

# NB7L216MNEVB

## NB7L216 Evaluation Board User's Manual



ON Semiconductor®

<http://onsemi.com>

### EVAL BOARD USER'S MANUAL

#### Description

This document describes the NB7L216 evaluation board and the appropriate lab test setups. It should be used in conjunction with the NB7L216 data sheet which contains full technical details on the device specifications and operation.

The evaluation board is designed to facilitate a quick evaluation of the NB7L216 GigaComm™ High Gain Differential Receiver/Driver.

#### Board Lay-up

The evaluation board is implemented in two layers and provides a high bandwidth 50 Ω controlled impedance environment for higher performance. 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 NB7L216 device to the sense output. The second layer is 32 mils thick copper ground plane. For standard lab setup and test, a split (dual) power supply is required enabling the 50 ohm impedance in the scope to be used as termination of the ECL signals ( $V_{TT} = V_{CC} - 2.0$  V, in split power supply setup,  $V_{TT}$  is the system ground).

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

With this evaluation board, the following measurements could be performed in single-ended<sup>(1)</sup> or differential modes of operation:

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

1. Single-ended measurements can only be made at  $V_{CC} - V_{EE} = 3.3$  V using this board setup.

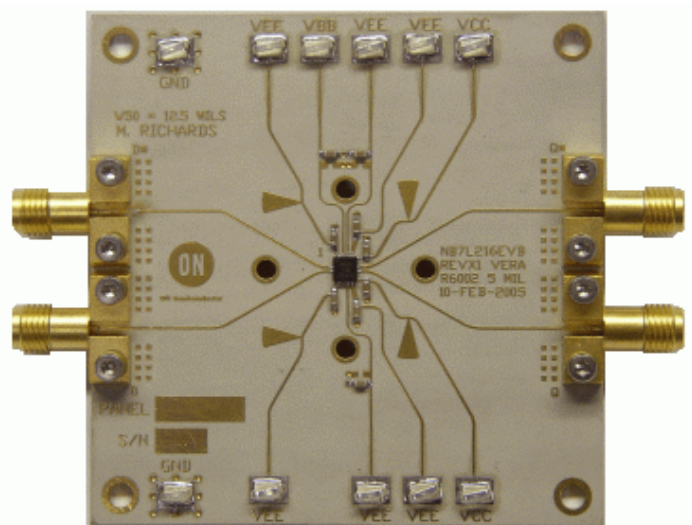
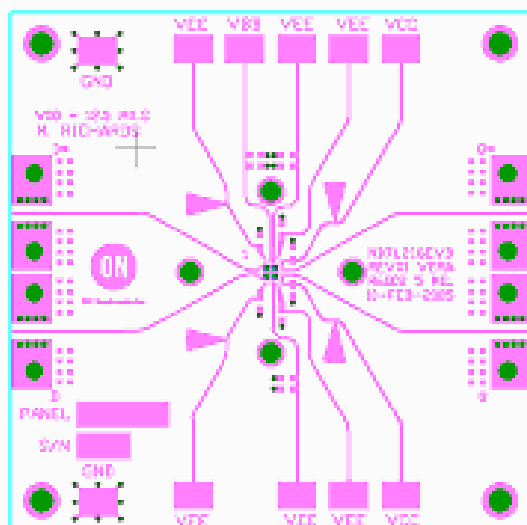


Figure 1. NB7L216 Evaluation Board

# NB7L216MNEVB

## 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		3/4

- Equipment used to generate example measurements.
- 50 GHz sampling head used (for effective rise, fall and jitter performance measurement)

### Setup

#### Step 1: Connect Power

1a: Three power levels must be provided to the board for  $V_{CC}$ ,  $V_{EE}$ , and GND via the surface mount clips. Using the split power supply mode,  $GND = V_{TT} = V_{CC} - 2.0 V$ .

**Table 2. NB7L216 POWER SUPPLY CONNECTIONS**

3.3 V Setup	2.5 V Setup
$V_{CC} = 2.0 V$	$V_{CC} = 2.0 V$
$V_{TT} = GND$	$V_{TT} = GND$
$V_{EE} = -1.3 V$	$V_{EE} = -0.5 V$

#### Step 2: Connect Inputs

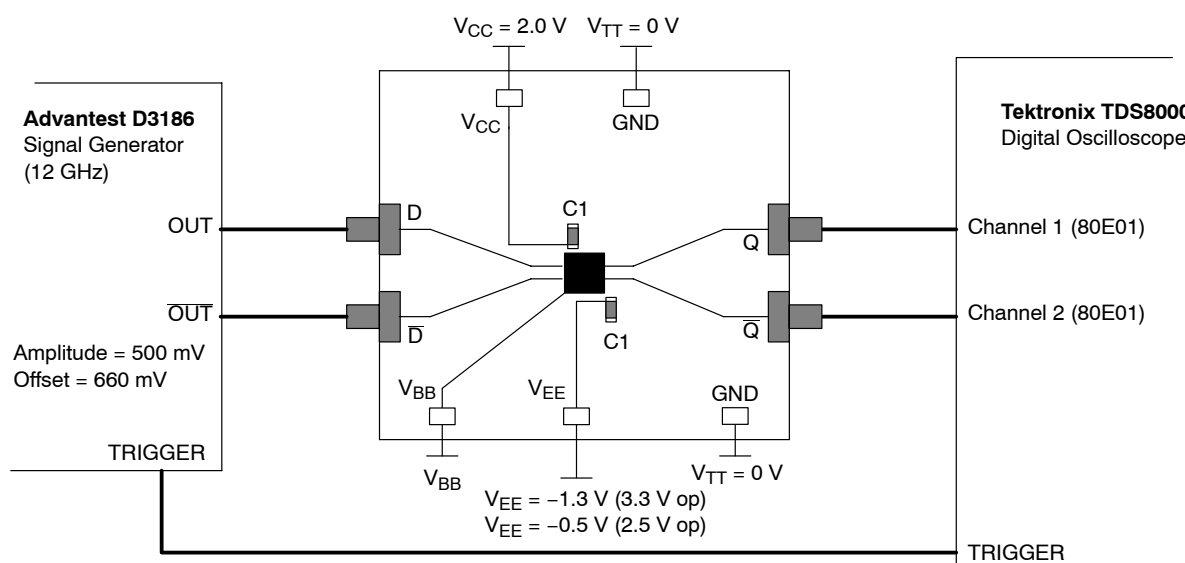
##### For Differential Mode (3.3 V and 2.5 V operation)

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

##### For Single-Ended Mode (3.3 V operation only)

2a: Connect the AC coupled single-ended output generator to input.

NOTE: Device may oscillate when the input is not driven. For best results, unconnected input should be terminated to  $V_{TT}$  through 50  $\Omega$  resistor.



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

**Figure 2. NB7L216 Board Setup – Time Domain (Differential Mode)**

# NB7L216MNEVB

## Setup (continued)

### Step 3: Setup Input Signals

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 660 mV (the center of a nominal RSECL output).

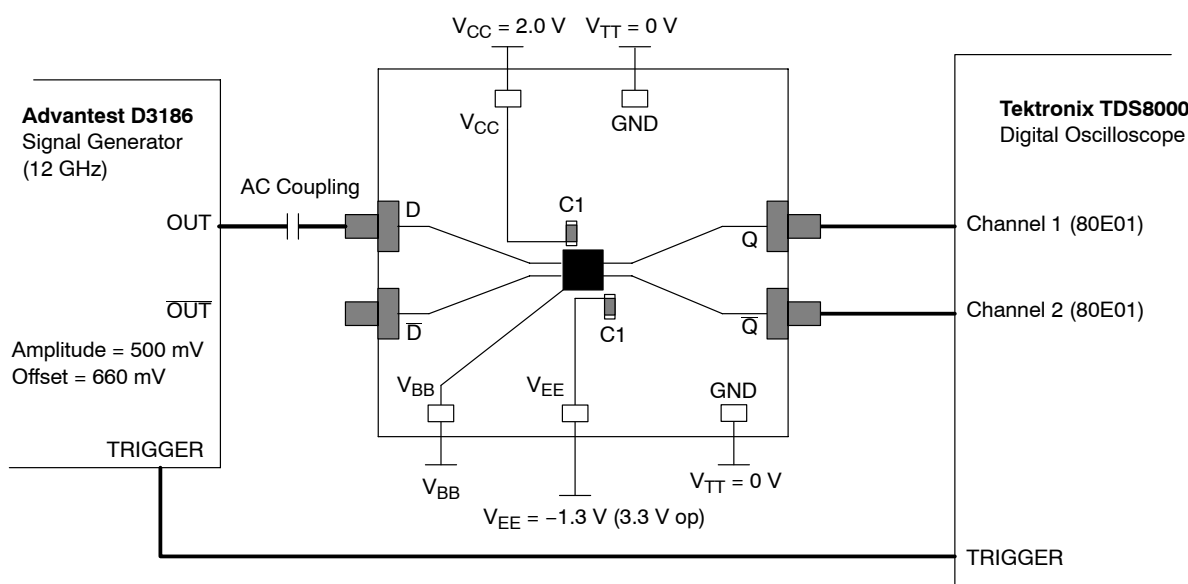
NOTE: The  $V_{CMR}$  (Voltage Common Mode Range) allows the signal generator offset to vary as long as crosspoint is within the  $V_{CMR}$  range. Refer to the device data sheet for further information.

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

### Step 4: Connect Output Signals

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  $V_{TT} = 0$  V, a standard 50  $\Omega$  SMA termination is recommended.



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

Figure 3. NB7L216 Board Setup – Time Domain (Single-Ended Mode)

## SETUP FOR FREQUENCY DOMAIN MEASUREMENTS

Table 3. 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		3/4

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

# NB7L216MNEVB

## Setup

### Step 1: Connect Power

1a: Three power levels must be provided to the board for  $V_{CC}$ ,  $V_{EE}$ , and GND via the surface mount clips. Using the split power supply mode,  $GND = V_{TT} = V_{CC} - 2.0 V$ .

**Table 4. NB7L216 POWER SUPPLY CONNECTIONS**

3.3 V Setup
$V_{CC} = 2.0 V$
$V_{TT} = GND$
$V_{EE} = -1.3 V$

NOTE: For frequency domain measurements, 2.5 V power supply is not recommended because additional equipment (bias tee, etc.) is needed for proper operation. The input signal has to be properly offset to meet  $V_{CMR}$  range of the device.

### Setup Test Configurations For Differential Operation

#### Small Signal Setup

#### Step 2: Input Setup

2a: Calibrate VNA from 1.0 GHz to 12 GHz.

Set input level to  $-35 \text{ dBm}$  at the output of the  $180^\circ$  Hybrid coupler (input of the DUT).

#### Step 3: Output Setup

3a: Set display to measure S21 and record data.

#### Large Signal Setup

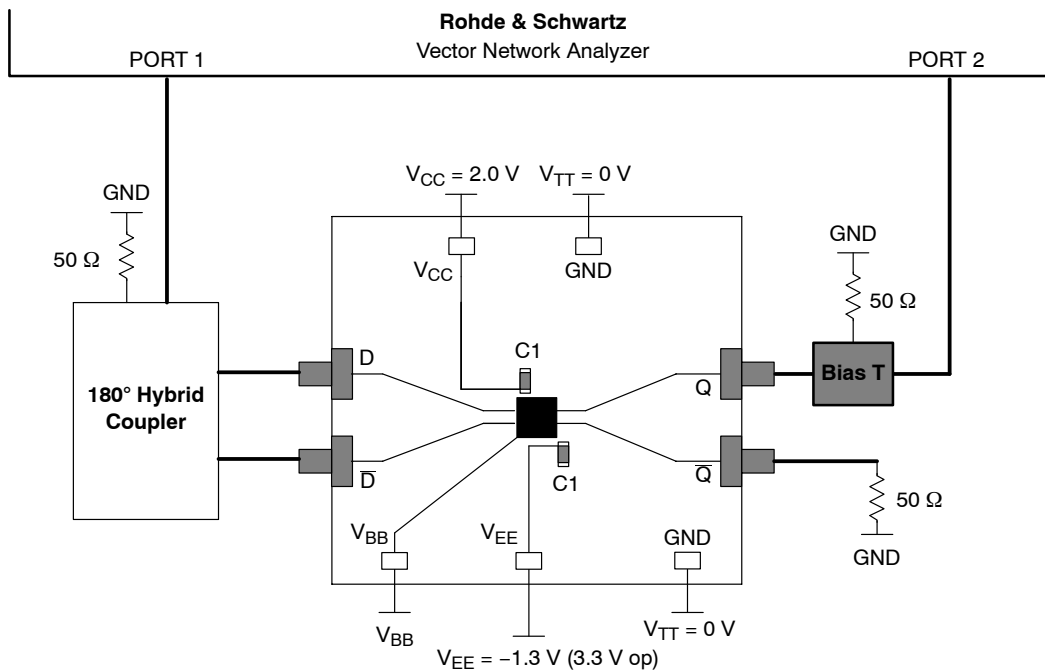
#### Step 2: Input Setup

2a: Calibrate VNA from 1.0 GHz to 12 GHz.

2b: Set input levels to  $-2.0 \text{ dBm}$  ( $500 \text{ mV}$ ) at the input of DUT.

#### Step 3: Output Setup

3a: Set display to measure S21 and record data.



**Figure 4. NB7L216 Board Setup – Frequency Domain (Differential Mode)**

### Setup Test Configurations For Single-Ended Operation

#### Single-Ended Mode – Small Signal

#### Step 2: Input Setup

2a: Calibrate VNA from 1.0 GHz to 12 GHz.

2b: Set input level to  $-35 \text{ dBm}$  at the input of DUT.

#### Step 3: Output Setup

3a: Set display to measure S21 and record data.

#### Single-Ended Mode – Large Signal

#### Step 2: Input Setup

2a: Calibrate VNA from 1.0 GHz to 12 GHz.

2b: Set input levels to  $+2 \text{ dBm}$  ( $500 \text{ mV}$ ) at the input of DUT.

#### Step 3: Output Setup

3a: Set display to measure S21 and record data.

# NB7L216MNEVB

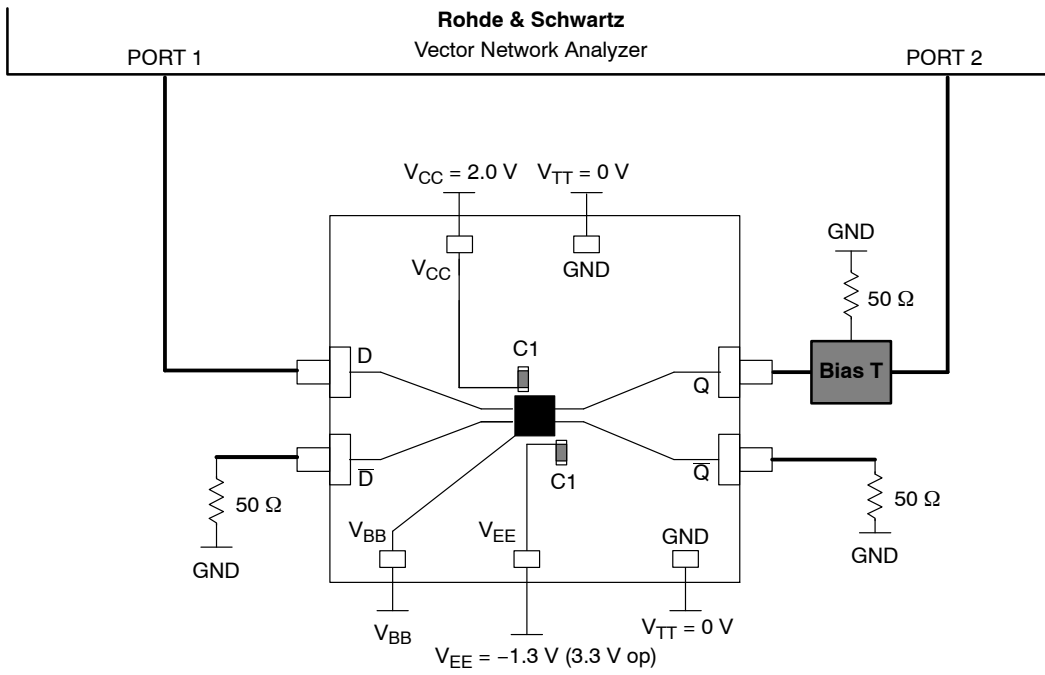


Figure 5. NB7L216 Board Setup – Frequency Domain (Single-Ended Mode)

# NB7L216MNEVB

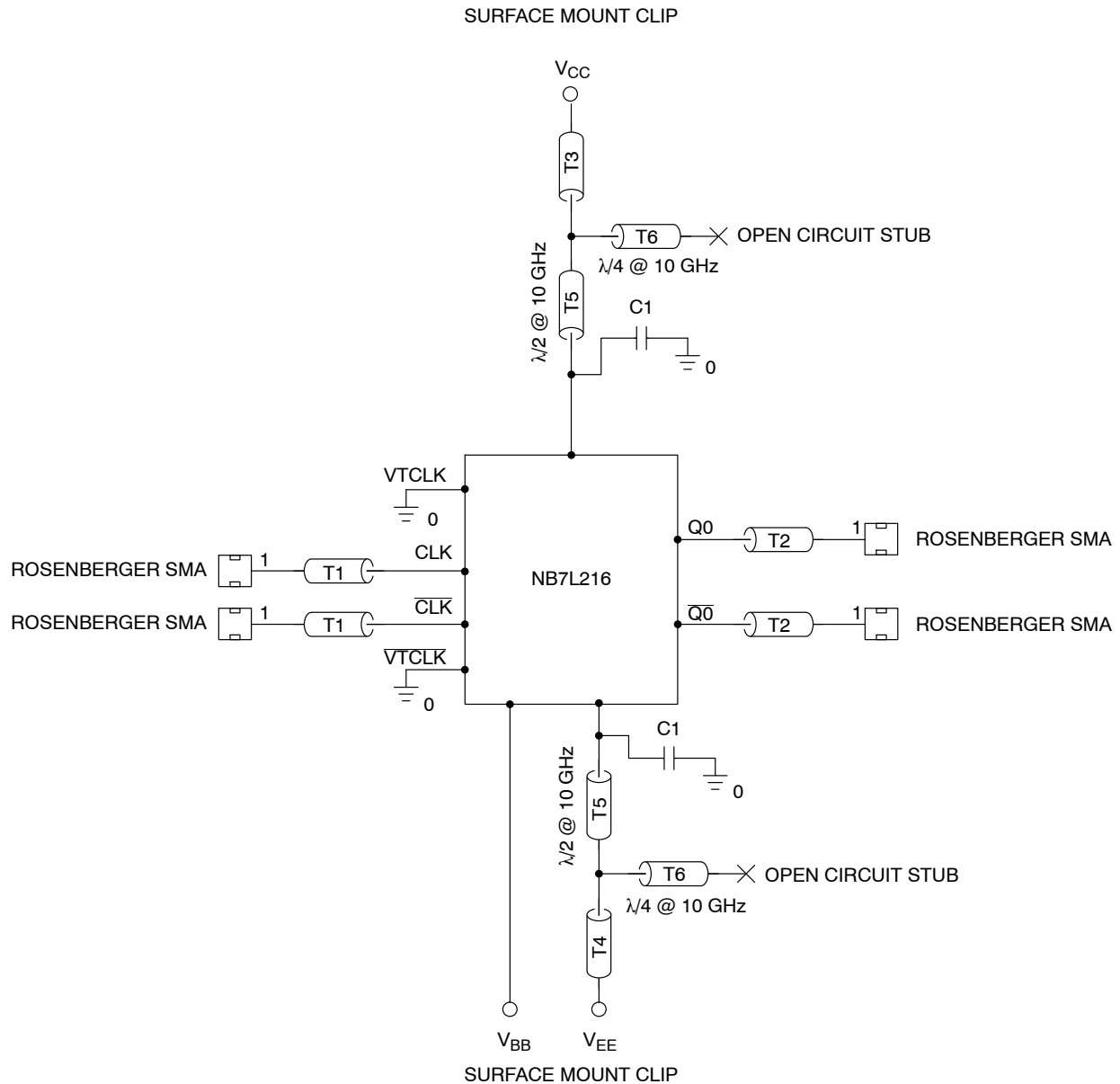
## MORE INFORMATION ABOUT EVALUATION BOARD

### Design Considerations for >12 GHz operation

While the NB7L216 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



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

Figure 6. Evaluation Board Schematic

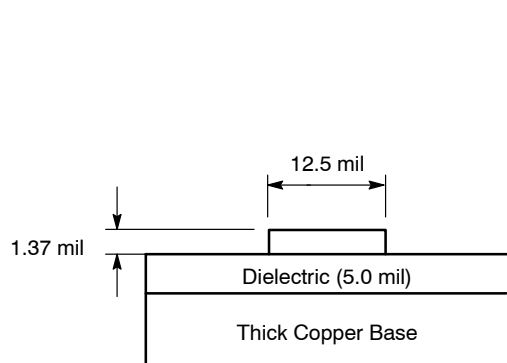
# NB7L216MNEVB

**Table 5. BILL OF MATERIALS**

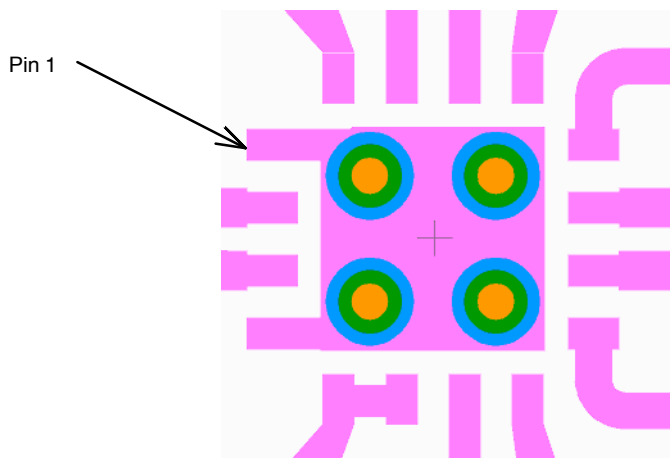
Part No	QTY	Description	Manufacturer	WEB address
NB7L216	1	Evaluation Board	ON Semiconductor	<a href="http://www.onsemi.com">http://www.onsemi.com</a>
5016	11	Test Point – ANVIL	Keystone	<a href="http://www.newark.com">http://www.newark.com</a> <a href="http://www.digikey.com">http://www.digikey.com</a>
32K243–40ME3	4	Gold plated connector	Rosenberger	<a href="http://www.rosenberger.de">http://www.rosenberger.de</a>
CO6BLBB2X5UX CO603C104K6RAC	8	2 MHz – 30 GHz capacitor 0603 0.1 $\mu$ F $\pm$ 10%	Dielectric Laboratories Kemet	<a href="http://www.dilabs.com">http://www.dilabs.com</a> <a href="http://www.newark.com">http://www.newark.com</a>

**Table 6. BOARD MATERIAL**

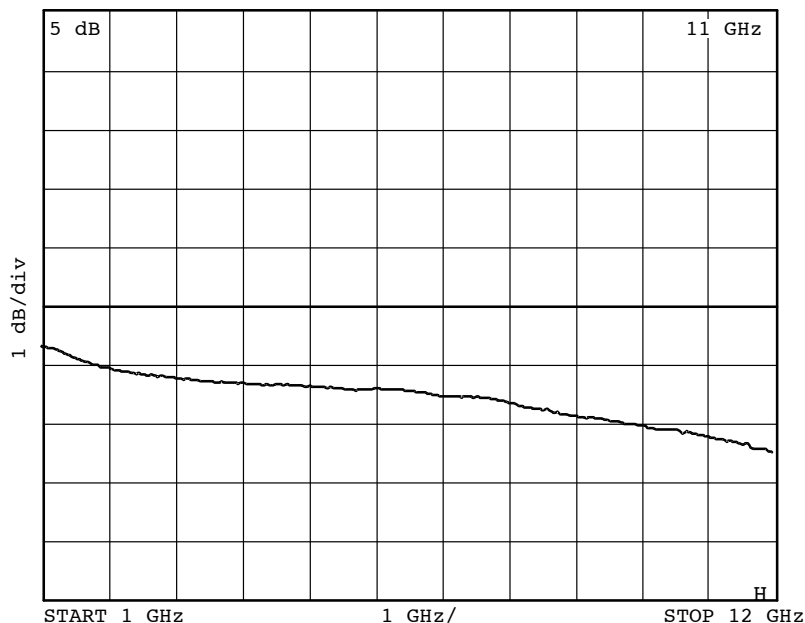
Material	Thickness
Rogers 6002	5 mil
Copper Plating	32 mil



**Figure 7. Board Stack-up**



**Figure 8. Layout Mask for NB7L216**



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

**Figure 9. Insertion Loss**

# NB7L216MNEVB

## 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

NB7L216 Data Sheet, *2.5V/3.3V, 12Gb/s Multi Level Clock/Data Input to RSECL, High Gain 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

Device	Package	Shipping†
NB7L216MN	QFN-16	123 Units / Rail
NB7L216MNG	QFN-16 (Pb-Free)	123 Units / Rail
NB7L216MNR2	QFN-16	3000 / Tape & Reel
NB7L216MNR2G	QFN-16 (Pb-Free)	3000 / Tape & Reel

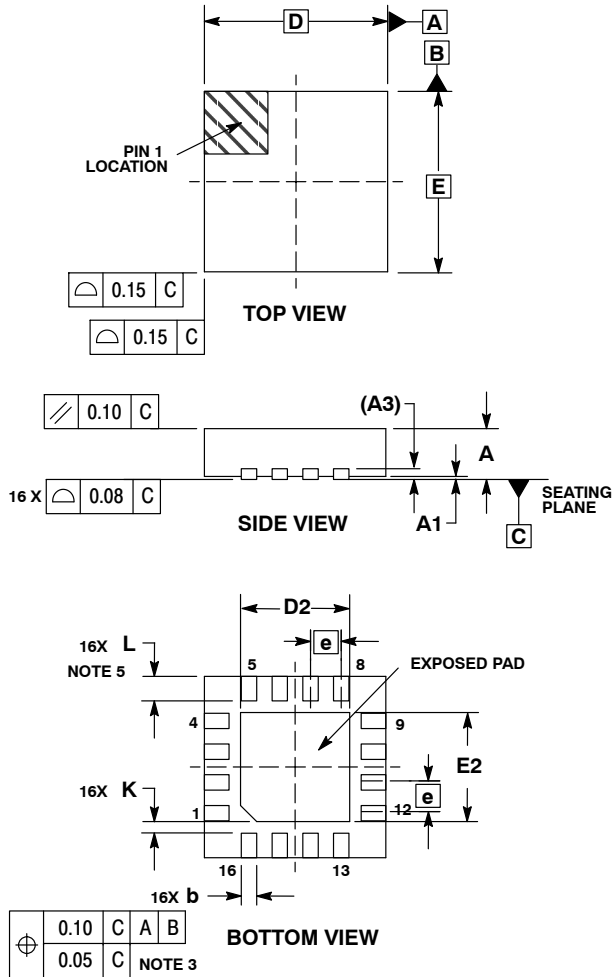
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



# NB7L216MNEVB

## PACKAGE DIMENSIONS

16 PIN QFN  
CASE 485G-01  
ISSUE B

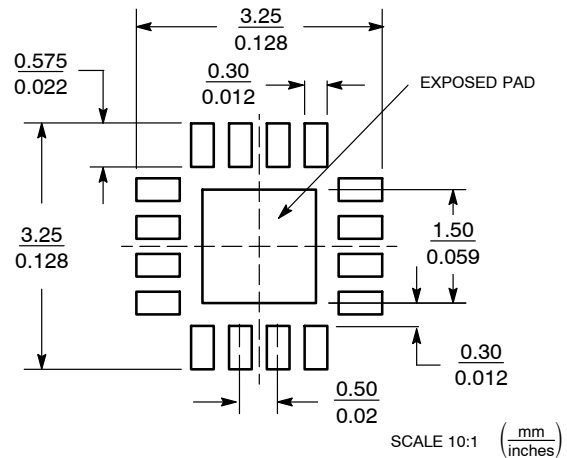


**NOTES:**

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.  $L_{MAX}$  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

**SOLDERING 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.

GigaComm is a trademark of Semiconductor Components Industries, LLC.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

**PUBLICATION ORDERING INFORMATION**

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** orderlit@onsemi.com

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local Sales Representative