SM302
InGaAs Array Spectrometer

User Manual

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1. Introduction.

1.1. Mission Statement

Our mission is to provide our customers with reliable products, on time, and at a fair price. We are continually striving to maintain the highest standards, by assuring defect-free products and by providing prompt and courteous customer service.

The staff at Spectral Products will be happy to answer any questions about our products and our services. For immediate assistance, please contact the Spectral Products directly at (505) 296-9541, by fax (505) 998-4746, or by e-mail at sales@spectralproducts.com

1.2. Warranty

This product is warranted to be free of defects in materials and workmanship for one year from date of purchase.

This manual and the software it describes are provided free of charge as a service to the customer. The software is intended to be used as a tool for development and as an example of one possible method of code implementation. It is not intended to be a "user application."

Any software associated with this product is provided "as is" with no warranty, expressed or implied. While it is Spectral Products' intent to provide error-free development tools, no guarantee is made regarding either the accuracy or usefulness of this material.

Failures or damages resulting from lack of operator attention to proper procedures, failure to follow operating instructions, unauthorized modifications, and natural disasters are not covered under this warranty.

The SM302 does not contain any user serviceable parts. **Removing its cover, without explicit written permission from Spectral Products , will void any written or implicit warranty.**

Spectral Products reserves the right, without prior or further notice, to make changes to any of its products described or referred to herein to improve reliability, function, or design.

Spectral Products accepts no liability for incidental or consequential damages arising from the use of this software.

Spectral Products does not recommend the use of its components or software products in life support applications wherein a malfunction or failure of the product may directly threaten life or result in injury.

Spectral Products does not recommend that this product be used on the same power line as other equipment with high current draw requirements.

1.3. Copyrights

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1.4. Product Overview

The SM302 is a versatile, high performance and complete InGaAs array spectrometer that consists of a low noise 256- element InGaAs array detection module, a high precision computer controlled tunable spectrograph optimized for the spectral range of 0.9 to 1.7 μm (.09 to 2.6μm extended), a 16-bit data acquisition board, and Windows®based operating software.

The dual grating capacity spectrometer comes preloaded with one grating and slit tailored for high-resolution work throughout the usable range of the detector. An optional second grating may be loaded to add wide coverage capability, or both gratings may be user specified to achieve desired coverage and resolution. Integrated filters allow the user to selectively block out unwanted higher orders, and the standard dual function entrance can accept light directly coupled through the built-in slit or from a standard NIR fiber.

The SM302 detector is a multiplexed InGaAs array that is thermoelectrically cooled and temperature stabilized to ensure long-term operation stability. The multichannel detection with a readout rate of 333 kHz or faster both reduces measurement time and enhances signal-to-noise ratio.

The complete package consists of four parts: 1. an entrance mechanism with a built-in slit, a fiber coupling adapter, and an order sorting filter: 2. a tunable spectrograph of standard Czerny-Turner arrangement using high quality optics; 3. a linear InGaAs sensor array with thermo electric cooling and driving circuitry;

4. a computer interface for data acquisition.

All the optical components and driving electronics are enclosed in an aluminum housing for stable operation.

The SM302 employs a multiplexed InGaAs array as its NIR detection element. The array is cooled and temperature stabilized at -10°C which ensures long-term operation stability. The SM302 can operate at a readout rate of 100kHz or faster allowing fast measurement and averaging operation to be performed in a short period of time.

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1.5. Product Specifications

- **Number of pixels :** 256
- **Pixel size:** 50 by 200μm
- **Bad Pixels:** Standard (2% max), Extended (5% max)
- **Peak sensitivity** Standard (1.55μm), Extended (2.3μm)
- **Peak responsivity:** Standard (0.95 A/W), Extended (1.1 A/W)
- **Spectral response range: (**0.9 to 1.7μm standard mode) (0.9 to 2.6μm extended mode).
- **Pixel resolution:** 7nm with standard module and slit option.
- **Light entrance:** Dual SMA/50μm slit standard. Other slit or fiber connections options available.
- **f#:** 3.9
- **Grating:** One 600 grooves per mm included. Additional gratins available upon request.
- **Grating control:** Rs232
- **Filter:** Permanent 0.9 μm low blocking filter included. 1.3 μm low blocking flip-filter in extended model.
- **Filter (Extended Only)** LPF – 1300nm – 2500nm
- **InGaAs power supply:** *Input voltage = 100-120V AC with DB15 connector.
- **SM302 spectrograph power supply:** UL listed 110/220 V power pack, meets or exceeds UL1950, CSA 1402C, and IEC 950 with 9 pin din connector.
- **Stray light rejection:** better then 10^{-3}
- **Analog to digital:** 16-bit PCI interface, 333 kHz
- **Integration time:** Min: 5 ms, Max: 10 s
- **Dark Current @ 25°C:** Standard (0.1 pA typ.), Extended (1000 pA typ.)
- **Noise mV rms:** Standard 0.15, Extended 0.18
- **Maximum non-uniformity:** Standard +/- 5% max, Extended +/-10% max
- **Dynamic range:** Standard (10,000:1), Extended (8,000:1)
- **Dimensions:** 10.5” x 5” x 4” (LxWxH)
- **Detector cooling:** Standard (-10°C one stage TE), Extended (-20°C two stage TE)
- **Weight (detector):** 3lb.
- **Software:** Windows control program and LabView® drivers included.

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2. Getting Started.

2.1. Checking System Requirements

Check to make sure that your computer meets the minimum requirements for the SM302 InGaAs system.

2.1.2. Requirements for the Hardware

- 1 serial port for spectrograph communication
- 1 PCI slot for the data acquisition card
- A mouse or any other pointing device
- A VGA, SVGA display, or 1024x768
- Any IBM compatible machine with a Pentium II processor or higher

2.1.3. Requirements for Software

- Minimum of 64 MB of RAM recommended.
- A hard disk with at least 10MB free space, and 7MB for installation.
- Microsoft Windows version 98 or newer in standard or enhanced mode.

2.1.4. Checking System Package Contents

Check to make sure that your package contains all of the following components.The SM302 system consists of:

- 1 SM302/SM302-EX unit.
- 1 SM302/SM302-EX Power supply.
- NI-DAQ 6034E card.
- 1 DK12V10 CMSP110 power supply.
- 1 Y power cord for the CMSP110.
- 1 Standard RS-232 cable (9 to 9D sub)
- 1 68 pin cable
- 1 male 9 pin to male 9 pin cable.
- 1 male15 pin to male 15 pin cable.
- 1 Spectral Products Spectral Products Installation software CD.
- 1 SM302 user manual
- 1 software manual (LabView)
- 2 CDs for Ni-DAQ driver software.

2.1.5. Installing Software

Refer to software manual (SM302/SM302 EX Spectra P/N 1080523) for instructions on installing and running software.

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2.2 HardWare SetUp

2.2.1 Installing the SM302 PC1605E card

One of the routine precautions you must be aware of when working with computer components is the problem of static electric discharge

.

Note: Leave the PC16052E card in its static-resistant bag until you are ready to install it.

Caution: Static electricity discharge may permanently damage your system. In order to avoid this problem during installation procedures, please follow the guidelines below:

- Discharge any static electricity build up in your body by touching a large grounded metal surface or the computer's case (if plugged in), for a few seconds.
- During installation procedures, avoid any contact with internal parts. Handle cards only by their edges.

General instructions for installing the board are given since the design of computer chassis varies. Refer to your computer's reference manual for information on removing the computer cover.

1. Turn OFF the power of your computer and any other connected peripheral devices.
2. Unplug the power cord from the back of the computer.
3. Remove the computer's cover by removing its mounting screws and sliding off the cover.
4. Remove the slot bracket by unscrewing the holding screw and sliding it out. Save this screw for securing the board after it's installed.
5. Install the PC16052E card in any available PCI bus slot in you PC.

2.2.2 Attaching the SM302 cables

Before proceeding with the following steps, make sure that the camera power supply is off.

1. Attach the male/male 9 pin D-sub cable to the camera receptacle and power supply.
2. Attach the male/male 15 pin D sub cable to the camera receptacle and power supply.
3. Attach the 68 pin cable to the back of the PC16052E card (in the back of your computer) and power supply.
4. Attach the RS232 male/female 9 pin D-sub cable to the back of the spectrograph and to any available com port on your computer.

2.2.3 Connecting the Spectrometer power supply

The Spectrometer is powered by the HUP80-24 power pack. Attach the Y power cable to the din connector of the power supply and plug in the locking barrel plug in the back of the Spectrometer. The other line is a +5V source for a optional controller.

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3.0 Operation

3.1 SM302 Spectrometer Serial Port Layout

The RS232 connection requires a cable with a DB9-M subminiature connector at the Spectrometer, and a computer communications port connector as appropriate for the user. Spectral Products offers a DK12AT, DK12PS and DK12MA cable for connecting to AT, PS2 and MAC style computers, respectively.

Pin Assignments for the Female DB-9 Connector at Rear of SM302 Spectrograph (See Figure 1 and 2)

Pin	NAME	FUNCTION
1	DCD	Not used with the Spectrometer
2	RxD	Data out (from Spectrometer to computer)
3	TxD	Data in (from computer to Spectrometer)
4	DTR	Not used with the Spectrometer
5	GND	Signal ground
6	DSR	Not used in Spectrometer
7	RTS	Request to send (from computer)
8	CTS	Clear to send (from Spectrometer)
9	RNG	Not used in Spectrometer

The pin assignments above are mapped one-to-one between the cable connection of a SM302 Spectrometer and an IBM-AT style serial communications port.

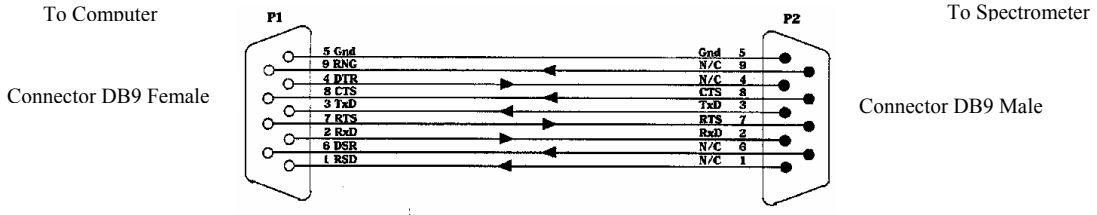

Figure 1. Spectrometer to AT 9 Pin Serial

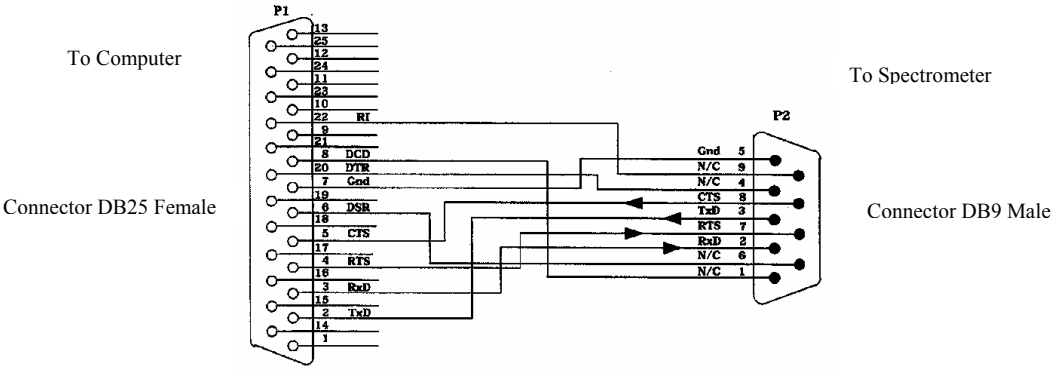

Figure 2. Spectrometer To PC 25-Pin Serial Port

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3.2 SM302 Spectrograph Optical Layout

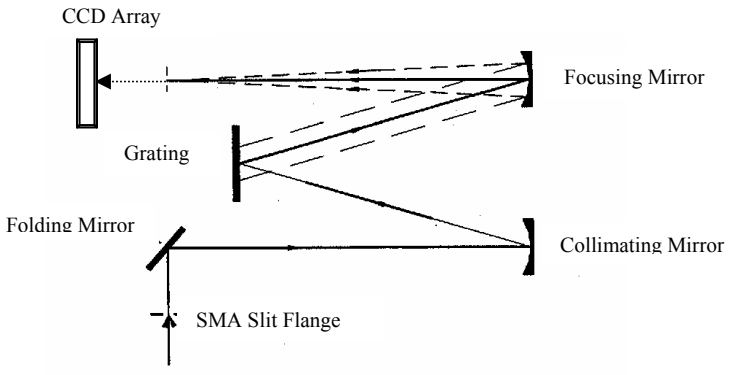

Figure 3 SM302 Optical Path

3.3 SM302 Spectrometer Wavelength Ranges.

The grating angle is restricted to angles between 0 to 70 degrees. The upper restriction is imposed because the grating is almost edge-on to the incident beam beyond this angle. From these restrictions, one may use the grating equations to calculate the valid ranges and step sizes for any particular grating. The table below lists the maximum wavelength for each grating set in the Spectrograph's software.

UPPER WAVELENGTH SCAN LIMIT AND MAXIMUM WAVELENGTH INCREMENTS PER ANGULAR STEP FOR DIFFERENT GRATINGS
(Lower wavelength scan limit is zero)

Grating	**Upper Limit**
Grv/mm	nm
1200	1500
600	3000
300	6000
150	12000
75	24000
50	36000
45	40000

3.4 Using the LPF 1300 Filter

On the SM302 **Extended** models it might be necessary to use the LPF 1300 filter. Mounted on the side of the unit is a black knob with an In and Out position. The LPF 1300 will filter out any first or second orders below 1300nm (**IN** position). With the LPF 1300 filter in the **OUT** position the LPF 900 filter will filter any first or second orders below 900nm.

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3.5 Slit changes

The standard slit size of the SM302 is 50µ. The slit is located in the back of the housing of the SMA flange on the SM302 entrance. If a different slit size is preferred you must order the new slit by contacting Spectral Products Spectral Products Group at (505) 296-9541.

The replacement slits are shipped mounted on a paddle assembly. The paddle will fit in the back end of the SMA flange. The following are steps necessary to install your new slit:

Warning: ***Remove power from the Spectrometer and disconnect cables from the Camera.***

1.) Remove the four 4-40 screws from the SM302 hood and remove. *For the **Extended** version you must first remove the LPF1300 knob by loosening the bottom set screw. Please make note of the orientation of the knob before removing.*
2.) Remove the two 4-40 screws from the front face of the SMA Flange. Remove flange and existing slit paddle.
3.) Place SM302 on its side with the entrance face up.
4.) Carefully place the new slit paddle in the slot that is located on the back of the SMA flange.
5.) Place SMA flange on the SM302 entrance and secure with the two 4-40 screws.
6.) Reverse process for the hood replacement.

3.6 Grating Change

The SM302 must be returned to the factory for graing addition / change.
Please contact Spectral Products Spectral Products Group at (505) 296-9541 for a RGA number.

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Appendices

A. SM302 /SM302 Power Supply Block Diagram

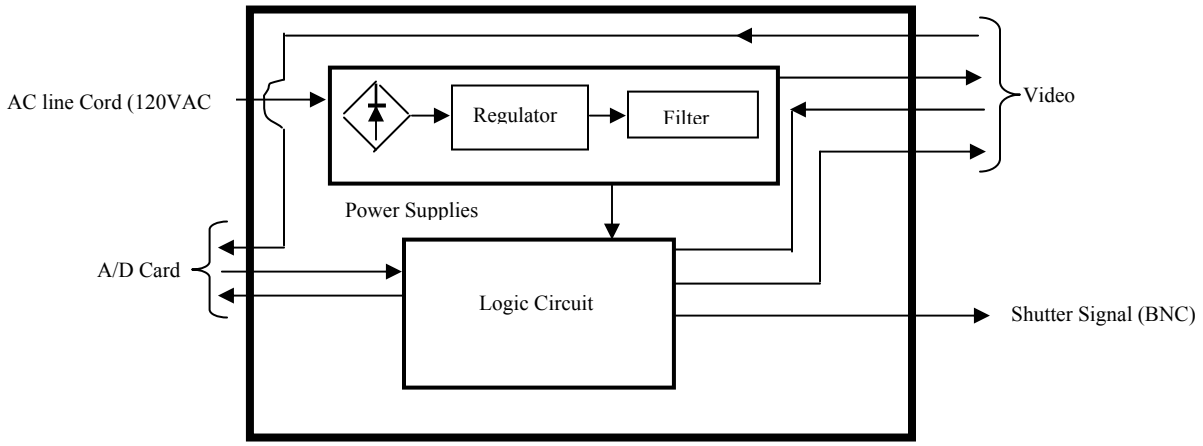

Figure 4. Power Supply interface box block diagram.

B. SM302 Power Supply Jumper Configuration

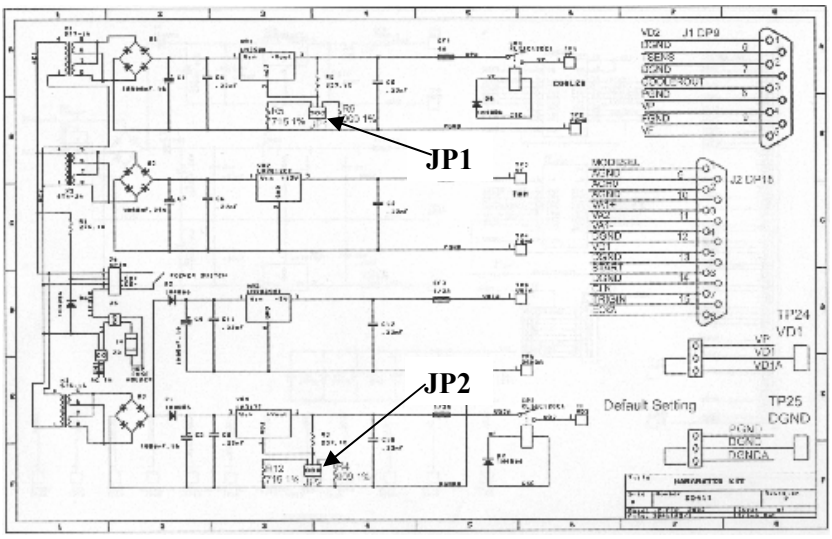

Figure 5 Hardware Jumper setting for SM302 Power Supply

To set power supply to run the SM302 standard, jumper to R12 is set for 5V (**JP1**). To set the SM302 Extended, jumper R4 is set for 6V (**JP2**).

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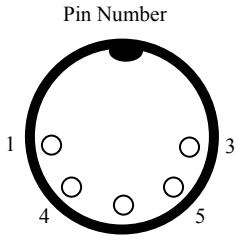
C Spectrometer Power Supply

Pin	Dual
1	Common
2	Common
3	+5.0V Imin 0.5A Imax 7.0A
4	Common
5	+15V Imin 0.1A Imax 3.0A



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C. Grating Selection

Grating groove/mm	Peak (nm)	Bandwidth (nm)	Resolution (nm)	Status
600	1200	126	< 1	INCLUDED SM302
	1600	113		INCLUDED SM302-EX
	1850	97		special order
	2500	70		special order
300	1200	280	< 2	special order
	1700	270		special order
	2000	260		STOCK
	2500	250		STOCK
150	1250	580	4	STOCK
	2000	570		special order
	2500	560		special order
75	1700	1170	8	STOCK
	2000	1170		special order
	2500	1160		special order
45	1750	1970	13	STOCK

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