

## 0.25 $\Omega$ Low-Voltage Dual SPDT Analog Switch

### DESCRIPTION

The DG3535, DG3536 is a sub 1  $\Omega$  (0.25  $\Omega$  at 2.7 V) dual SPDT analog switches designed for low voltage applications.

The DG3535, DG3536 has on-resistance matching (less than 0.05  $\Omega$  at 2.7 V) and flatness (less than 0.2  $\Omega$  at 2.7 V) that are guaranteed over the entire voltage range. Additionally, low logic thresholds makes the DG3535, DG3536 an ideal interface to low voltage DSP control signals.

The DG3535, DG3536 has fast switching speed with break-before-make guaranteed. In the On condition, all switching elements conduct equally in both directions. Off-isolation and crosstalk is - 69 dB at 100 kHz.

The DG3535, DG3536 is built on Vishay Siliconix's high-density low voltage CMOS process. An epitaxial layer is built in to prevent latchup. The DG3535, DG3536 contains the additional benefit of 2000 V ESD protection.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. For MICRO FOOT analog switching products manufactured with tin/silver/copper (SnAgCu) device terminations, the lead (Pb)-free "-E1" suffix is being used as a designator.

### FEATURES

- Low voltage operation
- Low on-resistance -  $R_{ON}$ : 0.25  $\Omega$  at 2.7 V
- - 69 dB OIRR at 2.7 V, 100 kHz
- MICRO FOOT® package
- ESD protection > 2000 V

### BENEFITS

- Reduced power consumption
- High accuracy
- Reduce board space
- 1.6 V logic compatible
- High bandwidth

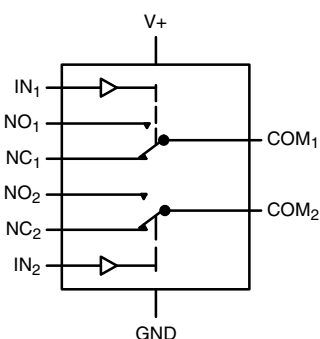
### APPLICATIONS

- Cellular phones
- Speaker headset switching
- Audio and video signal routing
- PCMCIA cards
- Battery operated systems
- Relay replacement


**RoHS**  
COMPLIANT

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

**DG3535, DG3536**  
MICRO FOOT 10-Bump



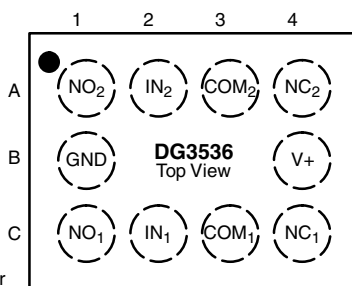
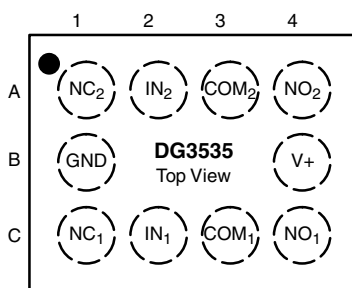
**Device Marking**

A1 Locator



3535 = Example Base Part Number

xxx = Data/Lot Traceability Code



**TRUTH TABLE**

| Logic | NC1 and NC2 | NO1 and NO2 |
|-------|-------------|-------------|
| 0     | ON          | OFF         |
| 1     | OFF         | ON          |

**ORDERING INFORMATION**

| Temp. Range      | Package                                                                  | Part Number                                        |
|------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| - 40 °C to 85 °C | MICRO FOOT: 10 Bump<br>(4 x 3, 0.5 mm Pitch,<br>238 $\mu$ m Bump Height) | DG3535DB-T5-E1<br>DG3535DB-T1-E1<br>DG3536DB-T5-E1 |

| ABSOLUTE MAXIMUM RATINGS                       |                                             |                       |      |
|------------------------------------------------|---------------------------------------------|-----------------------|------|
| Parameter                                      |                                             | Limit                 | Unit |
| Reference V+ to GND                            |                                             | - 0.3 to + 6          | V    |
| IN, COM, NC, NO <sup>a</sup>                   |                                             | - 0.3 to (V+ + 0.3 V) |      |
| Continuous Current (NO, NC, COM)               |                                             | ± 300                 | mA   |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle) |                                             | ± 500                 |      |
| Storage Temperature                            | (D Suffix)                                  | - 65 to 150           | °C   |
| Package Solder Reflow Conditions <sup>b</sup>  | IR/Convection                               | 250                   |      |
| ESD per Method 3015.7                          |                                             | > 2                   | kV   |
| Power Dissipation (Packages) <sup>c</sup>      | MICRO FOOT: 10 Bump (4 x 3 mm) <sup>d</sup> | 457                   | mW   |

Notes:

a Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

b Refer to IPC/JEDEC (J-STD-020B)

c All bumps welded or soldered to PC board.

d Derate 5.7 mW/°C above 70 °C.

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

| SPECIFICATIONS (V+ = 3.0 V)                          |                                                         |                                                                                                                  |                    |                         |                   |                   |      |
|------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------|-------------------|-------------------|------|
| Parameter                                            | Symbol                                                  | Test Conditions<br>Otherwise Unless Specified<br>V+ = 3 V, ± 10 %, V <sub>IN</sub> = 0.5 V or 1.4 V <sup>e</sup> | Temp. <sup>a</sup> | Limits<br>- 40 to 85 °C |                   |                   | Unit |
|                                                      |                                                         |                                                                                                                  |                    | Min. <sup>b</sup>       | Typ. <sup>c</sup> | Max. <sup>b</sup> |      |
| Analog Switch                                        |                                                         |                                                                                                                  |                    |                         |                   |                   |      |
| Analog Signal Range <sup>d</sup>                     | V <sub>NO</sub> , V <sub>NC</sub> ,<br>V <sub>COM</sub> | V+ = 2.7 V, V <sub>COM</sub> = 0.6/1.5 V<br>I <sub>NO</sub> , I <sub>NC</sub> = 100 mA                           | Full               | 0                       |                   | V+                | V    |
| On-Resistance <sup>d</sup>                           | R <sub>ON</sub>                                         |                                                                                                                  | Room<br>Full       |                         | 0.25              | 0.4<br>0.5        | Ω    |
| R <sub>ON</sub> Flatness <sup>d</sup>                | R <sub>ON</sub><br>Flatness                             |                                                                                                                  | Room               |                         |                   | 0.15              |      |
| On-Resistance<br>Match Between Channels <sup>d</sup> | ΔR <sub>DS(on)</sub>                                    |                                                                                                                  | Room               |                         |                   | 0.05              |      |
| Switch Off Leakage Current                           | I <sub>NO(off)</sub><br>I <sub>NC(off)</sub>            | V+ = 3.3 V,<br>V <sub>NO</sub> , V <sub>NC</sub> = 0.3 V/3 V, V <sub>COM</sub> = 3 V/0.3 V                       | Room<br>Full       | - 2<br>- 20             |                   | 2<br>20           | nA   |
|                                                      | I <sub>COM(off)</sub>                                   |                                                                                                                  | Room<br>Full       | - 2<br>- 20             |                   | 2<br>20           |      |
| Channel-On Leakage Current                           | I <sub>COM(on)</sub>                                    | V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.3 V/3 V                                     | Room<br>Full       | - 2<br>- 20             |                   | 2<br>20           |      |
| Digital Control                                      |                                                         |                                                                                                                  |                    |                         |                   |                   |      |
| Input High Voltage <sup>d</sup>                      | V <sub>INH</sub>                                        |                                                                                                                  | Full               | 1.4                     |                   |                   | V    |
| Input Low Voltage                                    | V <sub>INL</sub>                                        |                                                                                                                  | Full               |                         |                   | 0.5               |      |
| Input Capacitance                                    | C <sub>in</sub>                                         |                                                                                                                  | Full               |                         | 10                |                   | pF   |
| Input Current                                        | I <sub>INL</sub> or I <sub>INH</sub>                    | V <sub>IN</sub> = 0 or V+                                                                                        | Full               | 1                       |                   | 1                 | μA   |



| SPECIFICATIONS (V+ = 3.0 V)         |                |                                                                                                     |                    |                            |                   |                   |      |
|-------------------------------------|----------------|-----------------------------------------------------------------------------------------------------|--------------------|----------------------------|-------------------|-------------------|------|
| Parameter                           | Symbol         | Test Conditions<br>Otherwise Unless Specified<br>V+ = 3 V, ± 10 %,VIN = 0.5 V or 1.4 V <sup>e</sup> | Temp. <sup>a</sup> | Limits<br>- 40 °C to 85 °C |                   |                   | Unit |
|                                     |                |                                                                                                     |                    | Min. <sup>b</sup>          | Typ. <sup>c</sup> | Max. <sup>b</sup> |      |
| Dynamic Characteristics             |                |                                                                                                     |                    |                            |                   |                   |      |
| Turn-On Time                        | tON            | VNO or VNC = 2.0 V, RL = 50 Ω, CL = 35 pF                                                           | Room Full          |                            | 52                | 82<br>90          | ns   |
| Turn-Off Time                       | tOFF           |                                                                                                     | Room Full          |                            | 43                | 73<br>78          |      |
| Break-Before-Make Time              | t <sub>d</sub> |                                                                                                     | Room               | 1                          | 6                 |                   |      |
| Charge Injection <sup>d</sup>       | QINJ           | CL = 1 nF, VGEN = 1.5 V, RGEN = 0 Ω                                                                 | Full               |                            | 21                |                   | pC   |
| Off-Isolation <sup>d</sup>          | OIRR           | RL = 50 Ω, CL = 5 pF, f = 100 kHz                                                                   | Room               |                            | - 69              |                   | dB   |
| Crosstalk <sup>d</sup>              | XTALK          |                                                                                                     | Room               |                            | - 69              |                   |      |
| NO, NC Off Capacitance <sup>d</sup> | CNO(off)       | VIN = 0 or V+, f = 1 MHz                                                                            | Room               |                            | 145               |                   | pF   |
|                                     | CNC(off)       |                                                                                                     | Room               |                            | 145               |                   |      |
| Channel-On Capacitance <sup>d</sup> | CNO(on)        |                                                                                                     | Room               |                            | 406               |                   |      |
|                                     | CNC(on)        |                                                                                                     | Room               |                            | 406               |                   |      |
| Power Supply                        |                |                                                                                                     |                    |                            |                   |                   |      |
| Power Supply Current                | I+             | VIN = 0 or V+                                                                                       | Room Full          |                            | 0.001             | 1.0<br>1.0        | μA   |

Notes:

a. Room = 25 °C, Full = as determined by the operating suffix.

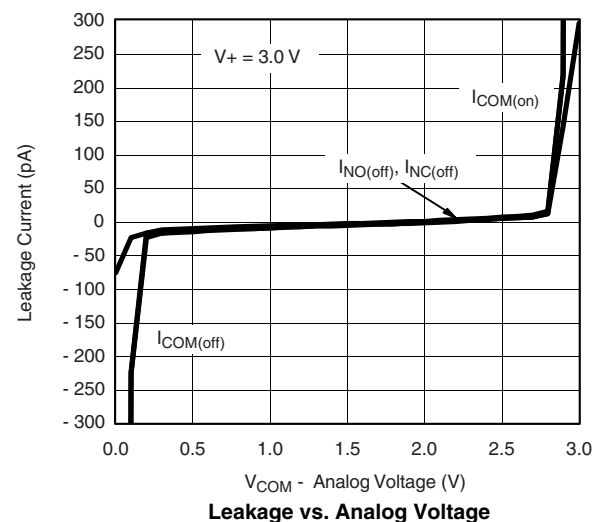
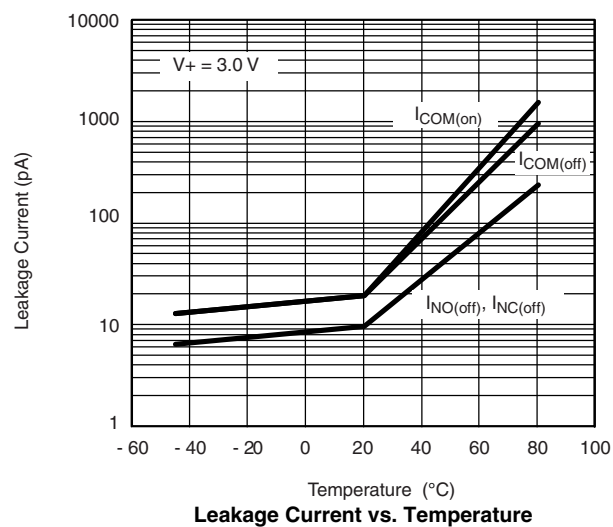
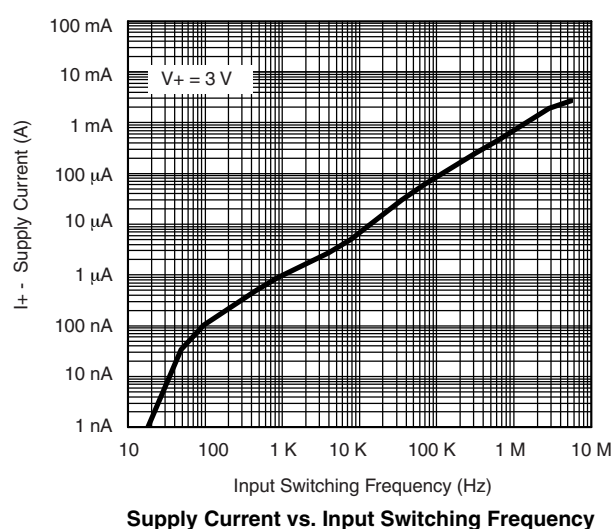
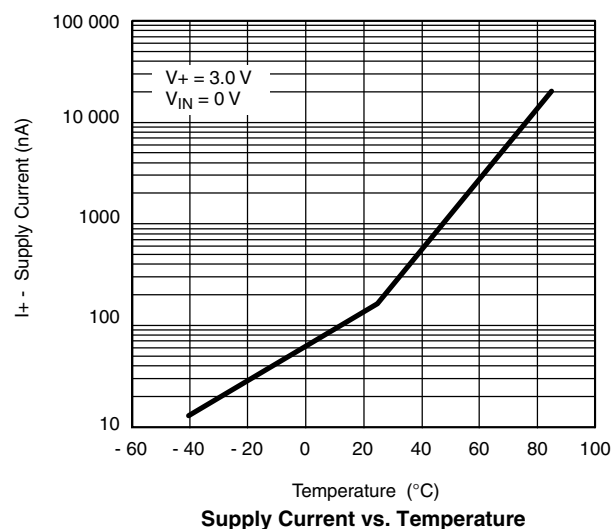
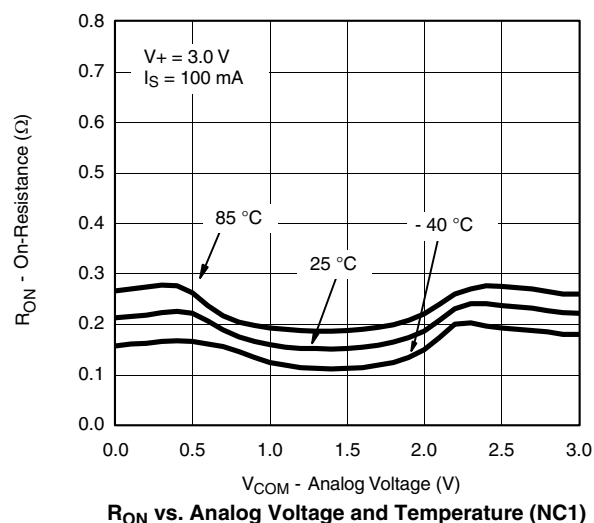
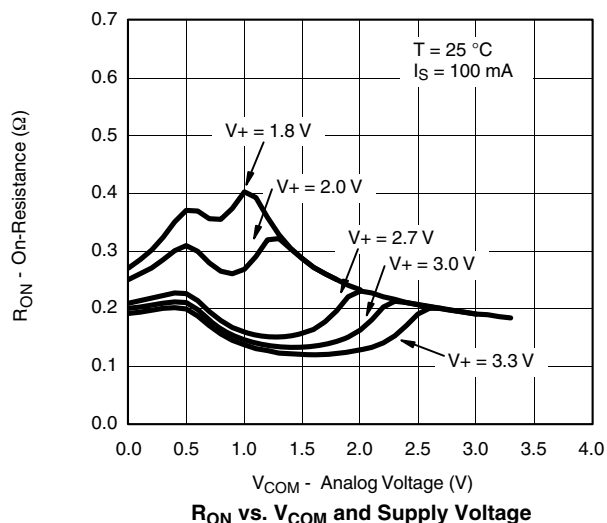
b. Typical values are for design aid only, not guaranteed nor subject to production testing.

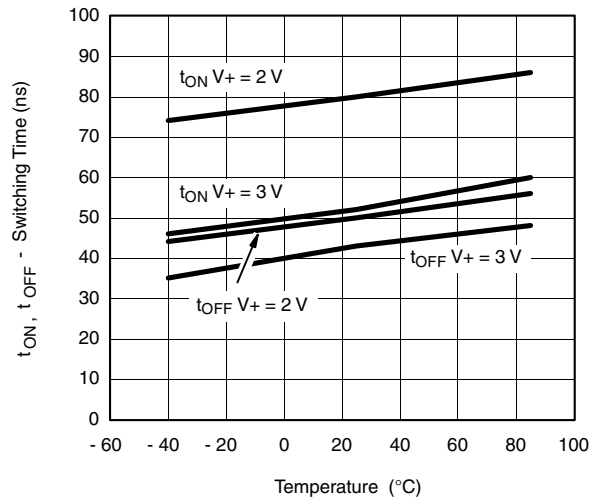
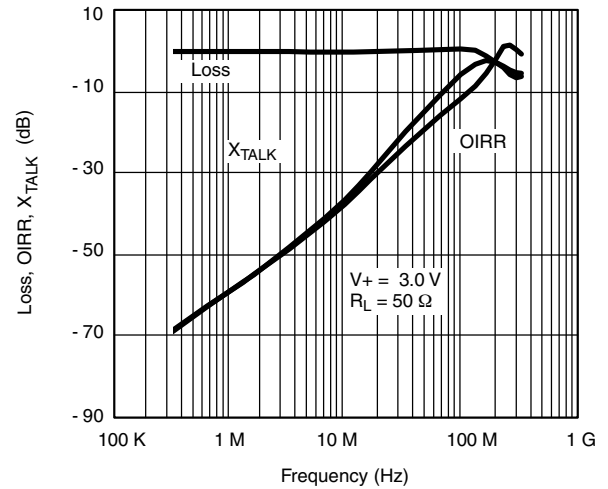
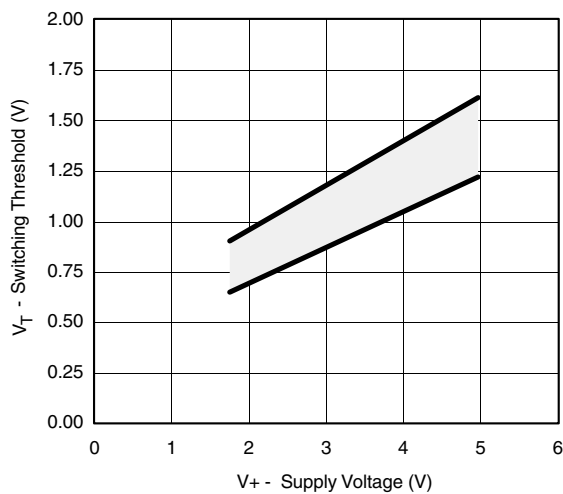
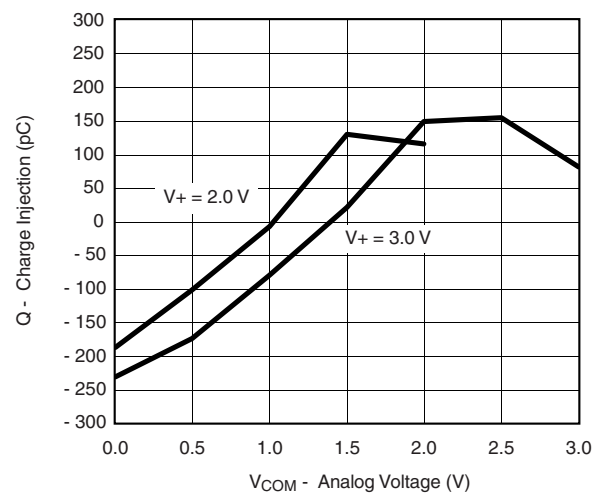
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

d. Guarantee by design, nor subjected to production test.

e.  $V_{IN}$  = input voltage to perform proper function.

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



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

**Switching Time vs. Temperature**

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

**Switching Threshold vs. Supply Voltage**

**Charge Injection vs. Analog Voltage**

### TEST CIRCUITS

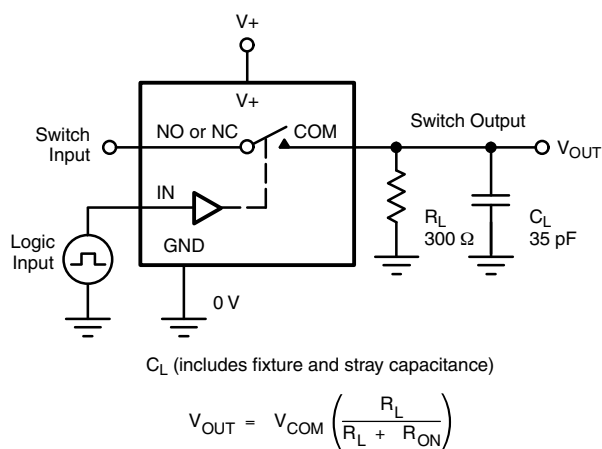


Figure 1. Switching Time

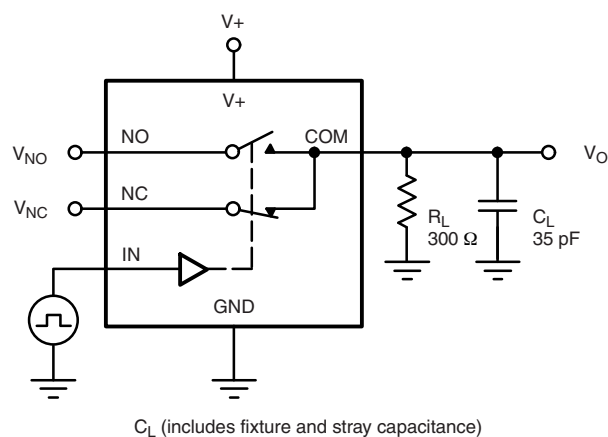


Figure 2. Break-Before-Make Interval

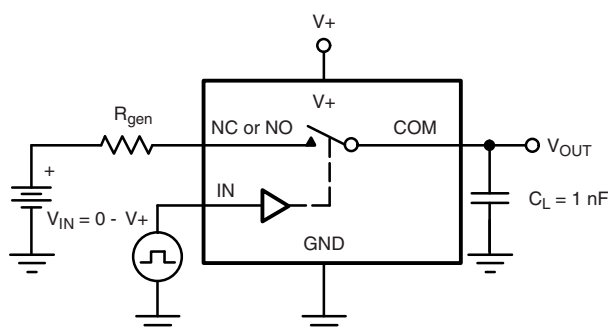
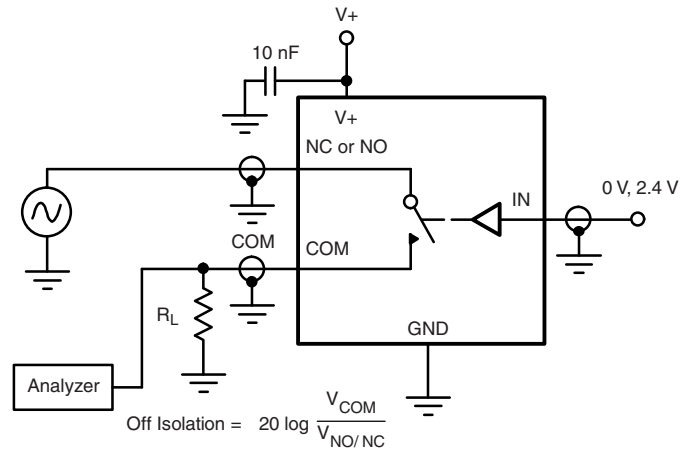
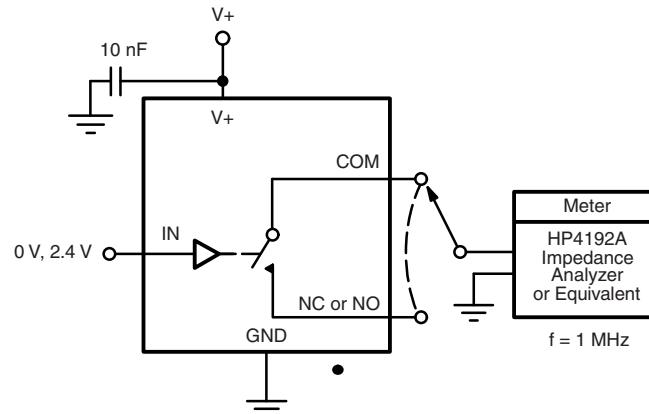
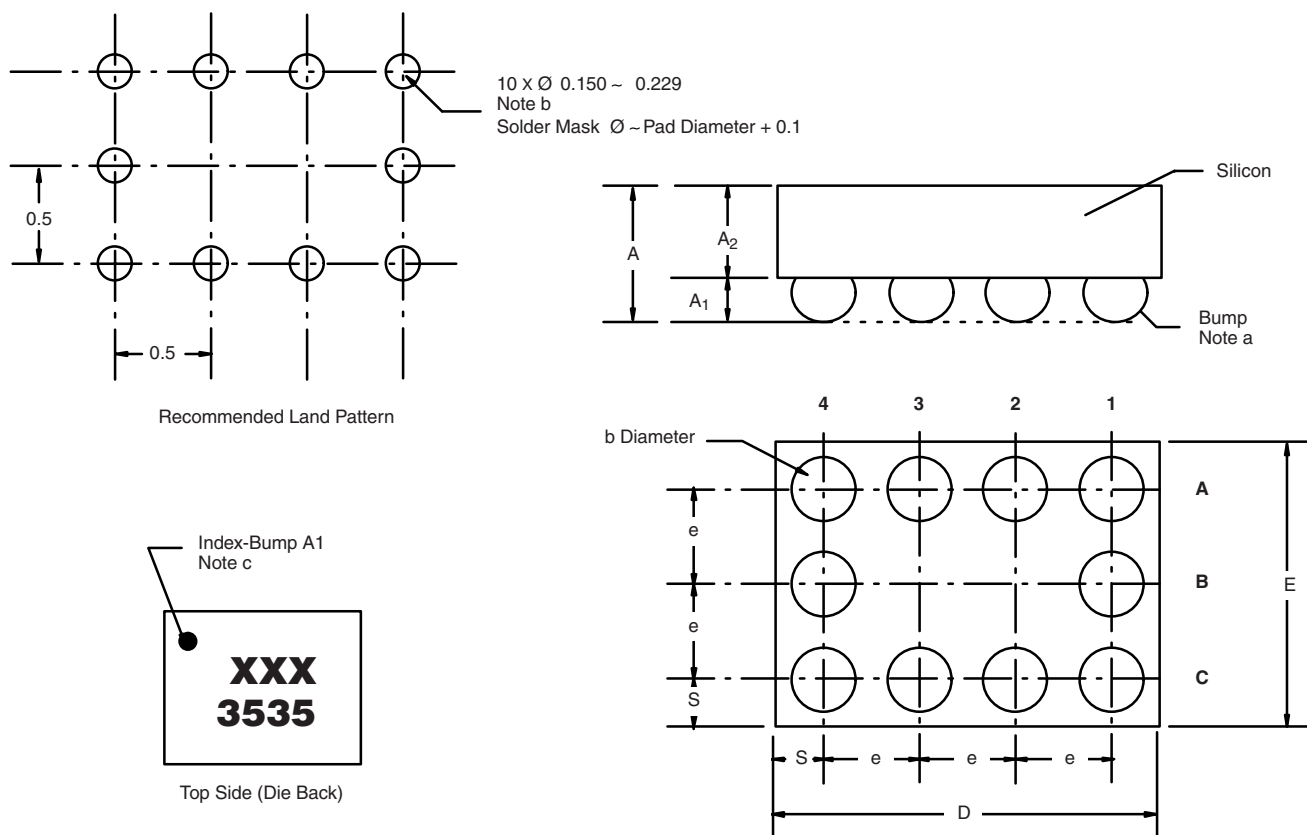


Figure 3. Charge Injection

**TEST CIRCUITS**

**Figure 4. Off-Isolation**

**Figure 5. Channel Off/On Capacitance**

## PACKAGE OUTLINE

### MICRO FOOT: 10 BUMP (4 x 3, 0.5 mm PITCH, 0.238 mm BUMP HEIGHT)



Notes (Unless Otherwise Specified):

- a. Bump is Lead Free Sn/Ag/Cu.
- b. Non-solder mask defined copper landing pad.
- c. Laser Mark on silicon die back; back-lapped, no coating. Shown is not actual marking; sample only.

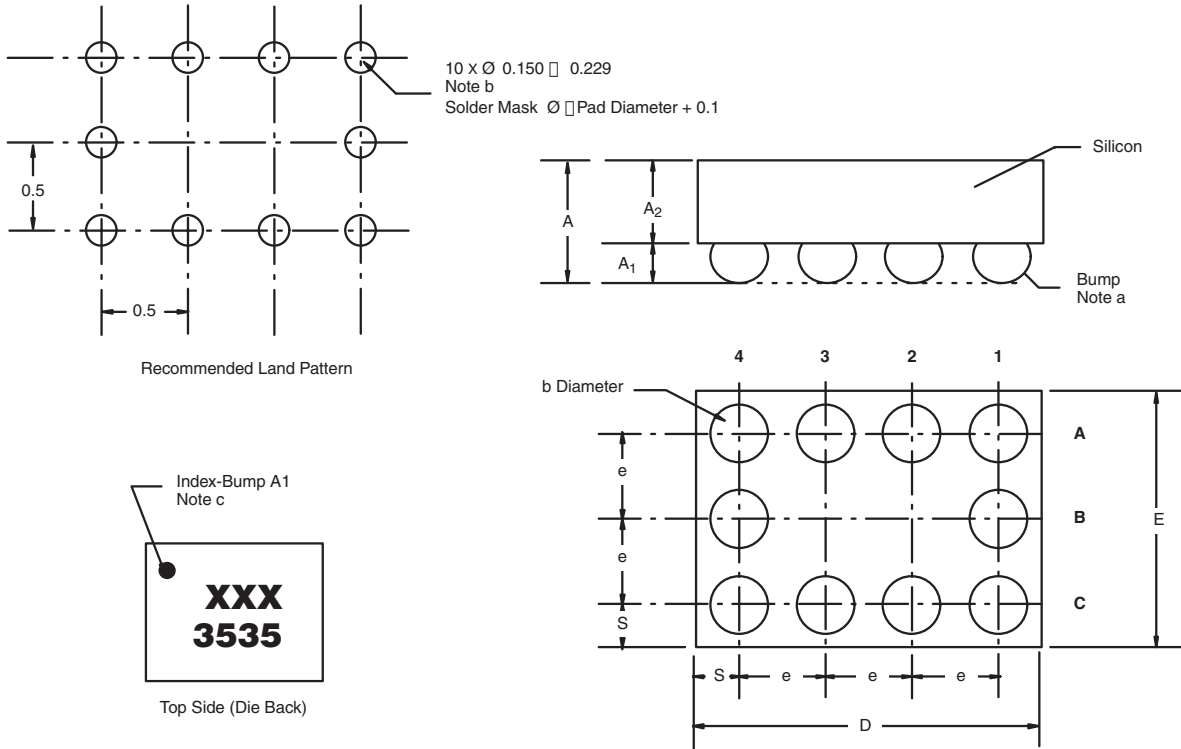
| Dim.           | Millimeters <sup>a</sup> |       | Inches       |        |
|----------------|--------------------------|-------|--------------|--------|
|                | Min.                     | Max.  | Min.         | Max.   |
| A              | 0.688                    | 0.753 | 0.0271       | 0.0296 |
| A <sub>1</sub> | 0.218                    | 0.258 | 0.0086       | 0.0102 |
| A <sub>2</sub> | 0.470                    | 0.495 | 0.0185       | 0.0195 |
| b              | 0.306                    | 0.346 | 0.0120       | 0.0136 |
| D              | 1.980                    | 2.020 | 0.0780       | 0.0795 |
| E              | 1.480                    | 1.520 | 0.0583       | 0.0598 |
| e              | 0.5 BASIC                |       | 0.0197 BASIC |        |
| S              | 0.230                    | 0.270 | 0.0091       | 0.0106 |

Notes:

- a. Use millimeters as the primary measurement.

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?72961](http://www.vishay.com/ppg?72961).

## MICRO FOOT: 10-BUMP (4 mm x 3 mm, 0.5 mm PITCH, 0.238 mm BUMP HEIGHT)



### Notes

(unless otherwise specified)

- a. Bump is lead (Pb)-free Sn/Ag/Cu.
- b. Non-solder mask defined copper landing pad.
- c. Laser mark on silicon die back; back-lapped, no coating. Shown is not actual marking; sample only.

| DIM.           | MILLIMETERS <sup>a</sup> |       | INCHES       |        |
|----------------|--------------------------|-------|--------------|--------|
|                | MIN.                     | MAX.  | MIN.         | MAX.   |
| A              | 0.688                    | 0.753 | 0.0271       | 0.0296 |
| A <sub>1</sub> | 0.218                    | 0.258 | 0.0086       | 0.0102 |
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| E              | 1.480                    | 1.520 | 0.0583       | 0.0598 |
| e              | 0.5 BASIC                |       | 0.0197 BASIC |        |
| S              | 0.230                    | 0.270 | 0.0091       | 0.0106 |

### Note

- a. Use millimeters as the primary measurement.

ECN: S11-1065-Rev. A, 13-Jun-11  
 DWG: 6001



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