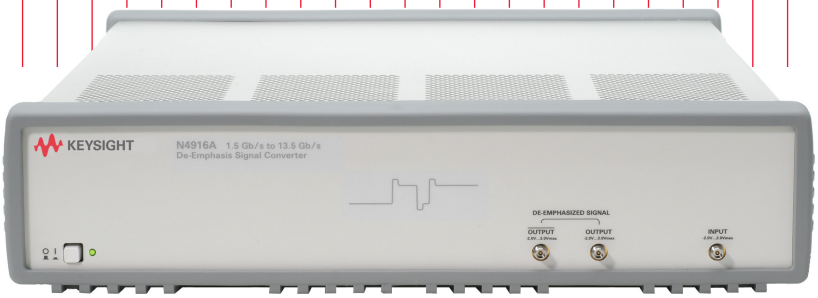
# Keysight N4916A
# De-Emphasis Signal Converter

Data Sheet

Version 1.1




KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

# De-Emphasis Signal Injection Enables Robust Receiver and Board Designs:

- Industry-first de-emphasis signal converter
- Variable de-emphasis post-cursor up to 12 dB in 0.1 dB steps
- Differential outputs
- Supports data rates up to 13.5 Gb/s
- Convenient operation with integrated user interface for the Keysight J-BERT N4903A and the 81141/81142A serial pulse data generators
- Worst-case testing with jitter feed-through capability
- Simple upgrade for installed Keysight Technologies, Inc. equipment

# Industries First De-Emphasis Signal Converter

## Robust Receiver Designs

The Keysight N4916A de-emphasis signal converter enables design and test engineers to accurately characterize gigabit serial ports and channels that operate with de-emphasized signals. This results in more robust receiver designs, with reliable operation in real PC board environments.

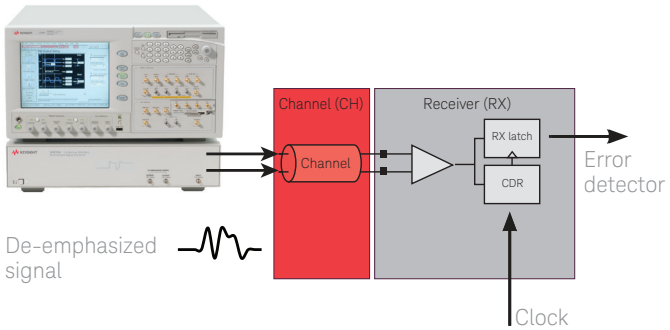



Figure 1. The de-emphasis signal converter allows emulating a transmitter by varying the de-emphasis in a wide range. This enables to check if the receiver works properly with a real–world channel that generates ISI (Inter Symbol Interference) effects. Alternatively injecting de-emphasized signals allows minimizing the ISI effects caused by the test board environment, helpful when testing receivers with most ideal inputs signal conditions.

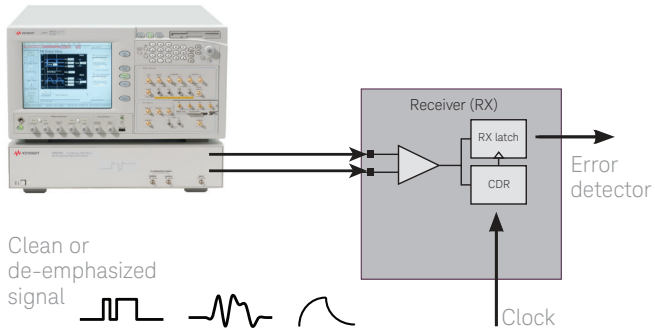



Figure 2. When the receiver is tested directly, the de-emphasized signal can be used to characterize if the receiver works properly with over- and under-compensation of channel effects. Jitter can be added on top for worst case stress testing of the receiver port.

De-emphasis is a commonly used technique for transmitting electrical signals at gigabit data rates to compensate for signal degradations caused by printed circuit boards, e.g. by mother-boards, add-in cards or backplanes.

The most popular high-speed electrical standards require transmitter de-emphasis, sometimes also called pre-emphasis. These standards are: PCI Express®, SATA 3 Gb/s, fully buffered DIMM, CEI, and 10 Gb Ethernet.

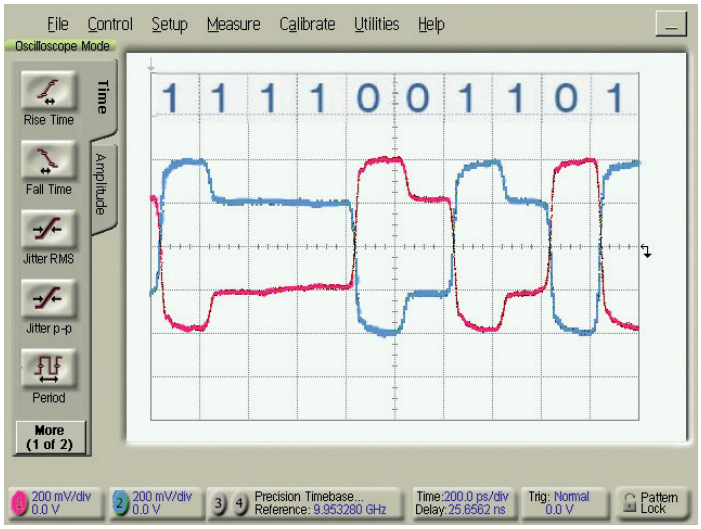



Figure 3. De-emphasized differential signal generated with the N4916A and the J-BERT N4903A at 5 Gb/s data rate, 400 mV, 6 dB de-emphasis. Screen shot captured with an Keysight 86100C DCA-J with 70 GHz remote sampling module 86118A.

# User Interface

The N4916A de-emphasis signal converter can be controlled from the graphical user interface of the J-BERT N4903A high-performance serial BERT and the 81141A/81142A serial pulse data generators.

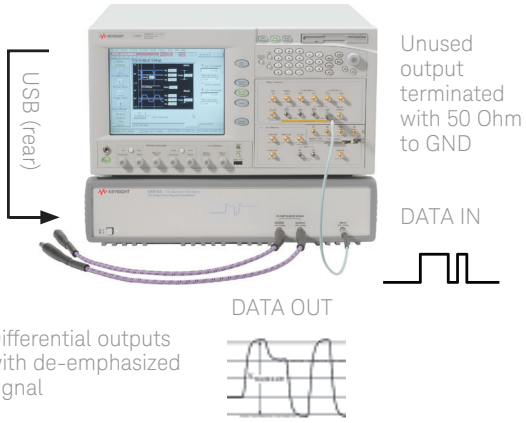



Figure 4. A configuration example for generating a differential de-emphasis signal when controlling the N4916A with the J-BERT N4903A.

The de-emphasis signal parameters can be controlled via the user interface of the Keysight J-BERT N4903A or 81141/81142A serial pulse data generators.

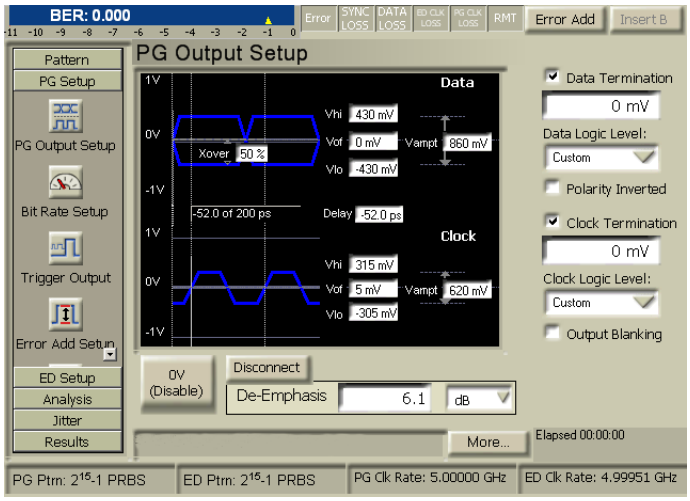



Figure 5. The de-emphasis amplitude can be set conveniently as dB or % value in the pattern generator output setup window.

# Specifications

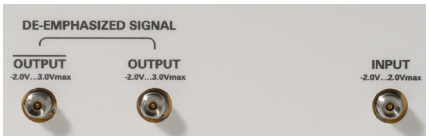



Figure 6. Front panel connectors of N4916A

## De-emphasized signal output (OUTPUT)

Table 1. Output characteristics. All timing parameters are measured at ECL levels.

| | |
|---|---|
| Range of operation | 1.5 to 13.5 Gb/s<br>(12.5 Gb/s max. with J-BERT N4903A) |
| Format | NRZ |
| Output amplitude | Single-ended: 100 mV to 0.8 V, 5 mV resolution<br>Differential: 200 mV to 1.6 V, 10 mV resolution |
| Output voltage window | –1.2 to +1.8 V if terminated to GND. Addresses PECL (3.3 V) terminated to +1.3 V, ECL terminated to –2 V, LVDS, CML. |
| De-emphasis amplitude ratio of post-cursor | 0 to 12.0 dB in 0.1 dB steps. Entry in dB or %. |
| Transition time | < 30 ps (20 to 80%) typical |
| Total jitter | < 30 ps peak-peak typical (with jitter injection disabled in J-BERT and 81141/81142A) |
| External termination voltage | –2 V to +3V[1] |
| Jitter feed-through | Yes |
| Interface | Differential or single-ended, DC-coupled, 50 Ω. Terminate unused output. |
| Connector | 2.4 mm, female |

1. For positive termination voltage or termination GND, external termination voltage must be less than 3 V below VOH. For negative termination voltage, the external termination voltage must be less than 2 V below VOH. The external termination voltage must be less than 3 V above VOL.

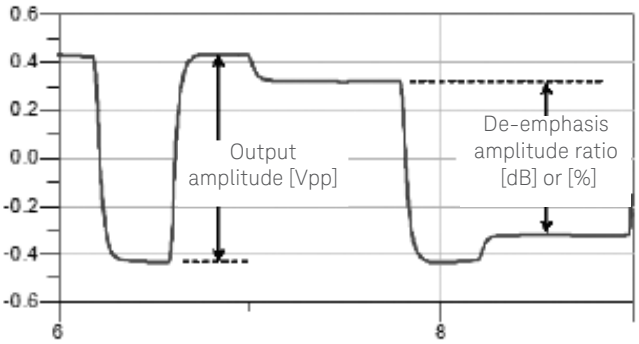



Figure 7. Definition of nominal output voltage and de-emphasis amplitude

## Data input (INPUT)

Signals have to be used from DATA OUT of the J-BERT N4903A or the 81141/2A serial pulse data generator. The unused output has to be terminated with 50 Ω to GND.

Table 2. Input characteristics

| | |
|---|---|
| Levels | Automatically handled by generator |
| Mark density of input pattern | 45 % to 55 % |
| Interface | Single-ended, DC-coupled, 50 Ω to Ground |
| Connector | 2.4 mm, female |

## General characteristics

Table 3. Mainframe characteristics

| | |
|---|---|
| Operating temperature | 5 to 40 °C |
| Storage temperature | –40 to + 70 °C |
| Operating humidity | 95 % relative humidity non-condensing |
| Storage humidity | 50% relative humidity |
| Power requirements | 100-240 Vac, ±10%,<br>50-60 Hz; 100-120 Vac,<br>±10%, 400 Hz. |
| Power consumption | 170 VA max. |
| Physical dimensions | Width: 426 mm<br>Height: 89 mm<br>Depth: 521 mm |
| Weight (net) | 10 kg |
| Weight (shipping max) | 12.5 kg |
| Sound power level | LWA < 55 dB (A) according to ISO 77795 |
| Recommended re-calibration period | 1 year. See order instructions for calibration services. |

## Rear panel connectors

USB 2.0, power

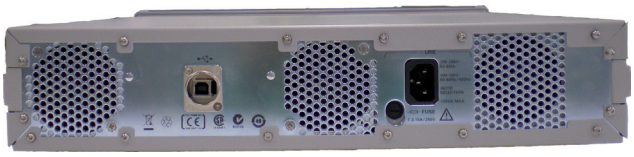


Figure 8. Rear panel of the N4916A

## Remote Control Interfaces

Via USB 2.0 to the controlling instruments N4903A or 81141/2A. These offer GPIB (IEEE 488), LAN, and USB 2.0

## Remote Control Languages

SCPI or via the web server of the Keysight J-BERT N4903A or the 81141/2A.

## Regulatory Standards

### Safety

IEC 61010-1:2001; EN 61010-1:2001;
CAN/CSA-C22.2 No. 61010-1-04; ISA – 82.02.01: 2004
UL 61010-1: 2004

### EMC

IEC 61326-1:1997 + A1: 1998;
EN 61326-1:1997 + A1: 1998

## Quality Management

ISO 9004, ISO 14000

## Software Control

These software revisions are a pre-requisite to control the N4916A de-emphasis signal converter:

- J-BERT N4903A requires SW revision 4.8 or later.
- 81141/2A requires SW revision 4.8 or later.

See **www.keysight.com/find/n4916** for software downloads.

## Specification Assumption

The specifications in this document describe the instrument's warranted performance. Non-warranted values are described as typical. All specifications are valid in a temperature range from 5 to 40 °C ambient temperatures after a warm-up phase of 30 minutes. If not otherwise stated, all inputs and outputs need to be terminated with 50 Ω to Ground. All specifications, if not otherwise stated, use the recommended cable set N4910A (2.4 mm, 24" matched pair) and the N4915A-004 2.4 mm cable from the generator output to the de-emphasis signal converter input.

# Order Instructions

## De-emphasis signal converter N4916A

Includes one 50 Ω termination (SMA), one 2.4 mm to SMA adapter, a USB cable, a commercial calibration report and certificate ("UK6"), and a getting started guide.

## Calibration

| | |
|---|---|
| Calibration services | R1282A |

## Productivity assistance

| | |
|---|---|
| Remote or on-site Productivity assistance | R1380-N49xx PS-S20 and PS-S20-02 |

## Recommended accessories

| | |
|---|---|
| One 2.4 mm cable (m-m) | N4915A-004 |
| 2.4 mm cable kit (matched pair) | N4910A |
| Rack mount kit | 81110A-1CM |

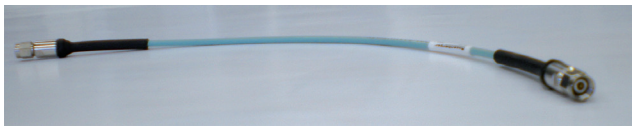


Figure 9. 2.4 mm cable N4915A-004 for connecting N4916A

| Related Literature | Publication Number |
|---|---|
| *J-BERT N4903A,* Data Sheet | 5989-2899EN |
| *81141/2A Serial Pulse Data Generator*, Data Sheet | 5989-3052EN |
| *De-emphasized Signal Generation with the Keysight N4916A De-Emphasis Signal Converter,* Product Note | 5989-7193EN |

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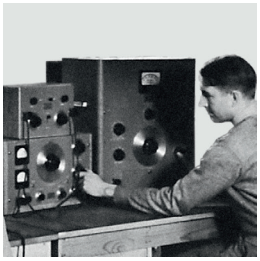

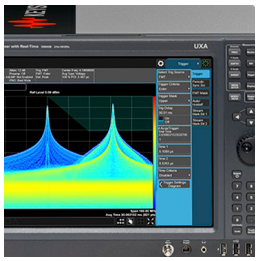

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