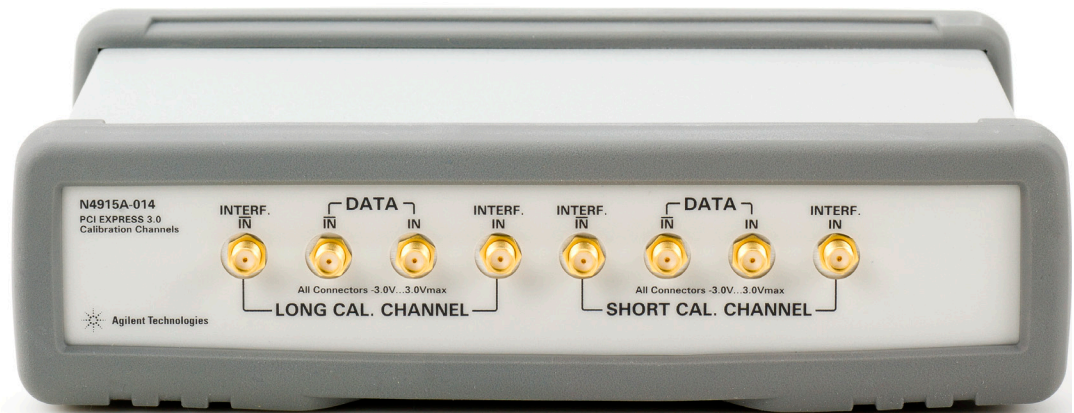




# Agilent N4915A-014

## PCI Express 3.0<sup>®</sup> Calibration Channels

Data Sheet Revision 1.0



### Features and Benefits

- Repeatable and accurate receiver stress conditions
- Compliant to PCI Express 3.0 base specification
- Provides short and long channel
- Sinusoidal Interference (S.I.) inputs
- Automated receiver tests supported by Agilent N5393C and N5990A test automation software
- Small size, rack mountable



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## PCI Express 3.0 Receiver Test

The PCI Express 3.0 base specification defines the receiver test requirements for chipsets and ASICs. In difference to previous standards, the receiver test is now “normative” (a “must”), and no longer informative (“optional”). When transmitting 8 GT/s over FR4 PC board material the signal distortions become significant. PCIe 3.0 compliant receivers have to tolerate a certain eye closure while ensuring the bit error ratio remains  $<10^{-12}$ .

## Accurate Receiver Tolerance Testing for PCI Express 3.0

Agilent offers test equipment which provides repeatable and accurate receiver voltage stress and jitter tolerance testing. The setup includes J-BERT N4903B, the N4916B de-emphasis signal converter, N4915A-014 PCIe 3.0 calibration channels, 81150A/81160A pulse function generator as interference source, Infiniium 90000 X-Series oscilloscopes for stress calibration and N5990A test automation software.

## Accurate Stress Calibration

The N5990A-101 test software for PCIe receivers automates the stress calibration procedure. This includes capturing signals with a real-time oscilloscope at an accessible test point (TP2) and constructing the eye opening as seen inside the receiver at TP2P (for reference see PCIe 3.0 base specification chapter 4.3.4.4.1; figure 4.71 ) by post-processing the package model, CTLE (continuous time linear equalizer), receiver’s clock recovery, DFE (decision feedback equalizer) and limiting amplifier.

## Higher R&D Efficiency by Automating Stressed Jitter and Voltage Tests

Besides the stress calibration, the N5990A-101 software provides automated receiver testing for all revisions of PCIe specifications. Users can pick the tests from the user interface, add margins if desired, get guidance for instrument cabling, and the software controls all connected test instruments used in the setup. Compliance and characterization tests are supported and test reports can be exported.

## Repeatable Stress Conditions with PCIe 3.0 Calibration Channels

The N4915A-014 PCIe 3.0 calibration channels allow reproducing the worst-case channel conditions (PC-board traces in the real world) that a PCIe 3.0 compliant receiver will have to tolerate. A detailed description is available on the following pages.

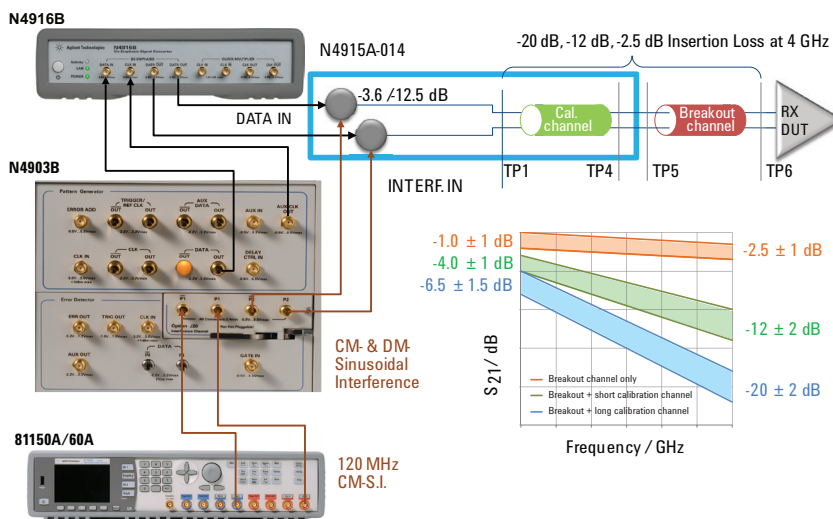


Figure 1. PCI Express 3.0 receiver test setup (according to base specification)

## N4915A-014 PCIe 3.0 Calibration Channels

The N4915A-014 PCIe 3.0 calibration channels provide a long and a short channel. The insertion loss of the breakout channel (which has to be part of the custom test board) was taken into account during the design of the channels. The interference input allows adding the differential mode and common mode sinusoidal interference signal to the de-emphasized and jittered pattern stream.

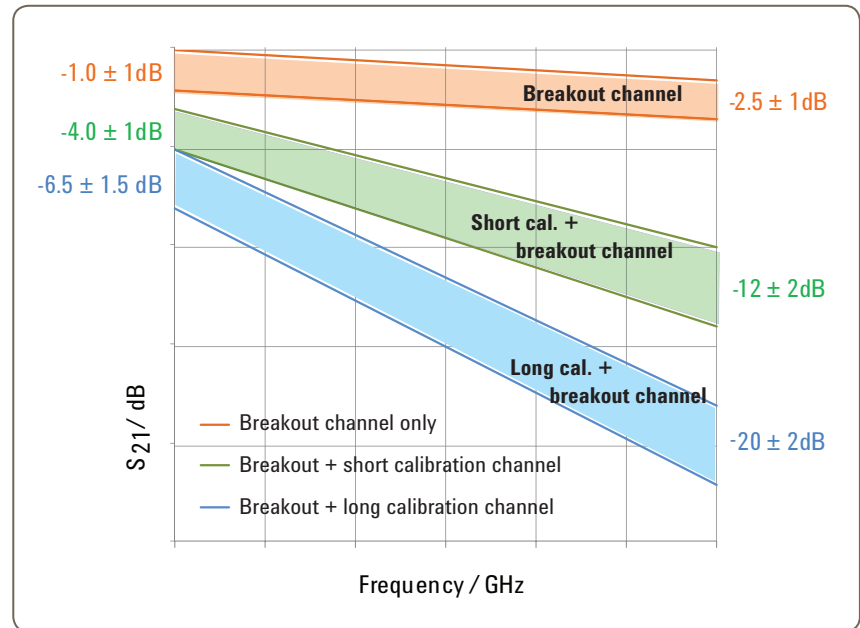


Figure 2. Insertion loss requirements according to PCI Express 3.0 base specifications

## Specifications for N4915A-014

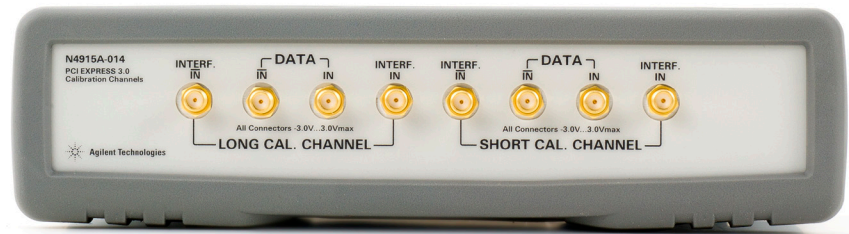


Figure 3. Front panel view of N4915A-014

Table 1. Specifications for N4915A-014

|  |   |
|--|---|
| Insertion loss short channel <sup>[1]</sup>  | -12 dB @ 4 GHz  |
| Insertion loss long channel <sup>[1]</sup>   | -20 dB @ 4 GHz  |
| Insertion loss accuracy  | < +/- 2 dB typical  |
| Return loss  | < -15 dB typical up to 8 GHz                                      |
| DC resistance between test point 1 (TP1) according PCIe 3.0 base specification) to Data Output (TP4) | 3.5 $\Omega$ typical (long), 2.0 $\Omega$ typical (short)         |
| Input level attenuation  | -12.5 dB typical for INTERFERENCE IN, -3.6 dB typical for DATA IN |
| Max. input voltage level   | -3.0 V to +3.0 V  |
| Interfaces   | differential, DC coupled, 50 $\Omega$                             |
| Connectors   | SMA, female   |
| Rear panel   | data output connectors  |

[1] includes breakout ("Replica") channel as shown in figure 1+2, cables from N4916B to DATA IN and from DATA OUT to TP5 and N4916B. PCIe 3.0 rev. 1.0 chapter 4.3.4.3.1 defines any HF loss caused by the generator and combiner and the connections between TP1 - TP3 and TP4 - TP5 that represent cabling are to be included in the  $S_{21}$  measurement.

Table 2. General characteristics for N4915A-014

|   |   |
|---|---|
| Operating temperature   | 0 to 55 °C                                |
| Storage temperature   | -40 to 70 °C                              |
| Operating humidity  | 95% relative humidity non-condensing      |
| Storage humidity  | 50% relative humidity                     |
| Physical dimensions bench top with bumper and connectors: (WxHxD) | 228 x 59 x 222 mm<br>(9.0 x 2.3 x 8.7 in) |
| Rack mount without bumper   | 1/2 x 19" width, 1U height                |
| Weight net  | 840 g (1.9 lb)                            |
| Weight shipping   | ~3 kg (~6.6 lb)                           |
| Warranty period   | 1 year                                    |
| Regulatory standards  | EMC: IEC 61326-1                          |

## Specification Assumption

The specifications in this document describe the instrument's warranted performance. All specifications are valid in a range from 5 °C to 40 °C ambient temperature. If not otherwise stated, all unused inputs and outputs need to be terminated with 50 Ω to GND. Non-warranted values are described as typical. All specifications, if not otherwise stated, are valid using J-BERT N4903B, N4916B, 81150A or 81160A, 15442A SMA cable set. *Values and descriptions in italic are preliminary.*



Figure 4. Rear panel view of N4915A-014

## Related Literature

| Title   | Publication Number |
|---|--------------------|
| Accurate Calibration of Receiver Stress Test Signals for PCI Express® rev. 3.0 Application Note | 5990-6599EN        |
| J-BERT N4903B Data Sheet  | 5990-3217EN        |
| N4916B De-emphasis Signal Converter Data Sheet  | 5990-4630EN        |
| N5990A Test Automation Software Data Sheet  | 5989-5483EN        |
| N5393C PCIe3.0 Test Software Data Sheet   | 5989-1240EN        |
| 81150A/60A Pulse Function Arbitrary Noise Generator Data Sheet                                  | 5989-6433EN        |

## Ordering Information

| Model Number | Description   |
|--------------|---|
| N4915A-014   | PCI Express 3.0 calibration channels (includes: four 50 $\Omega$ terminations, SMA) |
| 15442A       | Four SMA cables, two sets are recommended to pick pairs with matched skew.          |
| E5810A-100   | Rack-mount kit  |

For PCIe 3.0 receiver test according base specification the following instrument and software configurations and accessories are recommended:

| Model Number              | Description   |
|---------------------------|---|
| N4903B-C13 -J10 -J11 -J20 | J-BERT high-performance serial BERT with jitter sources           |
| N4916B                    | De-emphasis signal converter                                      |
| N4915A-010                | Matched cable pair for connecting N4916B to J-BERT                |
| 81150A-002 or 81160A-002  | Pulse function generator  |
| DSAX91604A                | Oscilloscope with 13 GHz or higher bandwidth                      |
| 1169A                     | Infinimax 12 GHz probe system                                     |
| N5380A                    | Probe head for Infinimax II, 1160 series                          |
| N5380-64701               | SMA Probe Head Support  |
| N5465A                    | InfiniiSim for de-embedding                                       |
| E2688A                    | Serial Data Analysis  |
| N5393C                    | PCIe 3.0 TX test application software for scope (optional)        |
| N5990A-010 -101           | PCIe 3.0 receiver test automation SW                              |
| N5990A-301                | PCIe 3.0 link training suite (optional, for CEM test recommended) |
| N4871A                    | Three matched SMA cable pairs to connect 81150A/81160A            |
| 15442A                    | Two sets of four SMA-to-SMA cables unmatched                      |
| 15443A                    | One SMA (m) to SMA (m) matched cable pair, $\pm 25$ ps, 1 m       |
| 1250-2015                 | Two BNC-to-SMA adapters (for 81150A/81160A)                       |

For PCIe 3.0 receiver test according card electromechanical specification (rev. 0.9) the following accessories are recommended:

| Model Number  | Description   |
|---------------|---|
| PSPL5340-10dB | Asymmetrical power splitters 10 dB (for adding S.I. to N4916B outputs)                |
| N4880A        | Reference clock multiplier (only for main board test to use J-BERT in ext.clock mode) |
| Pci-sig       | PCIe 3.0 CBB and CLB  |



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