NBSG16BAEVB, NBSG16VSBAEVB

Evaluation Board Manual for NBSG16 and NBSG16VS

ON Semiconductor®

http://onsemi.com

EVALUATION BOARD MANUAL

DESCRIPTION

This document describes the NBSG16/16VS evaluation board and the appropriate lab test setups. It should be used in conjunction with the NBSG16/16VS data sheets which contain full technical details on the device specifications and operation. The same PCB is used to evaluate both devices.

The evaluation board is designed to facilitate a quick evaluation of the NBSG16/16VS GigaComm™ Differential Receiver/Driver. The NBSG16 is designed to function as a high speed receiver/driver device with a reduced output swing capability suitable for use in high speed signal amplification and backplane interface applications. The Reduced Swing ECL (RSECL) output ensures minimal noise and fast switching edges. The NBSG16VS has the option to vary the output amplitude swing (additional V_{CTRL} modulation pin, labeled VS on evaluation board).

The evaluation board is implemented in two layers for higher performance. 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(1) or differential modes of operation:

- Jitter
- Output Skew
- Gain/Return Loss
- Eye Pattern Generation
- Frequency Performance
- Output Rise and Fall Time
- V_{IHCMR} (Input High 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. NBSG16/16VS Evaluation Board

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 (Note 3)

1. Equipment used to generate example measurements within this document.
2. 50 GHz sampling head used (for effective rise, fall and jitter performance measurement)
3. An additional power supply cable with a surface mount clip is necessary to test the NBSG16VS due to the V_{CTRL} connection.

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.

NBSG16/16VS Power Supply Connections	
3.3 V Setup	**2.5 V Setup**
V_{CC} = 2.0 V (Two Places)	V_{CC} = 2.0 V (Two Places)
V_{TT} = GND (One Place)	V_{TT} = GND (One Place)
V_{EE} = -1.3 V (One Place)	V_{EE} = -0.5 V (One Place)

NBS/16VS Only Power Supply Connection	
3.3 V Setup	**2.5 V Setup**
V_{CTRL} (One Place)	V_{CTRL} (One Place)

NOTE: **For NBSG16VS only**: Adjustable power supply is needed to modulate output amplitude by varying V_{CTRL} pin as shown in Figures 2 through 6. Connect the V_{CTRL} (Output Amplitude Swing Control) voltage level for the desired output swing. Refer to NBSG16VS data sheet Figures 4 and 5.

Step 2:

Connect Inputs

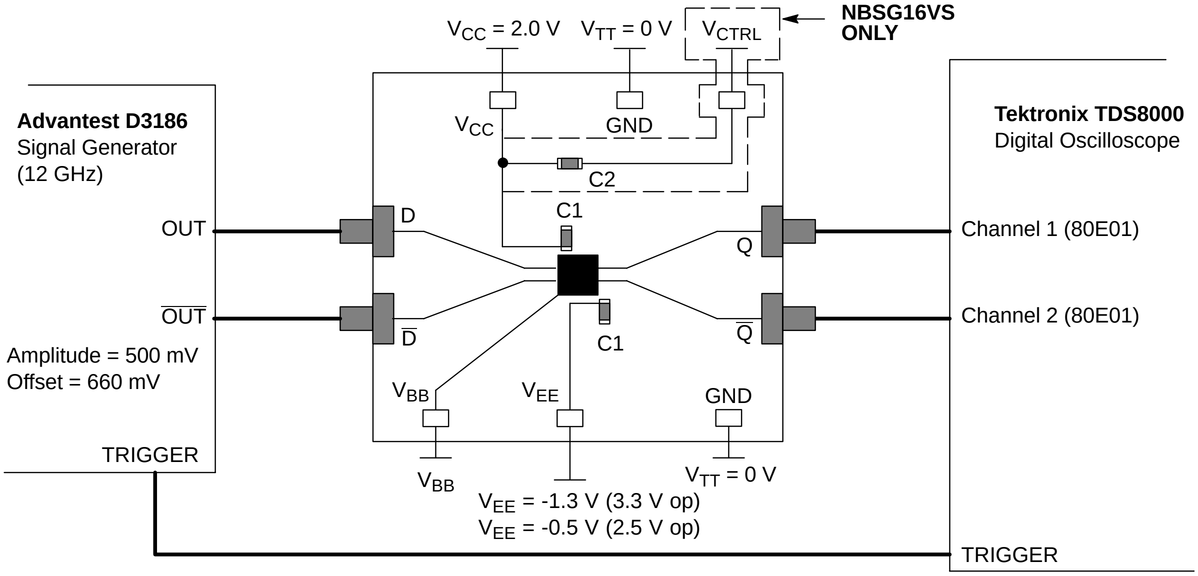
For Differential Mode (3.3 V and 2.5 V operation)

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

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 Ω resistor



NOTE: All differential cable pairs ***must be*** matched.
WARNING: V_{CTRL} ***must not*** be connected for NBSG16 evaluation board connection or damage may result

Figure 2. NBSG16/16VS Board Setup - Time Domain (Differential Mode)

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_{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.

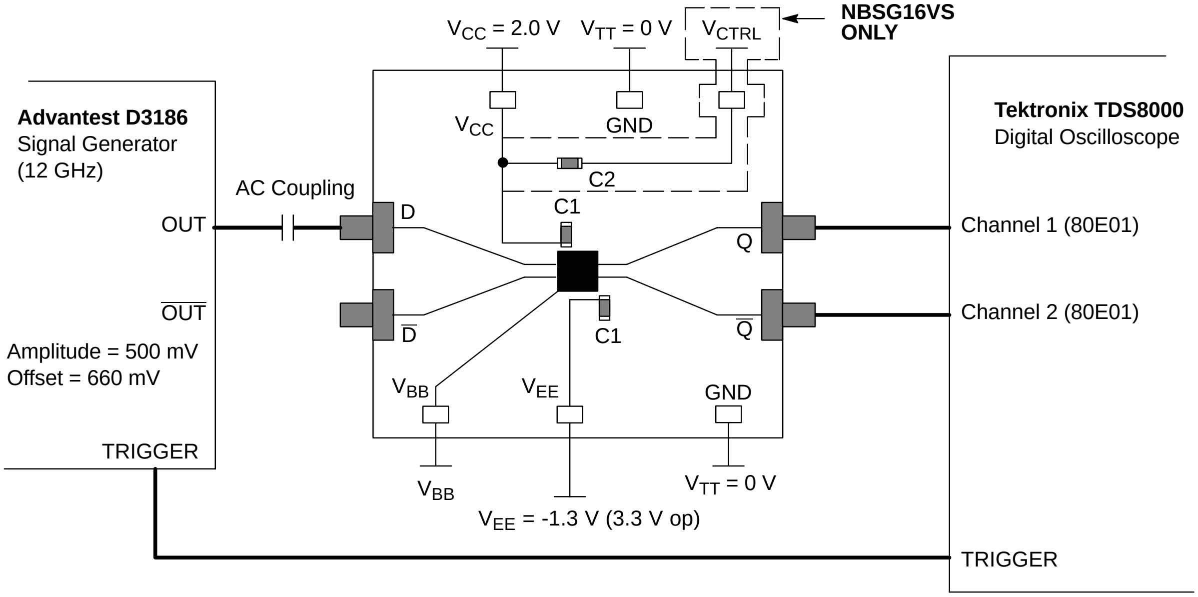
3c: Set the generator output for a PRBS data signal, or for a square wave clock signal with a 50% duty cycle.

Step 4:

Connect Output Signals

4a: Connect the outputs of the device (Q, $\overline{Q}$) to the oscilloscope. The oscilloscope sampling head must have internal 50 Ω 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 Ω resistor for best operation. Unused pairs may be left unconnected. Since V_{TT} = 0 V, a standard 50 Ω SMA termination is recommended.



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

Figure 3. NBSG16/16VS Board Setup - Time Domain (Single-Ended Mode)

Setup for Frequency Domain Measurements

Table 2. Basic Equipment

Description	Example Equipment (Note 4)	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 Ω Resistor Termination	Picosecond Model #5542-219	1
Matched High Speed Cables with SMA Connectors	Storm, Semflex	3
Power Supply Cables with Clips		3/4 (Note 5)

4. Equipment used to generate example measurements within this document.
5. An additional power supply cable with a surface mount clip is necessary to test the NBSG16VS due to the V_{CTRL} connection.

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.

NBSG16/16VS Power Supply Connections
3.3 V Setup
V_{CC} = 2.0 V (Two Places)
V_{TT} = GND (One Place)
V_{EE} = -1.3 V (One Place)

NBS/16VS Only Power Supply Connection
3.3 V Setup
V_{CTRL} (One Place)

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_{IHCMR} 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. 2b: Set input level to –35 dBm at the output of the 180° 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 dBm (500 mV) at the input of DUT.
Step 3:	**Output Setup** 3a: Set display to measure S21 and record data.

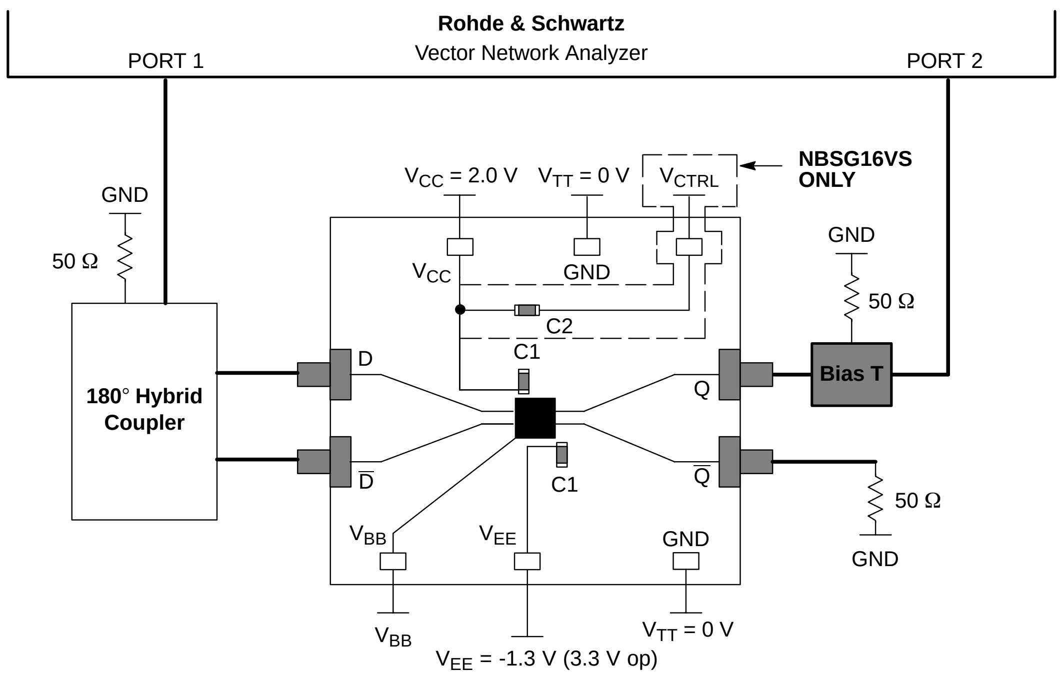


Figure 4. NBSG16/16VS Board Setup – Frequency Domain (Differential Mode)

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 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 dBm (500 mV) at the input of DUT.
Step 3:	**Output Setup** 3a: Set display to measure S21 and record data.

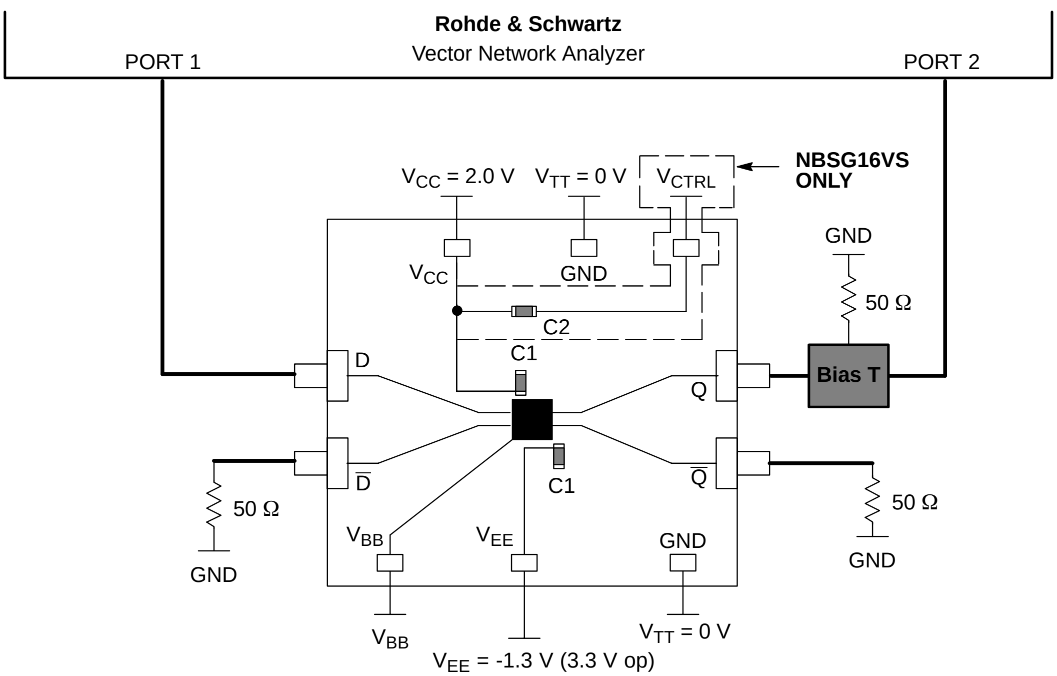


Figure 5. NBSG16/16VS Board Setup – Frequency Domain (Single-Ended Mode)

More Information About Evaluation Board

Design Considerations for >10 GHz operation

While the NBSG16/16VS 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

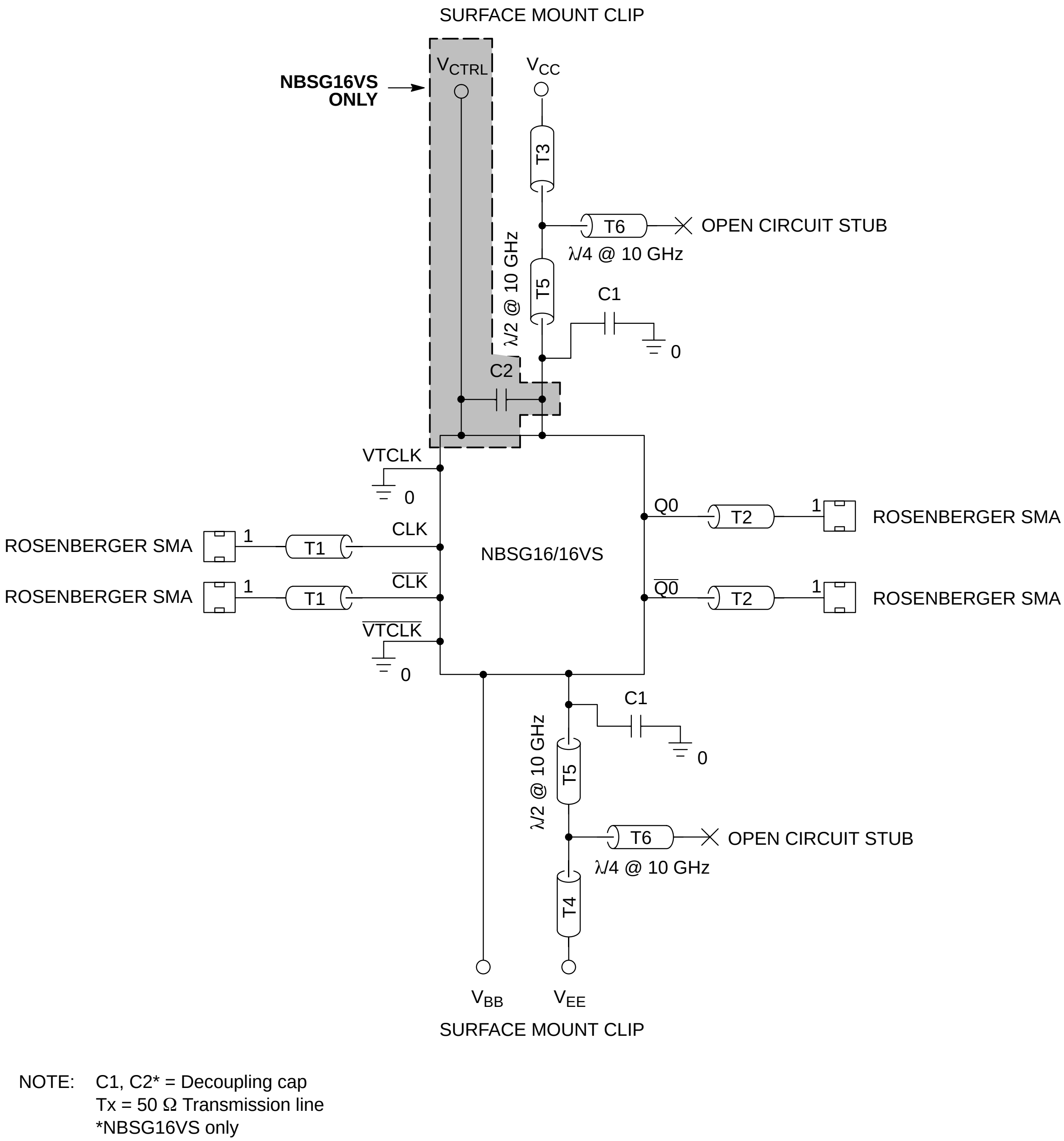


Figure 6. Evaluation Board Schematic

Table 3. Parts List

Part No	Description	Manufacturer	WEB address
NBSG16BA	2.5V/3.3V SiGe Differential Receiver/Driver with RSECL Outputs	ON Semiconductor	http://www.onsemi.com/NBSG16
NBSG16VS	2.5V/3.3V SiGe Differential Receiver/Driver with Variable Output Swing	ON Semiconductor	http://www.onsemi.com/NBSG16VS
32K243-40ME3	Gold plated connector	Rosenberger	http://www.rosenberger.de
CO6BLBB2X5UX	2 MHz – 30 GHz capacitor	Dielectric Laboratories	http://www.dilabs.com

Table 4. Board Material

Material	Thickness
Rogers 6002	5 mil
Copper Plating	32 mil

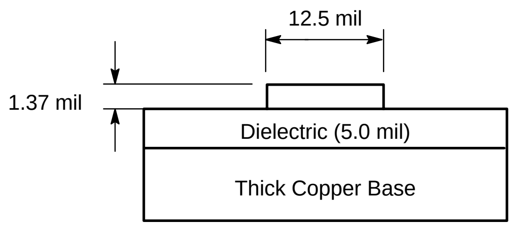


Figure 7. Board Stack-up

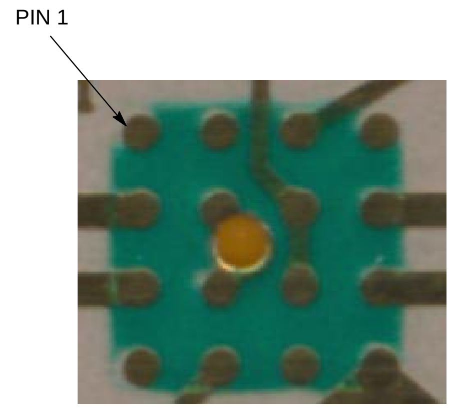
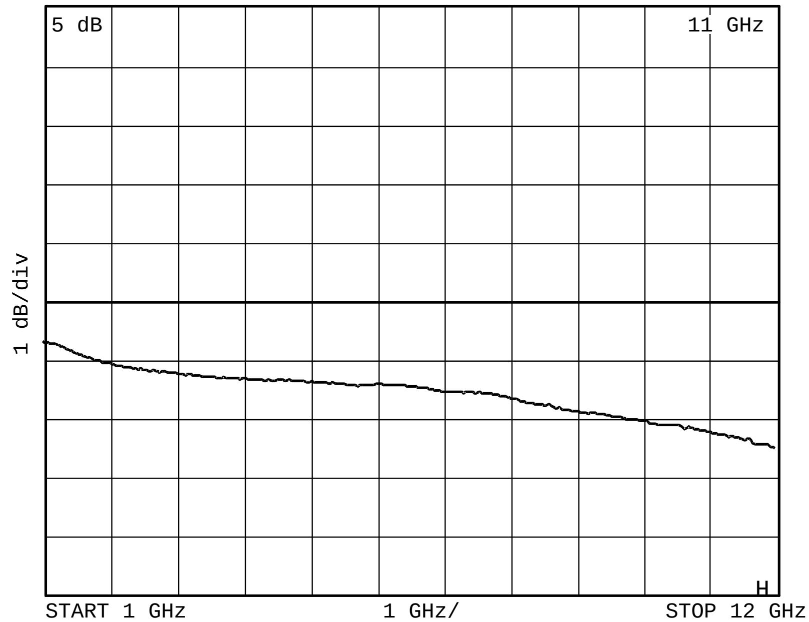


Figure 8. Layout Mask for NBSG16/16VS



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

Figure 9. Insertion Loss

EXAMPLE MEASUREMENTS IN FREQUENCY DOMAIN (V_{CC} – V_{EE} = 3.3 Volts)

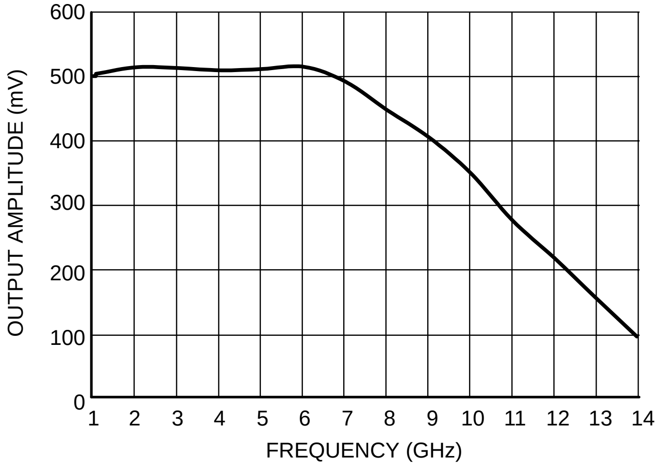


Figure 10. Fmax - Amplitude vs. Frequency (NBSG16: V_{CC} - V_{EE} = 3.3 V @ 25°C)

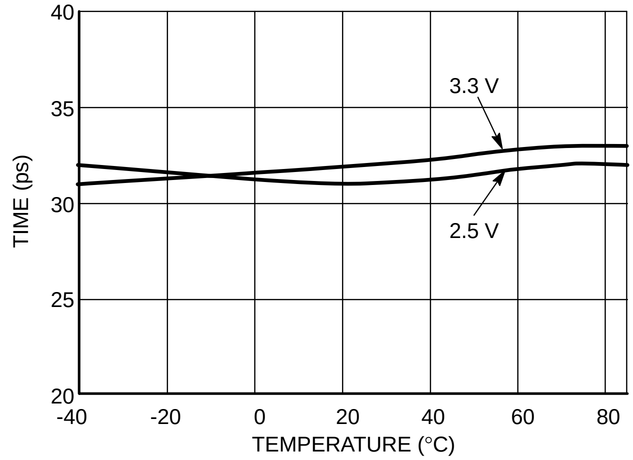


Figure 11. NBSG16 T_r vs. Temperature and Supply Voltage

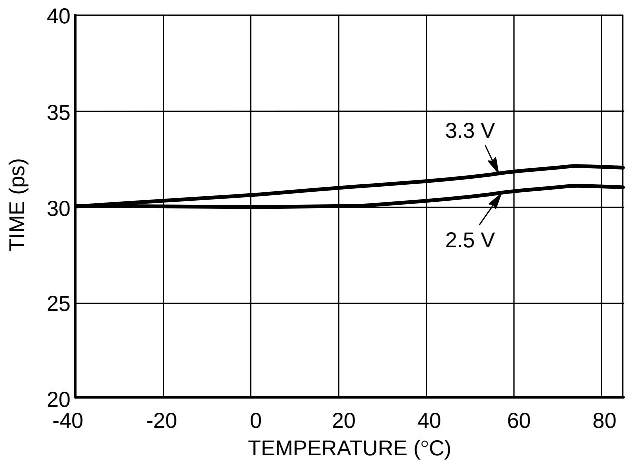


Figure 12. NBSG16 T_f vs. Temperature and Supply Voltage

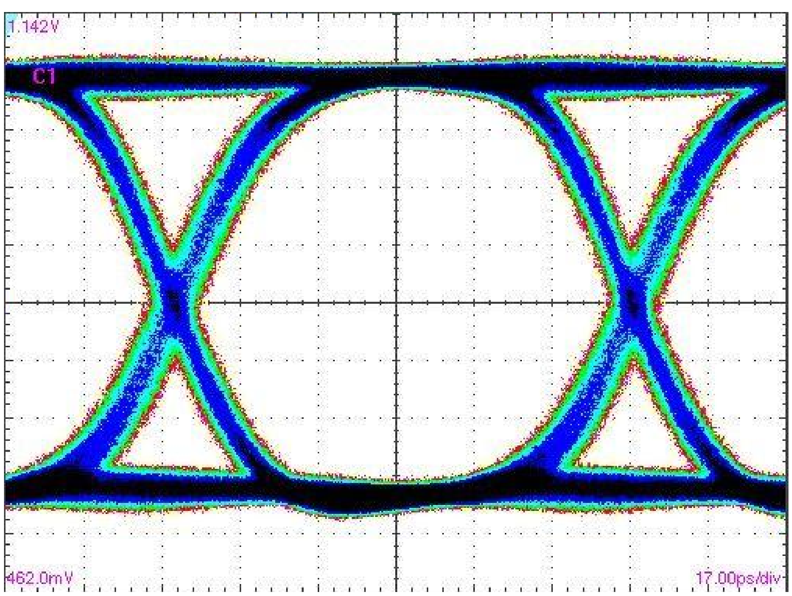


Figure 13. NBSG16: Eye Diagram at 10 Gbps with PRBS 2^31-1 (total Pk-Pk system jitter including the signal generator is 15 ps)

Figure 14. NBSG16: Small Signal Gain (S21) Q0-Q1B

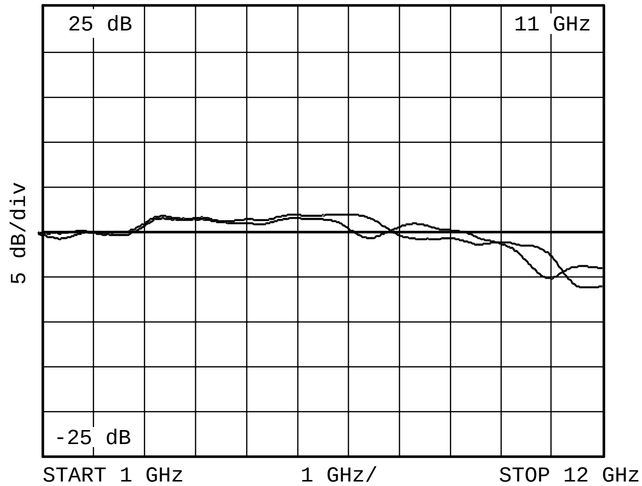


Figure 15. NBSG16: Large Signal Gain (S21) Q0 – Q1B

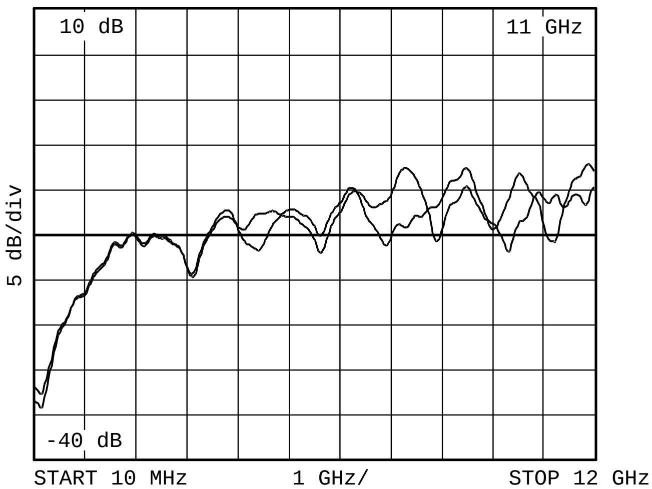


Figure 16. NBSG16: D, DB Return Loss (S11) Q – QB

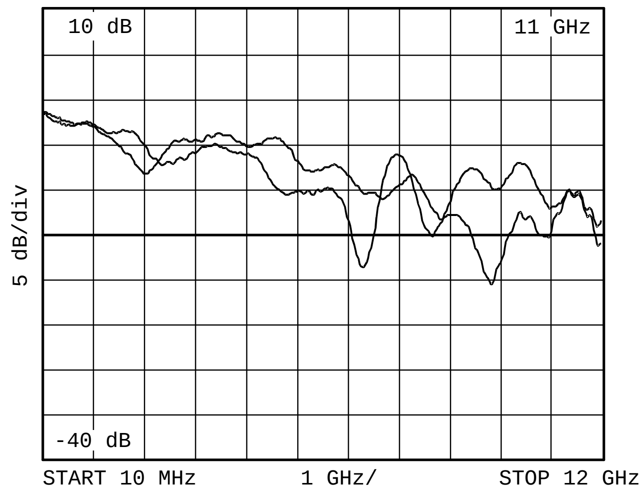


Figure 17. NBSG16: Return Loss (S22) Q - QB

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

NBSG16/D, Data Sheet, *NBSG16, 2.5V/3.3V SiGe Differential Receiver/Driver with RSECL Outputs*

NBSG16VS/D, Data Sheet, *NBSG16VS, 2.5V/3.3V SiGe Differential Receiver/Driver with Variable Output Swing*

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

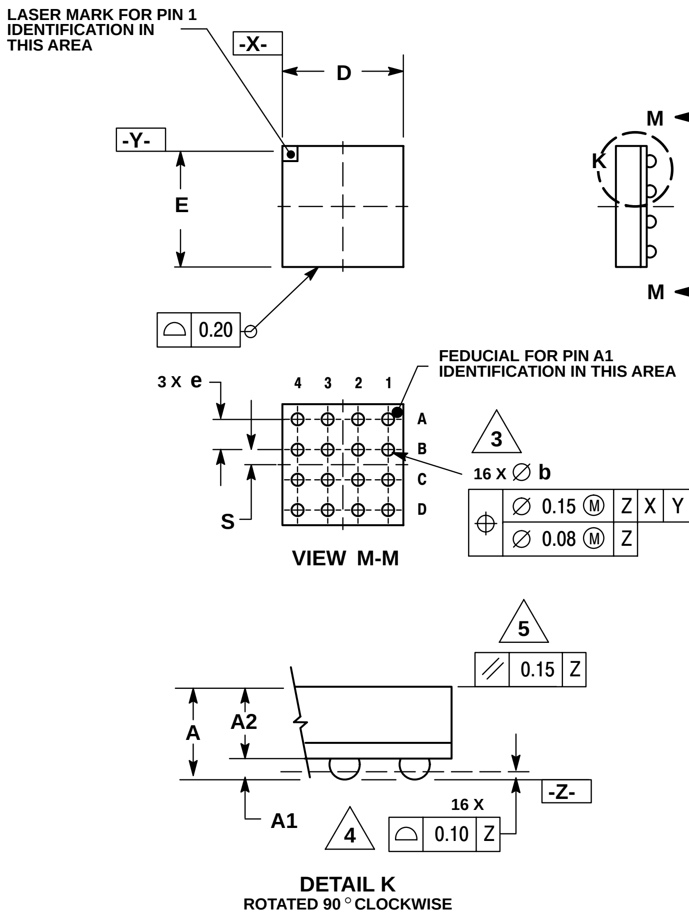
AND8075/D, Application Note, *Board Mounting Considerations for the FCBGA Packages.*

ORDERING INFORMATION

Orderable Part No	Description	Package	Shipping
NBSG16BA	2.5V/3.3V SiGe Differential Receiver/Driver with RSECL Outputs	4X4 mm FCBGA/16	100 Units/Tray
NBSG16BAR2	2.5V/3.3V SiGe Differential Receiver/Driver with RSECL Outputs	4X4 mm FCBGA/16	500 Units/Reel
NBSG16VSBA	2.5V/3.3V SiGe Differential Receiver/Driver with Variable Output Swing	4X4 mm FCBGA/16	100 Units/Tray
NBSG16VSBAR2	2.5V/3.3V SiGe Differential Receiver/Driver with Variable Output Swing	4X4 mm FCBGA/16	500 Units/Tray
NBSG16BAEVB	NBSG16 Evaluation Board		
NBSG16VSBAEVB	NBSG16VS Evaluation Board		

PACKAGE DIMENSIONS

FCBGA-16
BA SUFFIX
PLASTIC 4X4 (mm) BGA FLIP CHIP PACKAGE
CASE 489-01
ISSUE O



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO DATUM PLANE Z.
4. DATUM Z (SEATING PLANE) IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. PARALLELISM MEASUREMENT SHALL EXCLUDE ANY EFFECT OF MARK ON TOP SURFACE OF PACKAGE.

	MILLIMETERS	
DIM	MIN	MAX
A	1.40 MAX	
A1	0.25	0.35
A2	1.20 REF	
b	0.30	0.50
D	4.00 BSC	
E	4.00 BSC	
e	1.00 BSC	
S	0.50 BSC	

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: ONlit@hibbertco.com

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

JAPAN: ON Semiconductor, Japan Customer Focus Center
2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051
Phone: 81-3-5773-3850

ON Semiconductor Website: http://onsemi.com

For additional information, please contact your local Sales Representative.