

## ORDERING INFORMATION

| Temp. Range      | Package            | Part Number                                          |
|------------------|--------------------|------------------------------------------------------|
| - 40 °C to 85 °C | 16-pin plastic DIP | DG411DJ<br>DG411DJ-E3                                |
|                  |                    | DG412DJ<br>DG412DJ-E3                                |
|                  |                    | DG413DJ<br>DG413DJ-E3                                |
|                  | 16-pin narrow SOIC | DG411DY<br>DG411DY-E3<br>DG411DY-T1<br>DG411DY-T1-E3 |
|                  |                    | DG412DY<br>DG412DY-E3<br>DG412DY-T1<br>DG412DY-T1-E3 |
|                  |                    | DG413DY<br>DG413DY-E3<br>DG413DY-T1<br>DG413DY-T1-E3 |
|                  | 16-pin TSSOP       | DG411DQ-E3<br>DG411DQ-T1-E3                          |
|                  |                    | DG412DQ-E3<br>DG412DQ-T1-E3                          |
|                  |                    | DG413DQ-E3<br>DG413DQ-T1-E3                          |

## ABSOLUTE MAXIMUM RATINGS

| Parameter                                                     | Limit                                                   | Unit        |    |
|---------------------------------------------------------------|---------------------------------------------------------|-------------|----|
| V + to V -                                                    | 44                                                      | V           |    |
| GND to V -                                                    | 25                                                      |             |    |
| V <sub>L</sub>                                                | (GND - 0.3) to (V+) + 0.3                               |             |    |
| Digital Inputs <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub> | (V-) -2 to (V+) + 2<br>or 30 mA, whichever occurs first |             |    |
| Continuous Current (Any terminal)                             |                                                         | 30          | mA |
| Peak Current, S or D (Pulsed at 1 ms, 10 % duty cycle)        |                                                         | 100         |    |
| Storage Temperature                                           | (AK, AZ suffix)                                         | - 65 to 150 | °C |
|                                                               | (DJ, DY suffix)                                         | - 65 to 125 |    |
| Power Dissipation (Package) <sup>b</sup>                      | 16-pin plastic DIP <sup>c</sup>                         | 470         | mW |
|                                                               | 16-pin narrow SOIC <sup>d</sup>                         | 600         |    |
|                                                               | 16-pin CerDIP <sup>e</sup>                              | 900         |    |
|                                                               | LCC-20 <sup>e</sup>                                     | 900         |    |

Notes:

a. Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V + or V - will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

b. All leads welded or soldered to PC board.

c. Derate 6 mW/°C above 25 °C.

d. Derate 7.6 mW/°C above 75 °C.

e. Derate 12 mW/°C above 75 °C.



| SPECIFICATIONS <sup>a</sup>               |                     |                                                                                                                                                            |                    |                   |                               |                   |                              |                   |      |
|-------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-------------------------------|-------------------|------------------------------|-------------------|------|
| Parameter                                 | Symbol              | Test Conditions<br>Unless Specified<br>V <sub>+</sub> = 15 V, V <sub>-</sub> = - 15 V<br>V <sub>L</sub> = 5 V, V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup> | Temp. <sup>b</sup> | Typ. <sup>c</sup> | A Suffix<br>- 55 °C to 125 °C |                   | D Suffix<br>- 40 °C to 85 °C |                   | Unit |
|                                           |                     |                                                                                                                                                            |                    |                   | Min. <sup>d</sup>             | Max. <sup>d</sup> | Min. <sup>d</sup>            | Max. <sup>d</sup> |      |
| Analog Switch                             |                     |                                                                                                                                                            |                    |                   |                               |                   |                              |                   |      |
| Analog Signal Range <sup>e</sup>          | V <sub>ANALOG</sub> |                                                                                                                                                            | Full               |                   | - 15                          | 15                | - 15                         | 15                | V    |
| Drain-Source On-Resistance                | R <sub>DS(on)</sub> | V <sub>+</sub> = 13.5 V, V <sub>-</sub> = - 13.5 V<br>I <sub>S</sub> = - 10 mA, V <sub>D</sub> = ± 8.5 V                                                   | Room Full          | 25                |                               | 35<br>45          |                              | 35<br>45          | Ω    |
| Switch Off Leakage Current                | I <sub>S(off)</sub> | V <sub>+</sub> = 16.5, V <sub>-</sub> = - 16.5 V<br>V <sub>D</sub> = ± 15.5 V, V <sub>S</sub> = ± 15.5 V                                                   | Room Full          | ± 0.1             | - 0.25<br>- 20                | 0.25<br>20        | - 0.25<br>- 5                | 0.25<br>5         | nA   |
|                                           | I <sub>D(off)</sub> |                                                                                                                                                            | Room Full          | ± 0.1             | - 0.25<br>- 20                | 0.25<br>20        | - 0.25<br>- 5                | 0.25<br>5         |      |
| Channel On Leakage Current                | I <sub>D(on)</sub>  | V <sub>+</sub> = 16.5 V, V <sub>-</sub> = - 16.5 V<br>V <sub>S</sub> = V <sub>D</sub> = ± 15.5 V                                                           | Room Full          | ± 0.1             | - 0.4<br>- 40                 | 0.4<br>40         | - 0.4<br>- 10                | 0.4<br>10         |      |
| Digital Control                           |                     |                                                                                                                                                            |                    |                   |                               |                   |                              |                   |      |
| Input Current, V <sub>IN</sub> Low        | I <sub>IL</sub>     | V <sub>IN</sub> under test = 0.8 V                                                                                                                         | Full               | 0.005             | - 0.5                         | 0.5               | - 0.5                        | 0.5               | μA   |
| Input Current, V <sub>IN</sub> High       | I <sub>IH</sub>     | V <sub>IN</sub> under test = 2.4 V                                                                                                                         | Full               | 0.005             | - 0.5                         | 0.5               | - 0.5                        | 0.5               |      |
| Dynamic Characteristics                   |                     |                                                                                                                                                            |                    |                   |                               |                   |                              |                   |      |
| Turn-On Time                              | t <sub>ON</sub>     | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S</sub> = ± 10 V, see figure 2                                                                    | Room Full          | 110               |                               | 175<br>240        |                              | 175<br>220        | ns   |
| Turn-Off Time                             | t <sub>OFF</sub>    |                                                                                                                                                            | Room Full          | 100               |                               | 145<br>160        |                              | 145<br>160        |      |
| Break-Before-Make Time Delay              | t <sub>D</sub>      | DG413 only, V <sub>S</sub> = 10 V<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                                        | Room               | 25                |                               |                   |                              |                   |      |
| Charge Injection                          | Q                   | V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω<br>C <sub>L</sub> = 10 nF                                                                                       | Room               | 5                 |                               |                   |                              |                   | pC   |
| Off Isolation <sup>e</sup>                | OIRR                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF,<br>f = 1 MHz                                                                                                 | Room               | 68                |                               |                   |                              |                   | dB   |
| Channel-to-Channel Crosstalk <sup>e</sup> | X <sub>TALK</sub>   |                                                                                                                                                            | Room               | 85                |                               |                   |                              |                   |      |
| Source Off Capacitance <sup>e</sup>       | C <sub>S(off)</sub> | f = 1 MHz                                                                                                                                                  | Room               | 9                 |                               |                   |                              |                   | pF   |
| Drain Off Capacitance <sup>e</sup>        | C <sub>D(off)</sub> |                                                                                                                                                            | Room               | 9                 |                               |                   |                              |                   |      |
| Channel On Capacitance <sup>e</sup>       | C <sub>D(on)</sub>  |                                                                                                                                                            | Room               | 35                |                               |                   |                              |                   |      |
| Power Supplies                            |                     |                                                                                                                                                            |                    |                   |                               |                   |                              |                   |      |
| Positive Supply Current                   | I <sub>+</sub>      | V <sub>+</sub> = 16.5 V, V <sub>-</sub> = - 16.5 V<br>V <sub>IN</sub> = 0 V or 5 V                                                                         | Room Full          | 0.0001            |                               | 1<br>5            |                              | 1<br>5            | μA   |
| Negative Supply Current                   | I <sub>-</sub>      |                                                                                                                                                            | Room Full          | - 0.0001          | - 1<br>- 5                    |                   | - 1<br>- 5                   |                   |      |
| Logic Supply Current                      | I <sub>L</sub>      |                                                                                                                                                            | Room Full          | 0.0001            |                               | 1<br>5            |                              | 1<br>5            |      |
| Ground Current                            | I <sub>GND</sub>    |                                                                                                                                                            | Room Full          | - 0.0001          | - 1<br>- 5                    |                   | - 1<br>- 5                   |                   |      |

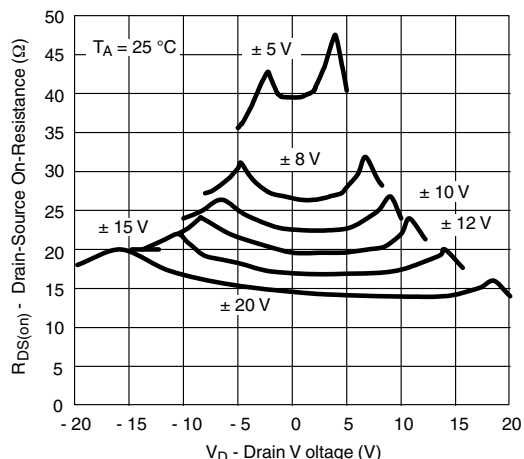
| SPECIFICATIONS <sup>a</sup> (for Unipolar Supplies) |                     |                                                                                                                                   |                    |                   |                               |                   |                              |                   |      |
|-----------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-------------------------------|-------------------|------------------------------|-------------------|------|
| Parameter                                           | Symbol              | Test Conditions<br>Unless Specified<br>V + = 12 V, V - = 0 V<br>V <sub>L</sub> = 5 V, V <sub>IN</sub> = 2.4 V, 0.8 V <sup>f</sup> | Temp. <sup>b</sup> | Typ. <sup>c</sup> | A Suffix<br>- 55 °C to 125 °C |                   | D Suffix<br>- 40 °C to 85 °C |                   | Unit |
|                                                     |                     |                                                                                                                                   |                    |                   | Min. <sup>d</sup>             | Max. <sup>d</sup> | Min. <sup>d</sup>            | Max. <sup>d</sup> |      |
| Analog Switch                                       |                     |                                                                                                                                   |                    |                   |                               |                   |                              |                   |      |
| Analog Signal Range <sup>e</sup>                    | V <sub>ANALOG</sub> |                                                                                                                                   | Full               |                   |                               | 12                |                              | 12                | V    |
| Drain-Source On-Resistance                          | R <sub>DS(on)</sub> | V + = 10.8 V,<br>I <sub>S</sub> = - 10 mA, V <sub>D</sub> = 3 V, 8 V                                                              | Room Full          | 40                |                               | 80<br>100         |                              | 80<br>100         | Ω    |
| Dynamic Characteristics                             |                     |                                                                                                                                   |                    |                   |                               |                   |                              |                   |      |
| Turn-On Time                                        | t <sub>ON</sub>     | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S</sub> = 8 V, see figure 2                                              | Room Hot           | 175               |                               | 250<br>400        |                              | 250<br>315        | ns   |
| Turn-Off Time                                       | t <sub>OFF</sub>    |                                                                                                                                   | Room Hot           | 95                |                               | 125<br>140        |                              | 125<br>140        |      |
| Break-Before-Make Time Delay                        | t <sub>D</sub>      | DG413 only, V <sub>S</sub> = 8 V<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                | Room               | 25                |                               |                   |                              |                   |      |
| Charge Injection                                    | Q                   | V <sub>g</sub> = 6 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 10 nF                                                                | Room               | 25                |                               |                   |                              |                   | pC   |
| Power Supplies                                      |                     |                                                                                                                                   |                    |                   |                               |                   |                              |                   |      |
| Positive Supply Current                             | I <sub>+</sub>      | V + = 13.5 V, V <sub>IN</sub> = 0 V or 5 V                                                                                        | Room Hot           | 0.0001            |                               | 1<br>5            |                              | 1<br>5            | μA   |
| Negative Supply Current                             | I <sub>-</sub>      |                                                                                                                                   | Room Hot           | - 0.0001          | - 1<br>- 5                    |                   | - 1<br>- 5                   |                   |      |
| Logic Supply Current                                | I <sub>L</sub>      |                                                                                                                                   | Room Hot           | 0.0001            |                               | 1<br>5            |                              | 1<br>5            |      |
| Ground Current                                      | I <sub>GND</sub>    |                                                                                                                                   | Room Hot           | - 0.0001          | - 1<br>- 5                    |                   | - 5                          |                   |      |

### Notes:

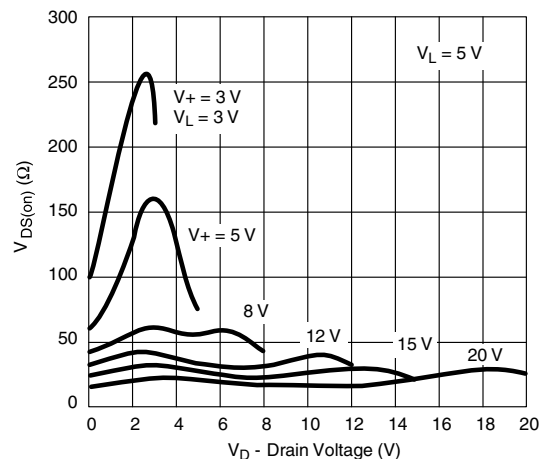
- Refer to process option flowchart.
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guaranteed by design, not subject to production test.
- $V_{IN}$  = input voltage to perform proper function.

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

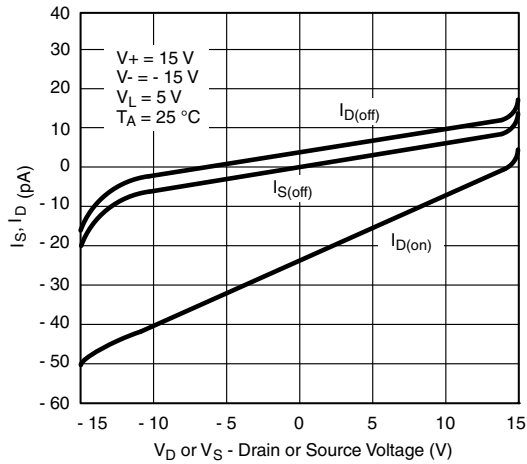
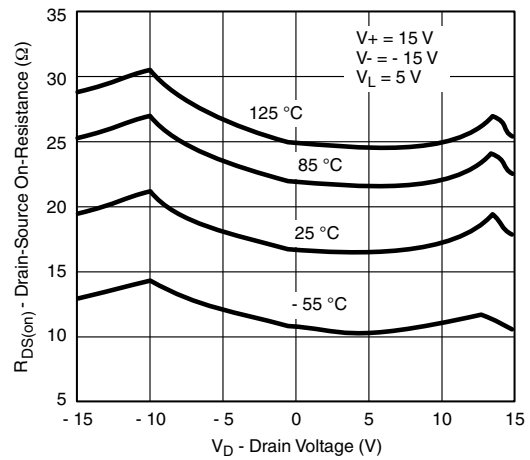
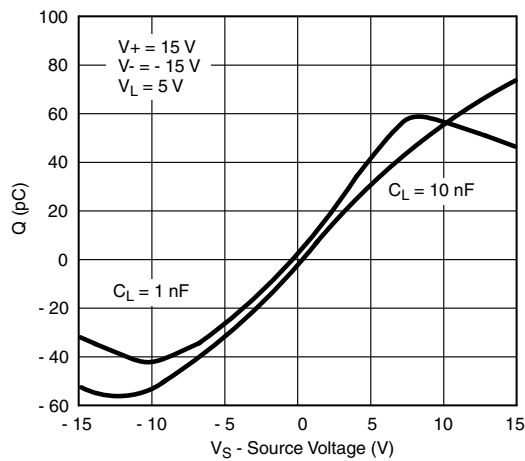
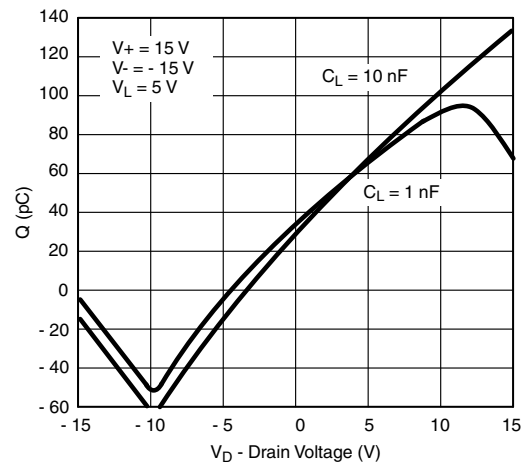
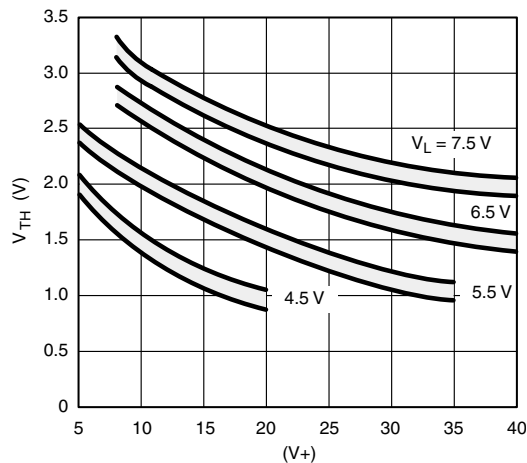
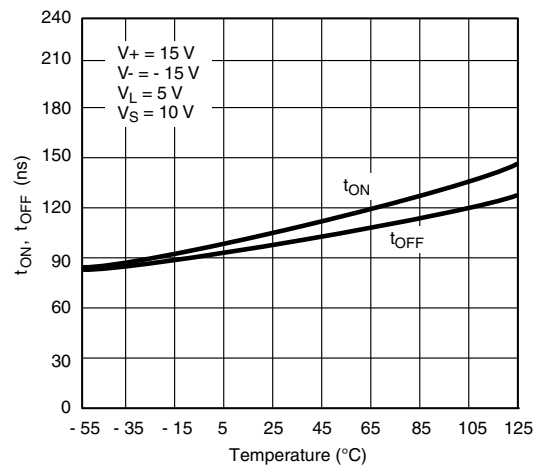
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



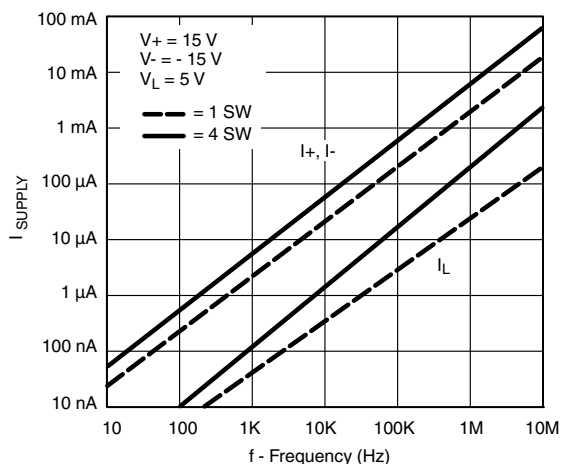
On-Resistance vs.  $V_D$  and Power Supply Voltage



On-Resistance vs.  $V_D$  and Unipolar Supply Voltage

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

**Leakage Current vs. Analog Voltage**

 **$I_D, I_S$  Leakages vs. Temperature**

**Charge Injection vs. Analog Voltage**

**Charge Injection vs. Analog Voltage**

**Input Switching Threshold vs. Supply Voltage**

**Switching Time vs. Temperature**

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



Supply Current vs. Input Switching Frequency

## SCHEMATIC DIAGRAM (Typical Channel)

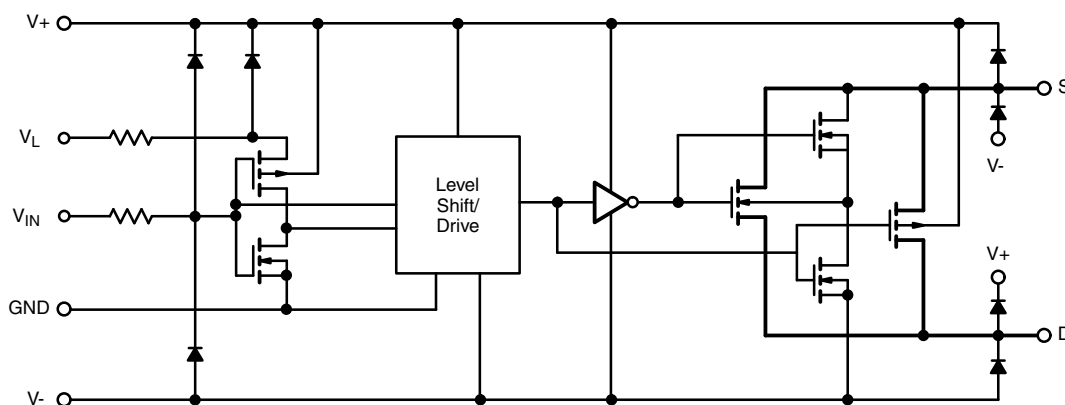
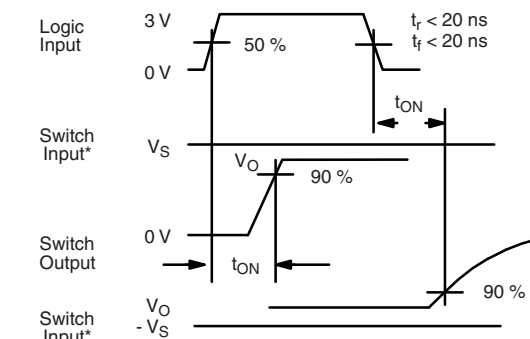
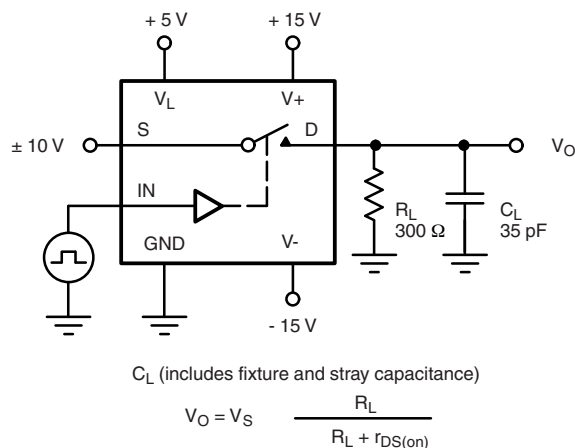


Figure 1.

## TEST CIRCUITS



\*  $V_S = 10$  V for  $t_{ON}$ ,  $V_S = -10$  V for  $t_{OFF}$

Note: Logic input waveform is inverted for switches that have the opposite logic sense control

Figure 2. Switching Time

## TEST CIRCUITS

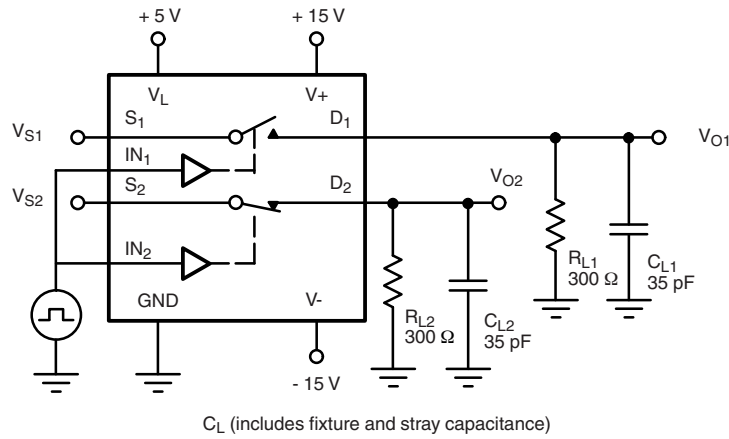
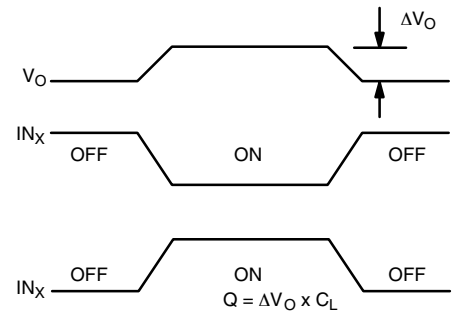
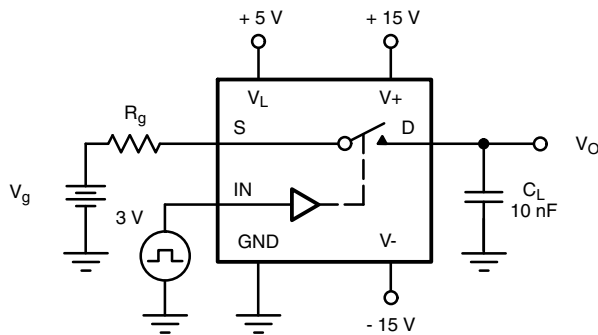
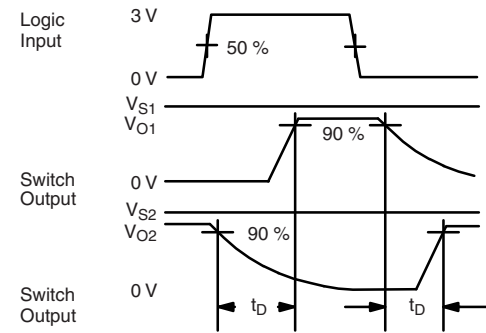


Figure 3. Break-Before-Make (DG413)



$IN_X$  dependent on switch configuration Input polarity determined by sense of switch.

Figure 4. Charge Injection

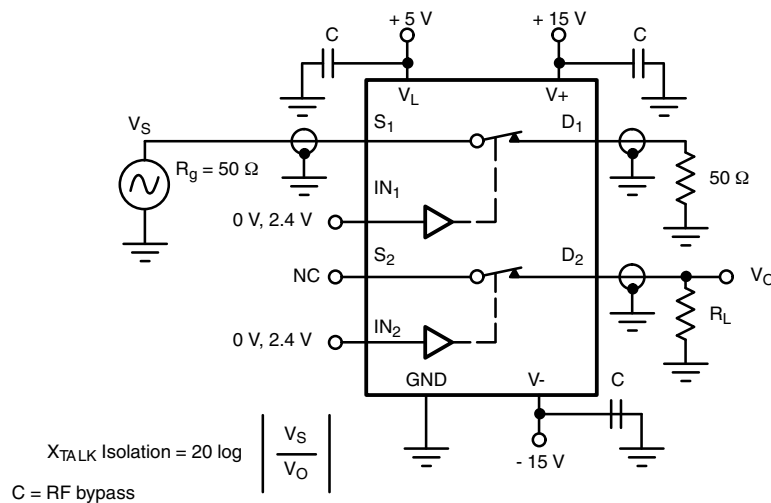


Figure 5. Crosstalk

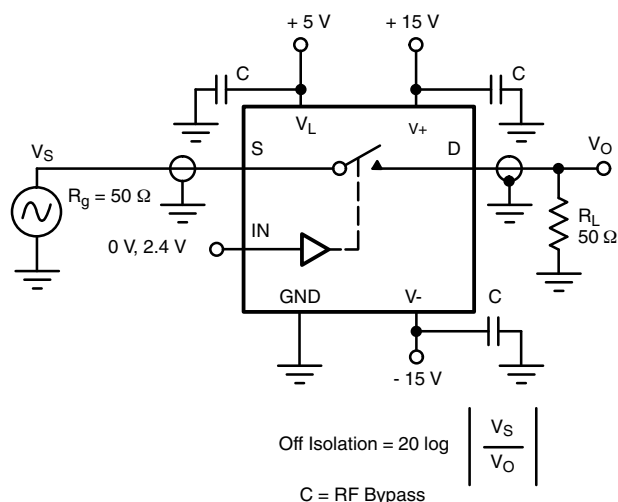


Figure 6. Off Isolation

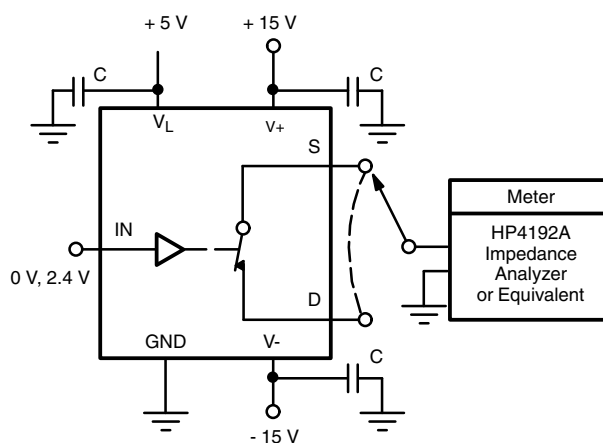


Figure 7. Source/Drain Capacitances

## APPLICATIONS

### Single Supply Operation:

The DG411, DG412, DG413 can be operated with unipolar supplies from 5 V to 44 V. These devices are characterized and tested for unipolar supply operation at 12 V to facilitate the majority of applications. In single supply operation, V+ is tied to VL and V- is tied to 0 V. See Input Switching Threshold vs. Supply Voltage curve for VL versus input threshold requirements.

### Summing Amplifier

When driving a high impedance, high capacitance load such as shown in figure 8, where the inputs to the summing amplifier have some noise filtering, it is necessary to have shunt switches for rapid discharge of the filter capacitor, thus preventing offsets from occurring at the output.

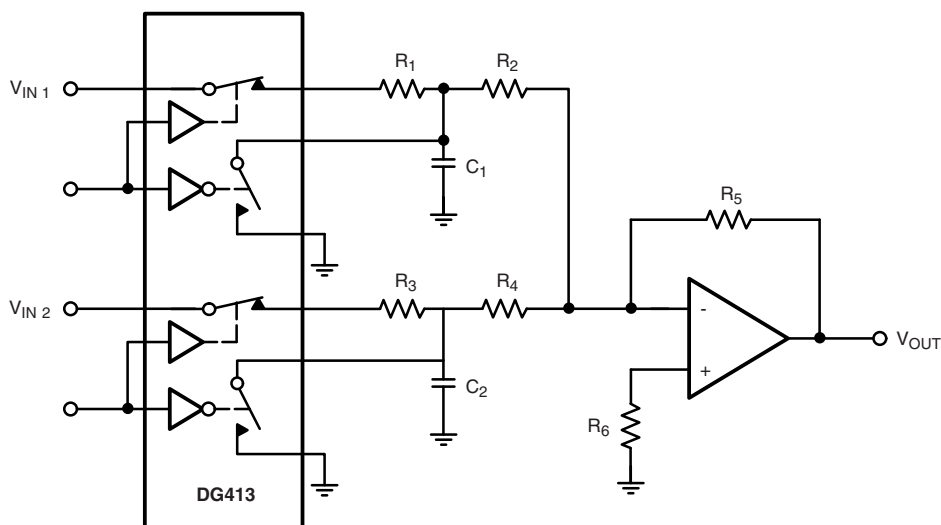


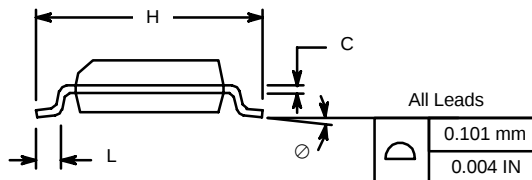
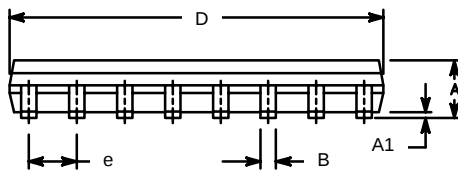
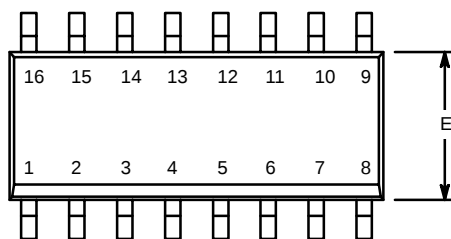
Figure 8. Summing Amplifier

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?70050](http://www.vishay.com/ppg?70050).



### SOIC (NARROW): 16-LEAD

JEDEC Part Number: MS-012

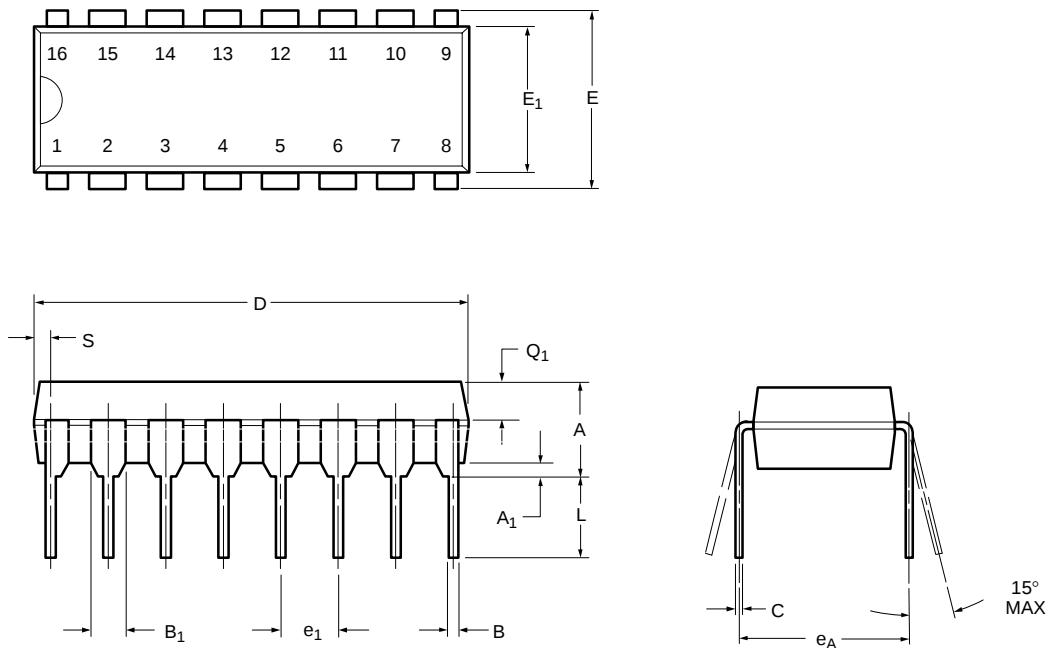


| Dim            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | Min         | Max   | Min       | Max   |
| A              | 1.35        | 1.75  | 0.053     | 0.069 |
| A <sub>1</sub> | 0.10        | 0.20  | 0.004     | 0.008 |
| 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



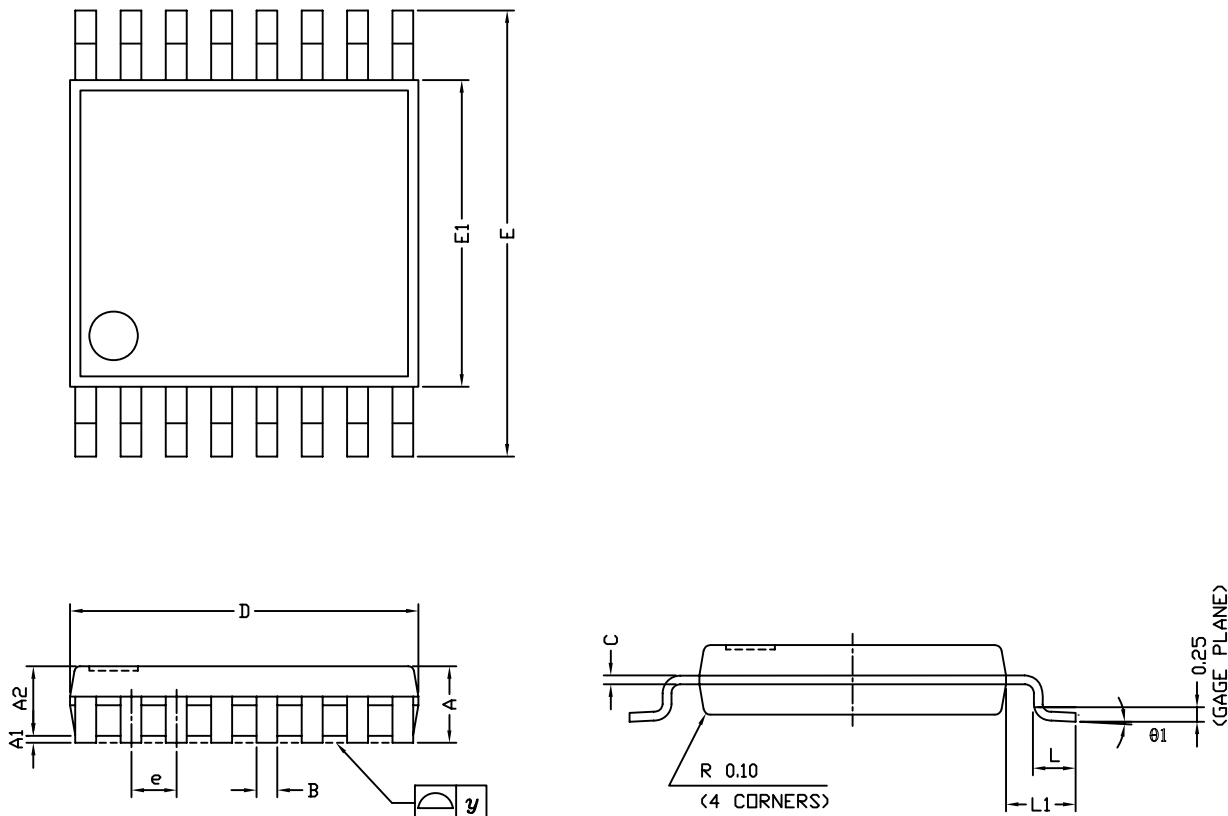
**PDIP: 16-LEAD**



| 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

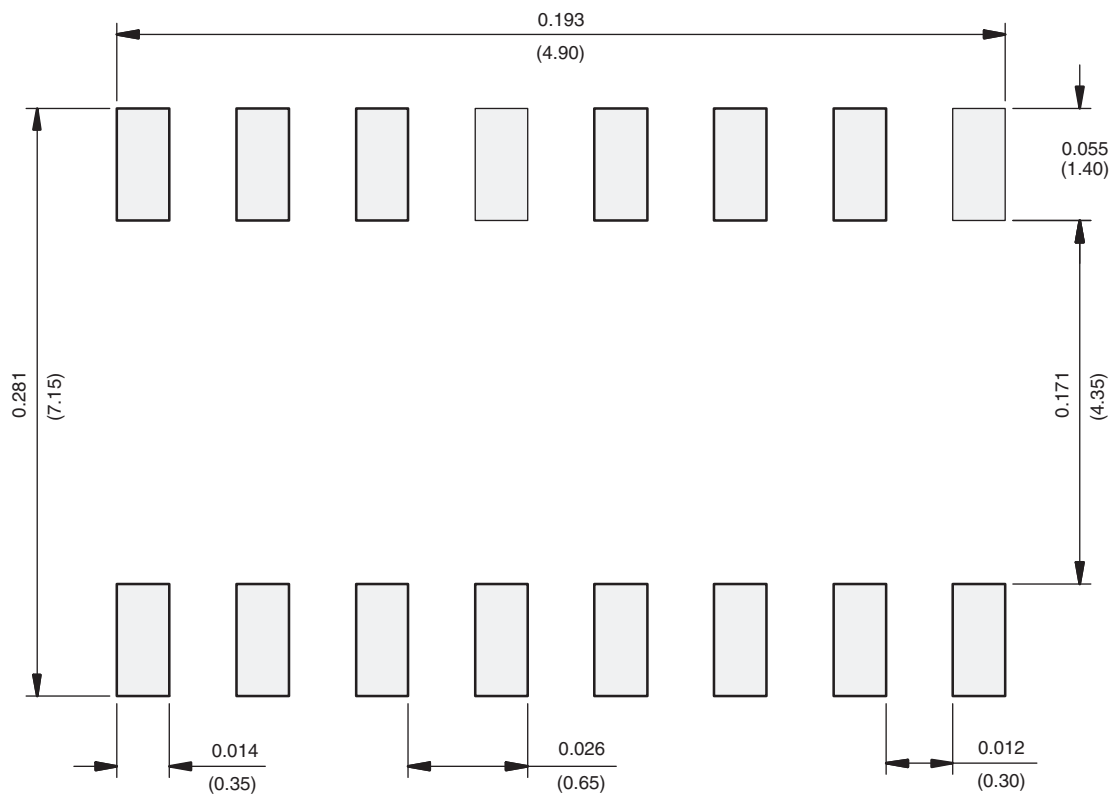
## TSSOP: 16-LEAD



| 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                      |                           |       |      |

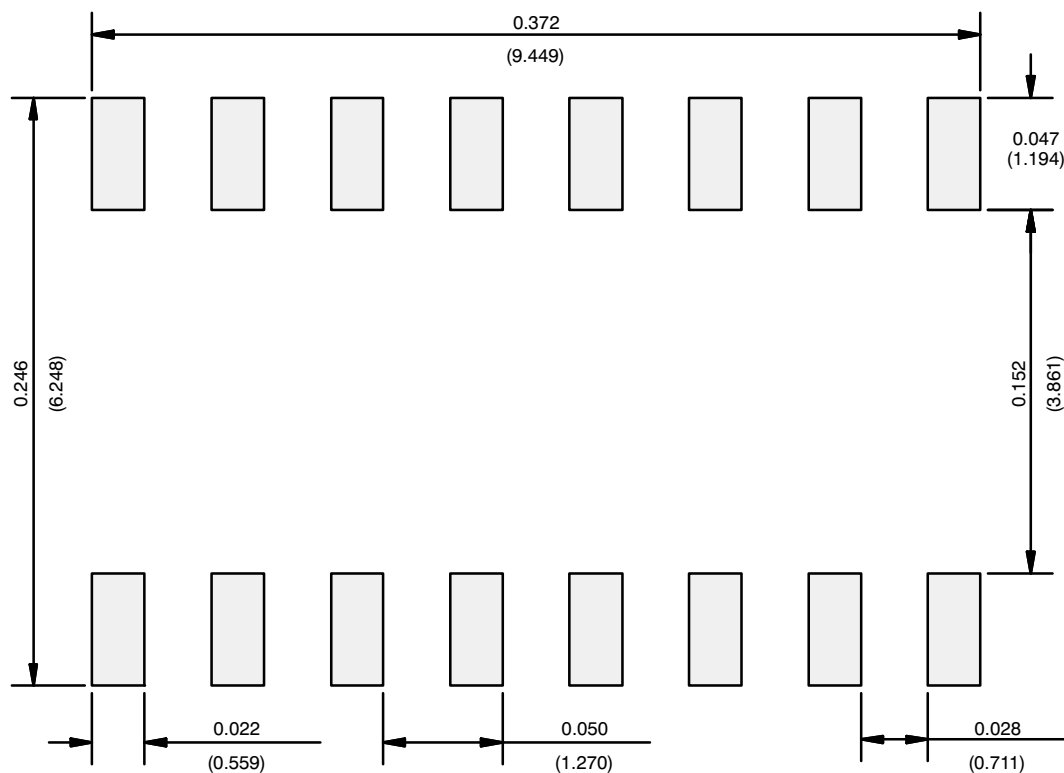


## RECOMMENDED MINIMUM PAD FOR TSSOP-16



Recommended Minimum Pads  
Dimensions in inches (mm)

## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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