

# NLAS3899B

## Dual DPDT Low $R_{ON}$ , Low Capacitance Switch

The NLAS3899B is a dual DPDT analog switch designed for low power audio and dual SIM card applications. The low  $R_{ON}$  of  $3.0\ \Omega$  (typical) is ideal for routing audio signals to or from a moderately high impedance load. In addition, the low  $C_{ON}$  of 20 pF (typical) gives the NLAS3899B a high bandwidth of 280 MHz, perfect for dual SIM card applications.

### Features

- Single Supply Operation  
1.65 to 4.3 V  $V_{CC}$   
Function Directly from Li-Ion Battery
- Low ON Resistance ( $3.0\ \Omega$  Typical Across  $V_{CC}$ )
- Low  $C_{ON}$  (20 pF Typical)
- Bandwidth 280 MHz
- Maximum Breakdown Voltage: 5.5 V
- Low Static Power
- Interfaces with 1.8 V Chipset
- These are Pb-Free Devices

### Typical Applications

- Cell Phone Speaker/Microphone Switching
- Ringtone-Chip/Amplifier Switching
- Dual SIM Card Data Switching
- Four Unbalanced (Single-Ended) Switches

### Important Information

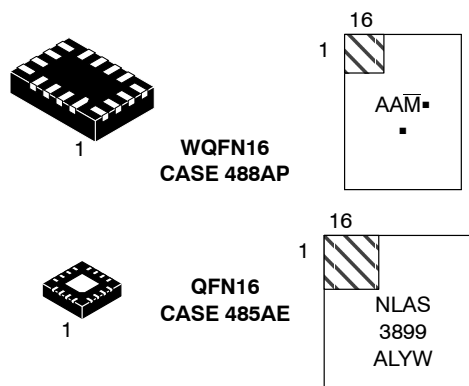
- ESD Protection:  
Human Body Model (HBM) 1000 V – All Pins  
5000 V – I/O to GND
- Continuous Current Rating Through each Switch  $\pm 300$  mA
- Conforms to: JEDEC MO-220, Issue H, Variation VEED-6
- Package:
  - ♦ 1.8 x 2.6 x 0.75 mm WQFN16 Pb-Free
  - ♦ 3.0 x 3.0 x 0.9 mm QFN16 Pb-Free



**ON Semiconductor®**

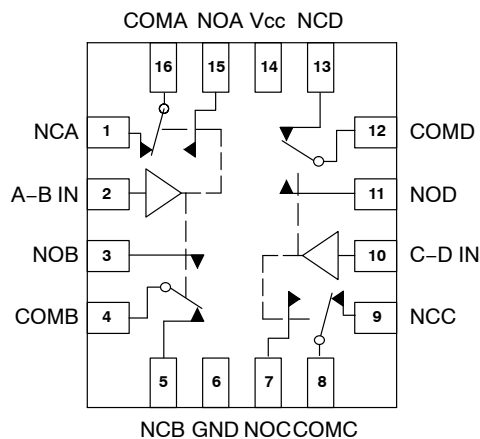
<http://onsemi.com>

### MARKING DIAGRAMS



XX = Specific Device Code  
A = Assembly Location  
M = Date Code/Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

# NLAS3899B

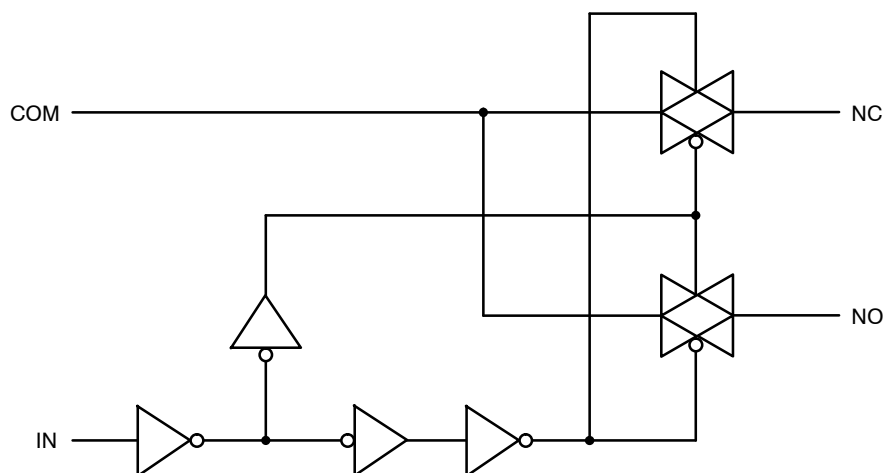


Figure 1. Input Equivalent Circuit

## PIN DESCRIPTION

| QFN PIN #                 | Symbol          | Name and Function       |
|---------------------------|-----------------|-------------------------|
| 1, 3, 5, 7, 9, 11, 13, 15 | NO A-D, NC A-D  | Independent Channels    |
| 2, 10                     | A-B IN, C-D IN  | Controls                |
| 4, 8, 12, 16              | COM A-D         | Common Channels         |
| 6                         | GND             | Ground (V)              |
| 14                        | V <sub>CC</sub> | Positive Supply Voltage |

## TRUTH TABLE

| IN | NO   | NC   |
|----|------|------|
| H  | ON   | OFF* |
| L  | OFF* | ON   |

\*High impedance.

## OPERATING CONDITIONS

### MAXIMUM RATINGS

| Symbol              | Pins              | Parameter                        | Value                         | Condition      | Unit |
|---------------------|-------------------|----------------------------------|-------------------------------|----------------|------|
| V <sub>CC</sub>     | V <sub>CC</sub>   | Positive DC Supply Voltage       | -0.5 to +5.5                  |                | V    |
| V <sub>IS</sub>     | NOx, NCx, or COMx | Analog Signal Voltage            | -0.5 to V <sub>CC</sub> + 0.5 |                | V    |
| V <sub>IN</sub>     | A-B IN, C-D IN    | Control Input Voltage            | -0.5 to 5.5                   |                | V    |
| I <sub>IS_CON</sub> | NOx, NCx, or COMx | Analog Signal Continuous Current | ±300                          | Closed Switch  | mA   |
| I <sub>IS_PK</sub>  | NOx, NCx, or COMx | Analog Signal Peak Current       | ±500                          | 10% Duty Cycle | mA   |
| I <sub>IN</sub>     | A-B IN, C-D IN    | Control Input Current            | ±20                           |                | mA   |
| T <sub>STG</sub>    |                   | 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 4.3     |                                        | V    |
| $V_{IS}$   | NOx, NCx, or COMx | Analog Signal Voltage       | GND to $V_{CC}$ |                                        | V    |
| $V_{IN}$   | A-B IN, C-D IN    | Control Input Voltage       | GND to 4.3      |                                        | V    |
| $T_A$      |                   | Operating Temperature Range | -40 to +85      |                                        | °C   |
| $t_r, t_f$ |                   | Input Rise or Fall Time     | 20              | $V_{CC} = 1.6\text{ V} - 2.7\text{ V}$ | ns/V |
|            |                   |                             | 10              | $V_{CC} = 3.0\text{ V} - 4.5\text{ V}$ |      |

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 | 1 kV            |
| I/O to GND | Human Body Model | 5 kV            |

## DC Electrical Characteristics

Typical: T = 25°C; V<sub>CC</sub> = 3.0 V

### CONTROL INPUT (Typical: T = 25°C; V<sub>CC</sub> = 3.0 V)

| Symbol          | Pins              | Parameter             | Test Conditions                       | V <sub>CC</sub><br>(V) | -40°C to +85°C |      |            | Unit |
|-----------------|-------------------|-----------------------|---------------------------------------|------------------------|----------------|------|------------|------|
|                 |                   |                       |                                       |                        | Min            | Typ  | Max        |      |
| V <sub>IH</sub> | A-B IN,<br>C-D IN | Control Input High    |                                       | 3.0<br>4.3             | 1.3<br>1.6     |      |            | V    |
| V <sub>IL</sub> | A-B IN,<br>C-D IN | Control Input Low     |                                       | 3.0<br>4.3             |                |      | 0.5<br>0.6 | V    |
| I <sub>IN</sub> | A-B IN,<br>C-D IN | Control Input Leakage | 0 ≤ V <sub>IN</sub> ≤ V <sub>CC</sub> | 4.3                    |                | ±0.1 | ±1.0       | μA   |

### SUPPLY CURRENT AND LEAKAGE (Typical: T = 25°C; V<sub>CC</sub> = 3.0 V)

| Symbol                      | Pins              | Parameter         | Test Conditions                                                                                                                                                                                                                        | V <sub>CC</sub><br>(V) | -40°C to +85°C |      |      | Unit |
|-----------------------------|-------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------|------|------|------|
|                             |                   |                   |                                                                                                                                                                                                                                        |                        | Min            | Typ  | Max  |      |
| I <sub>NO/NC</sub><br>(OFF) | NCx, NOx          | OFF State Leakage | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>NC/NO</sub> = 0.3 V<br>V <sub>COM</sub> = 4.0 V                                                                                                                         | 4.3                    |                | ±10  | ±300 | nA   |
| I <sub>COM</sub><br>(ON)    | COMx              | ON State Leakage  | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>NO</sub> = 0.3 V or 4.0 V with<br>V <sub>NC</sub> floating or<br>V <sub>NC</sub> = 0.3 V or 4.0 V with<br>V <sub>NO</sub> floating<br>V <sub>COM</sub> = 0.3 V or 4.0 V | 4.3                    |                | ±10  | ±300 | nA   |
| I <sub>CC</sub>             | V <sub>CC</sub>   | Quiescent Supply  | V <sub>IN</sub> and V <sub>IS</sub> = V <sub>CC</sub> or GND<br>I <sub>D</sub> = 0 A                                                                                                                                                   | 1.65 – 4.3             |                | ±1.0 | ±2.0 | μA   |
| I <sub>OFF</sub>            | A-B IN,<br>C-D IN | Power Off Leakage | V <sub>IN</sub> = 4.3 V or GND                                                                                                                                                                                                         | 0                      |                | ±0.5 | ±2.0 | μA   |

### ON RESISTANCE (Typical: T = 25°C; V<sub>CC</sub> = 3.0 V)

| Symbol            | Pins             | Parameter                | Test Conditions                                                     | V <sub>CC</sub><br>(V)   | -40°C to +85°C |                          |                          | Unit |
|-------------------|------------------|--------------------------|---------------------------------------------------------------------|--------------------------|----------------|--------------------------|--------------------------|------|
|                   |                  |                          |                                                                     |                          | Min            | Typ                      | Max                      |      |
| R <sub>ON</sub>   | NOx, NCx<br>COMx | ON Resistance            | I <sub>ON</sub> = -100 mA<br>V <sub>IS</sub> = 0 to V <sub>CC</sub> | 2.5<br>3.0<br>3.6<br>4.3 |                | 3.0<br>2.6<br>2.5<br>2.2 | 4.0<br>3.0<br>3.0<br>2.5 | Ω    |
| R <sub>FLAT</sub> | NOx, NCx<br>COMx | R <sub>ON</sub> Flatness | I <sub>ON</sub> = -100 mA<br>V <sub>IS</sub> = 0 to V <sub>CC</sub> | 3.0<br>4.3               |                | 0.8<br>1.1               |                          | Ω    |
| ΔR <sub>ON</sub>  | NOx, NCx<br>COMx | R <sub>ON</sub> Matching | I <sub>ON</sub> = -100 mA<br>V <sub>IS</sub> = 0 to V <sub>CC</sub> | 3.0<br>4.3               |                | 0.8<br>0.7               |                          | Ω    |

## AC ELECTRICAL CHARACTERISTICS

**TIMING/FREQUENCY** (Typical: T = 25°C; V<sub>CC</sub> = 3.0 V, R<sub>L</sub> = 50 Ω, C<sub>L</sub> = 35 pF, f = 1 MHz)

| Symbol           | Pins             | Parameter         | Test Conditions       | V <sub>CC</sub><br>(V) | -40°C to +85°C |     |     | Unit |
|------------------|------------------|-------------------|-----------------------|------------------------|----------------|-----|-----|------|
|                  |                  |                   |                       |                        | Min            | Typ | Max |      |
| t <sub>ON</sub>  | IN to NCx or NOx | Turn On Time      |                       | 2.3 – 4.3              |                | 30  | 40  | ns   |
| t <sub>OFF</sub> | IN to NCx or NOx | Turn Off Time     |                       | 2.3 – 4.53             |                | 20  | 30  | ns   |
| t <sub>BBM</sub> | IN to NCx or NOx | Break Before Make |                       | 3.0                    | 2              | 15  |     | ns   |
| BW               |                  | -3dB Bandwidth    | C <sub>L</sub> = 5 pF | 1.65 – 4.3             |                | 280 |     | MHz  |

**ISOLATION AND THD** (Typical: T = 25°C; V<sub>CC</sub> = 3.0 V, R<sub>L</sub> = 50 Ω, C<sub>L</sub> = 5 pF, f = 1 MHz)

| Symbol           | Pins         | Parameter                    | Test Conditions                                                                                                                                     | V <sub>CC</sub><br>(V) | -40°C to +85°C |       |     | Unit |
|------------------|--------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------|-------|-----|------|
|                  |              |                              |                                                                                                                                                     |                        | Min            | Typ   | Max |      |
| Q                |              | Charge Injection             | V <sub>IN</sub> = V <sub>CC</sub> to GND<br>R <sub>IS</sub> = 0 Ω, C <sub>L</sub> = 1.0 nF<br>Q = C <sub>L</sub> - ΔV <sub>OUT</sub>                | 1.65 – 4.3             |                | 111   |     | pC   |
| THD              |              | Total Harmonic Distortion    | F <sub>IS</sub> = 20 Hz to 20 kHz<br>R <sub>L</sub> = R <sub>gen</sub> = 600 Ω,<br>C <sub>L</sub> = 1.0 pF<br>V <sub>IS</sub> = 1.0 V <sub>PP</sub> | 3.0                    |                | 0.007 |     | %    |
| V <sub>ONL</sub> |              | Maximum Feed-through On Loss | V <sub>IN</sub> = 0 dBm @ 100 kHz to 50 MHz<br>V <sub>IN</sub> centered between V <sub>CC</sub> & GND                                               | 1.65 – 4.3             |                | -0.06 |     | dB   |
| O <sub>IRR</sub> | NOx          | Off Isolation                | V <sub>IN</sub> = 0<br>V <sub>NO</sub> or V <sub>NC</sub> (pk-pk) = 1.0 V                                                                           | 1.65 – 4.3             |                | -67   |     | dB   |
| Xtalk            | COMx to COMy | Non-Adjacent Channel         | V <sub>NO</sub> or V <sub>NC</sub> (pk-pk) = 1.0 V                                                                                                  | 1.65 – 4.3             |                | -100  |     | dB   |

**CAPACITANCE** (Typical: T = 25°C; V<sub>CC</sub> = 3.0 V, R<sub>L</sub> = 50 Ω, C<sub>L</sub> = 5 pF, f = 1 MHz)

| Symbol           | Pins           | Parameter       | Test Conditions                                | V <sub>CC</sub><br>(V) | -40°C to +85°C |     |     | Unit |
|------------------|----------------|-----------------|------------------------------------------------|------------------------|----------------|-----|-----|------|
|                  |                |                 |                                                |                        | Min            | Typ | Max |      |
| C <sub>IN</sub>  | A-B IN, C-D IN | Control Input   |                                                | 0 V                    |                | 5.0 |     | pF   |
| C <sub>ON</sub>  | NCx to COMx    | Through Switch  | V <sub>IN</sub> = 0V                           | 3.0 V                  |                | 20  |     | pF   |
| C <sub>OFF</sub> | NCx NOx        | Unselected Port | V <sub>IS</sub> = 3.0V, V <sub>IN</sub> = 3.0V | 3.0 V                  |                | 10  |     | pF   |

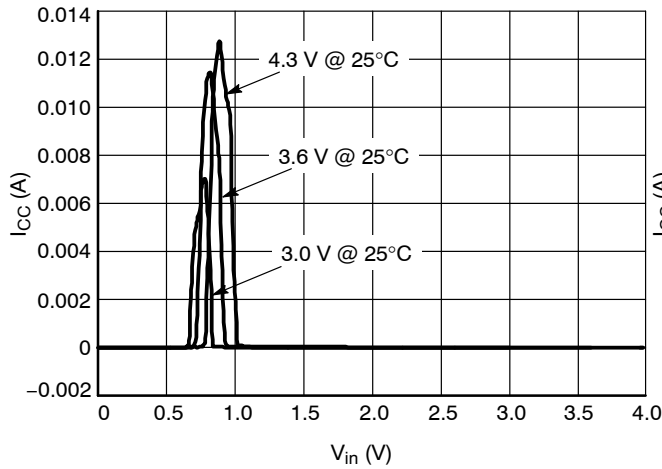


Figure 2.  $I_{CC}$  vs.  $V_{in}$

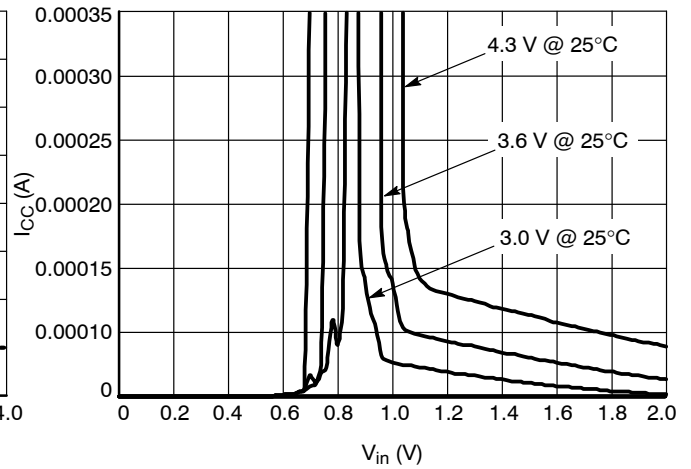


Figure 3. (Expanded View)  $I_{CC}$  vs.  $V_{in}$

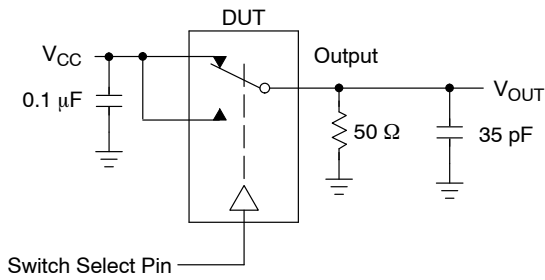


Figure 4.  $t_{BMM}$  (Time Break-Before-Make)

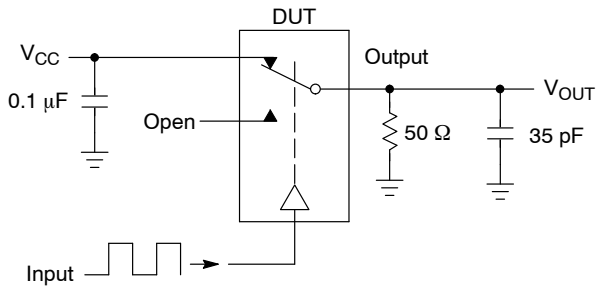
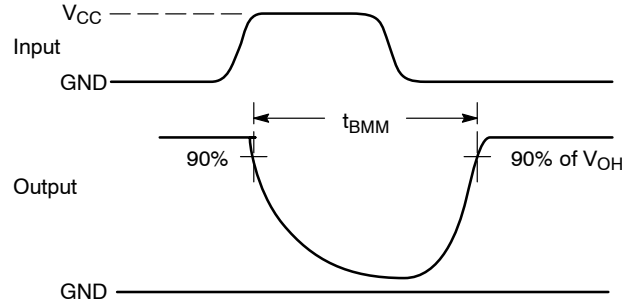


Figure 5.  $t_{ON}/t_{OFF}$

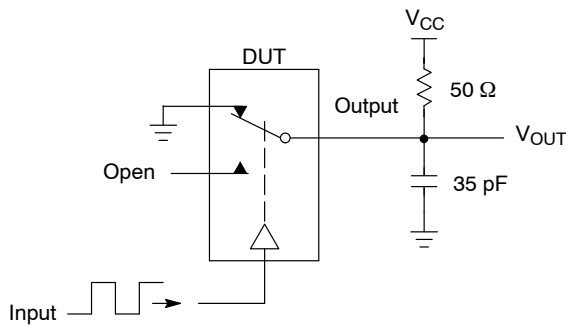
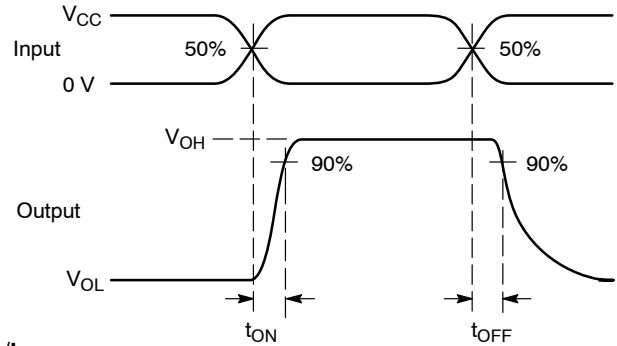
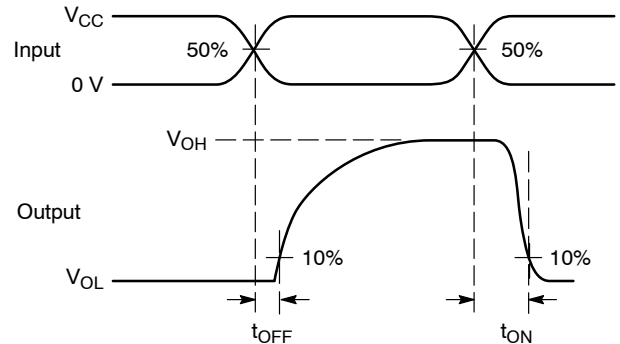
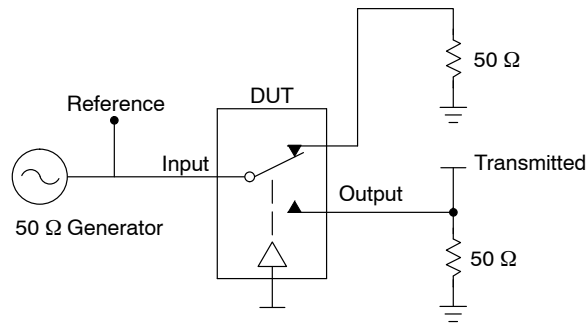


Figure 6.  $t_{ON}/t_{OFF}$





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.

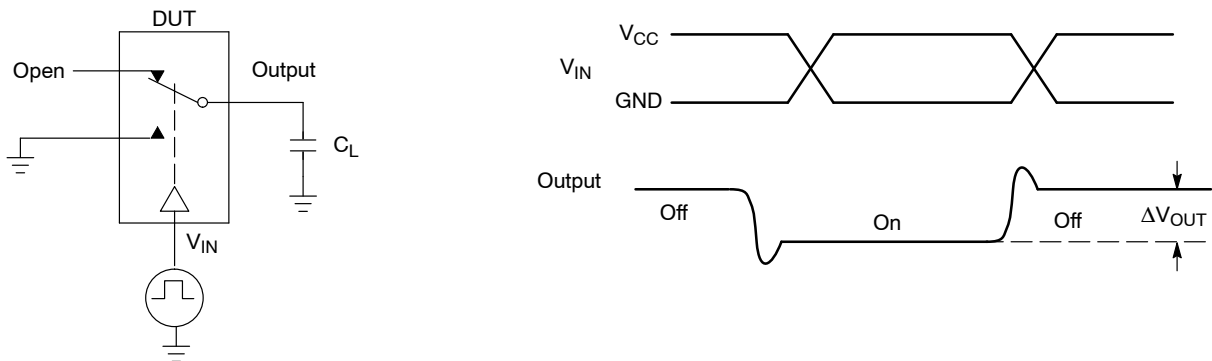
$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log } \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

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

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



**Figure 8. Charge Injection: (Q)**

## NLAS3899B

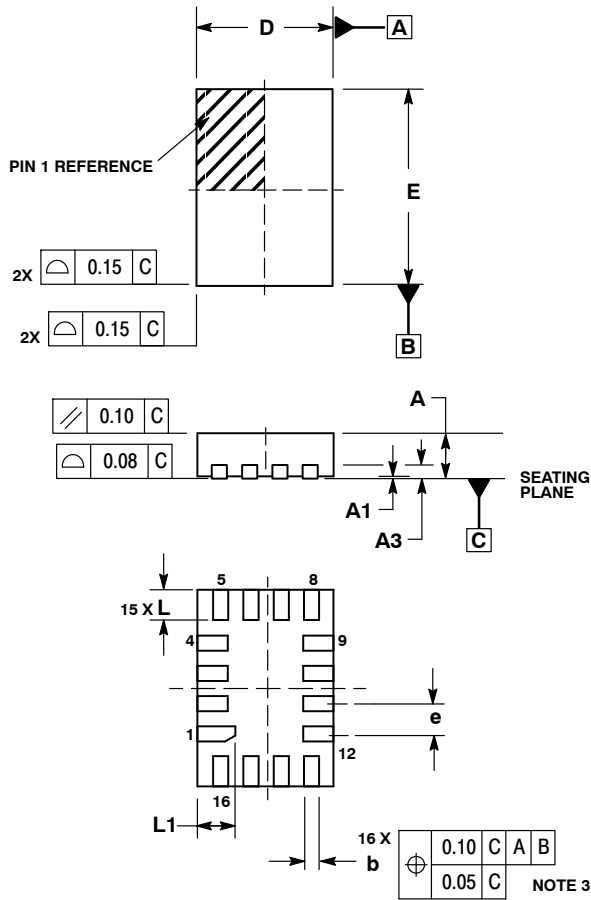
### DEVICE ORDERING INFORMATION

| Device Order Number | Package Type        | Tape & Reel Size <sup>†</sup> |
|---------------------|---------------------|-------------------------------|
| NLAS3899BMNTBG      | WQFN16<br>(Pb-Free) | 3000 / Tape & Reel            |
| NLAS3899BMNTXG      | QFN16<br>(Pb-Free)  | 3000 / Tape & Reel            |

<sup>†</sup>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.

PACKAGE DIMENSIONS

WQFN16 (1.8x2.6x0.4P)  
CASE 488AP-01  
ISSUE A

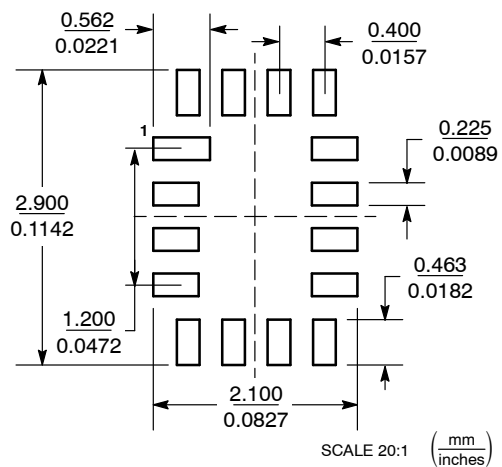


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. EXPOSED PADS CONNECTED TO DIE FLAG. USED AS TEST CONTACTS.

| MILLIMETERS |      |       |
|-------------|------|-------|
| DIM         | MIN  | MAX   |
| A           | 0.70 | 0.80  |
| A1          | 0.00 | 0.050 |
| A3          | 0.20 | REF   |
| b           | 0.15 | 0.25  |
| D           | 1.80 | BSC   |
| E           | 2.60 | BSC   |
| e           | 0.40 | BSC   |
| L           | 0.30 | 0.50  |
| L1          | 0.40 | 0.60  |

MOUNTING FOOTPRINT

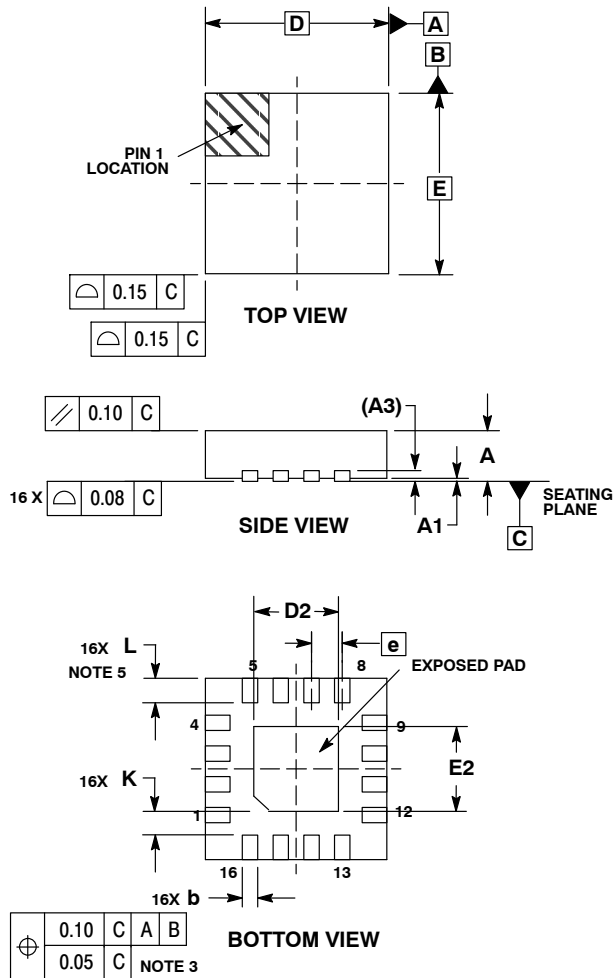


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# NLAS3899B

## PACKAGE DIMENSIONS

**QFN16 3\*3\*0.85 MM, 0.5 P**  
CASE 485AE-01  
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 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. OUTLINE MEETS JEDEC DIMENSIONS PER MO-220, VARIATION VEED-6.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN         | NOM   | MAX   |
| A   | 0.800       | 0.900 | 1.000 |
| A1  | 0.000       | 0.025 | 0.050 |
| A3  | 0.200 REF   |       |       |
| b   | 0.180       | 0.250 | 0.300 |
| D   | 3.00 BSC    |       |       |
| D2  | 1.250       | 1.40  | 1.550 |
| E   | 3.00 BSC    |       |       |
| E2  | 1.250       | 1.40  | 1.550 |
| e   | 0.500 BSC   |       |       |
| K   | 0.200       | ---   | ---   |
| L   | 0.300       | 0.400 | 0.500 |

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