



**THE DATASHEET OF  
DG413LDQ-T1-E3**



## Precision Monolithic Quad SPST Low-Voltage CMOS Analog Switches

### DESCRIPTION

The DG411L, DG412L, DG413L are low voltage pin-for-pin compatible companion devices to the industry standard DG411, DG412, DG413 with improved performance.

Using BiCMOS wafer fabrication technology allows the DG411L, DG412L, DG413L to operate on single and dual supplies. Single supply voltage ranges from 3 to 12 V while dual supply operation is recommended with  $\pm 3$  to  $\pm 6$  V.

Combining high speed ( $t_{ON}$ : 19 ns), flat  $R_{DS(on)}$  over the analog signal range ( $5 \Omega$ ), minimal insertion lose ( $-3$  dB at 280 MHz), and excellent crosstalk and off-isolation performance ( $-50$  dB at 50 MHz), the DG411L, DG412L, DG413L are ideally suited for audio and video signal switching.

The DG411L and DG412L respond to opposite control logic as shown in the Truth Table. The DG413L has two normally open and two normally closed switches.

### FEATURES

- 2.7- thru 12 V single supply or  $\pm 3$ - thru  $\pm 6$  dual supply
- On-resistance -  $R_{DS(on)}$ :  $17 \Omega$
- Fast switching -  $t_{ON}$ : 19 ns
- $t_{OFF}$ : 12 ns
- TTL, CMOS compatible
- Low leakage: 0.25 nA
- 2000 V ESD protection

### BENEFITS

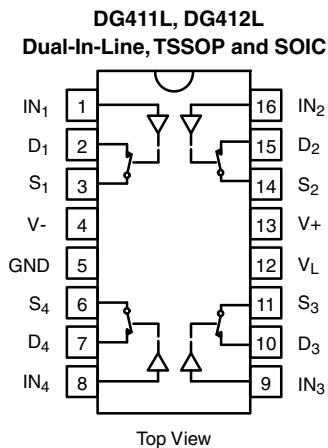
- Widest dynamic range
- Low signal errors and distortion
- Break-before-make switching action
- Simple interfacing

### APPLICATIONS

- Precision automatic test equipment
- Precision data acquisition
- Communication systems
- Battery powered systems
- Computer peripherals
- SDSL, DSLAM
- Audio and video signal routing

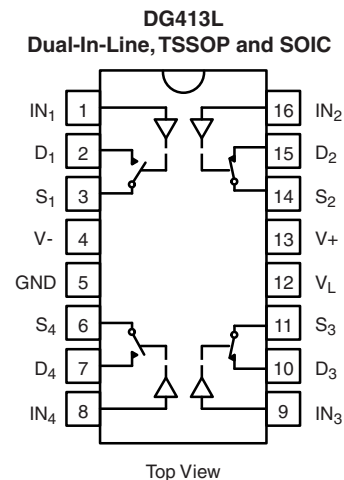


### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



| TRUTH TABLE |        |        |
|-------------|--------|--------|
| Logic       | DG411L | DG412L |
| 0           | ON     | OFF    |
| 1           | OFF    | ON     |

Logic "0"  $\leq 0.8$  V  
Logic "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"  $\leq 0.8$  V  
Logic "1"  $\geq 2.4$  V

\* Pb containing terminations are not RoHS compliant, exemptions may apply

| ORDERING INFORMATION  |                    |  |
|-----------------------|--------------------|--|
| Temp. Range           | Package            | Part Number  |
| <b>DG411L, DG412L</b> |                    |  |
| - 40 °C to 85 °C      | 16-Pin Narrow SOIC | DG411LDY<br>DG411LDY-E3<br>DG411LDY-T1<br>DG411LDY-T1-E3 |
|                       |                    | DG412LDY<br>DG412LDY-E3<br>DG412LDY-T1<br>DG412LDY-T1-E3 |
|                       | 16-Pin TSSOP       | DG411LDQ<br>DG411LDQ-E3<br>DG411LDQ-T1<br>DG411LDQ-T1-E3 |
|                       |                    | DG412LDQ<br>DG412LDQ-E3<br>DG412LDQ-T1<br>DG412LDQ-T1-E3 |
| <b>DG413L</b>         |                    |  |
| - 40 °C to 85 °C      | 16-Pin Narrow SOIC | DG413LDY<br>DG413LDY-E3<br>DG413LDY-T1<br>DG413LDY-T1-E3 |
|                       | 16-Pin TSSOP       | DG413LDQ<br>DG413LDQ-E3<br>DG413LDQ-T1<br>DG413LDQ-T1-E3 |

| ABSOLUTE MAXIMUM RATINGS                                      |  |             |    |
|---|--|-------------|----|
| Parameter   | Limit  | Unit        |    |
| V <sub>+</sub> to V <sub>-</sub>                              | - 0.3 to 13  | V           |    |
| GND to V <sub>-</sub>   | 7  |             |    |
| 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         |    |

**Notes:**

a. 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.

b. All leads welded or soldered to PC board.

c. Derate 7 mW/°C above 75 °C

d. Derate 7.6 mW/°C above 75 °C

e. Derate 12 mW/°C above 75 °C.



| SPECIFICATIONS <sup>a</sup> (Single Supply 12 V) |                     |   |                    |                   |                                      |                   |                                     |                   |      |
|--|---------------------|---|--------------------|-------------------|--------------------------------------|-------------------|-------------------------------------|-------------------|------|
| Parameter  | Symbol              | Test Conditions<br>Unless Otherwise 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 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 <sub>ANALOG</sub> |   | Full               |                   | 0                                    | 12                | 0                                   | 12                | V    |
| Drain-Source 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<br>Full       | 20                |                                      | 30<br>45          |                                     | 30<br>40          | Ω    |
| Switch Off Leakage Current                       | I <sub>S(off)</sub> | V <sub>D</sub> = 1/11 V, V <sub>S</sub> = 11/1 V  | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>10           | nA   |
|  | I <sub>D(off)</sub> |   | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>10           |      |
| Channel On Leakage Current                       | I <sub>D(on)</sub>  | V <sub>S</sub> = V <sub>D</sub> = 11/1 V  | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>10           |      |
| <b>Digital Control</b>                           |                     |   |                    |                   |                                      |                   |                                     |                   |      |
| Input Current, V <sub>IN</sub> 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, V <sub>IN</sub> 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<br>Full       | 20                |                                      | 50<br>70          |                                     | 50<br>60          | ns   |
| Turn-Off Time                                    | t <sub>OFF</sub>    |   | Room<br>Full       | 12                |                                      | 30<br>48          |                                     | 30<br>40          |      |
| Break-Before-Make 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               | 6                 |                                      |                   |                                     |                   |      |
| 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                 |                                      |                   |                                     |                   | pC   |
| Off-Isolation <sup>e</sup>                       | OIRR                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz   | Room               | 71                |                                      |                   |                                     |                   | dB   |
| Channel-to-Channel Crosstalk <sup>e</sup>        | X <sub>TALK</sub>   |   | Room               | 95                |                                      |                   |                                     |                   |      |
| 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                |                                      |                   |                                     |                   |      |
| <b>Power Supplies</b>                            |                     |   |                    |                   |                                      |                   |                                     |                   |      |
| Positive Supply Current                          | I <sub>+</sub>      | V <sub>IN</sub> = 0 or 5 V  | Room<br>Full       | 0.02              |                                      | 1<br>7.5          |                                     | 1<br>5            | μA   |
| Negative Supply Current                          | I <sub>-</sub>      |   | Room<br>Full       | - 0.002           | - 1<br>- 7.5                         |                   | - 1<br>- 5                          |                   |      |
| Logic Supply Current                             | I <sub>L</sub>      |   | Room<br>Full       | 0.002             |                                      | 1<br>7.5          |                                     | 1<br>5            |      |
| Ground Current                                   | I <sub>GND</sub>    |   | Room<br>Full       | - 0.002           | - 1<br>- 7.5                         |                   | - 1<br>- 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 data sheet.
- 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.

| <b>SPECIFICATIONS<sup>a</sup></b> (Dual Supply $\pm 5$ V) |              |   |                    |                   |                                      |                   |                                     |                   |          |
|---|--------------|---|--------------------|-------------------|--------------------------------------|-------------------|-------------------------------------|-------------------|----------|
| Parameter   | Symbol       | Test Conditions<br>Unless Otherwise 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> | Ty.p <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> |          |
| <b>Analog Switch</b>                                      |              |   |                    |                   |                                      |                   |                                     |                   |          |
| Analog Signal Range <sup>e</sup>                          | $V_{ANALOG}$ |   | Full               |                   | - 5                                  | 5                 | - 5                                 | 5                 | V        |
| Drain-Source On-Resistance                                | $R_{DS(on)}$ | $V_+ = 5$ V, $V_- = -5$ V<br>$I_S = 10$ mA, $V_D = \pm 3.5$ V   | Room<br>Full       | 20                |                                      | 33<br>45          |                                     | 33<br>40          | $\Omega$ |
| Switch Off<br>Leakage Current <sup>g</sup>                | $I_{S(off)}$ | $V_+ = 5.5$ V, $V_- = -5.5$ V<br>$V_D = \pm 4.5$ V, $V_S = \pm 4.5$ V   | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>10           | nA       |
|   | $I_{D(off)}$ |   | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>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<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>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<br>Full       | 21                |                                      | 50<br>70          |                                     | 50<br>60          | ns       |
| Turn-Off Time <sup>e</sup>                                | $t_{OFF}$    |   | Room<br>Full       | 16                |                                      | 35<br>50          |                                     | 35<br>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               | 6                 |                                      |                   |                                     |                   |          |
| Charge Injection <sup>e</sup>                             | Q            | $V_g = 0$ V, $R_g = 0 \Omega$ , $C_L = 10$ nF   | Room               | 5                 |                                      |                   |                                     |                   | pC       |
| 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               | 85                |                                      |                   |                                     |                   |          |
| Source Off Capacitance <sup>e</sup>                       | $C_{S(off)}$ | f = 1 MHz   | Room               | 9                 |                                      |                   |                                     |                   | pF       |
| Drain Off Capacitance <sup>e</sup>                        | $C_{D(off)}$ |   | Room               | 9                 |                                      |                   |                                     |                   |          |
| Channel On Capacitance <sup>e</sup>                       | $C_{D(on)}$  |   | Room               | 20                |                                      |                   |                                     |                   |          |
| <b>Power Supplies</b>                                     |              |   |                    |                   |                                      |                   |                                     |                   |          |
| Positive Supply Current <sup>e</sup>                      | $I_+$        | $V_{IN} = 0$ or 5 V   | Room<br>Full       | 0.03              |                                      | 1<br>7.5          |                                     | 1<br>5            | $\mu$ A  |
| Negative Supply Current <sup>e</sup>                      | $I_-$        |   | Room<br>Full       | - 0.002           | - 1<br>- 7.5                         |                   | - 1<br>- 5                          |                   |          |
| Logic Supply Current <sup>e</sup>                         | $I_L$        |   | Room<br>Full       | 0.002             |                                      | 1<br>7.5          |                                     | 1<br>5            |          |
| Ground Current <sup>e</sup>                               | $I_{GND}$    |   | Room<br>Full       | - 0.002           | - 1<br>- 7.5                         |                   | - 1<br>- 5                          |                   |          |

Notes:

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- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guaranteed by design, not subject to production test.
- $V_{IN}$  = input voltage to perform proper function.
- 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 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 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 <sub>ANALOG</sub> |  | Full               |                   |                                      | 5                 |                                     | 5                 | V    |
| Drain-Source 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<br>Full       | 35                |                                      | 50<br>88          |                                     | 50<br>75          | Ω    |
| <b>Dynamic Characteristics</b>                  |                     |  |                    |                   |                                      |                   |                                     |                   |      |
| 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<br>Hot        | 27                |                                      | 50<br>90          |                                     | 50<br>60          | ns   |
| Turn-Off Time <sup>e</sup>                      | t <sub>OFF</sub>    |  | Room<br>Hot        | 15                |                                      | 30<br>55          |                                     | 30<br>40          |      |
| Break-Before-Make Time 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               | 6                 |                                      |                   |                                     |                   |      |
| 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               | 0.5               |                                      |                   |                                     |                   | pC   |
| <b>Power Supplies</b>                           |                     |  |                    |                   |                                      |                   |                                     |                   |      |
| Positive Supply Current <sup>e</sup>            | I <sub>+</sub>      | V <sub>IN</sub> = 0 or 5 V   | Room<br>Hot        | 0.02              |                                      | 1<br>7.5          |                                     | 1<br>5            | μA   |
| Negative Supply Current <sup>e</sup>            | I <sub>-</sub>      |  | Room<br>Hot        | - 0.002           | - 1<br>- 7.5                         |                   | - 1<br>- 5                          |                   |      |
| Logic Supply Current <sup>e</sup>               | I <sub>L</sub>      |  | Room<br>Hot        | 0.002             |                                      | 1<br>7.5          |                                     | 1<br>5            |      |
| Ground Current <sup>e</sup>                     | I <sub>GND</sub>    |  | Room<br>Hot        | - 0.002           | - 1<br>- 7.5                         |                   | - 1<br>- 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 data sheet.
- 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.

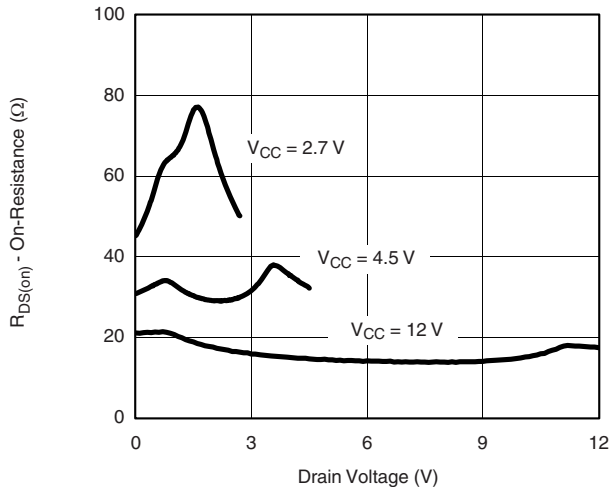
| SPECIFICATIONS <sup>a</sup> (Single Supply 3 V) |              |  |                    |                   |                                      |                   |                                     |                   |               |
|---|--------------|--|--------------------|-------------------|--------------------------------------|-------------------|-------------------------------------|-------------------|---------------|
| Parameter                                       | Symbol       | Test Conditions<br>Unless Otherwise Specified<br>$V_+ = 3\text{ V}$ , $V_- = 0\text{ V}$<br>$V_L = 3\text{ V}$ , $V_{IN} = 0.4\text{ V}^f$ | 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> |               |
| <b>Analog Switch</b>                            |              |  |                    |                   |                                      |                   |                                     |                   |               |
| Analog Signal Range <sup>e</sup>                | $V_{ANALOG}$ |  | Full               |                   | 0                                    | 3                 | 0                                   | 3                 | V             |
| Drain-Source On-Resistance                      | $R_{DS(on)}$ | $V_+ = 2.7\text{ V}$ , $V_- = 0\text{ V}$<br>$I_S = 5\text{ mA}$ , $V_D = 0.5, 2.2\text{ V}$   | Room<br>Full       | 65                |                                      | 80<br>115         |                                     | 80<br>100         | $\Omega$      |
| Switch Off Leakage Current <sup>g</sup>         | $I_{S(off)}$ | $V_+ = 3.3$ , $V_- = 0\text{ V}$<br>$V_D = 1, 2\text{ V}$ , $V_S = 2, 1\text{ V}$  | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>10           | nA            |
|   | $I_{D(off)}$ |  | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>10           |               |
| Channel On Leakage Current <sup>g</sup>         | $I_{D(on)}$  | $V_+ = 3.3\text{ V}$ , $V_- = 0\text{ V}$<br>$V_S = V_D = 1, 2\text{ V}$   | Room<br>Full       |                   | - 1<br>- 15                          | 1<br>15           | - 1<br>- 10                         | 1<br>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                                    | $t_{ON}$     | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$<br>$V_S = 1.5\text{ V}$ , see figure 2  | Room<br>Full       | 50                |                                      | 85<br>150         |                                     | 85<br>110         | ns            |
| Turn-Off Time                                   | $t_{OFF}$    |  | Room<br>Full       | 30                |                                      | 60<br>100         |                                     | 60<br>85          |               |
| Break-Before-Make Time Delay                    | $t_D$        | DG413L only, $V_S = 1.5\text{ V}$<br>$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$  | Room               | 6                 |                                      |                   |                                     |                   |               |
| Charge Injection <sup>e</sup>                   | Q            | $V_g = 0\text{ V}$ , $R_g = 0\ \Omega$ , $C_L = 10\text{ nF}$  | Room               | 1                 |                                      |                   |                                     |                   | pC            |
| 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               | 85                |                                      |                   |                                     |                   |               |
| Source Off Capacitance <sup>e</sup>             | $C_{S(off)}$ | f = 1 MHz  | Room               | 6                 |                                      |                   |                                     |                   | pF            |
| Drain Off Capacitance <sup>e</sup>              | $C_{D(off)}$ |  | Room               | 6                 |                                      |                   |                                     |                   |               |
| Channel On Capacitance <sup>e</sup>             | $C_{D(on)}$  |  | Room               | 20                |                                      |                   |                                     |                   |               |

Notes:

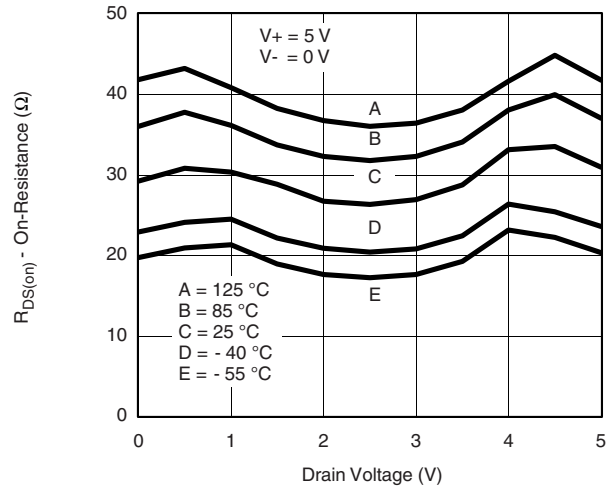
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum,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

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

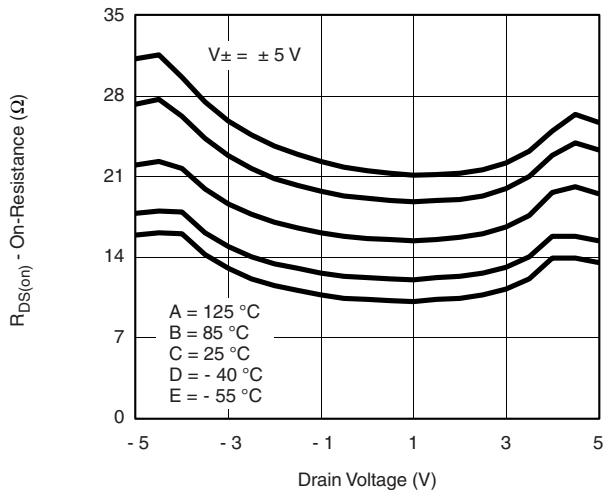
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



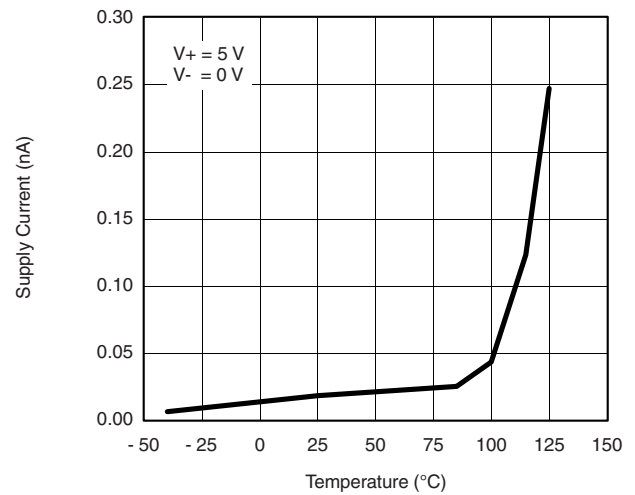
**$R_{DS(on)}$  vs. Drain Voltage (Single Supply)**



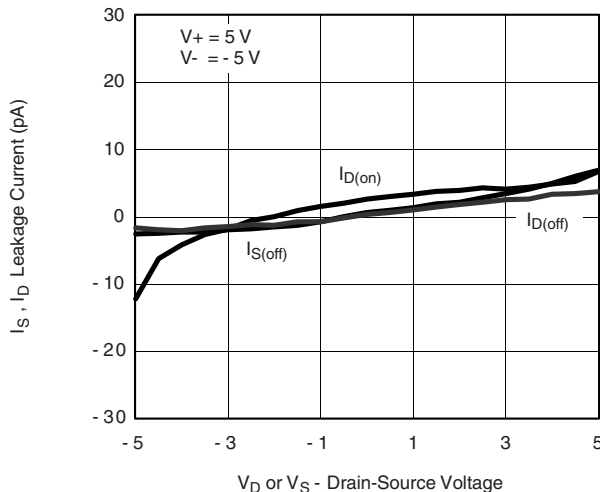
**$R_{DS(on)}$  vs. Drain Voltage and Temperature (Single Supply)**



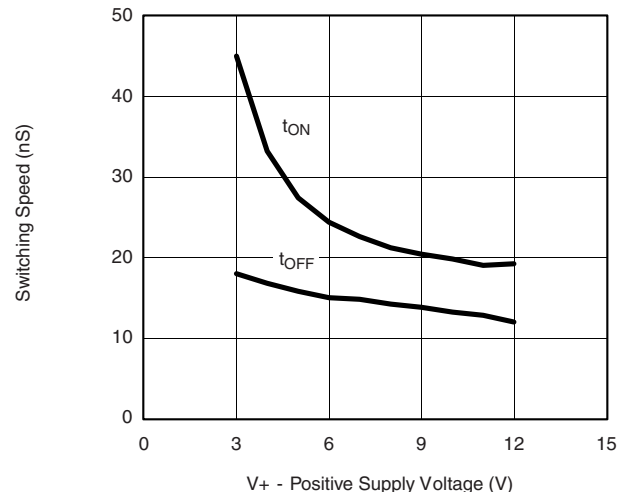
**$R_{DS(on)}$  vs. Drain Voltage and Temperature (Dual Supply)**



**Supply Current vs. Temperature**

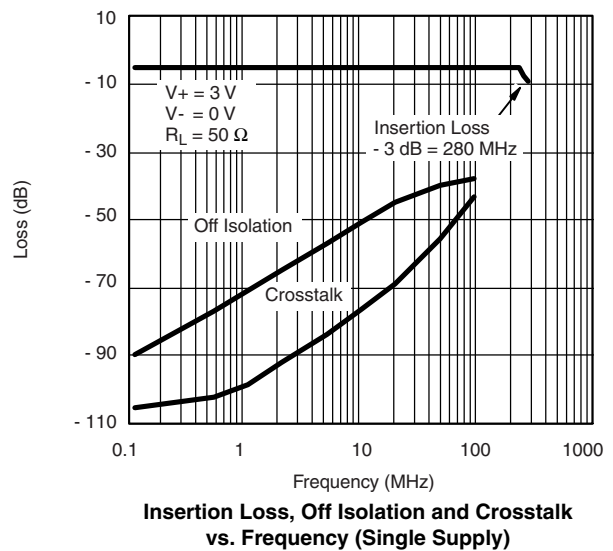
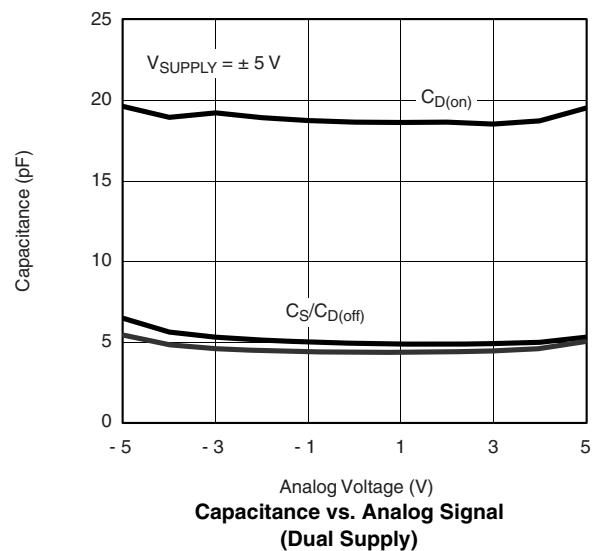
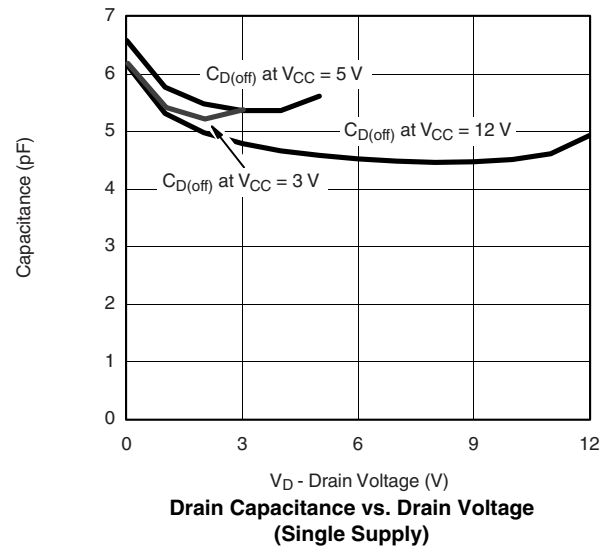
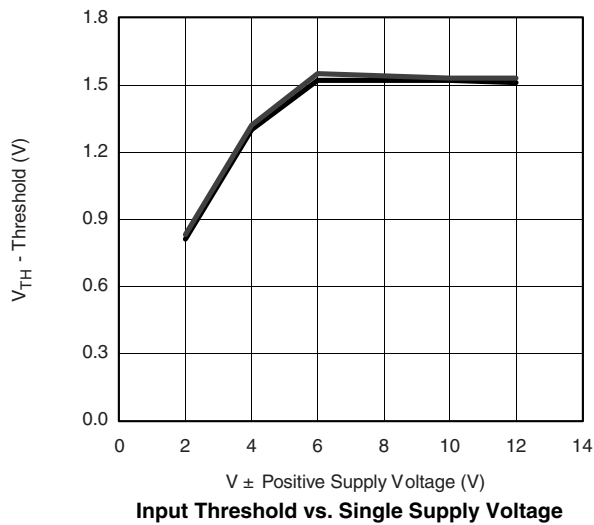
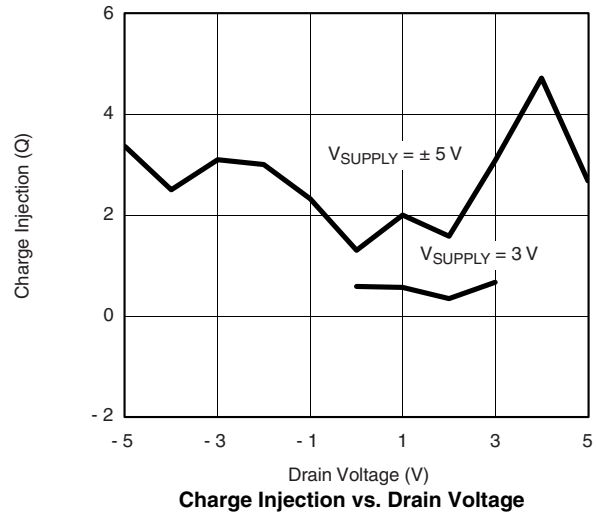
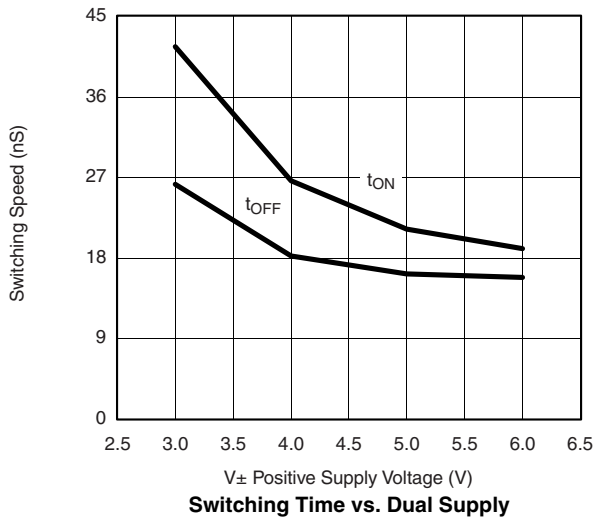


**Leakage Current vs. Analog Voltage (Dual Supply)**



**Switching Time vs. Single Supply**

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



## SCHEMATIC DIAGRAM (Typical Channel)

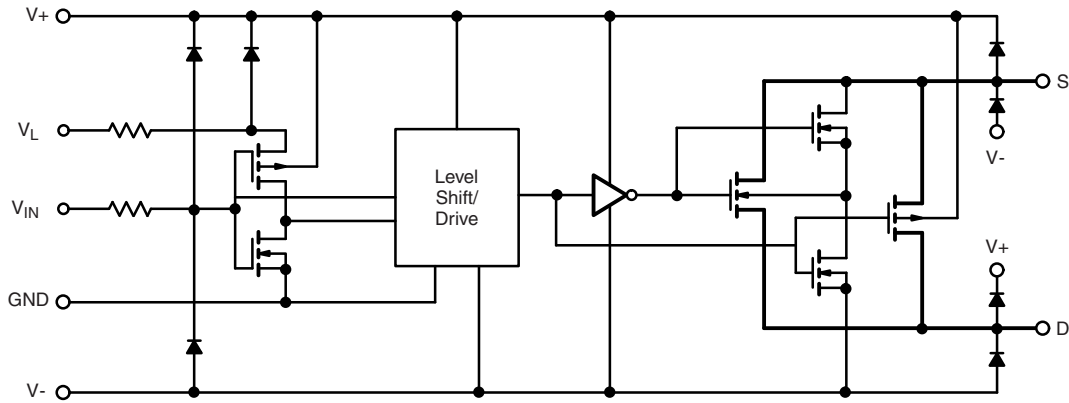
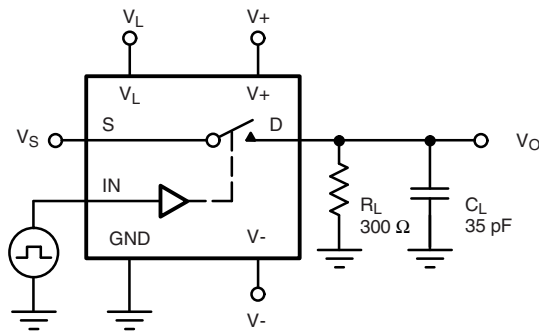


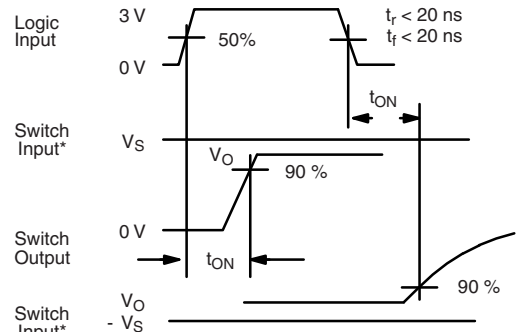
Figure 1.

## TEST CIRCUITS



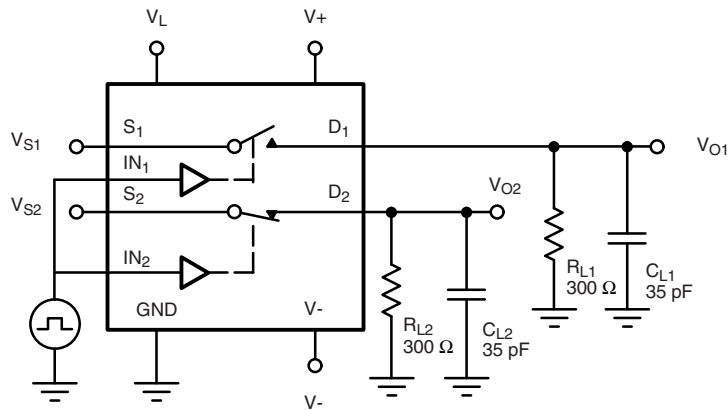
$C_L$  (includes fixture and stray capacitance)

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



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

Figure 2. Switching Time



$C_L$  (includes fixture and stray capacitance)

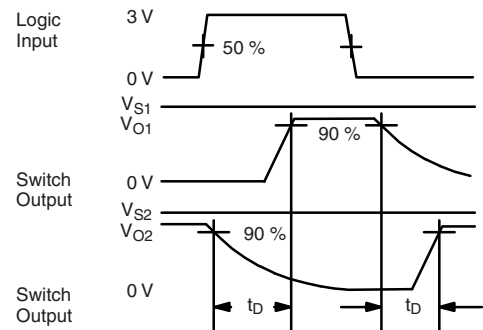
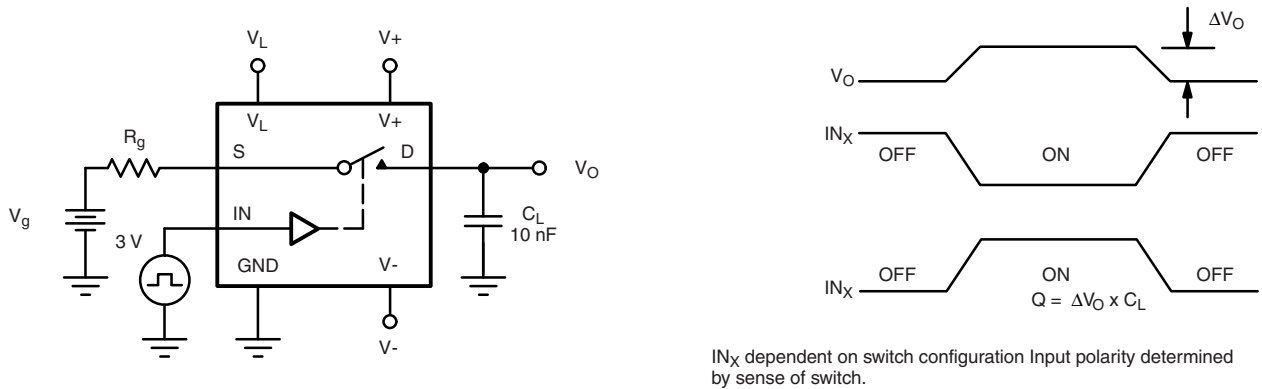
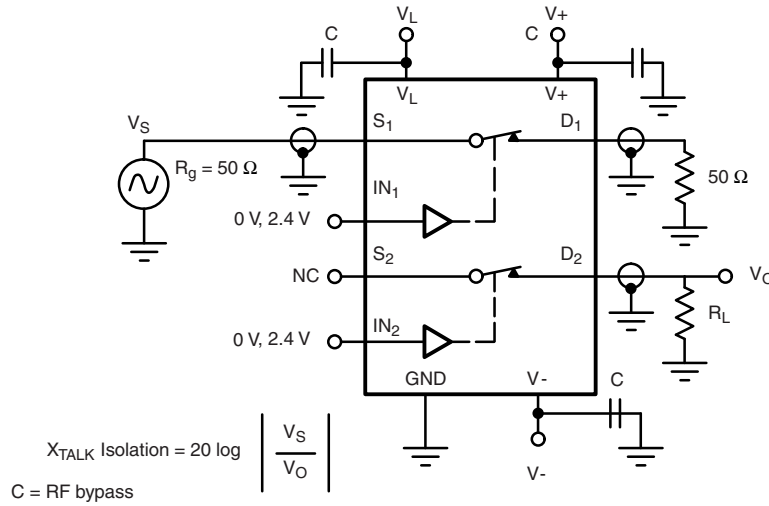


Figure 3. Break-Before-Make (DG413L)

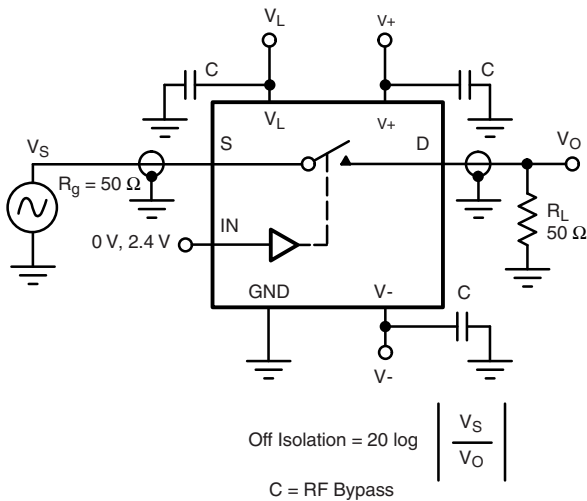
## TEST CIRCUITS



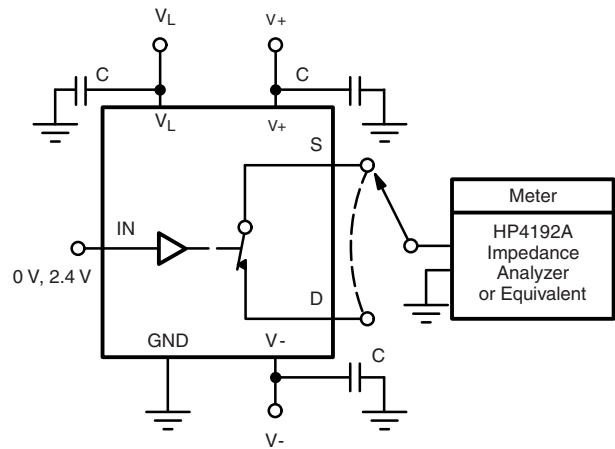
**Figure 4. Charge Injection**



**Figure 5. Crosstalk**



**Figure 6. Off-Isolation**



**Figure 7. Source/Drain Capacitances**

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

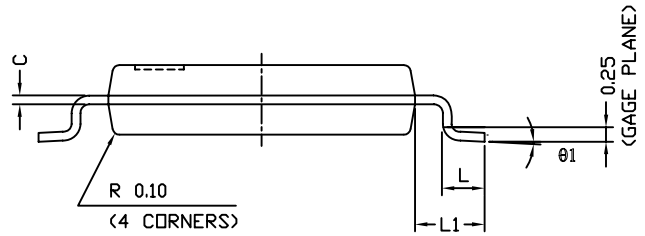


| Dim            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | Min         | Max   | Min       | Max   |
| A              | 1.35        | 1.75  | 0.053     | 0.069 |
| A <sub>1</sub> | 0.10        | 0.20  | 0.004     | 0.008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



## 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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