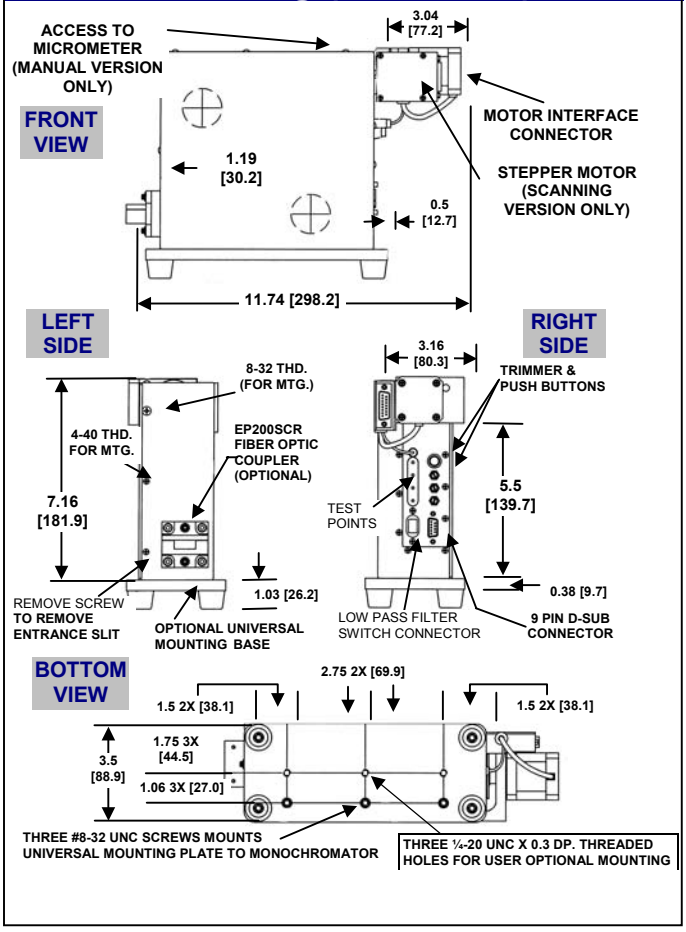
Monochromator

Manual – EP200Mmd
Scanning – EP200Msd

Features and Benefits

- Enables measurement in low light applications through high-gain photomultiplier tube
- Adjusts for varying light conditions through automatic gain control feature when used with Verity's system controllers
- Avoids overlapping spectra through excellent resolution
- Manual and scanning versions to meet the needs of different applications
- Repeatable wavelength measurement through hardened lead screw assembly

Outline Drawing (with base)

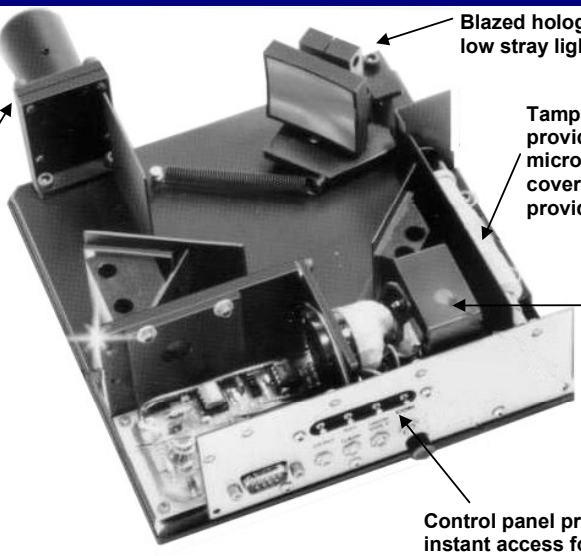


Description

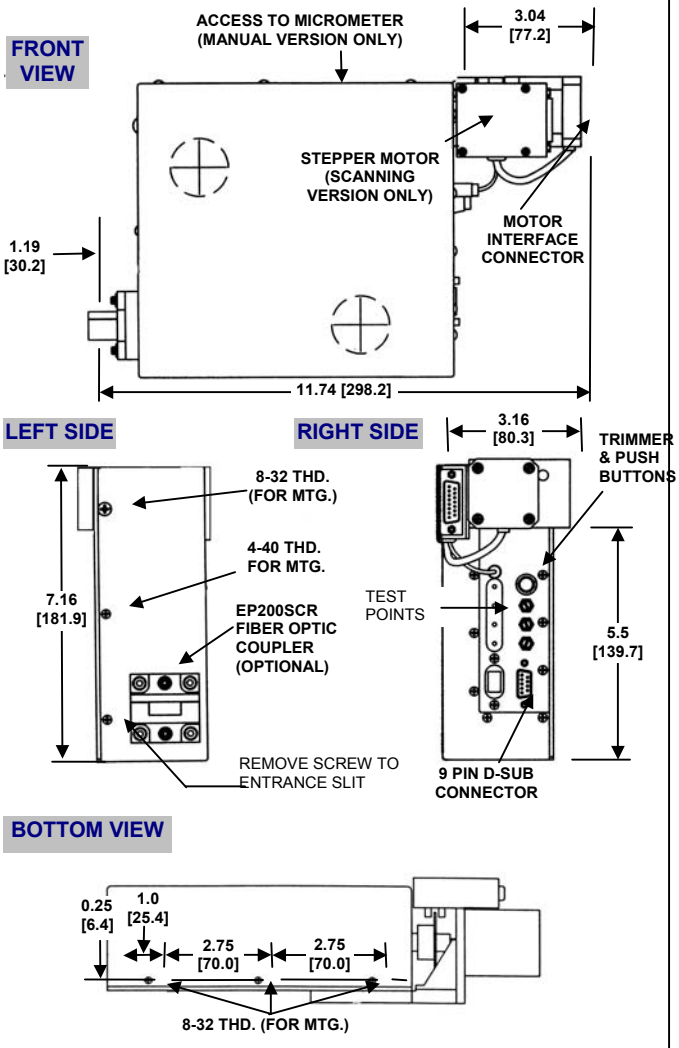
The EP200 Series monochromators are designed to measure a single wavelength of light in the range of 185–925nm. When used with Verity's system controllers and the proper optical input path, the EP200 Series provides robust endpoint detection for production or research applications.

The EP200 Series is used extensively in semiconductor and related thin film applications for endpoint detection in etch, CVD etchback, photoresist stripping and related applications. The EP200Mmd is designed for manual adjustment of wavelengths. The EP200Msd permits computer-controlled spectral scanning through the use of a stepper motor, hardened lead screw assembly and position encoders. These elements allow the scanning monochromator to reposition itself for different wavelengths when a process recipe changes or a new product calls for monitoring a new endpoint emission. Performance of the EP200 Series monochromators is enhanced by its wide spectral range, superior wavelength resolution (up to 0.2nm) and extraordinary dynamic range of the photomultiplier tube (PMT).

Operation



Outline Drawing (without base)

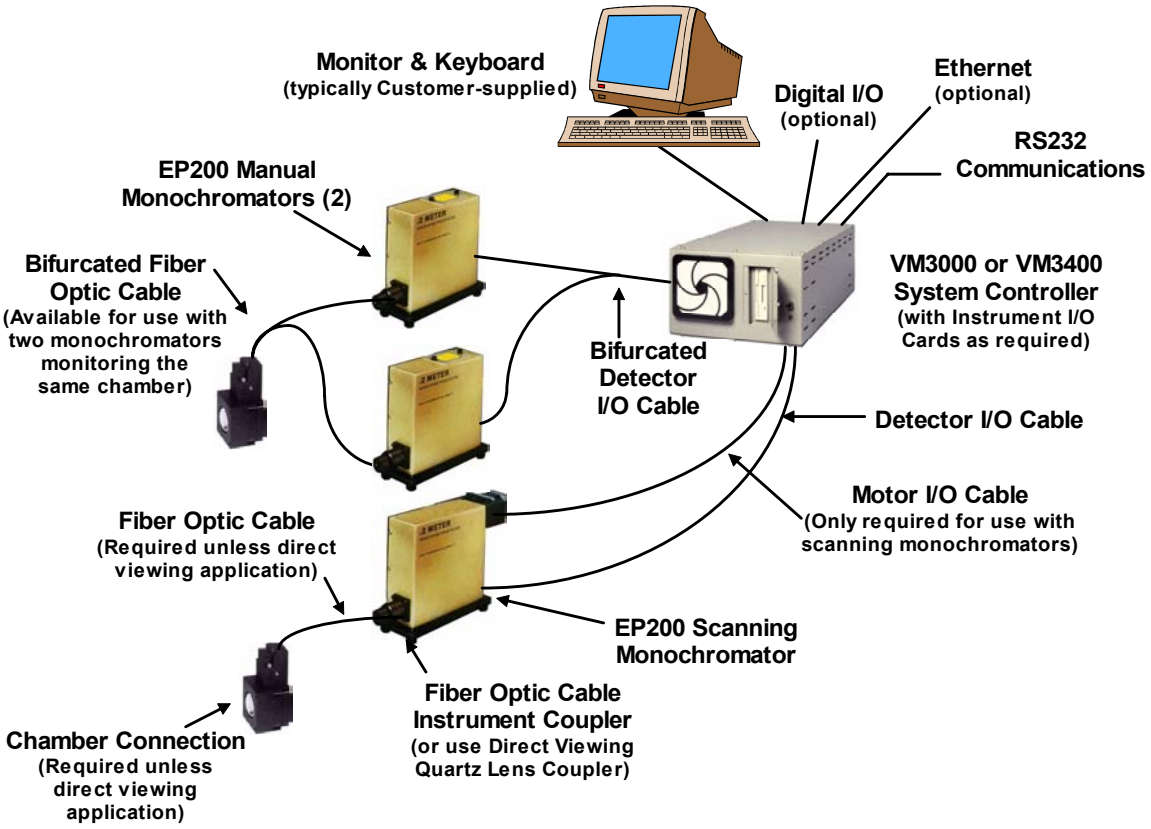


Light entering the front optical slit floods the holographic grating, the dispersing element that transforms the incident light into its component spectrum. Additional optics redirect the light spectrum to the exit slit and the PMT detector just behind the exit slit. Wavelength selection and scanning is accomplished by rotating the grating under motor control (EP200Msd) or manual (EP200Mmd) control, thereby shifting the spectral line that is presented at the exit slit leading to the PMT. The EP200 Series also features an internal, feedback-regulated, high voltage power supply to control PMT sensitivity.

The system controller offered by Verity comes bundled with the ScanView software application that permits wavelength selection and scanning (EP200Msd only), endpoint process control, data storage, and data reprocessing. The system controller provides automatic gain control by driving the PMT's high voltage power supply to obtain the desired detector output. This compensates for the effects of both short- and long-term optical signal deterioration. See page 7, Automatic Gain Control, for additional information.

System Schematic

Depicted below is a typical system schematic. Wide ranges of configurations are possible to meet the needs of different applications.



System Controller

The system controller provides for:

- Endpoint detection using proprietary Neural Network or threshold software
- A graphical user interface
- External communications through digital I/O, RS232, and Ethernet
- Power to detector
- Automatic gain control of photomultiplier tube

System controller platforms include:

- VM3400 provides asynchronous control using Windows NT-based ScanView IV software
- VM3000 provides synchronous control using DOS-based ScanView III software
- SDC2001 provides an OEM synchronous embedded control of manual monochromators or detectors

Optical Connection

- Viewing can be direct using a quartz lens coupler, or indirect using fiber optic cables and a chamber connector as depicted above
- Bifurcated fiber optic cables are available for applications using two monochromators to monitor the same system. Verity offers a selection of chamber connectors for use with its fiber optic cable

Instrument Interface Cards
Instrument Cables

- Operation of each **scanning monochromator** requires an interface card (DAS-200) in the VM3000/3400, a detector I/O cable, and motor I/O cable
- Operation of **two manual monochromators** requires a dual interface card (DAS-225) in the VM3000/3400 and a bifurcated detector I/O cable
- Operation of a **single manual monochromator** requires a single detector I/O cable for each monochromator and a dedicated dual interface card (DAS-205) in the VM3000/3400

Specifications

Model Number	EP200Mmd	EP200Msd
Type	Manual Monochromator	Scanning Monochromator
Performance/Optics		
Range	185–920nm	185–920nm
Resolution (maximum)	0.2nm	
Bandpass/Slit Width	Slit Width (microns) Bandpass (nm) 50..... 0.2 100..... 0.4 250..... 1.0 500..... 2.0 1000..... 4.0	
Grating	Concave holographic, 1200 grooves/mm optimized in visible or UV; F/3.5 aperture (See page 6, Relative Efficiency vs. Wavelength graph for UV Enhanced/Standard gratings.)	
Focal Length	200mm	
Photomultiplier Tube	Standard, Selected Standard, or UV Enhanced (See page 6, Quantum Efficiency vs. Wavelength, for the UV Enhanced and Standard PMT.)	
Scan Speed	Not designed for scanning	Variable to 4000nm/min
Electronics		
Power[1]	+15VDC @ 50mA –15VDC @ 225mA	+15VDC @ 50mA –15VDC @ 225mA Power to drive stepper motor assembly
Input Signal for PMT Gain[1]	2–10VDC	
Output Signal[1]	0–10VDC	
PMT High Voltage Output Range	–300 to –1000VDC	
Amplifier	A two-stage amplifier provides low noise and independent zero and gain control. It is laser trimmed for very low offset and drift.	
Mechanical		
Slits	Straight, 5mm height, removable	
Dimensions (excluding mounting base) [inches (mm)]	7.51 (190.8) x 2.63 (66.8) x 7.16 (181.9) [See Outline Drawings for details]	10.54 (267.7) x 3.16 (80.3) x 7.16 (181.9) [See Outline Drawings for details]
Safety		
Compliance	CE and Semi S2-93 compliant, Year 2000 (Y2K) not applicable	

[1]Power, input signals, and output signals are controlled by a DAS-205/225 (manual monochromators) and a DAS-200 (scanning monochromator) instrument interface cards, which are installed in the VM3000/3400. Alternatively, the SDC2001 provides this functionality for manual monochromators.

Pin-Out Assignments – EP200Mmd

DB9M D-Subminiature Connector	
Pin	**Description**
1	Remote High Voltage Programming (Optional)[2], 2-10VDC
2	Power input line, –15 VDC (225mA), polarity protected
3	Power input line, +15 VDC (50mA), polarity protected
4	Remote High Voltage Monitor (10mV/V)
5	Signal output, 0-10VDC
6	DC Offset (Zero Voltage)
7	Circuit Ground Return
8	Not Used
9	Circuit Ground Return

[2]**Note:** High voltage programming control is either local or remote. When ordered with the remote control option, pin 1 is enabled to support PMT high voltage programming. This enables automatic gain control when used with any of Verity's system controllers.

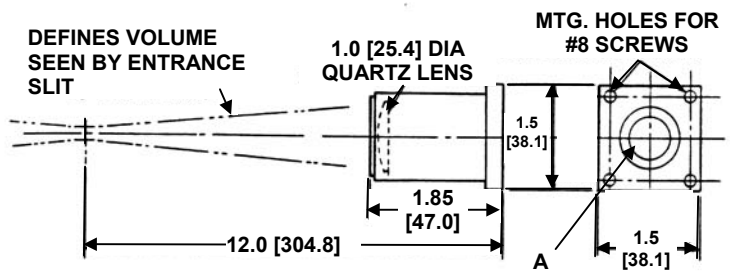
Normally, a DAS-205 or DAS-225 card in the VM3000/3400 is used to control manual monochromators. At left, the connector pin-out table is included to enable customer control of manual monochromators without the use of Verity's DAS-205/225 cards. The pin-out of the EP200Msd scanning monochromators is not included, since stepper motor control requires the use of a Verity DAS-200 card. Verity encourages the use of its system controllers, since these controllers provide data acquisition, endpoint algorithms, instrument control, automatic gain control, user interface and tool interface.

Quartz Lens Couplers

Direct viewing with the EP200 Series is facilitated through a quartz lens coupler. Unlike indirect viewing, a fiber optic cable and chamber connection are not required. Quartz lens couplers can be ordered as part of the EP Series monochromator model number. To order replacement or additional couplers, use the part numbers shown below.

Description	Model Number	Part Number
FIXED FOCUS	EP200FFL	1000120

Use with EP200 Series Only

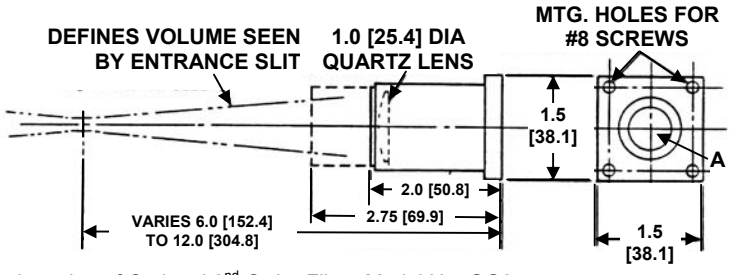


This coupler bolts to the inlet of the monochromator, limits the field of vision of the entrance slit, and forces it to see only emissions from a volume that is shaped to fit most plasma systems. By placing the lens next to a viewport window, maximum efficiency can be attained. The fixed focus coupler transmits UV, VIS, and NIR.

A=Location of Optional 2nd Order Filter, Model No. GG375

Description	Model Number	Part Number
ADJUSTABLE FOCUS	EP200LC	1002441

Use with EP200 Series Only

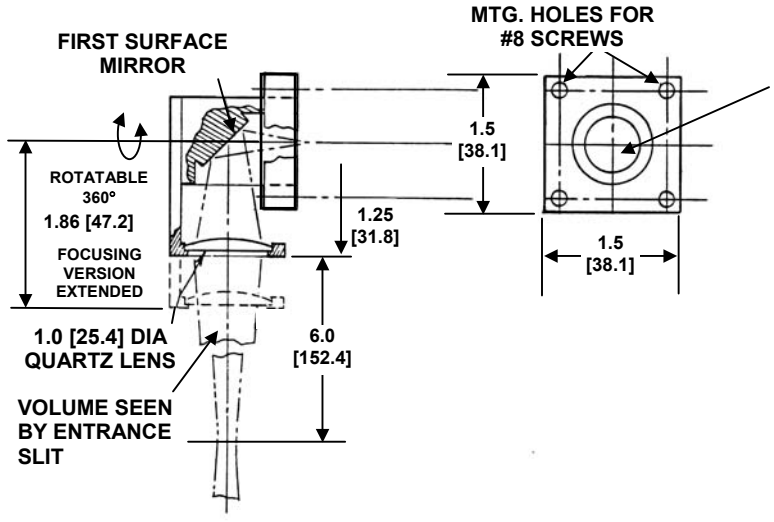


This coupler bolts to the inlet of the monochromator and can perform exactly like Model No. EP200-FFL above. Additionally, the lens can be repositioned to bring the waist of the observed volume closer to the monochromator. This allows flexibility in matching the needs of specific applications. This coupler transmits UV, VIS, and NIR.

A=Location of Optional 2nd Order Filter, Model No. GG375

Description	Model Number	Part Number
ADJUSTABLE FOCUS – RIGHT ANGLE	EP200FLC	1000505

Use with EP200 Series Only



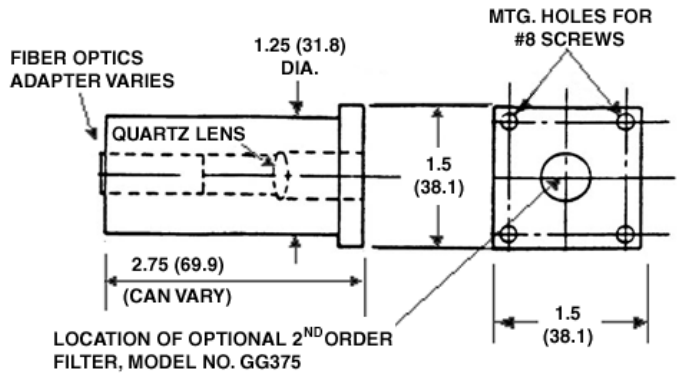
This coupler bolts to the inlet of the monochromator and provides a 90° change in direction, rotation about the axis of the entrance slit, and lens adjustment for focusing. This coupler transmits UV, VIS, and NIR.

Fiber Optic Instrument Couplers – Spot or Slit Terminated Cable

Indirect viewing systems include an instrument coupler, fiber optic cable and chamber connection. The instrument couplers listed below allow connection of either spot or slit-terminated fiber optic cables to the EP Series monochromator. These couplers can be ordered as part of the EP Series monochromator model number. To order replacement or additional couplers, use the part numbers below. See page 77-85 for a list of the fiber optic cable and chamber connection information.

Description	Model Number	Part Number
OPTIC COUPLER FOR **SPOT** TERMINATED CABLES	EP200FOC	1001858

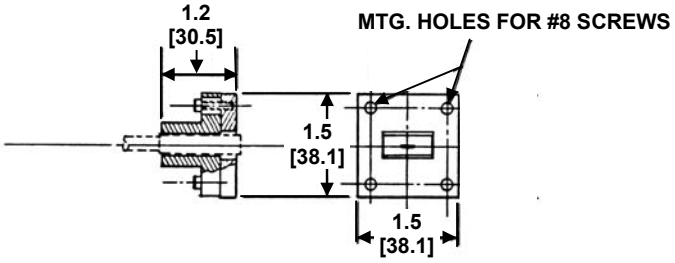
Use with EP200 Series Only



This device bolts to the inlet of the monochromator and provides a way to anchor various types of fiber optic cables while efficiently configuring the rays entering the detector in a proper geometry to illuminate the detector. It transmits UV, VIS, and NIR. Specify “spot”-type fiber optic cable end configuration when ordering. Using a spot-to-spot cable with a monochromator results in some signal loss, as compared to the spot-to-slit cables. The effect depends, in part, on the monochromator slit width selected. Fiber optic spot-terminated cables are sometimes employed in applications with ample illumination, as they are less expensive than slit-terminated cables.

Description	Model Number	Part Number
OPTIC COUPLER FOR **SLIT** TERMINATED CABLES	EP200SCR	1000295

Use with EP200 Series only



This coupler bolts to the inlet of the monochromator and accepts the slit-shaped fiber cable and provides alignment means to optimize throughput. It transmits UV, VIS, and NIR. Specify “slit”-type fiber optic cable end configuration when ordering.

Ordering Information – EP200Mmd/EP200Msd

Part Number

EP200M*aa-b c d e-ffff g h i*

Coupler

	Model No.	Part No.
For Fiber Optic Cable		
A.....Spot-terminated cable	EP200FOC	1001858
B.....Slit-terminated cable	EP200SCR	1000295
For Quartz Lens		
H.....Fixed Focus	EP200FFL	1000120
I .....Adjustable Focus	EP200LC	1002441
J.....Right Angle, Adj. Focus	EP200FLC	1000505
N.....No coupler		

Part numbers and model numbers are provided in the event replacement or additional couplers are required.

Zero Control

L .....Local (on instrument by potentiometer)
R.....Remote (0–10VDC)

When using Verity's system controller, selecting the remote option allows the VM3x00 to rezero the PMT output, when needed. Only select the local option in the case of customer-designed instrument controllers that do not take advantage of the EP200's Zero Control capability.

PMT Voltage Control

L .....Local (on instrument by potentiometer)
R.....Remote (0–10VDC)

When using Verity's system controller, selecting the remote option provides for automatic gain control of the PMT. Only select the local option in the case of customer-designed instrument controllers that do not take advantage of the PMT's automatic gain control capability.

Slit Size

0050 .....50 microns
0100 .....100 microns
0250 .....250 microns
0500 .....500 microns
1000 .....1000 microns

Monochromator slits are available in widths shown. The smallest slit width gives the best spectral resolution, while the widest slit width gives the best sensitivity in low light applications. The most commonly used slit is 500 microns, which gives 2nm resolution.

Mounting Base

B.....With Mount Base
N.....Without Mount Base

See the Outline Drawings for details with or without the mounting base.

Photomultiplier Tube Range

U.....UV Enhanced (185–650nm)
S.....Standard (200–920nm)
C.....Selected Standard (200–920nm)

UV Enhanced detectors are recommended in applications where the primary wavelength of interest is below 350nm. The Selected Standard offers improved sensitivity and signal-to-noise ratio over the standard PMT. See page 6, Detector Spectral Response, for additional details.

Grating

S.....Standard
U.....UV

A UV-enhanced grating can replace the standard diffraction grating to increase UV sensitivity in the monochromator (185–350nm). This also reduces the sensitivity to light above 500nm, so it should only be used if UV is the primary application. See page 6, Relative Efficiency vs. Wavelength graph, for these grating types.

2nd Order Filter

F .....Included
N.....Not Included

When the monochromator is set to wavelengths above about 400nm, the monochromator will respond both to light at the selected wavelength and to light at one-half that wavelength. Therefore, strong UV lines can interfere with the measurement of faint lines above 400nm. To avoid this problem, Verity offers as an optional 2nd order filter. It is manually switched into place when monitoring lines above 400nm and eliminates signal contamination by strong UV light. This filter must be switched out to measure light below 400nm. Alternatively, an external 2nd order filter can be used. See page 48, Ancillary Equipment, for additional details.

Manual/Scanning

md ..Manual
sd....Scanning

The wavelength can be set manually by adjusting the micrometer setting or automatically using the VM3000/3400 through the DAS-200 instrument I/O card.