

Details about Programming the PTR CB-3 at Station 7 for Wavelength Scans

A. Setting the Scan Rate

The CB-3 stepper motor controller sets the scan rate of the mini-chrom SDMC1-03 monochromator by controlling the step rate of a 0.9 degree-per-step stepper motor (800 steps/rev). For the -03 monochromator, there are 50 nm/rev or 0.0625 nm/step.

The desired scan rate can be calculated from equation 1

$$R \text{ (nm/min)} = 3.75 (V/D) \quad (\text{eq. 1})$$

where V is the basic velocity and D is a divider. Values for common scan rates are shown in Table A.

Table A. Parameters for scan rates using the CB-3

Scan Rate (nm/min)	V (steps/s)	D (divider)
1	40	150
5	40	30
10	80	30
25	40	6
50	40	3
100	80	3
150	40	1
200	160	3
500	400	3
Slew	1000	1

B. Programming the CB-3 stepper motor controller for wavelength scans.

The CB-3 is programmed by sending commands from a computer over an RS-232 serial line. You will operate the controller in command mode issuing commands from a PC which is running in the STEPPER MOTOR CONTROL or TERMINAL mode.

Boot up the computer, select the TERMINAL icon from the CH 461 folder. Now, turn the power on to the CB-3 and strike any key on the keyboard. Something similar to the following should appear on the screen:

V2.07

If not, contact the instructor. Once communication with the controller has been established you can begin to send commands. The first command that needs to be sent is **E2**. This command energizes the motor and prepares it to move (this needs to be done every time you power up the CB-3). Commands are simply issued by typing them on the keyboard and hitting enter. Examples of the commands you will use most often are listed in table B.

Table B. Important commands for the CB-3 Stepper Motor Controller

COMMAND	DESCRIPTION
F1000,0 Find Home	Scan to the low wavelength mechanical stop with V=1000 (slew). This position corresponds to the low limit wavelength listed in the monochromator specs (e.g., -40 nm).
+ # Step positive (decrease wavelength)	The stepper motor will step the desired # of steps away from the current position.
- # Step negative (increase wavelength)	Same as above only steps are in the negative direction.
V # Basic velocity	Sets the stepping velocity (see part I of this handout).
D # Divider	All stepping speeds will be divided by this number. Used in determining the stepping velocity (see part I).
K # Ramp	Set the velocity ramp rate (usually 0)
O # Set origin	Sets the origin. We will usually set the origin to the zero order of the monochromator.
X Examine	Prints the current scan parameters on the CRT screen.
Z Read position	Returns the current value of the position counter.
E2 Energize	Energizes the stepper motor. This command needs to be entered before the stepper motor can be told to move.

E3 De-energize	De energizes the stepper motor coils - This command should be executed whenever the motor is going to sit for long periods of time to prevent overheating.
ESC Escape key	Abort current command, or scan. Returns a "#".

To use the CB-3 to choose a wavelength or do a calibrated wavelength scan, the following information must be known. First, the step resolution of the monochromator is 0.0625 nm/step. This means that each step of the stepper motor will cause the monochromator to change its peak output wavelength by 0.0625 nm. This also means that there are 16 steps/nm. Thus, to step 10 nm away from the current position requires exactly 160 steps of the stepper motor. Also, the direction of the stepper motor is opposite the change in wavelength (e.g. Moving from zero to 100 nm is -1600 steps).

Next, the location of the zero order of the monochromator must be determined so that the position corresponding to 0 nm is known. Fortunately, this position should have already been determined, and be written on a label on the monochromator (e.g. ~20 nm, -330 steps). The position of the zero order is referenced to a known point- the low wavelength mechanical stop. Thus, to move the monochromator in the above example to its zero order, type the following commands:

F1000,0 Find Home (low wavelength)

-330 Move 330 steps in the – direction (longer wavelength)

A white light image of the slit should now be visible at the focal point in the cell. If this is not the case, something is wrong. This position is the reference point for all subsequent wavelength scans.

To choose a specific wavelength

To calculate the number of steps from the zero order position, use

$$\# \text{ of steps} = - (16 \text{ steps/nm}) \times \lambda(\text{in nm})$$

For example, to move the monochromator to 500 nm, you need to tell it to go -8000 steps (500 nm X 16 step/nm) from the zero order position .

Table C. The position of the stepper motor of the monochromator relative to the zero order for several wavelengths.

WAVELENGTH (nm)	POSITION
250	-4000
300	-4800
350	-5600
375	-6000
500	-8000
700	-11200

To do a wavelength scan with Terminal:

For a wavelength scan, go to zero order, go to the starting wavelength, set the scan parameters (V and D) for the desired scan rate, and choose the number of steps to go to the end wavelength.

To do a wavelength scan with Monochromator:

Set the Initial Wavelength: Enter a starting wavelength (resolution 0.125 nm) in the *Initial λ* box, and then click *Go to Initial* to send the monochromator to the starting wavelength. Do this at the start of each scan.

Prepare to Scan: Enter an ending wavelength in the *Final λ* box and select a *Scan Rate*, and click *Begin Scan*.

Cancel Scan: This button is available during a scan. Press it to stop the current monochromator operation immediately.

Save Plot: (bottom of display window) Click to write the output file and name it.

Other settings in Monochromator:

Channel to Plot: (bottom of display window) We will use channel Dev1/ai0 (channel zero on the interface connector box); other channels are available.

Voltage Range: (bottom of display window) Selects for the Full Scale setting on the ADC board. +/- 200 mV; +/- 1 V; +/-5 V and +/- 10 V are available. The resolution of the signal changes with this setting

Run Notes: (bottom of display window) Place for comments that are included when the data are saved to the output file.

Zero Offset: Enables operator to make small adjustment to the monochromator position (scroll arrows) and change the zero offset value when recalibrating zero order.

Set New Zero Offset: After optimizing white light signal, input the step number for the true zero order position (000 nm) in the box called zero offset then close the program and reopen it. The new zero order offset value should be displayed (and it is stored in the OFFSET.DAT file).