# Low-Voltage, Low $r_{ON}$, Dual DPDT Analog Switch

## DESCRIPTION

The DG3015 is a dual double-pole/double-throw monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low power, high speed, low on-resistance and small physical size, the DG3015 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG3015 is built on Vishay Siliconix's low voltage JI2 process. An epitaxial layer prevents latchup. Break-before-make is guaranteed.

The switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

## FEATURES

- Low Voltage Operation (2.7 V to 3.3 V)
- Low On-Resistance - $r_{ON}$: 0.80 Ω
- 3 dB Loss at 100 MHz
- Fast Switching: $t_{ON}$ = 40 ns, $t_{OFF}$ = 35 ns
- MICRO FOOT® Package

Pb-free
RoHS COMPLIANT

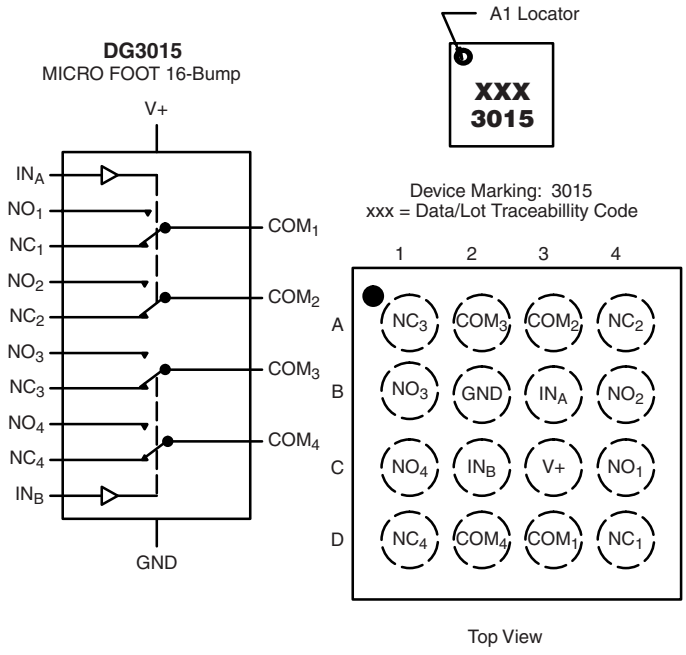
## BENEFITS

- Reduced Power Consumption
- High Accuracy
- Reduce Board Space
- TTL/1.8 V Logic Compatible
- High Bandwidth

## APPLICATIONS

- Cellular Phones
- Speaker Headset Switching
- Audio and Video Signal Routing
- PCMCIA Cards
- Battery Operated Systems

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION




| TRUTH TABLE | | |
|---|---|---|
| **Logic** | **NC1, 2, 3 and 4** | **NO1, 2, 3 and 4** |
| 0 | ON | OFF |
| 1 | OFF | ON |

| ORDERING INFORMATION | | |
|---|---|---|
| **Temp Range** | **Package** | **Part Number** |
| - 40 to 85 °C | MICRO FOOT: 16 Bump (4 x 4, 0.5 mm Pitch, 238 µm Bump Height) | DG3015DB-T2-E1 |

| **ABSOLUTE MAXIMUM RATINGS** $T_A$ = 25 °C, unless otherwise noted | | | |
|---|---|---|---|
| **Parameter** | | **Limit** | **Unit** |
| Reference V+ to GND | | - 0.3 to + 6 | V |
| IN, COM, NC, NO[a] | | - 0.3 to (V+ + 0.3 V) | |
| Current (Any terminal except NO, NC or COM) | | 30 | mA |
| Continuous Current (NO, NC or COM) | | ± 150 | |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle) | | ± 250 | |
| Storage Temperature | (D Suffix) | - 65 to 150 | °C |
| Package Solder Reflow Conditions[b] | IR/Convection | 250 | |
| Power Dissipation (Packages)[c] | MICRO FOOT: 16 Bump (4 x 4 mm)[d] | 719 | 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 9.0 mW/°C above 70 °C.

*Permanent damage to the device may occur when the "Absolute Maximum Ratings" are exceeded. These stress ratings do not indicate conditions for which the device is intended to be functional. Functionality is only guaranteed to the conditions specified by the parametric table within the document.*

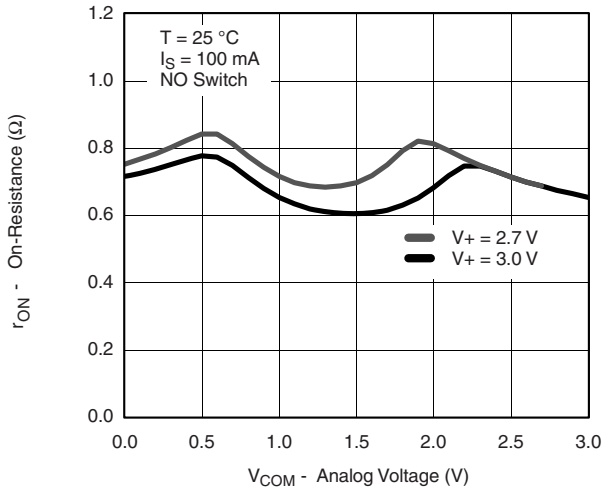
| **SPECIFICATIONS (V+ = 3 V)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Test Conditions Otherwise Unless Specified** | | **Limits** - 40 to 85 °C | | | |
| **Parameter** | **Symbol** | V+ = 3 V, ± 10 %, $V_{IN}$ = 0.4 V or 2.0 V[e] | **Temp[a]** | **Min[b]** | **Typ[c]** | **Max[b]** | **Unit** |
| **Analog Switch** | | | | | | | |
| Analog Signal Range[d] | $V_{NO}$, $V_{NC}$, $V_{COM}$ | | Full | 0 | | V+ | V |
| On-Resistance | $r_{ON}$ | V+ = 2.7 V, $V_{COM}$ = 0.2 V/1.5 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room<br>Full | | 0.80 | 1.2<br>1.3 | Ω |
| $r_{ON}$ Flatness | $r_{ON}$ Flatness | V+ = 2.7 V, $V_{COM}$ = 0 to V+, $I_{NO}$, $I_{NC}$ = 100 mA | Room | | 0.16 | | |
| $r_{ON}$ Match | $\Delta r_{ON}$ | | Room | | 0.15 | | |
| Switch Off Leakage Current | $I_{NO(off)}$<br>$I_{NC(off)}$ | V+ = 3.3 V, $V_{NO}$, $V_{NC}$ = 1 V/3 V, $V_{COM}$ = 3 V/1 V | Room<br>Full | - 2<br>- 20 | | 2<br>20 | nA |
| | $I_{COM(off)}$ | | Room<br>Full | - 2<br>- 20 | | 2<br>20 | |
| Channel-On Leakage Current | $I_{COM(on)}$ | V+ = 3.3 V, $V_{NO}$, $V_{NC}$ = $V_{COM}$ = 1 V/3 V | Room<br>Full | - 2<br>- 20 | | 2<br>20 | |
| **Digital Control** | | | | | | | |
| Input High Voltage | $V_{INH}$ | | Full | 2 | | | V |
| Input Low Voltage | $V_{INL}$ | | Full | | | 0.4 | |
| Input Capacitance | $C_{in}$ | | Full | | 4 | | pF |
| Input Current | $I_{INL}$ or $I_{INH}$ | $V_{IN}$ = 0 or V+ | Full | - 1 | | 1 | µA |
| **Dynamic Characteristics** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{NO}$ or $V_{NC}$ = 2.0 V, $R_L$ = 300 Ω, $C_L$ = 35 pF | Room<br>Full | | 40 | 65<br>67 | ns |
| Turn-Off Time | $t_{OFF}$ | | Room<br>Full | | 35 | 60<br>62 | |
| Break-Before-Make Time | $t_d$ | | Full | 1 | 3 | | |
| Charge Injection[d] | $Q_{INJ}$ | $C_L$ = 1 nF, $V_{GEN}$ = 0 V, $R_{GEN}$ = 0 Ω | Room | | 7 | | pC |
| Off-Isolation[d] | OIRR | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 1 MHz | Room | | - 67 | | dB |
| Crosstalk[d] | $X_{TALK}$ | | Room | | - 70 | | |
| $N_O$, $N_C$ Off Capacitance[d] | $C_{NO(off)}$ | $V_{IN}$ = 0 or V+, f = 1 MHz | Room | | 63 | | pF |
| | $C_{NC(off)}$ | | Room | | 67 | | |
| Channel-On Capacitance[d] | $C_{NO(on)}$ | | Room | | 200 | | |
| | $C_{NC(on)}$ | | Room | | 196 | | |

| SPECIFICATIONS (V+ = 3 V) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Symbol | Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, $V_{IN}$ = 0.4 V or 2.0 V[e] | Temp[a] | Limits - 40 to 85 °C Min[b] | Typ[c] | Max[b] | Unit |
| **Power Supply** | | | | | | | |
| Power Supply Range | V+ | | | 2.7 | | 3.3 | V |
| Power Supply Current | I+ | $V_{IN}$ = 0 or V+ | Full | | | 1.0 | µA |

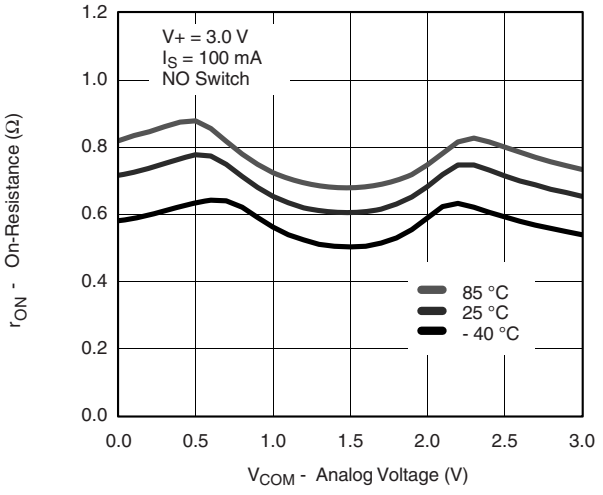
Notes:
a. Room = 25 °C, Full = as determined by the operating suffix.
b. Typical values are for design aid only, not guaranteed nor subject to production testing.
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
d. Guarantee by design, nor subjected to production test.
e. $V_{IN}$ = input voltage to perform proper function.

*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.*

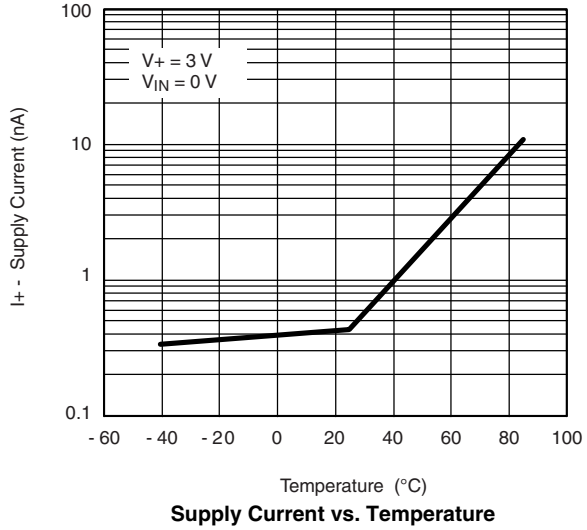
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



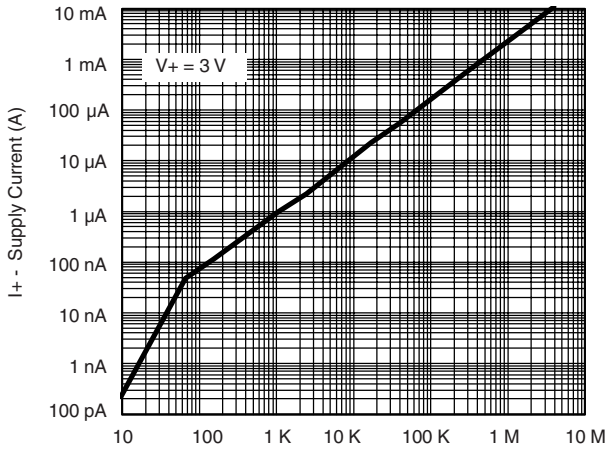

**$r_{ON}$ vs. $V_{COM}$ and SIngle Supply Voltage**




**$r_{ON}$ vs. Analog Voltage and Temperature**

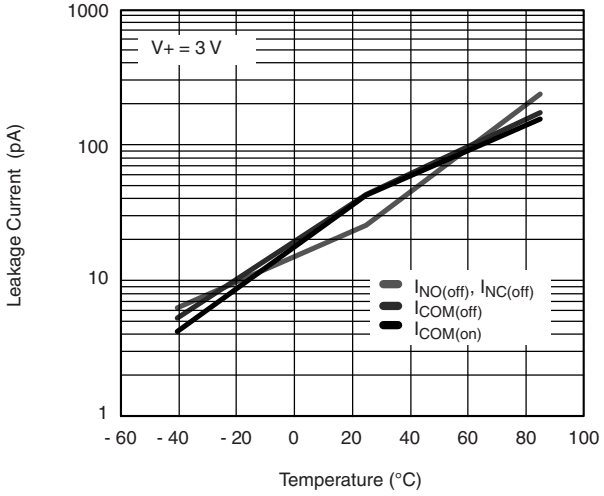



**Supply Current vs. Temperature**

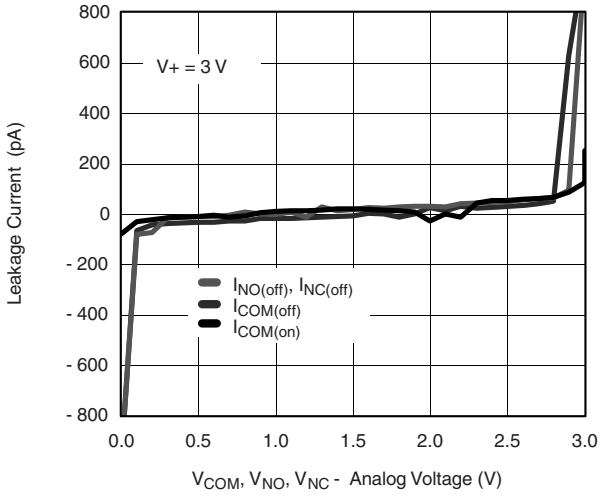



**Supply Current vs. Input Switching Frequency**

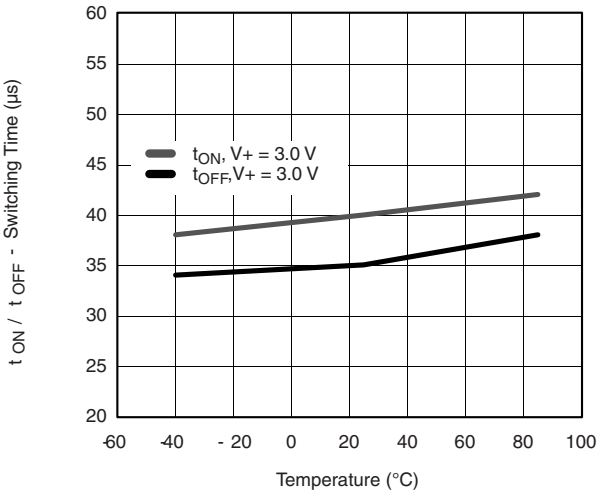
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



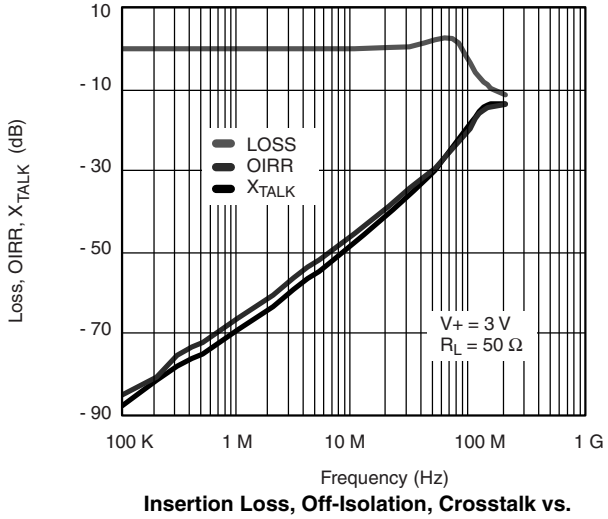

**Leakage Current vs. Temperature**



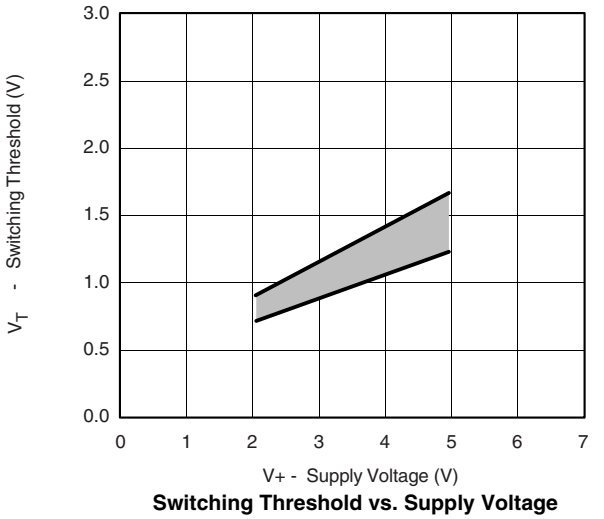

**Leakage vs. Analog Voltage**



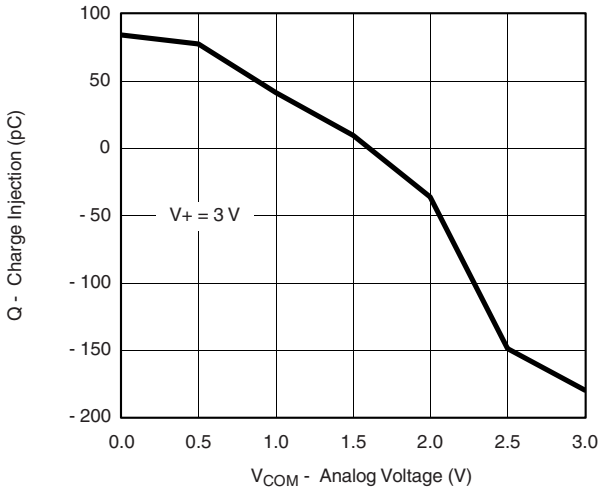

**Switching Time vs. Temperature**




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

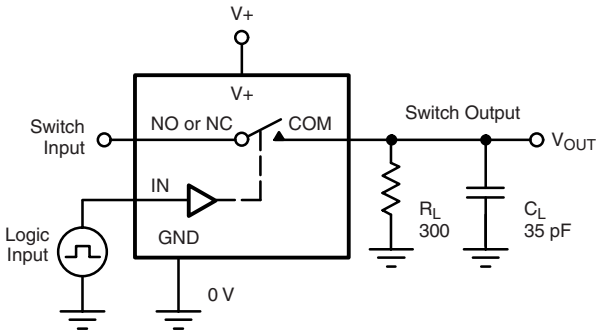



**Switching Threshold vs. Supply Voltage**



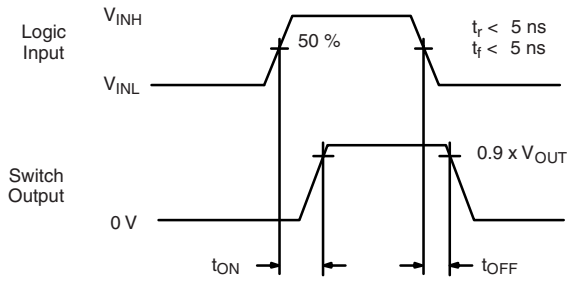

**Charge Injection vs. Analog Voltage**

## TEST CIRCUITS



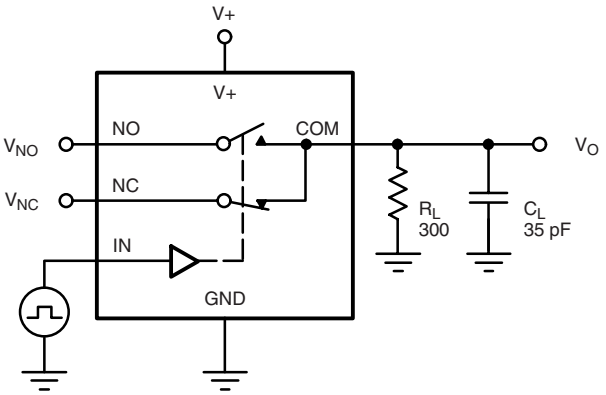

$C_L$ (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM}\left(\frac{R_L}{R_L + R_{ON}}\right)$$




Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

**Figure 1. Switching Time**




$C_L$ (includes fixture and stray capacitance)

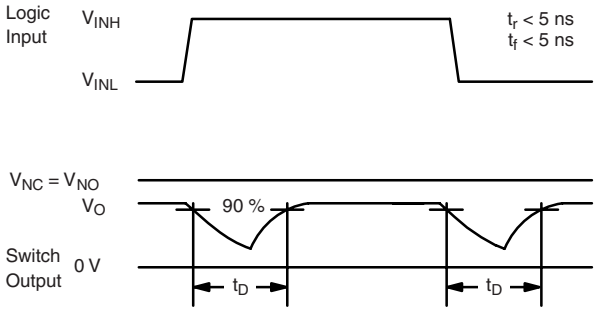
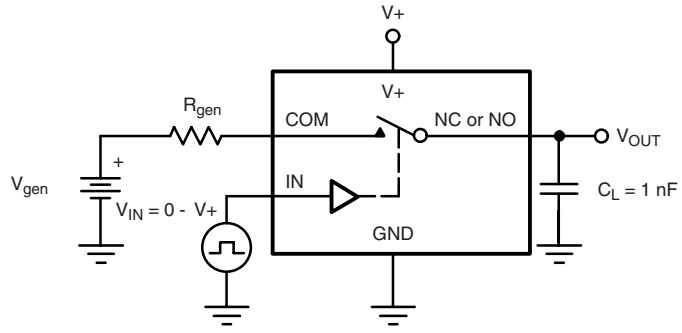
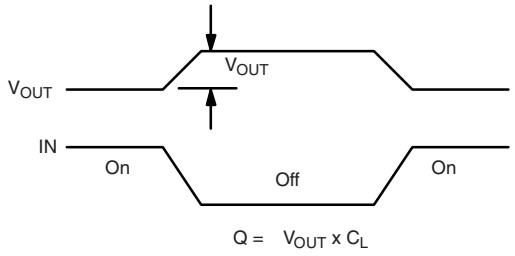



**Figure 2. Break-Before-Make Interval**




Q = $V_{OUT}$ x $C_L$

IN depends on switch configuration: input polarity determined by sense of switch.

**Figure 3. Charge Injection**

## TEST CIRCUITS

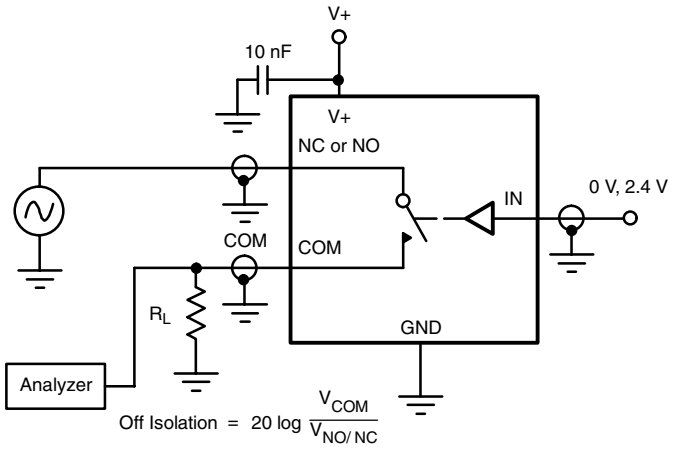



**Figure 4. Off-Isolation**

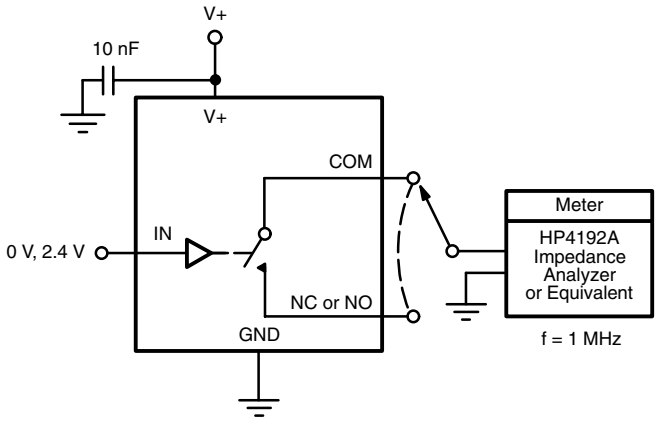
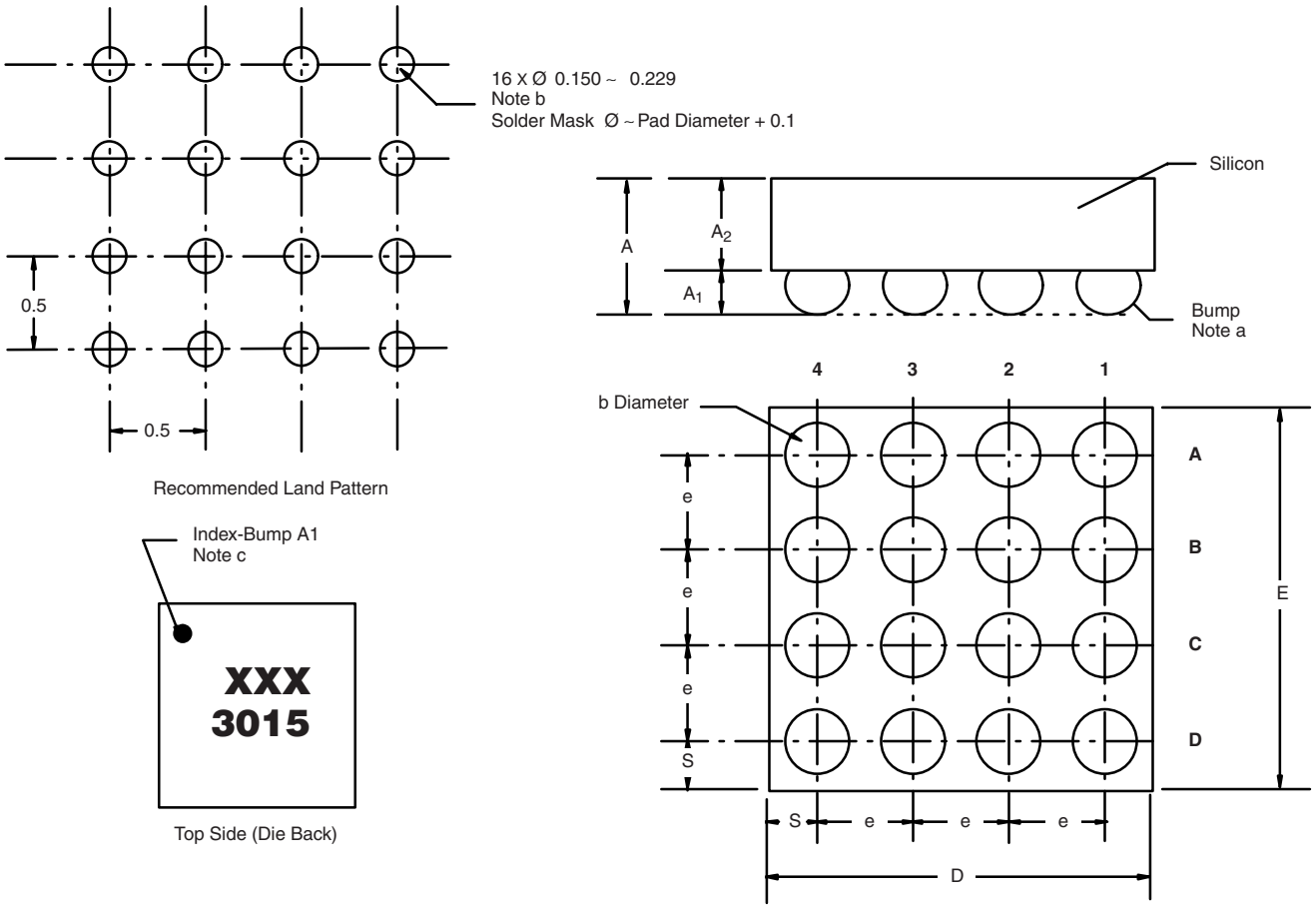



**Figure 5. Channel Off/On Capacitance**

## PACKAGE OUTLINE

### MICRO FOOT: 16 BUMP (4 x 4, 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[a] | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| **A** | 0.688 | 0.753 | 0.0271 | 0.0296 |
| **$A_1$** | 0.218 | 0.258 | 0.0086 | 0.0102 |
| **$A_2$** | 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** | 1.980 | 2.020 | 0.0780 | 0.0795 |
| **e** | 0.5 BASIC | | 0.0197 BASIC | |
| **S** | 0.230 | 0.270 | 0.0091 | 0.0106 |

Notes:
a. Use millimeters as the primary measurement.

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