

▼ CHAPTERS

Fiber Patch
Cables

Bare Fiber

Fiber
OptomechanicsFiber
ComponentsTest and
Measurement

▼ SECTIONS

PRO8000 Platform

TXP5000 Platform

PMD/PDL System

Benchtop Systems

Optical Switches

Optical Modulators

Optical Spectrum
Analyzers

PAX5710-T Series of Polarimeters (Page 1 of 3)

PAX5710VIS-T
(Cables and Laptop Included)

Applications

- Free-Space and In-Fiber Polarimetry
- ER Measurements on PMF
- DOP Measurements
- Polarimeter Unit for the PMD5000 System

Specifications

- **Input Power Range:**^a -40 dBm to 0 dBm
- **Azimuth Angle Accuracy:**^{b,c} $\pm 0.25^\circ$
- **Ellipticity Angle Accuracy:**^b $\pm 0.25^\circ$
- **Degree of Polarization Accuracy:** $\pm 0.5\%$ Full Scale
- **Wavelength Range:**
 - VIS: 400 - 700 nm
 - IR1: 700 - 1000 nm
 - IR2: 1000 - 1350 nm
 - IR3: 1300 - 1700 nm
- **Maximum Measurement Rate:** 333 Samples/s
- **Fiber Input:** FC/PC (Others Available Upon Request)
- **Free-Space Input:** Ø3 mm, <3 mrad Beam Divergence
- **Analog Interface (Via Front Panel D-Sub):**
 - Outputs: S1, S2, S3, Power/dBm, and DOP (Complete Stokes Vector Plus DOP)
 - Inputs: Trigger
- **Digital Interface Outputs:** S1, S2, S3, Power, DOP, Azimuth, and Ellipticity
- **Warm-Up Time for Rated Accuracy:** <15 min
- **Operating Temperature:** 5 - 40 °C

a) Absolute power range depends on the current wavelength, which can be as large as -60 dBm to 10 dBm. Above specifications valid within the -40 dBm to 0 dBm range.

b) For any SOP with $-30^\circ < \text{ellipticity} < 30^\circ$

c) Azimuth angle is defined as the inclination angle of the major axis of the polarization ellipse to the horizontal axis. The ellipticity angle is given as $\arctan(b/a)$ where b is the length of the minor axis and a is the length of the major axis of the polarization ellipse.

Introduction - PAX5710-T Polarimeter

The PAX5710-T Series polarimeter system is a flexible and powerful polarization analysis system based on our modular TXP5000 platform (see pages 1178 - 1179). This polarimeter system is designed for different applications ranging from classic polarization measurements to complex tasks like evaluating optical components with the Jones matrix algorithm within the PMD5000 system. It is also well suited for determining the extinction ratio (ER) of polarization-maintaining fibers (PMF) and for alignment of PMF to laser modules. The PAX5710-T series is specifically engineered for accurate measurements of polarization-related effects for high dynamic ranges with wavelengths from 400 to 1700 nm. It consists of the analyzer with an external sensor head for free-space and fiber-based optical systems. In contrast to our IPM5000 Series, which allows transmission of the optical output, the PAX5710-T Series uses all incident light for the measurement without any optical output.

How it Works

The optical unit of a PAX5710-T measurement sensor consists of a rotating quarter-wave plate, a fixed polarizer, and a photodiode (see Figure 1). The wave plate transforms the input polarization depending on the actual rotating angle. Then, the polarizer only transmits the portion of light that has its polarization parallel to the transmission axis. As a result, the polarization modulation is converted into an amplitude modulation. The photodiode supplies a current that is proportional to the optical power. A Fourier transformation is used to accurately calculate all polarization-relevant parameters like SOP, DOP, azimuth, ellipticity, Stokes vectors, etc.

SOP and DOP Measurements

The PAX5710-T analyzes the state of polarization and the degree of polarization of optical signals in either free-space or optical fibers. The resulting data can be viewed using the graphical user interface that is supplied with each PAX unit. The state of the input polarization is completely characterized by different representations. As can be seen in Figure 2, the polarization data is presented in a number of forms: on the Poincaré sphere, as numeric results, or as a polarization ellipse with the handedness noted. The degree of polarization and the total optical power are also provided.

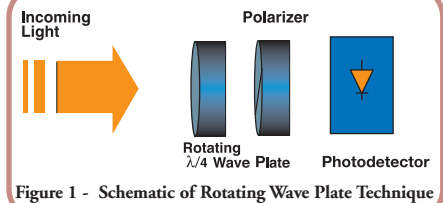


Figure 1 - Schematic of Rotating Wave Plate Technique

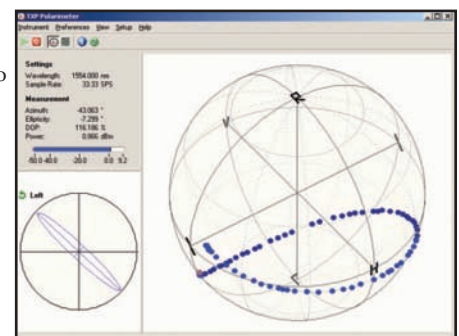


Figure 2 - Polarimeter GUI

PAX5710-T Series of Polarimeters (Page 2 of 3)

Long-Term Polarization Measurements

Another standard feature is the scope mode, which looks similar to an oscilloscope display. The polarization can be examined continuously over time or initiated with a software or hardware trigger signal. A maximum of 1024 data points can be collected. Another feature is the pre-trigger function, which can be activated in each trigger mode. A user-configurable number of samples are stored in a ring buffer until the trigger pulse is given. All acquired data before and after the trigger pulse are displayed in a diagram. Therefore, real-time monitoring of the system's polarization behavior can be realized with the PAX measurement system. The measured data can be stored in an ASCII format file (CSV). The data file contents can be viewed with any text editor and can be further processed using third-party software packages such as MathCAD, Mathematica, or Excel.

Software Features

The software for the PAX system includes drivers for LabVIEW™, LabWindows™/CVI™, MSVC, and Borland C. These drivers enable you to write your own applications to adapt the polarimeter into a complete optical setup. Included in the software are features specifically geared towards extinction ratio (ER) measurements (see below).

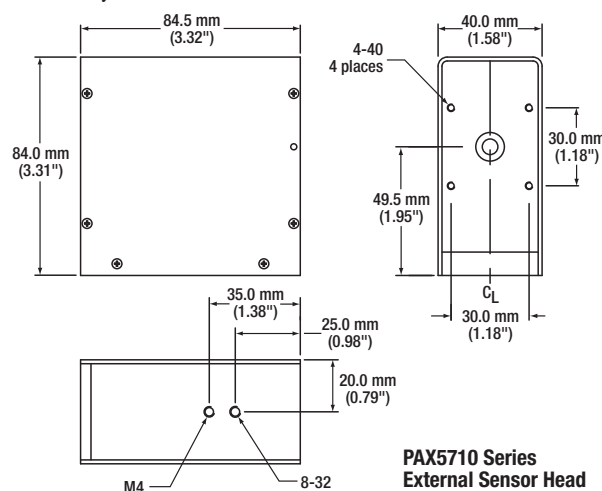
System Configurations

Due to its modular design and the various models available, the PAX system is an ideal tool for various types of polarization-related measurement tasks in research and development laboratories as well as for final inspection in manufacturing. The PAX5710-T series can be used for free-space and fiber-based applications in the 400 to 1700 nm wavelength range. See the following page 1182 for ordering information.

The PAX5710 consists of a TXP-compatible module and an external polarization measurement sensor. The PAN5710 external measurement sensor (see next page 1182) facilitates polarization analysis in free-space setups. It can be easily mounted to optical benches using the M4 x 0.7 or #8-32 mounting hole provided on the bottom surface of the head. It is also compatible with our extensive line of 30 mm cage system components. The optical light field to be measured should enter the aperture of the sensor nearly perpendicular to the front panel. The beam diameter should be less than 3 mm to guarantee that all of the light reaches the detector.

All sensors are supplied with a fiber collimator for FC/PC fiber connectors to allow polarization measurements on fiber-based systems.

Application Idea External PAX Sensor Heads



**PAX5710 Series
External Sensor Head**

Please refer to our website for complete models and drawings.

Extinction Ratio Measurement on Polarization-Maintaining Fibers

Extinction ratio (ER) is a key qualifier of polarization-maintaining fibers (PMF) and PM couplings. Using the standard features built into the PAX software, ER measurements can be made quickly and reliably in the 0 to 45 dB range.

The measured ER parameter refers to the PMF directly connected to the polarimeter input.

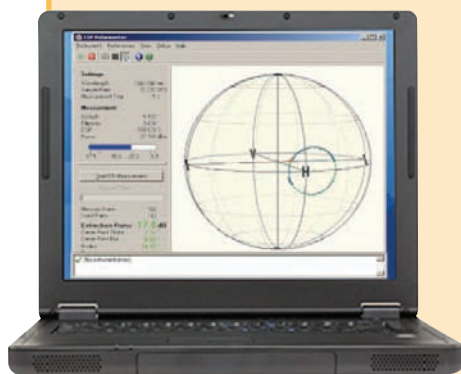
The easiest measurement technique is to find the maximum expansion of the polarization ellipse compared to the ideal linear state. Since this expansion is dependent on the fiber stress, a lot of values have to be recorded

while the fiber is stressed, pulled, or a wavelength scan is performed.

This technique requires the highest accuracy in the measurement of the ellipticity angle. With a very high ER, the setup is prone to measurement inaccuracies. The PAX5710-T uses an optimized algorithm to mitigate this issue. The data collected from fiber stressing is used to fit a circle on the Poincaré sphere. The radius of the circle, expressed in degrees, is representative of the maximum expansion of the polarization ellipse.

Only the relative polarization measurement accuracy determines the ER measurement error, since the shift of the circle to any position on the Poincaré sphere is irrelevant as long as the size of the circle remains unchanged. Errors resulting from poorly or angle-polished fibers have no influence on the final value, only the ER of the stressed fiber segment measured.

The ER measurement on PMF is integrated in the PAX5710-T software, along with all polarimeter-related functions.



PAX5710-T Series of Polarimeters (Page 3 of 3)

PAX5710-T Series of Benchtop Free-Space Polarimeters

The PAX5710-T versions consist of a TXP5004 chassis with USB connection, a PAX5710 electronics card, one external polarimeter sensor, and pre-configured notebook computer, making this a complete free-space measurement system right out of the box. This package includes all of the necessary cables for connecting the sensor and computer.



PAX5710VIS-T
Cables, External Sensor Head, Chassis, and Laptop Included (All Sensor Heads are Factory Calibrated)

The wavelength range can be easily changed by purchasing one of the sensor heads shown below.

ITEM #	\$	£	€	RMB	DESCRIPTION
PAX5710VIS-T	\$ 7,991.00	£ 5,753.52	€ 6,952.17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 400 - 700 nm
PAX5710IR1-T	\$ 7,991.00	£ 5,753.52	€ 6,952.17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 700 - 1000 nm
PAX5710IR2-T	\$ 7,991.00	£ 5,753.52	€ 6,952.17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 1000 - 1350 nm
PAX5710IR3-T	\$ 7,991.00	£ 5,753.52	€ 6,952.17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 1300 - 1700 nm



PAN5710IR2
External Sensor Head

External Measurement Heads for PAX5710-T Series

The External Measurement Heads of the PAX5710 Series of Polarimeters can be exchanged to switch to a different wavelength range without the need to purchase a complete new system. The external heads of the PAN5710 Series allow free-space and fiber-based measurements with easy integration in optical setups.

Features

- Extend the Wavelength Range Options of an existing PAX5710 System
- Free-Space and Fiber Input

ITEM #	\$	£	€	RMB	DESCRIPTION
PAN5710VIS	\$ 3,461.00	£ 2,491.92	€ 3,011.07	¥ 27,584.17	PAX External Sensor Head, 400 - 700 nm
PAN5710IR1	\$ 3,461.00	£ 2,491.92	€ 3,011.07	¥ 27,584.17	PAX External Sensor Head, 700 - 1000 nm
PAN5710IR2	\$ 3,461.00	£ 2,491.92	€ 3,011.07	¥ 27,584.17	PAX External Sensor Head, 1000 - 1350 nm
PAN5710IR3	\$ 3,461.00	£ 2,491.92	€ 3,011.07	¥ 27,584.17	PAX External Sensor Head, 1300 - 1700 nm

Putting it all together

For more details, see pages 1192 - 1195



PMD5000 Series
Complete PMD Analysis System
(Laptop Included)



The PMD5000 Series combines our DPC5500 Series deterministic polarization controller, one of our IPM5300 Series or PAX5720IR3 Series polarimeters, and an external tunable laser source with a specialized software package. This combination creates a versatile polarization-mode dispersion (PMD) and a polarization-dependent loss (PDL) measurement system.

The PMD5000 series provides extensive measurement and analysis of PMD on both broadband and narrowband components, optical fibers, and installed optical systems. It is capable of determining polarization dependent loss (PDL) and polarization dependent gain (PDG). PMD measurements of complex optical networks can be performed as well as PMD monitoring of dark channels.