLE (DG408)**

| A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> | 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 (DG409)**

| A <sub>1</sub> | A <sub>0</sub> | EN | ON SWITCH |
|----------------|----------------|----|-----------|
| X              | X              | 0  | None      |
| 0              | 0              | 1  | 1         |
| 0              | 1              | 1  | 2         |
| 1              | 0              | 1  | 3         |
| 1              | 1              | 1  | 4         |

**Notes**

- Logic "0" =  $V_{AL} \leq 0.8\text{ V}$
- Logic "1" =  $V_{AH} \geq 2.4\text{ V}$
- X = Do not care

**ORDERING INFORMATION (Commercial)**

| PART  | CONFIGURATION | TEMP. RANGE     | PACKAGE            | ORDERING PART NUMBER |
|-------|---------------|-----------------|--------------------|----------------------|
| DG408 | 8:1 x 1       | -40 °C to 85 °C | 16-pin plastic DIP | DG408DJ              |
|       |               |                 |                    | DG408DJ-E3           |
|       |               |                 | 16-pin SOIC        | DG408DY              |
|       |               |                 |                    | DG408DY-E3           |
|       |               |                 |                    | DG408DY-T1           |
|       |               |                 |                    | DG408DY-T1-E3        |
|       |               |                 | 16-pin TSSOP       | DG408DQ-E3           |
|       |               |                 |                    | DG408DQ-T1-E3        |
| DG409 | 4:1 x 2       | -40 °C to 85 °C | 16-pin plastic DIP | DG409DJ              |
|       |               |                 |                    | DG409DJ-E3           |
|       |               |                 | 16-pin SOIC        | DG409DY              |
|       |               |                 |                    | DG409DY-E3           |
|       |               |                 |                    | DG409DY-T1           |
|       |               |                 |                    | DG409DY-T1-E3        |
|       |               |                 | 16-pin TSSOP       | DG409DQ-E3           |
|       |               |                 |                    | DG409DQ-T1-E3        |

**Note**

- T1 indicates Tape and Reel, -E3 indicates Lead-Free and RoHS Compliant, NO -E3 indicates standard Tin/Lead finish.

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                                     |                                           | LIMIT                                                    | UNIT |
|---------------------------------------------------------------|-------------------------------------------|----------------------------------------------------------|------|
| Voltages Referenced to V-                                     | V+ to V- <sup>e</sup>                     | 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 20 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                                           | (DJ, DY suffix)                           | -65 to 125                                               | °C   |
| Power Dissipation (Package) <sup>b</sup>                      | 16-pin plastic DIP <sup>c</sup>           | 450                                                      | mW   |
|                                                               | 16-pin narrow SOIC and TSSOP <sup>d</sup> | 600                                                      |      |

**Notes**

- Signals on S<sub>x</sub>, D<sub>x</sub> or I<sub>Nx</sub> exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads soldered or welded to PC board.
- Derate 6 mW/°C above 75 °C.
- Derate 7.6 mW/°C above 75 °C.
- Also applies when V- = GND.

**SPECIFICATIONS <sup>a</sup>**

| PARAMETER                                                  |                           | SYMBOL               | TEST CONDITIONS UNLESS OTHERWISE SPECIFIED                                    | TEMP. <sup>b</sup>                            | TYP. <sup>c</sup> | D SUFFIX<br>-40 °C to 85 °C |                   | UNIT |    |
|------------------------------------------------------------|---------------------------|----------------------|-------------------------------------------------------------------------------|-----------------------------------------------|-------------------|-----------------------------|-------------------|------|----|
|                                                            |                           |                      | V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V                                 |                                               |                   | MIN. <sup>d</sup>           | MAX. <sup>d</sup> |      |    |
|                                                            |                           |                      | V <sub>AL</sub> = 0.8 V, V <sub>AH</sub> = 2.4 V <sup>f</sup>                 |                                               |                   |                             |                   |      |    |
| Analog Switch                                              |                           |                      |                                                                               |                                               |                   |                             |                   |      |    |
| Analog Signal Range <sup>e</sup>                           |                           | V <sub>ANALOG</sub>  |                                                                               | Full                                          | -                 | -15                         | 15                | V    |    |
| Drain-Source On-Resistance                                 |                           | R <sub>DS(on)</sub>  | V <sub>D</sub> = ± 10 V, I <sub>S</sub> = -10 mA                              | Room                                          | 40                | -                           | 100               | Ω    |    |
|                                                            |                           |                      |                                                                               | Full                                          | -                 | -                           | 125               |      |    |
| R <sub>DS(on)</sub> Matching Between Channels <sup>g</sup> |                           | ΔR <sub>DS(on)</sub> | V <sub>D</sub> = ± 10 V                                                       | Room                                          | -                 | -                           | 15                |      |    |
| Source Off Leakage Current                                 |                           | I <sub>S(off)</sub>  | V <sub>S</sub> = ± 10 V,<br>V <sub>D</sub> = ± 10 V, V <sub>EN</sub> = 0 V    | Room                                          | -                 | -0.5                        | 0.5               | nA   |    |
|                                                            |                           |                      |                                                                               | Full                                          | -                 | -5                          | 5                 |      |    |
| DG408                                                      | Drain Off Leakage Current | I <sub>D(off)</sub>  | V <sub>D</sub> = ± 10 V,<br>V <sub>S</sub> = ± 10 V,<br>V <sub>EN</sub> = 0 V | Room                                          | -                 | -1                          | 1                 |      |    |
| DG408                                                      |                           |                      |                                                                               | Full                                          | -                 | -20                         | 20                |      |    |
| DG409                                                      |                           |                      |                                                                               | Room                                          | -                 | -1                          | 1                 |      |    |
| DG409                                                      |                           |                      |                                                                               | Full                                          | -                 | -10                         | 10                |      |    |
| DG408                                                      | Drain On Leakage Current  | I <sub>D(on)</sub>   | V <sub>S</sub> = V <sub>D</sub> = ± 10 V<br>sequence each switch on           | Room                                          | -                 | -1                          | 1                 |      |    |
| DG408                                                      |                           |                      |                                                                               | Full                                          | -                 | -20                         | 20                |      |    |
| DG409                                                      |                           |                      |                                                                               | Room                                          | -                 | -1                          | 1                 |      |    |
| DG409                                                      |                           |                      |                                                                               | Full                                          | -                 | -10                         | 10                |      |    |
| Digital Control                                            |                           |                      |                                                                               |                                               |                   |                             |                   |      |    |
| Logic High Input Voltage                                   |                           | V <sub>INH</sub>     |                                                                               | Full                                          | -                 | 2.4                         | -                 | V    |    |
| Logic Low Input Voltage                                    |                           | V <sub>INL</sub>     |                                                                               | Full                                          | -                 | -                           | 0.8               |      |    |
| Logic High Input Current                                   |                           | I <sub>AH</sub>      | V <sub>A</sub> = 2.4 V, 15 V                                                  | Full                                          | -                 | -10                         | 10                | μA   |    |
| Logic Low Input Current                                    |                           | I <sub>AL</sub>      | V <sub>EN</sub> = 0 V, 2.4 V, V <sub>A</sub> = 0 V                            | Full                                          | -                 | -10                         | 10                |      |    |
| Logic Input Capacitance                                    |                           | C <sub>in</sub>      | f = 1 MHz                                                                     | Room                                          | 8                 | -                           | -                 | pF   |    |
| Dynamic Characteristics                                    |                           |                      |                                                                               |                                               |                   |                             |                   |      |    |
| Transition Time                                            |                           | t <sub>TRANS</sub>   | see figure 2                                                                  | Full                                          | 160               | -                           | 250               | ns   |    |
| Break-Before-Make Interval                                 |                           | t <sub>OPEN</sub>    | see figure 4                                                                  | Room                                          | -                 | 10                          | -                 |      |    |
| Enable Turn-On Time                                        |                           | t <sub>ON(EN)</sub>  | see figure 3                                                                  | Room                                          | 115               | -                           | 150               |      |    |
|                                                            |                           |                      |                                                                               | Full                                          | -                 | -                           | -                 |      |    |
| Enable Turn-Off Time                                       |                           | t <sub>OFF(EN)</sub> |                                                                               | Room                                          | 105               | -                           | 150               |      |    |
| Charge Injection                                           |                           | Q                    | C <sub>L</sub> = 10 nF, V <sub>S</sub> = 0 V                                  | Room                                          | 20                | -                           | -                 | pC   |    |
| Off Isolation <sup>h</sup>                                 |                           | OIRR                 | V <sub>EN</sub> = 0 V, R <sub>L</sub> = 1 kΩ,<br>f = 1 MHz                    | Room                                          | -75               | -                           | -                 | pF   |    |
| Source Off Capacitance                                     |                           | C <sub>S(off)</sub>  | V <sub>EN</sub> = 0 V, V <sub>S</sub> = 0 V,<br>f = 1 MHz                     | Room                                          | 3                 | -                           | -                 |      |    |
| DG408                                                      | Drain Off Capacitance     | C <sub>D(off)</sub>  | V <sub>EN</sub> = 0 V,<br>V <sub>D</sub> = 0 V,<br>f = 1 MHz                  | Room                                          | 26                | -                           | -                 |      |    |
| DG409                                                      |                           |                      |                                                                               | Room                                          | 14                | -                           | -                 |      |    |
| DG408                                                      | Drain On Capacitance      | C <sub>D(on)</sub>   |                                                                               | Room                                          | 37                | -                           | -                 |      |    |
| DG409                                                      |                           |                      |                                                                               | Room                                          | 25                | -                           | -                 |      |    |
| Power Supplies                                             |                           |                      |                                                                               |                                               |                   |                             |                   |      |    |
| Positive Supply Current                                    |                           | I <sub>+</sub>       |                                                                               | V <sub>EN</sub> = V <sub>A</sub> = 0 V or 5 V | Full              | 10                          | -                 | 75   | μA |
| Negative Supply Current                                    |                           | I <sub>-</sub>       |                                                                               |                                               | Full              | 1                           | -75               | -    |    |
| Positive Supply Current                                    |                           | I <sub>+</sub>       | V <sub>EN</sub> = V <sub>A</sub> = 0 V or 5 V                                 | Room                                          | 0.2               | -                           | 0.5               | mA   |    |
|                                                            |                           |                      |                                                                               | Full                                          | -                 | -                           | 2                 |      |    |
| Negative Supply Current                                    |                           | I <sub>-</sub>       |                                                                               |                                               | Full              | -                           | -500              | -    | μA |



| SPECIFICATIONS <sup>a</sup> (Single Supply) |                      |                                                                         |                    |                   |                             |                   |      |
|---------------------------------------------|----------------------|-------------------------------------------------------------------------|--------------------|-------------------|-----------------------------|-------------------|------|
| PARAMETER                                   | SYMBOL               | TEST CONDITIONS UNLESS OTHERWISE SPECIFIED                              | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | D SUFFIX<br>-40 °C to 85 °C |                   | UNIT |
|                                             |                      | V <sub>+</sub> = 12 V, V <sub>-</sub> = 0 V                             |                    |                   | MIN. <sup>d</sup>           | MAX. <sup>d</sup> |      |
|                                             |                      | V <sub>AL</sub> = 0.8 V, V <sub>AH</sub> = 2.4 V <sup>f</sup>           |                    |                   |                             |                   |      |
| Analog Switch                               |                      |                                                                         |                    |                   |                             |                   |      |
| Drain-Source On-Resistance <sup>e,f</sup>   | R <sub>DS(on)</sub>  | V <sub>D</sub> = 3 V, 10 V, I <sub>S</sub> = -1 mA                      | Room               | 90                | -                           | -                 | Ω    |
| Dynamic Characteristics                     |                      |                                                                         |                    |                   |                             |                   |      |
| Switching Time of Multiplexer <sup>e</sup>  | t <sub>TRANS</sub>   | V <sub>S1</sub> = 8 V, V <sub>S8</sub> = 0 V, V <sub>IN</sub> = 2.4 V   | Room               | 180               | -                           | -                 | ns   |
| Enable Turn-On Time <sup>e</sup>            | t <sub>ON(EN)</sub>  | V <sub>INH</sub> = 2.4 V, V <sub>INL</sub> = 0 V, V <sub>S1</sub> = 5 V | Room               | 180               | -                           | -                 |      |
| Enable Turn-Off Time <sup>e</sup>           | t <sub>OFF(EN)</sub> |                                                                         | Room               | 120               | -                           | -                 |      |
| Charge Injection <sup>e</sup>               | Q                    | C <sub>I</sub> = 1 nF, V <sub>S</sub> = 0 V, R <sub>S</sub> = 0         | Room               | 5                 | -                           | -                 | pC   |

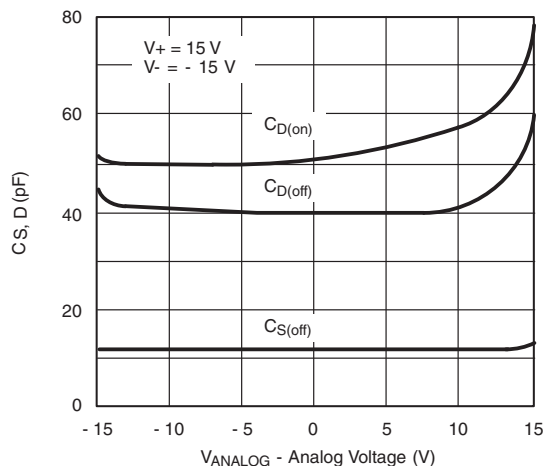
**Notes**

- Refer to PROCESS OPTION FLOWCHART.
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- Guaranteed by design, not subject to production test.
- V<sub>IN</sub> = input voltage to perform proper function.
- ΔR<sub>DS(on)</sub> = R<sub>DS(on)</sub> max. - R<sub>DS(on)</sub> min.
- Worst case isolation occurs on channel 4 due to proximity to the drain pin.

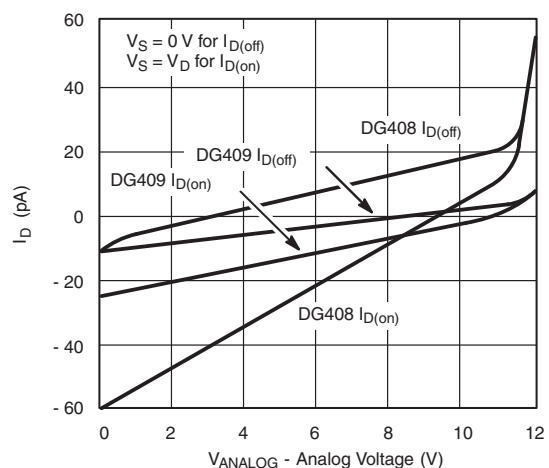
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



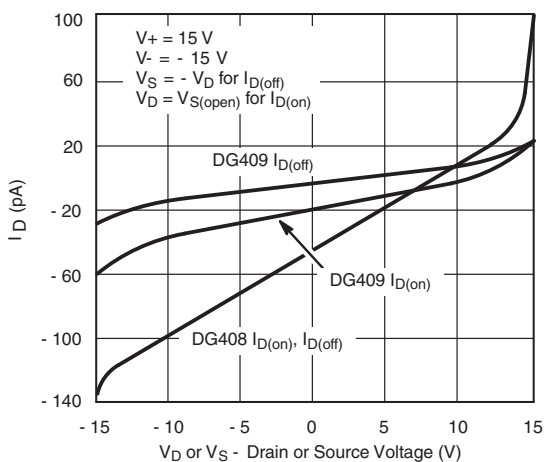
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



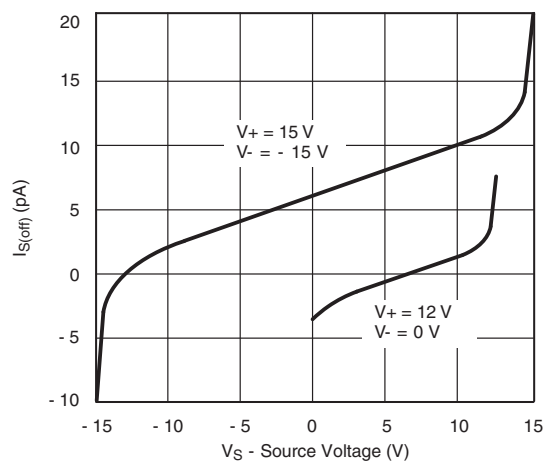
**Source/Drain Capacitance vs. Analog Voltage**



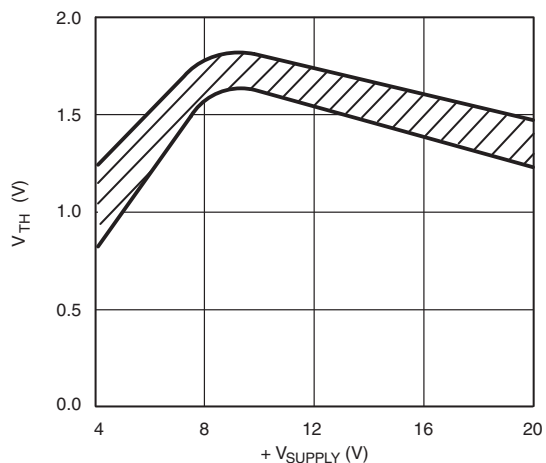
**Drain Leakage Current vs. Source/Drain Voltage**  
(Single 12 V Supply)



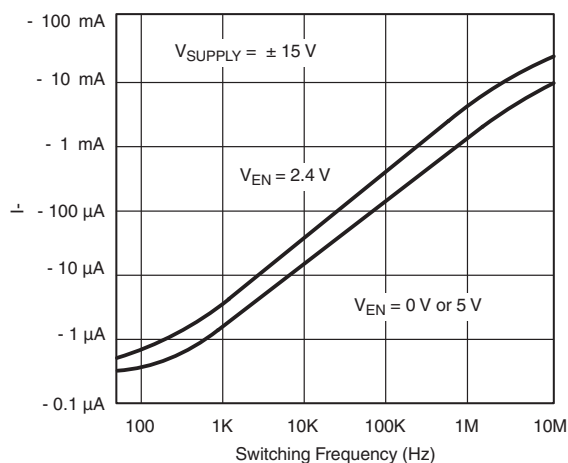
**Drain Leakage Current vs. Source/Drain Voltage**



**Source Leakage Current vs. Source Voltage**



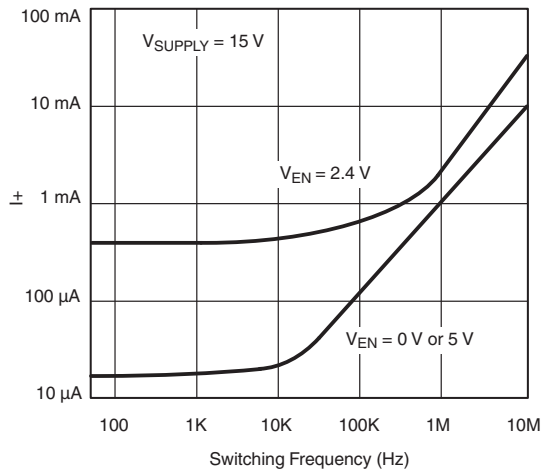
**Input Switching Threshold vs. Supply Voltage**



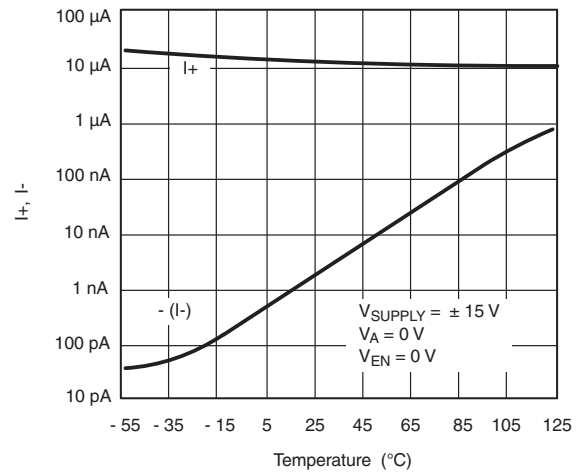
**Negative Supply Current vs. Switching Frequency**



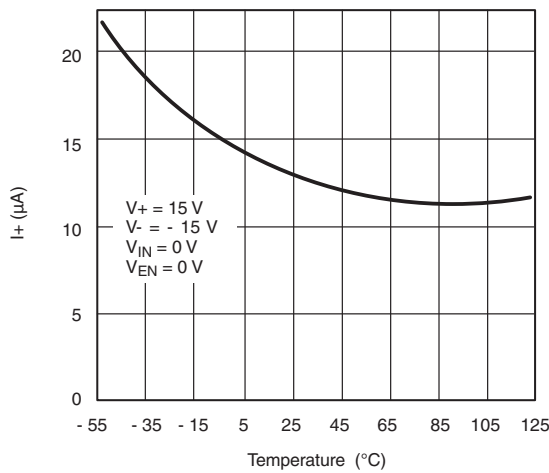
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



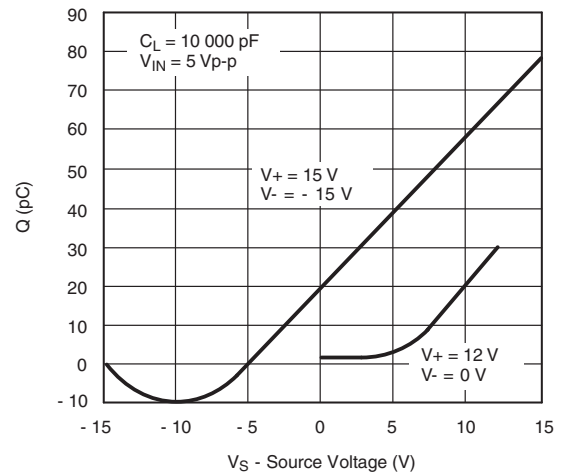
**Positive Supply Current vs. Switching Frequency**



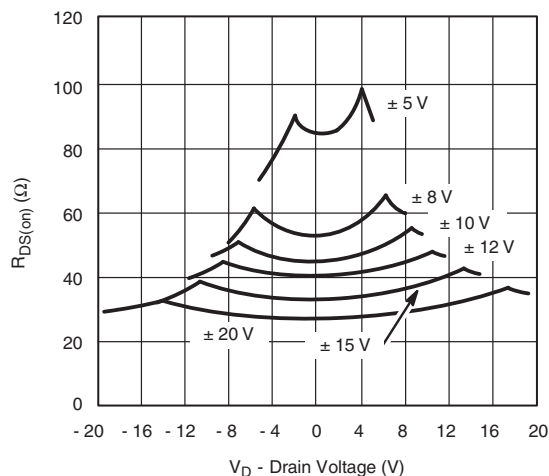
**$I_{SUPPLY}$  vs. Temperature**



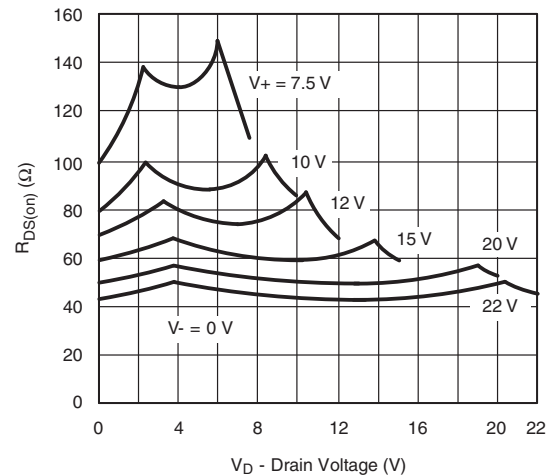
**Positive Supply Current vs. Temperature (DG408)**



**Charge Injection vs. Analog Voltage**



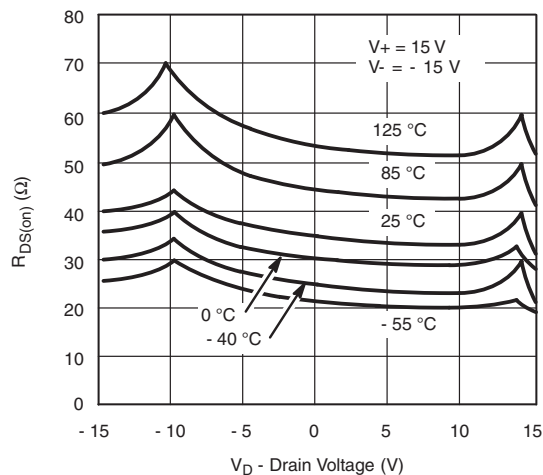
**$R_{DS(on)}$  vs.  $V_D$  and Supply**



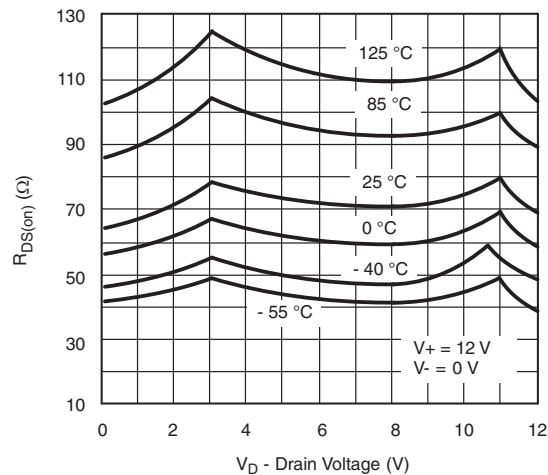
**$R_{DS(on)}$  vs.  $V_D$  and Supply (Single Supply)**



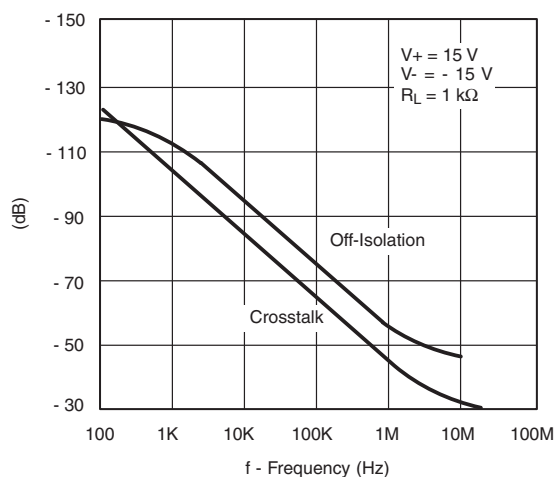
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



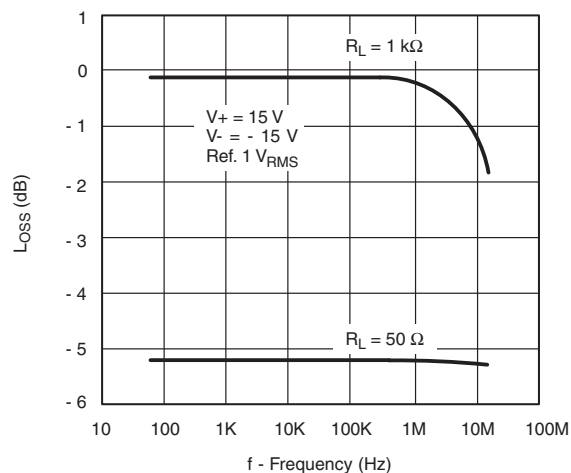
**$R_{DS(on)}$  vs.  $V_D$  and Temperature**



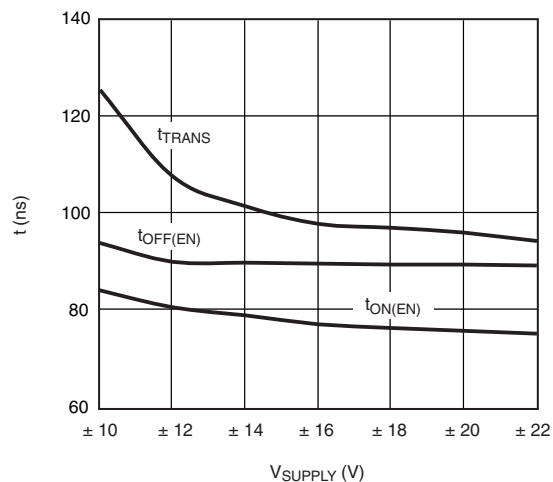
**$R_{DS(on)}$  vs.  $V_D$  and Temperature (Single Supply)**



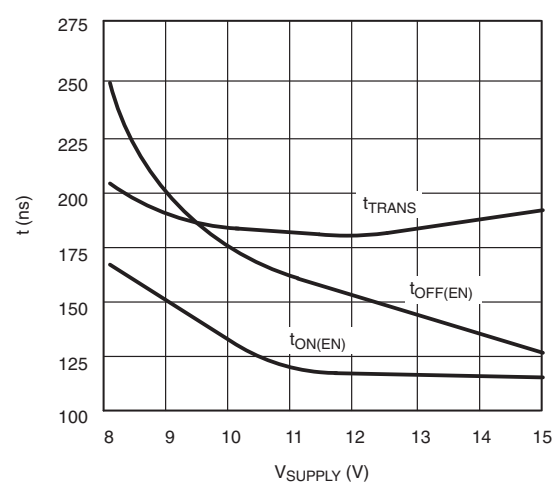
**Off Isolation and Crosstalk vs. Frequency**



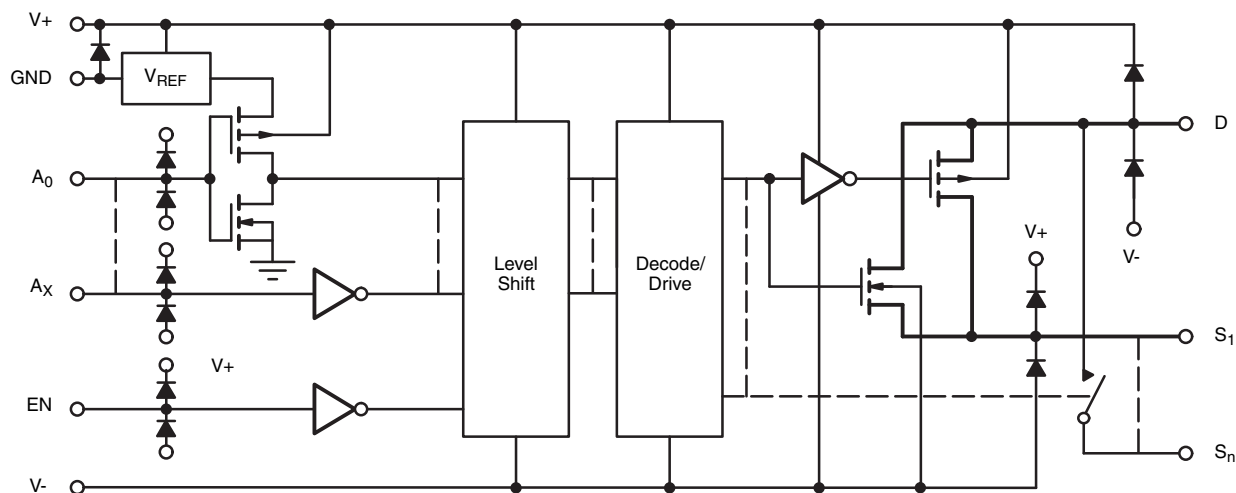
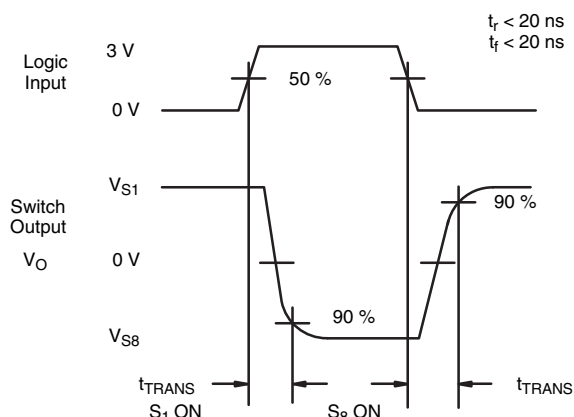
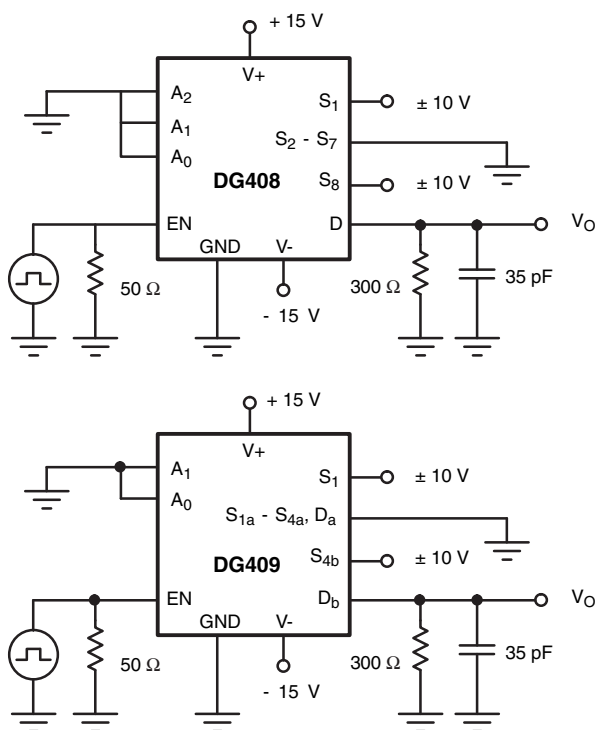
**Insertion Loss vs. Frequency**

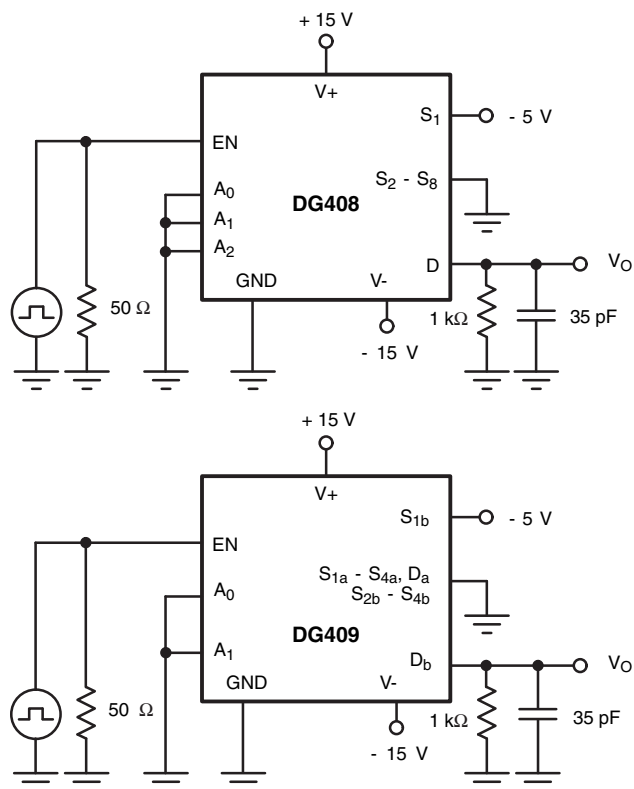
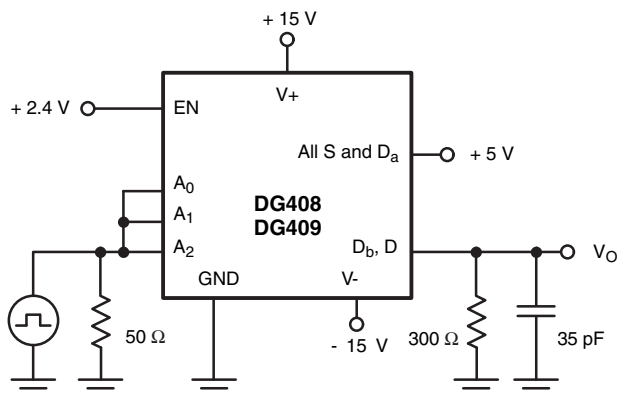
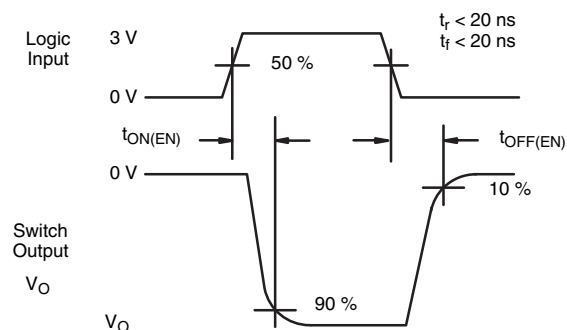
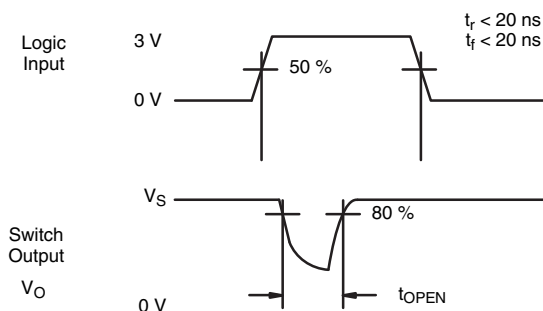


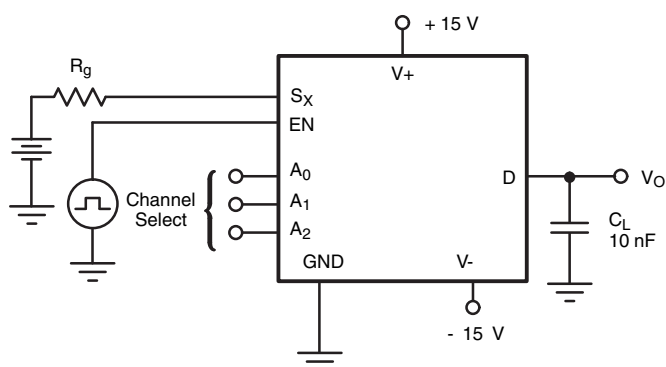
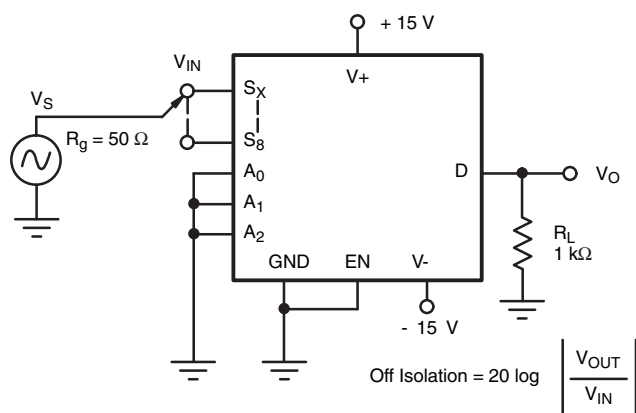
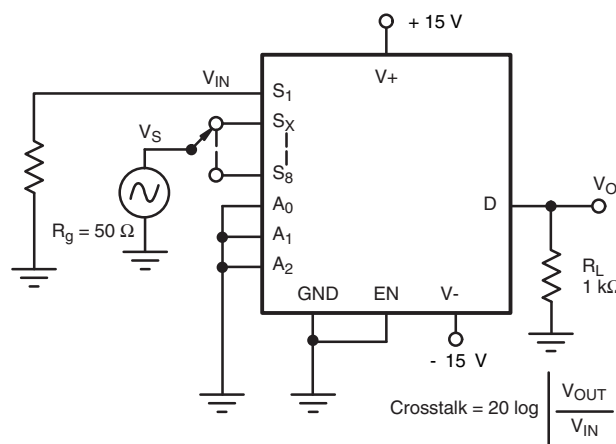
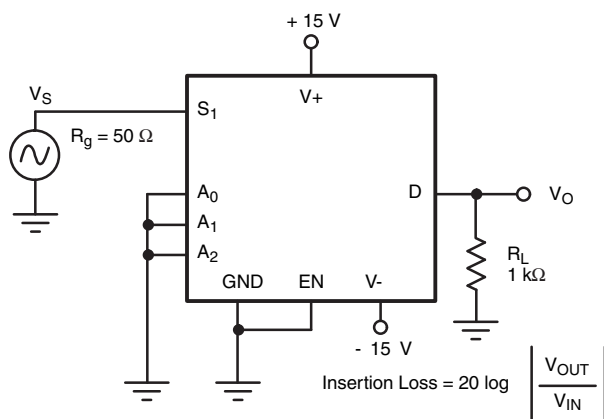
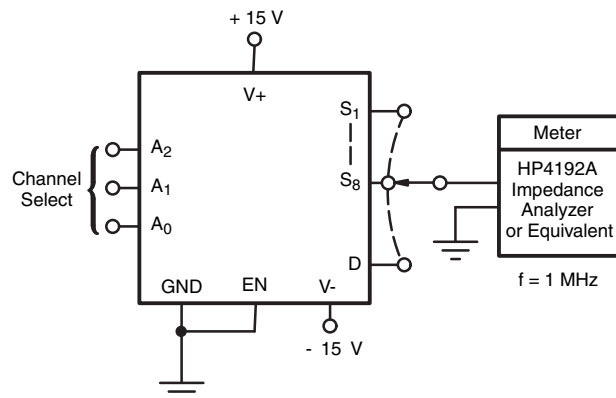
**Switching Time vs. Bipolar Supply**



**Switching Time vs. Single Supply**

**SCHEMATIC DIAGRAM** (Typical Channel)

**Fig. 1**
**TEST CIRCUITS**

**Fig. 2 - Transition Time**

**TEST CIRCUITS**

**Fig. 3 - Enable Switching Time**

**Fig. 4 - Break-Before-Make Interval**


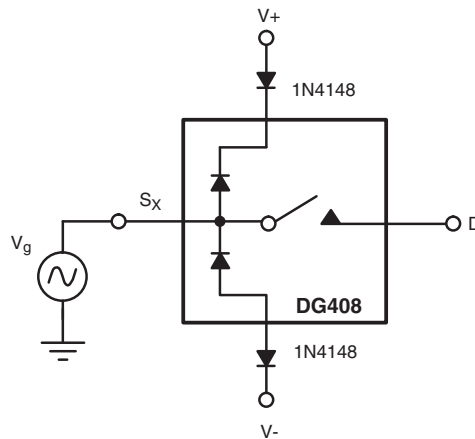
**TEST CIRCUITS**

**Fig. 5 - Charge Injection**

**Fig. 6 - Off Isolation**

**Fig. 7 - Crosstalk**

**Fig. 8 - Insertion Loss**

**Fig. 9 - Source Drain Capacitance**

## APPLICATION HINTS

### Overvoltage Protection

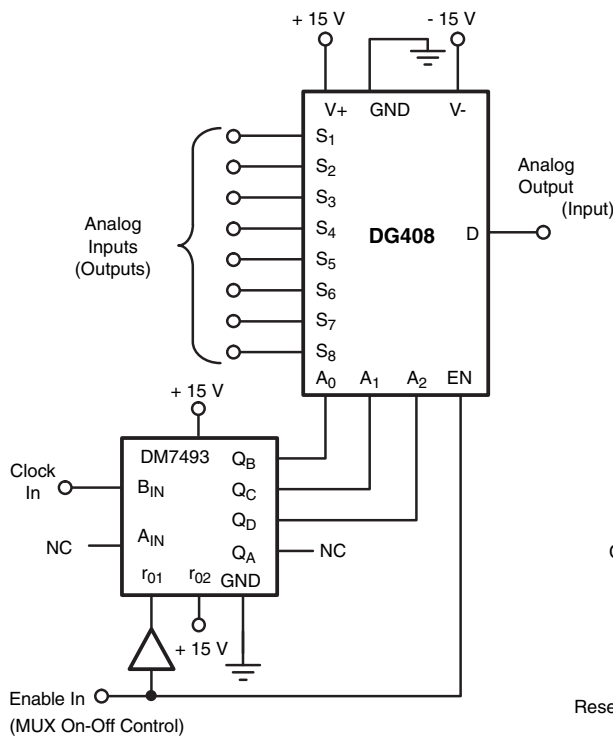
A very convenient form of overvoltage protection consists of adding two small signal diodes (1N4148, 1N914 type) in series with the supply pins (see figure 10). This arrangement effectively blocks the flow of reverse currents. It also floats the supply pin above or below the normal  $V_+$  or  $V_-$  value. In this case the overvoltage signal actually becomes the power

supply of the IC. From the point of view of the chip, nothing has changed, as long as the difference  $V_S - (V_-)$  does not exceed + 44 V. The addition of these diodes will reduce the analog signal range to 1 V below  $V_+$  and 1 V above  $V_-$ , but it preserves the low channel resistance and low leakage characteristics.

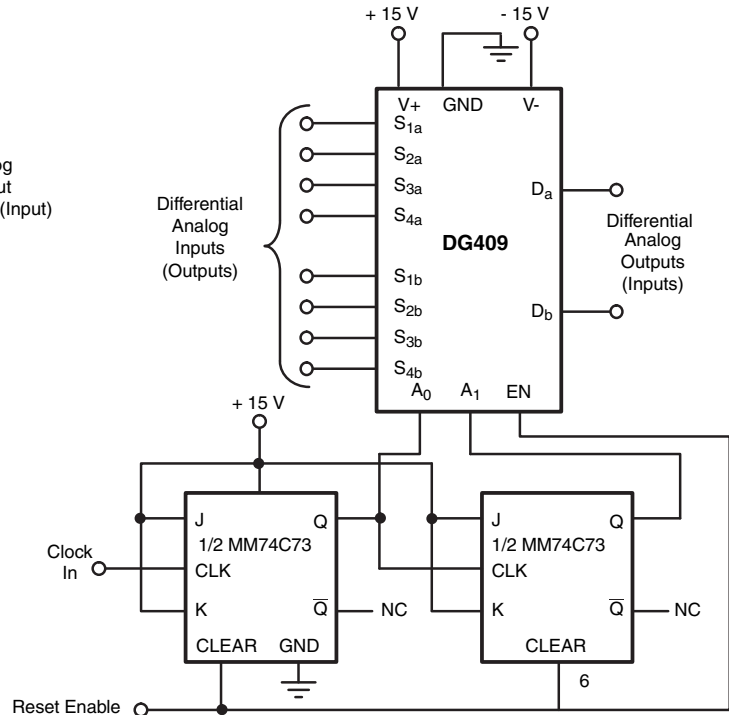


**Fig. 10 - Overvoltage Protection Using Blocking Diodes**

### 8-Channel Sequential Multiplexer/Demultiplexer



### Differential 4-Channel Sequential Multiplexer/Demultiplexer



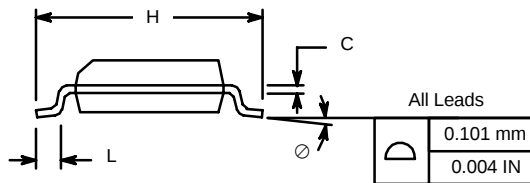
**Fig. 11**

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?70062](http://www.vishay.com/ppg?70062).



### SOIC (NARROW): 16-LEAD

JEDEC Part Number: MS-012

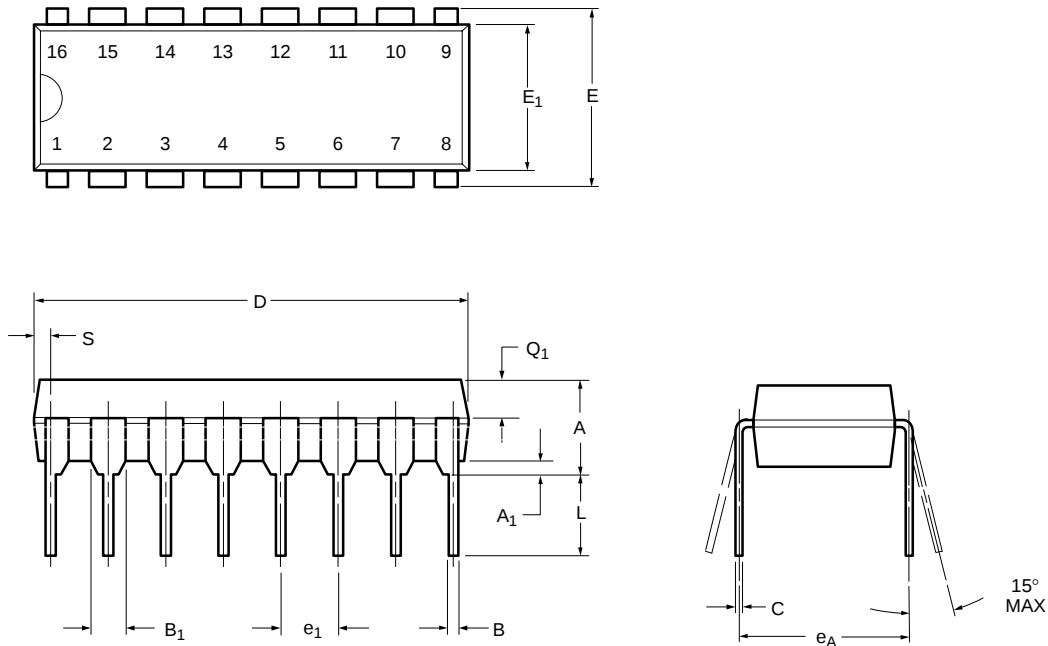


| Dim            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | Min         | Max   | Min       | Max   |
| A              | 1.35        | 1.75  | 0.053     | 0.069 |
| A <sub>1</sub> | 0.10        | 0.20  | 0.004     | 0.008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

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



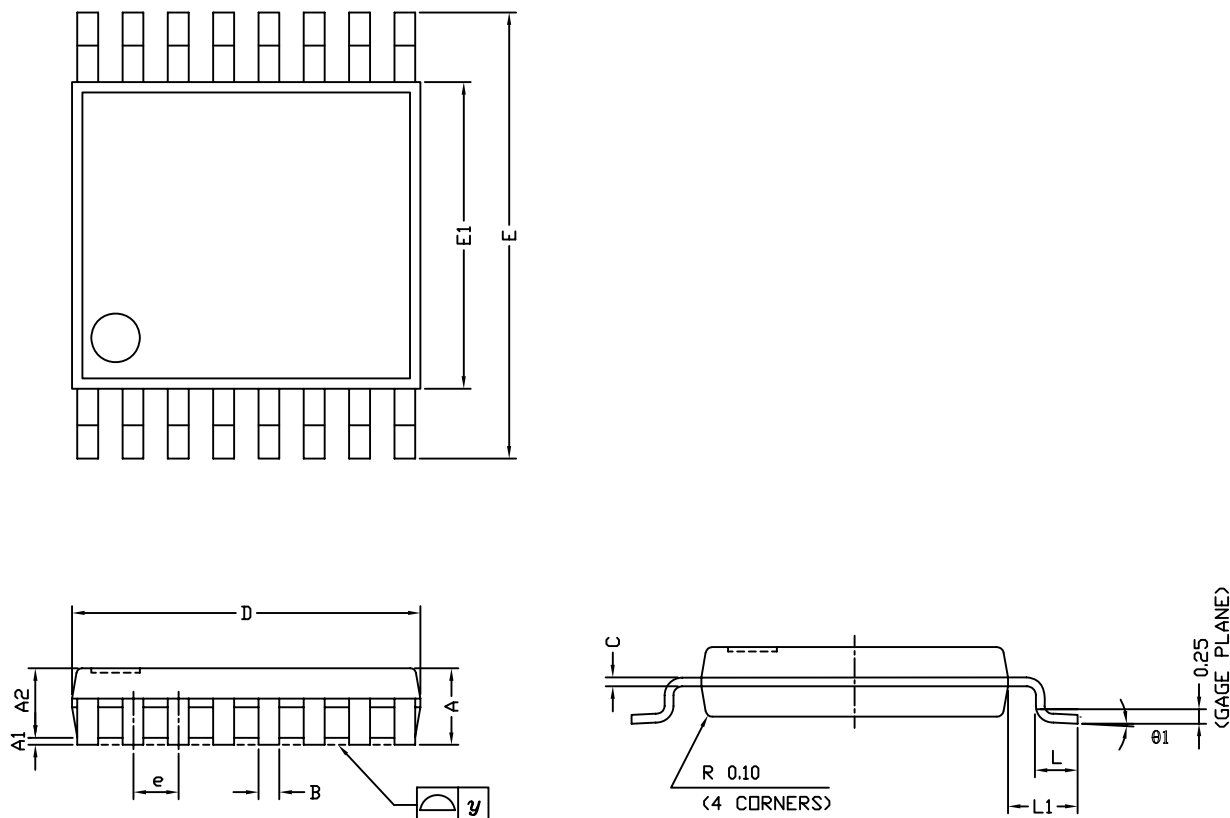
**PDIP: 16-LEAD**



| Dim            | MILLIMETERS |       | INCHES |       |
|----------------|-------------|-------|--------|-------|
|                | Min         | Max   | Min    | Max   |
| 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 |

ECN: S-03946—Rev. D, 09-Jul-01  
DWG: 5482

## TSSOP: 16-LEAD



| Symbols                        | DIMENSIONS IN MILLIMETERS |       |      |
|--------------------------------|---------------------------|-------|------|
|                                | Min                       | Nom   | Max  |
| A                              | -                         | 1.10  | 1.20 |
| A1                             | 0.05                      | 0.10  | 0.15 |
| A2                             | -                         | 1.00  | 1.05 |
| B                              | 0.22                      | 0.28  | 0.38 |
| C                              | -                         | 0.127 | -    |
| D                              | 4.90                      | 5.00  | 5.10 |
| E                              | 6.10                      | 6.40  | 6.70 |
| E1                             | 4.30                      | 4.40  | 4.50 |
| e                              | -                         | 0.65  | -    |
| L                              | 0.50                      | 0.60  | 0.70 |
| L1                             | 0.90                      | 1.00  | 1.10 |
| y                              | -                         | -     | 0.10 |
| θ1                             | 0°                        | 3°    | 6°   |
| ECN: S-61920-Rev. D, 23-Oct-06 |                           |       |      |
| DWG: 5624                      |                           |       |      |

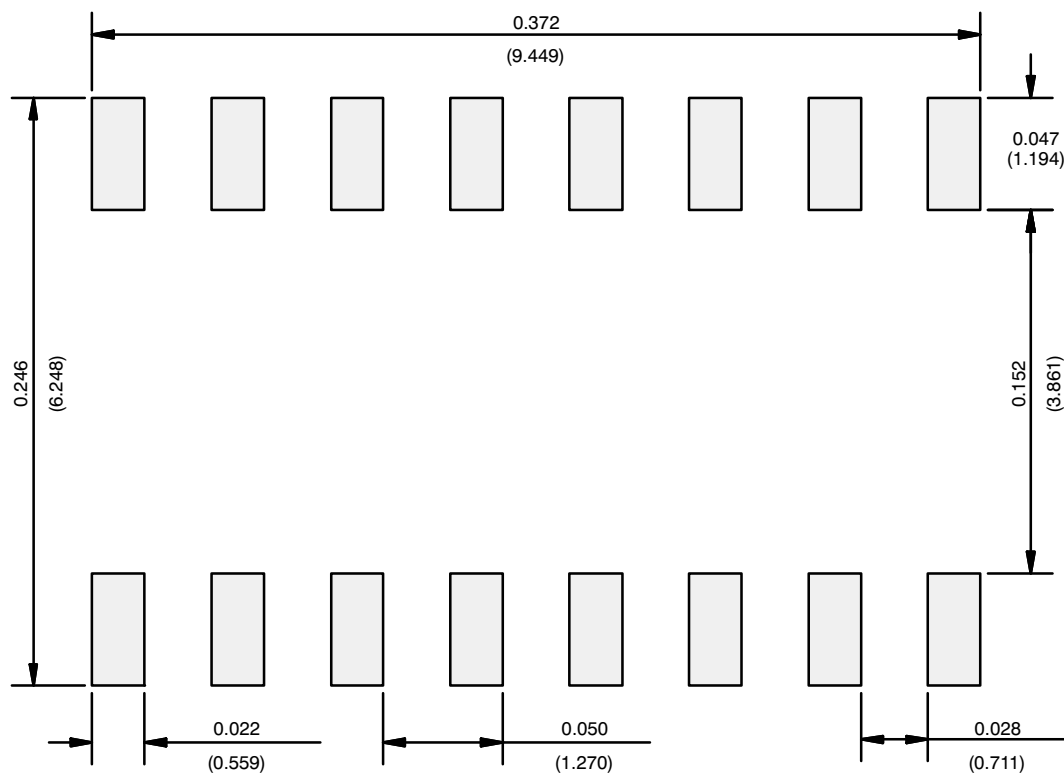


## RECOMMENDED MINIMUM PAD FOR TSSOP-16



Recommended Minimum Pads  
Dimensions in inches (mm)

## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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