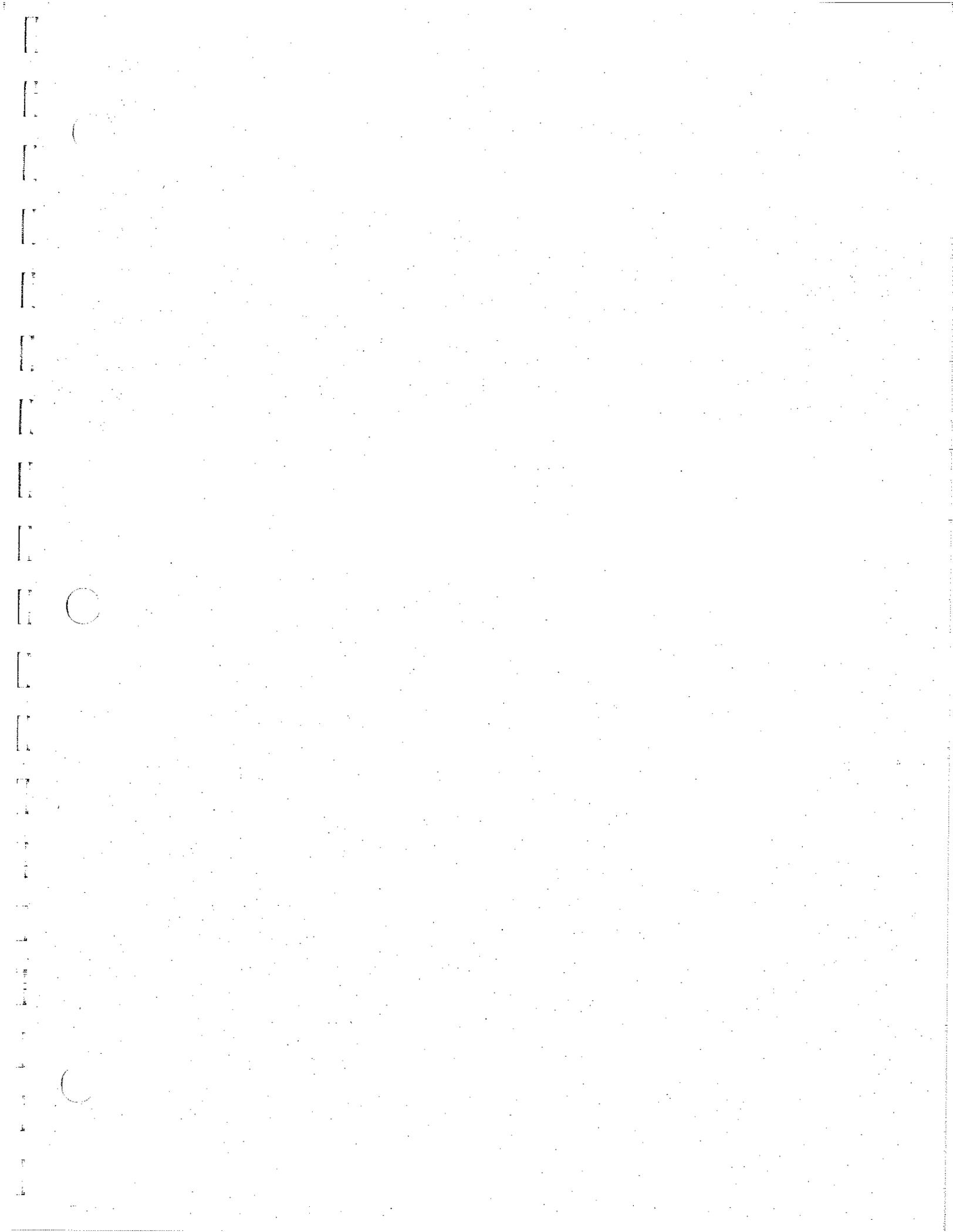


H10, H20 & DH10
COMPACT MONOCHROMATORS
USER MANUAL



H10, H20, & DH10 MONOCHROMATORS

About the Manuals...

There may be more than one manual, depending on the system configuration. To find the manual that has the information needed, these guidelines may help.

- Each manual generally covers a product and the features and accessories peculiar to and/ or contained within that product.
- Accessories that can be applied to various products are usually covered by separate documentation.
- Software that is exclusively used with one instrument or system is normally covered in the manual for that product.
- Software that can be used with a number of other products is covered in its own manual.
- If reading about a product that interacts with other products, references will be made to other documentation as necessary.

H10, H20, & DH10 MONOCHROMATORS

H10, H20, & DH10 MONOCHROMATORS

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H10, H20, & DH10 MONOCHROMATORS

Overview:

The H10, H20 and DH10 are designed as compact, durable, general purpose monochromators. Each of these instruments has a solid cast bases surrounding the precision components, protecting them from misalignment by all but the most extreme abuse. These small, rugged instruments will withstand rougher treatment than other monochromators.

Each J-Y compact monochromator delivers exceptional performance for its size. The key elements that make this performance possible are the Jobin-Yvon type IV aberration corrected holographic gratings. These gratings replace three optical elements in traditional designs. The light collection, diffraction, and aberration corrected focusing to the exit are all accomplished by the gratings.

Because the gratings are holographic, the ghosts that occur with ruled gratings are eliminated. Standard holographic gratings have broad, relatively flat response. The available blazed holographic gratings provide high efficiency, comparable to classically ruled gratings, but, again, without the ghosts.

The design minimizes stray light, providing spectral purity and signal to noise ratios beyond the reach of other monochromators in their size class.

Standard H10, H20, and DH10 monochromators include a manual drive with a three digit mechanical wavelength counter. This counter displays the tuned wavelength in nanometers for a monochromator equipped with a 1200 g/mm grating. The optional 600 and 300 g/mm gratings require a 2 X and 4 X multiplication of the counter reading, respectively. A fine lead screw version with a four digit counter provides direct wavelength readout for the 800 g/mm grating.

H10, H20, & DH10 MONOCHROMATORS

Unpacking:

The monochromator was shipped in packing designed to protect it from harm under normal shipping conditions. If shipping damage is noticed upon delivery, the carrier should note such damage on the receipt, and sign all copies. This will facilitate processing a damage claim with the carrier.

Open the top of the shipping carton and remove packing material until the instrument is exposed.

Reach down around the edges of the instrument, grasp the bottom, and lift it out of the remaining packing. Place it on a sturdy table. Check through the packing thoroughly and gather the small parts and documents that were shipped with it.

Inspection for Damage:

Inspect the instrument for visible evidence of any damage. Check that all readily visible mechanical and electrical components are in their proper places and intact. If damage is evident, do not operate the instrument. Notify Instruments SA / J-Y Optical Systems Customer Service Department and the carrier at once.

Many public carriers do not recognize claims for concealed damage reported later than 15 days after delivery. For a shipping damage claim, inspection by the carrier agent is normally required. For this reason, the original packing should be retained as evidence. While Instruments SA, Inc. is not liable for damage in transit, the company will extend every effort to aid and advise.

These instruments are shipped with the gratings mounted. Unless the monochromator is an H20 with extra gratings, there is no need to remove any covers.

If for any reason the cover is removed, take care not to touch any of the optical surfaces in the instrument. Damage can easily occur and degrade performance. Such damage is not covered by the warranty. Fingerprints on a grating surface cause permanent damage. Once a fingerprint is on a grating, it is probably best to leave it alone. (See Care of Optical Components on page 18) Attempts to remove a fingerprint usually do not significantly restore any lost grating performance, even though the cosmetic appearance may be improved. There is a high risk of cleaning attempts contributing to further damage and degradation of performance.

H10, H20, & DH10 MONOCHROMATORS

Operation:

The compact monochromators and their accessories have been designed to be mechanically and optically compatible. The mountings have a 28 mm diameter X 1 mm pitch threaded collar to mount small accessories.

The instruments may be operated in any orientation. If the application requires an inverted position, we recommend securing the slit inserts with black vinyl electrical tape.

No routine maintenance is required. The moving parts are properly lubricated at the factory and will need no attention for many years of normal use.

Wavelength Counter Readings:

With a 1200 g/mm grating, (or an 800 g/mm when the monochromator is equipped with a fine lead screw and 4- digit counter) the wavelength of the light allowed to pass to the exit will be the same as the counter reading on the monochromator. In these cases the counter reads directly in nanometers.

For other groove densities, the actual wavelength will differ from the counter reading by a factor inversely proportional to the difference in groove density. For example, when a 600 g/mm grating is in use in a monochromator that has a counter that reads directly for 1200 g/mm, the actual wavelength will be $1200 / 600$, or 2 X the mechanical counter reading.

The counters are supplied with a locking lever below the wavelength tuning knob. When the instrument is to be parked at a specific wavelength, the lock will prevent accidental detuning. If a motor drive is attached, be sure to leave the lever in the unlocked position.

Interchangeable Fixed Slits:

The monochromator is provided with a complement of fixed slit inserts. These may be interchanged to set the spectral bandpass. The H10 and H20 have a standard set of two each: 0.5 mm, 1.0 mm, and 2.0 mm slits. The DH10 has additional 1.0 and 2.0 mm slits. The size of each slit is marked on the slit insert.

A height limiter (fish tail) slide is provided at each entrance and exit slit. the maximum height is 8 mm, the minimum, 2 mm. When resolution improvement or a small image spot size matter more than total light throughput, this may be accomplished by limiting the slit height. Otherwise, 8 mm height usually gives the best results.

Notice that each slit insert has a button at the top. Insert the slits into the slit holders at the entrance and exit with the buttons facing outward. To begin with, insert a 2.0 mm slit in the entrance and the exit slit holders. For a DH10, also insert a 2.0 mm slit in the intermediate slit holder. Be sure that the button slides into the inset provided.

H10, H20, & DH10 MONOCHROMATORS

Choosing Slit Widths:

For most applications, entrance and exit slits should be the same size. The intermediate slit of the DH10 should be 2 X the width of the entrance and exit, unless they are 2 mm or greater, in which case the intermediate slit should be the same size.

Decreasing the slit width increases spectral resolution by limiting bandpass. Conversely, the wider the slit, the less resolution. Of course, the amount of light allowed to pass through the instrument is proportional to the slit area.

To calculate the bandpass for a given slit width,

$$\text{Bandpass} = \text{Linear Dispersion} \times \text{Slit Width}$$

The practical minimum bandpass for this series of monochromators is achieved with 0.1 mm slits. There is no guarantee that further reduction of slit width will decrease the spectral bandwidth. Of course, smaller slits can be used to limit light, if that is desired.

Note that the dispersion specifications given on page 17 are valid only for 1200 g/mm gratings. The following table lists dispersion for all gratings.

Linear Dispersion	H10	H20	DH10
1200 g / mm	8 nm / mm	4 nm / mm	4 nm / mm
800 g / mm	12 nm / mm	6 nm / mm	6 nm / mm
600 g / mm	16 nm / mm	8 nm / mm	8 nm / mm
300 g / mm	32 nm / mm	16 nm / mm	16 nm / mm

If the application demands bandpasses that cannot be obtained with the standard slit inserts or others on hand, please contact Instruments SA, Inc. to order additional inserts. A range of sizes from 0.025 to 4.0 mm is available.

Ultimate Wavelength Calibration:

Factory calibration is appropriate for general use over a broad range. However, for the most demanding applications, in such cases, it may be possible to attain performance over a confined spectral range surpassing the published specifications that apply over broader ranges.

In order to obtain reproducible, high accuracy wavelength selection, a stepper motor drive system is essential. If an optional controller or software was included in the order, refer to the user manual shipped with it for calibration procedures.

If controlling the monochromator by other means, the following general instructions will help assure the most accurate, reproducible results.

A spectral line source or a filter with a sharp transition is needed for this level of calibration accuracy.

H10, H20, & DH10 MONOCHROMATORS

In the region of interest, choose a filter transition or a spectral line that is emitted by the light source, and tune to it. Be certain not to confuse it with other lines, even from other spectral orders. Precisely locate the transition or peak, with the final pass coming in the scanning direction to remove backlash.

The backlash allowance recommended for Compact Monochromators with 1200 g/mm gratings is 10 nm (or 200 steps if you are using an ISA controller or stepper driver, or any other half step driver).

Use the narrowest available slit inserts to sharpen the peak. When satisfied that the exact peak location is found, make the final pass in the scanning direction with backlash removed. Record the actual wavelength value for that position and the counter reading. If the grating you are using has a groove density other than the base groove density for your monochromator, you must apply a conversion factor to the actual wavelength to arrive at the correct value. Note any minor offset between the peak's actual wavelength and the counter reading. For a range of about 100 nm you can consider this offset to be constant. The offset should be within the wavelength accuracy specification. If not, you may wish to reset the counter by removing the wavelength knob and loosening the setscrews to reposition the counter relative to the shaft.

When a 600 g/mm grating is in use in a monochromator that has a counter that reads directly for 1200 g/mm, the actual wavelength will be 1200/600 (or 2 X) the mechanical counter reading.

Check your calibration by tuning to another nearby line. For accuracy and reproducibility specifications, refer to the specifications section on page 17.

Mounting Provisions:

The ISA compact monochromators have threaded slit adapters for mounting accessories and tapped holes in their bases for mounting on larger structures. Refer to the appendix on page 22 to find the interface drawing of the monochromator. These drawings provide mounting dimensions.

Environmental Considerations:

For best long term performance, the monochromator should be kept in an atmosphere free of dust, corrosives and smoke. For specified performance, it should be operated in a room where temperature is maintained within $\pm 5^\circ\text{C}$.

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Optional Accessories:

Instruments SA offers complete line of accessories for all of the compact monochromators:

- **Light sources for the ultraviolet, visible, and infrared regions.**
- **Fiber optic cables and coupling interfaces.**
- **Sample compartments.**
- **Filter mounts and wheels.**
- **Shutters for exposure control and background acquisition.**
- **Photodetectors for the ultraviolet, visible, and infrared regions.**
- **Stepper motors and drivers.**
- **Computer ready control interfaces.**
- **Signal acquisition electronics.**
- **Spectroscopic software with integrated control, acquisition, storage, manipulation, and plotting capabilities**

For further information about these items, please call Instruments SA directly.

By phone: 908-494-8660.

Or fax: 908-549-5125.

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TTL Stepper Drive Interface:

This section details the functionality of the optional 22.900.093 Spectrometer I/O interface. It is designed for those who wish to interface directly to the hardware using TTL logic.

This discussion does not apply to systems with optional 232 or 488 interfaces, or the DataScan controller refer to the DataScan or Spectrometer Control manuals if those interfaces are used.

The appendix on page 25 includes a pin function table for the Standard Spectrometer I/O (TTL) connector.

Interface Signal Descriptions

The Interface Control Circuits are TTL compatible (they are all uni-directional), and the pin connections are arranged to be consistent with the full line of SPEX and the smaller Jobin-Yvon Monochromators.

The input signals are terminated in the traditional 220/330 ohm pull-up / pull-down arrangement, the termination then feeds a Schmitt trigger input (74 HCT14).

DIRECTION: Pin 9

The DIRECTION signal is an input to the Stepper Drive Interface Card which is used to control the direction of movement wavelength drive motor. This line may be left high or low during transitions between devices, but should be asserted to the appropriate level at least 500 ns before any STEP pulses are made. The return for this line is on pin 23.

The wavelength drive card is provided a jumper option to determine the direction of rotation for a high or low DIR input signal.

STEP: Pin 11

This line should be kept HIGH (1) and activated by asserting it LOW and then HIGH. The negative (low going) edge initiates the step or switching action. The return for this line is on pin 24.

This signal is used to generate step pulses for the wavelength motor and slit stepper motors or to strobe the position data to the shutter or DC motors. The maximum repetition rate to the wavelength motor is 500 Hz.

The STEP line should be held high during any SELECT or DIRECTION signal transitions.

LOW LIMIT: Pin 12

This line is asserted low when the wavelength drive travels to the short wavelength end of its travel and contacts the limit switch. Pin 25 is the return. This line is inactive with the MMI-H1020 motor which has no limit switches. For the HR320, this line is used as a limit override input. Short it to pin 25 to override the limit and allow the drive to be moved back to the operating range.

HIGH LIMIT: Pin 13

This line is asserted low when the wavelength drive travels to the long wavelength end of its travel and contacts the limit switch. Pin 25 is the return. This line is inactive with the MMI-H1020 motor which has no limit switches. For the HR320, this line is activated for both high and low limits.

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Accessory Installation:

A full line of accessories are available for the H10, H20 and DH10, from light sources, optical fibers and interfaces to detectors and sample compartments. Most of these are shipped with separate documentation. The accessories described here are only those which are user installable and, in effect, become part of the monochromator.

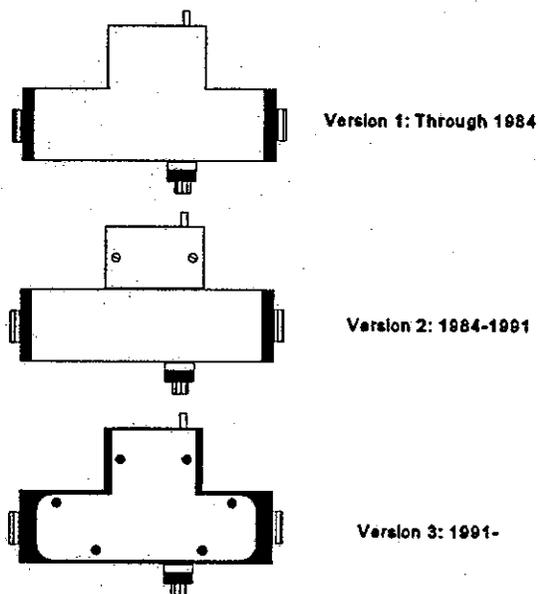
Additional Gratings:

All current production H20 monochromators are provided with an interchangeable grating mount. For older H20's refer to the figure below showing the three versions and compare your instrument with the top views. If your H20 is version 2 or 3, the grating mount is interchangeable.

If yours is version 1, it was originally shipped with a non-interchangeable mount, although it is possible that it has been upgraded to the interchangeable mount. The non-interchangeable mount has no alignment pins. If this mount is loosened or removed, alignment is lost. To upgrade to an interchangeable mount, contact our Customer Service Department.

To interchange gratings, the following procedure should be followed to prevent damage or misalignment.

- Turn the wavelength counter to 000
- Lock the counter, by pushing the lock lever to the right
- Remove the top cover using the following method appropriate for your version:
 - For version 1: Remove the two 9/16" hex socket head screws from the bottom of the instrument, and lift the cover straight up
 - For version 2: Remove the two slotted screws from the top of the rear portion of the cover, and lift this portion of the cover straight up
 - For version 3: Remove the six thumbscrews and lift the top cover off
- Next, remove the existing grating:



Note that if your grating mount has no alignment pins, it is NOT interchangeable, and it should not be disturbed.

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- Firmly grasp the grating *mount* ... avoid touching the surface of the grating. Fingerprints and rub marks on the grating surface practically always should be considered as permanent damage.
- While applying clockwise torque to the grating mount, remove the mounting (M3) screw.
- Gently pull the grating mount straight up and out of the instrument.
- Place the grating in a clean plastic jar with foam padding *behind* the grating mount to protect it from damage during storage.
- To install another grating:
- Remove the grating from its packing material.
- Firmly grasp the grating *mount* ... avoid touching the surface of the grating.
- Place the grating in the instrument, insuring that the guide pins are aligned with the hole and slot in the grating mount.
- Press the grating mount straight down until it touches the rotation platform.
- install the mounting screw.
- replace the cover(s).
- unlock the counter.
- If ultimate wavelength accuracy is required refer to page 9 for calibration instructions.

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MMI-H1020 Stepper Motor:

Locate the motor and the small parts bag shipped with it. The bag contains two hex keys and two pieces of the shaft coupling.

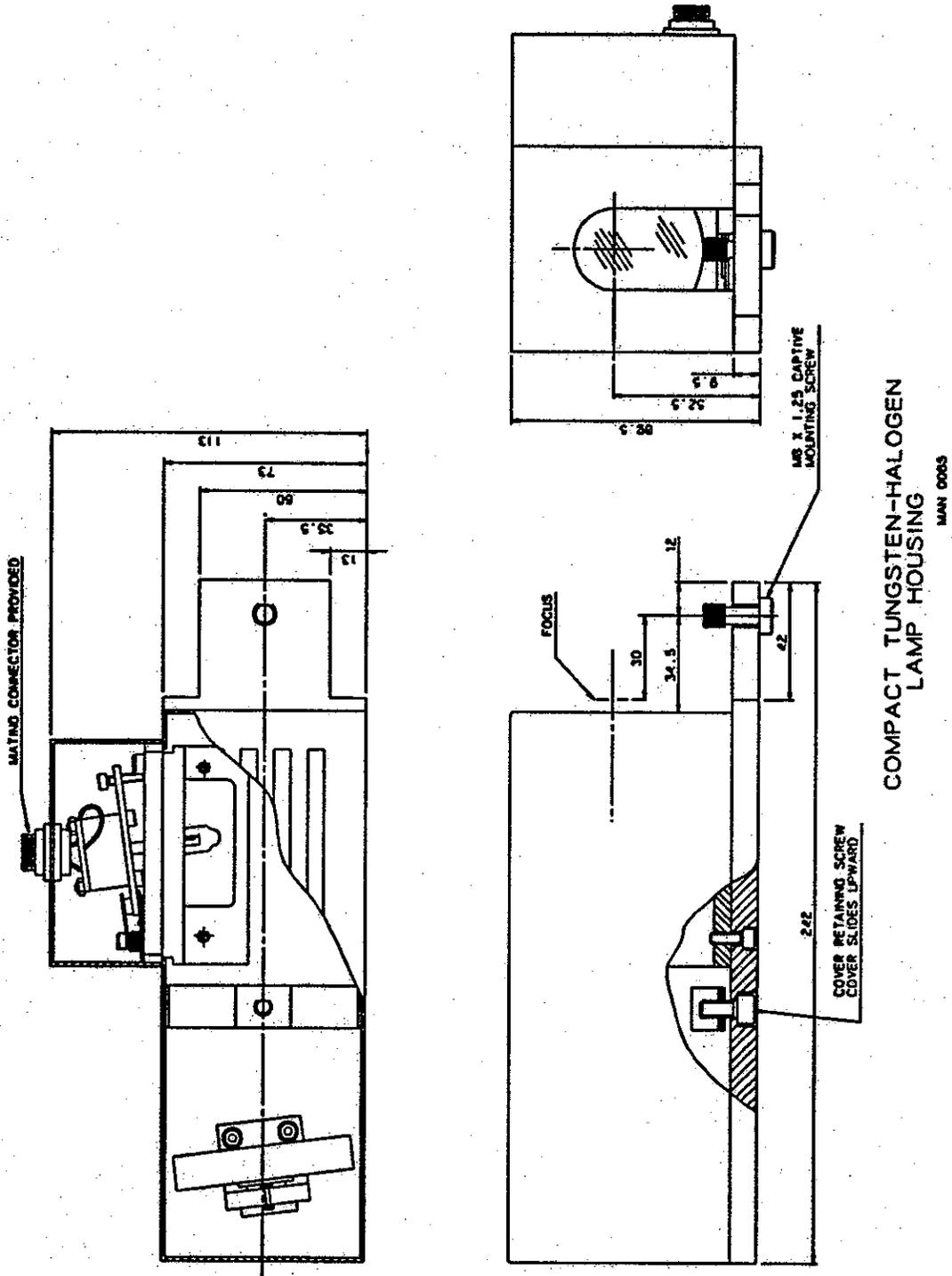
- Remove the cover of the motor assembly.
- Attach the metal piece of the shaft coupling to the exposed end of the drive shaft on the monochromator. Tighten the set screw with the smaller hex key. Place the plastic coupling piece onto the shaft coupling.
- Bolt the motor assembly to the tapped holes in monochromator casting, to the right of the shaft. Be sure that the plastic coupling meshes with the drive coupling on the motor.
- Replace the motor assembly cover.
- Connect the motor cable to the Stepper Driver, JY-232/488, DataScan2, DataLink, or SpectraLink controller. For SpectrAcq Controllers with a SAQ/CTI use a Stepper Driver. For SpectrAcq controllers without a SAQ/CTI use a JY232 connected to either the SpectrAcq or the host computer.

304.30.552 and 304.30.551 Compact Tungsten - Halogen Light Source:

This housing is designed exclusively for the H10, H20, and DH10 monochromators. (We also offer a Universal Lamp Housing which supports deuterium, xenon, tungsten and globar modules.)

- To attach the source housing to the monochromator, only one bolt is required. This is a captive 8 mm screw that is provided with the housing. The screw passes upward through the mounting tab and screws into the 8 mm threaded hole in the bottom of the monochromator base under the entrance slit. For the H20, the leveling leg must be removed.
- Connect the cable provided between the connector on the back of the housing and the power supply. If the source housing was ordered alone, without a power supply, a mating connector is provided for wiring to another power source. The lamp has a 100 watt, 24 volt rating. Output stability will depend on the regulation of the supply. See page 25 for the connector pin list.
- The lamp housing is shipped with the bulb installed. When the lamp must be relaced, be careful not to touch the bulb itself, as skin oils can degrade performance. Remove the cover and replace the lamp.
- Once the lamp is installed, small adjustments to the lamp mounting bracket may be performed. Monitor signal strength after the exit of the monochromator to optimize the throughput.

H10, H20, & DH10 MONOCHROMATORS



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Specifications:

Specifications	H10	H20	DH10
Focal length	100 mm	200 mm	100 mm
Aperture ratio	f / 3.5	f / 4.2	f / 3.5
Grating size	32 X 32 mm	45 X 45 mm	32 X 32 mm
Linear dispersion with 1200 g/mm grating	8 nm / mm	4 nm / mm	4 nm / mm
Bandpass with standard slits (0.5, 1.0, 2.0 mm) and 1200 g/mm grating	4, 8, 16 nm	2, 4, 8, nm	2, 4, 8, nm
Resolution with 0.1 mm slits, 1200 g/mm grating	1.0 nm	0.5 nm	0.5 nm
Stray light rejection, 8 bandpasses from laser, and integrated light at 230 nm, with 270 nm cutoff filter and 150 W xenon lamp	10^{-5} @ 8 band-passes from laser \leq .5% integrated at 230 nm.	10^{-5} @ 8 band-passes from laser. \leq .5% integrated at 230 nm.	2×10^{-9} @ 8 band-passes from laser.
Wavelength accuracy (linearity over 500 nm range, with 1200 g/mm)	± 1.0 nm	± 1.0 nm	± 1.0 nm
Reproducibility with 1200 g/mm grating and backlash corrected with motor drive	± 0.25 nm	± 0.25 nm	± 0.25 nm
Weight	2 Kg (4.5 lb.)	3.2 Kg (7 lb.)	4 Kg (9 lb.)

H10, H20, & DH10 MONOCHROMATORS

Installation and Care of Optical Components:

Excepting those times when exchanging optional gratings, most users will not need to open the instrument after the initial unpacking.

Mirrors and Gratings:

The mirrors and gratings in your spectrometer require no routine maintenance. Still, care should be exercised to prevent damage to their surfaces which will degrade throughput. Your spectrometer should be kept in an atmosphere free of dust, corrosives and smoke. Be careful to avoid touching a grating surface.

WARNING: Never turn the swingaway mirrors by hand when the power is on. The gearhead motors are delicate. Forcing them manually may result in time consuming, costly repair.

Dust or other solid debris should be blown off with dry dusting gas or nitrogen. Be sure to hold cans of dusting gas upright. If they are tilted or inverted, liquid propellant may be discharged, causing greater damage to the optic. If particles cannot be dislodged, consider leaving well enough alone, rather than risking surface damage. A fingerprint on a mirror or grating surface should be flushed off as soon as practical by squirting the surface of the mirror with research-grade methanol from a clean squeeze bottle. The power to the 270M should be turned off to avoid damage to the electronics, and should remain off until all traces of methanol vapor have dissipated, precluding any risk of ignition. Gratings should be removed from the instrument for flushing. When flushing a mirror, place some paper towels below the mirror to absorb the excess methanol. Blow off the grating or mirror with dry dusting gas or nitrogen to prevent spots or streaks. Be careful to avoid squirting or splashing the electronics or mechanical components. If the flow from the wash bottle does not remove the fingerprint, call Spex Customer Service for further advice.

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User Troubleshooting:

Your monochromator is designed to provide years of reliable service. If you are experiencing a problem, reviewing this section before contacting us will save time and help you to eliminate some simple errors that can be easily corrected.

Some of the more common difficulties that may be encountered are listed below. With each, some suggestions are given that will correct the problem for most cases.

Low signal throughput:

- Make sure that the light from the source or sample is well coupled to the entrance slit. Ideally, the light should be collected by a lens or concave mirror and imaged on the entrance slit. The coupling optics must be aligned on the optical axis of the monochromator.
- The monochromator's F# should be matched by the coupling optics. The best coupling for a source larger than the entrance slit is obtained with 1:1 magnification. For smaller sources, a proportional magnification factor will allow collection at a faster f# than that of the monochromator.
- If fiber optics are directly butted against the entrance slit, be sure that the fiber(s) are positioned in the slit opening. Align the fiber so that the cone of light emerges centered on the optical axis of the monochromator. The fiber type should be chosen to match the fiber aperture cone to the monochromator F#.

High stray light:

- Enclose the complete optical path to prevent scattered light from entering the system.
- Check to be sure that all covers are snug and that light seals are not damaged.
- In extreme cases, it may be helpful to cover the slit insert and seal the height limiter slide with black electrical tape.

Wavelength calibration unreliable for motorized scanning:

- Be sure that the wavelength counter lock lever is fully in the unlocked position.
- Check and re-tighten both ends of the shaft coupling to the motor.
- Reduce the initial step rate in the controlling program to prevent the motor from skipping steps.

No communications with the controlling instrument or computer:

- Check cable connections for partially dislodged connectors
- Refer to the troubleshooting section in the manual provided with the controlling instrument(s) in your system, for further suggestions.

Refer to the service policy in the following section to contact us for further assistance.

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Service Policy:

If you need assistance in resolving a problem with your instrument, contact our Customer Service Department directly, or if outside the United States, through our representative or affiliate covering your location.

Often it is possible to correct, reduce, or localize the problem through discussion with our Customer Service Engineers.

All instruments are covered by a warranty. The warranty statement is printed on the inside back cover of this manual. Service for out-of-warranty instruments is also available, for a fee. Contact ISA for details and cost estimates.

If your problem relates to software, please verify your computer's operation by running any diagnostic routines that were provided with it. If there is a support diskette provided, refer to the manual for that diskette, and follow the troubleshooting procedures. Be ready to provide version numbers for the DOS that you are using, as well as the software version and firmware version of any controller or interface options in your system. To determine the firmware version of your DataScan 2, refer to the procedure in the appendix on page 31. The software version can be determined by reading the version from the welcome panel that is displayed when the software is loaded. Or select the software name at the right end of the menu bar and click on "About" to view the same panel. Also knowing the memory type and allocation, and other computer hardware configuration data from the PC's CMOS Setup utility may be useful.

In the United States, customers may contact the Customer Service department directly:

- By phone at (908) 494-8660.
- The Service fax numbers are (908) 549-2571 for Raman, 549-5157 for Fluorescence, or 549-9309 for Systems Group.
- Or you may write to:
Instruments SA, Inc.
Customer Service (Specify Raman, Fluorescence, or Systems Group)
3880 Park Avenue
Edison, N.J. 08820 U.S.A.

From other locations worldwide, contact the representative or affiliate for your location.

If an instrument or component must be returned, the method described on the following page should be followed to expedite servicing and reduce your down-time.

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Return Authorization:

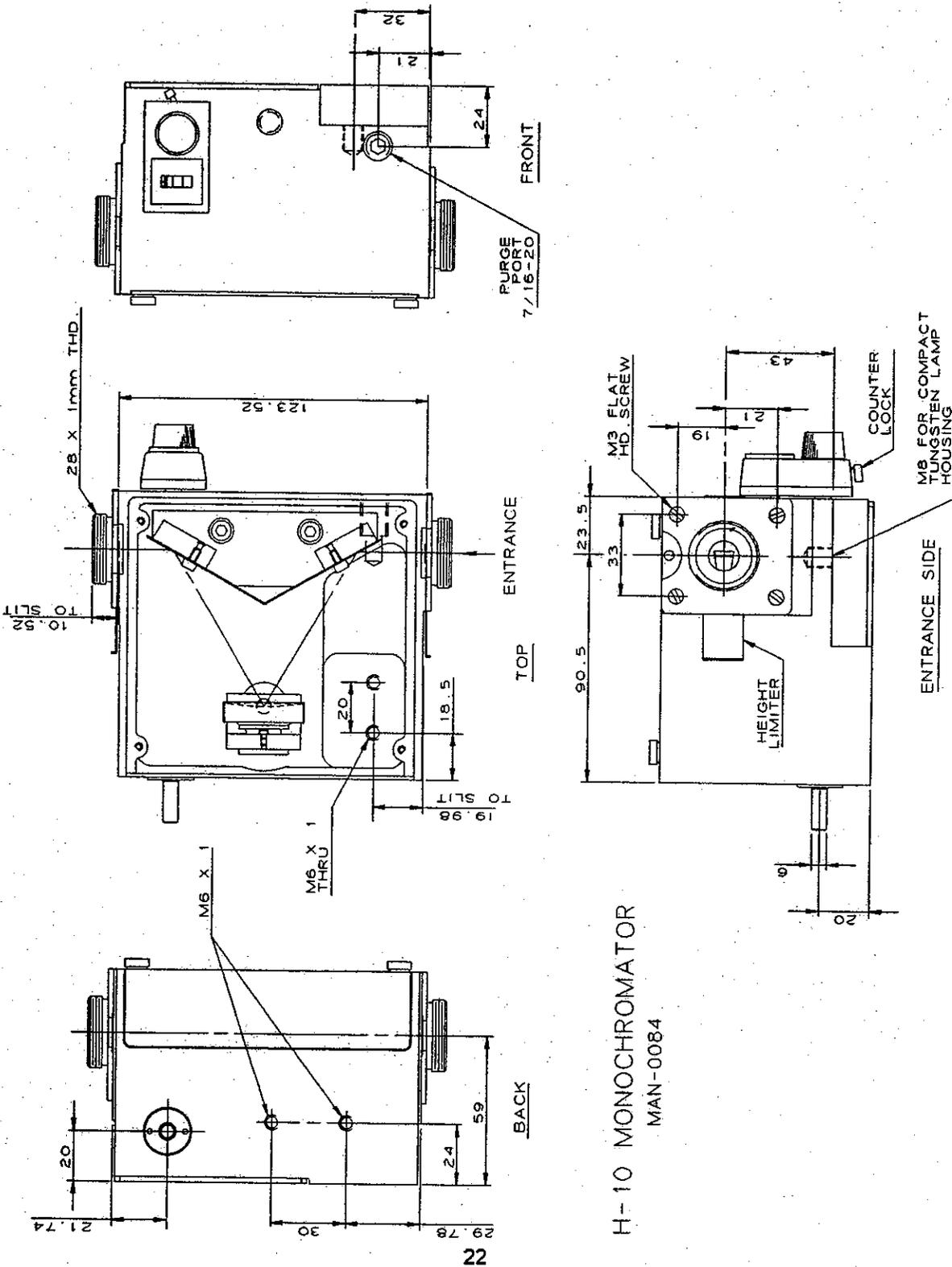
All instruments and components returned to the factory must be accompanied by a Return Authorization Number issued by our Customer Service Department.

To issue a Return Authorization number, we require:

- The model and serial number of the instrument
- A list of items and/or components to be returned
- A description of the problem, including operating settings
- The instrument user's name, mailing address, telephone, and fax numbers
- The shipping address for shipment of the instrument to you after service
- Your Purchase Order number and billing information for non-warranty services
- Our original Sales Order number, if known
- Your Customer Account number, if known
- Any special instructions

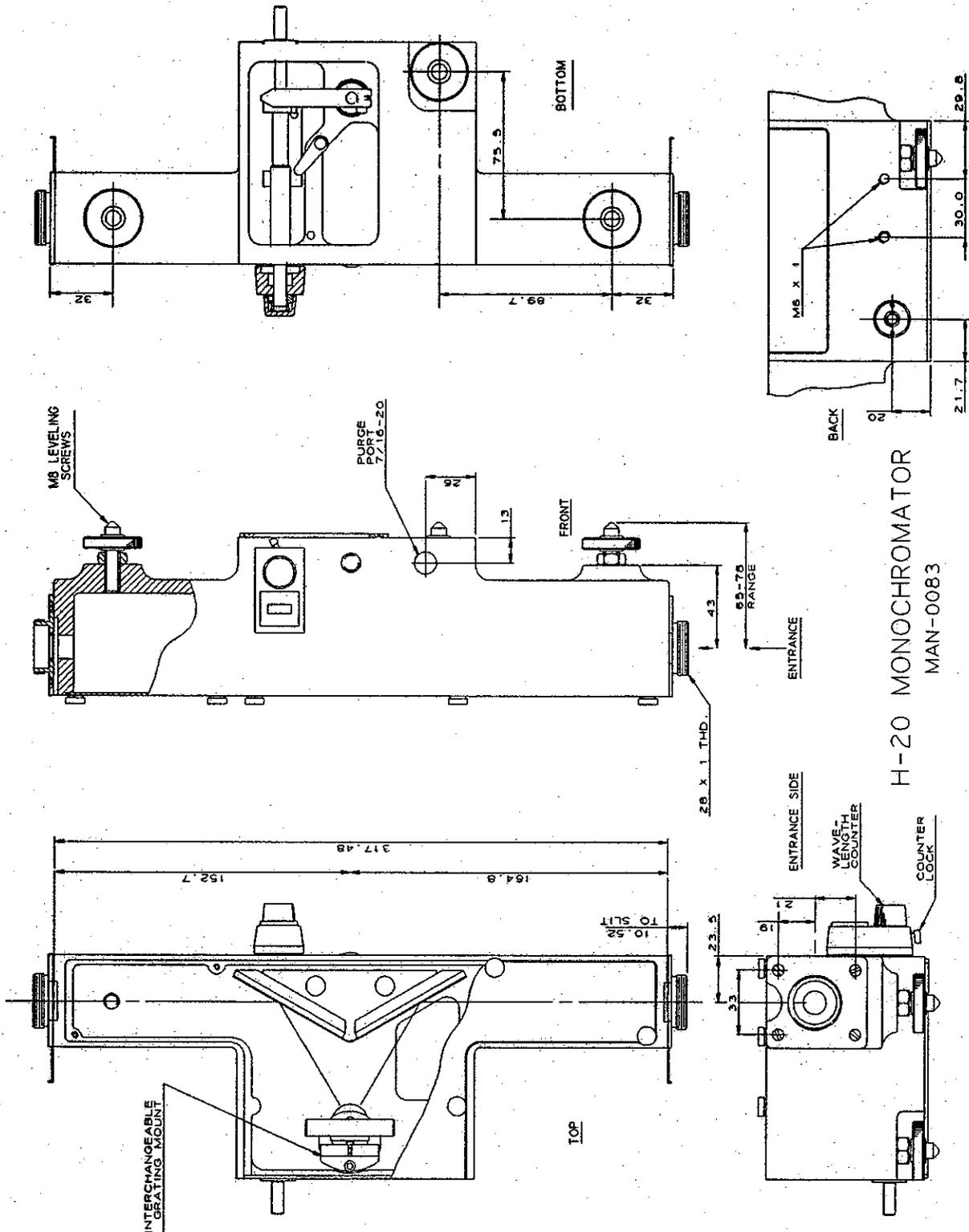
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Appendix 1: Optical / Mechanical Interface Drawings



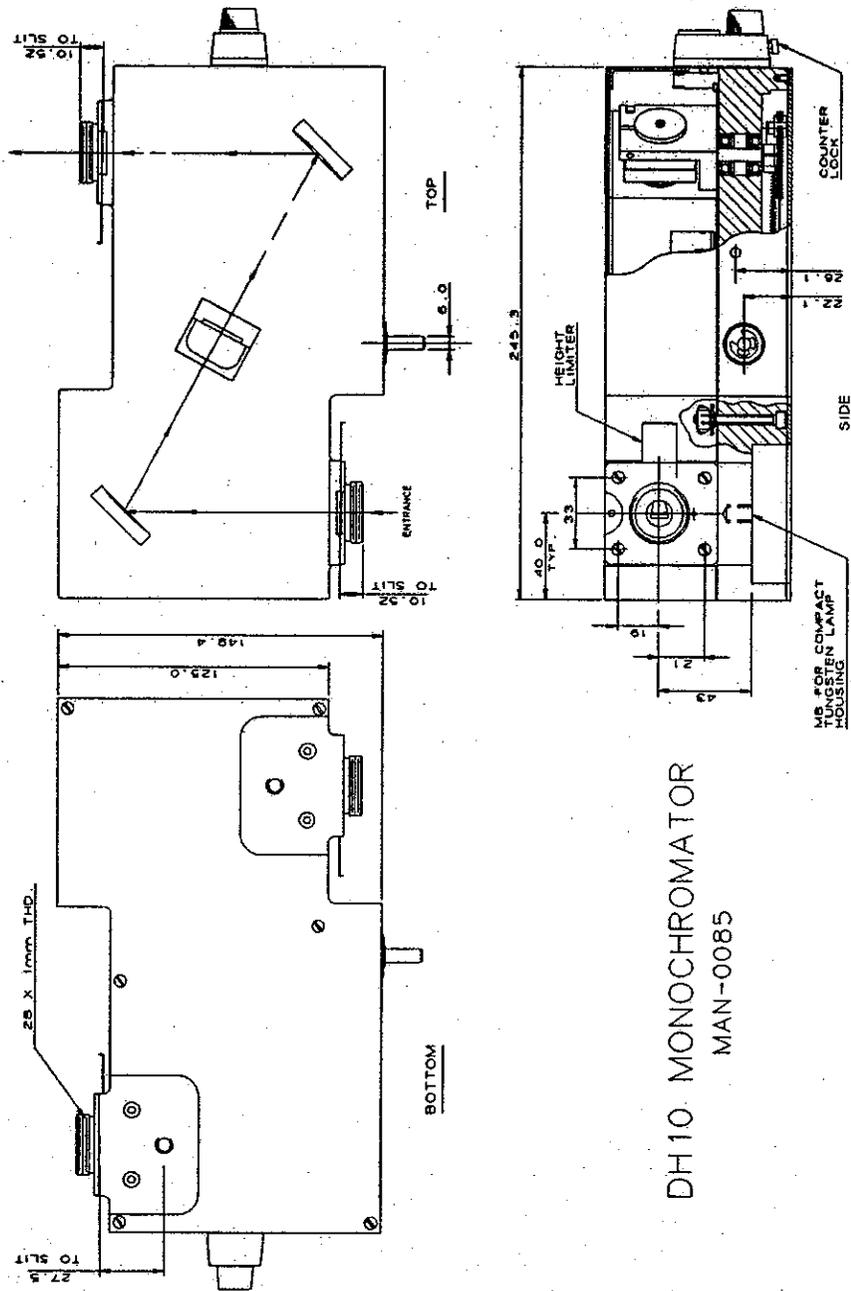
H-10 MONOCHROMATOR
MAN-0084

H10, H20, & DH10 MONOCHROMATORS



H-20 MONOCHROMATOR
MAN-0083

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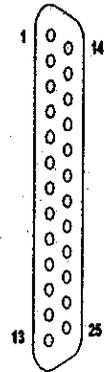
DH10 MONOCHROMATOR
MAN-0085

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Appendix 2 : Stepper Drive Interface Connector Pin Assignments

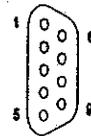
TTL Stepper Drive Interface Connector

<u>Pin#</u>	<u>Name</u>	<u>Function</u>
10	Direction	Input to assert direction for drive to move. High is generally forward, toward longer wavelengths.
23	Return	For Direction
11	Step	Pulse input to move a stepping device. Negative true (normally high), clocks on rising edge.
24	Return	For Step
12	LSWL	Output, goes low when low wavelength drive limit is reached
25	Return	For LSWL & LSWH
13	LSWH	Output, goes low when high wavelength drive limit is reached



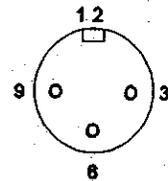
MMI-H1020 Stepper Motor Connector

<u>Pin#</u>	<u>Name</u>	<u>Function</u>
1	PH A COM	Center tap of "A" winding
2	PH B COM	Center tap of "B" winding
6	PH 1	Stepper motor Phase 1, top of "B" winding
7	PH 2	Stepper motor Phase 2, bottom of "B" winding
8	PH 3	Stepper motor Phase 3, top of "A" winding
9	PH 4	Stepper motor Phase 4, bottom of "A" winding



304.30.551 Compact Tungsten Lamp Housing Connector

<u>Pin#</u>	<u>Function</u>
12 o'clock	Index key, not a pin
9 o'clock	Lamp power (isolated circuit; no polarity requirement)
3 o'clock	Lamp power
6 o'clock	No connection



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