

# NB4L16MMNEVB

## Evaluation Board Manual for NB4L16M



ON Semiconductor®

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### EVALUATION BOARD MANUAL

#### DESCRIPTION

This document describes the NB4L16M evaluation board and the appropriate lab test setups. It should be used in conjunction with the NB4L16M data sheets which contain full technical details on the device specifications and operation.

The evaluation board is designed to facilitate a quick evaluation of the NB4L16M Differential Receiver / Driver / Translator. The NB4L16M is designed to function as a high speed receiver/driver/translator device with CML output for use in high speed signal amplification and backplane interface applications.

The board is implemented in two layers and provides a high bandwidth 50  $\Omega$  controlled impedance environment for higher performance. The first layer or primary trace layer is 5 mils thick Rogers RO6002 material, which is engineered

to have equal electrical length on all signal traces from the NB4L16M device to the sense output. The second layer is 32 mils thick copper ground plane.

#### What measurements can you expect to make?

With this evaluation board, the following measurements could be performed in differential modes of operation:

- Jitter
- Output Skew
- Gain/Return Loss
- Eye Pattern Generation
- Frequency Performance
- Output Rise and Fall Time
- $V_{CMR}$  (Input High Common Mode Range)

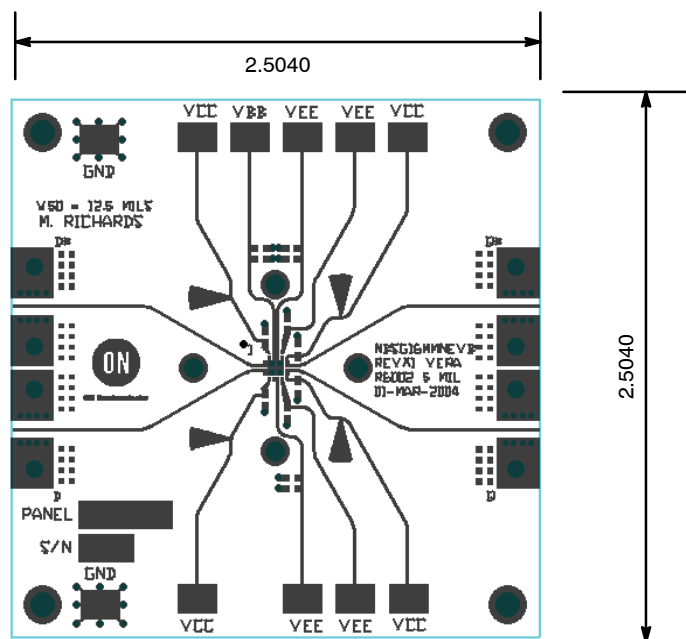


Figure 1. NB4L16MMN Evaluation PCB with Pin Label/Connection Change

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## SETUP FOR TIME DOMAIN MEASUREMENTS

**Table 1. BASIC EQUIPMENT**

| Description                                   | Example Equipment (Note 1)                | Qty. |
|-----------------------------------------------|-------------------------------------------|------|
| Power Supply with 4 outputs                   | HP6624A                                   | 1    |
| Oscilloscope                                  | TDS8000 with 80E01 Sampling Head (Note 2) | 1    |
| Differential Signal Generator                 | HP 8133A, Advantest D3186                 | 1    |
| Matched High Speed Cables with SMA Connectors | Storm, Semflex                            | 4    |
| Power Supply Cables with Clips                |                                           | 8    |

1. Equipment used to generate example measurements within this document.
2. 50 GHz sampling head used (for effective rise, fall and jitter performance measurement)

### SETUP

#### Connect Power

**Step 1:**

1a: Two power levels must be provided to the board for  $V_{CC}$  and  $V_{EE}$  via the surface mount clips.

| NB4L16M Power Supply Connections             |                                              |
|----------------------------------------------|----------------------------------------------|
| 3.3 V Setup                                  | 2.5 V Setup                                  |
| $V_{CC} = 0 \text{ V} = \text{GND}$          | $V_{CC} = 0 \text{ V} = \text{GND}$          |
| $V_{TT} = V_{CC} = 0 \text{ V} = \text{GND}$ | $V_{TT} = V_{CC} = 0 \text{ V} = \text{GND}$ |
| $V_{EE} = -3.3 \text{ V}$                    | $V_{EE} = -2.5 \text{ V}$                    |

#### Connect Inputs

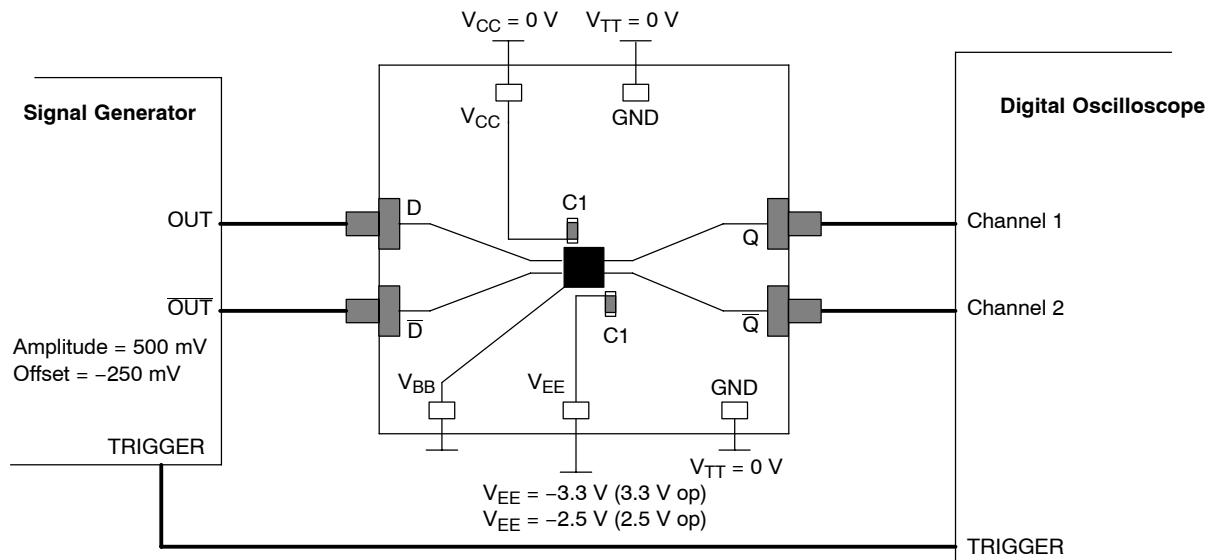
**Step 2:**

For Differential Mode (3.3 V and 2.5 V operation)

2a: Connect the differential output of the generator to the differential input of the device ( $D$  and  $\overline{D}$ ).

NOTE: Device may oscillate when the input is not driven.

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NOTE: All differential cable pairs **must be** matched.

Figure 2. NB4L16M Board Setup – Time Domain (Differential Mode)

### SETUP (continued)

#### Setup Input Signals

##### Step 3:

3a: Set the signal generator amplitude to 500 mV.

NOTE: The signal generator amplitude can vary from 75 mV to 900 mV to produce a 400 mV DUT output.

3b: Set the signal generator offset to -250 mV.

NOTE: The  $V_{IHCMR}$  (Input High Voltage Common Mode Range) allows the signal generator offset to vary as long as  $V_{IH}$  is within the  $V_{IHCMR}$  range. Refer to the device data sheet for further information.

3c: Set the generator output for a PRBS data signal, or for a square wave clock signal with a 50% duty cycle.

#### Connect Output Signals

##### Step 4:

4a: Connect the outputs of the device ( $Q$ ,  $\bar{Q}$ ) to the oscilloscope. The oscilloscope sampling head must have internal 50  $\Omega$  termination to ground.

NOTE: Where a single output is being used, the unconnected output for the pair **must be** terminated to  $V_{TT}$  through a 50  $\Omega$  resistor for best operation. Unused pairs may be left unconnected. Since  $V_{TT} = 0\text{ V}$ , a standard 50  $\Omega$  SMA termination is recommended.

### Setup for Frequency Domain Measurements

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**Table 2. BASIC EQUIPMENT**

| Description                                    | Example Equipment (Note 3) | Qty |
|------------------------------------------------|----------------------------|-----|
| Power Supply with 4 outputs                    | HP 6624A                   | 1   |
| Vector Network Analyzer (VNA)                  | R&S ZVK (10 MHz to 40 GHz) | 1   |
| 180° Hybrid Coupler                            | Krytar Model #4010180      | 1   |
| Bias Tee with 50 $\Omega$ Resistor Termination | Picosecond Model #5542-219 | 1   |
| Matched High Speed Cables with SMA Connectors  | Storm, Semflex             | 3   |
| Power Supply Cables with Clips                 |                            | 8   |

3. Equipment used to generate example measurements within this document.

## SETUP

### Step 1:

#### Connect Power

1a: Two power levels must be provided to the board for  $V_{CC}$  and  $V_{EE}$  via the surface mount clips.

| NB4L16M Power Supply Connections    |
|-------------------------------------|
| <b>3.3 V Setup</b>                  |
| $V_{CC} = 0 \text{ V} = \text{GND}$ |
| $V_{TT} = V_{CC} = \text{GND}$      |
| $V_{EE} = -3.3 \text{ V}$           |

## SETUP TEST CONFIGURATIONS FOR DIFFERENTIAL OPERATION

### Small Signal Setup

#### Step 2:

##### Input Setup

- 2a: Calibrate VNA from 1.0 GHz to 12 GHz.
- 2b: Set input level to  $-35 \text{ dBm}$  at the output of the 180° Hybrid coupler (input of the DUT).

#### Step 3:

##### Output Setup

- 3a: Set display to measure  $S_{21}$  and record data.

### Large Signal Setup

#### Step 2:

##### Input Setup

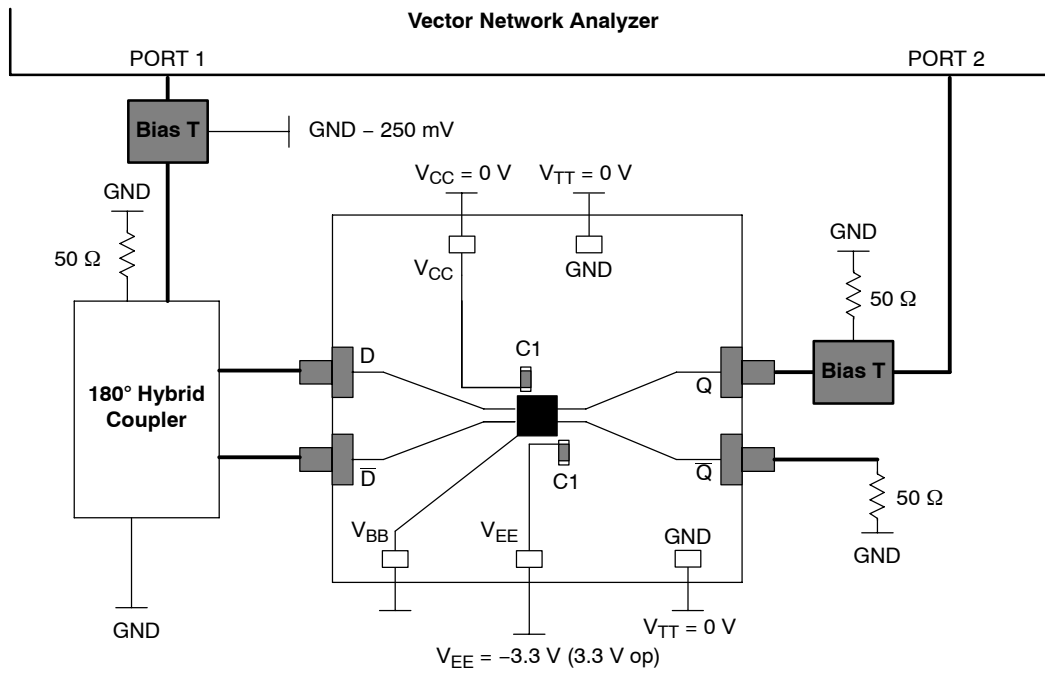
- 2a: Calibrate VNA from 1.0 GHz to 12 GHz.
- 2b: Set input levels to  $-2.0 \text{ dBm}$  (500 mV) at the input of DUT.

#### Step 3:

##### Output Setup

- 3a: Set display to measure  $S_{21}$  and record data.

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**Figure 3. Board Setup – Frequency Domain (Differential Mode)**

**NB4L16MMNEVB**

## MORE INFORMATION ABOUT EVALUATION BOARD

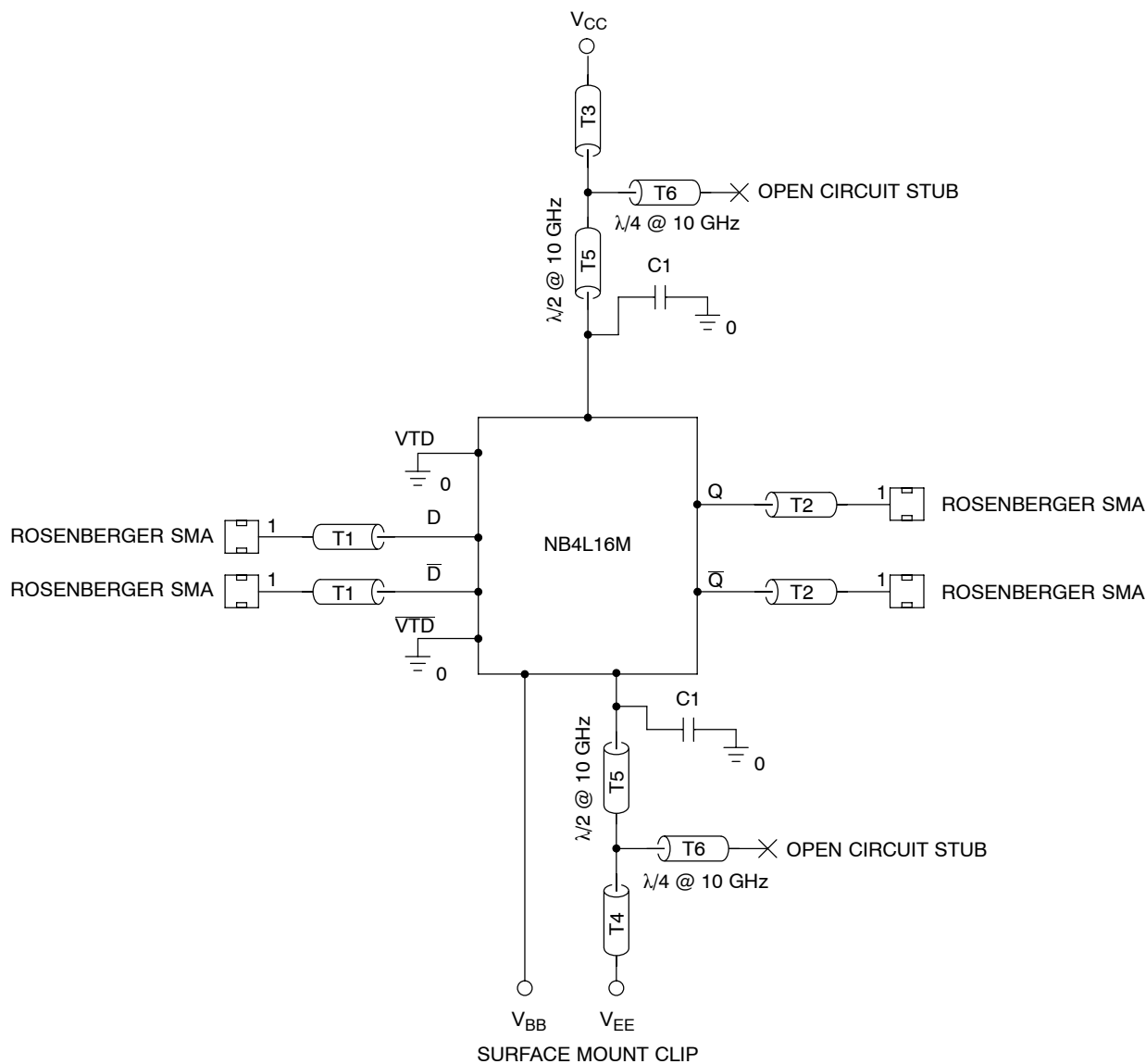
## Design Considerations for >10 GHz operation

While the NB4L16M is specified to operate at 12 GHz, this evaluation board is designed to support operating frequencies up to 20 GHz.

The following considerations played a key role to ensure this evaluation board achieves high-end microwave performance:

- Optimal SMA connector launch
- Minimal insertion loss and signal dispersion
- Accurate Transmission line matching (50 ohms)
- Distributed effects while bypassing and noise filtering

## SURFACE MOUNT CLIP



NOTE: C1, C2\* = Decoupling cap  
Tx = 50  $\Omega$  Transmission line

### Figure 4. Evaluation Board Schematic

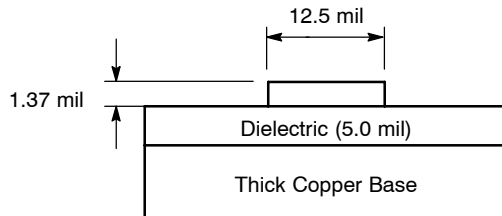
# NB4L16MMNEVB

**Table 3. PARTS LIST**

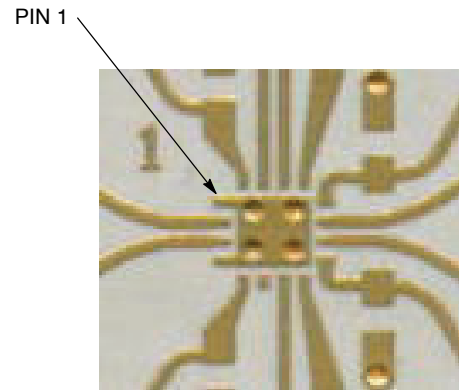
| Part No                      | Qty | Description                                                                                                   | Manufacturer                     | WEB address                                                                                                              |
|------------------------------|-----|---------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| NB4L16MMN                    | 1   | 2.5 V/3.3 V, 5 Gb/s Multi Level Clock/Data Input to CML Receiver/Driver/ Translator with Internal Termination | ON Semiconductor                 | <a href="http://www.onsemi.com">http://www.onsemi.com</a>                                                                |
| 32K243-40ME3                 | 4   | Gold Plated Connector                                                                                         | Rosenberger                      | <a href="http://www.rosenberger.de">http://www.rosenberger.de</a>                                                        |
| CO6BLBB2X5CO6<br>03CL04K6RAC | 9   | 2 MHz – 30 GHz Capacitor<br>0603 0.1 $\mu$ F $\pm$ 10%                                                        | Dielectric Laboratories<br>Kemet | <a href="http://www.dilabs.com">http://www.dilabs.com</a><br><a href="http://www.newark.com/">http://www.newark.com/</a> |
| SO16                         | 9   | Test Point–Anvil                                                                                              | Keystone                         | <a href="http://www.newark.com">http://www.newark.com</a><br><a href="http://www.digikey.com">http://www.digikey.com</a> |

**Table 4. BOARD MATERIAL**

| Material       | Thickness |
|----------------|-----------|
| Rogers 6002    | 5 mil     |
| Copper Plating | 32 mil    |



**Figure 5. Board Stack-up**



**Figure 6. Layout Mask for NB4L16M**



NOTE: The insertion loss curve can be used to calibrate out board loss if testing under small signal conditions.

**Figure 7. Insertion Loss**

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## ADDITIONAL EVALUATION BOARD INFORMATION

### www.onsemi.com

In all cases, the most up-to-date information can be found on our website.

- Sample orders for devices and boards
- New Product updates
- Literature download/order
- IBIS and Spice models

### References

NB4L16M/D, Data Sheet, 2.5V/3.3V, 5 Gb/s Multi Level Clock/Data Input to CML Driver / Receiver / Buffer / Translator with Internal Termination

AND8077/D, Application Note, GigaComm™ (SiGe) SPICE Modeling Kit.

AND8075/D, Application Note, Board Mounting Considerations for the FCBGA Packages.

## ORDERING INFORMATION

| Part No      | Description                                                                                                             | Package                 | Shipping           |
|--------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------------|
| NB4L16MMN    | 2.5V/3.3V, 5 Gb/s Multi Level Clock/Data Input to CML Driver / Receiver / Buffer / Translator with Internal Termination | 3X3 mm QFN-16           | 123 Units/Tray     |
| NB4L16MMNG   | 2.5V/3.3V, 5 Gb/s Multi Level Clock/Data Input to CML Driver / Receiver / Buffer / Translator with Internal Termination | 3X3 mm QFN-16 (Pb-Free) | 123 Units/Tray     |
| NB4L16MMNR2  | 2.5V/3.3V, 5 Gb/s Multi Level Clock/Data Input to CML Driver / Receiver / Buffer / Translator with Internal Termination | 3X3 mm QFN-16           | 3000 / Tape & Reel |
| NB4L16MMNEVB | NB4L16MN Evaluation Board                                                                                               |                         |                    |

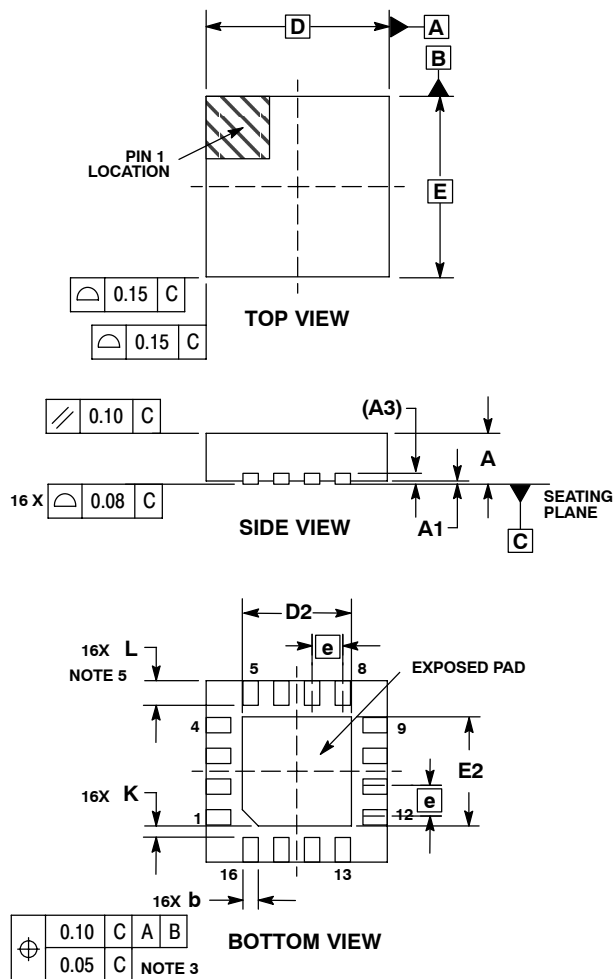
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



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## PACKAGE DIMENSIONS

16 PIN QFN  
MN SUFFIX  
CASE 485G-01  
ISSUE B



### 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. L<sub>max</sub> CONDITION CAN NOT VIOLATE 0.2 MM MINIMUM SPACING BETWEEN LEAD TIP AND FLAG

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 0.80        | 1.00 |
| A1  | 0.00        | 0.05 |
| A3  | 0.20        | REF  |
| b   | 0.18        | 0.30 |
| D   | 3.00        | BSC  |
| D2  | 1.65        | 1.85 |
| E   | 3.00        | BSC  |
| E2  | 1.65        | 1.85 |
| e   | 0.50        | BSC  |
| K   | 0.20        | ---  |
| L   | 0.30        | 0.50 |

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