



## **GP40 GRADIENT PUMP OPERATOR'S MANUAL**

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# 1 • Introduction

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## ***GP40 Gradient Pump***

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# 1 • Introduction

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## 1.1 Overview

The GP40 Gradient Pump is an integral part of a DX 500 chromatography system. It is a microprocessor-based, dual-piston, variable-speed, gradient delivery system designed to blend and pump mixtures of up to four different mobile phases at precisely controlled flow rates. The pump can deliver the selected mobile phase composition isocratically, or as a multistep linear or curved gradient. A Digital Signal Processor (DSP) provides high speed control of pump flow and pressure.

The GP40 can operate as a stand-alone product or with other Dionex modules as part of a complete chromatography system. It can also be used with non-Dionex modules that meet interface requirements for software, TTL, or relay control.

The GP40 can be controlled locally, using the front panel keypad and display, or from a remote host computer with a Dionex DX LAN™ interface installed and PeakNet software installed on the host computer. Limited remote control is also available from any device capable of providing compatible TTL signals to control the pump.

The pump's two basic modes of control, Direct control and Method control, enable it to operate with or without reference to time-based events.

The GP40 is available in four versions. An optional vacuum degas pump is available for all versions:

<b>GP40 Gradient Pump Version</b>	<b>With Degas Pump</b>	<b>Without Degas</b>
Standard bore with PEEK components	P/N 044117	P/N 044165
Standard bore with stainless steel components	P/N 044081	P/N 044085
Microbore with PEEK components	P/N 044086	P/N 044082
Microbore with stainless steel components	P/N 044083	P/N 044087

## **1.2 About This Manual**

This manual describes the installation, operation, and maintenance of the GP40 Gradient Pump.

Chapter 1, **Introduction**, introduces the product and conventions used in the manual, and provides safety information.

Chapter 2, **Description**, is a description of the physical aspects of the pump, followed by a description of the operating features.

Chapter 3, **Operation and Maintenance**, discusses the operating features and methods, and presents several examples of how to run methods. Routine preventive maintenance requirements are included in this chapter.

Chapter 4, **Troubleshooting**, lists possible causes of problems and provides step-by-step procedures to isolate and eliminate their sources.

Chapter 5, **Service**, presents step-by-step instructions for service and parts replacement routines.

Appendix A, **Specifications**, contains the GP40 specifications and installation site specifications.

Appendix B, **Installation**, describes the installation steps necessary to place the GP40 Gradient Pump into operation.

Appendix C, **User Interface**, illustrates and describes all front panel menus and screens.

Appendix D, **Pump Head Replacement**, explains how to change the pump heads from 100  $\mu$ L standard bore to 25  $\mu$ L microbore, or vice versa.

Appendix E, **Relay and TTL Control**, describes the relay and TTL input and output functions and provides setup examples.

### 1.2.1 Typefaces

Typefaces are used in this manual as follows:

- Capitalized bold type indicates a front panel button:  
Press **Enter** to begin running the method.
- Upper-case bold type indicates the name of a screen, the name of a menu, or an on-screen entry:  
Go to the **METHOD** screen.  
Move the cursor to the **EDIT** field.

### 1.2.2 Safety Messages and Notes

This instrument is designed to comply with the requirements for safety set forth in IEC 1010, *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use*.

This manual contains warnings and precautionary statements that can prevent personal injury and/or damage to the instrument when properly followed. Safety messages appear in bold type and are accompanied by icons.



Indicates a potential hazard which could result in serious injury or loss of life. Any hazard of this type will be located behind a barrier and will be accessible only by use of a tool. Access may be required during installation, maintenance, or service.



Indicates a potential hazard to the operator, or damage to the instrument or other property.



Indicates that the function or process of the instrument may be impaired. Operation does not constitute a hazard.

Informational messages also appear throughout this manual. These are labeled NOTE and are in bold type:

### **NOTE**

**NOTES call attention to certain information. They alert you to an unexpected result of an action, suggest how to optimize the performance of the instrument, etc.**

### **1.2.3 Symbols**

The symbols below appear on the pump, or on pump labels.



Alternating current



Protective conductor terminal



Power supply is on



Power supply is off

## 1.3 Related Manuals

During installation and operation of the GP40, you may need to refer to one or more of the following manuals (depending on your system) for information about other modules and components included in a DX 500 system.

The following manuals are included with their respective modules or components:

- *AS3500 Autosampler Editor Manual* (Document No. 034913)
- *AS40 Automated Sampler Operator's Manual* (Document No. 034970)
- *CD20 Conductivity Detector Operator's Manual* (Document No. 034854)
- *ED40 Electrochemical Detector Operator's Manual* (Document No. 034855)
- *E01 Eluent Organizer Installation Instructions* (Document No. 034582)
- *Pressurizable Reservoir Installation Instructions* (Document No. 034851)
- *LC10 Chromatography Organizer Operator's Manual* (Document No. 034858)
- *LC20 Chromatography Enclosure Operator's Manual* (Document No. 034859)
- *LC30 Chromatography Oven Operator's Manual* (Document No. 034860)

The following manual is included in the GP40 Ship Kit:

- *Installation of Dionex Ferrule Fittings* (Document No. 034213)

***GP40 Gradient Pump***

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## 2 • Description

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***GP40 Gradient Pump***

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## 2 • Description

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The GP40 Gradient Pump consists of two single-unit DX 500 enclosures (see Figure 2-1). The upper unit houses the electronic components, and the lower unit houses the pump heads and other mechanical pump assemblies.

The GP40 is designed to have other single- or dual-unit modules stacked on top of it, to a maximum of four units. See Section B.4 for the recommended stacking configuration for DX 500 systems.

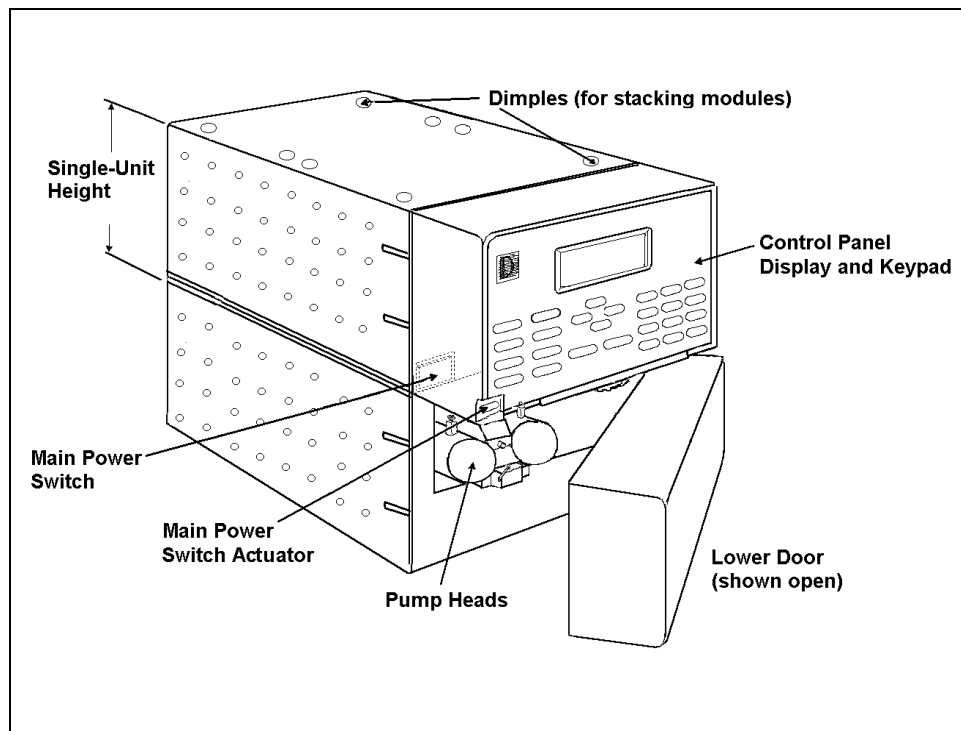


Figure 2-1. GP40 Enclosure

## **2.1 Front Control Panel**

The control panel on the upper door of the GP40 enclosure contains the liquid crystal display (LCD), the membrane keypad, and the actuator for the main power switch (see Figure 2-2). The door opens to provide access to the electronics chassis, described in Section 2.2.

### **Screen Contrast**

Information is displayed on the LCD, also called the *screen*. To adjust the screen contrast, use the knurled knob in the recess below the keypad (see Figure 2-2).

### **Tilt Panel**

To maximize visibility, the front control panel can be tilted to four different positions. To tilt the panel, support the door at the left side (to prevent it from opening) and lift firmly on the tab in the middle of the recess below the keypad (see Figure 2-2). Push on the tab to return the panel to its vertical position.

### **Power Switches**

The main power switch is on the bulkhead behind the upper door (see Figure 2-1). An actuator for the main power switch is on the outside of the front door, at the lower left corner (see Figure 2-2). The actuator functions only when the door is fully closed.

When the door is open, press the main power switch on the bulkhead, instead of the actuator, to turn the module off and on.



**CAUTION**

**To prevent damage to the pump circuitry and components, always wait at least 15 seconds after powering down before turning on the power again.**

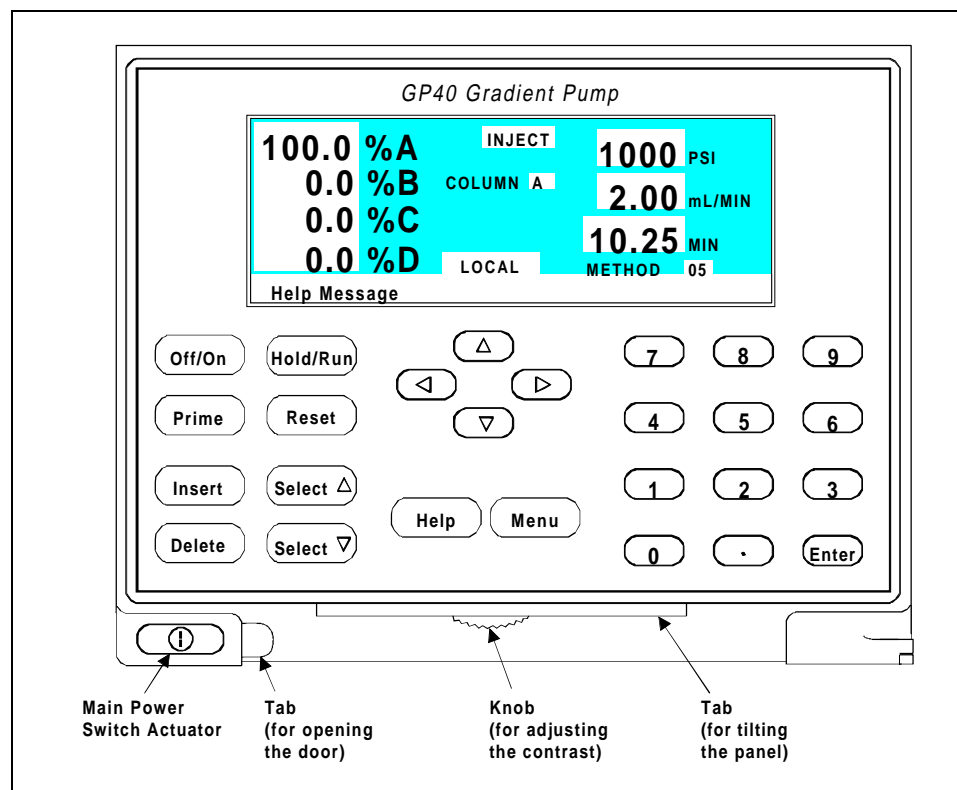


Figure 2-2. GP40 Display and Keypad Layout

### 2.1.1 Control Panel Keypad

The keypad is used to directly control pump operation, as well as to create and modify programmed series of timed events, called *methods*. In summary:

- Press **Menu** to display a list of available screens.
- In the screens, only the fields shown in reverse video can be edited. Other fields display information only.
- To edit a field, use the four directional arrow buttons to position the cursor in the reverse video fields. Use the numerical buttons to enter variable values. Use the **Select  $\Delta$**  and **Select  $\nabla$**  buttons to choose between

predetermined options. Pressing a **Select** button increases (or decreases) a numerical value by one, while holding down a **Select** button increases (or decreases) a numerical value continuously.

- To execute the selected value, press **Enter**, or press an arrow button to move the cursor to the next field and automatically enter the value.

A high-pitched beep sounds when you press a button. When an error occurs, this beep is lower in frequency. The beeps can be disabled from the **MODULE SET-UP** screen (see Section C.1.6).

### Off/On

Turns the pump motor off and on.

In Direct control (see Section 2.8), turning on the motor causes it to pump isocratically using the displayed eluent percentages and flow rate.

In Method control (see Section 2.8.2), turning on the motor causes it to pump at the eluent percentages and flow rate for the elapsed time of the selected method, or at the initial conditions (when the method clock is at **INIT**).

### Prime

This button is used when priming the pump heads. **Prime** causes the pump to run at maximum volume (2.5 mL/min, microbore; 10.0 mL/min standard bore). If the pump motor is off when you press **Prime**, the pump automatically turns on. To exit priming and return to the normal flow rate, press **Prime** again or press **Off/On** to turn the pump motor off. See Section B.2.7 for detailed priming instructions.

**Insert**

Inserts a new timed step into a method. This button functions only when the cursor is in a **TIME** field in the **METHOD** or **METHOD** extension screen.

1. Move the cursor to the **TIME** field and press **Insert**. The new step is added after the cursor position. Parameter values in the new step are blank.
2. Fill in the time value and press **Enter** or a cursor arrow button. If you move the cursor to a different field before entering the time value, the inserted step will be incomplete and will disappear. You can insert timed steps in any order. After you press **Enter**, they will be automatically organized in correct chronological order.

**Delete**

Removes the value from the current entry field, allowing entry of a new value. To restore the previous value, move the cursor from the field before entering the new value.

In the **METHOD** screen, pressing **Delete** when the cursor is in a step entry field “blanks” the step parameter value. When the cursor is moved from the field, the field remains blank (the previous value is not restored as in other screens). Blank step fields indicate there is no change from the previous step.

To use **Delete** to delete an entire method step:

1. Position the cursor in the method’s time field and press **Delete**. The time is removed and the help line displays:

TO DELETE THIS STEP, PRESS DELETE AGAIN

2. Press **Delete** again to delete the step. If you do not want to delete the step, press any button except **Delete** or the decimal point and the original time and step parameters are then restored.

### **Hold/Run**

Turns the method clock off (**Hold**) and on (**Run**). This button functions only when the pump is under Method control (see Section 2.8.2).

When the method clock is in Hold, pressing **Hold/Run**, starts the clock. The clock starts either at the initial step of a new method, or if resuming an interrupted method, at the time at which the clock was put in Hold.

When the method clock is in Run, pressing **Hold/Run**, stops the clock, thereby “holding” the method and freezing the current conditions.

### **Reset**

Changes the method clock time to **INIT** and causes the initial conditions specified by the method to occur. This button functions only when the pump is in Method control.

If the method is running, it continues running. If the method is on hold, the method clock executes the initial conditions and holds.

### **Select** $\Delta$

and

### **Select** $\nabla$

When the cursor is positioned at a field that has predetermined parameters, these buttons cycle through the choices. In fields which have predetermined numeric values, **Select**  $\Delta$  increases the value by one unit and **Select**  $\nabla$  decreases the value by one unit. Holding down the **Select** button increases (or decreases) the value continuously. Press **Enter** or a cursor arrow button to execute the new value.

### $\leftarrow$ , $\uparrow$ , $\rightarrow$ , and $\downarrow$

The four cursor directional buttons move the cursor, in the direction of the arrow, to the next entry field. If there is no



changeable field in that direction, the cursor moves diagonally or remains where it is.

After entering or selecting a new value in an entry field, pressing an arrow button to move to another field also saves and/or executes the change. This performs the same function as pressing **Enter** followed by an arrow.

In a few fields the cursor arrow does not perform the enter function. You must press **Enter** after entering or selecting values in the following fields:

- **DIAGNOSTIC TEST** screen fields
- **SAVE TO** and **RUN** fields on the **METHOD** screen
- Calibration screen fields
- Menu fields

**Help**

Displays a help screen specific to the current entry field.

**Menu**

Displays one of three menus, depending on the current screen:

- From any operational screen, pressing **Menu** displays the **MENU of SCREENS**.
- From any diagnostic screen, pressing **Menu** displays the **DIAGNOSTIC MENU**. Pressing **Menu** again returns you to the **MENU of SCREENS**.
- From any calibration screen, pressing **Menu** displays the **CALIBRATION MENU**. Pressing **Menu** again returns you to the **DIAGNOSTIC MENU** and then to the **MENU of SCREENS**. See Figure C-1 for the GP40 screens and menu structure.

### Numeric Buttons

Enters numeric values into the current entry field. The numeric buttons are 0 through 9 and the decimal.

### Enter

Saves and/or executes changes made in entry fields. After pressing **Enter**, the cursor moves back to the left margin of the same field. It does not automatically move to the next entry field. In menu screens, pressing **Enter** opens the highlighted screen.

In the **METHOD** screen, pressing **Enter** saves entries to an edit copy only. To save the editing changes to a permanent method, move the cursor to the **SAVE TO** field, enter the method number, and press **Enter**.

## 2.1.2 Display Screens

When the pump has successfully powered-up and passed all diagnostic tests, the **POWER-UP** screen displays briefly (see Figure 2-3) and after a few seconds, the **MAIN** screen displays (see Figure 2-5). If one of the diagnostic tests fails at power-up, the **DIAGNOSTIC TEST** screen displays instead of the **MAIN** screen. See Section C.2.8 if this occurs.

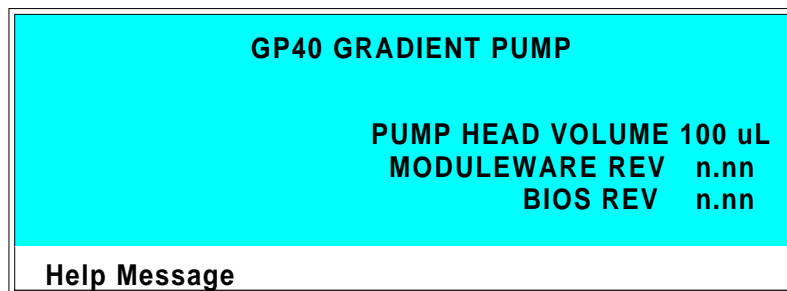


Figure 2-3. Power-Up Screen

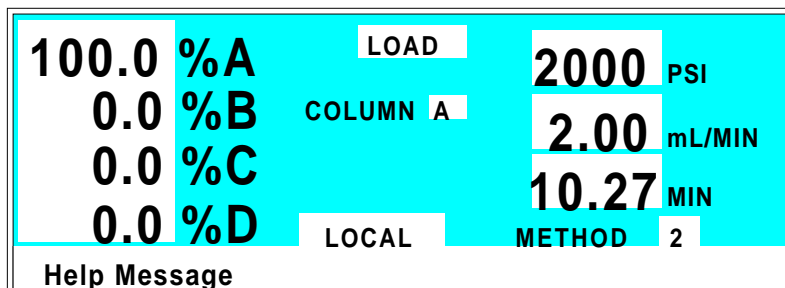


Figure 2-5. Main Screen

The **POWER-UP** screen can also be opened from the **DIAGNOSTIC MENU**, if you wish to view the information at a later time.

The **MAIN** screen displays status information in enlarged characters to make viewing easier from a distance. From the **MAIN** screen you can set pump operating parameters such as the percentage of eluents to run, the flow rate, or the method number to run.

To access the remaining GP40 screens, press the **Menu** button to display the **MENU of SCREENS** (see Figure 2-4). From the menu, you can select individual operational screens, or the **DIAGNOSTIC MENU** screen. To open a screen, enter the screen number and press **Enter**, or move the cursor to the desired screen name and press **Enter**. See Appendix C for a description of each GP40 screen.

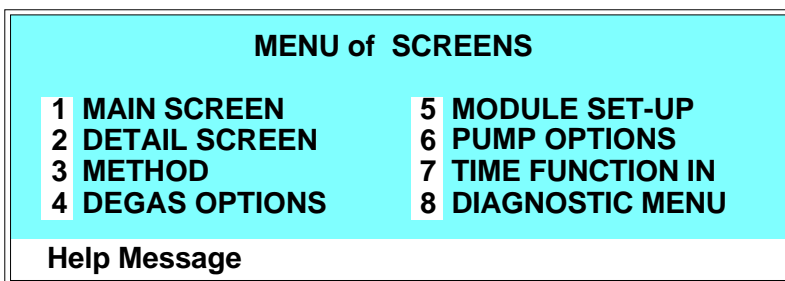


Figure 2-4. Menu of Screens

## 2.2 Electronics Chassis

The electronics chassis is located behind the upper door of the GP40 enclosure. The chassis includes several electronic cards (printed circuit boards) that are used to control the GP40. Connectors on the cards also allow communication between the GP40 and other DX 500 modules. Figure 2-6 shows the electronics components with the upper door open. To open the door, pull on the tab located to the right of the main power actuator (see Figure 2-2).



**Do not remove any of the electronics cards from the pump. There are no user-serviceable components on the cards. If servicing is required, it must be performed by qualified personnel and appropriate electrostatic discharge (ESD) handling procedures must be followed.**

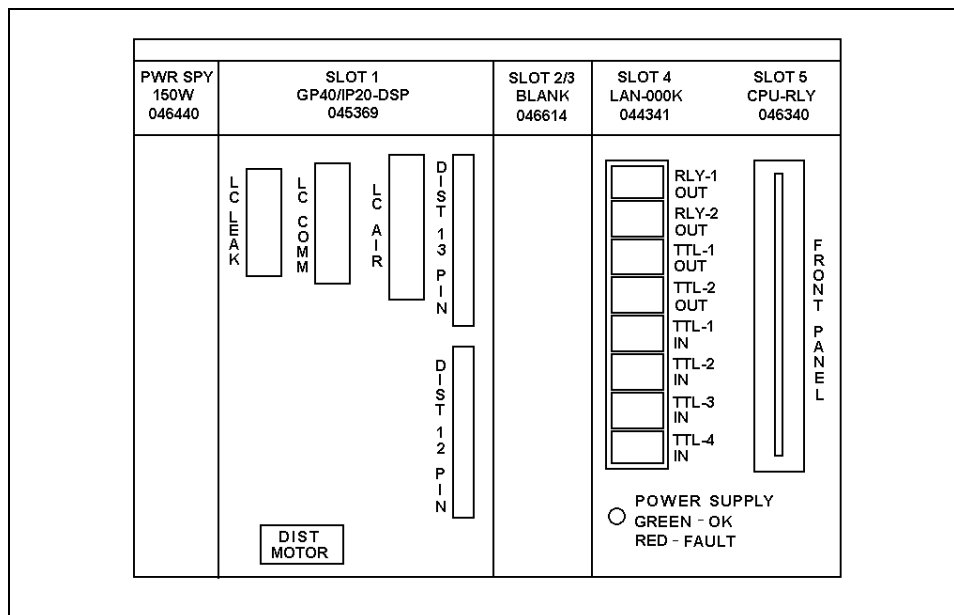


Figure 2-6. Electronics Chassis  
(Located behind pump upper door)

### **LC Leak**

The leak control cable from the LC20 Chromatography Enclosure or the LC10 Chromatography Organizer connects to the **LC LEAK** connector in slot 1.

When a leak occurs in the LC10 or LC20, it is reported to the GP40. The LC30 Chromatography Oven does not connect to the GP40 **LC LEAK** connector; it has its own internal leak control electronics.

### **LC30 Communication**

The LC30 Chromatography Oven's RJ-11 serial cable connects to the **LC COMM** connector in slot 1. When connected, the LC30 can be remotely controlled by the PeakNet workstation.

### **LC Air Valves**

The cable from the air solenoid valves on the LC10, LC20, or LC30 connects to the **LC AIR** connector in slot 1. When connected, the GP40 can electrically actuate the solenoid valves which control the position of the injection valve and the optional column switching valve in the LC10, LC20, and LC30. Use the **MAIN** or **METHOD** screen to select the valve positions. See Appendix C for a description of the screens.

### **TTL/Relay**

A strip of eight relay and TTL connectors is located in slot 4. These connectors interface with Dionex and non-Dionex modules for relay and TTL control of the pump. Appendix E describes the relay and TTL functions and the connections between the GP40 and other modules.

### **CPU**

Control Moduleware for the GP40 resides on the CPU/Relay cards.

## ***GP40 Gradient Pump***

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The CPU logic and Relay I/O cards occupy slot 5 in the card cage. The Relay I/O card rides piggyback on the CPU card and extends over the front of slot 4. The card is short enough to allow the optional DX LAN pump interface card (P/N 044195) to mount behind it in slot 4. A 60-pin ribbon cable links the CPU logic to the display and keypad. The logic monitors the internal power supply outputs, and reports the status on the multicolored LED at the bottom of slot 4.

- Green indicates normal operation.
- Red indicates a power fault. The module will enter its diagnostic state and inhibit all other controls until the fault is corrected. If this occurs, turn the power off for a few seconds and then turn it back on. If the problem persists, call Dionex.

## 2.3 Mechanical Chassis

The mechanical chassis is housed in a pull-out drawer located behind the lower door of the GP40 enclosure. The front of the chassis contains the interior components described in Section 2.4. Other mechanical assemblies are located inside the chassis drawer. For routine operation, the drawer must be pushed in and the drawer lock, located on the lower right corner of the chassis, tightened. The drawer is pulled out only for service procedures.



Observe the warning label on the inside of the lower door. The arrows on the label indicate moving mechanical parts that present pinch hazards when the pump is on and the mechanical drawer is open. Do not operate the pump with the mechanical chassis drawer pulled out.

## 2.4 Interior Components

Figure 2-7 shows the interior components located behind the lower door.

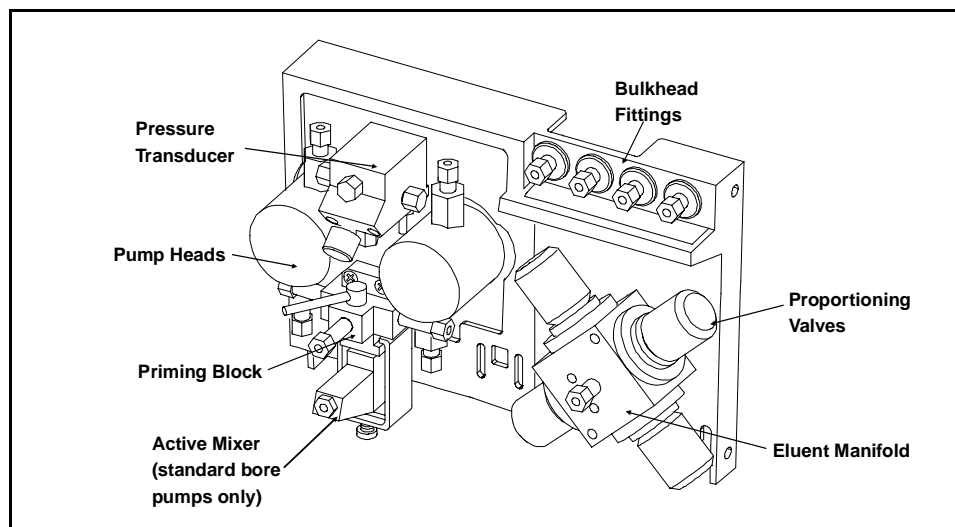


Figure 2-7. Interior Components

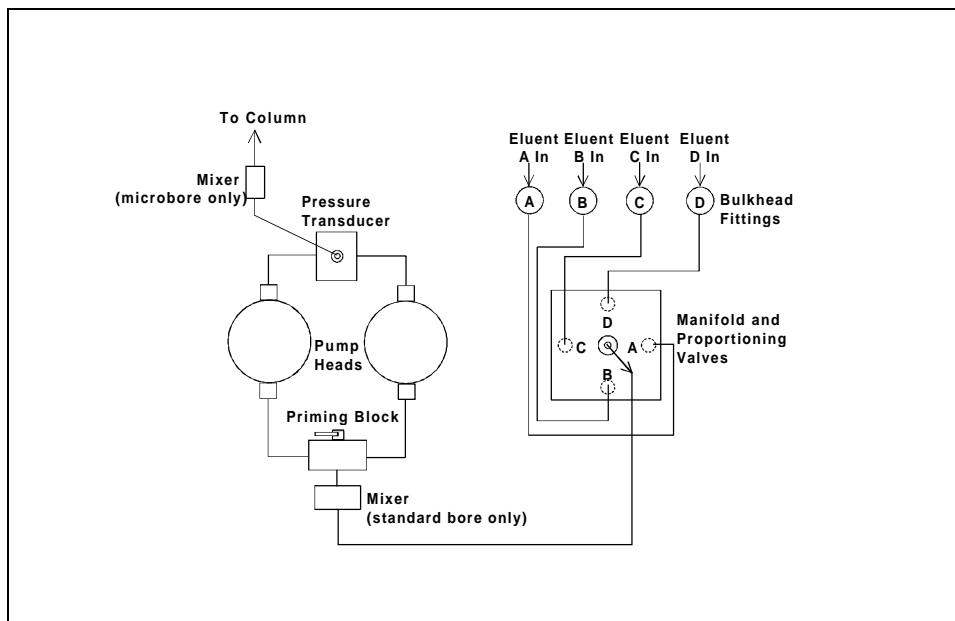


Figure 2-8. Eluent Flow Schematic

### 2.4.1 Pump Eluent Manifold

Front panel bulkhead fittings A through D are connected to the chemically-inert proportioning solenoid valves that control eluent selection. The proportioning valves generate the gradient mixture by cycling open and closed to deliver the desired percentage of each selected eluent to the manifold. The output from the four proportioning valves is combined in the manifold. Figure 2-8 shows the eluent flow path through the components.



### 2.4.2 Pump Heads

There are two GP40 pump head configurations: standard bore and microbore. The table below summarizes the features of each type and the operating conditions for each configuration.

Pump Head Type	Piston Volume	Pump Operation	Flow Rate (mL/min)*	Column Sizes	Maximum Operating Pressure
Standard Bore	100 µL	Isocratic	0.04 – 10.0	4-mm and 9-mm ID	35 MPa (5000 psi)
		Gradient	0.4 – 10.0	4-mm and 9-mm ID	35 MPa (5000 psi)
Microbore	25 µL	Isocratic and Gradient	0.01 – 2.50	1-mm – 4-mm ID	35 MPa (5000 psi)

\*Flow rates are adjustable in increments of 0.01 mL/min.

#### NOTE

Although there is some overlap in flow rates between the two pump versions, continuous operation of the microbore pump heads at flow rates above 2.0 mL/min will decrease seal and pump life. For the best extended operation at 2.0 mL/min or above, replace the microbore pump heads with standard bore pump heads. Similarly, when running gradients, the standard bore pump heads should not be used below 0.4 mL/min.

Instructions for replacing the pump head assembly are shipped with the replacement head and included in Appendix D of this manual. Contact your Dionex office to order the conversion pump head kits. Refer to Appendix D for kit part numbers.

See Figures 5-1 and 5-2 for an illustration of the pump heads and interconnecting lines.

### **2.4.3 Pump Mixers**

A pump mixer ensures complete mixing of the proportioned eluents prior to injection. Two types of mixers are available:

- In standard bore GP40 pumps (100  $\mu$ L piston volume), a Dionex active mixer (P/N 048988) is installed between the eluent manifold and the priming block. The active mixer contains an electromagnetic stir bar to mix the proportioned eluents.
- In microbore GP40 pumps (25  $\mu$ L piston volume), a GM-4 gradient mixer (P/N 049135) is installed between the pump outlet and the injection valve.

### **2.4.4 Pump Priming Block**

The priming block “tee” directs the flow of eluent from the manifold into the pump heads. The priming block is also used for rapid removal of air from the system.

Refer to Section B.2.7 for instructions on priming the pump heads.

### **2.4.5 Pressure Transducer**

From the priming block, the liquid stream is directed to the inlet check valves on the pump heads, through the pump heads, and finally through the outlet check valves to the pressure transducer.

Flow from the outlet check valves on the pump heads is combined in the pressure transducer. The pressure transducer measures the system pressure at this point. The interactive constant-flow/constant-pressure control program on the DSP precisely controls the pump motor speed to assure flow rate accuracy. A Kel-F disk and PTFE O-ring isolate the eluent from the metal pressure transducer.

The pressure transducer includes a pressure waste valve for use during priming of the pump. Open this valve for a few

seconds to relieve the pressure and force air out of the system, then close it to resume analysis (see Figure B-5).

Flow output from the pressure transducer is directed out of the pump module to the rest of the chromatography system (injection valve, column, detector). On microbore pumps, flow passes through the GM-4 mixer before entering the injection valve.

See Section B.2.5 in Appendix B for outlet line connections. Refer also to the manual for the module being used for specific interconnect information.

## **2.5 Vacuum Degas Pump Assembly (Optional)**

The Dionex vacuum degas pump (P/N 047263) provides continuous on-line vacuum degassing of one to four eluents (see Figure 2-9). If ordered, the assembly is installed in the pump at the factory. This assembly consists of:

- A 4-channel degas chamber (with degas membranes) with 17 mL internal capacity per channel
- A dual-stage diaphragm vacuum pump
- A solenoid valve
- An on-board vacuum sensor
- The electronics required to operate the vacuum pump
- Fittings, tubing, and other accessories

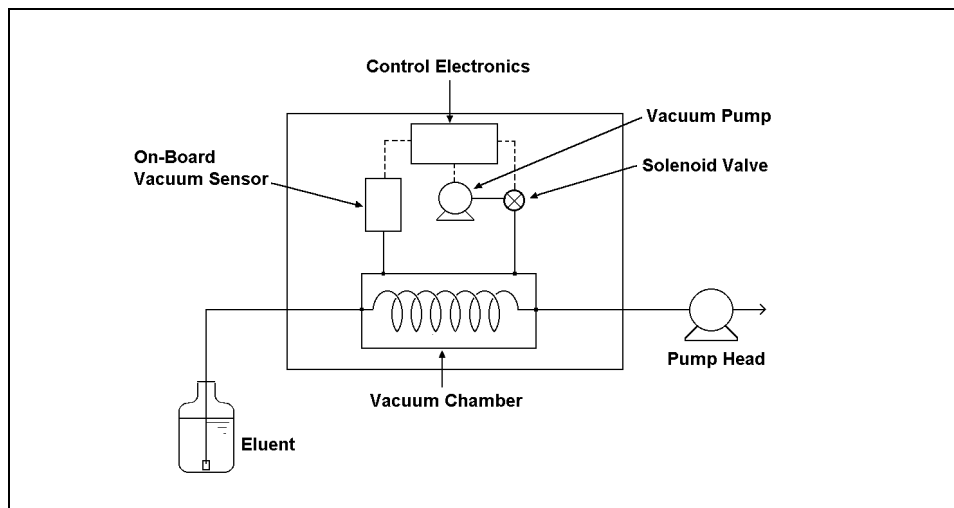


Figure 2-9. Vacuum Degas Component Schematic

By default, at power-up, the degas pump turns on for 2 minutes. Thereafter, the pump turns on for 30 seconds at 10-minute intervals. You can check the vacuum chamber pressure from the **DEGAS STATUS** screen (see Section C.3.4). The **DEGAS OPTIONS** screen allows you to change the cycle time and duration (see Section C.1.5).

All components of the vacuum degas assembly are made of inert materials or corrosion-resistant materials. However, Dionex recommends that you thoroughly flush any chemicals out of the tubing with deionized water after each use to avoid crystallization in the membrane pores.

## 2.6 Eluent Reservoirs

Dionex strongly recommends degassing all eluents and storing them in reservoirs pressurized with helium. This helps prevent bubbles (resulting from eluent outgassing) from forming in the eluent proportioning valves, pump heads, and the detector cell. Degassed eluents and pressurized reservoirs are especially important when combining aqueous and non-aqueous components (e.g., water and methanol). Pressurizable reservoirs allow eluents to be stored under

a specific atmosphere. The following reservoirs are available from Dionex:

- 1-liter glass reservoirs with shatterproof plastic coating (P/N 044126)
- 2-liter glass reservoirs with shatterproof plastic coating (P/N 044127)
- 1-liter plastic reservoirs (P/N 044128)
- 2-liter plastic reservoirs (P/N 044129)



**Do not use the 2-liter plastic reservoir (P/N 044129) for off-line vacuum degassing of eluents. The reservoir was not designed for this purpose.**

Refer to the *Pressurizable Reservoir Installation Instructions* (Document No. 034581) for installation details.

Two optional E01 Eluent Organizers (P/N 044125) fit on top of the system enclosure. Each organizer can accommodate up to two reservoirs with the volume listed below. Contact your Dionex office for ordering information.

No. of Reservoirs	Description	Total Volume in Liters
2	1 Liter glass or plastic	2 L
2	2 Liter plastic	4 L
1	2 Liter glass	2 L

## 2.7 Rear Panel

The rear panel contains the main power receptacle with fuses, and a BNC connector for interfacing the GP40 with the PeakNet workstation through the DX LAN. The rear panel is illustrated in Figure B-1 in Appendix B.

## 2.8 Functional Description

There are three ways to operate the GP40 pump:

- In Local mode, you use the front control panel buttons and screens to set operating parameters. See Section 2.8.1 for a description of Local mode.
- In Remote mode, you use PeakNet to send operating commands from the host computer via the DX LAN. See Section 2.8.1 for a description of Remote mode.
- With TTL input, a controlling device, such as an integrator or another DX 500 module, sends TTL signals to the pump. The TTL input signals can be used to turn the pump motor off and on, set the method clock to hold or run, or increment and decrement the method number. All other GP40 operating parameters must be set locally with the control panel. See Appendix E for a description of TTL control.

To select the operating mode:

1. Open either the **MAIN** or **DETAIL** screen. The operating mode field displays either **LOCAL** or **REMOTE** (see Figure 2-10).
2. To change the mode, move the cursor to this field; press **Select**  $\Delta$  or **Select**  $\nabla$  to toggle to the desired mode and press **Enter** or a cursor arrow button. (For TTL input control, set the GP40 to Local mode.)

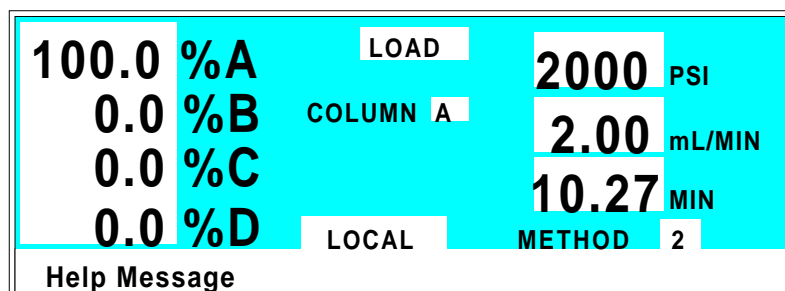


Figure 2-10. Main Screen

In addition to the operating modes, two pump control modes are available:

- In Direct control, commands are executed immediately when entered. Because there is no time-based program, the method clock is not used and **Hold/Run** and **Reset** do not operate.
- In Method control, commands are executed according to the timed steps in a programmed method. See Section 2.8.2 for details about Method control.

To select the control mode:

1. Open either the **MAIN** or **DETAIL** screen. The control mode field displays either **DIRECT CNTRL** or **METHOD** (see Figure 2-10).
2. To change the mode, move the cursor to this field; press **Select** Δ or **Select** ∇ to toggle to the desired mode and press **Enter** or a cursor arrow button.

**NOTE**

**If the GP40 is connected to a host computer, PeakNet commands can also be used to change the operating and control modes.**

Both Direct and Method control are available in either the Local mode or the Remote mode. The combination of available operating modes and control modes provides flexibility in the way the pump can be operated. The table below summarizes the different operating and control mode configurations:

Operating/Control Mode	Pump Operation
<b>Local/Direct</b>	Commands entered from the control panel and executed immediately after being entered
<b>Local/Method</b>	Commands entered from the control panel and executed by running a programmed method
<b>Remote/Direct</b>	Commands sent from PeakNet and executed immediately when received
<b>Remote/Method</b>	Commands sent from PeakNet and executed by running a programmed method

### **2.8.1 Operating Modes**

#### **Local Mode**

When the pump is powered up, it is in Local mode (see Figure 2-10). In Local mode, the pump accepts operating commands from two sources:

- Direct input from the front panel keypad
- TTL inputs from a remote controller, such as an integrator or another DX 500 module

#### **Remote Mode**

In Remote mode, the pump accepts operating commands from the host computer, which are sent via the DX LAN using PeakNet software.

Remote control can be set to either normal Remote or Locked Remote:

- In normal Remote mode, all front panel buttons function except **Hold/Run**. Operating parameters can be changed, providing they do not interfere with a method while it is running in remote control.
- In the Locked Remote mode, all operating changes from the GP40 front panel are disabled. Locked Remote mode can be selected only from the host computer. It can be cleared either from the computer or by powering the GP40 down. The GP40 always powers up in the Local mode.

If the pump is running a method when you change to the Remote mode, the computer will not interrupt the method unless you send an abort command from the computer.



### 2.8.2 Method Control

In Method control, commands are executed according to the time-based steps programmed in a method. Each step specifies the eluent composition and flow rate to be delivered by the pump at a given time. The selected eluent mixture is delivered either isocratically, or as a multistep linear or curved gradient. As the method runs, the GP40 calculates the changes in eluent composition required to deliver a gradient from one method step to the next or to match the selected curve.

Methods are programmed, saved, and edited from the **METHOD** screen (see Figure 2-11). See Section 3.3 for programming instructions.

METHOD EDIT 05					SAVE TO 06		RUN 10	
					LIMITs 0 - 5000 PSI			
TIME	%A	%B	%C	%D	C	V	FLOW	
INIT	25.0	25.0	25.0	25.0	0	L	1.00	>
0.00	100.0	0.0	0.0	0.0		I		>
123.45	10.0	22.2	32.3	35.5	5	L	2.00	>
345.67 v	17.2	19.6	33.2	30.0				>
Help Message								

Figure 2-11. Method Screen

The following summarizes basic information about using methods.

- The pump can run under method control while you are entering or editing any method, even the one that is currently running.
- When saving changes to the currently running method, or switching to a different method, the method clock continues running unaffected. Only those parameter changes which affect the method after the current time will be implemented in the current run.

- The GP40 can store up to 100 separate methods (0 through 99) in memory. The actual number is memory-dependent, i.e, depends on the size of each method and the amount of available memory. Typically, less than 100 can be stored.
- Methods are retained in memory even after the pump is powered-down.
- Each method can have a maximum of 50 time-based steps. Each method step specifies a time, an eluent composition, a gradient curve number, an injection valve position (Load or Inject), and a flow rate. Step 1 always starts at **INIT** (initial condition). Step 2 always starts at **TIME = 0.0**.
- After PeakNet downloads a method to the GP40, the computer sends a command to activate the method number and execute the **INIT** conditions step. If a method is running when the computer activates the new method, the old method is interrupted and the method clock is reset to **INIT** conditions.

### **2.8.3 Eluent Delivery**

#### **Isocratic Eluent Run**

The simplest use of the GP40 Gradient Pump is for the delivery of an isocratic (unchanging) mixture of one or more eluents. If more than one eluent is selected, the pump delivers a proportional mixture of the eluents based on the percentage of each eluent selected. The combined percentages of all eluents selected must total 100% or the pump will not run.

#### **Gradient Eluent Run**

The pump can produce step, linear, concave, or convex curves in eluent concentration over a specified time period. The slope of the gradient is determined by the selected gradient curve (see Figure 2-12) and the time between the starting and

ending points of a gradient step. It is important to note the following points:

- The curve number parameter determines whether the pump delivers a linear or curved gradient.

Curve numbers are defined as follows:

Curve No.	Gradient Type
1, 2, 3, 4	Convex
5	Linear (power-up default)
6, 7, 8, 9	Concave

- Convex curves cause rapid changes in eluent composition at the beginning of the curve and slower changes at the end. Concave curves cause slower changes at the beginning and rapid changes at the end.
- Slope changes over time become more extreme as curves go from 6 to 9 (more concave) and from 4 to 1 (more convex). Figure 2-12 shows the eluent composition profiles corresponding to curves 1 through 9, normalized for 0-100% for 10 minutes.

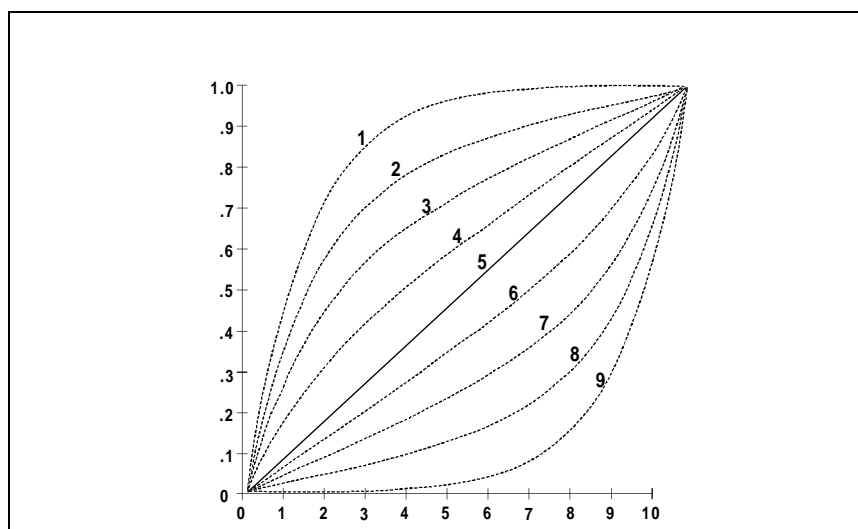


Figure 2-12. Eluent Composition Profile for Curves 1-9

### **NOTE**

**A curve number in a step instructs the pump to use the selected curve number when moving from the previous step to that step. Because there are no previous steps for INIT or TIME = 0.0, curve numbers cannot be entered for these steps.**

- The gradient slope does not change during a step if curve 5 (the default setting) is selected, because curve 5 represents a linear gradient.
- Any consecutive method steps specifying identical eluent compositions will generate an isocratic segment, regardless of the curve number selected.
- A step gradient change is a steep linear change from one eluent to another. A step change occurs automatically if the following three conditions occur: the time interval between two steps is less than 0.1 minute; at the beginning of the step, one eluent is at 0%; and at the end of the step, none of the eluents is at 0%.

## 3 • Operation and Maintenance

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***GP40 Gradient Pump***

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## 3 • Operation and Maintenance

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### 3.1 Getting Ready to Run

#### 3.1.1 Degas Eluents

Dionex strongly recommends degassing all eluents and storing them in reservoirs pressurized with filtered inert gas (see Section 3.1.3). This helps prevent bubbles (resulting from eluent outgassing) from forming in the eluent proportioning valves, pump heads, and the detector cell. Degassed eluents and pressurized reservoirs are especially important when combining aqueous and non-aqueous components (e.g., water and methanol).

The GP40 with the optional vacuum degas pump assembly provides continuous on-line vacuum degassing of eluents and reagents (four maximum).

If the GP40 is not equipped with the vacuum degas assembly, manually vacuum-degas eluents daily, as described below, and store them in pressurized reservoirs.

#### Degassing Eluents Manually

1. Prepare the eluent required for your application. Pour it into a vacuum flask and attach the flask to a vacuum pump or water aspirator.
2. Vacuum degas the eluent for 5 minutes by shaking or sonication.
3. Remove the flask from the vacuum. **Do not allow water to flow from the aspirator back into the flask.**
4. Pour the degassed eluent into a pressurizable reservoir. Be careful not to shake the eluent.

5. Install end-line filters and pressurize the reservoirs (see Sections 3.1.2 and 3.1.3).

### **3.1.2 Filter Eluents**

Always filter eluents before operation to remove small particulates that may contaminate the proportioning valves or the pump check valves and cause erratic flow rates or loss of prime. End-line filters (P/N 045987) are supplied in the pressurizable reservoir ship kits for this purpose.

Install an end-line filter on the end of each eluent line inside the reservoir. To prevent air from being drawn through the lines, make sure that the end of the filter reaches the bottom of the eluent reservoir.

### **3.1.3 Pressurize Eluent Reservoirs**

Pressurize eluent reservoirs with filtered inert gas (preferably helium). If helium is not available, argon or nitrogen can be used. Refer to the *Pressurizable Reservoir Installation Instructions* for details.

1. Verify that a regulator (P/N 046594) is installed on the gas supply line to the reservoirs.
2. Turn on the gas supply and adjust the pressure to 55 KPa (8 psi).



**Never pressurize the reservoirs above 69 KPa (10 psi).**



### **3.1.4 Start-Up**

1. Turn on the main pump power. The **POWER-UP** screen displays briefly (see Figure 2-3) and after a few seconds, the **MAIN** screen displays (see Figure 2-5). A series of diagnostics tests is run at power-up. If one of the tests fails, the **DIAGNOSTIC TEST** screen displays instead. See Section C.2.8 if this occurs.
2. Press **Off/On** to start the pump flow.
3. Check the pressure reading on the **MAIN** screen. The GP40 display updates the pressure readout once per piston stroke. The reading from one stroke to the next should be within 3%.

A variation of more than 3%, indicates the pump is out of prime. The pump can lose prime if it has been shut down for an extended period of time. (Overnight shutdown generally does not cause loss of prime.) Refer to Section B.2.7 for priming instructions, or see Section 4.1 for other conditions which can cause the pump to lose prime.

### **3.1.5 Selecting the Pressure Limits**

The high and low pressure limits automatically stop the pump in the event of a system malfunction (e.g., overpressurizing because of a blockage, or low pressure caused by a leak downstream from the pump).

When running under Direct control, enter the pressure limits from the **DETAIL** screen (see Figure 3-1).

When running under Method control, enter the limits from the **METHOD** screen as a part of each method. The limits are set in the **INIT** step and remain unchanged throughout the analysis. When a limit trip stops the pump, the method clock immediately stops and goes to Hold. The current status of the program that was running at the time is displayed on the front panel.

To select the limits:

1. Go to the **DETAIL** or **METHOD** screen and move the cursor to the **LIMIT** field.
2. Enter a low pressure limit that is 1.4 to 2 MPa (200-300 psi) below the normal system operating pressure, as indicated by the pressure display on the front panel. The low pressure limit is activated after 13 pump piston strokes, i.e., after 1.3 mL (standard) or 0.325 mL (microbore) of fluid is pumped through.
3. Enter a high pressure limit that is 2 to 2.75 MPa (300-400 psi) above the normal system operating pressure. The pump is equipped with a pressure limiter that prevents operation above 35 MPa (5076 psi).

<b>DETAIL SCREEN</b>				<b>TTL1</b>	<b>0</b>
100.0	%A	2125	PSI	<b>TTL2</b>	<b>1</b>
0.0	%B	2.00	mL/MIN	<b>RLY1</b>	<b>1</b>
0.0	%C	INJECT	SAMPLE	<b>RLY2</b>	<b>0</b>
0.0	%D	COLUMN	A		
		LIMIT	1200-1900 PSI		
<b>LOCAL</b>		<b>DIRECT CNTRL</b>			
Help Message					

Figure 3-1. Detail Screen: Setting Pressure Limits

### 3.2 Running Under Direct Control

Direct control is most often used for simple runs, such as the delivery of an isocratic (unchanging) mixture of one or more eluents.

#### Direct Control Example:

Specify an isocratic mixture of 60% eluent A, 25% eluent B, and 15% eluent C to be pumped at 2.0 mL/min. Figure 3-2 illustrates the isocratic profile for this example. Figure 3-3 illustrates the **MAIN** screen as it will appear when the example is set up.

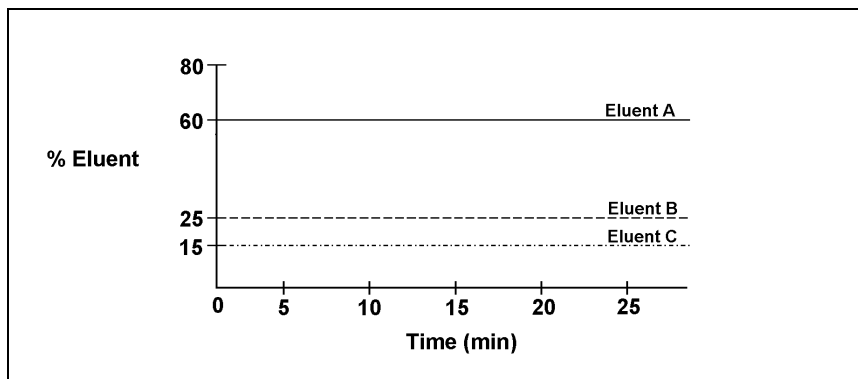


Figure 3-2. Isocratic Run Profile

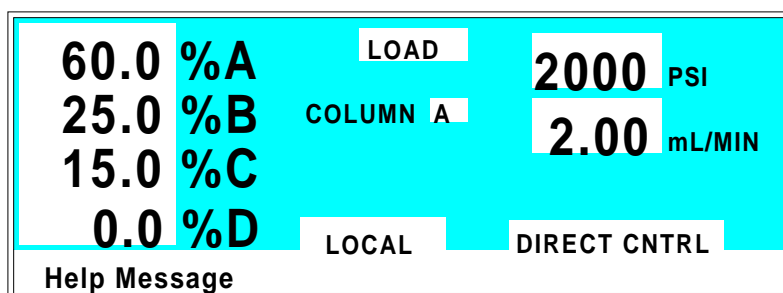


Figure 3-3. Main Screen: Running Under Direct Control

1. Go to the **MAIN** or **DETAIL** screen.
2. Check that the operating fields are set to **LOCAL** and **DIRECT CNTRL** (see Figure 3-3). If **REMOTE** and/or **METHOD** are currently set, move the cursor to the appropriate field; press **Select**  $\Delta$  or **Select**  $\nabla$  to toggle the value, and press **Enter** or a cursor arrow button.
3. Move to the **%A** field and enter 60; move to the **%B** field and enter 25; move to the **%C** field and press **Enter** (15 is automatically filled in to make the eluent percentages equal 100).
4. Move to the **mL/MIN** field and enter 2.
5. If the pump is currently off, press **Off/On** to turn on the motor and begin the isocratic delivery.

Wait at least 10 minutes after starting the pump or changing the flow rate before beginning an analysis. This allows the pump's real-time electronic pulse damping circuitry to stabilize the flow rate.

### 3.3 Running Under Method Control

This section provides general instructions on how to create, edit, and run methods. Section 3.4 provides step-by-step examples for creating linear gradient and curved gradient methods, and for modifying an existing method.

Use the following guidelines when entering time-based parameters in the **METHOD** screen:

- When setting method times, allow at least 10 minutes after starting the pump or changing the flow rate before beginning an analysis. This allows the pump's real-time electronic pulse damping circuitry to stabilize the flow rate.
- In the **%A**, **%B**, **%C**, and **%D** columns, enter decimal percentage values from 0.1% through 100% for the eluent compositions. The combined percentages for all eluents must total 100% or the pump will not run.
- In the **V** column, select the position of the injection valve (either **L** for load or **I** for inject).
- In the **FLOW** column, enter the pump flow rate. Flow rates are adjustable in increments of 0.01 mL/min. See Section 2.4.2 for the available flow rate ranges. They vary, depending on the size of the pump head and whether the run is isocratic or gradient.



IMPORTANT

**Continuous operation of the microbore pump heads at flow rates above 2.0 mL/min will decrease seal and pump life. For the best extended operation at 2.0 mL/min or above, replace the microbore pump heads with standard bore pump heads. Similarly, when running gradients, the standard bore pump heads should not be used below 0.4 mL/min.**

- For steps other than **INIT** and time zero, enter a curve number in the **C** column. The curve number determines whether the pump delivers a linear or curved gradient (see Section 2.8.3). The default is curve 5 (linear).

**NOTE**

A curve number in a step instructs the pump to use the selected curve number when moving from the previous step to that step. Because there are no previous steps for **INIT** or **TIME = 0.0**, curve numbers are not entered for these steps.

- If a step field is blank, the value set in the previous step is used.
- If a method contains more steps than can be displayed on one screen, they are scrolled off the screen. A small arrow down (v) next to the time entry at the bottom of the screen indicates there are additional steps below. A small arrow up (^) adjacent to the top time entry indicates there are additional steps above (see Figure 3-16). Move the cursor to the bottom or top of the screen and then move one more line to view the additional steps.

### **3.3.1 Creating a New Method**

You can create a new method when the method clock is in either **Hold** or **Run**.

1. Go to the **MAIN** or **DETAIL** screen.
2. Check that the pump is set to **LOCAL**. If **REMOTE** is currently set, move the cursor to the field; press **Select** Δ or **Select** ∇ to toggle the value, and press **Enter** or a cursor arrow button.
3. Go to the **METHOD** screen.
4. In the **EDIT** field, enter the number of the method to be created. You can enter the number of an unused method or the number of an existing method that you want to edit and save as a new method. If you enter the number of an unused method, the screen will look similar to the example screen in Figure 3-4.

5. In the **LIMITs** field, set the low and high pressure limits (see Section 3.1.5).

<b>METHOD EDIT</b>		5		<b>SAVE TO</b>		5		<b>RUN</b>		0	
				<b>LIMITs</b>		0 - 5000 PSI					
<b>TIME</b>	<b>%A</b>	<b>%B</b>	<b>%C</b>	<b>%D</b>	<b>C</b>	<b>V</b>	<b>FLOW</b>				
INIT	100.0				-	L	1.00	>			
0.00								>			
								>			
								>			
<b>Help Message</b>											

Figure 3-4. Method Screen: Creating a New Method

6. Each method starts out with two timed steps (see Figure 3-4). The first step is an initial conditions step with **INIT** in the **TIME** column. The second step is a time zero step with **0.00** in the **TIME** column. The parameters in each of these first two steps can be changed but the steps cannot be deleted. Enter the parameters for these two steps as required for the method.
7. To enter a new step, use one of the following methods:
  - Move the cursor to the empty **TIME** field below the last step and enter the elapsed time at which to start the new step.
  - Move the cursor to any of the **TIME** fields and press **Insert**. This adds a new step after the cursor position. Enter the elapsed time at which to start the new step.

After you press **Enter** or a cursor arrow button, timed steps are automatically organized in chronological order.
8. Enter the remainder of the parameters for the new step.

9. After entering the time-based parameters, move the cursor to the **SAVE TO** field. If you are editing an existing method, enter a new number for the method and press **Enter** to save the method to a new number. If not, press **Enter** to save the current method.

### **3.3.2 Running a Method**

1. If the pump motor is off, press **Off/On** to turn the motor on.
2. Go to the **MAIN** or **DETAIL** screen and, if necessary, toggle from **DIRECT CNTRL** to **METHOD** and from **REMOTE** to **LOCAL**.
3. In the **METHOD** field, enter the desired method number.

You can also select the method number in the **METHOD** screen. Move the cursor to **RUN** and enter the desired method number.

If the method clock is already running when you enter the method number, the method starts immediately.

If the clock is in Hold, press **Hold/Run** to start the method.

4. The elapsed time on the method clock when the method begins determines where (at what step and parameters) the method begins running:
  - If the method clock is at **INIT** or time zero, the method begins running using the **INITial** condition parameters.
  - If the method clock is greater than zero, the method begins running using the parameters specified in the step for that elapsed time. Press **Reset** to start the method at the **INITial** conditions.

### **3.3.3 Editing a Method**

After entering a method, you can modify it by changing, adding, or deleting steps and parameters. These changes can

be made when the method clock is stopped, or while it is running. If the method you are editing is currently running, the changes are stored in memory and implemented when you save the method.

After you save changes, there is no way to recall the original method. Therefore, if you plan to make experimental changes to a method but want to retain the original method in its unmodified form, save a copy of the original to a different number.

Use the following basic steps to edit a method:

1. Go to the **METHOD** screen. In the **EDIT** field, enter the number of the method to be modified.
2. Make changes as needed:
  - **To change a field's value**, position the cursor in the field and enter the new value. The previous value is automatically deleted.
  - **To add a method step**, move the cursor to any of the **TIME** fields and press **Insert**, or move the cursor to the empty **TIME** field below the last step and enter the elapsed time at which to start the new step. After you press **Enter** or a cursor arrow button, the new step is automatically moved to the correct chronological position. Continue entering parameters for the new step.
  - **To delete a method step**, move the cursor to the step to be deleted and press **Delete** twice.
3. When changes are complete, move the cursor to the **SAVE TO** field. Press **Enter** to save the changes to the current method, or enter a new method number and press **Enter**.

If you save changes to the currently running method, they are immediately incorporated in the run and executed at the programmed time. If, however, a change is made to an



event that has already been executed, it will not be incorporated as part of the current run. To run the changed version of the method, press **Reset** to restart the method at the **INIT**ial conditions.

#### **3.3.4 Deleting a Method**

To delete an entire method, move the cursor on the **METHOD** screen to the **INIT** step, then press **Delete** twice.

#### **3.3.5 Changing the Running Method**

To change from the method currently running to a different method, enter the new method number in the **RUN** field on the **METHOD** screen, and press **Enter**. The new method begins running using the parameters specified in the step for the current elapsed time. Press **Reset** to start the method at the **INIT**ial conditions.

#### **3.3.6 Controlling the Method Clock**

The **Hold/Run** button, the **Reset** button, and the **MIN** fields in the **MAIN** and **DETAIL** screens control the method clock:

- To start and stop the method clock, press **Hold/Run**.
- To reset the clock to **INIT**, press **Reset**.
- To set the clock to a specific elapsed time, enter the time into the **MIN** field in the **MAIN** or **DETAIL** screen. The method will start (or continue) running using the method parameters specified for that time.

### **3.4 Example Methods**

The examples in this section provide step-by-step instructions for creating three types of methods: isocratic, linear gradient, and curved gradient. The last example demonstrates how to edit a running method.

For all of the method examples, set the pump to Local mode, Method control. To do this, go to the **MAIN** or **DETAIL** screen, and if necessary, toggle from **DIRECT CNTRL** to **METHOD** and from **REMOTE** to **LOCAL**.

### 3.4.1 Isocratic Method Example

Specify an isocratic mixture of 60% eluent A, 25% eluent B, and 15% eluent C to be pumped at 2.0 mL/min. Figure 3-2 illustrates the isocratic profile for this example.

Figure 3-5 illustrates the **METHOD** screen as it will appear when the example is set up.

<b>METHOD EDIT</b>		1		<b>SAVE TO</b>		1		<b>RUN</b>		0	
				<b>LIMITs</b>		0		-		5000 PSI	
<b>TIME</b>	<b>%A</b>	<b>%B</b>	<b>%C</b>	<b>%D</b>	<b>C</b>	<b>V</b>	<b>FLOW</b>				
INIT	60.0	25.0	15.0		-	L	2.00	>			
0.00					-			>			
								>			
								>			
<b>Help Message</b>											

Figure 3-5. Method Screen: Isocratic Run Example

1. Go to the **METHOD** screen and enter a method number in the **EDIT** field (1, for example). The screen automatically changes the number in the **SAVE TO** field to the number of the method being edited.
  - If Method 1 currently exists and you want to delete it, move the cursor to **TIME = INIT** and press **Delete** twice to delete the entire Method 1.
  - If you want to retain the original Method 1, enter a new, unused, method number in the **EDIT** field.

2. Move the cursor to the **%A** field and enter 60; move to the **%B** field and enter 25; move to the **%C** field and press **Enter** (15 is automatically filled in to make the eluent percentages equal 100). Skip the **C** (Curve) and **V** (Valve) fields. Move to the **FLOW** field and enter a flow rate of 2.00.
3. Move the cursor to **SAVE TO** and press **Enter** to save the method.
4. Move the cursor to **Run**, enter the method number (1, in this case) and press **Enter** to select the programmed method. If the pump motor is off, press **Off/On** to start the pump delivering the eluent mixture.
5. If the method clock is in hold, press **Hold/Run** to start the method running.

### **3.4.2 Linear Gradient Method Example**

The following summarizes the linear gradient method steps:

- Create Method 2 to begin under isocratic conditions with 100% eluent A at 2.0 mL/min.
- After 5 minutes, begin adding eluent B and decreasing eluent A until, at 10 minutes, the mixture is 65% eluent A and 35% eluent B.
- Begin adding eluent C to the mixture while continuing to decrease eluent A and increase eluent B until, at 15 minutes, the eluent composition is 0% eluent A, 50% eluent B, and 50% eluent C.
- Continue increasing eluent C and begin decreasing eluent B until, at 25 minutes, the eluent composition is 100% eluent C.
- Make a step change to 100% eluent D at 25.01 minutes. Pump 100% eluent D for 4.99 minutes.

- At 30.01 minutes, return to 100% eluent A and re-equilibrate your system for the next analysis.

Figure 3-6 illustrates the gradient profile for this method.

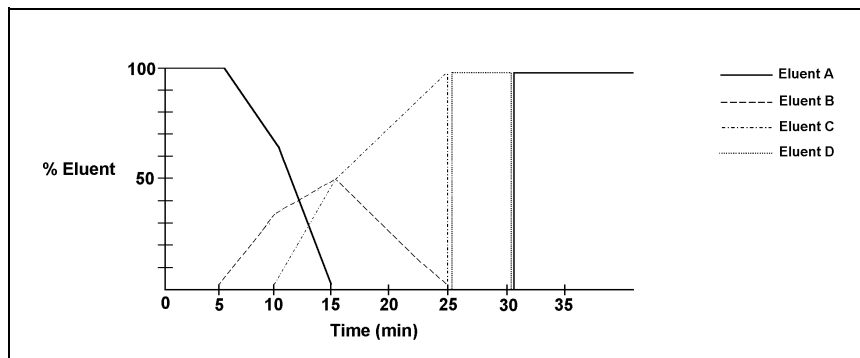


Figure 3-6. Linear Gradient Method Profile

1. Go to the **METHOD** screen and enter a method number in the **EDIT** field (2, for example).
  - If Method 2 currently exists and you want to delete it, move the cursor to **TIME = INIT** and press **Delete** twice to delete the entire Method 2.
  - If you want to retain the original Method 2, enter a new, unused, method number in the **EDIT** field.
2. Move to the **FLOW** field of the **INIT** step and enter a flow rate of 2.00.

Figure 3-7 illustrates the **METHOD** screen as it appears so far. You can now begin entering the method steps that will generate the gradient profile.

METHOD EDIT		2		SAVE TO		2		RUN		0	
				LIMITs		0 - 5000 PSI					
TIME	%A	%B	%C	%D	C	V	FLOW				
INIT	100.0				-	L	2.00	>			
0.00					-			>			
								>			
								>			
Help Message											

Figure 3-7. Linear Gradient Method Example  
(After Step 2)

3. Move the cursor to the **%A** field of the **TIME = 0** step and press **Enter**. 100% of eluent A is automatically filled in.
4. Move the cursor to the line below **TIME = 0**, and enter 5 to store a step at **TIME = 5.0** minutes. Then move the cursor to **%A** and press **Enter** to enter 100% and define a step with the same eluent composition as the previous step. Although there is no change in eluent parameters, the 100% of %A must be entered at 5.00 minutes to establish 5.00 as the gradient start point.

This marks the end of the isocratic section of the run and the beginning of the eluent B concentration ramp. From this point on, the concentration of eluent A decreases from 100% as the concentration of eluent B begins to increase from 0%.

5. Move the cursor to the next line. Enter 10 in the **TIME** field. Move the cursor to the **%A** field and enter 65, followed by 35 in the **%B** field.

After a total of 10 minutes (5 minutes of isocratic conditions plus 5 minutes to gradually decrease the amount of eluent A in the mixture while increasing the amount of eluent B), the eluent composition is 65% eluent A and 35% eluent B.

This step marks the end of the second segment and the beginning of the eluent C concentration ramp. Figure 3-8 illustrates the **METHOD** screen as it appears after Step 5.

METHOD EDIT		2	SAVE TO		2	RUN		0
			LIMITs		0	-		5000 PSI
TIME	%A	%B	%C	%D	C	V	FLOW	
INIT	100.0				-	L	2.00	>
0.00	100.0				-			>
5.00	100.0							>
10.00	65.0	35.0						>
Help Message								

Figure 3-8. Linear Gradient Method Example  
(After Step 5)

6. Move the cursor to the next line. Enter 15 in the **TIME** field. Move the cursor to the **%B** field and enter 50, followed by 50 in the **%C** field.

Beginning with the method step immediately preceding this one (**TIME** = 10), the pump begins adding eluent C, starting with 0%. When the method reaches this step (after 15 minutes), eluent C is at 50%, eluent B at 50%, and eluent A at 0%.

7. Move the cursor to the next line. Enter 25 in the **TIME** field. Move the cursor to **%C** and enter 100.

After a total of 25 minutes, the concentration of eluent B drops to 0% and the concentration of eluent C increases to 100%.

8. Move the cursor to the next line. Enter 25.01 in the **TIME** field. Move the cursor to **%D** and enter 100.

The concentration of eluent C drops to zero and the concentration of eluent D, which the pump began adding 0.6 seconds (0.01 min) earlier, reaches 100%. This is a *step change* in eluent composition to 100% eluent D. A

step change is a very steep linear gradient in which the eluent composition changes from one eluent to another in 6 seconds. Figure 3-9 illustrates the **METHOD** screen as it appears after Step 8.

METHOD EDIT		2		SAVE TO		2		RUN		0	
				LIMITs		0 - 5000 PSI					
TIME	%A	%B	%C	%D	C	V	FLOW				
10.00	65.0	35.0					2.00	>			
15.00		50.0	50.0					>			
25.00			100.0					>			
25.01				100.0				>			
Help Message											

Figure 3-9. Linear Gradient Method Example  
(After Step 8)

9. Move the cursor to the next line. Enter 30 in the **TIME** field. Move the cursor to the **%D** field and enter 100. The eluent composition remains unchanged at 100% eluent D for 4.99 minutes.
10. Move the cursor to the next line and enter 30.01 in the **TIME** field. Move the cursor to the **%A** field and enter 100. This causes another step gradient from 100% D to 100% A.
11. Move the cursor to the **SAVE TO** field and press **Enter** to save the method to memory. Figure 3-10 illustrates the completed method.

## GP40 Gradient Pump

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METHOD EDIT		2	SAVE TO		2	RUN		0
			LIMITs		0	-		5000 PSI
TIME	%A	%B	%C	%D	C	V	FLOW	
25.00	^		100.0				2.00	>
25.01				100.0				>
30.00				100.0				>
30.01	100.0							>
Help Message								

Figure 3-10. Linear Gradient Method Example  
(Complete)

12. Press **MENU** and **Enter** to go to the **MAIN** screen. Enter 2 in the **METHOD** field. Press **Reset** to reset the method to the **INIT** step (if necessary).
13. If the pump motor is off, press **Off/On** to start the pump.
14. If the method clock is in hold, press **Hold/Run** to start the method running. When the method reaches the last step in the method (**TIME = 30.01**), the pump will continue to pump isocratically until the clock is reset.



### 3.4.3 Curved Gradient Method Example

When attempting to optimize the separation of a single component in a complex mixture, it is often helpful to employ paired segments of a curved gradient. For example, if the analyte is an oligonucleotide that elutes with 0.32 M NaCl in a linear gradient run, you can move potentially interfering components of the sample away from the target oligonucleotide by first programming a segment from 0% to 32% of a 1 M NaCl solution using curve 2. Then, program a segment from 32% to 100% of 1 M NaCl using curve 8. The resulting gradient profile is shown in Figure 3-11.

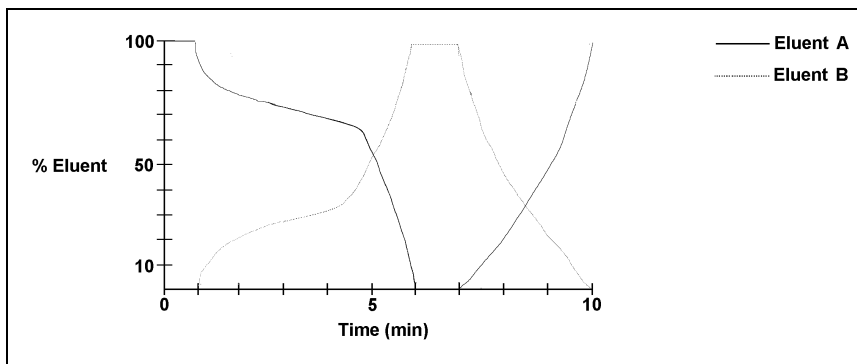
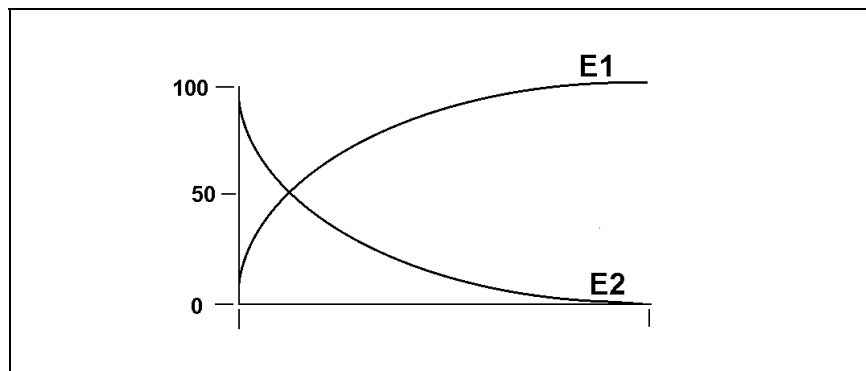


Figure 3-11. Gradient Curve Profile

In binary curve gradients, two elements follow curves which are mirror images (e.g., E1 = Curve 8 and E2 = curve 1 in Figure 3-12). See Section 2.8.3 for details about gradient curves.



*Figure 3-12. E1 and E2 Curves*

The following summarizes the curved gradient method example steps:

- Create Method 3 to begin under isocratic conditions with 100% eluent A (25 mM Tris buffer, pH 8.0) at 1.5 mL/min.
- After 1 minute, begin a convex addition of eluent B (25 mM Tris buffer, pH 8.0, containing 1.0 M NaCl) while decreasing eluent A until, after 2.5 minutes (total elapsed time = 3.5 minutes), the mixture is 68% eluent A and 32% eluent B.
- At that point, begin a 2.5-minute concave segment in which the amount of eluent A is decreased and the amount of eluent B is increased until the mixture is 100% eluent B (**TIME = 6.0**).
- Hold this for 1 minute (**TIME = 7**), then begin a 3-minute concave segment, reducing eluent B to 0% and increasing eluent A to 100%.

- Figure 3-13 illustrates the **METHOD** screen as it appears so far. You can now begin entering the method steps that will generate the curved gradient profile (see Figure 3-12).

## Help Message

Figure 3-13. Curved Gradient Method Example  
(After Step 2)

- This marks the end of the isocratic section of the run and the beginning of the eluent B concentration ramp. At this point, the concentration of eluent A begins to decrease from 100% as the concentration of eluent B begins increasing from 0%.

5. Move the cursor down to the next line and enter 3.5 in the **TIME** field. Move the cursor to **%A** and enter 68. Move the cursor to **%B** and enter 32.
6. Move the cursor to the **C** field and enter 3 to run gradient curve 3.

After a total of 3.5 minutes (1 minute of isocratic conditions plus 2.5 minutes to gradually decrease the amount of eluent A in the mixture while increasing the amount of eluent B), the eluent composition is 68% eluent A and 32% eluent B. Figure 3-14 illustrates the **METHOD** screen as it appears after Step 6.

METHOD EDIT		3		SAVE TO		3		RUN		0	
				LIMITs		0		-		5000 PSI	
TIME	%A	%B	%C	%D	C	V	FLOW				
INIT	100.0				-	L	1.50	>			
0.00	100.0				-			>			
1.00	100.0							>			
3.50	68.0	32.0			3			>			
Help Message											

*Figure 3-14. Curved Gradient Method Example:  
(After Completing Step 6)*

7. Move the cursor to the next line and enter 6 in the **TIME** field. Move the cursor to **%B** and enter 100.
  8. Move the cursor to the **C** field and enter 8.
- After a total of 6 minutes, the eluent composition is 0% eluent A and 100% eluent B.
9. Move the cursor to the next line and enter 7 in the **TIME** field. Move the cursor to **%B** and enter 100. The eluent composition remains unchanged at 100% eluent B for 1 minute.

10. Move the cursor to the next line and enter 10 in the **TIME** field. Move the cursor to **%A** and enter 100. After a total of 10 minutes, the concentration of eluent B drops to zero and the concentration of eluent A increases to 100%. Figure 3-15 illustrates the completed **METHOD** screen.
11. Move the cursor to the **SAVE TO** field and press **Enter** to save the method to memory.

<b>METHOD EDIT</b>		<b>3</b>	<b>SAVE TO</b>		<b>3</b>	<b>RUN</b>		<b>0</b>
			<b>LIMITs</b>		<b>0</b>	<b>- 5000 PSI</b>		
<b>TIME</b>	<b>%A</b>	<b>%B</b>	<b>%C</b>	<b>%D</b>	<b>C</b>	<b>V</b>	<b>FLOW</b>	
3.50	68.0	32.0			3		1.50	>
6.00		100.0			8			>
7.00		100.0						>
10.00	100.0							>
<b>Help Message</b>								

Figure 3-15. Curved Gradient Method Example  
(Complete)

#### 3.4.4 Editing a Running Method Example

After you enter a method, you can modify it by changing, adding, or deleting steps. If the method you are editing is currently running, the changes are not executed until you move the cursor to the **SAVE TO** field and press **Enter**.

The example describes how to make the following changes to Method 2, the linear gradient example (see Section 3.4.2):

- Change the eluent composition for the **TIME = 15** from 50% eluent B and 50% eluent C to 45% eluent B and 55% eluent C.
- Add a step to Method 2 at **TIME = 20.0** to make the eluent composition 40% eluent B and 60% eluent C.

Figure 3-16 illustrates the **METHOD** screen as it will appear when editing is complete. Figure 3-17 illustrates the edited gradient profile.

METHOD EDIT 2					SAVE TO 2		RUN 2	
					LIMITs 0 - 5000 PSI			
TIME	%A	%B	%C	%D	C	V	FLOW	
10.00 ^	65.0	35.0					2.00	>
15.00		45.0	55.0					>
20.00		40.0	60.0					>
25.00 v			100.0					>
Help Message								

Figure 3-16. Edited Linear Gradient Method Example:

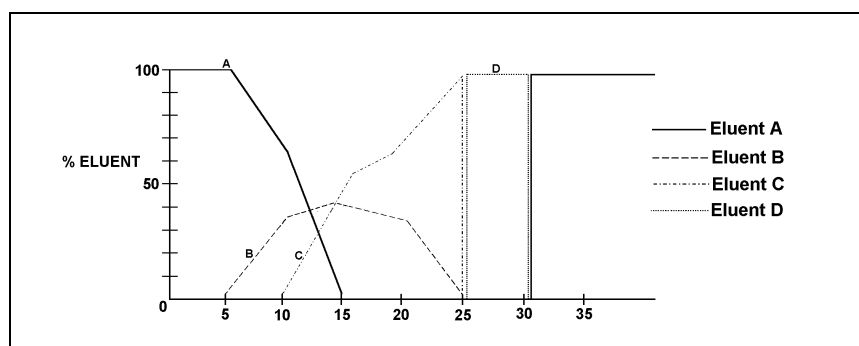


Figure 3-17. Gradient Profile After Editing

This example assumes that the example Method 2 is currently running.

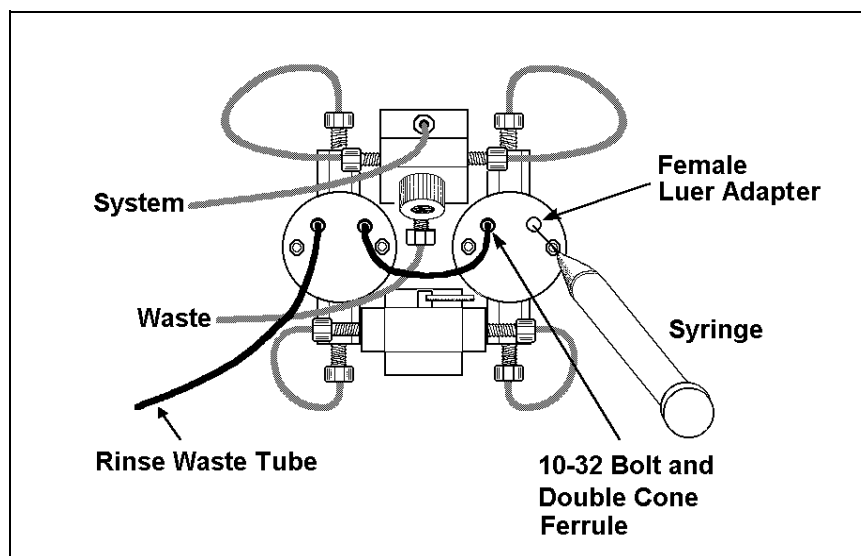
1. Go to the **METHOD** screen and enter 2 in the **EDIT** field.
2. Move the cursor down through Method 2 until you reach the **TIME = 15** step. Move the cursor to **%B** and enter 45. Move the cursor to **%C** and enter 55.
3. Move the cursor to the **TIME** field and press **Insert**. Enter 20 in the time field. Move the cursor to **%B** and enter 40. Move the cursor to **%C** and enter 60.
4. Move the cursor to the **SAVE TO** field and press **Enter**.
5. Press **Menu** and select either the **MAIN** screen or **DETAIL SCREEN**. Check the status of the method clock:

- If the elapsed time is less than 15 minutes (the time for the first change made to the method), the changes will be incorporated into this run and executed at the programmed time.
- If the elapsed time is greater than 15 minutes, the changes will not be incorporated into this run. To put the changes into effect, either press **Reset** to set the method clock to the **INITial** conditions, or enter an elapsed time in the **MIN** field that is less than 15 (10, for example). The method will restart, using the parameters programmed for **TIME=10**, and the method changes will be incorporated at the programmed time.

## **3.5 Routine Maintenance**

### **3.5.1 Daily Maintenance**

- When using a combination of eluents which contain both salt or base and solvent, rinse the piston frequently or continuously. Eluent tends to crystallize as the solvent evaporates; these crystals can abrade the piston and cause the main seal to leak. Rinse the piston before and after operation every day as described in the following steps.
  1. Open the lower pump door and locate the two rinse ports on the front of each of the pump heads. Either port can be used for rinsing. Figure 3-18 shows the typical rinse port connections.
  2. Place the end of the rinse waste tubing into a waste receptacle. Attach a small syringe containing 5 to 10 mL of deionized water to the rinse inlet female luer adapter.



*Figure 3-18. Rinsing the Pump Heads*



3. Inject deionized water into the fitting to rinse the pump heads. The water flows through the first head, then through the short connecting tubing to rinse the second head, and out to waste.
  4. Dispose of the waste water and close the door to the mechanical chassis.
- All components of the vacuum degas assembly are made of inert materials or corrosion-resistant materials. Dionex recommends that you thoroughly flush any chemicals out of the chambers and tubing with deionized water after each use to avoid crystallization in the membrane pores.
  - Check the entire mechanical chassis for leaks from the rinse ports, the eluent manifold connections and valves, the vacuum degas chamber, the bulkhead fittings, and the eluent reservoirs (see Figure 3-19). Tighten or replace any leaking fittings. Wipe up liquid spills and rinse dried reagents off the pump components with deionized water.

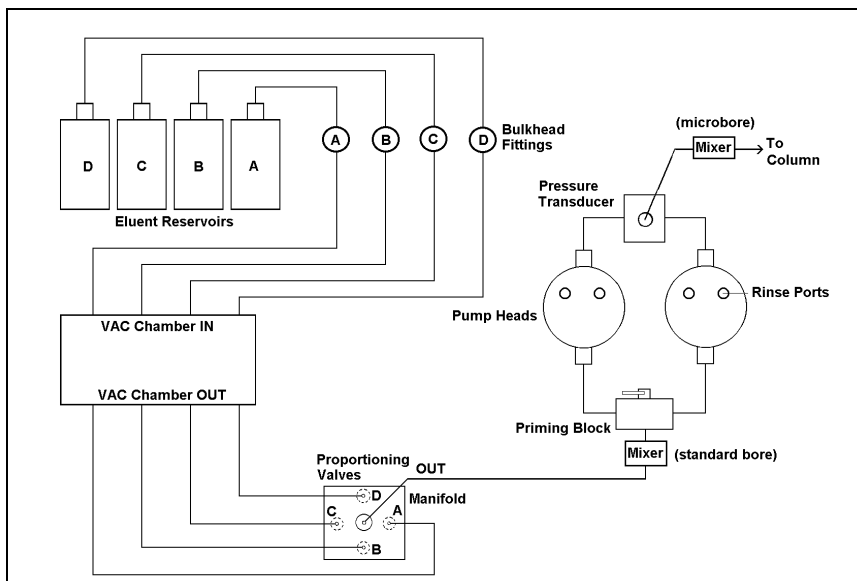


Figure 3-19. Eluent Flow Schematic

### **3.5.2 Periodic Maintenance**

- Replace both the primary and back-up piston seals in each pump head every 6 months, or sooner if you suspect a leak, operate the pump continuously, or routinely run at high pressure or high flow rates (see Section 5.2). A drop of solvent trapped in the end of the drain tubes is normal, but solvent flowing from the tubing indicates a leak.



**IMPORTANT**

**Normal friction and wear will gradually cause small leaks around the piston seals. If the piston seals are not replaced regularly, these leaks can eventually damage the pump mechanism, impair operation, and irreversibly damage the pump.**

- For standard bore (100  $\mu$ L) pumps, replace the filter (P/N 048277) in the active mixer every 6 months (see Section 5.7). Particles generated by the mixer can accumulate in the filter, causing erratic or reduced pump output.

### **3.6 Shutdown**

- Stop the pump by turning off the main power either on the GP40 or at the power source. Omit this step if you are going to maintain a continuous rinse on the pump heads.
- Rinse the pump pistons before and after daily operation to prevent build-up of salt crystals or other contaminants that can damage the piston seal (see Section 3.5.1).

- If the pump will not be used for three days or more, flush the system with deionized water to prevent contaminants from building up. Or, if this is not possible, maintain a continuous rinse through the system until you resume normal operation. Select a flow rate of 0.04 mL/min for standard pump heads or 0.01 mL/min for microbore pump heads, and set all four valves in the eluent manifold to 25% so that the valves are also flushed.



**Flushing the eluent manifold is extremely important if your eluents have a combination of salt or base and solvent. If salt precipitates in the valves, the valve diaphragms may be seriously damaged. If this happens, you will have to replace the entire valve assembly.**

- If the shutdown is for more than three days, reduce the pressure on the eluent reservoir(s) to approximately 21 KPa (3 psi).



## 4 • Troubleshooting

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## ***GP40 Gradient Pump***

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## 4 • Troubleshooting

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This chapter is a guide to troubleshooting common problems that may occur while operating the GP40 Gradient Pump. To use this guide, turn to the section that best describes the operating problem. There, you will find the possible causes of the problem listed in order of probability. If you cannot eliminate a problem on your own, notify your Dionex office.

If you cannot locate the problem here, refer to Appendix C for instructions on running the GP40 diagnostics program.

### 4.1 Left-Right Pump Head Pressure Fluctuations

**The GP40 display updates the pressure readout once per piston stroke. A variation of more than 3% from one stroke to the next indicates a problem.**

- **Pump out of prime; there is no eluent**
  1. Refill the eluent reservoirs. Also make sure that each eluent line extends to the bottom of the reservoir.
  2. Reprime the pump (see Section B.2.7).
- **Pump out of prime; eluents are improperly degassed**
  1. If the pump is not equipped with the optional degas pump assembly, degas the eluents manually (see Section 3.1.1). Reprime the pump (see Section B.2.7).
  2. If the pump is equipped with the optional degas pump assembly, test the degas pump:
    - a. Open the **DEGAS STATUS** screen. Press a **Select** key to toggle the **TEST** field to **RUN** and press **Enter**.
    - b. The pump should turn on and run for approximately 2 minutes. If it does not run, see Section 4.6.

- **Pump out of prime; eluent bottles are not pressurized**
  1. Pressurize the bottles (see Section 3.1.3).
  2. Reprime the pump (see Section B.2.7).
- **Pump out of prime; end-line filter is dirty or clogged**
  1. Replace the filter (P/N 045987).
  2. Reprime the pump (see Section B.2.7).
- **Pump out of prime; air leaks or blockages in inlet tubing**
  1. Check and replace any damaged fitting or tubing.
  2. Reprime the pump (see Section B.2.7).
- **If priming the pump does not eliminate excessive pressure fluctuations, the piston seal or check valves may be dirty or defective.**
  1. Select the **DSP STATUS** screen from the **DIAGNOSTIC MENU** and compare **PISTON PRESSURIZATION POINT** readings; the defective piston is the one with the higher pressurization point number.
  2. Follow these steps to isolate the cause:
    - a. Check for leaks from the piston rinse tubing. If there are no leaks, clean and/or replace the check valves (see Section 5.1). Dirty check valves are caused by impurities in the eluent. To prevent this in future, install an end-line filter (P/N 045987) on the end of each eluent line in the reservoirs.
    - b. If the piston rinse tubing leaks, or if you replace the check valves but the problem persists, replace the piston seals (see Section 5.2).



- c. Turn off the pump power. Using a 7-mm open-end wrench, loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis, between valves 3 and 4 (see the label on the inside of the lower door). Pull the drawer out about four inches. Turn on the pump and observe the pistons. Both pistons should move. If they do not, the rocker arm spring is broken. Notify your Dionex office.



**Observe the warning label on the inside of the lower door. The arrows on the label indicate moving mechanical parts that present pinch hazards when the pump is on and the mechanical drawer is open. Do not touch any parts within the mechanical chassis while the pump is on.**

- d. If the pistons move, then one or both may be broken or scratched. In this case, turn off the power, remove the pump head and examine the piston. If it is broken, replace it (see Section 5.3).
- e. If a piston moves slightly and then breaks contact with the rocker arm follower, replace the piston seal (see Section 5.2); it is too tight. (The rocker arm follower is the cylinder that holds the piston in place as it moves in and out of the pump head assembly. It has a magnet, which holds the piston.)
- f. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock. Turn on the power.

## **4.2 Pump Will Not Start**

- **Flow rate is set to zero**

Reset the flow rate (see Section 2.4.2).

- **While being primed, pump starts briefly; then stops because of high pressure limit**

Open the pressure transducer waste valve by turning the knob counterclockwise two turns (see Figure B-5).

## **4.3 Pump Stops**

- **Method or other remote input instructed the pump to stop**

Check the display screen for error messages. If none are displayed, the pump was probably instructed to stop by the method, computer, or other remote signal source.

- **Electrical cables improperly installed**

1. Place the pump in **LOCAL** mode, **DIRECT CONTROL**. Press **Off/On** to start the pump.
2. If a non-zero flow rate is displayed and the keypad LED is ON, verify that the electrical cables in the mechanical chassis are properly installed.
  - a. To access the mechanical chassis, first turn off the pump power.
  - b. Using a 7-mm open-end wrench or your fingers, loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis, between valves 3 and 4 (see the label on the inside of the lower door).
  - c. Pull the drawer out a few inches.
  - d. Check that all cables are seated properly in the connectors on the distribution card located on the top of the mechanical chassis.

- e. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock. Turn on the power.

- **Low pressure limit was tripped. The following message is displayed:**

Low Pressure Limit Violation

1. Verify that eluent is present in the channel selected. If the eluent reservoir is empty, refill it or select a channel which does have eluent. Prime the pump (see Sections B.2.7 and B.2.7) before resuming operation.
2. Make sure the waste valve on the pressure transducer is closed (i.e., turn the knob on the pressure transducer housing clockwise as shown in Figure B-5).



**Overtightening the pressure transducer waste valve may damage the valve and the pressure transducer housing.**

3. Make sure there are no liquid leaks in the flow system.
4. Place the pump in **LOCAL, DIRECT CONTROL**. Press **Off/On** to start the pump and verify that the pistons are moving and that you can hear the pump. If you hear the pump but the pistons are not moving, the main spring on the pump is broken. If there is no sound from the pump, check the LED on the CPU card inside the door to the electronics chassis. A red LED indicates a defective power supply. Replace the power supply (P/N 046440) (see Figure 2-6). Contact your Dionex office for help.

5. With the pump running, open the **DSP STATUS** screen and note whether the left-right pressure varies by more than 3% between strokes. If it does, refer to Section 4.1. If it does not, either increase the flow rate or reduce the low pressure limit setting and continue operation.
- **High pressure limit was tripped. The following message is displayed:**

High Pressure Limit Violation

1. Replace any crimped or blocked tubing downstream from the pressure transducer. If there is none, go on to Step 2.
  2. Open the pressure transducer waste valve by turning the knob counterclockwise about two turns as shown in Figure B-5. Check the pressure reading; if it is above 97 KPa (14 psi), recalibrate the pressure transducer (see Section C.3.6).
  3. Select a lower flow rate or, if it is safe to do so, increase the high pressure limit.
- **An error message beginning with “DSP” displays:**

There are several messages related to Digital Signal Processor (DSP) errors, for example, “DSP communication fails” and “DSP does not acknowledge.” These are all treated similarly:

    1. Power down by pressing the power switch. Verify that the DSP card is present and is properly installed in slot 1 of the electronics chassis card cage (see Figure 2-6).

2. Power up by pressing the power switch. The DSP error message should not reappear; if it does, notify your Dionex office. The power supply (P/N 046440), DSP card (P/N 045369), or CPU card (P/N 046340) may need replacing.



**Do not remove any of the electronic cards from the detector. There are no user-serviceable components on the cards. If servicing is required, it must be performed by qualified personnel and appropriate electrostatic discharge (ESD) handling procedures must be followed.**

- **The following error message displays:**

Motor Drive Fails

If the pump motor is in a runaway condition, the motor automatically shuts off and the above error message is displayed. Contact your Dionex office.

- **The following error message displays:**

Encoder index not found

1. Power down by pressing the power switch. Verify that the cables connected to the DSP card in the electronics chassis (see Figure 2-6) are seated properly.
2. Power up by pressing the power switch. The error message should not reappear; if it does, notify your Dionex office.

## 4.4 Liquid Leaks/Leak Alarm

- **Leaks from the front or rear of the piston head indicate a defective piston seal**

Replace the piston seal (see Section 5.2). If liquid is leaking from the rear of the piston, also replace the piston backup seal (see Section 5.2).

- **Leaks from any connection between the eluent reservoir and the pump heads indicates an eluent leak (see Figure 3-19)**

Tighten the fitting connections just enough to stop the leak.



**Overtightening the fitting connections may strip the threads in the valve block. If this happens, replace the entire manifold assembly (P/N 046203).**

- **Proportioning valve leaks**

Tighten loose fittings, or if there are no loose fittings, replace the valve (see Section 5.6).

- **Pressure transducer leaks**

Inspect the pressure transducer. If the waste valve is the source of the leak, replace the waste valve O-ring (see Section 5.5). If the leak is from the rear of the transducer, replace the pressure pad and O-ring (see Section 5.4).

- **Priming valve and/or tee manifold leaks**

Tighten any leaking fittings just enough to stop the leak. Also, verify that the small lever on the priming block is pushed all the way to the right (see Figure B-5). If this does not stop the leak, replace the priming block assembly (P/N 045730).

- **Interior mechanical chassis leaks**

1. To access the mechanical chassis, first turn off the pump power. Using an 7-mm open-end wrench or your fingers, loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis, between valves 3 and 4 (see the label on the inside of the lower door). Pull the drawer out a few inches.
2. Inspect for leaks and tighten any leaking fittings just enough to stop the leak. If the leak is caused by a damaged part, replace the part.

3. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock.

## **4.5 Noisy Pump Motor**

- **DSP (digital signal processing) card current limit has been exceeded. The card includes a built-in current limiter to protect the motor and motor drive.**

Check the three small LEDs in the upper left corner of the DSP card bulkhead. The DSP card is located behind the pump upper door in the electronics chassis. If the LEDs are flashing in time with the pump strokes, the current limiter is being activated. As the pump motor ages, it becomes less efficient and the current limit is activated more frequently. Activating the current limit is harmless, but if it occurs frequently, even at low speeds and/or pressures, the bottom plate assembly (P/N 045670) needs to be replaced. Call your Dionex office for assistance.

- **Hardware pressure limit has been exceeded. This indicates excessive pressure transducer offset.**

The DSP handles offset correction but the hardware has no correction. Replace the pressure transducer (P/N 045731). Call your Dionex office for assistance. After replacing the transducer, recalibrate the pressure slope and offset (see Section C.3.6).

- **Pressure servo oscillation**

Check the **DSP STATUS** screen to verify that the correct pump head volume and head material are selected. If the settings are correct but the problem persists, notify your Dionex office.

- **Out of prime**

Check the **DSP STATUS** screen and verify that there is less than 3% variation between the left and right pressurization points. If not, prime the pump (see Section B.2.7).

## **4.6 Vacuum Degas Pump Does Not Run**

- **DEGAS OPTIONS screen settings incorrect**

Open the **DEGAS OPTIONS** screen (press **Menu**, and **4**) and make sure that the **DEGAS PUMP** field is not set to **ALWAYS OFF**. If it is, select **BY SETTING** and then enter the desired cycle duration and frequency times (see Section C.1.5). By default, the pump runs 2 min at start-up, and thereafter, every 10 min for 30 sec.

- **Electrical cables improperly installed**

Manually test the degas pump.

1. Open the **DEGAS STATUS** screen (press **Menu**, **8**, **8**, and **3**). Press a **Select** key to toggle the **TEST** field to **RUN** and press **Enter**.
2. The pump should turn on and run for the cycle duration time specified in the **DEGAS OPTIONS** screen (2 minutes by default). If it does not run, verify that the cables connected to the pump in the electronics chassis (see Figure 2-6) and in the mechanical chassis are properly connected.
  - a. To access the mechanical chassis, first turn off the pump power.
  - b. Using a 7-mm open-end wrench or your fingers, loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis, between valves 3 and 4 (see the label on the inside of the lower door). Pull the drawer out a few inches.
  - c. Check that all cables are seated properly in the connectors on the distribution card located on the top of the mechanical chassis.
  - d. If the connections are correct, the distribution card (P/N 045714) may need to be replaced. Call your Dionex office for assistance.
  - e. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock.



## 4.7 Vacuum Degas Pump Calibration Fails

At the end of the degas calibration, the **DEGAS READING** value is less than 13000 and one of the following error messages appears:

Degas vacuum pump is not present or degas circuitry is malfunctioning.
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Vacuum Degas Fails
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Verify that the cable to the vacuum degas pump is connected to the distribution card in the mechanical chassis.

1. Turn off the power.
2. Use a 7-mm open-end wrench or your fingers to loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis, between valves 3 and 4. Pull the drawer out a few inches.
3. The distribution card is on the top of the mechanical chassis. Labels printed on the card identify the various cables plugged into it. The connector for the vacuum degas pump, labeled **VAC PUMP**, is near the right rear corner of the card. Check the connection.
4. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock. Turn on the power.
5. Retry the calibration. If the message reappears, notify your Dionex office.

## **4.8 Vacuum Degas Pump Low Vacuum**

The GP40 monitors the degas vacuum reading every 1 min. If the degas vacuum is lower than the monitoring value, the degas pump turns on. When the pump turns off, if the vacuum reading is 2000 or more lower than the monitoring value, the following message displays:

LOW VACUUM ALARM!!  
Check DEGAS OPTIONS settings or refer to  
service manual

Open the **DEGAS OPTIONS** screen (press **Menu**, and **4**). Try increasing the **CYCLE DURATION** time and/or decreasing the **TIME BETWEEN CYCLES**. If adjusting these settings does not solve the problem, contact your Dionex office.

## **4.9 Inoperative Relay Control Function**

- **Incorrectly installed cables**

Make sure the cables between the appropriate relay function and the input or output unit are properly connected (see Appendix E).

- **Method programming error**

Refer to Chapter 2 and Appendix C.

- **When attempting to set TTL2, the following message displays:**

TTL2 is set to indicate FLOW/NO FLOW.

The **TTL2 OUTPUT USAGE** field on the **PUMP OPTIONS** screen is currently set to signal when pump flow stops (**0 FLOW**). This setting is used to control the power to a Self-Regenerating Suppressor (SRS). To use TTL2 for another function, open the **PUMP OPTIONS** screen and set the **TTL2 OUTPUT USAGE** field to **NORMAL**.

## 4.10 Poor Chromatographic Reproducibility

- **Liquid lines incompletely flushed after an eluent change**

Attach a syringe to the priming block and draw at least 2.5 mL (10 mL if the vacuum degas assembly is not installed) of the new eluent through the liquid lines before beginning operation.

- **Leaking piston seal**

Check for liquid leaks at the rinse ports in the front of the pump heads. Replace the piston seal on any head with a leak (see Section 5.2).

- **Malfunctioning proportioning valve**

Test the valves (see Section C.2.8). If a test fails, the proportioning valve assembly may need to be replaced (see Section 5.6).

## ***GP40 Gradient Pump***

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## 5 • Service

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## ***GP40 Gradient Pump***

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## 5 • Service

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This chapter describes service and repair procedures for the mechanical components of the GP40. Each procedure specifies the problem it is intended to eliminate. Before replacing any part, refer to the troubleshooting information in Chapter 4 to isolate the cause of the problem. When ordering replacement parts, please include the model and serial number of the pump.

Substituting non-Dionex parts may impair detector performance, thereby voiding the product warranty. Refer to the warranty statement in the Dionex Terms and Conditions for more information.

### NOTE

**The pump's electronic components are not customer-serviceable.  
Repair of electronic components must be performed by Dionex.**

## 5.1 Cleaning the Check Valves

**A dirty check valve causes an erratic flow rate and may cause the pump to lose prime and/or be difficult to reprime.**

1. Turn off the main power switch, to prevent the pump from starting inadvertently.
2. Disconnect the tube fittings from the inlet and outlet check valve housings (see Figures 5-1 and 5-2).
3. Use a 12-mm ( $\frac{1}{2}$ -inch) wrench to loosen both check valve housings. Carefully remove the check valve cartridges from the housings.
4. Place the check valve housings and cartridges in a beaker with methanol, and sonicate or agitate for several minutes.
5. Rinse each check valve housing and cartridge thoroughly with filtered deionized water.

## GP40 Gradient Pump

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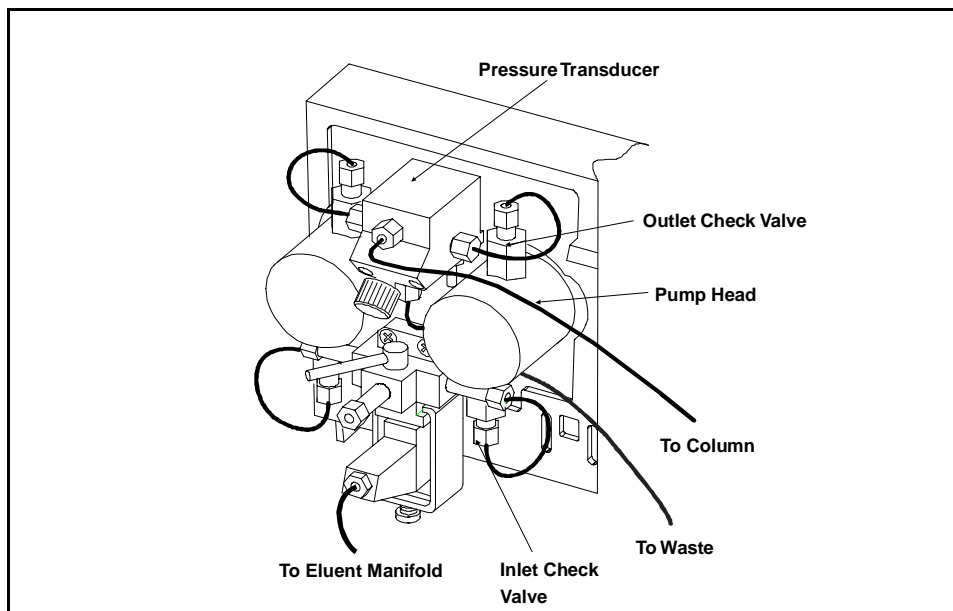


Figure 5-1. Pump Heads and Liquid Lines (PEEK)

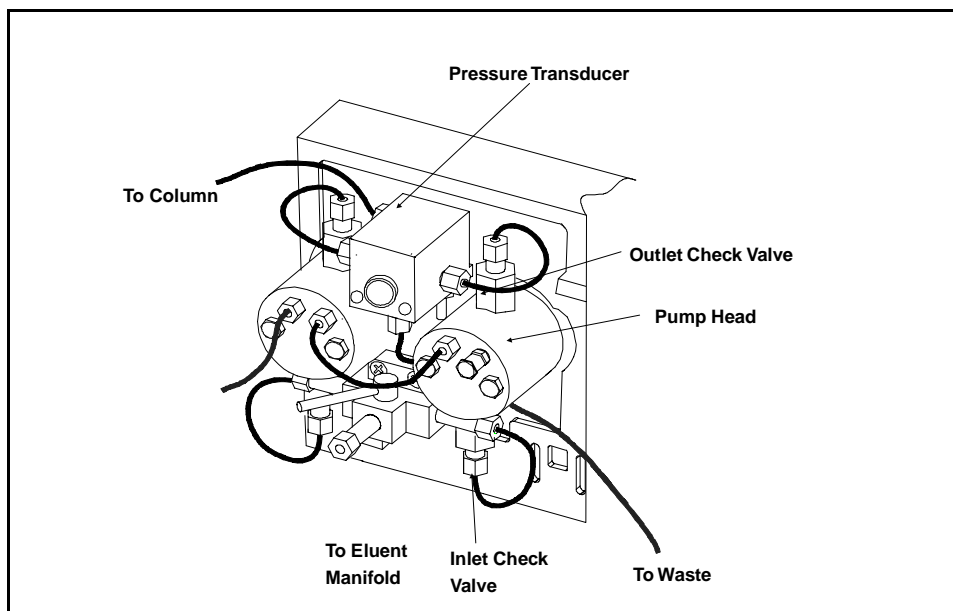


Figure 5-2. Pump Heads and Liquid Lines (SST)



6. The inlet check valve assembly housing has a 1/4-28 port. Replace the cartridge in the inlet check valve housing; the double-hole end of the cartridge should be visible. The outlet check valve assembly housing has a 10-32 port. Replace the cartridge in the outlet check valve housing; the single-hole end of the cartridge visible. Liquid flows through the check valve in the large single hole and out the small double holes.
7. Reinstall the check valves. Make sure that the inlet check valve is installed on the bottom of the head and that the outlet check valve is installed on the top of the head. Tighten only enough to seat (25 in-lb torque). Tighten a little more only if it leaks.



Overtightening may damage the pump head and the check valve housing and crush the check valve seats.

8. Reconnect the liquid lines. Turn on the main power.
9. Prime the pump (see Section B.2.7). If the pump will not prime and all other possible causes of the problem have been eliminated, replace the cartridge containing the check valve.

Check Valve Cartridge Type	Part Number
Standard Bore PEEK	047747
Standard Bore Stainless Steel	047755
Microbore PEEK	047748
Microbore Stainless Steel	048279

10. After replacing check valve cartridges, open the **ELAPSED TIME** screen (choice 2 of the **DIAGNOSTIC MENU**). Move the cursor to the **VALVES IN USE** field and press **Enter** to reset the field to 0 cycles.

## **5.2 Piston Seal Replacement**

**A damaged seal allows leakage past the piston and then through the rinse ports in the front of the pump heads. Flow rates will be low and erratic, producing chromatograms with longer than normal retention times.**

1. Turn off the main power switch.
2. Disconnect the tube fittings from the pressure transducer and the inlet check valve (see Figures 5-1 and 5-2).
3. Remove the two nuts from the pump head.
4. Carefully disengage the head from the piston by pulling the head straight off and away from its mounting guides.



**Lateral motion while disengaging the head from the piston may break the piston. If the piston is broken, be very careful when removing it; broken pistons have sharp edges and can cause cuts.**

5. Place the head (front end down) on a clean work surface and lift off the backup washer to expose the piston guide (see Figures 5-3 and 5-4).
6. The pistons are captured by a magnetic retention system and do not come off as part of the pump head assembly. After removing the pump head, apply just enough lateral force to overcome the magnetic field and release the pistons.

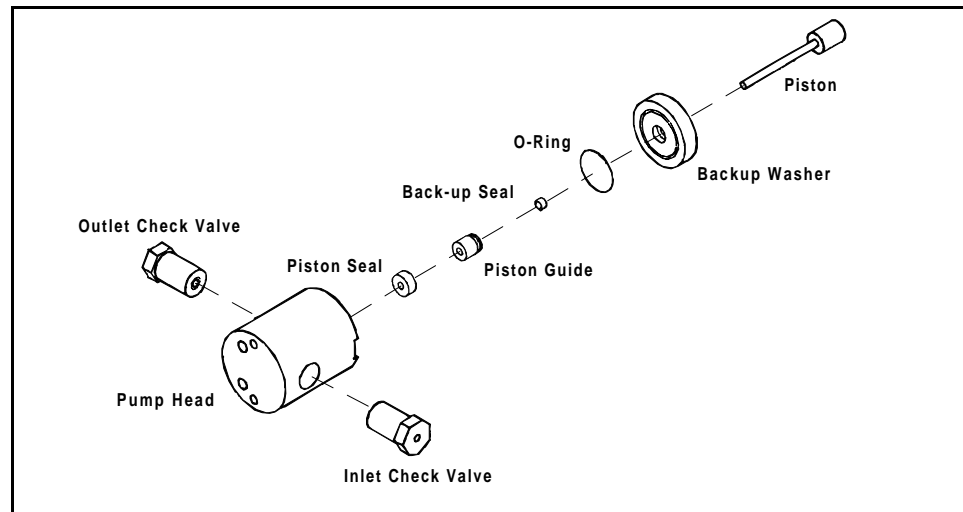


Figure 5-3. Pump Head Assembly

Component	Standard Bore/PEEK	Standard Bore/SST	Microbore/ PEEK	Microbore/ SST
Pump Head Assembly	045668	046313	045784	046342
Pump Head	047406	047409	047423	047414
Outlet Check Valve	047661	047665	047657	047663
Inlet Check Valve	047660	047664	047656	047662
Piston Seal	047583	047583	048526	048526
Piston Guide	045633	045633	045632	045632
Backup Seal	048722	048722	048721	048721
O-Ring	014895	014895	014895	014895
Backup Washer	045630	045630	045631	045631
Piston	045386	045386	045387	045387

Table 5-1. Pump Head Assembly Part Numbers

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7. To remove the piston guide and seal:
  - a. Fill the head cavity with deionized water by injecting through either the piston opening or the inlet check valve.
  - b. Reinsert the piston approximately 1/8-in into the seal (see Figure 5-4).
  - c. Install 10-32 fitting plugs (P/N 042772) on the inlet and outlet check valves. Tighten the plugs.
  - d. Push the piston into the head. This action will hydraulically unseat the seal and piston guide from the head. Remove the piston and pull off the guide and seal.
  - e. If the piston guide and seal do not come out, make sure the 10-32 plugs are tight. Then, add more water and repeat Steps b and d.
  - f. Remove the 10-32 fitting plugs.

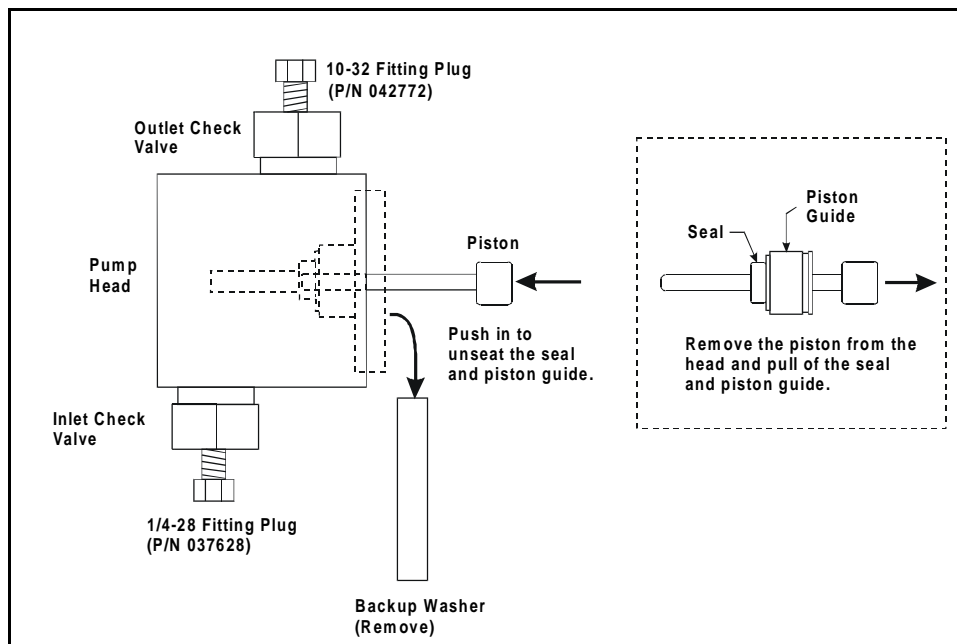


Figure 5-4. Removing the Piston Seal

8. To install the new seal and reinstall the piston guide:
  - a. Push the piston through the piston guide and the new seal. Then insert the piston, piston guide, and seal into the pump head until the seal makes contact with the bottom of the counterbore (see Figure 5-5, View A).
  - b. Hold the piston guide and seal in place and remove the piston from the head (see Figure 5-5, View B).
  - c. Seat the seal by pushing the piston guide into the head until it is flush with the head.

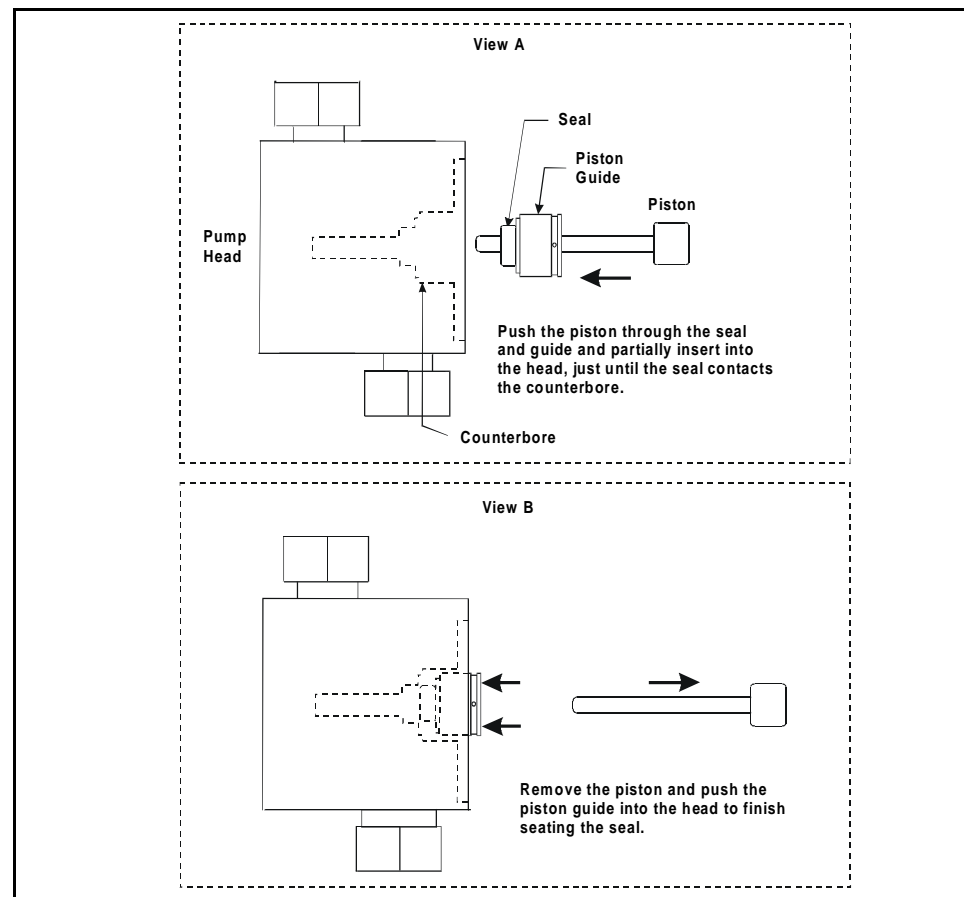


Figure 5-5. Installing the Piston Seal

9. Dionex recommends reinstalling the head and piston as a single assembly so that the piston will center itself. To do this, first press the backup washer into the head until it is flush with the indented surface of the head. Then, insert the piston *halfway* into the head. This ensures that the magnet in the follower picks up the piston. (The follower is the cylinder that holds the piston in place as it moves in and out of the pump head assembly.) Reinstall the head and piston assembly, using a wrench to tighten the nuts evenly (12 in-lb torque).
10. Reconnect the liquid line to the inlet check valve.
11. Reconnect the tube fittings to the pressure transducer.
12. Turn on the main power switch.
13. Open the **ELAPSED TIME** screen (choice 2 on the **DIAGNOSTIC MENU**). Press **Enter** to reset the **SEALS IN USE** field to 0 cycles. The pump is ready for normal operation.

### 5.3 Pump Piston Replacement

**Continued leaking through the rinse ports after replacing the piston seal (assuming the head is tight) indicates a dirty, scratched, or broken piston.**

1. Turn off the main power switch.
2. Disconnect the tube fittings from the pressure transducer and the inlet check valve (see Figures 5-1 and 5-2).
3. Remove the two acorn nuts from the pump head.



**Lateral motion while disengaging the head from the piston may break the piston. If the piston is broken, be very careful when removing it since broken pistons have sharp edges and can cause cuts.**

4. Slowly pull the head and allow it to separate from the housing. Carefully disengage the head from the piston by pulling the head straight off and away from the mounting guides.
5. The pistons are captured by a magnetic retention system and do not come off as part of the pump head assembly. After removing the pump head, apply just enough lateral force to overcome the magnetic field and release the pistons.
6. If the piston is broken, also replace the piston seal (see Section 5.2) and the backup seal.
7. Dionex recommends reinstalling the head and piston as a single assembly so that the piston will center itself. First press the backup washer into the head until it is flush with the indented surface of the head. Then, insert the piston *halfway* into the head. This ensures that the magnet in the follower picks up the piston. (The follower is the cylinder that holds the piston in place as it moves in and out of the pump head assembly.) Reinstall the head and piston, using a wrench to tighten the nuts evenly (12 in-lb torque).
8. Reconnect the liquid line to the inlet check valve.
9. Reconnect the tube fittings to the pressure transducer.
10. Turn on the main power switch and prime the pump (see Section B.2.7).

## 5.4 Pressure Transducer Pad and O-Ring Replacement

**A damaged pressure pad or O-ring will cause leakage around the base of the pressure transducer housing at the compression nut. Flow rates will be low, resulting in chromatograms with excessively long retention times.**

1. Turn off the pump.
2. Disconnect the liquid lines between the pressure transducer housing and the check valve housings (see Figure 5-1 and 5-2).

## GP40 Gradient Pump

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3. Disconnect the waste line from the pressure transducer housing.
4. Remove the system out line from the pressure transducer housing.
5. Disconnect the transducer connection from the distribution card.  
To access the card, use a 7-mm open-end wrench or your fingers to loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis, between valves 3 and 4. Pull the drawer out a few inches.

The distribution card is on the top of the mechanical chassis. Labels printed on the card identify the various cables plugged into it. The connector for the pressure transducer cable, labeled **PRESSURE**, is at the front of the card.

6. Remove the entire transducer assembly from the pump.
7. Remove the transducer cable assembly and sleeve (see Figure 5-6).

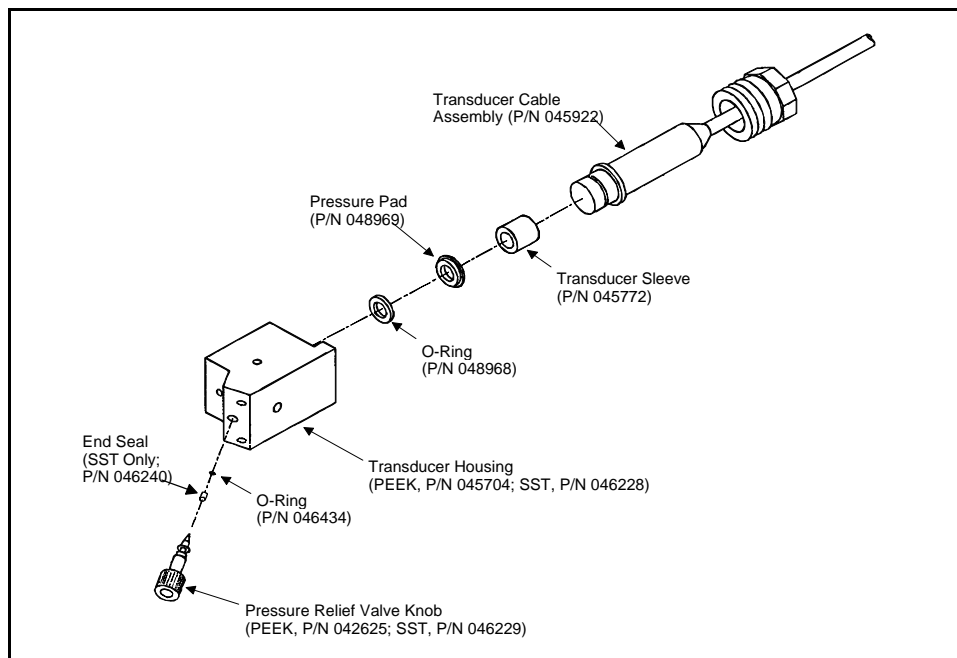


Figure 5-6. Pressure Transducer Assembly



8. Install a new O-ring (P/N 048968) and pressure pad (P/N 048969) in the housing. Reinstall the transducer assembly in the pump.
9. Reconnect the liquid lines from the check valve housings. Reconnect the outlet line and the waste line.
10. Reconnect the transducer cable to the distribution card.
11. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock.

### 5.5 Pressure Transducer Waste Valve O-Ring Replacement

**A damaged O-ring causes leakage around the base of the pressure transducer waste valve knob. Flow rates will be low, resulting in chromatograms with longer retention times.**

1. Turn off the pump.
2. Remove the valve from the pressure transducer housing by turning the knob counterclockwise until it comes loose from the housing.
3. Cut through the O-ring with a razor blade, being careful not to scratch the valve body, and remove the O-ring.
4. Carefully slide a new O-ring (P/N 046434) over the end of the valve and push it into the groove.
5. Wipe a very thin film of silicone grease on the O-ring.



**Excessive grease may contaminate the eluent as it flows through the pressure transducer housing.**

6. Reinstall the valve in the housing, turning the knob clockwise until the valve is seated.



**CAUTION**

**Overtightening the valve may damage the seat and pressure transducer housing.**

## **5.6 Proportioning Valve Replacement**

**A defective proportioning valve can cause nonreproducible eluent compositions. It may also introduce bubbles into the eluent stream or cause the pump to lose prime.**

### **NOTE**

**The proportioning valves and eluent manifold are a single assembly (P/N 046203). If a valve fails, replace the entire assembly.**

1. Turn off the main power switch.
2. Turn off the pressure on the eluent reservoirs and allow them to vent.
3. Disconnect the proportioning valve electrical connector from the distribution card. To access the card, use a 7-mm open-end wrench or your fingers to loosen the lock on the mechanical chassis drawer. The lock is on the lower right side of the chassis. Pull the drawer out a few inches.

The distribution card is on the top of the mechanical chassis. Labels printed on the card identify the various cables plugged into it. The connector for the proportioning valves, labeled **VALVES**, is at the front of the card.

4. Disconnect the liquid line from the manifold outlet (see Figure 5-7).

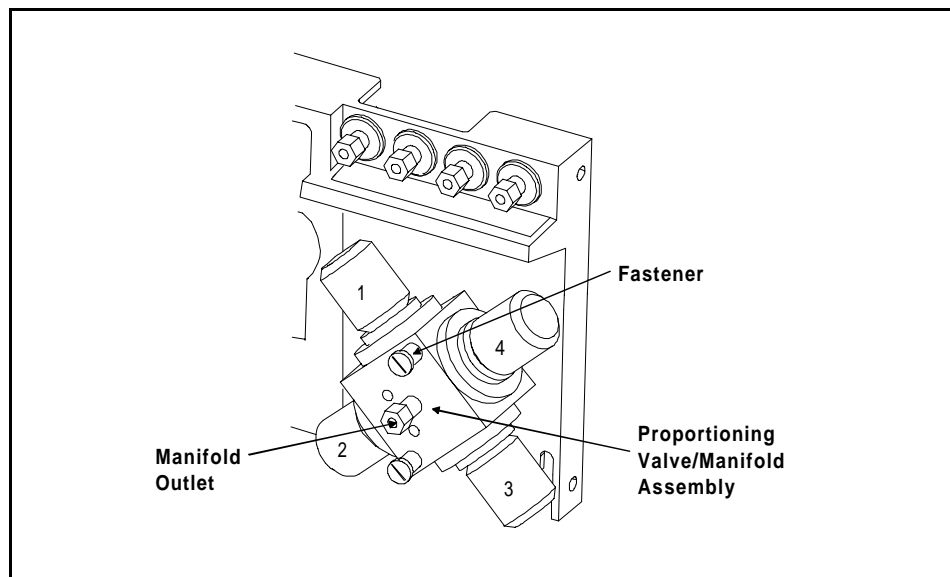


Figure 5-7. Location of Proportioning Valve Assembly

5. Loosen the captive fasteners securing the proportioning valve/manifold assembly to the bulkhead (see Figure 5-7). Pull the valve/manifold assembly forward and disconnect the eluent lines exiting the vacuum chamber. Remove the valve/manifold assembly completely from the bulkhead.
6. Thread the bundle of electrical lines from the new valve/manifold assembly through the bulkhead and up to the distribution card. Connect the valve electrical connector to the distribution card.
7. Connect the eluent lines to the new valve/manifold assembly. Make sure eluent lines A through D are in their appropriate valve ports.



**CAUTION**

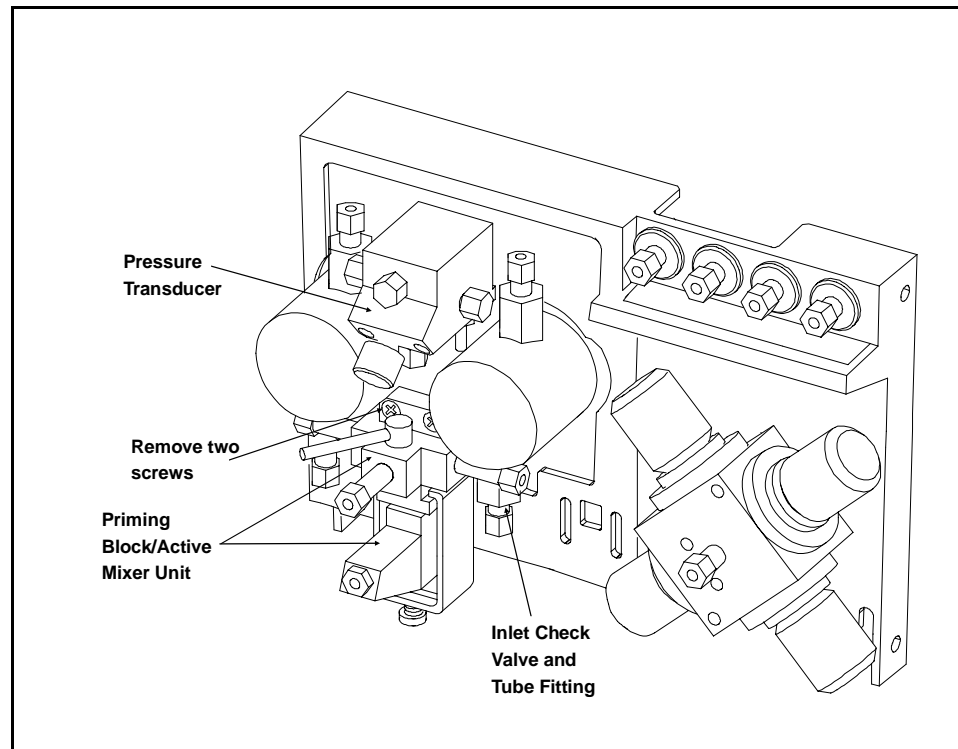
**Tighten liquid connections to the valve no more than fingertight plus one-quarter turn. Overtightening or crossthreading the valve fittings may strip the threads in the manifold block. If this happens, replace the valve/manifold assembly.**

8. Align the new assembly as shown in Figure 5-7 and mount it to the bulkhead. Tighten the fasteners.
9. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the drawer lock.
10. Attach the liquid line from the mixer (in standard bore systems) or the priming block (in microbore systems) to the manifold outlet.
11. To verify that the valves are functioning properly, connect a syringe to the priming valve. One at a time, select each eluent valve and draw liquid through the valve. If you can draw liquid through all of the valves, turn off the pump and repeat the process. You should not be able to draw liquid through the valves when they are off.
12. The pump is ready for normal operation.

### **5.7 Active Mixer Filter Replacement**

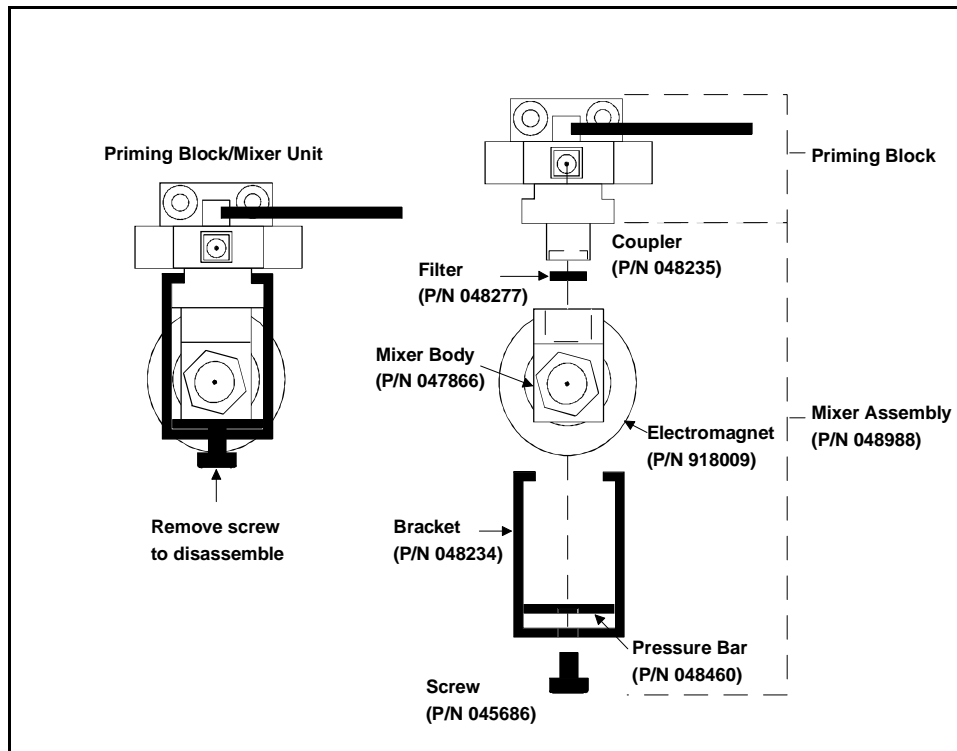
**A clogged mixer filter causes low or erratic flow rates; there will be little or no flow when the priming block lever is opened.**

1. Turn off the main power switch.
2. Disconnect the tubing from the pump head inlet check valves (see Figure 5-8).
3. Use a 1/2-inch wrench to loosen the two inlet check valves. **Carefully** remove the valve bodies and set them aside **in an upright position**.



*Figure 5-8. Location of Priming Block/Active Mixer Unit*

4. The priming block and active mixer form a single unit located below the pressure transducer. Remove the two Phillips screws holding the priming block/mixer unit in place (see Figure 5-8).
5. Carefully remove the priming block/mixer unit and set it, with the priming block lever facing up, on a clean surface directly in front of the pump. Be careful not to pull the unit out too far, causing tension on the two wires extending from the mixer. The wires are plugged into the distribution card inside the pump. They are long enough to allow servicing of the mixer, without having to be detached from the card.
6. Remove the screw (P/N 045686) from the bottom of the mixer bracket (P/N 048234) (see Figure 5-9). This screw secures the mixer to the priming block.



*Figure 5-9. Active Mixer Assembly*

7. Remove the mixer bracket by sliding it forward and off the front of the mixer body (P/N 047866).
8. Pull the priming block away from the mixer body.
9. The filter is installed on the end of the cylindrical coupler (P/N 048235) that extends from the top of the mixer body.
10. Using tweezers or a jeweler's screwdriver, remove the old filter. Install the new filter (P/N 048277).
11. Reassemble the priming block/mixer unit in reverse order of disassembly and reinstall it in the pump.

12. Reinstall the inlet check valves. Tighten only enough to seat (25 in-lb torque). Tighten a little more only if leaks occur. **DO NOT OVERTIGHTEN!** Overtightening may damage the pump head and the check valve housing and crush the check valve seats.
13. Reconnect the tube fittings. Turn on the power.

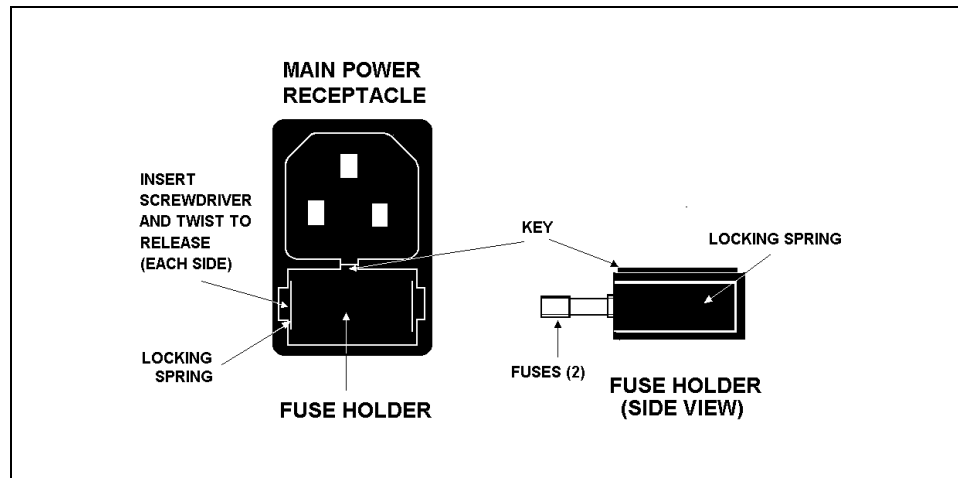
## 5.8 Changing Main Power Fuses

1. Turn off the main power.



**HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the GP40.**

2. The fuse holder is part of the main power receptacle on the rear panel (see Figure 5-10). A recessed lock is located on each side of the fuse holder. Using a small screwdriver or your fingernails, push each lock toward the center to release it. The fuse holder pops out approximately  $\frac{1}{16}$ -in when the locks release. When both locks are released, pull the fuse holder straight out of its compartment.
3. The holder contains two fuses. Replace these with new IEC127 fast-blow fuses rated 3.15 amps (P/N 954746). Dionex recommends replacing both fuses even though only one is open; the other fuse has been stressed and could fail even under normal operation.
4. Reinsert the fuse holder into its compartment. The fuse holder is keyed to fit only in its proper orientation. Apply sufficient pressure evenly against the holder to engage the two locks. The holder is flush against the panel when both locks are engaged.
5. Reconnect the main power cord and turn on the power.



*Figure 5-10. Main Power Fuse Holder*



# A • Specifications

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## ***GP40 Gradient Pump***

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## A • Specifications

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### A.1 Electrical

<b>Main Power Requirements</b>	85 to 270 Vac, 47/63 Hz; 2.5 amps. The GP40 power supply is main voltage auto-sensing and requires no manual adjustment.
<b>Fuse Requirements</b>	Two 3.15 amp fast-blow IEC127 fuses (P/N 954745)

### A.2 Environmental

<b>Operating Temperature</b>	10 °C to 50 °C (50 °F to 104 °F)
<b>Operating Humidity</b>	5 to 95% relative humidity (non-condensing)

### A.3 Physical

<b>Dimensions</b>	33.5 cm high x 22.5 cm wide x 42 cm deep (13.1 in x 8.9 in x 16.8 in) 6 cm clearance required in back of the module
<b>Weight</b>	19 kg (42 lbs)

### A.4 Display and Keypad

<b>Display</b>	Liquid crystal with adjustable backlighting.
<b>Keypad</b>	26-button pad for entering commands and numerical values for screen parameters.

## **A.5 Hydraulics**

<b>Eluent Selection</b>	Four different mobile phase components; each can be proportioned from 0-100%
<b>Pump</b>	Dual-piston, variable speed, 100 $\mu$ L (standard bore), 25 $\mu$ L (microbore) stroke, user-selectable constant pressure or constant flow feedback control
<b>Flow Rate</b>	Standard bore pump head: 0.04 to 10.0 mL/min, linearly variable in increments of 0.01 mL/min  Microbore pump head: 0.01 to 2.50 mL/min, linearly variable in increments of 0.01 mL/min
<b>Operating Pressure</b>	35 MPa (5000 psi) maximum
<b>Pressure Resolution</b>	0.07 MPa (10 psi)
<b>High Pressure Limit</b>	0 to 35 MPa (0-5000 psi) in increments of 0.05 MPa (7.25 psi); trips instantaneously
<b>Low Pressure Limit</b>	0. to 35 MPa (0 to 5000 psi) in increments of 0.05 MPa (7.25 psi); trips after a time-out of 0.4 mL for the standard bore GP40 or 0.1 mL for the microbore GP40
<b>Delay Volume</b>	Approximately 0.92 mL for standard bore pump heads or 0.72 mL for microbore pump heads, measured from the proportioning valve up to, and including, the 61-cm (24-in) pressure transducer outlet line

## **A.6 Gradient Control**

<b>Methods</b>	Stores up to 100 separate gradient methods (00 through 99), each of which may contain up to 50 separate steps. The actual number of stored methods depends on available memory.
<b>Control</b>	The keypad is used to select the pump's operating parameters and to program methods.
<b>Storage</b>	Non-volatile memory protects against the loss of programs during power-down or in the event of a power failure.
<b>Remote</b>	Limited remote operation via TTL-input logic level, and TTL-output and relay contact closures, or full remote programming and control through DX LAN interface.

## **A.7 Vacuum Degas Pump Assembly**

<b>Channels</b>	4-channel membrane vacuum degas
<b>Materials</b>	Wetted materials, PEEK, PTFE
<b>Performance</b>	>69% degas ratio @ 1 or 3 mL/min with 8.5 ppm O <sub>2</sub> at input 0.200 Kg F/cm <sup>2</sup> flow resistance @ 10 mL/min

## ***GP40 Gradient Pump***

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## **B • Installation**

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***GP40 Gradient Pump***

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## B • Installation

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### B.1 Facility Requirements

Appendix A contains the GP40 specifications for power, air pressure, operating temperature, and humidity. In addition to meeting the specifications listed in Appendix A, the GP40 installation facility should meet the following requirements:

- Install the GP40 on a sturdy table or workbench with at least 7.5 cm (3 in) free space behind the module for connections and ventilation. Install the module at a height that ensures convenient viewing of the front panel display and access to the interior.



**Lift the module only from the bottom or side surfaces. Lifting with the panel door will damage the door hinges. Use caution when lifting the module; it weighs 19 kg (42 lbs).**

- Provide a source of helium, nitrogen, or argon gas to pressurize the eluent and regenerant reservoirs. Helium is recommended.

#### NOTE

**If helium is not available, pressurize the reservoirs with argon or nitrogen. For details, refer to the *Pressurizable Reservoir Installation Instructions*.**

- Install a regulator (P/N 046594) on the gas supply line to the reservoirs.
- Always filter eluents to remove small particulates that may contaminate the pump. Install an end-line filter (P/N 045987) on the end of each eluent reservoir line. Filters are supplied in the pressurizable reservoir Ship Kits. Refer to the *Pressurizable Reservoir Installation Instructions* for details.

### B.2 Installation Instructions

The GP40 Ship Kit contains items necessary for completing the installation.

GP40 Gradient Pump Version	Ship Kit
Standard bore with PEEK components	P/N 046295
Standard bore with stainless steel components	P/N 046296
Microbore with PEEK components	P/N 047474
Microbore with stainless steel components	P/N 047475

#### B.2.1 Power Connection

You can control power to the GP40 from the main power switch on either the GP40 or from the LC30 Chromatography Oven (if present). In either case no adjustment is required to select the line voltage.

For on/off control from the GP40, connect the modular power cord (IEC 320 C13), provided with the module, from the main power receptacle on the rear panel (see Figure B-1) to a grounded, single-phase, power source.

For on/off control from the LC30 Chromatography Oven, connect an IEC jumper power cord (P/N 960748) provided in the LC30 Ship Kit from the main power receptacle on the GP40 rear panel to one of the four IEC auxiliary receptacles on the rear panel of the LC30. Leave the GP40 power switch on continuously and use the LC30 main power switch to turn the GP40 on and off. Other modules in the system can be connected to the LC30 in the same way, allowing the LC30 to function as the main power source for the system.



**SHOCK HAZARD**—To avoid electrical shock, a grounded receptacle must be used. Do not operate or connect to AC power mains without an earthed ground connection.



Operation at AC input levels outside of the specified operating voltage range may damage the GP40.

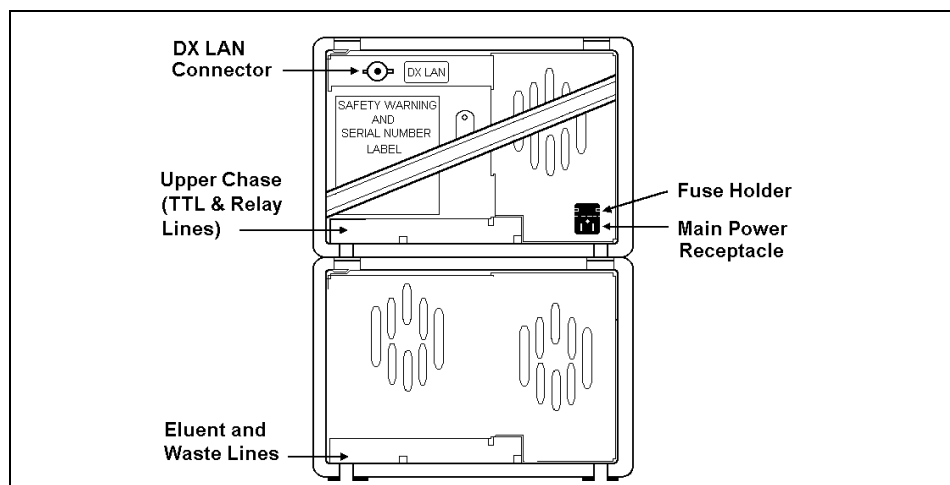


Figure B-1. GP40 Rear Panel

### B.2.2 Electronic Chassis Connections

The electronic chassis connections depend upon the chromatography module installed with the GP40.

#### LC30 Connections

1. Route the RJ-11 serial cable from the rear of the LC30 Chromatography Oven through the GP40 upper chase (see Figure B-1) or through one of the side slots. Connect the cable to the **LC COMM** connector on the pump electronic chassis (see Figure B-2).
2. Route the solenoid valve cable from the rear of the LC30 through the GP40 upper chase or through one of the side slots. Connect the cable to the **LC AIR** connector.

### LC10 or LC20 Connections

1. Route the leak sensor cable from the rear of the LC10 Chromatography Organizer or the LC20 Chromatography Enclosure through the GP40 upper chase (see Figure B-1) or through one of the side slots. Connect the cable to the **LC LEAK** connector on the pump electronic chassis (see Figure B-2).
2. Route the solenoid valve cable from the rear of the LC10 or LC20 through the GP40 upper chase or through one of the side slots. Connect the cable to the **LC AIR** connector.

#### NOTE

Refer to Appendix E for TTL and relay installation instructions.

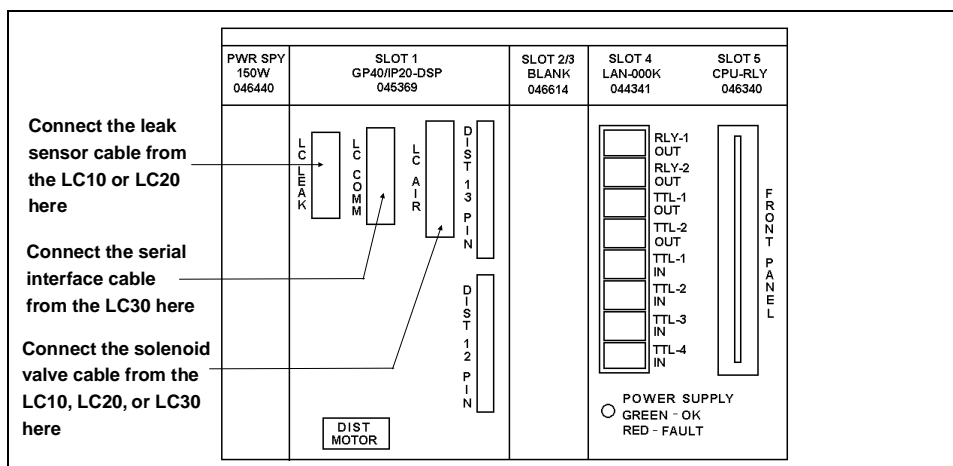


Figure B-2. GP40 Electronic Chassis  
(Located behind pump upper door)

### **B.2.3 DX LAN Network Connection (Optional)**

For the GP40 to communicate with PeakNet software, a pump interface card (P/N 044196) must be installed in the GP40 and the DX LAN cable (P/N 960404) must be connected to the DX LAN connector on the GP40 rear panel.



**STATIC—The GP40 electronics are not user-serviceable and the pump interface card should be installed by qualified personnel only. Observe standard anti-static procedures when installing the interface card or handling the CPU card.**



**To prevent damage to the pump, turn off the main power before installing the interface card. After confirming that the LED on the CPU card is off (not green or red), unplug the power. Do not rely on the front panel power switch.**

1. Remove any TTL/Relay plugs from the connectors at slot 4 on the electronic chassis (see Figure B-2).
2. Disconnect the 60-pin ribbon cable from the inside of the front panel by first closing the tilt panel to expose the connector and its ejector latches. Remove the cable by opening the ejector latches.
3. Using a screwdriver as a lever, open the white ejector latch at the bottom of the CPU card. Remove the CPU card, cable, and relay card as a single unit.
4. Insert the pump interface card into slot 4. Slide the card to the rear. Verify that the BNC connector is aligned with the hole at the rear and the card is aligned with the connector. Press firmly on the card until it mates fully with the connector on the rear panel.
5. Reinstall the CPU/relay card. Press firmly until the CPU card is inserted into the connector on the rear panel.

## ***GP40 Gradient Pump***

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6. Reconnect the ribbon cable to the 60-pin connector on the front panel. The header and connector are key-polarized near the center. The ejector latches should be partially open to accept the cable connector.
7. Connect the DX LAN cable (P/N 960405) to the DX LAN connector on the rear panel.
8. If the pump is the last module in the network to be connected, install a terminator plug (P/N 921034), shipped with PeakNet software, on the remaining port of the BNC tee connector. If this is not the last module, connect the cable from the next module to the BNC tee.



**Terminator resistor plugs must be installed at each end of the DX LAN. Verify that both ends of the DX LAN have terminator resistor plugs installed.**

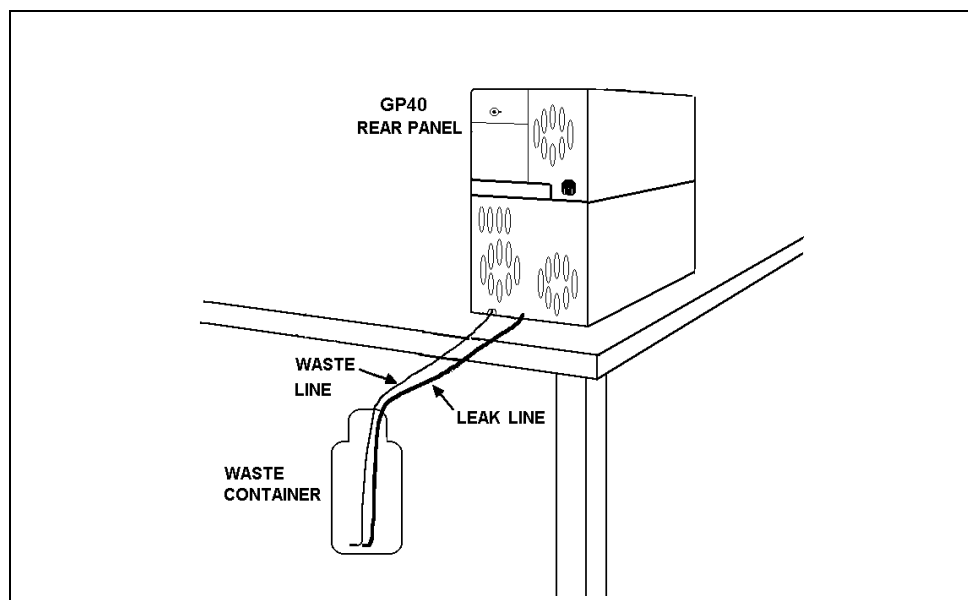
### **B.2.4 Waste Lines**

The GP40 requires two waste lines; one line from the pressure transducer assembly, and one from the leak drain. These lines are factory-installed and routed to the rear panel.

Place the free end of both waste lines into a single waste container positioned below the level of the GP40 to maintain a positive siphon (see Figure B-3).



**Neutralize acids and bases before disposal. Do not dispose of wastes containing organic solvents or heavy metals through the sewage or storm drain system.**



*Figure B-3. Eluent Waste Lines*

### **B.2.5 Eluent Outlet Line Connection**

Connect the eluent line exiting the pressure transducer to the appropriate injection valve or column in the LC10 Chromatography Organizer, LC20 Chromatography Enclosure, LC30 Chromatography Oven, or other system component. It is important to minimize the volume between the injection valve and detector. If possible, shorten the eluent line from the pump after determining the relative positions of all system modules.

Route the eluent outlet line either through the chase and out the rear panel or through the slot on the left side of the module.

### **B.2.6 Eluent Inlet Line Connections**

1. Locate eluent lines A through D in the Ship Kit (P/Ns 047694, 047695, 047696, 047697).
2. For each eluent reservoir to be used, connect an eluent line to the corresponding bulkhead fitting (A through D) on the right side of the front of the mechanical chassis (see Figure 2-5).

#### **NOTE**

**If an eluent channel is not used, plug its bulkhead fitting with a 1/4-28 plug (P/N 037628), for better degas performance of the channels in use.**

3. To keep track of the eluent connections, label each eluent reservoir with the letter of the bulkhead fitting it is connected to.



4. Install spiral wrap (P/N 035906) on the eluent lines to help organize them. Cut the spiral wrap into three pieces, each 15 cm (6 in) long. Gather all the eluent lines and hold them neatly together with one hand. Install one piece of spiral wrap on the eluent lines near the reservoirs, another piece near the middle of the lines, and the third piece near the pump.

### **B.2.7 Priming the Pump**

The priming procedure has two parts:

- Priming the eluent manifold
- Priming the pump heads

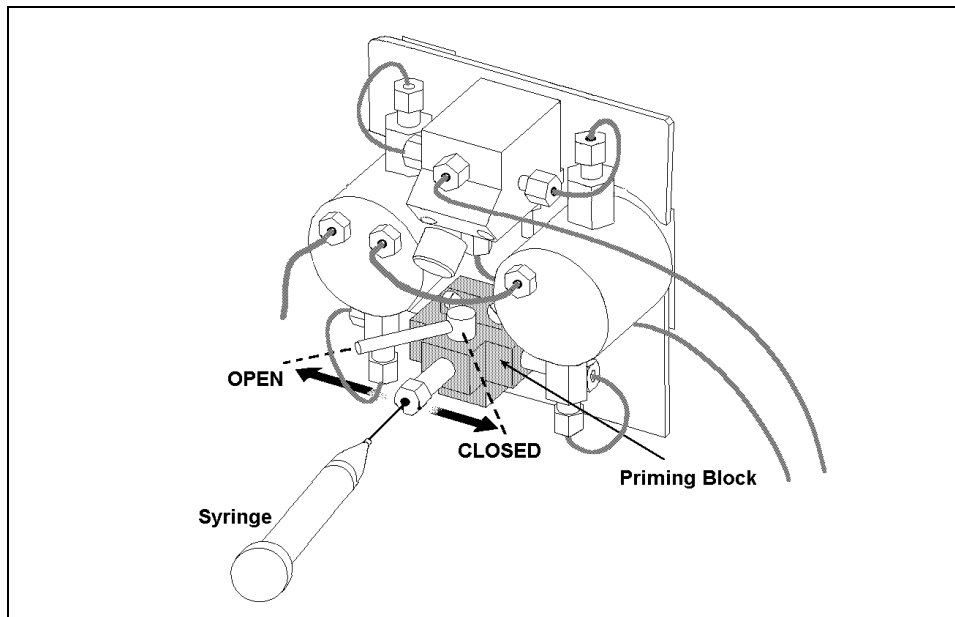
#### **Priming the Eluent Valve Manifold**

After the eluent reservoirs are connected to the front panel, the valve manifold must be separately primed with each eluent.

1. Open the **MAIN** screen and select **DIRECT CNTRL** and **LOCAL**.
2. Verify that the **Off/On** LED is in the on position.
3. Open the **MAIN** or **DETAIL** screen. Move the cursor to the desired eluent. Enter 100 to select 100% of that eluent and press **Enter** or a cursor arrow button. This automatically sets other eluents to 0%.
4. Set the flow rate to 0.
5. Connect a 10 mL syringe (P/N 016387) to the luer adapter on the priming block. Turn the lever on the priming block all the way to the left to its maximum open position (see Figure B-4).

#### **NOTE**

**Because the eluent is pressurized, liquid will flow into the syringe as soon as you turn the priming block lever.**



*Figure B-4. Priming the Eluent Valve Manifold*

6. Verify that the eluent is pressurized to 55 KPa (8 psi).
7. Use the syringe to draw liquid from the reservoir, and through the liquid lines, degas pump assembly, and eluent manifold. Because the degas assembly holds about 20 mL, you may need to draw several syringes of eluent before you see the bubbles which indicate the transition to the new eluent selected in Step 3. Continue drawing on the syringe until flow through the connecting tubing contains no more air bubbles.
8. Return to Step 3; select another eluent and repeat the priming procedure.
9. When the manifold has been primed with each eluent, move the lever on the priming block to the right to its fully closed position (see Figure B-4).
10. Press **Off/On** twice to return the pump to its normal operating mode.

### **Priming the Pump Heads**

1. Open the **MAIN** screen and select **DIRECT CNTRL** and **LOCAL**.
2. Open the pressure transducer waste valve (see Figure B-5) by turning the knob counterclockwise about two turns. When the waste valve is open, flow goes from the priming block through the pump heads and directly out to waste (bypassing the eluent out line to the column).

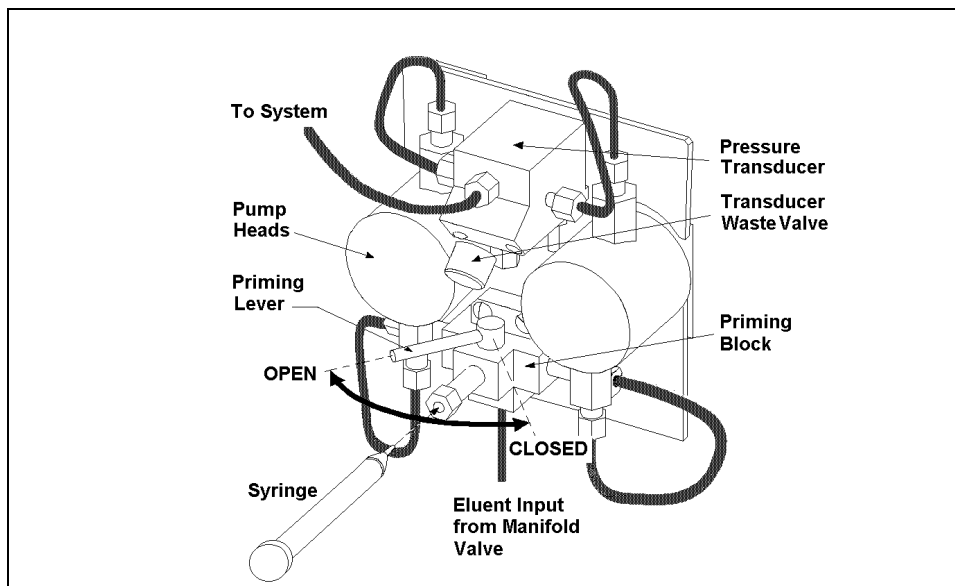


**Be sure to bypass all columns by opening the pressure transducer waste valve before priming the pump. This prevents overpressurizing the system and possibly damaging the columns.**

3. Press **Prime**. The pump will begin pumping at its maximum flow rate (10.0 mL/min for standard bore and 2.50 mL/min for microbore).
4. Allow the pump to prime until no bubbles can be seen exiting the waste line (about 5 minutes).
5. Press **Prime** again to return the flow to the normal rate.
6. Close the pressure transducer waste valve. The pump is now ready for normal operation.

#### **NOTE**

**After priming, check the pressure reading on the MAIN screen. The GP40 display updates the pressure readout once per piston stroke. The reading from one stroke to the next should be within 3%. A variation of more than 3%, indicates the pump is out of prime. If this is the case, go on to the following steps. Also refer to Section 4.1 for troubleshooting information.**



*Figure B-5. Priming the Pump Heads*

**Priming the Pump Heads with Alcohol**

1. Connect a 10 mL syringe (P/N 016387) to the luer adapter on the priming block (see Figure B-5).
2. Open the pressure transducer waste valve by turning the knob counterclockwise about two turns.
3. Move the lever on the priming block to the left as far as it will go (see Figure B-5). Press **Prime**.
4. Use the syringe to slowly push alcohol through the pump. Avoid pushing any air trapped in the syringe through the pump as this will result in loss of prime. Verify that alcohol with no trapped bubbles is traveling down the waste line from the transducer.
5. Allow the pump to run until you have pushed about 3 mL of alcohol from the syringe. Then, while maintaining pressure on the syringe, press **Off/On** to turn off the pump motor.

6. Continue to push on the syringe until you have closed the priming block valve by moving the lever all the way to the right.
7. Select 100% of the desired eluent and 0% for all other eluents.
8. Press **Prime** and flush the pump with eluent for 2 minutes for the standard pump heads, or 8 minutes for the microbore pump heads.



If you do not completely flush the alcohol from the pump before installing the columns, the columns may be irreparably damaged.

9. Disconnect the syringe from the priming block and close the pressure transducer waste valve. The pump is now ready for normal operation.

### B.3 Automatic SRS Power Control

TTL connections can be used to automatically switch off the power to a Self-Regenerating Suppressor (SRS) when the GP40 flow stops. The GP40 sends a TTL signal to the detector. After 5 minutes, the detector shuts off the SRS power. The 5-minute delay in shutoff allows momentary flow interruptions without disturbing the SRS.

1. Open the GP40 **PUMP OPTIONS** screen and set **TTL2 OUTPUT USAGE** to **0 FLOW** (see Figure B-6).

PUMP OPTIONS	
PUMP HEAD MATERIAL:	INERT
PUMP HEAD VOLUME:	100 $\mu$ L
CONTROL MODE:	PRESSURE
TTL2 OUTPUT USAGE:	0 FLOW
PRESSURE UNITS:	PSI
Help Message	

Figure B-6. Pump Options Screen

## GP40 Gradient Pump

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2. Open the CD20 or ED40 detector **TTL FUNCTION IN** screen and assign TTL3 to **SRS OFF/ON**.
3. Locate a pair of twisted black and red wires (P/N 043598) and two green TTL connector plugs (P/N 921019) in the GP40 Ship Kit.
4. Strip the ends of the wires and insert into the plugs. The signal wire (red) goes on top and the ground wire (black) goes on the bottom of each plug. Use the screwdriver (P/N 046985) provided in the Ship Kit to tighten the locking screws.
5. Plug one end of the cable into **TTL2 OUT** on the GP40. (The TTL connectors are located behind the upper door). Route the cable through the upper chases of the GP40 and the CD20 or ED40. Plug the other end into **TTL3 IN** on the detector (see Figure B-7).

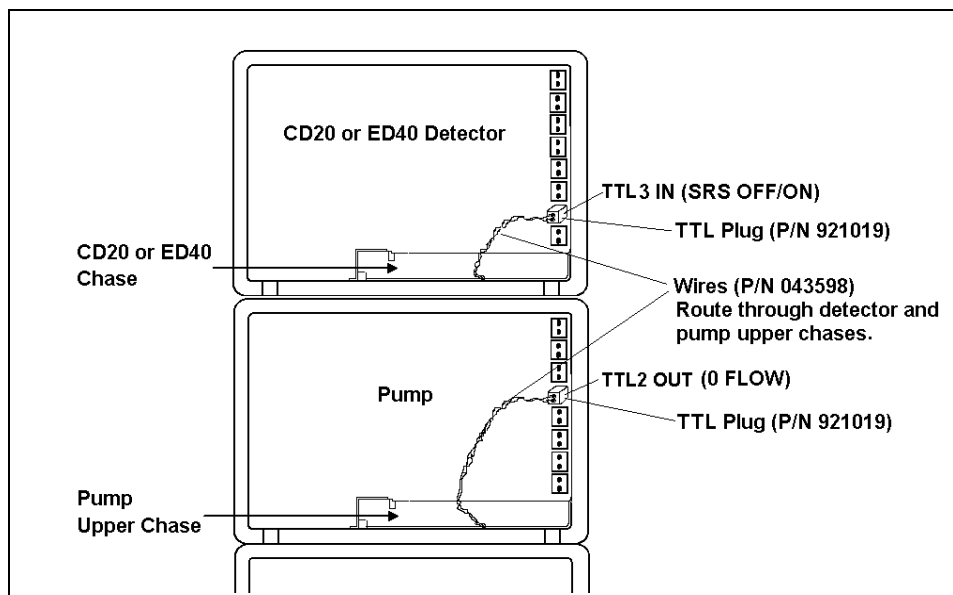


Figure B-7. TTL Connections for SRS Power Control  
(CD20/ED40 and GP40 Front Views without Front Doors)

## B.4 Stacking Modules

Dionex DX 500 modules are designed to be stacked on top of each other up to a maximum height of four units. The pump is two units high and typically sits on the workbench with a single-unit or double-unit detector module stacked on top of it. Figure B-1 illustrates the recommended stacking configuration.



**CAUTION**

Lift the module only from the bottom or side surfaces. Lifting with the panel door will damage the door hinges. Use caution when lifting the module; it weighs 19 Kg (42 lbs).

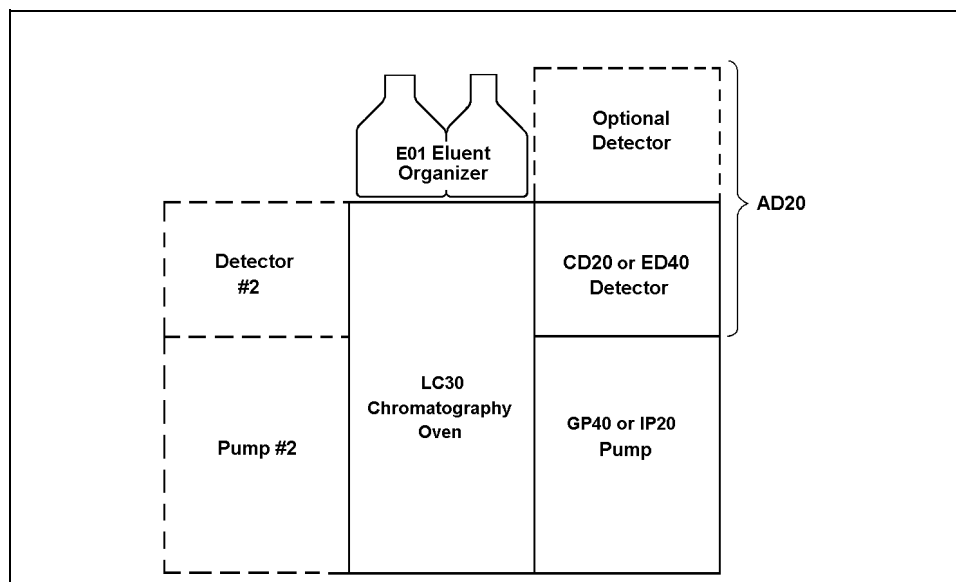


Figure B-1. Recommended Stacking Configuration

## **B.5 Securing Modules (Optional)**

The Ship Kit contains a shoe (P/N 046478) and tie (P/N 046476) for securing modules together. Installation of the shoe and tie is optional.

- The shoe is a gray-colored rubber rectangle with raised edges. It installs under two modules sitting side-by-side on the laboratory bench, for example, the LC30 Chromatography Oven and a GP40 Gradient Pump.
- The tie is a small flexible piece of gray-colored rubber tubing with enlarged square ends. It installs in the side slots of two adjacent modules.

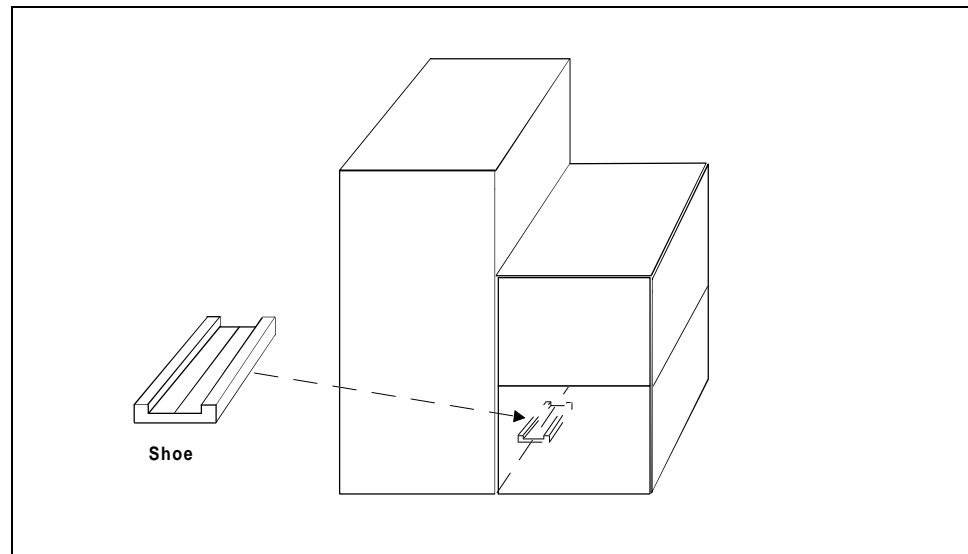
### **NOTE**

**The tie is not used with the LC30 Chromatography Oven.**

### **B.5.1 Installing a Shoe**

1. The bottom of each module contains a molded ribbing with a pocket on each side midway between the front and the rear of the module. One side of the shoe fits in the pocket of one module and the other side fits in the pocket of the adjacent module (see Figure B-2). To install the shoe, lift the edge of one module away from the adjacent module.
2. Place the shoe, with the grooved side up, under the lifted edge and slide the shoe along the edge until it fits into the pocket.
3. Press the shoe firmly into the pocket and carefully lower the module back onto the bench.
4. Lift the edge of the second module, align the front and rear edges of the two modules and then lower the second module over the shoe. Press down to seat the second module on the shoe.





*Figure B-2. Shoe Installation*

### **B.5.2 Installing a Tie**

1. Align the two modules side-by-side and open their doors.
2. Slide the narrow center portion of the tie into the side slot of one of the modules.
3. Grasp the enlarged end of the tie and pull to stretch the center portion of the tie.
4. Slide the stretched center portion into the side slot of the adjacent module. When you release the end, the tie acts as a spring, holding the two modules tightly together.

***GP40 Gradient Pump***

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## C • User Interface

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C.2.7	Keyboard Test . . . . .	C-20
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C.3.1	Calibration Menu . . . . .	C-25
C.3.2	Calibration Status . . . . .	C-26
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C.3.4	Degas Status . . . . .	C-28
C.3.5	Flow Calibration . . . . .	C-29
C.3.6	Pressure Offset Calibration . . . . .	C-30
C.3.7	Degas Pump Calibration . . . . .	C-31

## ***GP40 Gradient Pump***

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## C • User Interface

This appendix illustrates and describes all of the screens available for display on the front panel of the GP40. There are three categories of screens: operational, diagnostic, and calibration (see Figure C-1):

- *Operational* screens allow you to create, edit, and run methods that control pump operation, and to select default pump parameters.
- *Diagnostic* screens provide access to GP40 diagnostic information and tests.
- *Calibration* screens allow you to calibrate various GP40 functions; for example, the flow rate and the pressure offset.

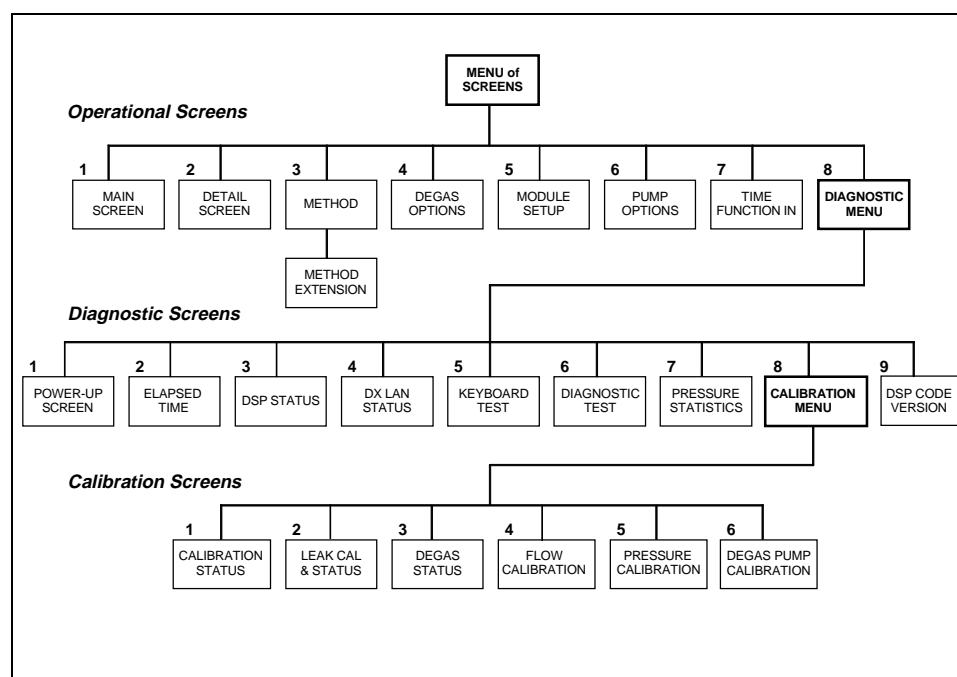


Figure C-1. GP40 Menu Structure

### NOTE

If no keypad buttons are pressed within a two-hour period, the backlight will automatically turn off and remain off until you press one of the buttons. In this case, pressing the button only turns on the backlight; it does not activate the button's function. Press the button twice to activate its function.

### Menu of Screens

This menu lists the GP40 user interface screens. It is displayed when you press **Menu**.

MENU of SCREENS	
1 MAIN SCREEN	5 MODULE SET-UP
2 DETAIL SCREEN	6 PUMP OPTIONS
3 METHOD	7 TIME FUNCTION IN
4 DEGAS OPTIONS	8 DIAGNOSTIC MENU
Help Message	

*Figure C-2. Menu of Screens*

There are two ways to select a screen from a menu:

1. Move the cursor to the field containing the screen number and press **Enter**.
2. Press the number button on the front panel keypad that corresponds to the screen number in the menu.

To display a brief description of each screen, press **Help**.

## C.1 Operational Screens

Operational screens are used for controlling the GP40 from the keypad. Following power-up, the **MAIN** screen displays (see Figure C-3).

### C.1.1 Main Screen

The **MAIN** screen displays after power-up and a six-second time-out of the **POWER-UP** screen. Use this screen to select the mode of operation, the method number to run (when in Method control), and basic operating parameters (when in Direct control).

The **MAIN** screen displays active data in large characters to make viewing easier from a distance.

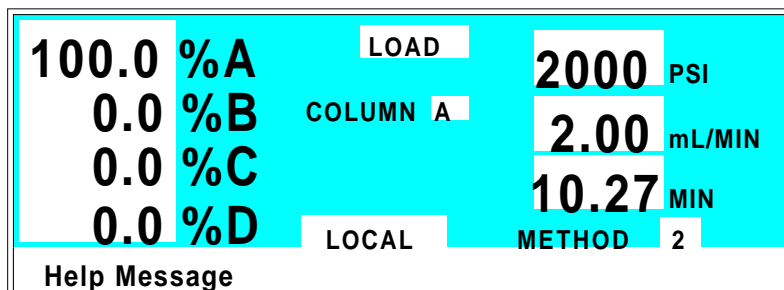


Figure C-3. Main Screen

<b>%A - %D</b>	Displays the percentage of each eluent currently in use. In Direct control, set the percentage in these fields, also.
<b>INJECT</b>	Selects the position of the injection valve. The choices are <b>INJECT</b> and <b>LOAD</b> .
<b>PSI (MPa, BAR)</b>	Displays the air pressure in psi, MPa or bar. Set the unit of measure from the <b>PUMP OPTIONS</b> screen.
<b>COLUMN</b>	Selects the active column ( <b>A</b> or <b>B</b> ) in the LC10, LC20, or LC30 chromatography module. Column B is available only when a column switching valve is installed in the chromatography module.

## **GP40 Gradient Pump**

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<b>mL/MIN</b>	Displays the eluent flow rate through the pump in milliliters per minute. In Direct control, set the flow rate in this field also.
<b>MIN</b>	Displays the total elapsed time that the method clock has been running. The value can be changed. When you enter a new elapsed time, the method settings corresponding to the new time go into effect.
<b>LOCAL/ REMOTE</b>	Press either <b>Select</b> button to toggle between the <b>LOCAL</b> and <b>REMOTE</b> modes. A command from the host computer can set the pump to <b>LOCKED RMT</b> to shut out operation from the keypad. The <b>LOCKED RMT</b> mode can be canceled only by a new command from the host computer, or by turning off the pump and then turning it back on.
<b>METHOD #</b>	Displays the number of the method currently running. The range is <b>0</b> through <b>99</b> . In Local mode, enter the method number to run in this field.



### C.1.2 Detail Screen

This screen provides the information contained in the **MAIN** screen as well as some additional operational parameters.

<b>DETAIL SCREEN</b>				TTL1	0
100.0	%A	2125	PSI	TTL2	1
0.0	%B	2.00	mL/MIN	RLY1	1
0.0	%C	INJECT	SAMPLE	RLY2	0
0.0	%D	COLUMN	A		
<b>CURVE 5</b>		LIMIT	0-5000 PSI		
REMOTE		METHOD	05	10.25	MIN
Help Message					

Figure C-4. Detail Screen

The additional fields are:

<b>TTL1</b>	Provides TTL and relay control of other devices. In
<b>TTL2</b>	Direct control, select <b>1</b> (on) or <b>0</b> (off). In Method
<b>RLY1</b>	control, set the TTL and relay fields from the
<b>RLY2</b>	<b>METHOD</b> screen. Appendix E describes TTL and relay control.
<b>CURVE</b>	Indicates the gradient curve selected in the current method step. Refer to Section 2.8.3 for details on the curve types.
<b>LIMIT</b>	The pressure limit range value in psi, MPa, or bar (see Section 3.1.5).

### C.1.3 Method Screen

Use this screen to select, edit, and save methods.

METHOD EDIT		05	SAVE TO		06	RUN		10
			LIMITs		0 - 5000	PSI		
TIME	%A	%B	%C	%D	C	V	FLOW	
INIT	25.0	25.0	25.0	25.0	0	L	1.00	>
0.00	100.0	0.0	0.0	0.0		I		>
123.45	10.0	22.2	32.3	35.5	5	L	2.00	>
345.67	17.2	19.6	33.2	30.0				>
Help Message								

Figure C-5. Method Screen

#### NOTE

In the %A- D, C, V and FLOW fields, a blank field indicates no change from the previous step.

<b>METHOD EDIT</b>	The method number (0 through 99) to edit.
<b>SAVE TO</b>	The method number (0 through 99) to save the current method to. It can be the same or different from the edit number.
<b>RUN</b>	The method number (0 through 99) to run. Entering a method number in this field does not affect the status of the method clock. The <b>Hold/Run</b> button on the front panel keypad controls the clock.
<b>LIMITS</b>	The low and high pressure limits (see Section 3.1.5), in psi, MPa, or bar. Select the unit of measure from the <b>PUMP OPTIONS</b> screen.
<b>TIME</b>	The elapsed time for each method step. Every method must begin with the <b>INIT</b> (initial) step, followed by the <b>TIME = 0.00</b> step. Each additional entry under <b>TIME</b> indicates the elapsed time at which the specified conditions (eluent percentages, curve number, flow rate, etc.) occur.

<b>%A - %D</b>	The percentage of each eluent occurring at the start of the step. The total of all eluents must equal 100%.
<b>C</b>	The gradient curve type ( <b>0</b> through <b>9</b> ) to use when moving from the previous step to the current step. See Section 2.8.3 for details on the curve types. Because there are no previous steps for <b>INIT</b> or <b>TIME = 0.0</b> , curve numbers are not entered for these steps.
<b>V</b>	The position of the injection valve, either <b>INJECT</b> or <b>LOAD</b> .
<b>FLOW</b>	The flow rate through the pump in milliliters-per-minute.
v	A small “v” adjacent to the bottommost time entry indicates there are additional lines below the last line in the screen. Use the arrow buttons to scroll down to the additional lines.
^	A caret (^) adjacent to the topmost time entry indicates there are additional lines above the top line. The caret displays only when the screen is scrolled down additional lines. Use the arrow buttons to scroll up to the additional lines.
>	A right-angle bracket (>) at the end of each data line indicates a lateral extension to that line. Move the cursor to the end of the line, then continue moving right to display the <b>METHOD</b> extension screen.

### C.1.4 Method Extension Screen

The method extension screen shows the column selection and TTL/relay output parameters for each step in the method. Use the topmost entries in the same manner as the **METHOD** screen. To return to the **METHOD**, move the cursor all the way to the left and then continue further.

METHOD EDIT 05			SAVE TO 06		RUN 10	
TTL OUT		RLY OUT				
COL	TTL1	TTL2	RLY1	RLY2	TIME	
< A	0	1	1	0	INIT	
< B	1		0		0.00	
< A		0	1	1	123.45	
					v 345.67	
Help Message						

Figure C-6. Method Extension Screen

<b>COLUMN</b>	Selects the active column ( <b>A</b> or <b>B</b> ) in the LC10, LC20, or LC30 chromatography module. Column B is available only when a column switching valve is installed in the chromatography module.
<b>TTL1</b>	Provides TTL and relay control of other devices.
<b>TTL2</b>	Select <b>1</b> (on) or <b>0</b> (off). Appendix E describes TTL and relay control.
<b>RLY1</b>	
<b>RLY2</b>	
<b>HELP</b>	If you attempt to leave the <b>METHOD</b> or <b>METHOD</b> extension screen without having first saved any changes, a prompt displays in the <b>HELP</b> entry line

SAVE CHANGES OR LOSE THEM BY EXITING?

To save changes, move the cursor to the **SAVE TO** field. Press **Enter** to save changes to the current method, or enter a different method number and press **Enter**.

### C.1.5 Degas Options

Use the **DEGAS OPTIONS** screen to set the duration and frequency of the degas pump cycles.

DEGAS OPTIONS		DEFAULT
DEGAS PUMP:	BY SETTING	
START-UP DURATION:	2 MIN	2 MIN
CYCLE DURATION:	30 SEC	30 SEC
TIME BETWEEN CYCLES:	10 MIN	10 MIN
Help Message		

Figure C-7. Degas Options Screen

**DEGAS PUMP** Selects operating options:  
**BY SETTING:** The degas pump runs according to the selected degas options.  
**MONITOR:** The GP40 monitors the degas vacuum reading every one minute. If the reading falls 500 counts below the calibration threshold value, the degas pump turns on and runs for the cycle duration time.  
**ALWAYS OFF:** The pump is always off.  
**ALWAYS ON:** The pump is always on. This setting is normally used only for testing the pump during servicing.

**START-UP DURATION** The length of time the pump runs at power-up (2-5 min).

**CYCLE DURATION** The length of time the pump runs during each cycle (0-120 sec).

**TIME BETWEEN CYCLES** The time to wait between cycles (1-99 min).

#### NOTE

Go to the **DEGAS PUMP CALIBRATION** screen to view the degas threshold value.

## **GP40 Gradient Pump**

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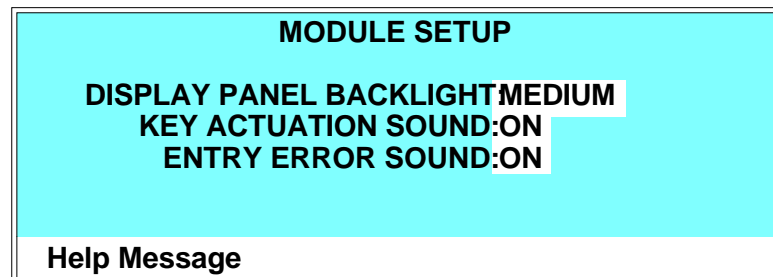
The GP40 monitors the degas vacuum reading every one minute. If the degas vacuum reading is at or below the alarm threshold value (2000 counts below the calibration threshold value), the following message displays:

LOW VACUUM ALARM!!  
Check DEGAS OPTIONS settings or refer to  
service manual

If this occurs, try increasing the **CYCLE DURATION** time and/or decreasing the **TIME BETWEEN CYCLES**. If adjusting these settings does not solve the problem, contact your Dionex office.

### C.1.6 Module Setup

Use this screen to adjust the display backlight, and to toggle the button and error tones on or off. Adjustments made in this screen will be the default until new adjustments are made.



*Figure C-8. Module Setup Screen*

<b>DISPLAY PANEL BACKLIGHT</b>	Selects a backlight of either <b>LOW</b> , <b>MEDIUM</b> , <b>HIGH</b> , or <b>OFF</b> .
<b>KEY ACTUATION SOUND</b>	Toggles the key sound <b>ON</b> or <b>OFF</b> .
<b>ENTRY ERROR SOUND</b>	Toggles the error sound <b>ON</b> or <b>OFF</b> .

### **C.1.7 Pump Options**

Use this screen to select the type of pump head installed and to set pump operation parameters. This data must be updated after changing to a different pump head type or when the operational requirements change.

The screenshot shows a screen titled "PUMP OPTIONS" with a cyan background. Below the title, five parameters are listed with their current values in white text on a black background: "PUMP HEAD MATERIAL: INERT", "PUMP HEAD VOLUME: 100  $\mu$ L", "CONTROL MODE: PRESSURE", "TTL2 OUTPUT USAGE: 0 FLOW", and "PRESSURE UNITS: PSI". At the bottom of the screen, there is a white bar with the text "Help Message".

*Figure C-9. Pump Options Screen*

<b>PUMP HEAD MATERIAL</b>	Change this parameter only after changing the pump heads. Select <b>INERT</b> for PEEK pump heads or <b>SST</b> for stainless steel pump heads.
<b>PUMP HEAD VOLUME</b>	Change this parameter only after changing the pump heads. Select <b>100 <math>\mu</math>L</b> for standard bore pump heads, or <b>25 <math>\mu</math>L</b> for microbore pump heads.
<b>CONTROL MODE</b>	Sets the pump flow control mode to <b>PRESSURE</b> or <b>FLOW</b> . Pressure mode uses pressure as the primary source of feedback to maintain flow rate stability. Flow mode uses motor speed as the primary source of feedback to maintain stability.
<b>TTL2 OUTPUT USAGE</b>	Selects the active state of the TTL OUT signal. Select <b>0 FLOW</b> or <b>NORMAL</b> . At <b>0 FLOW</b> , TTL2 is high. At <b>NORMAL</b> , TTL2 is low. Select <b>0 FLOW</b> to automatically switch off the power to a Self-Regenerating Suppressor when the pump flow stops. TTL2 out, on the pump must be connected to TTL3 in, on the CD20 or ED40 detector (see Section B.3 for details).
<b>PRESSURE UNITS</b>	Selects the unit of measure for pressure ( <b>PSI</b> , <b>MPa</b> , or <b>BAR</b> ).



### C.1.8 Time Function In

This screen displays the pump functions that can be controlled with TTL input from another device. The **MODE** field selects the type of input signal the pump will respond to. The signal type can be changed to match the signal of the controlling device. See Appendix E for details.

<b>TIME FUNCTION IN</b>	<b>MODE: NORMAL</b>	<b>EDGE</b>
<b>PUMP MOTOR OFF/ON: TTL 1</b>		
<b>HOLD-RESET-INIT COND/RUN: TTL 2</b>		
<b>INCREMENT METHOD NUMBER: TTL 3</b>		
<b>DECREMENT METHOD NUMBER: TTL 4</b>		
<b>Help Message</b>		

*Figure C-10. Time Function In Screen*

**MODE**

Select **NORMAL EDGE**, **INVERTED EDGE**, **NORMAL PULSE**, or **INVERTED PULSE**. Normal edge, the default mode, is compatible with the TTL output signals provided by DX 500 modules.

## **C.2 Diagnostic Screens**

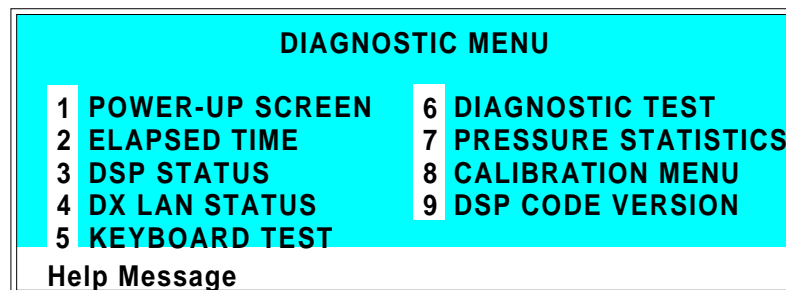
To access the pump diagnostics, select the **DIAGNOSTIC MENU** from the **MENU of SCREENS**. From a diagnostic screen, pressing **Menu** returns you to the **DIAGNOSTIC MENU**. From the **DIAGNOSTIC MENU**, pressing **Menu** returns you to the **MENU of SCREENS**.

### **C.2.1 Hexadecimal Entry Fields**

Several diagnostic screens require entering values in hexadecimal format. While the cursor is on one of these fields, enter the hexadecimal digits A through F by pressing the decimal [.] button, followed by the number button 0 through 5. In this scheme, .0 enters the digit A, .1 enters B, .3 enters C, and so forth. The decimal button has no effect on any other button; the remaining buttons ignore the decimal function and perform as usual.

### **C.2.2 Diagnostic Menu**

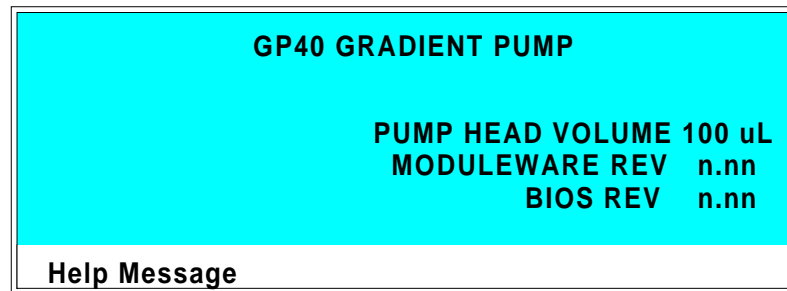
The **DIAGNOSTIC MENU** lists the available diagnostic screens. To display the menu, select option **8** from the **MENU of SCREENS**.



*Figure C-11. Diagnostic Menu*

### **C.2.3 Power-Up Screen**

This is the same power-up screen that displays when you turn on the GP40. When the pump is connected to the DX LAN, the DX LAN ID number also displays.



*Figure C-12. Power-Up Screen*

### C.2.4 Elapsed Time

This screen reports for how long various GP40 components have been in use. The status of each parameter updates in real time.

**ELAPSED TIME** **RESET**

**MODULE ON:** nnnnnnnn hours  
**BACKLIGHT:** nnnnnnnn hours  
**PUMP CYCLES:** nnnnnnnn cycles  
**SEALS IN USE:** nnnnnnnn cycles \*  
**VALVES IN USE:** nnnnnnnn cycles \*

Help Message

*Figure C-13. Elapsed Time Screen*

<b>MODULE ON</b>	Reports the total time the module has been powered up in its lifetime.
<b>BACKLIGHT</b>	Reports the total time the display backlight has been on in its lifetime.
<b>PUMP CYCLES</b>	Reports the total cumulative number of pump cycles during the life of the motor. This field automatically resets to 0 after the pump motor is replaced.
<b>SEALS IN USE</b>	Reports the total number of pump cycles since the last time the seals were replaced. Reset this field to 0 when the seals are replaced.
<b>VALVES IN USE</b>	Reports the total number of pump cycles since the last time the check valves were serviced. Reset this field to 0 when the valves are serviced.
<b>RESET</b>	Resets the <b>SEALS IN USE</b> , or <b>VALVES IN USE</b> counter to 0. Move the cursor to the corresponding asterisk (*) field and press <b>Enter</b> . Always reset the seals and valves counters to 0 when they are replaced or serviced.

### C.2.5 DSP Status

This screen reports the status of GP40 DSP (Digital Signal Processor) dynamic parameters. Status updates are in real time.

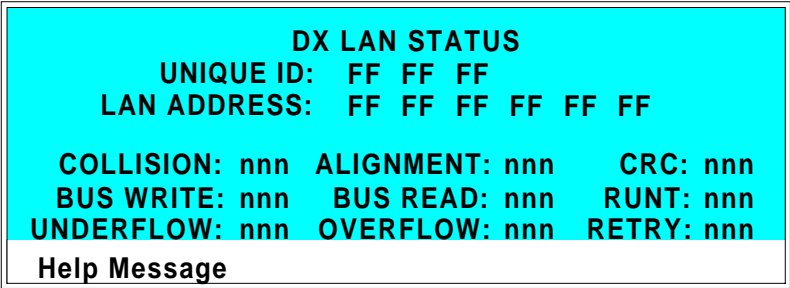
DSP STATUS	
PRESSURE: nnnn PSI	TACH VALUE: 5.00 V
FLOW MODE: OFF	HEAD MATERIAL: INERT
EN. FOUND: YES	HEAD VOLUME: 100uL
PRESSURIZATION POINTS	
LEFT: nnn	RIGHT: nnn
Help Message	

Figure C-14. DSP Status Screen

<b>PRESSURE</b>	Reports the current head pressure in psi, MPa, or bar.
<b>TACH VALUE</b>	Reports the current motor tachometer reading in volts.
<b>FLOW MODE</b>	Reports the flow mode as <b>ON</b> or <b>OFF</b> : <b>ON</b> = System is in constant flow mode. <b>OFF</b> = System is in pressure feedback mode.
<b>HEAD MATERIAL</b>	Reports the head material as set in the <b>PUMP OPTIONS</b> screen: <b>INERT</b> = PEEK heads <b>METAL</b> = Stainless steel heads
<b>EN. FOUND</b>	Reports when the encoder is found. Options are <b>YES</b> or <b>NO</b> .
<b>HEAD VOLUME</b>	Reports the head volume as set in the <b>PUMP OPTIONS</b> screen. The options are 100 µL for standard bore heads or 25 µL for microbore heads.
<b>PRESSURIZATION POINTS</b>	Reports the current pressurization point for the left and right pistons. The pressurization points are the points at which the pump speed is adjusted at each stroke to maintain a constant flow rate. A variation of more than 3% between the left and right readings indicates a problem (see Section 4.1).

**C.2.6 DX LAN Status**

The DX LAN driver monitors several types of errors that may occur on the network. The detector reads the DX LAN error counts and displays them on this screen, along with the DX LAN addresses.



*Figure C-15. DX LAN Status Screen*

<b>UNIQUE DX LAN ID</b>	Displays the three-byte DX LAN ID programmed into the detector Moduleware (in HEX). The ID is unique to the detector and never changes.
<b>DX LAN ADDRESS</b>	Displays the six-byte DX LAN address assigned by the PC (in HEX). The first three bytes are the system assignment and the last three bytes are the assignment within the system.
<b>COLLISION</b>	Indicates that 16 unsuccessful transmissions of the same packet occurred, due to collisions.
<b>BUS WRITE</b>	Indicates that a ready response could not be issued within 2.4 microseconds after the WR signal was asserted. This occurs when the transmit buffer memory is full.
<b>UNDERFLOW</b>	Indicates that data from the transmit section of the hardware buffer memory is not available for serial transmission. The DX LAN will continue to send out this data frame.
<b>ALIGNMENT</b>	Indicates that a packet was received with an alignment error, meaning that there were one

to seven extra bits at the end of the packet. This is usually caused by a collision or a faulty transceiver.

**BUS READ**

Indicates that a ready response could not be issued within 2.4 microseconds after the ready signal was asserted. This occurs when reading an empty buffer.

**OVERFLOW**

Indicates that the DX LAN hardware receive buffer became full and had to reject a packet for lack of space.

**CRC**

Indicates that a packet was received with a CRC error. This usually means that a collision has corrupted the packet.

**RUNT**

Indicates that a “runt” packet (one less than 15 bytes in length) was received. This usually occurs after a collision has truncated the original length.

**RETRY**

Indicates the number of retries required to transmit the last packet.

### **C.2.7 Keyboard Test**

This screen allows you to conduct an interactive test of the front panel keypad buttons.

OFF/ON	RUN/HOLD	UP	7	8	9
PRIME	RESET	LEFT	DOWN	RIGHT	4 5 6
INSERT	SEL UP	HELP	MENU	1	2 3
DELETE	SEL DOWN	0	.	E	
Help Message					

*Figure C-16. Keyboard Test Screen*

To test the buttons:

1. Press a button on the keypad. Its display changes to reverse video, confirming proper operation of that button.
2. Continue pressing all buttons in turn. Only the most recently pressed button shows in reverse video.
3. To end the test and return to the **DIAGNOSTIC MENU**, press **Menu** twice.



### C.2.8 Diagnostic Test

Use this screen to test the pump electronics. At power-up, some of these tests are run automatically. If any tests fail, the screen opens and displays the status of each test run. Additional tests may be run after the **DIAGNOSTIC TEST** screen is displayed. If errors occur, a message screen displays. When you clear the message, the **DIAGNOSTIC TEST** screen reappears. It remains open until you press the **Menu** button.

DIAGNOSTIC TEST			
PROPORTIONING VALVE: <input type="text" value="A"/> - OPEN			
<input type="text" value="P"/>	POWER	<input type="text" value="-"/>	LOOP COM
<input type="text" value="*"/>	CPU	<input type="text" value="-"/>	DSP COM
<input type="text" value="-"/>	DX LAN	<input type="text" value="-"/>	OVEN COM
		<input type="text" value="-"/>	PUMP LEAK
Help Message			

Figure C-17. Diagnostic Test Screen

#### NOTE

Running the following tests disturbs the equilibration of the pump as services cycle on and off. After testing, allow the system to equilibrate before resuming operation.

#### PROPORTION- ING VALVE

Selects a valve and displays its status (**OPEN** or **CLOSED**). When the screen opens, valve A is selected and the status field is blank.

To test a valve, first turn off the pump motor; then press a **Select** button to select the desired valve and press **Enter**. The valve opens. Thereafter, pressing **Enter** toggles the valve closed and open.

Pressing **Delete** following by **Enter** also closes the valve.

Exiting the **DIAGNOSTIC TEST** screen when the pump motor is off closes all valves.

## **GP40 Gradient Pump**

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To run one of the following tests, position the cursor in the edit field next to the test, press a **Select** button to select the asterisk (\*), and press **Enter**. When the test is complete, the edit field displays either pass (**P**) or fail (**F**).

<b>POWER</b>	Checks the +5, $\pm 15$ , and +24 volt monitor on the relay board.
<b>CPU</b>	Checks the CPU internal configuration and the Moduleware checksum.
<b>DX LAN</b>	Checks the DX LAN hardware configuration and loop back.
<b>LOOP COM</b>	Checks the LC30 Chromatography Oven communication hardware. A “loop-back” cable must be plugged into the oven communication port. The pump then runs a loop-back test on the port.
<b>DSP COM</b>	Checks communication between the pump CPU and the DSP (Digital Signal Processor) hardware by sending a command and waiting for the appropriate response.
<b>PUMP LEAK</b>	Checks the pump’s leak sensor for a correct, open circuit, or short circuit condition.
<b>EXTERNAL LEAK</b>	Checks the external leak sensor for a correct, open circuit, or short circuit condition.

### **NOTE**

Exiting the **DIAGNOSTIC TEST** screen clears the pass/fail indicators from the edit fields.

### C.2.9 Pressure Statistics

This screen monitors the pressure transducer and reports pressure status values. The status values update while the screen is displayed.

PRESSURE STATISTICS	
PRESSURE: nnnnn.nn PSI	FLOW MODE: ON
MAX: nnnnn.nn PSI	P-POINT LEFT: nnn
MIN: nnnnn.nn PSI	RIGHT: nnn
DURATION: nnnnn.nn MINUTES	
Active Method Lowers MIN/MAX Resolution	
Help Message	

Figure C-18. Pressure Statistics Screen

If a method is running when you go to the **PRESSURE STATISTICS** screen, the following message displays:

Active Method Lowers MIN/MAX Resolution
---

For more accurate readings, abort the method, change to Direct control mode, and then reopen the screen.

<b>PRESSURE</b>	The measured pressure from the pressure transducer.
<b>MAX</b>	The maximum pressure value during the duration of the test.
<b>MIN</b>	The minimum pressure value during the duration of the test.
<b>DURATION</b>	The duration of the test. The test starts upon entering this screen and terminates upon exiting by pressing the <b>Menu</b> button. To restart the test, press <b>Reset</b> ; the duration is set to 0 and all status values are set to the current pressure.
<b>FLOW MODE</b>	Reports the flow mode as <b>ON</b> or <b>OFF</b> : <b>ON</b> = System is in constant flow mode. <b>OFF</b> = System is in pressure feedback mode.

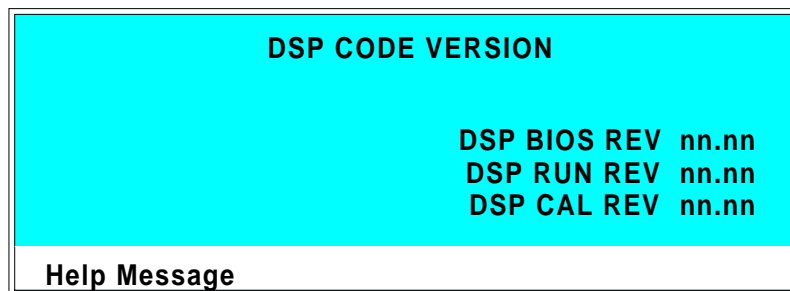
## **GP40 Gradient Pump**

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<b>P-POINT LEFT RIGHT</b>	Reports the current pressurization point for the left and right pistons. The GP40 updates the readout once per piston stroke. The pressure points should not vary more than 3% from one stroke to the next.
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### **C.2.10 DSP Code Version**

Displays the current digital signal processor (DSP) code revision numbers.

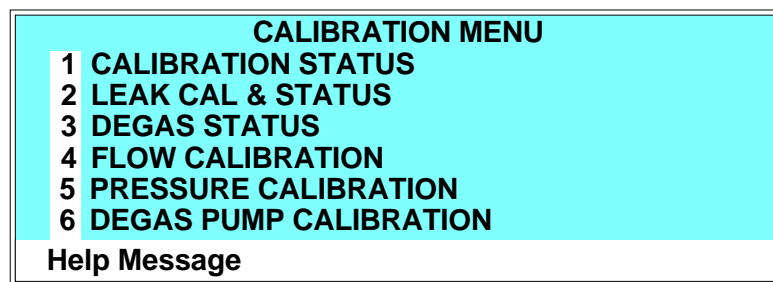


*Figure C-19. DSP Code Version Screen*

## **C.3 Calibration Screens**

To access the pump calibration screens, select the **DIAGNOSTIC MENU** from the **MENU of SCREENS**, and select option **8** to go to the **CALIBRATION MENU**.

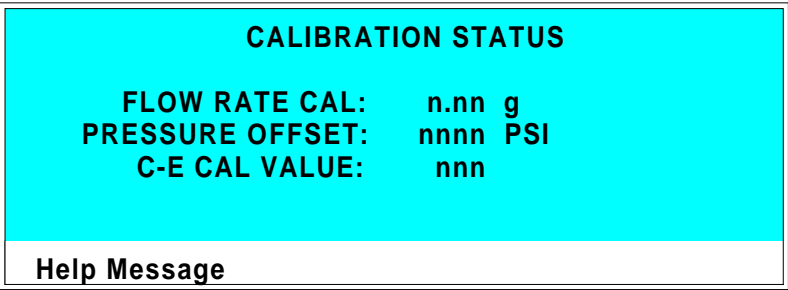
### **C.3.1 Calibration Menu**



*Figure C-20. Calibration Menu Screen*

**C.3.2 Calibration Status**

This screen reports the status of calibration parameters in real time.



*Figure C-21. Calibration Status Screen*

<b>FLOW RATE CAL</b>	The current flow rate calibration value.
<b>PRESSURE OFFSET</b>	The pressure offset calibration value as reported by the DSP.
<b>C-E CAL VALUE</b>	The current binary value for cam-encoder calibration as reported by the DSP.

### C.3.3 Leak Sensor Calibration and Status

This screen reports the status of leak sensor parameters. The **PUMP** column displays the status of the pump's internal leak sensor. The **EXTERNAL** column displays the status of the leak sensor in the LC10 Chromatography Organizer or the LC20 Chromatography Enclosure. If an LC10 or LC20 is not attached to the pump, the **EXTERNAL** fields display **NONE**.

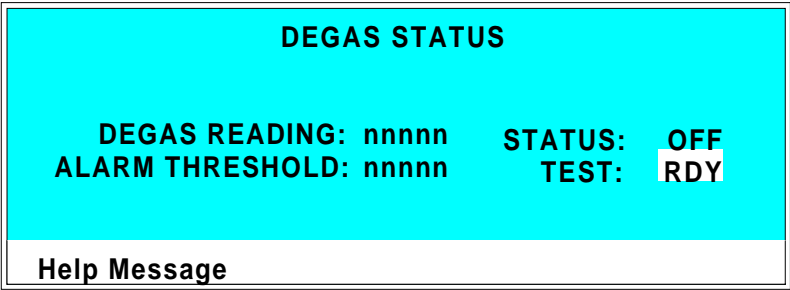
LEAK SENSOR CALIBRATION AND STATUS		
	PUMP	EXTERNAL
MEASURED VALUE:	2.48	2.75
CURRENT CONDITION:	WET	DRY
CALIBRATION VALUE:	2.50	2.60
LOW LEAK THRESHOLD:	2.70	2.50
Help Message		

Figure C-22. Leak Sensor Calibration and Status

<b>MEASURED VALUE</b>	The current measured voltage from the sensor in volts.
<b>CURRENT CONDITION</b>	The current <b>WET</b> , <b>DRY</b> , or <b>ERR</b> (error) condition of the sensor. <b>ERR</b> indicates an open or short circuit. To calibrate a leak sensor, select <b>CAL</b> and press <b>Enter</b> . After calibration the field will revert to <b>DRY</b> or <b>ERR</b> indication.
<b>CALIBRATION VALUE</b>	The value saved when the sensor was last calibrated.
<b>LOW LEAK THRESHOLD</b>	The threshold value below which a leak is indicated. This is based on the calibration value.

**C.3.4 Degas Status**

This screen reports the status of the vacuum degas pump calibration parameters in real time and allows testing of the degas pump.



*Figure C-23. Degas Status Screen*

<b>DEGAS READING</b>	The ADC reading from the degas pump pressure transducer.
<b>STATUS</b>	Reports whether the degas pump is on or off.
<b>ALARM THRESHOLD</b>	A degas reading value below this threshold value triggers the degas pump failure alarm.
<b>TEST</b>	Select <b>RUN</b> and press <b>Enter</b> to test the degas pump. The pump turns on, runs for 2 minutes. While the pump is running the <b>STATUS</b> field indicates <b>ON</b> . <b>Note:</b> There may be a delay of several seconds before the on/off status is updated.



### C.3.5 Flow Calibration

This screen reports the pump flow rate calibration and provides instructions for calibration.

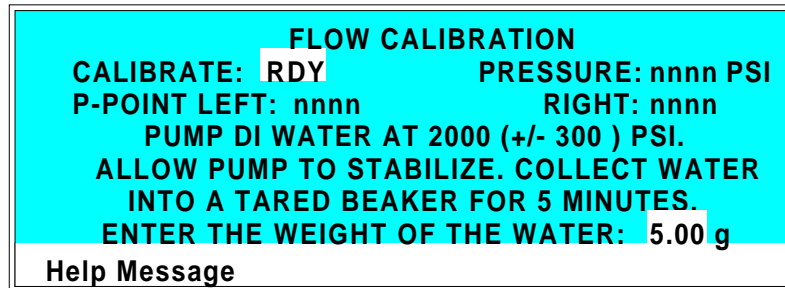


Figure C-24. Flow Calibration Screen

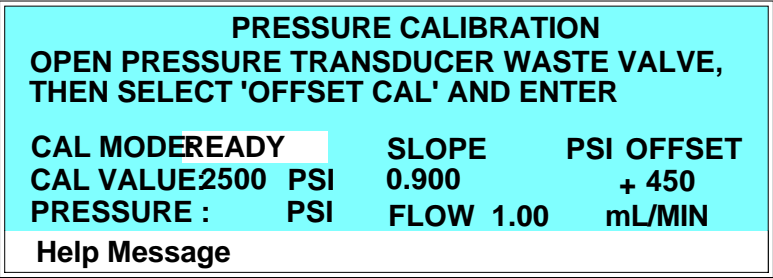
<b>CALIBRATE</b>	To calibrate the flow, select <b>CAL</b> and press <b>Enter</b> . The pump will use standard calibration parameters for pump control. When <b>RDY</b> is selected, the pump uses stored parameters from the last calibration.  After selecting <b>CAL</b> , follow the instructions on the screen for calibration. The time required for calibration varies depending on the pump head volume: 5 minutes for standard heads and 20 minutes for microbore heads.
<b>PRESSURE</b>	Displays the measured value from the pressure transducer.
<b>P-POINT LEFT RIGHT</b>	Displays the pressurization points for the left and right pump pistons. When the pump has stabilized, the left and right values are approximately equal (within 5).
<b>WEIGHT OF THE WATER</b>	After following the instructions for calibration, enter the measured weight of the water pumped into the beaker.

**C.3.6 Pressure Calibration**

Use this screen to calibrate the pump pressure offset and slope.

**NOTE**

Before beginning the calibration procedure, make sure that the pump is primed.



*Figure C-25. Pressure Calibration Screen: Initial View*

<b>CAL MODE</b>	Selects the calibration mode. <b>READY</b> The pump is ready for calibration. <b>OFFSET CAL</b> Calibrate the offset. <b>SLOPE CAL</b> Calibrate the slope. <b>SLOPE DFLT</b> Use the default slope value. <b>EDIT</b> Enter <b>SLOPE</b> and <b>OFFSET</b> values directly, without performing the calibration.
<b>CAL VALUE</b>	Pressure value entered during the slope calibration procedure.
<b>PRESSURE</b>	Current pressure reading from the transducer.
<b>SLOPE</b>	Calibrated slope value.
<b>PSI [MPa] OFFSET</b>	Calibrated offset value.
<b>FLOW</b>	Current flow rate.

To calibrate:

1. Stop the pump flow.
2. Go to the **PRESSURE CALIBRATION** screen.
3. Open the pressure transducer waste valve by turning it counterclockwise two turns (see Figure 2-7).
4. When the pressure reaches zero, select **OFFSET CAL** and press **Enter**. The offset calibration begins. When calibration is complete, the screen displays the following:

PRESSURE CALIBRATION				
CLOSE WASTE VALVE, INSTALL GAUGE. TURN PUMP ON AND ENTER GAUGE PRESSURE.				
CAL MODE	SLOPE CAL	SLOPE	PSI	OFFSET
CAL VALUE	2500 PSI	0.900		+ 450
PRESSURE :	PSI	FLOW	1.00	mL/MIN
Help Message				

Figure C-26. Pressure Calibration Screen: Second View

The **OFFSET** field displays the calibrated value. The **SLOPE** field does not change, and the **PRESSURE** field displays the new pressure based on the calibrated offset.

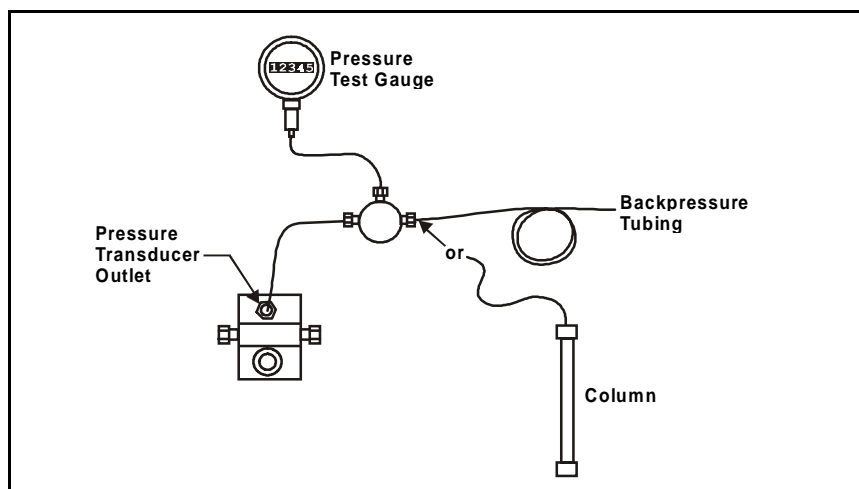
5. At this point, there are three choices for continuing:
  - **To finish the offset calibration and keep the current slope value**, press **Menu** to exit the **PRESSURE CALIBRATION** screen. The new offset value will be put into effect.
  - **To continue the calibration with a default slope value**, press **Enter**. The **SLOPE** field displays the default slope value. The **PRESSURE** field displays the new pressure based on the calibrated offset and the default slope. The screen then returns to the initial view and calibration is complete.

- To continue to the slope calibration procedure, select **SLOPE CAL** in the **CAL MODE** field and press **Enter**. The screen displays the following:

PRESSURE CALIBRATION			
'ENTER' TO USE SLOPE DEFAULT VALUE, OR SELECT 'SLOPE CAL' TO CONTINUE			
CAL MODE:	SLOPE DFLT	SLOPE	PSI OFFSET
CAL VALUE:	2500 PSI	0.900	+ 450
PRESSURE:	0 PSI	FLOW 1.00	mL/MIN
Help Message			

*Figure C-27. Pressure Calibration Screen: Third View*

6. Close the waste valve.
7. Install a pressure test gauge between the pressure transducer outlet and either a length of backpressure tubing, or a column (see Figure C-28). A pressure gauge assembly (P/N 046175), which includes a gauge, backpressure tubing, and required fittings, is available for this purpose. Contact your Dionex office for details.



*Figure C-28. Pressure Gauge Installation*

8. In the **FLOW** field, enter the flow rate normally used for your application.
9. Turn on the pump. The pressure will begin increasing. Allow the pressure gauge reading to stabilize.
10. This step depends on whether backpressure tubing or a column is installed:
  - If backpressure tubing is installed, the recommended pressure to use for calibration is  $17.25 \pm 0.17$  MPa ( $2500 \pm 25$  psi). If necessary, adjust the flow rate to bring the pressure to the recommended value. Increasing the flow rate increases the pressure; decreasing it decreases the pressure. When the gauge reading has stabilized at the recommended value, enter the reading in the **CAL VALUE** field.
  - If a column is installed, the pressure to use for calibration is determined by the application flow rate and the type of column installed. After allowing the pressure to stabilize, enter the reading in the **CAL VALUE** field.

**NOTE**

**The pressure gauge readings may fluctuate slightly as the left and right pump heads alternate piston strokes. You can ignore variations of about  $\pm 0.03$  MPa ( $\pm 5$  psi) or less. Larger fluctuations generally indicate that the pump is out of prime. If this occurs, prime the pump heads (see Section B.2.7) and then repeat Step 10.**

11. Press **Enter**. The slope calibration begins. When calibration is complete, the screen fields display the following:
  - The **SLOPE** field displays the new slope value.
  - The **PRESSURE** field displays the same value as the **CAL VALUE**.

**C.3.7 Degas Pump Calibration**

This screen allows calibration of the degas pump.

<b>DEGAS PUMP CALIBRATION</b>	
<b>CALIBRATE DEGAS THRESHOLD:</b>	<b>RDY</b>
<b>DEGAS PRESSURE READING:</b>	<b>nnnnn</b>
<b>DEGAS CALIBRATION VALUE:</b>	<b>nnnnn</b>
<b>Help Message</b>	

*Figure C-29. Degas Pump Calibration Screen*

<b>CALIBRATE DEGAS THRESHOLD</b>	To calibrate, select <b>CAL</b> and press <b>Enter</b> . After calibration is complete the entry reverts to <b>RDY</b> . <b>RDY</b> indicates no selection has been made and calibration will not occur.
<b>DEGAS PRESSURE READING</b>	Reports the current degas pressure reading.
<b>DEGAS CALIBRATION VALUE</b>	Reports the calibration value recorded during the last calibration. A known correct value can be entered into the field, instead of using the calibration procedure.

## D • Pump Head Conversion

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D.1	Cleaning the Original Pump Head Assembly . . .	D-3
D.2	Removing the Pump Head Assembly . . . . .	D-5
D.3	Installing the New Pump Head Assembly . . . . .	D-6
D.4	Replacing the Mixer . . . . .	D-9
D.4.1	Replacing an Active Mixer with a Microbore (GM-4) Mixer . . . . .	D-9
D.4.2	Replacing a Microbore (GM-4) Mixer with an Active Mixer . . . . .	D-13
D.5	Completing the Installation . . . . .	D-16

## ***GP40 Gradient Pump***

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## D • Pump Head Conversion

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The GP40 Gradient Pump is available with either a 100  $\mu$ L piston volume (standard bore) or 25  $\mu$ L piston volume (microbore) pump head assembly. Kits for converting to standard bore or microbore pump heads are available for PEEK and stainless steel versions. If required by an application, remove the original pump head assembly and install a different version. Contact your Dionex office to order the pump head assembly conversion kit.

- 100  $\mu$ L standard bore pump head, PEEK (P/N 046069)
- 25  $\mu$ L microbore pump head, PEEK (P/N 046082)

### NOTE

**This appendix covers conversion of PEEK pump heads only. For stainless steel pump head conversion kit part numbers and installation information, contact your Dionex office.**

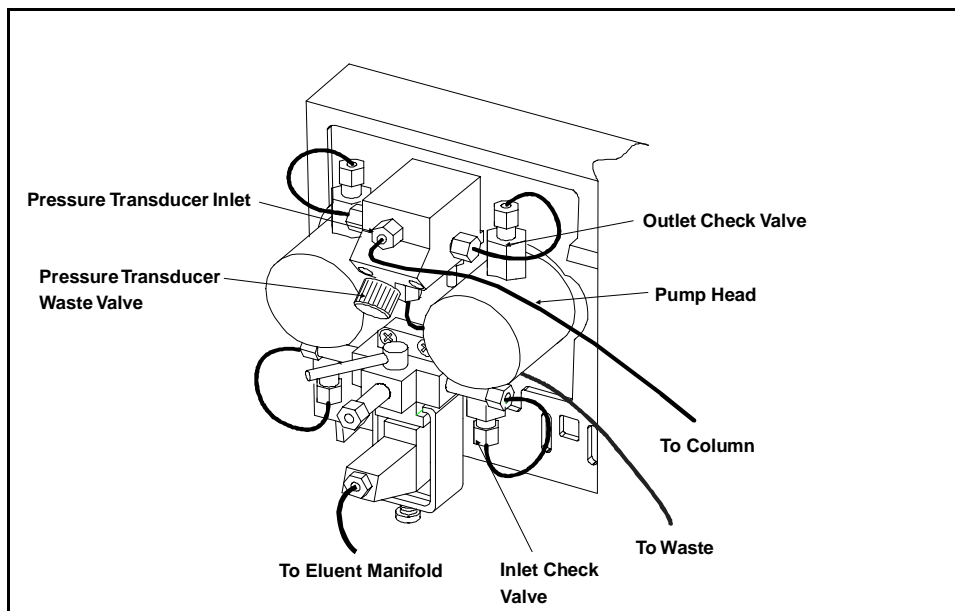
### D.1 Cleaning the Original Pump Head Assembly

Before removing the pump head assembly from the GP40 and placing it in storage, clean the heads by flushing with deionized water.

1. Use a 10 mL syringe (P/N 016387) to inject deionized water into the luer adapter in each pump head.
2. Fill a clean eluent reservoir with degassed, deionized water. Connect the reservoir to bulkhead fitting A on the front of the mechanical chassis drawer.
3. Pressurize the reservoir to 55 KPa (8 psi).



**Never pressurize the reservoir over 69 KPa (10 psi).**



*Figure D-1. Pump Heads and Liquid Lines*

4. Open the **MAIN** screen and select **LOCAL** and **DIRECT CNTRL**.
5. Open the pressure transducer waste valve (see Figure D-1) by turning the knob counterclockwise about two turns. Opening the waste valve directs flow from the priming block through the pump heads and out to waste (bypassing the eluent out line to the column).
6. Press **Prime**. The pump will begin pumping at its maximum flow rate (10 mL/min for standard bore and 2.5 mL/min for microbore).
7. Pump deionized water through the pump for at least 5 minutes.
8. Press **Off/On** to stop the pump motor.

## **D.2 Removing the Pump Head Assembly**

### **NOTE**

**The pump heads can be removed in any order.**

1. Turn off the main power switch.
2. Disconnect the tube fittings from the pressure transducer inlet and from the pump head inlet check valve (see Figure D-1).
3. Remove the two nuts from the pump head and set aside in a safe place.
4. Carefully disengage the head from the piston by pulling the head straight off and away from its mounting guides.



**Lateral motion while disengaging the head from the piston may break the piston. If the piston is broken, be very careful when removing it; broken pistons have sharp edges and can cause cuts.**

5. Place the head (front end down) on a clean work surface.
6. The pistons are captured by a magnetic retention system and do not come off as part of the pump head assembly. After removing the pump head, apply just enough lateral force to overcome the magnetic field and release the pistons.
7. Repeat Steps 2 through 6 for the other pump head.

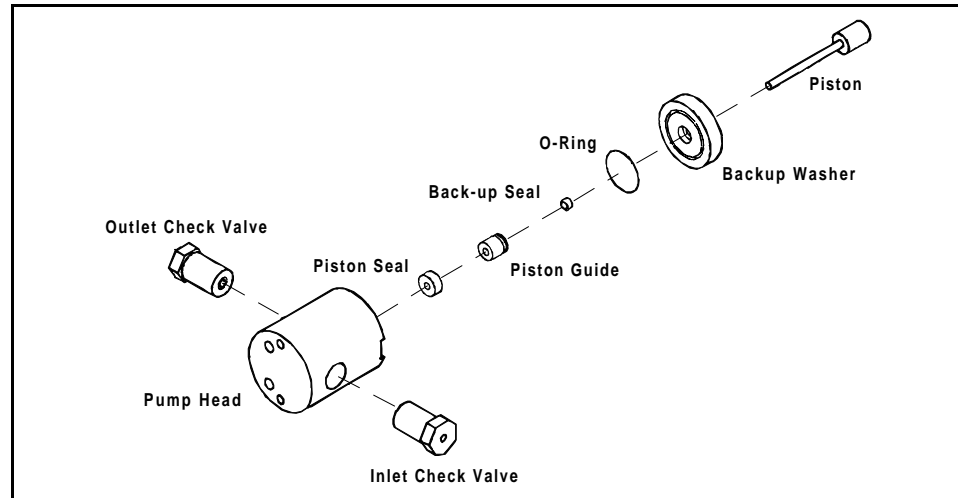
## **D.3 Installing the New Pump Head Assembly**

**NOTE**

**The pump heads can be installed in any order.**

Refer to Figure D-2 for assembly order of pump head components.

1. Unpack the new pump head assembly.
  - a. Remove the green sleeve caps (P/N 036570) and the yellow caps (P/N 036571) from the check valves on the new pump head assembly. Remove the protector caps (P/N 045044) from the new pump heads. Install these protective caps on the check valves and pump heads of your original pump head assembly and then place the assembly in the shipping container.
  - b. Remove the new piston assemblies from their plastic bottles and place them on a clean work surface. Place the original piston assemblies in the plastic bottles and put them in the shipping container.
  - c. Remove the new backup washers from their plastic bags and place them on a clean work surface. Place the original backup washers in the plastic bags and put them in the shipping container.
2. Verify that the backup seals in the new pump head assembly are seated squarely in the backup washers. If a seal has popped out or has become cocked, press the seal back in so that it is seated squarely in the washer.



*Figure D-2. Pump Head Assembly*

<b>Component</b>	<b>Standard Bore/PEEK</b>	<b>Microbore/ PEEK</b>
Pump Head	047406	047423
Outlet Check Valve	047661	047657
Inlet Check Valve	047660	047656
Piston Seal	047583	048526
Piston Guide	045633	045632
Backup Seal	048722	048721
O-Ring	014895	014895
Backup Washer	045630	045631
Piston	045386	045387

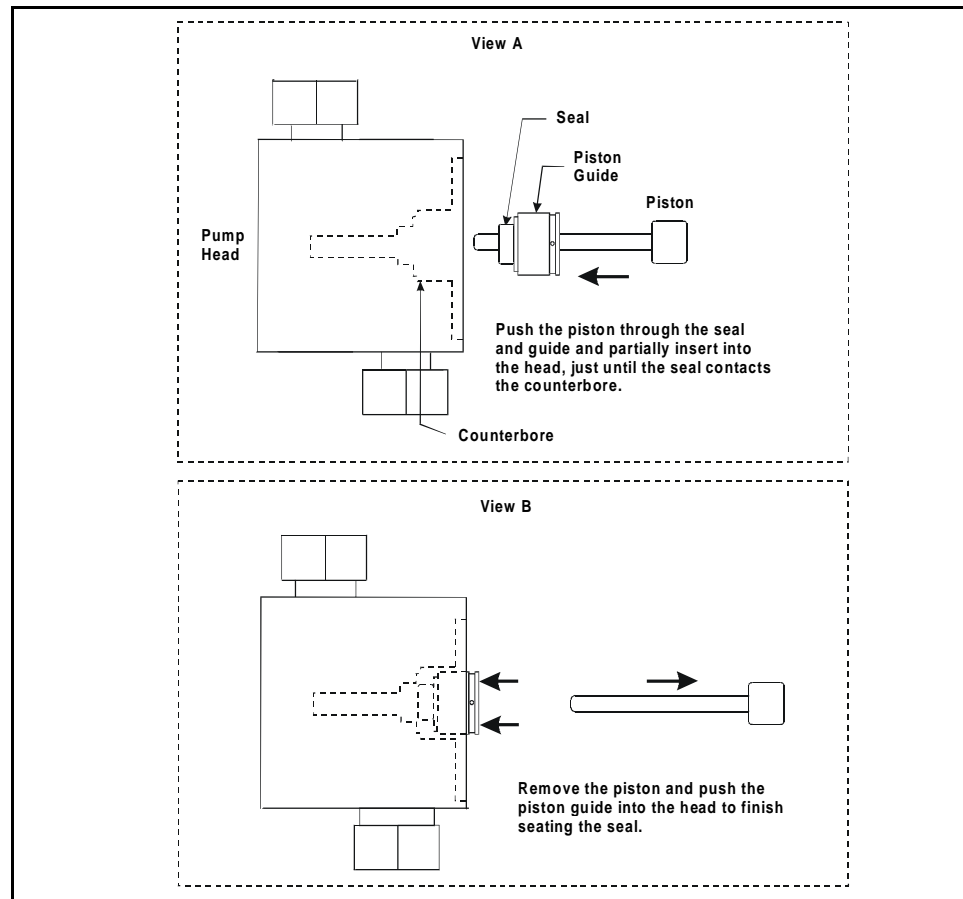
*Table 5-1. Pump Head Assembly Part Numbers*

3. Verify that the piston seal and piston guide are installed in the pump head. If they are not, follow these steps to install them:

## ***GP40 Gradient Pump***

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- a. Push the piston through the piston guide and the seal. Then insert the piston, piston guide, and seal into the pump head until the seal makes contact with the bottom of the counterbore (see Figure D-3, View A).
  - b. Hold the piston guide and seal in place and remove the piston from the head (see Figure D-3, View B).
  - c. Seat the seal by pushing the piston guide into the head until it is flush with the head.
4. Press the backup washer into the head. Make sure the washer is flush with the indented surface of the pump head. The washer fits very snugly in the head. Be sure it is completely seated and is not cocked.



*Figure D-3. Installing the Piston Seal*

5. Insert the piston *halfway* into the head. This ensures that the magnet in the follower picks up the piston. (The follower is the cylinder that holds the piston in place as it moves in and out of the pump head assembly.)
6. Install the head and piston assembly into the pump housing and replace the two acorn nuts and washers. Use a wrench to tighten them evenly (12 in-lb torque).
7. Repeat Steps 2 through 6 to install the second pump head.

### ***GP40 Gradient Pump***

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8. Reconnect both pressure transducer inlet fittings. Tighten the fittings fingertight, then an additional one-eighth turn (2 in-lb). Tighten further only if leaks occur. **DO NOT OVERTIGHTEN.**



## **D.4 Replacing the Mixer**

The type of mixer required by the GP40 depends on which pump head is installed:

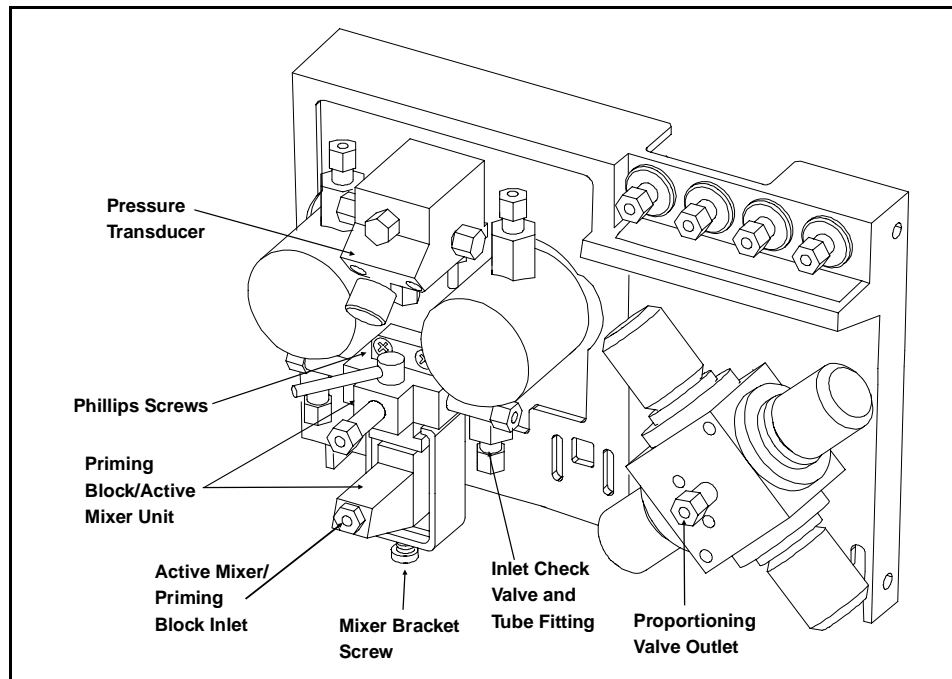
- Microbore PEEK pumps, require a GM-4 gradient mixer (P/N 049135) to be installed between the pump outlet and the injection valve.
- Standard bore PEEK pumps, require a Dionex active mixer (P/N 048988) to be installed between the eluent manifold and the priming block.

Replace the currently installed mixer with the appropriate mixer for the new pump heads (see Section D.4.1 for microbore GM-4 mixer installation instructions and Section D.4.2 for active mixer instructions).

### **D.4.1 Replacing an Active Mixer with a Microbore (GM-4) Mixer**

Install a GM-4 gradient mixer after changing to microbore pump heads.

1. Disconnect the tubing from the proportioning valve outlet and the active mixer/priming block inlet (see Figure D-4).
2. Disconnect the tubing from the priming block outlets and the pump inlets.
3. Use a 1/2-in wrench to loosen the two inlet check valves (see Figure D-4). **Carefully** remove the valve bodies and set them aside **in an upright position**.



*Figure D-4. Location of Priming Block/Active Mixer Unit*

4. Locate the lock on the mechanical chassis drawer. It is a bolt on the lower right side of the chassis, between valves 3 and 4. Use a 7-mm open-end wrench or your fingers to loosen the lock. Pull the drawer out a few inches.
5. Unplug the mixer power cable from the distribution card located on top of the mechanical chassis. Labels printed on the distribution card identify the various cables plugged into it. The connector for the mixer cable, labeled **P5 MIX**, is at the front of the card.
6. The priming block and active mixer form a single unit located below the pressure transducer. Remove the two Phillips screws holding the priming block/mixer unit in place.

7. Carefully remove the priming block/mixer unit and set it, with the priming block lever facing up, on a clean surface in front of the pump.
8. Make sure that the active mixer power cable is free from the mechanical chassis and then push the chassis back in place. Retighten the chassis lock.
9. Attach the replacement priming block (P/N 045730) to the mechanical chassis, using the two Phillips screws.
10. Reinstall the inlet check valves. Tighten only enough to seat (25 in-lb torque). Tighten a little more only if leaks occur. **DO NOT OVERTIGHTEN!** Overtightening may damage the pump head and the check valve housing and crush the check valve seats.
11. Locate the 9-in and the two 4-in pieces of 0.5-mm (0.020-in) ID Tefzel (P/N 035519) tubing in the kit. Connect the 9-in piece between the proportioning valve outlet and the priming block inlet (see Figure D-5), using two 1/4-28 reversed-ferrules (P/N 048950) and fittings (P/N 048952) for the connections. Connect a 4-in piece between each priming block outlet and pump inlet, using 1/4-28 reversed-ferrules and fittings for the connections.  
  
Tighten fittings fingertight, then an additional one-eighth turn (2 in-lb). Tighten further only if leaks occur. **DO NOT OVERTIGHTEN.**
12. The GM-4 gradient mixer installs between the eluent outlet of the GP40 pressure transducer and the inlet of the injection valve (see Figure D-5). Disconnect the tube fittings from the pressure transducer outlet and the injection valve inlet.

## GP40 Gradient Pump

13. Locate the 4-in piece of 0.125-mm (0.005-in) ID PEEK tubing (P/N 049427) in the kit. Connect one end of the tubing to the GM-4 mixer and connect the other end to the pressure transducer outlet. Use Dionex 10-32 ferrules (P/N 043276) and fittings (P/N 043275) for the connections.

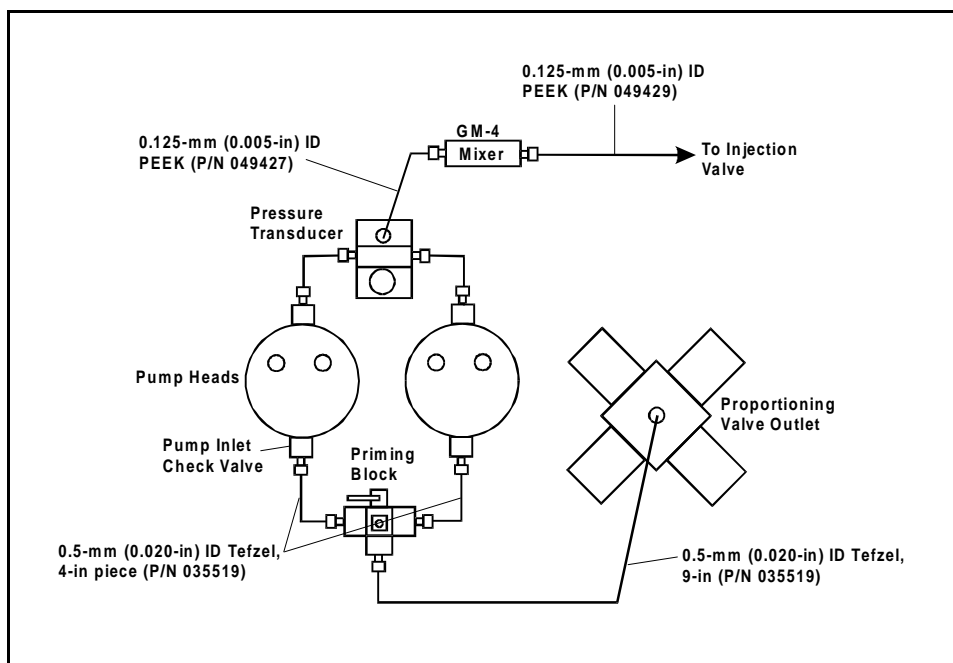


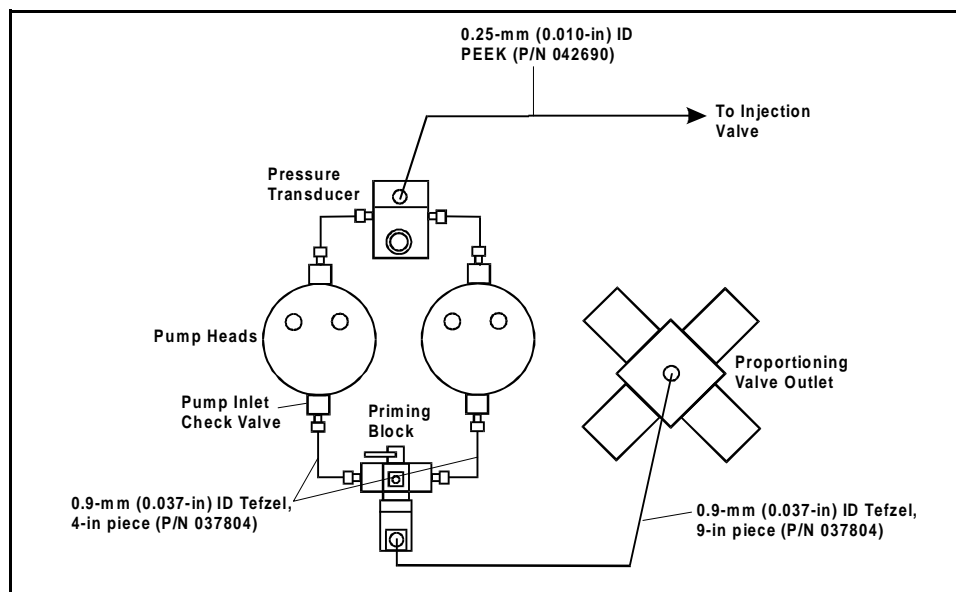
Figure D-5. Microbore Liquid Line Connections

14. Continue to Section D.5 for directions on completing the installation, including priming the pump heads, flushing the GM-4, and connecting it to the injection valve.

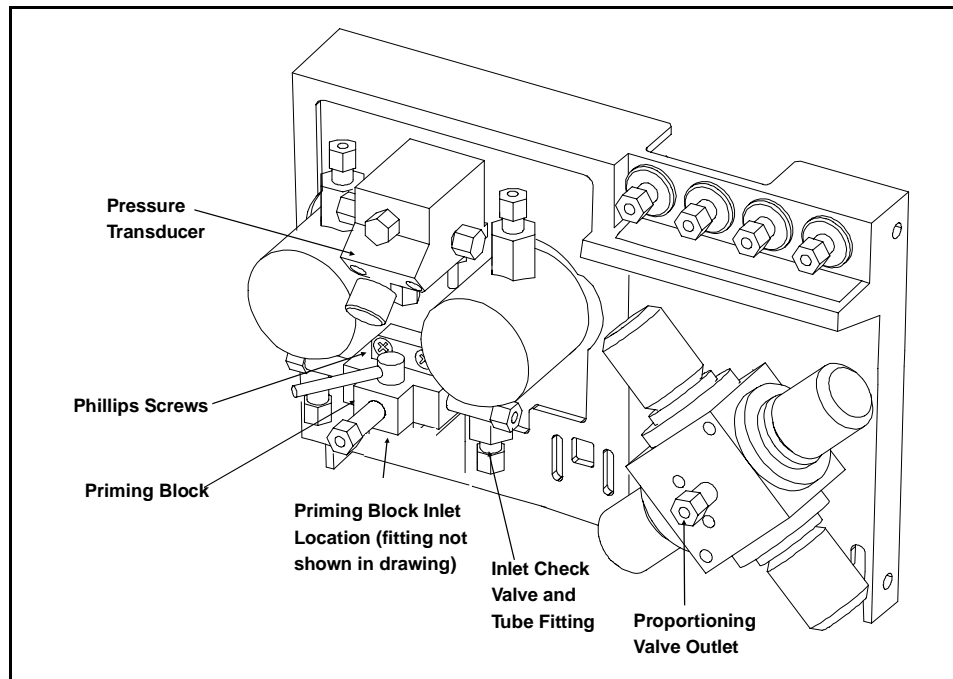
### **D.4.2 Replacing a Microbore (GM-4) Mixer with an Active Mixer**

Install an active mixer after changing to standard bore pump heads.

1. Disconnect the GM-4 mixer and the line to the injection valve from the pressure transducer.
2. Locate the 0.25-mm (0.010-in) ID PEEK tubing (P/N 042690) in the Ship Kit and connect it between the pressure transducer outlet and the injection valve inlet (see Figure D-6). Use Dionex 10-32 ferrules (P/N 043276) and fittings (P/N 043275) for the connections.
3. Use a 1/2-in wrench to loosen the two pump head inlet check valves (see Figure D-7). **Carefully** remove the valve bodies and set them aside **in an upright position**.
4. Disconnect the line from the proportioning valve outlet and the priming block inlet.



*Figure D-6. Standard Bore Liquid Line Connections*



*Figure D-7. Location of Priming Block*

5. Remove the two Phillips screws holding the priming block in place (see Figure D-7).
6. Carefully remove the priming block and set it aside.
7. Locate the lock on the mechanical chassis drawer. It is a bolt on the lower right side of the chassis, between valves 3 and 4. Use a 7-mm open-end wrench or your fingers to loosen the lock. Pull the drawer out a few inches.
8. Thread the active mixer power cable through the bulkhead and plug it into the distribution card located on the top of the mechanical chassis. Labels printed on the distribution card identify the various cables plugged into it. The connector for the mixer cable, labeled **P-5 MIX**, is at the front of the card.

9. Attach the new active mixer/priming block unit to the mechanical chassis, using the Phillips screws. Figure D-4 shows an installed active mixer/priming block unit.
10. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Retighten the chassis lock.
11. Reinstall the inlet check valves. Tighten only enough to seat (25 in-lb torque). Tighten a little more only if leaks occur. **DO NOT OVERTIGHTEN!** Overtightening may damage the pump head and the check valve housing and crush the check valve seats.
12. Locate the 0.9-mm (0.037-in) ID Tefzel™ (P/N 037804) tubing in the kit. Connect a 9-in piece between the proportioning valve outlet and the priming block inlet (see Figure D-6). Use two 1/4-28 reversed-ferrules (P/N 048950) and fittings (P/N 048952) for the connections. Connect a 4-in piece between each priming block outlet and pump inlet, using 1/4-28 reversed-ferrules and fittings for the connections.

Tighten fittings fingertight, then an additional one-eighth turn (2 in-lb). Tighten further only if leaks occur. **DO NOT OVERTIGHTEN.**

## **D.5 Completing the Installation**

1. Reconnect the main power cord to the rear panel of the GP40. Turn on the power switch.
2. After replacing a pump head, it is essential to enter the new pump data into the microprocessor so that it can adjust the flow rate display and DSP Moduleware parameters. To do this, press **Menu**, and **6** to open the **PUMP OPTIONS** screen (see Figure D-8). Select the new pump head volume.

<b>PUMP OPTIONS</b>	
<b>PUMP HEAD MATERIAL:</b>	<b>INERT</b>
<b>PUMP HEAD VOLUME:</b>	<b>100 <math>\mu</math>L</b>
<b>CONTROL MODE:</b>	<b>PRESSURE</b>
<b>TTL2 OUTPUT USAGE:</b>	<b>0 FLOW</b>
<b>PRESSURE UNITS:</b>	<b>PSI</b>
<b>Help Message</b>	

*Figure D-8. Pump Options Screen*

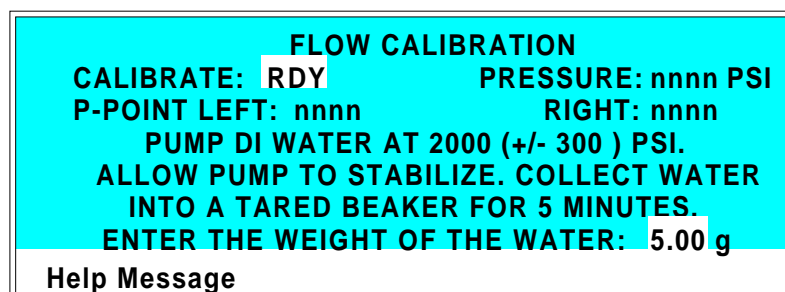
When you change the pump head volume in the **PUMP OPTIONS** screen, the microprocessor automatically adjusts the current flow rate appropriately. When changing from microbore to standard bore, the flow rate is increased by a factor of 4. When changing from standard bore to microbore, the flow rate is decreased by a factor of 4. For example, if the original flow rate is set at 1.0 mL/min and you change the pump head volume from 100  $\mu$ L to 25  $\mu$ L, the new flow rate is adjusted to 0.25 mL/min. Flow rates in method steps are not automatically adjusted.

3. If needed, refill the eluent reservoir connected to bulkhead fitting A with degassed, deionized water. Verify that it is pressurized to 55 KPa (8 psi).



4. Prime the new eluent line from the proportioning valves to the priming block inlet:
  - a. Open the **MAIN** screen (press **Menu** and **Enter**) and select **LOCAL** and **DIRECT CNTRL**.
  - b. Make sure that the **Off/On** button is in the on position.
  - c. Move the cursor to eluent A. Enter 100.
  - d. Move the cursor to the **ml/MIN** field and set the flow rate to 0.
  - e. Connect a 10 mL syringe (P/N 016387) to the luer adapter on the priming block. Move the lever on the priming block all the way to the left to its maximum open position (see Figure D-7).
  - f. Use the syringe to draw liquid through the line. Continue drawing on the syringe until no more air bubbles flow through the connecting tubing.
  - g. Move the lever on the priming block all the way to the right to its fully closed position.
5. Flush the new heads with deionized water:
  - a. Open the pressure transducer waste valve (see Figure D-7) by turning the knob counterclockwise about two turns.
  - b. Press **Prime** to start the pump motor. Flush the new pump heads with deionized water for at least 5 minutes.
  - c. After flushing, press **Off/On** to stop the pump motor.

6. Calibrate the flow with the new pump heads. To do this, press **Menu**, **8**, **8**, and **4** to open the **FLOW CALIBRATION** screen (see Figure D-9). Select **CAL** and press **Enter**. Follow the directions on the screen to calibrate the flow.

The image shows a screen with a cyan background and black text. The text is as follows:

**FLOW CALIBRATION**  
**CALIBRATE: RDY**      **PRESSURE: nnnn PSI**  
**P-POINT LEFT: nnnn**      **RIGHT: nnnn**  
**PUMP DI WATER AT 2000 (+/- 300 ) PSI.**  
**ALLOW PUMP TO STABILIZE. COLLECT WATER**  
**INTO A TARED BEAKER FOR 5 MINUTES.**  
**ENTER THE WEIGHT OF THE WATER: 5.00 g**

At the bottom of the screen, there is a white rectangular box with the text **Help Message** in black.

*Figure D-9. Flow Calibration Screen*

7. After calibration, press **Menu** to exit the **FLOW CALIBRATION** screen and put the new calibration parameters into effect, or press **Off/On** twice to turn the flow off and then back on.
8. Close the pressure transducer waste valve. If you are converting to standard bore pump heads, the pump is now ready for operation. If you are converting to microbore pump heads, continue to Step 9.
9. If you are converting to microbore pump heads, the GM-4 gradient mixer must be flushed and then connected to the injection valve.
  - a. Start the pump and set the flow rate to 2 mL/min. Flush the GM-4 mixer for 2 minutes to fill the mixer with eluent and remove any air. Stop the pump
  - b. Connect the outlet of the mixer to the inlet of the injection valve. Use 0.125-mm (0.005-in) ID PEEK tubing (P/N 049429) and 10-32 ferrules (P/N 043275) and fittings (P/N 043276) for the connections. The pump is now ready for operation.



## **E • TTL and Relay Control**

---

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## ***GP40 Gradient Pump***

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## E • TTL and Relay Control

The strip of eight 2-pin connectors on the GP40 electronic chassis provides two relay outputs, two TTL outputs, and four TTL inputs (see Figure E-1).

- Connect the outputs to the TTL or relay inputs of a Dionex or non-Dionex device to control functions in the connected device. The devices must be compatible with the GP40's TTL and relay signals.
- Connect the inputs to a Dionex or non-Dionex device to control four pump functions: pump motor on/off, method clock on/off, method number increment, and method number decrement.

Connection instructions and examples are in Section E.3.

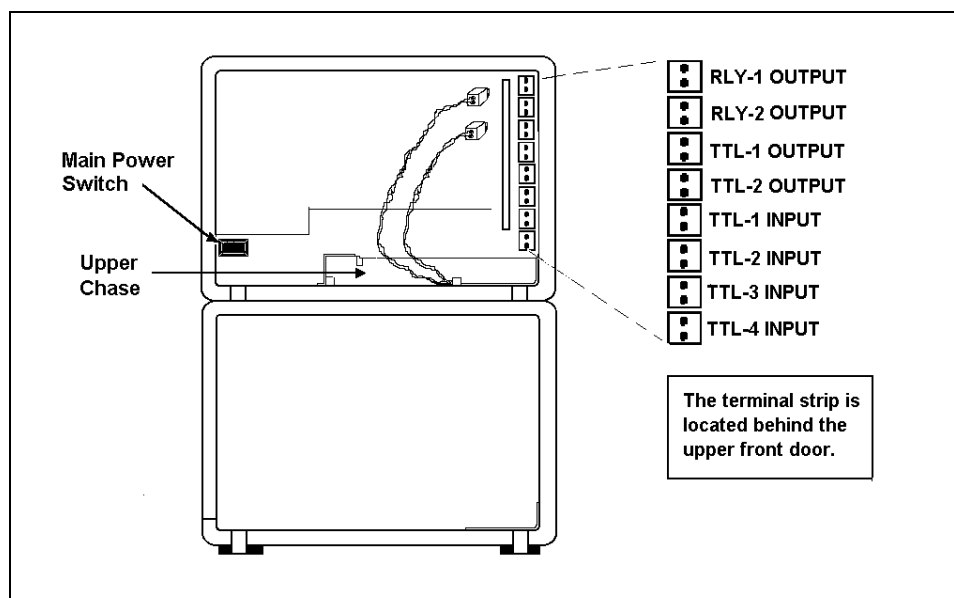


Figure E-1. TTL Connector Strip  
(GP40 Front View without Upper Door)

## **E.1 TTL and Relay Output Operation**

The GP40 provides two TTL outputs and two relay contacts to control functions in external devices such as an integrator, autosampler, or other DX 500 module.

After connecting the TTL and Relay outputs (see Section E.3), toggle the output states on and off from either the **DETAIL** screen or from the **METHOD** extension screen. The **METHOD** extension screen allows programming of the output states in method steps for timed operation (see Figure C-6 in Appendix C).

- To turn on a TTL or relay output, set the corresponding output field in the **DETAIL** screen or **METHOD** extension screen to **1** (closed).
- To turn off a TTL or relay output, set the corresponding output field to **0** (open).

For example, if TTL1 is connected to the Load relay on the AS40 Autosampler, setting **TTL1** to 1, as shown in Figure E-2, sends the signal to the AS40 to start the load cycle.

<b>DETAIL SCREEN</b>				<b>TTL1</b>	<b>1</b>
100.0	%A	2125	PSI	<b>TTL2</b>	<b>0</b>
0.0	%B	2.00	mL/MIN	<b>RLY1</b>	<b>0</b>
0.0	%C	LOAD	SAMPLE	<b>RLY2</b>	<b>0</b>
0.0	%D	COLUMN	A		
<b>CURVE 5</b>		LIMIT	0-3000 PSI		
LOCAL		DIRECT CNTRL			
Help Message					

*Figure E-2. Detail Screen*

## E.2 TTL Input Operation

The four TTL inputs can be connected to devices capable of providing TTL signals. The signal from the connected devices can control one to four specific functions in the GP40.

- **TTL input 1** turns the pump motor off and on.
- **TTL input 2** controls the pump method clock. A signal from the controlling device can turn the method clock on (Run) and off (Hold/Reset). Hold/Reset resets the method clock to zero and executes **INIT** conditions. The method will not run unless the pump motor is already on.
- **TTL input 3** increases the method number by one. Each additional signal increases the method number by one more.

When the method clock is zero (or **INIT**), increasing the method number executes the **INIT** conditions of the new method. When the method clock is greater than zero, increasing the method number begins running the new method at the current elapsed method clock time. This has the same result as selecting a new method number when the pump is in Local mode.

- **TTL input 4** decreases the method number by one. The operation is as described under TTL Input 3 above, except that method numbers decrease instead of increase.

### E.2.1 TTL Input Signal Modes

The GP40 TTL inputs respond to four types of signals to accommodate different types of device output signals. The default signal mode, *normal edge*, is compatible with the output signals provided by DX 500 modules. If the device connected to the GP40 outputs a different signal type, select a different signal mode from the **TIME FUNCTION IN** screen (see Figure E-3).



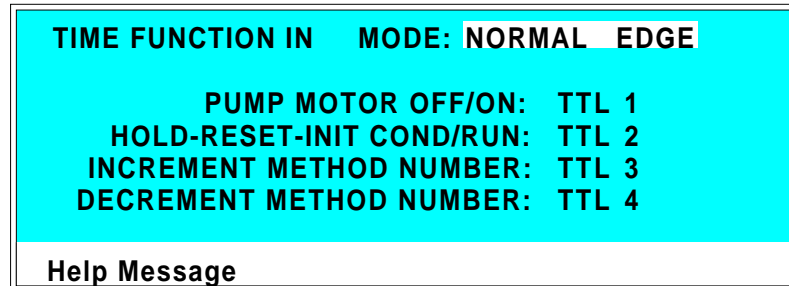


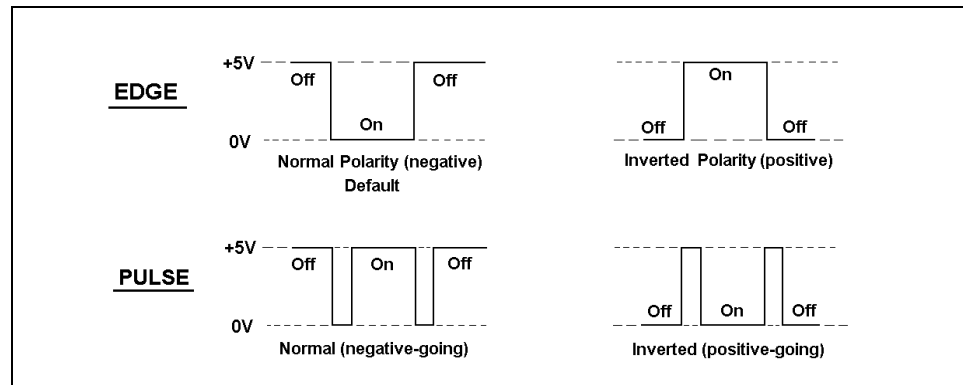
Figure E-3. Time Function In Screen

The four input signal modes are:

- *Normal Edge*: In normal edge operation, the negative (falling) edge of a signal turns on the function and the positive (rising) edge turns off the function (see Figure E-4). For example, a negative edge sent to TTL1 turns on the pump motor and a positive edge turns off the motor.
- *Inverted Edge*: The inverted edge mode works identically to the normal edge mode except that the positive and negative edges are reversed in function.
- *Normal Pulse*: In normal pulse operation, the negative (falling) edge of the TTL signal is the active edge and the positive (rising) edge is ignored. For example, applying a negative pulse to TTL1 when the pump motor is off turns the motor on. This has the same result as pressing the **Off/On** button on the front panel keypad.

The minimum pulse width guaranteed to be detected is 50 ms. The maximum pulse width guaranteed to be ignored as noise or invalid is 4 milliseconds. The action of the GP40 is undefined for pulses less than 50 ms or greater than 4 ms.

- *Inverted Pulse*: The inverted pulse mode operates identically to the normal pulse mode except that the positive and negative edges are reversed in function.

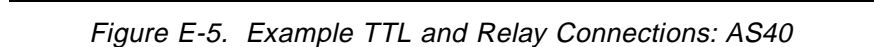


*Figure E-4. TTL and Relay Input Signal Modes*

### **E.3 TTL and Relay Connections**

The TTL/relay connector strip is located on the electronic chassis behind the upper door (see Figure E-1). Each 2-pin connector includes a signal pin and a ground pin.

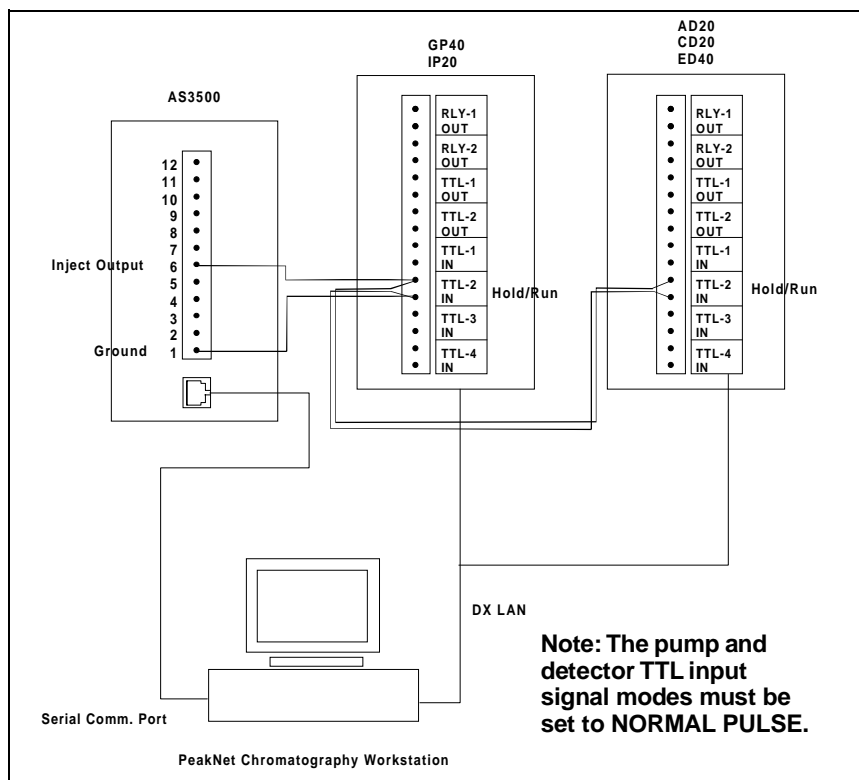
1. Twisted pairs of wires (P/N 043598) and eight two-pin connector plugs (P/N 921019) are provided in the GP40 Ship Kit. Attach a two-pin plug to both ends of each pair of wires to be connected. Strip the ends of the wires, insert into the plug, and use a screwdriver to tighten the locking screw. The signal wire goes on top and the ground wire goes on the bottom of each plug.
2. Connect these plugs to the TTL or relay connectors on the GP40 and the other module(s) as needed for your application. Check the polarity of each connection. Connect signal wires to signal (+) pins and ground wires to ground (-) pins. If necessary, remove wires from the two-pin plugs and reinsert them in the correct positions. Section E.3.1 shows example connections.
3. Route the wires from the GP40 electronic chassis through the upper chase to the rear panel, or through the side slots.
4. To remove the plugs from the connector strip, pull them straight out.



Figures E-6 and E-7 show two different TTL/relay connections for a DX 500 system connected to an AS3500 Autosampler:

- Setup 1, recommended for isocratic conditions, starts running each DX 500 module timed events method when the autosampler makes an injection.
- Setup 2, recommended for gradient conditions, starts running each DX 500 module method before the autosampler makes an injection. The method then controls when the autosampler injection occurs.

Refer to the AS3500 manual for details.



*Figure E-6. Example TTL and Relay Connections:  
AS3500 Setup 1*

## GP40 Gradient Pump

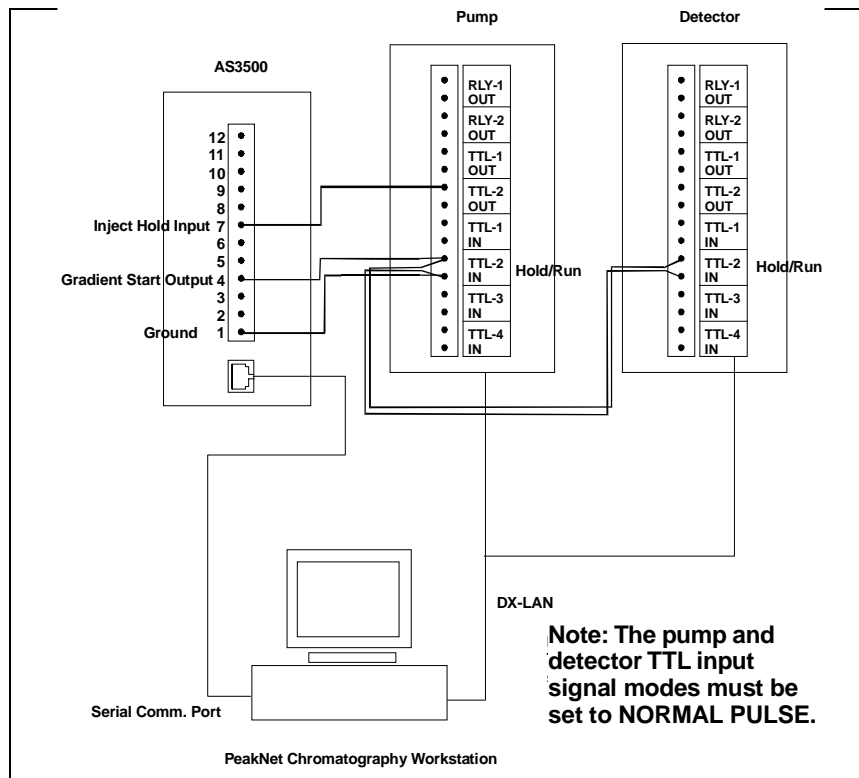
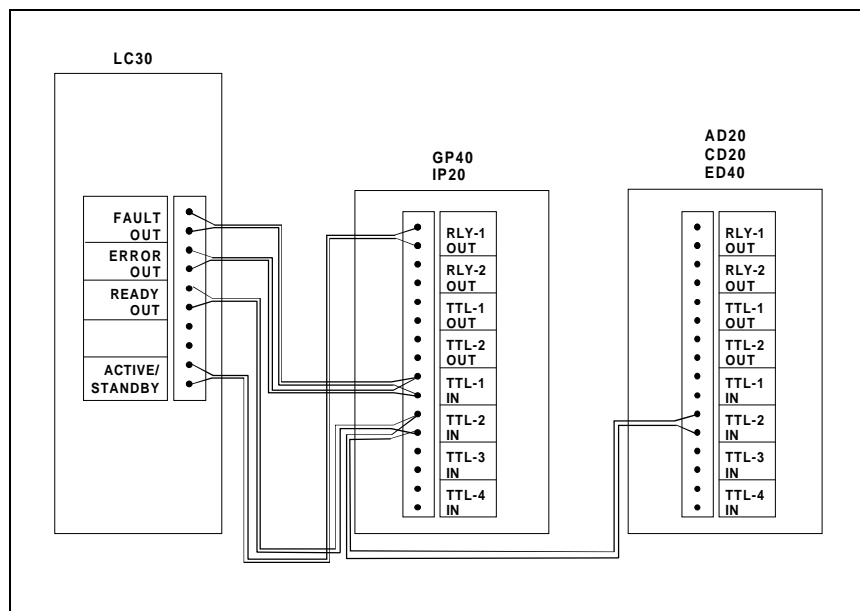


Figure E-7. Example TTL and Relay Connections:  
AS3500 Setup 2

Figure E-8 shows an example of TTL/relay connections for an LC30 Chromatography Oven. Refer to the LC30 manual for details.



*Figure E-8. Example TTL and Relay Connections: LC30*

## ***GP40 Gradient Pump***

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