

# 16 $\Omega$ , Low Parasitic Capacitance and Leakage, +12 V / +5 V / +3 V / $\pm$ 5 V Quad SPST Switches

## DESCRIPTION

The DG411LE, DG412LE, and DG413LE are monolithic quad single-pole-single-throw analog switches. The DG411LE and DG412LE differ only in that they respond to opposite logic levels. The DG413LE has two normally open and two normally closed switches. It can be given various configurations, including four SPST, two SPDT, and one DPDT.

The DG411LE, DG412LE, and DG413LE offer low on resistance of 16  $\Omega$ , low parasitic capacitance of 15 pF switch on capacitance, and low charge injection over the signal swing range.

The DG411LE, DG412LE, and DG413LE operate on single and dual supplies. Single supply voltage ranges from 3 V to 16 V while dual supply operation is recommended with  $\pm$  3 V to  $\pm$  8 V. Each switch conducts equally well in both direction when on, and blocks input voltages up to the supply levels when off.

The DG411LE, DG412LE, and DG413LE are available in 16 lead TSSOP, SOIC, and PDIP packages.

## FEATURES

- 3 V to 16 V single supply or  $\pm$  3 V to  $\pm$  8 V dual supply
- On-resistance  $R_{DS(on)}$ : 16  $\Omega$
- Low parasitic capacitance:  
 $C_{D(ON)}$ : 15 pF  
 $C_{S(OFF)}$ : 5 pF
- Less than 8 pC charge injection over the full signal swing range
- Fast switching  $t_{ON}$ : 16 ns  
 $t_{OFF}$ : 9 ns
- TTL, CMOS compatible
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

## Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.



Available  
**RoHS\***  
Available

## BENEFITS

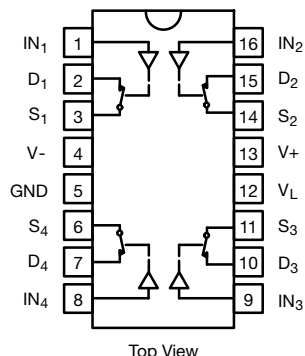
- Wide operation voltage range
- Low signal errors and distortion
- Fast switching time
- Minimized switching glitch

## APPLICATIONS

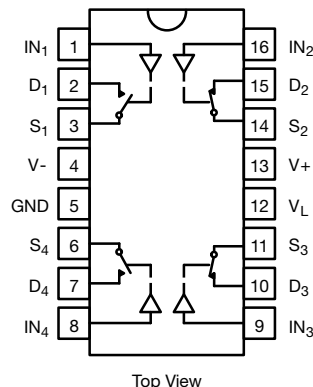
- Automatic test equipment
- Data acquisition systems
- Meters and instruments
- Medical and healthcare systems
- Communication systems
- Audio and video signal routing
- Relay replacement
- Battery powered systems
- Computer peripherals
- Audio and video signal routing

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

**DG411LE, DG412LE**  
Dual-In-Line, TSSOP and SOIC



**DG413LE**  
Dual-In-Line, TSSOP and SOIC



**TRUTH TABLE**

| LOGIC | DG411LE | DG412LE |
|-------|---------|---------|
| 0     | ON      | OFF     |
| 1     | OFF     | ON      |

Logic "0"  $\leq 0.8$  VLogic "1"  $\geq 2.4$  V**TRUTH TABLE**

| LOGIC | SW <sub>1</sub> , SW <sub>4</sub> | SW <sub>2</sub> , SW <sub>3</sub> |
|-------|-----------------------------------|-----------------------------------|
| 0     | OFF                               | ON                                |
| 1     | ON                                | OFF                               |

Logic "0"  $\leq 0.8$  VLogic "1"  $\geq 2.4$  V**ORDERING INFORMATION**

| TEMP. RANGE                   | CONFIGURATION | PACKAGE      | PART NUMBER      | MIN. ORDER / PACK. QUANTITY |
|-------------------------------|---------------|--------------|------------------|-----------------------------|
| -40 °C to +85 °C<br>Lead-free | DG411LE       | 16-pin TSSOP | DG411LEDQ-GE3    | Tube 360 units              |
|                               |               |              | DG411LEDQ-T1-GE3 | Tape and reel, 3000 units   |
|                               |               | 16-pin SOIC  | DG411LEDY-GE3    | Tube 500 units              |
|                               |               |              | DG411LEDY-T1-GE3 | Tape and reel, 2500 units   |
|                               | DG412LE       | 16-pin PDIP  | DG411LEDJ-GE3    | Tube 500 units              |
|                               |               |              | DG412LEDQ-GE3    | Tube 360 units              |
|                               |               | 16-pin SOIC  | DG412LEDQ-T1-GE3 | Tape and reel, 3000 units   |
|                               |               |              | DG412LEDY-GE3    | Tube 500 units              |
|                               | DG413LE       | 16-pin SOIC  | DG412LEDY-T1-GE3 | Tape and reel, 2500 units   |
|                               |               |              | DG412LEDJ-GE3    | Tube 500 units              |
|                               |               | 16-pin PDIP  | DG413LEDQ-GE3    | Tube 360 units              |
|                               |               |              | DG413LEDQ-T1-GE3 | Tape and reel, 3000 units   |
|                               |               | 16-pin SOIC  | DG413LEDY-GE3    | Tube 500 units              |
|                               |               |              | DG413LEDY-T1-GE3 | Tape and reel, 2500 units   |
|                               |               | 16-pin PDIP  | DG413LEDJ-GE3    | Tube 500 units              |
|                               |               |              |                  |                             |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                                     |                            | LIMIT                                                 | UNIT |
|---------------------------------------------------------------|----------------------------|-------------------------------------------------------|------|
| V+ to V-                                                      |                            | -0.3 to +18                                           | V    |
| GND to V-                                                     |                            | 18                                                    |      |
| V <sub>L</sub>                                                |                            | (GND -0.3) to (V+) +0.3                               |      |
| I <sub>N</sub> <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub> |                            | -0.3 to (V+) +0.3<br>or 30 mA, whichever occurs first |      |
| Continuous Current (Any terminal)                             |                            | 30                                                    | mA   |
| Peak Current, S or D (Pulsed 1 ms, 10 % duty cycle)           |                            | 100                                                   |      |
| Storage Temperature                                           | (DQ, DY suffix)            | -65 to +125                                           | °C   |
|                                                               | (AK suffix)                | -65 to +150                                           |      |
| Power Dissipation (Packages) <sup>b</sup>                     | 16-pin TSSOP <sup>c</sup>  | 450                                                   | mW   |
|                                                               | 16-pin SOIC <sup>d</sup>   | 650                                                   |      |
|                                                               | 16-pin CerDIP <sup>e</sup> | 900                                                   |      |
| ESD Human Body Model (HBM); per ANSI / ESDA / JEDEC® JS-001   |                            | 2500                                                  | V    |
| Latch Up Current, per JESD78D                                 |                            | 400                                                   | mA   |

**Notes**

- Signals on S<sub>x</sub>, D<sub>x</sub>, or I<sub>Nx</sub> exceeding V<sub>+</sub> or V<sub>-</sub> will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC board.
- Derate 7 mW/°C above 75 °C.
- Derate 7.6 mW/°C above 75 °C.
- Derate 12 mW/°C above 75 °C.

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.



| SPECIFICATIONS <sup>a</sup> (Single Supply 12 V) |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
|--------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-----------------------------------------|-------------------|----------------------------------------|-------------------|------|
| PARAMETER                                        | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 12 V, V <sub>-</sub> = 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>LIMITS<br>-55 °C to +125 °C |                   | D SUFFIX<br>LIMITS<br>-40 °C to +85 °C |                   | UNIT |
|                                                  |                     |                                                                                                                                                                      |                    |                   | MIN. <sup>d</sup>                       | MAX. <sup>d</sup> | MIN. <sup>d</sup>                      | MAX. <sup>d</sup> |      |
| Analog Switch                                    |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
| Analog Signal Range <sup>e</sup>                 | V <sub>ANALOG</sub> |                                                                                                                                                                      | Full               | -                 | 0                                       | 12                | 0                                      | 12                | V    |
| Drain-Source<br>On-Resistance                    | R <sub>DS(on)</sub> | V <sub>+</sub> = 10.8 V, V <sub>-</sub> = 0 V<br>I <sub>S</sub> = 10 mA, V <sub>D</sub> = 2/9 V                                                                      | Room               | 16                | -                                       | 26                | -                                      | 26                | Ω    |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 40                | -                                      | 35                |      |
| Switch Off Leakage Current                       | I <sub>S(off)</sub> | V <sub>D</sub> = 1/11 V, V <sub>S</sub> = 11/1 V                                                                                                                     | Room               | -                 | -1                                      | 1                 | -1                                     | 1                 | nA   |
|                                                  | I <sub>D(off)</sub> |                                                                                                                                                                      | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
|                                                  |                     |                                                                                                                                                                      | Room               | -                 | -1                                      | 1                 | -1                                     | 1                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
| Channel On Leakage<br>Current                    | I <sub>D(on)</sub>  | V <sub>S</sub> = V <sub>D</sub> = 11/1 V                                                                                                                             | Room               | -                 | -1                                      | 1                 | -1                                     | 1                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
| Digital Control                                  |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
| Input Current, VIN Low                           | I <sub>IL</sub>     | V <sub>IN</sub> under test = 0.8 V                                                                                                                                   | Full               | 0.01              | -1.5                                    | 1.5               | -1                                     | 1                 | μA   |
| Input Current, VIN High                          | I <sub>IH</sub>     | V <sub>IN</sub> under test = 2.4 V                                                                                                                                   | Full               |                   | -1.5                                    | 1.5               | -1                                     | 1                 |      |
| 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> = 5 V, see figure 2                                                                                | Room               | 16                | -                                       | 50                | -                                      | 50                | ns   |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 70                | -                                      | 60                |      |
| Turn-Off Time                                    | t <sub>OFF</sub>    |                                                                                                                                                                      | Room               | 9                 | -                                       | 30                | -                                      | 30                |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 48                | -                                      | 40                |      |
| Break-Before-Make<br>Time Delay                  | t <sub>D</sub>      | DG413L only, V <sub>S</sub> = 5 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                                                 | Room               | 5                 | -                                       | -                 | -                                      | -                 | pC   |
| Charge Injection <sup>e</sup>                    | Q                   | V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 10 nF                                                                                                   | Room               | 6.6               | -                                       | -                 | -                                      | -                 | pC   |
| Off-Isolation <sup>e</sup>                       | OIRR                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                                                                                              | Room               | 68.4              | -                                       | -                 | -                                      | -                 | dB   |
| Channel-to-Channel<br>Crosstalk <sup>e</sup>     | X <sub>TALK</sub>   |                                                                                                                                                                      | Room               | 114               | -                                       | -                 | -                                      | -                 |      |
| Source Off Capacitance <sup>e</sup>              | C <sub>S(off)</sub> | f = 1 MHz                                                                                                                                                            | Room               | 5                 | -                                       | -                 | -                                      | -                 | pF   |
| Drain Off Capacitance <sup>e</sup>               | C <sub>D(off)</sub> |                                                                                                                                                                      | Room               | 6                 | -                                       | -                 | -                                      | -                 |      |
| Channel-On Capacitance <sup>e</sup>              | C <sub>D(on)</sub>  |                                                                                                                                                                      | Room               | 15                | -                                       | -                 | -                                      | -                 |      |
| Power Supplies                                   |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
| Positive Supply Current                          | I <sub>+</sub>      | V <sub>IN</sub> = 0 V or 5 V                                                                                                                                         | Room               | 0.02              | -                                       | 1                 | -                                      | 1                 | μA   |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 7.5               | -                                      | 5                 |      |
| Negative Supply Current                          | I <sub>-</sub>      |                                                                                                                                                                      | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -7.5                                    | -                 | -5                                     | -                 |      |
| Logic Supply Current                             | I <sub>L</sub>      |                                                                                                                                                                      | Room               | 0.002             | -                                       | 1                 | -                                      | 1                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 7.5               | -                                      | 5                 |      |
| Ground Current                                   | I <sub>GND</sub>    |                                                                                                                                                                      | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -7.5                                    | -                 | -5                                     | -                 |      |

**Notes**

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



| SPECIFICATIONS <sup>a</sup> (Dual Supply ± 5 V)  |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
|--------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-----------------------------------------|-------------------|----------------------------------------|-------------------|------|
| PARAMETER                                        | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 5 V, V <sub>-</sub> = -5 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>LIMITS<br>-55 °C to +125 °C |                   | D SUFFIX<br>LIMITS<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               | -                 | -5                                      | 5                 | -5                                     | 5                 | V    |
| Drain-Source<br>On-Resistance                    | R <sub>DS(on)</sub> | V <sub>+</sub> = 5 V, V <sub>-</sub> = -5 V,<br>I <sub>S</sub> = 10 mA, V <sub>D</sub> = ± 3.5 V                                                                     | Room               | 18                | -                                       | 30                | -                                      | 30                | Ω    |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 42                | -                                      | 37                |      |
| Switch Off<br>Leakage Current <sup>g</sup>       | I <sub>S(off)</sub> | V <sub>+</sub> = 5.5, V <sub>-</sub> = -5.5 V,<br>V <sub>D</sub> = ± 4.5 V, V <sub>S</sub> = ± 4.5 V                                                                 | Room               | -                 | -1                                      | 1                 | -1                                     | 1                 | nA   |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
|                                                  | I <sub>D(off)</sub> |                                                                                                                                                                      | Room               | -                 | -1                                      | 1                 | -1                                     | 1                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
| Channel On<br>Leakage Current <sup>g</sup>       | 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                                                                        | Room               | -                 | -1                                      | 1                 | -1                                     | 1                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
| Digital Control                                  |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
| Input Current, V <sub>IN</sub> Low <sup>e</sup>  | I <sub>IL</sub>     | V <sub>IN</sub> under test = 0.8 V                                                                                                                                   | Full               | 0.05              | -1.5                                    | 1.5               | -1                                     | 1                 | μA   |
| Input Current, V <sub>IN</sub> High <sup>e</sup> | I <sub>IH</sub>     | V <sub>IN</sub> under test = 2.4 V                                                                                                                                   | Full               | 0.05              | -1.5                                    | 1.5               | -1                                     | 1                 |      |
| Dynamic Characteristics                          |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
| Turn-On Time <sup>e</sup>                        | t <sub>ON</sub>     | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF,<br>V <sub>S</sub> = ± 3.5 V, see figure 2                                                                            | Room               | 17                | -                                       | 50                | -                                      | 50                | ns   |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 70                | -                                      | 60                |      |
| Turn-Off Time <sup>e</sup>                       | t <sub>OFF</sub>    |                                                                                                                                                                      | Room               | 12                | -                                       | 35                | -                                      | 35                |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 50                | -                                      | 40                |      |
| Break-Before-Make Time<br>Delay <sup>e</sup>     | t <sub>D</sub>      | DG413L only, V <sub>S</sub> = 3.5 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                                               | Room               | 5                 | -                                       | -                 | -                                      | -                 |      |
| Charge Injection <sup>e</sup>                    | Q                   | V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 10 nF                                                                                                   | Room               | 5.8               | -                                       | -                 | -                                      | -                 | pC   |
| Off Isolation <sup>e</sup>                       | OIRR                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                                                                                              | Room               | 68                | -                                       | -                 | -                                      | -                 | dB   |
| Channel-to-Channel<br>Crosstalk <sup>e</sup>     | X <sub>TALK</sub>   |                                                                                                                                                                      | Room               | 113               | -                                       | -                 | -                                      | -                 |      |
| Source Off Capacitance <sup>e</sup>              | C <sub>S(off)</sub> | f = 1 MHz                                                                                                                                                            | Room               | 5                 | -                                       | -                 | -                                      | -                 | pF   |
| Drain Off Capacitance <sup>e</sup>               | C <sub>D(off)</sub> |                                                                                                                                                                      | Room               | 6                 | -                                       | -                 | -                                      | -                 |      |
| Channel On Capacitance <sup>e</sup>              | C <sub>D(on)</sub>  |                                                                                                                                                                      | Room               | 14                | -                                       | -                 | -                                      | -                 |      |
| Power Supplies                                   |                     |                                                                                                                                                                      |                    |                   |                                         |                   |                                        |                   |      |
| Positive Supply Current <sup>e</sup>             | I <sub>+</sub>      | V <sub>IN</sub> = 0 V or 5 V                                                                                                                                         | Room               | 0.03              | -                                       | 1                 | -                                      | 1                 | μA   |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 7.5               | -                                      | 5                 |      |
| Negative Supply Current <sup>e</sup>             | I <sub>-</sub>      |                                                                                                                                                                      | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -7.5                                    | -                 | -5                                     | -                 |      |
| Logic Supply Current <sup>e</sup>                | I <sub>L</sub>      |                                                                                                                                                                      | Room               | 0.002             | -                                       | 1                 | -                                      | 1                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -                                       | 7.5               | -                                      | 5                 |      |
| Ground Current <sup>e</sup>                      | I <sub>GND</sub>    |                                                                                                                                                                      | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |      |
|                                                  |                     |                                                                                                                                                                      | Full               | -                 | -7.5                                    | -                 | -5                                     | -                 |      |

**Notes**

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



| SPECIFICATIONS <sup>a</sup> (Single Supply 5 V) |                     |                                                                                                                                                                     |                    |                   |                                         |                   |                                        |                   |      |
|-------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|-----------------------------------------|-------------------|----------------------------------------|-------------------|------|
| PARAMETER                                       | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 5 V, V <sub>-</sub> = 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>LIMITS<br>-55 °C to +125 °C |                   | D SUFFIX<br>LIMITS<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               | -                 | -                                       | 5                 | -                                      | 5                 | V    |
| Drain-Source<br>On-Resistance <sup>e</sup>      | R <sub>DS(on)</sub> | V <sub>+</sub> = 4.5 V,<br>I <sub>S</sub> = 5 mA, V <sub>D</sub> = 1 V, 3.5 V                                                                                       | Room               | 36                | -                                       | 50                | -                                      | 50                | Ω    |
|                                                 |                     |                                                                                                                                                                     | Full               | -                 | -                                       | 88                | -                                      | 75                |      |
| Dynamic Characteristics                         |                     |                                                                                                                                                                     |                    |                   |                                         |                   |                                        |                   |      |
| Turn-On Time <sup>e</sup>                       | t <sub>ON</sub>     | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF,<br>V <sub>S</sub> = 3.5 V, see figure 2                                                                             | Room               | 27                | -                                       | 50                | -                                      | 50                | ns   |
|                                                 |                     |                                                                                                                                                                     | Hot                | -                 | -                                       | 90                | -                                      | 60                |      |
| Turn-Off Time <sup>e</sup>                      | t <sub>OFF</sub>    |                                                                                                                                                                     | Room               | 15                | -                                       | 30                | -                                      | 30                |      |
|                                                 |                     |                                                                                                                                                                     | Hot                | -                 | -                                       | 55                | -                                      | 40                |      |
| Break-Before-Make Time<br>Delay <sup>e</sup>    | t <sub>D</sub>      | DG413L only, V <sub>S</sub> = 3.5 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                                              | Room               | 11                | -                                       | -                 | -                                      | -                 | pC   |
| Charge Injection <sup>e</sup>                   | Q                   | V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 10 nF                                                                                                  | Room               | 3.3               | -                                       | -                 | -                                      | -                 |      |
| Power Supplies                                  |                     |                                                                                                                                                                     |                    |                   |                                         |                   |                                        |                   |      |
| Positive Supply Current <sup>e</sup>            | I <sub>+</sub>      | V <sub>IN</sub> = 0 V or 5 V                                                                                                                                        | Room               | 0.02              | -                                       | 1                 | -                                      | 1                 | μA   |
|                                                 |                     |                                                                                                                                                                     | Hot                | -                 | -                                       | 7.5               | -                                      | 5                 |      |
| Negative Supply Current <sup>e</sup>            | I <sub>-</sub>      |                                                                                                                                                                     | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |      |
|                                                 |                     |                                                                                                                                                                     | Hot                | -                 | -7.5                                    | -                 | -5                                     | -                 |      |
| Logic Supply Current <sup>e</sup>               | I <sub>L</sub>      |                                                                                                                                                                     | Room               | 0.002             | -                                       | 1                 | -                                      | 1                 |      |
|                                                 |                     |                                                                                                                                                                     | Hot                | -                 | -                                       | 7.5               | -                                      | 5                 |      |
| Ground Current <sup>e</sup>                     | I <sub>GND</sub>    |                                                                                                                                                                     | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |      |
|                                                 |                     |                                                                                                                                                                     | Hot                | -                 | -7.5                                    | -                 | -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 datasheet.
- Guaranteed by design, not subject to production test.
- $V_{IN}$  = input voltage to perform proper function.
- Leakage parameters are guaranteed by worst case test conditions and not subject to test.



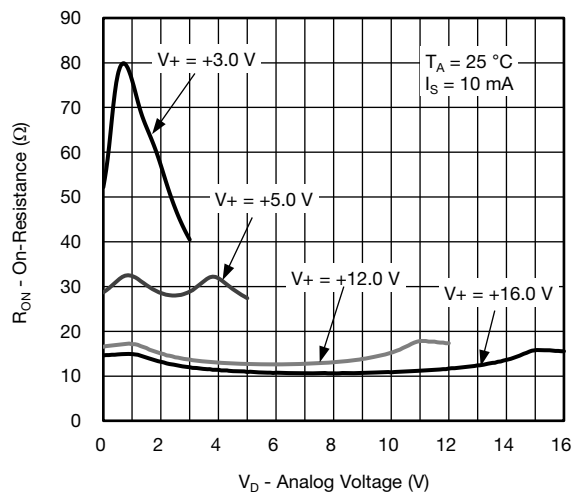
| SPECIFICATIONS <sup>a</sup> (Single Supply 3 V) |                     |                                                                                                                                                                     |                    |                   |                                      |                   |                                     |                   |      |
|-------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|--------------------------------------|-------------------|-------------------------------------|-------------------|------|
| PARAMETER                                       | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 3 V, V <sub>-</sub> = 0 V<br>V <sub>L</sub> = 3 V, V <sub>IN</sub> = 0.4 V, 2.0 V <sup>f</sup> | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | A SUFFIX LIMITS<br>-55 °C to +125 °C |                   | D SUFFIX LIMITS<br>-40 °C to +85 °C |                   | UNIT |
|                                                 |                     |                                                                                                                                                                     |                    |                   | MIN. <sup>d</sup>                    | MAX. <sup>d</sup> | MIN. <sup>d</sup>                   | MAX. <sup>d</sup> |      |
| Analog Switch                                   |                     |                                                                                                                                                                     |                    |                   |                                      |                   |                                     |                   |      |
| Analog Signal Range <sup>e</sup>                | V <sub>ANALOG</sub> |                                                                                                                                                                     | Full               | -                 | 0                                    | 3                 | 0                                   | 3                 | V    |
| Drain-Source<br>On-Resistance                   | R <sub>DS(on)</sub> | V <sub>+</sub> = 2.7 V, V <sub>-</sub> = 0 V,<br>I <sub>S</sub> = 5 mA, V <sub>D</sub> = 0.5, 2.2 V                                                                 | Room               | 106               | -                                    | 130               | -                                   | 130               | Ω    |
|                                                 |                     |                                                                                                                                                                     | Full               | -                 | -                                    | 150               | -                                   | 140               |      |
| Switch Off<br>Leakage Current <sup>g</sup>      | I <sub>S(off)</sub> | V <sub>+</sub> = 3.3, V <sub>-</sub> = 0 V,<br>V <sub>D</sub> = 1, 2 V, V <sub>S</sub> = 2, 1 V                                                                     | Room               | -                 | -1                                   | 1                 | -1                                  | 1                 | nA   |
|                                                 |                     |                                                                                                                                                                     | Full               | -                 | -15                                  | 15                | -10                                 | 10                |      |
|                                                 | I <sub>D(off)</sub> |                                                                                                                                                                     | Room               | -                 | -1                                   | 1                 | -1                                  | 1                 |      |
|                                                 |                     |                                                                                                                                                                     | Full               | -                 | -15                                  | 15                | -10                                 | 10                |      |
| Channel On<br>Leakage Current <sup>g</sup>      | I <sub>D(on)</sub>  | Room                                                                                                                                                                | -                  | -1                | 1                                    | -1                | 1                                   |                   |      |
|                                                 |                     | Full                                                                                                                                                                | -                  | -15               | 15                                   | -10               | 10                                  |                   |      |
| Digital Control                                 |                     |                                                                                                                                                                     |                    |                   |                                      |                   |                                     |                   |      |
| Input Current, V <sub>IN</sub> Low              | I <sub>IL</sub>     | V <sub>IN</sub> under test = 0.4 V                                                                                                                                  | Full               | 0.005             | -1.5                                 | 1.5               | -1                                  | 1                 | μA   |
| Input Current, V <sub>IN</sub> High             | I <sub>IH</sub>     | V <sub>IN</sub> under test = 2.4 V                                                                                                                                  | Full               | 0.005             | -1.5                                 | 1.5               | -1                                  | 1                 |      |
| 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> = 1.5 V, see figure 2                                                                             | Room               | 57                | -                                    | 85                | -                                   | 85                | ns   |
|                                                 |                     |                                                                                                                                                                     | Full               | -                 | -                                    | 150               | -                                   | 110               |      |
| Turn-Off Time                                   | t <sub>OFF</sub>    |                                                                                                                                                                     | Room               | 25                | -                                    | 60                | -                                   | 60                |      |
|                                                 |                     |                                                                                                                                                                     | Full               | -                 | -                                    | 100               | -                                   | 85                |      |
| Break-Before-Make Time<br>Delay                 | t <sub>D</sub>      | DG413L only, V <sub>S</sub> = 1.5 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                                                                              | Room               | 24                | -                                    | -                 | -                                   | -                 |      |
| Charge Injection <sup>e</sup>                   | Q                   | V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 10 nF                                                                                                  | Room               | 2                 | -                                    | -                 | -                                   | -                 |      |
| Off Isolation <sup>e</sup>                      | OIRR                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz                                                                                                             | Room               | 68                | -                                    | -                 | -                                   | -                 | dB   |
| Channel-to-Channel<br>Crosstalk <sup>e</sup>    | X <sub>TALK</sub>   |                                                                                                                                                                     | Room               | 107               | -                                    | -                 | -                                   | -                 |      |
| Source Off Capacitance <sup>e</sup>             | C <sub>S(off)</sub> | f = 1 MHz                                                                                                                                                           | Room               | 6                 | -                                    | -                 | -                                   | -                 | pF   |
| Drain Off Capacitance <sup>e</sup>              | C <sub>D(off)</sub> |                                                                                                                                                                     | Room               | 7                 | -                                    | -                 | -                                   | -                 |      |
| Channel On Capacitance <sup>e</sup>             | C <sub>D(on)</sub>  |                                                                                                                                                                     | Room               | 15                | -                                    | -                 | -                                   | -                 |      |

**Notes**

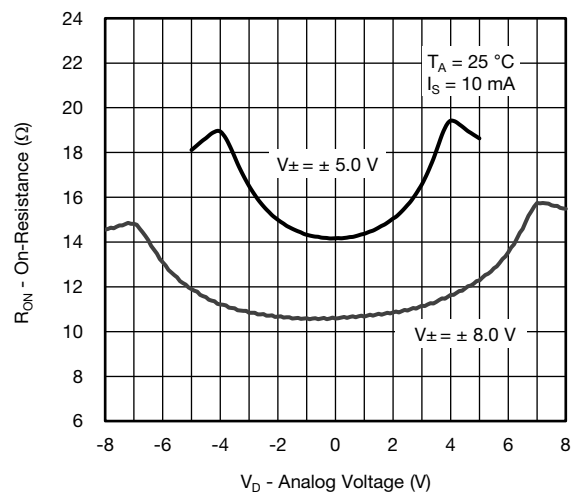
- a. Refer to PROCESS OPTION FLOWCHART.  
b. Room = 25 °C, full = as determined by the operating temperature suffix.  
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.  
d. The algebraic convention whereby the most negative value is a minimum and the most positive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



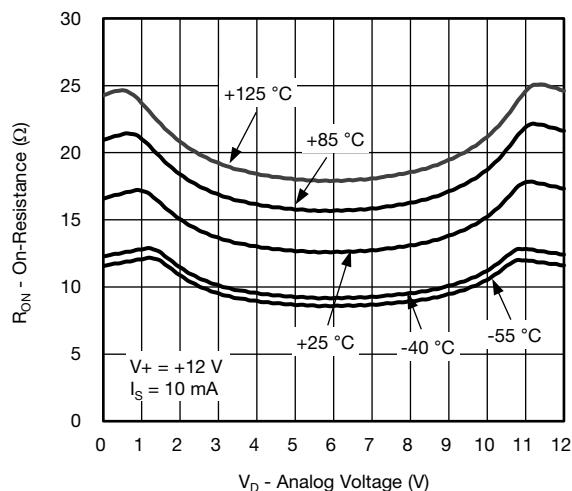
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



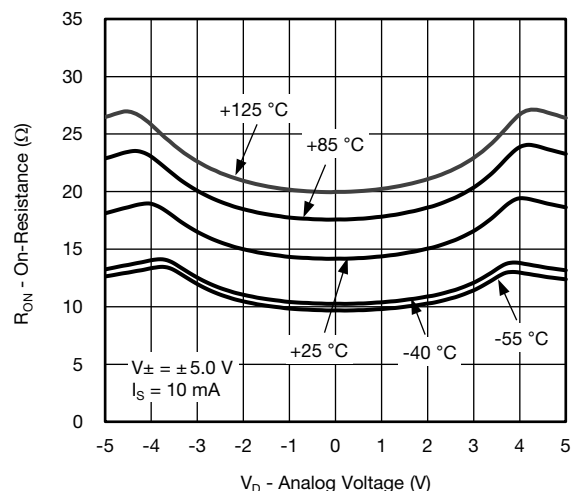
**$R_{DS(on)}$  vs. Drain Voltage (Single Supply)**



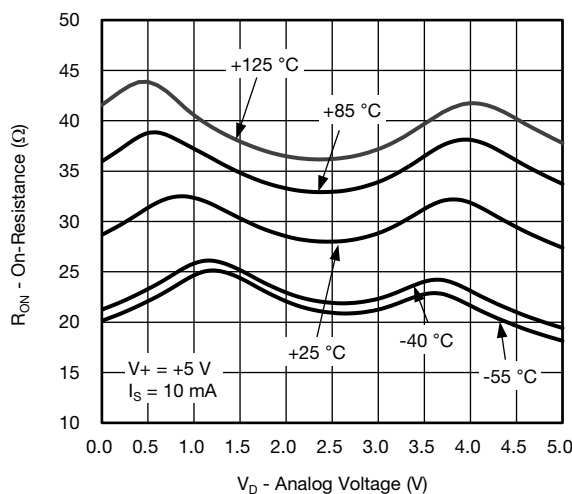
**$R_{DS(on)}$  vs. Drain Voltage and Temperature (Single Supply)**



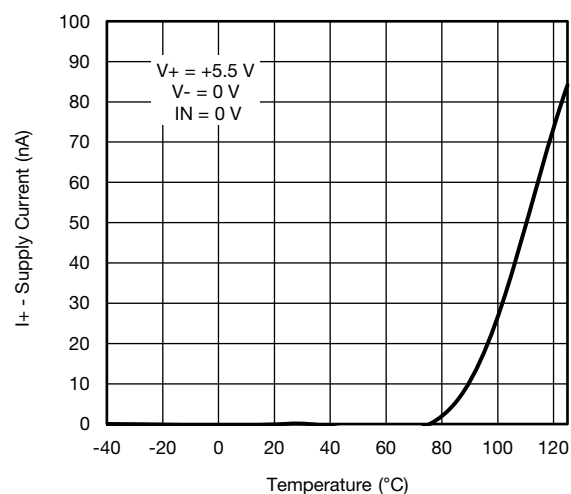
**$R_{DS(on)}$  vs. Drain Voltage and Temperature**



**Supply Current vs. Temperature**



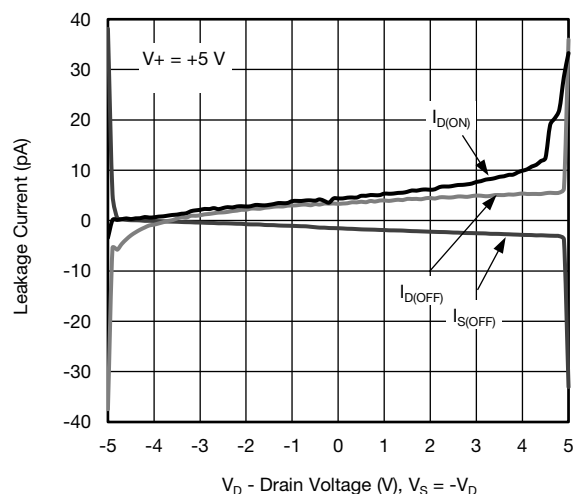
**$R_{DS(on)}$  vs. Drain Voltage and Temperature**



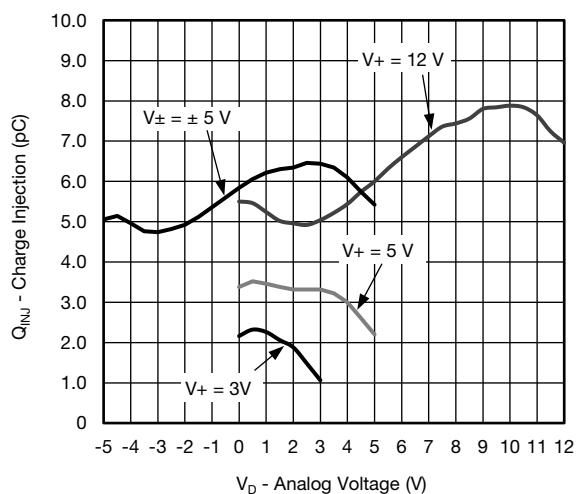
**Switching Time vs. Single Supply**



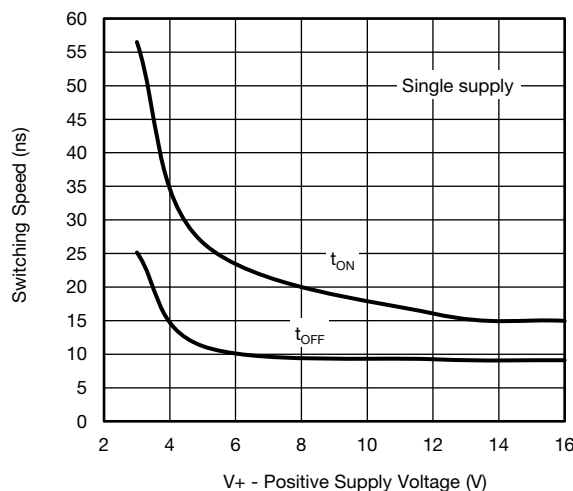
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



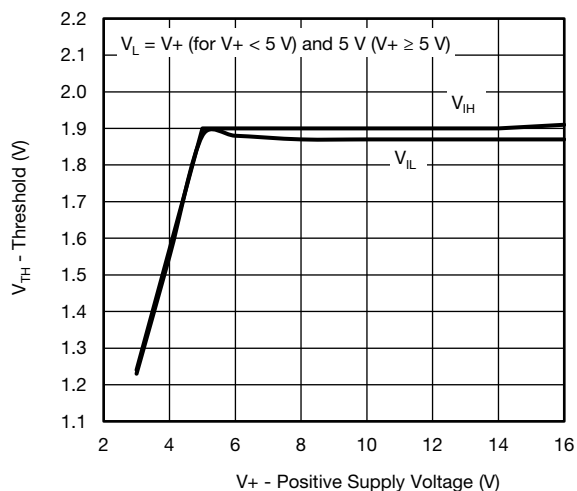
**Leakage Current vs. Drain Voltage**



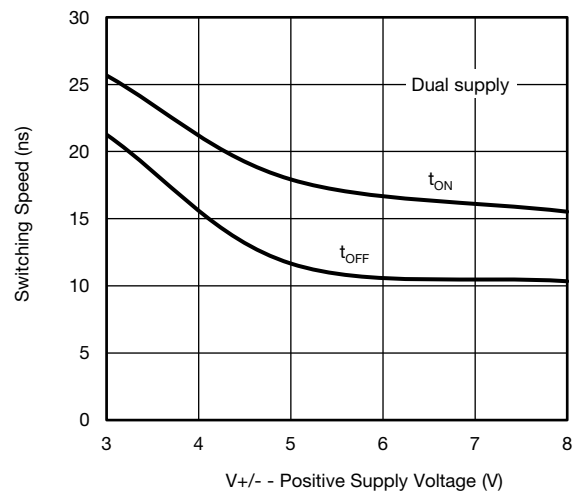
**Charge Injection vs. Drain Voltage**



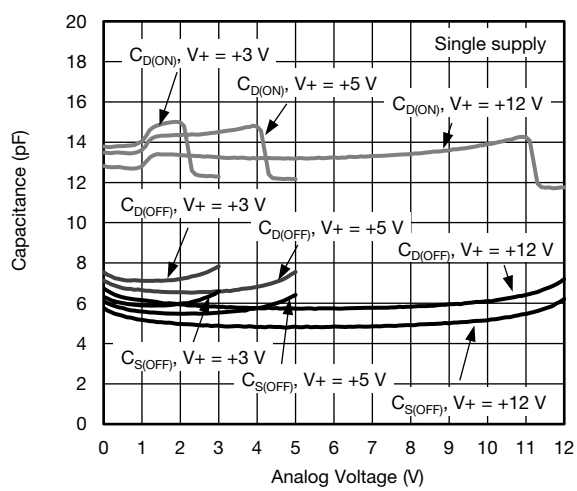
**Switching Time vs. Single Supply Voltage**



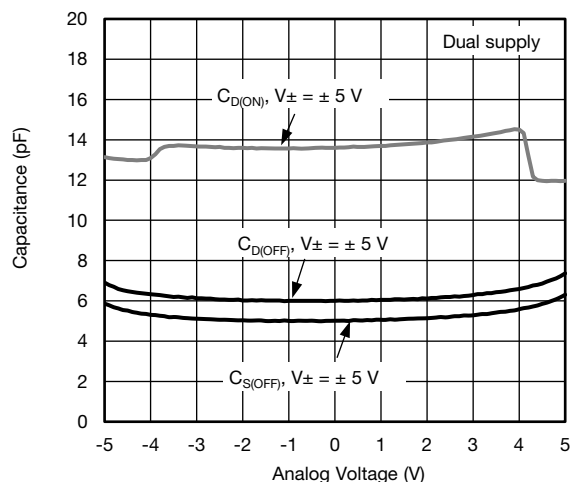
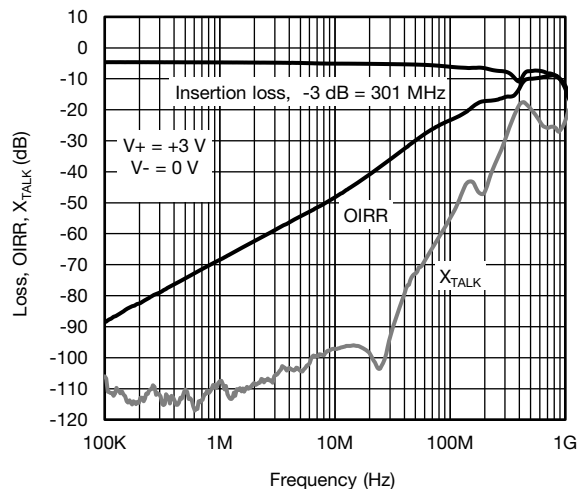
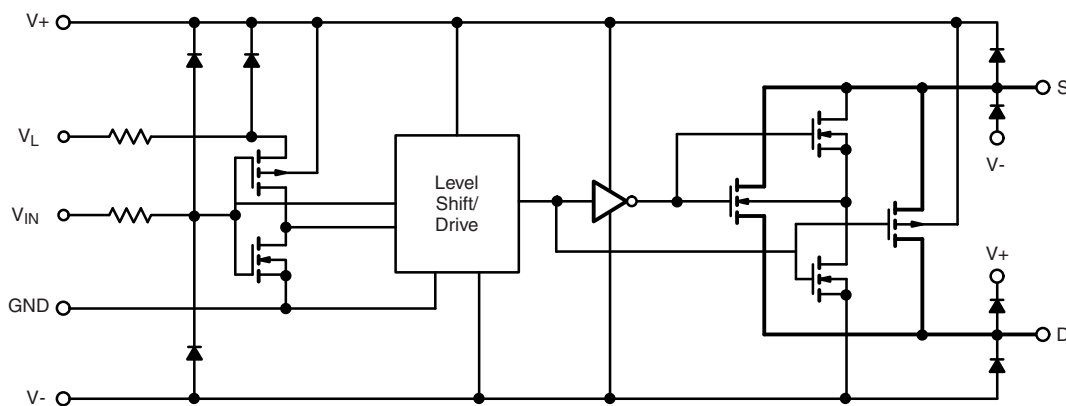
**Threshold vs. Single Supply Current**

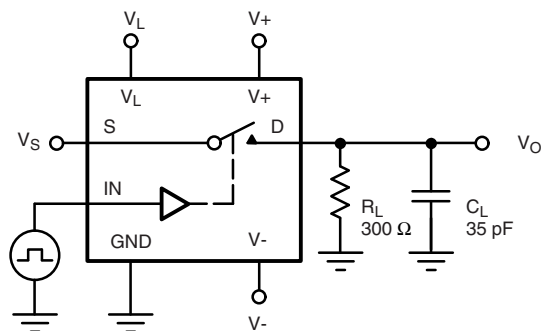


**Switching Time vs. Dual Supply Voltage**

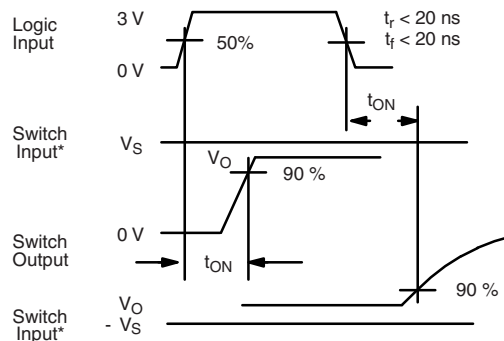


**Drain Capacitance vs. Drain Voltage (Single Supply)**

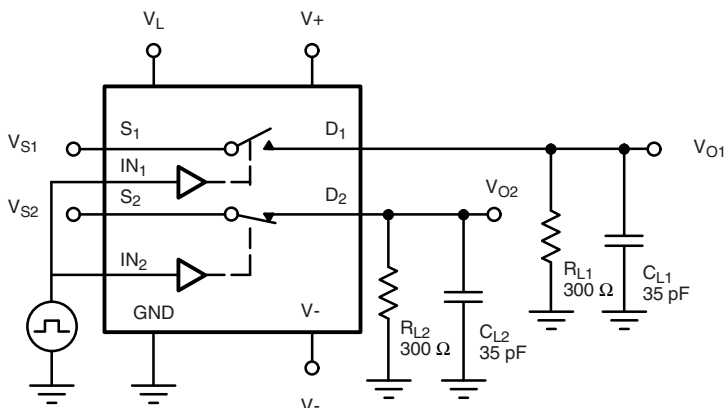
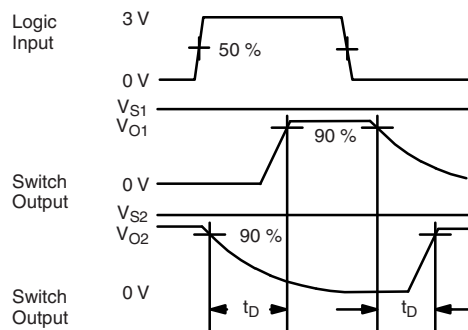
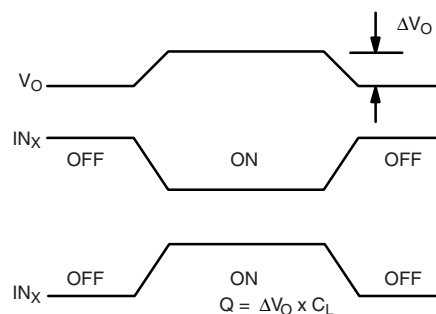
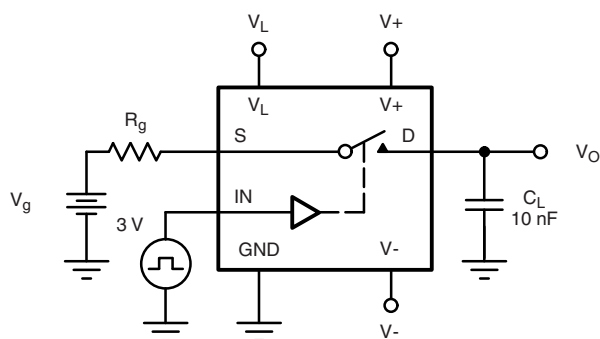
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Drain Capacitance vs. Drain Voltage (Dual Supply)**

**Insertion Loss, Off Isolation and Crosstalk vs. Frequency**
**SCHEMATIC DIAGRAM** (Typical Channel)

**Fig. 1**

**TEST CIRCUITS**

 $C_L$  (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$



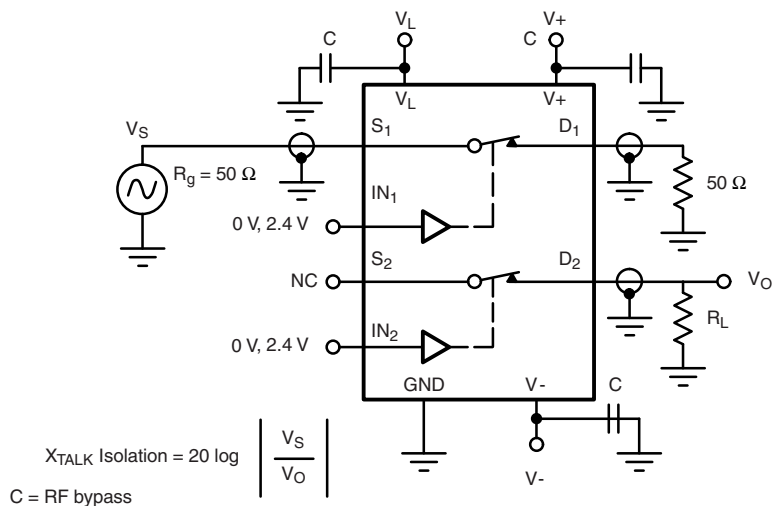
Note: Logic input waveform is inverted for switches that have the opposite logic sense control

**Fig. 2 - Switching Time**

 $C_L$  (includes fixture and stray capacitance)

**Fig. 3 - Break-Before-Make (DG413LE)**


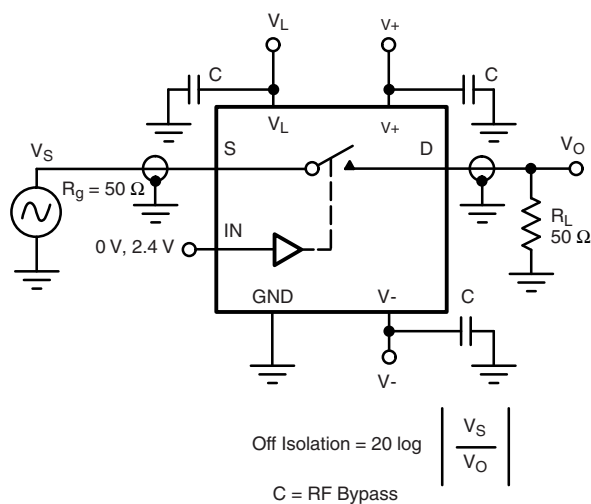
$IN_x$  dependent on switch configuration Input polarity determined by sense of switch.

**Fig. 4 - Charge Injection**

## TEST CIRCUITS



### Fig. 5 - Crosstalk



### Fig. 6 - Off-Isolation

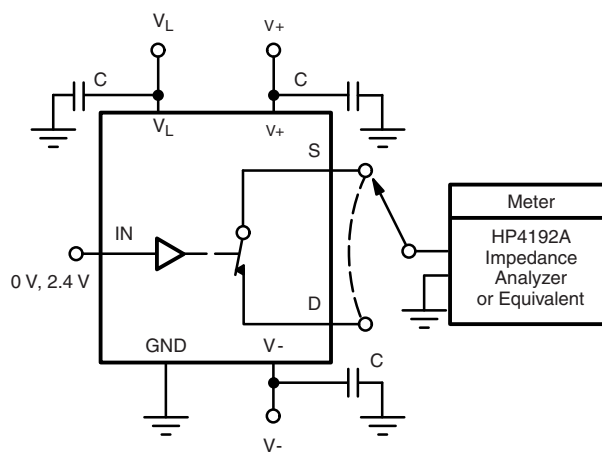


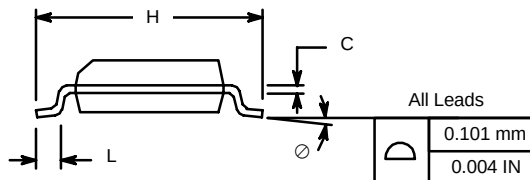
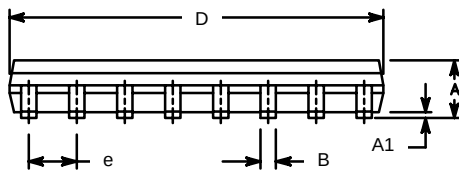
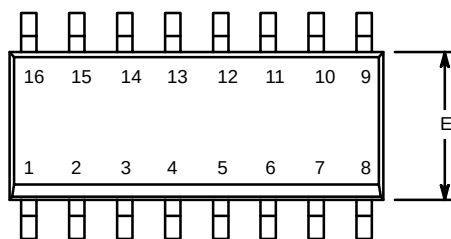
**Fig. 7 - Source / Drain Capacitances**

*Vishay Silconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silcon 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?78091](http://www.vishay.com/ppg?78091).*



### SOIC (NARROW): 16-LEAD

JEDEC Part Number: MS-012

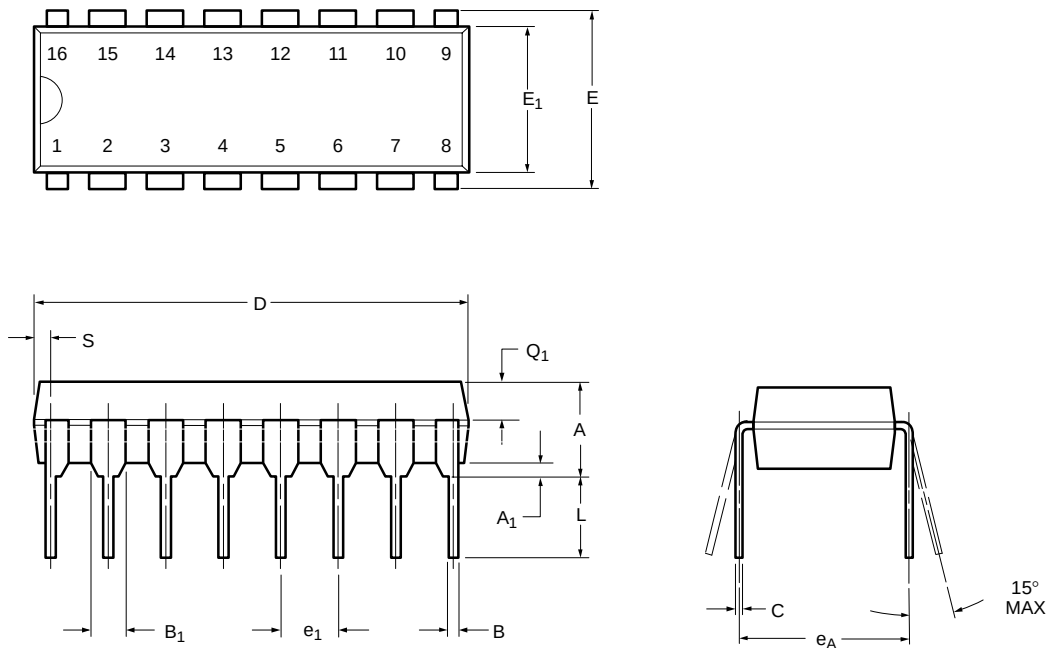


| Dim            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | Min         | Max   | Min       | Max   |
| A              | 1.35        | 1.75  | 0.053     | 0.069 |
| A <sub>1</sub> | 0.10        | 0.20  | 0.004     | 0.008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



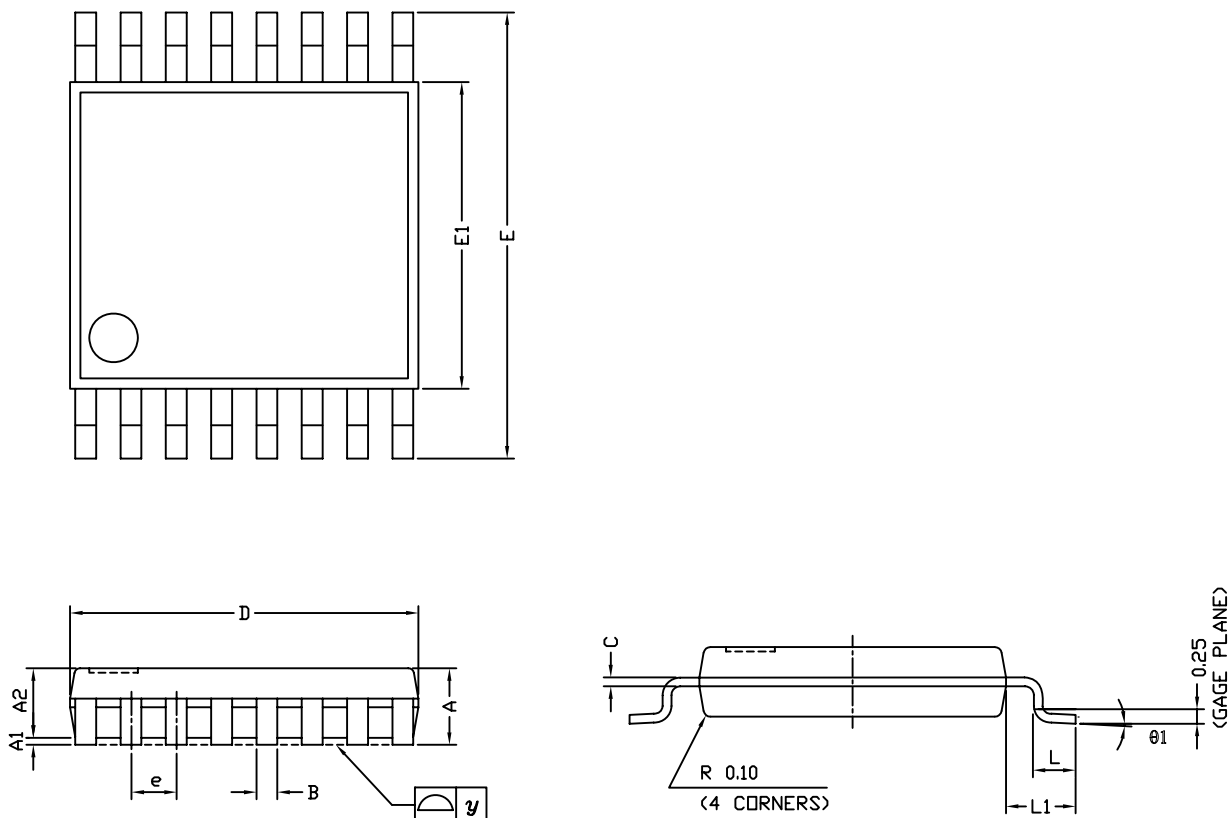
**PDIP: 16-LEAD**



| 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

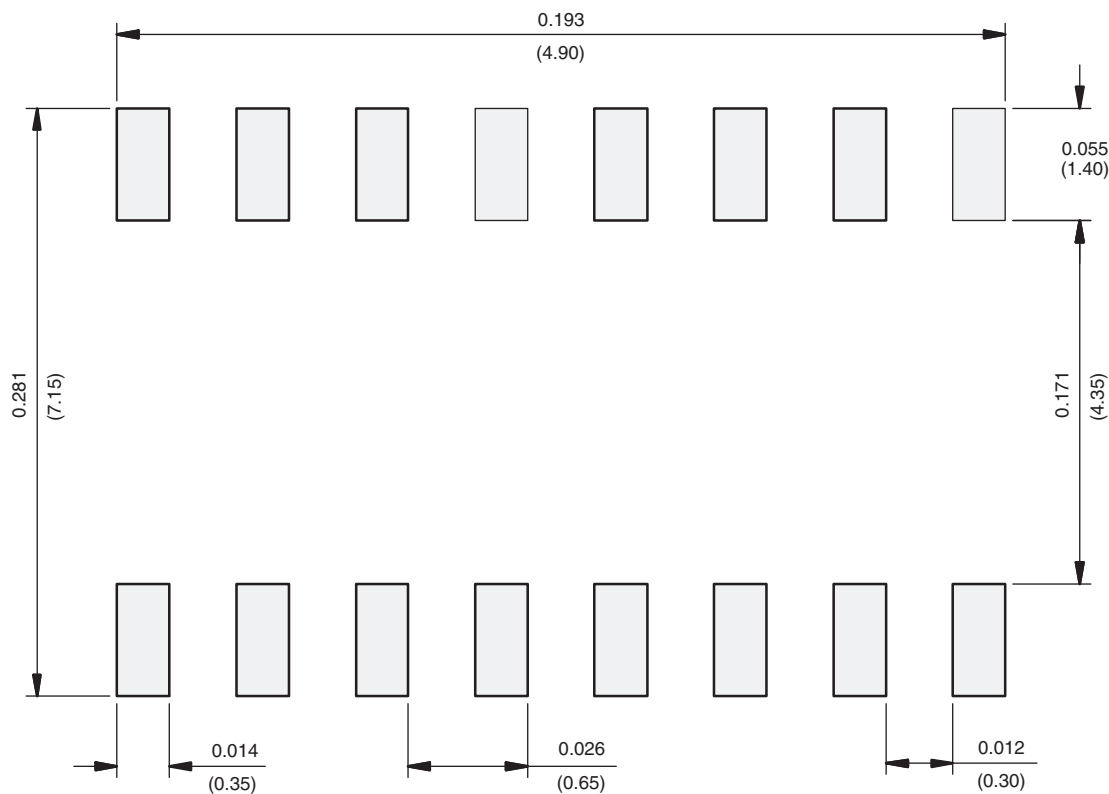
## TSSOP: 16-LEAD



| 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                      |                           |       |      |

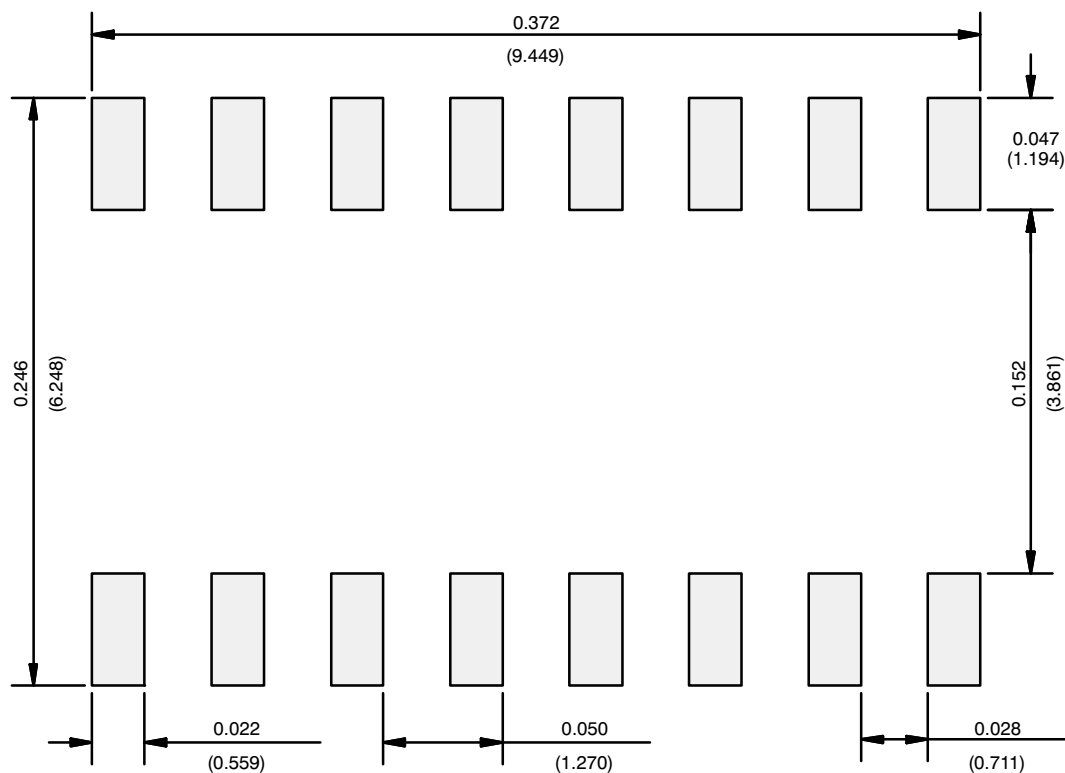


## RECOMMENDED MINIMUM PAD FOR TSSOP-16



Recommended Minimum Pads  
Dimensions in inches (mm)

## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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

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

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

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

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

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

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

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