



OZ Optics

shop.ozoptics.com
www.ozoptics.com

219 Westbrook Road
Ottawa, ON, Canada, K0A 1L0

Toll-free: 1-800-361-5415
Telephone: 1-613-831-0981
Fax: 1-613-836-5089
sales@ozoptics.com

BENCHTOP POLARIZATION EXTINCTION RATIO METER

PRELIMINARY SPECIFICATIONS

Features:

- Measures up to 50 dB polarization extinction ratios (for specific wavelength range)
- Very wide wavelength range: 450 to 900 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
- $\pm 0.5^\circ$ 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

Applications:

- Fiber optic component manufacturing and testing
- PMC and PBS PER and coupling ratio testing
- PM fiber laser diode pigtailed
- 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:

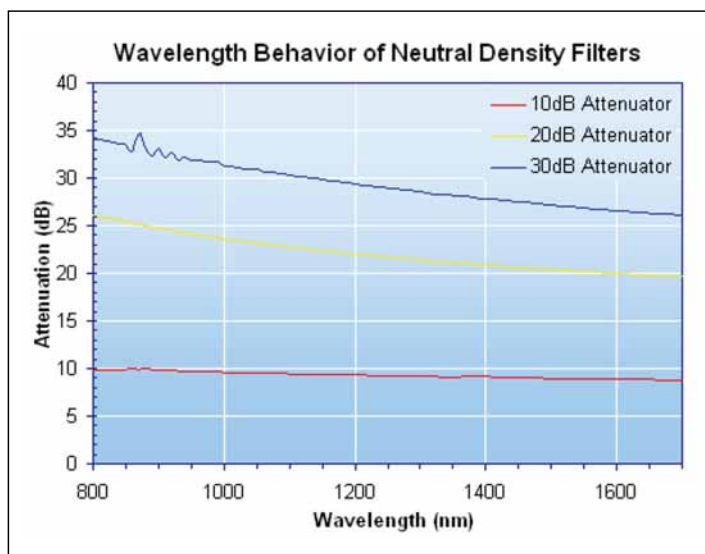
OZ Optics' Polarization Extinction Ratio Meter allows one to quickly measure the output extinction ratio of light from a fiber. A rotating polarizer measures the extinction ratio (ER) and the orientation of the transmission axis with respect to the key on the connector. As an option, neutral density 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.



ER-1000 front view



Ordering Information For Standard Parts:

| Bar Code | Part Number | Description |
|-----------------------------|-----------------------------------|---|
| Benchtop 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 = 50dB. 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 = 30dB for wavelengths from 850 nm to 1290 nm and ER=35dB 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 > 30dB 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 = 30dB. 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 400-1000 nm |
| 14320 | ER-23A-VIS | FC/APC removable receptacle for ER meter optimized for 400-1000 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=30dB 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=30dB minimum |

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

Standard Product Specifications¹:

| | | | | |
|----------------------------------|--|--|---|--------------------|
| 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 | 30dB | 40dB for 1290 nm to 1650 nm 0 to 50dB for 1550 nm & input power >-5 dBm 0 to 40dB for 1550 nm & input power >-15 to -5 dBm 0 to 30dB for 1550 nm & input power >-25 to -15 dBm 0 to 20dB for 1550 nm & input power >-35 to -25 dBm | 30dB for 850 nm to 1290 nm 35dB for 1290 nm to 1650 nm | 30dB |
| Dynamic Range | 40dB | 60dB | 47dB | 35dB |
| Extinction Ratio Accuracy | ±0.5dB | ±0.15dB for ER < 30 dB ¹ | ±0.5dB | ±0.5dB |
| Extinction Ratio Resolution | 0.01dB | | | |
| 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 1550 nm linearly polarized source plus a master 1550 nm 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 >20dB attenuation, the wavelength should be specified. Note: Exposing the detector to power higher than +17dBm (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 = 50dB. 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 µm PM 1550 nm fiber, 0.9 mm OD jacketed, 1 meter long with connectors aligned and locked to the slow axis. ER=30dB minimum |
| 13386 | PMJ-3A3A-1550-8/125-1-1-1-ER=30-G | Master patchcord, angled FC/PC to angled FC/PC, 8/125 µm PM 1550 nm fiber, 0.9 mm OD jacketed, 1 meter long with connectors aligned and locked to the slow axis. ER=30dB 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: 10dB, 20dB, 30dB or 35dB

Note: For attenuations over 20dB, specify the wavelength in nm

W = Wavelength Range (in nm) **VIS** for 450-900 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.

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
2.5U = Universal adaptor for
2.5 mm diameter ferrules
1.25U = Universal adaptor for
1.25 mm diameter ferrules

Consult factory for special connector and ferrule adaptors.

Description

Part Number

Extinction Ratio Meter:

ER-1000-**W**

Attenuators:

ER-ND-**P-W**

Connector Adaptors:

ER-2**X-W**

W = Wavelength Range in nm:
VIS for 400-1000 nm
IR for 850-1650 nm
1800/2400 for 1800-2400 nm

Reference Patchcords:

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)

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

ER = 30 for fiber core size
equal to 5µm to 8µm
ER = 25 for 4µm and 3.5µm
core fiber.

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, 2mW highly stable polarized fiber optic source with built in TEC isolator over 40dB 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 = 30dB. 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 35dB 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 35dB 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 30dB, 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 μ W 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 μ W 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