SCIENCETECH 9055

DIRECT DRIVE MONOCHROMATOR

INSTRUCTION MANUAL

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SCIENCETECH

Scientific Instrument Designers and Manufacturers

SERIAL Nº 97009

SCIENCETECH 9055 MONOCHROMATOR USER'S MANUAL

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1. Introduction

1.1 Monochromator/spectrograph modes

The Sciencetech 9055 is designed to work in the following modes:
- Scanning monochromator driven by stepping motor system and controlled from a host compatible computer.
- Flat-field spectrograph for use with Linear Diode Array detector systems.

The basic design of this instrument allows a relatively high resolution for an instrument of this size throughout the spectral range.

1.2 Unpacking and shipping

The 9055 is packaged in such a way that possibility of damage in transit is minimized. If the package is damaged, or if after unpacking, any signs of damage become apparent, a claim should be filled with the carrier immediately.

If the instrument must be returned, contact Sciencetech Inc. for previous approval. A full description of the reason for return should be included.

1.3 Preparation for use

a. Inspect the exterior of the monochromator for any noticeable defects. If any are present, contact Sciencetech Inc. immediately.

b. The packing box should contain:
- SCIENCETECH 9055 monochromator.
- RS232 cable for computer connection.
- Power cable.
- Brackets for attachment to optical table.
- Software disk.

1.4 Typical set-up

The 9055 has no sine arm, thus it can be used only in a computer controlled automatic scanning mode with the proper drive software: it has neither manual control not mechanical wavelength display.
The entrance and exit slits are mounted on the front ports, unless the customer has requested otherwise (note: we call "front" the side that shows two circular plates; the grating assembly is close to it).
A detector can be mounted in the either exit port, or two detectors using our accessory dual detector box (see options chapter 9). The exit flat field allows the use of detector arrays.

The 9055 can be shipped with up to three gratings mounted according to customer request. The gratings can be replaced by the user.

2. Principles of operation

2.1 Optics

Figure 1 shows a diagram of the instrument. Light coming from the entrance slit is collimated by the entrance spherical mirror MA and reflected towards the grating G. At the grating, the beam is diffracted, and depending on the grating angle, collimated beams of the required wavelengths are send to the exit mirror. The spherical exit mirror focuses the light onto the exit slit. Only wavelengths within a given narrow bandwidth can exit. The bandwidth is determined by the limit optical resolution, by the grating pitch and by the width of the slits. A schematic view and dimensions is included in section 4.

Front or side entrance and exit ports are available. The side ports are accessed through 45° plane mirrors. These plane mirrors do not degrade the image quality when they reflect the beam. Consequently the resolution and calibration are equally good regardless of which optical path is chosen. Detector arrays of up to 25.4 mm can be mounted on the exit front port.

2.2 Dispersion

For a 1200 line/mm grating the dispersion is 3.2 nm/mm and it remains approximately constant over the entire wavelength range. For 600 lines/mm it is 8.0 nm/mm.
For the 9055 the dispersion vs. the line density on the grating can be approximately calculated by

$$D(nm/mm) = 5000/(\text{grating lines/mm})$$

2.3 Resolution

The resolution is the width of the narrowest bandpass δ_λ that can be resolved at wavelength lambda. The resolution depends on the width of the entrance and exit slits

$$\delta_\lambda = W * D$$

where

W	width of the slits (see below)
D	reciprocal linear dispersion

There is a minimum value for δ_λ even when the slit is almost closed, this value is determined by the optical characteristics of the system and is limited by optical aberrations, quality of the optics and mechanics and precision of focus. This value is generally given as the theoretical resolution of the instrument. For the 9055 with a grating of 1200 lines/mm, this value is better than 0.2 nm.

The instrument resolution is the convolution of the blur sizes (widths) (the blur width is also dependent of the slit heights)

$$w_{slits}(x) = \int w_{in}(x-w) * w_{out}(w) * dw$$

where w_{in}, w_{out} are the slit intensity functions as a function of the lateral position. For standard straight slits

$$w_{in}, w_{out}(w) = \begin{cases} 1 & \text{for } |w| < W_{in}/2,\ W_{out}/2 \\ 0 & \text{otherwise} \end{cases}$$

where W_{in}, W_{out} are the width of the input and output slits respectively

$$w_{total}(x) = \int w_{slits}(x-w) * w_{blur}(w) * dw$$

where w_{blur} is the intensity (lateral Green) function due to spherical aberration and coma of the spherical mirrors.

For example, for two short slits wider than the blur size of 60 µm (equivalent to 1.7 nm for a 1200 l/mm grating) the transfer function is a symmetrical truncated pyramid of $W_{max} + W_{min}$ at the base and $W_{max} - W_{min}$ at the top (where $W_{max} = Max[W_{in}, W_{out}]$ and $W_{min} = Min[W_{in}, W_{out}]$ for a system with 1:1 magnification) (see fig 2). This implies that the resolution defined as the linewidth @50% (FWHM) amplitude is W_{max}/dispersion. It is determined only by the wider slit. This is not strictly true, because σ (standard deviation) of the convolution is slightly larger than that of each of the rectangular starting functions of each slit, but that is the manner in which spectrometer resolution was defined before computers became common place and, besides tradition, this calculation does not make a large error.

When the individual transfer function is not rectangular (e.g. for the blur), the resolution is larger than the maximum of each of the functions (e.g., in the extreme case of two gaussians the convolution is another gaussian with $\sigma=[\sigma_{12}+\sigma_{22}]^{½}$). Again, one of the standard ways to include the blur size when defining the resolution is saying that the resolution is the maximum of the input and output slits and the blur size or, in another way, that the resolution is obtained for a slit opening equal to the blur size. The error made when such an approximation is done, is larger in this case because the intensity function is not rectangular.

At the same time, the throughput of the spectrometer is proportional to the product of the width of the two slits, thus the combination of the slit widths that gives the best product [throughput*resolution] is with both slits being of similar width (actually, because the input and output focal lengths are different to provide coma optimization, the optimum output slit width is 5/4 of the input slit width).

Wmax is calculated as

$$W_{max} = Max[W_{in}, W_{out}]$$

To include the blur size we have taken the worst case approximation in our formula by using the Gaussian formula. This gives a different kind of response as a function of the slit width as given by fig. 3.

The formulas that we use for slit adjustment are

$$W_{in} = [r^2 - W_{blur}^2]^{½}/D$$

$$W_{out} = [r^2 - W_{blur}^2]^{½}/D$$

where

r	Desired resolution
W_{blur}	Blur size depending of the slit height
D	Reciprocal linear dispersion
	D = 3.2 nm/mm for a 1200 l/mm grating

2.4 Resolving Power

The resolving power is given by

$$R = \lambda / \delta(\lambda)$$

For a diffraction grating, the theoretical value of the resolving power is

$$R_o = m * N$$

where

m	diffraction order
N	total number of lines engraved on the total area of the grating

2.5 Optic equations for Czerny-Turner Monochromators

For a Czerny-Turner monochromator with entrance angle=2*A and exit angle 2*B, the angle between the incident and diffracted beam in the grating is 2A+2B=2Φ.

The grating equation is

$$m * \lambda = d * [\sin(2A-\Theta) - \sin(2B+\Theta)] \quad (1)$$

where

m	diffraction order
λ	wavelength
d	separation between grooves in the grating
Θ	grating angle with respect to monochromator axes (axes from the entrance slit to the vertex of the entrance mirror i.e., perpendicular to the focal plane)
$2A-\Theta$	incident angle with respect to the grating normal
$2B+\Theta$	diffracted angle with respect to the grating normal

Equation (1) can be rewritten as

$$m * \lambda = 2 * d * \cos(\Phi) * \sin(\Theta+\Theta_o) \quad (2)$$

with $\Phi = A+B$
and $\Theta_o = A-B$

For the specular reflection (zero order diffraction) to exit at the required position, the grating has to be at an angle $-\Theta_o$. In a symmetric monochromator $\Phi=2*A$ and $\Theta_o=0$. The 9055 is asymmetric monochromator.

In a system with a diode array, the set wavelength is the one at the centre of the array.

2.6 Aberration correction

The Sciencetech 9055 monochromator uses input and output spherical mirrors of different focal lengths and different spherical mirror incidence angles to eliminate coma at 600 nm. The resolution is limited by the spherical aberration and, for tall slit openings, by the slit curvature. Sciencetech offers optional curved slits for high resolution/high throughput spectrometers.

2.7 Blazed gratings efficiency (ruled or holographic)

Blazed diffraction gratings have grooves cut or "blazed" at a particular angle so that most of the light is diffracted at a particular wavelength for a given diffraction order. Typically the grooves are flat but form an angle with the grating surface. The peak efficiency of a blazed grating corresponds to diffraction angles close to the angles for specular reflection on the groove surface. The blaze wavelength is the wavelength at which the grating has maximum efficiency for first order diffraction. When operating in a higher order m, the peak efficiency will be at a the blaze wavelength divided by m. Figures 4.a,b,... show some typical efficiencies.

To estimate the useful range of a grating, the "2/3-3/2" rule can be used. The efficiency will drop to half of its peak value at about 2/3 of the blaze wavelength and again at 3/2 of the value at the maximum. The drop is very sharp for wavelengths below $2/3\lambda_b$, so it is not recommended its use below this value. The drop at long wavelengths is slow, so generally the grating is useful above the "3/2" limit. But because the s and p components have different drop wavelength, the exit radiation will be strongly polarized.

The discussion above is valid for ruled or holographic gratings that are "blazed". Standard holographic gratings have grooves with a sinusoidal profile. For these grating the efficiency is more or less constant over the nominal working range. Standard efficiency for these gratings is approximately 30%.

3. TECHNICAL SPECIFICATIONS

All specifications are for a 1200 l/mm grating except when stated otherwise.

Drive	Computer controlled direct drive
Number of gratings	Up to 3 in turret with computer controlled change
Concave mirror focal lengths	
Input	200.0 mm
Output	250.0 mm
Distance from input to output slit	140 mm
Aperture ratio	f/3.5 calculated with equivalent circle or f/4.0 using mirror side (square 50 mm grating)
Resolution	Better than 0.2 nm with a 1200 l/mm grating for all wavelengths
Dispersion (with a 1200 l/mm grating)	
Input	4.0 nm/mm
Output	3.2 nm/mm
Turret minimum step angle (with a 400 step/rev motor)	0.0032° in half step mode 0.00064° in half step mode
Scanning resolution	depending on the wavelength, between 0.03 and 0.05 nm for a 400 step/rev motor, between 0.06 and 0.1 nm for the optional 200 step/rev motor
Wavelength accuracy	±0.2 nm
Wavelength reproducibility	±0.1 nm
Grating change reproducibility	±0.1 nm

4. Instrument description

4.1 Layout parameters

The Sciencetech 9055 is a modified Czerny-Turner monochromator, with a stepper motor driving the grating turret directly the grating through a worm and gear drive. Up to 3 user replaceable gratings can be installed. The same drive is used to change gratings during operation.

All distances are referred to the entrance slit

- Z distances: to the plane of the slits, along the entrance beam
- X distances: perpendicular to Z, on the layout plane
- The mirror distances are measured from mirror vertex

Entrance mirror	Mirror size: 54 mm square ZA = 200 mm Tilt angle A = 15.40° XA = 0
Exit mirror	Mirror size: 54 * 75 mm ZB = 250 mm XB = 140 mm Tilt angle B = 10.01°
Grating	ZG = 75 mm XG = 79.1 mm Grating size 50*50 mm Grating angle at 0 nm = -5.4°
Φ angle	25.31°
Gear number of teeth	140
Exit slit	ZE = 0 XE = 140 mm
Flat field angle	-1.69° (CW from above)

4.2 Main Features

4.2.1 Special layout

Most instruments that give resolutions of the order or better than 0.2 nm (spherical aberration limit) show significant stray light produced by multiple diffractions in the grating due to their small off-axis angles, and by insufficient internal baffling due to the same reason (that imposes space constraints in the optical path). Some of them also have vignetting for the same reason. The modified Czerny-Turner design permits high throughput and resolution, while maintaining the off-axis angles large enough to avoid vignetting and to minimize stray light. The input and output spherical mirrors are larger than the grating, enough to avoid vignetting without introducing multiple diffractions. Careful baffling further reduces stray light.

4.2.2 Gratings

Any available flat grating can be used. For spectrometers with flat gratings, the wavelength and resolution for a given grating angle and slit widths are both inversely proportional to the number of grating lines per mm: e.g., with a grating of 600 l/mm and a slit width of 1 mm, the resolution is 1mm*(3800/600)=6.4nm. This means that the best grating to use is the one with the maximum number of lines that can still diffract the desired wavelength. For example, for wavelengths longer than 1000 nm, a 1200 l/mm grating will give twice the resolution but worse illumination than a 600 l/mm grating due to smaller area projection at large grating angles. Figures 5.a,b,c show the theoretical resolution vs. wavelength for different grating pitches. The design resolution was verified by measurements using 2 mm high slits. Figure 6.a,b show a scan of Hg lines.

4.2.3 Input and output ports

Two identical flanges on the input and output ports of the instrument, the side ones are covered with a plate. The front ones are the operational ones and are fitted with a slit. Fixed 45° mirrors can be installed in either port, it the two are installed the input is on line with the output to the exit slit and the detectors. For either port (straight or 90°) the central ray is perpendicular to the face of the instrument. Both the input and output 45° mirrors can be if reinstalled without the need to realign them.

Externally accessible swing-in mirrors can be installed as a factory option.

The slit assemblies have a precision ground alignment pin and mating hole. When moving the slit assemblies from the front port to the side port or viceversa, the reposition precision of the assembly is better than 0.002". Figure 7 shows the dimensions of the slit housing, including the position of the mounting holes for user built accessories.

Either port can be used as the input or output port except when detector arrays are used. The user decision must be based on the numerical aperture of the source or detector: the element with the higher numerical aperture should be located in the left port (labelled input).

Array detectors must be connected to the front exit port with an adaptor with the appropriate tilt to match the flat field. Up to 1" wide diode arrays (e.g. 1024 elements with 25 μm pitch) can be used.

4.2.4 Slits

The slits are straight, bilaterally adjustable. The width of each slit is varied a with micrometer screw between 0 and 6.5 mm with an accuracy of 10μm (a standard micrometer head is used with 1:1 travel:width ratio). The height is varied with a slide from 0 to 10 mm (vertical curtains from 0 to 20 mm and from 10 to 20 mm are available).

Available as an option are fiberoptic flanges.

4.2.5 Electronics

All electronics are included inside the monochromator housing. The power supply provides power for the motor and the microprocessor control board. The microprocessor communicates with the computer using an RS232 interface. Driver software in Basic is included.
The Microprocessor instructions are included in chapter 6.

5. <u>Operating instructions</u>

5.1 Introduction

The Sciencetech 9055 can be controlled from any computer with a serial port. The automatic scanning is done with a stepping motor controlled by an internal microprocessor. Communication of the microprocessor with the host computer is through an RS232 interface.

5.2 Power Switch

The power switch is located on the back of the monochromator and turns the stepper motor on and off.

The power switch must be in the "on" position when operating in the computer-controlled mode or the computer cannot establish contact with the motor: the program issues a warning.

5.4 Grating selection

If the spectrometer has been purchased with more than one grating, gratings can be selected by the computer. The standard grating order is in descending pitch (ascending wavelength ranges) When only one grating is purchased, it is mounted in position 1.

For a grating of 1200 l/mm the maximum wavelength is 1,200 nm.

5.6 Opening the monochromator

If the monochromator must be opened, either to replace gratings or change the optical path by removing one or both of the flat mirrors:

1. Unscrew the 8 screws fastening the top of the monochromator to the body.
2. Lift off the top lid.

Do not loosen the side screws: the alignment of the monochromator will change.

5.7 Mirror care and replacement

All mirrors used in Sciencetech monochromators are first surface, aluminized and overcoated for protection and improved reflectance.

WARNING
Do not touch or attempt to clean mirror or grating surfaces. This can produce scratches which will degrade their performance.

The two flat mirrors are used for path selection, their removal and later replacement to change the optical path can be done by the user. To remove a mirror:

1. Remove the lid.
2. Remove the 4 mm Allen screw that holds the mirror frame.
3. Grab the mirror frame and pull up the mirror assembly. **Do not touch the mirror surface.**
4. Reinstall the lid.

To reinsert a flat mirror:
1. Remove the lid.
2. Grab the mirror frame and insert it in the locating pin. **Do not touch the mirror surface.**
3. Insert the 4 mm Allen screw that holds the mirror frame. While holding the mirror frame in such a way that the cut is in contact with the other locating pin, tighten the Allen screw.
4. Reinstall the lid.

If the user wants both ports readily available swing-away mirrors are an option.

The input spherical mirror is used to collimate the radiation coming from the entrance slit, the output mirror focuses it in the exit slit. These mirrors are factory adjusted for maximum resolution.

WARNING
Do not adjust the alignment screws in the back of either spherical mirror. This will degrade alignment and calibration.

5.8 Grating care and replacement

The 9055 uses standard plane reflective diffraction gratings. Any standard 50*50 mm grating can be mounted in the turret. See the list of available gratings in section 9. Efficiency curves for these gratings are given in figures 4.a,b,...

WARNING
Reflection diffraction gratings have an extremely delicate surface, DO NOT TOUCH IT. The grating efficiency could be seriously deteriorated. Do not attempt to clean the grating.

To mount a grating:
1. Open monochromator housing as indicated in section 5.5.
2. Remove the two set screws that hold the desired grating frame
4. Use the protruding center screw to pull up the grating frame with the grating holder.
5. Carefully insert the new grating.
7. Reassemble.
8. Measure the new offset for that grating (see below).

If a grating has been changed or the alignment has been adjusted, the offset of the grating needs to be recalculated to avoid a wavelength error. To calculate the new offset:

1. Put a light source in the input of the monochromator.
2. Run the 9055 software to initialize the monochromator.
3. Use the software to change to the desired grating.
4. Change the wavelength in small increments to locate the zero position of the grating.
5. Write down the Grating Position when the grating is zeroed.
6. Compute the new zero offset for the desired grating as:
   ZeroOffset = GratingPosition - (GratingID - 1) x 186667
7. Exit the program and edit the configuration file so that the new grating zero offset is stored in the configuration file.

5.9 Spectrograph mode

The 9055 can be converted into an spectrograph for detector arrays of up to 1" size. The exit slit is replaced by an optional diode array mount, tilted at an angle that optimizes the focusing for the different wavelengths. Sciencetech offers a detector array systems with optical analysis software.

6. Computer control

6.1 Introduction

This is the hardware and software manual for the stepper motor control for the Sciencetech monochromator model # 9055 with the filter wheel and lamp switching mirror options.

6.2 Hardware

Communication with the motor control computers is done via RS232 normal (not null) cables. The communication speed is 9600 baud. Handshaking is via the RTS, CTS lines. The communication format is 8 bits, no parity, 1 start bit, 1 stop bit.

The grating drive motor is a 12V, 30Ω per winding, 400 step per revolution stepper controlled by a microprocessor of the 6800 family through two 8-bit stepper motor controller IC's (7 plus sign: -127 to 127).

The filter wheel drive motor is a 12V, 90Ω per winding, 48 step per revolution stepper controlled by a microprocessor of the 6800 family through two 8-bit stepper motor controller IC's (7 plus sign: -127 to 127).

The lamp switching mirror drive motor is a 12V, 76Ω per winding, 200 step per revolution stepper controlled by a microprocessor of the 6800 family through two 8-bit stepper motor controller IC's (7 plus sign: -127 to 127). The controller for this motor is connected as a slave to the filter wheel motor and may only be accessed by communication with the filter wheel controller. All stepper motor parameters for the lamp switching mirror controller are fixed and cannot be changed by the user.

The microprocessors can operate the motors in one of two modes: half step or microstepping. In microstepping, there are 10 μ-steps per full motor step. In half step mode, the current at the position between full step positions (one winding at full current, the other one off) is not with both windings fully turned on but rather with decreased current. This setup of constant power permits better control and reproducibility of the step size.

The grating turret has two optical edge sensors, one coarse one and a fine one, are used to index the position of the turret to provide a reference position for the software. There is no other hardware feedback of the gear position.

The filter wheel has a single optical edge sensor to index the position of the wheel to provide a reference position for the software. There is no other hardware feedback of the filter wheel position.

The lamp switching mirror has two optical edge sensors, one at each end of the mirror travel. The motor controller can only move the mirror from one edge sensor to the other. No intermediate mirror positions are available in this system.

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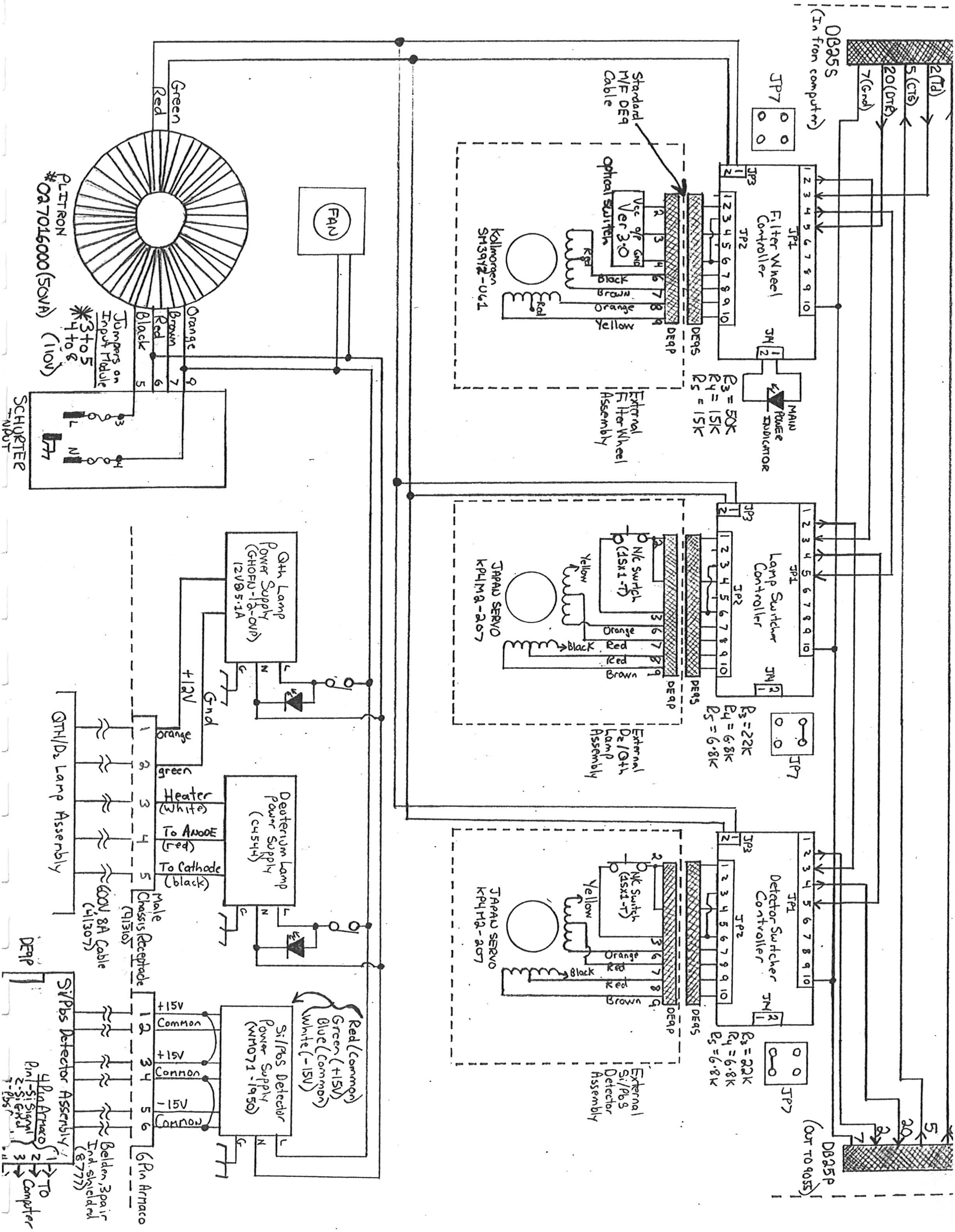
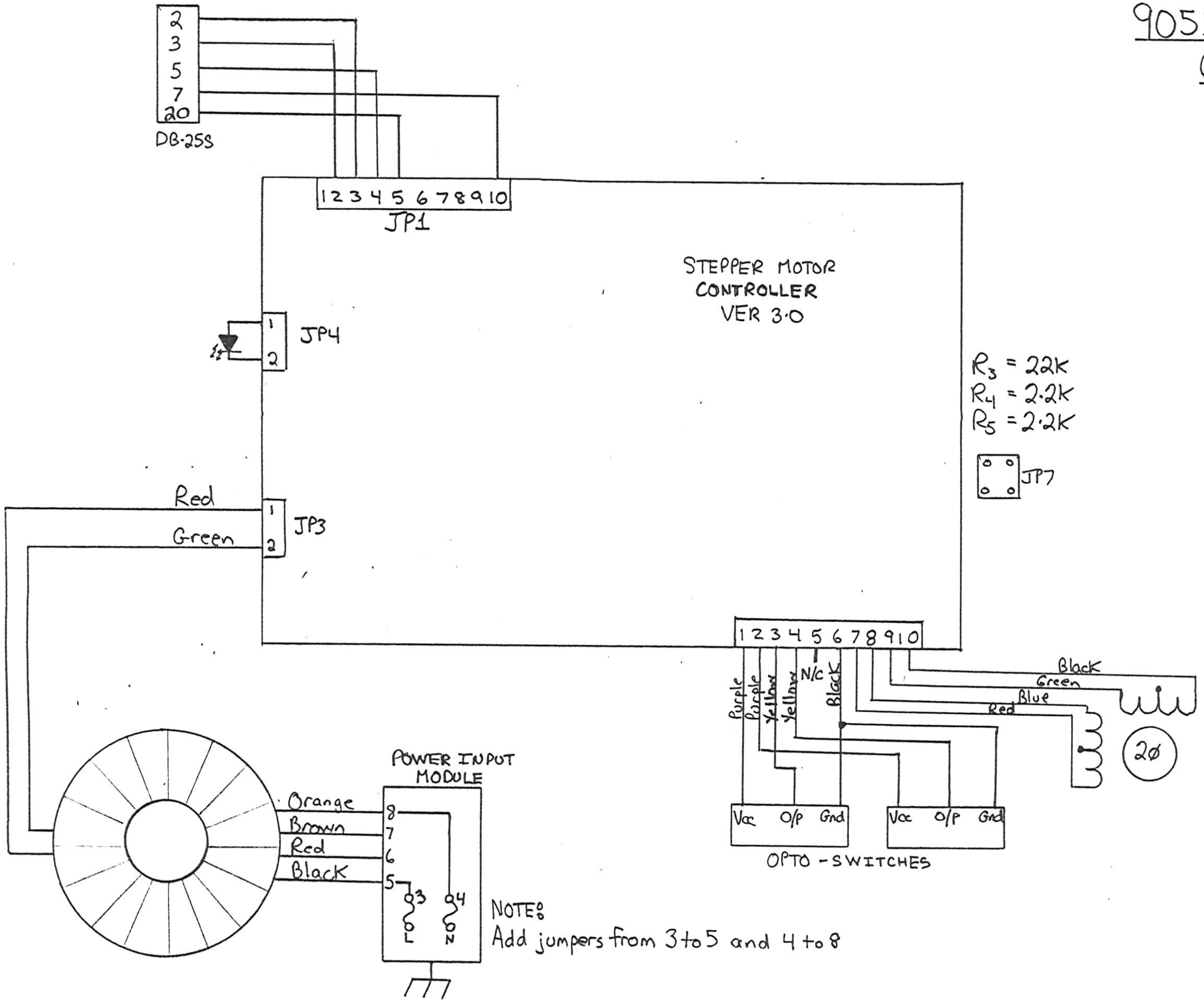
POWER UNIT (Intectra, Job #254)



9055 MONOCHROMATOR
(Intectra)



Bill of Material for Intecra ELECTRONICS ONLY

Ref #	Schematic Ref	Description	Manufacturer	Source P/N	Supplier
		Power Unit (1000)			
		Motor Controller Boards (1100)			
		9055 Monochromator (2000)			
		Motor Controller Board (2100)			
		Opto-Switch Assembly (2200)			
		Si/Pbs Detector (3000)			
		Si Detector (3100)			
		Pbs Detector (3200)			
		D2/QTH Lamp Ass'y (4000)			
		Filter Wheel (5000)			
		Opto-Switch Assembly (5100)			
1000		Power Unit			
1001		CASE	Vero Electronics	212-201466A	Electronic Pkging Sys
1002		50VA Xfmr, 2x110, 1x24	Ulveco	AA25856	Ulveco
1003		Power input module with switch	SCHURTER	KG10.6101.151	PS Components
1004		Fuse Drawer for AC input Mod.	SCHURTER	4305.0012	PS Components
1005		Voltage Selector (110,220)	SCHURTER	4305.0048.03	PS Components
1006		DB-25 Connector (Female)	ITT Cannon	DB-25S	Electrosonic
1007		DB-25 Connector (Male)	ITT Cannon	DB-25P	Electrosonic
1008		AC COOLING FAN (4 1/2")	NMB	4715FS-12T-B50	NEWARK
1009		Fan Guard/30 PPI Filter (4 1/2")	FAN-S DIV.	09450-F/30	NEWARK
1010		AC Power Cord	Belden	17251	Electrosonic
1011		Terminal Block	Cinch	4EDS	Electrosonic
1012		6 PIN INLINE PLUG	ARMACO	DD7263	ARMACO
1013		6 PIN Chassis Receptacle	ARMACO	DD7363	ARMACO
1014		Power Supply (12V@5.1A)	Tectrol	GHOFN-12-OVP	Electrosonic
1015		Power Supply (Deuterium Lamp)	Hamamatsu	C4544	Hamamatsu
1016		Power supply, +15v, -15v	ELPAC	WMO71-1950	Electrosonic
1017		6 Ft Male to Female DB25 Cable	Jameco	134990	Jameco
1018		Green LED (Low Current)	I.D.I.	4300F5LC	Electrosonic
1019		SPST SWITCH	Eaton Switch	1600-12E	NEWARK
1020		9 Pin D-sub Connector (female)	ITT Cannon	DE-9S	Electrosonic
1021		Green LED (120 Vac, built-in Resistor)	MODE	55-445-0	Electrosonic
1022		Chassis Mount AC Receptacle	SCHURTER	4300.0702	NEWARK
1023		5 Pole Chassis Receptacle	Brad Harrison	41310	NEWARK
1024		9 Pin D-Sub Cable 6FT M/F	Jameco	25700	Jameco
1100		Motor Controller Boards			
1101	C1,C2	Capacitor, 27pF Ceramic	Philips	681-58279	Electrosonic
1102	C3,15,16,17,18,19	10uf,25V, Radial Capacitor	Philips	030-36109	Electrosonic

Bill of Material for Intecra ELECTRONICS ONLY

Ref #	Schematic Ref	Description	Manufacturer	Source P/N	Supplier
1103	C20	Capacitor, 10uf 35V Tantilum	KEMET	T352G106K035AS-	Electrosonic
1104	C5	Capacitor 3.3nF 50V Ceramic	Philips	CW15C332K	Electrosonic
1105	C6,C7	Capacitor, 820pF 100V Ceramic	Philips	CW15A821K	Electrosonic
1106	C8	Capacitor, 1000uf,35V Electro	Philips	037-30102	Electrosonic
1107	C9	Capacitor, 100uf, 25V Electro	Philips	031-36101	Electrosonic
1108	C4,C14	Capacitor, 0.1uF 50V Ceramic	Philips	CW20C104K	Electrosonic
1109	JP1,JP2	10 Pin Locking Header	PANDUIT	MLSS100-10	Electrosonic
1110	JP4	3 Pin Locking Header	PANDUIT	MLSS100-3	Electrosonic
1111	JP3	2 Pin Locking Header	PANDUIT	MLSS100-2	Electrosonic
1112	JP1,JP2	10 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-10	Electrosonic
1113	JP4	3 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-3	Electrosonic
1114	JP3	2 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-2	Electrosonic
1115	R2	Resistor 10M 1/4W 1%	Philips	MRS25F-10M	Electrosonic
1116	R6,R7	Resistor 2.2R 1/4W 5%	Philips	CR25-2.2R	Electrosonic
1117	R8 & R9 (See Note 1)	Resistor 0.2R 1/4W	RCD	RSFIAR22-5%	Electrosonic
1118	R13	Resistor 4.7R 1/4W 5%	Philips	CR25-4R7	Electrosonic
1119	R30	Resistor 330R 1/4 5%	Philips	CR25-330R	Electrosonic
1120	R4,R5 (See Note 2)	Resistor (selected to match motor)	Philips	CR25-??	Electrosonic
1121	R3 (See Note 2)	Resistor (selected to match motor)	Philips	CR25-??	Electrosonic
1122	SIP1,2,3	Resistor, 10K 10Pin SIP	BOURNS	4610X-101-103	Electrosonic
1123	FOR U4	14 Pin DIP Socket	Augat	214-AG19DC	Electrosonic
1124	FOR U5	16 Pin DIP Socket	Augat	216-AG19DC	Electrosonic
1125	FOR U8,U9	22 Pin DIP Socket	Augat	322-AG19DC	Electrosonic
1126	FOR U1	40 Pin DIP Socket	Augat	240-AG19DC	Electrosonic
1127	D	Bridge Rectifier 50PIV, 50A Surge	DIODES INC.	DF005M	Electrosonic
1128	U6	Regulator, +5V	MOTOROLA	MC7805CT	Electrosonic
1129		Heatsink	Wakefield	273-AB	Electrosonic
1130	Y1	Crystal, 4 Mhz	RALTRON	A-4.000000-18	Electrosonic
1131	D1	Diode, 12V Zener	MOTOROLA	1N5349B	NEWARK
1132	U1	MICROCONTROLLER	MOTOROLA	MC68HC705C8ACP	Electrosonic
1133	U2	Precision Voltage Reference	MOTOROLA	LM285Z-2.5	Electrosonic
1134	U3	Under Voltage Sensor	MOTOROLA	MC34064P-5	Electrosonic
1135	U4	TTL Inverter	MOTOROLA	SN74LS04	NEWARK
1136	U5	RS 232 Driver	Linear Tech.	LT1081CN	Electrosonic
1137	U8	Stepper Motor Driver	Ericsson	PBL3771	Deskin Sales
1138	U9	Micro Stepper Controller	Ericsson	PBM3960	Deskin Sales
1139		Printed Circuit Board	S&P Flex	916041/42	S&P Flex
Note 1:		R8 & R9 = 0.2 Ohm for Optical Switch, R8 & R9 = 10K for Mechanical Switch			
Note 2:	VEXTA	R3=22K, R4=2.2K, R5=2.2K			

Ref #	Schematic Ref	Description	Manufacturer	Source P/N	Supplier
	KOLLMORGEN	R3=50K, R4=15K, R5=15K			
	JAPAN	R3=22K, R4=6.8K, R5=6.8K			
2000		9055 Monochromator			
2001		15VA Xfmr 2x110, 1x24	Ulveco	AA25857	Ulveco
2002		Power input module with switch	SCHURTER	KG10.6101.151	PS Components
2003		Voltage Selector (110,220)	SCHURTER	4305.0048.03	PS Components
2004		Fuse Drawer for AC input Mod.	SCHURTER	4305.0012	PS Components
2005		Terminal Block	Cinch	4EDS	Electrosonic
2006		AC Power Cord	Belden	17251	Electrosonic
2007		DB-25 Connector (Female)	ITT Cannon	DB-25S	Electrosonic
2008		Miniature limit switch	Micro-switch	1SX1-T	Electrosonic
2009		Stepping Motor	VEXTA	PX243-03AA	Tri-R Power
2100		Motor Controller Boards			
2101	C1,C2	Capacitor, 27pF Ceramic	Philips	681-58279	Electrosonic
2102	C3,15,16,17,18,19	10uf,25V, Radial Capacitor	Philips	030-36109	Electrosonic
2103	C20	Capacitor, 10uf 35V Tantilum	KEMET	T352G106K035AS-	Electrosonic
2104	C5	Capacitor 3.3nF 50V Ceramic	Philips	CW15C332K	Electrosonic
2105	C6,C7	Capacitor, 820pF 100V Ceramic	Philips	CW15A821K	Electrosonic
2106	C8	Capacitor, 1000uf,35V Electro	Philips	037-30102	Electrosonic
2107	C9	Capacitor, 100uf, 25V Electro	Philips	031-36101	Electrosonic
2108	C4,C14	Capacitor, 0.1uF 50V Ceramic	Philips	CW20C104K	Electrosonic
2109	JP1,JP2	10 Pin Locking Header	PANDUIT	MLSS100-10	Electrosonic
2110	JP4	3 Pin Locking Header	PANDUIT	MLSS100-3	Electrosonic
2111	JP3	2 Pin Locking Header	PANDUIT	MLSS100-2	Electrosonic
2112	JP1,JP2	10 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-10	Electrosonic
2113	JP4	3 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-3	Electrosonic
2114	JP3	2 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-2	Electrosonic
2115	R2	Resistor 10M 1/4W 1%	Philips	MRS25F-10M	Electrosonic
2116	R6,R7	Resistor 2.2R 1/4W 5%	Philips	CR25-2.2R	Electrosonic
2117	R8 & R9	Resistor 0.2R 1/4W	RCD	RSFIAR22-5%	Electrosonic
2118	R13	Resistor 4.7R 1/4W 5%	Philips	CR25-4R7	Electrosonic
2119	R30	Resistor 330R 1/4 5%	Philips	CR25-330R	Electrosonic
2120	R4,R5	Resistor 2.2K 1/4W 5%	Philips	CR25-2K2	Electrosonic
2121	R3	Resistor 22K 1/4W 5%	Philips	CR25-22K	Electrosonic
2122	SIP1,2,3	Resistor, 10K 10Pin SIP	BOURNS	4610X-101-103	Electrosonic
2123	FOR U4	14 Pin DIP Socket	Augat	214-AG19DC	Electrosonic
2124	FOR U5	16 Pin DIP Socket	Augat	216-AG19DC	Electrosonic
2125	FOR U8,U9	22 Pin DIP Socket	Augat	322-AG19DC	Electrosonic
2126	FOR U1	40 Pin DIP Socket	Augat	240-AG19DC	Electrosonic

Bill of Material for Intecra ELECTRONICS ONLY

Ref #	Schematic Ref	Description	Manufacturer	Source P/N	Supplier
2127	D	Bridge Rectifier 50PIV, 50A Surge	DIODES INC.	DF005M	Electrosonic
2128	U6	Regulator, +5V	MOTOROLA	MC7805CT	Electrosonic
2129		Heatsink	Wakefield	273-AB	Electrosonic
2130	Y1	Crystal, 4 Mhz	RALTRON	A-4.000000-18	Electrosonic
2131	D1	Diode, 12V Zener	MOTOROLA	1N5349B	NEWARK
2132	U1	MICROCONTROLLER	MOTOROLA	MC68HC705C8ACP	Electrosonic
2133	U2	Precision Voltage Reference	MOTOROLA	LM285Z-2.5	Electrosonic
2134	U3	Under Voltage Sensor	MOTOROLA	MC34064P-5	Electrosonic
2135	U4	TTL Inverter	MOTOROLA	SN74LS04	NEWARK
2136	U5	RS 232 Driver	Linear Tech.	LT1081CN	Electrosonic
2137	U8	Stepper Motor Driver	Ericsson	PBL3771	Deskin Sales
2138	U9	Micro Stepper Controller	Ericsson	PBM3960	Deskin Sales
2139		Printed Circuit Board	S&P Flex	916041/42	S&P Flex
2200	2 Required	**Opto-Switch Assembly**			
2201		Printed Circuit Board	Scitech	Version 3.0	Scitech
2202		Opto Switch	Optek	OPB871N56	NEWARK
2203	R1	Resistor 330R 1/4 5%	Philips	CR25-330R	Electrosonic
2204	R2	Resistor 1K 1/4W 5%	Philips	CR25-1K	Electrosonic
2205	R3	Resistor 470R, 1/4W 5%	Philips	CR25-470R	Electrosonic
2206	C1	Capacitor, 0.1uF 50V Ceramic	Philips	CW20C104K	Electrosonic
2207	Q1	NPN Transistor	NATIONAL	2N3904	Electrosonic
3000		**Si/Pbs Detector Assembly**			
3001		9 Pin D-sub Connector (male)	ITT Cannon	DE-9P	Electrosonic
3002		Stepper Motor	Japan Servo	KP4M2-207	Stock
3003	Supply, +15V,-15V	6 PIN INLINE PLUG	ARMACO	DD7263	ARMACO
3004	Supply, +15V,-15V	6 PIN Chassis Receptacle	ARMACO	DD7363	ARMACO
3005	Output signal	4 PIN INLINE PLUG	ARMACO	DD7244	ARMACO
3006	Output signal	4 PIN Chassis Receptacle	ARMACO	DD7344	ARMACO
3007	To A/D Card	DC-37 Connector (Female)	ITT Cannon	DC-37S	Electrosonic
3008		Miniature limit switch	Micro-switch	1SX1-T	Electrosonic
3100		**Si Detector**			
3101		Printed Circuit Board	AP Circuits	PPAV1.0	AP Circuits
3102	Pd	Photodiode (UV Sensor)	Hamamatsu	S1336-5BQ	Hamamatsu
3103	U1	OP AMP	Texas Instruments	TLC271CP	NEWARK
3104	U2	Regulator, -5V 100mA	MOTOROLA	MC79L05ACP	Electrosonic
3105	U3	Regulator, +12V 100mA	MOTOROLA	MC78L12ACP	Electrosonic
3106	C1 & CF	Capacitor, 2pF 100V silver mica	Miconics	DM5-0200	Electrosonic
3107	Ro	Resistor 2.2K 1/4W 5%	Philips	CR25-2K2	Electrosonic
3108	Ri	Resistor 100R 1/4W 5%	Philips	CR25-100R	Electrosonic

Bill of Material for Integra *ELECTRONICS ONLY*

Ref #	Schematic Ref	Description	Manufacturer	Source P/N	Supplier
3109	C2 & C3	Capacitor, 10uf 35V Tantilum	KEMET	T352G106K035AS-	Electrosonic
3110	C4 & C5	Capacitor, 15uf, 16V Tantilum	KEMET	T352E156K016AS7	Electrosonic
3111	D1 & D2	Diode	NATIONAL	1N914	Electrosonic
3112	R1 & Rf	Resistor 10M 1/4W 5%	Philips	CR25-10M	Electrosonic
3113	Ra	Not Populated			
3114	Rb	short pads marked 'B' & 'c' for med. bias			
3200		PbS Detector			
3201		PbS Detector	Hamamatsu	C4893	Hamamatsu
4000		D2/QTH Lamp Ass'y			
4001		Cable, 6ft 600V 8Amp	Brad Harrison	41307	NEWARK
4002		Strain Relief	Olflex Cable	S2311	NEWARK
4003		9 Pin D-sub Connector (male)	ITT Cannon	DE-9P	Electrosonic
4004		Stepper Motor	Japan Servo	KP4M2-207	Stock
4005		Miniature limit switch	Micro-switch	1SX1-T	Electrosonic
4006		50 Watt, 12V Qth Lamp	Osram		Christie Lites
4007		30 Watt Deuterium Lamp	Hamamatsu	L6311-50	Hamamatsu
5000		Filter Wheel			
5001		Stepper Motor	Kollmorgen	SM39Y2-U61	Wainbee Ltd
5002		Filter #1	Open position for UV/VIS up to 600nm		
5003		Filter #2	GG400 (2mm Thick) for 440 to 750nm		
5004		Filter #3	RG665 (3mm Thick) for 700nm to 1.25um		
5005		Filter #4	RG1000 (3mm Thick) for 1.25um to 1.8um		
5006		Filter #5	OCLI LO1530-6 (0.40" Thick) for 1.6um to 3um		
5007		Filter #6	Blocked to allow zero to the detector		
5100		Opto Switch Assembly			
5101		Printed Circuit Board	Scitech	Version 3.0	Scitech
5102		Opto Switch	Optek	OPB871N55	NEWARK
5103	R1	Resistor 330R 1/4 5%	Philips	CR25-330R	Electrosonic
5104	R2	Resistor 1K 1/4W 5%	Philips	CR25-1K	Electrosonic
5105	R3	Resistor 470R, 1/4W 5%	Philips	CR25-470R	Electrosonic
5106	C1	Capacitor, 0.1uf 50V Ceramic	Philips	CW20C104K	Electrosonic
5107	Q1	NPN Transistor	NATIONAL	2N3904	Electrosonic

Bill Of Material For 9055 Monochromator (Intectra) ELECTRONICS ONLY

Ref#	Schematic Ref	Description	Manufacturer	Source P/N	Supplier
1000		**Main Unit**			
1001		15VA Xfmr 2x110, 1x24	Ulveco	AA25857	Ulveco
1002		Power input module with switch	SCHURTER	KG10.6101.151	PS Components
1003		Voltage Selector (110,220)	SCHURTER	4305.0048.03	PS Components
1004		Fuse Drawer for AC input Mod.	SCHURTER	4305.0012	PS Components
1005		Terminal Block	Cinch	4EDS	Electrosonic
1006		AC Power Cord	Belden	17251	Electrosonic
1007		DB-25 Connector (Female)	ITT Cannon	DB-25S	Electrosonic
1008		Miniature limit switch	Micro-switch	1SX1-T	Electrosonic
2009		Stepping Motor	VEXTA	PX243-O3AA	Tri-R Power
2100		**Motor Controller Boards**			
2101	C1,C2	Capacitor, 27pF Ceramic	Philips	681-58279	Electrosonic
2102	C3,15,16,17,18,19	10uf,25V, Radial Capacitor	Philips	030-36109	Electrosonic
2103	C20	Capacitor, 10uf 35V Tantilum	KEMET	T352G106K035AS-	Electrosonic
2104	C5	Capacitor 3.3nF 50V Ceramic	Philips	CW15C332K	Electrosonic
2105	C6,C7	Capacitor, 820pF 100V Ceramic	Philips	CW15A821K	Electrosonic
2106	C8	Capacitor, 1000uf,35V Electro	Philips	037-30102	Electrosonic
2107	C9	Capacitor, 100uf, 25V Electro	Philips	031-36101	Electrosonic
2108	C4,C14	Capacitor, 0.1uF 50V Ceramic	Philips	CW20C104K	Electrosonic
2109	JP1,JP2	10 Pin Locking Header	PANDUIT	MLSS100-10	Electrosonic
2110	JP4	3 Pin Locking Header	PANDUIT	MLSS100-3	Electrosonic
2111	JP3	2 Pin Locking Header	PANDUIT	MLSS100-2	Electrosonic
2112	JP1,JP2	10 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-10	Electrosonic
2113	JP4	3 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-3	Electrosonic
2114	JP3	2 Pin Mascon Conn. (22AWG)	PANDUIT	CE100F22-2	Electrosonic
2115	R2	Resistor 10M 1/4W 1%	Philips	MRS25F-10M	Electrosonic
2116	R6,R7	Resistor 2.2R 1/4W 5%	Philips	CR25-2.2R	Electrosonic
2117	R8 & R9	Resistor 0.2R 1/4W	RCD	RSFIAR22-5%	Electrosonic
2118	R13	Resistor 4.7R 1/4W 5%	Philips	CR25-4R7	Electrosonic
2119	R30	Resistor 330R 1/4 5%	Philips	CR25-330R	Electrosonic
2120	R4,R5	Resistor (selected to match motor)	Philips	CR25-??	Electrosonic
2121	R3	Resistor (selected to match motor)	Philips	CR25-??	Electrosonic
2122	SIP1,2,3	Resistor, 10K 10Pin SIP	BOURNS	4610X-101-103	Electrosonic
2123	FOR U4	14 Pin DIP Socket	Augat	214-AG19DC	Electrosonic
2124	FOR U5	16 Pin DIP Socket	Augat	216-AG19DC	Electrosonic
2125	FOR U8,U9	22 Pin DIP Socket	Augat	322-AG19DC	Electrosonic
2126	FOR U1	40 Pin DIP Socket	Augat	240-AG19DC	Electrosonic

Bill Of Material For 9055 Monochromator (Intectra) ELECTRONICS ONLY

2127	D	Bridge Rectifier 50PIV, 50A Surge	DIODES INC.	DF005M	Electrosonic
2128	U6	Regulator, +5V	MOTOROLA	MC7805CT	Electrosonic
2129		Heatsink	Wakefield	273-AB	Electrosonic
2130	Y1	Crystal, 4 Mhz	RALTRON	A-4.000000-18	Electrosonic
2131	D1	Diode, 12V Zener	MOTOROLA	1N5349B	NEWARK
2132	U1	MICROCONTROLLER	MOTOROLA	MC68HC705C8ACP	Electrosonic
2133	U2	Precision Voltage Reference	MOTOROLA	LM285Z-2.5	Electrosonic
2134	U3	Under Voltage Sensor	MOTOROLA	MC34064P-5	Electrosonic
2135	U4	TTL Inverter	MOTOROLA	SN74LS04	NEWARK
2136	U5	RS 232 Driver	Linear Tech.	LT1081CN	Electrosonic
2137	U8	Stepper Motor Driver	Ericsson	PBL3771	Deskin Sales
2138	U9	Micro Stepper Controller	Ericsson	PBM3960	Deskin Sales
2139		Printed Circuit Board	S&P Flex	916041/42	S&P Flex
2200	2 Required	**Opto-Switch Assembly**			
2201		Printed Circuit Board	Scitech	Version 3.0	Scitech
2202		Opto Switch	Optek	OPB871N55	NEWARK
2203	R1	Resistor 330R 1/4 5%	Philips	CR25-330R	Electrosonic
2204	R2	Resistor 1K 1/4W 5%	Philips	CR25-1K	Electrosonic
2205	R3	Resistor 470R, 1/4W 5%	Philips	CR25-470R	Electrosonic
2206	C1	Capacitor, 0.1uF 50V Ceramic	Philips	CW20C104K	Electrosonic
2207	Q1	NPN Transistor	NATIONAL	2N3904	Electrosonic

SCIENCETECH — 9055 MONOCHROMATOR

TITLE: MONO ASS'Y — PART LIST NO. 953000 — SHEET 1 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	C953012	1	TURRET		
	A953017	1	TURRET SHAFT		
		1	THRUST WASHER 1 1/4 x 1/16	TORRINGTON TRB-1220	
		1	THRUST BEARING	TORRINGTON NTA-1220	
		1	THRUST WASHER 1 1/4 x 1/32	TORRINGTON TRA-1220	
		1	SPACER 1/4 x 1/8	SDP A7X8-C08125	
		1	BEARING 1/4 x 5/8	TORRINGTON SIKDD7	
	C953010	1	GEAR HOUSING		
		1	SPACER 1/4 x 1/8	SDP A7X8-C08125	
		1	ANTI-BACKLASH WORM GEAR 140T.	SDP SIB86A-C064B140S	
		1	GEAR CLAMP	SDP S3402Y-C230	
	A953024	2	RETAINING SLEEVE		

SCIENCETECH

EQUIP. 9055 MONOCHROMATOR

TITLE MONO ASS'Y

PART LIST NO. 953000

SHEET 2 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
		2	M3 x 3 SET SC.	SPAE-NAUR 481-011	
	A953018	1	WORM SHAFT		
		2	BEARING 1/4 x 5/8	TORRINGTON SIKDD7	
		1	WORM 64P .250 BORE	SDP SID96Z-P064SS	
		1	SPACER 1/4 x 1/8	SDP A7X8-C08125	
		1	BEARING 1/4 x 5/8	TORRINGTON SIKDD7	
	B953011	1	BEARING HOUSING		
		4	M4 x 16 HEX CAP SC	SPAE-NAUR 367-020	
		2	THRUST WASHER 1 1/4 x 1/32	TORRINGTON TRA-1220	
		1	THRUST BEARING	TORRINGTON NTA-1220	
	A953014	1	THRUST WASHER		
		1	M4 x 8 BUT. HD SC.	SPAE-NAUR 366-310	

TITLE MONO ASS'Y

PART LIST NO. 953000

SHEET 3 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	D953001	1	CHASSIS		
		4	M4x10 HEX CAP SC.	SPAE-NAUR 367-018	
	C953015	3	GRATING HOLDER		
			GRATING		AS REQ'D
		6	M3x12 HEX CAP SC	SPAE-NAUR 367-011	
	A953019	1	SENSOR MOUNT		
		2	M4x12 HEX CAP SC.	SPAE-NAUR 367-019	
	A953020	1	SENSOR HOLDER		
		2	M3x12 HEX CAP SC	SPAE-NAUR 367-011	
		1	PCB ASS'Y SENSOR	OUTLINE A953023	
		1	M2x6 HEX CAP SC	SPAE-NAUR 366-003	

SCIENCETECH — 9055 MONOCHROMATOR

TITLE: MONO ASS'Y — PART LIST NO. 953000 — SHEET 4 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	B953022	1	MOTOR MOUNT		
		2	M4 x 12 HEX CAP SC	SPAE-NAUR 367-019	
		1	MOTOR 400 STEP	VEXTA PX243M-03AA	
		4	4-40 x 1/2 HEX CAP SC.	SPAE-NAUR HX-1	
	A953021	1	SENSOR WHEEL		
		1	M3 x 5 SET SC.	SPAE-NAUR 481-013	
		1	SHAFT COUPLING	HELICAL PROD. AE062-8-5mm	
	A953020	1	SENSOR HOLDER		
		2	M3 x 12 HEX CAP SC.	SPAE-NAUR 367-011	
		1	PCB ASS'Y SENSOR	OUTLINE A953023	
		1	M2X6 HEX CAP SC.	SPAE-NAUR 366-663	

SCIENCETECH

EQUIP. 9055 MONOCHROMATOR

TITLE MONO ASS'Y

PART LIST NO. 953000

SHEET 5 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	B916068	2	MIRROR BASE		
		2	DOWEL PIN 1/4 x 3/4	SPAE-NAUR 238-039	
		4	M4x10 HEX CAP SC.	SPAE-NAUR 367-018	
	C916077	1	I/P MIRROR HOLDER		
	C916078	1	O/P MIRROR HOLDER		
		2	MIRROR 2 x 1 1/2		
		2	M4x16 HEX CAP SC	SPAE-NAUR 367-020	
	C953006	1	GRATING BAFFLE		
	B953007	1	LH. BAFFLE		
	B953008	1	RH BAFFLE		

SCIENCETECH

EQUIP. 9055 MONOCHROMATOR

TITLE MONO ASS'Y

PART LIST NO. 953000

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
		4	M3 x 10 BUT SC	SPAE-NAUR 366-657	
		4	M3 HEX NUT	SPAE-NAUR 156-010	
		4	M3 x 8 BUT SC.	SPAE-NAUR 366-656	
	B953009	1	CENTRE BAFFLE		
		2	M3 x 8 BUT SC	SPAE-NAUR 366-656	
	A916013	1	MIRROR HOLDER		
		1	MIRROR 55 x 55 x 200fl		
	A916013	1	MIRROR HOLDER		
		1	MIRROR 55 x 75 x 250fl		
	A916014	2	MIRROR BASE		
	B916015	2	MIRROR MOUNT		
		4	M4 x 10 HEX CAP SC	SPAE-NAUR 367-018	

SCIENCETECH | EQUIP. 9055 MONOCHROMATOR

TITLE MONO ASSY | PART LIST NO. 953000 | SHEET 7 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	A871061	6	SCREW MOD.		
		2	SPRING COMP .30 D. X .50 L .036 WIRE	ASSOC. SPRING C0300-038-0500	
		2	M4 FLAT WASHER	SPAE-NAUR 657-007ZP	
		2	M4 HEX NUT	SPAE-NAUR 156-012	
		6	M4 X 12 HEX CAP SC	SPAE-NAUR 367-019	
	B916032	1	PCB BRACKET		
		3	M4 X 8 BUT SC	SPAE-NAUR 367-017	
		1	MOTOR CONTROL PCB		
		4	M3 X 10 BUT SC	SPAE-NAUR	
		1	TERMINAL BLOCK	ESSCO 4EDS	
		2	M2 X 10 HEX CAP SC	SPAE-NAUR 366-005	

SCIENCETECH | EQUIP. 9055 MONOCHROMATOR

TITLE MONO ASS'Y | PART LIST NO. 953000 | SHEET 8 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	C953005	1	BACK PANEL		
		1	VOLTAGE SELECTOR	SCHURTER 4305 0048 01	2 FUSES 1 AMP
		1	AC CONNECTOR CASING	SCHURTER KG10 6101 151	
		1	FUSE DRAWER	SCHURTER 4305 0012	
		2	M3 x 10 FLAT SC	SPAE-NAUR 366-566	
		1	CONNECTOR 25 PIN	ITT CANNON DB-25-P	
		2	SCREW LOCK	ITT CANNON D110551	
		1	LED RED		
		1	GROMMET		
		1	TRANSFORMER TOROID	PILTRON 005 012000	
		1	M4 x 40 HEX CAP SC	SPAE-NAUR 367-042	CUT AS REQ'D
		1	10 FLAT WASHER	SPAE-NAUR 656-043	
		2	M4 x 10 HEX CAP SC.	SPAE-NAUR 367-018	

TITLE MONO ASS'Y | PART LIST NO. 953000 | SHEET 9 OF 10

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	C953004	1	FRONT PANEL		
		2	M4 x 10 HEX SOC SC	SPAE-NAUR 367-018	
	873035	2	SLIT ASS'Y		
		2	O RING $1\frac{3}{4} \times \frac{1}{16}$	SPAE-NAUR OR-031N	
		8	M3 x 18 FLAT SC	SPAE-NAUR 366-569	
	D953002	1	LH PANEL		
	D953003	1	RH PANEL		
		6	M4 x 10 HEX SOC SC	SPAE-NAUR 367-018	
		8	M4 x 16 HEX SOC SC	SPAE-NAUR 367-020	
		2	PLUG BUTTON $1\frac{1}{2}$ DIA	SPAE-NAUR 245-038	

7055 MONOCHROMATOR

TITLE MONO ASS'Y

PART LIST NO. 953000

ITEM NO	DWG NO	QTY	DESCRIPTION	MFG & NO	REMARKS
	B916007	2	FOOT BRACKET		
		4	M4 x8 HEX CAP SC	SPAE-NAUR 367-017	
	B953013	1	ELECT COVER		
		2	M3x6 BUT. SC.	SPAE-NAUR 366-653	
		1	LABEL "DANGER"		
	B953016	1	COVER		
		10	M3x10 BUT SC	SPAE-NAUR 366-657	
		10	M3 NYLON WASHER	SPAE-NAUR 655-010	

7. OPTIONS AND ACCESSORIES

Swing-away mirrors
One or both of the standard fixed flat mirrors that select the 90°ports, can be replaced by swing-away mirrors, controllable from the outside of the monochromator. This allows easy access to two input port for two different source and two output ports for two detectors.

Fiber optics adaptors
This adaptor flange replaces any slit and can be mounted in the front or side exit ports. It can accommodate FC/PC connectors, NTT style.

Diode array mounting flange
This flange is mounted in the front of the exit slit. It can accommodate up to 1" diode array detectors. its surface is tilted at an angle to optimize the flatness of the focal plane.

Light sources

Sciencetech offers arc and QTH lamps and power supplies for visible and near IR applications. The arc lamp housings for Xe, Hg-Xe or Hg lamps of up to 150W use a high efficiency ellipsoidal reflector with a N.A. matched to that of the spectrometer for maximum throughput and minimum stray light. For infrared applications, Sciencetech offers a chopper and infrared sources and detectors.

Detectors.

Four configurations are possible:

1. Single solid state detector. Sciencetech provides flange mounted Si photodiode for the visible or UV enhanced Si for the UV/visible or Ge photodiode for near IR. The astigmatic segment length is approximately 5mm. This means that no light will be lost when using diode detectors of this diameter to measure.

2. Side window PMT with housing. It bolts to the exit slit assembly.

3. A two detector box is used with a manually operated folding mirror to switch detectors: a 5mm diameter Ge and a 6mm side Si photodiode, or for small signals, a PMT in place of the Si detector. There are internal optics to focus the input slit on each detector and a filter drawer in front of the Si detector to eliminate multiple diffraction orders from the grating. It accepts 1" round or square filters (Sciencetech offers square long pass filters from 320 to 1000nm), and it can also be used to hold interferometric 1" filters if desired. The detectors are mounted on a PC board with its own voltage regulators and transconductance preamplifier (10MΩ transconductance) for minimum noise in AC measurements. Ground loop pickup has been minimized. The

signal cable from each detector is terminated with a BNC connector. The optics in the focus box has a magnification <1 in both the Ge and Si directions (our Ge detector has a diameter of 5mm). Light will start to be lost with a 5mm Ge detector when an input slit is used with a height larger than approximately 12mm, an extreme condition.

4. A 1" linear diode array in the front port.

8. Available Gratings

1. Ruled:

Grooves/mm	Blaze wavelength
50	12 or 18 μm
75	8, 10 or 12 μm
150	500 nm, 4, 6 or 8 μm
200	730 nm, 1.05, 1.7, 2.6 or 3 μm
300	300 or 500 nm, 2, 3, 3.5 or 4 μm
600	200, 300, 400, 500 or 750 nm,1, 1.25, 1.6, 2.5 and 2.7 μm
1200	150, 200, 250, 300, 500, 600 or 750 nm, 1 or 1.2 μm
1800	500 nm
2400	300 nm

2. Holographic:

Grooves/mm	Operation range
1200	190-800 nm
1800	200-800 nm
2400	200-600 nm
3600	200-400 nm

9. LIST OF FIGURES

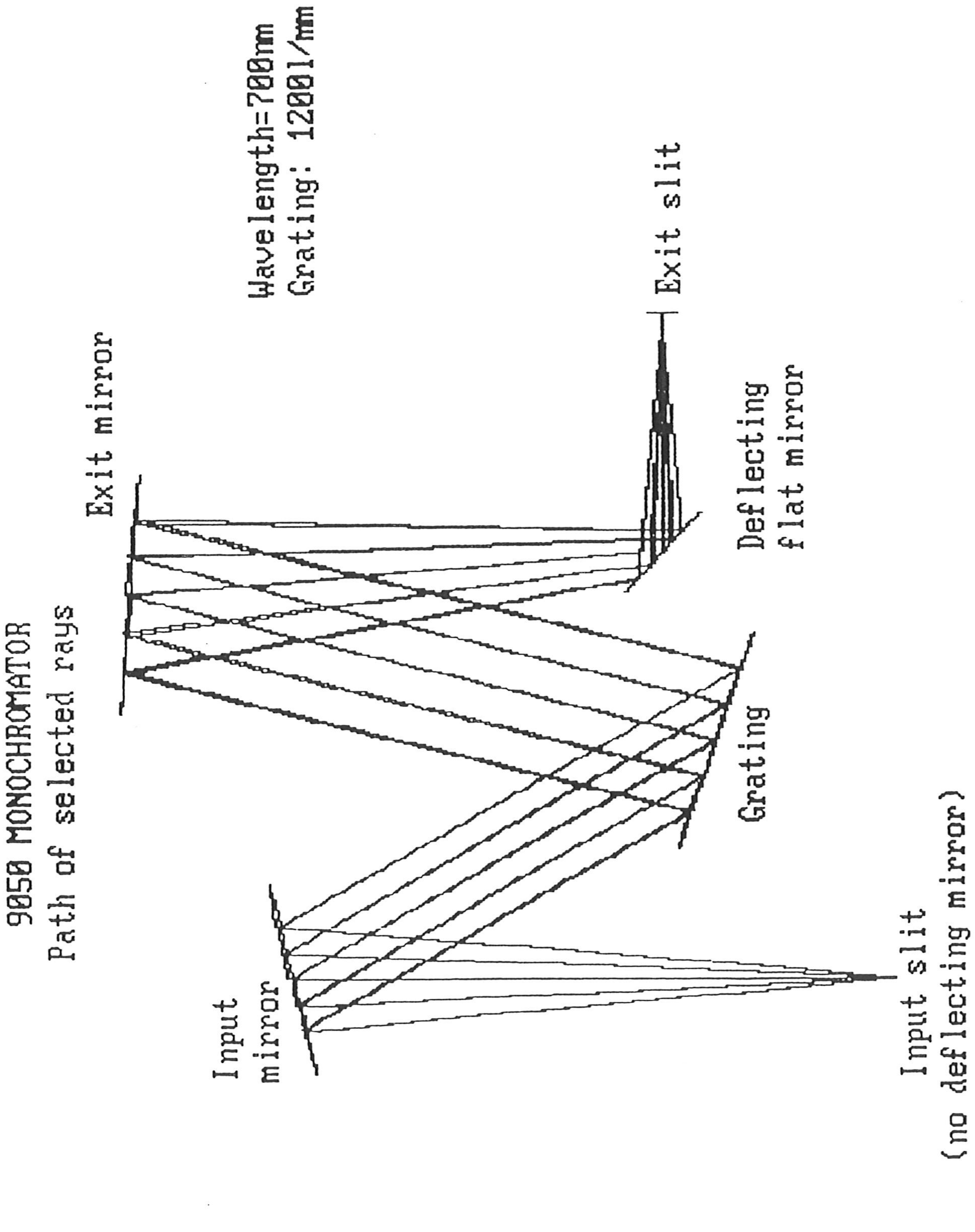
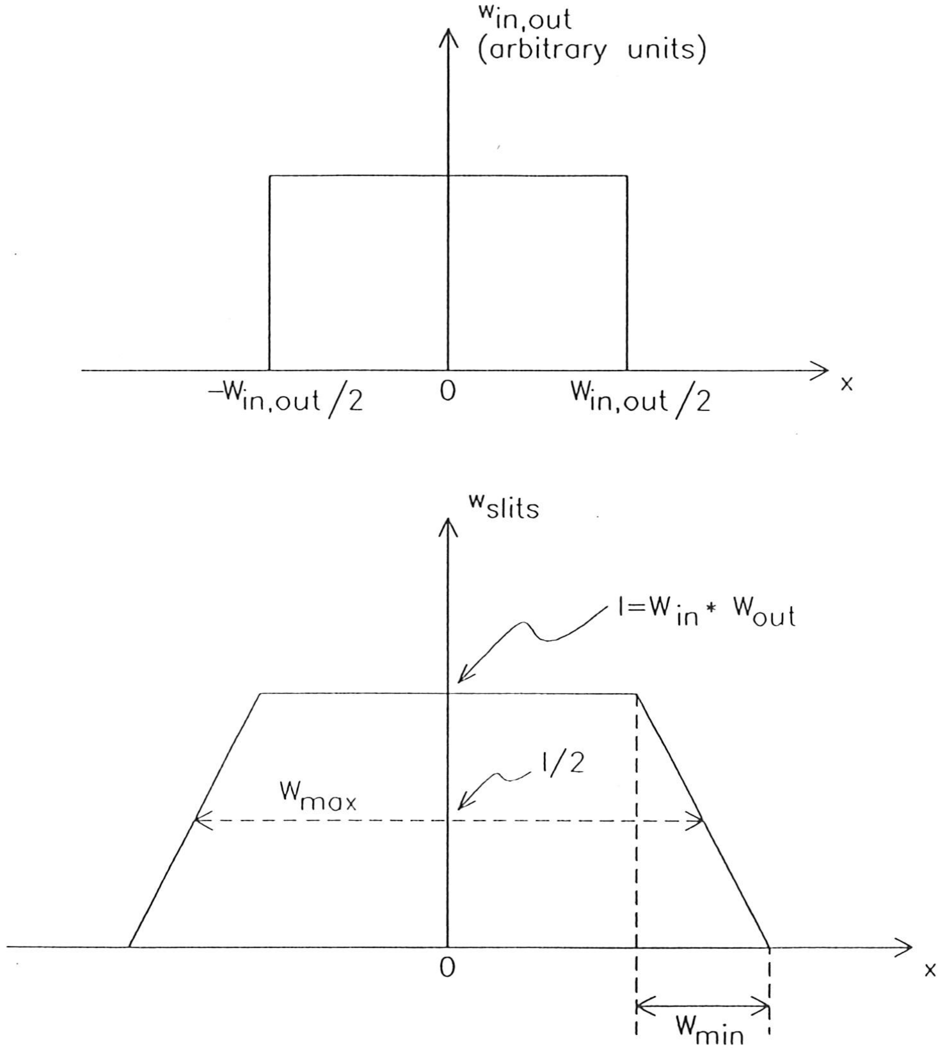

9050 MONOCHROMATOR
Path of selected rays
Wavelength=700nm
Grating: 1200l/mm
Exit mirror
Exit slit
Deflecting
flat mirror
Grating
Input
mirror
Input slit
(no deflecting mirror)

Figure 1



win,out
(arbitrary units)
x
−Win,out /2
0
Win,out /2
wslits
I=Win * Wout
I/2
Wmax
0
x
Wmin

Figure 2

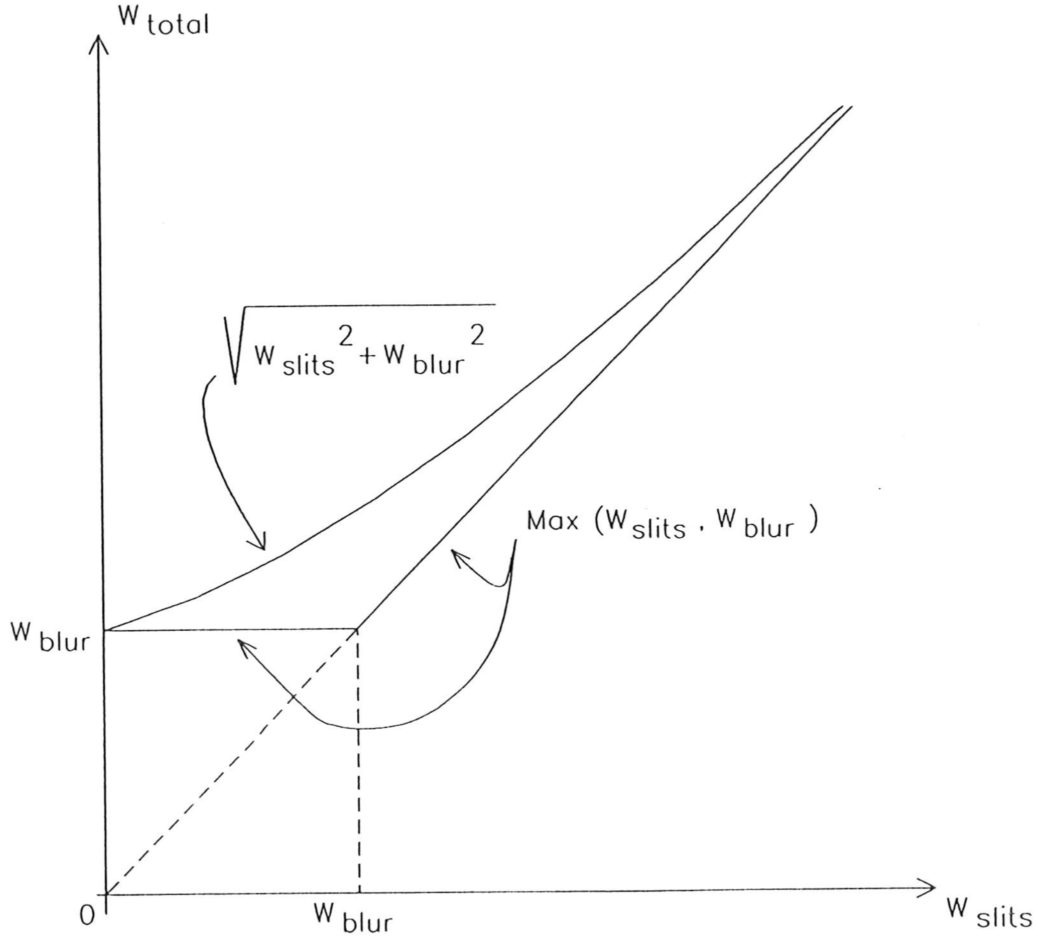

W total
√(W slits 2 + W blur 2)
Max (W slits , W blur)
W blur
0
W blur
W slits

Figure 3

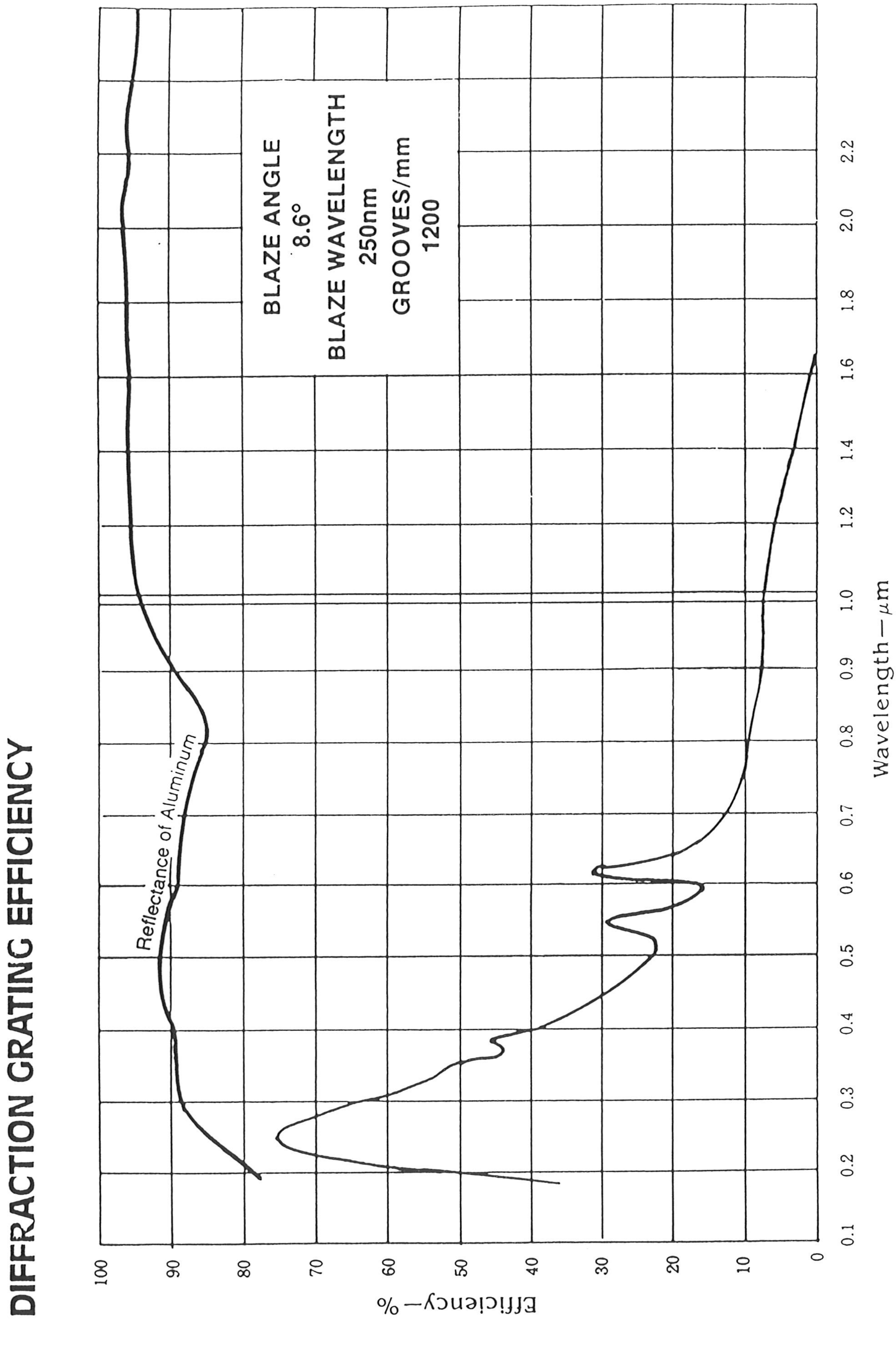

DIFFRACTION GRATING EFFICIENCY
BLAZE ANGLE
8.6°
BLAZE WAVELENGTH
250nm
GROOVES/mm
1200
Reflectance of Aluminum
Efficiency — %
Wavelength — μm
0
10
20
30
40
50
60
70
80
90
100
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.2
1.4
1.6
1.8
2.0
2.2

Figure 4a

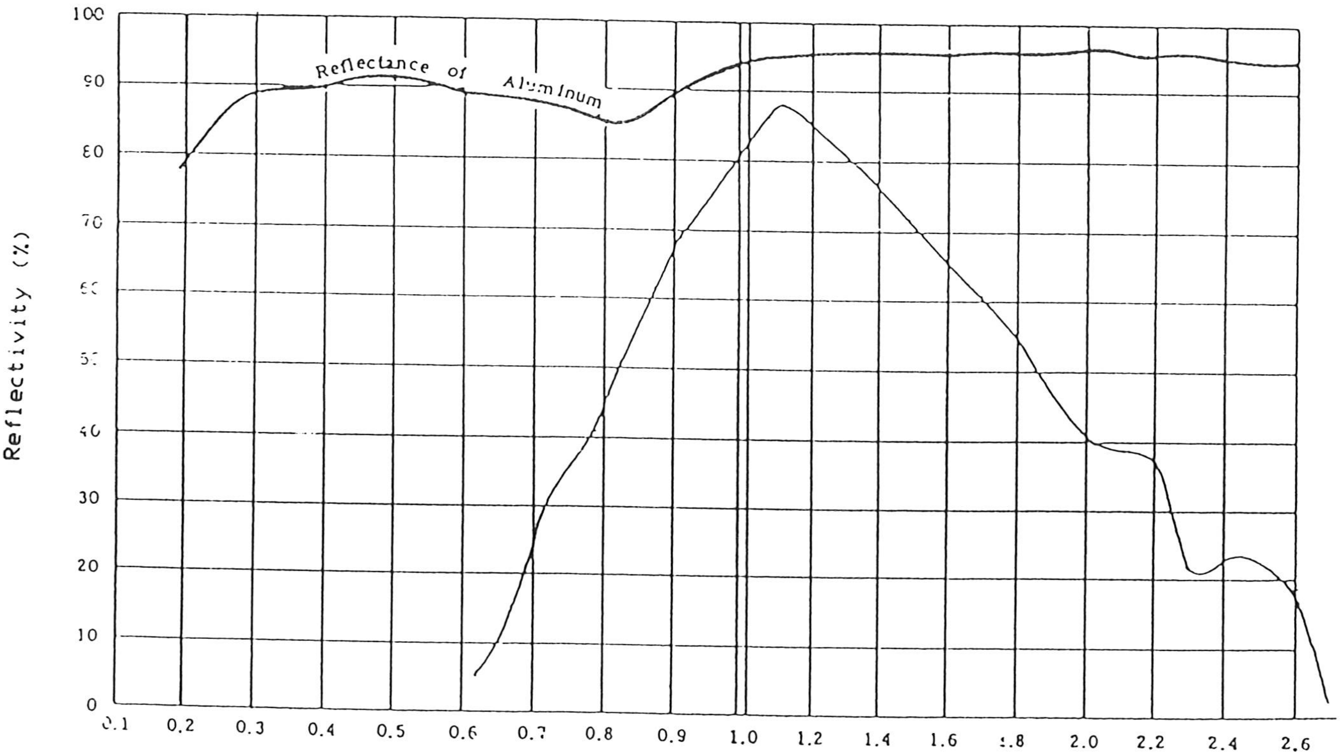
MILTON ROY COMPANY

DAVID RICHARDSON GRATING LABORATORY
ANALYTICAL PRODUCTS DIVISION · 820 LINDEN AVENUE · ROCHESTER, NY 14625 · (716) 248-4000 · TELEX 97-8286

DIFFRACTION GRATING EFFICIENCY

Measured under near-Littrow conditions
with 8° between incident and diffracted beams
- relative to reflectance of aluminum

Polarized at 45°



Wavelength - µm

1st Order

Cat. No. 35-53-06-560
Serial No. 2870-1
Grooves/mm 600
Remarks

Date 2-17-86
Blaze Angle 22°
Blaze Wavelength 1.25 µm

DAVID RICHARDSON GRATING LABORATORY

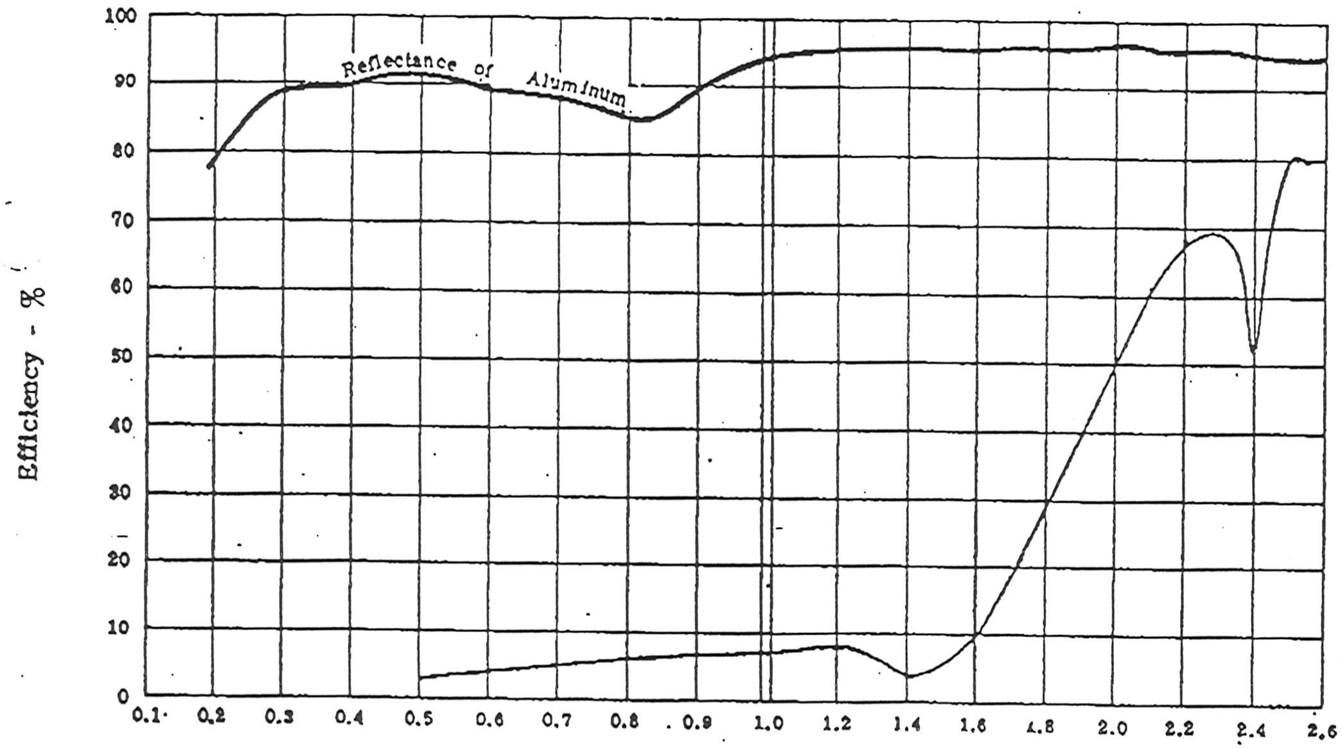
Figure 4b

Fax (716) 248-4014

DIFFRACTION GRATING EFFICIENCY

Measured under near-Littrow conditions
with 8° between incident and diffracted beams
- relative to reflectance of aluminum

Polarized at 45°



Wavelength - μm

1st Order

Cat. No. 35-53-15-780
Serial No. 2539-1-20-11
Grooves/mm 300
Remarks

Date 7-13-77
Blaze Angle 26°45'
Blaze Wavelength 3.0 μm

DAVID RICHARDSON GRATING LABORATORY

820 Linden Avenue
Rochester, NY 14625
Telephone (716) 248-4158
Telex: 444-1037
Fax (716) 248-4014

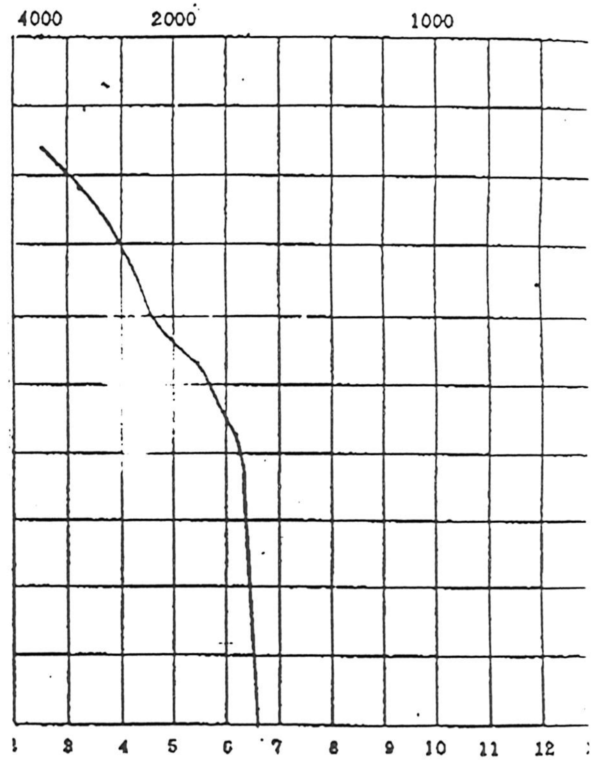
JE, ROCHESTER

ON GRAT

Measured under near-l
with 4° between incident a

Polarized a

Wavenum



Wavelength

1st

. No. 35-53-15-780 D
ial No. 2539-1-20-11 B
oves/mm 300 B
iarks

Figure 4c

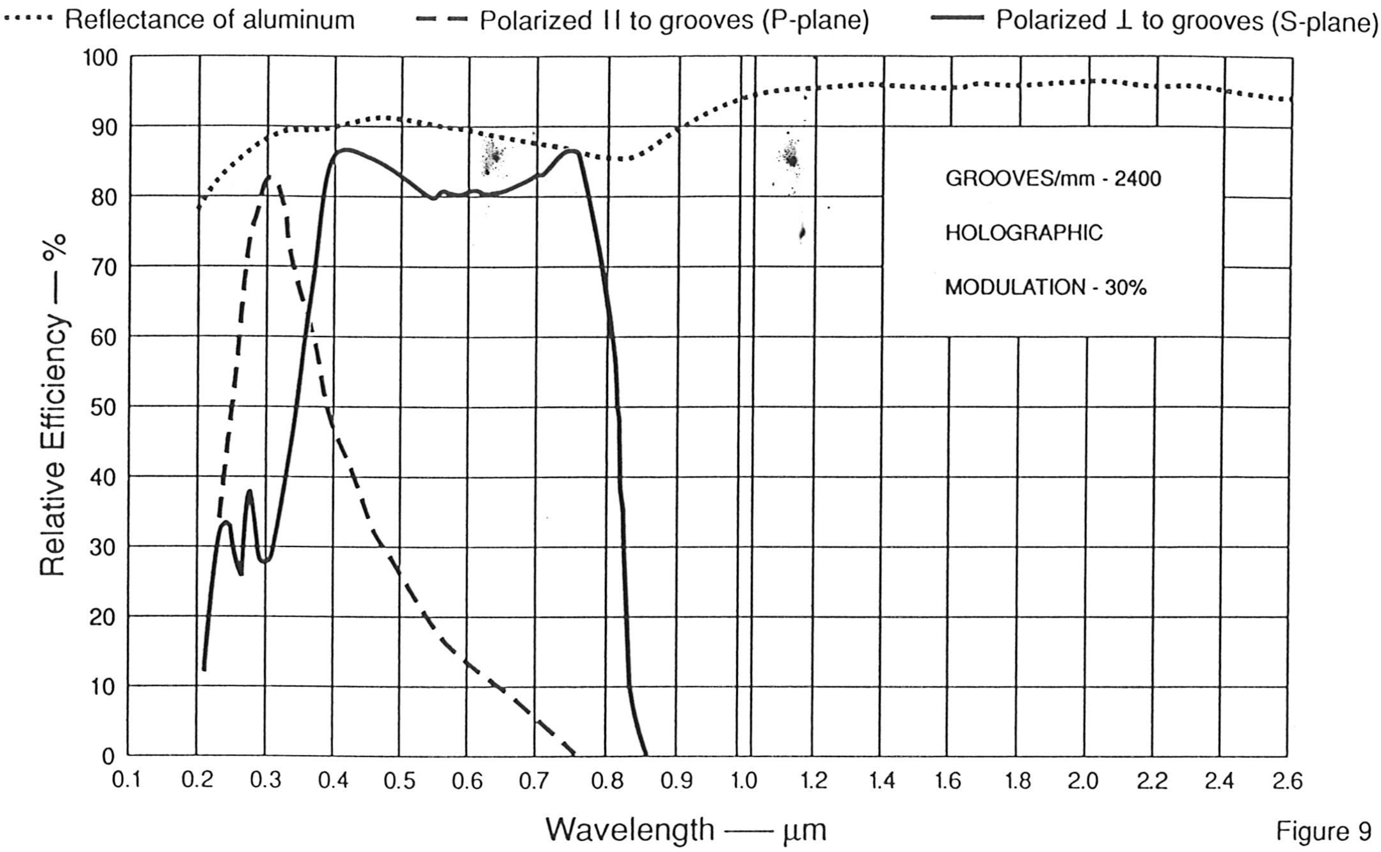


Figure 9

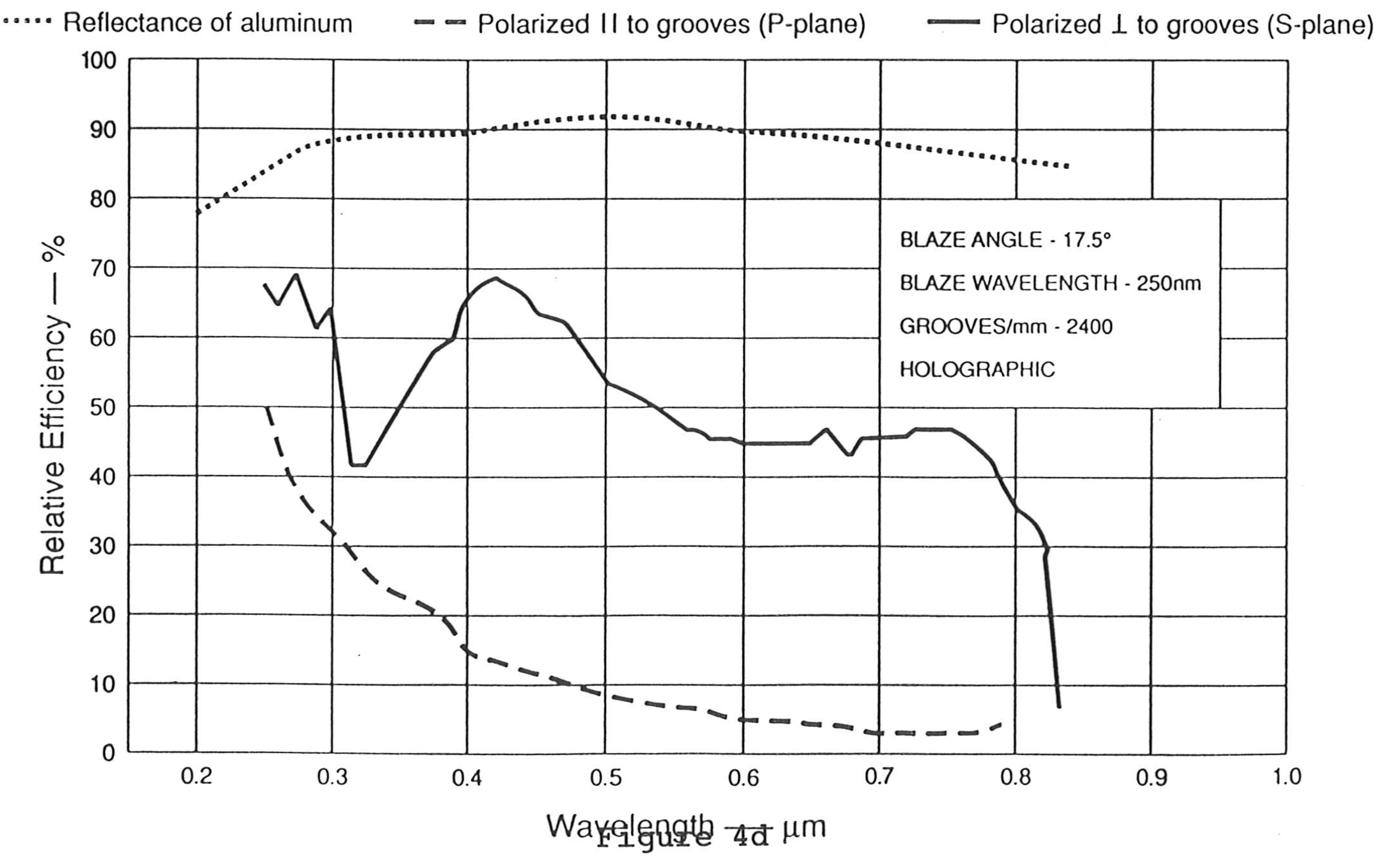


Figure 4d

MILTON ROY

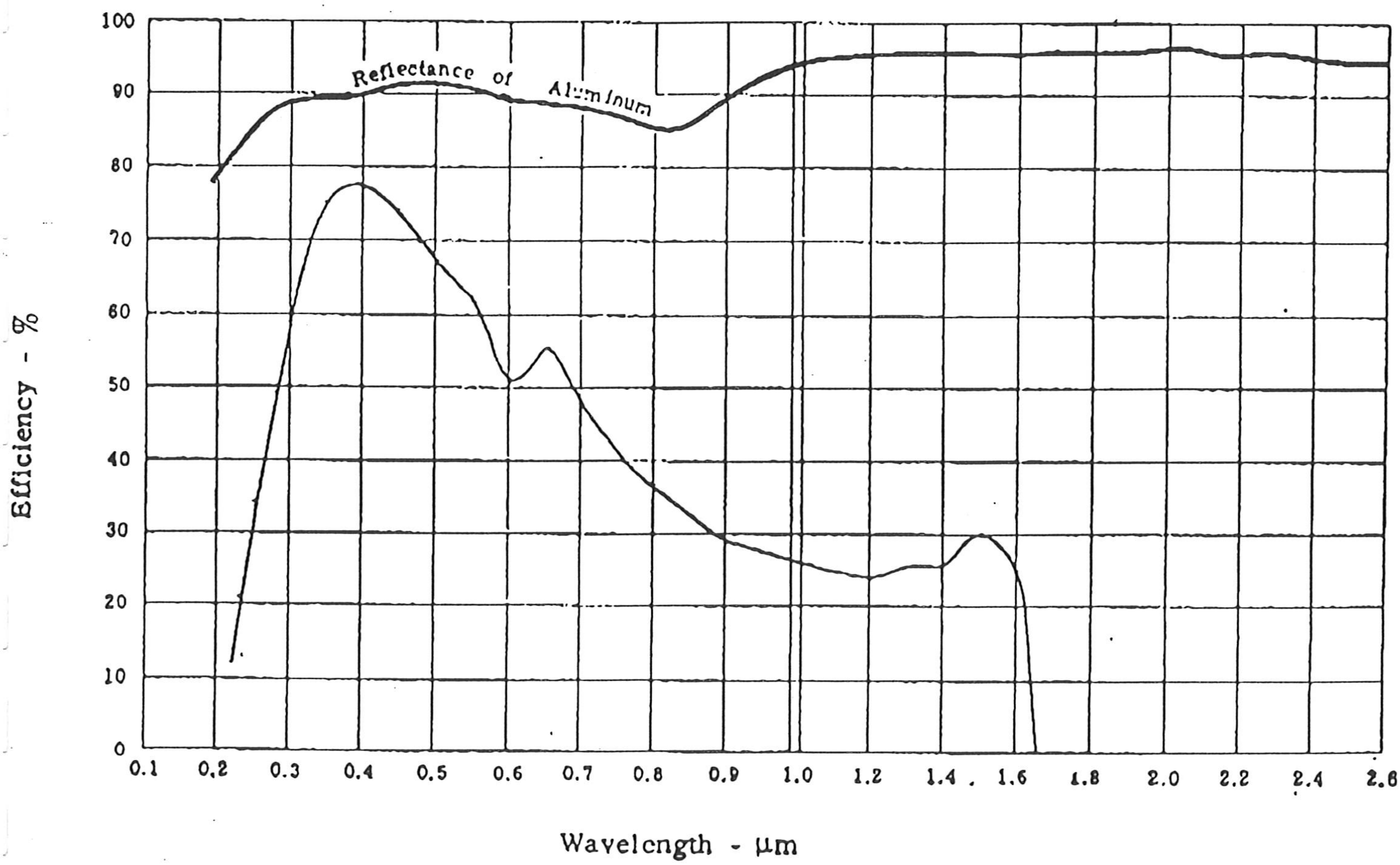
Analytical Products Division
820 Linden Avenue
Rochester, NY 14625
Telephone (716) 248-4158
Telex: 444-1037
Fax (716) 248-4014

ROCHESTER, NEW YORK 14625 • (716) 385-1000

DIFFRACTION GRATING EFFICIENCY

Measured under near-Littrow conditions
with 8° between incident and diffracted beams
- relative to reflectance of aluminum

Polarized at 45°



1st Order

Cat. No.	35-50-09-330	Date	5-5-80
Serial No.	1004-14-2	Blaze Angle	14°14'
Grooves/mm	1200	Blaze Wavelength	4100 Å
Remarks			

Figure 4e

DAVID RICHARDSON GRATING LABORATORY

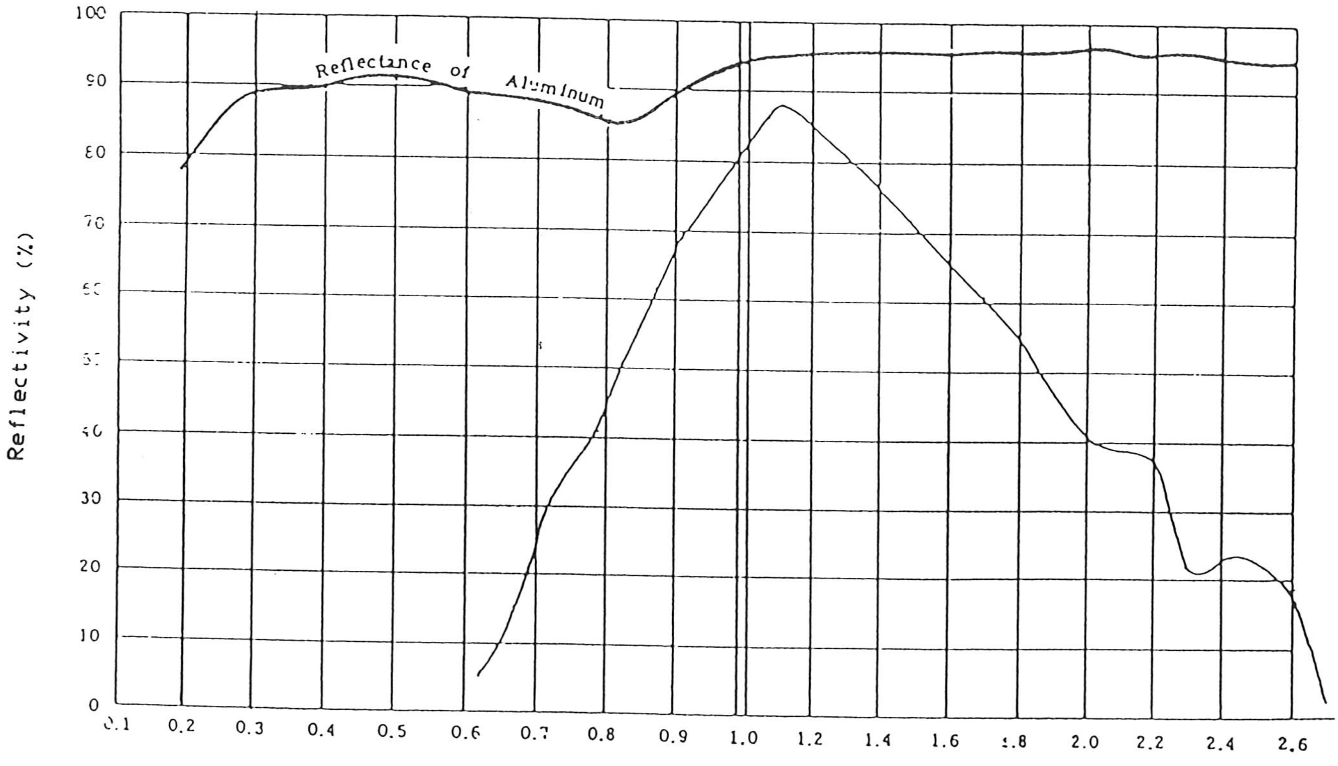
MILTON ROY COMPANY

DAVID RICHARDSON GRATING LABORATORY
ANALYTICAL PRODUCTS DIVISION · 820 LINDEN AVENUE · ROCHESTER, NY 14625 · (716) 248-4000 · TELEX 97-8286

DIFFRACTION GRATING EFFICIENCY

Measured under near-Littrow conditions
with 8° between incident and diffracted beams
- relative to reflectance of aluminum

Polarized at 45°



1st Order

Cat. No.	35-53-06-560	Date	2-17-86
Serial No.	2870-1	Blaze Angle	22°
Grooves/mm	600	Blaze Wavelength	1.25 µm
Remarks			

DAVID RICHARDSON GRATING LABORATORY

Figure 4f

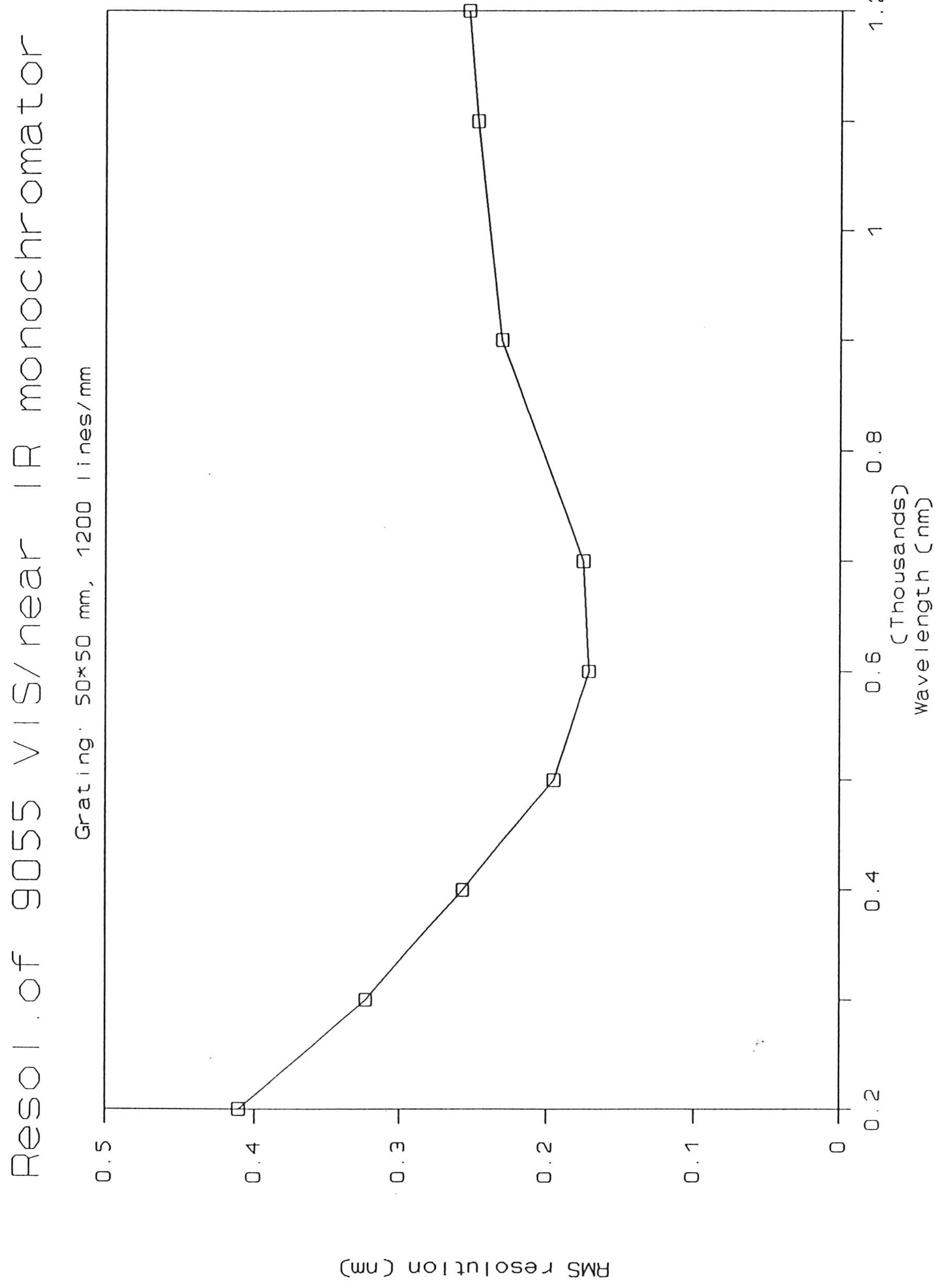

Resol.of 9055 VIS/near IR monochromator
Grating: 50*50 mm, 1200 lines/mm
0.5
0.4
0.3
0.2
0.1
0
RMS resolution (nm)
0.2
0.4
0.6
0.8
1
1.2
(Thousands)
Wavelength (nm)

Figure 5a

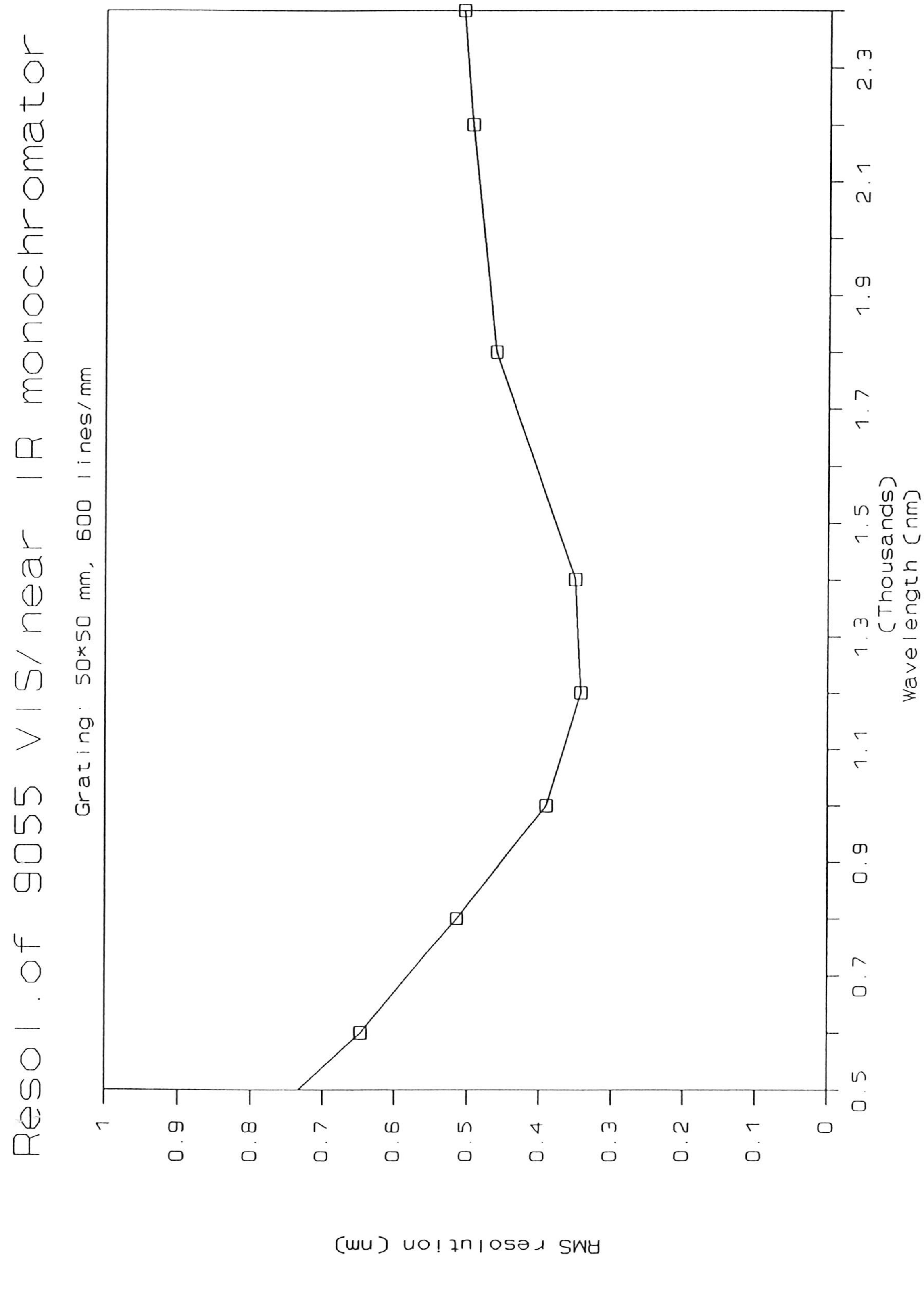
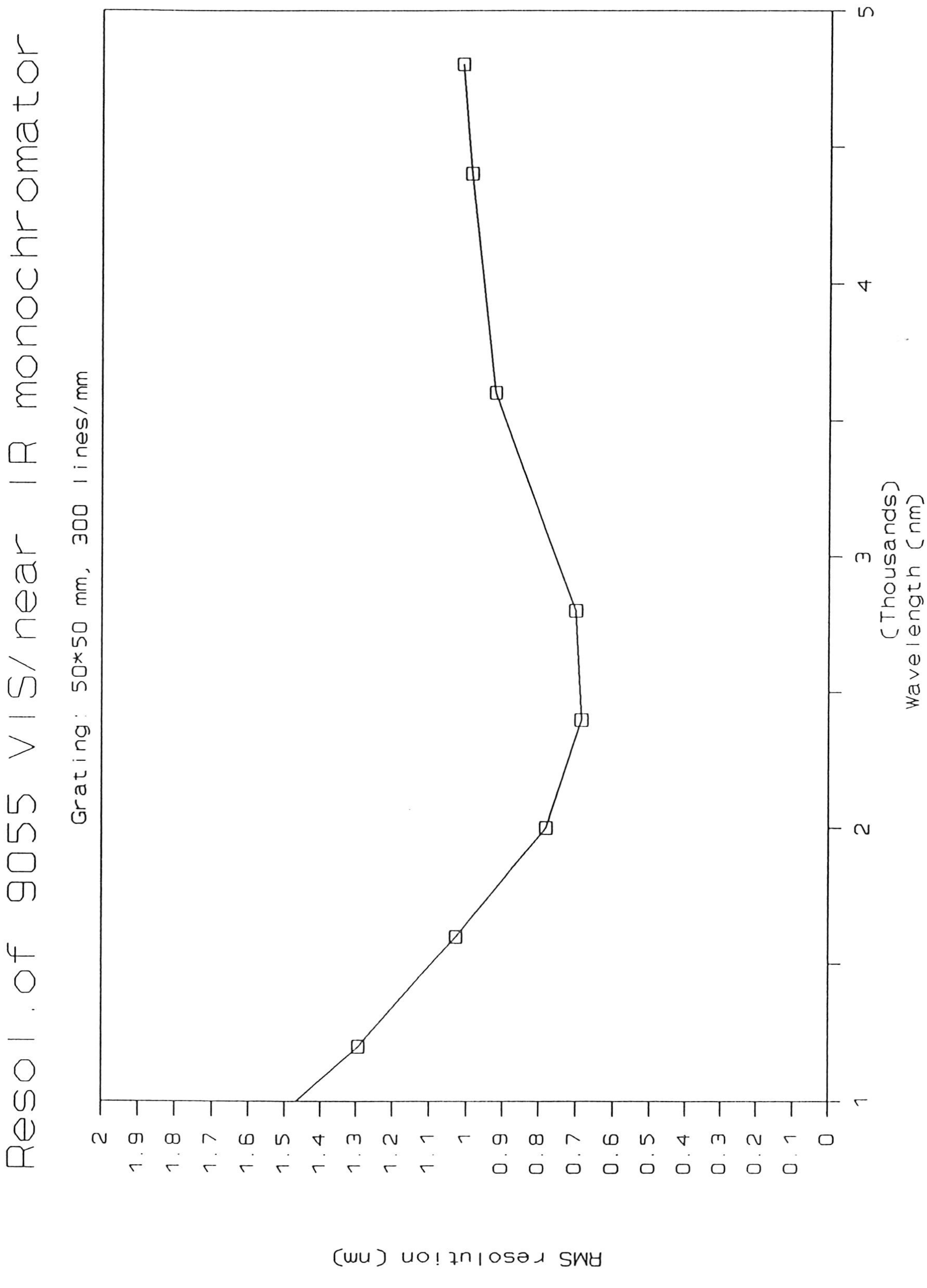

Resol.of 9055 VIS/near IR monochromator
Grating: 50*50 mm, 600 lines/mm
RMS resolution (nm)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
0.7
0.9
1.1
1.3
1.5
1.7
1.9
2.1
2.3
(Thousands)
Wavelength (nm)

Figure 5b



Resol. of 9055 VIS/near IR monochromator
Grating: 50*50 mm, 300 lines/mm
RMS resolution (nm)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
1
2
3
4
5
(Thousands)
Wavelength (nm)

Figure 5c

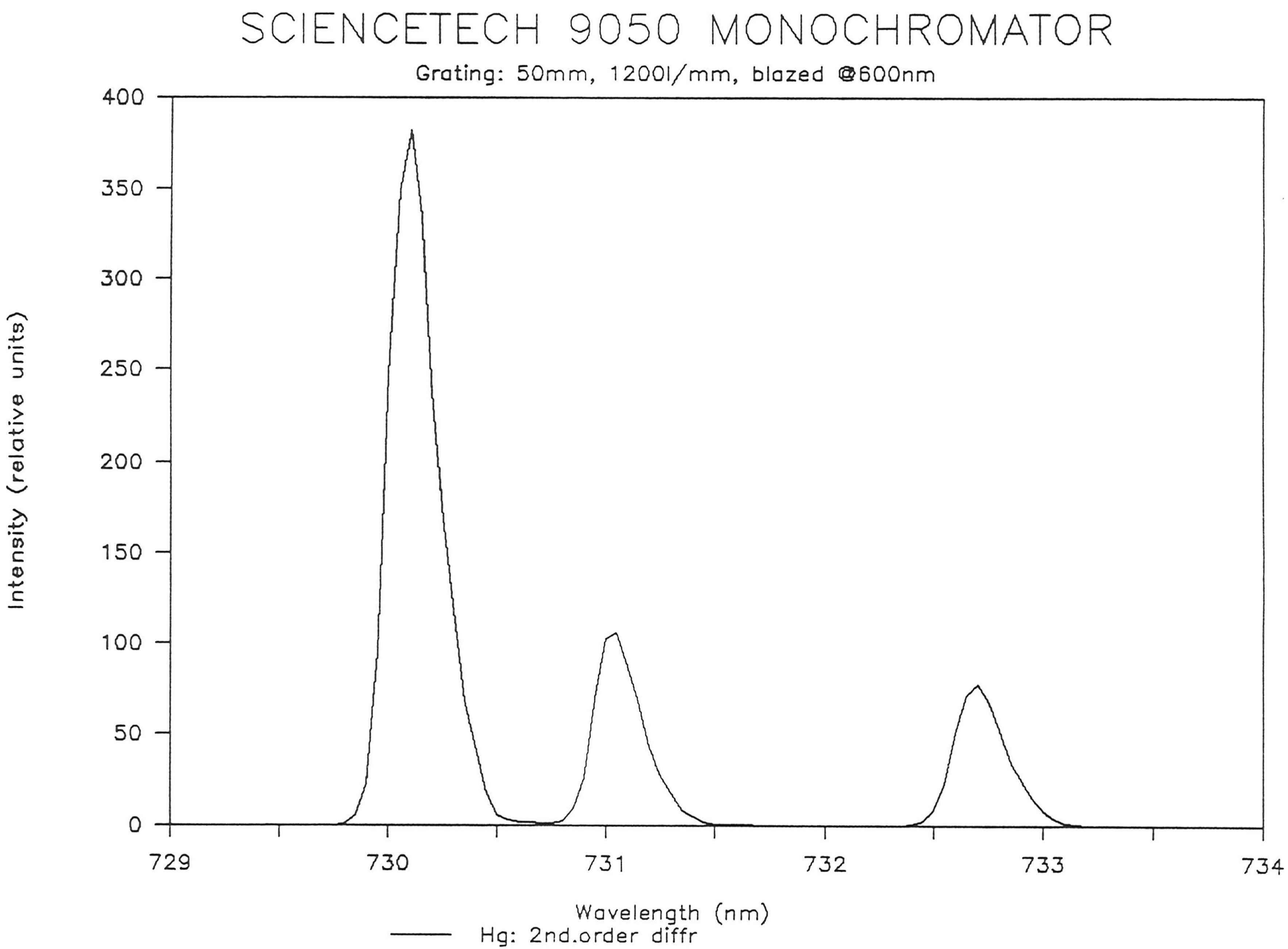

SCIENCETECH 9050 MONOCHROMATOR
Grating: 50mm, 1200l/mm, blazed @600nm
Intensity (relative units)
400
350
300
250
200
150
100
50
0
729
730
731
732
733
734
Wavelength (nm)
Hg: 2nd.order diffr

Figure 6a

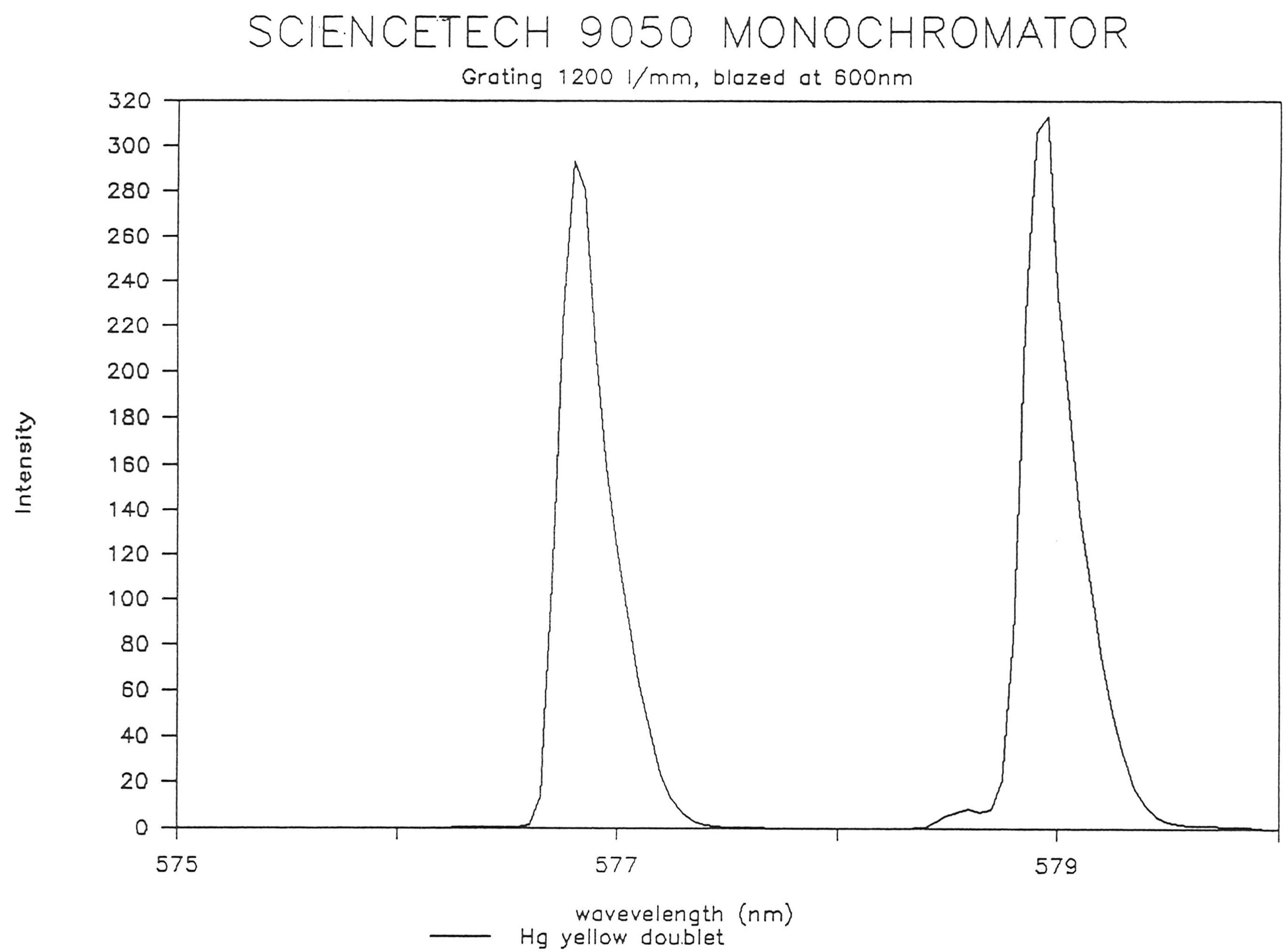
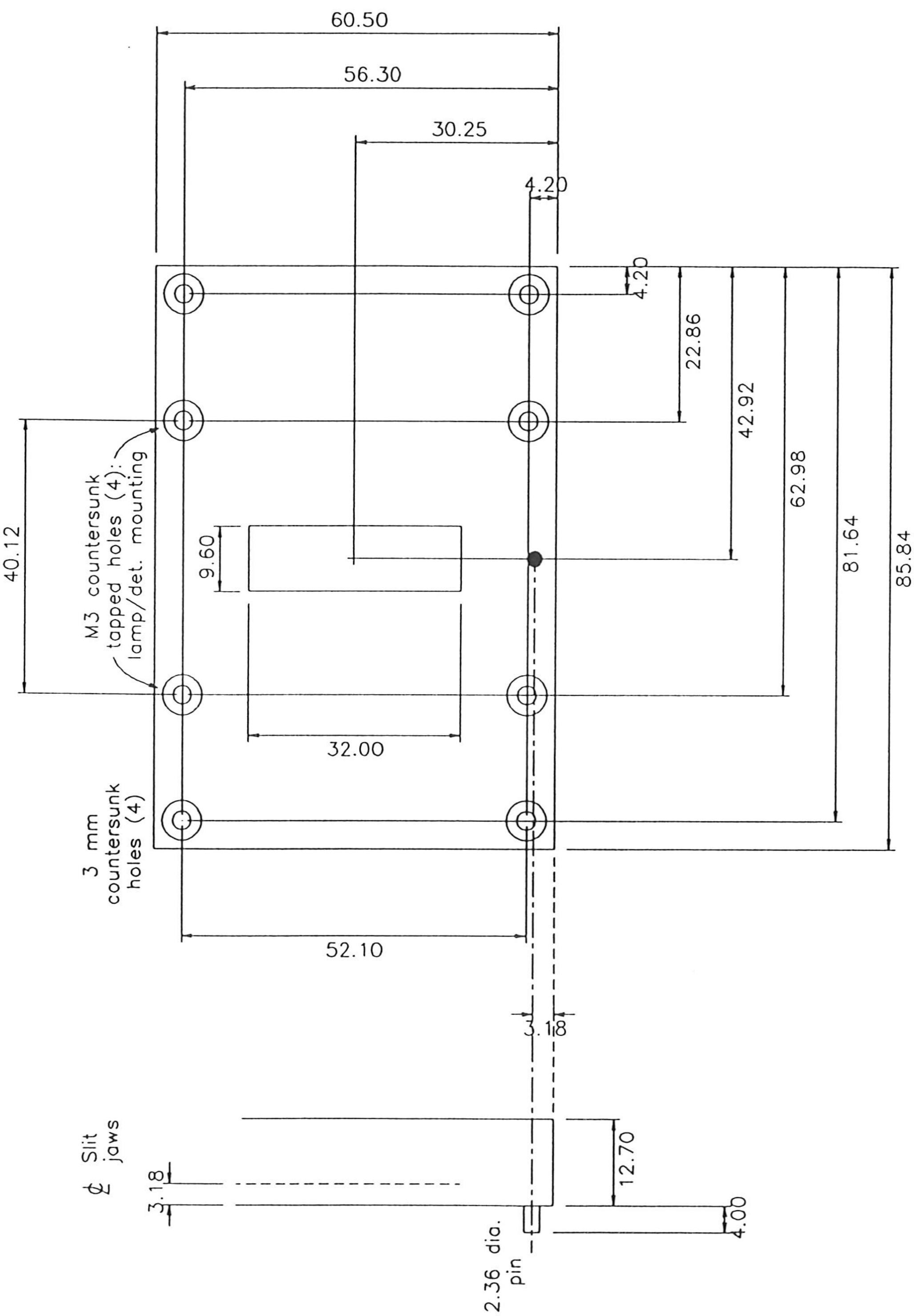

SCIENCETECH 9050 MONOCHROMATOR
Grating 1200 l/mm, blazed at 600nm
Intensity
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
575
577
579
wavevelength (nm)
Hg yellow doublet

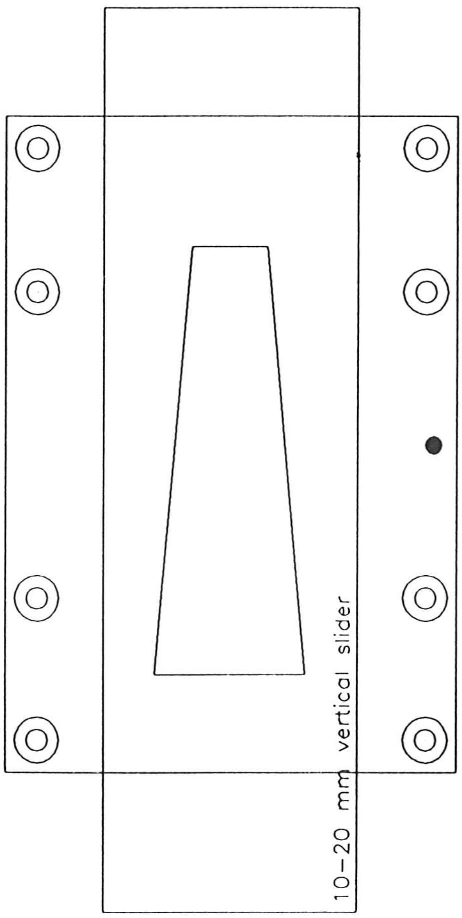
Figure 6b

Figure 7.a



Adjustable slit with continuous height variation
9010/9050 spectrometer family

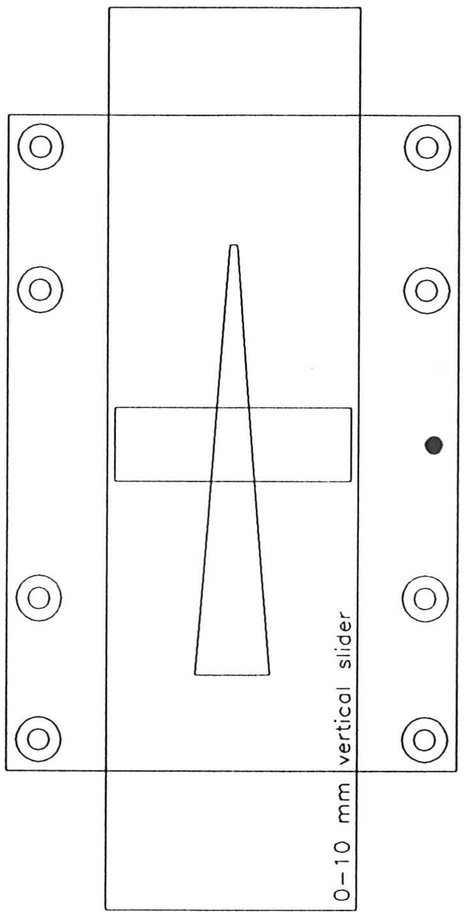
Figure 7.b



Adjustable slit with continuous height variation
9010/9050 spectrometer family

Figure 7.c

Adjustable slit with continuous height variation
9010/9050 spectrometer family



Sciencetech spectroscopic system

MAIN OFFICE: SCIENCETECH INC. • 45 Meg Drive • London, Ontario Canada • N6E 2V2 • *Phone* (519) 668-0131 • *Fax* (519) 668-0132

RESEARCH LAB: McMaster University • Nuclear Research Building • Room B102A • 1280 Main St. West • Hamilton, Ontario Canada • L8S 4K1 • (905) 525-9140 *Ext.* 23123, 27560

Spectroscopic system

A Sciencetech scanning monochromator equipped with a detector, data acquisition board and the SciSpec software forms a complete spectroscopic system. Light coming from the optical source to the input slit of the monochromator is spectrally analyzed and the spectrum is digitized and stored using the supplied analog to digital convertor board. The SciSpec software allows complete control over all instrument functions and performs data analysis, storage, and printing. All data files are saved in an ASCII text format that can be easily imported into commercial spreadsheet packages.

The hardware and software is designed for use with a user supplied IBM compatible 486 computer system running MicroSoft Windows Version 3.1 or later. The computer system must have an available serial (COMM) port for communication with the monochromator and a free PC bus slot for the A/D board. A MicroSoft or IBM compatible mouse is recommended.

The software was written and tested on a 486DX/2 66 MHz machine with 4 MB of RAM memory. Data acquisition rates and data storage capabilities will depend on computer configuration.

Software Installation

SciSpec is a general purpose monochromator scanning and data acquisition program for use with all Sciencetech monochromators equipped with standard single channel detectors.

All of the software can be installed on your hard drive by running A:\SETUP from the Windows 3.1 Program Manager or by selecting and running A:\SETUP.EXE from the Windows 3.1 File Manager. After completing its initialization routines SETUP will ask for the destination directory. All of the program and configuration files will be installed to this directory. Several additional files will also be written to the WINDOWS and/or WINDOWS/SYSTEM directory.

Once the installation is complete SciSpec may be run as you would run any other Windows program (e.g. double click on the appropriate icon from Program Manager). The program was designed to utilize the standard Windows user interface and most of the standard features should be self explanatory to experienced Windows users. If you are unfamiliar with the Windows operating system you should refer to the documentation provided by MicroSoft. Help files are being written for these programs but are not yet available. If you have any questions about topics not covered in this manual please contact Sciencetech.

SCIENCETECH

Designers and Manufacturers of Quality Scientific Instrumentation Since 1985

SciSpec User's Guide

Version 2.3
June 1997

MAIN OFFICE: SCIENCETECH INC. • 45 Meg Drive • London, Ontario Canada • N6E 2V2 • *Phone* (519) 668-0131 • *Fax* (519) 668-0132
RESEARCH LAB: McMaster University • Nuclear Research Building • Room B102A • 1280 Main St. West • Hamilton, Ontario Canada • L8S 4K1 • (905) 525-9140 *Ext.* 23123, 27560

SciSpec 2.3 User's Guide

Sciencetech's SciSpec program is designed to facilitate the acquisition of spectroscopic data when using a Sciencetech motor drive monochromator with a single channel detector and data acquisition card. Monochromator control is accomplished by communicating with the monochromator's stepper motor controller through a serial port on the host computer. Additional motors can be controlled through the same port for filter wheel operation and/or computer controlled lamp and/or detector switching.

Voltage signals from the detector are acquired through an analog to digital convertor on the data acquisition card installed in the host computer.

Software Installation

SciSpec is a general purpose monochromator scanning and data acquisition program for use with all Sciencetech monochromators equipped with standard single channel detectors.

All of the software can be installed on your hard drive by running A:\SETUP from the Windows® 3.1 Program Manager or by selecting and running A:\SETUP.EXE from the Windows 3.1 File Manager. After completing its initialization routines SETUP will ask for the destination directory. All of the program and configuration files will be installed to this directory. Several additional files will also be written to the WINDOWS and/or WINDOWS/SYSTEM directory.

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Basic Concepts

Setup menu - Scan Mode submenu

The SciSpec program can operate in **Wavelength**, **Energy**, or **Time** scanning modes. In **Wavelength** and **Energy** scan modes data is collected as a function of the monochromator grating position. In **Time** Scan mode the grating position is fixed and data is recorded as a function of time.

Wavelength scanning is the "natural" scan mode for Sciencetech monochromators equipped with a sine-arm drive system. Wavelength is directly proportional to the grating position and scans are linear in wavelength units.

In **Energy** scan mode the program attempts to linearize the scanning by adjusting the number of motor steps per scan step. The linearization routine is limited by the step resolution of the monochromator and will work best when larger scan step sizes are selected.

In **Time** scan mode the program assumes that all time steps will be of equal duration. For very small step sizes on slower computer systems this may not be strictly true. In order to minimize the possibility of timing errors all rescaling features are disabled when the system dead time (i.e. the time in which the system is idle waiting for the next step) is less than 1 second. Avoid running other windows programs while operating in **Time** scan mode.

Acquire menu: Scan Types

Scans can be acquired as **Background, Reference,** or **Sample.** The type of the scan determines how it will be used in subsequent calculations.

A **Background** scan should be acquired if there is a background component to the signal which must be subtracted. If background subtraction is enabled then the background scan will be subtracted from both the Sample and Reference scans.

A **Reference** scan must be acquired if Transmission or Absorption measurements are to be performed.

Sample scans can be displayed as **Voltage, Absorbance, %Transmission** or **Radiance. Voltage** are the averaged readings from the analog to digital convertor and are the basic signal units used throughout the program. **Absorbance** is calculated as the negative logarithm of the **Sample/Reference** ratio. **%Transmission** is calculated as the **Sample/Reference** ratio times 100%. **Radiance** is the value calculated from the spectral and geometrical characteristics of a detector connected to the instrument through a diffuser or an integrating sphere.

Operating Instructions

Initialization

Turn on the monochromator and detector and run the SciSpec program. The Sciencetech logo should appear on the screen along with the **About SciSpec** message box. The system will now read the configuration file and, if necessary, the irradiance calibration file and test the monochromator communications.

If a **Communications Error** message appears this means that either the monochromator is not turned on or it is not connected to the COM1 port. Follow the instructions on the screen. If you are using a different serial communications port choose the **Cancel** option (you can change the port after the program is loaded - see **Monochromator Setup**).

If the monochromator is properly connected the program will reset all motors to the position that was last used.

The data acquisition card will now be tested. If an error occurs you will have to exit the SciSpec program and check the installation of the data acquisition card. Ensure that the base address switches on the card correspond to the base address setting in the CB.CFG file.

The main SciSpec screen will now appear.

The Main Screen

Title Bar

The Title Bar at the top of the screen indicates the program version (e.g. SciSpec2), the scan mode (e.g. Wavelength Scan), and the current file name.

Menu Bar

Immediately below the Title Bar is the Menu Bar. Menu items can be selected by clicking on them with the mouse or by holding down the Alt key and pressing the underlined letter in the menu caption.

Tool Bar

Beneath the Menu Bar is the Tool Bar which contains the RUN, PAUSE, and STOP buttons (see below). Mouse cursor coordinates are displayed on the right hand side of the Tool Bar when the cursor is over the Data Window.

Data Window

Scan data is plotted in the central Data Window. The Title, Comments, Time, and Date for the current scan are printed above the Data Window.

Status Bar

The Status Bar at the bottom of the screen displays status messages, the current scan number and scan type, the current grating position, and, when scanning, the current signal level.

Monochromator Setup

The first time you run the program you should select **Monochromator ...** from the **Setup** menu. This routine tests the monochromator connections and allows you to change the selected grating and communications port. **It is essential that the all of the information and settings displayed in this window match the actual monochromator configuration**.

Check that the Model Number, Serial Number, and grating information match the labels on the monochromator. If they do not then there is a problem with the SCISPEC.CFG file.

If your monochromator has more than one grating ensure that the correct grating is selected. Refer to the monochromator manual for details on switching gratings.

The **Status** section of this screen will indicate if the monochromator is **OK** or **Not Responding** and display the current wavelength and counter reading.

If the counter reading does not match the actual counter reading on the monochromator select the **Set Wavelength** button. You will have the choice of entering the correct wavelength in nanometers or selecting **Auto Zero. Auto Zero** will automatically set the monochromator wavelength to zero by searching for the monochromator's internal limit switch. Select **Done** to exit the Set Wavelength window.

The **ReInitialize Motor** button is used to reset the communications with the monochromator if a communications error has occurred (e.g. if the monochromator was accidentally turned off or disconnected).

The **Grating Selection** buttons are used to set the desired grating. When the selection is in **Automatic**, the grating will be selected by the system configuration file depending on the chosen wavelength: this should be the standard operating mode. For scans where it is desired to use a single grating (with no grating change during the scan) or when a mirror is used, select the grating manually.

Select **Done** to exit from the **Monochromator Setup** window.

Selecting the Scan Mode

The current scan mode is indicated on the Title Bar and by a check mark on the **Scan Mode** sub menu. The scan mode can be changed by selecting **Scan Mode** from the **Setup** menu then selecting the new scan mode from the **Scan Mode** sub menu.

When the scan mode is changed the **Scan Setup** window is displayed with scan parameters from the last time this particular scan mode was used.

Setting the Scan Parameters

Selecting **Scan Parameters** from the **Setup** menu will cause the **Scan Setup** window to be displayed, allowing you to set all relevant data acquisition, real-time display, and storage options. The **Scan Setup** window can be viewed without affecting the currently stored data. However, if the scan parameters are changed the currently stored data will be lost unless it has already been saved. You will be warned before data is erased. The written Title and Comments will not be affected, allowing the user to edit them without have to write them again.

The options available in the **Scan Parameters** and **Units** sections of the **Scan Setup** window depend on the **Scan Mode.** The **Scan Parameters** section allows you to set the scan limits and stepsize in the selected units. The **Number of Steps** is displayed for you information only and cannot be directly adjusted.

In **Wavelength** and **Energy** scan modes the selected units also determine the units that will be used on the **Wavelength Control** and **Status Bar.** In **Time** scan mode the **Wavelength Control** and **Status Bar** will use the default units of nanometers.

In **Energy** scan mode you have the additional option of scanning in relative energy units where the value in the **Relative To** box is subtracted from all absolute energy values. This option is useful for measurements such as Raman spectroscopy where the relevant parameter is the energy difference from the laser line.

The **Acquisition Options** determine how the data will be acquired and can be used to increase the signal to noise ratio.

The **Dwell Time** parameter determines the minimum amount of time that the system will wait between changing the monochromator position and reading the data acquisition card. The **Dwell Time** should be at least as long as the time constant of the detector system. Note that in **Time** scan mode the **Dwell Time** is irrelevant and is not displayed.

The **Signal Averaging** parameter determines the number of analog to digital convertor readings to be averaged at each step. This feature is extremely useful for averaging out short term fluctuations in the light source and increasing the signal to noise ratio of the data acquisition system. Care should be taken in **Time** scan mode to ensure that the signal averaging process does not take longer than the scan stepsize. The actual time required for each reading of the data acquisition card will depend on the speed of both the analog to digital convertor and the host computer system.

The **Scan Averaging** parameter determines the number of complete scans to be averaged. If the value of this parameter is greater than 1 the monochromator will scan repeatedly and a running average of the data will be performed as each data point is collected. The displayed and stored values are updated as each point is collected and averaged. This feature is useful for averaging out longer term fluctuations in the light source. The scan averaging feature is not available in **Time** scan mode.

The **Storage Options** control the number of **Sample** data sets that are displayed and stored. If **Single Sample Scan** is selected then the **Sample** data is overwritten each time a new scan is performed. If **Multiple Sample Scans** is selected then a new **Sample** data set will be created each time a new **Sample** scan is performed. A single **Background** and **Reference** data set is associated with each file regardless of the **Storage Option** chosen.

The **Real Time Display** options determine how the **Sample** data is displayed while the system is scanning. The **Real Time Display** options do not affect how the data is acquired or stored.

Setting the Communication Port

Ensure that the correct communications port is selected. Setting the **Communications** allows the user to change the system control serial port. It also display communication warning messages.

Setting the Filter Wheel

If a filter wheel is part of the system, the **Filter Selection** buttons are used to set the desired filter. When the selection is in **Automatic**, the filter will be selected by the system configuration file depending on the chosen wavelength: this should be the standard operating mode. For scans where it is desired to use a single filter (with no filter change during the scan), select the filter manually.

Setting the Light Source

If a lamp switcher is part of the system, the **Lamp Selection** buttons are used to set the desired light source. When the selection is in **Automatic**, the source will be selected by the system configuration file depending on the chosen wavelength: this should be the standard operating mode. For scans where it is desired to use a single lamp (with no lamp change during the scan), select the lamp manually.

Setting the Detector

If a detector switcher is part of the system, the **Detector Selection** buttons are used to set the desired detector. When the selection is in **Automatic**, the detector will be selected by the system configuration file depending on the chosen wavelength: this should be the standard operating mode. For scans where it is desired to use a single detector (with no detector change during the scan), select the detector manually.

Optimizing the Signal

The **Wavelength Control** window allows you to change the grating position and view the signal level in real time. The **Signal Level** indicator is easy to read from a distance giving instant feedback as you optimize the alignment of the optical system.

The **Wavelength Control** is accessed by selecting **Wavelength** from the **Menu Bar**. The current grating position is displayed using the units selected in the **Scan Parameters** window.

To step the monochromator to the red or blue simply click on the appropriate button or hold down the **Alt** key and use the **LEFT** and **RIGHT** arrow keys.

To change the step size you may type a new step size into the appropriate box, use the buttons beside the stepsize box to increment or decrement the stepsize, or hold down the **Alt** key and use the **UP** and **DOWN** arrow keys. Note that in **Energy** scan mode the step size is automatically updated as the grating position changes.

To go to a specific grating position type the desired position in the box beside the **Goto** button then press the button or press the enter key.

If a mirror is used instead of a grating, the displayed position is in motor µ-steps instead of in nm.

The **Signal Level** indicator displays the digitized signal level from the detector. This is also displayed as a percentage of the full scale signal by the green indicator bar at the bottom of this window.

Acquiring a Spectrum

The **Acquire** Menu allows the user to select the type of data to be acquired (**Background**, **Reference**, or **Sample**) and starts the scanning sequence. If you wish to display absorption or transmission as data is being collected use the **Real Time Display** options in the **Scan Setup** window.

The type of the current scan is indicated on the status bar at the bottom of the screen. Note that the colour of the text describing the data type corresponds to the colour of the corresponding data set in the data window.

Acquisition may also be started, paused, or stopped using the **RUN**, **PAUSE**, and **STOP** buttons located near the center of the screen above the data window. These buttons look and behave like the corresponding buttons on a standard audio cassette player.

The **RUN** button will start an acquisition of the currently selected data type (as indicated by a check mark on the **Acquire** menu). Holding down the **Alt** key and pressing **Enter** will accomplish the same function.

The **PAUSE** button may be used to temporarily interrupt the acquisition process without altering the screen display or the stored data. The acquisition may then be restarted by pressing **PAUSE** again or aborted by pressing **STOP**. The keyboard equivalents of the **PAUSE** button are the **Pause** key or the **F12** key.

The **STOP** button may be used to abort an acquisition sequence. The **Esc** key performs the same function. Scans which have been aborted cannot be restarted. However, all data stored before the scan was aborted remains valid until it is overwritten or erased.

Display Options

Stored data can be processed and displayed in a variety of ways using the various options presented on the **Display** menu.

Selecting **X axis ...** brings up a window which allows you to change the units, scaling, and format of the X axis values. This window may also be invoked by clicking the mouse anywhere along the X axis.

Selecting **Y Axis ...** brings up a window which allows you to change the scaling and format of the Y axis values. This window may also be invoked by clicking the mouse anywhere along the Y axis.

Selecting **Labels ...** brings up a window which allows you to change the title and comments on the current scan. Each scan has its own title and comments. The default labels for new scans are copied from the previous scan.

Selecting **Major Grid** will cause a grid to be overlayed onto the display window. The grid spacing will coincide with the major tick marks on the display axes.

Selecting **Minor Grid** will cause a grid to be overlayed onto the display window. The grid spacing will coincide with the minor tick marks on the display axes.

The second section of the **Display** menu allows you to specify the

type of processing performed on the displayed data. Note that if **Absorbance** or **Transmission** is selected the **Background** and **Reference** data will be hidden. If **Background Subtraction** is selected the **Background** data will be subtracted from the **Sample** and **Reference** data and the **Background** data will be hidden.
If **Radiance** is selected, the raw voltage measurement is scaled using the detector calibration file. The name of the calibration file is given to the program by the spectrometer configuration file (SCISPEC.CFG) under the title CalFile.

The bottom section of the **Display** menu allows you to access the **PeakFind** and **ScanList** windows.

Scan List

The **Scan List** may be accessed from the **Display** menu or by clicking on the **Scan** item on the status bar. A list of all stored data sets, as well as their type, colour, visibility, and time of acquisition is displayed.

Clicking once on any item will make the scan current (the scan ID and type will be displayed on the status bar and the scans' labels will appear above the data window). The visibility of a scan may be toggled by clicking on the visibility field. Double clicking on any item will make that scan visible and hide all others.

The **Show All** button will make all scans visible. If the display is currently showing **Absorbance** or **Transmission** it will be changed to **Counts** so that the **Background** and **Reference** scans may be displayed.

The **Edit Labels** button is included so that the **Labels** for the current scan may be edited without leaving the **Scan List** window.

Analyzing the Data

Peak positions and intensities can be measured by moving the mouse in the data window. The X and Y values at the mouse location are printed in the cursor box at the upper right side of the screen.

You can zoom in on a particular region of the spectrum by moving the mouse to the left edge of the region, pressing the left mouse button, and dragging the mouse to the right edge of the region. The region inside the rectangle drawn by the mouse will be rescaled and displayed when the mouse button is released. To zoom out simply click the right button.

Clicking the mouse anywhere on the data window will cause the Y axis to be rescaled so that the data fills the window.

Finding Peaks

The **Peak Find** routine locates peaks in the displayed portion of the indicated scan by searching for changes in the sign of the first derivative of the scan. If the sign changes and the Y axis value is above the threshold the peak is listed. The threshold is set as a percentage of the currently displayed range of Y axis values.

This **Peak Find** routine will work best on smooth spectra with distinct peaks. If your spectra are too noisy try increasing the **Signal Averaging** and/or **Scan Averaging** in the **Scan Setup** window.

The **Peak List** may be saved to a file by pressing the **Save** button. The **Copy** button copies the **Peak List** to the Windows clipboard so that it may be pasted into other Windows applications.

Saving Data to Disk

Data may be saved at any time by selecting **Save As ...** from the **File** menu. A standard windows dialogue box will appear allowing you to specify where the file is to be stored.

Note that only the raw (i.e. unprocessed except for averaging) data is stored. Data files are saved in an ASCII text format with string values enclosed in quotation marks and all values separated by commas. This format allows the data to be readily imported into commercial spreadsheet packages such as Lotus 123. All of the relevant scan parameters are included in the data files.

Retrieving Data from Disk

Any file which was saved with the SciSpec Version 2.00 software can be retrieved by selecting **Retrieve ...** from the **File** menu. All scan parameters, options, etc. are retrieved with the data so that after a file is retrieved the system setup is identical to when it was saved. In this way previous experiments can be easily recreated.

Printing

The entire data window can be printed at any time (except when scanning) by selecting **Print** from the **File** menu. The print file is sent to the Windows Print Manager to be printed.

Printer settings can be changed by selecting **Printer Setup ...** from the **File** menu.

Opening a New File

Selecting **New** from the **File** menu will erase all currently stored scans from memory and reset the Filename to its default values Data which has been saved to disk will not be affected. As when changing the scan parameters, the Title and Comments will not be affected.

Note: The windows and menus in this program are mostly self-explanatory, feel free to experiment with the various options. However, care should be taken not to overwrite the CB.CFG and SCISPEC.CFG files as these are crucial for proper system operation.

Version 3.0 Print date: October 2, 1997

Microprocessor instructions

General instruction format

Several controllers can be daisy chained into the same serial port. Each controller is identified by a value from 0 to 3.
Notes:
- The handshaking is also daisy chained: the CTS line goes down (disabled) when the RTS line goes down (another controller is not available) or when the internal buffer is full.
- Two wiring solutions are possible: internal box wiring and special cables to several boxes each with one controller.
- The unit # is assigned using the present 2 DIP switches.

(CR) stands for carriage return.
1. Into microprocessor. All instructions must follow the format:
   a. No leading digit for controller # 0 to allow the spectrometer software to be backwards compatible. Started with a single digit from 1 to 9 that identifies the controller to be used. Throughout this proposal, the controller identifying digit is indicated by the character #.
   b. Closed with a (CR).
   c. All blank spaces and line feeds are not significant.
   d. All command alphabetic characters in capital letters.
   e. All numbers are sent in ASCII (not binary).
   f. An error response will be produced when:
      i. The first (instruction) character (other than blank spaces or line feeds) is not recognized.
      ii. All characters other than the first one that are not the number leading - or + sign (for signed values) or a digit.
      iii. A digit before a sign character.
      iv. A sign character is present in a unsigned value.
      v. More digits than required by the variable.
   g. The digit sign is optional. If not present in a signed value, it is assumed to be positive.
   h. Zeros before other nonzero digit are ignored.
   i. Word format:
      i. Unsigned: several digits starting with the most significant one.
      ii. Signed: the ASCII character of the sign "+" or "-" (if missing, a positive number is assumed) followed by several digits.

   If less digits than necessary are sent, they are assumed to be the least significant ones (e.g., if 75 is sent for a digit between 1 and 9999, it is read as 75, not as 7500).

2. Microprocessor echo. After receiving an instruction addressed to it, the μ-p returns immediately the instruction including the

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controller identifier (if ≠ # 0) and the (CR).
All instructions and responses will be buffered: the instruction/response is sent only after a [CR] is received to avoid scrambling messages.
If the instruction does not execute immediately, a delayed answer is given.

<u>Error return format</u>
3. The end switch error message can be produced at any time. Its format is "[#]E*", where "#" is the controller number (none or 0 for controller # 0) and "*" is "+" of "-" depending on the switch.
4. Any μ-p instruction that has a valid digit (i.e., one corresponding to a connected controller) as the first character but that violates the instruction format rules is returned in the format:

"[#]**..*"?(CR)(LF)

where **..* stands for the sent instruction.
[] stands for optional (controller # ≠ 0).

5. Delayed response. After completing an instruction addressed to it that requires delayed response, the μ-p returns the completion message, including the controller identifier (except for controller # 0).

INSTRUCTIONS

Initialization

1. **V**. Set the multiplier for the time per stage step (or microstep) during move and interval move operations, i.e., the time per single step is t * (1 to 999). v=1 to 999 in t units. v does not affect the find end-switch step time that is set at t, i.e., v=1. v is an unsigned word.

Computer: [#]Vv(CR)
μ-p delayed: none

Action: deposit v in μ-p memory. Immediate update (v is fetched before every step). Default: 10. Recommended: 1.

2. **T**. Set the time per step during move and interval move operations (including the find end-switch speed). t=2 to 9999. The step time has a resolution of 2μs, i.e. step time(μs) = 2*Int(t/2). t is an unsigned word.

Computer: [#]Tt(CR)
μ-p delayed: none

Action: deposit t in μ-p memory. Immediate update (t is fetched before every step). Default: 1000. Recommended: 1?0 for μ-step (limited by μp overhead) and 600 (limited by motor inductance) for half step.

3. **U**. Set/reset microstep.

a. **U0**. Set system to half step.
Computer: [#]U0(CR)
μ-p delayed: none

b. **U1**. Set microstep: 10 μ-steps per full step (5 μ-steps per half step). It uses sine/cosine tables.
Computer: [#]U1(CR)
μ-p delayed: none

Action: deposit u in one 1-byte μ-p memory. Update after the motor operation (if any) has been completed. Default: 0 (microstep off). When the system is changed back from μ-step to half step, the position of the motor is maintained, i.e., subsequent half steps are not within detente positions but from whatever "analog" position the motor was in the μ-step mode. This allows position tracking if switching back and forth between modes.

Equipment setup

4. **F**. Find end-switch.

Computer: [#]F+(CR) or [#]F-(CR) to find either switch.
μ-p delayed: normal: [#]+D(CR)(LF) or [#]-D(CR)(LF)
error: none

Action: move the stage until the desired end-switch is found. Find overrides Move or Interval move (immediate execution).

Equipment operation

If the motor is disconnected, the end switches are set thus all operation instructions will generate immediate end switch responses.

5. **M**. Move steps: m=-99999 to +99999. m is a signed word. Move the stage m motor steps (or μ-steps, controlled by the step size as selected by the U instruction)

Computer: [#]Mm(CR)
Error: [#]ME(CR)(LF) if I, M or F is active.
μ-p delayed: normal: [#]MD(CR)(LF)
error: [#]+E(CR)(LF) if the far end switch is set.
[#]-E(CR)(LF) if the near end switch is set.

Action: step the motor m (μ) motor steps, return normal message. If at any time the end switch turns on compare the sign of the end switch with that of m. If they are opposite, continue. If they are the same, stop and return error message. If an M, F or I instruction is active, an error message is returned.

6. **A**. Abort move, find switch or interval move. Stop the motor immediately.

Computer: [#]A(CR)
μ-p delayed: none

Action: abort any motor operation (M, I or F).

7. **Q**. Motor winding control.

a. **Q0**. All windings off (for manual motion).
Computer: [#]Q0(CR)
μ-p delayed: none

Action: disable (turn off) all stepper motor windings off.

b. **Q1**. Windings on.
Computer: [#]Q1(CR)
μ-p delayed: none

Action: enable stepper motor windings.

Default: windings on.

8. **C**. Motor winding manual setting.

a. **CAn**. Set current in winding A. -127 <= n <= 127.
Computer: [#]CAn(CR)
μ-p delayed: none

b. **CBn**. Set current in winding B. -127 <= n <= 127.
Computer: [#]CBn(CR)
μ-p delayed: none

E.g., to shut off the motor transmit CA0(CR), CB0(CR). A cycle of 8 half steps = 4 full steps = 3.6° would be ($90 = 127/\sqrt{2}$):

CA	127	90	0	-90	-127	-90	0	90
CB	0	90	127	90	0	90	127	90

9. **X**. Auxiliary digital control line #1 (in JP1: serial port header).

a. **X0**. Control line to ground (logic 0).
Computer: [#]X0(CR)
μ-p delayed: none

Action: ground control line.

b. **X1**. Raise control line (logic 1).
Computer: [#]X1(CR)
μ-p delayed: none

Action: raise control line.

Default: Control line grounded.

10. **Y**. Auxiliary control line #2. Same as #1 but with **Y0**, **Y1** (in JP1: serial port header).

The following instructions are used for semiautomatic scan.

11. **S**. Store size of interval: s=1-9999. Number of stepping motor steps per measurement interval. s is an unsigned word.

Computer: [#]Ss(CR)
μ-p delayed: none

Action: deposit s in μ-p memory. Immediate update if Interval step being executed. Default: 1.

12. **W**. Set wait time: w=1 to 999. Delay after interval step for equipment stabilization of stepper motor vibrations in 10 msec units i.e., delay is from 0.01 to 9.99 sec. w is an unsigned word.

Computer: [#]Ww(CR)
μ-p delayed: none

Action: deposit w in μ-p memory. Immediate update. Default: 0.

13. **I**. Interval move: i=-99999 to +99999. i is a signed word.

Computer: [#]Ii(CR)
Error: [#]IE(CR)(LF) if M is active.
μ-p delayed: normal: [#]ID(CR)(LF)
error: [#]+E(CR)(LF) if the far end switch is set.
[#]-E(CR)(LF) if the near end switch is set.

Action: move the stage i intervals, i.e., step the motor i*s motor steps (or μ-steps), wait 10*w msec, return normal message. If at any time the end switch turns on, stop and return error message. If an I, F or M instruction is active, an error message is returned.

The following instructions is used for cyclic operation: filter wheel drive and direct drive spectrometer drive.

14. **K**. End switch control.

a. **K0**. End switch is enabled (for linear operation and to find the zero in circular operation).
Computer: [#]K0(CR)
μ-p delayed: none

Action: enable the recognition of the end switch signal.

b. **K1**. End switch is disabled (for circular operation).
Computer: [#]K1(CR)
μ-p delayed: none

Action: the status of the two end switches is ignored: the motor continues to run even if the end switch in that direction is set, no message is issued.

Default: end switch operation enabled.

The following instructions address acceleration and deceleration for faster operation

15. **N**. Set the acceleration and deceleration. n=1 to 999 in .001msec^{-2} units. n is an unsigned word.

Computer: [#]Nn(CR)
μ-p delayed: none

Action: deposit n in μ-p memory in both n and o locations. Use the next time a new move (M or I) is started. Default: ?.

16. **O**. Set the acceleration and deceleration. n=1 to 999 in .001msec^{-2} units. o is an unsigned word.

Computer: [#]Oo(CR)
μ-p delayed: none

Action: deposit o in μ-p memory in the o location. Use the next time a new move (M or I) is started. Default: ?.

17. **P**. Set the minimum period for maximum speed. p=1 to 9999 in μsec units. p is an unsigned word.

Computer: [#]Pp(CR)
Error: [#]P?(CR)(LF) if p > v*t (see below).
μ-p delayed: none

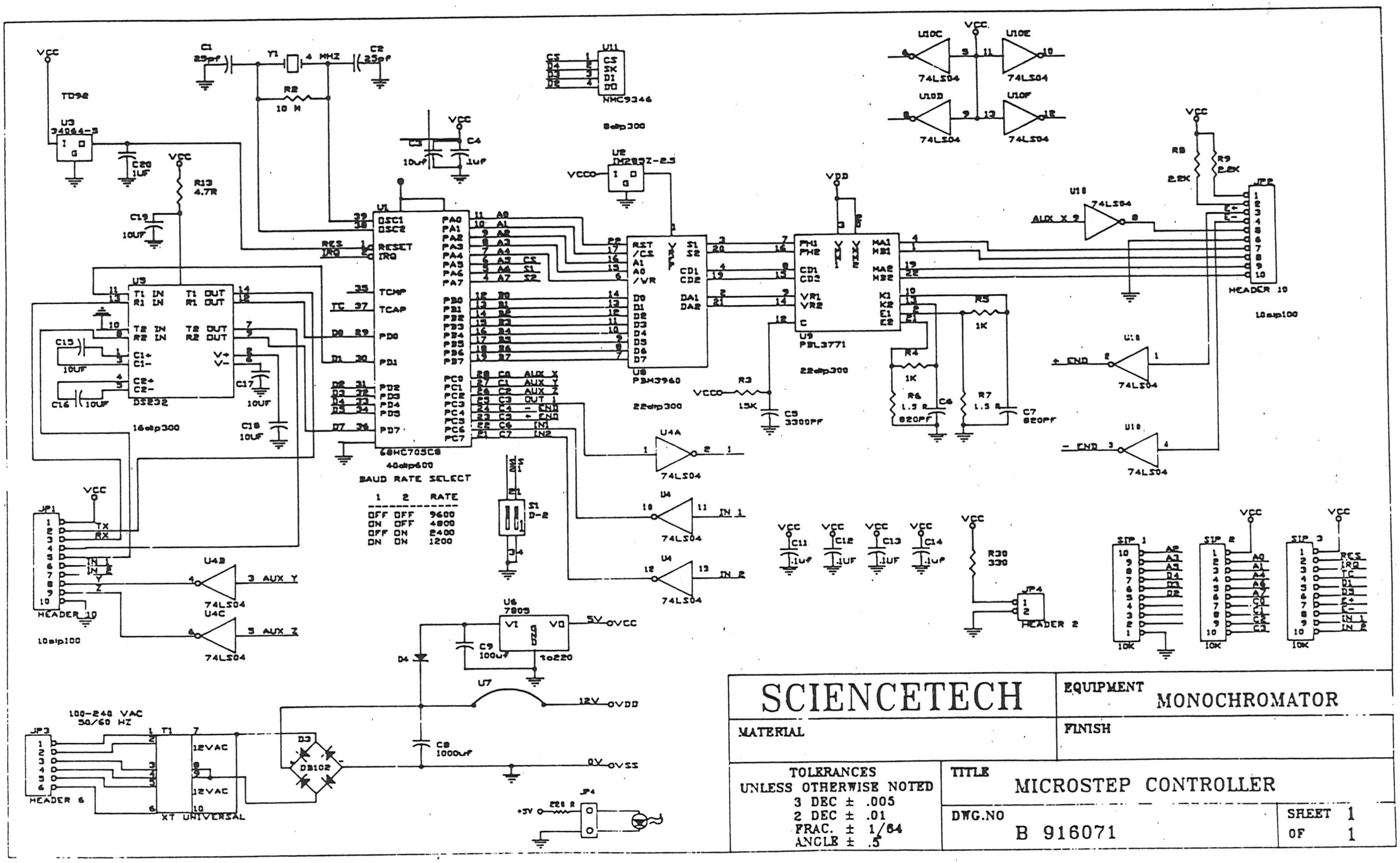
Action: deposit p in μ-p memory τ_{min}. Use the next time a new move (M or I) is started. Default: ?.

Operation: when x_0 steps are desired: step time is the product of v*t [μs] (I think !).

- Set the step time to the default value $\tau=\tau_0$. Set the move clock t=0.

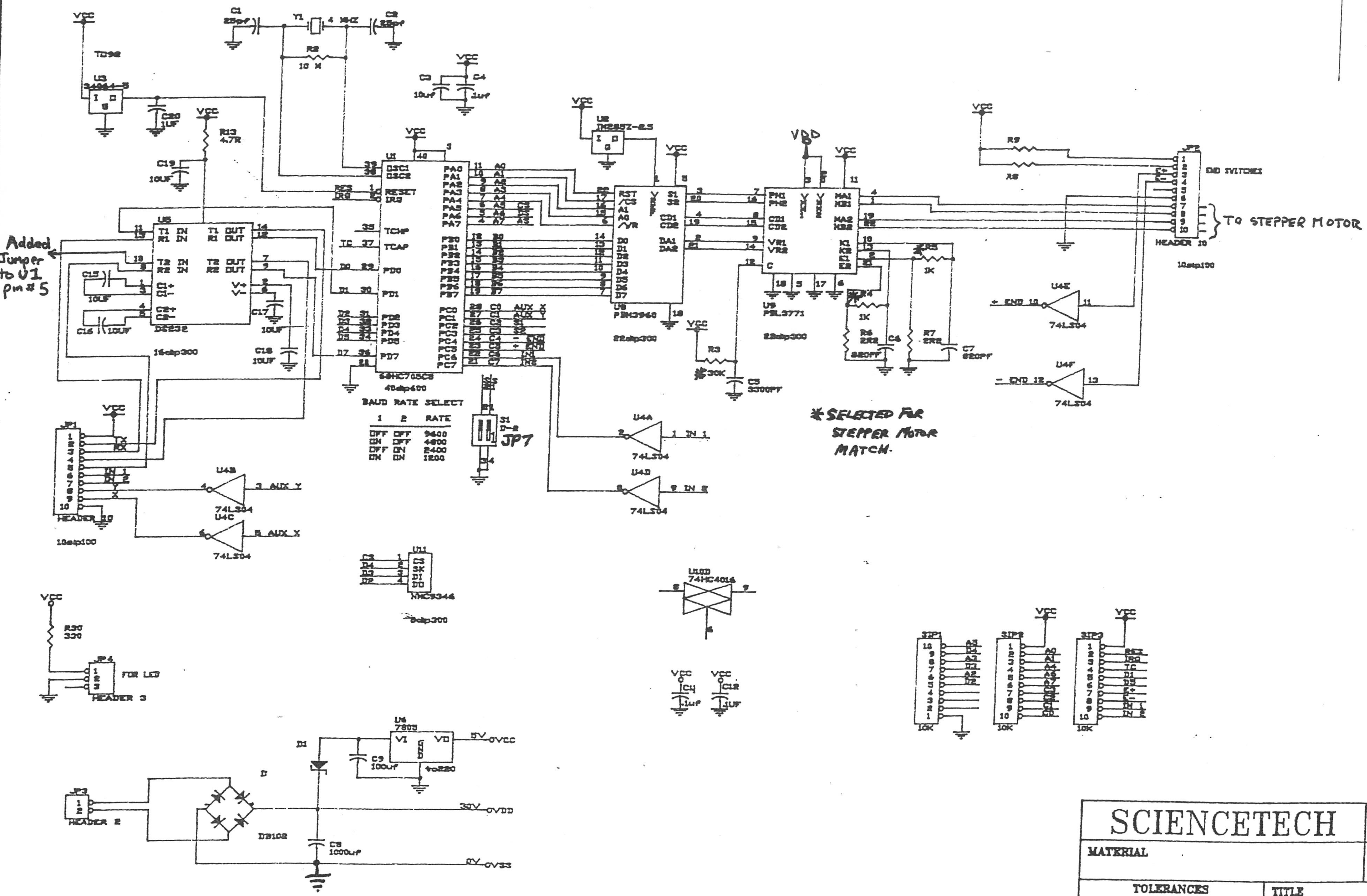
Loop:
- Do one step. Start the step clock.
- If $x=x_0/2-½$ $\tau<=\tau_{min}$ or if $x=x_0/2-½$: set the step time $\tau=\tau$ (this is used by odd numbered number of steps).
- If $x<x_0/2-½$: set the step time $1/\tau=1/\tau+n*t$.
- If $x>x_0/2-½$: set the step time $1/\tau=1/\tau-o*t$.
- When the clock answers, deposit the new τ (how to do that without introducing a delay ?)
- Loop until finished.

Note: there might be an increased stepping time due to the speed calculation, it should be kept to a minimum. The new minimum value should be evaluated. The minimum stepping time will be reduced by the removal of the master/slave operation (and it can be cut in half by going from 4 Mhz to 8 MHz clock).



SCIENCETECH
EQUIPMENT MONOCHROMATOR
MATERIAL
FINISH
TOLERANCES
UNLESS OTHERWISE NOTED
3 DEC ± .005
2 DEC ± .01
FRAC. ± 1/64
ANGLE ± .5
TITLE MICROSTEP CONTROLLER
DWG.NO B 916071
SHEET 1
OF 1
68HC705C8
40dip600
BAUD RATE SELECT
1 2 RATE
OFF OFF 9600
ON OFF 4800
OFF ON 2400
ON ON 1200
PBM3960
PBL3771
DS232
NMC9346
LM2937-2.5
34064-5
7805
DB102
XT UNIVERSAL
100-240 VAC
50/60 HZ
HEADER 10
HEADER 6
HEADER 2
74LS04

NO.	REVISION	DA



SCIENCETECH	EQUIPMENT MONOCHROMATOR
MATERIAL	FINISH

TOLERANCES UNLESS OTHERWISE NOTED	TITLE MICROSTEP CONTROLLER	
3 DEC ± .005 2 DEC ± .01 FRAC. ± 1/64 ANGLE ± .5	DWG.NO B 933001	SHEET 1 OF 1