## BRISTOL INSTRUMENTS

## **MULTI-WAVELENGTH METER**

### 438 Series



# Accurate, reliable, and fast WDM wavelength testing.

The 438 Series Multi-Wavelength Meter from Bristol Instruments combines proven Michelson interferometer-based technology with fast Fourier transform analysis in order to measure the wavelength, power, and OSNR of as many as 1000 discrete optical signals. With features such as high accuracy, 10 Hz measurement rate, and a broad operational range of 1000 to 1680 nm, the model 438 provides the most precise, efficient, and versatile wavelength testing of optical transceivers and WDM signals.

Two versions of the 438 Multi-Wavelength Meter are available. The model 438A is the most precise, providing an accuracy of  $\pm$  0.3 pm. For less exacting test requirements, the model 438B is a lower-priced

alternative with a wavelength accuracy of ± 1.0 pm. Continuous calibration with a built-in wavelength standard ensures the utmost confidence in the test results.

The rugged design of the 438 Multi-Wavelength Meter provides long-term reliable operation, backed by a five-year warranty on all parts and labor. This results in less downtime and the lowest cost of ownership available.



Software is available to convert the system to a high-resolution OSA.

#### **Key Features:**

- Wavelength accuracy as high as ± 0.3 pm.
- Continuous calibration with a built-in wavelength standard.
- Measurement confidence level of  $\geq$  99.7%.
- Power measured to an accuracy of  $\pm 0.5$  dB.
- Automatically calculates OSNR to > 40 dB.
- Automatic reporting of SMSR.
- Fastest measurement rate of 10 Hz.
- Broad operational range of 1000 nm to 1680 nm.
- Operates with CW and modulated signals.
- Convenient touch-screen display reports measurement data in a variety of formats.
- Interfacing via SCPI using USB, Ethernet, or GPIB.
- Rugged design for manufacturing environments.
- Five-year warranty covers all parts and labor.

NODEL         438A         4488           OPTICAL SIGNAL         CV with modulied           WAVELENGTH         CV with modulied           Range         Option -001 1270 - 1860 nml (75 - 256 THat or Option -002 1000 - 1600 nml (175 - 200 THat or 0.250 pmts per million is 0.250 pmts per mits per million is 0.250 pmts per million is 0.250 p	SPECIFICATIONS		438 Series
OPTICAL SIGNAL         CW and mediadated           WAXELENSTH         Range           Range         Option -001: 1270 - 1580 nml (127 - 250 THa)         Option -002: 1200 - 1680 nml (127 - 200 THa)           Accuracy 12.3         +-0.2 ports per million (+-0.5 pm nt 1560 nml)        0.6 pp nt per million        0.6 pp nt per million           Minimum Resolvable Separation N4        0.15 pm nt 1560 nml        0.6 pp nt per million        0.6 pp nt per million           Calibration         Continuous - balk-in stabilized single-frequency, there have         Continuous - balk-in stabilized single-frequency, there have         0.0001 nm	MODEL	438A	438B
WAVELENGTH         Option-0011270-1680 mm 1179-258 TH2         Option-002:1000-1680 mm 1179-300 TH2           Accuracy <sup>1,1,1</sup> = 0.2 parts per million {-0.2 pins at 1560 nm}         = 0.66 parts per million {-1.0 pins at 1560 nm}           Differential Accuracy <sup>1,1,1</sup> = 0.0 parts per million {-0.2 pins at 1560 nm}         = 0.50 parts per million {-0.2 pins at 1560 nm}           Option         Continuous - built in stabilized single-finguncy Melo lacer         Continuous - built in stabilized single-finguncy Melo lacer           Display Resolution         0.0000 nm         0.0000 nm         0.0000 nm           Units <sup>5</sup> mm cm 1016, 1330, and 1550 nm         0.0001 nm           POWER         Colliprotion Accuracy         + 0.5 dd (+ 0 nm from 1064, 1330, and 1550 nm)           Units <sup>5</sup> mm cm 1016, 1330, and 1550 nm         0.0001 nm           Polerization Dependence         1 0.5 dB (1000 - 1000 mm), litre dows - 00 dm         0.01 nm           Units         dBm cm/, µW         SIDE-MODE-SUPPRESSION RATIO <sup>4</sup> > 40 dd (100 overogen), a 100 CHz channel spacing         > 30 dd (100 overogen), a 50 GHz channel spacing           SIDE-MODE-SUPPRESSION RATIO <sup>4</sup> > 40 dd (100 overogen), a 100 CHz channel spacing         > 30 dd (100 overogen), a 50 GHz channel spacing           Maximum Rower         +10 dBm, cm of allows into trap anoxit. Nm, will         Side (100 overogen), a 50 GHz channel spacing	OPTICAL SIGNAL	CW and modulated	
Range         Option -001: 1270 - 1680 nm (178 - 286 The)         Option -002: 1000 - 1680 nm (178 - 100 The)           Accuracy 1+2.3         = 0.2 parts per million  = 0.2 parts 1500 nm)         = 0.65 parts per million         = 0.0001 nm	WAVELENGTH		
Accuracy <sup>2,2,3</sup> 1 0.2 parts per million (2.0 g no 0.1550 nm)         2.055 parts per million (2.10 pm ot 2550 nm)           Inferential Accuracy <sup>2,4,2,4</sup> - 0.3 parts per million         - 0.5 parts per million         - 0.5 parts per million           Minimum Resolvable Separation <sup>3,4</sup> 0.0 the (sparaty per willion (2.00 mm)         - 0.5 parts per million           Califoration         Continuous - built-in stabilized single-Requery Hele Iser         Continuous - built-in stabilized single-Requery Hele Iser           Display Resolution         0.00001 nm         0.00001 nm         0.0001 nm           Units <sup>3</sup> enc.m <sup>2</sup> , TH-           Calibration Accuracy         4.0.5 dB 4.3 0 nm from 1064, 1310, and 1590 nml           Interarity <sup>4</sup> e.0.3 dB (100 mm), fires above - 30 dBm           Display Resolution         0.001 m         0.01 dB           Units         dBm. MMD, µW         3.00 dB (100 mm, montol64, 1310, and 1590 nml           SIGE-MODE-SUPPRESSION RATIO *         9.40 dB (100 exernged), * 100 GBF tabant spoong         > 5.05 GB (100 exernged), * 5.05 GBF tabants qpoong           SIGE-MODE-SUPPRESSION RATIO *         > 4.00 dB (100 exernged), * 100 GBF tabants qpoong         > 5.05 GB (100 exernged), * 5.05 GBF tabants qpoong           SIGE-MODE-SUPPRESSION RATIO *         > 4.00 dB (120 exernged), * 100 GBF tabants qpoong 100 exernged), * 50 GBF tabants qpoong 4.00 dB (100 exernged), * 50 GBF tabants qpoong 4.00 dB (100 exe	Range	Option -001: 1270 – 1680 nm (179 – 236 THz)	Option -002: 1000 – 1680 nm (179 – 300 THz)
Differential Accuracy <sup>4</sup> ± 0.15 parts per million         ± 0.5 parts per million           Infinitum Resolvabile Separation <sup>1+4</sup> 10.0 Hz lequid per times input)         International control of the series           Calibration         Carimous - hubit in standard Hable laser         0.0001 nm         0.0001 nm           Units <sup>1+</sup> 0.0001 nm         0.0001 nm         0.0001 nm           Units <sup>1+</sup> 0.0001 nm         0.0001 nm         0.0001 nm           Exploration Accuracy         ± 0.5 dB (± 30 nm from 1-600 nm, lines chore - 30 dBm         0.0001 nm           Polorization Dependence         ± 0.5 dB (± 00 nm from 1-600 nm, lines chore - 30 dBm         0.01 dB           Units         0.01 dB         0.01 dB         0.01 dB           Units         * 40 dB 100 ownge(b), ± 100 dPc chorel spoot         > 50 dB (100 ownge(b), ± 50 dPc chorel spoot           SIDE-MODE SUPPRESSION RATIO *         * 40 dB 100 ownge(b), ± 100 dPc chorel spoot         > 50 dB (100 ownge(b), ± 50 dPc chorel spoot           Maximum Power         * 40 dB 100 ownge(b), ± 100 dPc chorel spoot         > 50 dB (100 ownge(b), ± 50 dPc chorel spoot           Maximum Number of Lines 7         * 40 dB 11770, 1000 mS, 55 dB (100 ownge(b), ± 100 dPc chorel spoot         > 50 dB (100 control spoot           Maximum Number of Lines 7         * 100 dPc control spoot         100 dPc control spoot         100 dPc contr	Accuracy <sup>1, 2, 3</sup>	± 0.2 parts per million (± 0.3 pm at 1550 nm)	± 0.65 parts per million (± 1.0 pm at 1550 nm)
Minimum Resolvable Separation **         10 GHz (equal power lines input)           Calibration         Continuous - built-in stabilized single-frequency Hele loser         Continuous - built-in standard Hele loser           Display Resolution         0.0000 nm         0.0001 nm         0.0001 nm           Units *         nm.cm*, THz           FOUNDER         Calibration Accuracy         ± 0.5 dB (e 30 nm from 1064, 1310, and 1550 nm)           Interdity 4         ± 0.3 dB (1000 1600 nm)         1000 nm)           Polycip Resolution         0.0001 nm         0.0001 nm           Units         ± 0.3 dB (1000 1600 nm)         1000 nm)           Display Resolution         0.0001 nm         0.0001 nm           Units         * 40 dB (100 overaget), * 100 GHz channel spacing         > 35 dB (100 overaget), * 50 GHz channel spacing           SIGE-MODE SUPPRESSION RATIO **         > 40 dB (1270 - 1500 nm), 35 dB (1000 - 1270 nm)         1000 nm           Maximum Power         * 40 dB (1270 - 1500 nm), 35 dB (100 0m - 1270 nm)         1000 nm           Maximum Power         * 40 dB (1270 - 1500 nm), 35 dB (100 0m - 1270 nm)         1000 nm           Maximum Number of Lines /*         0 Difference of measured workerghts no ingle dime ingle dim (1000 nm)           Dista Mo	Differential Accuracy <sup>4</sup>	± 0.15 parts per million	± 0.5 parts per million
Calibration         Cantinuous - built in stabilized single-frequency HeNe laser         Continuous - built in stabilized single-frequency HeNe laser           Display Resolution         0.00001 nm         0.00001 nm           Units *         mm. cm *, TH           Calibration Accuracy         ± 0.65 dB (± 30 nm from 1064, 1310, and 1550 nm)           Linearity 4         ± 0.3 dB 1000-1000 nm, lines above-30 dBm           Potrization Dependence         ± 0.3 dB 1000-1000 nm, lines above-30 dBm           Display Resolution         0.001 rd           Units *         0.40 dBm, mW, µW           SIGNAL-TO-NOISE RATIO **         > 40 dB (100 overoget), 2 30 dB rd > 0 dF (200 overoget), 2 50 GF (2 channel spacing > 35 dB (100 overoget), 2 50 GF (2 channel spacing space)           SIGNAL-TO-NOISE RATIO **         > 40 dB (102 overoget), 2 40 dB (100 overoget), 2 50 GF (2 channel spacing space)           SIGNAL-TO-NOISE RATIO **         > 40 dB (102 overoget), 2 40 dB (100 overoget), 2 50 GF (2 channel spacing space)           Moting Intermet Signal         -40 dBm (1270 - 1600 nm, -55 dBm (100 overoget), 2 50 GF (2 channel spacing space)           Moting Intermet Signal         -40 dBm (1270 - 1600 nm, -55 dBm (100 overoget), 4 00 dBm (1500 - 1500 nm)           Moting Intermet Signal         -40 dBm (1270 - 1600 nm, -55 dBm (100 overoget), 5 dB (4 PC connector), 50 dB (4 PC connect	Minimum Resolvable Separation <sup>3,4</sup>	10 GHz (equal power lines input)	
Display Resolution         0.00001 nm         0.00001 nm           Units 5         0.00001 nm         0.00001 nm           FVEE         0.00001 nm         0.00001 nm         0.00001 nm           Calibration Accuracy         2.05.69 (2.30 mm from 1064, 1310, ond 1550 nm)         0.00001 nm           Linearity 4         0.00001 nm         0.001.64         0.001.65           Polarization Dependence         2.05.69 (1.20 mm, inters above -30 dBm         0.001.67           Display Resolution         0.01.64         0.01.64           Units         0.40.68 (1000 overages), 2.50 GHz chonnel spocing         >3.6 dB (100 overages), 2.50 GHz chonnel spocing           Signative Resolution         >4.04.68 (1000 mm, 35 dBm (1000	Calibration	Continuous - built-in stabilized single-frequency HeNe laser	Continuous - built-in standard HeNe laser
Units <sup>3</sup> nn, cm <sup>3</sup> , TH2           POVER         Calibration Accuracy         £ 0.5 dB (± 30 nm from 1064, 1310, and 1550 nm)           Linearity 4         £ 0.3 dB (1000 - 1600 nm), lines above -30 dBm           Polization Dependence         £ 0.5 dB (1000 - 1600 nm), lines above -30 dBm           Display Resolution         0.01 dB         0.01 dB           Units         6 0.01 dB         0.01 dB           SIGENAL-TO-NOISE RATIO **         > 40 dB (100 overage), ± 100 GHz channel spading > 355 dB (E00 average), ± 50 GHz channel spading           SIGENAL-TO-NOISE RATIO **         > 30 dB ct ± 0.7 nm from peek           OPTI-CAL INPUT SIGNAL         > 30 dB ct ± 0.7 nm from peek           Sensitivity         Single-line input Multiple-line input 30 dB Berver, but not liss than single-line input 30 dB Berver at 10 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsplayed keel, +18 dBm, sum of al lines input (dsp	Display Resolution	0.00001 nm	0.0001 nm
PVVER         Calibration Accuracy         c 0.5 dB c 30 mm from 1064, 130, and 1550 mm]           Linearity 4         c 0.3 dB (1000 - 1600 nm). Linea above -30 dBm           Polorization Dependence         + 0.5 dB (1000 - 1600 nm)           Display Resolution         0.01 dB           Units         0.01 dB           SIGENAL-TO-NOISE RATIO 4-4         > 40 dB (100 everaged, ≥ 100 GHz channel spacing > 3 5 dB (100 averaged), ≥ 50 GHz channel spacing           SIDE-MODE-SUPPRESSION RATO*         > 30 dB be to 21 mm from peek           OPTCA            Sensitivity         Single-line input Multiple-line input         3 3 dB (1000 - 1220 nm), -30 dBm (1800 - 1650 nm) 3 3 dB below total input power, but not leas than single-line input sensitivity           Maximum Power         +10 dBm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all lines input (ldsplayed level, 1 adl Bm, sum of all	Units <sup>5</sup>	nm, cm <sup>-1</sup> , THz	
Calibration Accuracy         ± 0.5 dB (± 20 nm from 1084, 1310, and 1550 nm)           Linearity 4         ± 0.3 dB (1000 - 1600 nm), lines above -30 dBm           Polorization Dependence         ± 0.5 dB (1000 - 1600 nm)           Display Resolution         0.01 dB           Units         GBm, mW, µW           SIGENAL TO-NOISE RATIO 4*4         > 40 dB (1000 verages), ± 00 GHz channel spacing           SIDE-MODE-SUPPRESSION RATIO 4         > 30 dB dt ± 0.7 nm from pook           OPTICAL INPUT SIGNAL         > 30 dB dt ± 0.7 nm from pook           Maxiumum Power         +10 dBm, sum of al lines input (solo - 1650 nm)           Maxiumum Power         +10 dBm, sum of al lines input (solo lines input (s	POWER		
Linearity 4         ± 0.3 dB (1000 - 1600 nm), lines above -30 dBm           Polorization Dependence         ± 0.5 dB (1000 - 1600 nm)           Display Resolution         0.018           Units         dBm, mW, µW           SIGNAL-TO-NOISE RATIO +4         > 40 dB (100 overages), ± 100 CHz changeagoing         > 35 dB (100 overages), ± 50 GHz channel spacing           SIDE-MOE-SUPPRESSION RATIO +4         > 40 dB (1270 - 1600 nm), -35 dBm (1000 - 1270 nm), -30 dBm (1600 - 1650 nm), -30 dBm (1600 -	Calibration Accuracy	± 0.5 dB (± 30 nm from 1064, 1310, and 1550 nm)	
Polorization Dependence         ± 0.5 dB (1000 - 1600 nm)           Display Resolution         0.01 dB           Units         0.01 dB           Units         0.01 dB           SIGE-MODE-SUPPRESSION RATIO **         > 40 dB (100 averages), ± 100 GHz channel spoding > 35 dB (100 averages), ± 50 GHz channel spoding           SIDE-MODE-SUPPRESSION RATIO **         > 30 dB clob averages), ± 50 GHz channel spoding           SIDE-MODE-SUPPRESSION RATIO **         > 30 dB mode averages), ± 50 GHz channel spoding           SIDE-MODE-SUPPRESSION RATIO **         > 30 dB mode averages), ± 50 GHz channel spoding           Single-line input Maximum Power         +40 dBm (1270 - 1600 nm), -35 dBm (1000 - 1270 nm), -30 dBm (1600 - 1650 nm) 30 dB below tetal input power, but not less than single-line input sensitivity           Maximum Power         +10 dBm, sum of all lines input (lisplayel level), +18 dBm, sum of all lines input (lisplayel level)           Return Loss         35 dB (UPC connector), 50 dB (AFC connector)           Maximum Number of Lines *         1000           Data Mode         Single channel, list by wovelengths and power           Data Mode         Difference of measured wovelengths form TU grid values           Difference between the measured moximum and minimum values of wavelength and power           Difference between the measured moximum and minimum values of wavelength and power           Difference between the measured moximum and minimum val	Linearity <sup>4</sup>	± 0.3 dB (1000 – 1600 nm), lines above -30 dBm	
Display Resolution         0.01 dB           Units         0.01 dB           Units         0.01 dB           SIGNAL-TO-NOISE RATIO 4.4         >>40 dB (100 overages), ≥ 100 GHz channel spacing >>5 dB (100 overages), ≥ 50 GHz channel spacing           SIDE-MODE-SUPPRESSION RATIO 4         >>30 dB to 2.07 nm from peak           OPTICAL INPUT SIGNAL         -           Maximum Power         -           Assistivity         Single-line input Multiple-line input         -40 dBm (1270 - 1600 nm), -35 dBm (1000 - 1270 nm), -30 dBm (1600 - 1650 nm) 30 dB behow total input power, but not less than single-line input stark level)           Maximum Dower         +10 dBm, sum of all lines input (stargle level), +18 dBm, sum of all lines input (stargle level)           Maximum Number of Lines 7         100           Maximum Number of Lines 7         100           Data Mode         Difference of measured wavelengths total, list by power table           Data Mode         Difference of measured wavelengths total, list by power table           Difference between the measured maximum and minimum values of wavelength and power           Optical input         Difference of measured wavelengths from TUP grid values           Optical input         Cuptor of 100 <sup>-1</sup> Instrument Interface         Library of commands (SCP) via USB 2.0. Ethernet, and optional GPIB           FwrwonkettA1.4         None <td>Polorization Dependence</td> <td colspan="2">± 0.5 dB (1000 – 1600 nm)</td>	Polorization Dependence	± 0.5 dB (1000 – 1600 nm)	
Units         dBm,mW, µW           SIG ► L - TO - NOISE RATIO * *         > > 40 dB (100 averages), > 100 GHz channel spacing > > 35 dB (100 averages), > 50 GHz channel spacing           SIDE - KODE-SUPPRESSION RATIO *         > 30 dB dz ± 0.7 nm from peak           PT C L INPUT SIGNAL         - 30 dB dz ± 0.7 nm from peak           Sensitivity         Single-ine input Multiple-ine input         - 40 dBm (1270 - 1600 nm), -35 dBm (1600 - 1270 nm), -30 dBm (1600 - 1650 nm) 30 dB below total input power, but net less than angle-line input (safe level)           Return Loss         Single-Ine input Multiple-Ine input         - 40 dBm (1270 - 1600 nm), -35 dBm (1600 - 1650 nm) 30 dB below total input power, but net less than angle-line input (safe level)           Maximum Number of Lines 7         - 100-         - 100-           Maximum Number of Lines 7         Option -001: 10 Hz (0.1 s)         - 002: 6Hz (0.17 s)           MEASUREMENT RATE (TIME) *         Option -002: 10 Hz (0.1 s)         - 002: 6Hz (0.17 s)           Data Mode         Single-channel, list by waver table         - 002: 6Hz (0.17 s)           Difference of measured wavelength and powers from intrus values of wavelength and power         - 002: 6Hz (0.17 s)           Difference of measured wavelength and powers from intrus values of wavelength and power Difference between the measured wavelength and power         - 002: 6Hz (0.17 s)           Init Mode         Difference of measured wavelength and power         - 002: 6HZ (C) C FC/APC] <td>Display Resolution</td> <td colspan="2">0.01 dB</td>	Display Resolution	0.01 dB	
SIGNAL-TO-NOISE RATIO ***         > > 40 dB (100 averages), ≥ 100 GHz channel spacing         > 35 dB (100 averages), ≥ 50 GHz channel spacing           SIDE + MODE-SUPPRESSION RATIO *         > 30 dB act > 0.7 nm fram peak           OFTICAL INPUT SIGNAL         -40 dBm (1270 - 1600 nm), -35 dBm (1000 - 1270 nm), -30 dBm (1600 - 1650 nm), and dBm (1600 - 1650 nm), and dB mode > 1650 nm), and dB mode > 1600 mm), and dBm (1500 - 1650 nm), and dB mode > 1600 mm), and d	Units	dBm, mW, µW	
SIDE + KODE + SUPPRESSION RATIO <sup>4</sup> > 30 dB dt ≥ 0.7 mm from peck           PTICAL INPUT SIGNAL	SIGNAL-TO-NOISE RATIO 4,6	> 40 dB (100 averages), ≥ 100 GHz channel spacing > 35 dB (100 averages), ≥ 50 GHz channel spacing	
PTICAL INPUT SIGNAL           Sensitivity         Single-line input Multiple-line input         Single-line input Multiple-line input         Single-line input Multiple-line input           Maxiumum Power	SIDE-MODE-SUPPRESSION RATIO 4	> 30 dB at ≥ 0.7 nm from peak	
Sensitivity         Single-line input Multiple-line input         Single-line input           Maxiumum Power         0:100 dBm (1270 – 1600 mm), -55 dBm (1000 – 1270 nm), -00 dBm (1600 – 1670 nm), -000 dBm (170 nm), -000 dBm (17	OPTICAL INPUT SIGNAL		
Maxiumum Power         +10 dBm, sum of all ines input (displayed level), +18 dBm, sum of all lines input (sofe level)           Return Loss         35 dB (UPC connector), 50 dB (APC connector)           Maximum Number of Lines 7         0           Maximum Number of Lines 7         000000000000000000000000000000000000	Sensitivity Single-line input Multiple-line input <sup>4</sup>	-40 dBm (1270 – 1600 nm), -35 dBm (1000 – 1270 nm), -30 dBm (1600 – 1650 nm) 30 dB below total input power, but not less than single-line input sensitivity	
Return Loss         35 dB (UPC connector), 50 dB (APC connector)           Maximum Number of Lines 7         0           Maximum Number of Lines 7         0           MEASUREMENT RATE (TIME) °         0 ption -002: 6 Hz (0.17 s)           Data Mode         Surgement wodes           Data Mode         0           Delta Mode         Difference of measured wavelength table, list by power table           Drift Mode         Difference of measured wavelengths and powers from Ur grid values           Drift Mode         Difference between the measured maximum and minimum values of wavelength and power           Instrument Interface         Difference between the measured wavelength and power           Instrument Interface         Library of commands (SCPI) via USS J. Ethernet, and optional GPIB           FWFONMENTAL *         None           Warm-Up Time         None           Temperature IPressure I Humidity         +15°C to +30°C (-10°C to +70°C storage] 500 - 900 mr Hg   ≤ 90% R.H. et +40°C (no condensation)           DIMENSIONS AND WEIGHT         35° x 17.0° x 15.0° (89 mm x 432 mr x) 17 lbs (7.65 kg)           POWER REQUIREMENTS         90 - 264 VAC, 47 - 63 Hz, 80 VA max	Maxiumum Power	+10 dBm, sum of all lines input (displayed level), +18 dBm, sum of all lines input (safe level)	
Maximum Number of Lines <sup>7</sup> 1000           MEASUREMENT RATE (TIME) <sup>8</sup> Option -001: 10 Hz (0.1 s) Option -002: 6 Hz (0.17 s)           MEASUREMENT MODES         Data Mode         Single channel, list by wavelength table, list by power table           Data Mode         Option -001: 0 Hz (0.1 s) Option -002: 6 Hz (0.17 s)         Option -002: 6 Hz (0.17 s)           Data Mode         Single channel, list by wavelength table, list by power table         Option -002: 6 Hz (0.17 s)           Delta Mode         Optiference of measured wavelengths and powers from user-defined reference channel         Optiference between the measured maximum and minimum values of wavelength and power Difference between the measured maximum and minimum values of wavelength and power           Puts/OUTPUTS         Optical input         Optical input         Optical Single-mode filer (FC/UPC or FC/APC)           Instrument Interface         Library of commands (SCPI) via USE 20, Ethernet, and optional GPIB         None           Vorm-Up Time          None         None           Imperature   Pressure   Humidity         +15°C to +30°C (-10°C to +70°C storage)   500 - 90°C mm Hg   ≤ 90% RH. at +40°C (no condensation)         None           DIMENSIONS AND WEIGHT         3.5° x 17.0° x 15.0° (80 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)         None           POWER REQUIREMENTS         90 - 264 VAC, 47 - 63 Hz, 80 VA max         None	Return Loss	35 dB (UPC connector), 50 dB (APC connector)	
MEASUREMENT RATE (TIME) *       Option -001: 10 Hz (0.1 s) Option -002: 6 Hz (0.17 s)         MEASUREMENT MODES       Data Mode       Single channel, list by wavelength table, list by power table         Data Mode       Difference of measured wavelengths from ITU grid values       Difference channel         Delta Mode       Difference of measured wavelengths from UTU grid values       Difference channel         Drift Mode       Difference between the measured maximum and minimum values of wavelength and power       Difference between the measured current and start values of wavelength and power         Optical input       Optical input       9/125 µm single-mode fiber (FC/UPC or FC/APC)         Instrument Interface       Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         ENVIRONMENTAL 4       None         Warm-Up Time       <15 minutes	Maximum Number of Lines <sup>7</sup>	1000	
MEASUREMENT MODES           Data Mode         Single channel, list by wavelength table, list by power table           Delta Mode         Difference of measured wavelengths from ITU grid values Difference of measured wavelengths and powers from user-defined reference channel           Drift Mode         Difference between the measured maximum and minimum values of wavelength and power Difference between the measured current and start values of wavelength and power           INPUTS/OUTPUTS         Optical input           Optical input         9/125 μm single-mode fiber (FC/UPC or FC/APC)           Instrument Interface         Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB           ENVIRONMENTAL 4         None           Warm-Up Time         <15 minutes           Temperature   Pressure   Humidity         +15°C to +30°C (-10°C to +70°C storage)   500 - 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)           DIMENSIONS AND WEIGHT         3.5° x 17.0° x 15.0° (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)           POWER REQUIREMENTS         90 - 264 VAC, 47 - 63 Hz, 80 VA max           WARRANTY         Syears (ports and labor)	MEASUREMENT RATE (TIME) <sup>8</sup>	Option -001: 10 Hz (0.1 s) Option -002: 6 Hz (0.17 s)	
Data Mode       Single channel, list by wavelength table, list by power table         Delta Mode       Difference of measured wavelengths from ITU grid values Difference of measured wavelengths and powers from user-defined reference channel         Drift Mode       Difference between the measured maximum and minimum values of wavelength and power Difference between the measured current and start values of wavelength and power         NPUTS/OUTPUTS       Optical input         Optical input       9/125 µm single-mode fiber (FC/UPC or FC/APC)         Instrument Interface       Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         Varm-Up Time       <15 minutes         Temperature   Pressure   Humidity       +15°C to +30°C (-10°C to +70°C storage)   500 - 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)         DIMENSIONS AND WEIGHT       3.5° x 17.0° x 15.0° (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)         POWER REQUIREMENTS       90 - 264 VAC, 47 - 63 Hz, 80 VA max         WARRANTY       Syears (parts and labor)	MEASUREMENT MODES		
Delta Mode       Difference of measured wavelengths from ITU grid values Difference of measured wavelengths and powers from user-defined reference channel         Drift Mode       Difference between the measured maximum and minimum values of wavelength and power Difference between the measured current and start values of wavelength and power         INPUTS/OUTPUTS       Optical input       9/125 µm single-mode fiber (FC/UPC or FC/APC)         Instrument Interface       Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         ENVIRONMENTAL 4       None         Varm-Up Time       <15 minutes         Temperature   Pressure   Humidity       +15°C to +30°C (-10°C to +70°C storage)   500 – 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)         DIMENSIONS AND WEIGHT       3.5° x 17.0° x 15.0° (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)         POWER REQUIREMENTS       90 - 264 VAC, 47 - 63 Hz, 80 VA max         WARRANTY       5 years (parts and labor)	Data Mode	Single channel, list by wavelength table, list by power table	
Drift Mode       Difference between the measured maximum and minimum values of wavelength and power         Difference between the measured current and start values of wavelength and power         Difference between the measured current and start values of wavelength and power         Difference between the measured current and start values of wavelength and power         Difference between the measured current and start values of wavelength and power         Difference between the measured current and start values of wavelength and power         Optical input       9/125 µm single-mode fiber (FC/UPC or FC/APC)         Instrument Interface       Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         Environmental *       None         Warm-Up Time       <15 minutes	Delta Mode	Difference of measured wavelengths from ITU grid values Difference of measured wavelengths and powers from user-defined reference channel	
INPUTS/OUTPUTS         Optical input       9/125 µm single-mode fiber (FC/UPC or FC/APC)         Instrument Interface       1         Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         ENVIRONMENTAL*       None         Warm-Up Time       <15 minutes         Temperature   Pressure   Humidity       +15°C to +30°C (-10°C to +70°C storage)   500 - 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)         DIMENSIONS AND WEIGHT       3.5" x 17.0" x 15.0" (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)         POWER REQUIREMENTS       90 - 264 VAC, 47 - 63 Hz, 80 VA max         WARRANTY       5 years (parts and labor)	Drift Mode	Difference between the measured maximum and minimum values of wavelength and power Difference between the measured current and start values of wavelength and power	
Optical input       9/125 µm single-mode fiber (FC/UPC or FC/APC)         Instrument Interface       Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         ENVIRONMENTAL 4          Warm-Up Time          Temperature   Pressure   Humidity       +15°C to +30°C (-10°C to r70°C storage)   500 - 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)         DIMENSIONS AND WEIGHT       3.5″ x 17.0″ x 15.0″ (89 mm x 432 mm)   17 lbs (7.65 kg)         POWER REQUIREMENTS       90 - 264 VAC, 47 - 63 Hz, 80 VA max         WARRANTY       5 years (parts and labor)			
Instrument Interface       Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB         ENVIRONMENTAL 4       Common of the state of th	Optical input	9/125 µm single-mode fiber (FC/UPC or FC/APC)	
ENVIRONMENTAL 4       Marm-Up         Warm-Up Time       <15 minutes       None         Temperature   Pressure   Humidity       +15°C to +30°C (-10°C to r70°C storage)   500 - 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)         DIMENSIONS AND WEIGHT       3.5° x 17.0° x 15.0° (89 mm x 432 mm)   17 lbs (7.65 kg)         POWER REQUIREMENTS       90 - 264 VAC, 47 - 63 Hz, 80 VA max         WARRANTY       Constant	Instrument Interface	Library of commands (SCPI) via USB 2.0, Ethernet, and optional GPIB	
Warm-Up Time         < 15 minutes			
Temperature   Pressure   Humidity         +15°C to +30°C (-10°C to +70°C storage)   500 - 900 mm Hg   ≤ 90% R.H. at + 40°C (no condensation)           DIMENSIONS AND WEIGHT         3.5" x 17.0" x 15.0" (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)           POWER REQUIREMENTS         90 - 264 VAC, 47 - 63 Hz, 80 VA max           WARRANTY         5 years (parts and labor)	Warm-Up Time	< 15 minutes	None
DIMENSIONS AND WEIGHT         3.5" x 17.0" x 15.0" (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)           POWER REQUIREMENTS         90 - 264 VAC, 47 - 63 Hz, 80 VA max           WARRANTY         5 years (parts and labor)	Temperature   Pressure   Humidity	+15°C to +30°C (-10°C to +70°C storage)   500 – 900 mm Hg   $\leq$ 90% R.H. at + 40°C (no condensation)	
POWER REQUIREMENTS       90 - 264 VAC, 47 - 63 Hz, 80 VA max         WARRANTY       5 years (parts and labor)	DIMENSIONS AND WEIGHT	3.5" x 17.0" x 15.0" (89 mm x 432 mm x 381 mm)   17 lbs (7.65 kg)	
WARRANTY 5 years (parts and labor)	POWER REQUIREMENTS	90 - 264 VAC, 47 - 63 Hz, 80 VA max	
	WARRANTY	5 years (parts and labor)	

(1) Defined as measurement uncertainty, or maximum wavelength error, with a confidence level of  $\ge$  99.7%.

(2) Traceable to an NIST standard (SRM 2517a).

(3) For multi-wavelength measurement,  $\geq$  20 GHz channel separation is required to achieve specified wavelength accuracy.

Characteristic performance, but non-warranted. (4)

(5) Data in units of nm and cm<sup>-1</sup> are given as vacuum values.
(6) For lines above -25 dBm, 0.1 nm noise bandwidth.

(7) OSNR is reduced as the number of lines is increased.

(8) For single-line input. Multiple-line input may reduce the measurement rate.

Bristol Instruments reserves the right to change the specifications as may be required to permit improvements in the design of its products. Specifications are subject to change without notice.

