# NLAS5157

# Ultra-Low 0.4 Ω SPDT Analog Switch

The NLAS5157 is Single Pole Double Throw (SPDT) switch designed for audio systems in portable applications. The NLAS5157 features Ultra−Low $R_{ON}$ of 0.4 Ω typical at $V_{CC}$ = 3.0 V and 0.15 Ω $R_{ON}$ Flatness for +3.0 V supply across temperature. This device also has a broad $V_{CC}$ operating range of 1.65 V to 4.5 V, ideal for battery−powered devices.

The NLAS5157 is protected on all pins with 8 kV Human Body Model ESD protection. This allows the device to be placed in a variety of locations, including near the interface, without risk of damage.

### Features

- $R_{ON}$ = 0.4 Ω Typical @ $V_{CC}$ = 3.0 V
- $V_{CC}$ Range: 1.65 V to 4.5 V
- 8 kV Human Body Model ESD on All Pins
- These are Pb−Free Devices

### Typical Applications

- Mobile Phones
- Portable Devices

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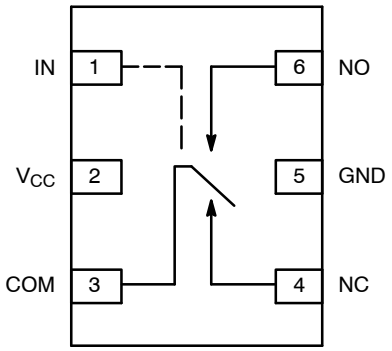
**UDFN6**
**CASE 517AQ**

**MARKING DIAGRAM**

A = Specific Device Code*
(Rotated 90°)
M = Date Code

**PIN ASSIGNMENTS**




(Top View)

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NLAS5157MUTCG | UDFN6 (Pb−Free) | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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## PIN DESCRIPTION

| PIN # | Name | Direction | Description |
|---|---|---|---|
| 1 | IN | Input | Control Input Select Line |
| 2 | $V_{CC}$ | Power | Voltage Supply |
| 3 | COM | I/O | Common Signal Line |
| 4 | NC | I/O | Normally Closed Signal Line |
| 5 | GND | Power | Ground |
| 6 | NO | I/O | Normally Open Signal Line |

## TRUTH TABLE

| Control Input | Function |
|---|---|
| L | NC Connected to COM |
| H | NO Connected to COM |

## MAXIMUM RATINGS

| Symbol | Pins | Rating | Value | Condition | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | $V_{CC}$ | Positive DC Supply Voltage | 0.5 to +5.5 | | V |
| $V_{IS}$ | NO, NC, or COM | Analog Signal Voltage | −0.5 to $V_{CC}$ + 0.5 | | V |
| $V_{IN}$ | IN | Control Input Voltage | −0.5 to +5.5 | | V |
| $I_{IS_CON}$ | NO, NC, or COM | Analog Signal Continuous Current | ±300 | Closed Switch | mA |
| $I_{IS_PK}$ | NO, NC, or COM | Analog Signal Peak Current | ±500 | 10% Duty Cycle | mA |
| $I_{IN}$ | IN | Control Input Current | ±20 | | mA |
| $T_{STG}$ | | Storage Temperature Range | −65 to 150 | | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Pins | Parameter | Value | Condition | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | $V_{CC}$ | Positive DC Supply Voltage | 1.65 to 4.5 | | V |
| $V_{IS}$ | NO, NC, or COM | Analog Signal Voltage | GND to $V_{CC}$ | | V |
| $V_{IN}$ | IN | Control Input Voltage (OVT) Overvoltage Tolerance | GND to 4.5 | | V |
| $T_A$ | | Operating Temperature Range | −40 to +85 | | °C |
| $t_r$, $t_f$ | | Input Rise or Fall Time | 20 | $V_{CC}$ = 1.6 V − 2.7 V | ns/V |
| | | | 10 | $V_{CC}$ = 3.0 V − 4.5 V | |

Minimum and maximum values are guaranteed through test or design across the **Recommended Operating Conditions**, where applicable. Typical values are listed for guidance only and are based on the particular conditions listed for each section, where applicable. These conditions are valid for all values found in the characteristics tables unless otherwise specified in the test conditions.

## ESD PROTECTION

| Pins | Description | Minimum Voltage |
|---|---|---|
| All Pins | Human Body Model | 7 kV |

## DC ELECTRICAL CHARACTERISTICS

**CONTROL INPUT** (Typical: T = 25°C; $V_{CC}$ = 3.0 V)

| Symbol | Pins | Parameter | Test Conditions | $V_{CC}$ (V) | –40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| $V_{IH}$ | IN | Control Input High | | 1.8 – 2.7<br>3.0<br>4.5 | 1.0<br>1.3<br>1.6 | | | V |
| $V_{IL}$ | IN | Control Input Low | | 1.8 – 2.7<br>3.0<br>4.5 | | | 0.4<br>0.5<br>0.6 | V |
| $I_{IN}$ | IN | Control Input Leakage | $0 \le V_{IN} \le V_{CC}$ | 4.5 | | ±0.1 | ±0.5 | μA |

**SUPPLY CURRENT AND LEAKAGE** (Typical: T = 25°C; $V_{CC}$ = 3.0 V)

| Symbol | Pins | Parameter | Test Conditions | $V_{CC}$ (V) | –40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| $I_{NO/NC}$ (OFF) | NC, NO | OFF State Leakage | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$V_{NC/NO}$ = 0.3 V<br>$V_{COM}$ = 4.0 V | 4.5 | | ±10 | ±100 | nA |
| $I_{COM}$ (ON) | COM | ON State Leakage | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$V_{NO}$ = 0.3 V or 4.0 V with $V_{NC}$ Floating or<br>$V_{NC}$ = 0.3 V or 4.0 V with $V_{NO}$ Floating<br>$V_{COM}$ = 0.3 V or 4.0 V | 4.5 | | ±20 | ±100 | nA |
| $I_{CC}$ | $V_{CC}$ | Quiescent Supply | $V_{IN}$ and $V_{IS} = V_{CC}$ or GND<br>$I_D$ = 0 A | 1.65 – 4.5 | | ±0.1 | ±1.0 | μA |
| $I_{OFF}$ | IN | Power Off Leakage | $V_{IN}$ = 4.5 V or GND | 0 | | ±0.5 | ±1.0 | μA |

**ON RESISTANCE** (Typical: T = 25°C; $V_{CC}$ = 3.0 V)

| Symbol | Pins | Parameter | Test Conditions | $V_{CC}$ (V) | –40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| $R_{ON}$ | NO, NC<br>COM | ON Resistance | $I_{ON}$ = –100 mA<br>$V_{IS}$ = 0 to $V_{CC}$ | 3.0<br>4.5 | | 0.4<br>0.35 | 0.6<br>0.5 | Ω |
| $R_{FLAT}$ | NO, NC<br>COM | $R_{ON}$ Flatness | $I_{ON}$ = –100 mA<br>$V_{IS}$ = 0 to $V_{CC}$ | 3.0<br>4.5 | | 0.12<br>0.15 | 0.16<br>0.17 | Ω |
| $\Delta R_{ON}$ | NO, NC<br>COM | $R_{ON}$ Matching | $I_{ON}$ = –100 mA<br>$V_{IS}$ = 0 to $V_{CC}$ | 3.0<br>4.5 | | 0.08<br>0.08 | 0.1<br>0.1 | Ω |

## AC ELECTRICAL CHARACTERISTICS

**TIMING/FREQUENCY** (Typical: T = 25°C; $V_{CC}$ = 3.0 V, $R_L$ = 50 Ω, $C_L$ = 35 pF, f = 1 MHz)

| Symbol | Pins | Parameter | Test Conditions | $V_{CC}$ (V) | –40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| $t_{ON}$ | IN to NC or NO | Turn On Time | | 2.3 – 4.3 | | 30 | 40 | ns |
| $t_{OFF}$ | IN to NC or NO | Turn Off Time | | 2.3 – 4.53 | | 18 | 25 | ns |
| $t_{BBM}$ | IN to NC or NO | Break Before Make | | 3.0 | 2 | 15 | | ns |
| BW | | –3dB Bandwidth | $C_L$ = 5 pF | 1.65 – 4.5 | | 36 | | MHz |

**ISOLATION AND THD** (Typical: T = 25°C; $V_{CC}$ = 3.0 V, RL = 50 Ω, CL = 5 pF, f = 1 MHz)

| Symbol | Pins | Parameter | Test Conditions | $V_{CC}$ (V) | –40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| Q | | Charge Injection | $V_{IN}$ = $V_{CC}$ to GND<br>$R_{IS}$ = 0 Ω, $C_L$ = 1.0 nF<br>Q = $C_L$ – $\Delta V_{OUT}$ | 1.65 – 4.3 | | 38 | | pC |
| THD | | Total Harmonic Distortion | $F_{IS}$ = 20 Hz to 20 kHz<br>$R_L$ = $R_{gen}$ = 600 Ω,<br>$C_L$ = 1.0 pF<br>$V_{IS}$ = 1.0 $V_{PP}$ | 3.0 | | 0.02 | | % |
| $O_{IRR}$ | NO | Off Isolation | $V_{IN}$ = 0<br>$V_{NO}$ or $V_{NC}$ (pk–pk) = 1.0 V | 1.65 – 4.5 | | –54 | | dB |
| Xtalk | COM to COMy | Non–Adjacent Channel | $V_{NO}$ or $V_{NC}$ (pk–pk) = 1.0 V | 1.65 – 4.5 | | –54 | | dB |

**CAPACITANCE** (Typical: T = 25°C; $V_{CC}$ = 3.0 V, $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 1 MHz)

| Symbol | Pins | Parameter | Test Conditions | $V_{CC}$ (V) | –40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| $C_{IN}$ | IN | Control Input | | 0 V | | 3.5 | | pF |
| $C_{ON}$ | NC to COM | Through Switch | $V_{IN}$ = 0V | 3.0 V | | 95 | | pF |
| $C_{OFF}$ | NC, NC | Unselected Port | $V_{IS}$ = 3.0V, $V_{IN}$ = 3.0 V | 3.0 V | | 47 | | pF |

## TYPICAL CHARACTERISTICS

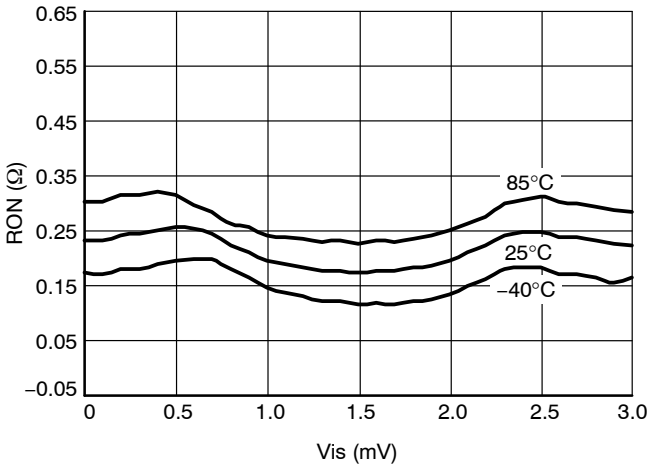



**Figure 1. RON vs. Vin @ Vcc = 3.0 V, All Temps**

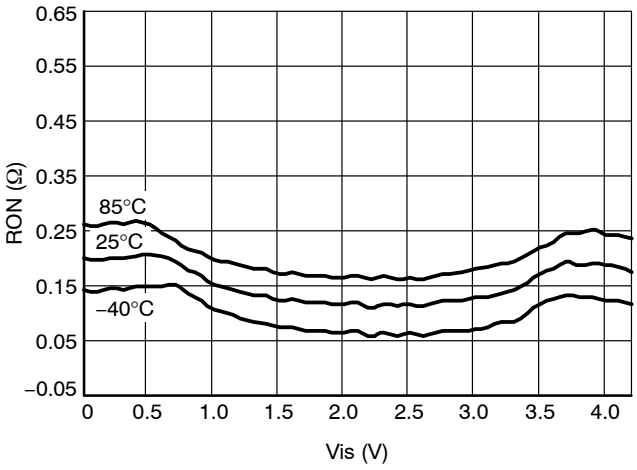



**Figure 2. RON vs. Vin @ Vcc = 4.3 V, All Temps**

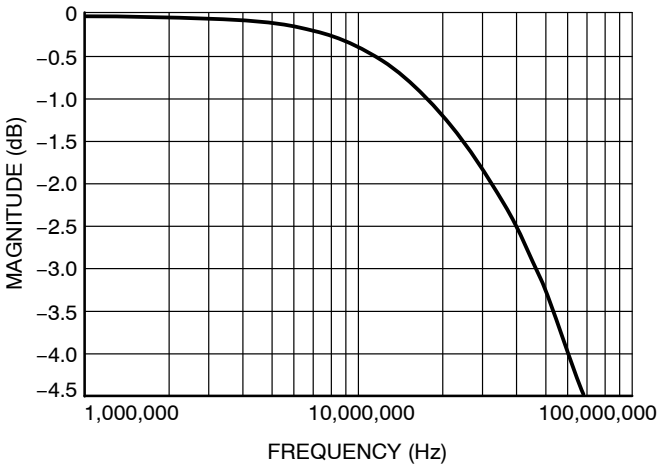



**Figure 3. Bandwidth vs. Frequency**

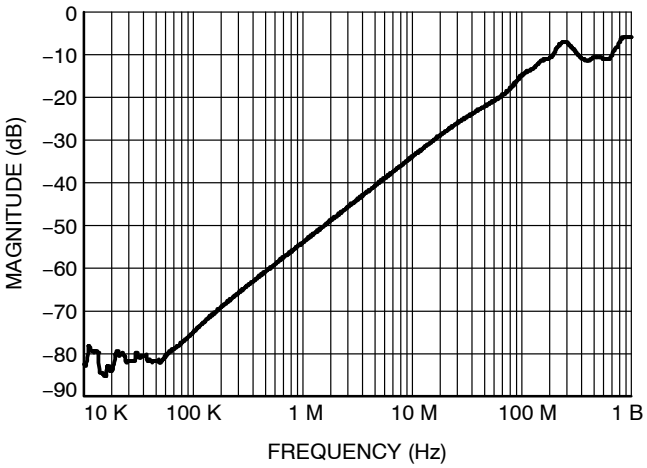



**Figure 4. Cross−Talk vs. Frequency @ 25°C**

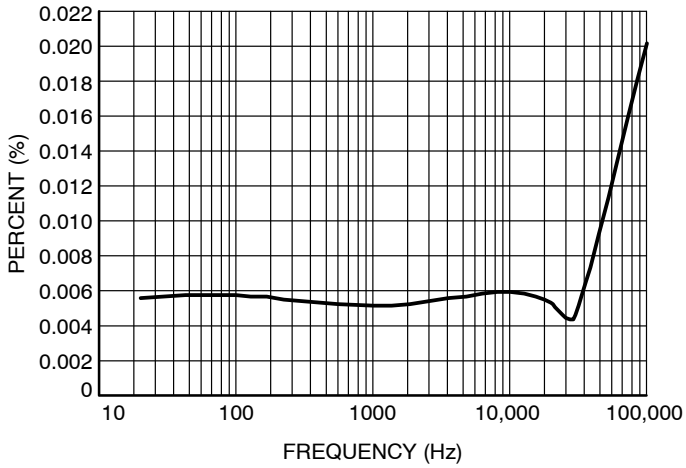



**Figure 5. THD vs. Frequency @ Vin = 1 Vpp**

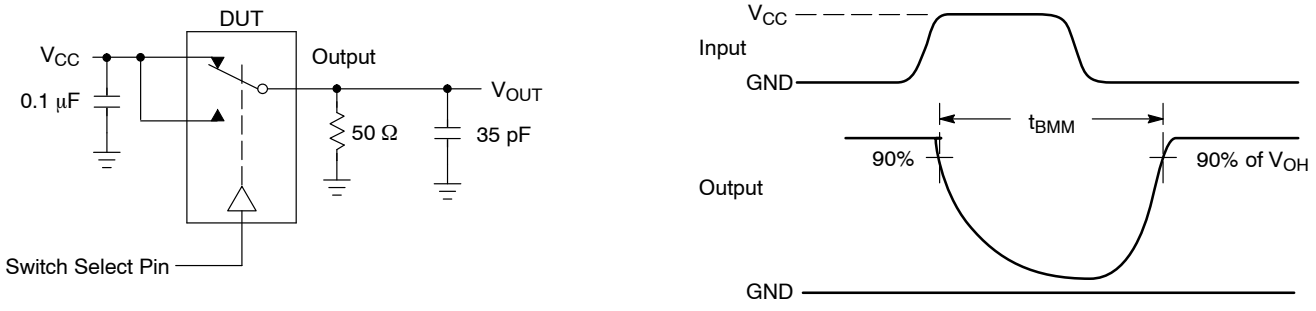



**Figure 6. $t_{BBM}$ (Time Break−Before−Make)**

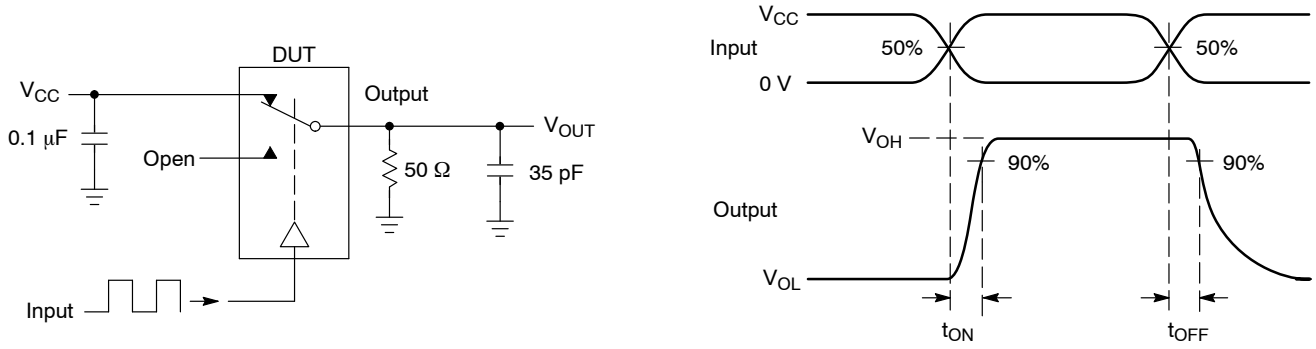



**Figure 7. $t_{ON}/t_{OFF}$**

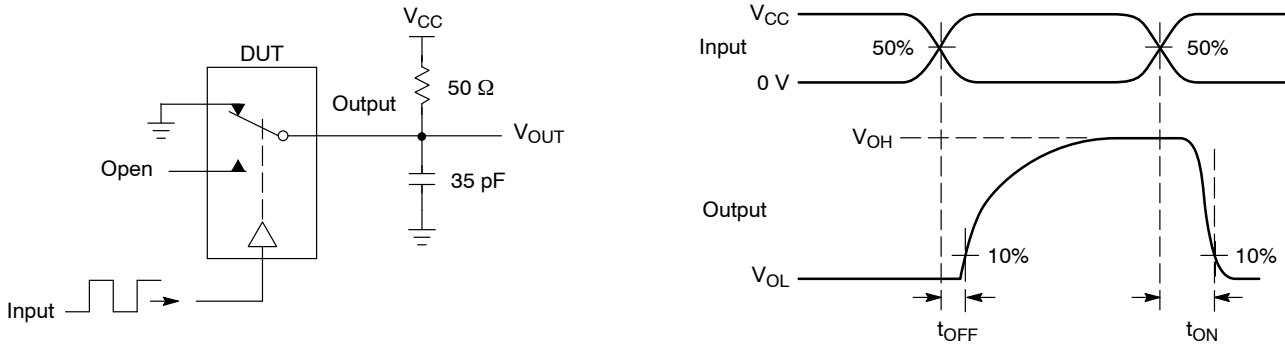
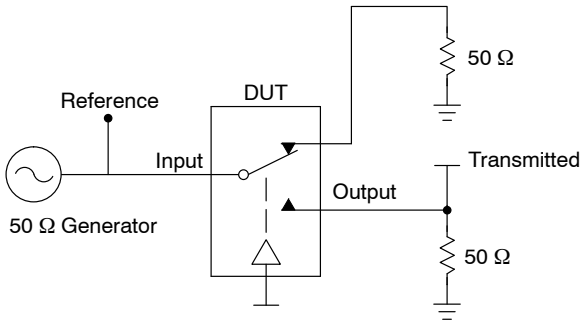



**Figure 8. $t_{ON}/t_{OFF}$**




Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch. $V_{ISO}$, Bandwidth and $V_{ONL}$ are independent of the input signal direction.

$V_{ISO}$ = Off Channel Isolation = 20 Log $\left(\frac{V_{OUT}}{V_{IN}}\right)$ for $V_{IN}$ at 100 kHz

$V_{ONL}$ = On Channel Loss = 20 Log $\left(\frac{V_{OUT}}{V_{IN}}\right)$ for $V_{IN}$ at 100 kHz to 50 MHz

Bandwidth (BW) = the frequency 3 dB below $V_{ONL}$
$V_{CT}$ = Use $V_{ISO}$ setup and test to all other switch analog input/outputs terminated with 50 Ω

**Figure 9. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/$V_{ONL}$**

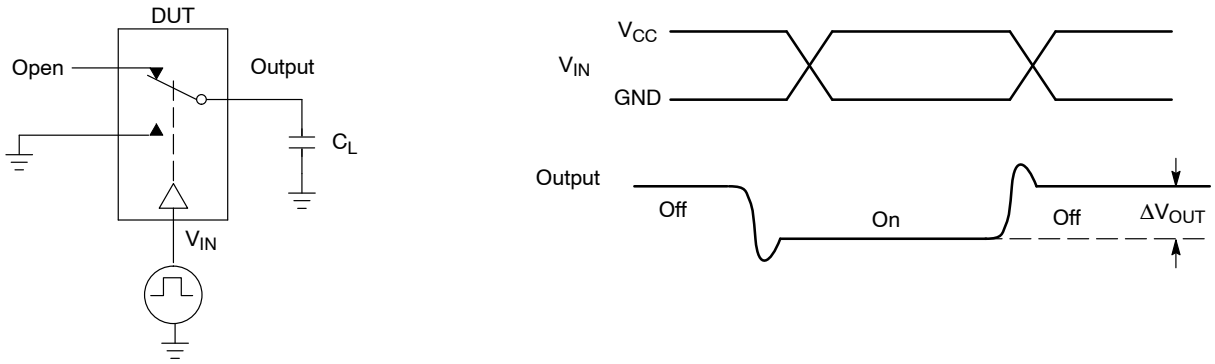
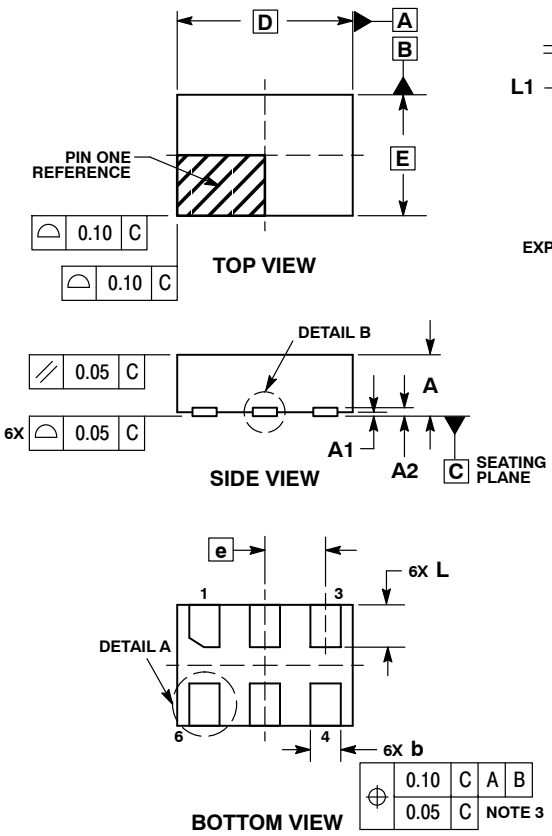
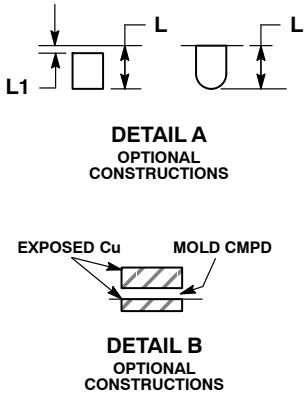



**Figure 10. Charge Injection: (Q)**

## PACKAGE DIMENSIONS

**UDFN6, 1.45x1.0, 0.5P**
CASE 517AQ
ISSUE O

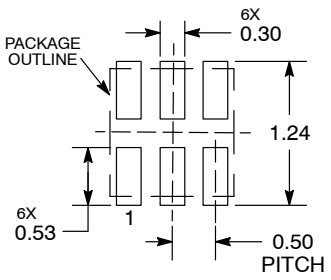



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A2 | 0.07 REF | |
| b | 0.20 | 0.30 |
| D | 1.45 BSC | |
| E | 1.00 BSC | |
| e | 0.50 BSC | |
| L | 0.30 | 0.40 |
| L1 | --- | 0.15 |

### MOUNTING FOOTPRINT




DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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