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OPERATION MANUAL
For Vacuum Monochromator or Spectrometer

Model #'s VM2FS,VM92,VS2FS and VS92

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Figure 1

1. General Information:

The VM/VS2FS is a compact fixed slit mono/spectrometer designed for ease of use in laboratory applications. The main components are shown in figure 1 and consist of (1) the mono/spectrometer body, (2) the wavelength adjusting screw, (3) the wavelength readout dial, (4) the fixed entrance and exit slits, and the concave diffraction grating. The diffraction grating is not seen in figure 1 because it is inside the mono/spectrometer body.

Light from the entrance slit is refracted according to the grating equation:

$$N\lambda/d = \sin\alpha + \sin\beta$$

Where:

N	=	diffraction order
λ	=	wavelength
d	=	groove spacing
α	=	angle of incidence to grating normal
β	=	angle of reflectance to grating normal

The entrance and exit slits are set at a fixed angle of 45 degrees apart. Light which is refracted such that $\alpha + \beta$ = theta is focuses onto the exit slit and can be picked up by a detector. Rotating the grating around its center of curvature causes the angles α and β to change. This causes light of different wavelengths to be focused onto the exit slit.

A single grating is used to maximize throughput in the vacuum ultraviolet region. The standard grating is a 37 mm square f/2.2 concave holographic grating with an aluminum/MgF2 overcoat. The reflective properties of this or any grating can be severely damaged by mechanical contact with any solid liquid or vapor. One should avoid touching or breathing on the surface of the grating or onto the slit openings.

2. Installation:

The VM2FS mono/spectrometer can be fixed in any orientation to a pumping station or vacuum through its (1) entrance slit, (2) exit slit or (3) rear pumping flange. If an experimental system with pump already exists it is likely that the mono/spectrometer will not need an additional pump since it has less than a 1 litre volume. Keep in mind that the VUV properties can be easily damaged by organic contaminants and use only oil free pumping systems.

The entrance and exit slits are inside flanges with 1 inch by 20 threads per inch (tpi) UNEF threads. These flanges can be directly attached to counter bored flanges of any design with a female 1 in. 20 threads and a shoulder to hold the o-ring.

Also supplied with the mono/spectrometer are 2.75 inch diameter CF type flanges that screw directly onto the 1 in 20 tpi flanges. This allows direct connection through either the entrance or exit slits.

An alternative to entrance or exit slit connection is through the 2.75 inch CF flange on the bottom of the mono/spectrometer. This flange can be attached with THREE ¼ inch screws threaded into blind holes in the mono/spectrometer bottom plate. Note that we recommend using a viton gasket instead of a copper gasket on this flange.

For optimal use with the model L-LFL Resonance EUV flow lamp we recommend pumping out of the bottom flange. This gives a differential pumping effect so a chamber at the output slit can be maintained at a low pressure (<10^-5 torr) while maintaining several torr of pressure in the flow lamp.

Mounting and Operating with a Diode

Any one of the several VUV diodes may be screwed directly on the mono/spectrometer exit slit or mounted on the CF flange at the exit slit. Typical currents at the specified bias range from 10^-12 amps to 10^-8 amps depending on the light source and the spectral line observed. The diodes without preamps (e g. gold diode, Silicon diode, CsTe and CsI diodes) require a positive bias voltage at the anode and a picoammeter at the cathode, both connections being made with coax connectors to the back of the diode assembly. Diodes with internal preamps connect through our standard power supplies (see instructions for power supplies.)

Example with a Gold Diode

To connect, electrically hook the anode to a regulated DC power supply capable of +100 volts and the cathode to a picoammeter. At positive anode bias a positive current will flow from the cathode. Generally the plateau will be achieved at about 20 volts for a Neon EVU source and 100 V for a He EUV source. At Resonance Ltd, most calibrations are performed with a bias of 100 V.

3. Adjusting the wavelength:

The wavelength in nanometers can be adjusted using the dial at the top of the mono/spectrometer. Calibrations are performed by scanning from lower to higher wavelengths. There is some backlash on the dial so that if the wavelength is set by scanning from high to low the dial must be set one nanometer lower than the observed wavelength in order to read the correct wavelength on the dial after calibration.

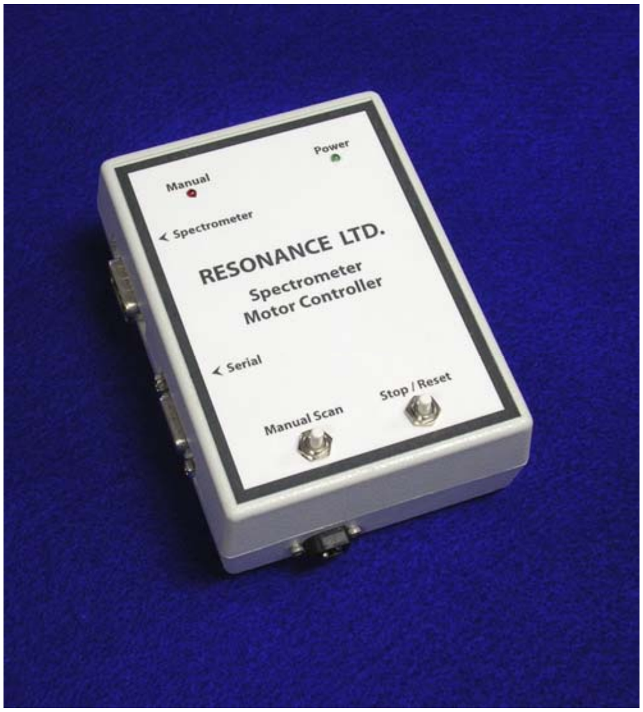

Figure 2

If your mono/spectrometer is motorized, you are still able to change the wavelength using the dial, but are also able to use the motor to do so. To use your motorized mono/spectrometer in manual mode, hold down the manual mode button on the control box and insert the serial cable. **NOTE: TO USE THE MOTORIZED MONO/SPECTROMETER IN MANUAL MODE, THE DIAL MUST BE SET TO**

ZERO BEFORE CONNECTING THE SERIAL CABLE. The motor will then scan the mono/spectrometer to the user-set minimum scan point and allow you to do the rest. Using HyperTerminal to control the motor is very easy. First, attach the controller box (figure 2) to the motor and to the computer which you will use to control the motor. Attach the power supply to the controller box and plug it in to an outlet. Start your computer and enter the HyperTerminal program. If the lines

Controller for Resonance Motor Driven Spectrometer
Enter Spectrometer Dial Position

do not appear, press the emergency stop/reset button on your motor control box. Enter the dial position and press the Enter key. You will now see a menu listing the following options:

(0) Display Menu
(1) Scan Minimum 0
(2) Scan Maximum 0
(3) Scan Speed 100nm per 10sec
(4) Jog Forward
(5) Jog Reverse
(6) Present position 100nm, Move to
(7) Start Scan
select:

Pressing 0 on your keyboard followed by the enter key will display this menu. Pressing 1 followed by the enter key will allow you to set the scan minimum, where you would like the scan to start from. Pressing 2 followed by the enter key will allow you to set the scan maximum, where you would like the motor to stop. Pressing 3 followed by the enter key will bring up a new menu that lists seven different scanning speeds with units of nm per 10seconds. To select one of these speeds, enter the number which appears beside the desired speed and then press the enter key. Pressing 4 followed by the enter key will bring the dial forward one step (one quarter of a millimeter). Pressing 5 followed by the enter key will bring the dial back one step (one quarter of a millimeter). Pressing 6 followed by the enter key will allow you to enter a desired dial position and move the dial to that position. Pressing 7 will set the mono/spectrometer to the scan start position and prompt the user to hit the "/" key to start the motor and the scan.

If at any time, the scan sequence must be aborted, press the emergency stop/reset button located on the motor controller box.

The mono/spectrometer can be scanned through zero order. We do not recommend scanning more than 50nm below zero order. Also we do not recommend scanning to more than 700 nm with the VUV model mono/spectrometer. Scanning outside the –50 to 700 nm range should not damage the mono/spectrometer, but may result in jamming the lead screw on the grating drive, which will make wavelength calibration necessary.

4. An Example of a Step-by-Step Operation:

The L-LFL flow lamp can be operated with any non-corrosive gas to obtain EUV spectra. Typically, the supply line is pressurized to a few PSI above ambient pressure (10 to 100 kPa). To operate:

1. Pump out the gas supply line

   The green Cajon valve is first opened to pump out the supply line up to the pressure gauge head. The pressure should fall to better than 10^-1 torr in the mono/spectrometer at this stage.

2. Purge the supply line with gas

   The main cylinder valve to the gas supply should be opened and the green valve closed.

3. Adjust the flow of gas

   In normal operation (with Ar, Xe, Kr, Ne, He, or N2) the green valve should be just cracked open so that the flow of gas is quite small. This will maintain a few torr in the flow lamp and less than 10^-1 torr in the mono/spectrometer.

4. Switch on the RF in the flow lamp and start the lamp

   After the gas is flowing the RF should be switched on by plugging in the wall unit. If a power supply is used the voltage should be set to 28 volts and the current should be in the 0.2 to 0.6-amp range. Usually the plasma will be self-starting. However, if it does not self-start then the power connection should be checked as well as the pressure in the mono/spectrometer (the lamp will not start when this pressure is > ~1 torr). If the lamp still will not start a Tesla coil (set on low) can be touched to the glass tube inside the lamp housing.

5. Optimize the intensity

   Once the plasma is ignited, using the gold diode or similar detector can quickly optimize the intensity.

   The signal with the gold diode should be monitored and the flow adjusted until the signal is optimized.

Appendix 1: Calibration Data

Mono/spectrometer Specifications

Date:_____________ Initial_________________

Identification:

Mono/spectrometer Model/Serial Number: V_______

Entrance Slit:

Type ______________________________
Height/Width ______________________________

Exit Slit:

Type ______________________________
Height/Width ______________________________

Grating:

Grooves/mm ______________________________
Blank size ______________________________
Focal Length ______________________________
Resolution ______________________________

Vacuum:

Ultimate Vacuum (torr) ______________________________
Seal type ______________________________
Body type ______________________________
Castings ______________________________
Mating flanges ______________________________
____

Wavelength drive:

Type ______________________________
Backlash ______________________________
Accuracy ______________________________

Mono/spectrometer Calibration

Date: ___________________ Initial ___________________________

Equipment:

Mono/spectrometer Model/Serial Number V s/n
Detector Model/Serial Number _________________________
Lamp Model/Serial Number _________________________

Conditions:

Lamp Voltage/Current _________________________
Detector Voltage _________________________

Gas Flow/Wavelength/Det Cur/Flux __________________________
____
____

Resolution:

Wavelength/delta wvlnth/order num __________________________
____
____