QUANTIFI PHOTONICS®

A Teradyne Company


# BERT

## 1100 SERIES
## NRZ AND PAM4 BERT/PPG

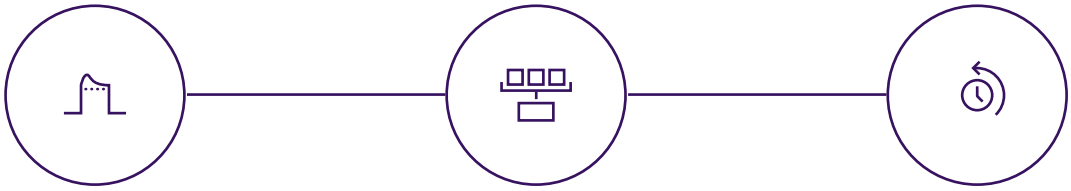
SPECIFICATION SHEET

AVAILABLE IN PXI

quantifiphotonics.com

Quantifi Photonics' BERT-1102 is an 8-channel PPG and Error Detector for the design, characterization and manufacturing test of optical transceivers and opto-electrical components with symbol rates up to 28 GBaud/s in both NRZ and PAM4 formats.

With scalability and exceptional signal fidelity, it is a cost-effective test solution for up to 400 Gb/s communication eco-systems.



### Programmable de-emphasis and CTLE processor

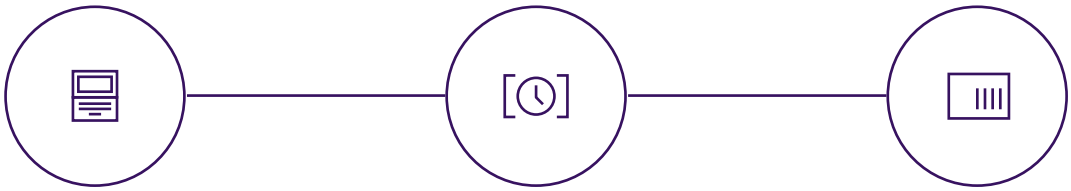
Programmable 7-tap PPG Tx de-emphasis and error detector receiver continuous-time linear equalizer (CTLE) allow the user to compensate for finite coaxial cable interconnect loss.

### Single platform testing

Conduct all your DUT characterization on one platform (optical and electrical testing can be integrated in PXIe) and spend less time switching cables and patchcords between instruments.

### Built-in clock recovery

Each error detect channel has its own independent, simultaneous, clock-and-data recovery (CDR); this makes BERT testing a versatile and easy-to-use instrument. There is no need for additional clock recovery hardware to run the Error Detector.



### Simple control with intuitive GUI

Save time and reduce complexity with the easy-to-use cohesionUI GUI. Control all channels and functions from its single panel interface (including all other Quantifi Photonics modules in the system from the same intuitive interface).

### Internal clock synthesizer

An integrated clock synthesizer is provided internally as part of the PPG for additional convenience and hassle-free operation. No external clock generator is required.

### Extremely high channel density in PXI

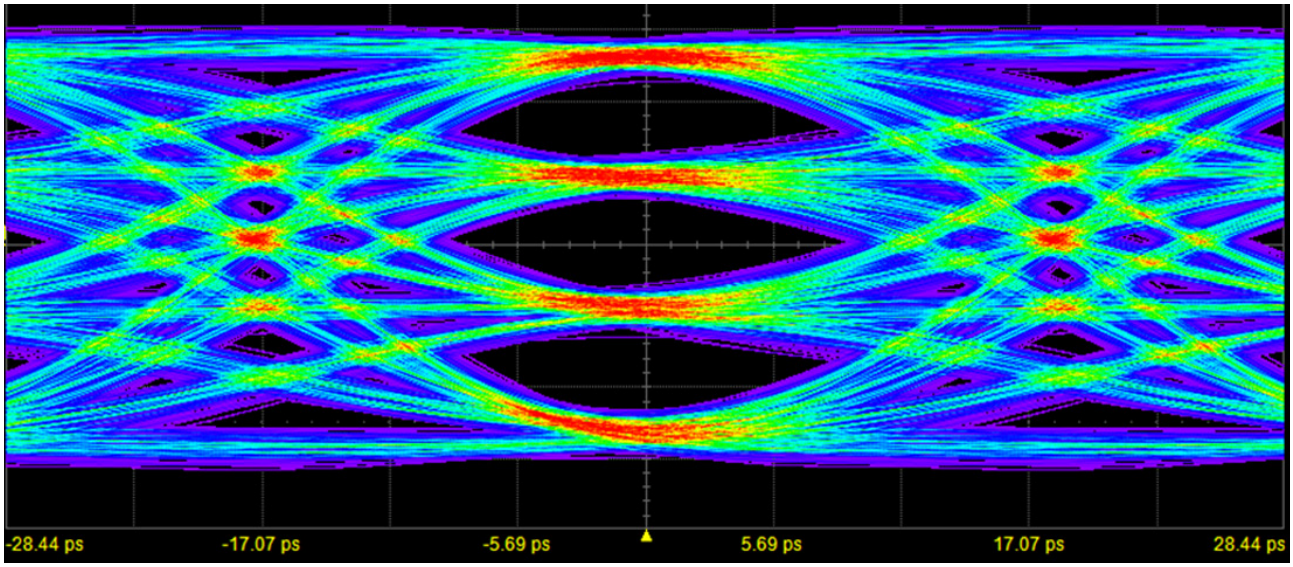
With 8-channels per two-slot PXIe module, fit up to 64 synchronized 28 GBaud channels (with either NRZ or PAM4 per channel) per single PXIe mainframe.

## TARGET APPLICATIONS

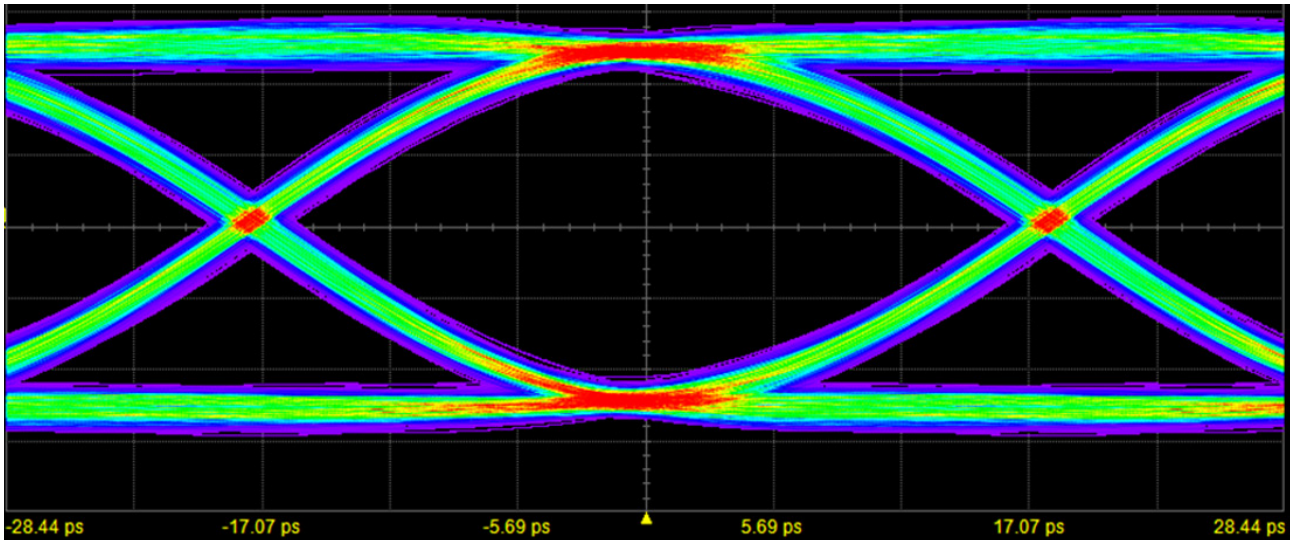
- Multi-channel BER Tester for optical or electrical transceivers running up to 28 GBaud per channel
- Active optical cable testing
- High speed SerDes, clock-data-recovery, and laser-driver testing and characterization
- General purpose 28 GBaud Pulse Pattern Generator (NRZ and PAM4)
- Automated testing for manufacturing, utilizing PXIe platform's extensive support modules for all other types of optical and electrical testing in a single PXIe platform

## EXAMPLE DATA SIGNALS

# Example of one channel 28 Gbaud (56 Gbps) PAM4 PRBS data signal generated by the BERT-1102 PPG




# Example of one channel 28 Gbps NRZ PRBS data signal generated by the BERT-1102 PPG

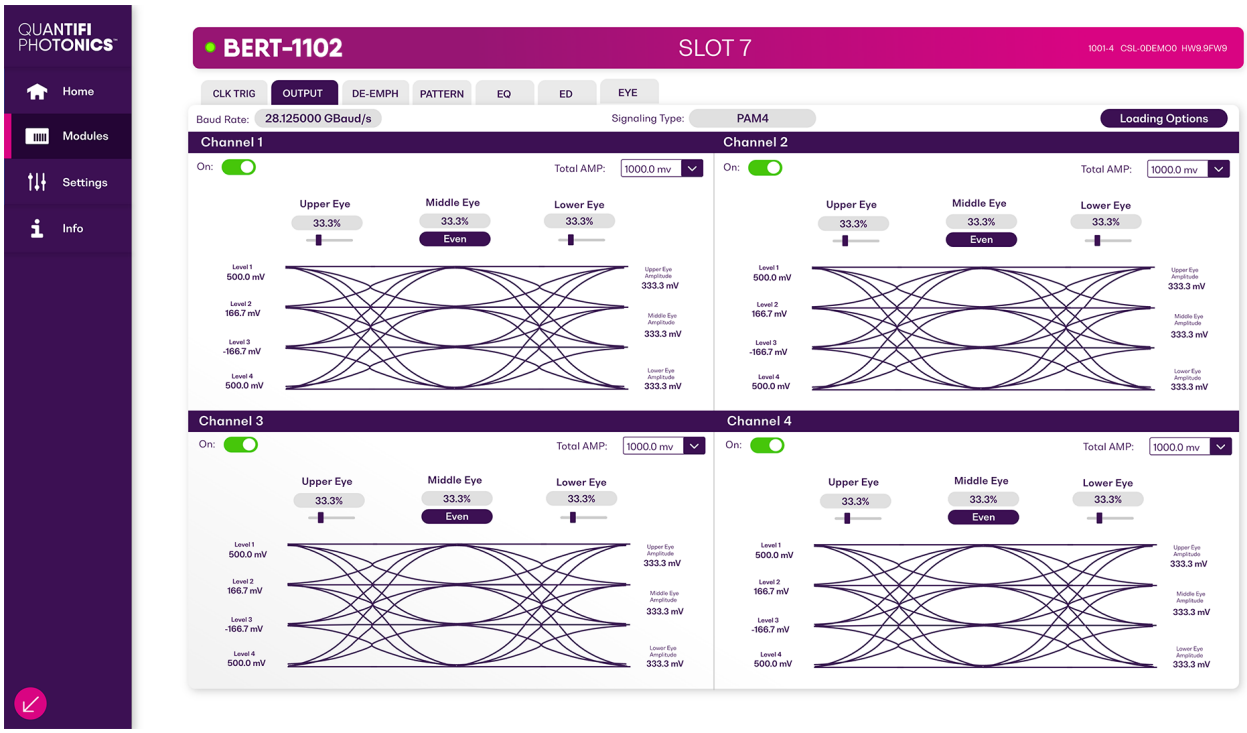


# Simple, Intuitive Control with CohesionUI™

CohesionUI makes it simple to control our PXI or MATRIQ instruments from a PC, tablet or smartphone. Its cutting-edge design offers a sleek modern interface, cross device compatibility, customizable views and remote network access.

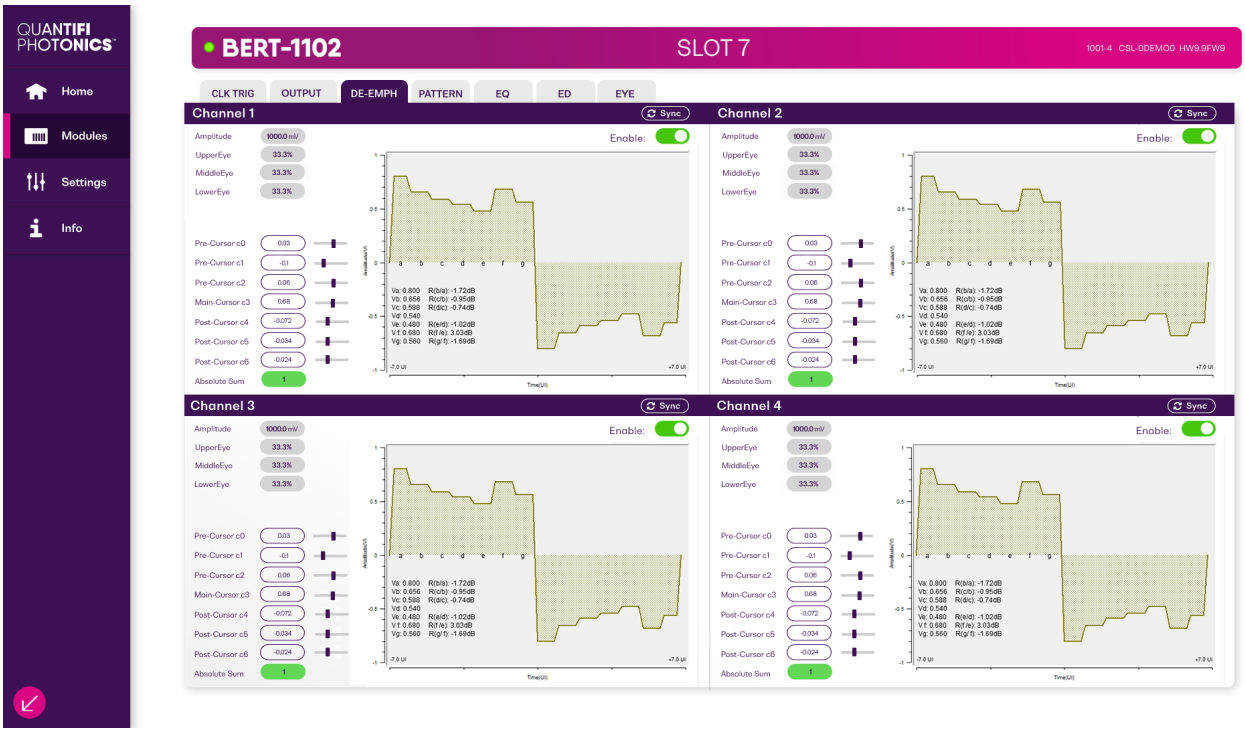
# PPG output level control

The OUTPUT menu in the CohesionUI GUI for the BERT 1100 Series allows the user to set the PPG's electrical output amplitudes for either NRZ or PAM4 type signals. The user can independently modify the total peak-peak amplitudes of either the NRZ (two levels) or PAM4 (four levels) outputs. In addition to being able to modify the relative levels in the NRZ and PAM4 signals, each channel can be set independently at different levels from each other, including independent channel enable-disable toggling.



# PPG de-emphasis 7-tap control

The BERT 1100 Series PPG outputs can be adjusted with a 7-tap emphasis control. The user can independently set both pre-cursor and post-cursor emphasis on the PPG electrical outputs in order to compensate for inter-symbol interference in the transmission medium as well as finite cable losses. It is possible to engage both pre- and post-cursor de-emphasis simultaneously.



# Error detect equalization and BER bathtub and eye histogram menu

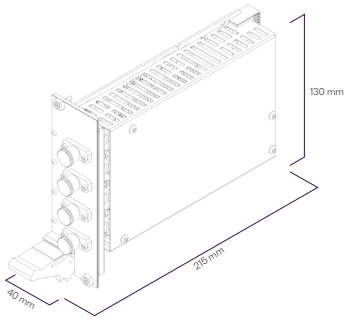
Each of the Error Detect (ED) input channels is equipped with a continuous-time linear equalizer (CTLE) with user adjustable boost values from 0 dB to 12 dB relative to the 14 GHz gain of the receiver. In addition to being able to adjust the receiver's CTLE equalizations, the user can perform a histogram scan independently for each receiver ED channel. These histograms provide immediate feedback to the user as to how balanced and effective the receive equalization is for optimizing the error rate performance.

# 3D BER eye contour measurement menu

An eye scan feature is provided on each of the receiver channels. These provide a color-contoured graphical result indicating how each channel is affected by either horizontal phase or vertical amplitude adjustments on the channel's decision thresholds (commonly referred to as "slicer" levels). The instrument will automatically scan the entire unit interval (bit period) both in phase alignment and vertical decision voltage and present the color coded error rate in a 2D plot for those offsets in the graphical result.

These eye patterns are similar to what traditional time-domain oscilloscopes with an optical converter on their input would see for an eye-pattern test, but are performed rapidly by utilizing all the BER measurements results for every measured bit and do not require the trigger-and-sample approach used by an oscilloscope.

## FORM FACTOR


**BERT-1102-8-PXIE**

# Our expanding range of PXIe optical test solutions are used by customers in mixed-signal test and measurement systems, reducing complexity, lowering the cost of test and accelerating time to market.

- Multi vendor, open standard with over 2500 PXI modules available
- Advanced timing and synchronization capabilities across instruments
- Low latency, high performance processing and fast data throughput
- Design and build scalable, high channel count systems
- Small footprint and lower power consumption

| General Specifications | 1102 |
|---|---|
| Bus connection | PXIe |
| Slot count | 2 |
| Dimensions (H x W x D) | 130 x 40 x 215 mm \| 5.1 x 1.6 x 8.5 inches |
| Weight | ~ 1 kg \| ~ 2.2 lbs |
| Operating temperature range | 5 °C to 45 °C \| 41 °F to 113 °F |
| Storage temperature range | -40 °C to 70 °C \| -40 °F to 158 °F |

| Pulse Pattern Generator | 1102 |
|---|---|
| Number of channels | 8 |
| RF output | AC-coupled differential [6] |
| RF connector | 2.92 mm breakout cable [7] |
| Impedance | 100 ohms between differential outputs |
| Data coding | NRZ and PAM4 |
| Data rate (Gbps, NRZ format) [1,8] | 1.25, 2.5, 3.125, 4.25, 5.1562, 6.25, 7.5, 8.5, 9.83040, 9.95328, 10.13760, 10.3125, 10.709, 10.755, 10.9365, 11.049, 12.16512, 12.5, 14.025, 15, 20.2125, 20.625, 20.9375, 21.875, 24.33024, 25, 25.78125, 26.31453453, 26.5625, 28.125 |
| Symbol rate (Gbaud, PAM4 format) [2,8] | 7.5, 8.5, 9.8304, 9.95328, 10.1376, 10.3125, 10.709, 10.755, 10.9365, 11.049, 12.16512, 12.5, 14.025, 15, 16.25, 16.875, 20.625, 20.9375, 21.25, 21.875, 23.125, 23.28125, 25, 25.78125, 26.31453453, 26.5625, 28.125 |
| Data rate (Gbps, PAM4 format) [2,8] | 15.00, 17.00, 19.6608, 19.90656, 20.2752, 20.6250, 21.4180, 21.51, 21.8730, 22.0980, 24.33024, 25.00, 28.05, 30.00, 32.5, 33.75, 41.25, 41.875, 42.50, 43.75, 46.25, 46.5625, 50.00, 51.5625, 52.62906905, 53.125, 56.250 |
| PRBS and other data patterns | **NRZ:** PRBS7/9/11/13/15/23/31/58<br>**PAM4:** PRBS7Q/9Q/11Q/13Q/15Q/23Q/31Q/58Q<br>And inverted patterns, Square Wave, Transmitter test patterns JP03B, SSPRQ, LIN and CJT patterns |
| Output amplitude (mV differential) | Adjustable 600 to 1000 mV |
| Output amplitude steps (mV differential) | 100 |
| Rise/fall time (20% to 80%) | TBD |
| Intrinsic jitter | TBD |
| Crossing point adjustment | None |
| Programmable de-emphasis | 7 tap, programmable pre and post-cursor |
| Polarity inversion | Yes |

| Error Detector | 1102 |
|---|---|
| Number of channels | 8 |
| RF input | AC-coupled differential [6] |
| Impedance | 100 ohms between differential outputs |
| Data rate (Gbps, NRZ format) [1, 8] | 1.25, 2.5, 3.125, 4.25, 5.1562, 6.25, 7.5, 8.5, 9.83040, 9.95328, 10.13760, 10.3125, 10.709, 10.755, 10.9365, 11.049, 12.16512, 12.5, 14.025, 15, 20.2125, 20.625, 20.9375, 21.875, 24.33024, 25, 25.78125, 26.31453453, 26.5625, 28.125 Gbps |
| Symbol rate | 7.5, 8.5, 9.8304, 9.95328, 10.1376, 10.3125, 10.709, 10.755, 10.9365, 11.049, 12.16512, 12.5, 14.025, 15, 16.25, 16.875, 20.625, 20.9375, 21.25, 21.875, 23.125, 23.28125, 25, 25.78125, 26.31453453, 26.5625, 28.125 |
| Data rate (Gbps, PAM4 format) [1, 8] | 15.00, 17.00, 19.6608, 19.90656, 20.2752, 20.6250, 21.4180, 21.51, 21.8730, 22.0980, 24.33024, 25.00, 28.05, 30.00, 32.5, 33.75, 41.25, 41.875, 42.50, 43.75, 46.25, 46.5625, 50.00, 51.5625, 52.62906905, 53.125, 56.250 |
| PRBS patterns [1,2] | **NRZ:** PRBS7/9/11/13/15/23/31/58<br>**PAM4:** PRBS7Q/9Q/11Q/13Q/15Q/23Q/31Q/58Q |
| Sensitivity [3] | 100 mV peak-peak differential |
| Max operational input | 1200 mV peak-peak differential |
| Clock source | Independent CDR on each input channel |
| Polarity inversion | Yes |
| Equalizer | Feed forward equalizer with 3 taps pre-cursor, main cursor and 6 taps post-cursors<br>1 tap PAM4 DFE<br>PM4 1+D decoder filter to cancel 1/(1+D) pattern generator DFE encoder<br>Optional PAM4 reflection canceler to reduce group delay effects<br>PAM4 Level Dependent Equalizer (LEDQ) to equalize the two inner level of the PAM4 eye |
| Eye contours | 3D Eye Monitor on each input to allow advanced measurements such as BER contours and eye parameters. Supported for rate > 1.25 Gbps. |

| Divided Clock Output | 1102 |
|---|---|
| Rf output | Single-ended SMA |
| Impedance | 50 ohms (AC coupled) |
| Frequency | 1/2, 1/4, 1/8, or 1/16 of the clock rate |
| Intrinsic jitter | TBD |
| Output amplitude | 700 mV (typical) |
| Selectable clock divider | Divide by 2, 4, 8 or 16 |

The Divided Clock Output signal (trigger out) is designed to enable a quick evaluation of the transmitter's operation, prior to a signal quality test using the BERT-1102's Error Detector. For full transmitter characterization such as eye diagram testing and jitter measurements, a clock recovery unit is recommended.

| Clock and Data Recovery | 1102 |
|---|---|
| Data rate (NRZ format) | 1.25 to 28.125 Gbaud<br>(1.25 Gbps to 29 Gbps)[1] |
| Data rate (PAM4 format) | 15 to 28.125 Gbaud<br>(30 Gbps to 56.25 Gbps)[2] |
| Loop bandwidth | TBD<br>(target: FC/1667 default, tunable 1 to 23 MHz) |
| CDR output | No |

| Breakout Cables | 1102 |
|---|---|
| Length | 30 or 60 cm |
| Connectors [4] | 2.92 mm, Male |
| Skew | < 2 ps skew match |

**Notes**

1. NRZ is selectable for discrete rates, the rate can deviate by +/- 100 ppm maximum.
2. PAM4 is selectable for discrete rates, the rate can deviate by +/- 100 ppm maximum.
3. Sensitivity of ED for NRZ is 50 mV peak-peak differential; for PAM4 with levels 0, 1, 2, 3, sensitivity is 100 mVp-p differential for level 0 to 3.
4. The front panel of the BERT uses a compact 1x8 Mini Coax for the PPG outputs as well as the ED inputs. For convenience, Quantifi Photonics offers cable assemblies to adapt all 1x8 outputs into individual 2.92 mm Male type RF connectors with skew-matching for all channels. For best performance and for all specifications referenced in the tables, the 1x8 Mini Coax to 2.92 mm BERT-9007-1 assembly is recommended. The cable assemblies come in 1x8 assemblies with 2.92 mm Male style on the user end, and an industry standard compact 1x8 rigidly held connector with >40 GHz performance on the instrument front-panel end of the cable assemblies.
5. RMA Jitter specifications assume that test method uses a precision timebase equivalent-time sampling oscilloscope (example: Keysight 86100 with 86107A precision timebase, or Tektronix DSA8300 with 82A04 phase reference module. Samplers in this setup are assumed to have >40 GHz bandwidth and reference clock fed into the precision timebase and/or phase reference module in setup is considered "jitter free" as a reference.
6. Each channel of the PPG output and ED inputs have two complimentary 50-ohm ac-coupled coaxial connections. Each channel's positive and negative outputs are independent 50-ohm coaxial transmission lines.
7. The PPG and ED outputs each use a compact 1x8 RF output of Mini Coax connectors. QP provides both 1x8 SMA and 1x8 2.92 mm breakout cable assemblies designed to quickly plug into the front panel 1x8 connector buses with skew matching on the differential output. Details on these 1x8 breakout cables is provided at the end of the specification table in the Breakout Cable section, as well as being listed on the Ordering Information page. The instrument comes standard with two 1x8 2.92 mm breakout individual Male type RF connectors, but the user is free to order replacement and/or additional breakout cables directly from Quantifi Photonics.
8. The data rates of any transmitter are determined by the Baud Rate and the type of signal format. The Baud Rate is the rate at which symbols are clocked into a system during a bit period (bit period = 1/(Baud Rate)), and in the case of Non-return to Zero format (NRZ) there are only two levels in each bit period which is the equivalent of one bit of information per bit period, therefore the data rate in bits-per-second for NRZ is equal to (Baud Rate in 1/s)*(1 bit). PAM4 is a data format which uses four levels in the data symbol for each bit period; four levels represents two bits worth of information for each bit period, therefore the data rate for PAM4 is (Baud Rate 1/s)*(2 bits). Example: a PAM4 type signal with a Baud Rate of 10.3125 GBaud has a data rate of 20.625 Gbits-per-second (often expressed as 20.625 Gbps or 20.625 Gb/s).

## ORDERING INFORMATION

BERT - XXXX - X - PXIE

**Model number**
**1102** = 1 to 28 GBaud, NRZ and PAM4 (includes necessary BERT-9007 30 cm male breakout cables)

**Number of channels**
**8** = 8 channels

## OPTIONAL EXTRAS

BERT - XXXX

**9007** = Replacement 30cm 1x8 2.92mm male breakout cable for BERT-110X
**9008** = Replacement 60cm 1x8 2.92mm male breakout cable for BERT-110X

If your application requires different length cables than what you see listed here, please contact your Quantifi Photonics sales representative about alternative custom lengths cable assemblies.

## WARRANTY INFORMATION

This product comes with a standard 1 year warranty.

## EXTENDED WARRANTIES AND CALIBRATION PLANS

With an **extended warranty and calibration plan** you'll spend more time focused on your priorities and less time worrying about maintenance.

Add a **3 or 5 year extended warranty** when you purchase your Quantifi Photonics instruments.


### Guarantee performance

Ensure your equipment is operating at the best it can be for reliable and accurate results.

### Lower cost of ownership

Lock in savings and maximise your testing budget with a lower base cost of ownership.

### Peace of mind

Spend less time worrying about maintenance and more on generating results.

## CALIBRATION PLANS FOR ADDITIONAL DISCOUNTS

Order a **calibration plan** when purchasing your Quantifi Photonics instruments and get additional discounts.

**10% Discount** On calibrations ordered at the time of purchase.

**25% Discount** Add on an extended warranty and receive a 25% discount on calibrations.

Over time and with regular use, all optical parts and connectors require re-calibration and maintenance to guarantee accurate and reliable performance. We recommend Quantifi Photonics optical instruments are re-calibrated every 12 months. With an instrument calibration performed by Quantifi Photonics technicians you receive:

- Comprehensive calibration to factory specifications
- End-to-end inspection to ensure all instrument functions are working and connectors are clean
- Firmware, software and documentation updates
- Certificate of calibration which includes detailed test results

# How to do I **secure my extended warranty or calibration plan**?

Contact your Quantifi Photonics sales representative or email **sales@quantifiphotonics.com**

Extended warranties and calibration plans must be ordered at the time of purchase and are available only for Quantifi Photonics' products. The 25% calibration discount only applies to calibrations while the product is covered by the extended warranty period.

Our portfolio of optical & electro-optical test modules is rapidly expanding to meet a wide range of customer requirements and applications.

For more details visit **quantifiphotonics.com/products**

## Tunable Laser Sources

Versatile telecom laser sources with full tunability across C or L bands. Narrow 100 kHz linewidth, up to 16.5 dBm of power, optional whisper mode to disable frequency dither.

## Fixed Wavelength Laser Sources

Highly-customizable DFB or FP laser sources available in a wide range of wavelengths and powers up to 24 dBm. Supports SMF, MMF and PMF.

## Swept, Tunable Continuous Wave Laser

Swept, tunable continuous wave (CW) laser source with 0.01 dB power stability and 400 nm/s high-speed scan rate for R&D and production testing.

## Superluminescent Diode Broadband Light Source

Super-luminescent LED light source with high output power, large bandwidth and low spectral ripple and various wavelengths.

## Erbium-Doped Fibre Amplifier (EDFA)

High power Erbium-Doped Fiber Amplifier for signal power amplification in C and L bands with various control modes, including automatic gain control.

## Variable Optical Attenuator (VOA)

Fast attenuation speed with low insertion loss and built-in power monitoring. Operates in fixed attenuation or constant output power modes. Support SMF, MMF and PMF.

## Polarization Controller & Scrambler

High-speed automated polarization control with broad wavelength coverage from 1260nm to 1650nm, low insertion loss and back reflection. Full remote control via intuitive GUI, LabVIEW or SCPI.

## Optical Power Meters

Fast terminating or inline monitoring of optical signal power from -60 to +10 dBm across 750 – 1700 nm wavelengths. Model with logarithmic analog output for applications such as silicon photonics fiber alignment.

## Optical Spectrum Analyzer (OSA)

Cost-effective, spectral measurement in a compact module with built-in analysis for: SMSR, OSNR & spectral width. Targeted wavelengths for specific applications in O band, C band & L band.

## Optical-to-Electrical Converter

High bandwidth, broadband O-to-E converter. Available in a range of configurations; choose from 1 or 2 channels, AC or DC coupling and various conversion gain and operating wavelength ranges.

## Digital Sampling Oscilloscope (DSO)

Digital equivalent-time sampling oscilloscope (DSO) with high-quality precision timebase and low jitter mode, available in 1 or 2 channels in a compact benchtop instrument.

## Bit Error Rate Tester (BERT)

4 or 8-channel Pulse Pattern Generator and Error Detector at rates up to 29 Gbps for the design, characterization and production of optical transceivers and opto-electrical components.

## Photonic Doppler Velocimeter (PDV)

Purpose-built module for Photonic Doppler Velocimetry (PDV). A circulator, two VOAs and a passive coupler all built into one compact module.

## Optical Switch

Proven reliability and fast switching time. Wide variety of switch onfigurations: 1x4, 1x16, 16x16 and more. Models support SMF, MMF and PMF.

## Photocurrent Amplifier

Versatile photodiode amplifier to measure photocurrent in photonic integrated circuit (PIC) applications. Digital and analog measurement.

## Passive Component Integration

Integrate passive optical components of your choice such as WDM couplers, splitters, band-pass filters, PM beamsplitters and circulators. SMF, MMF and PMF.

# Test. Measure. Solve.™

Quantifi Photonics provides test solutions to help customers unlock scalable and cost-effective high-volume manufacturing of photonic integrated circuits (PICs), co-packaged optics and pluggable optics. The company's portfolio includes a wide range of photonic test instruments, and digital sampling oscilloscopes, available as benchtop or the industry-standard PXI format to support cost-effective, high-throughput design verification testing and high-volume manufacturing.

## To find out more, get in touch with us today.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