

# 0.5 pC Charge Injection, 100 pA Leakage, Dual SPDT Analog Switch

## DESCRIPTION

The DG636 is an analog CMOS, dual SPDT switch, designed to operate from a +2.7 V to +12 V single supply or from  $\pm 2.7$  V to  $\pm 5$  V, dual supplies. The DG636 is fully specified at +3 V, +5 V and  $\pm 5$  V. All control logic inputs have guaranteed 2 V logic high limits when operating from +5 V or  $\pm 5$  V supplies and 1.4 V when operating from a 3 V supply.

The DG636 switches conduct equally well in both directions and offer rail to rail analog signal handling.  $< 1$  pC low charge injection, coupled with very low switch capacitance and leakage current makes this product ideal for use in precision instrumentation applications. Operating temperature range is specified from  $-40$  °C to  $+125$  °C. The DG636 is available in 14 lead TSSOP and the space saving 1.8 mm x 2.6 mm miniQFN package.

## FEATURES

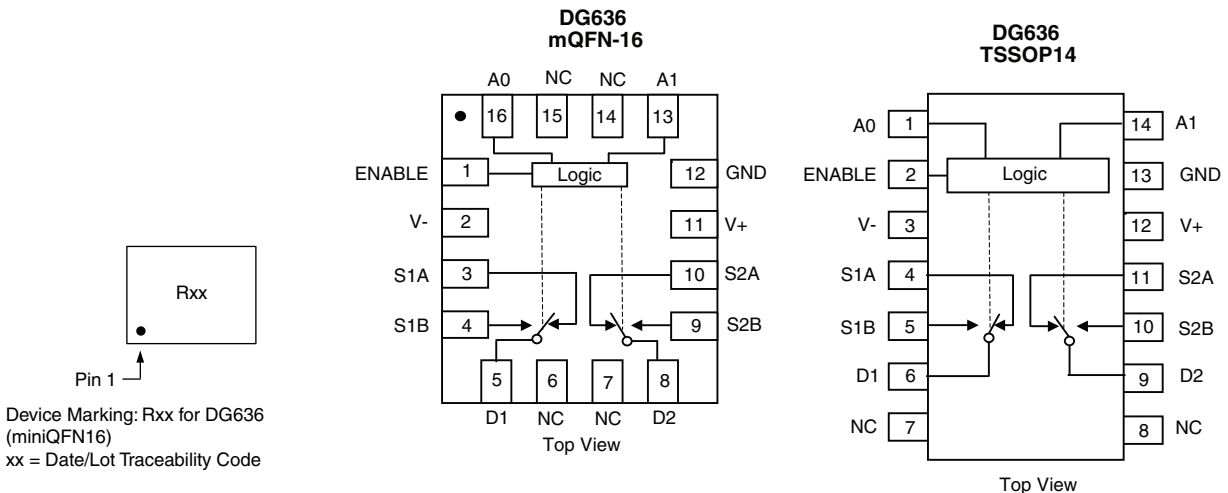
- Ultra low charge injection ( $\pm 0.5$  pC, typ. over the full analog signal range)
- Leakage current  $< 0.5$  nA max. at 85 °C (for DG636EQ-T1-E3)
- Low switch capacitance ( $C_{\text{soff}}$ , 2 pF typ.)
- Low  $R_{\text{DS(on)}}$  - 115  $\Omega$  max.
- Fully specified with single supply operation at 3 V, 5 V and dual supplies at  $\pm 5$  V
- Low voltage, 2.5 V CMOS/TTL compatible
- 600 MHz, - 3 dB bandwidth
- Excellent isolation and crosstalk performance (typ.  $> -60$  dB at 10 MHz)
- Fully specified from  $-40$  °C to  $+85$  °C and  $-40$  °C to  $+125$  °C
- 14 pin TSSOP and 16 pin miniQFN package (1.8 mm x 2.6 mm)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## APPLICATIONS

- High-end data acquisition
- Medical instruments
- Precision instruments
- High speed communications applications
- Automated test equipment
- Sample and hold applications

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION





| TRUTH TABLE  |                |    |                      |
|--------------|----------------|----|----------------------|
| ENABLE INPUT | SELECTED INPUT |    | ON SWITCHES          |
|              | A1             | A0 | DG636                |
| L            | X              | X  | All Switches Open    |
| H            | L              | L  | D1 to S1A, D2 to S2A |
| H            | L              | H  | D1 to S1B, D2 to S2A |
| H            | H              | L  | D1 to S1A, D2 to S2B |
| H            | H              | H  | D1 to S1B, D2 to S2B |

| ORDERING INFORMATION           |                |               |
|--------------------------------|----------------|---------------|
| TEMP. RANGE                    | PACKAGE        | PART NUMBER   |
| -40 °C to +125 °C <sup>a</sup> | 14 pin TSSOP   | DG636EQ-T1-E3 |
|                                | 16 pin miniQFN | DG636EN-T1-E4 |

**Note**

a. -40 °C to +85 °C datasheet limits apply.

| ABSOLUTE MAXIMUM RATINGS ( $T_A = 25\text{ °C}$ , unless otherwise noted) |  |     |      |
|---|--|-----|------|
| PARAMETER   | LIMIT  |     | UNIT |
| V+ to V-  | 14   |     | V    |
| GND to V-   | 7  |     |      |
| Digital Inputs <sup>a</sup> , $V_S$ , $V_D$                               | (V-) -0.3 to (V+) +0.3<br>or 30 mA, whichever occurs first |     |      |
| Continuous Current (Any Terminal)   | 30   |     | mA   |
| Peak Current, S or D (Pulsed 1 ms, 10 % Duty Cycle)                       | 100  |     |      |
| Storage Temperature   | -65 to +150  |     | °C   |
| Power Dissipation (Package) <sup>b</sup>                                  | 14 pin TSSOP <sup>c</sup>                                  | 450 | mW   |
|   | 16 pin miniQFN <sup>d,e</sup>                              | 525 |      |
| Thermal Resistance (Package) <sup>b</sup>                                 | 14 pin TSSOP   | 178 | °C/W |
|   | 16 pin miniQFN   | 152 |      |

**Notes**

- Signals on SX, DX, or INX exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC board.
- Derate 5.6 mW/°C above 70 °C.
- Derate 6.6 mW/°C above 70 °C.
- Manual soldering with iron is not recommended for leadless components. The miniQFN-16 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper lip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.



| SPECIFICATIONS FOR DUAL SUPPLIES                   |                       |  |                    |                   |                   |                   |                   |                   |      |
|--|-----------------------|--|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|
| PARAMETER  | SYMBOL                | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V+ = 5 V, V- = -5 V<br>VIN A0, A1 AND ENABLE = 2 V, 0.8 V <sup>a</sup> | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | -40 °C to +125 °C |                   | -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                 | -5                | 5                 | V    |
| On-Resistance                                      | R <sub>DS(on)</sub>   | I <sub>S</sub> = 1 mA, V <sub>D</sub> = -3 V, 0 V, +3 V  | Room               | 70                | -                 | 115               | -                 | 115               | Ω    |
|  |                       |  | Full               | -                 | -                 | 160               | -                 | 140               |      |
| On-Resistance Match                                | ΔR <sub>ON</sub>      | I <sub>S</sub> = 1 mA, V <sub>D</sub> = ± 3 V  | Room               | 1                 | -                 | 5                 | -                 | 5                 | Ω    |
|  |                       |  | Full               | -                 | -                 | 6.5               | -                 | 6.5               |      |
| On-Resistance Flatness                             | R <sub>FLATNESS</sub> | I <sub>S</sub> = 1 mA, V <sub>D</sub> = -3 V, 0 V, +3 V  | Room               | 10                | -                 | 20                | -                 | 20                | Ω    |
|  |                       |  | Full               | -                 | -                 | 33                | -                 | 22                |      |
| Analog Signal Range <sup>e</sup>                   | V <sub>ANALOG</sub>   |  | Full               | -                 | -5                | 5                 | -5                | 5                 | V    |
| On-Resistance                                      | R <sub>DS(on)</sub>   | I <sub>S</sub> = 1 mA, V <sub>D</sub> = -3 V, 0 V, +3 V  | Room               | 70                | -                 | 115               | -                 | 115               | Ω    |
|  |                       |  | Full               | -                 | -                 | 160               | -                 | 140               |      |
| On-Resistance Match                                | ΔR <sub>ON</sub>      | I <sub>S</sub> = 1 mA, V <sub>D</sub> = ± 3 V  | Room               | 1                 | -                 | 5                 | -                 | 5                 | Ω    |
|  |                       |  | Full               | -                 | -                 | 6.5               | -                 | 6.5               |      |
| On-Resistance Flatness                             | R <sub>FLATNESS</sub> | I <sub>S</sub> = 1 mA, V <sub>D</sub> = -3 V, 0 V, +3 V  | Room               | 10                | -                 | 20                | -                 | 20                | Ω    |
|  |                       |  | Full               | -                 | -                 | 33                | -                 | 22                |      |
| Switch Off Leakage Current<br>(for 14 pin TSSOP)   | I <sub>S(off)</sub>   | V+ = 5.5 V, V- = -5.5 V<br>V <sub>D</sub> = ± 4.5 V, V <sub>S</sub> = ∓ 4.5 V  | Room               | ± 0.01            | -0.1              | 0.1               | -0.1              | 0.1               | nA   |
|  |                       |  | Full               | -                 | -18               | 18                | -0.5              | 0.5               |      |
|  | I <sub>D(off)</sub>   |  | Room               | ± 0.01            | -0.1              | 0.1               | -0.1              | 0.1               |      |
|  |                       |  | Full               | -                 | -18               | 18                | -0.5              | 0.5               |      |
| Channel On Leakage Current<br>(for 14 pin TSSOP)   | I <sub>D(on)</sub>    | V+ = 5.5 V, V- = -5.5 V,<br>V <sub>S</sub> = V <sub>D</sub> = ± 4.5 V  | Room               | ± 0.01            | -0.1              | 0.1               | -0.1              | 0.1               | nA   |
|  |                       |  | Full               | -                 | -18               | 18                | -0.5              | 0.5               |      |
| Switch Off Leakage Current<br>(for 16 pin miniQFN) | I <sub>S(off)</sub>   | V+ = 5.5 V, V- = -5.5 V<br>V <sub>D</sub> = ± 4.5 V, V <sub>S</sub> = ∓ 4.5 V  | Room               | ± 0.01            | -1                | 1                 | -1                | 1                 | nA   |
|  |                       |  | Full               | -                 | -18               | 18                | -2                | 2                 |      |
|  | I <sub>D(off)</sub>   |  | Room               | ± 0.01            | -1                | 1                 | -1                | 1                 |      |
|  |                       |  | Full               | -                 | -18               | 18                | -2                | 2                 |      |
| Channel On Leakage Current<br>(for 16 pin miniQFN) | I <sub>D(on)</sub>    | V+ = 5.5 V, V- = -5.5 V,<br>V <sub>S</sub> = V <sub>D</sub> = ± 4.5 V  | Room               | ± 0.01            | -1                | 1                 | -1                | 1                 | nA   |
|  |                       |  | Full               | -                 | -18               | 18                | -2                | 2                 |      |
| <b>Digital Control</b>                             |                       |  |                    |                   |                   |                   |                   |                   |      |
| Input Current, V <sub>IN</sub> Low                 | I <sub>IL</sub>       | V <sub>IN</sub> A0, A1 and ENABLE<br>Under test = 0.8 V  | Full               | 0.005             | -0.1              | 0.1               | -0.1              | 0.1               | μA   |
| Input Current, V <sub>IN</sub> High                | I <sub>IH</sub>       | V <sub>IN</sub> A0, A1 and ENABLE<br>Under test = 2 V  | Full               | 0.005             | -0.1              | 0.1               | -0.1              | 0.1               |      |
| Input Capacitance <sup>e</sup>                     | C <sub>IN</sub>       | f = 1 MHz  | Room               | 3.4               | -                 | -                 | -                 | -                 | pF   |



| SPECIFICATIONS FOR DUAL SUPPLIES             |                     |  |                    |                   |                   |                   |                   |                   |      |
|--|---------------------|--|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|
| PARAMETER                                    | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V+ = 5 V, V- = -5 V<br>VIN A0, A1 AND ENABLE = 2 V, 0.8 V <sup>a</sup> | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | -40 °C to +125 °C |                   | -40 °C to +85 °C  |                   | UNIT |
|  |                     |  |                    |                   | MIN. <sup>d</sup> | MAX. <sup>d</sup> | MIN. <sup>d</sup> | MAX. <sup>d</sup> |      |
| <b>Dynamic Characteristics</b>               |                     |  |                    |                   |                   |                   |                   |                   |      |
| Transition Time                              | t <sub>trans</sub>  | V <sub>S(CLOSE)</sub> = 3 V, V <sub>S(OPEN)</sub> = 0 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                 | Room               | 20                | -                 | 70                | -                 | 70                | ns   |
|  |                     |  | Full               | -                 | -                 | 105               | -                 | 80                |      |
| Turn-On Time                                 | t <sub>ON</sub>     | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S</sub> = ± 3 V   | Room               | 16                | -                 | 60                | -                 | 60                |      |
|  |                     |  | Full               | -                 | -                 | 90                | -                 | 65                |      |
| Turn-Off Time                                | t <sub>OFF</sub>    |  | Room               | 15                | -                 | 52                | -                 | 52                |      |
|  |                     |  | Full               | -                 | -                 | 76                | -                 | 56                |      |
| Break-Before-Make<br>Time Delay              | t <sub>D</sub>      | V <sub>S</sub> = 3 V<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF   | Room               | 15                | -                 | -                 | -                 | -                 |      |
|  |                     |  | Full               | -                 | 5                 | -                 | 5                 | -                 |      |
| Charge Injection <sup>e</sup>                | Q                   | V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω, C <sub>L</sub> = 1 nF  | Room               | 0.1               | -                 | -                 | -                 | -                 | pC   |
| Off Isolation <sup>e</sup>                   | OIRR                | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz   | Room               | -58               | -                 | -                 | -                 | -                 | dB   |
| Bandwidth <sup>e</sup>                       | BW                  | R <sub>L</sub> = 50 Ω  | Room               | 610               | -                 | -                 | -                 | -                 | MHz  |
| Channel-to-Channel<br>Crosstalk <sup>e</sup> | X <sub>TALK</sub>   | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz   | Room               | -88               | -                 | -                 | -                 | -                 | dB   |
| Source Off Capacitance <sup>e</sup>          | C <sub>S(off)</sub> | f = 1 MHz  | Room               | 2.1               | -                 | -                 | -                 | -                 | pF   |
| Drain Off Capacitance <sup>e</sup>           | C <sub>D(off)</sub> |  | Room               | 4.2               | -                 | -                 | -                 | -                 |      |
| Channel On Capacitance <sup>e</sup>          | C <sub>D(on)</sub>  |  | Room               | 11.3              | -                 | -                 | -                 | -                 |      |
| Total Harmonic Distortion <sup>e</sup>       | THD                 | Signal = 1 V <sub>RMS</sub> , 20 Hz to 20 kHz,<br>R <sub>L</sub> = 600 Ω   | Room               | 0.01              | -                 | -                 | -                 | -                 | %    |
| <b>Power Supplies</b>                        |                     |  |                    |                   |                   |                   |                   |                   |      |
| Power Supply Current                         | I+                  | V <sub>IN</sub> = 0 V, or V+   | Room               | 0.001             | -                 | 0.5               | -                 | 0.5               | μA   |
|  |                     |  | Full               | -                 | -                 | 1                 | -                 | 1                 |      |
| Negative Supply Current                      | I-                  |  | Room               | -0.001            | -0.5              | -                 | -0.5              | -                 |      |
|  |                     |  | Full               | -                 | -1                | -                 | -1                | -                 |      |
| Ground Current                               | I <sub>GND</sub>    |  | Room               | -0.001            | -0.5              | -                 | -0.5              | -                 |      |
|  |                     |  | Full               | -                 | -1                | -                 | -1                | -                 |      |



| SPECIFICATIONS FOR SINGLE SUPPLY                   |                      |   |   |                   |                   |                   |                   |                   |      |    |
|--|----------------------|---|---|-------------------|-------------------|-------------------|-------------------|-------------------|------|----|
| PARAMETER  | SYMBOL               | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V <sub>+</sub> = 5 V, V <sub>-</sub> = 0 V<br>V <sub>IN A0, A1 AND ENABLE</sub> = 2 V, 0.8 V <sup>a</sup> | TEMP. <sup>b</sup>  | TYP. <sup>c</sup> | -40 °C to +125 °C |                   | -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    |    |
| On-Resistance                                      | R <sub>DS(on)</sub>  | I <sub>S</sub> = 1 mA, V <sub>D</sub> = +3.5 V  | Room  | 120               | -                 | 170               | -                 | 170               | Ω    |    |
|  |                      |   | Full  | -                 | -                 | 250               | -                 | 200               |      |    |
| On-Resistance Match                                | ΔR <sub>ON</sub>     | I <sub>S</sub> = 1 mA, V <sub>D</sub> = +3.5 V  | Room  | 3                 | -                 | 5                 | -                 | 5                 | Ω    |    |
|  |                      |   | Full  | -                 | -                 | 12                | -                 | 10                |      |    |
| Switch Off Leakage Current<br>(for 14 pin TSSOP)   | I <sub>S(off)</sub>  | V <sub>+</sub> = 5.5 V, V <sub>-</sub> = 0 V<br>V <sub>D</sub> = 1 V/4.5 V, V <sub>S</sub> = 4.5 V/1 V  | Room  | ± 0.01            | -0.1              | 0.1               | -0.1              | 0.1               | nA   |    |
|  |                      |   | Full  | -                 | -18               | 18                | -0.5              | 0.5               |      |    |
|  | I <sub>D(off)</sub>  |   | Room  | ± 0.01            | -0.1              | 0.1               | -0.1              | 0.1               |      |    |
|  |                      |   | Full  | -                 | -18               | 18                | -0.5              | 0.5               |      |    |
| Channel On Leakage Current<br>(for 14 pin TSSOP)   | I <sub>D(on)</sub>   | V <sub>+</sub> = 5.5 V, V <sub>-</sub> = 0 V<br>V <sub>S</sub> = V <sub>D</sub> = 1 V/4.5 V   | Room  | ± 0.01            | -0.1              | 0.1               | -0.1              | 0.1               | nA   |    |
|  |                      |   | Full  | -                 | -18               | 18                | -0.5              | 0.5               |      |    |
| Switch Off Leakage Current<br>(for 16 pin miniQFN) | I <sub>S(off)</sub>  | V <sub>+</sub> = 5.5 V, V <sub>-</sub> = 0 V<br>V <sub>D</sub> = 1 V/4.5 V, V <sub>S</sub> = 4.5 V/1 V  | Room  | ± 0.01            | -1                | 1                 | -1                | 1                 | nA   |    |
|  |                      |   | Full  | -                 | -18               | 18                | -2                | 2                 |      |    |
|  | I <sub>D(off)</sub>  |   | Room  | ± 0.01            | -1                | 1                 | -1                | 1                 |      |    |
|  |                      |   | Full  | -                 | -18               | 18                | -2                | 2                 |      |    |
| Channel On Leakage Current<br>(for 16 pin miniQFN) | I <sub>D(on)</sub>   | V <sub>+</sub> = 5.5 V, V <sub>-</sub> = 0 V,<br>V <sub>S</sub> = V <sub>D</sub> = 1 V/4.5 V  | Room  | ± 0.01            | -1                | 1                 | -1                | 1                 | nA   |    |
|  |                      |   | Full  | -                 | -18               | 18                | -2                | 2                 |      |    |
| <b>Digital Control</b>                             |                      |   |   |                   |                   |                   |                   |                   |      |    |
| Input Current, V <sub>IN</sub> Low                 | I <sub>L</sub>       | V <sub>IN A0, A1 and ENABLE</sub><br>Under test = 0.8 V   | Full  | 0.005             | -0.1              | 0.1               | -0.1              | 0.1               | μA   |    |
| Input Current, V <sub>IN</sub> High                | I <sub>H</sub>       | V <sub>IN A0, A1 and ENABLE</sub><br>Under test = 2 V   | Full  | 0.005             | -0.1              | 0.1               | -0.1              | 0.1               | μA   |    |
| Input Capacitance                                  | C <sub>IN</sub>      | f = 1 MHz   | Room  | 4.3               | -                 | -                 | -                 | -                 | pF   |    |
| <b>Dynamic Characteristics</b>                     |                      |   |   |                   |                   |                   |                   |                   |      |    |
| Transition Time                                    | t <sub>TRANS</sub>   | V <sub>S(CLOSE)</sub> = 3 V, V <sub>S(OPEN)</sub> = 0 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF  | Room  | 36                | -                 | 75                | -                 | 75                | ns   |    |
|  |                      |   | Full  | -                 | -                 | 120               | -                 | 95                |      |    |
| Enable Turn-On Time                                | t <sub>ON(EN)</sub>  |   | Room  | 30                | -                 | 70                | -                 | 70                |      |    |
|  |                      |   | Full  | -                 | -                 | 102               | -                 | 80                |      |    |
| Enable Turn-Off Time                               | t <sub>OFF(EN)</sub> |   | Room  | 17                | -                 | 47                | -                 | 47                |      |    |
|  |                      |   | Full  | -                 | -                 | 88                | -                 | 63                |      |    |
| Break-Before-Make-Time                             | t <sub>BMM</sub>     |   | Room  | 23                | -                 | -                 | -                 | -                 |      | ns |
|  |                      |   | Full  | -                 | 5                 | -                 | 5                 | -                 |      |    |
| Charge Injection                                   | Q                    |   | C <sub>L</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>GEN</sub> = 0 V | Full              | 0.1               | -                 | -                 | -                 |      | pC |
| Off-Isolation <sup>e</sup>                         | OIRR                 |   | f = 10 MHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF              | Room              | -58               | -                 | -                 | -                 |      | dB |
| Crosstalk <sup>e</sup>                             | X <sub>TALK</sub>    | Room  |   | -81               | -                 | -                 | -                 |                   |      |    |
| Bandwidth <sup>e</sup>                             | BW                   | R <sub>L</sub> = 50 Ω   | Room  | 520               | -                 | -                 | -                 | MHz               |      |    |
| Total Harmonic Distortion                          | THD                  | Signal = 1 V <sub>RMS</sub> , 20 Hz to 20 kHz,<br>R <sub>L</sub> = 600 Ω  | Room  | 0.009             | -                 | -                 | -                 | %                 |      |    |
| Source Off Capacitance <sup>e</sup>                | C <sub>S(off)</sub>  | f = 1 MHz   | Room  | 2.5               | -                 | -                 | -                 | pF                |      |    |
| Drain Off Capacitance <sup>e</sup>                 | C <sub>D(off)</sub>  |   |   | 6.4               | -                 | -                 | -                 |                   |      |    |
| Channel On Capacitance <sup>e</sup>                | C <sub>D(on)</sub>   |   |   | 11.3              | -                 | -                 | -                 |                   |      |    |



| SPECIFICATIONS FOR SINGLE SUPPLY |                  |  |                    |                   |                   |                   |                   |                   |               |
|----------------------------------|------------------|--|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------|
| PARAMETER                        | SYMBOL           | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>$V_+ = 5\text{ V}, V_- = 0\text{ V}$<br>$V_{IN\ A0, A1\ \text{AND}\ \text{ENABLE}} = 2\text{ V}, 0.8\text{ V}^a$ | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | -40 °C to +125 °C |                   | -40 °C to +85 °C  |                   | UNIT          |
|                                  |                  |  |                    |                   | MIN. <sup>d</sup> | MAX. <sup>d</sup> | MIN. <sup>d</sup> | MAX. <sup>d</sup> |               |
| <b>Power Supplies</b>            |                  |  |                    |                   |                   |                   |                   |                   |               |
| Power Supply Current             | I+               | $V_{IN} = 0\text{ V}, \text{ or } V_+$   | Room               | 0.001             | -                 | 0.5               | -                 | 0.5               | $\mu\text{A}$ |
|                                  |                  |  | Full               | -                 | -                 | 1                 | -                 | 1                 |               |
| Negative Supply Current          | I-               |  | Room               | -0.001            | -0.5              | -                 | -0.5              | -                 |               |
|                                  |                  |  | Full               | -                 | -1                | -                 | -1                | -                 |               |
| Ground Current                   | I <sub>GND</sub> |  | Room               | -0.001            | -0.5              | -                 | -0.5              | -                 |               |
|                                  |                  |  | Full               | -                 | -1                | -                 | -1                | -                 |               |

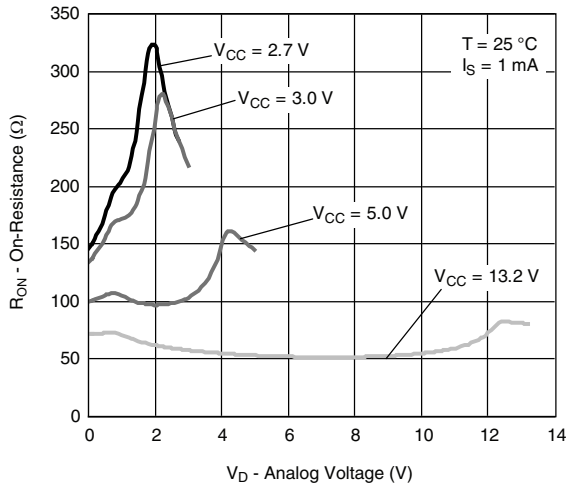
| SPECIFICATIONS FOR SINGLE SUPPLY                   |                     |  |                    |                   |                   |                   |                   |                   |               |
|--|---------------------|--|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------|
| PARAMETER  | SYMBOL              | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>$V_+ = 3\text{ V}, V_- = 0\text{ V}$<br>$V_{IN\ A0, A1\ \text{AND}\ \text{ENABLE}} = 1.4\text{ V}, 0.6\text{ V}^a$ | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | -40 °C to +125 °C |                   | -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               | -                 | -                 | 3                 | -                 | 3                 | V             |
| On-Resistance                                      | R <sub>DS(on)</sub> | $I_S = 1\text{ mA}, V_D = +1.5\text{ V}$   | Room               | 200               | -                 | 245               | -                 | 245               | $\Omega$      |
|  |                     |  | Full               | -                 | -                 | 325               | -                 | 290               |               |
| On-Resistance Match                                | $\Delta R_{ON}$     | $I_S = 1\text{ mA}, V_D = +1.5\text{ V}$   | Room               | 5                 | -                 | 6                 | -                 | 11                | $\Omega$      |
|  |                     |  | Full               | -                 | -                 | 13                | -                 | 6                 |               |
| Switch Off Leakage Current<br>(for 14 pin TSSOP)   | I <sub>S(off)</sub> | $V_+ = 3\text{ V}, V_- = 0\text{ V}$<br>$V_D = 1\text{ V}/3\text{ V}, V_S = 3\text{ V}/1\text{ V}$   | Room               | $\pm 0.01$        | -0.1              | 0.1               | -0.1              | 0.1               | $\text{nA}$   |
|  |                     |  | Full               | -                 | -18               | 18                | -0.5              | 0.5               |               |
|  | I <sub>D(off)</sub> |  | Room               | $\pm 0.01$        | -0.1              | 0.1               | -0.1              | 0.1               |               |
|  |                     |  | Full               | -                 | -18               | 18                | -0.5              | 0.5               |               |
| Channel On Leakage Current<br>(for 14 pin TSSOP)   | I <sub>D(on)</sub>  | $V_+ = 3\text{ V}, V_- = 0\text{ V}$<br>$V_S = V_D = 1\text{ V}/3\text{ V}$  | Room               | $\pm 0.01$        | -0.1              | 0.1               | -0.1              | 0.1               |               |
|  |                     |  | Full               | -                 | -18               | 18                | -0.5              | 0.5               |               |
| Switch Off Leakage Current<br>(for 16 pin miniQFN) | I <sub>S(off)</sub> | $V_+ = 3.3\text{ V}, V_- = 0\text{ V}$<br>$V_D = 1\text{ V}/3\text{ V}, V_S = 3\text{ V}/1\text{ V}$   | Room               | $\pm 0.01$        | -1                | 1                 | -1                | 1                 |               |
|  |                     |  | Full               | -                 | -18               | 18                | -2                | 2                 |               |
|  | I <sub>D(off)</sub> |  | Room               | $\pm 0.01$        | -1                | 1                 | -1                | 1                 |               |
|  |                     |  | Full               | -                 | -18               | 18                | -2                | 2                 |               |
| Channel On Leakage Current<br>(for 16 pin miniQFN) | I <sub>D(on)</sub>  | $V_+ = 3.3\text{ V}, V_- = 0\text{ V}$<br>$V_S = V_D = 1\text{ V}/3\text{ V}$  | Room               | $\pm 0.01$        | -1                | 1                 | -1                | 1                 |               |
|  |                     |  | Full               | -                 | -18               | 18                | -2                | 2                 |               |
| <b>Digital Control</b>                             |                     |  |                    |                   |                   |                   |                   |                   |               |
| Input Current, V <sub>IN</sub> Low                 | I <sub>L</sub>      | $V_{IN\ A0, A1\ \text{and}\ \text{ENABLE}}$<br>Under test = 0.6 V  | Full               | 0.005             | -1                | 1                 | -1                | 1                 | $\mu\text{A}$ |
| Input Current, V <sub>IN</sub> High                | I <sub>H</sub>      | $V_{IN\ A0, A1\ \text{and}\ \text{ENABLE}}$<br>Under test = 1.4 V  | Full               | 0.005             | -1                | 1                 | -1                | 1                 |               |
| Input Capacitance                                  | C <sub>IN</sub>     | f = 1 MHz  | Room               | 4.3               | -                 | -                 | -                 | -                 | pF            |



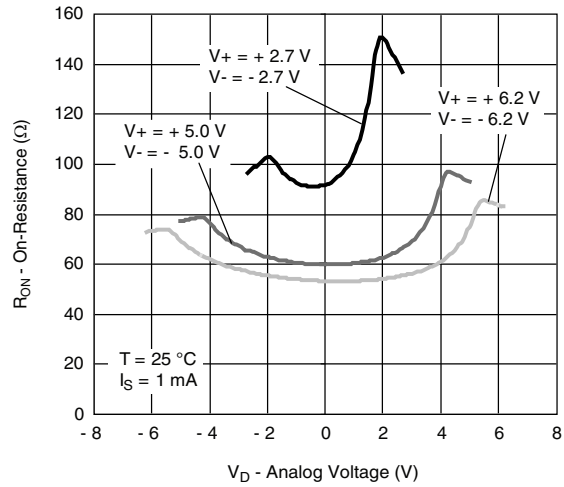
| SPECIFICATIONS FOR SINGLE SUPPLY    |                      |   |                    |                   |                   |                   |                   |                   |      |
|-------------------------------------|----------------------|---|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|
| PARAMETER                           | SYMBOL               | TEST CONDITIONS<br>UNLESS OTHERWISE<br>SPECIFIED<br>V+ = 3 V, V- = 0 V<br>VIN A0, A1 AND ENABLE = 1.4 V, 0.6 V <sup>a</sup> | TEMP. <sup>b</sup> | TYP. <sup>c</sup> | -40 °C to +125 °C |                   | -40 °C to +85 °C  |                   | UNIT |
|                                     |                      |   |                    |                   | MIN. <sup>d</sup> | MAX. <sup>d</sup> | MIN. <sup>d</sup> | MAX. <sup>d</sup> |      |
| <b>Dynamic Characteristics</b>      |                      |   |                    |                   |                   |                   |                   |                   |      |
| Transition Time                     | t <sub>TRANS</sub>   | V <sub>S(CLOSE)</sub> = 3 V, V <sub>S(OPEN)</sub> = 0 V,<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF                  | Room               | 95                | -                 | 130               | -                 | 130               | ns   |
|                                     |                      |   | Full               | -                 | -                 | 190               | -                 | 160               |      |
| Enable Turn-On Time                 | t <sub>ON(EN)</sub>  |   | Room               | 77                | -                 | 108               | -                 | 108               |      |
|                                     |                      |   | Full               | -                 | -                 | 161               | -                 | 131               |      |
| Enable Turn-Off Time                | t <sub>OFF(EN)</sub> |   | Room               | 35                | -                 | 76                | -                 | 76                |      |
|                                     |                      |   | Full               | -                 | -                 | 112               | -                 | 88                |      |
| Break-Before-Make-Time              | t <sub>BMM</sub>     |   | Room               | 45                | -                 | -                 | -                 | -                 |      |
|                                     |                      |   | Full               | -                 | 5                 | -                 | 5                 | -                 |      |
| Charge Injection                    | Q                    | C <sub>L</sub> = 1 nF, R <sub>GEN</sub> = 0 Ω, V <sub>GEN</sub> = 0 V   | Full               | 0.24              | -                 | -                 | -                 | -                 | pC   |
| Off-Isolation <sup>e</sup>          | OIRR                 | f = 10 MHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF  | Room               | -57               | -                 | -                 | -                 | -                 | dB   |
| Crosstalk <sup>e</sup>              | X <sub>TALK</sub>    |   | Room               | -93               | -                 | -                 | -                 | -                 |      |
| Bandwidth <sup>e</sup>              | BW                   | R <sub>L</sub> = 50 Ω   | Room               | 442               | -                 | -                 | -                 | -                 | MHz  |
| Total Harmonic Distortion           | THD                  | Signal = 1 V <sub>RMS</sub> , 20 Hz to 20 kHz,<br>R <sub>L</sub> = 600 Ω  | Room               | 0.09              | -                 | -                 | -                 | -                 | %    |
| Source Off Capacitance <sup>e</sup> | C <sub>S(off)</sub>  | f = 1 MHz   | Room               | 2.5               | -                 | -                 | -                 | -                 | pF   |
| Drain Off Capacitance <sup>e</sup>  | C <sub>D(off)</sub>  |   | Room               | 6.4               | -                 | -                 | -                 | -                 |      |
| Channel On Capacitance <sup>e</sup> | C <sub>D(on)</sub>   |   | Room               | 11.7              | -                 | -                 | -                 | -                 |      |
| <b>Power Supplies</b>               |                      |   |                    |                   |                   |                   |                   |                   |      |
| Power Supply Current                | I+                   | VIN = 0 V, or V+  | Room               | 0.001             | -                 | 0.5               | -                 | 0.5               | μA   |
|                                     |                      |   | Full               | -                 | -                 | 1                 | -                 | 1                 |      |
| Negative Supply Current             | I-                   |   | Room               | -0.001            | -0.5              | -                 | -0.5              | -                 |      |
|                                     |                      |   | Full               | -                 | -1                | -                 | -1                | -                 |      |
| Ground Current                      | IGND                 |   | Room               | -0.001            | -0.5              | -                 | -0.5              | -                 |      |
|                                     |                      |   | Full               | -                 | -1                | -                 | -1                | -                 |      |

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

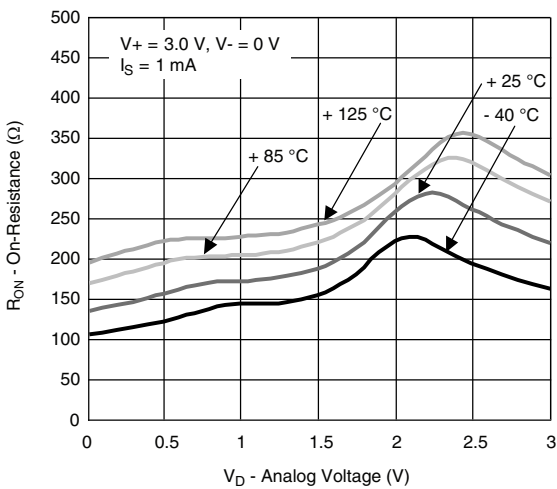
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



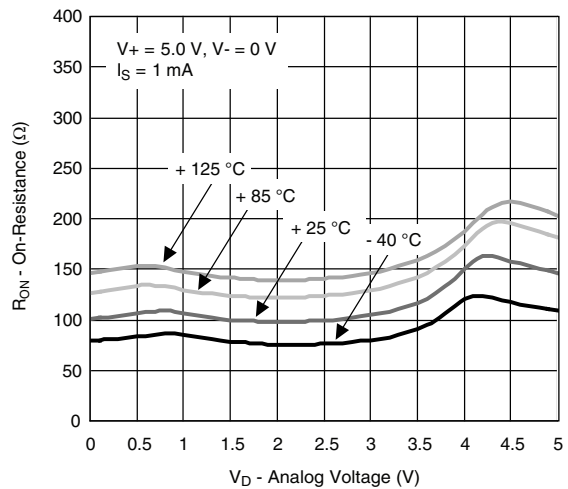
**On-Resistance vs.  $V_D$  (Single Supply Voltage)**



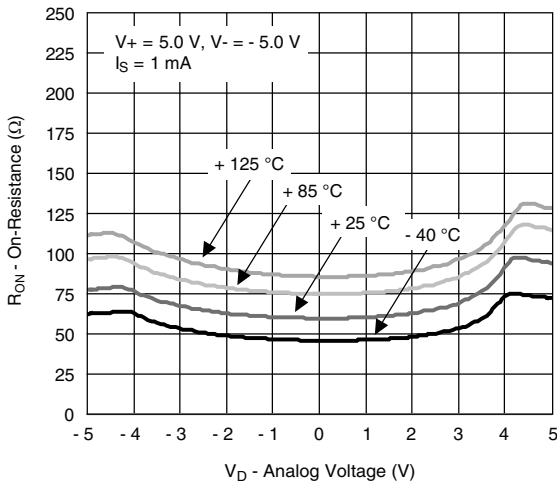
**On-Resistance vs.  $V_D$  (Dual Supply Voltage)**



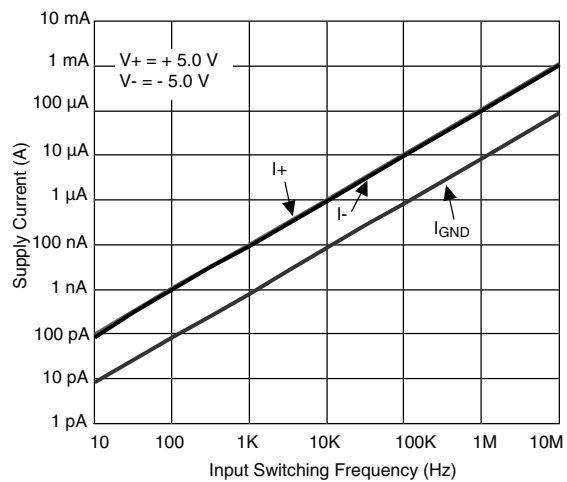
**On-Resistance vs. Analog Voltage and Temperature**



**On-Resistance vs. Analog Voltage and Temperature**



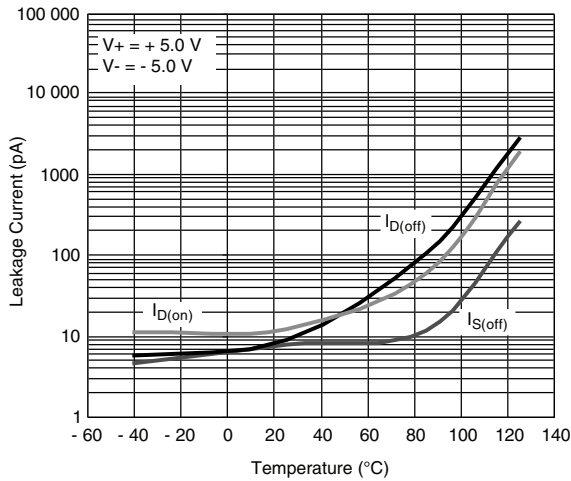
**On-Resistance vs. Analog Voltage and Temperature**



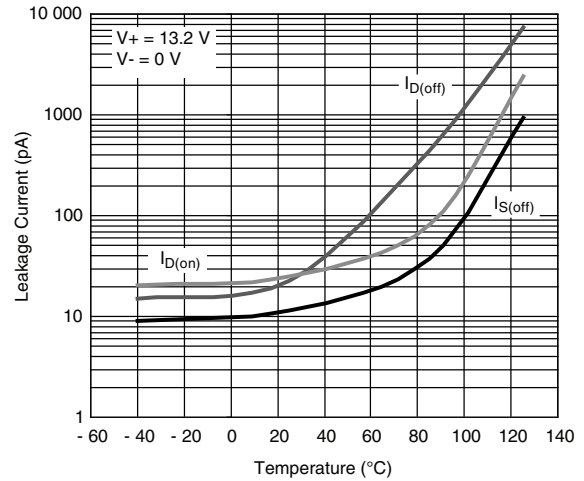
**Supply Current vs. Input Switching Frequency**



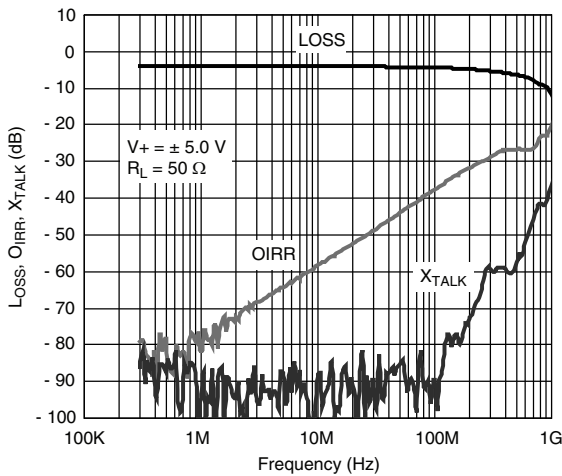
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



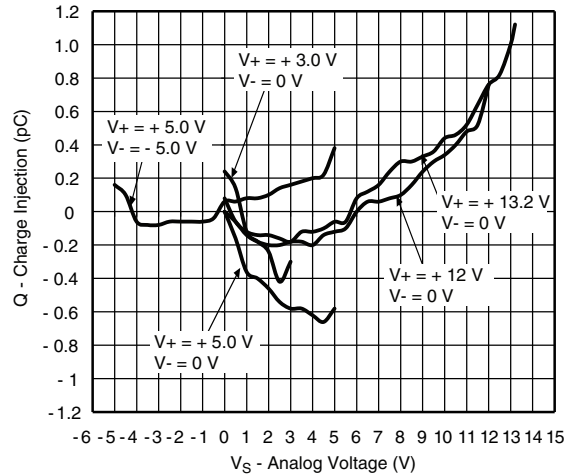
**Leakage Current vs. Temperature**



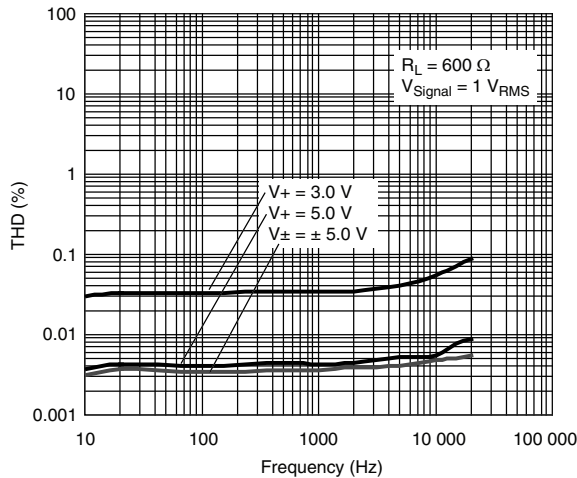
**Leakage Current vs. Temperature**



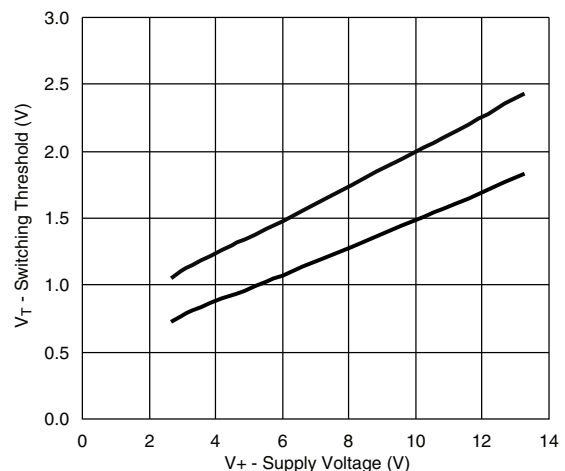
**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**



**Charge Injection vs. Analog Voltage**



**Total Harmonic Distortion vs. Frequency**



**Switching Threshold vs. Supply Voltage**

TEST CIRCUITS

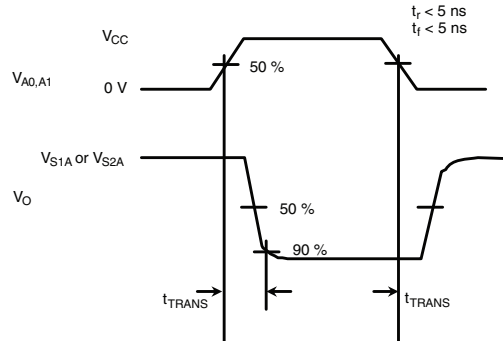
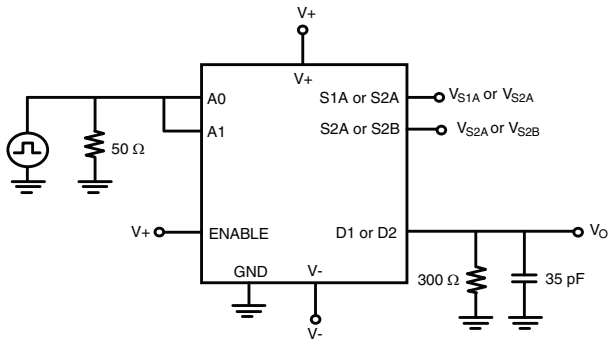


Fig. 1 - Transition Time

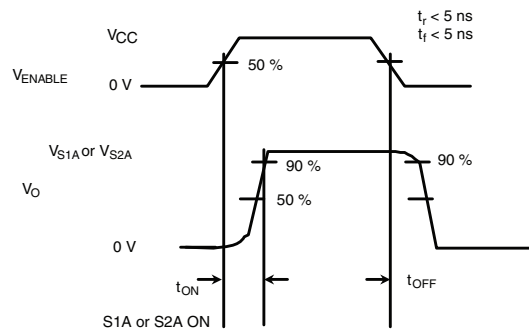
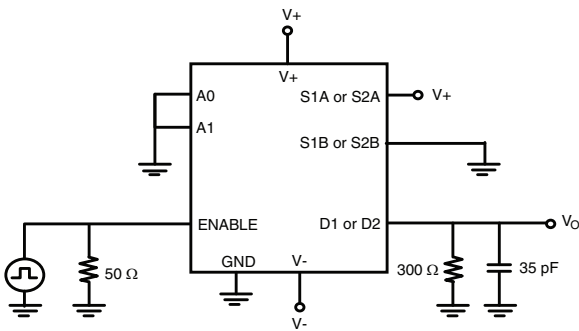


Fig. 2 - Enable Switching Time

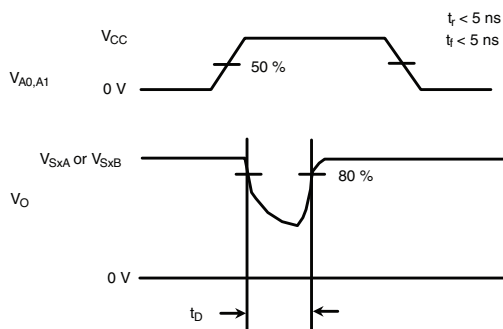
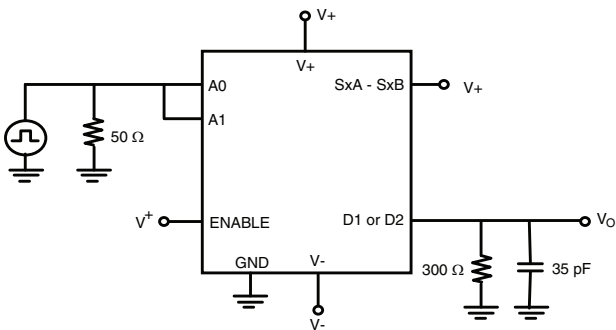


Fig. 3 - Break-Before-Make

TEST CIRCUITS

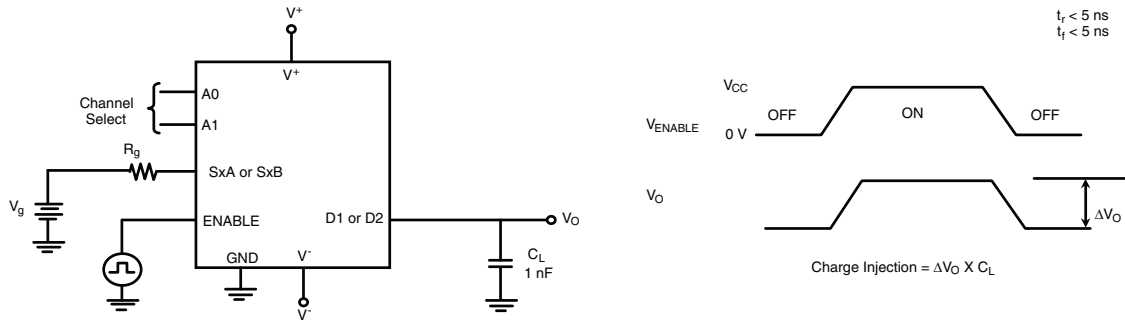
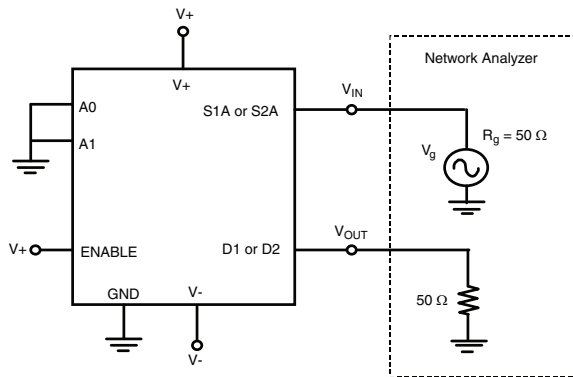
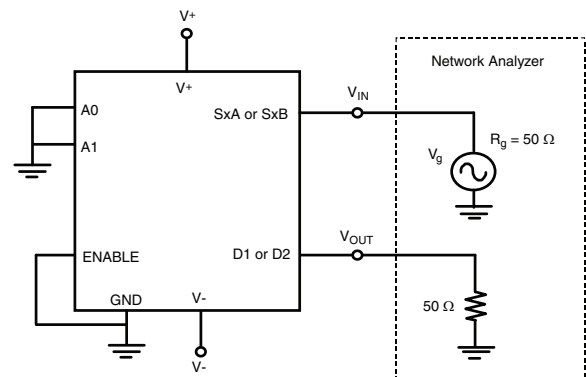


Fig. 4 - Charge Injection



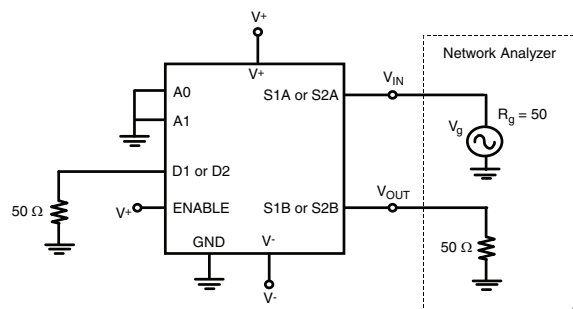
$$\text{Insertion Loss} = 20 \log \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

Fig. 5 - Insertion Loss



$$\text{Off Isolation} = 20 \log \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

Fig. 7 - Off-Isolation



$$\text{Cross Talk} = 20 \log \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

Fig. 6 - Crosstalk

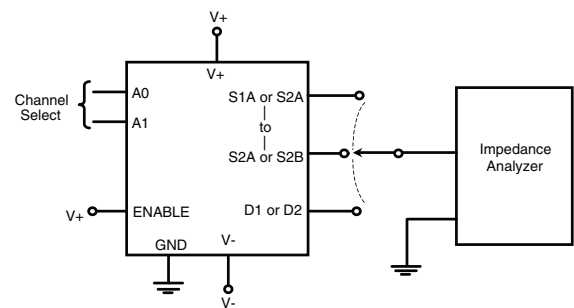
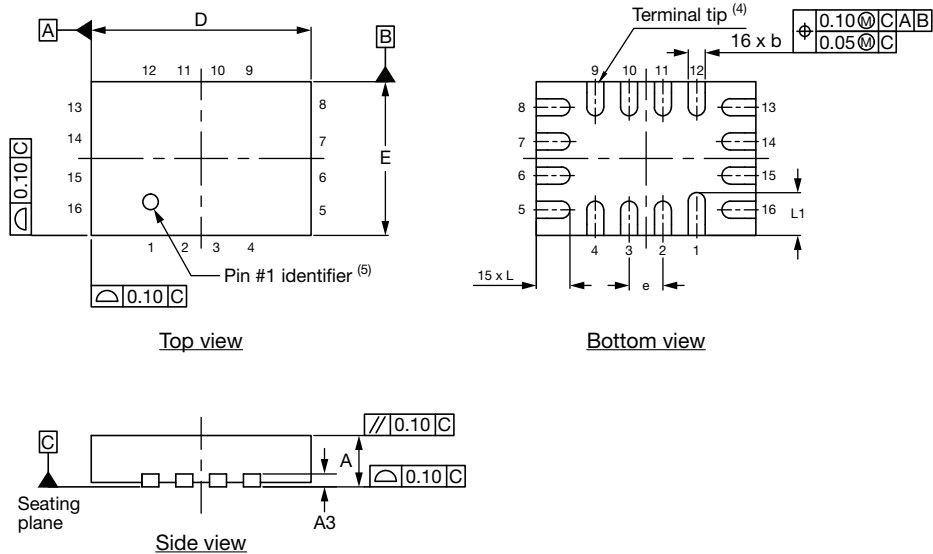


Fig. 8 - Source/Drain Capacitance

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## Thin miniQFN16 Case Outline



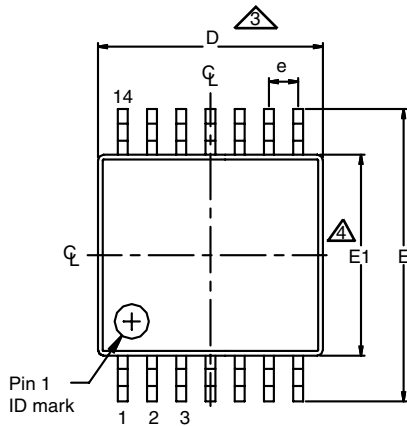
| DIMENSIONS        | MILLIMETERS <sup>(1)</sup> |      |      | INCHES     |       |       |
|-------------------|----------------------------|------|------|------------|-------|-------|
|                   | MIN.                       | NOM. | MAX. | MIN.       | NOM.  | MAX.  |
| A                 | 0.50                       | 0.55 | 0.60 | 0.020      | 0.022 | 0.024 |
| A1                | 0                          | -    | 0.05 | 0          | -     | 0.002 |
| A3                | 0.15 ref.                  |      |      | 0.006 ref. |       |       |
| b                 | 0.15                       | 0.20 | 0.25 | 0.006      | 0.008 | 0.010 |
| D                 | 2.50                       | 2.60 | 2.70 | 0.098      | 0.102 | 0.106 |
| e                 | 0.40 BSC                   |      |      | 0.016 BSC  |       |       |
| E                 | 1.70                       | 1.80 | 1.90 | 0.067      | 0.071 | 0.075 |
| L                 | 0.35                       | 0.40 | 0.45 | 0.014      | 0.016 | 0.018 |
| L1                | 0.45                       | 0.50 | 0.55 | 0.018      | 0.020 | 0.022 |
| N <sup>(3)</sup>  | 16                         |      |      | 16         |       |       |
| Nd <sup>(3)</sup> | 4                          |      |      | 4          |       |       |
| Ne <sup>(3)</sup> | 4                          |      |      | 4          |       |       |

### Notes

- (1) Use millimeters as the primary measurement.
- (2) Dimensioning and tolerances conform to ASME Y14.5M. - 1994.
- (3) N is the number of terminals. Nd and Ne is the number of terminals in each D and E site respectively.
- (4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.
- (5) The pin 1 identifier must be existed on the top surface of the package by using identification mark or other feature of package body.
- (6) Package warpage max. 0.05 mm.

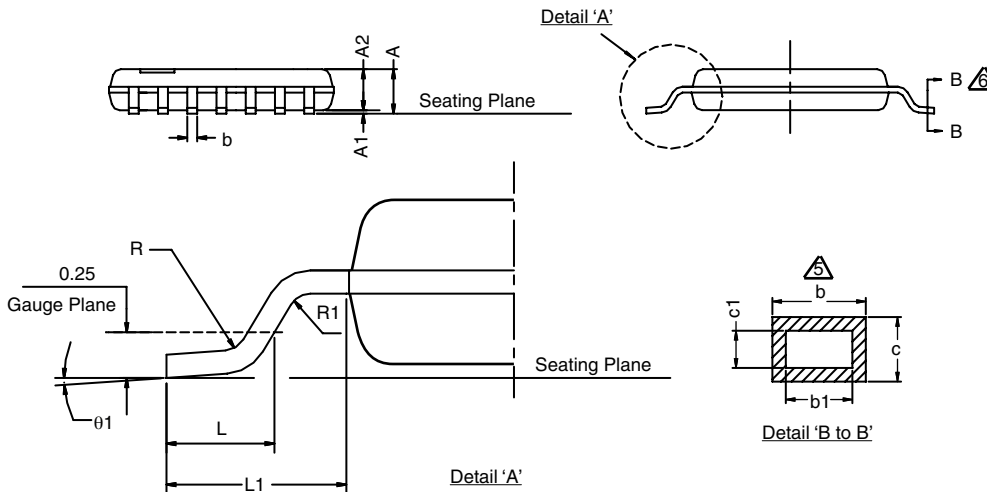
ECN: T16-0226-Rev. B, 09-May-16  
DWG: 6023

## 14L TSSOP



**Notes:**

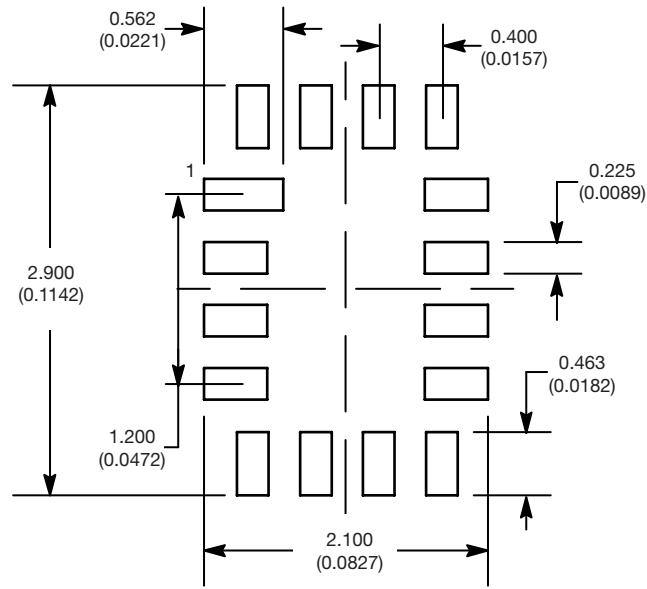
1. All dimensions are in millimeters (angles in degrees)
2. Dimensioning and tolerancing per ANSI Y14.5M-1982
- ⚠ Dimension 'D' does not include mold flash, protrusions or gate burrs
- ⚠ Dimension 'E1' does not include internal flash or protrusion
- ⚠ Dimension 'b' does not include dambar protrusion
- ⚠ Cross section B to B to be determined at 0.10 mm to 0.25 mm from the lead tip



| SYMBOL | MINIMUM | NOMINAL  | MAXIMUM |
|--------|---------|----------|---------|
| A      | -       | -        | 1.20    |
| A1     | 0.05    | -        | 0.15    |
| A2     | 0.80    | 0.90     | 1.05    |
| D      | 4.9     | 5.0      | 5.1     |
| E1     | 4.3     | 4.4      | 4.5     |
| E      | 6.2     | 6.4      | 6.6     |
| L      | 0.45    | 0.60     | 0.75    |
| R      | 0.09    | -        | -       |
| R1     | 0.09    | -        | -       |
| b      | 0.19    | -        | 0.30    |
| b1     | 0.19    | 0.22     | 0.25    |
| c      | 0.09    | -        | 0.20    |
| c1     | 0.09    | -        | 0.16    |
| θ1     | 0°      | -        | 8°      |
| L1     |         | 1.0 ref. |         |
| e      |         | 0.65 BSC |         |

ECN: T-07766-Rev. A, 14-Jan-08  
 DWG: 5962

## RECOMMENDED MINIMUM PADS FOR MINI QFN 16L



Mounting Footprint  
Dimensions in mm (inch)



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