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Operating Instructions
for
Acton Research Corporation
SpectraPro DSP-300i
Double Monochromator

Ver 2.0

DSP-300i Double Monochromator
Operating Instructions

I.   Description:

The Acton Research Corporation DSP-300i is a double monochromator consisting of two SP-300i monochromators specially set-up in series and mounted to a common baseplate. The exit slit of the first monochromator is the entrance slit of the second monochromator. The two monochromators are synchronized through a serial link which operates at a much faster data transfer speed that the RS-232 port. Control of the double monochromator is through the RS-232 port or GPIB port of the "master" monochromator, labeled "Monochromator A", or the monochromator to which the light source is attached. The "slave" monochromator, or the monochromator to which the detector is attached, is labeled "Monochromator B" and receives all of its commands from the master. The two monochromators may be operated independently, if desired, by redefining the double monochromator status in software as described in the commands on the following pages.

II.   Installation:

The DSP-300i monochromator is shipped fully tested and assembled except for interconnecting cables. Connect the serial link cable between the two 15 pin serial connectors (Ser. Link) on each of the two monochromators. Connect each of the two power supply modules to the two 6 pin power connectors on the rear of the DSP-300i. These power supplies are interchangeable. If communicating with the DSP-300i by RS-232, connect the serial cable provided between the RS-232 port on the master monochromator or "Monochromator A" and the com1 or com2 port on a PC compatible computer. If communicating with the DSP-300i by GPIB, connect the user supplied or optional GPIB cable between the GPIB connector on the master monochromator and the GPIB controller in the computer.

III.   Double Monochromator Operation:

To begin operation of the DSP-300i, connect each power supply to the line voltage and turn on both power supplies. The monochromators should be turned on simultaneously or the master monochromator should be turned on first. After initialization, the DSP-300i may be controlled from the RS-232 port or the GPIB

port of the master monochromator using the standard commands of the SP-300i with additional commands for control of the individual monochromators when connected as a double. Refer to the SP-300i instruction manual for a complete description of single monochromator operation and a description of the standard command set.

Commands can be sent as single commands or grouped in strings of commands. All commands are single words (contain no spaces) and all commands in a string are separated by at least one space. Parameters, if needed, precede the command and are separated from the command by at least one space (e.g. 546.7 GOTO).

For RS-232 operation, the port set-up is 9600 baud, 8 data bits, 1 stop bit and no parity. All commands or strings of commands must be terminated with a carriage return (0D hex). The SpectraPro responds to a command when the command has been completed by sending the characters OK followed by carriage return and line feed (hex ASCII sequence 20 6F 6B 0D 0A). The default condition is to echo each character that is set to the SpectraPro.

When using the IEEE-488 or GPIB interface, the default device address is 11. The device address can be set to any value from 1 to 30 using the command **SET-ID.** The command **?ID** is used to read back the IEEE address. Each command or string of commands must be terminated with a carriage return (0D hex). When sending a command or string of commands, it is important to wait for the SpectraPro to complete the processing of that command string before sending another command. This is accomplished by checking the status byte. The SpectraPro controls bits in the IEEE-488 status byte which can be read from the IEEE-488 controller. The command for reading this status byte will be unique to your IEEE controller. For example, with National Instrument controllers, the command is IBRSP. With CEC controllers, the command is SPOLL.

IEEE-488 Status Byte Bits:
        Bit 0 0 = command is being processed
                1 = SpectraPro ready for another command
        Bit 1 0 = no errors
                1 = SpectraPro detected an error in the command
        Bit 7 0 = no response or response has been read
                1 = SpectraPro generated a response which is now ready to be sent

Note that with some fast computers, it is necessary to add a few milliseconds delay in your porgram after sending a command and before checking the status byte to allow time for the status byte to be updated.

Monochromator Wavelength Movement Commands:

GOTO   Goes to destination wavelength at maximum motor speed. Accepts destination wavelength in nm as a floating point number with up to 3 digits after the decimal point or whole number wavelength with no decimal point.

                    e.g. 322.123 GOTO

<GOTO>   Same as GOTO

NM   Goes to destination wavelength at constant nm/min rate specified by last NM/MIN command. Accepts destination wavelength in nm as a floating point number with up to 3 digits after the decimal point or whole number wavelength with no decimal point.

<NM>   Same as NM

>NM   Similar to the **NM** command except it returns control to user immediately rather than waiting for completion of monochromator wavelength move. Can be used with **?NM** or **MONO-?DONE** below. This command must be terminated with the **MONO-STOP** command listed below.
Note: Use the **NM** command when communication with the monochromator during the scan is not required.

?NM   Returns present wavelength in nm to 0.01nm resolution with units nm appended.

                    e.g. ?NM   300.00 nm

MONO-?DONE   Used with >NM command to determine if monochromator has reached the destination. Returns 0 if move is not complete, 1 if move is complete.

MONO-STOP   Stops the monochromator wavelength wavelength move after use of the **>NM** command and terminates the **>NM** command.

NM/MIN   Specifies scan rate for NM and <NM> commands. Range
              0.01 to 1000 nm/min for 1200 g/mm grating. Accepts rate as
              a floating point number with up to 2 digits after the decimal
              point or whole number with no decimal point.
                  e.g. 10.05 NM/MIN
              Maximum value for any grating = 8000 nm/min.

?NM/MIN   Returns present scan rate in nm/min to 0.01 nm/min
              resolution with units nm/min appended.
                  e.g. ?NM/MIN   100.00 nm/min.

Grating Control Commands:

GRATING   Places specified grating in position to the wavelength of the
              wavelength on the present grating. Up to 9 gratings are
              allowed on 3 turrets. This command takes a grating number
              from 1 - 9.   IMPORTANT NOTE: This command
              assumes that the correct turret is specified by the TURRET
              command. For example, using grating numbers 1, 4 and 7
              will place the first grating on the installed turret into that
              position and call up the parameters for the grating number
              specified.

?GRATING   Returns the number of the grating presently being used
              numbered 1-9.

?GRATINGS Returns the list of installed gratings with position groove
              density and blaze. The present grating is specified with an
              arrow.

TURRET   Specifies the presently installed turret or the turret to be
              installed.
                  e.g. If installing the second turret, issue the command
              2 TURRET to insure using the correct parameters.

?TURRET   Returns the currently installed turret number 1-3.

The following command is used for grating installation by ARC part#.

INSTALL   Installs new grating parameters into the non-volitile memory of the SpectraPro monochromator. Uses the part# of the grating to specify the parameters.

                    e.g. 1-120-500 5 INSTALL places a 1200 g/mm grating blazed at 500nm into the second grating position on turret #2.

The following commands are used for grating installation by grating parameters.

SELECT-GRATING   Specifies the grating number to be installed 1-9.

G/MM   Specifies groove density of grating to be installed in g/mm.
                    e.g. 1200 G/MM

BLAZE   Specifies the blaze wavelength and units of the grating to be installed with 7 characters of the user's choice. Unlike other commands, this command is issued before the parameters. After the command is issued, the SP-300 responds with "_____" . Seven characters are then entered (these may be numbers, letters, spaces or special characters).

UNINSTALL   Used to remove a grating and its parameters from the SP-300 non-volatile memory.

Diverter Control Commands:

EXIT-MIRROR   Designates the exit diverter mirror to receive the diverter control commands. This command is for SpectraPro monochromators which can accept two diverter mirrors. The SP-300 monochromators will accept this command but it is not required in these monochromators.

ENT-MIRROR   Designates the entrance diverter mirror to receive the diverter control commands. This command is for SpectraPro monochromators which can accept two diverter mirrors. The SP-300 monochromators will not accept this command.

FRONT   Moves the designated diverter mirror to position the beam to the front port position.

SIDE   Moves the designated diverter mirror to position the beam to the side port position.

?MIRROR   Returns the position of the designated diverter mirror with the responsed " front" and "side".

?MIR   Returns the position of the designated diverter mirror with the responses 0 for front and 1 for side.

Slit Width Control Commands:

FRONT-EXIT-SLIT   Designates front exit slit to receive slit control commands. Note: the designation remains in effect until changed by another slit designator; this command does not have to be repeated until the designated slit is changed.

SIDE-EXIT-SLIT   Designates side exit slit to receive slit control commands.

FRONT-ENT-SLIT   Designates front entrance slit to receive slit control commands.

SIDE-ENT-SLIT   Designates side entrance slit to receive slit control commands.

MICRONS   Sets the slit width for the designated slit in the range of 10 to 3000 microns to 1 micron resolution.

?MICRONS   Returns the slit width setting in microns to the nearest 1 micron.

SHOME   Sets the motorized slits to the initialization slit setting. This is 10 microns for the continuously variable slits and 50 microns for the indexable slits.

Grating Calibration Commands:

INIT-OFFSET   Sets offset value for the designated grating. Default values are 0 for gratings 1, 4, and 7; 1536000 for gratings 2, 5 and 8; and 3072000 for gratings 3, 6 and 9. The limits on the settings are +/- 2500 for a 1200 g/mm grating. This corresponds to an error of greater than +/- 5nm for a 1200 g/mm grating. The limits are adjusted for grating groove density e.g. error for a 600 g/mm grating is +/- 5000. The grating designator used with this command is grating# - 1
         e.g. 3072056. 8 INIT-OFFSET for setting offset on grating #9 - 3rd grating on turret #3.
Note that this command requires a decimal point after the offset value.

INIT-SP300-OFFSET   Same as INIT-OFFSET above except no decimal point is used after the offset value.
         e.g.   3072056 8 INIT-SP300-OFFSET

INIT-GADJUST   Sets grating adjustment value for the designated grating. Default values are 10000 for all gratings. The limits on the parameter for this command are +/- 1000 for all gratings. The grating designator used with this command is the grating# - 1.
         e.g. 9993 1 INIT-GADJUST   for setting gadjust on the second grating of turret #1.
Note: this command is to maintain compatibility with previous SpectraPro applications. For new appliations, use the
INIT-SP300-GADJUST command below.

INIT-SP300-GADJUST   Sets grating adjustment value for the designated grating. Default values are 1000000 for all gratings. The limits on the parameter for this command are +/- 100000 for all gratings. The grating designator used with this command is the grating# -1.
         e.g. 999322 4 INIT-SP300-GADJUST
for setting gadjust on the second grating of turret #2.

MONO-EESTATUS   Returns setup and grating calibration parameters for all gratings.

RESTORE-FACTORY-SETTINGS Returns all parameters including grating calibration parameters to the original factory calibrated settings. Note that this command will overwrite any calibration parameters set by the user.

MONO-RESET Initializes SpectraPro monochromator. Necessary after using INIT-OFFSET, INIT-GADJUST or INIT-SP300-GADJUST.

HELLO Same as MONO-RESET. Used to maintain compatibility with existing applications.

MODEL Returns model number of SpectraPro monochromator.
e.g. MODEL   SP-306

SERIAL Returns serial number of SpectraPro monochromator. Format is 7 digits with first 3 digits the model#.
e.g. SERIAL   3060232

The following are the Start-Up parameters and their default values:
Default Values:

TURRET	#1
GRATING	#1
WAVELENGTH	0.0 nm
SCAN SPEED	100.0 nm/min

INIT-GRATING Selects which of the three gratings on the installed turret the SpectraPro will go to after finding 0.0 nm on the first grating of the installed   turret.
e.g. 2 INIT-GRATING   selects the second grating as the default.
Accepts values 1-9.

INIT-WAVELENGTH Sets an initial wavelength for the SpectraPro after initialization. e.g. 435.84 INIT-WAVELENGTH

INIT-SRATE Sets an initial scan rate for the SpectraPro.
e.g. 500.0 INIT-SRATE

The special commands and notes on standard commands are described below.

The commands **GOTO, <GOTO>, NM, <NM>, NM/MIN, GRATING**

all control both the master and slave monochromators simultaneously. When using the NM and <NM> commands, a slight delay may be noticed at the end of the monochromator move to synchronize the monochromator positions.

The remaining commands in the standard instruction set control the master monochromator only. In some cases, such as the **?GRATING, ?GRATINGS** and **?NM** commands the results will, by default, apply to both monochromators. When it is necessary to use the other commands such as the grating installation commands or calibration commands for the slave monochromator, move the RS-232 cable or GPIB cable to the slave monochromator port or attach an additional cable to the desired slave port. The individual commands will then affect only the slave monochromator.

In addition, there are the following special commands which allow control of the individual monochromators in the double. The monochromator to receive the command is specified by the commands **MONO1** for the master (labeled "Monochromator A") or **MONO2** for the slave monochromator (labeled "Monochromator B").

{GOTO}	Same as GOTO for the separate monochromators. This allows positioning the monochromators to different wavelengths. e.g. MONO2 200 {GOTO} will position the slave monochromator only to 200nm
{NM}	Same as NM for separate monochromators. This allows scanning one monochromator while the other is at a fixed wavelength. e.g. MONO1 500 NM will scan only the master monochromator.
{GRATING}	Same as GRATING for separate monochromators. This allows positioning and scanning monochromators with different gratings selected in each. Note that while the desired wavelength will be as specified in both

monochromator   after a move, tracking during the move is
not   guaranteed if different gratings are used.

{?GRATING}	Same as ?GRATINGS for separate monochromators

{TURRET}	Same as TURRET for separate monochromators
{?TURRET}	Same as ?TURRET for separate monochromators
{INIT-DOUBLE}	Used to set the double monochromator status

{INIT-DOUBLE} Used to set the double monochromator status
  0 not a double
  2 slave
  3 master
     e.g. 3 INIT-DOUBLE sets the
          monochromator to be the master in a
          double setup

{?EEDOUBLE} Returns the double status as defined above

{DOUBLE-RESET} Resets both monochromators

{?EEOPTIONS} Returns the type and position of diverter mirrors
and slits for each monochromator.
The options variable is a six digit number with
the following digit designations:
1st digit (msd) mirror status
        0 - no motorized mirrors
        1 - motorized exit mirror only
        2 - motorized entrance mirror only
        3 - motorized entrance and exit mirrors
2nd digit - side entrance slit status
3rd digit - front entrance slit status
4th digit - front exit slit status
5th digit - side exit slit status
        0 - no slit or adapter installed
        1 - manually adjustable slit
        2 - fixed slit
        3 - focal plane adapter
        4 - motorized slit - continuously variable
        5 - fiber optic adapter
        6 - motorized slit - indexable
6th digit - not assigned
e.g. 140160 would designate a monochromator
with a motorized exit mirror, a side entrance
continuously variable motorized slit, no front

entrance slit, a manually adjustable front exit
slit   and a motorized indexable side exit slit.

The commands MONO1 and MONO2 also are used with all of the standard
diverter and slit commands listed above. For example MONO2 SIDE-ENT-SLIT
50 MICRONS would move the motorized side entrance slit on monochromator 2
to 50 microns.

IV.   Removal of the Monochromators from the Base Plate:

The following procedure is recommended for removing the monochromators from
the base plate:

1.   Assure power is "Off" on both monochromator power supplies.
2.   Disconnect all cables attached to both monochromators.
3.   Remove any accessories attached to the exit slit of the slave
       monochromator (monochromator "B").
4.   Locate on the bottom side of the base plate three 10-32 socket head
       cap screws that secure monochromator "B" to the base plate.
       Remove these three cap screws.
5.   Very carefully lift monochromator "B" straight up 1/8" (3mm), move
       it away from monochromator "A" approximately 1/2" (13mm) and
       then remove it completely from the base plate.
6.   If desired, monochromator "A" can be removed from the base plate.
       Remove the three cap screws securing it to the base plate. Remove
       monochromator "A".