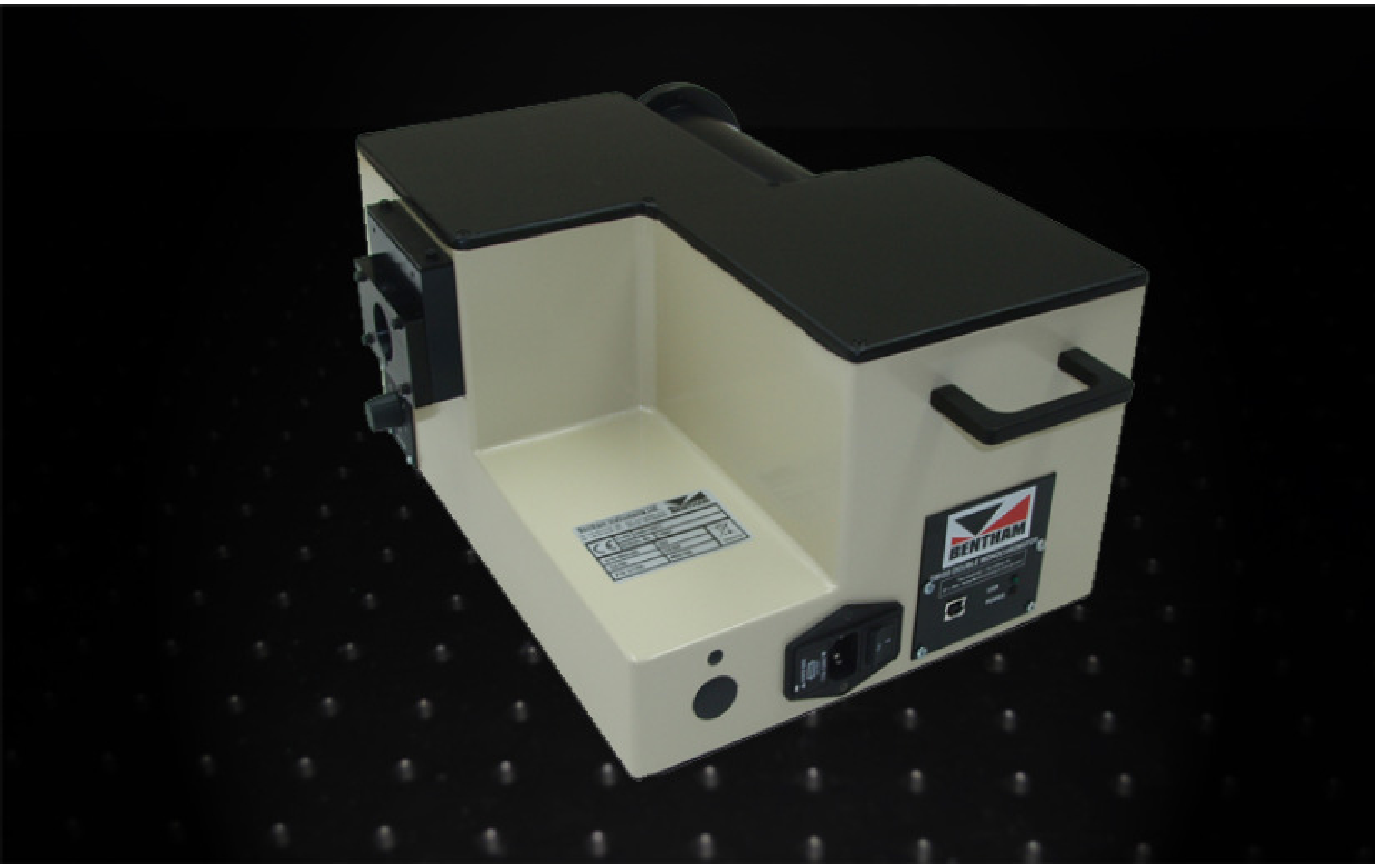
DMC150

COMPACT DOUBLE MONOCHROMATOR



BENTHAM

User Manual

Bentham Instruments Limited

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1 INTRODUCTION

This manual has been written to provide information on the use of the base DMc150 compact double monochromator and all standard options pertaining thereto.

2 GUARANTEE

Bentham Instruments warrants each instrument to be free of defects in material and workmanship for a period of one year after shipment to the original purchaser. Liability under this warranty is limited to repairing or adjusting any instrument returned to the factory for that purpose. The warranty of this instrument is void if the instrument has been modified other than in accordance with written instructions from Bentham, or if defect or failure is judged by Bentham to be caused by abnormal conditions of operation, storage or transportation.

This warranty is subject to verification by Bentham, that a defect or failure exists, and to compliance by the original purchaser with the following instructions.

Before returning the instrument, please notify Bentham with full details of the problem, including model number and serial number of the instrument concerned. After receiving the above information, Bentham will issue an RMA reference number and provide shipping instructions.

After receipt of shipping instructions, ship the instrument “carriage paid” to Bentham. Full liability for damage during shipment is borne by the purchaser. We recommend that instruments shipped to us are fully insured and packed surrounded by at least two inches of shock-absorbing material. Specific transit packaging as used in monochromators etc. must be installed.

Bentham reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This warranty is expressly in lieu of all other obligations or liabilities on the part of Bentham, and Bentham neither assumes, nor authorises any other person to assume for it, any liability in connection with the sales of Bentham’s products.

NOTHING IN THIS GUARANTEE AFFECTS YOUR STATUTORY RIGHTS.

3 NOTICE FOR CLIENTS IN EUROPEAN UNION

This product is designated for separate collection at an appropriate collection point. Do not dispose of as household waste.

Bentham are fully WEEE compliant, our registration number is WEE/CB0003ZR.

Should you need to dispose of our equipment please telephone +44 (0) 113 385 4352/4356, quoting account number 135419.

4 CONTACT BENTHAM

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5 OVERVIEW

The DMc150 is composed of two 150mm focal length single monochromators operating in tandem, driven by a common grating drive.

In each component single monochromator, a kinematically mounted diffraction grating is installed. This mount allows the facile changing of gratings, maintaining the wavelength calibration.

All pairs of gratings of a given DMc150 are set up such that they share the same calibration factor, in this case the monochromator park position.

Multiple configurations are accommodated by the addition, at the entrance/ exit ports, of an additional slit with a computer-controlled selection mirror (SAM) between the two.

The entrance and exit ports can be fitted with either fixed, micrometer variable or motorised variable slits.

Figure 1:- DMc150F-U monochromator

A 6- or 8-position order sorting filter wheel is situated behind the entrance port to suppress all but the first diffraction order. Included is a blank disk to act as a shutter.

All control electronics for the monochromator drive, internal filter wheel, motorised slits and SAMs are situated on the underside of the unit.

Mains and the controlling USB connections are made directly to the DMc150.

6 GRATING DRIVE

In each half of the DMc150, is to be found a kinematic mount upon which may be installed a single diffraction grating.

The pair of grating mounts are connected by a sine-bar mechanism and driven by a stepping motor, used in the micro-stepping mode; 3000 steps per revolution of the motor turns a lead screw of 0.5mm per turn, which in turn drives a sine bar attached to the pair of gratings.

To the grating drive is fitted a two-stage encoder, allowing the unit to be sent to a fixed datum point (positive limit). On software initialisation, the turret is sent to this position, or “parked”.

The DMc150 drive being based on a mechanical sine law conversion, the wavelength scale has a sinusoidal aspect which can be corrected.

In common with all gear systems, the grating drive in the DMc150 suffers from backlash, a region of inaction immediately after the direction of rotation be changed, albeit reduced by the design of the drive. This is easily overcome by ensuring that the desired location of the turret (wavelength) be at all times approached from the same direction.

To go therefore from a higher to a lower wavelength, the turret should be moved beyond the target location which is then approached in the direction of increasing wavelength.

7 DIFFRACTION GRATINGS

In each half of the DMc150 may be kinematically mounted a single diffraction grating.

The diffraction gratings for the DMc150 are 33x33mm, provided in a mount for attachment to the kinematic mount. On the former mount there exists three corner screws which are used to set the grating position and which define the grating stup/ calibration and should not be touched. Projecting from the mount is a stud which passes through the kinematic mount to allow attachment of the grating with a leaf spring fork.

On purchasing a monochromator, all gratings are factory fitted. For those gratings purchased at a later time, further information concerning grating installation is provided in § 8.

The following table summarises the maximum recommended range of use in the DMc150 of the most popular diffraction gratings offered by Bentham:-

Between zero nanometres (at which position the grating acts as a mirror) and the minimum cited wavelength, problems may be encountered with re-diffracted light whereby the zero diffraction order is coincident with the diffraction grating, and “re-diffracted”.

Above the maximum cited wavelength, the grating is rotated to such an extent that the angle of incidence of light onto the grating shall approach 90°.

Line density (g/mm)	Maximum λ Range (g/mm)
2400	200-675 nm
1800	200-900 nm
1200	300-1200 nm
830	500-1800 nm
600	800-2500 nm
400	1- 3 µm
300	1.5-5.5 µm
150	2.4-8.0 µm
100	4.5-16.2 µm
75	6- 21 µm
50	9- 27 µm

Table 1: Grating maximum range of use

8 GRATING INSTALLATION

8.1 INTRODUCTION

The gratings supplied for use with the DM150 are mounted on a kinematic system which allows them to be interchanged quickly and without the loss of calibration.

On the gratings, as seen below, are screws to adapt to the kinematic mount, the positions of which have been manipulated at calibration and must not be touched. A varnish is used to ensure non removal.

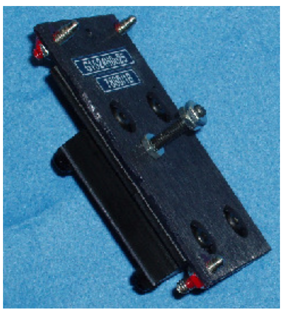


Figure 2:- Diffraction grating

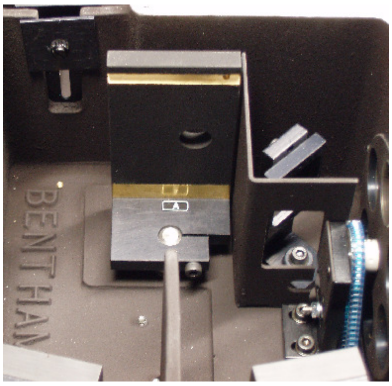
Gratings supplied with the instrument have been fully adjusted in manufacture and the user needs only install them as required and for critical applications, make a simple check for any shift of calibration which might have occurred in transit.

When gratings are purchased after delivery of the monochromator, the user must make simple once and for all adjustments to the new grating.

8.2 PROCEDURE FOR INSTALLING GRATINGS

TAKE GREAT CARE NOT TO TOUCH THE FRONT SURFACE OF THE GRATING, OR THE MIRRORS IN THE DMC150 WITH ANYTHING.

- Remove the lid of the Monochromator by unscrewing the six 3mm socket head screws
- Note that the gratings are position specific- on the rear of each grating is written 1A or 1B.
- Using a silk or felt glove, grasp the edges of grating A, to be installed in the entrance section of the monochromator (near to filter wheel), labelled A
- Hold the leaf spring (fork) with one hand, position the grating on its' mount with the other
- Pass the retaining bolt through the grating mount, and gently rock the grating to ensure in place in groove of kinematic plate



Figures 3 & 4:-Grating mount and grating in place

Figure 5:- Grating retained by leaf

- Repeat with grating B

Follow the procedure described later in §15 to check wavelength calibration of monochromator to ensure correct installation of gratings.

9 ORDER-SORTING FILTER WHEEL

The governing diffraction equation admits solutions for integer multiples of the wavelength in consideration, thus diffraction orders.

Most spectroradiometry is performed on the first order contribution; it is necessary to avoid measurement of higher diffraction orders for correct measurements.

A 6- or 8-position order sorting filter wheel is to be found inside the monochromator entrance port, fitted with order sorting filters suitable for the spectral range of use

Below 400nm, no filters are required since for the next highest diffraction order, the second, the corresponding wavelength is less than 200nm which is blocked in any case by the atmosphere.

Spectral range	Required OS Filter
<400 m	None
400-700nm	OS400
700-1250nm	OS700
1250-2000nm	OS1250
2000-3600nm	OS2000
3.6-6 µm	OS3600
6-10.5 µm	OS6000
10.5-21 µm	OS10500
> 21µm	please consult

Table 2: Required order sorting filters

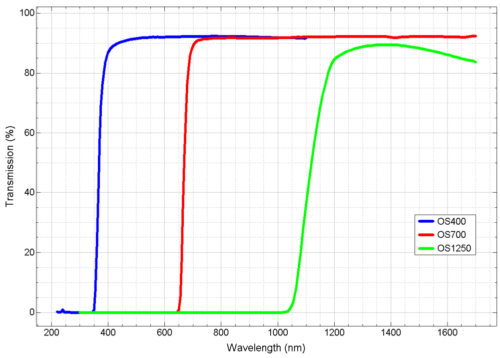


Figure 6:-Typical OS filter transmission

10 ENTRANCE AND EXIT SLITS

10.1 INTRODUCTION

The entrance and exit slits of the DMc150 can be fitted with either of the following assemblies: fixed, micrometer variable or motorised variable.

10.2 FIXED SLITS

Where the fixed slit option is purchased, 3 sets of slits are provided according the required system bandwidth.

Fixed slit carriers incorporate a spring leaf to push the slit against its datum face to ensure the correct placement of the slit.

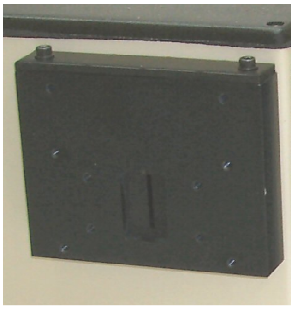


Figure 7:-Fixed slit

Changing entrance and exit slits:-

- Remove fixed slit cover with M3 Allen key
- Using pincers, pull out slit
- Place new slit in holder with etched side facing away from monochromator, flat rear of slit against the monochromator
- Push fixed slit down, firmly into place
- Replace cover

Changing middle slit:-

The same procedure as above applies, noting that the etched side should face away from the first monochromator (that having the power supply and USB interface).

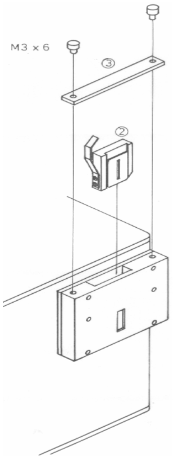


Figure 8:- Changing fixed slits

It should be noted that where a photomultiplier detector is mounted to the slit in question, the high voltage is switched off during the changing of the slit to prevent exposure to ambient lighting.

IT IS IMPORTANT THAT THE SLITS ARE INSTALLED IN THE CORRECT ORIENTATION, ELSE A WAVELENGTH ERROR RESULTS.

10.3 MICROMETER VARIABLE SLITS

Micrometer variable slits make use of a Vernier calliper controlled pair of bi-lateral slits, variable from 10µm to 10mm.

Figure 9:-Micrometer variable slit

One rotation of the calliper is equivalent to 0.5mm in slit width; the slit dimension can be read off the Vernier.

To the base of the barrel a knurled nut locks the position (clockwise). This should be undone (anti-clockwise) before changing the dimensions of the slit.

Forcing the calliper beyond the zero position can result in damaging the bi-lateral slits.

10.4 MOTORISED VARIABLE SLITS

Motorised variable slits are comprised of stepping motor-driven bi-lateral slits, driven either from the internal monochromator electronics or from an external MAC electronics bin, and are variable from 10µm to 10mm.

Figure 10:-Motorised variable slit

Each slit should be connected to the correct drive (numbered), and all cables should be firmly attached.

NEVER CONNECT OR DISCONNECT SLIT CABLES WHILST MAC ELECTRONICS/ MONOCHROMATOR POWERED ON!

The motorised slits are entirely controlled by computer through the USB interface, please see §13.

11 SWING AWAY MIRRORS

Swing away mirrors allow the addition of a supplementary entrance/ exit port to each component TMc300, the solenoid based mirror being set to either relay the beam from one slit or to move out of the beam to use the other.

In such a manner the DMc150 may have two entrance or two exit ports.

12 MONOCHROMATOR BANDWIDTH

The monochromator bandwidth, defined in nm, is the range of wavelengths seen by the detector at one time, and is directly linked to the monochromator slits in use.

This is an important quantity to take into account, particularly when measuring sources have fine spectral features such as line emission- for example the measurement of a source having two spectral lines 1nm apart with a system bandwidth of 5nm, will result in the measurement of a single line.

In many instances this is of no concern, since the power measured is nevertheless correct.

The effect of monochromator entrance and exit slits on monochromator bandwidth can be viewed in two manners.

In the first instance, the monochromator is an imaging system; the input port is imaged at the exit port; the dimension of the monochromator entrance slit defines the image size at the exit port.

Furthermore, at the exit of the monochromator, since the light incident thereupon is dispersed, on can imagine the wavelength axis running along parallel to the wall of the exit slit, and the size of this slit determines how many wavelengths can be seen at one time.

One can imagine therefore an infinite number of images of the entrance slit, of incrementally differing wavelength, presented parallel to the exit slit; whichever of the two are the largest, defines the bandwidth of the system.

In a double monochromator, a further slit is included, the middle slit (in the case of a system having additive dispersion).

The purpose of this slit is to reduce the amount of stray light going from the first to second monochromators and should at all times be set to at least 20% larger than the largest slit in the system, else tracking problems between the component monochromators will result.

The slit function of a monochromator provides interesting information with regards the device performance and the system bandwidth.

The slit function may be determined by the measurement of a source of narrow spectral width, such as a laser.

One should perform a measurement at smaller steps than the system bandwidth (for example 0.1nm), over a spectral range of around four times the expected bandwidth, centred on the expected wavelength of the emission line, for example 632.8nm for the HeNe laser.

The full width half maximum (FWHM) of this spectrum provides the bandwidth of the system.

Inspecting the signal at one bandwidth, two bandwidths etc. relative to the peak, provides information of the stray light performance of the system.

If the entrance and exit slits are of the same dimension, the slit function will have a triangular profile, otherwise, the function will be flat-topped.

It is worth noting that care should be taken in making this measurement - it is not sufficient to shine a laser in the entrance slit of the monochromator.

This measurement should ideally be performed by filling the entrance slit, for example with the use of an integrating sphere, and illuminating the sphere with the source.

Finally, it follows of course that slit dimension has an impact of the light throughput of the monochromator, and in certain instances where a reduction in signal is required, either the entrance or exit slit is reduced, whilst maintaining the same system bandwidth.

It is preferable that the slit to be reduced is the exit slit to avoid any conflict with the input optic.

For information, the following table shows the bandwidth obtained for the monochromator and gratings of this system with a range of slit widths, for the single and double configurations.

IT IS IMPORTANT TO REMEMBER THAT TO PERFORM A SCAN WITH A STEP SIZE LOWER THAN THE BANDWIDTH OBTAINED IS SATISFACTORY, ON THE CONTRARY TO STEP LARGER THAN THE BANDWIDTH RESULTS EFFECTIVELY IN THE LOSS OF INFORMATION.

Grating Groove Density (l/mm)		**2400**	**1200**	**600**	**400**	**300**	**150**	**100**	**75**	**50**
Reciprocal Dispersion (nm/mm)		**1.35**	**2.70**	**5.40**	**8.11**	**10.81**	**21.62**	**32.42**	**43.23**	**64.85**
Slit widths (mm)	**Part no. for pair of slits**	**Bandwidth produced (nm)**								
0.05	FS (0.05)	0.07	0.14	0.27	0.41	0.54	1.08	1.62	2.16	3.24
0.1	FS (0.10)	0.14	0.27	0.54	0.81	1.08	2.16	3.24	4.32	6.48
0.2	FS (0.20)	0.27	0.54	1.08	1.62	2.16	4.32	6.48	8.65	12.97
0.37	FS (0.37)	0.50	1.00	2.00	3.00	4.00	8.00	12.00	16.00	23.99
0.4	FS (0.40)	0.54	1.08	2.16	3.24	4.32	8.65	12.97	17.29	25.94
0.5	FS (0.50)	0.68	1.35	2.70	4.05	5.40	10.81	16.21	21.62	32.42
0.56	FS (0.56)	0.76	1.51	3.03	4.54	6.05	12.10	18.16	24.21	36.31
0.74	FS (0.74)	1.00	2.00	4.00	6.00	8.00	16.00	23.99	31.99	47.99
1	FS (1.00)	1.35	2.70	5.40	8.11	10.81	21.62	32.42	43.23	64.85
1.12	FS (1.12)	1.51	3.03	6.05	9.08	12.10	24.21	36.31	48.42	72.63
1.48	FS (1.48)	2.00	4.00	8.00	12.00	16.00	31.99	47.99	63.98	95.97
1.85	FS (1.85)	2.50	5.00	10.00	15.00	19.99	39.99	59.98	79.98	119.97
2	FS (2.00)	2.70	5.40	10.81	16.21	21.62	43.23	64.85	86.46	129.69
2.78	FS (2.78)	3.76	7.51	15.02	22.53	30.05	60.09	90.14	120.18	180.27
3.7	FS (3.70)	5.00	10.00	19.99	29.99	39.99	79.98	119.97	159.96	239.93
4	FS (4.00)	5.40	10.81	21.62	32.42	43.23	86.46	129.69	172.92	259.39
5.56	FS (5.56)	7.51	15.02	30.05	45.07	60.09	120.18	180.27	240.36	360.55
8	FS (8.00)	10.81	21.62	43.23	64.85	86.46	172.92	259.39	345.85	518.77
10	-	13.51	27.02	54.04	81.06	108.08	216.16	324.23	432.31	648.47

Table 3: Single configuration bandwidth

Grating Groove Density (l/mm)		2400	1200	600	400	300	150	100	75	50
Reciprocal Dispersion (nm/mm)		**0.68**	**1.35**	**2.70**	**4.05**	**5.40**	**10.81**	**16.21**	**21.62**	**32.42**
Slit widths (mm)	**Part no. for pair of slits**	**Bandwidth produced (nm)**								
0.05	FS (0.05)	0.03	0.07	0.14	0.20	0.27	0.54	0.81	1.08	1.62
0.1	FS (0.10)	0.07	0.14	0.27	0.41	0.54	1.08	1.62	2.16	3.24
0.2	FS (0.20)	0.14	0.27	0.54	0.81	1.08	2.16	3.24	4.32	6.48
0.37	FS (0.37)	0.25	0.50	1.00	1.50	2.00	4.00	6.00	8.00	12.00
0.4	FS (0.40)	0.27	0.54	1.08	1.62	2.16	4.32	6.48	8.65	12.97
0.5	FS (0.50)	0.34	0.68	1.35	2.03	2.70	5.40	8.11	10.81	16.21
0.56	FS (0.56)	0.38	0.76	1.51	2.27	3.03	6.05	9.08	12.10	18.16
0.74	FS (0.74)	0.50	1.00	2.00	3.00	4.00	8.00	12.00	16.00	23.99
1	FS (1.00)	0.68	1.35	2.70	4.05	5.40	10.81	16.21	21.62	32.42
1.12	FS (1.12)	0.76	1.51	3.03	4.54	6.05	12.10	18.16	24.21	36.31
1.48	FS (1.48)	1.00	2.00	4.00	6.00	8.00	16.00	23.99	31.99	47.99
1.85	FS (1.85)	1.25	2.50	5.00	7.50	10.00	19.99	29.99	39.99	59.98
2	FS (2.00)	1.35	2.70	5.40	8.11	10.81	21.62	32.42	43.23	64.85
2.78	FS (2.78)	1.88	3.76	7.51	11.27	15.02	30.05	45.07	60.09	90.14
3.7	FS (3.70)	2.50	5.00	10.00	15.00	19.99	39.99	59.98	79.98	119.97
4	FS (4.00)	2.70	5.40	10.81	16.21	21.62	43.23	64.85	86.46	129.69
5.56	FS (5.56)	3.76	7.51	15.02	22.53	30.05	60.09	90.14	120.18	180.27
8	FS (8.00)	5.40	10.81	21.62	32.42	43.23	86.46	129.69	172.92	259.39
10	-	6.75	13.51	27.02	40.53	54.04	108.08	162.12	216.16	324.23

Table 4: Double configuration bandwidth

13 SOFTWARE CONTROL

13.1 INTRODUCTION

The DTMc300 may be controlled, as part of a Bentham spectroradiometer system, with BenWin+ or by customer written applications based on the Bentham Instruments SDK.

For further details of control with the SDK, please consult the SDK manual.

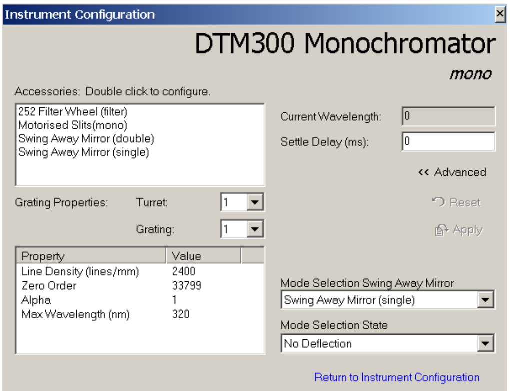
For an overview of the instrument settings in BenWin+ please see the following. For use of the software to perform spectral measurements, please consult the BenWin+ manual.

13.2 MONOCHROMATOR

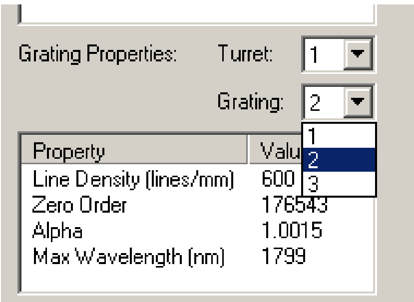
The properties of the DTMc300 are obtained in the following menu item:-

Instruments/ Monochromator

Selecting *Advanced>>* gives access to the grating properties: line density, zord, alpha and maximum wavelength.



The drop down arrow allows toggling between gratings and turrets.



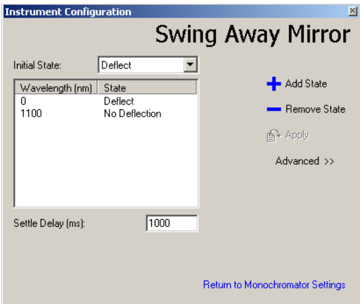
The zord and alpha parameters for each grating are obtained from the calibration certificate.

The max wavelength is the selection criterion from one to another grating. This should not exceed that recommended in table 1, but can be changed to optimise signal, for example where one grating loses efficiency another might gain (taking into account both change in efficiency and change in bandwidth as one migrates to another grating).

For USB- based systems, the settle delay can be set to 0ms. In the case of IEEE monochromators, a settle delay of 100ms is suggested.

13.3 SWING AWAY MIRROR (SAM)

Accessed via a link in the monochromator page is the SAM page, named according to their positions.



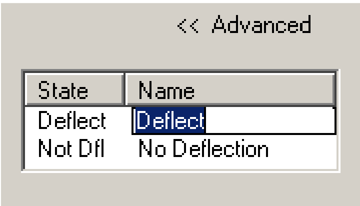
Here, one might add (“+”) a number of states (or remove by highlighting and hitting “–“).

Define states by the wavelength of insertion (inclusive), and the SAM state.

SAM states are as follows:-

- Deflect- deviate light from current path
- No deflection- move out of beam

In *Advanced>>* we can name the two SAM states for easier setting up.

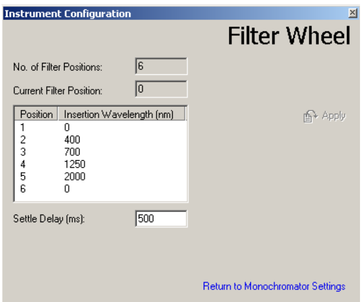


Settle delay of 1000ms is sufficient.

13.4 FILTER WHEEL

The properties of the filter wheel are obtained in the following menu item:-

Instruments/ Filter wheel



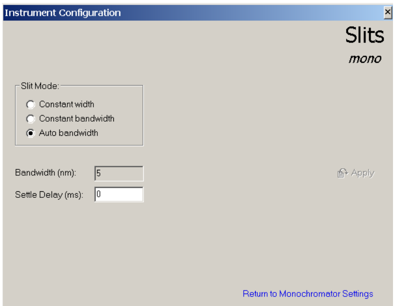
The insertion wavelength relevant to the filter in a given position should be input. The order need not be ascending.

A settle delay of 1000ms is sufficient.

13.5 MOTORISED SLITS

The properties of the motorised slits are obtained in the following menu item:-

Instruments/ Motorised slits



There are 3 available modes of operation:-

- **constant width** - input required dimension
- **constant bandwidth** - input required bandwidth
- **auto** - sets the bandwidth to the step size defined in the scan setup page

IT SHOULD BE NOTED THAT HAVING CALIBRATED A SYSTEM IN AUTO MODE AT A GIVEN STEP SIZE, TO CHANGE THE STEP SIZE WOULD INVALIDATE THE CALIBRATION.

A settle delay of 100ms is sufficient.

13.6 Configuration Files Syntax

Please consult the BenWin+ manual for further information concerning configuration file syntax.

14 WAVELENGTH SELECTION

The first order grating equation for the TMc300 is:

$$\lambda = 2d \, Sin\theta \, Cos\beta$$

Where:

λ, = wavelength (m)

d = groove spacing of the diffraction grating (m)

θ = grating angle in degrees

β = a fixed angle determined by the design of the monochromator (cosβ for the TMc300 = 0.9727)

The grating angle required for wavelength λ is therefore given by:-

$$\theta = \sin^{-1}\left(\frac{\lambda.RD.10^{-6}}{1.9454}\right)$$

Where λ is in nm, RD in grooves per mm.

The zord value given for each grating corresponds to the number of motor steps between the datum point and zero angle for that grating (at which point the grating acts as a mirror).

The Alpha value given for each grating is used to modify the calculated grating angle to give the best wavelength accuracy.

The position of the grating for a given wavelength is calculated as the number of motor steps from the datum point.

Position= (θxAlphax(500000/360))+zord

This is calculated for the turrets of both component TMc300s.

15 WAVELENGTH CALIBRATION

15.1 OVERVIEW

The DMc150 was wavelength calibrated in factory.

We recommend that the customer periodically checks the wavelength calibration, particularly if the device has been transported.

The initial wavelength calibration procedure typically consists of placing a white light source on the monochromator entrance slit and finding the required grating drive position to obtain the zero order position for each grating in turn.

At this position, the white light is transmitted through to the exit of the monochromator.

This procedure represents a gross calibration, from which can be obtained a dial park reading. With this information one can measure a source having known line emission to refine the calibration.

To this end a mercury lamp is typically employed, which emits a number of spectral lines in the region 250-700nm, whose position never changes.

In practice, higher diffraction orders are useful when performing wavelength calibration to provide a larger number of reference points. It is of course important to ensure that whilst observing the higher order lines, the order sorting filters of the monochromator are de-activated. This is done by setting the insertion wavelength of the non-required filters to 0nm (in BenWin+, instruments menu/ filter wheel).

The following summarises a number of the useful mercury lines. Those marked in red are particularly strong lines, leading therefore to higher orders with a measurable contribution.

1st Order	2nd Order	3rd Order	4th Order	5th Order	6th Order	7th Order
184.91						
194.17						
226.22						
237.83						
248.2						
253.65	507.3	760.95	1014.6	1268.25	1521.9	1775.55
265.2						
280.35						
289.36						
296.73						
302.15						
312.57	625.14	937.71	1250.28	1562.85		
313.17						
334.15						
365.02	730.04	1095.06	1460.08	1825.1		
365.44						
366.33						
404.66	809.32	1213.98	1618.64			
407.78						
434.75						
435.84	871.68	1307.52	1743.36			
491.6						
496.03						
546.07	1092.14	1638.21				

576.96						
579.07						
690.7						
1013.98						

Table 5: Principle Hg emission lines

15.2 SPECTRAL MEASUREMENTS

Spectral measurements are performed, the positions of these lines checked and the calibration factors, alpha and zord changed to bring the monochromator into calibration. We recommend that the customer does not change alpha however.

Where the Hg lines are too low in wavelength, the zord value should be increased and vice versa.

As a guide, for 2400g/mm in the double configuration, 100steps corresponds to ~1nm, and 50 steps in the single configuration. The dispersion of the 1200g/mm grating is half this, etc.

Measurements in step of 0.1nm (with the slits in manual bandwidth where motorised slits are used) should be made of the regions around the Hg lines, and either the peak values or FWHM central wavelength taken as the position of the line.

Be aware of the slits presently in use in the system. Having for example 5nm slits and looking at the lines around 365nm, one will effectively see several lines which can distort the result and wrongly show lack of calibration.

In the case of infrared gratings where there is no useful emission of the Hg source, gratings are set up with the zero-order position, setting the monochromator to 0nm and ensuring the white light is transmitted through the exit slit.

Where a mercury lamp is not available, overhead fluorescent lamps are often of use since they contain mercury gas.

Because of the glass envelope of the lamp no light is emitted below 350nm.

Where a system contains SAMs, the calibration procedure should be repeated in all ports.

15.3 DMC150 CALIBRATION

The calibration of the DMc150 should be performed with the smallest slits width intended to be used (where motorised slits are used, they should be in manual bandwidth mode).

Measurements should be made of a mercury source and the park dial reading modified to bring the device into calibration.

16 SETTING MAINS VOLTAGE

The DMc150 is fitted with a switch mode power supply.

Fuses are fitted dependant on location. Fuses are:-

110 V - 1260mA anti- surge

220/240V – 630mA anti- surge

18 NEW GRATING INSTALLATION

Due to the complex procedure required to set up gratings in the DMc150 we recommend this operation is performed at Bentham.

19 PRECAUTIONS

The following is a list of specific precautions aimed to preserve this system for good use:

- Do not touch gratings nor optics
- Do not subject monochromator to violent physical shock- this may invalidate wavelength calibration
- Do not use over-long screws when mounting items to entrance slit for fear of damaging bi-lateral slits
- Do not let the slits bear any heavy objects
- Do not (dis)connect motorised slit cables whilst MAC electronics powered on
- Do not (dis)connect external filter wheel cable whilst MAC electronics powered on

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