Model 789A-3 Scan Controller

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Section 1
INSTALLATION

1.1 Selecting or Checking Power Setting for Model 789A-3

1. Disconnect power cord from the unit.

2. Locate the power connection and fuse area on the rear panel of the Model 789A-3.

Fuse

Voltage
Selection Card

Fuse Pull lever

Sliding plastic
cover
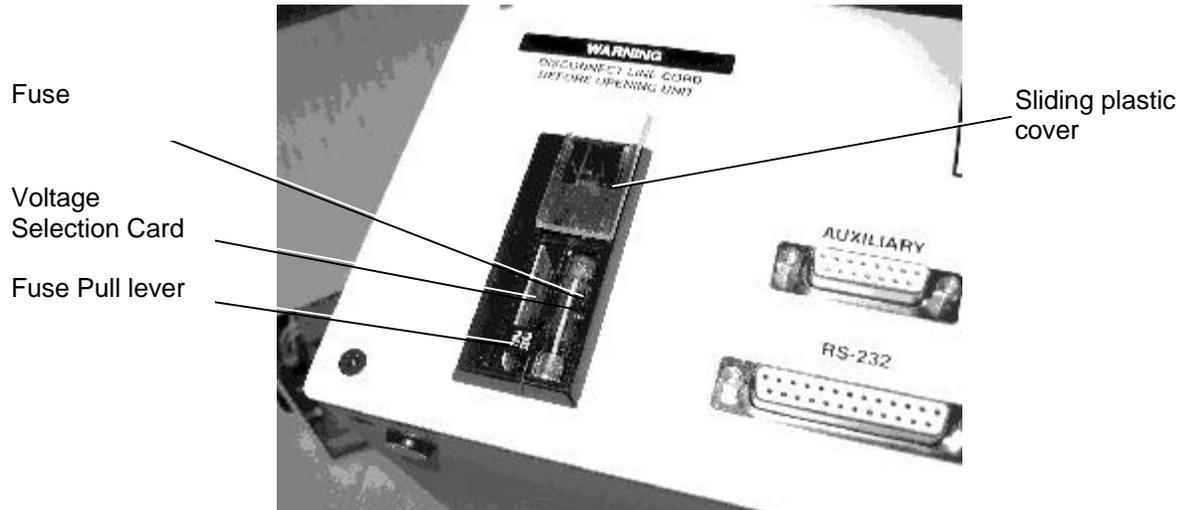
3. Identify the fuse, fuse pull lever and circuit card all mounted close together under the sliding plastic cover. See photo above.

4. By pulling the fuse pull lever up, the fuse can be removed. The fuse must be removed in order to pull out the circuit card to check or change the power setting.

5. There are four possible positions for the card. See example below for proper card orientatin for 220 V operation.

6. If known, we will set the power to local convention prior to shipment.

EXAMPLE: With the fuse viewed as below, the operating voltage will appear through a small notch, once the voltage selection card is installed.
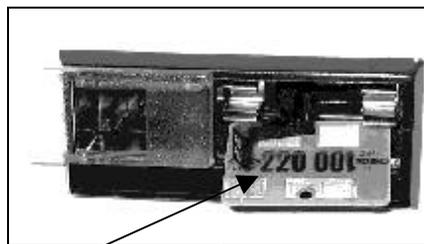
This example is for 220V operation.

1.2 Connections

Make all connections as shown in the diagram below.

WARNING!

NEVER ATTEMPT TO DISCONNECT OR RECONNECT ANY CABLING WHILE POWER IS APPLIED.

FAILURE TO OBSERVE THIS PRECAUTION WILL DAMAGE THE DRIVER CIRCUITRY AND VOID YOUR WARRANTY!

WARNING
Never attempt to disconnect or re-con-nect the Stepper motor while the "MOTOR" switch is in the "ENABLE" mode. Failure to observe this precaution will damage the driver circuitry and void your warranty!

| Power Input | RS 232 Port | Limit Switches | Stepping Motor |
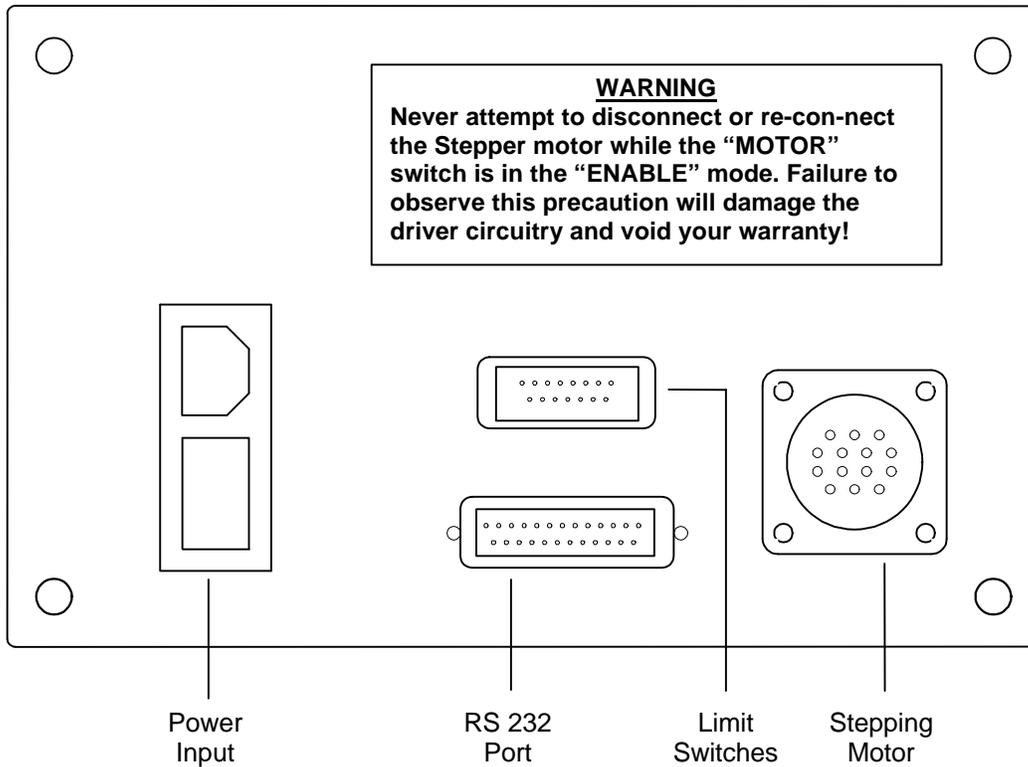
Model 789A-3 Controller - Rear Panel

Section 2
EXPLANATION OF CONTROLS
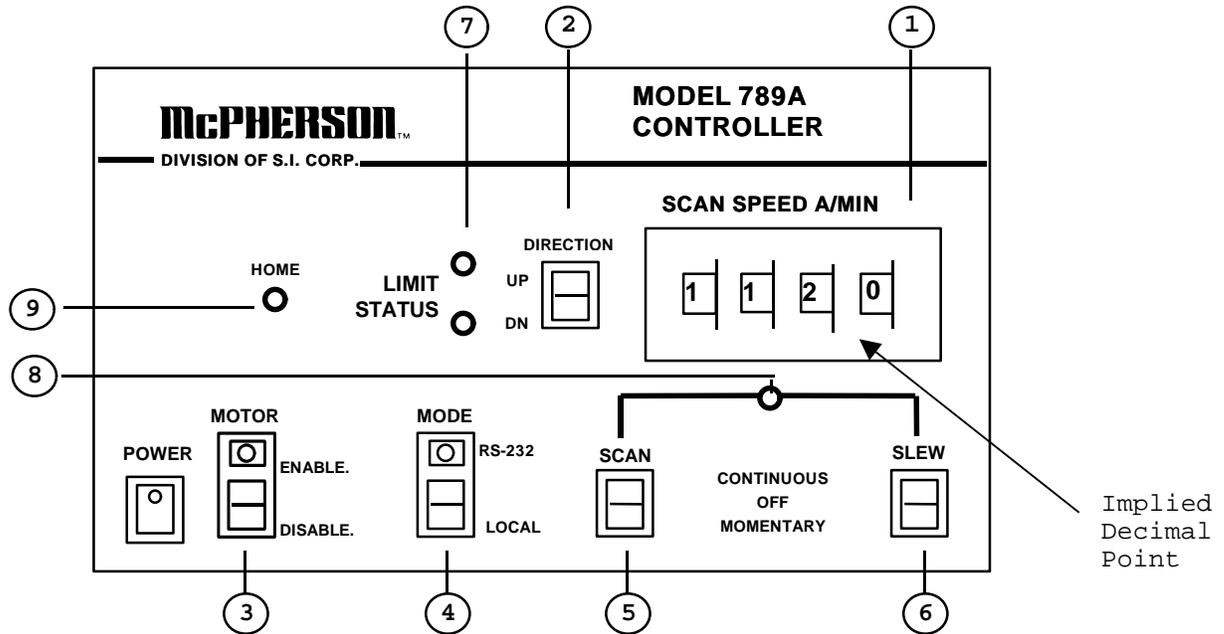
1	Scan Speed	4 position thumb wheel switch allows operator to select any scanning speed between .1 to 999.9 angstroms per minute for most instruments based on DIP Switch setting for grating selected. **NOTE:** Switch setting above is read as "112.0" A/Minute
2	Direction	Allows operator to select direction of "Scan" and/or "Slew".
3	Motor	Engages stepper motor when "Enabled" for scanning and disengages motor when "Disabled" if manual adjustment of wavelength is desired.
4	Mode	Selects scanning from either front panel controls or computer control via the RS232 port located on the rear panel.
5	Scan	Allows operator to continuously or momentarily scan the monochromator at scan speed selected on the thumb wheel switch.
6	Slew	Allows operator to continuously or momentarily override the scan switch, causing the motor to rotate at the maximum allowable velocity (set at factory).
7	Limit Switch Status	Dual colored LED's for high and low limits. LED will show green if limit switches are operating normally. LED will show red if limit is engaged or not connected properly.
8	Scan Status	Lights when motor is in motion from Local or RS232 operation.
9	Optional Home Switch	Lights when optionally installed "Home" switch is detected.

Section 3
GRATING SELECTION

1. Disconnect AC power from controller.

2. Remove the four screws from the top panel.

3. Remove top panel.

4. Locate the model monochromator with its grating on the table below and continuing on page 3-2. Notes are explained on page 3-3.

5. Set S1 on the controller board per the table.

6. Replace the top panel and its screws.

7. Apply power to controller.

789A-3 Grating Selection Table

Monochromator Model	Grating G/MM	nM /MOTOR REV	Å /MOTOR REV	8	7	6	5	4	3	2	1	Notes
	150	40	400	1	1	0	0	0	1	1	1	(1)
205, 207, 209,	300	20	200	1	1	0	0	0	1	1	1	
216.5, 218, 219,	600	10	100	0	1	1	0	0	0	1	1	
231, 235, 2051,	1200	5	50	0	0	1	1	0	0	0	1	
2061, 2062, 2062M3,	1800	3.33	33.3	0	1	1	0	0	0	1	1	(2)
	2400	2.5	25	0	0	0	1	1	0	0	0	
	3600	1.66	16.6	0	0	1	1	0	0	0	1	(3)
	100	120	1200	1	1	0	0	0	1	1	1	(8)
	150	80	800	1	1	0	0	0	1	1	1	(4)
	300	40	400	1	1	0	0	0	1	1	1	(5)
2035, 275D, 275	600	20	200	1	1	0	0	0	1	1	1	
	1200	10	100	0	1	1	0	0	0	1	1	
	1800	6.66	66.6	1	1	0	0	0	1	1	1	(2)
	2400	5	50	0	0	1	1	0	0	0	1	
	3600	3.33	33.3	0	1	1	0	0	0	1	1	(3)

Model 789A-3 Scan Controller

789A-3 Grating Selection Table (continued)

Monochromator Model	Grating G/MM	nM /MOTOR REV	Å	8	7	6	5	4	3	2	1	Notes
272 (Note 13)	570	12.5	125	0	0	1	1	0	0	0	1	(14)
	1140	25	250	0	0	0	1	1	0	0	0	
	1710	37.5	375	1	1	0	0	0	1	1	1	(15)
	2280	50	500	0	0	1	1	0	0	0	1	
225, 241, 2253M5	150	20	200	1	1	0	0	0	1	1	1	
	300	10	100	0	1	1	0	0	0	1	1	
	600	5	50	0	0	1	1	0	0	0	1	
	1200	2.5	25	0	0	0	1	1	0	0	0	
	1800	1.66	16.6	0	0	1	1	0	0	0	0	(2)
	2400	1.25	12.5	0	0	0	1	1	0	0	0	(6)
	3600	0.83	8.3	0	0	1	1	0	0	0	1	(3)
X-RAY CZERNEY-TURNER (XCT)	100	12	120	0	1	1	1	0	1	1	1	
	150	8	80	0	1	0	0	1	1	1	1	
	300	4	40	0	0	1	0	0	1	1	1	
	600	2	20	0	0	0	1	0	0	1	1	
	1200	1	10	0	0	0	0	1	0	0	1	
	1800	0.66	6.6	0	0	0	1	0	0	1	1	(2)
	2400	0.5	5	0	0	0	0	1	0	0	1	(9)
	3600	0.33	3.3	0	0	0	0	1	0	0	1	(3)
302	150	0.25	2.5	1	1	0	0	0	1	1	1	(1)
	300	0.5	5	1	1	0	0	0	1	1	1	
	600	1	10	0	1	1	0	0	0	1	1	
	1200	2	20	0	0	1	1	0	0	0	1	
	1800	3	30	0	1	1	0	0	0	1	1	(2)
	2400	4	40	0	0	0	1	1	0	0	0	
	3600	6	60	0	0	1	1	0	0	0	1	(3)
608 Pre-Disperser	N/A	10	100	0	1	1	0	0	0	1	1	
248/310G	ALL	0.1 INCH		0	0	0	1	0	0	1	1	(7,10)
247	ALL	0.025 INCH		0	0	1	1	0	0	0	1	(7,11)
Motorized Slit	N/A	25 MICRONS		0	0	0	1	1	0	0	0	(12)

789A-3 Grating Selection Table **(Notes)**

(1) Set to 300 G/mm selection and multiply selected speed by 2.

(2) Set to 600 G/mm selection and divide selected speed by 3.

(3) Set to 1200 G/mm selection and divide selected speed by 3.

(4) Set to 600 G/mm selection and multiply selected speed by 4.

(5) Set to 600 G/mm selection and multiply selected speed by 2.

(6) Set to 1200 G/mm selection and divide selected speed by 2.

(7) 789A-3 motor resolution set to 18,000 steps/revolution.

(8) Set to 600 G/mm selection and multiply by 6.

(9) Set to 1200 G/mm selection and multiply selected speed by 2.

(10) 789A-3 Scan Speed Setting of 1-0-0-0 = 1 inch/minute

(11) 789A-3 Scan Speed Setting of 1-0-0-0 = 0.1 inch/minute

(12) 789A-3 Scan Speed Setting of 1-0-0-0 = 100 Microns/min. [English Scale (25 Microns/rev.]

(13) Disregard implied decimal point for Model **272** **ONLY.**

(14) Set to 1140 G/mm selection and multiply selected speed by 2.

(15) Set to 1140 G/mm selection and divide selected speed by 1.5.

Section 4
OPERATION

4.1 Manual Mode

1. Set mode switch to "local".
2. Set motor switch to "enable".
3. Select direction of scan.
4. Select scan speed.

NOTE: 1000 on thumb wheel switch = 100.0 Å/min.
0010 on thumb wheel switch = 1.0 Å/min.

5. Place scan switch in the "continuous" position. Monochromator should be scanning at the selected speed.
6. Place scan switch in the center position when scan is completed.

4.2 Computer Mode

1. Refer to the diagram below for correct connections between the 789A-3 and the computer's COM PORT.
2. Set mode switch to "RS232." LED should light.
3. Refer to Section 5 for programming over the RS232 port.
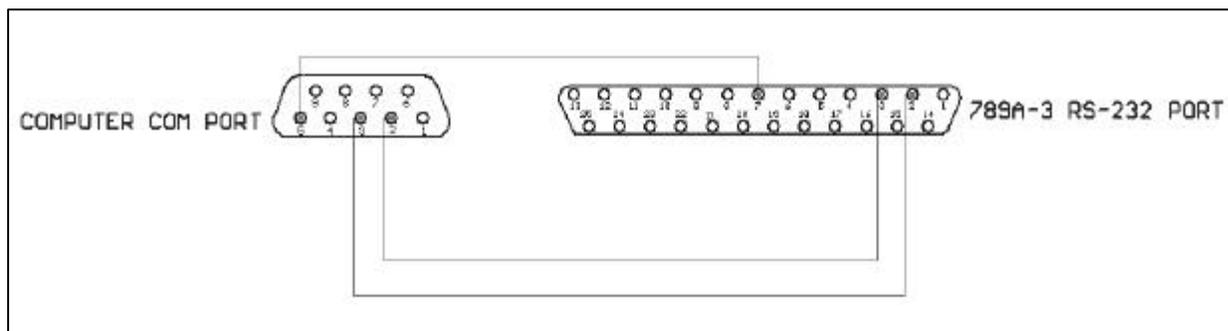
Section 5
PROGRAMMING OVER RS232

5.1 Set-Up

1. Apply power to your computer and select a communication program such as "Hyper-Terminal". Set RS232 parameters as follows:

Baud Rate	=	9600
Parity	=	None
Data Bits	=	8
Stop Bits	=	1
Flow Control	=	X ON / X OFF

Press the spacebar once. If communications have been established, the serial interface will send a "sign on" message (ie: V2.53) in response to the spacebar. The message will be a software Rev. number. The 789A-3 Controller is now in "Command Mode" and ready to accept more instructions.

NOTE:
If the sign on message does not appear, check the following:

a)   Is the 789A-3 powered?
b)   Is the RS232 cable connected to the correct COM PORT?
c)   Are the RS232 Parameters listed earlier set properly?
d)   The most frequent problem is the orientation of the receive (RD) and the transmit (TD) lines of the RS232 connector. For example, the 789A-3 uses a 25 pin "D-Sub" connector. The illustration in Section 4 shows the typical connection between the 789A-3 and the computer's COM PORT.

2.   To calculate how many steps are required to scan from one wavelength to another:

a)   Ending wavelength (-) starting wavelength = scan distance.
b)   Refer to the Grating Selection Table in Section 3 to determine Å/Revolution for your instrument.
c)   Distance in steps = [wavelength distance desired / Å per motor revolution] **X** 36,000 steps.

EXAMPLE: For a Model 2035 Monochromator with a 1200 G/mm Grating:

To scan from 100 Å to 200 Å

1. Scan distance = 200 Å (-) 100 Å = 100 Å
2. Distance in steps = [100 Å / 100 Å per motor revolution] **X** 36,000 = 36,000 steps.
3. Enter "+36000" (CR).

5.2 789A-3 Command Summary

Command			Description	Result(s)
ASCII	DECIMAL	HEX		
[SPACE]	32	20	Initialize	Enables communication with scan controller. This command must be entered first on initial power-up. If using a terminal program, pressing the "space bar" will achieve the same result. The controller will respond with its current software version.
[CR]	13	0D	Carriage Return	This command must follow all commands entered. If using a terminal program, pressing the "Carriage Return" or "Enter" key will achieve the same result.
@	64	40	Soft Stop	Causes deceleration to a stop.
^C	3	03	Reset	(1) Stops motion. (2) Sets counter to "0" (3) Assumes "Idle" state
C1	67	43	Clear	Erases pre-programmed parameters. Only use when an unexplainable scanning error has occurred.
G	103	67	Run Internal Program	Executes a program stored in non-volatile memory after entering [G] followed by the program's starting address.
I	73	49	Starting Velocity	Starting and stopping speed of scan.
K	75	4B	Ramp Slope	Acceleration /deceleration factor. Value less than 127 will result in both acceleration and deceleration having the same slope. Entering 2 values will set the acceleration slope to the first value and the deceleration slope to the second value. Range = 0-255
P	80	50	Enter & Exit Program Mode	Entering P0 through P1000 sets the 789A-3 into internal program mode. See the Programming Sample for more details.

(Continued on next page.)

5.2 789A-3 Command Summary (continued)

Command			Description	Result(s)
ASCII	DECIMAL	HEX		
S	83	53	Save	Stores parameters to non-volatile memory. Should be used if parameters had to be re-entered after "C1" command.
V	86	56	Scanning Velocity	Sets scan speed in steps per second. Range = 36 sps to 60000 sps. **(1)**
X	88	58	Examine Parameters	Sends values of "K", "I", and "V" parameters. Actual values may be slightly different from entered values. This is due to internal calibration to system clock oscillator.
]	93	5D	Read Limit Switch Status	0 = No limit encountered. 32 = Home Limit Encountered. 64 = High limit encountered. 128 = Low limit encountered.
+	43	2B	Index Scan in "Up" Direction	+36000 = Scan 36000 steps in upward direction. This scan usually results in 1 motor revolution. Max. value = 8388600.
-	45	2D	Index Scan in "Down" Direction	-36000 = Scan 36000 steps in downward direction. This scan usually results in 1 motor revolution. Maximum value = 8388600.
^	94	5E	Read Moving Status	0 = No motion detected. 1 = Moving 2 = High in constant velocity. 16 = Slewing - Ramping complete.

(1) Note: See Section 5.5

5.3 Program Entry in Non-Volatile Memory

The following procedure outlines the necessary sequence of commands to store and execute a program from N.V. Memory.

Note: ASCII characters may be entered in either upper or lower case.

To enter a program, press "P" immediately followed by the starting address. It is advisable to start at address 0 the first time. This is because as the program is entered, the memory locations used for different length instructions are automatically assigned. As each instruction is entered and a (CR) or Enter key is pressed, the next available address appears. The difference between this address and the starting address depends on the byte size of the command. When all commands have been entered for a program, the last line must be "[address line] P (CR)". This stores the program and returns control to the command mode. The starting and ending address, together with the user assigned name of the program, should be recorded for later recall and use. To run the program, simply enter "G" immediately followed by the starting address and (CR). The program executes on the (CR) or (Enter) key.

NOTE:
If G (CR) is entered <u>WITHOUT</u> program Address, the program at address 0 is executed (if present.)

To view any program stored, enter "Q" (or Query) followed by the starting address, followed by (CR). To scroll through the program line by line, continue to press (CR). At the end of each program, reenter "Q" followed by the starting address to view next program. If no program resides at the next address, the # sign will appear. It then becomes necessary to enter a new "Q" or (Query) followed by the starting address of interest.

To change values in an existing program, enter "P" followed by the address line you wish to change. Enter new instruction and press (CR). To exit program mode, press (ESC) or Escape.

5.4 Erasing All or Part of N.V. Memory

There are a total of 2048 bytes in the N.V. Memory. This breaks down into 8 pages of 256 bytes per page. To erase an entire page, enter [C1] and (CR). Use [X] or [Q] (followed by program address) commands to verify removal.

IMPORTANT:

**If all pages are erased, the values for
K, I and V must be reentered and saved.**

5.5 Calculating Velocity Parameter

To calculate motor velocity parameter:

(1)   Refer to Grating Selection Chart in Section 3.

(2)   Locate your Instrument Model and Grating .

(3)   Note the nM or Å per motor revolution.

Important!
Once you select either nM or Å, you must stay with the your selection throughout the equation!

(4)   Unless otherwise stated in an Addendum, the standard motor resolution is 36000 Steps per Revolution. (For example: your instrument is a 2061 with a 1200 G/mm Grating. The nM per revolution is 5 nM. Therefore, 5 nM = 36000 motor steps).

(5)   Divide your desired scan rate by the nM or Å per motor revolution determined earlier.

(6)   Multiply the result from Step 5 by 36000.

(7)   Divide the result from Step 6 by 60 to convert from motor steps per minute to pulses per second. This is the number entered after the "V" (ie: "v12000")

5.6 Sample Program

Object:	To scan the Model 207 monochromator with 1200 G/mm grating at a rate of 100 Å/min. over a range of 500Å, then change direction and slew back to starting wavelength at a rate of 50,000Å/minute. Enter P84 (CR) as shown. **Note:** Program line number automatically increments depending on command byte size.

Program Entry: P84 (CR)

Program Line	Command	Description
84	V12000	12,000 steps/sec. (100Å/min.)
87	+ 360000	500Å wavelength range (360,000 steps)
93	W1000	Wait 1000 milliseconds to change velocity
96	V60000	Change V to 60,000 steps/sec. (50,000Å/min.)
98	-360000	Change direction and return 360,000 steps
102	P (CR)	Stores program, exit to command mode

Program Exit: P (CR)