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BENCHTOP POLARIZATION EXTINCTION RATIO METER

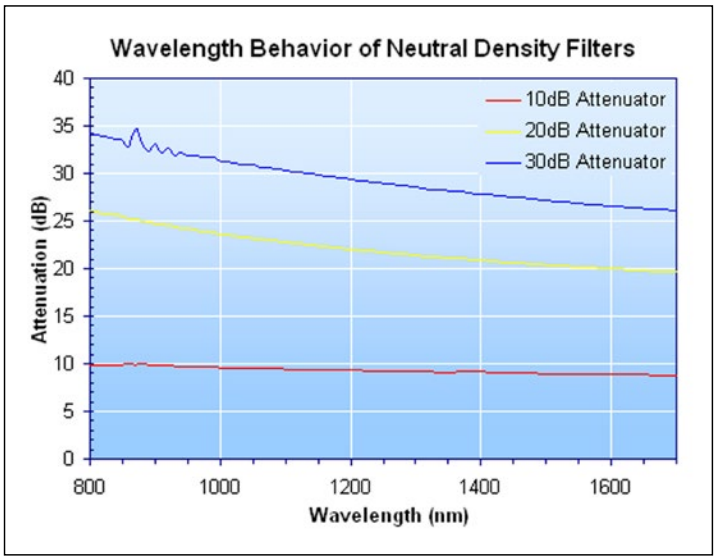
Features:

- Measures up to 50 dB polarization extinction ratios (for specific wavelength range)
- Very wide wavelength range: 450 to 900 nm and 550 to 1000 nm for visible wavelength range; 850 to 1650 nm or 1800 to 2400 nm for IR wavelength range
- ±0.15 dB ER accuracy up to 30 dB
- ±0.5° angle accuracy
- 0.01 dB ER resolution and 0.3° angle resolution
- Power measurement up to 2 Watts
- Interchangeable connector adaptors
- Logging mode for continuous measurement
- USB communications interface
- Touch screen display
- Built-in memory for store and recall functions

ER-1000 front view

Applications:

- Fiber optic component manufacturing and testing
- PMC and PBS PER and coupling ratio testing
- PM fiber laser diode pigtailing
- PM fiber patch cord production and testing
- PM fiber fusion splice testing
- Automatic alignment
- Quality control and measurement
- Product development
- Component and system troubleshooting



Product Description:

OZ Optics' Polarization Extinction Ratio Meter allows one to quickly measure the output extinction ratio of light from a fiber. A rotating polarizer measures the extinction ratio (ER) and the orientation of the transmission axis with respect to the key on the connector. As an option, neutral density filters can be added to the Extinction Ratio Meter, to extend the maximum power range. These filters can be easily inserted and removed, without disturbing your setup. These filters allow power levels up to 2 Watts to be measured.

The meter operates in several modes. In real time mode, the meter gives the extinction ratio and alignment. In logging mode, the meter gives the worst case extinction ratio over a given time span. This mode is ideal for QA measurements.

In addition the meter can provide a relative power readout, proportional to the input power in dB. This readout is updated at up to 650 times per second. The computer interface allows the unit to be used with computer control units, for alignment purposes. The combination of polarization and relative power functions allows the unit to be used for complete auto-alignment of polarization maintaining components.

Ordering Information For Standard Parts:

Bar Code	Part Number	Description
		Benchop ER Meters
56051	ER-1000-1290/1650-ER=50	Fiber Optic Polarization Extinction Ratio Benchtop Meter for wavelengths from 1290 nm to 1650 nm. ER = 50 dB. Receptacle is not included. Input power is up to 1 mW.
56052	ER-1000-IR	Fiber Optic Polarization Extinction Ratio Benchtop Meter for wavelengths from 850 nm to 1650 nm. ER = 30 dB for wavelengths from 850 nm to 1290 nm and ER=35 dB for wavelengths longer than 1290 nm. Receptacle is not included. Input power is up to 1 mW.
56055	ER-1000-VIS	Fiber Optic Polarization Extinction Ratio Benchtop Meter for wavelengths from 450 nm to 900 nm. ER > 30 dB over the wavelength range. Receptacle is not included. Input power is up to 1 mW.
56053	ER-1000-1800/2400-ER=30	Fiber Optic Polarization Extinction Ratio Benchtop Meter for wavelengths from 1800 nm to 2400 nm. ER = 30 dB. Receptacle is not included. Input power is up to 1 mW.
		Receptacles
13440	ER-23-1290/1650-ER=40	Super and Ultra FC removable receptacle for ER Meter for wavelengths from 1290 nm to 1650 nm achieving up to 40 dB extinction ratio
13441	ER-23A-1290/1650-ER=40	Angled FC removable receptacle for ER Meter for wavelengths from 1290 nm to 1650 nm achieving up to 40 dB extinction ratio
8705	ER-23-IR	Super and Ultra FC removable receptacle for ER Meter for wavelengths from 850 nm to 1650 nm achieving up to 30 dB extinction ratio
7525	ER-23A-IR	Angled FC removable receptacle for ER Meter for wavelengths from 850 nm to 1650 nm achieving up to 30 dB extinction ratio
7528	ER-2SC-IR	SC removable receptacle for ER Meter for wavelengths from 850 nm to 1650 nm achieving up to 30 dB extinction ratio
8874	ER-2LC-IR	LC removable receptacle for ER Meter for wavelengths from 850 nm to 1650 nm achieving up to 30 dB extinction ratio
7526	ER-28-IR	ST removable receptacle for ER Meter for wavelengths from 850 nm to 1650 nm achieving up to 30 dB extinction ratio
13165	ER-23-VIS	Super and Ultra FC/PC removable receptacle for ER meter optimized for 480-1000 nm
14320	ER-23A-VIS	FC/APC removable receptacle for ER meter optimized for 480-1000 nm
		Attenuators
10626	ER-ND-10-450/1700	10 dB attenuator for ER Meter for wavelengths from 450 nm to 1700 nm
8704	ER-ND-20-IR	20 dB attenuator for ER Meter for wavelengths from 850 nm to 1650 nm
9471	ER-ND-35-1250/1650	35 dB attenuator for ER Meter for wavelengths from 1250 nm to 1650 nm
		Sources
11378	PFOSS-02-3-1550-1-ER=40	1550 nm, 1 mW Polarized Fiber Optic Source with a Super/Ultra FC/PC receptacle and rotatable polarizer achieving up to 40 dB extinction ratio (Refer to Data Sheet titled Polarized Fiber Optic Source for further information.)
13507	PFOSS-02-3-1310-1-ER=40	1310 nm, 1 mW Polarized Fiber Optic Source with a Super/Ultra FC/PC receptacle and rotatable polarizer achieving up to 40 dB extinction ratio
13509	PFOSS-02-3A-1310-1-ER=40	1310 nm, 1 mW Polarized Fiber Optic Source with angled FC/PC receptacle and rotatable polarizer achieving up to 40 dB extinction ratio
13508	PFOSS-02-3A-1550-1-ER=40	1550 nm, 1 mW Polarized Fiber Optic Source with angled FC/PC receptacle and rotatable polarizer achieving up to 40 dB extinction ratio
		Reference Patchcords
13390	PMJ-3U3U-1550-8/125-1-1-1-ER=30-G	Master patchcord, Ultra FC/PC to Ultra FC/PC, 8/125 um PM 1550 nm fiber, 0.9 mm OD jacketed, 1 meter long with connectors aligned and locked to the slow axis. ER=30 dB minimum
13386	PMJ-3A3A-1550-8/125-1-1-1-ER=30-G	Master patchcord, angled FC/PC to angled FC/PC, 8/125 um PM 1550 nm fiber, 0.9 mm OD jacketed, 1 meter long with connectors aligned and locked to the slow axis. ER=30 dB minimum

Note: This is only a partial list of standard parts offered by OZ Optics. Other parts are available as standard products.

Standard Product Specifications[1]:

Part Number	ER-1000-VIS	ER-1000-1290/1650-ER=50	ER-1000-IR	ER-1000-1800/2400
Bar Code Number	56055	56051	56052	56053
Wavelength Range	450 nm to 900 nm[2]	1290 nm to 1650 nm	850 nm to 1650 nm	1800 nm to 2400 nm
Extinction Ratio Range	30 dB	40 dB for 1290 nm to 1650 nm 0 to 50 dB for 1550 nm & input power >-5 dBm 0 to 40 dB for 1550 nm & input power >-15 to –5 dBm 0 to 30 dB for 1550 nm & input power >-25 to –15 dBm 0 to 20 dB for 1550 nm & input power >-35 to –25 dBm	30 dB for 850 nm to 1290 nm 35 dB for 1290 nm to 1650 nm	30 dB
Dynamic Range	40 dB	60 dB	47 dB	35 dB
Extinction Ratio Accuracy	±0.5 dB	±0.15 dB for ER < 30 dB[1]	±0.5 dB	±0.5 dB
Extinction Ratio Resolution	0.01 dB			
Angular Accuracy[3]	± 0.5 degrees			
Angular Resolution	0.3 degrees			
Update Rate (Extinction Ratio)	2.7 Hz			
Update Rate (Relative Power)	650 Hz			
Input Optical Power[4]	50 µW to 1.0 mW			
Communication Interface	USB			
Input Supply Voltage	Universal 50/60 Hz 110/220V AC/DC 12 volt adapter			
Dimensions	100 x 280 x 300 mm (excluding handle and connectors)			
Weight	4.1 kg (9 lb)			
Operating Temperature	-10° to 55°C (14 to 131°F)			
Storage Temperature	-30° to 70°C (-22 to 158°F)			
Storage Humidity	<85%, RH non condensing at -30° to 70°C (-22 to 158°F)			
Display	Touch Screen			

1 Typical value. Tested at 23°C ± 2°C with a linearly polarized source plus a master polarization maintaining patchcord, after a 30 minute warm-up period.

2 Dependent on receptacle used, by default the receptacle is aligned at 780 nm and the lens is coated with MgF2 on both surfaces.

3 For FC style connectors with high tolerance keyway.

4 Without attenuator. Higher powers can be measured with an attenuator. When ordering an attenuator with >20 dB attenuation, the wavelength should be specified. Note: Exposing the detector to power higher than +17 dBm (50 mW) without attenuator for a short period of time (3 minutes) can damage the detector.

Ordering Examples For Standard Parts:

A customer in Europe needs an Benchtop Extinction Ratio Meter to measure the polarization properties of pigtailed laser diodes, to confirm that the polarization extinction ratio exceeds 30 dB. The lasers are 1550 nm lasers, with output power between 5 and 10 mW. The fibers are terminated with either Super FC/PC, or with FC/APC connectors. The customer also wants a source and reference patchcord for comparison. The following equipment will be needed:

Bar Code	Part Number	Description
56051	ER-1000-1290/1650-ER=50	Fiber Optic Polarization Extinction Ratio Benchtop Meter for wavelengths from 1290 nm to 1650 nm. ER = 50 dB. Receptacle is not included. Input power is up to 1 mW
13440	ER-23-1290/1650-ER=40	Super and Ultra FC removable receptacle for ER Meter for wavelengths from 1290 nm to 1650 nm achieving up to 40 dB Extinction Ratio
13441	ER-23A-1290/1650-ER=40	Angled FC removable receptacle for ER Meter for wavelengths from 1290 nm to 1650 nm achieving up to 40 dB Extinction Ratio
10626	ER-ND-10-450/1700	10 dB attenuator for ER Meter for wavelengths from 450 nm to 1700 nm
11378	PFOSS-02-3-1550-1-ER=40	1550 nm, 1 mW Polarized Fiber Optic Source with a Super/Ultra FC/PC receptacle and Rotatable polarizer achieving up to 40 dB Extinction Ratio (Refer to data sheet titled Polarized Fiber Optic Source for further information.)
13390	PMJ-3U3U-1550-8/125-1-1-1-ER=30-G	Master patchcord, Ultra FC/PC to Ultra FC/PC, 8/125 um PM 1550 nm fiber, 0.9 mm OD jacketed, 1 meter long with connectors aligned and locked to the slow axis. ER=30 dB minimum
13386	PMJ-3A3A-1550-8/125-1-1-1-ER=30-G	Master patchcord, angled FC/PC to angled FC/PC, 8/125 um PM 1550 nm fiber, 0.9 mm OD jacketed, 1 meter long with connectors aligned and locked to the slow axis. ER=30 dB minimum

Ordering Information For Custom Parts:

OZ Optics welcomes the opportunity to provide custom designed products to meet your application needs. As with most manufacturers, customized products do take additional effort so please expect some differences in the pricing compared to our standard parts list. In particular, we will need additional time to prepare a comprehensive quotation, and lead times will be longer than normal. In most cases non-recurring engineering (NRE) charges, lot charges, and a 1 piece minimum order will be necessary. These points will be carefully explained in your quotation, so your decision will be as well-informed as possible. We strongly recommend buying our standard products.

Questionnaire For Custom Parts:

1) What is your application?
2) Will you be using the device at a specific wavelength?
3) What is the maximum extinction ratio that you will need to measure?
4) Do you require external control from a computer?
5) What type of computer interface do you require?
6) What is the maximum power level that you will be using?
7) What type of connector will you be using?

P = Attenuation Level: 10 dB, 20 dB, 30 dB or 35 dB
Note: For attenuations over 20 dB, specify the wavelength in nm

W = Wavelength Range (in nm) **VIS** for 450-900 nm
550/1000 for 550-1000 nm
IR for 850-1650 nm
1800/2400 for 1800-2400 nm

Note: If an ER of 50dB is required then specify either 980/1060 or 1290/1650 for the wavelength, and add "-ER=50" to the part number. ER>50 dB is only achieved on IR models over 980 to 1060 nm, and 1290 to 1650 nm wavelength ranges.

Description	Part Number
Extinction Ratio Meter:	ER-1000-***W***
Attenuators:	ER-ND-***P***-***W***

X = Connector Code: 3A = Angled NTT-FC/PC
8 = AT&T-ST
E = E2000
SC = SC
SCA = Angled SC
LC = LC
LCA = Angled LC
MU = MU

Consult factory for special connector and ferrule adaptors.

Connector Adaptors: ER-2***X***-***W***

W = Wavelength Range in nm:
VIS for 480-1000 nm
IR for 850-1650 nm
1800/2400 for 1800-2400 nm

Reference Patchcords:

PMJ-***XY***-***W***-***a/b***-1-1-1-***ER=nn***-G

X,Y = Connector Code: 3A = Angled NTT-FC/PC
3S = Super NTT-FC/PC connector
3U = Ultra NTT-FC/PC connector
8 = AT&T-ST
SC = SC
SCA = Angled SC
LC = LC
MU = MU

Consult factory for special connector and ferrule adaptors.

W = Wavelength (in nm):
Example: (1550 for 1550 nm, 1300 for 1300 nm, 980 for 980 nm)

a/b = Fiber core and cladding sizes, in microns:
(6/125 for 980 nm PM fiber, 7/125 for 1300 nm PM fiber, 8/125 for 1550 nm PM fiber)

ER = 30 for fiber core size equal to 5 µm to 8 µm

ER = 25 for 4 µm and 3.5 µm core fiber.

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Ordering Example for Custom Parts:

A manufacturer of high power lasers for 2000 nm applications wants to do incoming extinction ratio qualification, at 2000 nm, of any purchased optical components prior to using them in his systems. They need to order these following parts:

Bar Code	Part Number	Description
45284	HIPFOSS-02-3A-2020-2-ER=40-SP	2020 nm, 2 mW Highly Stable Polarized Fiber Optic Source with an angle FC/APC compatible receptacle, rotatable polarizer, achieving over 40 dB extinction ratio. SP:2020+/-20 nm, 2 mW highly stable polrized fiber optic source with built in TEC isolator over 40 dB extinction ratio
56053	ER-1000-1800/2400-ER=30	Fiber Optic Polarization Extinction Ratio Benchtop Meter for wavelengths from 1800 nm to 2400 nm. ER = 30 dB. Receptacle is not included. Input power is up to 1 mW.
42851	ER-23A-1800/2400-ER=35	Angled FC removable receptacle for ER Meter for wavelengths from 1800 nm to 2400 nm achieving up to 35 dB extinction ratio. Tested at discrete wavelength. Performance over specified wavelength range guaranteed by design only.
45213	ER-23-1800/2400-ER=35	FC/ PC, UPC removable receptacle for ER Meter for wavelengths from 1800 nm to 2400 nm achieving up to 35 dB extinction ratio. Tested at discrete wavelength. Performance over specified wavelength range guaranteed by design only.

Application Notes:

Comparison of the OZ ER meter with results from a polarimeter

A common alternate technique used in polarization analysis is through the use of a polarimeter. These devices work by mathematically mapping the output polarization from a source onto what is known as a Poincaré sphere. By monitoring the variation of the polarization over time on this Poincaré sphere, one can calculate the variation in the polarization and presumably the degree of polarization itself.

There are two principle drawbacks with this technique. The first is that to map the polarization onto the Poincaré sphere, polarimeters subtract any randomly polarized light from the signal. Thus any calculation of the polarization extinction ratio using a polarimeter ignores this signal. This results in reported values that are more optimistic than that given by the OZ Extinction Ratio Meter. The Extinction Ratio Meter gives a more conservative and more reliable result.

The second drawback is that most fiber optic polarimeters utilize singlemode fiber to transmit light to its internal sensors. The singlemode fiber itself changes the polarization to an arbitrary polarization. Therefore fiber optic polarimeters are only suitable for measuring relative changes. This makes them unsuitable for alignment of polarization maintaining connectors.

General Considerations

OZ Optics Polarization Extinction Ratio Meters, together with OZ Optics Highly Stable Polarized Sources, provide a quick, reliable, and effective means to align, characterize, and QA polarization maintaining components. To ensure that your measurements are as accurate as possible, the following precautions should be taken.

1. Check your reference angle:

The OZ Optics Extinction Ratio Meter provides a reading of the polarization axis orientation compared to the keyway on the receptacle. However, if the receptacle is exchanged or replaced, the orientation might be changed by a few degrees.

To ensure that the angle reading is accurate, OZ Optics supplies master reference patchcords. These patchcords maintain polarization to better than 30 dB, and are aligned to within ±1.5 degrees of the connector keyway. A menu option allows one to adjust the angle reference to any desired value, allowing one to compensate for any offset. Note that a misalignment of θ degrees between the source and the fiber will degrade the extinction ratio and the maximum ER that can be achieved will be given by:

$$ER \leq 10 \log (\tan^2 \theta)$$

2. Stress the fiber:

When working with a highly coherent source, such as a DFB laser, it is possible to get readings that initially meet specifications, but degrade over time. This degradation of the extinction level can take several minutes to occur. This behavior occurs because part of the light within the fiber is traveling along the wrong axis. At the output end of the fiber the light traveling along the slow and fast axes combine to form a unique polarization state. If the two signals are in phase with one another, they will form linearly polarized light. However, as the fiber is stressed, the phase relation will change and so will the output polarization.

To check for this behavior, one should stress the fiber while measuring the polarization. The meter has a data logging mode for this function. To use it, activate the logging mode through the menu, then apply stress to the device under test. One common method is to simply wrap the fiber several turns around a mandrel, 40 or 50 mm in diameter. Such a mandrel is available from OZ Optics. A second technique is to heat the fiber with a warming plate. After stressing the fiber, stop the logging mode. The meter will then display the worst case extinction ratio, and the variation in the polarization angle. Use these readings as the performance specification. Refer to the manual for further details.

3. Look both ways:

If a device is being used to transmit light in either direction, then it should be inspected in both directions. The performance of a device will depend on the direction in which it is used. This is because stresses and microbends usually occur near the fiber ends. If the microbend is at the output end of the fiber, then the output polarization may be rotated, but otherwise remain static. However if the microbend is at the input end, then the polarization is perturbed before travelling through the fiber, so the polarization will vary.

4. Autoalign components using the computer interface.

The meter can report both power and extinction ratios to a computer control system via the USB interface. This can be used to develop an auto-alignment system. The power level can be reported at over 650 samples per second, which is sufficient for rapid alignment. A complete set of application notes, one on polarization measurements (POLARIZATION MAINTAINING MEASUREMENT SYSTEMS), the other on how to use the meter for alignment applications (AUTOMATED POLARIZATION ALIGNMENT) are available from our website (www.ozoptics.com).

5. Measurement limits

The detection circuitry for the ER meter has an overall dynamic range of about 60 dB. When the input signal has a power level within the range of 300 µW to 1 mW (a 5 dB range), this leaves at least a 55 dB range for the ER measurement itself. Since the extinction ratio is based on the ratio of two values, a minimum and a maximum, the minimum value may approach the noise floor of the instrument if the extinction ratio is really good or the input power is close to 300 µW or below. In such a case, the minimum value may default to the noise floor of the instrument. Under these conditions, the instrument may not be able to provide an accurate reading. However, it will be able to determine a worst case value, which will be indicated to the user as such. By using a higher-powered source, the instrument will be able to provide an improved reading. For example, with a low power signal, the ER meter may indicate that an extinction ratio is >27 dB. If the user needs to know whether the actual value is over 30 dB, then a more powerful source should be used. If the ER meter has an optional attenuator installed, the user could simply remove the attenuator.

ER-1000 front view angled

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