



## POLARIZATION ENTANGLEMENT TOMOGRAPHY ANALYZER

**PRELIMINARY**

### Features:

- Plug-and-play analyzer with a controller unit
- Customized software and intuitive GUI
- Quick and precise polarization state rotators
- Compact size and small footprint

### Applications:

- Polarization state tomography
- Automation of multi-polarization state analysis

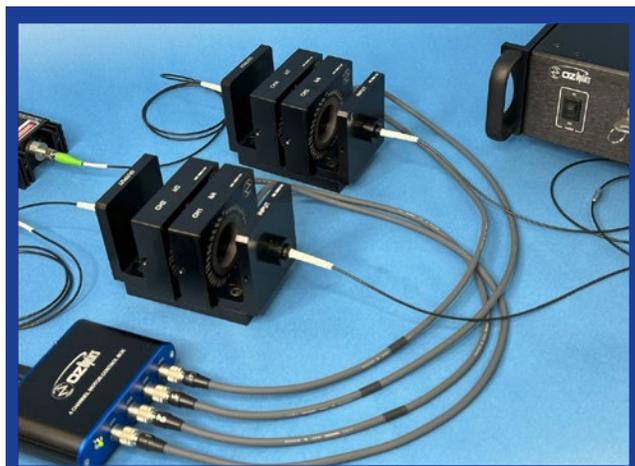
### Product Description:

This cost-effective analyzer reduces the complexity level, effort, and cost to perform one of the most precise polarization entanglement analysis using two detectors [1]. The analyzer as shown in Figure 1 is provided along with a control unit, USB cable and power supply. The intuitive graphical user interface (GUI) can be used to perform any desired wave plate rotation. Default settings allow one to perform a set of 36 measurements (shown in Figure 3) in the canonical basis  $\{H, V, D, A, R, L\} \otimes \{H, V, D, A, R, L\}$ , for generating precise tomography through two single-photon detectors.

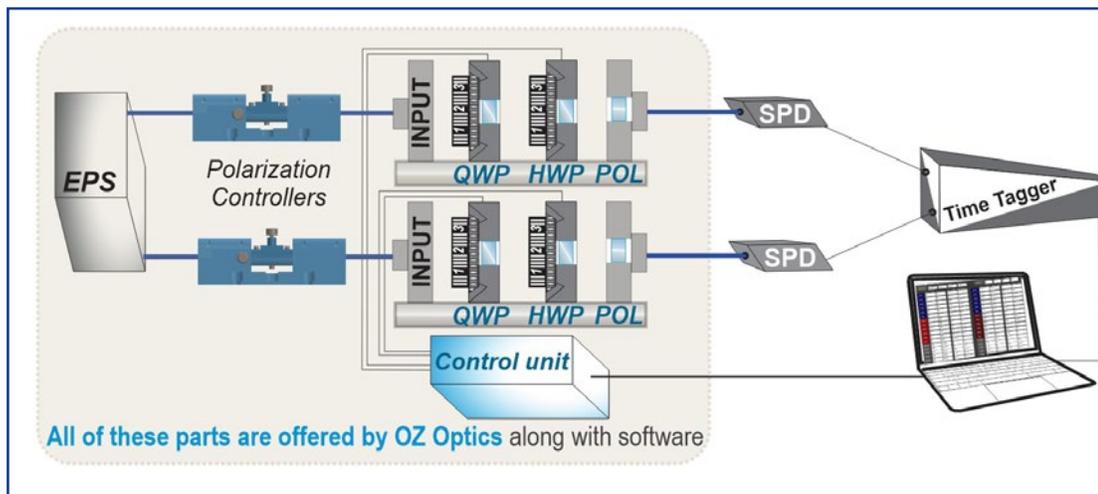
This device consists of two rotation stages as shown in Figure 2. Each stage contains a rotatable quarter-wave plate (QWP), rotatable half-wave plate (HWP) and fixed polarizer, which can be replaced with a polarizing beam splitter (PBS) if required. The input and output ports are coupled to fiber pigtailed. Systems with connector receptacles or collimators for free-space detection can also be provided.

This polarization system rotates the polarization states of the photon pairs with sub-degree precision. This is achieved through built-in encoders enabling closed loop operation. The coincidences rate, which is the core of reconstructing a photon pair polarization state, is thus realized at high precision with excellent repeatability in the course of a quick experiment.

In addition, heralding efficiency of a given polarization entangled-photon source can be maintained thanks to high coupling efficiency between the input and output fibers delivering the photon pairs from the source to the detectors with a negligible optical loss.



**Figure 1.** A photo of a Quantum Polarization State Analyzer illustrating the two motorized rotation stages and the control unit along with the GUI.



**Figure 2.** Schematic of a Quantum Polarization State Analyzer illustrating the two motorized rotation stages and the control unit. In each stage, a rotatable quarter-wave plate (QWP), half-wave plate (HWP) and fixed polarizer (POL) combination allows projection into any single-qubit basis. The two-qubit measurements are then recorded from the two rails feeding two single-photon detectors, connected to a time tagging unit.

## Specifications

Parameters	
Optical Insertion loss	<0.75 dB*
Optical Wavelength (nm)	1550, 810 or upon request
Repeatability	0.1°
DC Voltage Input	5 V
Communication	TTL RS232 via USB port
Environmental Operating Conditions	
Temperature Range	15 to 40 °C
Maximum Relative Humidity	<80% at 31 °C (Non-Condensing)

\* Measured at 1550 nm at room temperature

Current Position	CH1	CH2	CH3	CH4	Quick Move	CH1	CH2	CH3	CH4
	45.01*	22.5*	0.01*	0.01*		0	0	0	0
	Alice QWP	Alice HWP	Bob QWP	Bob HWP		Alice QWP	Alice HWP	Bob QWP	Bob HWP
HH	0	0	0	0	AH	-45	67.5	0	0
HV	0	0	0	45	AV	-45	67.5	0	45
HD	0	0	45	22.5	AD	-45	67.5	45	22.5
HA	0	0	-45	67.5	AA	-45	67.5	-45	67.5
HR	0	0	45	0	AR	-45	67.5	45	0
HL	0	0	-45	0	AL	-45	67.5	-45	0
VH	0	45	0	0	RH	45	0	0	0
VV	0	45	0	45	RV	45	0	0	45
VD	0	45	45	22.5	RD	45	0	45	22.5
VA	0	45	-45	67.5	RA	45	0	-45	67.5
VR	0	45	45	0	RR	45	0	45	0
VL	0	45	-45	0	RL	45	0	-45	0
DH	-45	22.5	0	0	LH	-45	0	0	0
DV	45	22.5	0	45	LV	-45	0	0	45
DD	45	22.5	45	22.5	LD	-45	0	45	22.5
DA	45	22.5	-45	67.5	LA	-45	0	-45	67.5
DR	45	22.5	45	0	LR	-45	0	45	0
DL	45	22.5	-45	0	LL	-45	0	-45	0

Figure 3. Analyzer GUI allowing for 36 measurements.

## Ordering Information:

(Pigtail Style, Polarization Entanglement Analyzer)

**MQA-100-11-W-a/b-l-O-P-LB-XY-JD-L**

**W** = is the operating wavelength in nm

**a/b** = Fiber core/cladding

**L** Input fiber type: S = Singlemode (standard)  
P = Polarization maintaining

**Q** Output Fiber type: M = Multimode  
S = Singlemode  
P = Polarization maintaining

**P** = Polarizer option 1 = for Polarizer  
PBS = for Polarizing Beam Splitter

**LB** = Backreflection level: 40, 50, or 60 dB  
60 dB for 1550 nm only

**L** = length (meter)

**JD** = Fiber Jacket Type:  
1 = 900 Micron OD hytel jacket  
3 = 3 mm OD Kevlar reinforced PVC cable  
See Table 7 of the Standard Tables data sheets for other jacket types

**XY** Input and Output Connector Codes:  
3S = Super NTT-FC/PC  
3U = Ultra NTT-FC/PC  
3A = Angled NTT-FC/PC  
LC = LC  
LCA = Angled LC  
SC = SC  
SCA = Angled SC  
See Table 6 of the Standard Tables data sheet for other connectors

References:

[1] J. B. Altepeter, E. R. Jeffrey, P. G. Kwiat, S. Tanzilli, N. Gisin, and A. Acin "Experimental Methods for Detecting Entanglement" Phys. Rev. Lett. 95, 033601, 15 July 2005.



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