



## 16 Ω, Low Parasitic Capacitance and Leakage, +12 V / +5 V / +3 V / ± 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 Ω, 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 ± 3 V to ± 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 ± 3 V to ± 8 V dual supply
- On-resistance  $R_{DS(on)}$ : 16 Ω
- 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

### BENEFITS

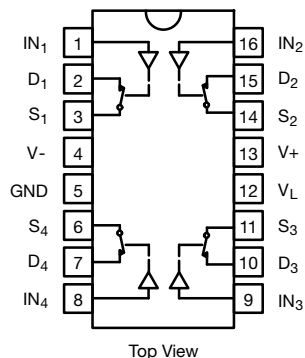
- Wide operation voltage range
- Low signal errors and distortion
- Fast switching time
- Minimized switching glitch

### APPLICATIONS

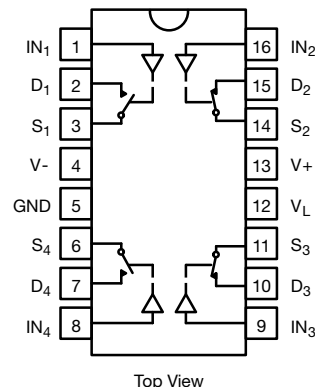
- Automatic test equipment
- Data acquisition systems
- Meters and instruments
- Medical and healthcare systems
- Communication systems
- Audio and video signal routing
- Relay replacement
- Battery powered systems
- Computer peripherals
- Audio and video signal routing

### 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   |
|                               |               | 16-pin PDIP      | DG411LEDJ-GE3             | Tube 500 units              |
|                               |               |                  | DG411LEDJ-T1-GE3          | Tube 500 units              |
|                               | DG412LE       | 16-pin TSSOP     | DG412LEDQ-GE3             | Tube 360 units              |
|                               |               |                  | DG412LEDQ-T1-GE3          | Tape and reel, 3000 units   |
|                               |               | 16-pin SOIC      | DG412LEDY-GE3             | Tube 500 units              |
|                               |               |                  | DG412LEDY-T1-GE3          | Tape and reel, 2500 units   |
|                               |               | 16-pin PDIP      | DG412LEDJ-GE3             | Tube 500 units              |
|                               |               |                  | DG412LEDJ-T1-GE3          | Tube 500 units              |
| DG413LE                       | 16-pin TSSOP  | 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            |                             |
|                               |               | DG413LEDJ-T1-GE3 | Tube 500 units            |                             |

| ABSOLUTE MAXIMUM RATINGS  |  |             |    |
|---|--|-------------|----|
| PARAMETER   | LIMIT  | UNIT        |    |
| V <sub>+</sub> to V <sub>-</sub>  | -0.3 to +18  | V           |    |
| GND to V <sub>-</sub>   | 18   |             |    |
| V <sub>L</sub>  | (GND -0.3) to (V <sub>+</sub> ) +0.3                               |             |    |
| I <sub>N</sub> <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub>           | -0.3 to (V <sub>+</sub> ) +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 <sup>®</sup> 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> |      |
|  |                     |  |                    |                   | <b>Analog Switch</b>                    |                   |  |                   |      |
| 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   |
|  |                     |  | Full               | -                 | -15                                     | 15                | -10                                    | 10                |      |
|  | I <sub>D(off)</sub> |  | 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                |      |
| <b>Digital Control</b>                           |                     |  |                    |                   |   |                   |  |                   |      |
| 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                 |      |
| <b>Dynamic Characteristics</b>                   |                     |  |                    |                   |   |                   |  |                   |      |
| 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                 | -                                       | -                 | -                                      | -                 |      |
| 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                                       | -                 | -                                      | -                 | -    |
| 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                | -                                       | -                 | -                                      | -                 |      |
| <b>Power Supplies</b>                            |                     |  |                    |                   |   |                   |  |                   |      |
| 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 $\pm 5$ V) |              |  |   |                   |   |                   |  |                   |          |    |
|---|--------------|--|---|-------------------|---|-------------------|--|-------------------|----------|----|
| PARAMETER   | SYMBOL       | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>$V_+ = 5$ V, $V_- = -5$ V<br>$V_L = 5$ V, $V_{IN} = 2.4$ 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> |          |    |
| <b>Analog Switch</b>                                |              |  |   |                   |   |                   |  |                   |          |    |
| Analog Signal Range <sup>e</sup>                    | $V_{ANALOG}$ |  | Full  | -                 | -5                                      | 5                 | -5                                     | 5                 | V        |    |
| Drain-Source<br>On-Resistance                       | $R_{DS(on)}$ | $V_+ = 5$ V, $V_- = -5$ V,<br>$I_S = 10$ mA, $V_D = \pm 3.5$ V   | Room  | 18                | -                                       | 30                | -                                      | 30                | $\Omega$ |    |
|   |              |  | Full  | -                 | -                                       | 42                | -                                      | 37                |          |    |
| Switch Off<br>Leakage Current <sup>g</sup>          | $I_{S(off)}$ | $V_+ = 5.5$ , $V_- = -5.5$ V,<br>$V_D = \pm 4.5$ V, $V_S = \pm 4.5$ V  | Room  | -                 | -1                                      | 1                 | -1                                     | 1                 | nA       |    |
|   |              |  | Full  | -                 | -15                                     | 15                | -10                                    | 10                |          |    |
|   | Room         |  | -   | -1                | 1                                       | -1                | 1                                      |                   |          |    |
|   | Full         |  | -   | -15               | 15                                      | -10               | 10                                     |                   |          |    |
| Channel On<br>Leakage Current <sup>g</sup>          | $I_{D(on)}$  | $V_+ = 5.5$ V, $V_- = -5.5$ V,<br>$V_S = V_D = \pm 4.5$ V  | Room  | -                 | -1                                      | 1                 | -1                                     | 1                 |          |    |
|   |              |  | Full  | -                 | -15                                     | 15                | -10                                    | 10                |          |    |
| <b>Digital Control</b>                              |              |  |   |                   |   |                   |  |                   |          |    |
| Input Current, $V_{IN}$ Low <sup>e</sup>            | $I_{IL}$     | $V_{IN}$ under test = 0.8 V  | Full  | 0.05              | -1.5                                    | 1.5               | -1                                     | 1                 | $\mu$ A  |    |
| Input Current, $V_{IN}$ High <sup>e</sup>           | $I_{IH}$     | $V_{IN}$ under test = 2.4 V  | Full  | 0.05              | -1.5                                    | 1.5               | -1                                     | 1                 |          |    |
| <b>Dynamic Characteristics</b>                      |              |  |   |                   |   |                   |  |                   |          |    |
| Turn-On Time <sup>e</sup>                           | $t_{ON}$     | $R_L = 300 \Omega$ , $C_L = 35$ pF,<br>$V_S = \pm 3.5$ V, see figure 2   | Room  | 17                | -                                       | 50                | -                                      | 50                | ns       |    |
|   |              |  | Full  | -                 | -                                       | 70                | -                                      | 60                |          |    |
| Turn-Off Time <sup>e</sup>                          | $t_{OFF}$    |  | Room  | 12                | -                                       | 35                | -                                      | 35                |          |    |
|   |              |  | Full  | -                 | -                                       | 50                | -                                      | 40                |          |    |
| Break-Before-Make Time<br>Delay <sup>e</sup>        | $t_D$        |  | DG413L only, $V_S = 3.5$ V,<br>$R_L = 300 \Omega$ , $C_L = 35$ pF | Room              | 5                                       | -                 | -                                      | -                 |          | -  |
| Charge Injection <sup>e</sup>                       | Q            |  | $V_g = 0$ V, $R_g = 0 \Omega$ , $C_L = 10$ nF                     | Room              | 5.8                                     | -                 | -                                      | -                 |          | -  |
| Off Isolation <sup>e</sup>                          | OIRR         | $R_L = 50 \Omega$ , $C_L = 5$ pF, $f = 1$ MHz  | Room  | 68                | -                                       | -                 | -                                      | -                 | dB       |    |
| Channel-to-Channel<br>Crosstalk <sup>e</sup>        | $X_{TALK}$   |  | Room  | 113               | -                                       | -                 | -                                      | -                 |          |    |
| Source Off Capacitance <sup>e</sup>                 | $C_{S(off)}$ |  | $f = 1$ MHz   | Room              | 5                                       | -                 | -                                      | -                 | -        | pF |
| Drain Off Capacitance <sup>e</sup>                  | $C_{D(off)}$ | Room   |   | 6                 | -                                       | -                 | -                                      | -                 |          |    |
| Channel On Capacitance <sup>e</sup>                 | $C_{D(on)}$  | Room   |   | 14                | -                                       | -                 | -                                      | -                 |          |    |
| <b>Power Supplies</b>                               |              |  |   |                   |   |                   |  |                   |          |    |
| Positive Supply Current <sup>e</sup>                | $I_+$        | $V_{IN} = 0$ V or 5 V  | Room  | 0.03              | -                                       | 1                 | -                                      | 1                 | $\mu$ A  |    |
|   |              |  | Full  | -                 | -                                       | 7.5               | -                                      | 5                 |          |    |
| Negative Supply Current <sup>e</sup>                | $I_-$        |  | Room  | -0.002            | -1                                      | -                 | -1                                     | -                 |          |    |
|   |              |  | Full  | -                 | -7.5                                    | -                 | -5                                     | -                 |          |    |
| Logic Supply Current <sup>e</sup>                   | $I_L$        |  | Room  | 0.002             | -                                       | 1                 | -                                      | 1                 |          |    |
|   |              |  | Full  | -                 | -                                       | 7.5               | -                                      | 5                 |          |    |
| Ground Current <sup>e</sup>                         | $I_{GND}$    |  | 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>$V_+ = 5\text{ V}$ , $V_- = 0\text{ V}$<br>$V_L = 5\text{ V}$ , $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^f$ | 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> |               |
| <b>Analog Switch</b>                            |              |  |                    |                   |   |                   |  |                   |               |
| Analog Signal Range <sup>e</sup>                | $V_{ANALOG}$ |  | Full               | -                 | -                                       | 5                 | -                                      | 5                 | V             |
| Drain-Source<br>On-Resistance <sup>e</sup>      | $R_{DS(on)}$ | $V_+ = 4.5\text{ V}$ ,<br>$I_S = 5\text{ mA}$ , $V_D = 1\text{ V}$ , $3.5\text{ V}$  | Room               | 36                | -                                       | 50                | -                                      | 50                | $\Omega$      |
|   |              |  | Full               | -                 | -                                       | 88                | -                                      | 75                |               |
| <b>Dynamic Characteristics</b>                  |              |  |                    |                   |   |                   |  |                   |               |
| Turn-On Time <sup>e</sup>                       | $t_{ON}$     | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 3.5\text{ V}$ , see figure 2  | Room               | 27                | -                                       | 50                | -                                      | 50                | ns            |
|   |              |  | Hot                | -                 | -                                       | 90                | -                                      | 60                |               |
| Turn-Off Time <sup>e</sup>                      | $t_{OFF}$    |  | Room               | 15                | -                                       | 30                | -                                      | 30                |               |
|   |              |  | Hot                | -                 | -                                       | 55                | -                                      | 40                |               |
| Break-Before-Make Time<br>Delay <sup>e</sup>    | $t_D$        | DG413L only, $V_S = 3.5\text{ V}$ ,<br>$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$  | Room               | 11                | -                                       | -                 | -                                      | -                 |               |
| Charge Injection <sup>e</sup>                   | Q            | $V_g = 0\text{ V}$ , $R_g = 0\ \Omega$ , $C_L = 10\text{ nF}$  | Room               | 3.3               | -                                       | -                 | -                                      | -                 | pC            |
| <b>Power Supplies</b>                           |              |  |                    |                   |   |                   |  |                   |               |
| Positive Supply Current <sup>e</sup>            | I+           | $V_{IN} = 0\text{ V or }5\text{ V}$  | Room               | 0.02              | -                                       | 1                 | -                                      | 1                 | $\mu\text{A}$ |
|   |              |  | Hot                | -                 | -                                       | 7.5               | -                                      | 5                 |               |
| Negative Supply Current <sup>e</sup>            | I-           |  | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |               |
|   |              |  | Hot                | -                 | -7.5                                    | -                 | -5                                     | -                 |               |
| Logic Supply Current <sup>e</sup>               | $I_L$        |  | Room               | 0.002             | -                                       | 1                 | -                                      | 1                 |               |
|   |              |  | Hot                | -                 | -                                       | 7.5               | -                                      | 5                 |               |
| Ground Current <sup>e</sup>                     | $I_{GND}$    |  | Room               | -0.002            | -1                                      | -                 | -1                                     | -                 |               |
|   |              |  | Hot                | -                 | -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



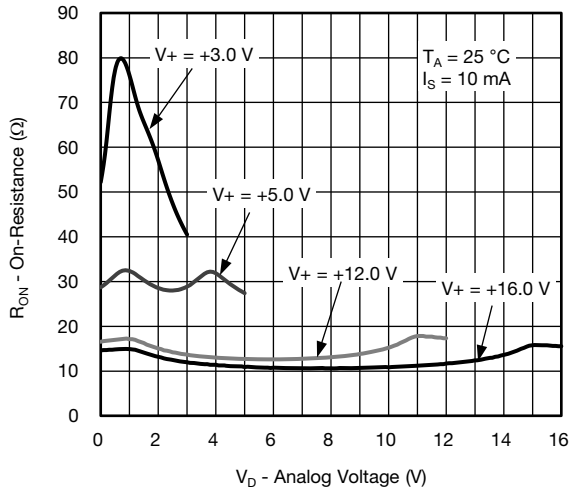
| SPECIFICATIONS <sup>a</sup> (Single Supply 3 V) |              |   |  |                   |                                     |                   |                                     |                   |               |   |
|---|--------------|---|--|-------------------|-------------------------------------|-------------------|-------------------------------------|-------------------|---------------|---|
| PARAMETER                                       | SYMBOL       | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>$V_+ = 3\text{ V}, V_- = 0\text{ V}$<br>$V_L = 3\text{ V}, V_{IN} = 0.4\text{ V}, 2.0\text{ V}^f$ | TEMP. <sup>b</sup>   | TYP. <sup>c</sup> | ASUFFIX 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> |               |   |
| <b>Analog Switch</b>                            |              |   |  |                   |                                     |                   |                                     |                   |               |   |
| Analog Signal Range <sup>e</sup>                | $V_{ANALOG}$ |   | Full   | -                 | 0                                   | 3                 | 0                                   | 3                 | V             |   |
| Drain-Source On-Resistance                      | $R_{DS(on)}$ | $V_+ = 2.7\text{ V}, V_- = 0\text{ V}, I_S = 5\text{ mA}, V_D = 0.5, 2.2\text{ V}$  | Room   | 106               | -                                   | 130               | -                                   | 130               | $\Omega$      |   |
|   |              |   | Full   | -                 | -                                   | 150               | -                                   | 140               |               |   |
| Switch Off Leakage Current <sup>g</sup>         | $I_{S(off)}$ | $V_+ = 3.3, V_- = 0\text{ V}, V_D = 1, 2\text{ V}, V_S = 2, 1\text{ V}$   | Room   | -                 | -1                                  | 1                 | -1                                  | 1                 | nA            |   |
|   |              |   | Full   | -                 | -15                                 | 15                | -10                                 | 10                |               |   |
|   | $I_{D(off)}$ |   | Room   | -                 | -1                                  | 1                 | -1                                  | 1                 |               |   |
|   |              |   | Full   | -                 | -15                                 | 15                | -10                                 | 10                |               |   |
| Channel On Leakage Current <sup>g</sup>         | $I_{D(on)}$  | $V_+ = 3.3\text{ V}, V_- = 0\text{ V}, V_S = V_D = 1, 2\text{ V}$   | Room   | -                 | -1                                  | 1                 | -1                                  | 1                 |               |   |
|   |              |   | Full   | -                 | -15                                 | 15                | -10                                 | 10                |               |   |
| <b>Digital Control</b>                          |              |   |  |                   |                                     |                   |                                     |                   |               |   |
| Input Current, $V_{IN}$ Low                     | $I_{IL}$     | $V_{IN}$ under test = 0.4 V   | Full   | 0.005             | -1.5                                | 1.5               | -1                                  | 1                 | $\mu\text{A}$ |   |
| Input Current, $V_{IN}$ High                    | $I_{IH}$     | $V_{IN}$ under test = 2.4 V   | Full   | 0.005             | -1.5                                | 1.5               | -1                                  | 1                 |               |   |
| <b>Dynamic Characteristics</b>                  |              |   |  |                   |                                     |                   |                                     |                   |               |   |
| Turn-On Time                                    | $t_{ON}$     | $R_L = 300\ \Omega, C_L = 35\text{ pF}, V_S = 1.5\text{ V}, \text{ see figure 2}$   | Room   | 57                | -                                   | 85                | -                                   | 85                | ns            |   |
|   |              |   | Full   | -                 | -                                   | 150               | -                                   | 110               |               |   |
| Turn-Off Time                                   | $t_{OFF}$    |   | Room   | 25                | -                                   | 60                | -                                   | 60                |               |   |
|   |              |   | Full   | -                 | -                                   | 100               | -                                   | 85                |               |   |
| Break-Before-Make Time Delay                    | $t_D$        |   | DG413L only, $V_S = 1.5\text{ V}, R_L = 300\ \Omega, C_L = 35\text{ pF}$ | Room              | 24                                  | -                 | -                                   | -                 |               | - |
| Charge Injection <sup>e</sup>                   | Q            |   | $V_g = 0\text{ V}, R_g = 0\ \Omega, C_L = 10\text{ nF}$                  | Room              | 2                                   | -                 | -                                   | -                 |               | - |
| Off Isolation <sup>e</sup>                      | OIRR         | $R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$   | Room   | 68                | -                                   | -                 | -                                   | -                 | dB            |   |
| Channel-to-Channel Crosstalk <sup>e</sup>       | $X_{TALK}$   |   | Room   | 107               | -                                   | -                 | -                                   | -                 |               |   |
| Source Off Capacitance <sup>e</sup>             | $C_{S(off)}$ |   | f = 1 MHz  | Room              | 6                                   | -                 | -                                   | -                 |               | - |
| Drain Off Capacitance <sup>e</sup>              | $C_{D(off)}$ | Room  |  | 7                 | -                                   | -                 | -                                   | -                 |               |   |
| Channel On Capacitance <sup>e</sup>             | $C_{D(on)}$  | Room  |  | 15                | -                                   | -                 | -                                   | -                 |               |   |

**Notes**

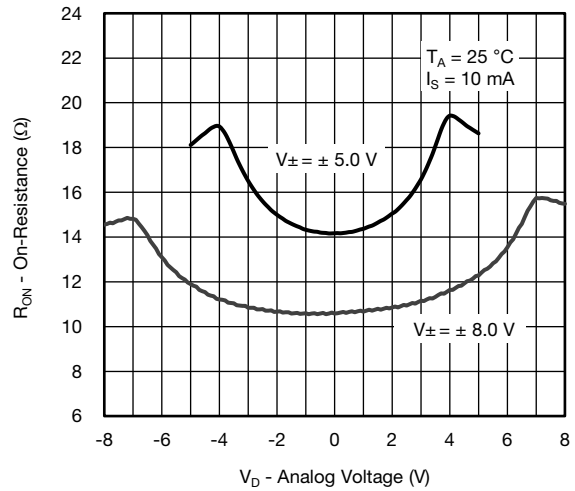
- a. Refer to PROCESS OPTION FLOWCHART
- b. Room = 25 °C, full = as determined by the operating temperature suffix
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
- d. The algebraic convention whereby the most negative value is a minimum and the most positive 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



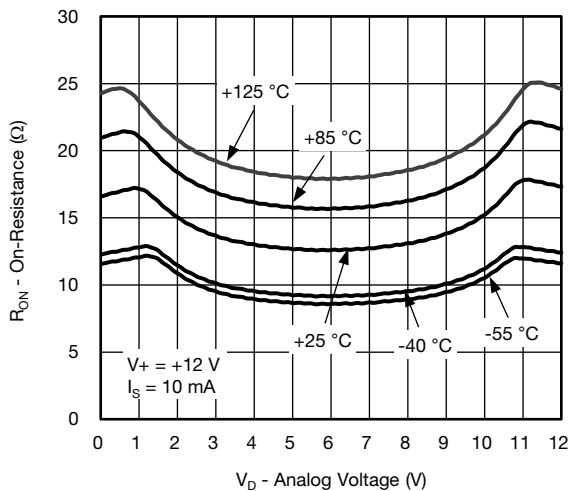
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



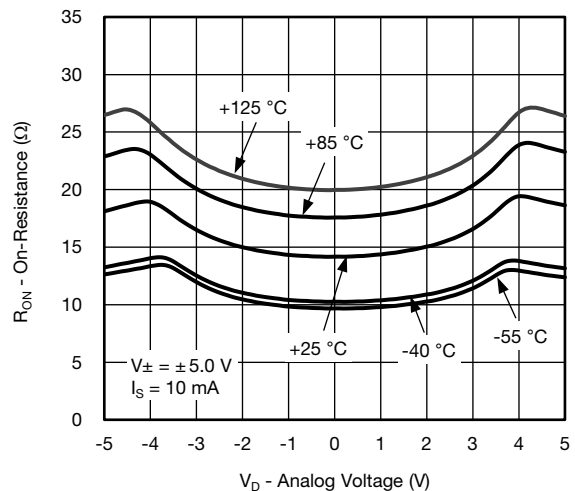
$R_{DS(on)}$  vs. Drain Voltage (Single Supply)



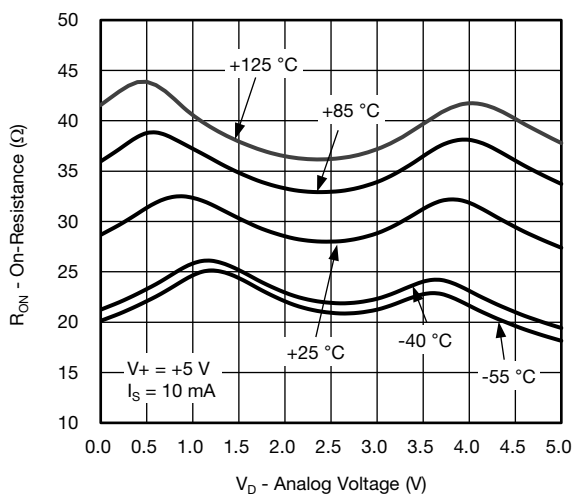
$R_{DS(on)}$  vs. Drain Voltage and Temperature (Single Supply)



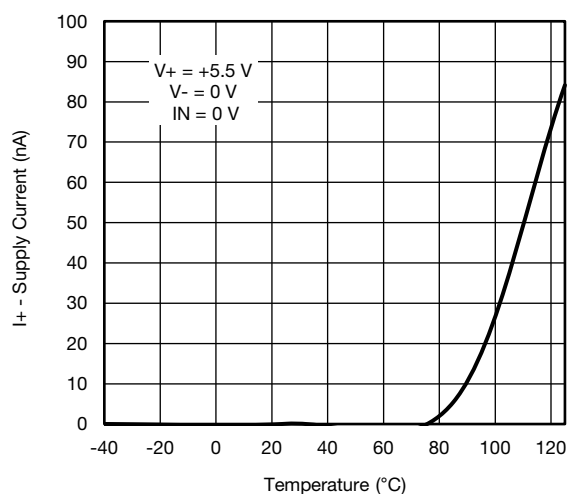
$R_{DS(on)}$  vs. Drain Voltage and Temperature



Supply Current vs. Temperature



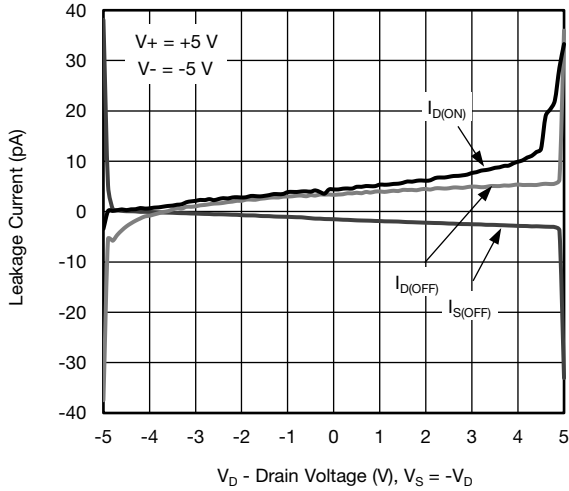
$R_{DS(on)}$  vs. Drain Voltage and Temperature



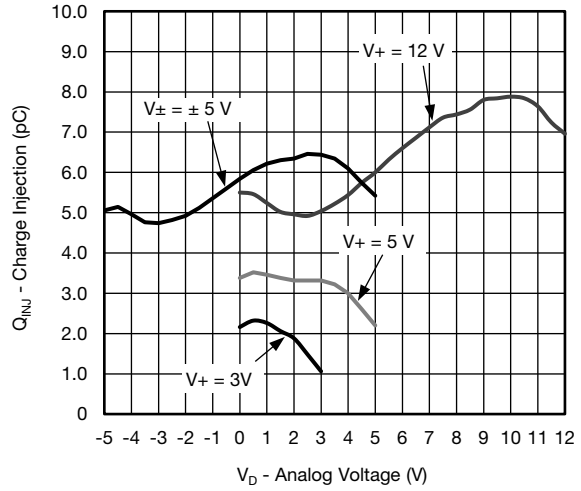
Switching Time vs. Single Supply



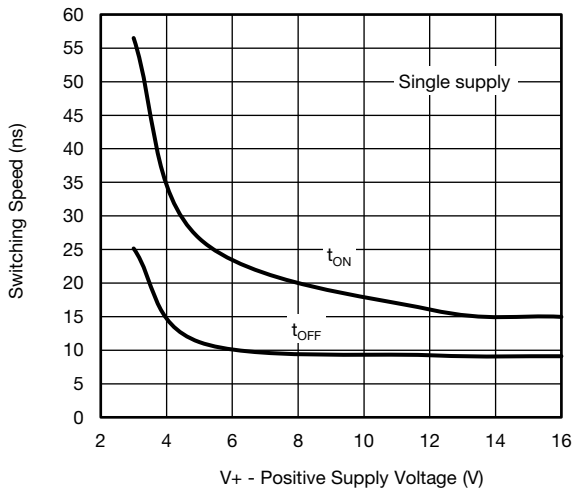
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



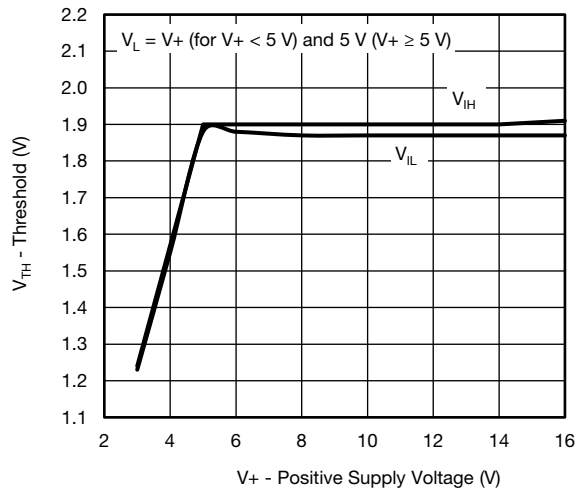
Leakage Current vs. Drain Voltage



Charge Injection vs. Drain Voltage



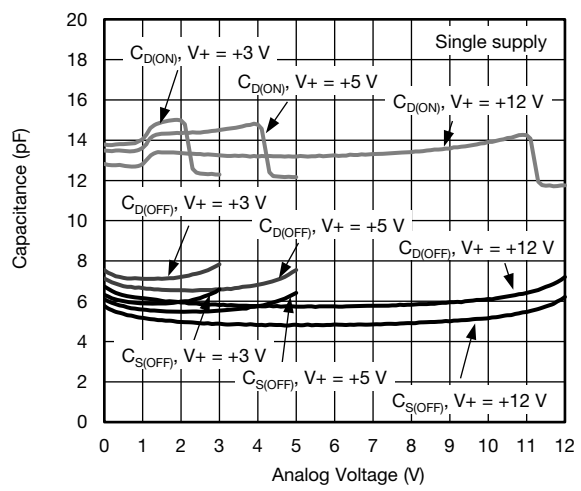
Switching Time vs. Single Supply Voltage



Threshold vs. Single Supply Current



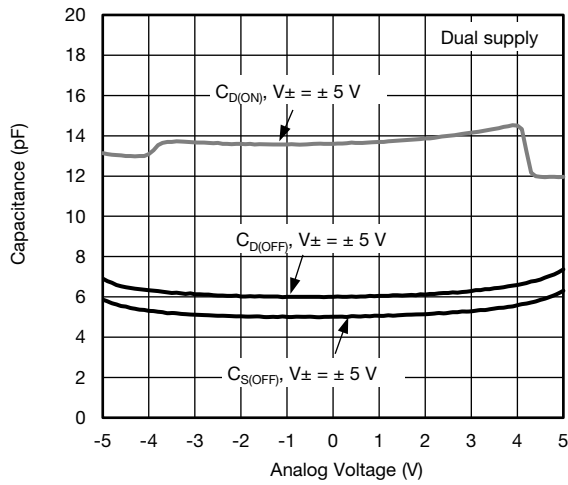
Switching Time vs. Dual Supply Voltage



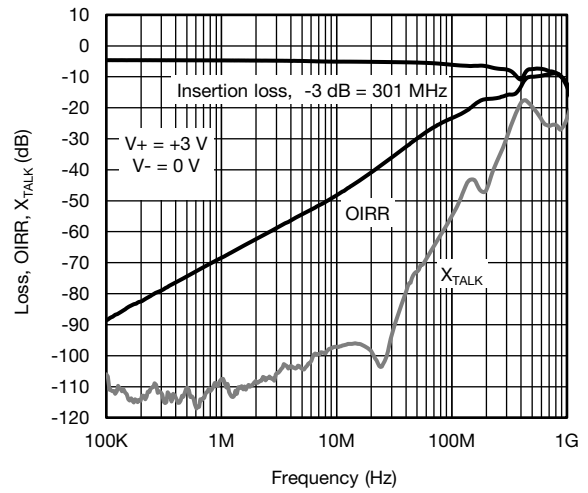
Drain Capacitance vs. Drain Voltage (Single Supply)



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

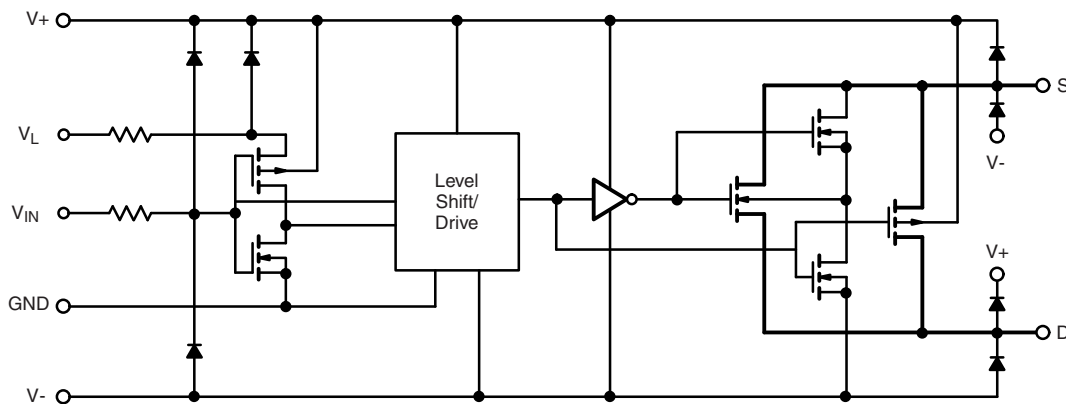


**Drain Capacitance vs. Drain Voltage (Dual Supply)**



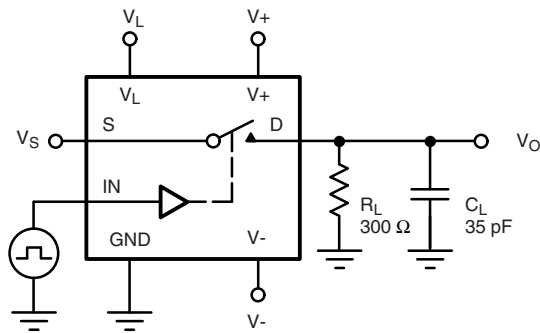
**Insertion Loss, Off Isolation and Crosstalk vs. Frequency**

**SCHEMATIC DIAGRAM** (Typical Channel)



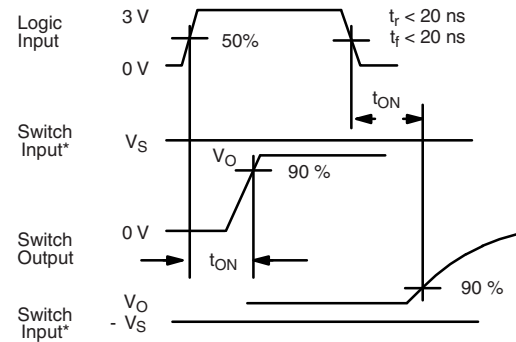
**Fig. 1**

## TEST CIRCUITS



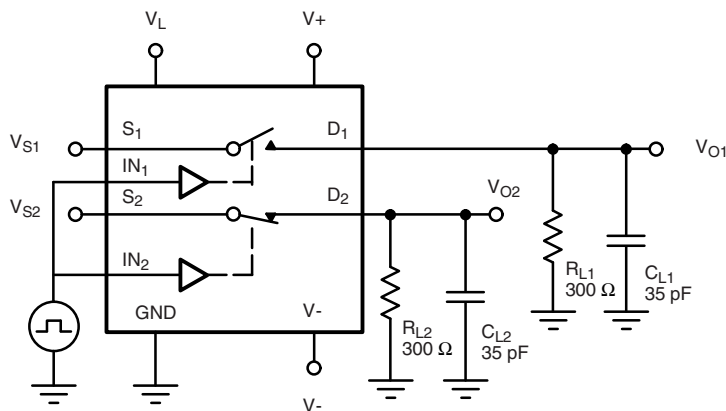
$C_L$  (includes fixture and stray capacitance)

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



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)

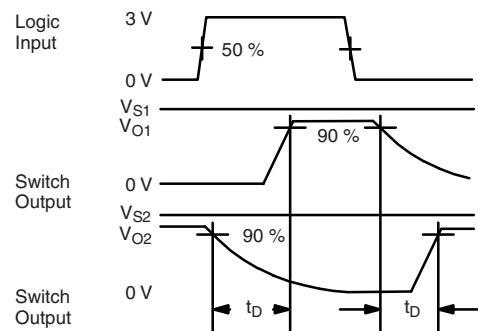
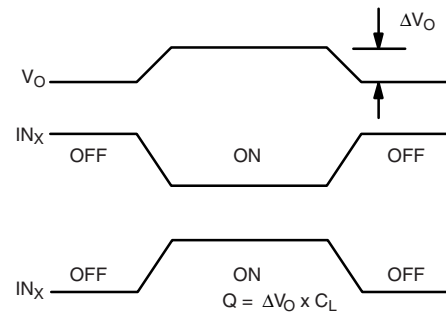
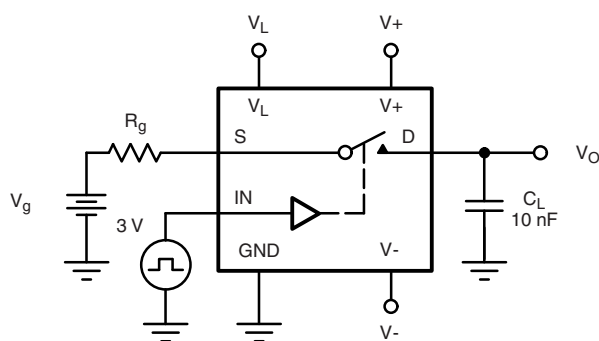


Fig. 3 - Break-Before-Make (DG413LE)



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

Fig. 4 - Charge Injection

TEST CIRCUITS

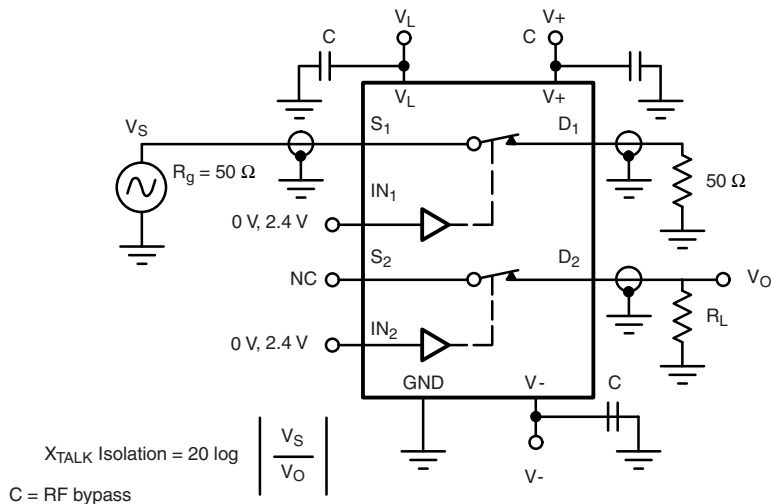


Fig. 5 - Crosstalk

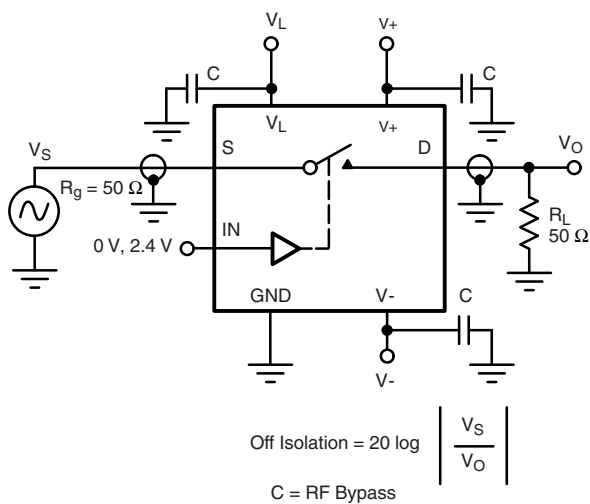


Fig. 6 - Off-Isolation

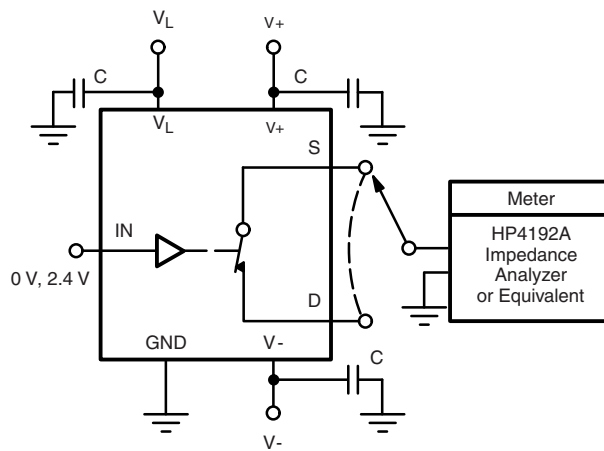


Fig. 7 - Source / Drain Capacitances

Vishay 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?78091](http://www.vishay.com/ppg?78091).

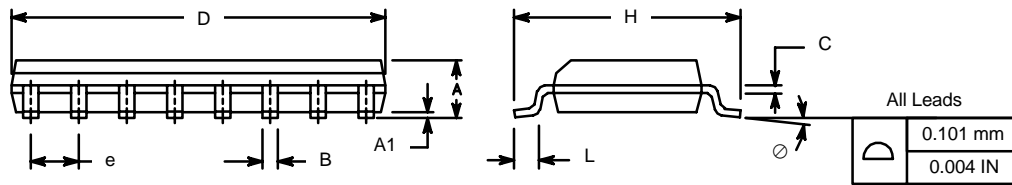


**SOIC (NARROW): 16-LEAD**  
JEDEC Part Number: MS-012

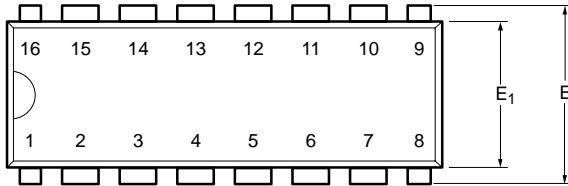


| Dim            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | Min         | Max   | Min       | Max   |
| A              | 1.35        | 1.75  | 0.053     | 0.069 |
| A <sub>1</sub> | 0.10        | 0.20  | 0.004     | 0.008 |
| 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 |
| ∅              | 0°          | 8°    | 0°        | 8°    |

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



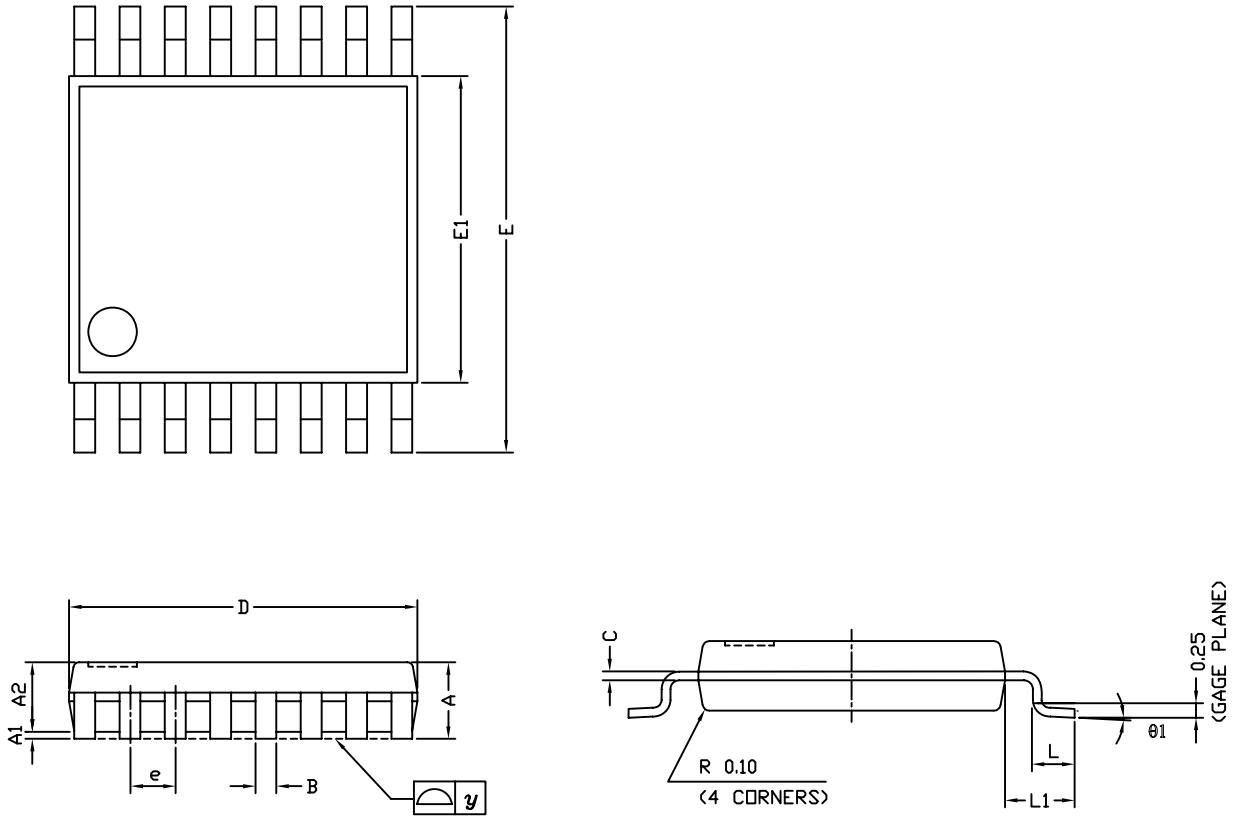
### PDIP: 16-LEAD



| Dim                  | MILLIMETERS |       | INCHES |       |
|----------------------|-------------|-------|--------|-------|
|                      | Min         | Max   | Min    | Max   |
| <b>A</b>             | 3.81        | 5.08  | 0.150  | 0.200 |
| <b>A<sub>1</sub></b> | 0.38        | 1.27  | 0.015  | 0.050 |
| <b>B</b>             | 0.38        | 0.51  | 0.015  | 0.020 |
| <b>B<sub>1</sub></b> | 0.89        | 1.65  | 0.035  | 0.065 |
| <b>C</b>             | 0.20        | 0.30  | 0.008  | 0.012 |
| <b>D</b>             | 18.93       | 21.33 | 0.745  | 0.840 |
| <b>E</b>             | 7.62        | 8.26  | 0.300  | 0.325 |
| <b>E<sub>1</sub></b> | 5.59        | 7.11  | 0.220  | 0.280 |
| <b>e<sub>1</sub></b> | 2.29        | 2.79  | 0.090  | 0.110 |
| <b>e<sub>A</sub></b> | 7.37        | 7.87  | 0.290  | 0.310 |
| <b>L</b>             | 2.79        | 3.81  | 0.110  | 0.150 |
| <b>Q<sub>1</sub></b> | 1.27        | 2.03  | 0.050  | 0.080 |
| <b>S</b>             | 0.38        | 1.52  | .015   | 0.060 |

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

## TSSOP: 16-LEAD

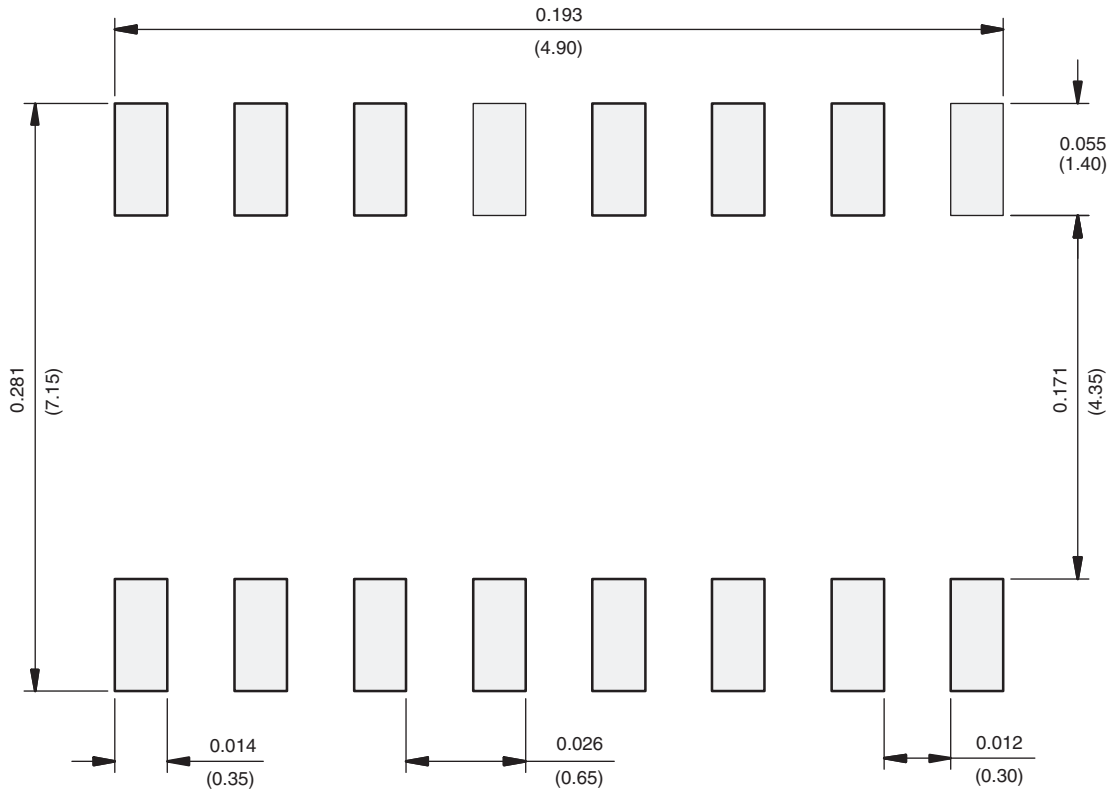


| Symbols | DIMENSIONS IN MILLIMETERS |       |      |
|---------|---------------------------|-------|------|
|         | Min                       | Nom   | Max  |
| A       | -                         | 1.10  | 1.20 |
| A1      | 0.05                      | 0.10  | 0.15 |
| A2      | -                         | 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

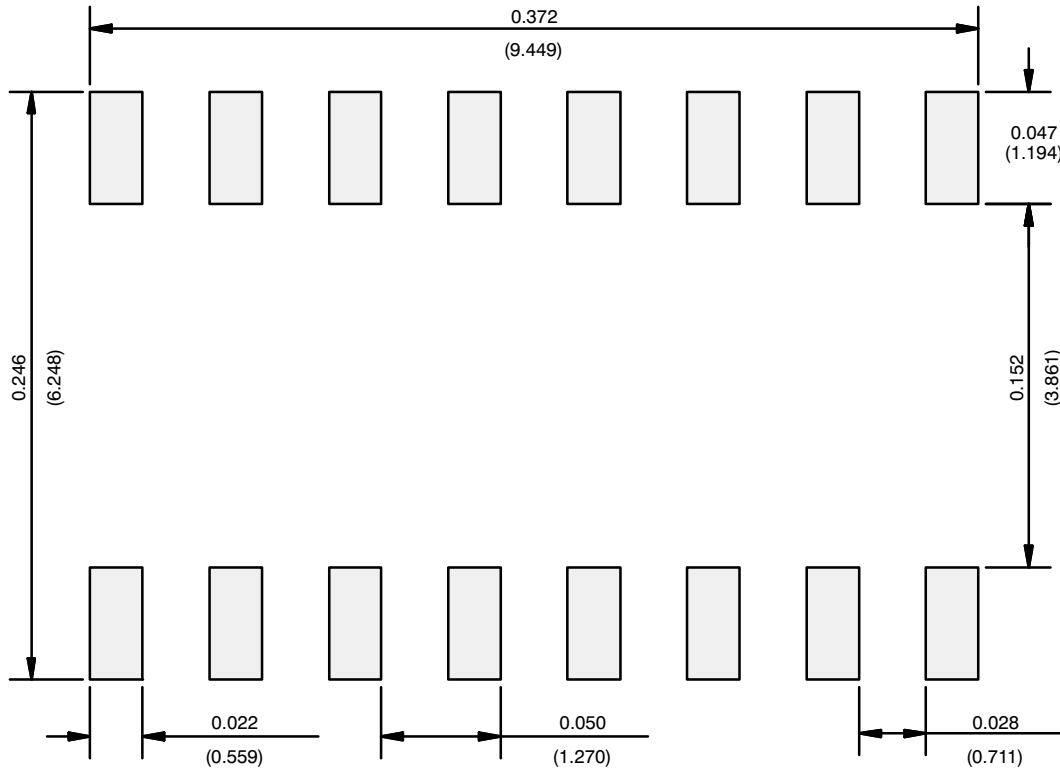


**RECOMMENDED MINIMUM PAD FOR TSSOP-16**



Recommended Minimum Pads  
Dimensions in inches (mm)

## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)





## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.