INSTRUCTION MANUAL

Model 789A-4

Scan Controller

Serial Number: _____

McPHERSON™

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WARNING FOR FIELD RETROFITS

ALWAYS CHECK THE MOTOR'S DEFAULT DIRECTION BEFORE USE.

Older instruments do not have the "Auto Reverse" feature. Please review Motor Direction section of this manual for options.

- If your 789A-4 Controller is replacing Models 788 to 789A-3 Controllers, or is controlling a non-McPherson instrument, consult the Motor Direction section located in the 789A-4 Instruction Manual for motor reversal.

- If your system has a single 789A-4 Controller matched to an instrument, it should be factory configured for correct operation.

- If your system has multiple 789A-4 Controllers they will be labeled for their assigned instruments. Verify each 789A-4 Controller is connected to its assigned monochromator or device. While there is virtually no chance of damage, connecting the communication cable(s) to the wrong controller(s) will affect your data.

Configuration Factory Checked	Signed

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NOTICE

THIS EQUIPMENT HAS BEEN CAREFULLY PACKAGED FOR SHIPMENT, AND THE TRANSPORTATION CARRIER IS RESPONSIBLE FOR DELIVERY TO YOU IN GOOD CONDITION.

If the shipment is NOT delivered in good condition and in accordance with quantity shown on the Bill of Lading or Packing Slip, note the shortage or damage on both the delivery receipt and freight bill, or use the special form provided by United Parcel Service or the Post Office.

EFFECTIVE JULY 1, 1972 the Interstate Commerce Commission has ruled that Transportation Companies will not honor any losses or damage claims unless exceptions are noted on the freight bill at the time of delivery. IT IS THE BUYER'S RESPONSIBILITY TO MAKE A COMPLETE INSPECTION IMMEDIATELY UPON RECEIPT OF PURCHASED GOODS.

If you accept shipment from the transportation carrier short of what is listed on the Bill of Lading - or in damaged condition - without having proper notation made by the Carrier, you do so at your own risk.

If bundles or crates are in apparent good order but contents are found to be damaged, call Carrier for adjuster to view same and have the Transportation Carrier/United Parcel/Post Office mark the freight bill or packing slip relative to such concealed damage.

MAKE YOUR CLAIM AT ONCE, FOR THE TRANSPORTATION COMPANY/UNITED PARCEL/POST OFFICE HAVE A LIMITED TIME FOR PRESENTATION OF CLAIMS.

We are willing to assist you in every possible manner in collecting claims for loss or damage on this shipment, but cannot be responsible for filing or collecting claims or replacing materials. Claims for Loss or Damage on shipment may not be deducted from our invoice, nor payment of the invoice be withheld awaiting adjustment of such claims, as WE CANNOT GUARANTEE SAFE DELIVERY.

IMPORTANT NOTICE

ELECTRICAL EQUIPMENT MAY BE DANGEROUS IF NOT HANDLED WITH CAUTION. ALL INSTRUMENTS SHOULD BE OPERATED WITH PROPER GROUNDS ON POWER LINES. ELECTRICAL OR ELECTRICALLY OPERATED COMPONENTS SHOULD NOT BE EXPOSED OR HANDLED WITHOUT BEING SWITCHED OFF AND DISCONNECTED FROM THE POWER LINE.

McPHERSON WILL NOT BE RESPONSIBLE FOR ANY DAMAGE CAUSED BY SUCH UNITS IF INSTRUCTIONS HEREIN ARE NOT FOLLOWED, AND REPAIRS ARE NOT PERFORMED BY COMPANY-TRAINED OR COMPANY-LICENSED PERSONNEL.

SECTION 1
INTRODUCTION

The Model 789A-4 scan controller is a high resolution stepper system designed to control and drive McPherson Spectrometers and a variety of other motor driven devices

Easy to program and operate, this scanning system precisely positions gratings or other devices requiring accurate control.

1.1 Features

Features include:
No confusing switches or controls.
Limit Switch, Homing & Motor Interlock Systems.
LED's provide "at a glance" system information.
RS232 communication with USB adapter included.
Standard 36000 Steps/Motor Revolution. Up to 50000 Steps/Motor Revolution available; consult factory.
Universal power input (100 to 240 VAC Operation).

1.2 Software

McPherson Spectrometer Control Software is available at an additional cost.

SECTION 2
INSTALLATION

2.1 Fuse Replacement

To replace the fuse:

1. Locate and remove the fuse slot cover (see Rear Panel diagram below
2. Replace with the following fuse: 2A/250V, SLO-BLO, 5 x 20mm. This fuse is used throughout the 100 to 240 VAC range.

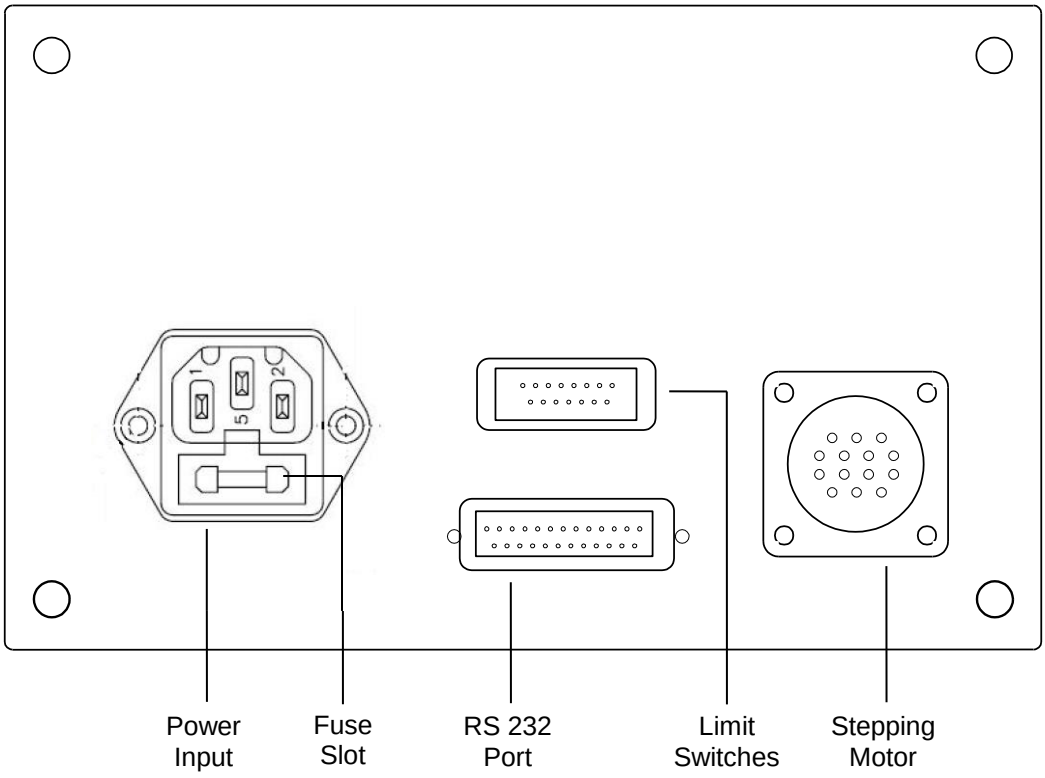
2.2 Connections

Make all connections as shown in the diagram below.

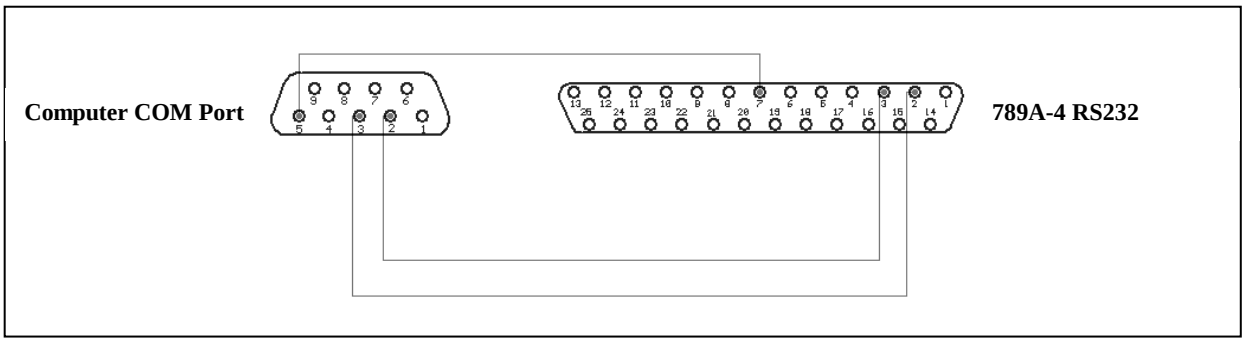
WARNING!

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!



Refer to the diagram below for correct connections between the 789A-4 and the computer's COM Port.

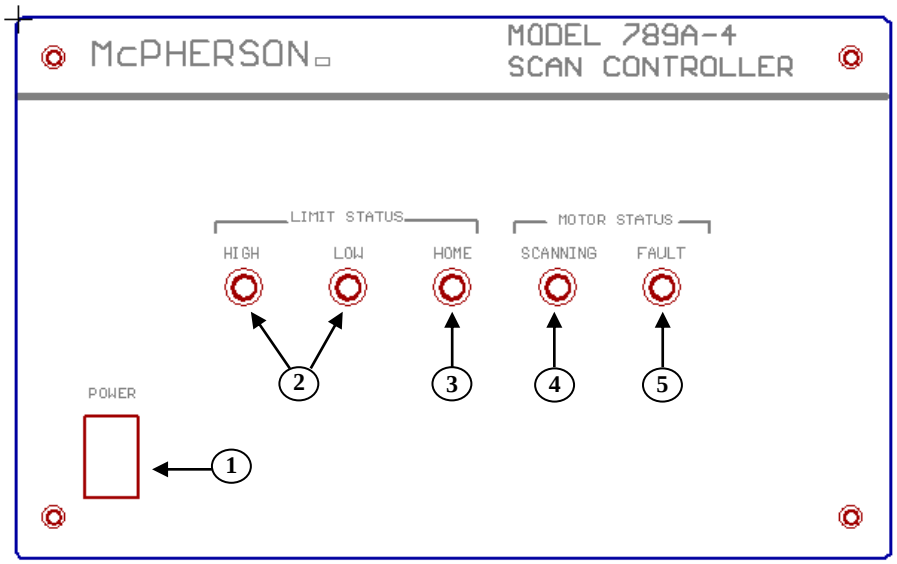


Important!

One USB to RS232 Converter is included with the 789A-4 for newer computers without RS232 COM Ports. Please take the time to read the accompanying literature. Use the supplied CD to install the converter's drivers. Your computer's Device Manager is used to configure the port settings created by the converter. Further information on using Device Manager can be found in the computer operating system's Help files.

SECTION 3
EXPLANATION OF FEATURES

3.1 Front Panel



1	Power Switch	Connects/Disconnects Power to the 789A-4 Controller.
2	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. If both LED's show red, check the Limit Cable connections.
3	Home Status LED	Lights when the "Home" switch is blocked during homing function. This LED is disabled during normal operation.
4	Scan Status	Lights when motor is in motion.
5	Fault LED	Lights when motor is disconnected or driver circuit failure

SECTION 4
Setup

4.1 COM Port Set-Up

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 789A-4's serial interface will send a "sign on" message (for example: "V2.55") in response to the spacebar. The message will be a firmware Rev. number. The 789A-4 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-4 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-4 uses a 25 pin "D-Sub" connector. The illustration in Section 2 shows the typical connection between the 789A-4 and the computer's COM Port.

4.2 Motor Direction

If your 789A-4 was purchased with an instrument or device, the default direction has been factory set.

Important!

If the 789A-4 is part of a retrofit kit, the default direction should always be verified before performing any scans.

1) *If possible, manually rotate the motor at least 3 turns toward the center of the leadscrew's travel. Note the wavelength counter reading.*
2) *Apply power to the 789A-4.*
3) *Enable communication by sending an ASCII space.*
4) *Send "+36000" with an ASCII* [ENTER]. *The wavelength counter should have incremented.*
5) *If the motor rotated in the wrong direction, change the S1 switch to "CW".*

4.3 789A-4 Grating Selection

Select the instrument(device) from the table below.

789A-4 Grating Selection Table

Monochromator model	Grating, g/mm	nm/Motor Rev.
205, 207, 209, 216.5,218, 219, 213, 235, 2051, 2061, 2062, 2062M3 (S/N 100 & above)	150	32
	300	16
	600	8
	1200	4
	1800	2.66
	2400	2
	3600	1.33
205, 207, 209, 216.5,218, 219, 213, 235, 2051, 2061, 2062, 2062M3 (S/N below 100)	150	40
	300	20
	600	10
	1200	5
	1800	3.33
	2400	2.5
	3600	1.66
2035 (S/N 310 & above)	30	500
	75	200
	150	100
	300	50
	600	25
	1200	12.5
	1800	8.33
	2400	6.25
	3600	4.16
2035 (Up to S/N 309) 275D, 275	100	120
	150	80
	300	40
	600	20
	1200	10
	1800	6.66
	2400	5
	3600	3.33

Monochromator model	Grating, g/mm	nm/Motor Rev.
272	570	12.5
	1140	25
	1710	37.5
	2280	50
225, 241 2253M5	150	20
	300	10
	600	5
	1200	2.5
	1800	1.66
	2400	1.25
	3600	0.83
X-RAY CZERNEY-TURNER (XCT)	100	12
	150	8
	300	4
	600	2
	1200	1
	1800	0.66
	2400	0.5
	3600	0.33
302(1), 270(2)	150	16
	300	8
	600	4
	1200	2
	1800	01.33
	2400	1
	3600	0.66
608 Pre-Disperser	N/A	10
248/310G(3)	ALL	0.1 inch
247	ALL	0.025 inch
Motorized slit	N/A	250 µm Typ. (Check Factory)

1) 5:1 Gear ratio between motor and lead screw.
2) 3:1 Gear ratio between motor and lead screw.
3) Motor set to 18000 steps/motor revolution.

SECTION 5
OPERATION

5.1 Power up

Once all connections have been made, place the POWER switch to the "ON" position. The LIMIT STATUS LED's will light along with the motor "FAULT" LED. After a few seconds, the "FAULT" LED should turn off. If the "FAULT" LED stays on, check the motor cable connections. If the motor connections appear good, contact the factory as soon as possible.

For best results:

1) Follow the setup procedures when operating for the first time.
2) Always perform the Homing Procedure anytime power is disconnected from the 789A-4.
3) Consult the McPherson Spectrometer Software manual.
4) If you are not using the McPherson software, follow the Command Summary starting on the next page.
   (a) After power-up, always send an ASCII [SPACE] before any other command is sent.
   (b) Start with simple moves until you are comfortable with the controller.

For advanced users, a supplement is included with this manual. This supplement goes into greater detail about the communications board. Please keep in mind McPherson does not use every command available. Any commands used that are not listed in this manual run the risk of unstable operation.

5.2 Homing

Homing should always be done prior to scanning after power up.

Your new monochromator is most likely equipped with a "HOME" position switch. Consult the instrument's manual for the home wavelength. Do not attempt to home your instrument if there is no home switch installed.

The "Home Switch" is disabled for routine scanning due to the LED portion emitting IR light, possibly causing issues in systems working in the IR. The "Home" switch is enabled by sending the ASCII command "A8" via the RS232 port to the 789A-4 Controller.

Sending the ASCII command "A24" prepares the controller for the final sequence of the homing procedure.

The homing procedure consists of several steps:

1) Determining if the current wavelength is above or below the "Home" wavelength.
2) Setting the wavelength to the correct starting position (approximately 1 to 2 motor revolution below Home).
3) Initiating the final homing sequence.

After the homing procedure has completed, sending the command "A0" disables the "Home" switch.

5.2a Homing Procedure

1) Apply power to 789A-4 Controller and send ASCII [Spacebar] to initialize the 789A-4 COM port.
2) See the Homing Table below.

Finding Home Position with Home Switch Blocked

Line	Command	Explanation	Notes
1	A8	Enable Home Circuit	
2	]	Check Limit Status	If Home Switch is blocked, bit 5 is active- response = 32 "Home" LED is lit.
3	M+23000	Move at constant velocity (23 KHz)	For a faster move, enter +3000000.
4	]	Check Limit Status	Send every 0.8 seconds until bit 5 clears.
5	@	Soft Stop	Stop when Homing flag is located.
6	-108000	Back into Home Switch 3 motor revolutions	
7	+72000	Go 2 motor revolutions up	Removes backlash
8	A24	Enable "High Accuracy" Circuit	
8	F1000,0	Find edge of Home Flag at 1000 steps/sec	Scan will stop when edge is found
9	A0	Disable Home Circuit	Necessary on monochromators with Home Switch inside optic chamber. Switch uses IR LED.

Finding Home Position with Home Switch Clear

Line	Command	Explanation	Notes
1	A8	Enable Home Circuit	
2	]	Check Limit Status	If Home Switch is clear, bit 5 is active- response = 0 "Home" LED is not lit.
3	M-23000	Move at constant velocity (23 KHz)	For a faster result, enter -3000000.
4	]	Check Limit Status	Send every 0.8 seconds until bit 5 is active
5	@	Soft Stop	Stop when Homing flag is located.
6	-108000	Back further into Home Switch 3 motor revolutions	
7	+72000	Go 2 motor revolutions up	Removes backlash
8	A24	Enable "High Accuracy" Circuit	
8	F1000,0	Find edge of Home Switch at 1000 steps/second	Scan will stop when edge is found
9	A0	Disable Home Circuit	Necessary on monochromators with Home Switch inside optic chamber. Switch uses IR LED.

5.3 789A-4 Command Summary

Command			Description	Result(s)
ASCII	**DECIMAL**	**HEX**		
[SPACE]	32	0x20	Initialize	**This command must be entered first after power-up.** Enables communication with scan controller. If using a terminal program, pressing the "space bar" will achieve the same result. The
[CR]	13	0x0D	Carriage Return	**This command must follow all remaining commands entered**. If using a terminal program, pressing the "Carriage Return" or “Enter” key will achieve the same result.
@	64	0x40	Soft Stop	Causes deceleration to a stop.
^C	3	0x03	Reset	(1) Stops motion. (2) Sets counter to "0" (3) Assumes "Idle" state
A0	65, 48	0x41 0x30	Home Switch Disabled	Default Value
A8	65, 56	0x41 0x38	Home Switch Enabled	Home Swiched Powered & Ready
A24	65, 50, 52	0x41 0x32 0x34	Home Accuracy Circuit Enabled	Used in final move of a Homing function.
C1	67,49	0x43 0x31	Clear	Erases pre-programmed parameters. Only use when an unexplainable scanning error has occurred.
F	102	0x66	Find Edge	Used in final phase of Homing. Home switch must be blocked. Sending “F1000,0” will cause the motor to move upward at 1000 steps/second until home switch is cleared.
G	103	0x67	Run Internal Program	Executes a program stored in non-volatile memory after entering [G] followed by the program’s starting address.
I	73	0x49	Starting Velocity	Starting and stopping speed of scan.

5.3 789A-4 Command Summary (continued)

Command			Description	Result(s)
ASCII	DECIMAL	HEX		
K	75	0x4B	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	0x50	Enter & Exit Program Mode	Entering P0 through P1000 sets the 789A-3 into internal program mode. See the manual supplement for more details.
M	13	0x0D	Move at constant velocity	Entering M10000 will cause the motor to move at 10000 steps/second until hitting a limit or by sending "@".
S	83	0x53	Save	Stores parameters to non-volatile memory. Should be used if parameters had to be re-entered after "C1" command.
V	86	0x56	Scanning Velocity	Sets scan speed in steps per second. Range = 36 sps to 60000 sps. **(1)**
W	87	0x57	Pause	Wait *n* milliseconds *n* = 0 to 65535 Example – W2000 = Pause 2000mS
X	88	0x58	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	0x5D	Read Limit Switch Status	0 = No limit encountered. 32 = Home Limit Encountered. 64 = High limit encountered. 128 = Low limit encountered.
+	43	0x2B	Index Scan in "Up" Direction	+36000 = Scan 36000 steps in upward direction. This scan usually results in 1 motor revolution. Max. value = 8388600.
-	45	0x2D	Index Scan in "Down" Direction	-36000 = Scan 36000 steps in downward direction. This scan usually results in 1 motor revolution. Maximum value = 8388600.

Note 1 = Scanning velocities may not be the exact value entered.

5.3 789A-4 Command Summary (continued)

Command	DECIMAL	HEX	Description	Result(s)
^	94	0x5E	Read Moving Status	0 = No motion detected. 1 = Moving 2 = High in constant velocity. 16 = Slewing - Ramping complete.

5.4 Calculating Velocity Parameter

To calculate motor velocity parameter:

1. Refer to Grating Selection Chart.
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! Remember 1 nM = 10 Å.

4. Unless otherwise stated, 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 4 nM. 4 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”).

5.5 Sample Program

Object:	To scan a Model 207 monochromator with 1200 G/mm grating at a rate of 100 nM/minute over a range of 40 nM, then change direction and slew back to starting wavelength at a rate of 400 nM/minute.

Program Line	Command	Description
1	V15000	15,000 steps/sec. (100 nM/min.)
2	+ 360000	40 nM wavelength scan (360,000 steps)
3	W1000	Wait 1000 milliseconds to change velocity
4	V60000	Change V to 60,000 steps/sec. (400 nM/min.)
5	-396000	Change direction and return 396,000 steps
6	+36000	Change direction and increment 36000 steps. These last two steps eliminate mechanical backlash.

Appendix

Warranty and Assistance, Warranty Exceptions, and Returning Goods

Warranty and Assistance

McPherson products are warranted to be free from defects in material and workmanship and conform to the specifications furnished by the company at date of delivery. The company's obligation under this warranty is limited to servicing, adjusting, or repairing or replacing any McPherson made part or parts thereof, returned to the factory or in the field. Shipping or travel expenses to be prepaid by customer both ways. Items manufactured by McPherson carry a warranty of one year. Purchased items carry the original manufacturer's guarantee where available.

McPherson shall not be liable for consequential damages resulting from accidents, alterations, misuse, improper installation, handling by improperly qualified personnel, operation on low or excessive voltages, or any use in violation of operating instructions furnished by the company.

If any defect appears upon receipt, the purchaser shall promptly notify the company. No material will be accepted for repair or replacement without prior authorization from the company. (See instructions for returning goods on page A-3.) Upon such authorization and in accordance with instructions from the company, parts, materials or equipment for which repair or replacement is requested shall be returned to the company for examination, or be examined in the field. Shipping and/or travel charges will be quoted and must be prepaid by the purchaser. Final determination as to whether a product or part is actually defective rests with the company.

For parts not subject to warranty or after lapse of warranty period, an estimate of repair charges will be submitted to the customer before servicing the equipment.

The company reserves the right to make changes or improve its products and will supply such replacement where available without imposing upon itself the obligation to supply the same in lieu of its product(s) previously offered and/or manufactured.

This warranty is in lieu of all other obligations or liabilities expressed or declared on the part of the company. The company neither assumes, nor authorizes any other person to assume for them, other obligations or liability in connection with the sale of equipment manufactured by McPherson.

Warranty Exceptions

The warranty will not apply in case of any misuse, neglect of instructions and violations of the policy. Furthermore, the performance of systems assembled by the customer which incorporate McPherson parts, supplies or instruments is not covered by this warranty. The following indicate other exceptions to the one year warranty.

Parts and Supplies — Optics, photomultipliers, MCP PDA, CCD, and other detectors, light sources, fuses, rubber products (i.e. o-rings, gaskets), quartz capillaries and any other items that can be damaged by misuse, overexposure and/or are of expendable nature will not be warranted unless received defective or destroyed by the malfunctioning of warranted components.

Obvious Abuse — Components or assemblies that require replacement or repair due to obvious abuse or unauthorized repair attempts will not be subject to or considered a warranted item.

This certifies that Model _____ , S/N _____ carries a limited warranty of one year from date of delivery, with above limitations and terms.

This certifies that Model _____ , S/N _____ carries a purchased * second year of limited warranty beginning one year after the original date of delivery, with above limitations and terms.

_____

*Additional warranties and / or service subject to written quotations and purchase orders.

Returning Goods

Please observe the following procedure when returning goods:

Obtain a return material authorization (RMA) number from McPherson. This number must appear on the outside of the package returned.

1. For WARRANTY repairs obtain an RMA Number.

This return material authorization number must appear on the outside of the package and on all documents and packing slips, etc. A description of the problem and/or repairs needed should be enclosed and the information should include the purchase date, the original purchase order number, McPherson job number and invoice number (if possible).
The serial number must be included.

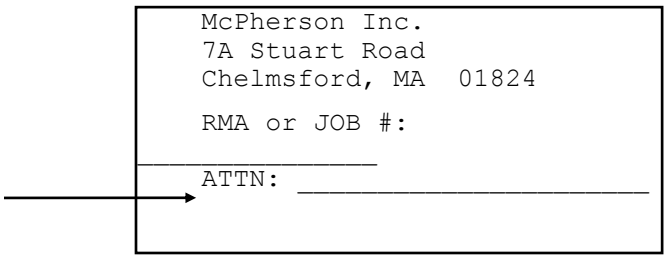
2. For NON-WARRANTY repairs obtain a JOB number.

A purchase order for defect evaluation in the amount of $250.00 has to be issued. This should be done before returning the instrument or the purchase order must accompany the instrument.

After completion of the evaluation, McPherson will provide a quotation detailing the cost of needed repairs and shipping.

Thereafter, McPherson will expect to receive a purchase order for the amount quoted. The evaluation charge will be credited against this amount. Upon receipt of the purchase order, work will commence.

3. Return the goods, shipping and insurance prepaid, to:



4. If the return shipment comes from outside the USA, the following additional information should be on all paperwork as well as on the outside of the package. To avoid possible customs charges.
   a) USA Made Equipment
   b) NOT FOR SALE
   c) Submitted for repair/service
   d) To Be Returned