Varian 440 Fraction Collector

Service Manual

Installation Category II
Pollution Degree 2
Safety Class 1 (EN 61010-1)

VARIAN

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Varian, Inc. – Serving Industries Worldwide

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Contents

1. General Information

Information in this manual is for use by Varian trained, Varian-qualified or Varian-approved FSRs (Field Support Representatives). This manual provides information to maintain and service the fraction collector. The service manual may be viewed online.

Site preparation and operator training are described in the Varian modular liquid chromatograph pre-installation instructions and the fraction collector Hardware manual.

- Varian Modular Liquid Chromatograph pre-installation guide (publication number 8510253100)
- Varian 440-LC Fraction Collector Operation Manual (publication number 8510252500)

The software installation guidelines are described in the operator's manual and in section 3 of this manual.

1.1 How to Use this Manual

The safety practices and hazards section described below are provided to help the user operate the fraction collector safely. Read these safety practices thoroughly before attempting to operate the fraction collector, and always operate the fraction collector in accordance with these safety practices.

All information contained in this publication is relevant to the fraction collector.

1.2 Finding Information

There is a comprehensive Table of Contents in the front section of the manual detailing each chapter.

The Spare Parts section of this manual (Section 6) contains a comprehensive ordering information list of spares and their part numbers. Where possible, pictures are used to illustrate a part for visual identification.

Electronic and mechanical schematics including layouts and assembly drawings are included in the Schematics section of the manual (Section 8).

Service manual updates will be provided by Varian when necessary and will come in the form of Service Bulletins or Service News Flashes or Service How To sheets.

1.3 Conventions

The following conventions have been used throughout the documentation:

- Menus, menu options and field names (e.g. select **Copy** from the **Edit** menu) have been typed in bold. Bold is also used to signify the pushbuttons appearing throughout the software (e.g. click **OK**).
- ALL CAPITALS indicate keyboard and mouse commands (e.g. press the F2 key) and text you must type in from the keyboard (e.g. type SETUP at the prompt).

1.4 Tips

A Tip is used to give practical hints to help you achieve the best possible performance from your instrument.

1.5 General

This section provides an overview of the fraction collector and contains important information about:

- Design features
- Safety practices and hazards.

1.6 Design Features

The fraction collector is manufactured according to a Quality system certified to ISO-9001. The guaranteed specifications are based on the ±3 sigma statistical confidence level of the final acceptance tests performed at the factory.

1.7 Safety Practices and Hazards

Information on safety practices appears throughout the documentation (both hard copy and on-line) provided with your instruments and accessories. Before servicing the instrument or accessories you must thoroughly read these safety practices.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Observe all relevant safety practices at all times.

1.7.1 General Safety Information

Operation of a Varian 440 fraction collector involves the use of hazardous materials including corrosive fluids and flammable liquids. Careless, improper or unskilled use of this fraction collector can cause death or serious injury to personnel, and/or severe damage to equipment and property.

The fraction collector incorporates interlocks and covers that are designed to prevent inadvertent contact with any potential hazards. If the instrument is used in any manner not specified by Varian, this protection may be impaired. It is good practice to develop safe working habits that do not depend upon the correct operation of the interlocks for safe operation. It is essential that no interlock or cover is bypassed, damaged or removed.

The safety practices described below are provided to help the user operate the instrument safely. Read each safety topic thoroughly before attempting to operate the instrument and ALWAYS operate the fraction collector in accordance with these safety practices.

1.7.2 Electrical Hazards

Exposure to high voltages can cause severe skin damage, while close contact with the electrical components can result in severe heat burns to the skin, and an electrical discharge which may cause death, severe electric shock or sub-surface skin burns.

The fraction collector has been carefully designed to operate safely and effectively when using components that conform to Varian's design criteria. Use of non-approved components in the fraction collector may render the system inoperative and/or hazardous. It may also invalidate the warranty on the instrument. Use only related components supplied or authorized by Varian.

- Disconnect the instrument from all power sources before removing protective panels to avoid exposure to potentially dangerous voltages. Panels or covers which are retained by screws may be opened ONLY by Varian-trained, Varian-qualified, or Varian-approved Customer Service Representatives. Consult the manuals or product labels supplied with your PC to determine which parts are operator-accessible.
- When it is necessary to use a non-original power cord plug, make sure the replacement cord adheres to the color coding and polarity described in the manual and all local building safety codes.
- Good grounding/earthing is essential to avoid a potentially serious electric shock hazard. Ensure that there is an integral ground connection between the metal base of the detector and the 3 pin earth-grounded receptacle. Consult the manuals or product labels supplied with your PC for the relevant grounding requirements.
- Replace blown fuses with fuses of the size and rating shown on the fuse panel or in the manual.
- Replace faulty or frayed power cords immediately with the same type and rating.
- Make sure that voltage sources and line voltage match the value for which the instrument is wired.
- Avoid using power supplies from a source that may be subject to electrical or RF interface from other services (for example, large electrical motors, elevators and welders).

The fraction collector electronics are powered by the personal computer (PC) controlling the instrument. The fraction collector is powered by mains power 110V to 240V and will contain dangerous voltages when in operation. Do not remove any of the fraction collector panels or covers if the fraction collector is in use and do not operate the fraction collector with the panels or covers removed.

The fraction collector is certified to European safety requirements per Council Directives EN 61010:1998 'Safety Requirements for electrical equipment for measurement, control and laboratory use'.

To reduce the risks of electrical shock, this equipment employs a three-wire electrical cord and plug to connect the equipment to earth ground.

To preserve this safety feature:

- Make sure the matching wall outlet receptacle is properly wired and earth grounded to provide a protective earth.

Never use:

- A three-wire to two-wire plug adapter.
- A two wire extension cord
- Non-grounding multiple outlet receptacle power boards.

Ensure to position the fraction collector so that it is easy to access the mains power switch or to remove the power cord.

Any servicing of this equipment which requires removal of covers or panels can expose parts, which involve the risk of electric shock or personal injury. Refer such servicing to trained, qualified personnel.

1.7.3 Fire Hazards

To ensure safety against fire the fraction collector is protected by fuses that provide multiple levels of protection against over-current conditions:

- The unit is protected by a power inlet fuse;
- The internal electrical circuits are protected by fuses;
- The internal fuses are not user replaceable and are not accessible to the user. These can only be replaced by an Authorized Service Agent; and
- The power inlet fuse is a user-replaceable fuse. For continued protection against risk of fire, replace the fuse only with the same type and rating specified. Replacement fuses are available from the Authorized Service Agent.

1.7.4 Pinching Hazards

The fraction probe assembly uses high torque motors that are strong enough to cause injury if fingers become jammed in the transport mechanism. Do not attempt to change or remove fraction tubes or trays while the transport is in motion. Never place fingers behind the fraction probe assembly while a sequence is running. Your fingers may become jammed between the assembly and the frame of the fraction collector if the transport mechanism moves in a direction that you are not expecting. Before servicing the transport mechanism, make sure the fraction collector is unplugged and turned off'.

1.7.5 Panels and Covers Hazards

All panels or covers that are retained by screws on the fraction collector may be opened only by Varian-trained, Varian-qualified or Varian-approved Field Service Representatives (FSRs). Consult the manuals or product labels supplied with your PC, monitor and printer/plotter to determine which parts are accessible.

1.7.6 Other Precautions

Use of the fraction collector may involve materials, solvents and solutions which are flammable, corrosive, toxic or otherwise hazardous. Careless, improper or unskilled use of such materials, solvents and solutions can create explosion hazards, fire hazards, toxicity and other hazards that can result in death, serious personal injury or damage to equipment.

Always ensure that laboratory safety practices governing the use, handling and disposal of hazardous materials are strictly observed. These safety practices should include wearing appropriate safety clothing and safety glasses.

Consult the manuals supplied with your PC, monitor and for their specific ventilation requirements.

Great care should be taken when working with glass or quartz parts to prevent breakage and cuts. This is especially important when removing or replacing glass fraction tubes.

Use only Varian-supplied spares with your instrument.

1.7.7 Information Symbols

The following symbols appear on the fraction collector to provide you with additional information:

I	Mains power on
0	Mains power off
	Fuse
	Single phase alternating current
	When attached to the rear of the instrument, indicates that the product complies with the requirements of one or more EU directives.
	When attached to the rear of the product, indicates that the product has been certified (evaluated) to CSA 1010.1 and UL 3101-1.
	When attached to the rear of the product, indicates that the product complies with the Australian EMC requirement

1.7.8 Warnings and Cautions

A Warning message is used in the text when failure to observe instructions or precautions could result in death or injury.

The following is a list of symbols that appear in conjunction with warnings in this manual or on the fraction collector. The hazard they describe is also shown.

1.7.8.1 Warning

A triangular symbol indicates a warning. A 'Warning' message appears in the manual when failure to observe instructions or precautions could result in death or injury. Symbols depicting the nature of the specific hazard are also placed alongside warnings.

Warning – Electrical shock
Ensure that the Fraction Collector is always connected to the mains supply protective earth. Ensure to position the Fraction Collector so that it is easy to operate the mains power switch or to remove the power cord.

The meanings of the symbols that may appear alongside warnings in the documentation or on the instrument itself are as follows:

Read all warnings and cautions carefully and observe them at all times.

Broken glass

Corrosive liquid

Electrical shock

Eye hazard

Fire hazard

Heavy weight (danger to feet)

Heavy weight (danger to hands)

Moving parts

1.7.8.2 Caution

A ‘Caution’ message is used when failure to observe instructions could result in damage to equipment (Varian supplied and/or associated equipment).

Caution	Corrosive chemicals can damage the solvent lines of the fraction collector.

1.7.8.3 Note

Note A note is used to give advice or information.

The following symbol may be used on warning labels attached to the instrument. When you see this symbol you must refer to the relevant operation or service manual for the correct procedure referred to by that warning label.

1.7.9 Color Coding

The various indicator lights appearing on Varian instruments and associated accessories are color-coded to represent the status of the instrument or accessory.

- A green light indicates the instrument is in normal/standby mode.
- An orange light indicates that a potential hazard is present.
- A blue light indicates that operator intervention is required.
- A red light warns of danger or an emergency.

1.7.10 Federal Communications Commission (FCC)

The following is a Federal Communications Commission advisory:

This equipment generates, uses, and can radiate radio frequency energy and if not installed and operated in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device

pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user, at their own expense, will be required to take whatever measures may be required to correct the interference.

1.7.11 CE Compliant Products

The fraction collector has been designed to comply with the requirements of the Electro-magnetic Compatibility (EMC) Directive and the Low Voltage (electrical safety) Directive (commonly referred to as the LVD) of the European Union.

Varian has confirmed that each product complies with the relevant Directives by testing a prototype against the prescribed EN (European Norm) standards.

Proof that a product complies with the Directives is indicated by:

- The CE Marking appearing on the rear of the product; and
- The documentation package that accompanies the product that contains a copy of the Declaration of Conformity. This Declaration is the legal declaration by Varian that the product complies with the Directives and also shows the EN standards to which the product was tested to demonstrate compliance. It is also signed by Varian's Authorized Representative in the EU, and by the representative of the manufacturing plant

1.8 Service Philosophy

1.8.1 Varian Customer Support Policies

Warranty	12 months, though this may vary according to location.
Hardware support period	5 years from date of last unit manufacture. After this time, parts will be provided if available.

1.8.2 Service Policy

In the normal course of field servicing, it is Varian's policy to troubleshoot and repair to a modular level at the fraction collector location.

Software diagnostic routines are available to aid in fault isolation. These are to be used in conjunction with conventional test equipment to effect on-site repairs.

In situations where minimizing downtime is the prime consideration, board or module exchange should be considered, but only after preliminary attempts to repair, have proven unsuccessful. Component level repair should not be attempted outside a designated service repair center. Electronic assemblies with surface mount components are not field repairable.

1.8.3 Spare Parts Policy

Operational spare parts for all Varian instruments and major accessories will be held in stock for a period of five years after shipment of the final production unit. Spare parts may be provided after this five-year period, but only on an ‘as available’ basis. Operational spare parts are defined as those individual electrical or mechanical parts that are susceptible to failure through fair wear-and-tear during their normal operation. Examples include resistors, inductors, capacitors, semi-conductor devices, relays, lamps, temperature probes, detectors elements, motors, wiring board assemblies and the like.

General hardware (for example, sheet metal parts, structural members, assemblies and castings) will normally outlast the useful life of the detector and therefore will only be supplied on an availability basis after the final production unit is manufactured.

Proprietary items and components that are unique to the Varian equipment should be sourced from the Varian Service Center. Other components may be sourced locally unless otherwise specified in this manual.

1.8.4 Warranty

All Varian products are warranted against defects in materials and workmanship, but not against consequential damages. Full details relating to the terms of warranty are available from any Varian Sales and Service Office or Agency. No other warranty is expressed or implied. Consumable items such as (but not limited to) light sources, temperature probes and other glassware items are subject to a limited or pro-rated warranty. The Varian warranty provides for specific legal rights. There may also be other rights that vary from country to country, or region to region.

The warranty applies only to the installed Varian equipment, and cannot be extended to cover the associated miscellaneous installations that remain the customer's responsibility. By the same reason, the warranty does not cover problems that may be caused by misuse of the equipment, wrong applications, operator's inexperience etc. Standard

Warranty will cover 12 months, though this may vary according to location.

1.8.5 OEM Warranty

Personal Computers (PCs), printers, modem, other PC accessories and OEM accessories used with the fraction collector are not covered by Varian warranty. Generally this type of equipment is sourced locally and therefore local supplier or vendor warrantees will apply.

1.8.6 Contract Maintenance

After expiry of the warranty time, the service and/or repair of the fraction collector are handled on a time and materials basis, in accordance with the Varian standard service or contract maintenance arrangements. Quotations for contract maintenance may be obtained from any Varian Sales Office or Service Center.

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2. Pre-installation

The Varian 440 fraction collector has been fully tested and proven to specification before dispatch from the manufacturing plant.

This chapter contains general information that is relevant to the preparation of an installation site and details the facilities which must be provided to ensure that the system can be effective. Detailed operating procedures are provided in the operation manual or Help that is supplied with the instrument.

- 8510252500 - Varian 440-LC Fraction Collector Operation Manual.

For installations that are to be done by Varian personnel, the customer should complete the Pre-installation checklist contained in the Pre-installation manual.

- 8510253100 - Varian Liquid Chromatography Modules Pre-Installation Manual

Note A copy of the checklist must be received from the customer before attempting to install the fraction collector.

Note A copy of the above mentioned manuals can be obtained from Varian or downloaded from the Varian support website.

2.1 Weights and dimensions

Warning

Some of the packages are large and heavy. To avoid the chance of injury to personnel or accidental damage to the equipment, always use two or more people when handling the packages or lifting equipment into position. Never attempt to lift the packages alone.

System Unit	Height	Width	Depth	Weight
Fraction Collectors				
440-LC fraction collector (unpacked)	480 mm 19 in.	400 mm 16 in.	600 mm 24 in.	18 kg 34 lb
Shipping dimensions	500 mm 20 in.	760 mm 30 in.	760 mm 30 in.	31 kg 69 lb

2.2 Electrical specifications

2.2.1 Mains supply

The installation of electrical power supplies must comply with the rules and/or regulations imposed by local authorities responsible for the supply of electrical energy to the workplace.

Warning

Good electrical grounding is essential to avoid potentially serious shock hazards. A 3-wire outlet with ground connection must be provided for the detector. Make certain that power outlets are earth-grounded at the grounding pin.

All power supplies must be single-phase AC voltage, three-wire system (active, neutral, earth) and should be terminated at an appropriate power outlet receptacle that is within reach of the fraction collector power cord assembly. For safety reasons, a separate power outlet receptacle should be provided for each unit in the system. Do not plan to use extension cords or outlet adaptors.

All 440 fraction collectors are supplied with a 2 meter (6’ 6") long power cord and three-pin plug assembly that is compatible with common standards applicable in the local area.

Avoid using power supplies from a source that may be subject to electrical or RF interference from other services (large electric motors, elevators, and welders for example).

Required voltage supply: 100-240 VAC ± 10 VAC
50-60 ± 1 Hz
1.8 A
75 Watt

2.2.2 Fuses

When replacing fuses ensure the power to the unit has been turned off and the power supply cable has been disconnected. Use a thin blade screw driver to unclip the cover and slide out the pull out fuse compartment. Remove the blown fuse and replace with a fuse of the same type and rating.

Slide the pull out fuse compartment back into the unit and clip the cover back into place. Reconnect the power supply cable and switch on power to the unit.

Part number Description

19 100107 00 - FUSE 250V, 3.15A, 5 x 20mm LONG
19 100091 00 - FUSE, 250V, 5A, 5 x 20mm LONG

Note For safety reasons, any other internal fuse or circuit breaker is not operator accessible, and should be replaced only by Varian-authorized personnel. See figure 19, 20 and 21 on page 43.

2.2.3 External connections

Mains inlet coupler:	6 A 250 VAC IEC type	
RS-232:	9 way D-range type	
Mains power cord connector:		
Australia:	10 A 250 VAC	Complies with AS3112
USA:	10 A 125 VAC	Complies with NEMA 5-15P
Europe:	6 A 250 VAC	Complies with CEE7 sheet vii or NFC61.303 VA

3. Installation Procedure

3.1 Hardware Installation

This section provides instructions for installing the 440 fraction collector. Detailed operating procedures are provided in the Hardware Operation Manual and also included in the online help.

Warning

For electrical safety, always position the fraction collector so that it is easy to operate the mains power switch or to remove the power cord.

Where:

1. Theta axis
2. Z axis slide
3. Retaining ring
4. Probe mounting block
5. Knurled mount nut on the probe assembly
6. Ferrule holding the metal probe
7. Probe
8. Rack
9. Rack location mat

Figure 1. Fraction collector components

Internal modules, covers and panels must not be removed except by Varian trained, qualified or authorized Customer Support Representatives, unless otherwise specified.

Make sure to open the packaging and check received goods against the packing list, together with the customer. Report any missing or incorrect items to the customer support organization of where the order was placed and have them send replacements if necessary.

There are several steps involved in installing your fraction collector:

1. Assembling the fraction collector.
2. Connecting the fraction collector to the HPLC system.
3. Determining the delay volume.

3.1.1 Assembling the Varian 440-LC Fraction Collector

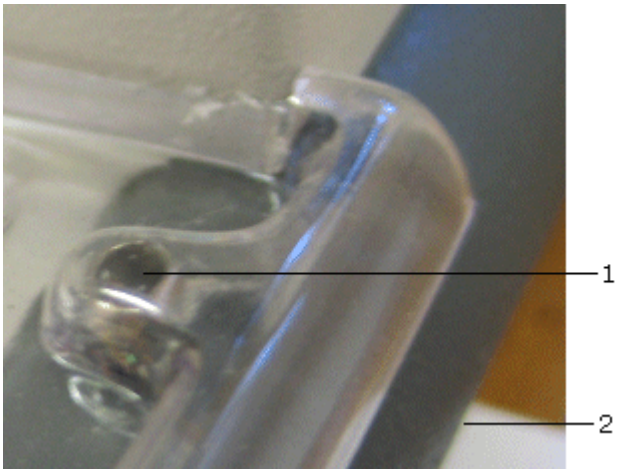
Carefully follow the instructions provided below to assemble your instrument.

Assembling the 440-LC Fraction Collector includes installing the:

- Spill Tray
- Rack Location Mat
- Probe and tubing
- Sample racks

Note Position the fraction collector on the side of the HPLC system closest to the detector output to help decrease the delay volume.

3.1.1.1 Installing the Spill Tray



Where:

1. Alignment pin underneath the raised locating tabs
2. Right side towards the back of the instrument

Figure 2. Spill tray alignment pin and rack location mat raised locating tabs

The spill tray will catch most solvent spills. Always clean up spills immediately.

To install the spill tray:

1. Ensure the alignment pins protrude above the base support tube.
2. Locate the tray so that the two alignment pins at the rear of the base support tube fit into the slots in the spill tray.
3. Lower the spill tray until the front edge rests on the front of the base support tube.
4. Check that the spill tray is firmly fitted.

Note The spill tray must be firmly in position so that it does not move.

3.1.1.2 Installing the Rack Location Mat

The rack location mat is installed on top of the spill tray.

To fit the rack location mat:

There are cut outs in the sides and the rear of the rack location mat. The cut outs slot over the raised locating tabs that are molded into the spill tray to ensure proper alignment. See the image above for details.

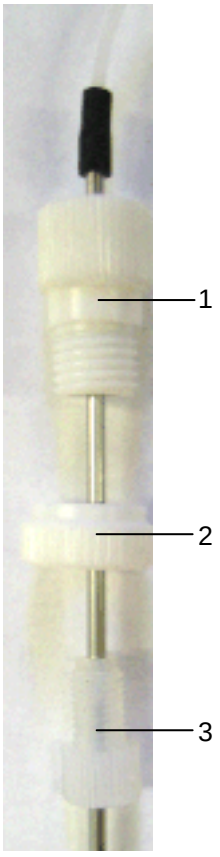
1. Position the rack location mat over the spill tray and press the mat onto the locating tabs.
2. Check that the rack location mat fits firmly in place by trying to move it side to side. There should not be any movement. If the rack location mat is loose, refit it.
3. If it does not fit properly contact your local Varian office or representative.

3.1.1.3 Installing the Probe and Tubing

For image details, see Figure 1, Page 13.

To install the sample probe and probe tubing:

1. Turn the fraction collector off.
2. Slide the Z-axis slide to the top of the probe carriage.
3. Manually rotate the probe arm so that it can be easily accessed.
4. See *Figure 3* below. Disassemble the probe kit by unscrewing the nut holding the metal probe from the bottom of the lower knurled mount nut and then the lower knurled mount nut from the top knurled mount nut.



Where:

1. Knurled mount on the probe assembly
2. Lower knurled mount nut on the probe assembly
3. Ferrule holding the metal probe

Figure 3. Close-up view of the probe disassembled.

5. Insert the probe into the probe mounting block. See Figure 1, Page 13.

6. Secure the lower knurled mount nut to the top knurled mount nut.
7. Secure the nut holding the metal probe into the bottom of the lower knurled mount nut.
8. Clip the tubing into the tube restraint which is the small hook at the top of the Z-axis slider. Allow for a small length in the tubing to prevent kinking the tubing.
9. Run the tubing to the left around the probe arm housing.
10. Attach the split ring (also called the retaining ring) as shown below. The retaining ring is split to attach it through the loop on the underside of the probe arm housing.
11. Feed the tubing through the retaining loop attached to the underside of the housing. See the image below for more information.

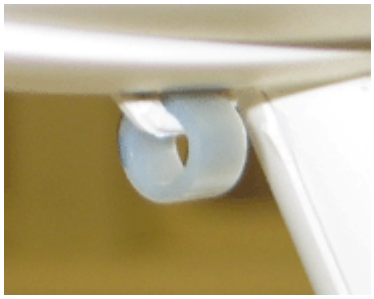
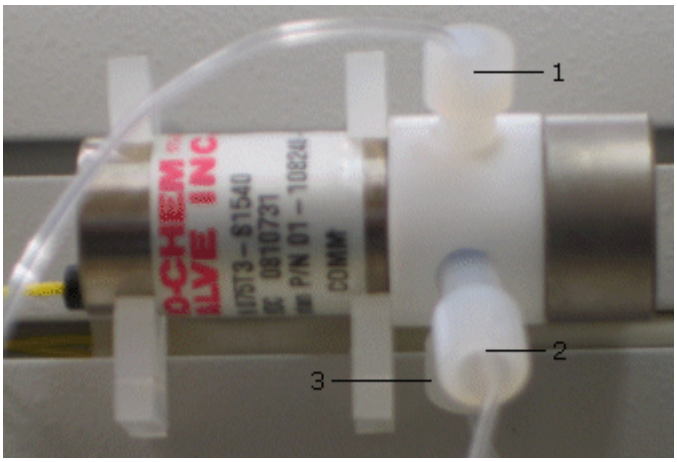


Figure 4. Retaining loop on underside of the probe arm housing

12. Screw the tubing fitting into the bottom (port 3) of the valve.



Where:

1. To waste
2. From detector outlet or back pressure restrictor
3. To the probe

Figure 5. Fraction collector valve

Note It is important to ensure that the length of the tubing from the probe to the valve allows the probe arm to move freely in all axes. If it is too tight, it will restrict movement and may cause movement failure. If it is too loose, the probe arm may become tangled in the tubing as it moves. Tubing length for the tubing between the valve and the detector depends on fraction collector placement. If the tubing is too long between the detector output and the fraction collector probe end, your samples may not correspond correctly to the fraction collector markers on your chromatogram. When choosing the length of tubing ensure it is long enough to allow free movement of the arm but not too long to delay sample delivery into the tubes. The delay volume calculation will compensate for this effect.

13. Move the probe arm to the right side of the fraction collector and rotate the probe arm fully to the right to check that the tubing is completely free to move.
14. Manually position the probe arm in the middle along the X axis.

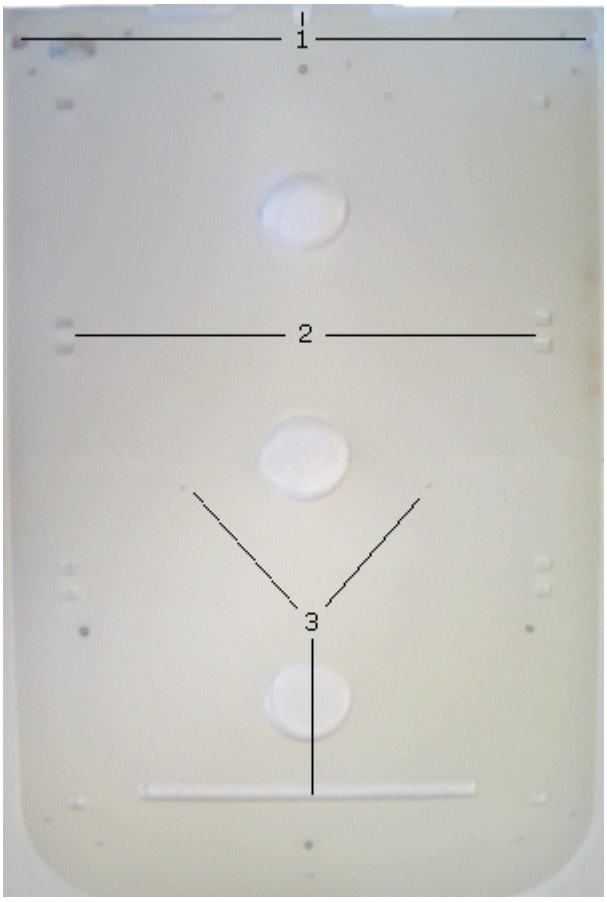
15. Rotate the probe arm through its full extent to check that the tubing is free to allow full movement in all directions.

    If the length is not correct, remove and then replace the tubing, install the fittings and tubing onto the fraction collector. Repeat steps 12-14 to test the tubing length.

16. Adjust the length of the sample line from the HPLC system.
17. In port 2 of figure 5, screw in the fitting with Tefzel ™ tubing. Connect the other end of this tubing to the HPLC system's detector outlet or to the back pressure restrictor if one is present. This tubing should be as short as possible.
18. In port 1 of figure 5, screw in the fitting with Teflon tubing. Put the other end of the tubing into your waste container.

3.1.1.4 Installing the Sample Racks

Fit the pegs on the rack into the holes on the rack location mat if you are using the standard racks. The rack closest to the rear of the fraction collector is considered rack number one. If you are using the fraction collector rack (Type 128 – 15 x 45 mm OD tubes – 4 mL vials or Type 200 – 12 x 32 mm OD tubes – 2 mL vials) slide the extended portion on the bottom of the rack into the long slit on the rack location mat.



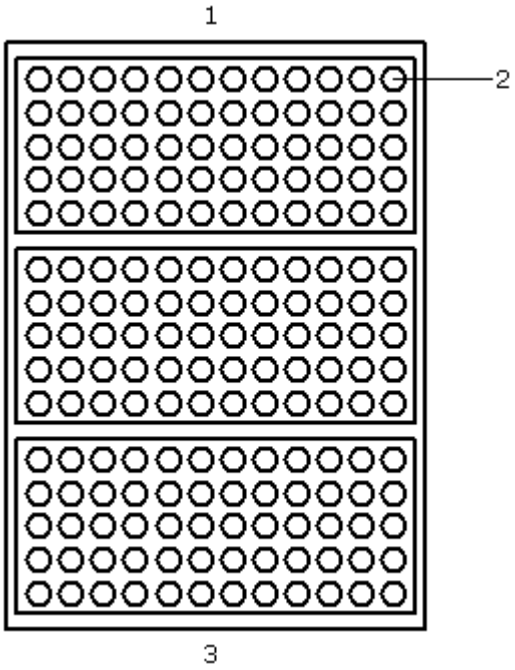
Where:

1. Cut-outs at the side and rear of the rack location mat
2. Holes for standard tube racks
3. Holes for the fraction collector rack

Figure 6. Rack location mat

3.1.1.5 Rack Orientation

The image in figure 7 shows an example of where the first sample is delivered to and the orientation of the standard racks provided with the fraction collector.



Where:

1. Rear of the fraction collector
2. First sample dispensed in this position, rack 1, tube 1
3. Front of the fraction collector

Figure 7. Rack location mat

3.1.1.6 Connecting the Power

Before connecting any part of the Varian 440-LC Fraction Collector to the mains power supply, check you have the correct power supply.

Warning – Electrical Shock – Fire Hazard
Application of the wrong supply voltage can create a fire hazard, or a potentially serious shock hazard, and can seriously damage the instrument and any attached ancillary equipment. Do not connect the instrument to the mains power until you have ensured that the mains power supply from the outlets in your laboratory is within the range.

The connection panel of the Varian 440-LC is located on the rear of the control column. The panel contains relays, indicators, DIP switches, the power socket and switch, and a RS-232 port for communication between the Varian 440-LC and the computer that is running instrument control software.

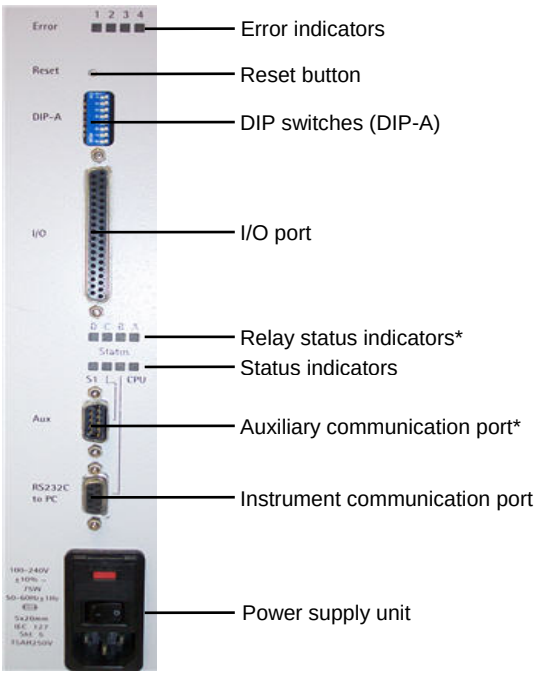


Figure 8. The connection panel of the Varian 440-LC.

Before connecting the mains power for the first time, check each fuse as described in Section 5.9, Page 42.

Electrical power for the Varian 440-LC must be provided through a three-wire outlet with ground connection. The outlet must be rated for at least 75 VA.

Warning – Electrical Shock
Good grounding is essential to avoid a potentially serious shock hazard. Ensure that power receptacles are earth-grounded at the grounding pin.

Three power cables are supplied with the Varian 440-LC. Select the correct one for your location. Ensure that the power switch is turned off (**0**), and then plug one end of the power cable into the Varian 440-LC—both the switch and the power socket are located on the connection panel at the rear of the control column—and the other into the mains power outlet.

Note In some countries, it may be necessary to fit a suitable three pin power plug to the cord. A three pin earthed power outlet must be used.

Ensure the Varian 440-LC is always connected to the mains supply protective earth.

Do not switch on the Varian 440-LC until all checks and settings for the Operating Mode have been completed.

When the Varian 440-LC is turned on, it will go through initialization tests and set the probe position. If the initialization process is not successful, refer to the troubleshooting information that is provided within Section 7.

Ensure that the probe arm's movement is not interfered with during operation/initialization.

During the initialization sequence:

1. The probe rises to the full extreme of the Z-axis,

2. The probe travels to the full extremes of the X-axis and rotates to the full extremes of the Theta-axis.
3. Then the probe is positioned at the back left of the fraction collector.

3.1.1.7 Instrument Communication Port

The instrument communication port, see *Figure 8*, is used to connect the Varian 440-LC to the computer or MIB controlling the instrument.

3.1.1.8 I/O Port

The I/O port is used with a 440-LC Fraction Collector I/O Interface board, part number 0210233800 when connecting the fraction collector to a non-Galaxie HPLC system.

3.1.1.9 Auxiliary Communications Port

The Auxiliary communications port provided on the Varian 440-LC is not used in current Varian software.

3.1.2 Connecting Fraction Collector to LC System

There are two possible ways to connect your Varian 440-LC Fraction Collector:

- With an existing or new modular system and Galaxie software. See Section 3.1.2.1, Page 20.
- With a modular system with no software or software other than Galaxie controlling the HPLC. See Section 3.1.2.4, Page 21.

The following sections provide instructions on how to connect your Varian 440-LC Fraction Collector to the system options mentioned above.

3.1.2.1 Connecting the 440-LC Fraction Collector to an Existing or New Varian Modular HPLC System with Galaxie Software

There are two ways to connect your fraction collector:

- Fraction collector to computer
- Fraction collector to MIB800 or MIB850

Once the fraction collector is connected to the computer or MIB, skip to Section 3.2.1, Page 27 to configure your system in Galaxie.

3.1.2.2 Connecting the 440-LC to the Computer

To connect your Varian 440-LC to the computer:

1. Plug one end of the supplied RS-232 cable into the instrument communication port.
2. Connect the other end of the RS-232 cable to a serial port on your computer.

Ensure that the correct communications parameters are set for both the Varian 440-LC and the computer in the Galaxie software. The required instrument communication settings are listed within Table 1. Only the Baud rate setting can be altered, via the instrument software. The instrument software must also be set to the corresponding values.

Table 1. Communication parameters for Varian 440-LC.

Baud rate	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

3.1.2.3 Connecting your 440-LC to an MIB800 or MIB850

To connect your Varian 440-LC to the MIB:

1. Plug one end of the supplied RS-232 cable into the instrument communication port.
2. Connect the other end of the RS-232 cable to a conversion cable, part number 0390793814. This will convert the 9-pin D connector to an RJ-45 which is then plugged into the serial ports on the back of the MIB.

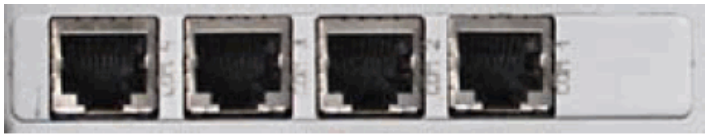


Figure 9. Serial ports on the MIB800 or MIB850.

3.1.2.4 Connecting the 440-LC Fraction Collector to a Modular HPLC System without Galaxie Software

Use the wiring diagrams in figure 10 and 11, as an example of how to connect your Varian 440-LC Fraction Collector.

Additional cables and interface boards may be needed to connect the detector and pumps and fraction collector.

- 3 wire LC interconnect cable R007200141 or 01-107441-00 for most connections.
- LC analog signal cable 01-107442-00 for the detector to the Analog +, - and ground points on J3 on the Varian 440-LC I/O Interface Board.
- The Varian 440-LC I/O Interface Board, part number 02-102338-00
- 325/335 Relay Interface Board, part number 02-101875-00 or 02-101875-90
- 210/218 Rear Back Panel Interface, part number 51-408927-00 (supplied with the pumps)

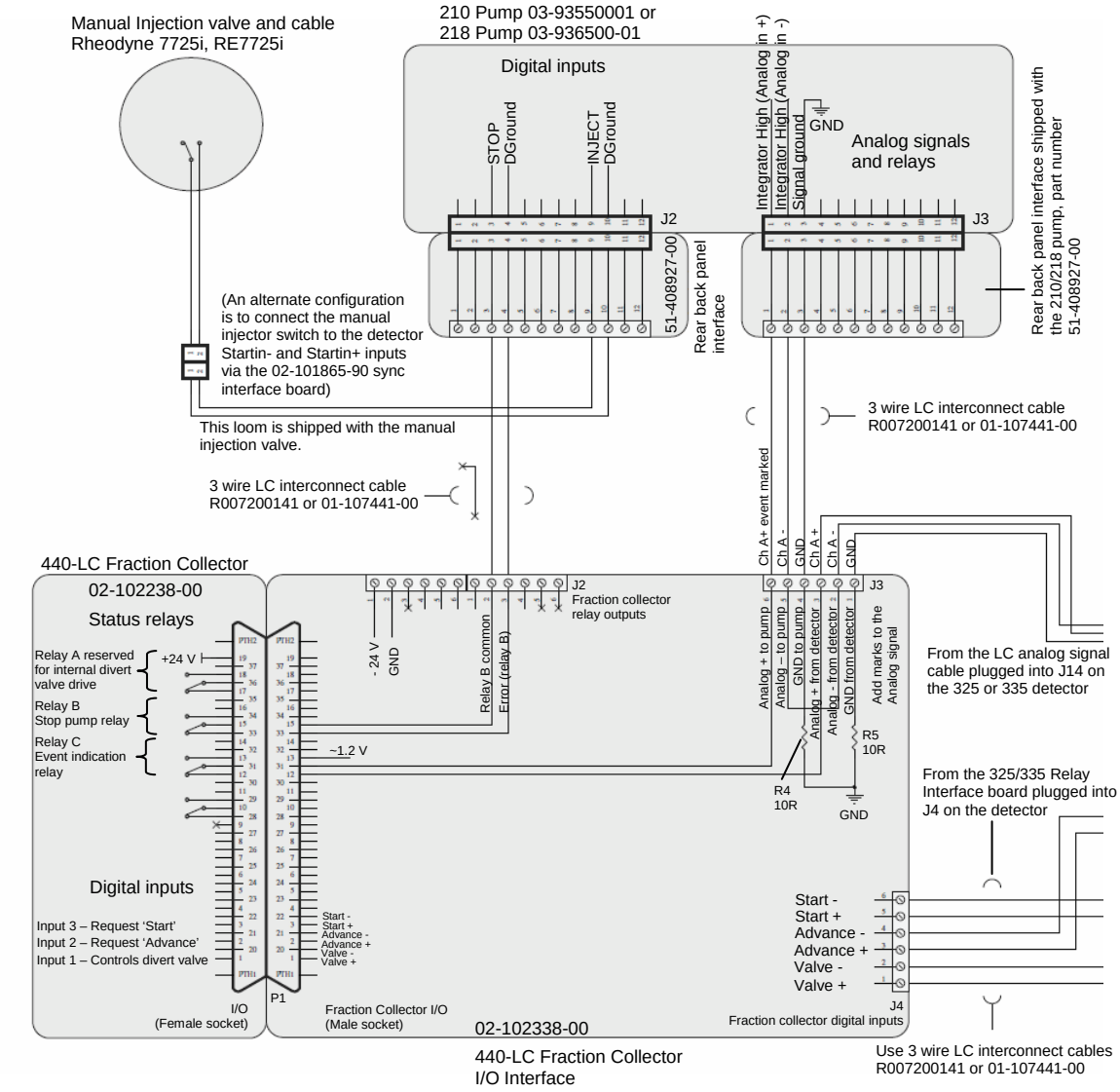


Figure 10. Fraction collector example wiring diagram for non-Galaxie systems, showing the 440-LC Fraction Collector I/O Interface Board and 210/218 pumps to 325/335 detector connections.

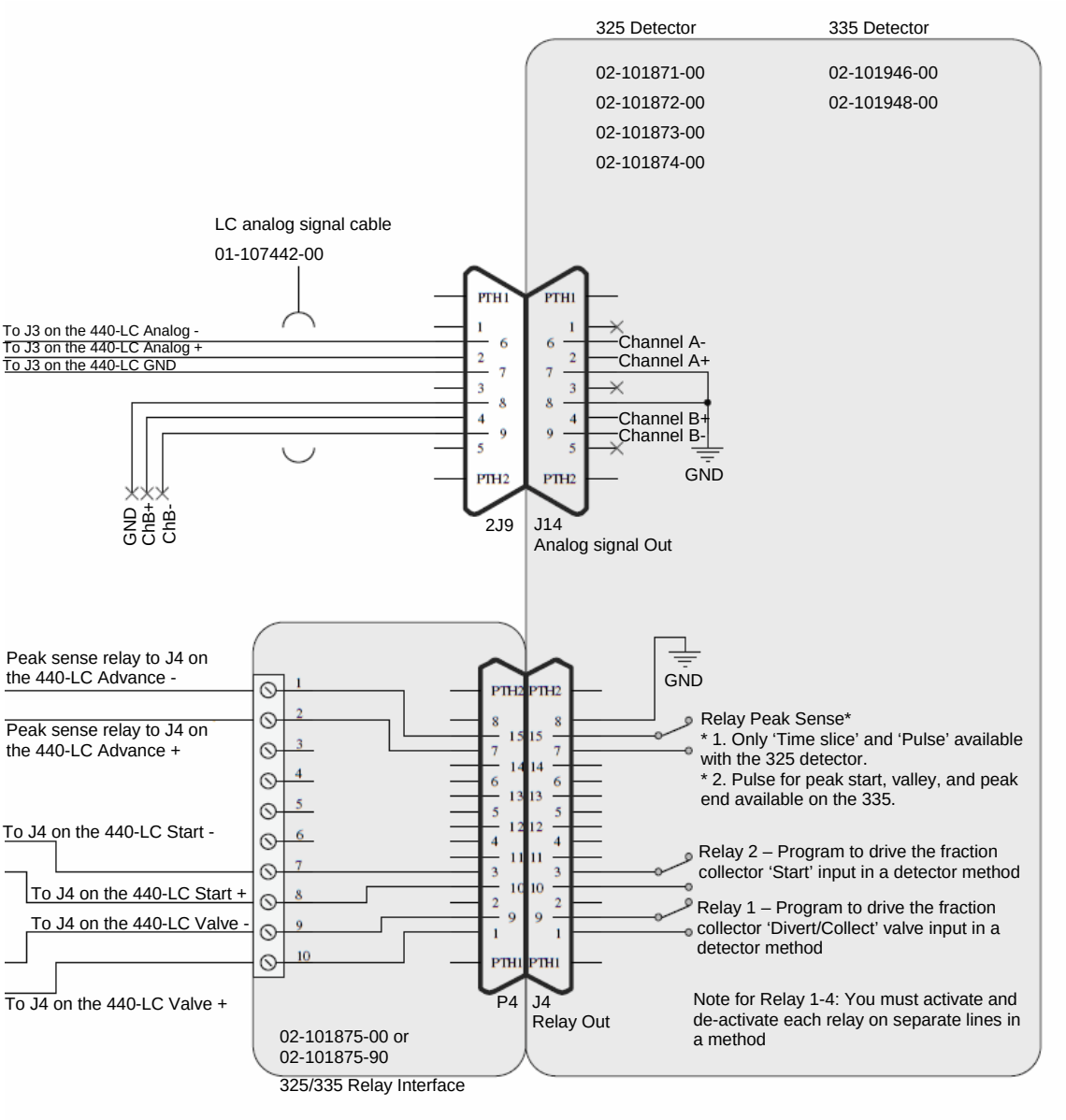


Figure 11. Fraction collector wiring diagram for non-Galaxie systems showing the connections between the 325/335 detector and the 440-LC Fraction Collector I/O Interface Board, part number 02-102338-00.

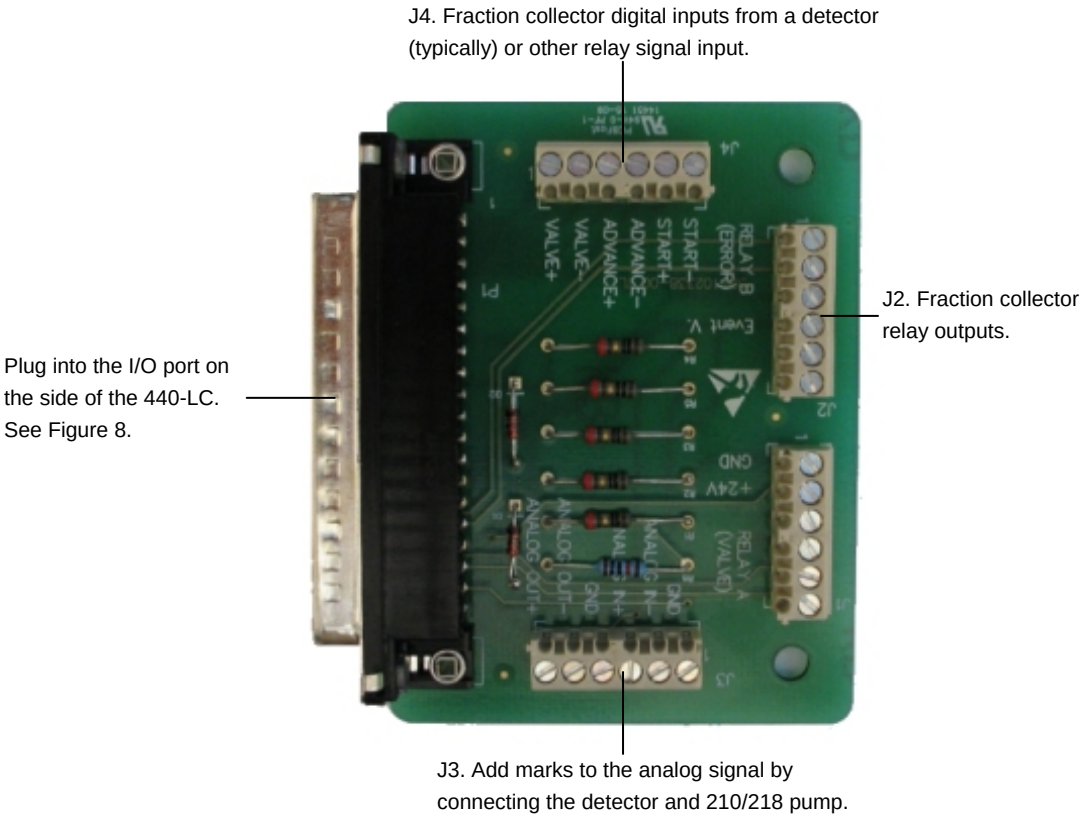


Figure 12. 440-LC Fraction Collector I/O Interface board, p/n 0210233800.

See the Varian Modular HPLC System Driver Installation and Configuration Instructions, publication number 8510252400, for instructions on how to install the 440-LC Console software that you can use to control the fraction collector.

3.2 Software Installation

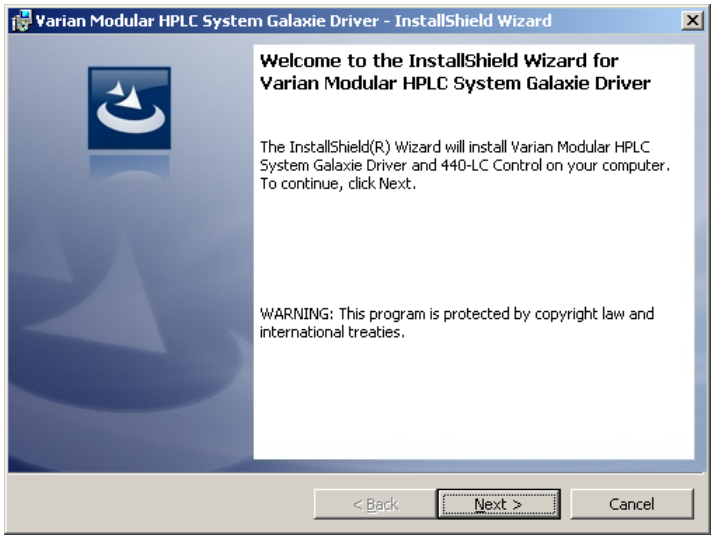
There are two possible ways to connect your Varian 440-LC Fraction Collector:

- With an existing or new modular system and Galaxie software.
- With a modular system with no software or software other than Galaxie controlling the HPLC.

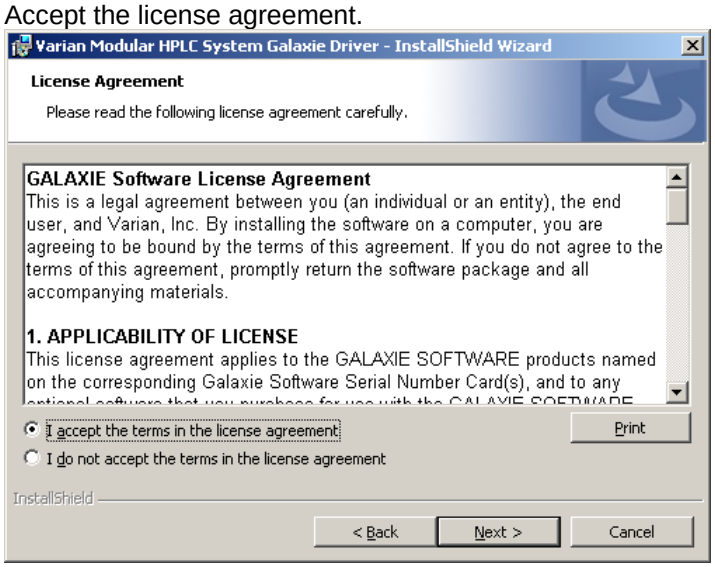
You will need to install the Varian 440-LC software accordingly

Install the software as followed:

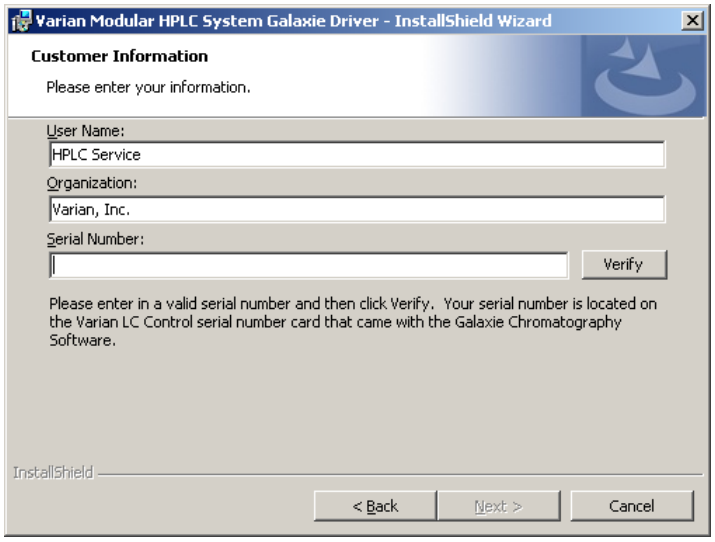
1. Insert the 440-LC driver disk and allow the installer to run.



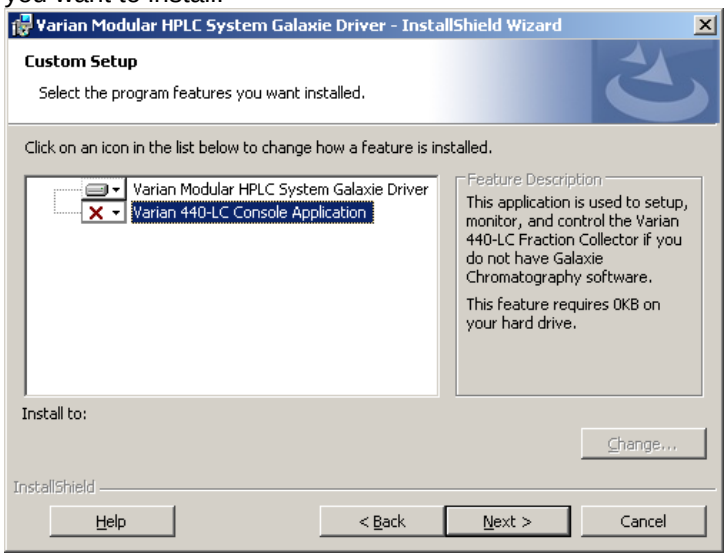
2. Accept the license agreement.



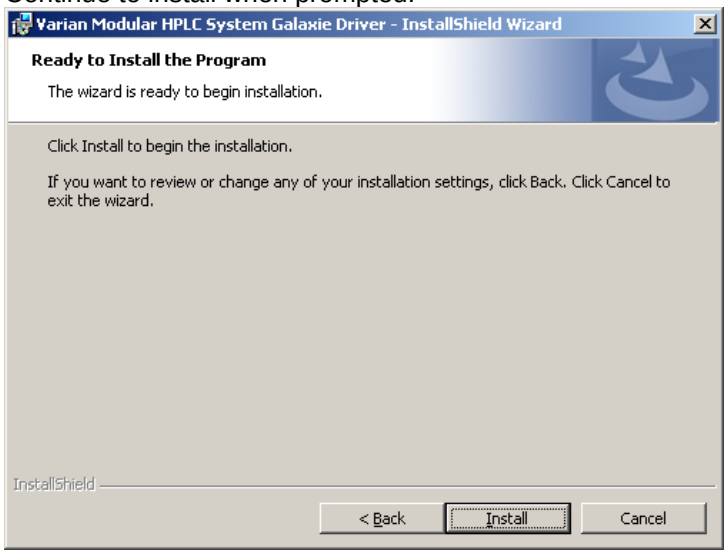
3. Enter the customer information and a valid license number.



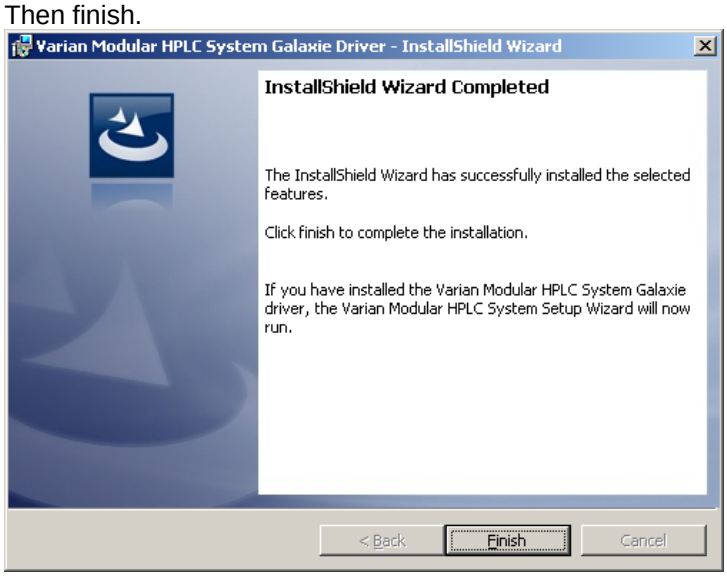
4. Depending on whether you are using Galaxie or not, select what you want to install.



5. Continue to install when prompted.



6. Then finish.

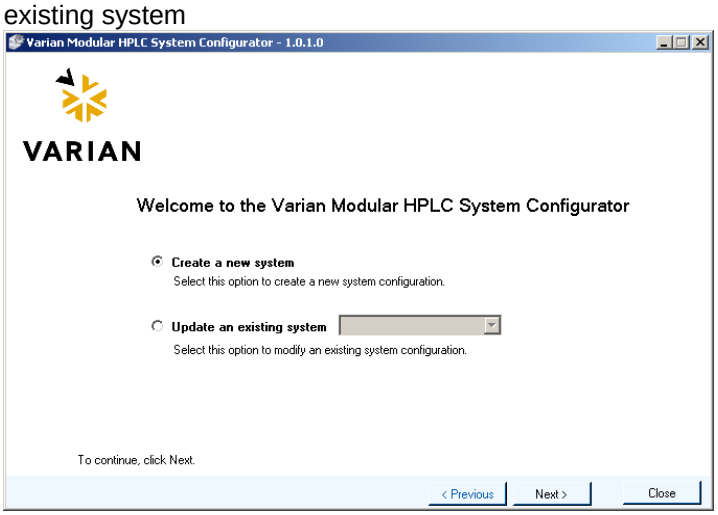


The following sections provides instructions on how to configure your Varian 440-LC Fraction Collector software depending on the system options mentioned above.

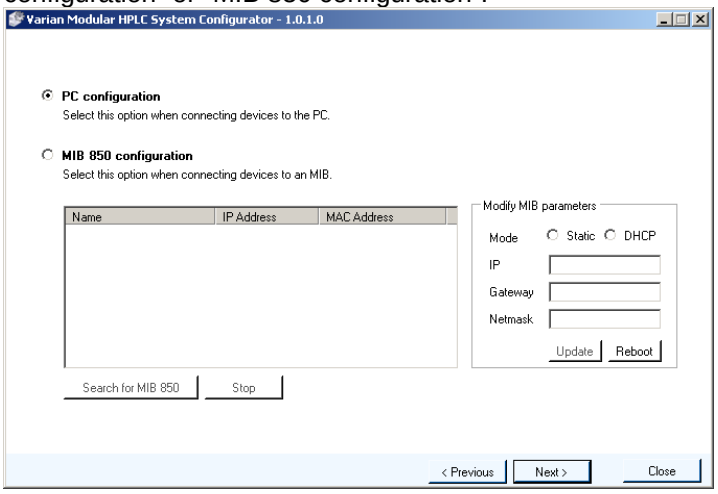
3.2.1 Configuring Fraction Collector in Galaxie Software

In order to operate the Varian 440-LC using Galaxie software, you must configure a system.

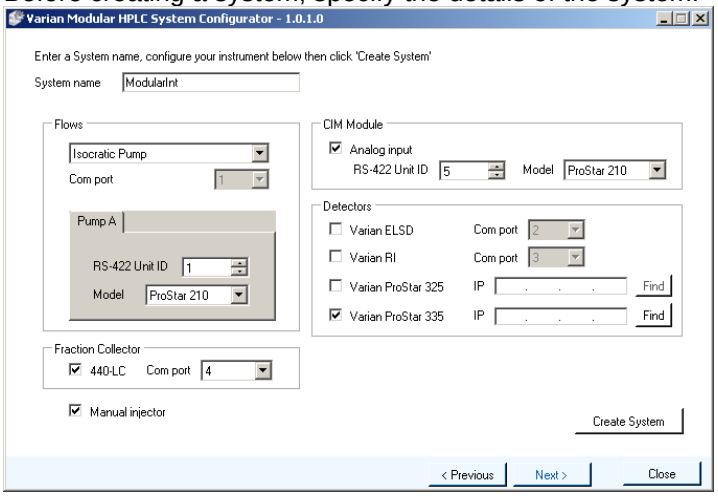
1. Once the software installation is finished, if the galaxie driver was part of the selections in step 4 of section 3.2, the “Setup Wizard” opens up. Select either to create a new system, or to update an existing system



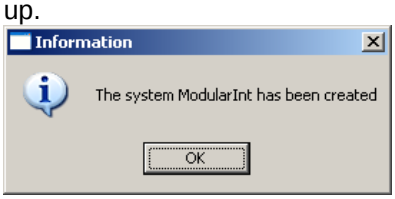
2. Depending on the hardware connections, select “PC configuration” or “MIB 850 configuration”.



3. Before creating a system, specify the details of the system.



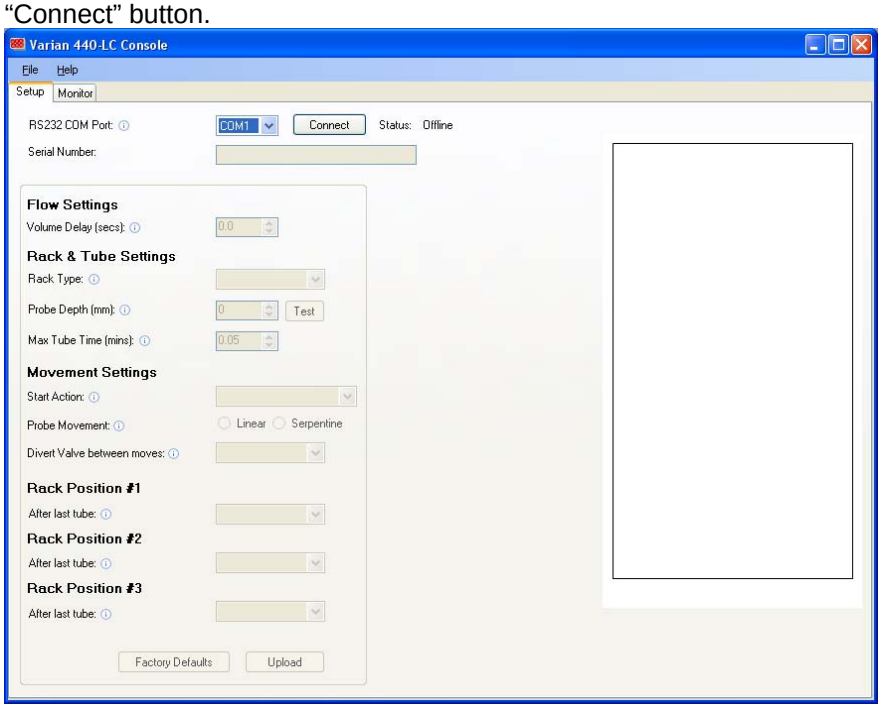
4. Upon clicking the “Create System” button, the specified system will be created in Galaxie. Make sure you acknowledge the pop-up.



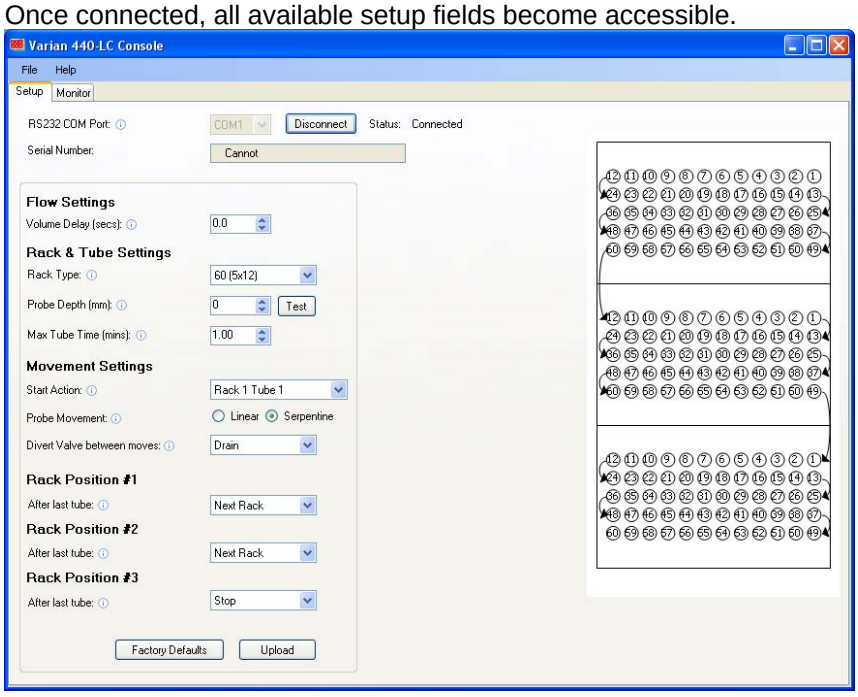
Once you have configured your system go to Section 3.3, in this manual for instructions on how to determine the volume delay and probe depth.

3.2.2 Configuring Fraction Collector with 440-LC console

Open the Varian 440-LC console software. In the opening window, select the COM port to which the fraction collector is connected and click the “Connect” button.



Once connected, all available setup fields become accessible.



Publication no. 8510253500, Issue 1, August 2009

3.3 Determining the Volume Delay and Probe Depth

You will need to determine the volume delay (the length of time it takes for the liquid to go from the outlet of the detector to the probe). Using the volume delay option will help compensate for the extra time required for the sample to reach the collection tube.

You will also need to determine the correct probe depth for the probe to travel across the racks without interference.

See Section 5.6 and 5.7, Page 42 for instructions on how to determine the volume delay and probe depth.

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4. Operation

The Varian 440-LC Fraction Collector can be used in three different configurations:

- With an existing or new modular system and Galaxie software
- With a Varian 900-LC Series HPLC system and Galaxie software
- With a modular system with no software or software other than Galaxie controlling the HPLC. Fraction collector control is through the Varian 440-LC Fraction Collector Console software provided on the driver installation disk.

4.1 Turning on the Instrument and Software

Before starting the Varian 440-LC Fraction Collector, carefully read the Safety Practices and Hazards section at the front of this manual.

Warning – Moving Parts
The probe arm of the Varian 440-LC can move without warning posing a potential hazard due to its moving parts. Do not place your hands or objects near the probe arm when the 440-LC is turned on.

To switch on the Varian 440-LC Fraction Collector:

1. Ensure the Varian 440-LC is connected via a three-pin, earthed power cord to a three-pin, grounded power outlet.
2. Turn on the power using the switch on the connection panel (Figure 8, Page 19), which is located on the rear of the control column.

Note The Varian 440-LC will start up and perform an initialization sequence. The initialization sequence moves the probe arm through the extent of the range of movement and finishes with the probe repositioned at the back left of the fraction collector.

Should the Varian 440-LC fail to initialize, refer to Section 7.6, Page 66.

3. Turn on the software:
   (a) For Galaxie users click **Start > Programs > Galaxie > Galaxie**.
   (b) For non Galaxie systems double-click the Varian 440-LC Console icon on the desktop.

4.2 Creating a Method Using Galaxie Software

When using the Varian 440-LC with an existing or new modular system and Galaxie software, you will find step-by-step instructions for common operations in the Varian Modular HPLC System Help. To access this information click **Start > Programs > Galaxie > Help > Varian Modular HPLC System Help**.

When using the 440-LC with a 900-LC Series HPLC, you will find step-by-step instructions for common operations in the Varian 900-LC Series

HPLC Help. To access this information click **Start** > **Programs > Galaxie > Help > Varian 900-LC Series HPLC Help**.

4.3 Controlling Fraction Collector with 440-LC Console

The Varian 440-LC Console is used to set up and monitor the fraction collector when Galaxie is not used as the HPLC control software.

To setup and monitor the fraction collector:

1. Double-click the Varian 440-LC Console icon to open the control software.
2. Select the correct COM port for your fraction collector communication from the RS232 Com Port drop-down menu.
3. Click **Connect**.
4. Select or enter all required parameters. For information on each setting, hover your cursor over the field or information bubble to view the associated tip.
5. Click **Upload** to save the settings.
6. Click the **Monitor** tab.
7. Place the correct racks and tubes on the fraction collector.
8. The fraction collector will wait for the input signal to start if selected or click **Collect** to start the fraction collector using the settings uploaded in Step 5.

The current rack, tube and divert valve positions are displayed on the Monitor tab. The rack display shows filled tubes and the current tube.

9. To manually move the probe, click Next Rack, Next Tube, or Home.
10. To change the divert valve position click either Valve-Collect or Valve-Drain.

The Monitor Log on the Monitor tab records the tube and rack location of each fraction from each sample. It is recommended that you save this Log by clicking Save Log. Click Clear Log to delete the log information.

The Comms Log records every communication between the fraction collector and the computer. If an error occurs it is recommended you save the Comms Log. Click Clear Log to delete the log information.

Tip To have the Console window stay on top of all other windows, click **File > Stay on Top**.

Tip The Console software window is resizable. Drag the sides until just the Stop, Collect, Next Tube and progress bar are showing for a basic fraction collector Console panel.

5. Maintenance Procedures

5.1 Introduction

The 440 Fraction Collector has been designed for low maintenance and there are no user adjustments necessary under normal operating conditions.

This chapter includes the Varian 440-LC Fraction Collector maintenance requirements that may be carried out by a Field Service Representative (FSR).

5.2 Routine Maintenance

While there are no parts that require frequent maintenance, you should always:

- Confirm that the tubing from the probe to the HPLC system is secure and kink-free.
- Check the probe and tubing for blockages.
- Clean any spills by removing, draining and rinsing the spill tray.

5.2.1 General Cleaning

Cleaning should be performed using warm water and a soft, lint-free cloth. This will help preserve the plastic components and painted surfaces.

Any spills should be wiped up immediately.

To avoid clogging the probe and tubing, a rinse solution should always be pumped through the fraction collector at the end of a run.

If necessary, the fraction collector probe can be removed from the fraction collector and placed in an ultrasonic bath for cleaning.

- The exterior surfaces of the fraction collector should be kept clean and any spills should be wiped up immediately.
- All cleaning should be done with a soft lint free cloth. If necessary, this cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents. This will assist to preserve the plastic components and painted surfaces.
- Check the x-axis and z-axis timing belts for cracks, splits or colour deterioration and belt tension.
- The fraction collector requires little or no lubrication throughout its lifetime; however lubrication of the x-axis shaft should be checked periodically.

5.2.2 Cleaning the Probe

Run washing solution compatible with your HPLC system and current solvent through the fraction collector tubing. If it is completely blocked replace the tubing.

Sonicating the probe and tubing may help clean any particulates out of the tubing. If sonicating the probe and tubing assembly does not remove the blockage, replace it.

For information on how to remove and replace the probe, please see Section 5.5, on page 37.

5.2.3 Cleaning the Spill Tray and Rack Mat

To clean the spill tray and rack mat:

1. Turn the fraction collector off.
2. Remove the racks.
3. Lift up and remove the rack mat.
4. Carefully lift up and remove the spill tray.
5. Clean the spill tray and rack mat.
6. Dispose of any waste in the appropriate manner.

Warning – Chemical Hazard – Inhalation Hazard – Fire Hazard
Tubing may contain residual chemicals which may be harmful if you come in contact with them. Some solvents may have flammable properties. To avoid injury or damage to equipment, consult the MSDS and always follow appropriate safety guidelines when using chemicals and solvents and always wear appropriate safety equipment and clothing.

5.2.4 Lubrication

Lubrication of the x-axis is designed to reduce friction between the carriage block and the left x-axis shaft providing smooth travel of the x-axis carriage. If vibration or erratic movements of the x-axis carriage are observed we recommend you check and lubricate the lubrication pad.

To lubricate the single x-axis shaft, follow the guidelines below:

1. Remove the rear panel. Refer to Section 5.3, Removal and replacement procedures.
2. Remove the x-axis Cover. Refer to Section 5.3, Removal and replacement procedures.
3. Remove the theta-axis PCB. Refer to Section 5.3, Removal and replacement procedures.
4. Rotate the theta-axis driven gear to expose lubrication well.
5. Add 1 mL of DOW CORNING 200 (R) FLUID, 200 CS into the well.
6. To complete, reverse the above procedure.

Warning – Shock Hazard
Death, serious injury, or painful electrical shock can result by contact with the 440-LC circuits, devices and components. This instrument contains electrical circuits, devices and components operating at dangerous voltages.

Warning – Moving Parts
The probe arm of the Varian 440-LC can move without warning posing a potential hazard due to its moving parts. Always switch off the power to the Varian 440-LC before installing or removing parts.

5.3 Component Installation and Replacement Procedures

Information is provided on the following:

- Installing the low delay volume tubing
- Replacing the probe and probe tubing
- Determining the volume delay time
- Determining the probe depth
- Replacing the tubing
- Replacing the fuses

Warning – Chemical Hazard – Inhalation Hazard – Fire Hazard
Tubing may contain residual chemicals which may be harmful if you come in contact with them. Some solvents may have flammable properties. To avoid injury or damage to equipment, consult the MSDS and always follow appropriate safety guidelines when using chemicals and solvents and always wear appropriate safety equipment and clothing.

Where:

1. Theta axis
2. Z axis slide
3. Probe
4. Rack
5. Rack location mat
6. Retaining ring
7. Probe mounting block
8. Knurled mount nut on the probe assembly
9. Ferrule holding the metal probe

Figure 13. Fraction collector components

5.4 Installing the Low Delay Volume Tubing

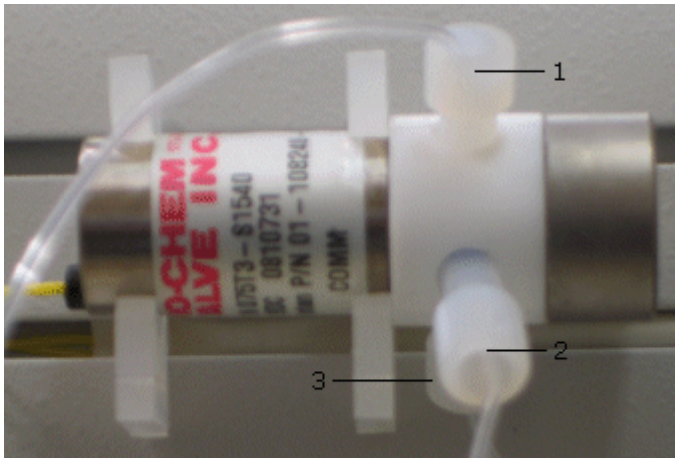
Use this tubing for operation of the fraction collector at or below 1 mL/min or collection of very narrow (<30 seconds wide) peaks to assure good results.

Caution This kit should not be used when operating at flows of 2 mL/min or higher.

Warning – Chemical Hazard – Inhalation Hazard – Fire Hazard
Tubing may contain residual chemicals which may be harmful if you come in contact with them. Some solvents may have flammable properties. To avoid injury or damage to equipment, consult the MSDS and always follow appropriate safety guidelines when using chemicals and solvents and always wear appropriate safety equipment and clothing.

To fit the low delay volume tubing:

1. Identify and remove the tube that runs from the divert valve to the fraction collector probe. (Port 3 on the divert valve).



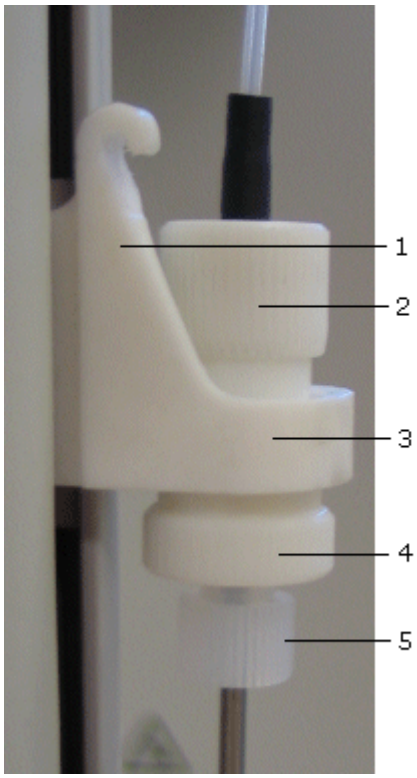
Where:

1. To waste
2. From detector outlet or back pressure restrictor
3. To the probe

Figure 14. Divert valve tubing positions

2. Cut the supplied narrow bore tube (0.10 inch ID or 0.025 cm tubing) to an equal length.
3. Use the original nut and the new ferrule supplied with the tubing kit.
4. Screw the tubing into the divert valve and insert it into the fraction collector probe.
5. Repeat this process for the tubing between the detector or back pressure restrictor and the divert valve, using the original nut and the new ferrule supplied with the tubing kit.
6. Follow the next procedure, ‘Replacing the Probe and Probe Tubing’, to remove the existing tubing and replace it with the low delay volume tubing into the metal probe.

5.5 Replacing the Probe and Probe Tubing



Where:

1. Z axis slide
2. Top knurled mount nut on the probe assembly
3. Probe mounting block
4. Lower knurled mount nut on the probe assembly
5. Ferrule holding the metal probe

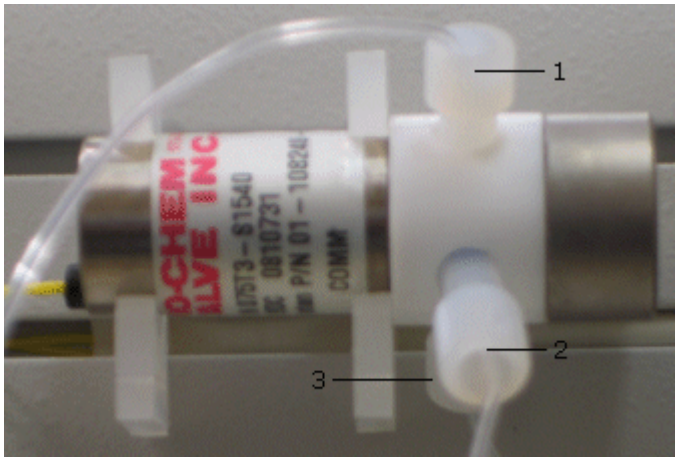
Figure 15. Probe details

Warning – Moving Parts
The probe arm of the Varian 440-LC can move without warning and so poses a potential hazard due to its moving parts. Always switch off the power to the Varian 440-LC before installing or removing the sample probe.

Warning – Chemical Hazard – Inhalation Hazard – Fire Hazard
Tubing may contain residual chemicals which may be harmful if you come in contact with them. Some solvents may have flammable properties. To avoid injury or damage to equipment, consult the MSDS and always follow appropriate safety guidelines when using chemicals and solvents and always wear appropriate safety equipment and clothing.

To remove the sample probe and probe tubing:

1. Turn the fraction collector off.
2. Move the Z-axis slide to the top of the probe carriage.
3. Manually rotate the probe arm so that it can be easily accessed.
4. Unscrew the tubing from the divert valve position 3.



Where:

1. To waste
2. From detector outlet or back pressure restrictor
3. To the probe

Figure 16. Divert valve tubing positions

5. Remove the tubing from the tube restraint in the Z axis slider.
6. Remove the tubing from the split retaining ring at the underside of the housing.

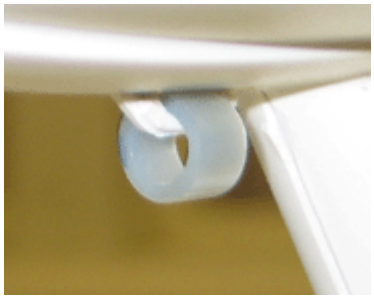
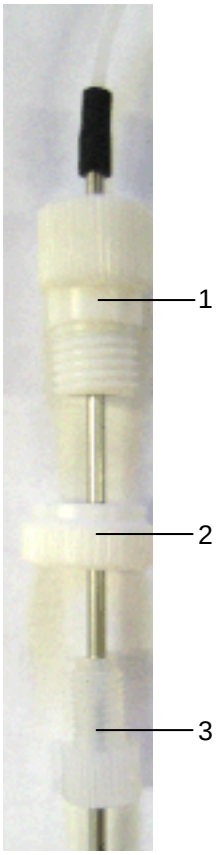


Figure 17. Retaining ring on underside of housing

7. Disassemble the probe by unscrewing the ferrule holding the metal probe from the bottom of the knurled mount and then remove the lower knurled mount nut that retains the knurled mount.



Where:

1. Knurled mount on the probe assembly
2. Lower knurled mount nut on the probe assembly
3. Ferrule holding the metal probe

Figure 18. Probe assembly shown disassembled

8. Lift the probe and tubing out of the Z-axis slide.
9. Pull the tubing out of the probe if you are replacing the tubing.
10. The Tefzel ™ tubing is secured by the black tubing. You will need to fit the black tubing back over the Tefzel ™ tubing and metal probe once the new tubing has been installed.

To install the sample probe and probe tubing:

1. Slide the 1/16 inch OD x 0.20 inch ID Tefzel ™ or the 1/16 inch OD x 0.010 inch ID (for the low delay volume kit) tubing into the stainless steel probe if you are replacing the tubing inside the probe.
2. Push the tubing down into the probe so that at least 0.5 cm tubing protrudes from the end of the probe.
3. Slide the probe into the probe mounting block.
4. Fit and tighten the knurled nut holding the probe to the knurled mount.
5. Fit and tighten the ferrule to the knurled mount.
6. Clip the tubing into the tube restraint in the Z-axis slider. Allow for a little extra length in the tubing to prevent kinking.
7. Feed the tubing through the retaining ring at the underside of the housing. The retaining ring is split to allow you to slide the tubing into it.
8. Screw the tubing fitting into the bottom port of the valve.

Note It is important to ensure that the length of the tubing allows the probe arm to move freely in all axes. If it is too tight, it will restrict movement and may cause movement failure. If it is too loose, the probe arm may become tangled in the tubing as it moves. It is also important to keep the tubing length to a minimum to avoid a large delay volume.

9. Move the probe arm to the front and back of the fraction collector while rotating the probe arm fully to check that the tube is completely free to move. It is also important to keep the minimum length of tubing to minimize the delay volume.
10. Manually position the probe arm at the midpoint along the X axis.
11. Rotate the probe arm through its full extent to check that the tubing is free to allow full movement in all directions.
12. Determine the length of tubing for the sample line to the HPLC system. It is important to keep the minimum length of tubing to minimize the delay volume.
13. The Tefzel ™ tubing is secured by the black tubing. You will need to fit the black tubing back over the Tefzel ™ tubing and metal probe once the new tubing has been installed.
14. Join the probe's Tefzel ™ tubing to the HPLC system's detector outlet or back pressure restrictor if one is present on your system.
15. Determine the volume delay time. See Section 5.6.

Note You will need to reset the volume delay in the Galaxie software or in the 440-LC Fraction Collector Console software.

5.6 Determining the Volume Delay

Warning – Chemical Hazard – Inhalation Hazard – Fire Hazard
Tubing may contain residual chemicals which may be harmful if you come in contact with them. Some solvents may have flammable properties. To avoid injury or damage to equipment, consult the MSDS and always follow appropriate safety guidelines when using chemicals and solvents and always wear appropriate safety equipment and clothing.

To determine the correct volume delay:

You will need a syringe filled with air and a weighed glass cylinder.

1. Turn on the Galaxie™ or the Console software, your HPLC system and the Varian 440-LC Fraction Collector.
2. Select the appropriate system in the Galaxie software or the appropriate COM port and then click **Connect** in the Console software.
3. Turn the divert valve to allow liquid to flow through the probe.

Caution **Caution**
If the divert valve is in the collect position liquid will flow out of the probe. Place a container underneath the probe to catch any liquid to avoid spills which may cause damage to your instrument.

(a) If you are using Galaxie software, double-click the Fraction Collector tile in the Status Overview and then click **Switch valve on**.

(b) If you are using the Varian 440-LC Console, click the **Monitor** tab and then click **Valve – Collect**.

4. Run the flow until there is water (or compatible solvent for your system) from the detector to the fraction collector probe.
5. Stop the flow.
6. Place the empty, weighed glass cylinder under the valve to collect all liquid that comes out.
7. Disconnect the outlet tubing at the detector.
8. Connect the syringe to the end of the tubing.
9. Using the syringe, push air through the tubing until air exits the probe.
10. Weigh the cylinder with liquid and subtract out the weight of the cylinder to get the weight of the liquid.
11. If you are using water at room temperature then 1 µL ≈ 1 µg of water. If your liquid weighed 300 µg then your delay volume is 300 µL.
12. Enter the volume into the volume delay field in either:
    (c) The system parameters tab in the device settings in the Galaxie software. Click **Save System Parameters**.
    (d) The 440-LC Console software on the Setup tab. Click **Upload** to send the information to the fraction collector.

5.7 Determining the Correct Probe Depth

Caution Do not set a probe depth height that will lower the probe into the tube. The probe height should move the probe down to just above the tubes. The probe is not raised up before moving to the next tube.

Instructions are provided for the Galaxie software and 440-LC Console software.

To determine the probe depth using the Galaxie software:

1. Turn on the Galaxie™ Software, your HPLC system and the Varian 440-LC Fraction Collector.
2. Select the appropriate system in the Galaxie software.
3. Scroll to the Fraction Collector area in the System Parameters tab in the Device Settings window.
4. Click in the Probe Depth field to edit the value and then press ENTER on your keyboard or use the arrow buttons to move the probe up or down.

The probe will move to Rack X, position 1 and move to the depth specified. X is the rack number of which of the Probe Depth is being edited.

5. Repeat steps 4-5 until the correct probe depth has been determined.
6. Enter in the Probe Depth to the remaining positions if you are using the same tubes for each rack position.
7. Repeat steps 4-6 for the remaining positions if you are using the different tubes for each rack position.

To determine the probe depth when using the 440-LC Console software:

1. Turn on the 440-LC Console software, your HPLC system modules and the Varian 440-LC Fraction Collector.
2. Select the appropriate COM port and then click **Connect** in the Console software.

3. Enter a probe depth and then click **Test** to move the probe down to that depth.
4. Repeat until the probe sits just above the tube so that it can travel uninterrupted across the tubes.
5. When all other settings are selected in the Console software, click **Upload** to save the settings to the fraction collector.

5.8 Replacing the Tubing

Use this procedure to replace the tubing from the valve to the detector or the valve to the waste.

Warning – Chemical Hazard – Inhalation Hazard – Fire Hazard
Tubing may contain residual chemicals which may be harmful if you come in contact with them. Some solvents may have flammable properties. To avoid injury or damage to equipment, consult the MSDS and always follow appropriate safety guidelines when using chemicals and solvents and always wear appropriate safety equipment and clothing.

To replace the tubing:

1. Turn the flow off.
2. Open the purge valve to release any residual pressure.
3. Unscrew the fitting from the valve at port 1 or 2. See Figure 16, Page 38.
4. Unscrew the fitting at the detector outlet (or back pressure restrictor) if applicable.
5. Replace the tubing and/or fittings as needed. Tighten the nuts to finger-tight.
   Tubing: 0.02 inch ID, 1/16 inch OD
   Nut: Short 1/16" Flangeless Tefzel ™
   Ferrule: 1/16 Flangeless Natural Tefzel ™
6. Close the purge valve.
7. Turn on the flow and check for leaks.
8. Determine the volume delay. See Section 5.6.

5.9 Replacing the Fuse

Replace a blown fuse with one of the same type and rating.

Note Always check the information printed on the back of the fraction collector for the correct fuse type, as this is the most up to date.

Warning – Electrical Shock – Fire Hazard
Use of an incorrect fuse poses a fire hazard and/or increases the risk of an electrical shock. To prevent reduced safety protection or unwanted fusing, always ensure that the marking on the fuse matches the screening shown adjacent to the voltage selector switches.

To check/change the fuse:

1. Disconnect the Varian 440-LC from the mains power supply.
2. Use a thin, flat-blade screwdriver (or similar tool) to pry open the cover of the fuse compartment, which is located on the power supply unit near the bottom of the connection panel on the rear of the Varian 440-LC.

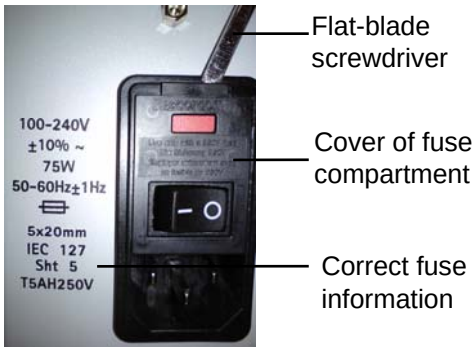


Figure 19. Opening the flap of the fuse compartment

3. Slide out the fuse holder from the compartment.

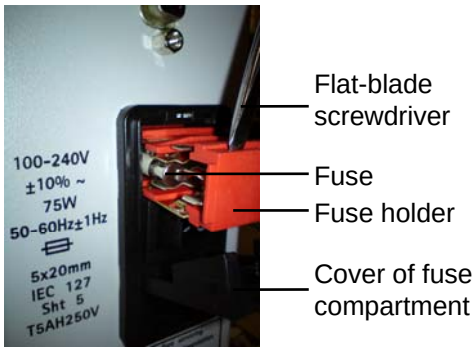


Figure 20. Sliding the fuse holder out of the compartment

4. Check that each fuse is of the correct type and that it is not damaged. If necessary, replace the fuse(s) in the holder.
5. Ensure each fuse is held securely by the prongs inside the holder. If the contact is too loose, remove the fuse from the holder and then use a pair of pliers to compress the distance between the prongs, so as to tighten their grip on the fuse. Replace the fuse.

Figure 21. Fuse holder

6. Slide the fuse compartment back into the compartment and clip the cover back into place, ensure that it clicks into the locked position.
7. Reconnect the power supply cable and switch on power to the unit.

5.10 Removal and installation of covers

5.10.1 Rear panel

Remove the rear panel as follows:

1. Remove the eight M3x6 screws and M3 star washers the secure the rear panel to the column case.
2. Remove and lay the rear panel on the work area, taking care not to stress the rear panel ground strap.
3. If necessary remove the M4x12 screw that secures the ground strap to the rear panel and place the rear panel in a safe area.

Install the rear panel as follows:

1. Secure the rear panel ground strap to the rear panel with the M4 x 12 Screw and two M4 star washers. Order: star washer, ground strap, star washer, M4 x 12 screw.
2. Secure the rear panel to the column case using the eight M3x6 screws and M3 star washers.

5.10.2 Probe arm assembly covers

Remove the probe arm assembly covers as follows:

1. Remove the two M4x10 self-tapping screws and the two M3x12 screws.
2. Remove the front cover from the probe arm.
3. Manoeuvre the probe arm about the theta-axis until the lower edge of the top cover is fully exposed. Unclip the top cover from the probe arm and x-axis cover.
4. Rotate the probe arm to gain access to the rear cover mounting screws.
5. Remove the four M4x10 self-tapping screws and remove the rear cover from the probe arm.

Install the probe arm assembly covers as follows:

1. Position the rear cover on the probe arm, align the mounting holes in the centre plate and secure with the four M4x10 self-tapping screws. Take care not to strip the threads from the mounting posts in the rear cover when tightening the screws.
2. Rotate the probe arm until the rear cover is located behind the x-axis cover.
3. Clip the top cover into position against the x-axis carriage.
4. Rotate the probe arm to engage the lower edge of the top cover behind the rear cover.
5. Position the front cover over the probe arm assembly and align the mounting holes then secure the front cover with the two M4x10 self tapping screws and the two M3x12 screws.

5.10.3 X-axis cover

Remove the x-axis cover as follows:

1. Remove the rear panel.
2. Remove the four M4x20 screws securing the x-axis cover to the column.
3. Slide the probe arm to the end of its travel.
4. Carefully slide the x-axis cover off.
5. Remove the x-axis carriage cover.

Install the x-axis cover as follows:

1. Slide the probe arm to the end of its travel.

2. Align the x-axis cover with the x-axis shafts and carefully slide the x-axis cover into position.
3. Secure the x-axis cover to the column using the four M4x20 screws, ensuring that they align with the mounting points in the x-axis cover.
4. Install the x-axis carriage cover
5. Install the rear panel

5.11 Removal and installation of timing belts

5.11.1 Z-axis timing belt

Remove the z-axis timing belt as follows:

1. Remove the probe arm front cover.
2. Remove the z-axis PCB.
3. Remove the three M3x12 screws that secure the z-axis brace plate to the z-axis centre plate.
4. Carefully remove the z-axis brace plate.
5. Loosen the screw retaining the tensioning idler, and turn the screw out one full turn.
6. Move the tensioning idler just enough to release the pressure on the timing belt. Take care not to stretch the idler spring.
7. Remove the timing belt from the idler pulleys and the z-axis carriage.
8. Remove the timing belt from the stepper motor pulley.

Install the z-axis timing belt as follows:

1. Loosen the screw retaining the idler pulley and gently extend the idler spring to allow the timing belt to pass over the idler pulley during installation. Tighten the screw.
2. Ensure that one idler pulley is located on each of the three spigots provided on the z-axis centre plate, and one on the spigot on the tensioning idler. Ensure that the idler pulleys rotate freely.
3. Route the timing belt over the idler pulleys and the z-axis carriage.
4. Loosen the screw retaining the idler pulley to allow the idler spring to adjust the tension on the timing belt. Tighten the screw.
5. Check that the z-axis carriage moves freely through its full travel along the z-axis shafts.
6. Secure z-axis brace plate to the z-axis centre plate using the three M3x12 screws.
7. Install the z-axis PCB.
8. Install the probe arm front cover.

5.11.2 X-axis timing belt

Remove the x-axis timing belt as follows:

1. Remove the x-axis cover.
2. Remove the probe arm front cover.
3. Turn the M3x6 screw retaining the tensioning idler out one full turn.
4. Move the tensioning idler just enough to release the pressure on the timing belt.
5. Take care not to stretch the idler spring.
6. Remove the timing belt from the idler pulley.
7. Remove the two M4x10 self tapping screws that retain the belt from the x-axis carriage block.

8. Remove the belt clamp from the timing belt.
9. Remove the timing belt by sliding the belt through the slot in the column chassis.

Install the x-axis timing belt as follows:

1. Check that the length of the timing belt is 842 mm for the 440 fraction collector, cut the timing belt to suit if required.
2. Fit the timing belt over the drive pulley on the x-axis stepper motor the feed the timing belt through the slot in the chassis column and over the tensioning idler pulley.
3. Clamp the ends of the timing belt together, three teeth from each end, with the belt clamp.
4. Secure the belt clamp to the x-axis carriage with the two M4x10 self tapping screws.
5. Allow the spring to apply tension to the timing belt. Re-tighten the M3x6 screw.
6. Slide the x-axis carriage along the x-axis shafts several times to ensure smooth movement.
7. Install the probe arm front cover.
8. Install the x-axis cover.

5.12 Removal and installation of PCBs

Caution

Before handling printed circuit board assemblies, ensure that the proper precautions are taken to electrically ground technicians and equipment. This is to prevent potential damage to the printed circuit board assemblies by static discharge.

5.12.1 FFC cable connectors

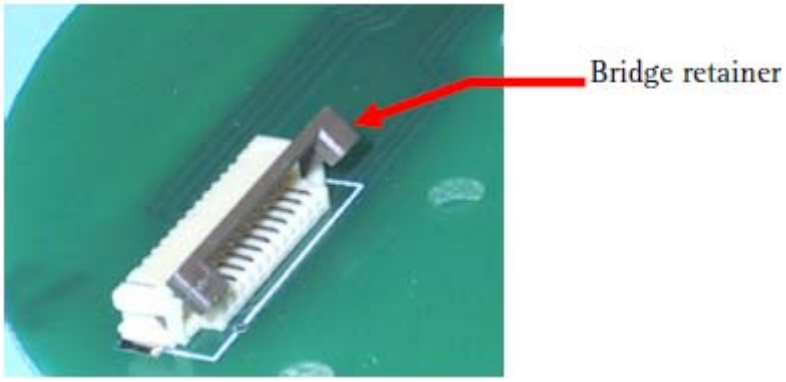


Figure 23. PCB cable connector

1. Carefully open the bridge retainer of the connector by sliding forward of the connector and lifting up; see Figure 5.
2. Gently slide the FFC cable fully into the connector ensuring the cable is central to the connector and with the blue stripe on the cable showing.
3. Pull the bridge retainer of the connector down and slide back into the connector to lock the cable into position.

Figure 24. PCB cable connected

5.13 Remove and install the x-axis encoder PCB

5.13.1 Remove the x-axis encoder PCB

1. Remove the rear cover.
2. Disconnect the x-axis FFC and motor cable.
3. Remove the two M3x6 screws and star washers.
4. Carefully remove x-axis encoder PCB so as not to damage the encoder wheel.

5.13.2 Install the x-axis encoder PCB

1. Locate the x-axis encoder PCB on the x-axis motor bracket. Ensure that the encoder wheel can turn freely through the encoder sensor mounted to the PCB.
2. Secure the x-axis encoder PCB to the x-axis motor bracket using two M3x6 Screws.
3. Install and check the encoder wheel alignment.
4. Connect the x-axis FFC and motor cable.
5. Install the rear cover.

5.14 Remove and install the theta-axis PCB

5.14.1 Remove the theta-axis PCB

1. Remove the x-axis cover.
2. Disconnect the x-axis FFC cable from the theta-axis PCB.
3. Unclip the ferrite from theta-axis PCB, taking care not to damage the FFC cable.
4. Disconnect the theta-axis stepper motor cable from the theta-axis PCB.
5. Disconnect the z-axis FFC cable from the theta-axis PCB.
6. Turn the each of four M4x10 self tapping screws securing the theta-axis PCB to the x-axis carriage a half a turn. Do not remove these screws.
7. Taking care not to damage the encoder wheel or encoder, slowly slide the theta-axis PCB from the securing screws – rotating the PCB clockwise whilst sliding out will help in removal.

5.14.2 Install the theta-axis PCB

1. Align the slots in the theta-axis encoder PCB with the four M4x10 self tapping screws in the top of the x-axis carriage assembly.

2. Ensure that the encoder wheel has located inside the sensor pick-up area and carefully slide the theta-axis Encoder PCB fully home against the screws and tighten all four screws.
3. Install and check the encoder wheel alignment.
4. Connect the theta-axis motor cable to the theta-axis PCB.
5. Install the x-axis cover.

5.15 Remove and install the z-axis encoder PCB

5.15.1 Remove the z-axis encoder PCB

1. Remove the probe arm front cover.
2. Remove the z-axis FFC cable clamp and disconnect the FFC cable. Take care not to damage the FFC cable.
3. Disconnect the z-axis motor cable.
4. Remove the two M3x6 screws that secure the z-axis PCB to the captive nuts on the z-axis centre plate.
5. Carefully remove the z-axis PCB.

5.15.2 Install the z-axis encoder PCB

1. Locate the z-axis encoder PCB on the centre plate; ensure the encoder wheel can turn freely through the encoder sensor mounted to the PCB.
2. Secure the z-axis encoder PCB to the captive nuts on the z-axis centre plate using the two M3x6 screws.
3. Locate the side of the sensor with the white diode symbol.
4. Install and check encoder wheel alignment.
5. Connect the z-axis FFC and motor cable.
6. Install the probe arm front cover.

5.16 Remove and install the main PCB

5.16.1 Prepare the main PCB for installation

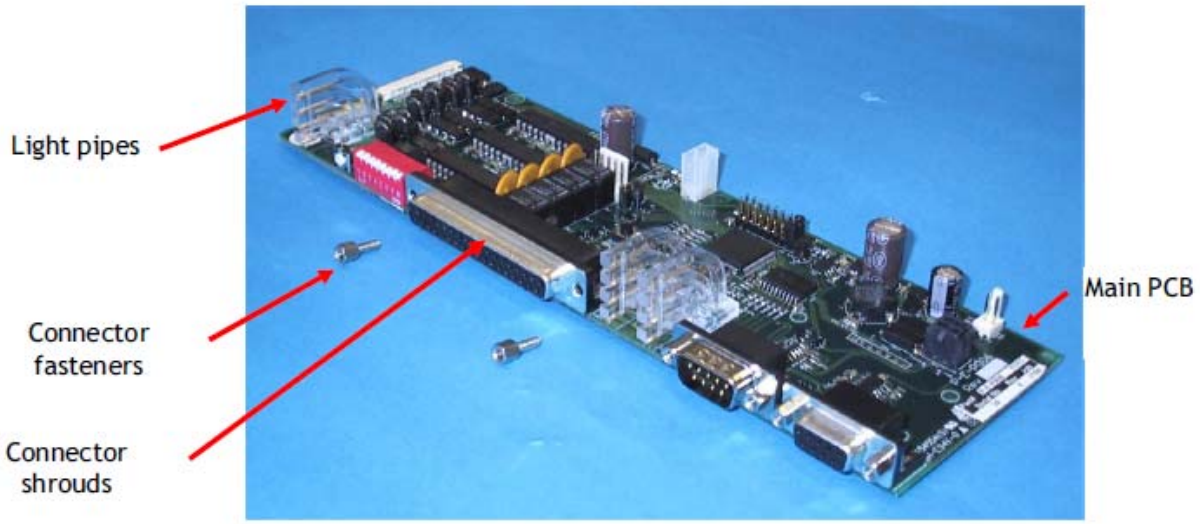


Figure 25. Preparing the main PCB for installation

1. Ensure that the three light pipes on the 440 fraction collector have been fitted to the PCB.

2. Take note of the orientation of the connector shrouds, as they are free to fall off the connectors when the connector fasteners are removed.
3. Remove the six connector fasteners from the connector shrouds and retain.

5.16.2 Remove the main PCB

1. Remove the rear panel
2. Disconnect accessories cable if fitted.
3. Disconnect the power cable.
4. Disconnect the x-axis and theta-axis FFC.
5. Remove the six connector fasteners.
6. Remove the three M3 x 12mm screws and M3 star washers that secure the main PCB.
7. Carefully remove the main PCB and discard.

5.16.3 Install the main PCB

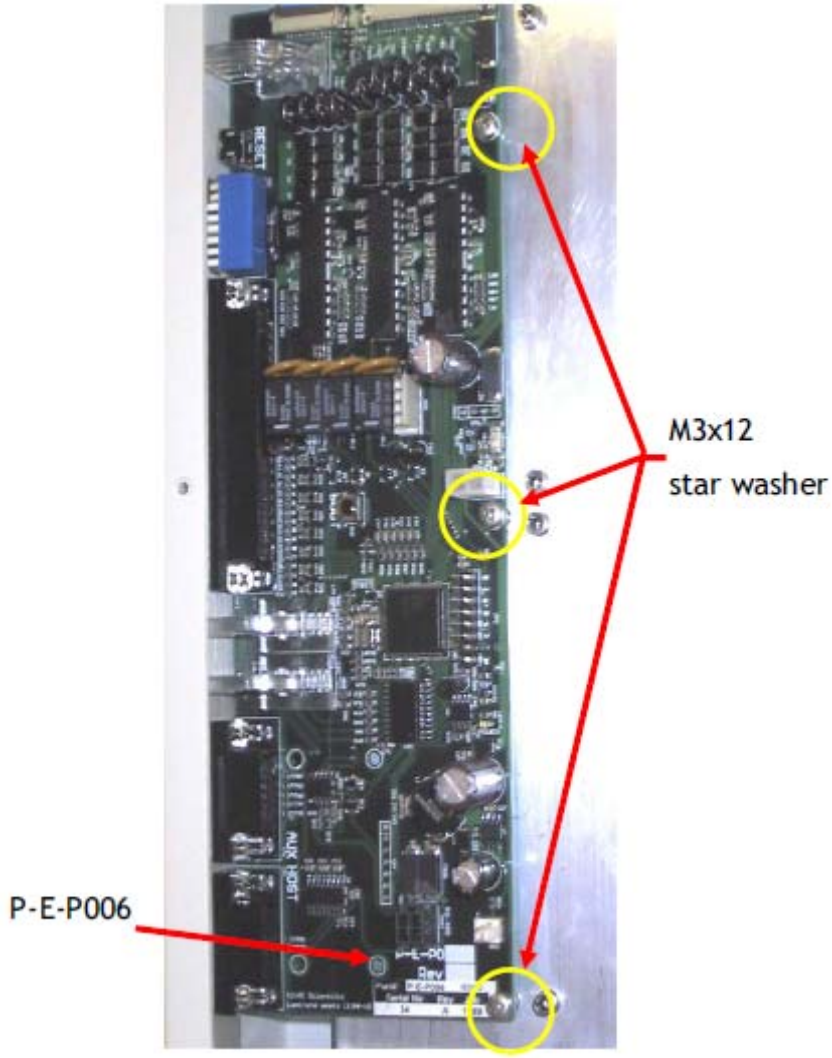


Figure 26. Install the main PCB

1. Position the main PCB with the light pipes and connectors correctly located in the cut-outs in the side of the column case.
2. Move the main PCB as required aligning the three mounting holes in the main PCB with the PCB spacers.

3. Secure the main PCB in position with three M3 x 12mm screws and M3 star washers; refer to the circles on Figure 8 for mounting locations.
4. Insert the six connector fasteners through the case to the connector shrouds and fasten.
5. Connect the x-axis and theta-axis FFC.
6. Connect the power cable.
7. Connect the accessories cable if fitted.
8. Install rear panel.

Note After installation of a new main PCB, recalibration of the fraction collector is necessary.

5.17 Remove and install the accessories PCB

5.17.1 Remove the accessories PCB

1. Remove the rear panel.
2. Disconnect the accessories cable from the accessories PCB.
3. Disconnect the daisy chain accessories cable if fitted.
4. Remove the four M3 x 12mm screws and M3 star washers that secure the accessories PCB.
5. Carefully remove the accessories PCB and discard.

5.17.2 Install the accessories PCB

1. Move the accessories PCB as required aligning the four mounting holes with the PCB spacers.
2. Secure the accessories PCB in position with four M3 x 12 mm screws and M3 star washers.
3. Connect the accessories cable to the accessories PCB.
4. Connect the daisy chain accessories cable if fitted.
5. Check that the address on the board is correct.
6. Install the rear panel.

5.18 Remove and install the x-axis stepper motor

5.18.1 Remove the x-axis stepper motor

1. Remove the rear cover.
2. Remove the x-axis cover.
3. Remove the x-axis PCB.
4. Loosen the grub screw on the Encoder wheel and remove the encoder wheel.
5. Loosen the x-axis belt tension by using the x-axis tensioning idler.
6. Remove the belt from the x-axis idler pulley and x-axis drive pulley.
7. Loosen the grub screw on the drive pulley and remove the pulley.
8. Remove the spacer.
9. Loosen the two M4x12 screws and carefully remove the x-axis motor bracket and stepper motor.
10. Remove the four M3x6 screws and star washers from the x-axis motor bracket and discard the x-axis stepper motor.

5.18.2 Install the x-axis stepper motor

1. Secure the x-axis motor bracket to the stepper motor with the four M3x6 mm screws ensuring that the PCB mounting holes are orientated to the same side of the stepper motor as the wiring connections.
2. Slide the spacer down the stepper motor shaft.
3. Slide drive pulley down the stepper motor shaft until firmly positioned against spacer.
4. Rotate the drive pulley on the stepper motor shaft to align the grub screw to the flat of the stepper motor shaft and tighten.
5. Slide the x-axis motor bracket into the slot in the chassis column.
6. Tighten the two M4x12 screws to retain the x-axis motor bracket in position.
7. Fit the timing belt over the drive pulley on the x-axis stepper motor and over the tensioning idler pulley.
8. Using the x-axis tensioning idler, allow the spring to apply tension to the timing belt. Re-tighten the screw.
9. Slide the x-axis carriage along the x-axis shafts several times to ensure smooth movement.
10. Slide the encoder wheel onto the stepper motor shaft.
11. Rotate the encoder wheel to align the grub screw to the flat of the stepper motor shaft and tighten.
12. Install the x-axis PCB.
13. Install the x-axis cover.
14. Install the rear cover.

5.19 Remove and install the theta-axis stepper motor

5.19.1 Remove the theta-axis stepper motor

1. Remove the x-axis cover.
2. Remove the theta-axis PCB.
3. Loosen the grub screw on the theta-axis encoder wheel and slide the encoder wheel off the motor shaft.
4. Loosen the grub screw from the stepper motor drive gear and slide the gear off the motor shaft.
5. Slide the spacer off the motor shaft.
6. Rotate the theta-axis driven gear so that it is possible to remove the four M3x6 screws that hold the theta-axis stepper motor to the x-axis carriage block.
7. Remove the four M3x6 screws that hold the theta-axis stepper motor to the x-axis carriage block. Take care not to damage the theta-axis driven gear.
8. Carefully remove the theta-axis stepper motor.

5.19.2 Install the theta-axis stepper motor

1. Carefully feed the theta-axis stepper motor cable into the x-axis carriage block.
2. Orientate the theta-axis stepper motor into the x-axis carriage block with the wires facing the column.
3. Secure the theta-axis stepper motor to the x-axis carriage block using the four M3x6 screws. Take care not to damage the theta-axis driven gear.
4. Slide the spacer onto the stepper motor shaft.

5. Rotate the drive gear to align the grub screw to the flat of the stepper motor shaft.
6. Push the drive gear fully home and tighten the grub screw.
7. Slide the encoder wheel onto the stepper motor shaft
8. Rotate the encoder wheel to align the grub screw to the flat of the stepper motor shaft and tighten.
9. Install the theta-axis PCB.
10. Install the x-axis cover.

5.20 Remove and install the z-axis stepper motor

5.20.1 Remove the z-axis stepper motor

1. Remove the probe arm covers.
2. Remove the z-axis timing belt.
3. Loosen the grub screw securing the encoder wheel, and carefully remove the encoder wheel.
4. Remove the two M3x12 screws and M3 star washers securing the stepper motor to the z-axis centre plate.
5. Remove the two M3x6 screw and star washers that secure the stepper motor and centre plate to the theta-axis shaft.
6. Remove the stepper motor and discard.

5.20.2 Install the z-axis stepper motor

1. Secure the stepper motor and centre plate to the theta-axis shaft using the two M3x12 screws and star washers.
2. Secure the stepper motor to the z-axis centre plate using the two M3x6 screws and star washers.
3. Install and check encoder wheel alignment.
4. Install the z-axis belt.
5. Install the probe arm covers.

5.21 Install and check encoder wheel alignment

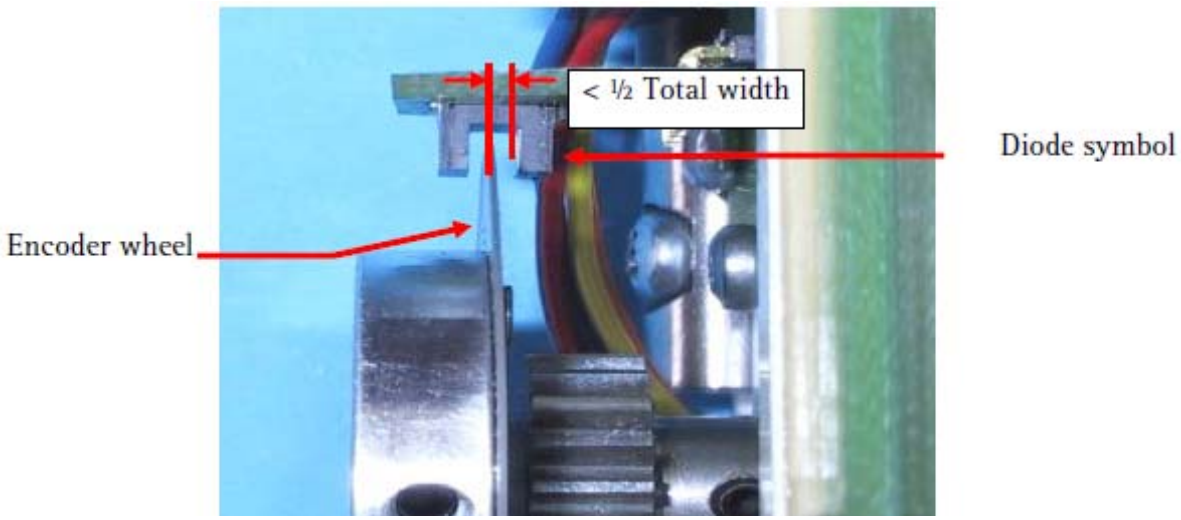


Figure 27. Encoder wheel alignment

1. Check the position of the encoder wheel. The clearance between the encoder wheel and the side of the encoder sensor bearing the diode symbol should be less than half the total gap.

2. Tighten the grub screw to secure the encoder wheel to the stepper motor shaft.

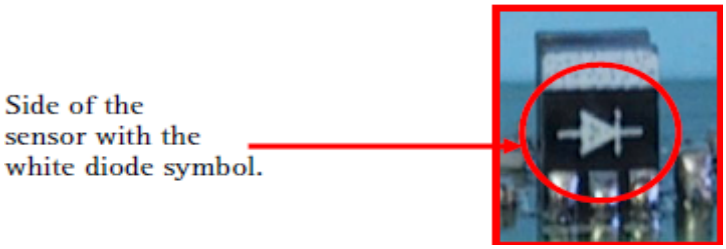


Figure 28. Encoder wheel alignment

Note The encoder sensor bears the symbol for a diode on one side. Ensure the position of the encoder wheel is closest to this side; the closer the better. However, ensure that the encoder wheel does not rub on the sensor.

5.22 Remove the z-axis shafts

1. Remove the probe arm covers.
2. Rotate the theta arm to gain access to the z-axis shafts.
3. Slide the z-axis carriage to the bottom of its travel.
4. Carefully slide the two z-axis shafts through the holes in the upper tab of the z-axis centre plate and the z-axis carriage.

5.23 Install the z-axis shafts

1. Carefully slide the two z-axis shafts through the holes in the upper tab of the z-axis centre plate and the z-axis carriage.
2. Locate the z-axis shafts into the retaining holes in the accessories plate and press until fully home.
3. Holding the shafts in place, check that the z-axis carriage moves freely through its full travel along the z-axis shafts.
4. Install the probe arm covers.

5.24 Remove the power supply

1. Remove the rear panel.
2. Disconnect the 6-way power cable connector and the 5-way ground cable connector from the power supply.
3. Remove the three M4x8 screws and star washers that secure the power supply.
4. Remove and discard the power supply.

5.25 Install the power supply

1. Align the lower screw mounting holes and insert and tighten two M4 x 8 mm screws with star washers.
2. Insert one M4 x 8 mm screw with star washer into the power supply top-mounting lug and tighten the screw
3. Connect the 6-way power cable connector and the 5-Way ground cable connector to the power supply.
4. Install the rear panel.

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6. Spare Parts

For additional spare parts and consumables ordering information, refer to the Varian, Inc. Web site: www.varianinc.com

6.1 Consumables

6.1.1 Sample Racks

Type	Capacity no. tubes x OD	Part number
21	21 x 30 mm	6610026600
24	24 x 25 mm	6610026500
40	40 x 20 mm	6610025500
60	60 x 16 mm	6610025400
90	90 x 13 mm	6610026400
128	128 x 12 mm (4 mL capacity)	7910056000
200	200 x 15 mm (2 mL capacity)	7910060100

6.1.2 Rack Overlays

These overlays are designed to improve the location of 18 mm OD and 16 mm OD tubes in the respective racks.

Description	Part number
Kit, Rack Conversion for Type 40 rack, 18 mm OD holes.	6610026000
Kit, Rack Conversion for Type 60 rack, 16 mm OD holes.	6610026100

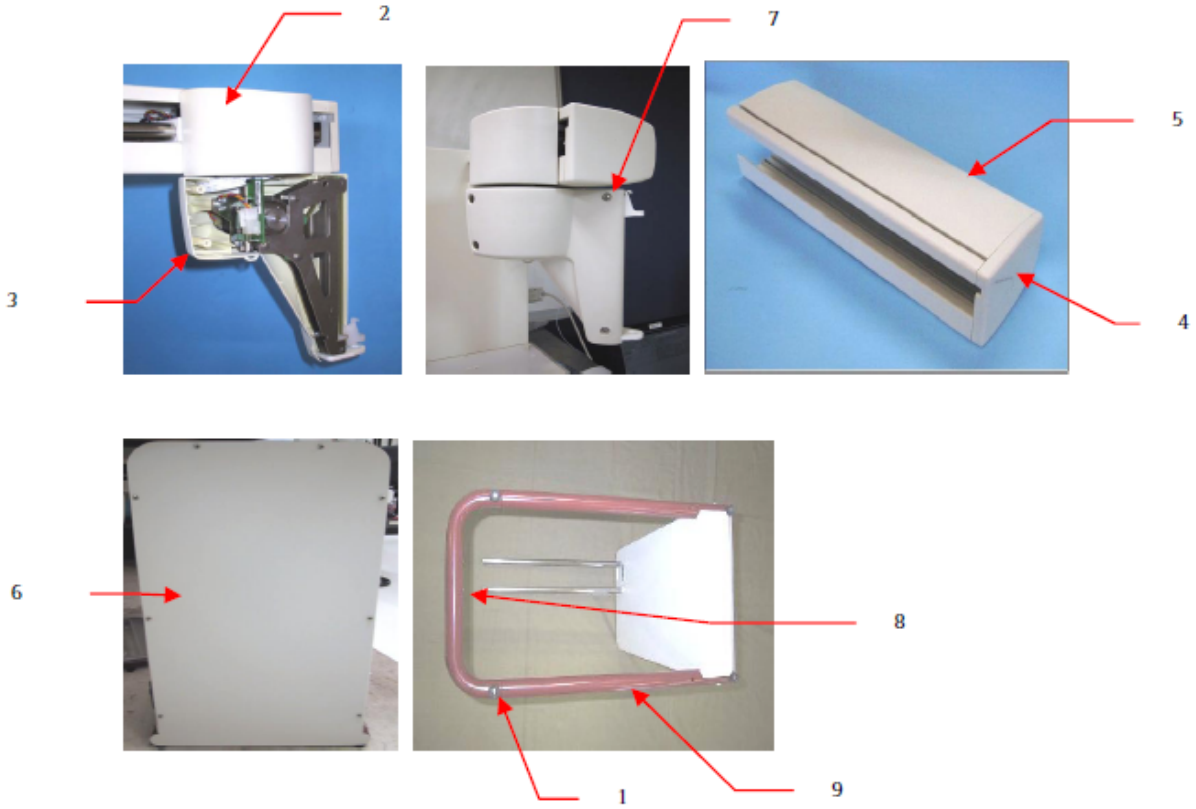
6.1.3 Tubing and Probes

Description	Part number
Kit probe 0.020" ID SS Sleeved 440-LC	9910130800

6.1.4 Miscellaneous Spares

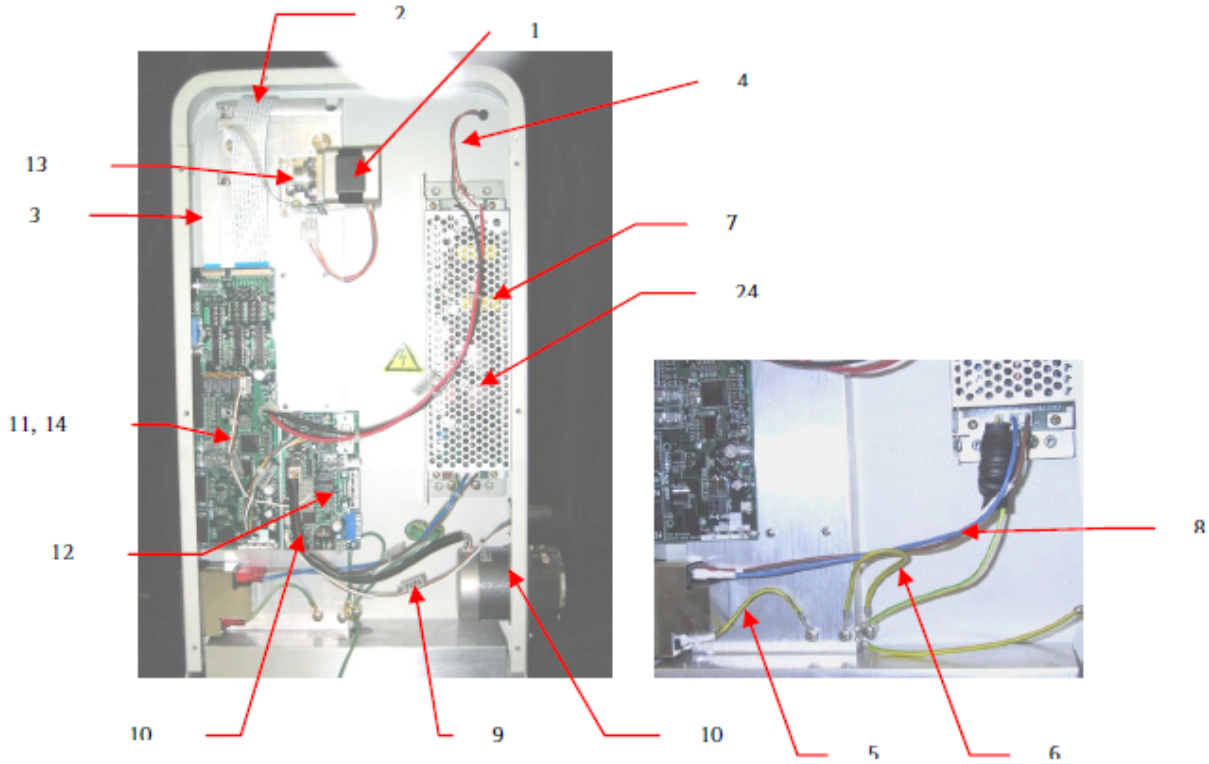
Description	Part number
Polypropylene tubes 16 mm OD x 125 mm height (bag of 125 tubes)	3710051100
Fraction collector spill tray	6610025100
Trolley (cart) for the fraction collector. Features lockable wheels and lower shelf for storage.	9910056300
2 mL screw top wide opening clear glass vials, 12x32 mm, 9 mm red caps with PTFE/Silicone liners	0392611549
4 mL screw top amber glass vials, 15x45 mm, 13 mm black caps with PTFE/Silicone liners	0392611602
Fuse 5 A 440-LC FC	1910009100
Fuse 3.15 A 440-LC FC	1910010700

6.2 Covers



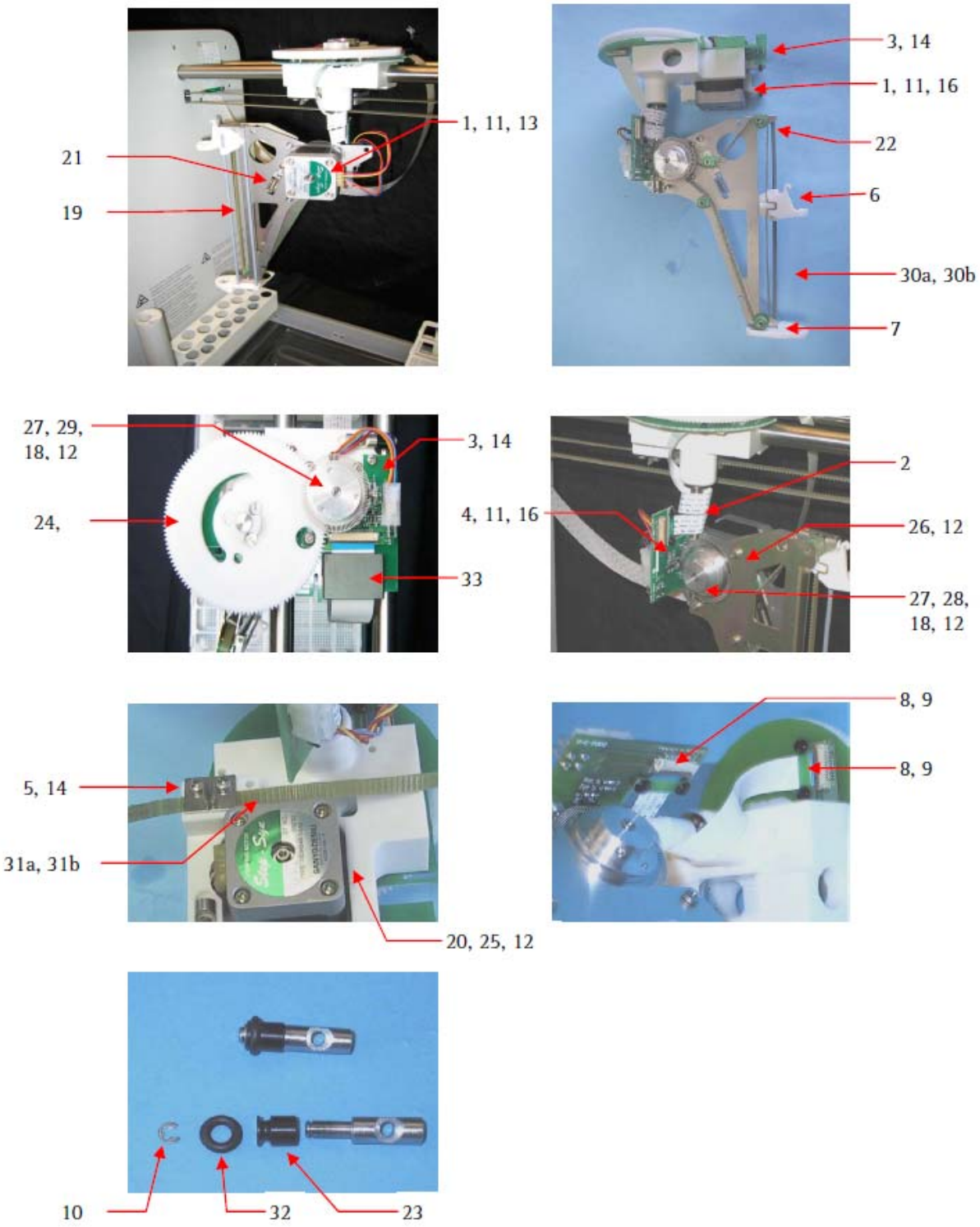
ID	Description	Part number
1	Mount foot rubber	0810167400
2	Cover top	0910188700
3	Cover probe arm back (SPS3)	0910188900
	Cover probe arm front (SPS3)	0910189100
4	Cover x-axis end cap	0910189200
5	Cover x-axis (SPS3)	0910195300
6	Cover back panel (SPS3)	0910195600
7	Cover screw caps (probe arm)	0910197100
8	Base support tube	3710047400
9	Base leg	4110061300
	Spill tray (SPS3)	6610025100
	Platten 440 LC (plastic spill tray)	0910281300
	Spring pin	1510249800
	Screw M3 x 6mm	1510250500
	Screw M3 x 12mm	1510250700
	Screw M8 x 30 cap	1510250900
	Screw M4 x 10mm	1510251100
	Washer star M3	1510251500
	Washer star M4	1510251600
	Screw M4 x 16mm	1510254700
	Screw M4 x 8mm	1510254800
	Assy Main Cover 440-LC	0110824500
	Drain Pipe	0110827500

6.3 Control Electronics



ID	Description	Part number
1	Assy stepper motor	0110726290
2	Assy cable theta-axis FFC	0110728000
3	Assy cable z-axis and x-axis FFC	0110728100
4	Assy loom LED	0110728300
5	Assy loom AC earth	0110728400
6	Assy loom ground wire	0110728500
7	Assy loom DC power	0110728600
8	Assy loom AC power	0110728700
	Assy cable DB9F to DB9M extension	7910046300
	Assy cable aux com/control	0110729100
	Assy loom 3-way valve (includes solenoid)	0110824700
11	Assy pwb main (440-LC)	0210225790
13	Assy pwb x-axis encoder	0210185190
15	Screw M3 x 6 mm	1510250500
16	Screw M3 x 12 mm	1510250700
17	Washer star M3	1510251500
18	Washer star M4	1510251600
19	Screw M4 x 8 mm	1510254800
20a	Fuse 5 A	1910009100
20b	Fuse 5 A	1910009100
21	Mains connector socket	4410009700
22	Encoder wheel	5410047100
23	Encoder wheel hub	5410047200
24a	Power supply – 75 W (SPS3)	7910045090

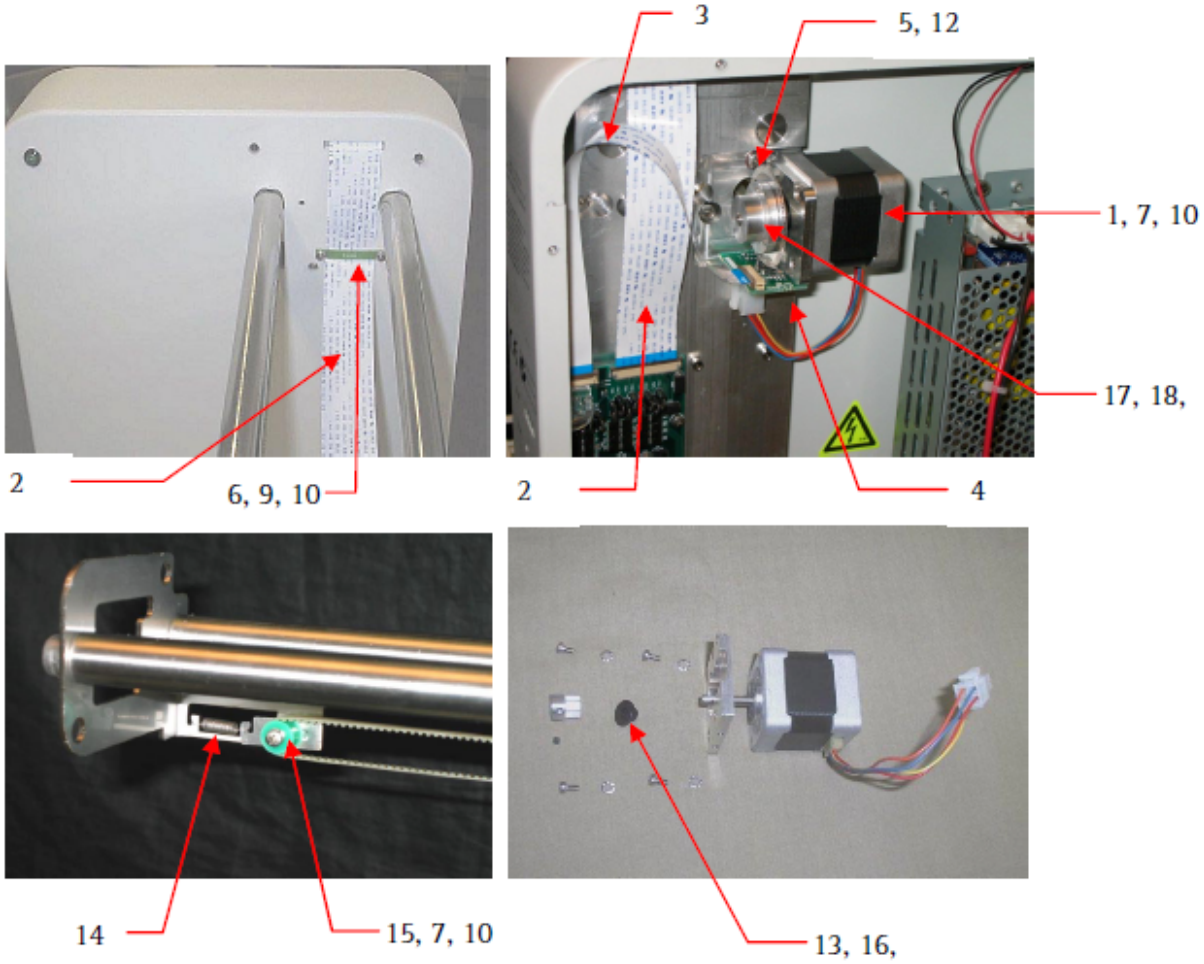
6.4 Probe Arm



ID	Description	Part number
1	Assy stepper motor	0110726290
2	Assy cable z-axis and x-axis FFC	0110728100
3	Assy pwb theta-axis encoder	0210185090
4	Assy pwb z-axis encoder	0210185290
5	Belt clamp	0810162400
6	Z-axis carriage	0810166500
7	Accessories plate	0810167100
8	Cable clamp z-axis	0810168200
9	Snap rivets plastic	1510249700
10	Circlip	1510250100

11	Screw M3 x 6 phillips	1510250500
12	Grubscrew	1510250600
13	Screw, M3 x 12	1510250700
14	Screw M4 x 10 self tapping	1510251100
15	Clip, 10 mm shaft retainer	1510251300
16	Washer M3	1510251500
17	Screw, M4 x 6 csk	1510253700
18	Screw, M2 x 6 csk	1510254600
19	Shaft, z-axis	4110060300
20	Spacer – theta-axis motor	4210087400
21	Spring, idler	4610034500
22	Pulley, idler	5410046600
23	Roller stub axle	5410046700
24	Gear, theta-axis drive	5410046800
25	Pulley, drive theta-axis	5410046900
26	Pulley, drive z-axis	5410047000
27	Encoder wheel	5410047100
28	Encoder wheel hub – theta	5410047200
29	Encoder wheel hub – z-axis / x-axis	5410047300
30a	Belt timing – 500 mm	5410047400
31a	Belt timing – 880 mm (cut to 842 mm)	5410047500
32	O-ring	6910041200
33	Ferrite cable shield	7410007200
34	Lubricating fluid 200cs	8210038900

6.5 Probe Arm: X-axis



ID	Description	Part number
1	Assy stepper motor	0110726290
2	Assy cable theta-axis FFC	0110728000
3	Assy cable z-axis and x-axis FFC	0110728100
4	Assy pwb x-axis encoder	0210185190
5	Clamp plugs	0810166600
6	Clamp, theta cable	0810168100
7	Screw M3 x 6 Phillips	1510250500
8	Grubscrew	1510250600
9	Screw M3 x 12	1510250700
10	Washer M3	1510251500
11	Screw, M2 x 6 csk	1510254600
12	Screw, M4 x 16	1510254700
13	Spacer, nylon	4210089900
14	Spring, idler	4610034500
15	Pulley, idler	5410046600
16	Pulley, drive	5410047000
17	Encoder wheel	5410047100
18	Encoder wheel hub	5410047200
	Solenoid Mount	0810212500

6.6 Special tools

ID	Description	Part number
1	Posidrive screwdriver, No. 2	7210027900
Kit Alignment SPS3		**9910121600**
2	Tool accuracy confirmation jig SPS3	7211088300
3	Tool calibration probe SPS3	7211094800
4	CD SPS autosampler service training	8510210000

7. Diagnostics and Troubleshooting

This is a quick guide to identifying and correcting possible problems with your fraction collector. The list of problems is not exhaustive, so if you cannot correct the problem using the information provided you should contact your Varian representative.

Information is provided on the following:

- Fractions not correlating to the tick marks on the Galaxie software
- Liquid is not delivered to the tubes
- Probe hits the top of the tubes or is not low enough
- The arm is not moving correctly in the X, theta or Z axes
- The fraction collector shows offline in Status Overview
- The green indicator on the front of the fraction collector is off
- The CPU activity LEDS on the rear of the fraction collector are off
- Fraction collector is not initializing
- Error status LEDs are showing an error

Warning – Shock Hazard
Access to the power supply unit and components requires removal of the main housing. This should only be carried out by a Varian representative.

ALWAYS replace the fuses located in the pull-drawer of the fraction collector input switch unit with those of exactly the same type and rating specified.

Symptom	Possible Cause	Suggested Remedy
Fractions not correlating to the tick marks on the Galaxie software	Delay volume incorrect	Determine the correct delay volume and enter it into the System Parameters or Console software. See Section 5.6, Page 40.
Liquid is not delivered to the tubes	Tubing is clogged	Check the tubing for blockages and replace if necessary. See Section 5.8, Page 42.
	Probe is clogged	Clean the probe. See Section 5.2.2, Page 33. Replace the probe. See Section 5.5, Page 37.
	Valve is sticking	Replace the valve. Contact your Varian representative.
Probe hits the top of the tubes or is not low	The probe depth is not set correctly	Set the probe depth. See Section 5.7, Page 41.

Symptom	Possible Cause	Suggested Remedy
enough	The wrong rack is chosen	Choose the correct rack in System Parameters or the 440-LC Console software. See the 900-LC Series HPLC Help or the 440-LC Fraction Collector Console software Help tips.
	The wrong vials are being used	Replace with the correct vials.
The arm is not moving correctly in the X, theta or Z axes	Motor not operating correctly	Run the Reset procedure. See Section 7.1, Page 63. Run the Self-test procedure. See Section 7.2, Page 64. Contact your Varian representative if a test fails.
The fraction collector shows offline in Status Overview	Fraction collector is turned off	Turn the fraction collector on. Check the power cable connections. Check the fuses. See Section 5.9, Page 42.
	Fraction collector is on but not communicating	Check the RS232 cable connections. Reboot the fraction collector. Troubleshoot communication. See Section 7.5, Page 65. Check the LEDs. See Section 7.3, Page 64.
The green indicator on the front of the fraction collector is off	Indicator may be faulty	Turn off the fraction collector. Wait 10 seconds before turning the unit on again. If the unit initializes but the light does not come on then the indicator is faulty.
	Fuse has blown	Replace the fuse. See Section 5.9, Page 42.
	No mains power	Check the mains supply.
	Internal power supply is faulty.	Contact your Varian representative.
The CPU activity LEDS on the rear of the fraction collector are off	The indicator is faulty.	Turn off the fraction collector. Wait 10 seconds before turning the unit on again. If the probe arm initializes but the light does not come on then the indicator is faulty. Further confirmation of a failure can be confirmed by observing the status of the other LED indicators, the communications, and by resetting the fraction collector by powering it off and, then on. If it does not perform the initialization sequence by driving the probe arm there is a fault.
	The main electronics board is faulty.	Contact your Varian representative.
	The internal power supply is faulty.	Contact your Varian representative.
Fraction collector is not initializing	Probe arm or probe are unable to move to the correct positions.	Turn the power off to the fraction collector. Check for mechanical obstructions. Turn the fraction collector on to allow it to attempt the reset procedure. Watch where the fraction collector fails during the initialization procedure. See Section 7.6, Page 66. Contact your Varian representative.
Error status LEDs are showing an error	See Section 7.3, Page 64.	

7.1 Reset Procedure

The reset procedure identifies problems with the movement of the fraction collector on the X and Theta axes. If the unit successfully completes the reset procedure, then the motor's operation and the action of the carriages is correct.

Reset is initiated by depressing the recessed button. A small pointed device is required to depress the switch on the connection panel.

7.2 Self-Test Sequence

The self-test sequence tests that the fraction collector functions on X, Theta, and Z axes by moving through the standard and sample positions for the currently loaded rack settings. It does not test the serial communications. If the self-test sequence is successful, it is only necessary to check the serial port connection to the instrument PC.

7.3 Error Status Indicator Codes

Error indicators have been provided to give a quick view of the status of the fraction collector and of the possible cause of incorrect functioning of the unit. Refer to image above for the location of the error indicator LEDs.

The error indicators are a line of blue LEDs on the side panel of the fraction collector. They are used to provide a visual indicator of an error that has occurred with the fraction collector. Other more extensive error reporting is available via the software commands.

The error indicators illuminate to show the binary error code for the fault. E4 is the least significant bit in the binary code.

If an error occurs, the binary error code is indicated and an error message is sent to the Galaxie software, for example Error 7 = 0111. (Theta-axis position error). Refer to the table below for the error indicator codes.

E_1	E_2	E_3	E_4	Error Number	Error Description	Action
0	0	0	0	0	No Error.	-
0	0	0	1	1	Reserved.	-
0	0	1	0	2	Program memory check-sum error.	Contact your Varian representative.
0	0	1	1	3	Configuration memory check-sum error.	Contact your Varian representative.
0	1	0	0	4	RAM Test error.	Contact your Varian representative.
0	1	0	1	5	Reserved.	-
0	1	1	0	6	X-axis position error. The X-axis motor was commanded to move, but did not reach the desired position.	Troubleshoot the probe arm.
0	1	1	1	7	Theta-axis position error. The Theta-axis motor was commanded to move, but did not reach the desired position.	Troubleshoot the probe arm.
1	0	0	0	8	Z-axis position error. The Z-axis motor was commanded to move, but did not reach the desired position.	Troubleshoot the probe arm.
1	0	0	1	9	Reserved.	-
1	0	1	0	10	Reserved.	-
1	0	1	1	11	X-axis movement detected without the motor being commanded to move.	Troubleshoot the probe arm.
1	1	0	0	12	Theta-Axis movement detected without the motor being commanded to move.	Troubleshoot the probe arm.
1	1	0	1	13	Z-axis movement detected without the motor being commanded to move.	Troubleshoot the probe arm.
1	1	1	0	14	Reserved.	-
1	1	1	1	15	Reserved.	-

7.4 Probe Arm Jam

A probe arm jam is indicated when the fraction collector cannot complete its instructed move. This could be due to:

- The probe arm hitting an obstacle while moving into position.
- The probe arm not reaching a position within the defined limits of the intended position. This causes the probe movement to cease. (Movement errors of less than 1 mm are enough to cause a probe jam.)
- The mechanical movement being abnormally stiff, making it difficult for the probe arm to move. The probe drive will cease.

In all cases, if an error occurs, the error indicator LEDs will show the error code and an error message will be sent to the computer.

If the probe arm becomes jammed, the error control system will lock the motor drive and send an error message to the computer and to the error indicator LEDs.

If this happens, re-initialize the fraction collector (power off, wait 10 seconds, power on) and then watch for correct initialization.

If the probe line has been squashed as a result of the probe arm jam, the tubing should be replaced to prevent low sample flow or carryover.

7.5 Communications

This LED flashes when serial communications from the client computer are received. Use the computer to send software commands to the fraction collector. If the LED flashes, the internal computer is operating and it is receiving commands from the HPLC system computer, and its power supply is operational.

Note The flashing only indicates that a character has been received. It does not indicate that the command is correct.

If the fraction collector shows offline in the Status Overview or won't connect to the Console software follow these steps to troubleshoot.

1. Check that the RS232 cable between the HPLC system or computer and fraction collector is firmly connected and screwed into place.
2. Initialize the fraction collector to ensure that it is in a working state. Turn off the power switch, wait 10 seconds and turn the power switch on.
3. When the software is started the software lights the LED linked to the RS232 connector.
4. Check that the fraction collector LED flashes while commands are being sent to the fraction collector. If there are flashes, this indicates that the fraction collector has received a message from the instrument computer. It will always respond on receipt of the Enter key regardless of the success of the message (this will indicate the Baud Rate is correct).
5. If there are no flashes, confirm that the fraction collector is functioning by watching for the CPU Activity LED to flash. Refer to the image above for the location of this LED. This should take about 10–15 seconds. If this does not occur, reset the fraction collector to ensure that it follows through the reset sequence and then wait until the CPU Activity LED flashes. If this is successful then retest from step 4 above.
6. If unsuccessful, contact your Varian representative.

7.6 Failure to Initialize

The fraction collector initialization process is a powerful self-diagnostic tool. The initialization procedure is as follows:

On power up, the fraction collector runs through the initialization sequence and sets the probe position. The probe moves to all the physical limits of the working envelope of the fraction collector and then returns to the home position at the drain. This initialization sequence will be performed each time the fraction collector is switched on. The probe travels through the following sequence:

- Probe raises to the full extreme of the Z-axis
- Probe travels to the full extremes of the X-axis
- Probe travels to the full extremes of the Theta axis
- Probe positions itself at the back left of the fraction collector.

If the fraction collector fails to initialize, the probe arm has not travelled the required distance along one or all of the axes. One or more LEDs will light to indicate an error.

In this section, detail diagnostic and troubleshooting procedures relevant to the instrument model. For example:

There are two tools that can be used to troubleshoot the Microplate Reader:

- The diagnostic LEDs on the Microplate Reader main board.
- The communications program called HyperTerminal that is supplied in Microsoft™ Windows™.

7.7 MDS manufacturing & diagnostics software

7.7.1 Before starting

1. Remove the rear panel (refer to Section 5) to access the BOOT button on each installed PCB and visual confirmation of the internal jumper settings.
2. Connect the power cable and the serial communication cable to the fraction collector, and turn the unit ON.
3. Open up the SPS MDS and check the main screen (Figure. 29) for correct DIP and Jumper settings. This also displays the current Main Board Firmware and Accessory Board Firmware. You may be prompted to check your communications port settings.

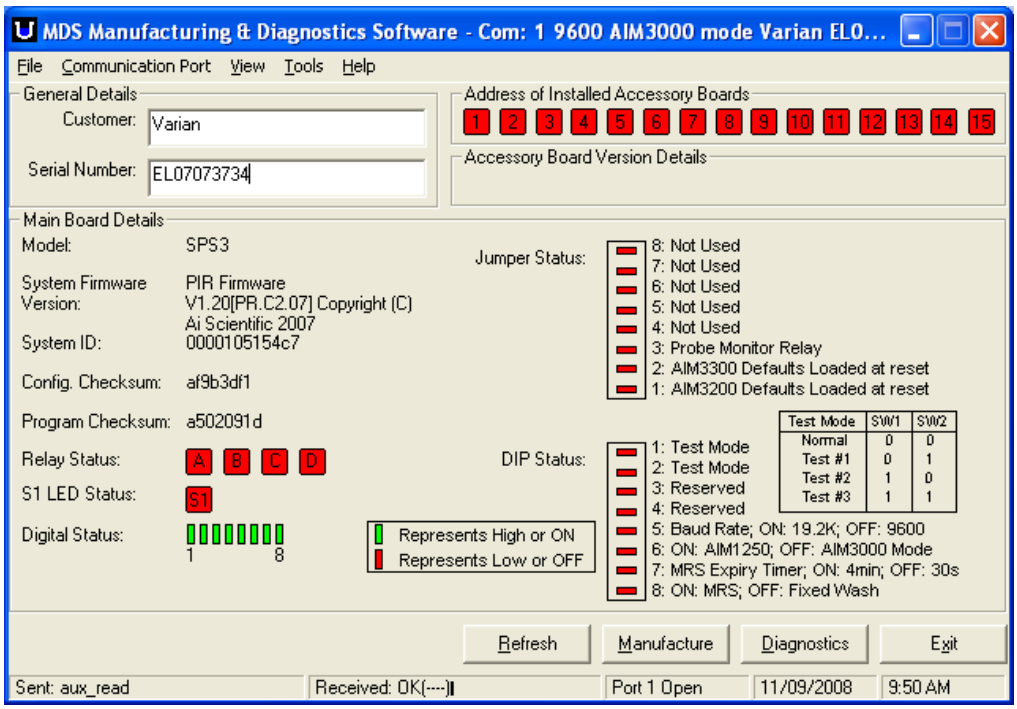


Figure 29. Varian MDS software

4. Click on the Diagnostics button at the bottom of the screen.

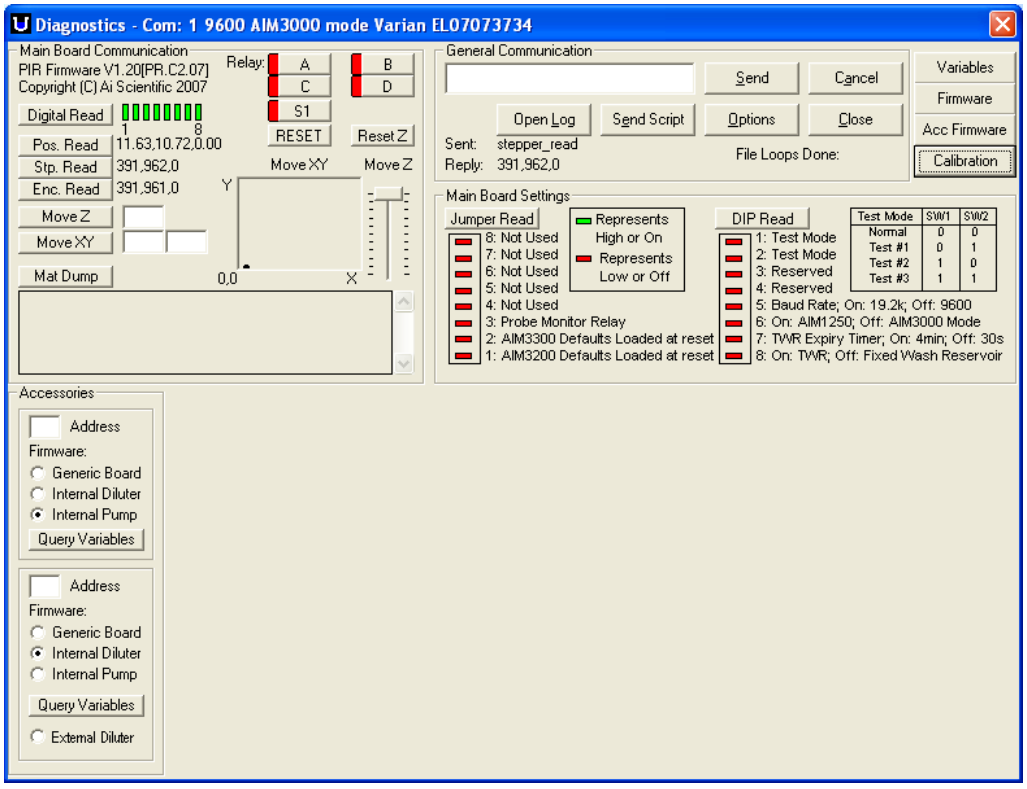


Figure 30. Varian MDS software, Diagnostics window.

5. Click on the Variables button in the top right of the Diagnostics window. Save the variables to a text file for reference later. Close the Variables window. The diagnostics screen displays the current status of the fraction collector including accessories. Each button has Tool Tip text that can be accessed by moving the mouse pointer over a button and waiting for the Tool Tip to appear. The fraction collector can be queried and tested for faults using the tools in the diagnostics page.

7.7.2 Reload Fraction Collector Calibration Coefficients

6. Connect the Fraction Collector serial cable directly to the serial port of the PC.
7. Once the serial cable is connected to the PC, power up the fraction collector and allow it to go through it's start up routine. Then launch the Varian SPS MDS software.

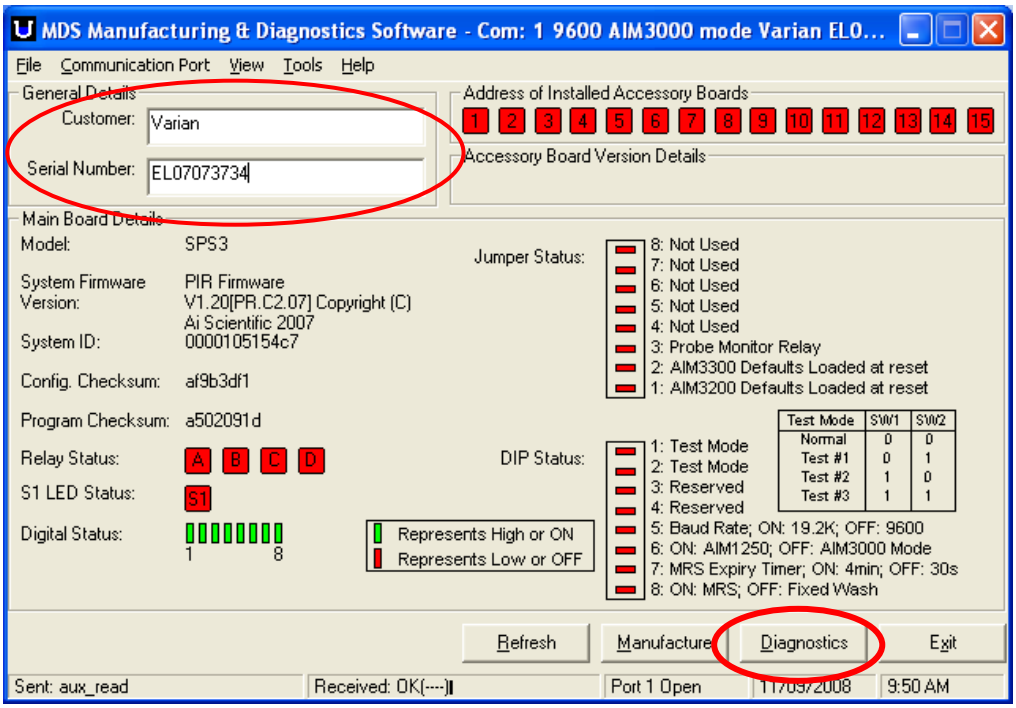


Figure 31. Varian SPS MDS Software Front Page

8. Insert the customer Details and Serial number of the unit. Then click the Diagnostics Button. You should now see the screen in Figure 32.

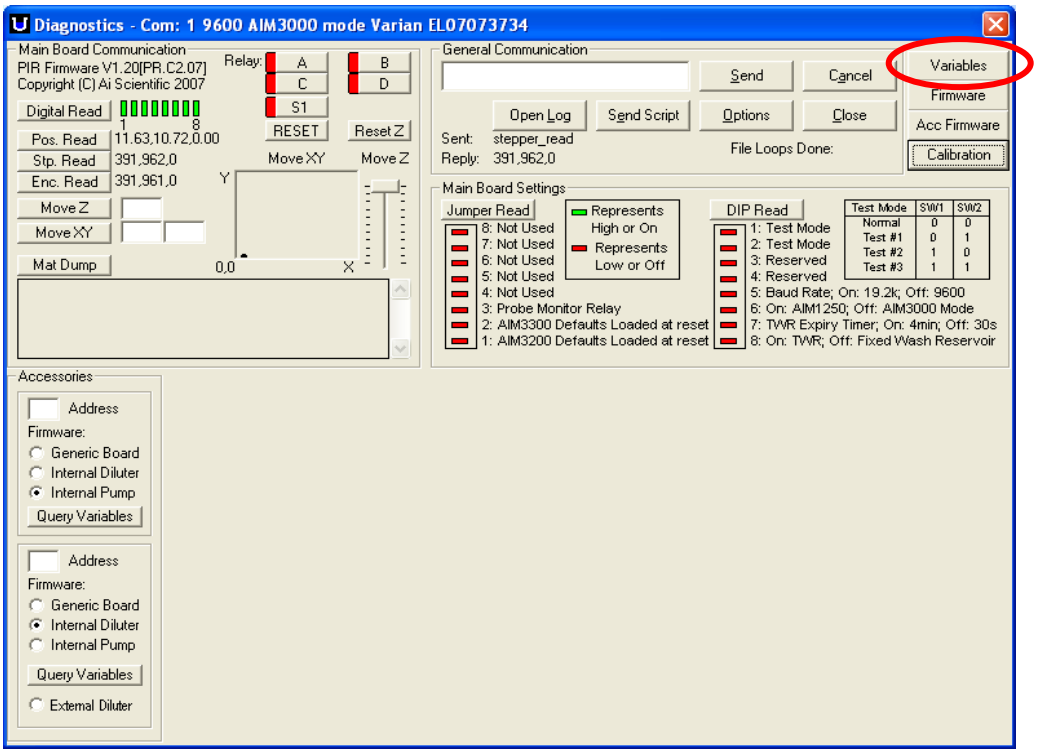


Figure 32. Diagnostics Section of the SPS Software

9. Select the Variables option (Figure 32) and that should open the Calibration Variables Page.

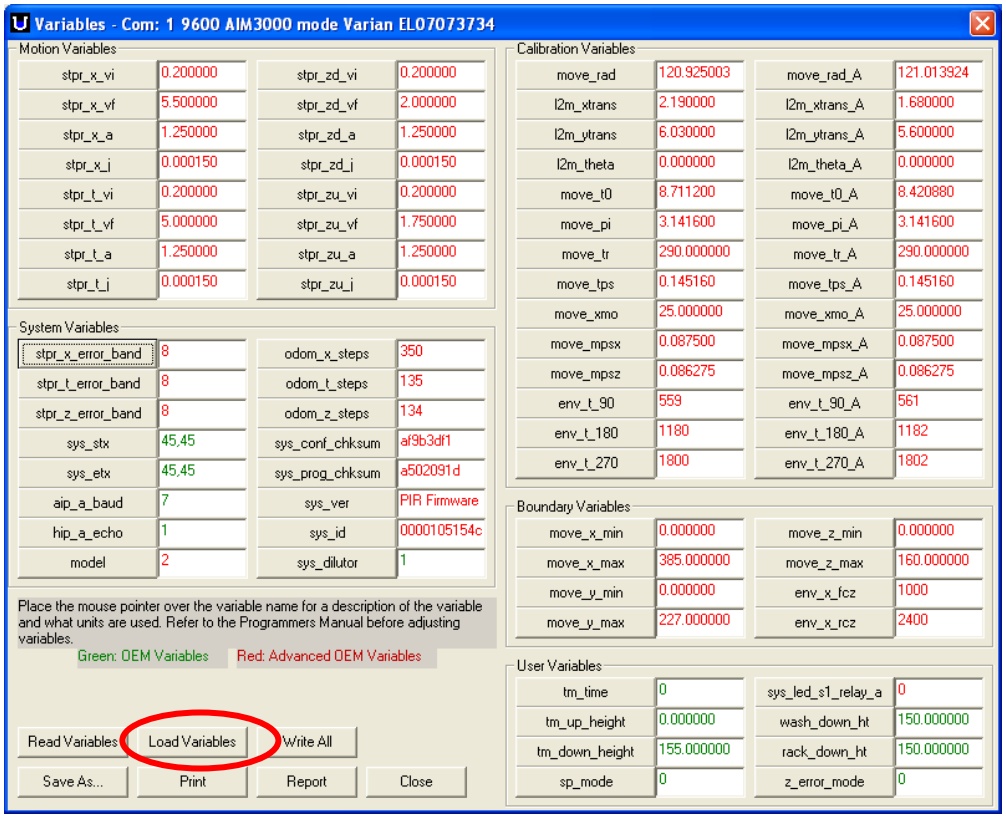


Figure 33. Variables Page

10. Click the Load Variables button (Figure 33), and then select the txt file that has the calibration coefficients that you want to load up (Figure 34). It is a good idea to make the variables file name one that reflects the serial number of the Fraction Collector. If you have multiple files, then add a date stamp to your file name to ensure that you can distinguish them from each other.

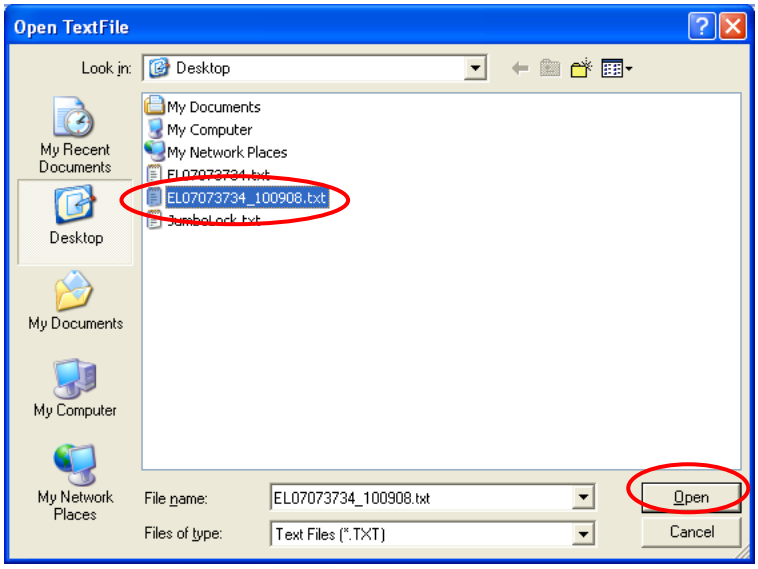


Figure 34. Calibration File Selection

11. Once you have selected the desired file to upload and pressed the Open (Figure 34). You will then need to select the Write All (Figure 35) option to write the variable to the firmware. You can then close the Variables page.

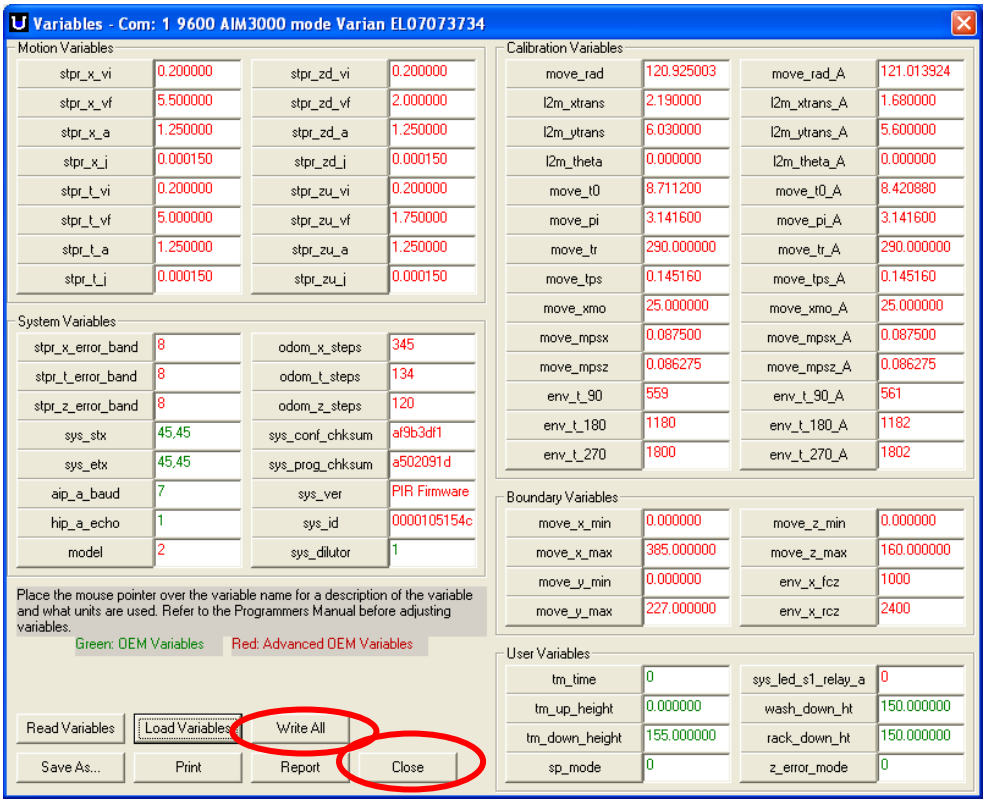


Figure 35. Writing the Calibration to the Firmware

12. Press the Close button again (Figure 36) and you will be back to the main page of the software (Figure 37).

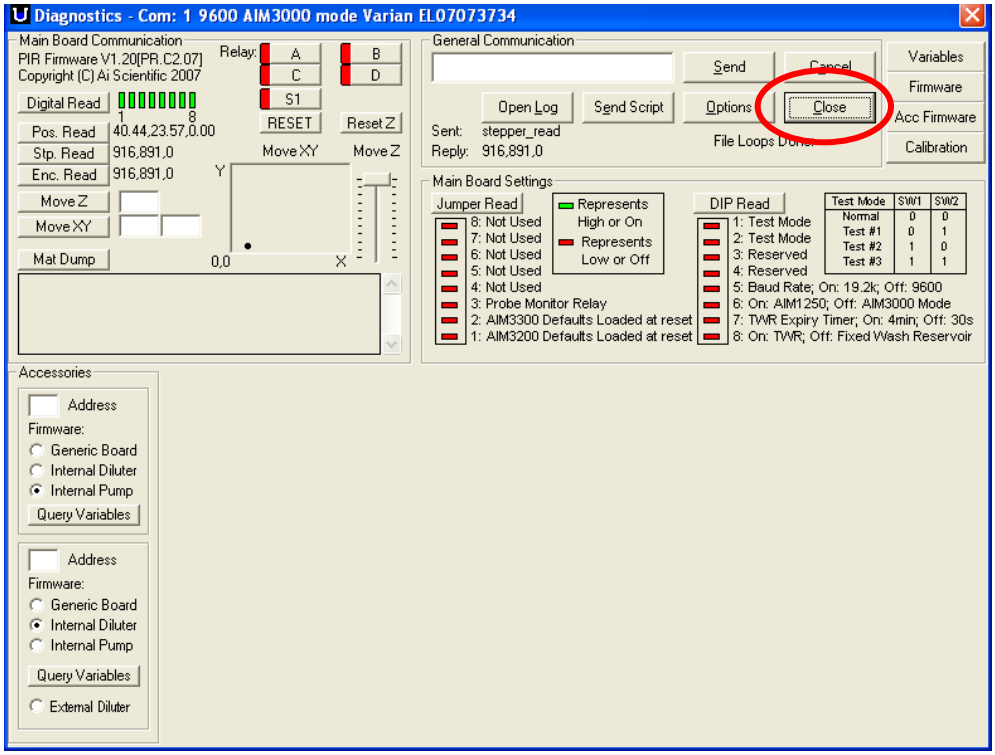


Figure 36. Closing the Diagnostics Page

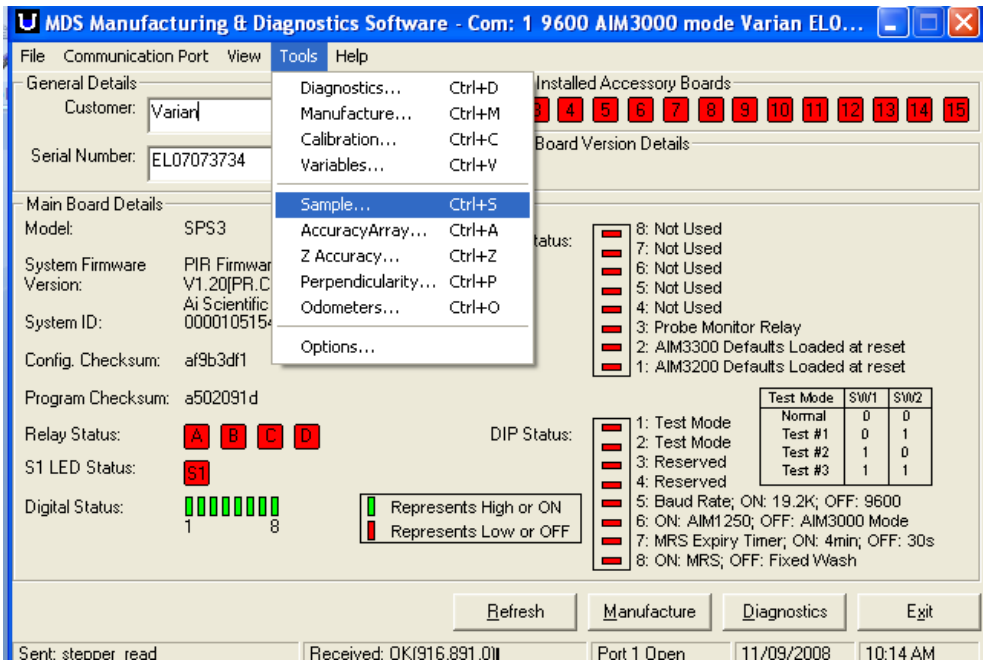


Figure 37. Main Page of the software

13. Select the Tools option from the pull down menu and click on Sample (Figure 37). This will open the window in Figure 38 where you can choose which racks the Fraction Collector has and the rack size.

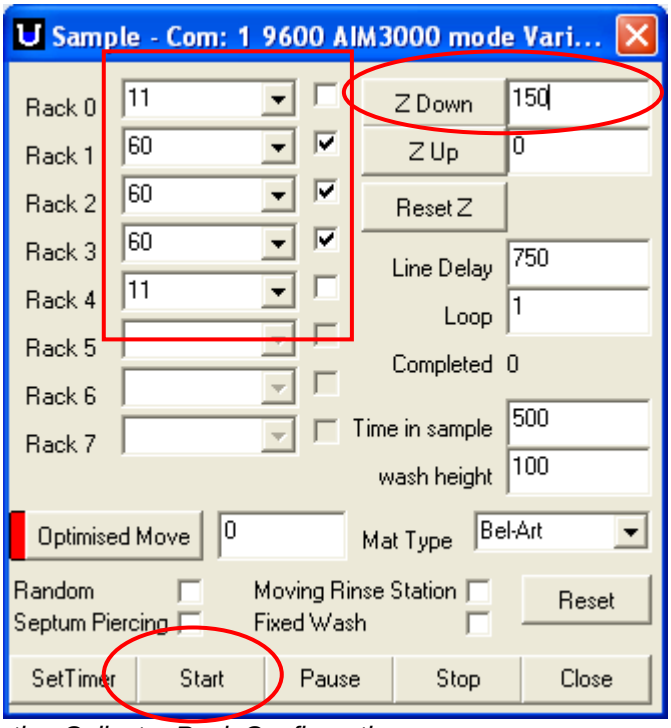


Figure 38. Fraction Collector Rack Configuration

14. The different rack positions are shown in Figure 39

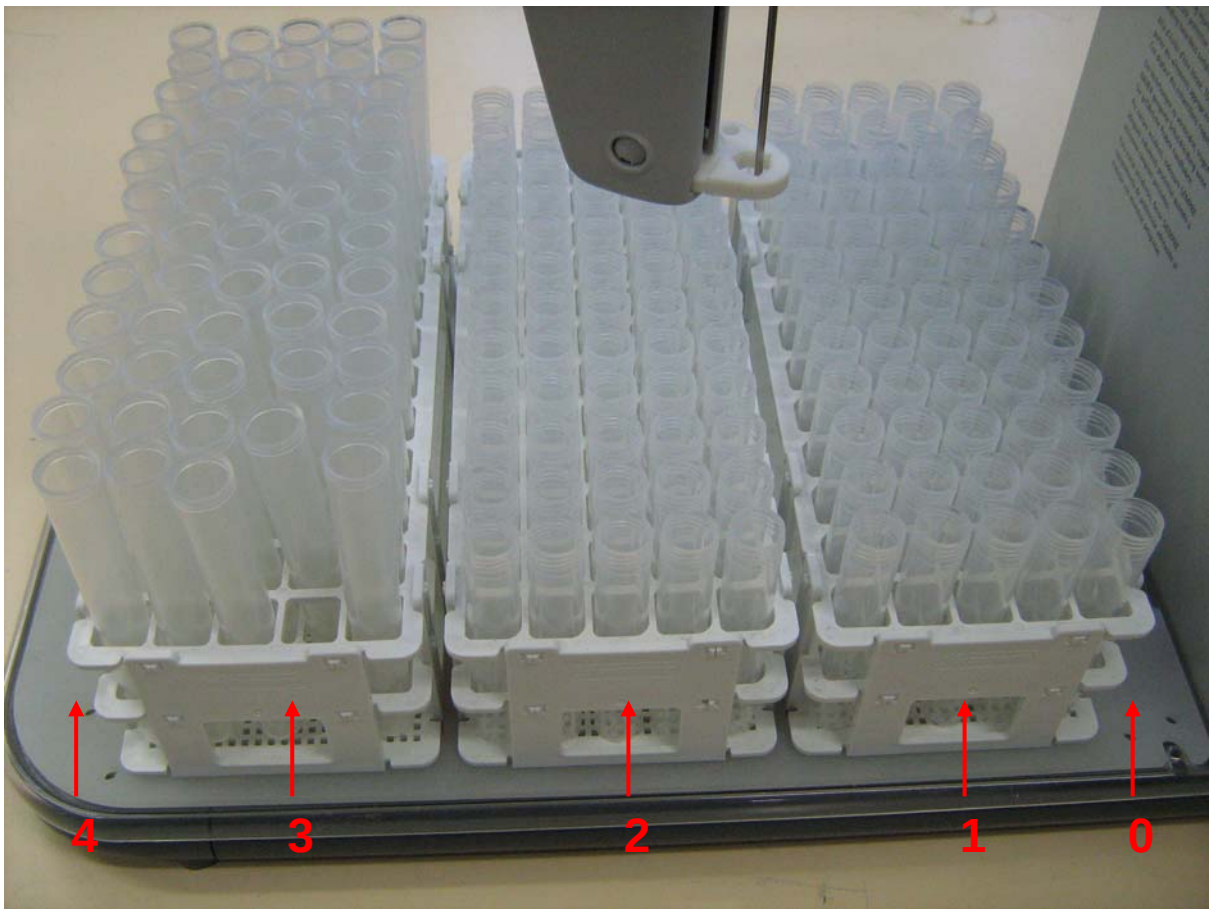


Figure 39. Rack Positions on the Fraction Collector

15. Select a Z down (Figure 38) value so that you can easily see if the probe is going into the sample collection tube properly. A value of about 150 is a good value to use. Once you are happy with the setup, click on the Start button and the probe will move through all the positions for the number of racks you have selected.

7.7.3 Calibrating the 440-LC Fraction Collector

The fraction collector should be calibrated when any of the following conditions occur:

- Loss of alignment, and re-installing the factory calibration coefficients does not solve the problem
- After mechanical repairs to the drive assemblies
- Replacement of the main control board.

To properly calibrate the fraction collector's probe, position both a lower level and an upper level plane calibration must be preformed. The Fraction Collector then extrapolates the positions for all the tubes in any rack from the 3D reference points acquired during the calibration. Before proceeding with the fraction collector alignment procedure, make sure that you have all the tools necessary. A fraction collector alignment kit (SPS3 Alignment kit) can be ordered under part number 99-101216-00. This kit consists of the following items;

- Assy probe 0.8 mm (This is an SPS3 probe, but it is longer than the one on the 440-LC and is easier to use for alignment)
- Alignment tool (see Figure 40)
- SPS 3 Autosampler Resource CD (Ignore the included videos)

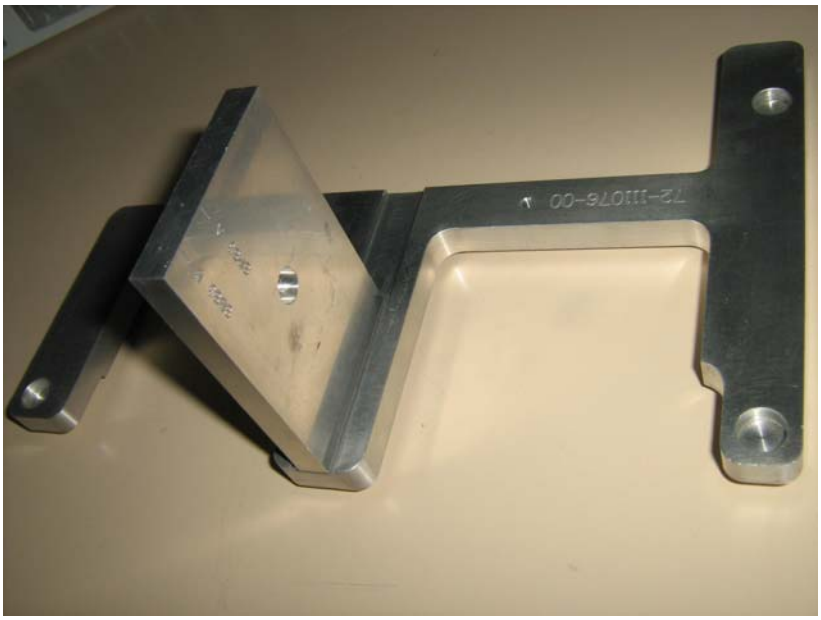


Figure 40. Top Layer Plane Alignment Tool

7.7.3.1 Fraction Collector Calibration Lower Level Plane

1. Attach the Calibration Probe (Assy probe 0.8mm) to the Fraction Collector.
2. Connect the Fraction Collector directly to the PC with the Varian MDS Software via a serial cable.
3. Switch on the Fraction Collector.
4. Launch the Varian MDS program and select the Diagnostics button.

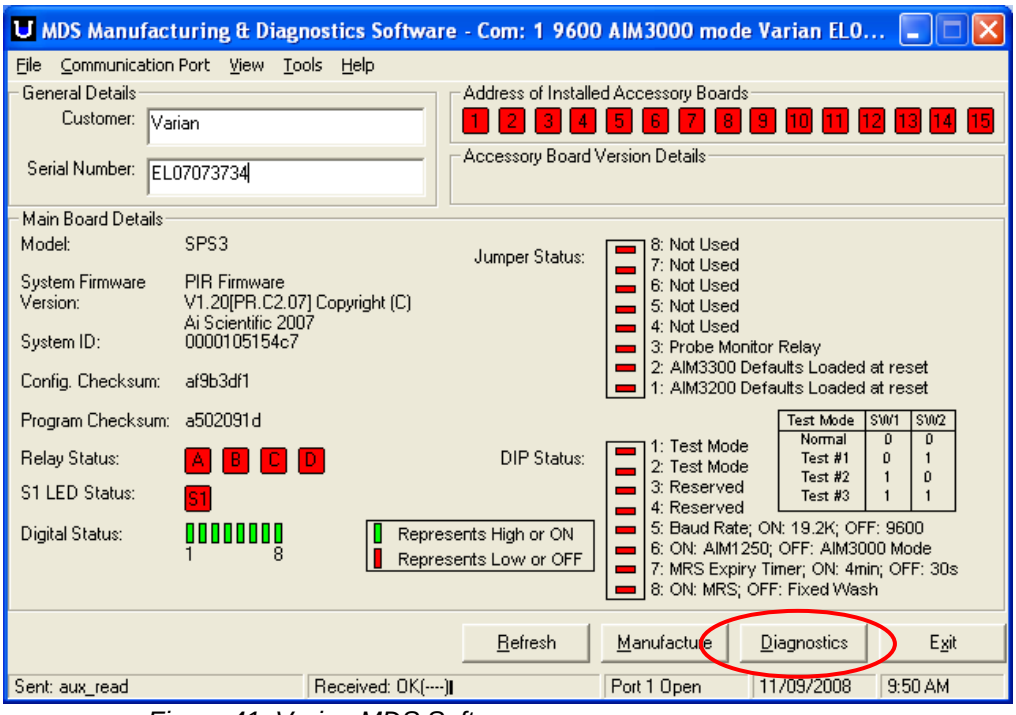


Figure 41. Varian MDS Software

5. In the diagnostics window (Figure 42), click on the Calibration button.

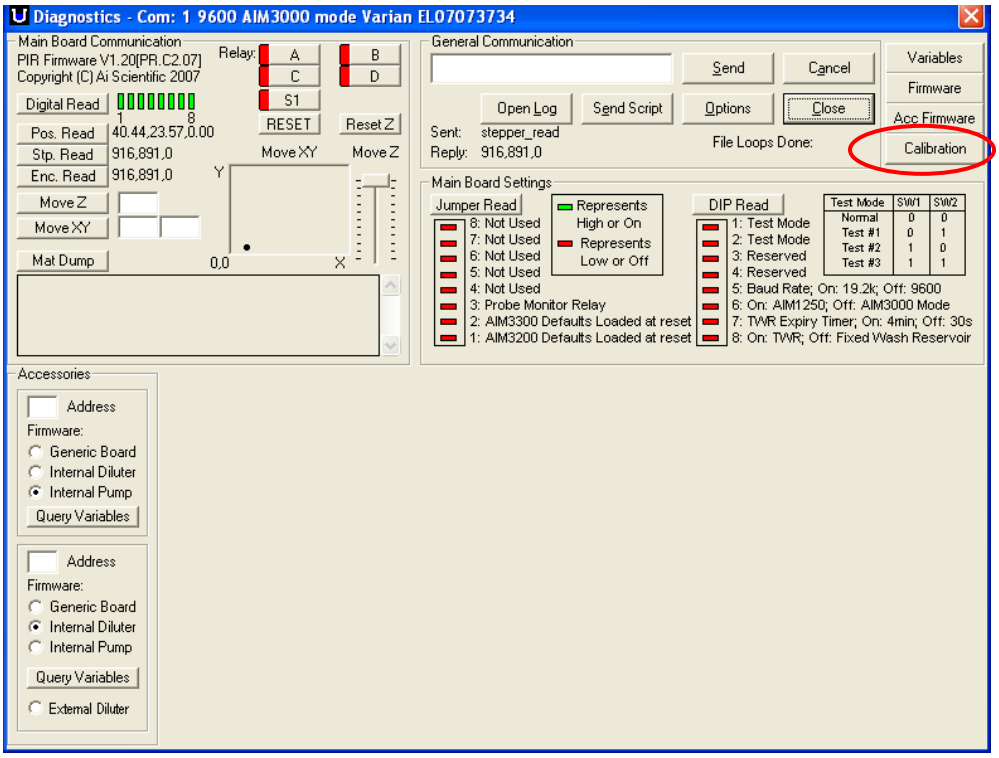


Figure 42. Diagnostics Screen of the Varian MDS Software

6. Once the calibration window (Figure 42) opens up Clear the X and Y Offsets on the Lower Plane Calibration.

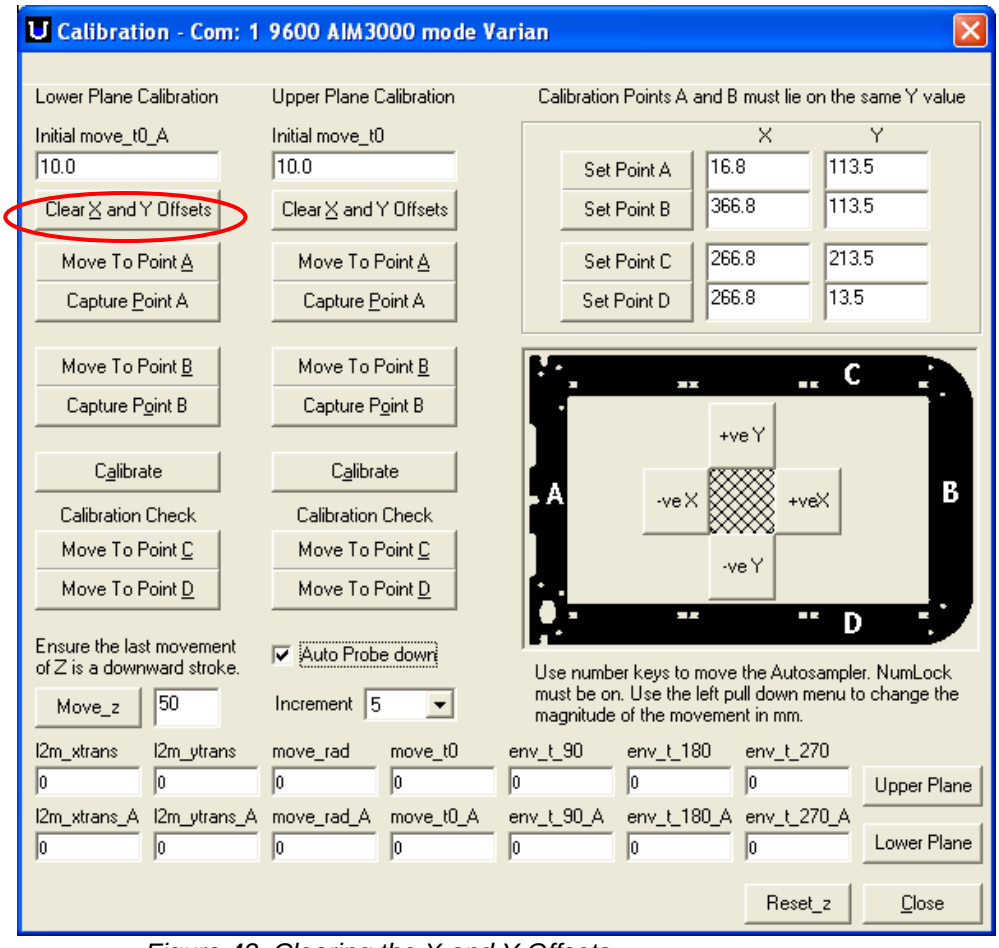


Figure 43. Clearing the X and Y Offsets

7. Remove the sample racks from the Fraction Collector tray. With the sample racks off the tray you should be able to see 4 small dimples (Figure 44) in the white plastic rack holder (Figure 45). Each of these dimples corresponds to a position (A, B, C, D).

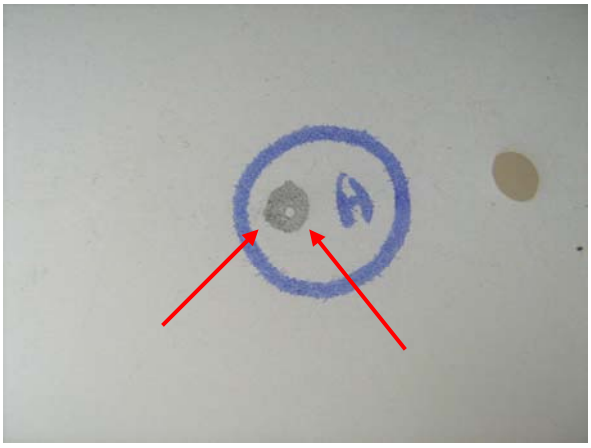


Figure 44. Example Dimple in Position "A"

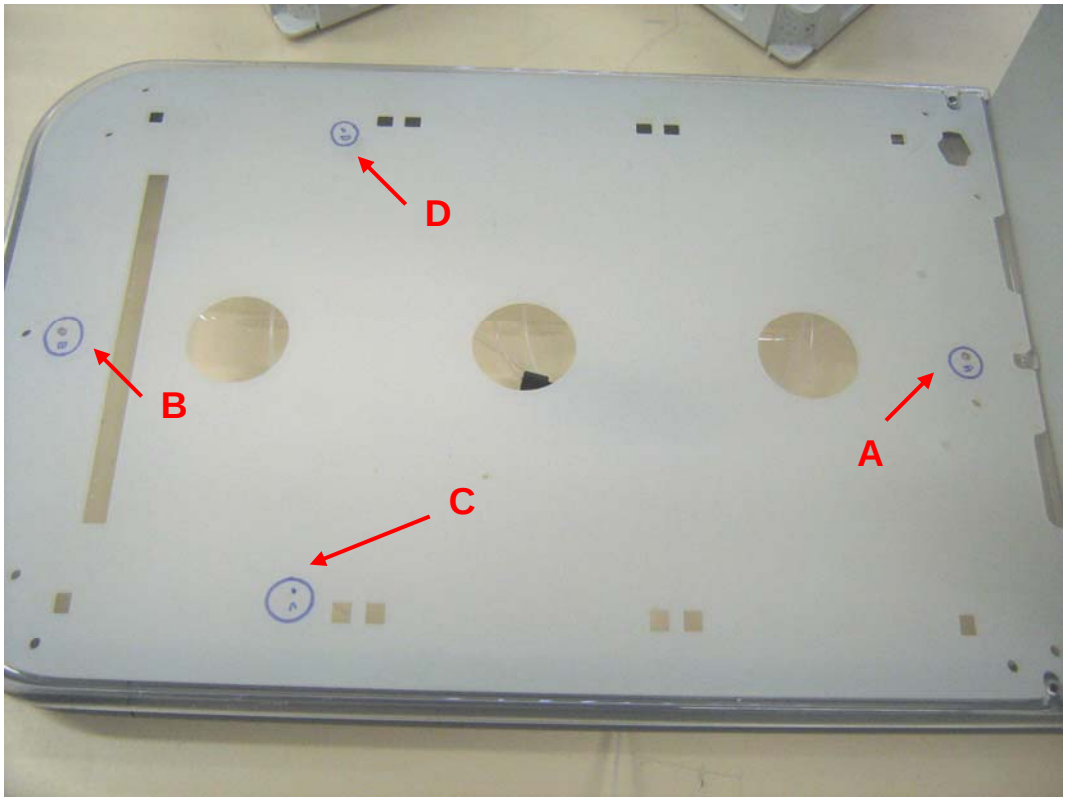


Figure 45. White Sample Rack Holder Tray with 4 Dimples

8. Move the probe to position A by selecting the Move to Point A (Figure 46). Lower the probe by selecting the Move_z button (Figure 46), and change the depth of the downward stroke (the higher the number the further down it goes). In order to move the probe in the X and Y direction use the buttons marked +/- ve X and Y (Figure 46). The step increment can be adjusted by changing the value in the Increment pull down menu (Figure 46).

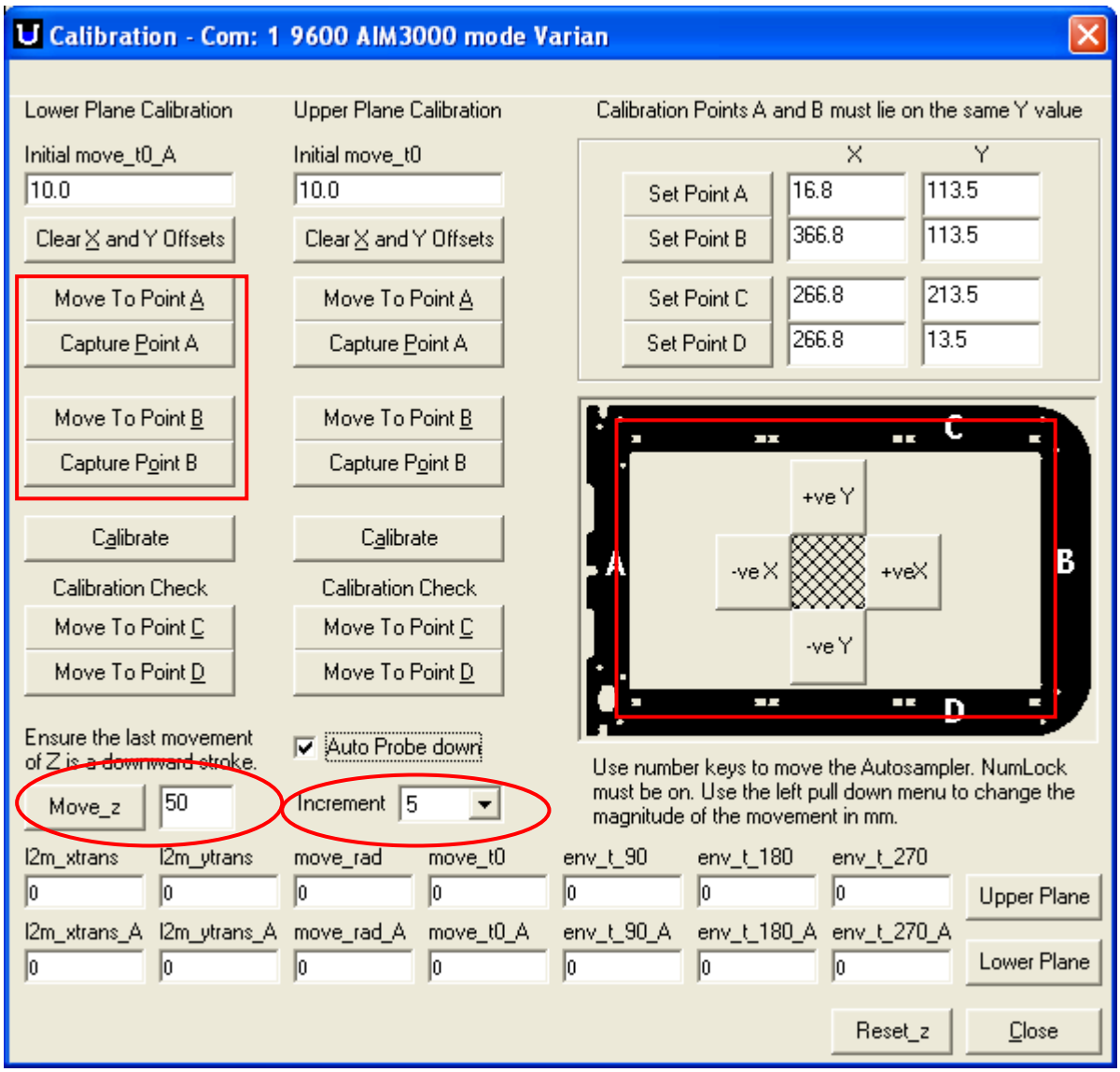


Figure 46. Calibration Page

9. When the probe is correctly positioned over position A, then press the Capture Point A button (Fig 46) to lock in the coordinates.
10. Repeat the above steps for Point B making sure that you use the Move to Point B, and Capture Point B button (Figure 46).
11. Once both the A and B points have been calibrated, click on the Calibrate button to lock in the calibration coordinates of the lower level plane (Figure 47).
12. The Calibration can be checked by moving the probe to position C (Move to Point C) Figure 47. The probe should be within 1 mm of the point C. Moving the probe to position D (Move to Point D) will further confirm (assuming that it is also within 1 mm) that the whole lower level has been calibrated properly.

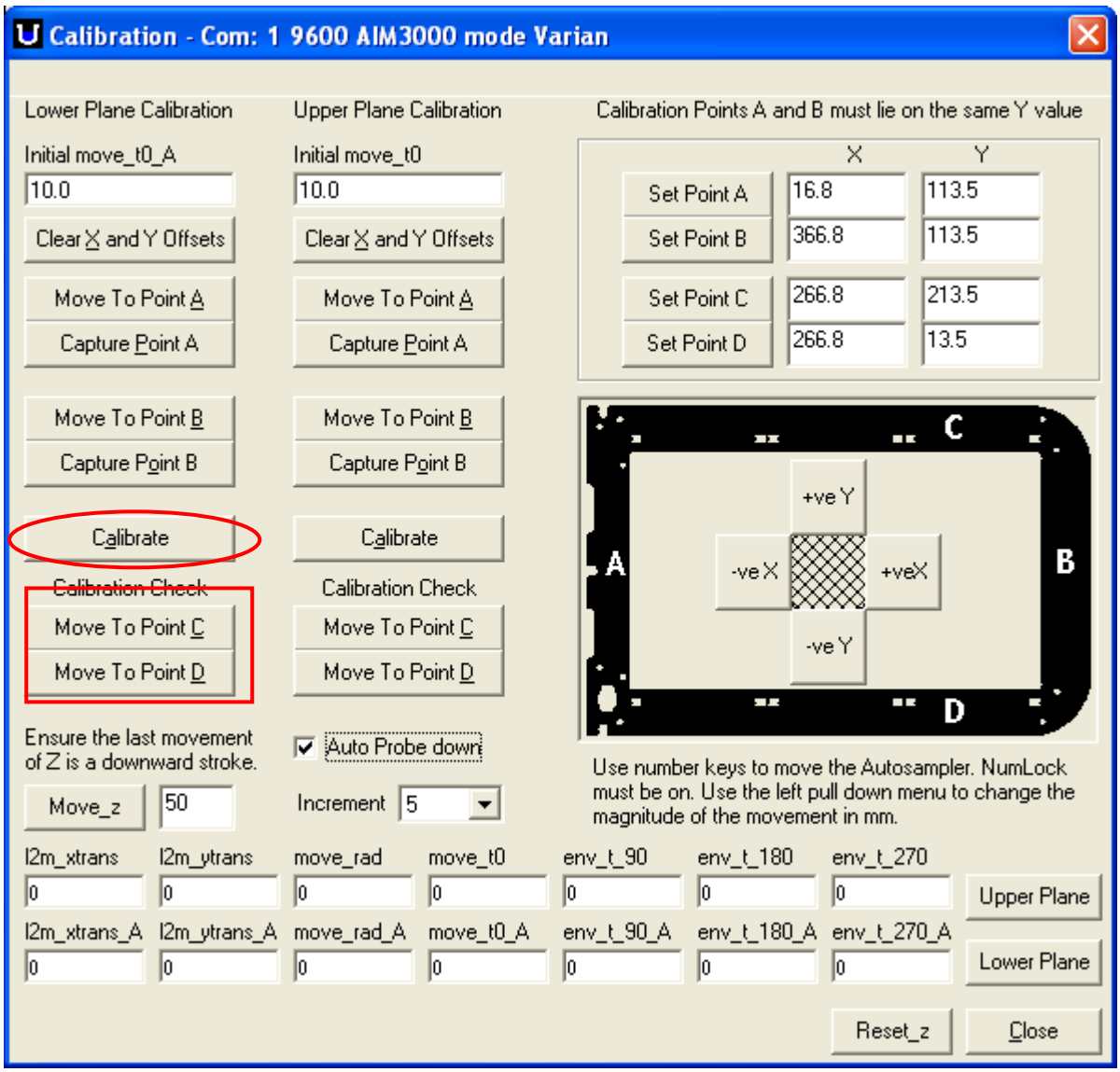


Figure 47. Calibrating and Checking the Calibration

13. Proceed to the upper level Calibration.

7.7.3.2 Fraction Collector Calibration Upper Level Plane

This portion of the Calibration requires the alignment tool (SPS 3 Alignment kit P/N 99-101216-00).

Makes sure that you have completed the Lower Level Plane calibration, before proceeding to the upper level calibration.

1. Clear the upper plane calibration X and Y offset (Clear X and Y Offset) Figure 48.

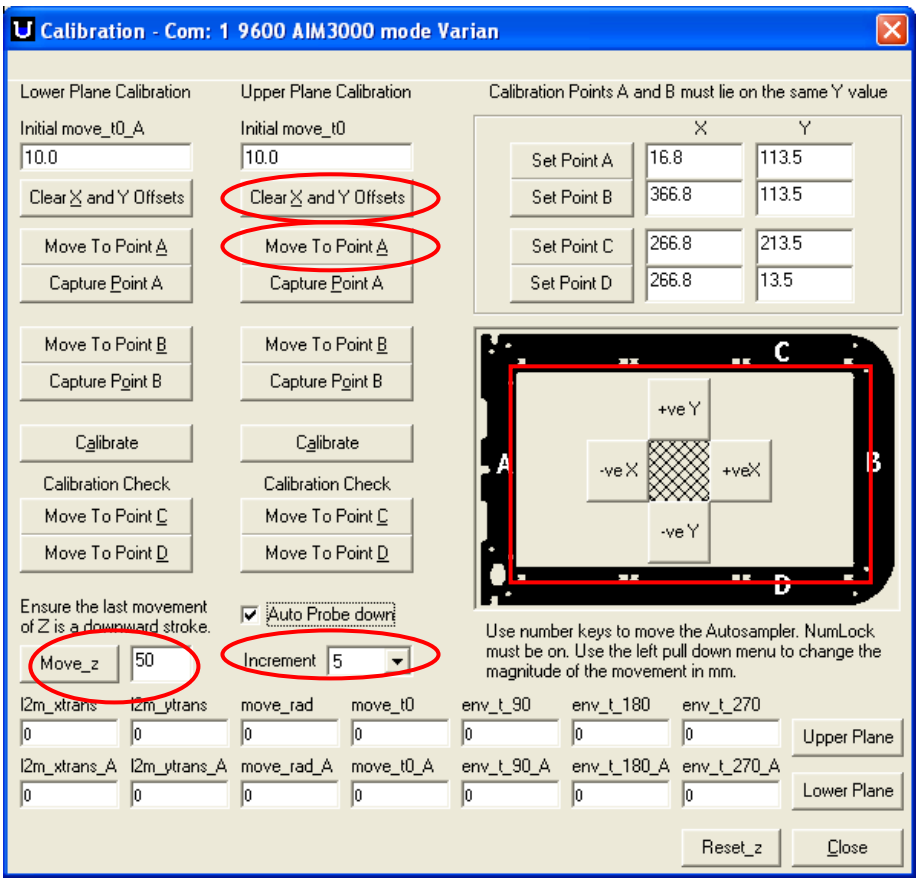


Figure 48. Clearing the Upper Level Calibration Coefficients

2. Place the alignment tool on top of the sample rack tray holder in such a way that the top 2 feet (they will have a pointy bottom) slip into the two holes in the tray (Figure 49). Once the alignment tool is in place it should look like the one in Figure 50.

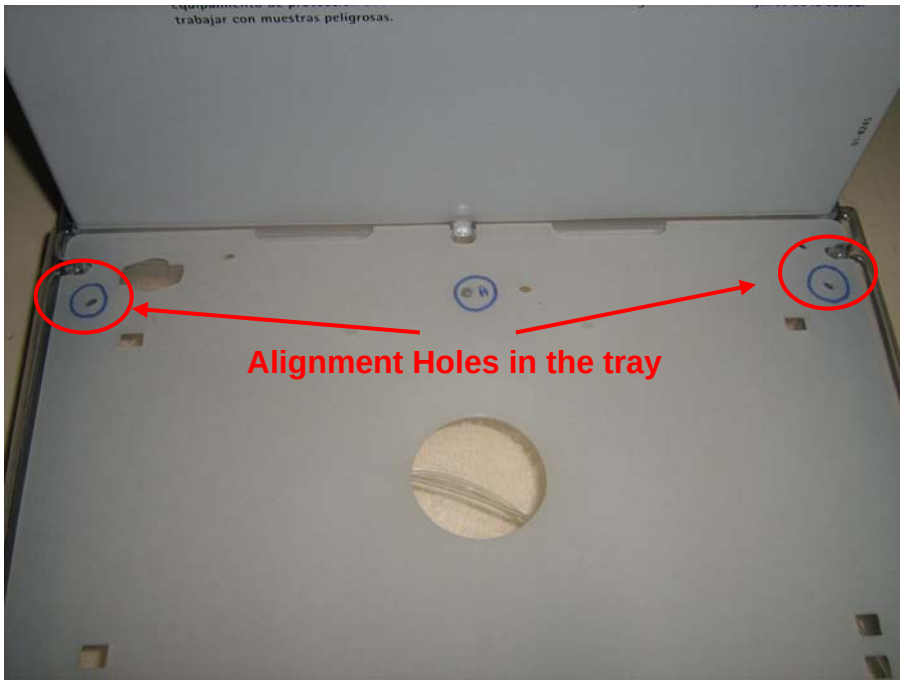


Figure 49. Holes in the Plate to Calibrate Point A

Figure 50. Alignment Tool in Position to Calibrate Point A

3. Select the Move To Point A button(Figure 48), and then using the X & Y movement buttons (Figure 48) align the probe so that it rests right above the point A dimple (Figure 51) in the tool. Do not forget to adjust the Move_z (Figure 48) depth adjustment to avoid running the probe into the alignment jig. Remember that fine adjustment of the probe can be made by changing the Increment pull down menu (Figure 48).

Figure 51. Point A on the Alignment tool

4. Once the probe is positioned over the point A dimple, then select the Capture Point A button (Figure 52).

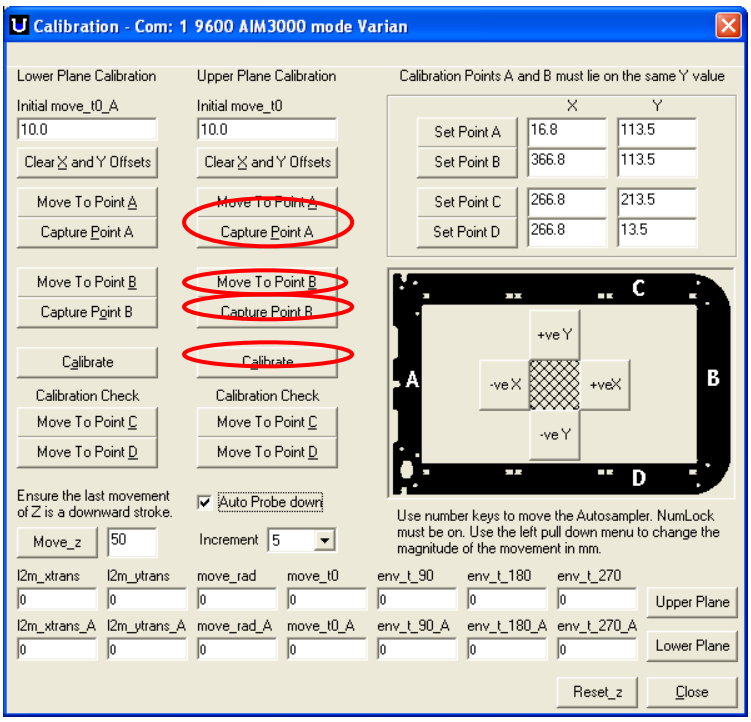


Figure 52. Capturing Point B

5. Locate the holes in the front side of the fraction collector rack holder tray (Figure 53) and move the alignment tool in such a way that the front pointy feet are now in the second set of holes shown in Figure 53. Once the alignment tool is positioned, it should look like Figure 54.

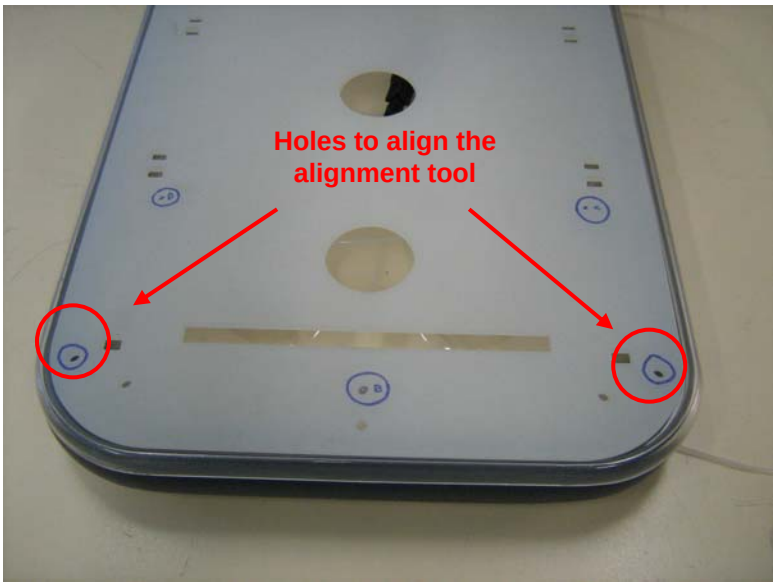


Figure 53. Alignment holes on sample tray

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Figure 54. Alignment Tool Position in the Tray for B Point Calibration

6. Move the probe to position B (Move To Point B) Figure 55, and follow the same alignment process as mentioned for the position A calibration. Once you are happy with the probe alignment over position B (Figure 55) in the alignment tool, click the Capture Point B button (Figure 52). Click the Calibrate button (Figure 52) to lock in the new calibration coordinates. There is no need to check Point C and D.

Figure 55. Calibration Point B in the Alignment Tool

7.7.3.3 Calibration Test:

To test the new calibration coordinates remove the assy probe 0.8mm and re-attach the fraction collector probe. Once you have successfully attached the fraction collector probe, go back to the main page of the Varian MDS software and follow the procedure below:

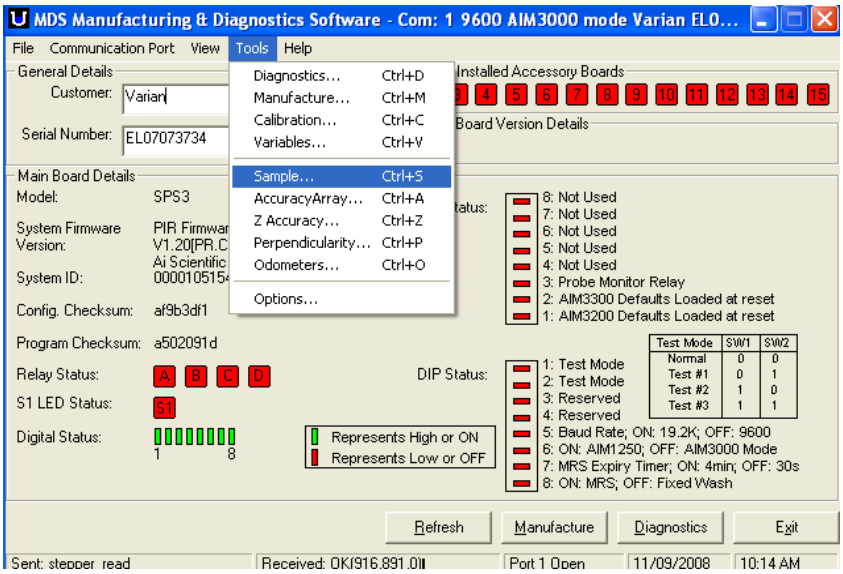

Figure 56. Main Page of the software

1. Select the Tools option from the pull down menu and click on Sample (Figure 56). This will open the window in Figure 57 where you can choose which racks the fraction collector has and the rack size.

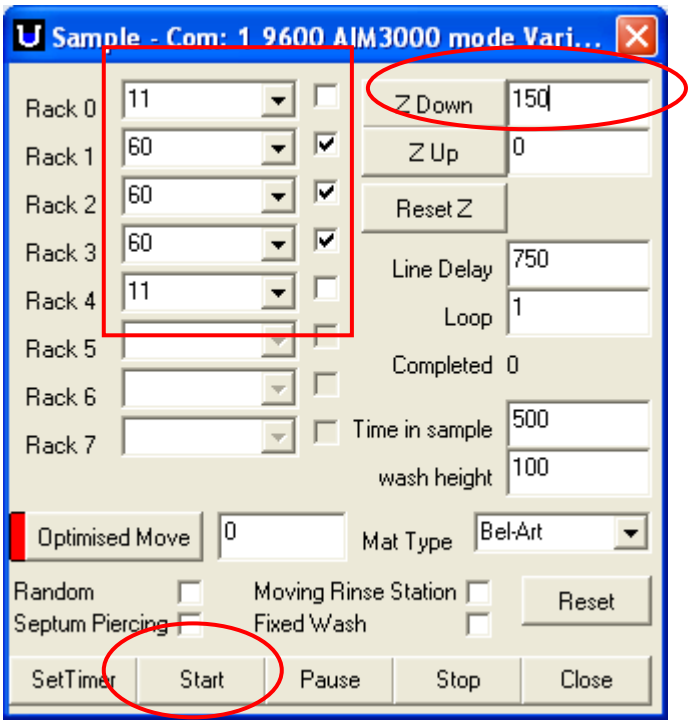

Figure 57. Fraction Collector Rack Configuration

2. The different rack positions are shown in Figure 58

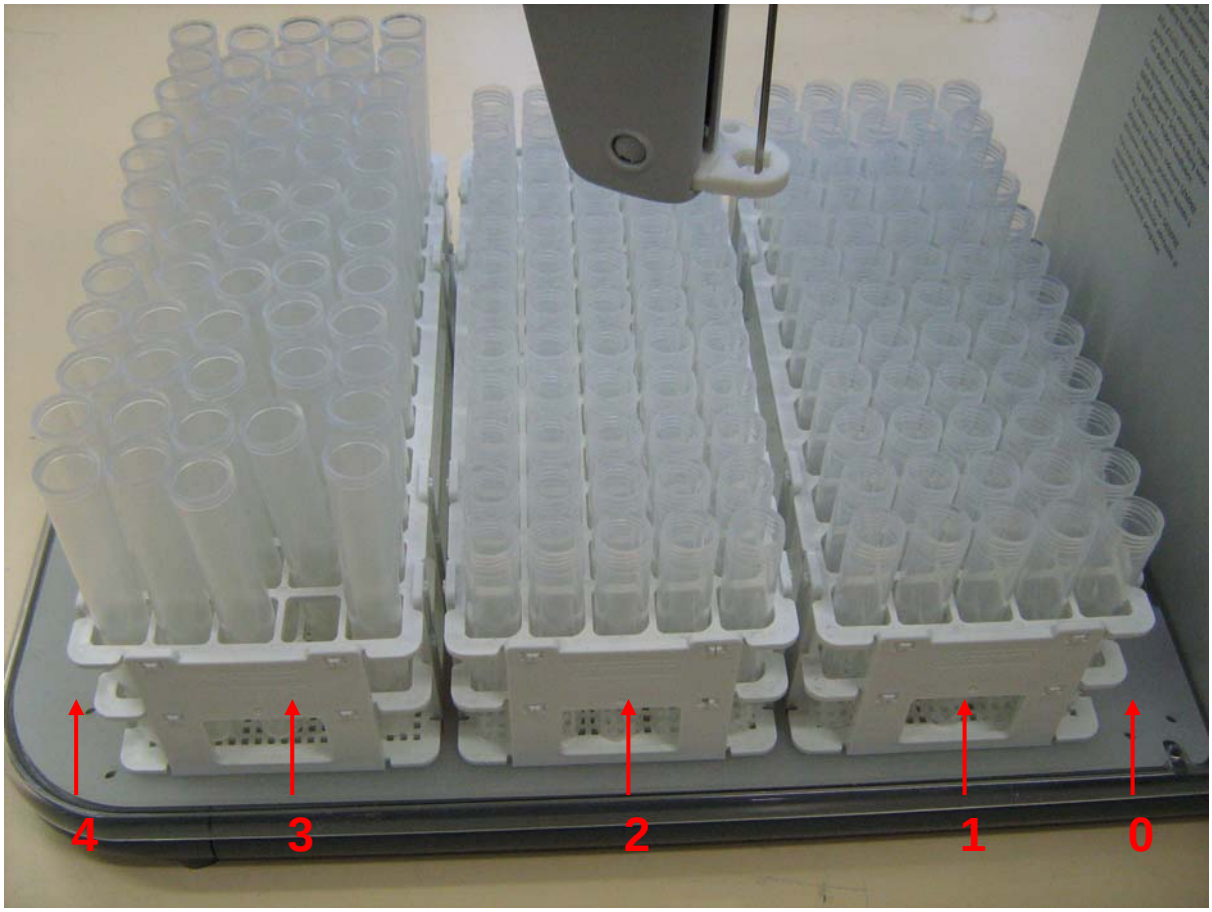

Figure 58. Rack Positions on the Fraction Collector

3. Select a Z down (Figure 57) value so that you can easily see if the probe is going into the sample collection tube properly. I usually pick a value of about 150. Once you are happy with the setup, click on the Start button and the probe will move through all the positions for the number of racks you have selected.
4. If the probe goes into all the fraction collector tubes without any problems, then close the Varian MDS software and reconnect the serial cable from the fraction collector to the back of the 900-Series back panel.

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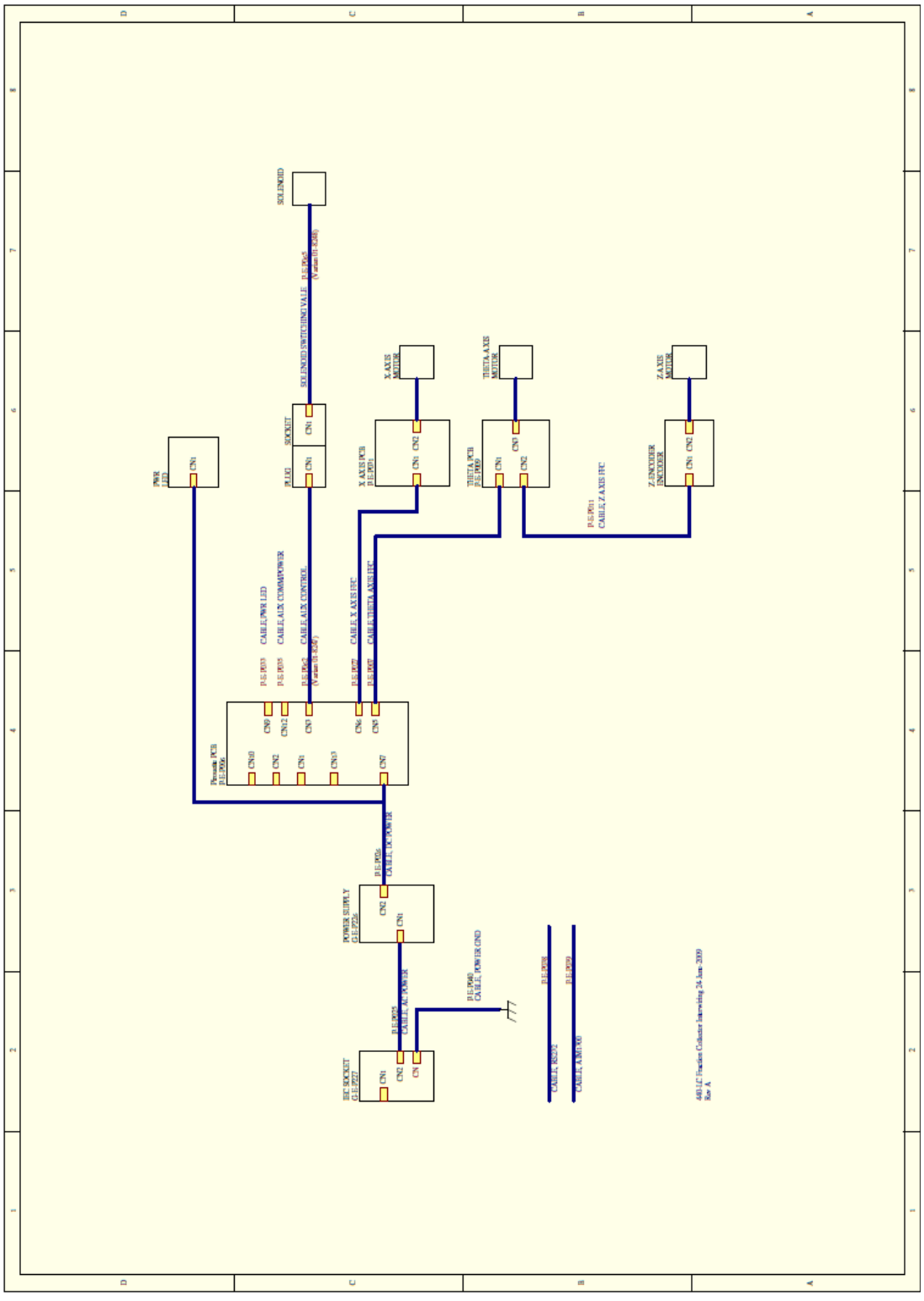
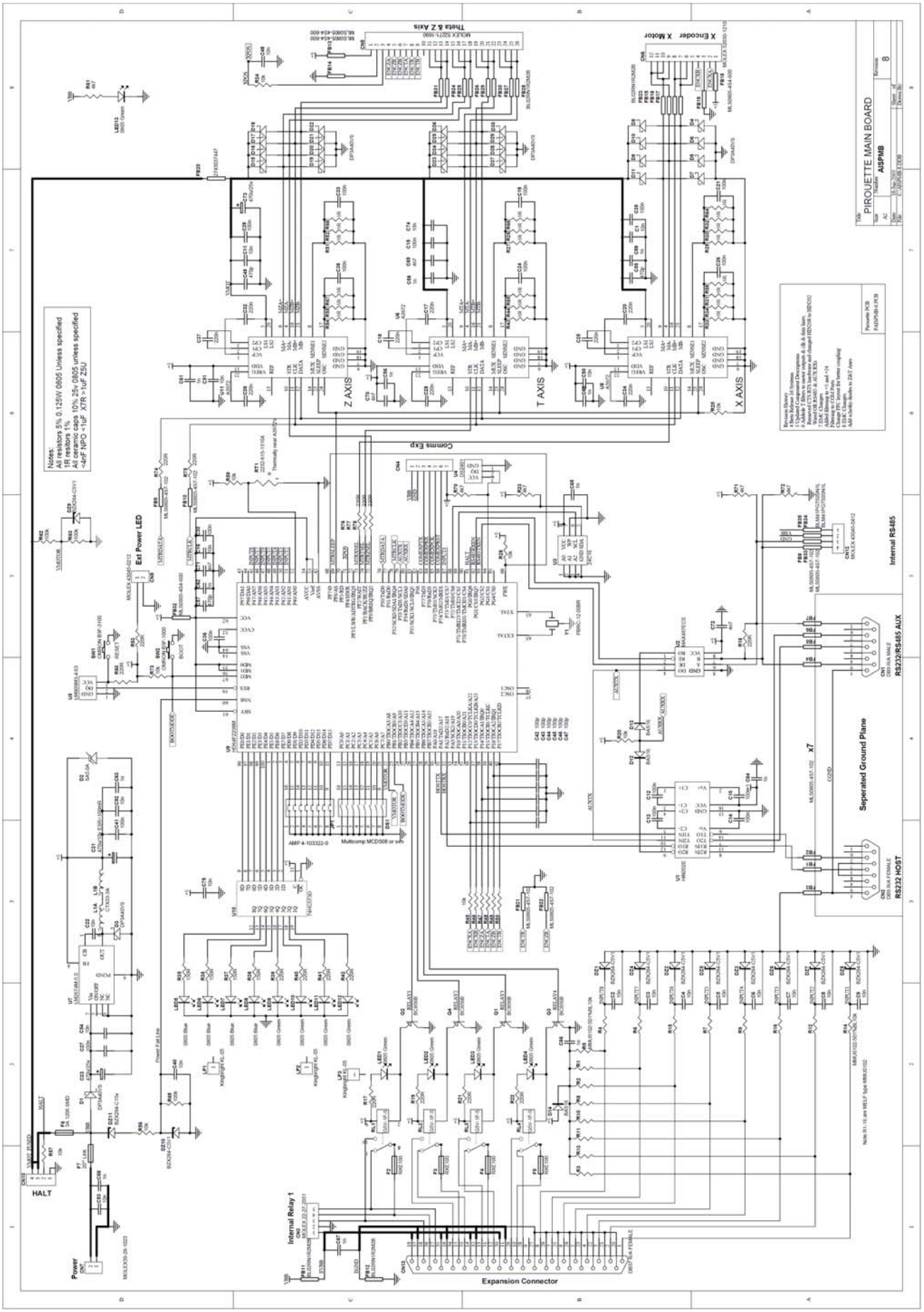
8. Electronic and mechanical schematics

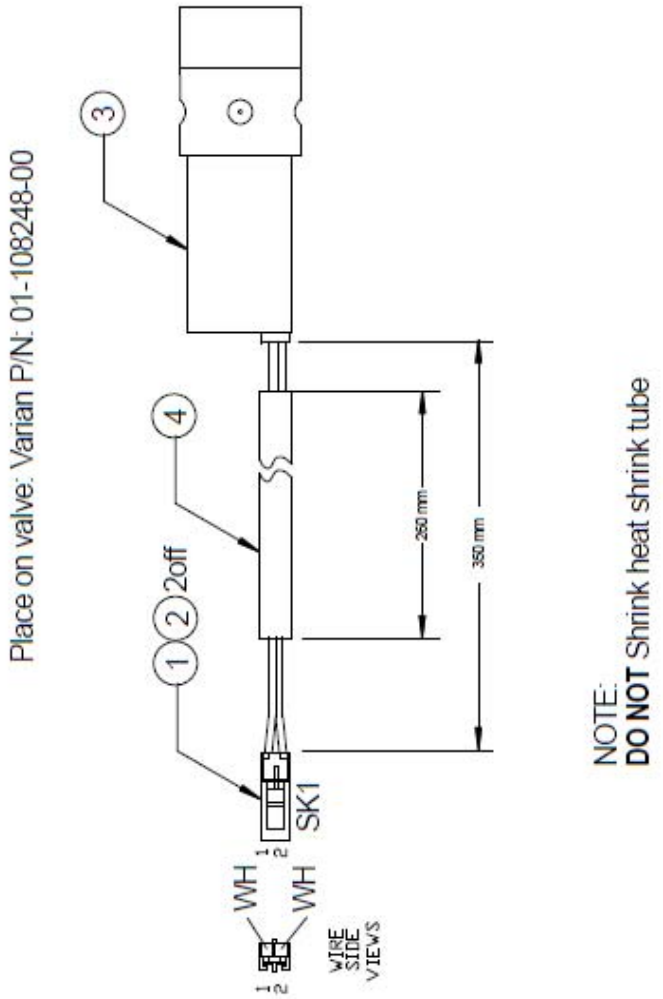
8.1 Fraction Collector inter wiring



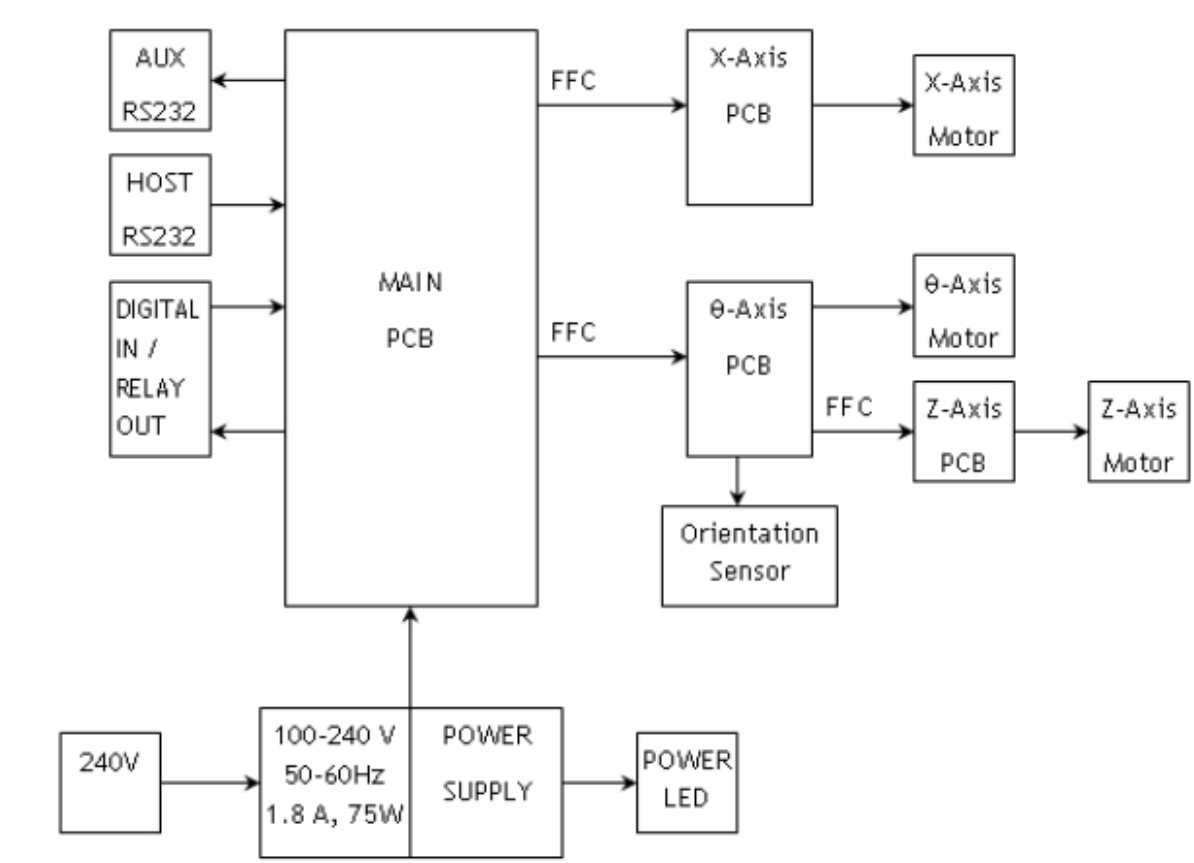
8.2 Fraction Collector Power board Assembly Schematics



8.3 Assembly Loom 3-way Valve



8.4 Block Diagram



Functional blocks:

- Main PCB: Main control PCB. 100-240 V Power input, drives all three axes (stepper motors), contains upgradeable firmware using the MDS software. Can also connect one Accessory PCB to drive internal device such as wash pump.
- AUX RS232: Auxiliary RS232 Communications Port for external devices such as a diluter or peristaltic pump.
- HOST RS232: Host communications port for communication to the AIM3300 for control or diagnostics.
- Digital IN/ Relay OUT: 8 Digital inputs/ 4 Relay outputs to control External devices.
- FFC: Flat FLEXIBLE Cable. Provides communication and power to other
- modules.
- X-axis PCB: Encoder PCB for the x-axis motor, used for collision detection.
- Z-axis PCB: Encoder PCB for the z-axis motor, used for collision detection.
- θ-axis PCB: Encoder PCB for the theta-Axis motor, used for collision detection and also has a sensor to determine probe arm orientation on start-up only.