High Speed In-line Polarimeter

450–2500 nm ± 50 nm, 50 kHz speed

DATASHEET

Return to the Webpage

The POLA series in-line polarimeter is designed for high-speed polarization measurement and cost-effective optical characterization without interrupting data traffic. The device outputs four voltage signals that enable the calculation of both the Degree of Polarization (DOP) and the State of Polarization (SOP) of light passing through the device within microseconds. The POLA series is ideal for integration into polarization monitoring systems, polarization stabilization modules, and polarization characterization instruments. A preamplifier is integrated inside the IPOLA device to provide analog signals for SOP and DOP calculations. Optional PCB boards with amplifiers and computer interfaces are available to facilitate system integration. Each device is supplied with calibration matrix data required for accurate polarization calculations. For OEM applications, versions without the preamplification integration and calibration matrix are also available. Standard operating wavelengths are 1550 nm and 1310 nm. Other wavelengths can be supported upon request and require Non-Recurring Engineering (NRE).The IPOLA can also be combined with a polarization controller for automatic polarization state control, available in the APSC series products, enabling automated polarization management in advanced optical systems.

Features

- High Speed
- Low Loss
- Compact Size
- No Moving Parts
- Low Cost

Applications

- Optical Component Tests
- Quantum System
- Instruments
- Sensors

Specifications

Parameter		Min	Typical	Max	Unit
Center Wavelength		450		2500	nm
Operation Wavelength Range [1]			100		nm
Insertion Loss [1]			0.8	1.2	dB
Return Loss			55		dB
PDL (SM)			< 0.25		dB
PMD			< 0.1		ps
Wavelength Dependent Loss [1]			0.15		dB
Optical Power Sensitivity [1]			5		µW
Optical Input Power [1]		0.5		5	mW
Optical Damage Power		300			mW
Measurement Bandwidth (with PCB)			50		kHz
SOP Uncertainty (At Calibration Wavelength)				1	%
DOP Uncertainty (At Calibration Wavelength)				±2	%
Calibrated Wavelengths	1550nm version	1520, 1530, 1540, 1550, 1560			nm
	1310nm version	1310, others user specified			
Electrical Interface		10 pin w/o preamplifier board 20 pin w/preamplifier board			
Electrical Power Supply		-5 V to -10 V w/o preamplifier board ±12 V w/preamplifier board			
Operating Temperature		-10		+70	°C
Storage Temperature		-40		+85	°C

Note:

[1]. @1550nm. Shorter wavelength will increase loss and reduce wavelength range. Values are referenced without connectors.

RoHS COMPLIANT

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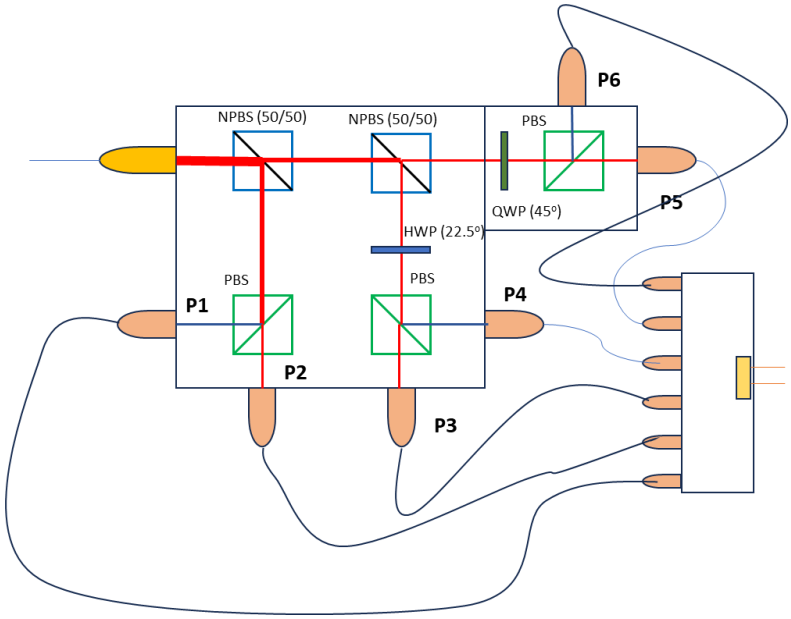
DATASHEET

Configuration



So=2(P1+P2)
S1=2(P1-P2)
S2=4(P4-P3)
S3=4(P6-P5)

In operation, it needs to do the calibration to measure each components transmission and reflection.

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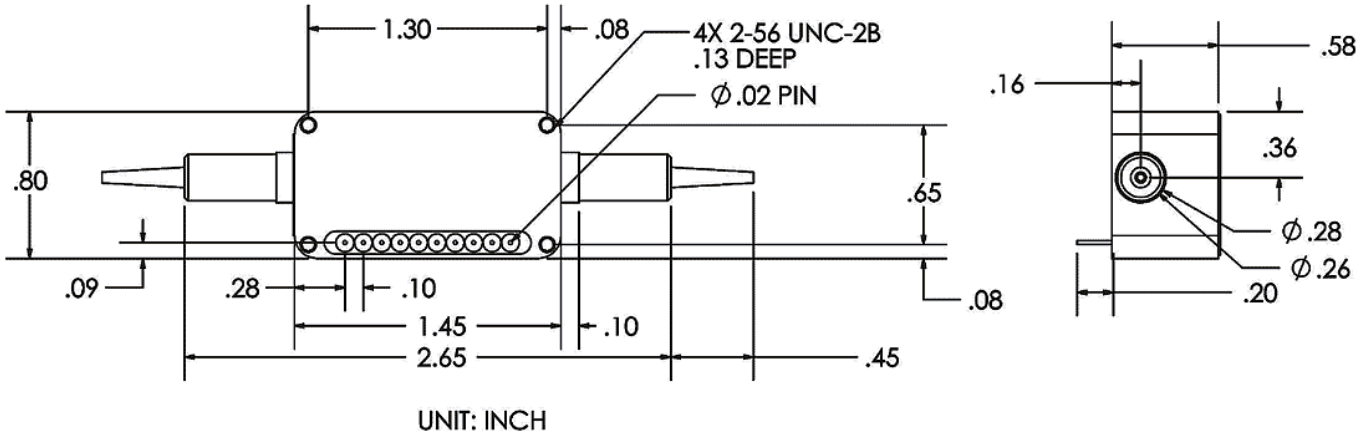
Mechanical Dimensions



*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

Optical Interface

1. The optical module has two fiber pigtails: one for the input and the other for the output.
2. An arrow ("→") sign is marked on the side of the package to indicate the direction of the input light beam.
3. For the PM fiber output option, the slow axis is aligned with the 0° vertical line.
4. It contains four detector with coordinate orientation as shown in the table below. (OEM version has direct access to these 4 detectors without preamplifications. The measured Stokes parameters are based on this coordinate system,.

Stokes parameter (s_1,s_2, s_3)	State of Polarization (SOP)
(1,0,0)	Linear SOP oriented at 45°
(-1,0,0)	Linear SOP oriented at –45°
(0,1,0)	Linear SOP oriented at 0°
(0,0,1)	Right hand circular SOP

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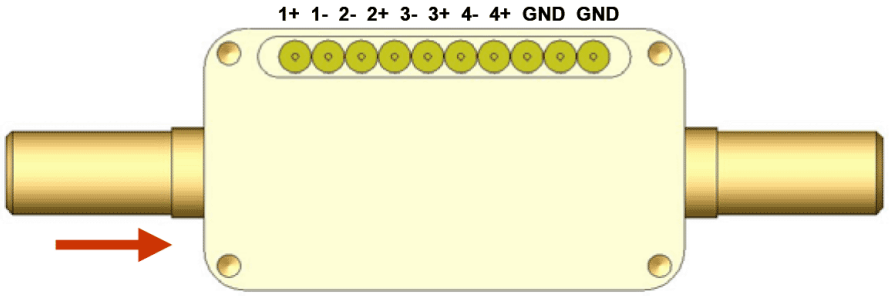
Electrical Interface - Pin locations (back side view)



Pin 1	NC
Pin 2	GND
Pin 3	NC
Pin 4	GND
Pin 5	V4
Pin 6	GND
Pin 7	V3
Pin 8	GND
Pin 9	V2
Pin 10	GND
Pin 11	V1
Pin 12	GND
Pin 13	+12V
Pin 14	GND
Pin 15	GND
Pin 16	GND
Pin 17	-12V
Pin 18	GND
Pin 19	NC
Pin 20	GND

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DATASHEET

Operation Instruction With Driver

•The polarimeter and its matched, factory-calibrated driver form a plug-and-play module for customer-specific applications.
•Connect the included DC power supply to the module.
•Connect the four SMA 0–5 V analog outputs to a polarization controller, data-acquisition system, or other equipment as required.
•Apply the optical input signal. The module is now ready for operation.

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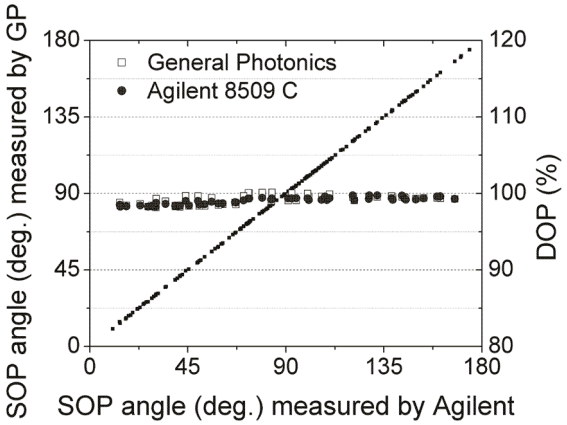
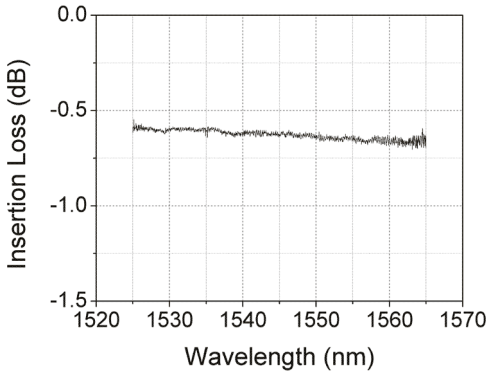
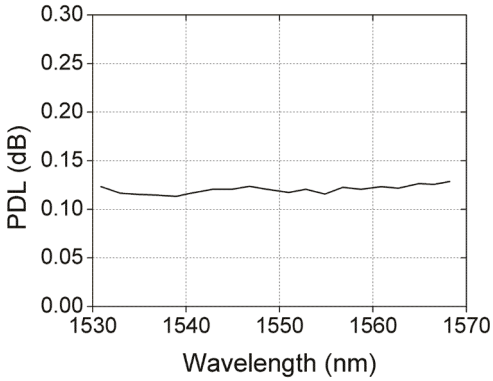
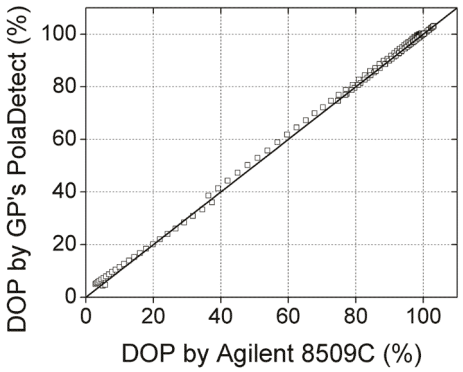
Typical Responsivity with Standard Tap Ratios for Different Wavelengths









Ordering Information (Part Number)

	□□□□	□	□	□	□	□	□	□
Prefix	**Center Wavelength**	**Configuration**	**Driver**	**Fiber Type**	**Fiber Cover**	**Fiber Length**	**Connector [1]**	**Type [2]**
POLA-	1550nm = 1550 1310nm = 1310 1064nm = 1064 850nm = 0850 780nm = 0780 450nm = 0450 Special = 0000	Standard = 1 No preamplifier = 2 Special = 0	Non = 1 Yes = 2	SM28 = 1 PM1550 = 5 PM1310 = 3 Special = 0	Bare = 1 0.9mm tube = 2 Special = 0	0.25m = 1 0.5m = 2 Special = 0	None = 1 FC/PC = 2 FC/APC = 3 SC/PC = 4 SC/APC = 5 ST/PC = 6 LC/PC = 7 Special = 0	Standard = 1 Space Grade = 2 Mil-Grade = 3 Special = 0

[1]. The default connector configuration uses fiber with 0.9 mm buffer protection. The connector cannot be installed directly onto bare fiber because the bare fiber is prone to damage during shipping. However, the connector can be assembled on bare fiber if a 3 cm protective loose tube is added for reinforcement. The customer may remove this protective tube after testing. The optical power handling of a standard connector is less than 0.5 W for SMF-28 fiber and decreases further for smaller-core fibers.

[2]. Space-grade devices are designed and manufactured to meet qualification standards for space applications. Mil-grade devices are manufactured using specialized processes to ensure extended operational life in harsh environments, including exposure to vibration and large temperature fluctuations.

Items marked in red are available by special order and require a Non-Recurring Engineering (NRE) fee.

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DATASHEET

Q & A (page 1)

Q1: What is the operating wavelength range (or bandwidth)?
A: Standard devices operate from 1260 nm to 1650 nm, covering all typical telecom wavelengths. Performance data are typically provided at 1550 nm, with data at 1310 nm available upon request.
An ultra-broadband version is also available, covering 970–1650 nm. Datasheets for wavelengths other than 1550 nm or 1310 nm may not be available.

Q2: Can I operate at 980 nm, 1060 nm, 1310 nm, or 530 nm wavelengths?
A: Yes. Devices can be customized with user-provided fiber or General Photonics' in-house fiber for wavelengths outside the standard 1550 nm range, including 980 nm, 1060 nm, 1310 nm, or 530 nm for single-mode propagation.
The operating wavelength must be specified when ordering. Standard fibers cover 1260–1650 nm or 980–1310 nm. Devices using nonstandard fibers may have different performance characteristics and warranty terms.

Q3: What is the insertion loss (IL) of the device?
A: Devices are manufactured with continuous optical fiber. Total insertion loss includes intrinsic fiber loss and mechanical effects. Typical IL is ~0.05 dB at 1550 nm.

Q4: What is the activation loss of the device?
A: Activation loss is the change in device insertion loss during operation, primarily caused by micro-bending in the fiber when PZTs are actuated.
Activation loss is specified under full DC voltage (150 V). Devices are designed for extremely low activation loss, typically <0.01 dB, and special units with <0.005 dB are available upon request.

Q5: Why is low activation loss important?
A: Low activation loss is critical for two main applications:

- PDL measurements: Higher activation loss increases measurement uncertainty. For example, an activation loss of 0.2 dB adds at least 0.2 dB uncertainty to the measurement.
- Polarization scrambling: Higher activation loss introduces amplitude noise into the optical signal, which can degrade signal quality or interfere with detection.

Q6: What is the difference between a Polarization Controller and a Scrambler?

Feature	Polarization Controller	Polarization Scrambler
Function	Static or quasi-static polarization control	Dynamic polarization scrambling
Optimized parameters	Speed and bandwidth	Low activation loss (<0.01 dB) and low resonant V_{π}

Q7: What is the response time of the device?
A: When driven by a low-amplitude square wave, the rise and fall times (switch-on time) are approximately 30 µs.

Q8: How fast can you switch from one SOP to another SOP using the device?
A: The switching speed depends on the number of steps used by the control algorithm and actuators to reach the desired SOP.

- The fastest switching occurs when only one step is involved: ~30 µs.
- For multiple steps, switching speed is approximately N × 30 µs (N = number of steps).
- A small settling time may be required for the final SOP to stabilize. Overall, switching speed depends on the control algorithm.

Q9: Can SOP Stokes values be maintained when the driving voltage is switched from ON to OFF? How repeatable is it?
A: Tests using the PCS-3X with constant DC voltages (V1=V2=V3=70V) showed a drift rate of ~0.01 dB/hr over 12 hours when the fiber was taped to an optical table. This demonstrates excellent SOP stability under both ON and OFF conditions.

Q10: Is there any hysteresis in your actuator?
A: Yes. The actuator exhibits non-symmetric displacement when forward and reverse voltages are applied. Hysteresis curves can be observed in optical transmission on an oscilloscope when an oscillating voltage is applied. Hysteresis increases with sweep voltage amplitude.

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Q & A (page 2)

Q11: How can I use the device as a polarization stabilizer?
A: An SOP stabilization system requires three elements:

1. SOP generator (device functions as this)
2. SOP monitor (e.g., polarimeter)
3. Control circuit

Based on the driving conditions and SOP monitor signals, a control circuit can be implemented for open-loop or closed-loop SOP stabilization.

Q12: Will your electro-mechanical actuator damage optical fiber?
A: No. The maximum mechanical stress applied to the fiber is comparable to or smaller than typical polarization-maintaining fibers. Manufacturing processes and material selection ensure high durability, and under extreme activation conditions, the fiber's MTTF exceeds one billion years.

Q13: What drivers are available for the polarization controllers?
A: The controller can be supplied with or without an integrated driver board.

- With integrated driver: On-board DC/DC converter, accepts 0–5V analog control or digital TTL control. Mini integrated drivers are also available for OEM applications.
- Without driver: Requires external high-voltage supply.

Q14: How can I remote control the driver? Do you provide operation utilities for remote communication?
A: The device can be digitally controlled using TTL levels, requiring:

- R/W bit, chip select, 2 channel-control bits, and 12 signal bits.
- A DIO card can generate control signals and many DIO cards can be remote-controlled via RS-232 or USB.

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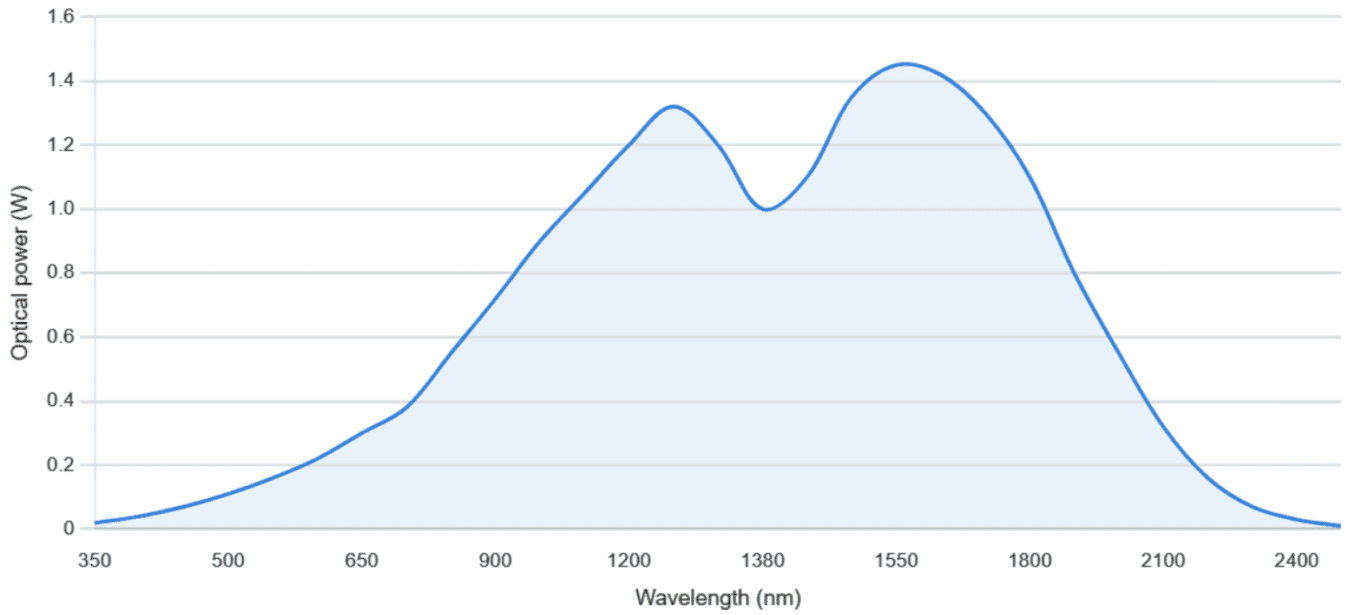
Regular Single Mode / Polarization Maintaining Fiber Optical Power Handing vs Wavelength



Single mode fiber optical power is limited by nonlinear effects in addition to absorption that increase loss and generate heat. The curve shows the approximate safe CW power envelope for standard single-mode fiber. Actual limits depend on fiber design, core size, length, and laser characteristics. Specialty fibers can significantly increase the power limit.

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