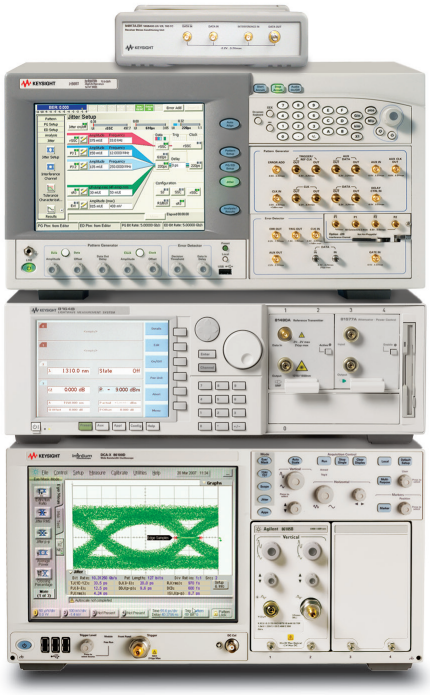
Keysight Technologies N4917A
Optical Receiver
Stress Test Solution

Data Sheet Version 1.3
New: Extension to 8G Fibre Channel

KEYSIGHT
TECHNOLOGIES

Repeatable optical receiver stress tests according to 10GbE IEEE 802.3ae, 8GFC and 10GFC standards

- Targets 10 GbE -LR/ -ER / -SR, 8GFC, 10GFC
- One E/O reference transmitter for 1310 nm and 1550 nm, single mode and one for 850 nm, multi mode
- One O/E reference receiver for 750 nm to 1640 nm, single mode and multi mode
- Data rates at standard's target and up to 14.2 Gb/s in reference transmitter mode
- Automation and adjustments included in the software
- Conformance tests and characterization
- Adjustable ER, OMA, sinusoidal interference (SI), periodic jitter (PJ)
- Jitter tolerance and receiver sensitivity (BER vs OMA) result screens
- Repeatable results



Optical reference transmitter and receiver stress test solution

Optical Receiver Stress Test

The calibrated optical receiver stress test solution provides accurate signal stress for receiver tolerance and compliance testing. It is available for the popular standards of 10 Gb Ethernet IEEE 802.3ae for -LR, -ER, -SR, and for 8G and 10G Fibre Channel. The parameters of ER, OMA, SI and PJ are calibrated and can be dialed so VECP and total jitter are be precisely set.

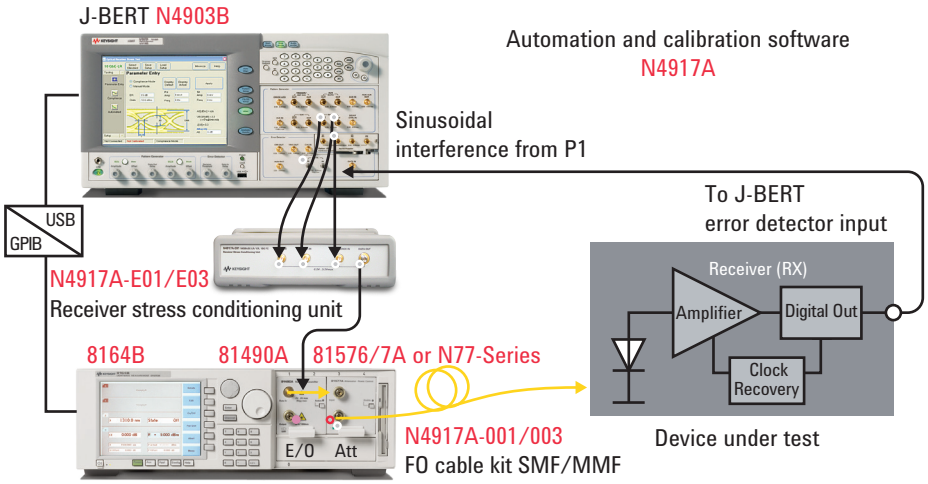


Figure 1. Optical receiver stress test setup for 10GbE and 10GFC standards

The stress signal is generated from the J-BERT N4903B with help of the N4917A-E01 receiver stress conditioning unit. The output of the N4917A-E01/-E03 drives the 81490A optical reference transmitter, which connects to the 81576A or N77-Series optical attenuator. The output of the optical attenuator connects to the device under test (DUT). The DUT electrical output connects to the J-BERT N4903B error detector input.

This closes the loop for BER measurement, which is the base for the highest level measurements of receiver sensitivity or jitter tolerance. If the DUT output is available only as optical signal, the conversion of the optical signal for electrical BER measurement can be performed with the help of the 81495A reference receiver, which can be added to the setup, but is not mandatory.

Optical Receiver Stress Test

For 8GFC the receiver stress test setup is slightly different as shown in Figure 2. A compliant stress conditioning can be achieved with J-BERT's built-in ISI traces.

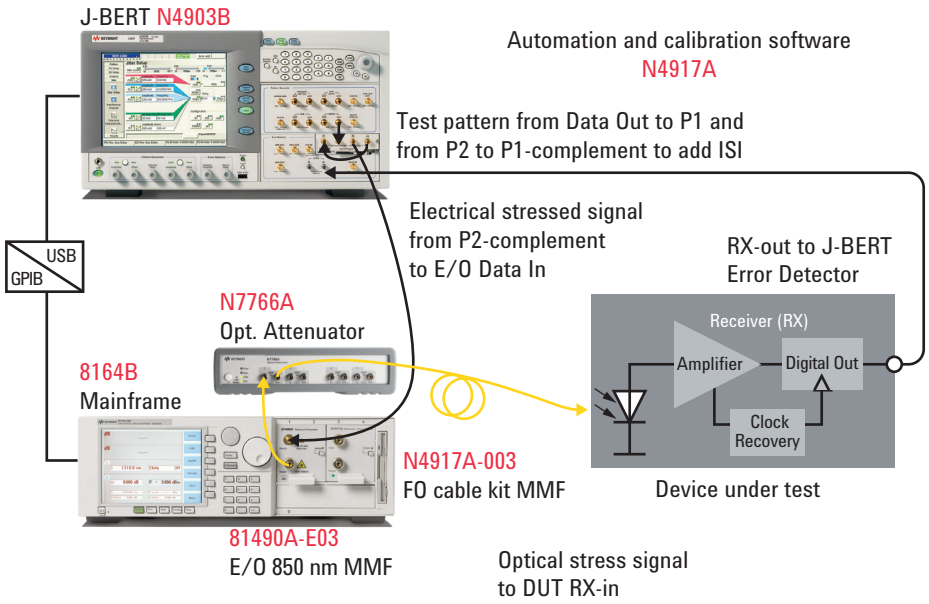


Figure 2. Optical receiver stress test setup for 8GFC

10 GbE/10GFC/8GFC stressed eye test signals

Table 1. Stressed eye signal impairment resources

	Stressed eye signal	Required	Notes
Jitter	Sinusoidal jitter (SJ) Random jitter (RJ)	Yes Optional	Provided by J-BERT N4903B
Amplitude impairments	Sinusiodal interference (SI) Intersymbol interference (ISI)	Yes Yes	Provided by J-BERT N4903B and N4917A-E01/ -E03 receiver stress conditioning unit

User Interface

The N4917A software runs on a PC with Windows® XP or Windows 7 (32 bit only). It controls the instrument setup over a USB to GPIB interface.

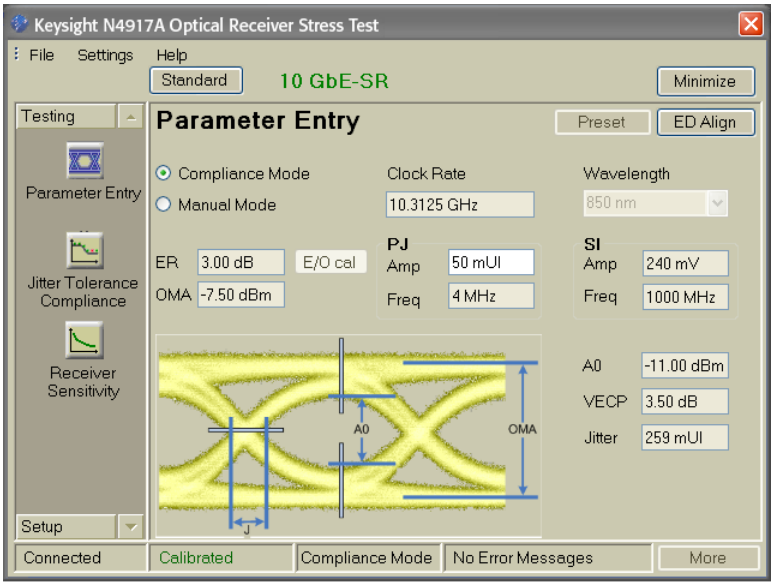


Figure 3. Parameter entry for ER, OMA, PJ and SI. For the defined standards the values for AO, VECP and total jitter will be displayed.

The user interface operates the instruments interactively, runs the compliance test automating various measurements (such as jitter tolerance) and controls the instrument's setup and calibration. Interactive operation lets the user vary the optical parameters using dials. The automated measurements provide the generation of a report file.

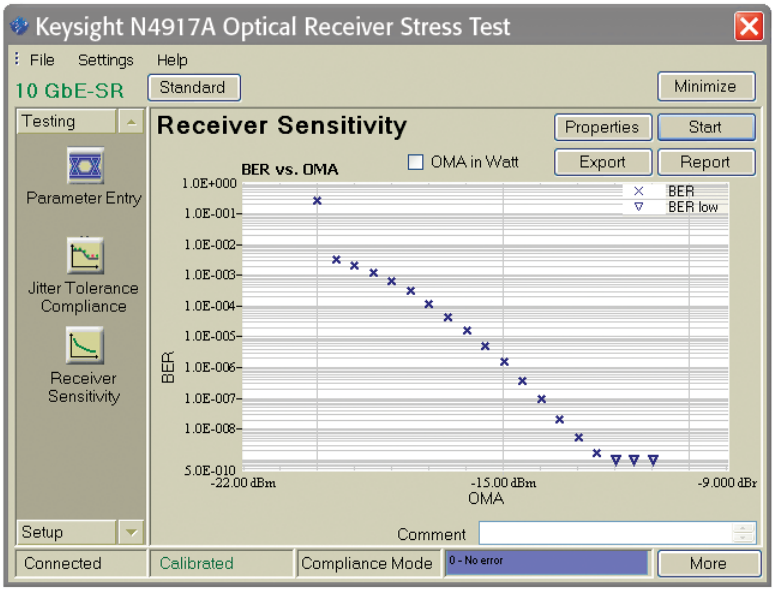


Figure 4. Jitter receiver sensitivity compliance measurement

Definitions

Optical receiver stress is defined by a compliance eye and a jitter tolerance curve (the standard calls it “mask”)

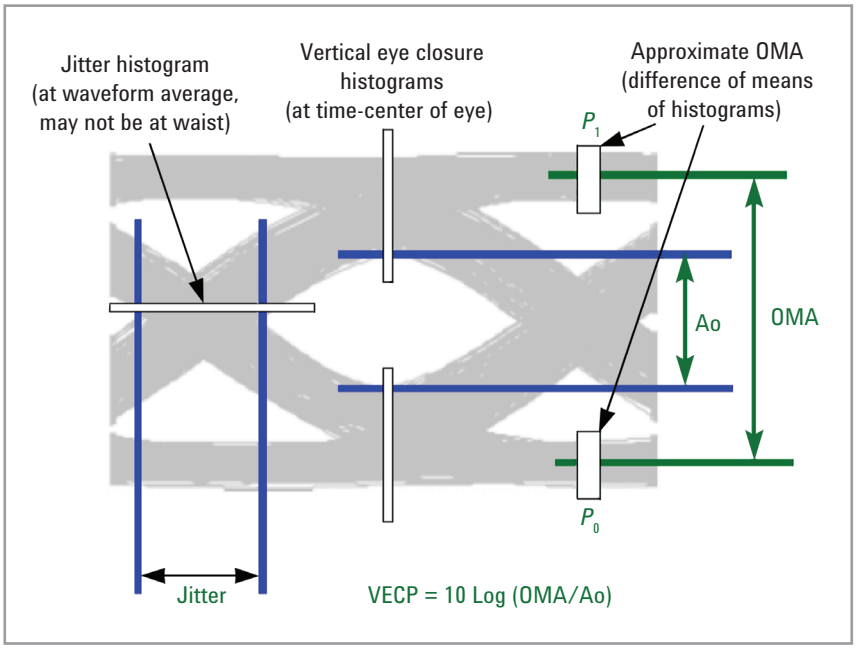


Figure 5. Compliance eye: definition of OMA, A0 and VECP according IEEE 802.ae, clause 52

Applied sinusoidal jitter peak-to-peak amplitude (UI)

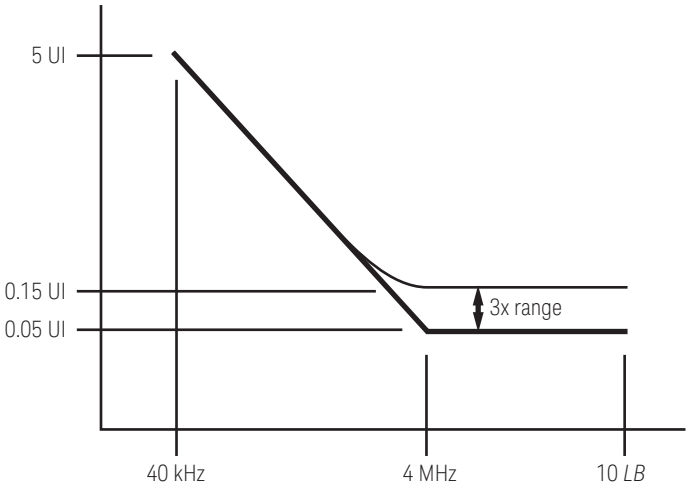


Figure 6. Jitter tolerance curve for 10 GBASE -LR/ -ER/ -SR and 10GFC

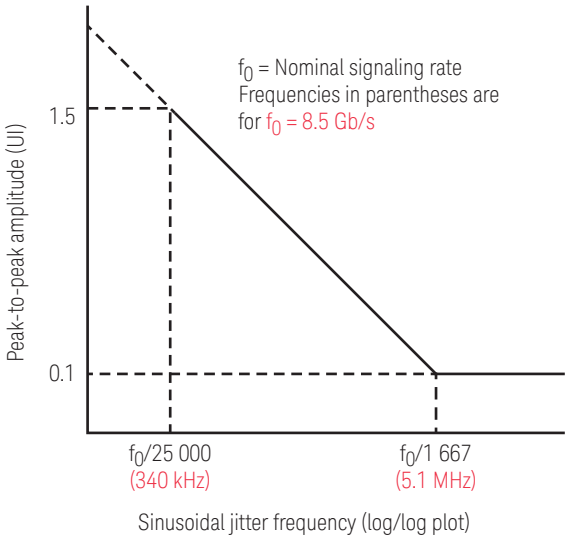


Figure 7. Jitter tolerance curve for 8GFC receiver test

Specifications

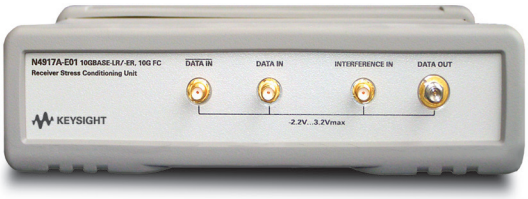


Figure 8. Front panel view of N4917A-E01 stress conditioning unit

Table 2. Receiver stress test solution

Optical wavelength	1310 nm and 1550 nm	850 nm
Optical fiber	Single-mode fiber (SMF) 9/125 µm	Multimode fiber (MMF) 50/125 µm
Extinction ratio	Adjustable from 1.5 to 10.0 dB @ 1310 nm, 1.5 to 7.5 dB @ 1550 nm	Adjustable from 1.5 to 7.5 dB @ 850 nm
OMA	Up to -5 dBm (0.32 mW)[1] @ ER = 3 dB, adjustable 0 to -60 dB by 0.01 dB	Up to -5 dBm (0.32 mW) @ ER = 3 dB, adjustable 0 to -35 dB by 0.05 dB
VECP from filter (no jitter added)	1.5 dB typical at ER = 3	2.0 dB typical at ER = 3
Eye mask margin, according to IEEE 802.3ae Clause 52 definition	0.15 UI typical	0.15 UI typical
Random jitter	1 ps rms typical	1.5 ps rms typical
Periodic jitter (PJ)	According Periodic and Sinusoidal Jitter of N4903B -J10	According Periodic and Sinusoidal Jitter of N4903B -J10
Sinusoidal interference (SI)	0 to 400 mV @ 500 MHz to 3.2 GHz, 1 MHz resolution; VECPmax 7 dB typical at ER = 3	0 to 400 mV @ 500 MHz to 3.2 GHz, 1 MHz resolution; VECPmax 7 dB typical at ER = 3
Repeatability of the sensitivity measurement	0.5 dB typical	0.5 dB typical

Footnote 1. Up to -0 dBm (1 mW) @ ER = 3 dB, adjustable 0 to -60 dB by 0.01 dB when using 86105B/D

Specification assumption

The specifications in this document describe the solution's warranted performance. Non-warranted values are described as typical. More specifications are available in the data sheets of the individual instruments (N4903B, 81490A, 81576A, N77-Series). All specifications are valid after a warm-up phase as specified for the individual instruments. If not otherwise stated, all electrical inputs and outputs need to be terminated with 50 Ω to ground. All specifications, if not otherwise stated, are using the recommended N4917A accessories.

For the verification of the specifications a 86100C/D wide- bandwidth oscilloscope with 86105B/C/D optical module is recommended. A PRBS pattern of 2^11-1 is recommended if not otherwise stated. For the measurement of ER the use of the extinction ratio correction factor is recommended [1]. For the measurement of OMA a pattern of ..1100.. is recommended. For the measurement of RJ the use of the 86107A precision timebase module is recommended, which is not mandatory for the N4917A setup.

Typical Signals Provided by the Optical Receiver Stress Test Solution

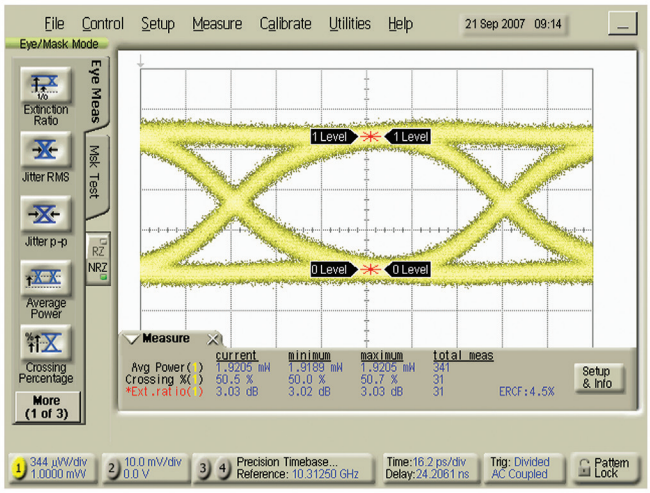


Figure 9. Eye diagram of the optical signal using the N4917A-E01 without any additional jitter added, measurement of ER and crossing point (PRBS 2^11-1 pattern)

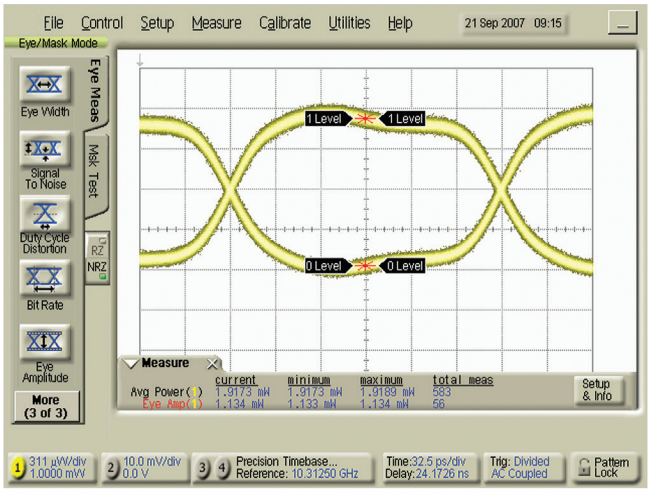


Figure 10. Eye diagram of the optical signal using the N4917A-E01 without any jitter added, measurement of OMA (..1100.. pattern)

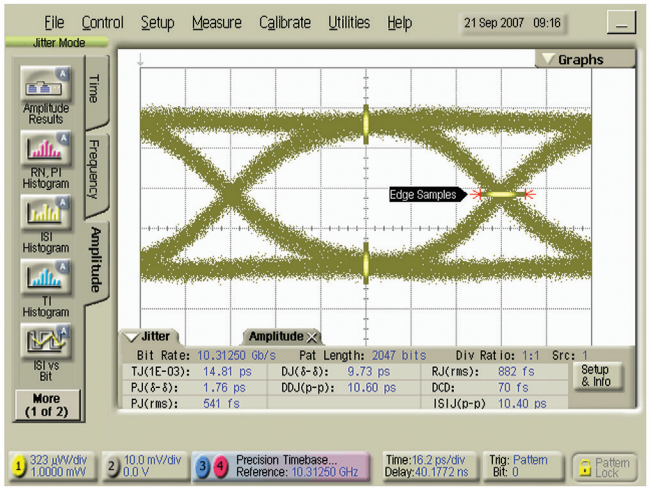


Figure 11. Jitter measurement of the optical signal using the N4917A-E01 without any jitter added (PRBS 2^11-1 pattern)

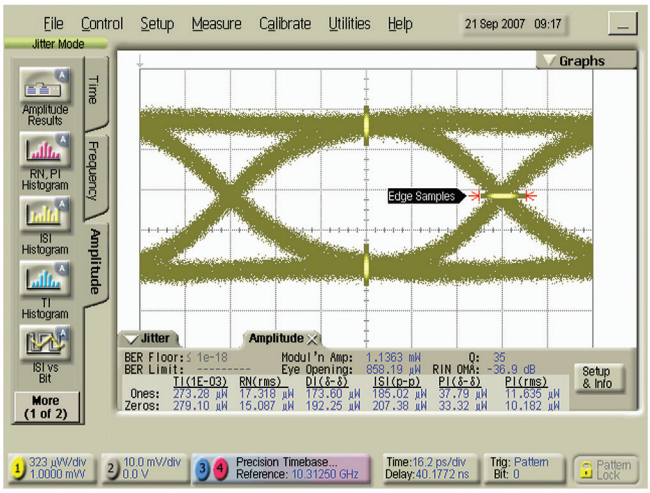


Figure 12. Amplitude measurement of the optical signal using the N4917A-E01 without any jitter added (PRBS 2^11-1 pattern)

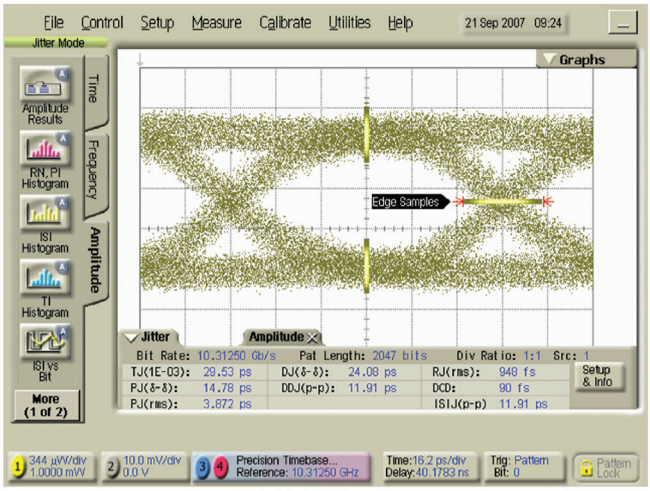


Figure 13. Jitter measurement of the optical signal using the N4917A-E01 with 50 mUI periodic jitter and sinusoidal jitter added for a VECP of 2.2 (PRBS 2^11-1 pattern)

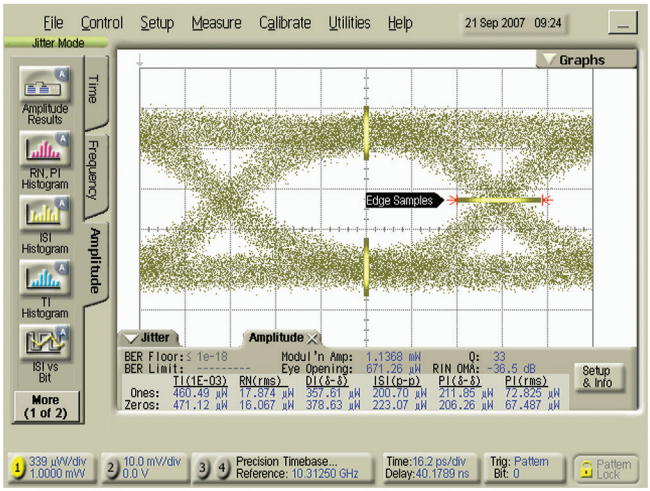


Figure 14. Amplitude measurement of the optical signal using the N4917A-E01 with 50 mUI periodic jitter and sinusoidal jitter added for a VECP of 2.2 (PRBS 2^11-1 pattern)

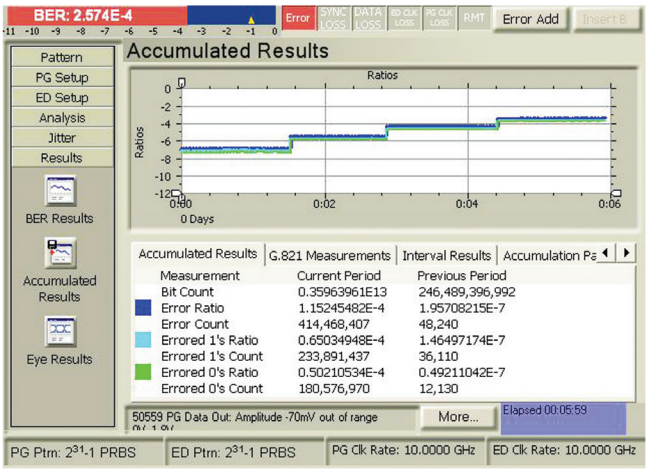


Figure 15. Short term stability: the OMA is varied that an actual DUT delivers finite BER, the measurement runs for 6 minutes and the BER is continuously recorded (x-axis is time, y-axis is BER)

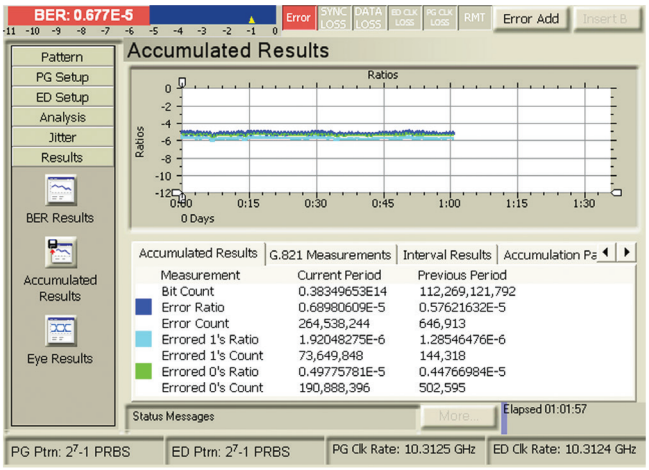


Figure 16. Long term stability: the OMA is set that an actual DUT delivers a BER = .6e-5, the measurement runs for 1 hour and the BER is continuously recorded (x-axis is time, y-axis is BER)

Optimization, Adjustments and DUT Configuration

The setup to run the N4917A software with the necessary accessories is described in Figure 17. The N4917A automation and calibration software provides adjustable parameters for ER, OMA, SI and PJ. At the standard compliance settings it displays the values for A0, VECP and the total jitter (TJ) according to the definition of IEEE802.3ae 2002 with help of an extrapolation from measured point gathered during a calibration process.

The software performs a cabling check, including an optimization for the phase matching of the differential data connection between N4903B data out and N4917A-E01 data in. This optimization is recommended the first time after setup, or whenever the cabling was removed. This cabling check is required for the 10GbE and 10GFC standards, for the 8GFC this check might be skipped by the user.

Beside the base points for the above parameters, it optimizes the operating point of the 81490A reference transmitter and it optimizes the crossing point of the optical signal for a minimum amount of duty cycle distortion (DCD).

The gathered information is stored in a file with reference to date and standard, which can be loaded any time later, multiple files can be generated, per default the latest is in use. Beside the optimization and the adjustments, the software stores in the second step the setup of the DUT.

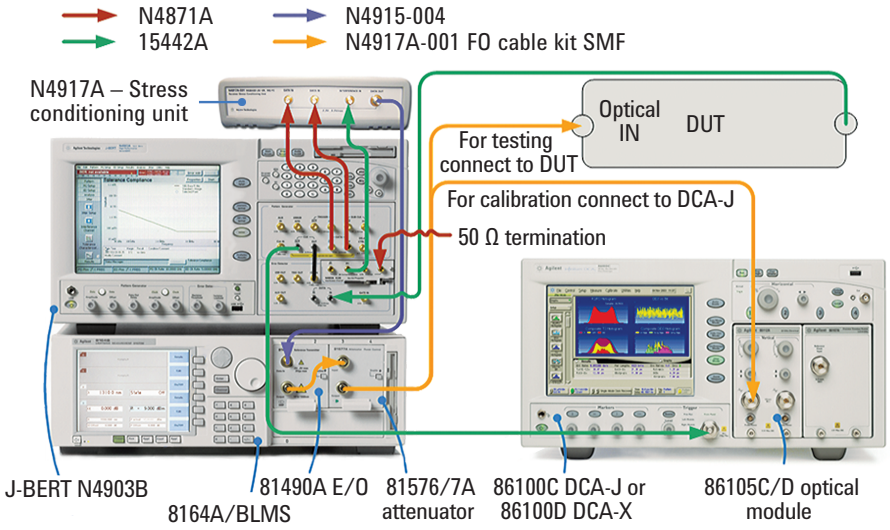


Figure 17. Setup for calibration including the recommended accessories for the 10GbE and 10GFC standards

Software/PC Requirements

N4917A software runs on an external PC/MS Windows XP or Windows 7 (32 bit only)

Requirements:
VGA (640 x 480), MS Windows XP operating system with SP2, Microsoft.NET Framework 2.0

Keysight IO Libraries Suite rev. 15.5 or later, Keysight N490X IVI - COM Driver 1.2.7

Interfaces: USB

Instruments firmware requirement:
N4903B rev 7.2 or higher
81600C rev. FW A10.01 or higher
86100D FW A 10.70
8164B rev. 5.25 or higher

Order Instructions

N4917A-001 Single mode fiber kit containing:
2x patch cords FC/PC - FC/PC single mode
1x patch cord LC/PC - FC/PC single mode
4x 81000FI connector interface FC/PC/SPC
1x 81000LI connector interface LC (DUT)

N4917A-003 Multimode fiber kit containing:
1x patch cord FC/PC - FC/PC multimode 50 µm
1x patch cord FC/APC - FC/PC multimode 50 µm
1x patch cord LC/PC - FC/PC multimode 50 µm
1x 81000FI connector interface FC/PC/SPC
1x 81000NI connector interface FC/APC
1x 81000LI connector interface LC (DUT)

N4917A-E01 Receiver stress conditioning unit and calibration and automation software CD ROM
10 Gb Ethernet - LR, - ER and 10 GFC

N4917A-E03 Receiver stress conditioning unit and software CD ROM
10 Gb Ethernet -SR and 8GFC (only for software)

Recommended accessories (not included in N4917A-E01/-E03):
1x 82357B USB/GPIB interface or 1x E5810A LAN/GPIB Gateway
3x 10833A/B GPIB cable, 1/2m
1x N4871A matched cable pair
1x 15442A four SMA cables
1x N4915A-004 2.4 mm cable
1x 8710-1765 torque wrench
1x 15442A four SMA cables (only for 8GFC; in addition for connecting N4903B-J20)

Order Instructions *continued*

Table 3. Recommended and supported instruments

Recommended instrument models and options	**1310/1550 nm (10GBase-ER,-LR, 10GFC)**	**850 nm (10GBase-SR, 8GFC)**
BERT	N4903B, -C13, -J10, -J12, -J20	
Stress conditioning unit with calibration and automation software	N4917A-E01	N4917A-E03 (SW 1.3 or higher for support of 8GFC)
E/O	81490A-135	81490A-E03
LMS mainframe	8164B	
Attenuator	81576A	N7766A-050
Oscilloscope mainframe	86100D-ETR, -200, -300	
Oscilloscope module	86105C-100, -200, -300	

Other usable instrument models and options	1310/1550 nm (10GBase-ER,-LR, 10GFC)	850 nm (10GBase-SR, 8GFC)
BERT	N4903A/B-CTR, -A01, -J11, -D14, -002, -A02	
LMS mainframe	8163A, 8164A, 8163B, 8166A, 8166B	
O/E	81495A-085	
Attenuator	81577A (the fibers with angled connectors are not provided with the N4917A-E01)	
	N7751A, N7752A, N7761A, N7762A, N7764A	N7768A
Oscilloscope mainframe	86100C-001,-200, -300, -201/-202	
Oscilloscope modules	86105B-101/ -102/ -103/ -111/ -112/ -113	
	86107A	
	86105D	

Not supported instrument models and options
N4903B -C07 -G07 -G13

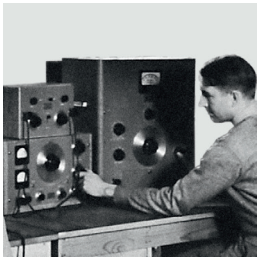
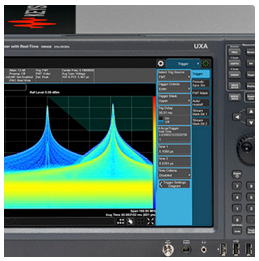
Productivity assistance:
Remote or on-site (R1380-N49xx)
Productivity assistance (PS-S20 and PS-S20-02)

Related Keysight Literature	Pub.No.
Improving the Accuracy of Optical Transceiver Extinction Ratio Measurements	5989-2602EN
Keysight J-BERT N4903B High-Performance Serial BERT with Complete Jitter Tolerance Testing Data Sheet	5990-3217EN
BERT Family Brochure	5988-9514EN
Keysight 86100C Wide-Bandwidth Oscilloscope Mainframe and Modules Data Sheet	5989-0278EN

Related Keysight Literature	Pub.No.
Keysight 86100D DCA-X Wide-Bandwidth Oscilloscope Data Sheet	5990-5824EN
Keysight 8163B Lightwave Multimeter, 8164B Lightwave Measurement System, 8166B Lightwave Multichannel System Data Sheet	5988-3924EN
Keysight 86105C High Sensitivity, Broad Wavelength Plug-In Module Data Sheet	5989-1604EN
Keysight 81490A Reference Transmitter 1310 & 1550 nm Data Sheet	5989-7326EN
Keysight 81495A Reference Receiver Data Sheet	5989-7526EN
Keysight N77-Series Attenuators Data Sheet	5990-4394EN

Evolving Since 1939

Our unique combination of hardware, software, services, and people can help you reach your next breakthrough. We are unlocking the future of technology.
From Hewlett-Packard to Agilent to Keysight.


myKeysight

myKeysight
www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

http://www.keysight.com/find/emt_product_registration
Register your products to get up-to-date product information and find warranty information.

KEYSIGHT SERVICES
Accelerate Technology Adoption.
Lower costs.

Keysight Services
www.keysight.com/find/service
Keysight Services can help from acquisition to renewal across your instrument's lifecycle. Our comprehensive service offerings—one-stop calibration, repair, asset management, technology refresh, consulting, training and more—helps you improve product quality and lower costs.

CALIBRATION UP TO 10 YEARS WARRANTY
ASSURANCE PLANS

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 11 2626
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-9-7-17)

DEKRA Certified
ISO9001 Quality Management System

www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2015
Quality Management System

KEYSIGHT TECHNOLOGIES

Published in USA, December 2, 2017
5989-6315EN
www.keysight.com