DIONEX

GS50 GRADIENT PUMP
OPERATOR'S MANUAL

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1 • Introduction

1.1 Overview

The GS50 Gradient Pump is a microprocessor-based eluent (or *mobile phase*) delivery system. Its variable-speed, serial-piston design ensures pulse-free pumping for the most demanding applications. The GS50 delivers mixtures of up to four mobile phase components at precisely controlled flow rates. The selected mobile phase composition can be delivered as isocratic, isocratic proportioned, linear ramp, step, curved, or any combination of these. A DSP (Digital Signal Processor) provides high speed, extremely accurate control of pump flow.

The two basic modes of pump control, Direct control and Method control, enable the GS50 to operate either with or without reference to time-based events. The GS50 is usually controlled:

- *Locally*, from the front panel keypad and display, *or*
- *Remotely* (via the Dionex DX-LAN™ interface), from a computer running one of these Dionex chromatography software products: Chromeleon® (Release 6.1 or later) or PeakNet® 6 (Release 6.1 or later).

Limited remote control is available from any device capable of providing compatible TTL signals to the pump.

The GS50 can function as a stand-alone instrument or as part of a chromatography system. The chromatography system may include non-Dionex instruments, provided that they meet the GS50 interface requirements for software, TTL, or relay control.

GS50 Options

- *Vacuum degas assembly*

The vacuum degas assembly provides online degassing of up to four eluents, at times and durations specified by the user. Dionex strongly recommends vacuum degassing eluents in order to help prevent bubbles (caused by eluent outgassing) from forming in the eluent proportioning valves, pump heads, and detector flow cell. The vacuum degas assembly must be installed at the factory.

- *Standard delay volume conversion kit*

The GS50 is plumbed at the factory to ensure a delay volume of <400 µL. Dionex offers a standard delay volume conversion kit (P/N 056968) that contains the parts needed to replumb the pump to obtain a delay volume of <800 µL. Increasing the delay volume will improve mixing noise at flow rates of 1.0 mL/min and above. The pump must be replumbed at the installation site; for instructions, see Section 5.7.

The following table lists the GS50 product versions available from Dionex.

System	GS50 with Vacuum Degas Assembly	GS50 without Vacuum Degas Assembly
DX-600	P/N 059481	P/N 059479
BioLC	P/N 059493	P/N 059491

NOTE The GS50 Gradient Pump is designed to perform ion chromatography and BioLC applications only and should not be used for any other purpose. If there is a question regarding appropriate usage, contact Dionex.

1.2 About This Manual

Chapter 1 Introduction	Presents a brief overview of the GS50 Gradient Pump. Explains the meaning of safety messages and icons in the manual and safety labels on the pump.
Chapter 2 Description	Describes physical aspects of the GS50, including the front panel controls, rear panel connections, electronics, and mechanical components. Describes the pump operating modes and control modes.
Chapter 3 Operation and Maintenance	Describes key operating features and how to create, edit, and run methods from the GS50 front panel. Lists routine preventive maintenance requirements.
Chapter 4 Troubleshooting	Lists possible causes of problems, as well as step-by-step procedures to resolve them.
Chapter 5 Service	Contains step-by-step instructions for routine service and parts replacement procedures.
Appendix A Specifications	Lists the GS50 specifications and installation site requirements.
Appendix B Installation	Describes how to install the GS50.
Appendix C User Interface	Illustrates and describes all of the screens that can be displayed on the GS50 front panel.
Appendix D Relay and TTL Control	Describes Relay and TTL input and output functions; provides setup examples.
Appendix E Reordering Information	Lists spare parts for the pump.

1.2.1 Typefaces

- Capitalized bold type indicates a front panel button:

  Press **Enter** to begin running the method.

- Uppercase bold type indicates the name of a menu or screen, 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 manual contains warnings and precautionary statements that can prevent personal injury and/or damage to the GS50 when properly followed. Safety messages appear in bold type and are accompanied by icons, as shown below.

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Indicates a potentially hazardous situation which, if not avoided, may result in death or serious injury.

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

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

Messages d'avertissement en français

Signale une situation de danger immédiat qui, si elle n'est pas évitée, entraînera des blessures graves à mortelles.

Signale une situation de danger potentiel qui, si elle n'est pas évitée, pourrait entraîner des blessures graves à mortelles.

Signale une situation de danger potentiel qui, si elle n'est pas évitée, pourrait entraîner des blessures mineures à modérées. Également utilisé pour signaler une situation ou une pratique qui pourrait gravement endommager l'instrument mais qui n'entraînera pas de blessures.

Warnhinweise in Deutsch

Bedeutet unmittelbare Gefahr. Mißachtung kann zum Tod oder schwerwiegenden Verletzungen führen.

Bedeutet eine mögliche Gefährdung. Mißachtung kann zum Tod oder schwerwiegenden Verletzungen führen.

Bedeutet eine mögliche Gefährdung. Mißachtung kann zu kleineren oder mittelschweren Verletzungen führen. Wird auch verwendet, wenn eine Situation zu schweren Schäden am Gerät führen kann, jedoch keine Verletzungsgefahr besteht.

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 the user to an unexpected result of an action, suggest how to optimize instrument performance, etc.

1.3 Safety Labels

The TUV GS, C, US Mark safety label and the CE Mark label on the GS50 indicate that the GS50 is in compliance with the following standards: EN 61010-1:1993 (safety), CAN/CSA-C22.2 No. 1010.1-92 (safety), UL 3101-1/10.93 (safety), EN 50082-1:1992 (susceptibility), and EN 55011:1991 (emissions).

These symbols appear on the GS50 or on GS50 labels.

Alternating current

Protective conductor terminal

Power supply is on

Power supply is off

2 • Description

The GS50 Gradient Pump enclosure consists of two units:

- The control panel is located on the door of the upper unit. The electronics chassis, which contains the power supply and several electronics cards (printed circuit boards), is inside the upper unit. For a description of the control panel, see Section 2.1. For a description of the electronics, see Section 2.2.
- The lower unit houses mechanical components (the eluent proportioning valves, pump heads, pressure transducer, etc.). For a description of the mechanical components, see Section 2.3.

2.1 Front Control Panel

The control panel on the upper door of the GS50 enclosure contains a liquid crystal display (LCD), a membrane keypad, and the actuator for the main power switch (see Figure 2-1). The door opens to provide access to the electronics chassis (see Section 2.2).

Screen Contrast

Information is displayed on the front panel LCD, or *screen*. To adjust the screen contrast, use the knurled knob in the recess below the keypad (see Figure 2-1).

Power Switch

The main power switch for the GS50 is on the bulkhead behind the upper door of the enclosure. An actuator for the main power switch is on the outside of the front door, at the lower left corner (see Figure 2-1).

The actuator functions only when the door is fully closed. When the door is open, turn the pump on and off by pressing the main power switch on the bulkhead.

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

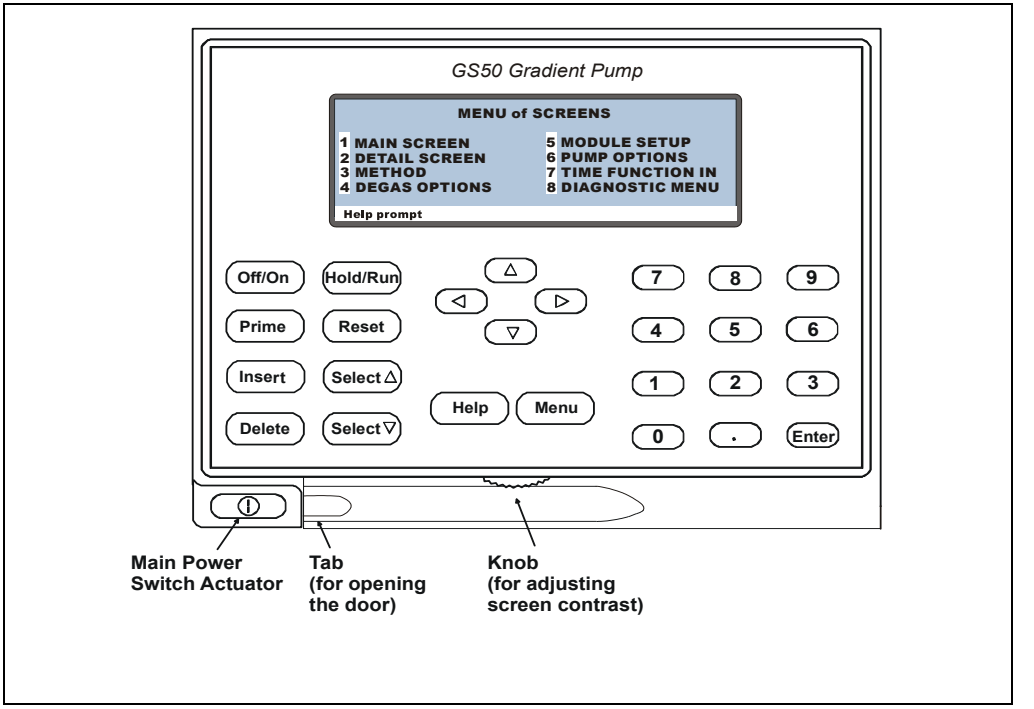


Figure 2-1. GS50 Display and Keypad Layout

2.1.1 Control Panel Keypad

Use the control panel keypad for direct control of GS50 operation or to create and modify a programmed series of timed events, called a *method*.

- Press the **Menu** button to display a list of screen options. To view a screen, press the numeric button on the keypad that corresponds to the screen number. For example, press 3 to view the **METHOD** screen.
- You can edit the reverse video fields on a screen. Other fields display information, but cannot be edited.
- To edit a parameter, use the four directional arrow buttons to position the cursor in the reverse video field. Use the numeric buttons to enter a variable value. Use the **Select** ∆ and **Select** ∇ buttons to choose an entry from among predetermined options.

- Press **Enter** to execute the selected value *or* press an arrow button to simultaneously confirm the selected value and move the cursor to the next field.
- When you press a front panel button, a high-pitched beep sounds. If an error occurs, this beep is lower in frequency. You can disable the beeps from the **MODULE SET-UP** screen (see Section C.1.7).

Button	Function
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, when the method clock is at **INIT**, at the initial conditions.
Prime	Operates the pump in the mode reserved for priming the pump heads. If the pump motor is off when **Prime** is pressed, the pump automatically turns on. To exit the priming mode and return to the previously selected flow rate, press **Prime** again or press **Off/On** to turn off the pump motor. See Section B.2.7 for complete priming instructions.
Insert	Inserts a new timed step into a method. This button functions only when the cursor is in a **TIME** field on either the **METHOD** or **METHOD** events 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. Note: If you move the cursor out of the **TIME** field before entering a time value, the inserted step disappears because it is incomplete. 3. Insert steps in any order. When you press **Enter**, the GS50 Moduleware organizes steps in the correct chronological order.

Table 2-1. GS50 Front Panel Buttons

Button	Function
Delete	**Delete** performs these functions: • Cancels an entry that is in progress and restores the previous value. • Returns a field to its default value (if no entry is in progress). • "Blanks" the parameter value for a method step. On the **METHOD** screen, move the cursor to a step entry field, press **Delete** once, and move the cursor out of the field. The field remains blank, indicating that the value entered for the previous step is still in effect. • Deletes a method step. On the **METHOD** screen, move the cursor to the **TIME** field for the step to be deleted and press **Delete** twice. Note: If you accidentally press **Delete** once, immediately press any button except **Delete** to restore the original time and step parameters. • Deletes an entire method. On the **METHOD** screen, move the cursor to the **TIME** field of the **INIT** step and press **Delete** twice.
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 at the initial step of a new method or, if resuming an interrupted method, at the time the clock was put in Hold. When the method clock is in Run, pressing **Hold/Run** stops the clock; this "holds" the method and freezes 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 (see Section 2.8.2). If the method is running, it continues running. If the method is on hold, the method maintains the initial conditions.

Table 2-1. GS50 Front Panel Buttons (Continued)

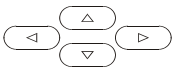
Button	Function
Select △ Select ▽	• The **Select** buttons step through predetermined options in entry fields. In a field with predetermined numeric choices, pressing **Select** Δ increases the value by one unit, pressing **Select** ∇ once decreases the value by one unit, and holding down a **Select** button increases (or decreases) the value. To confirm the selected value, press **Enter** or a cursor arrow button. • When the GS50 is running under Method control (see Section 3.3), pressing a **Select** button when the cursor is in the elapsed time field steps you through the programmed steps in the method that is currently running.
	• Pressing an arrow button moves the cursor, in the direction of the arrow, to the next entry field (if one exists). At the end of a line, the left arrow wraps the cursor around to the next entry field on the line above; the right arrow wraps the cursor to the next entry field on the line below. The up and down arrows do not wrap around. • Pressing an arrow button immediately after entering or selecting a new value in an entry field saves and/or executes the new value (just as pressing **Enter** does), except when the cursor is in the following locations: **DIAGNOSTIC TEST** screen fields, **SAVE TO** and **RUN** fields on the **METHOD** screen, **CALIBRATION** screen fields, and **Menu** fields.
Help	Displays context-sensitive help information, if available.
Menu	• When an operational screen is displayed, pressing **Menu** displays the **MENU of SCREENS**. • When a diagnostic screen is displayed, pressing **Menu** displays the **DIAGNOSTIC MENU**. • When a calibration screen is displayed, pressing **Menu** displays the **CALIBRATION MENU**. Note: The **Menu** button is disabled when a pressure ripple calibration sequence is running (see Section C.3.6).

Table 2-1. GS50 Front Panel Buttons (Continued)

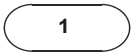
Button	Function
	Pressing a numeric button enters a numeric value into the current entry field. When a menu is displayed, pressing the numeric button that corresponds to a menu option displays the screen.
	**Enter** performs these functions: • Saves and/or executes changes made in entry fields (except on the **METHOD** screen). On the **METHOD** screen, pressing **Enter** saves entries to an edit copy. To save editing changes to a permanent method, move the cursor to the **SAVE TO** field, enter the method number, and press **Enter**. • When a menu is displayed, pressing **Enter** opens the highlighted screen.

Table 2-1. GS50 Front Panel Buttons (Continued)

2.1.2 Display Screens

When the pump powers up and passes all diagnostic tests, the **POWER-UP** screen (see Figure 2-2) is displayed briefly, followed by the **MAIN** screen (see Figure 2-3). If a diagnostic test fails, the **DIAGNOSTIC TEST** screen appears instead of the **MAIN** screen; see Section C.2.5 for details.

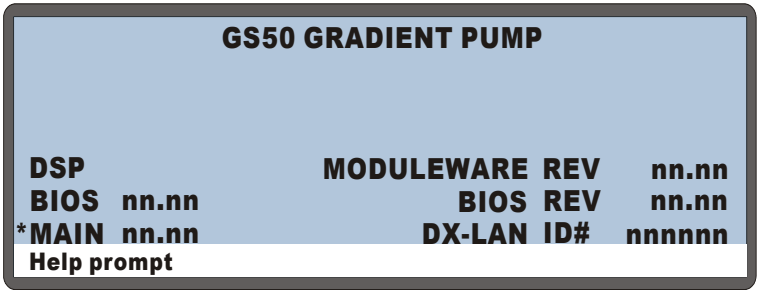


Figure 2-2. Power-Up Screen

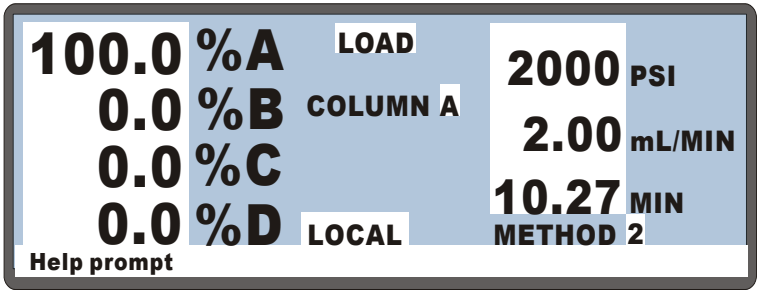


Figure 2-3. Main Screen

NOTE **You can check the information on the POWER-UP screen whenever you wish by selecting the screen from the DIAGNOSTIC MENU (see Section C.2.1).**

The **MAIN** screen displays status information in enlarged characters to enable you to view the screen from a distance. Use the **MAIN** screen to select the flow rate, operating mode, percentage of eluents to run, and other operating parameters.

To access the remaining GS50 screens, press the **Menu** button to display the **MENU of SCREENS** (see Figure 2-4).

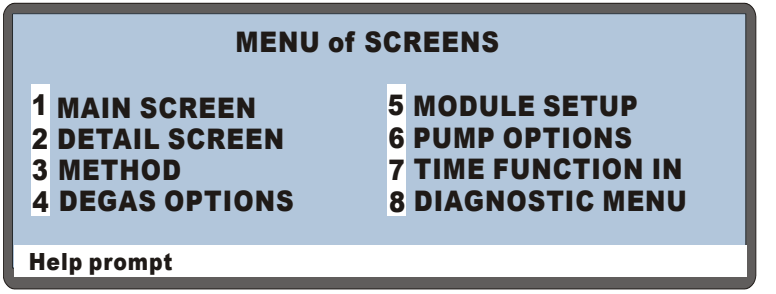


Figure 2-4. Menu of Screens

There are two ways to view a screen option:

- Press the numeric button on the GS50 front panel keypad that corresponds to the screen number on the menu. For example, press 3 to select and display the **METHOD** screen.
- Move the cursor to the field containing the screen number and press **Enter**.

See Appendix C for a description of these screens.

2.2 Electronics Chassis

The GS50 electronics chassis contains the power supply and several electronics cards (printed circuit boards) required for pump control (see Figure 2-5). Connectors on the electronics cards enable the GS50 to communicate with other Dionex modules.

The electronics chassis is located behind the upper door of the GS50 enclosure. To open the door, pull on the tab located to the right of the main power actuator (see Figure 2-1).

Do not remove any of the electronics cards from the GS50. The components on the cards cannot be serviced by the user. If servicing is required, it must be performed by qualified personnel and appropriate electrostatic discharge (ESD) handling procedures must be followed.

Ne retirez aucune des cartes électroniques de la pompe. Aucun des composants sur les cartes ne peut être réparé par l'utilisateur. Toute réparation doit être effectuée par un personnel qualifié utilisant des procédures correctes de décharge électrostatique.

Halten Sie sich von der Elektronik des GS50 fern. Die Elektronik kann nicht vom Anwender gewartet werden. Falls ein Service erforderlich ist, ist dieser von qualifiziertem Personal durchzuführen. Dabei müssen die geeigneten Verfahren zur elektrostatischen Entladung (ESD) eingehalten werden.

LC LEAK

The leak control cable from the LC10 Chromatography Organizer or the LC20 Chromatography Enclosure connects to the **LC LEAK** connector in slot 1 of the GS50 electronics chassis. If a leak occurs in the LC10 or LC20, it is reported to the pump.

NOTE Do not connect the LC25 Chromatography Oven or the LC30 Chromatography Oven to the LC LEAK connector. These ovens contain internal leak control electronics.

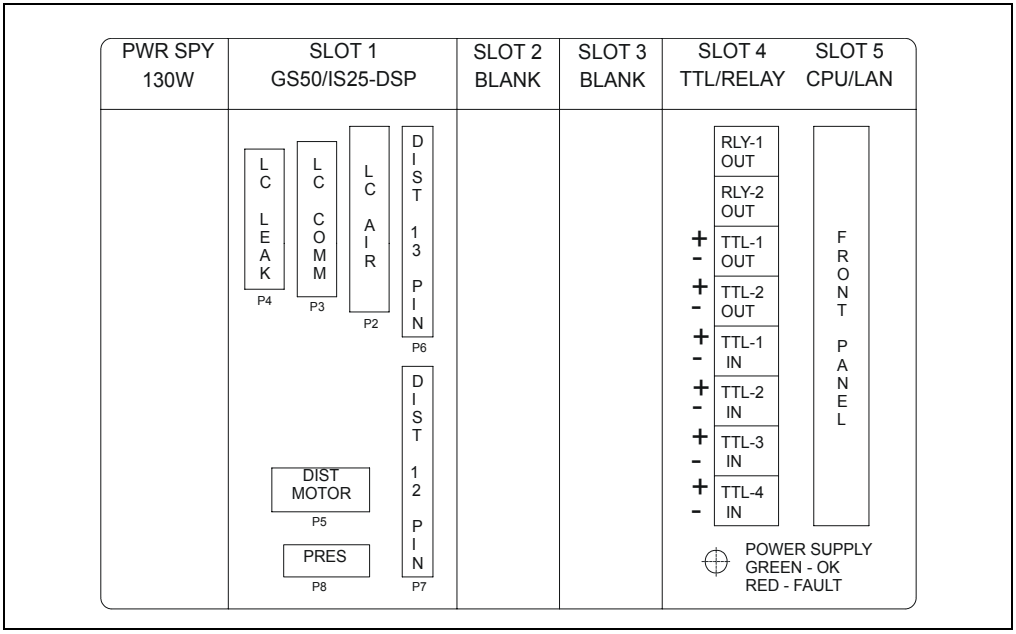


Figure 2-5. GS50 Electronics Chassis

LC COMM

The LC30 Chromatography Oven's RJ-11 serial cable connects to the **LC COMM** connector in slot 1 of the GS50 electronics chassis. When connected here, the LC30 can be remotely controlled by a host computer running Chromeleon or PeakNet 6 software.

LC AIR

The cable from the air solenoid valves on the LC10, LC20, LC25, or LC30 connects to the **LC AIR** connector in slot 1 of the GS50 electronics chassis. When connected here, the GS50 can electrically actuate the solenoid valves that control the positions of the injection valve and the optional column switching valve.

To select the valve positions, go to either the **MAIN** screen (see Section C.1.2) or the **METHOD** screen (see Section C.1.4).

PRES

The **PRES** (pressure output) connector in slot 1 of the GS50 electronics chassis records changes in the pump operating pressure. The connector is for test purposes only.

To check the pressure, insert the plug (P/N 923617) provided in the GS50 Ship Kit (P/N 061222) into the **PRES** connector. (Pin 1 of the connector is Signal (pressure) and pin 2 is Ground.) Connect the other end of the plug to one of the following: a recorder, a Dionex UI20 Universal Interface, or an A/D converter. The output signal is equivalent to 1 mV/psi (i.e., 1000 psi = 1 volt out).

TTL/RELAY

A strip of eight relay and TTL connectors is located in slot 4 of the GS50 electronics chassis. These connectors interface with other devices for relay and TTL control of the pump. Refer to Appendix D for more information.

CPU/LAN Card

Control Moduleware for the pump resides on the CPU/LAN card located in slot 5 of the GS50 electronics chassis.

A 60-pin ribbon cable links the CPU logic to the front panel display and keypad. The logic monitors the internal power supply output. The color of the LED at the bottom of slot 5 indicates the status of the power supply output:

- A green LED indicates normal operation.
- A red LED indicates a power fault. When a power fault occurs, the GS50 enters a diagnostic state and inhibits all other controls until the fault is corrected. If this occurs, turn off the power for a few seconds and then turn it on again.

2.3 Mechanical Chassis

The GS50 mechanical chassis is housed in a drawer located behind the lower door of the enclosure. Open the mechanical chassis drawer only when components inside the drawer require servicing. Before resuming routine operation, push in the drawer and tighten the lock in the lower right corner of the chassis.

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 chassis drawer is open. Do not operate the pump when the chassis drawer is pulled out.

Respectez l'étiquette d'avertissement apposée à l'intérieur de la porte inférieure. Les flèches sur l'étiquette indiquent des pièces mécaniques mobiles qui posent un danger de pincement lorsque le GS50 est sous tension et le tiroir mécanique est ouvert. N'utilisez jamais le GS50 avec le tiroir du châssis mécanique ouvert.

Beachten Sie den Warnhinweis auf der Innenseite der unteren Tür. Die Pfeile auf dem Aufkleber weisen auf bewegliche mechanische Teile hin. Bei eingeschalteter Pumpe und geöffneter Mechanik besteht hier die Gefahr von Quetschungen. Die Pumpe darf nicht mit herausgezogenem Mechanikeinschub betrieben werden.

2.4 Interior Components

2.4.1 Pump Heads

Primary Pump Head

The primary head pumps the selected mobile phase into the secondary head (see Figure 2-6). The inlet and outlet check valves are located on the bottom and top, respectively, of the primary pump head. The priming valve is on the front of the pump head.

To open the priming valve, turn the knob one-quarter to one-half turn counterclockwise. When the priming valve is opened, liquid can flow into and out of the primary pump head via the port in the front of the valve (see Figure B-4).

NOTE The priming valve must be open when the pump is being primed with a syringe or with isopropyl alcohol. For detailed priming instructions, see Section B.2.7.

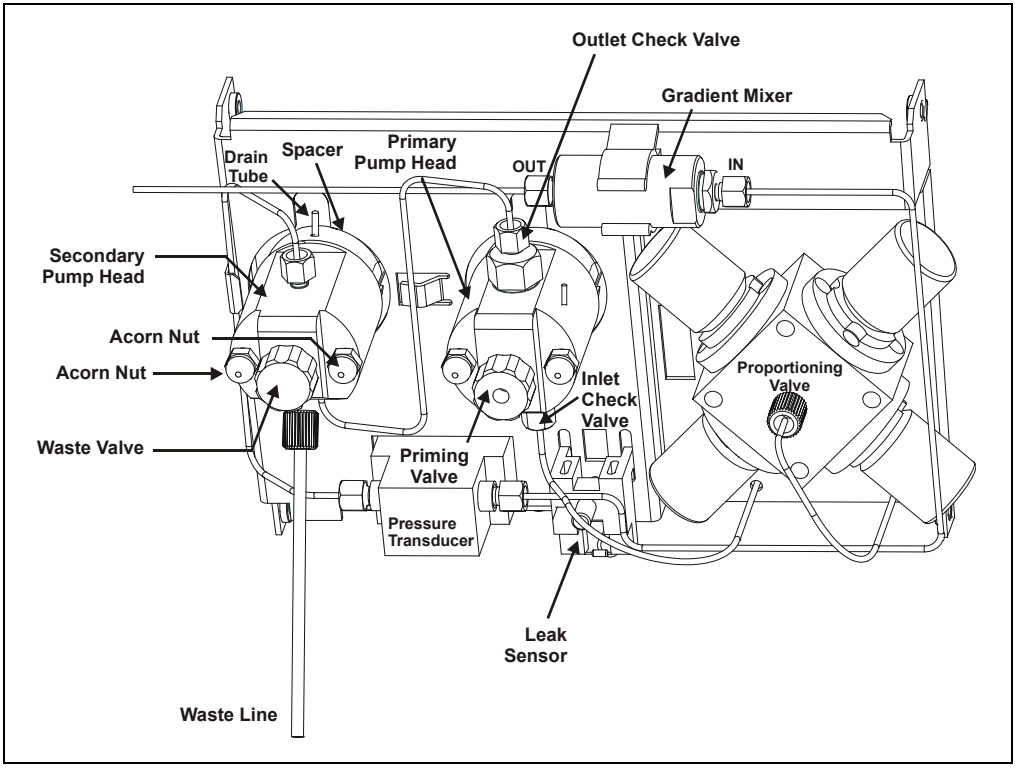


Figure 2-6. GS50 Mechanical Components

Secondary Pump Head

The secondary pump head delivers eluent to the remainder of the chromatography system (the injection valve, column, and detector). The waste valve is located on the front of the secondary pump head (see Figure 2-6).

To open the waste valve, turn the knob one-quarter to one-half turn counterclockwise. When the waste valve is in the open position, all output is directed to waste.

NOTE The waste valve must be open when the pump is being primed. For detailed priming instructions, see Section B.2.7.

Piston Seal Wash

The GS50 includes a piston seal wash assembly that can be set up to continuously rinse the back of the piston seals. Rinsing the piston seals removes salt crystals that can abrade the pistons, thereby causing the main piston seals to wear out prematurely and allow leaks. To use the seal wash feature, an external water source must be connected. See Section B.2.6 for connection instructions.

For continued protection of the pump, replace the piston rinse seal and the O-rings in the seal wash assembly (see Section 5.2) every 6 months, or whenever you replace the main piston seals for the GS50.

Proportioning Valves

Mobile phase flows from the eluent reservoirs, through the vacuum degas chambers (if the optional vacuum degas assembly is installed), and into the four-way proportioning valve assembly (see Figure 2-6). Programmed percentages of each eluent are proportioned in the four valves.

2.4.2 Pressure Transducer

Flow exiting the secondary pump head is directed to the pressure transducer (see Figure 2-6), which measures the system pressure. The DSP (digital signal processor) firmware precisely controls the pump motor speed to ensure flow rate accuracy and to maintain constant flow and constant pressure.

Flow output from the pressure transducer continues to the gradient mixer (see Section 2.4.3). From there, it is directed to the remainder of the chromatography system (the injection valve, column, and detector).

2.4.3 Gradient Mixer

A GM-4 Gradient Mixer (P/N 049136) is installed between the pressure transducer and the injection valve (see Figure 2-6). The mixer helps to ensure that proportioned eluents are mixed thoroughly.

NOTE If you replumb the GS50 for the standard delay volume (see Section 5.7), replace the GM-4 with a GM-5 Gradient Mixer (P/N 054044).

2.4.4 Flow Path

Figure 2-7 shows the liquid flow path through the pump.

Mobile phase flows from the reservoir(s) and through the vacuum degas chambers (if the vacuum degas assembly is installed). The selected proportions of mobile phase flow out of the proportioning valves, through a tubing assembly, and to the inlet check valve on the primary pump head. (The tubing assembly helps to ensure proper delivery, mixing, and damping of the mobile phase.)

The inlet check valve opens, drawing solvent into the primary pump head. At the same time, the secondary piston pushes forward, pushing solvent into the system. After completing the intake, the primary piston (moving at approximately twice the speed of the secondary piston) pushes solvent through the outlet check valve and into the secondary pump head.

The secondary head draws approximately 50% of the volume displaced by the primary piston; the remaining 50% is delivered directly into the system. The secondary piston delivers the drawn volume into the system during the intake of the primary piston. From the secondary head, flow is directed through the pressure transducer and then the gradient mixer.

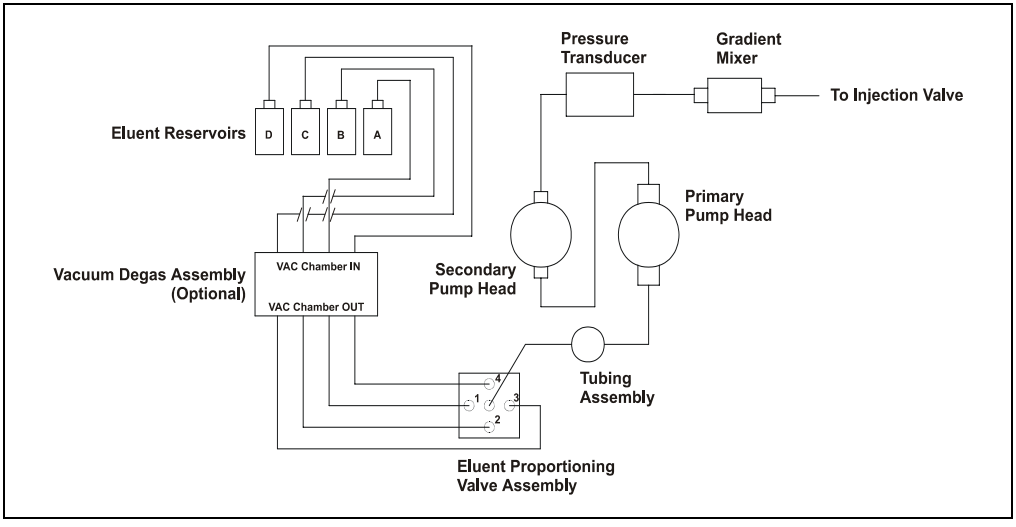


Figure 2-7. Flow Schematic

2.5 Vacuum Degas Assembly (Optional)

The vacuum degas assembly provides online degassing of up to four eluents, at times and durations specified by the user. The degas assembly, which must be installed in the GS50 at the factory, consists of:

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

By default, the degas pump turns on for 2 minutes when the GS50 power is turned on. Thereafter, the degas pump turns on for 30 seconds at 10-minute intervals. If necessary, go to the **MENU of SCREENS**, select the **DEGAS OPTIONS** screen (see Section C.1.6), and reset the cycle time and duration.

> **NOTE** **The DEGAS OPTIONS screen cannot be selected unless the vacuum degas assembly is installed. If necessary, go to the PUMP OPTIONS screen (see Section C.1.8) and check the DEGAS PUMP OPTION field; if the GS50 contains a vacuum degas assembly, the field indicates YES.**

To check the vacuum chamber pressure, go to the **CALIBRATION MENU** and select the **DEGAS PUMP CALIBRATION AND STATUS** screen (see Section C.3.3).

2.6 Eluent Reservoirs

NOTE Dionex strongly recommends vacuum degassing and filtering all eluents to help prevent bubbles, contaminants, and particles from passing through the system. Filtering eluents also helps reduce baseline noise and ensure system stability.

NOTE Although the GS50 does not require pressurized reservoirs, Dionex recommends pressurizing the reservoirs if eluents are manually degassed (see Section 3.1.1) or if eluents are sensitive to carbonate (NaOH) contamination. For more details, see the *Pressurizable Reservoir Installation Instructions* (Document No. 034581).

The following pressurizable reservoirs are available from Dionex:

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

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

N'utilisez pas le réservoir en plastique de 2 litres (N/P 044129) pour le dégazage à vide hors ligne d'éluants. Le réservoir n'a pas été conçu à cette fin.

Verwenden Sie den 2-Liter Plastikbehälter (Bestell-Nr. 044129) nicht zum Offline Vakkum-Entgasen von Eluenten. Der Behälter ist dafür nicht ausgelegt.

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

EO1 Eluent Organizer (Optional)

The Dionex E01 Eluent Organizer (P/N 044125) holds the eluent reservoirs in a liner that contains spills and leaks. The EO1 can also be used to pressurize the reservoirs.

Up to two EO1 Organizers can be placed on top of the system enclosure. The EO1 can accommodate either one or two reservoirs, depending on whether the reservoirs are made of glass or plastic (see the table below for details).

Number of Reservoirs	Type of Reservoir	Total Volume
2	Glass or plastic, 1-liter	2 liters
2	Plastic, 2-liter	4 liters
1	Glass, 2-liter	2 liters

2.7 Rear Panel

The rear panel of the GS50 contains the main power receptacle and fuses. It also includes a connector for installation of the DX-LAN interface. For an illustration of the rear panel, see Figure B-1 in Appendix B.

2.8 Functional Description

There are three ways to operate the GS50:

- In Local mode, use the front control panel buttons and screens to select operating parameters. See Section 2.8.1 for a description of Local mode.
- In Locked Remote mode, use Chromeleon or PeakNet 6 to send operating commands from the host computer via the DX-LAN. See Section 2.8.1 for a description of Locked Remote mode.
- With TTL input, a controlling device (for example, an integrator or another module) sends TTL signals to the pump. The TTL input signals can be used to trigger the following functions: turn the pump motor on/off and set the method clock to hold/run. All other pump operating parameters must be set locally from the control panel. See Appendix D for more information about TTL control.

To select the operating mode:

1. Go to either the **MAIN** or **DETAIL** screen.
2. The operating mode field displays either **LOCAL** or **REMOTE** (see Figure 2-8). To change the mode, move the cursor to this field, press **Select** ∆ or **Select** ∇ to toggle to the desired mode, and press **Enter** or a cursor arrow button. (For TTL input control, select Local mode.)

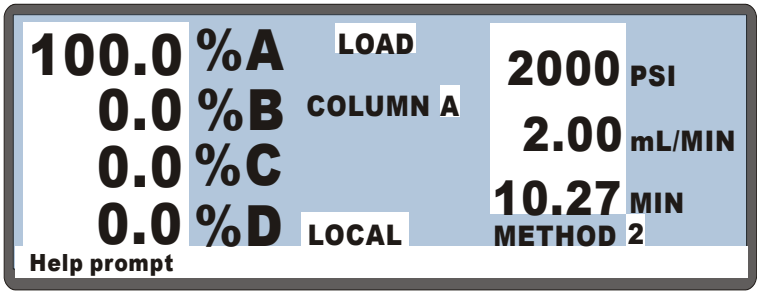


Figure 2-8. Main Screen

In addition to the operating modes, two control modes are available from the GS50 front panel:

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

To select the control mode (front panel control):

1. Go to either the **MAIN** or **DETAIL** screen.
2. The control mode field displays either **DIRECT CNTRL** or **METHOD** (see Figure 2-8). 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.

The table below summarizes the operating and control mode configurations for the GS50.

Operating/Control Mode	Pump Operation
Local/Direct	Commands are entered from the front panel and executed immediately after being entered.
Local/Method	Commands are entered from the front panel and executed by running a method programmed from the front panel or through a TTL input.
Locked Remote/Direct	Commands are sent from Chromeleon or PeakNet 6 and executed immediately when received.

2.8.1 Operating Modes

Local Mode

When the GS50 power is turned on, the pump is in Local mode (see Figure 2-8). In Local mode, the pump accepts operating commands from two sources:

- Direct input from the front panel keypad and screens. All operating functions are available.
- TTL inputs from a remote controller, such as an integrator or another module. The TTL input signals can be used to turn the pump motor on and off or to set the method clock to hold or run.

Locked Remote Mode

In Locked Remote mode, the GS50 accepts operating commands from the host computer and Chromeleon or PeakNet 6 software via the DX-LAN.

When the GS50 is controlled by Chromeleon or PeakNet 6, connecting the pump to the timebase automatically selects the Locked Remote operating mode. In this mode, time-based steps for the software are executed on the server, and the software then sends operating commands directly to the pump. All operating changes from the GS50 front panel are disabled.

To return the GS50 to Local mode, clear the **Connect** check box on the GS50 control panel in Chromeleon or PeakNet 6. To return to remote mode, select the **Connect** check box.

2.8.2 Method (Front Panel) 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 delivered by the pump at a given time. The selected eluent mixture can be delivered isocratically, or as a multistep linear or curved gradient. As the method runs, the GS50 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 created, saved, and edited on the **METHOD** screen (see Figure 2-9). See Section 3.3 for programming instructions.

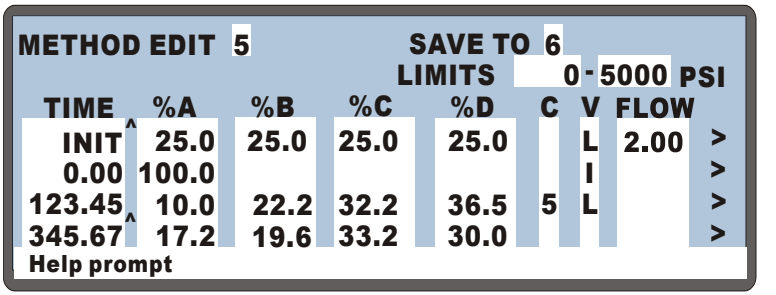


Figure 2-9. Method Screen

In summary:

- The GS50 can store up to 100 methods (0 through 99) in memory. The actual total, which is usually less than 100, depends on the size of each method and the amount of available memory.
- Each method can include up to 50 time-based steps. Each step specifies a time, an eluent composition, a gradient curve number, an injection valve position, and a flow rate. Step 1 always starts at **INIT** (initial condition). Step 2 always starts at **TIME = 0.0**.
- Methods are retained in memory after the pump is powered down.
- The pump can continue running under method control while you enter or edit another method.
- When you save changes to the currently running method or switch 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.

2.8.3 Eluent Delivery

Isocratic Eluent Run

The simplest use of the GS50 is to deliver 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. See Section 3.4.1 for an example of an isocratic method.

Gradient Eluent Run

The GS50 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 2-10) and the time between the starting and ending points of a gradient step.

Remember these key points:

- The curve number parameter determines whether the pump delivers a linear or curved gradient. For an example of a linear gradient method, see Section 3.4.2. For an example of a curved gradient method, see Section 3.4.3.
- Curve numbers are defined as follows:

Curve Number	Gradient Type
1, 2, 3, 4	Convex
5	Linear (power-up default)
6, 7, 8, 9	Concave

NOTE A curve number in a step instructs the pump to use the selected curve number when moving to that step from the previous step. Because the INIT and TIME=0.0 steps are not preceded by any steps, you cannot enter curve numbers for them.

- Curve 5 (the default setting) represents a linear gradient; therefore, the gradient slope does not change during a step if curve 5 is selected.

- 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 of the curve 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 2-10 shows the eluent composition profiles corresponding to curves 1 through 9, normalized for 0% to 100% for 10 minutes.
- Any consecutive method steps that specify 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 time interval between two steps is less than 0.1 minute (6 seconds).

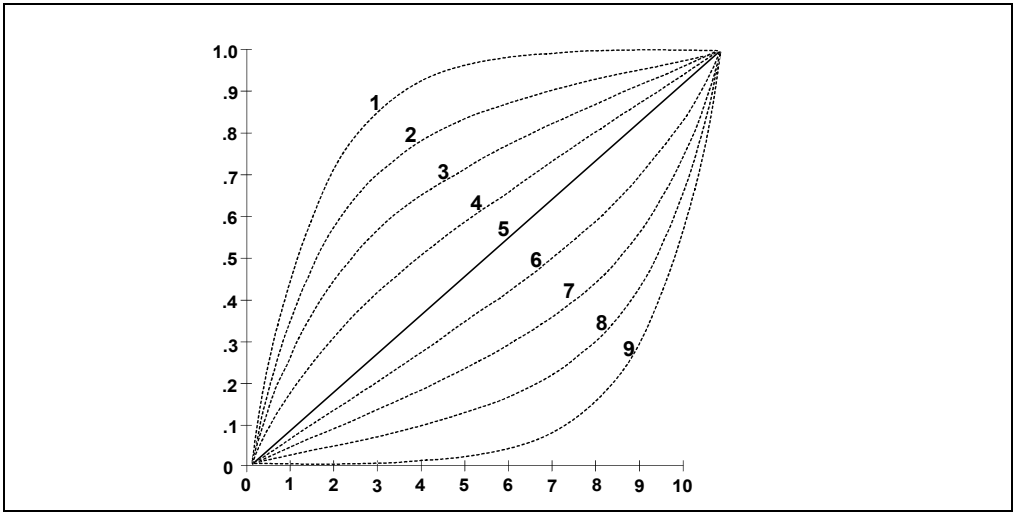


Figure 2-10. Eluent Composition Profile for Curves 1–9

3 • Operation and Maintenance

3.1 Getting Ready to Run

NOTE The GS50 Gradient Pump is designed to perform ion chromatography and BioLC applications only and should not be used for any other purpose. If there is a question regarding appropriate usage, contact Dionex.

3.1.1 Degas Eluents

Eluent quality significantly affects the performance of the GS50. To ensure optimal pump performance, observe these precautions:

- Dionex strongly recommends vacuum degassing all eluents. This helps prevent bubbles (caused by eluent outgassing) from forming in the eluent proportioning valves, pump heads, and detector cell. Degassing is especially important when combining aqueous and nonaqueous components (for example, water and acetonitrile).
- The optional vacuum degas assembly provides programmable, online degassing of up to four eluents (see Section 2.5). The vacuum degas assembly must be installed in the GS50 at the factory. If your GS50 does not include this option, manually degas eluents daily (following the instructions below) and store eluents in pressurized reservoirs.

Manual Degassing of Eluents

1. Prepare the eluent required for the application.
2. Pour the eluent into a vacuum flask and attach the flask to a vacuum pump or water aspirator.
3. Vacuum degas the eluent for 5 to 10 minutes by shaking or sonication.
4. Remove the flask from the vacuum. **Do not allow water to flow from the aspirator back into the flask.**
5. Pour the degassed eluent into a pressurizable reservoir. **Do not shake the eluent.**

6. Install end-line filters on each eluent line (see Section 3.1.2).
7. Pressurize the reservoirs (see Section 3.1.3).

3.1.2 Filter Eluents

Before beginning an analysis, always filter eluents. Filtering removes small particulates in the eluent that may contaminate the pump check valves or the eluent proportioning valves and cause erratic flow rates or loss of prime. All Dionex pressurizable reservoir Ship Kits include end-line filters for this purpose.

Before installation, thoroughly rinse the end-line filters (P/N 045987) with deionized water to remove any loose particles. Install a filter on the end of each eluent line, inside the reservoir.

Verify that the end of each filter extends to the bottom of the reservoir and that each filter is submerged in eluent. This prevents air from being drawn through the line. For more details, refer to the *Pressurizable Reservoir Installation Instructions*.

3.1.3 Pressurize Eluent Reservoirs

NOTE Although the GS50 does not require pressurized reservoirs, Dionex recommends pressurizing the reservoirs if eluents are manually degassed (see Section 3.1.1) or if eluents are sensitive to carbonate (NaOH) contamination. For more details, refer to the *Pressurizable Reservoir Installation Instructions*.

1. Install the pressurizable reservoirs above the pump.
2. Install a regulator (P/N 046594) on the gas supply line to the reservoirs.
3. Turn on the gas supply and adjust the pressure to 55 kPa (8 psi).

Never pressurize eluent reservoirs above 69 kPa (10 psi). Pressurizing reservoirs above this limit can cause the reservoir to explode.

Ne mettez jamais les réservoirs d'éluants sous une pression supérieure à 69 kPa (10 lb/po²).

Setzen Sie den Eluentbehälter auf keinen Fall einem Druck über 69 kPa aus.

3.1.4 Start-Up

1. Turn on the main power switch.
2. The **POWER-UP** screen appears briefly (see Figure 2-2), and is then replaced by the **MAIN** screen (see Figure 2-3).

   NOTE If a power-up diagnostic test fails, the DIAGNOSTIC TEST screen appears instead of the MAIN screen. See Section C.2.5 if this occurs.

3. If one of the following conditions applies, prime the pump (see Section B.2.7):
   - The eluent has been changed,
   - The eluent line is new (empty),
   - The eluent line contains air, *or*
   - The pressure display is unstable.
4. Select the flow rate required for your application.
5. Press **Off/On** to start the pump flow.
6. Check the pressure reading on the **MAIN** screen. The display is updated once per pump cycle; a variation of more than 3% from one pressure reading to the next indicates that the pump is out of prime. See Section 4.1 for conditions that cause the pump to lose prime.

   NOTE After starting the pump or changing the flow rate, wait at least 5 minutes (longer for flow rates below 1.0 mL/min) before beginning an analysis. This

allows the digital signal processor (DSP) program to stabilize the flow rate.

3.1.5 Selecting the Pressure Limits

The high and low pressure limits automatically stop the pump when a system malfunction occurs, such as overpressurization caused by a blockage or low pressure caused by a leak downstream from the pump.

- When pump operation is being controlled by Chromeleon or PeakNet 6, select the pressure limits from the software.
- When the pump is running under Local Direct control, enter the pressure limits on the **DETAIL** screen (see Figure 3-1).
- When the pump is running under Method control, enter the pressure limits on the **METHOD** screen (see Figure 3-5). The limits are set in the **INIT** step of the Method and remain the same throughout the analysis. When a limit trip stops the pump, the method clock immediately stops and goes to Hold. The front panel displays the current status of the program that was running when the pressure limit was tripped.

To select the pressure limits from the front panel:

1. Go to the **DETAIL** or **METHOD** screen and move the cursor to the **LIMITS** field (see Figure 3-1).

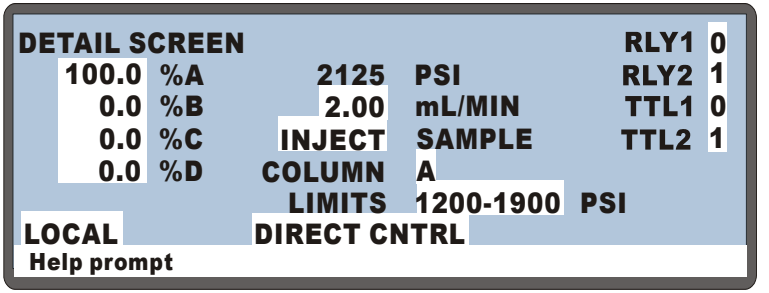


Figure 3-1. Detail Screen: Setting Pressure Limits

2. Enter a low pressure limit between 1.4 and 2.8 MPa (200 and 400 psi). The setting depends on the system operating pressure.

   NOTE To prevent the low pressure limit from being tripped each time the GS50 power is turned on, the limit is inactive for the first several piston strokes. If a break occurs after this period, the low pressure limit is activated instantaneously.

3. Enter a high pressure limit that is 3.4 MPa (500 psi) higher than the low pressure limit *and* 2.8 to 3.4 MPa (400 to 500 psi) above the normal system operating pressure.

   NOTE The GS50 is equipped with a pressure alarm limit that prevents pump operation above 35 MPa (5076 psi).

3.1.6 Calibrating the Pressure Ripple

During GS50 operation, a slight, momentary change in pressure, known as a *pressure ripple*, occurs each time one piston moves forward as the other piston moves backward. This pressure ripple during the transition between pistons is characteristic of dual-piston pumps and is not a defect.

Before beginning routine operation with the GS50, calibrate the pressure ripple to optimize pump operation. The calibration procedure forces the pump to "learn" the specific operating parameters for your application; this will minimize both baseline noise and the pressure ripple.

To calibrate the pressure ripple:

1. Check that all normal operating conditions for the application are in effect: the separator and guard columns are installed, the appropriate flow rate is selected, etc.
2. Press **Off/On** to start the pump flow. Run the pump for at least 10 minutes before going on to Step 3 and starting the calibration.

3. Go to the **CALIBRATION MENU** and select the **PRESSURE RIPPLE CALIBRATION** screen (see Figure 3-2).

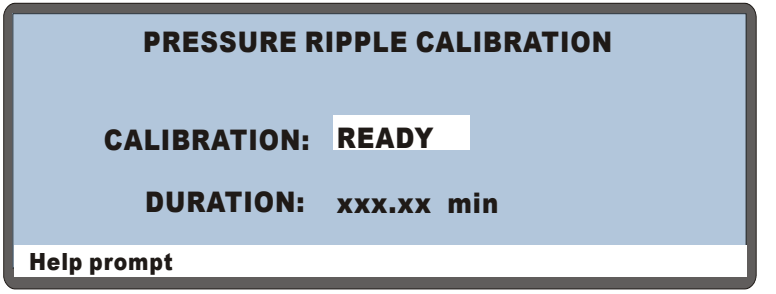


Figure 3-2. Pressure Ripple Calibration Screen

4. Move the cursor to the **CALIBRATION** field. Toggle the field from **READY** to **CALIBRATE**, and then press **Enter** to start the calibration.

   At a flow rate of 1.0 mL/min, it takes about 13 minutes to run the calibration sequence. The **DURATION** field reports how much time remains until the calibration is finished.

5. When the calibration sequence is complete, press **Menu** twice to exit the **PRESSURE RIPPLE CALIBRATION** screen and return to the **MENU of SCREENS**.

NOTE For more information about the PRESSURE RIPPLE CALIBRATION screen, see Section C.3.6.

3.2 Running Under Direct Control

When the Direct control operating mode is selected, commands are carried out immediately after they are entered and the selected operating parameters remain in effect until commands to change them are issued. This section describes the two types of Direct Control: Locked Remote and Local.

3.2.1 Locked Remote Direct Control

When the GS50 is controlled by either Chromeleon or PeakNet 6 software, connecting the pump to the timebase automatically selects the Locked Remote operating mode. After time-based steps for the software are executed on the server, the software sends operating commands directly to the pump. All operating changes from the GS50 front panel are disabled.

To return the GS50 to Local mode, clear the **Connect** check box on the GS50 control panel in Chromeleon or PeakNet 6. To return to remote mode, select the **Connect** check box.

For more information, refer to the online Help or the software user's guide.

3.2.2 Local Direct Control

To select Local Direct control, go to the **MAIN** or **DETAIL** screen.

- If **DIRECT CNTRL** is displayed, the GS50 is already in Direct control mode and no further action is necessary.
- If **METHOD** is displayed, move the cursor to **METHOD** and press **Select** ∆ or **Select** ∇ to toggle to **DIRECT CNTRL**. Press **Enter** or a cursor arrow button to activate the selection.

Local Direct Control Example

Specify an isocratic mixture of 60% eluent A, 25% eluent B, and 15% eluent C to be pumped at 1.0 mL/min (see Figure 3-3).

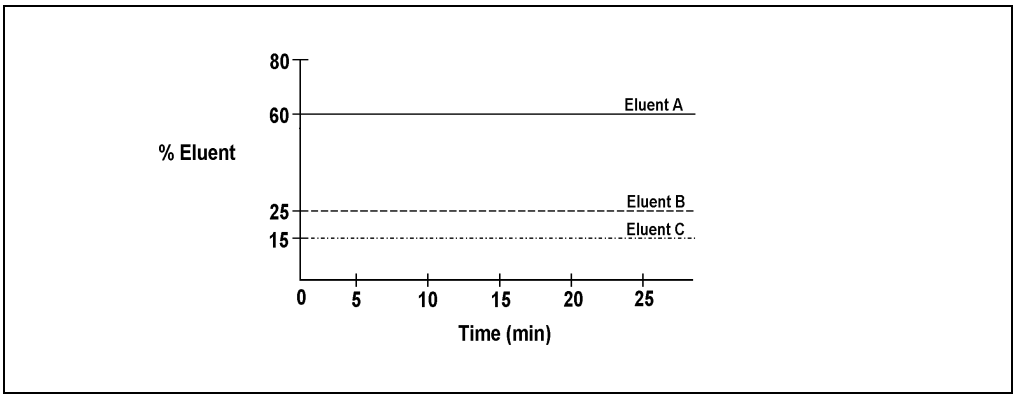


Figure 3-3. Isocratic Run Profile

1. Go to the **MAIN** or **DETAIL** screen. Figure 3-4 illustrates the **MAIN** screen as it appears when the example is set up.

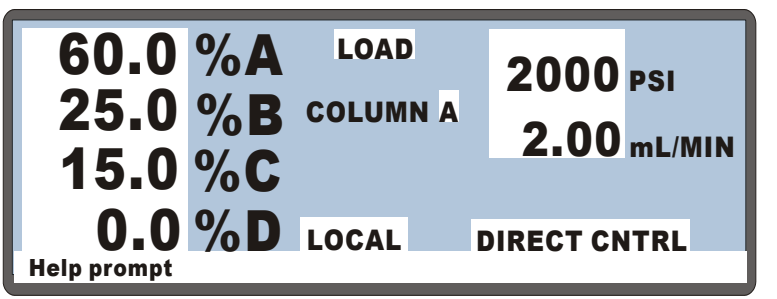


Figure 3-4. Main Screen: Running Under Local Direct Control

2. Check that the operating fields are set to **LOCAL** and **DIRECT CNTRL**. If **REMOTE** or **METHOD** is selected, move the cursor to the appropriate field, press **Select** Δ or **Select** ∇ 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** (do not enter a value).

   When you press **Enter**, the Moduleware automatically calculates the percentage required to make the total of all eluents equal 100. In this example, eluents A and B already total 85% (60 + 25 = 85), so the Moduleware will specify 15% of eluent C (100–85 = 15).

4. Move to the **mL/MIN** field and enter 1.

5. If the pump is off, press **Off/On** to turn on the motor and begin the isocratic delivery.

NOTE After starting the pump or changing the flow rate, wait at least 5 minutes (longer for flow rates below 1.0 mL/min) before starting an analysis. This delay allows the digital signal processor (DSP) program to stabilize the flow rate.

3.3 Running Under Method (Front Panel) Control

Method control is used primarily when the GS50 must communicate with non-Dionex software or when the pump is under integrator control. This section presents an overview of how to create, edit, and run methods from the GS50 front panel; for step-by-step examples, see Section 3.4.

When entering parameters on the **METHOD** screen, observe these guidelines:

- After starting the pump or changing the flow rate, wait at least 5 minutes (longer for flow rates below 1.0 mL/min) before beginning an analysis. The delay allows the digital signal processor (DSP) program to stabilize the flow rate.
- In the **%A**, **%B**, **%C**, and **%D** columns, enter a decimal percentage value from 0.1% through 100% for the eluent composition. The pump cannot run unless the combined total of all four eluents equals 100%.
- In the **V** column, select the injection valve position (**L** for load or **I** for inject).
- In the **FLOW** column, enter a flow rate from 0.5 to 5.0 mL/min. The flow rate is adjustable in increments of 0.01 mL/min.

NOTE The GS50 is optimized for operation at 1.5 mL/min or less.

- To have the pump deliver a linear or curved gradient (see Section 2.8.3), enter a curve number in the **C** column.

  NOTE The pump uses the curve number in a step when moving to that step from the one preceding it. Because the INIT and TIME=0.0 steps are not preceded by other steps, curve numbers cannot be entered for them.

- If a step field is "blank" (has no entry), the last selected value for the field remains in effect.
- The ∨ symbol next to the bottom time entry indicates that it is followed by at least one more step. Move the cursor to the entry and press the down arrow to see the additional step(s).
- The ^ symbol next to the top time entry indicates that it is preceded by at least one more step. Move the cursor to the entry and press the up arrow to see the additional step(s).
- The > symbol at the end of a line on the **METHOD** screen indicates a lateral extension to the line. Move the cursor to the end of the line and press the right arrow to display the **METHOD** events screen.

3.3.1 Creating a New Method

New methods can be created 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 it is not, move the cursor to the field, press **Select** Δ or **Select** ∇ to toggle the mode to **REMOTE**, and press **Enter** or a cursor arrow button.
3. Go to the **METHOD** screen.

4. In the **EDIT** field, enter either the number of the method to be created (if you plan to edit an unused method) or the number of an existing method (if you plan to modify this method and save the changes to a new method number). After entering an unused method number, the screen resembles the example in Figure 3-5.

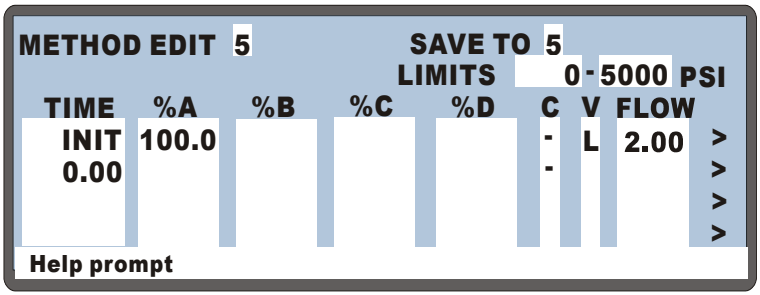


Figure 3-5. Method Screen: Creating a New Method

5. In the **LIMITS** field, set the low and high pressure limits (see Section 3.1.5).
6. Each method begins with two timed steps (see Figure 3-5): an initial conditions step (containing **INIT** in the **TIME** column) and a time zero step (containing **0.00** in the **TIME** column). Enter parameters for both steps.
7. Enter a new step, using one of these methods:
   - Move the cursor to the **TIME** field below the last step in the method and enter the elapsed time at which to start the new step. Press **Enter** or a cursor arrow button.
   - Move the cursor to any **TIME** field on the screen and press **Insert** to add a new step after the cursor position. Enter the elapsed time at which to start the new step. When you press **Enter** or a cursor arrow button, the GS50 Moduleware moves the new step to the correct chronological position.

8. Continue entering parameters for the new step. When you finish, move the cursor to the **SAVE TO** field and do one of the following:
   - After editing an unused method, press **Enter**.
   - After editing an existing method, enter a new number to save the method to and press **Enter**.

3.3.2 Running a Method

1. If the pump motor is off, press **Off/On** to turn on the motor.
2. Check that the pump is set to **LOCAL** mode, **METHOD** control:

   Go to the **MAIN** or **DETAIL** screen. If **REMOTE** or **DIRECT CNTRL** is selected, move the cursor to the field, press **Select** Δ or **Select** ∇ to toggle the value, and press **Enter** or a cursor arrow button.
3. In the **METHOD** field, enter the number of the method to run. If the method clock is already running, 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 (that is, at which step and parameters) the method begins running:
   - If the method clock is at **INIT** or time zero, the method begins running using the **INIT**ial 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. If you prefer to start the method at the **INIT**ial condition, press **Reset**.

3.3.3 Editing a Method

Existing methods can be modified by changing, adding, or deleting steps and parameters. Changes can be made while the method clock is stopped or running.

NOTE **After saving changes, there is no way to recall the original method. If you plan to make experimental changes to a method but also need to retain the original method, save the modified method to a new number.**

This is the basic procedure for editing a method:

1. Go to the **METHOD** screen. In the **EDIT** field, enter the number of the method to be modified.
2. Make the required changes:
   - *To change a parameter*, position the cursor in the field and enter the new parameter.
   - *To add a method step*, move the cursor to any **TIME** field and press **Insert**, or move the cursor to the **TIME** field below the last step and enter the elapsed time at which to start the new step. When you press **Enter** or a cursor arrow button, the Moduleware automatically moves the new step to the correct chronological position. Continue entering parameters for the new step.
   - *To delete a method step*, move the cursor to the **TIME** field of the step and press **Delete** twice.
3. When you finish editing, move the cursor to the **SAVE TO** field. Press **Enter** to save the changes to the current method number, or enter a new method number and press **Enter**.

   If the modified method is currently running, the changes are immediately incorporated in the run and executed at the programmed time, *unless* the modified event has already been executed. If this is the case, press **Reset** to restart the method at the **INIT**ial conditions and run the updated version of the method.

3.3.4 Deleting a Method

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

3.3.5 Changing the Running Method

To change from the method currently running to a different method, go to the **MAIN** or **DETAIL** screen, enter the new method number in the **METHOD** field, and press **Enter**.

The new method begins running, using the parameters specified in the step for the current elapsed time. If you prefer to start the method at the **INIT**ial conditions, press **Reset**.

3.3.6 Controlling the Method Clock

The method clock is controlled by the **Hold/Run** button, the **Reset** button, and the **MIN** fields on the **MAIN** and **DETAIL** screens.

- To start and stop the method clock, press **Hold/Run**.
- To reset the method clock to **INIT**, press **Reset**.
- To set the clock to a specific elapsed time, either enter the time in the **MIN** field on the **MAIN** screen *or* press a **Select** button to step through the programmed step times; when the appropriate step time is displayed, press **Enter**.

  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.

Before entering any of the example methods, set the pump to Local mode, Method control. Go to the **MAIN** or **DETAIL** screen and, if necessary, toggle from **REMOTE** to **LOCAL** and from **DIRECT CNTRL** to **METHOD**.

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 1.0 mL/min. Figure 3-3 illustrates the isocratic profile for this example. Figure 3-6 illustrates the **METHOD** screen as it appears when the example is set up.

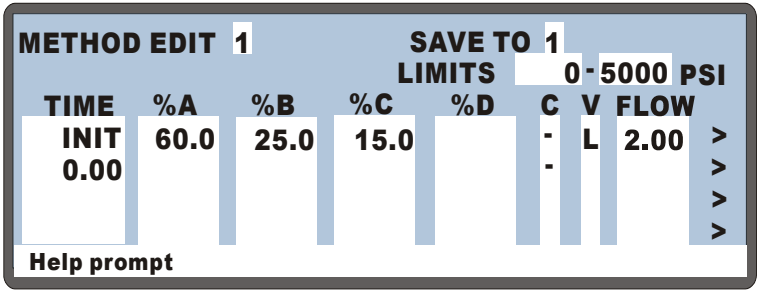


Figure 3-6. Method Screen: Isocratic Run Example

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

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). Ignore the **C** (Curve) and **V** (Valve) fields. Move to the **FLOW** field and enter a flow rate of 1.00.
3. Move the cursor to the **SAVE TO** field and press **Enter** to save the method.
4. Go to the **MAIN** or **DETAIL** screen, enter the new method number in the **METHOD** field (1, in this case), and press **Enter**. If the pump motor is off, press **Off/On** to have the pump start delivering the eluent mixture.
5. If the method clock is in hold, press **Hold/Run** to begin running the method.

3.4.2 Linear Gradient Method Example

Here is a summary of the linear gradient method steps:

- Create Method 2 to begin under isocratic conditions with 100% eluent A at 1.0 mL/min.
- Hold this for 5 minutes (**TIME = 5.00**).
- Begin a 10-minute segment in which the amount of eluent B is increased and the amount of eluent A is decreased until the mixture is 20% eluent A and 80% eluent B (**TIME = 15.00**).
- Hold this for 5 minutes (**TIME = 20.00**).
- At 20.10 minutes, return to 100% eluent A and re-equilibrate the system for the next analysis.

Figure 3-7 illustrates the gradient profile for this method.

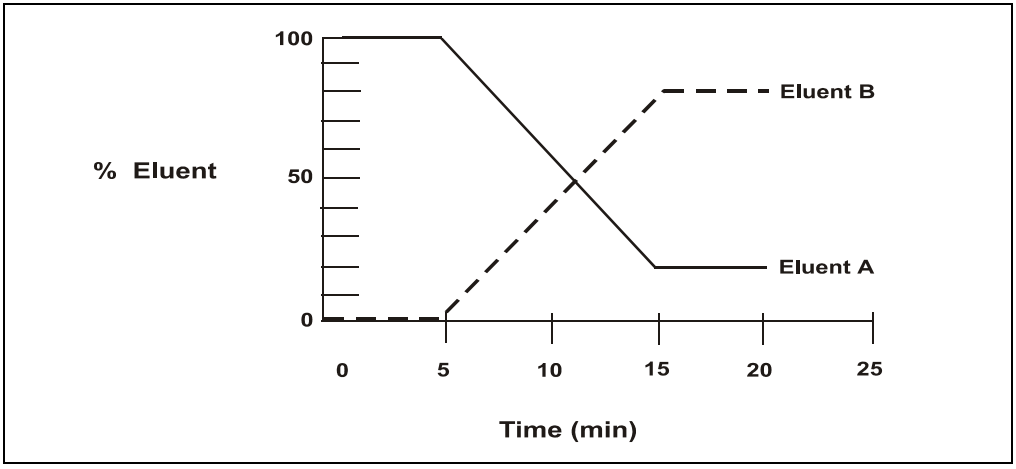


Figure 3-7. Linear Gradient Method Profile

1. Go to the **METHOD** screen and enter a method number (2, for example) in the **EDIT** field.
   - If Method 2 currently exists and you want to retain it, enter a new (unused) method number in the **EDIT** field.
   - If Method 2 currently exists and you want to delete it, move the cursor to **TIME = INIT** and press **Delete** twice.
2. Move to the **FLOW** field of the **INIT** step and enter a flow rate of 1.00.
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 = 5.00** minutes. Next, 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, 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 increases from 0%.

5. Move the cursor to the next line. Enter 15 in the **TIME** field. Move the cursor to the **%A** field and enter 20; enter 80 in the **%B** field.

   After a total of 15 minutes (5 minutes of isocratic conditions plus 10 minutes to gradually decrease the amount of eluent A in the mixture while increasing the amount of eluent B), the eluent composition is 20% eluent A and 80% eluent B. Figure 3-8 illustrates the **METHOD** screen as it appears after Step 5.

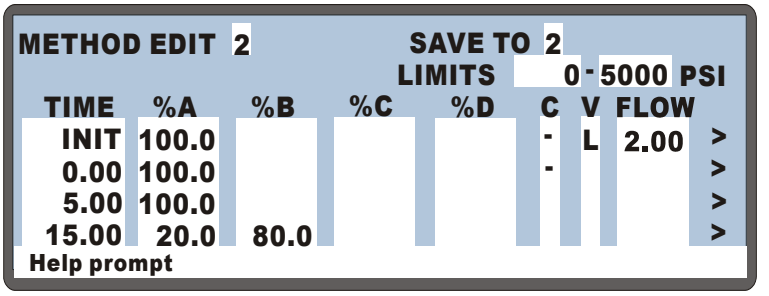


Figure 3-8. Linear Gradient Method Example (After Step 5)

6. Move the cursor to the next line. Enter 20 in the **TIME** field. Move the cursor to the **%A** field and enter 20; enter 80 in the **%B** field.

   The eluent composition remains unchanged at 20% eluent A and 80% eluent B for 5 minutes.

7. Move the cursor to the next line. Enter 20.10 in the **TIME** field. Move the cursor to the **%A** field and enter 100.

8. Move the cursor to the **SAVE TO** field and press **Enter** to save the method to memory. Figure 3-9 illustrates the completed method.

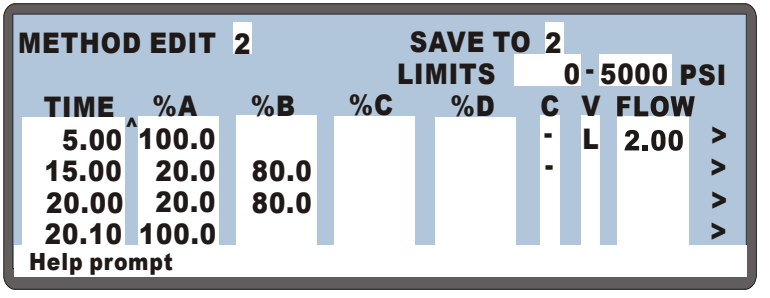


Figure 3-9. Linear Gradient Method (Completed)

9. 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.
10. If the pump motor is off, press **Off/On** to start the pump.
11. 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=20.10**), the pump continues to pump isocratically until the clock is reset.

3.4.3 Curved Gradient Method Example

Here is a summary of the curved gradient method example steps:

- Create Method 3 to begin under isocratic conditions with 100% eluent A at 1.5 mL/min.
- Hold this for 3 minutes (**TIME = 3.00**).
- Begin a 10-minute convex segment in which the amount of eluent B is increased and the amount of eluent A is decreased until the mixture is 100% eluent B (**TIME = 13.00**).
- Hold this for 2 minutes (**TIME = 15.00**).

Figure 3-10 illustrates the gradient profile for this method.

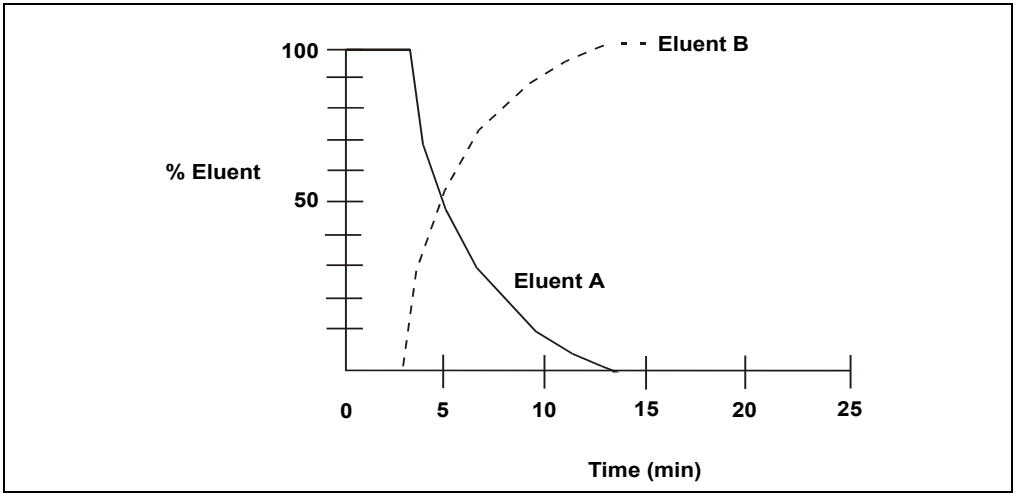


Figure 3-10. Gradient Curve Profile

1. Go to the **METHOD** screen and enter a method number (3, for example) in the **EDIT** field.
   - If Method 3 currently exists and you want to retain it, enter a new (unused) method number in the **EDIT** field.
   - If Method 3 currently exists and you want to delete it, move the cursor to **TIME = INIT** and press **Delete** twice.
2. Move to the **FLOW** field of the **INIT** step and enter a flow rate of 1.50.
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 down to the next line and enter 3 in the **TIME** field. Move to the **%A** field and press **Enter**. 100% of eluent A is automatically filled in.
5. Move the cursor to the **C** field and enter 5 to run gradient curve 5. Figure 3-11 illustrates the **METHOD** screen as it appears so far.

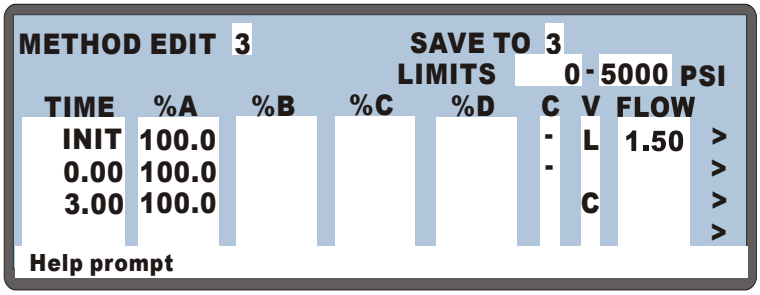


Figure 3-11. Curved Gradient Method Example (After Step 5)

6. Move the cursor down to the next line and enter 13 in the **TIME** field. Move the cursor to **%A** and enter 0. Move the cursor to **%B** and enter 100.
7. Move the cursor to the **C** field and enter 2 to run gradient curve 2.

   This marks the end of the isocratic section of the run and the beginning of the eluent B concentration ramp. After a total of 13 minutes (3 minutes of isocratic conditions plus 10 minutes to gradually decrease the amount of eluent A in the mixture while increasing the amount of eluent B), the eluent composition is 0% eluent A and 100% eluent B.

8. Move the cursor to the next line and enter 15 in the **TIME** field. Move the cursor to **%B** and enter 100.
9. Move the cursor to the **C** field and enter 2 to run gradient curve 2. The eluent composition remains unchanged at 100% eluent B for 2 minutes. Figure 3-12 illustrates the completed **METHOD** screen.

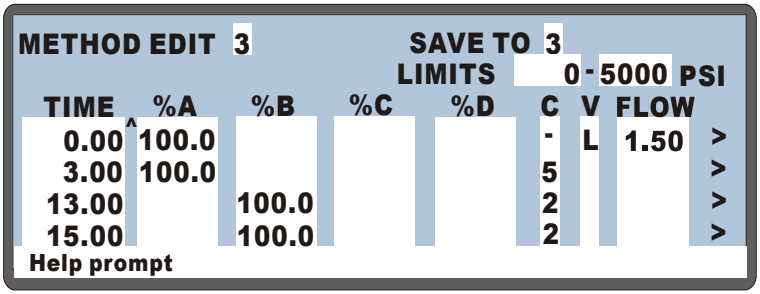


Figure 3-12. Curved Gradient Method Example (Complete)

10. Move the cursor to the **SAVE TO** field and press **Enter** to save the method to memory.

3.4.4 Editing a Running Method Example

After entering a method, you can change, add, and delete steps and parameters. If the method being edited is currently running, the changes are executed when you move the cursor to the **SAVE TO** field and press **Enter** (*unless* the modified event has already been executed).

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

- Change the eluent composition at **TIME = 15.00** from 20% eluent A and 80% eluent B to 20% eluent A, 60% eluent B, and 20% eluent C.
- Add a step at **TIME = 17.00** to make the eluent composition 40% eluent B and 60% eluent C.

Figure 3-13 illustrates the **METHOD** screen as it appears when editing is complete.

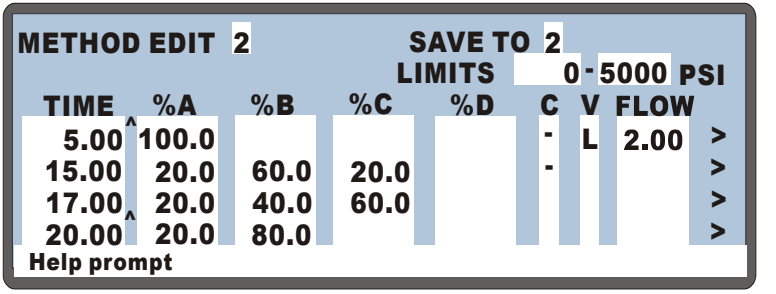


Figure 3-13. Edited Linear Gradient Method Example

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

1. Go to the **METHOD** screen and enter 2 in the **EDIT** field.
2. Move the cursor to the **TIME = 15.00** step of Method 2. Move the cursor to **%A** and enter 20; enter 60 for **%B**; and then enter 20 for **%C**.
3. Move the cursor to the **TIME** field and press **Insert**. Enter 17 in the time field. Move the cursor to **%B** and enter 40; enter 60 in the **%C** field.
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 on the screen.
   - 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. If it is necessary to put the changes into effect immediately, press **Reset** (to set the method clock to the **INIT**ial conditions) or enter an elapsed time of less than 15 (10, for example) in the **MIN** field.

3.5 Routine Maintenance

This section describes routine maintenance procedures that the user can perform. All other maintenance procedures must be performed by qualified Dionex personnel.

As Needed

- Refill the eluent reservoir.
- Make fresh eluent.
- Refill the bottle of flush solution for the piston seal wash assembly.

Daily

- If you are using a combination of eluents that contains both salt or base and solvent, wash the pump pistons frequently. The GS50 piston seal wash assembly continuously rinses the back of the piston seals to remove salt crystals and prolong the life of the seals. To use this feature, an external water source must be connected; see Section B.2.6 for more information.

  Also, do not store the pump with salt buffers in the flow path. Flush the entire flow path (excluding the column) with deionized water to prevent salt crystals from causing clogs.
- Check the entire mechanical chassis for leaks from the eluent proportioning valve assembly, valve connections, eluent reservoirs, and vacuum degas chamber (if the vacuum degas assembly is installed). Tighten or replace any leaking fittings. Wipe up liquid spills and rinse dried reagents off pump components with deionized water.
- Clean eluent reservoirs thoroughly (inside and out) with deionized water and let them air dry. If a reservoir still appears dirty, or if there is a slimy film on the interior, follow the cleaning procedure in the *Pressurizable Reservoir Installation Instructions*.

Weekly

- Check the junctions between the pump heads and the pump casting for evidence of liquid leaks. If the piston seal wash tubing is not connected, check the drain tubes at the rear of the pump heads for evidence of moisture. Normal friction and wear may gradually result in small liquid leaks around the piston seal. If unchecked, these leaks can gradually contaminate the piston housing, causing the pump to operate poorly. If leaks occur, replace the piston seals (see Section 5.2).
- Check the end-line filters and change if needed. When new, end-line filters are pure white. If the system is in continuous operation, change the filters weekly, or whenever they become discolored. Replace the filters more often if you notice bacterial buildup or if the mobile phase does not contain solvent.

NOTE **It is especially important to regularly replace end-line filters when using aqueous eluents, which may contaminate the filter with bacteria or algae. Although the contamination may not be visible, it can cause flow restrictions to the pump.**

Every Six Months

- Replace the main piston seals (see Section 5.2).
- Replace the piston rinse seals and O-rings (see Section 5.2).

Yearly

- Replace the backup seals (see Section 5.2).
- Inspect the check valves annually; replace as needed (see Section 5.1).
- Inspect the pistons annually; replace as needed (see Section 5.3).

3.6 Shutdown

- Rinse the pump pistons before and after daily operation to prevent buildup of salt crystals or other contaminants that can damage the piston seal. Never store the pump with salt buffers in the flow path.
- Before shutting down the GS50 for 3 days or more, flush the system with deionized water to prevent contaminants from building up. If this is not possible, maintain a continuous rinse through the system until normal operation is resumed. In addition, set the flow rate to 0.05 mL/min and set all four eluent percentages to 25% to ensure that the proportioning valve assembly is flushed.

Flushing the proportioning valves is extremely important if the eluents combine salt or base and solvent. If salt precipitates in the valves, it can seriously damage the valve diaphragms. If this happens, the entire proportioning valve assembly must be replaced (see Section 5.5).

- Before shutting down the GS50 for more than 3 days, reduce the pressure on the eluent reservoirs to about 21 kPa (3 psi).
- Before shutting down the GS50 for 4 weeks or more, Dionex recommends thoroughly flushing any chemicals out of the vacuum degas assembly tubing (if installed) with deionized water. This helps prevent crystallization in the membrane pores.
- Shut down the GS50 by turning off the main power switch.

4 • Troubleshooting

This chapter is a guide to troubleshooting minor problems that may occur during operation of the GS50 Gradient Pump. First, turn to the section of this chapter that best describes the operating problem. There, possible causes of the problem are listed in order of probability.

When necessary, you will be referred to other product manuals for additional information. These manuals are usually located on the Dionex Reference Library CD-ROM (P/N 053891).

If you are unable to resolve a problem, contact Dionex Technical Support. In the U.S., call 1-800-346-6390. Outside the U.S., call the nearest Dionex office.

4.1 Pressure Fluctuations Between Pump Heads

The GS50 display updates the pressure readout once per second. Excessive pressure variation (more than 3% difference from one pressure reading to the next) or a low pressure reading indicates a problem.

- **Pump out of prime; there is no eluent**
  1. Refill the eluent reservoirs. 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 GS50 contains a vacuum degas assembly, test the degas pump:
     a. Go to the **DEGAS PUMP CALIBRATION AND STATUS** screen (see Section C.3.3).
     b. Press a **Select** button to toggle the **RDY** field to **CAL** and press **Enter**.
     c. The degas pump should turn on and run for about 2 minutes; if it does not, see Section 4.6.
  2. If the GS50 does not contain a vacuum degas assembly, degas eluents manually (see Section 3.1.1) and reprime the pump (see Section B.2.7).

- **Eluents insufficiently degassed**

  If the GS50 contains a vacuum degas assembly, the degas pump automatically turns on periodically. Go to the **DEGAS OPTIONS** screen (see Section C.1.6) and increase the frequency. For example, run the degas pump for 30 seconds at 2-minute intervals.

  If eluents are manually degassed, degas them for longer periods of time.

- **Pump out of prime; end-line filter is dirty or clogged**

  1. When new, end-line filters (P/N 045987) are pure white. If the system is in continuous operation, replace the end-line filters weekly, or whenever a filter becomes discolored. Replace filters more often if bacterial buildup is visible or if the mobile phase does not contain solvent. See the *Pressurizable Reservoir Installation Instructions* for more information about end-line filters.

     NOTE It is especially important to regularly replace end-line filters when using aqueous eluents, which may contaminate the filter with bacteria or algae. The bacterial buildup may not be visible.

  2. Reprime the pump (see Section B.2.7).

- **Pump out of prime; blockages in inlet tubing**

  Kinked or clogged tubing causes the pump to be "starved" for eluent. Replace the tubing and fittings, and then reprime the pump (see Section B.2.7).

- **If priming does not eliminate excessive pressure fluctuations, check valves may be dirty or defective**

  Replace the check valves (see Section 5.1). Also, install an end-line filter (P/N 045987) on each eluent line (see Section 3.1.2); impurities in the eluent can cause dirty or defective check valves.

- **If priming does not eliminate excessive pressure fluctuations, piston seals may be dirty or defective**

  Replace the piston seals (see Section 5.2).

- **If priming does not eliminate excessive pressure fluctuations, piston may be scratched or broken**

  Replace the piston (see Section 5.2) and the piston seal (see Section 5.3).

4.2 Pump Does Not Start

- **Flow rate is set to zero**

  Reset the flow rate (see Section 2.4.1).

- **While being primed, pump starts briefly and an alarm sounds**

  1. The high pressure limit was tripped and the following message is displayed:

     ```
     High Pressure Limit Violation
     ```

     Check that the waste valve on the secondary pump head is opened (see Figure 2-6). To open the waste valve, turn the knob one-quarter to one-half turn counterclockwise.

  2. The low pressure limit was tripped and the following message is displayed:

     ```
     Low Pressure Limit Violation
     ```

     a. Verify that the low pressure limit setting is several hundred psi below the operating pressure (see Section 3.1.5).

     b. Make sure there are no liquid leaks in the flow system.

     c. Make sure both the priming valve and waste valve are closed (see Figure 2-6). To close a valve, turn the knob clockwise.

4.3 Pump Stops

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

  If no error message is displayed, the pump was probably instructed to stop by the method, computer, or other remote signal source. If you do not want the pump to stop, take the appropriate action: edit the method, etc.

- **Low pressure limit was tripped; the following message is displayed:**

```
Low Pressure Limit Violation
```

  1. Verify that the low pressure limit setting is several hundred psi below the operating pressure (see Section 3.1.5).
  2. Make sure there are no liquid leaks in the flow system.
  3. Verify that eluent is present in the selected channel. If the eluent reservoir is empty, refill it or select a channel which does have eluent. Prime the pump before resuming operation (see Section B.2.7).
  4. Make sure both the priming valve and the waste valve are closed (see Figure 2-6). To close a valve, turn the knob clockwise.
  5. Place the pump in **LOCAL** mode, **DIRECT CONTROL** (see Section 2.8). Press **Off/On** to start the pump. Verify that the pistons are moving and that pump operation is audible.

     If there is no sound from the pump, check the LED on the CPU/LAN card in the GS50 electronics chassis (see Figure 2-5). A green LED indicates normal operation; a red LED indicates a power fault. When a power fault occurs, the GS50 enters a diagnostic state and inhibits all other controls until the fault is corrected. If the LED is red, turn off the power for a few seconds and then turn it back on.

- **High pressure limit was tripped; the following message is displayed:**

```
High Pressure Limit Violation
```

1. The high pressure limit setting may be too low. As columns age, their backpressure increases and it may be necessary to compensate for this by increasing the high pressure limit. If the column is the source of the high backpressure, clean the column as instructed in the column manual. If this does not eliminate the problem, replace the column.
2. Observe a run to see whether the high pressure limit is triggered when injection occurs; if it is, the injection valve may be causing a blockage. This indicates that the rotor seal or stator may need replacement. Refer to the operator's manual for the chromatography module for instructions.
3. Make sure that no tubing is plugged or overtightened. To determine the source of the high backpressure, isolate segments of the flow path:
    a. Remove the pump outlet tubing at the injection valve.
    b. Press **Off/On** to turn on the pump. Set the flow rate to 1.0 mL/min and record the backpressure.
    c. One at a time, reconnect each component of the flow path. If reconnecting a component causes a sharp increase in backpressure, replace the component. Replace as many components as necessary to resume operation at the standard operating backpressure.
4. Verify that the pressure transducer offset reading is correct:
    a. Open the waste valve on the secondary pump head (see Section 2.5) by turning the knob one-quarter to one-half turn counterclockwise.
    b. Check the pressure reading; if it is above 97 kPa (14 psi), recalibrate the pressure transducer offset (see Section C.3.5).

- **A DSP-related error message is displayed:**

  Several error messages report problems related to the digital signal processor (DSP) program: *DSP communication fails*, *DSP does not acknowledge*, etc. When one of these messages is displayed, follow the procedure below.

  1. Turn off the GS50 by pressing the main power switch.
  2. Verify that the DSP card is correctly installed in slot 1 of the GS50 electronics chassis (see Figure 2-5).
  3. Turn on the GS50 power.
  4. If the DSP error message reappears, contact Dionex for assistance. One of these parts may need to be replaced: the power supply (P/N 046440), the DSP card, or the CPU/LAN card.

Do not remove any of the electronics cards from the pump. The components on the cards cannot be serviced by the user. If servicing is required, it must be performed by qualified personnel and appropriate electrostatic discharge (ESD) handling procedures must be followed.

Ne retirez aucune des cartes électroniques de la pompe. Aucun des composants sur les cartes ne peut être réparé par l'utilisateur. Toute réparation doit être effectuée par un personnel qualifié utilisant des procédures correctes de décharge électrostatique.

Halten Sie sich von der Elektronik des GS50 fern. Die Elektronik kann nicht vom Anwender gewartet werden. Falls ein Service erforderlich ist, ist dieser von qualifiziertem Personal durchzuführen. Dabei müssen die geeigneten Verfahren zur elektrostatischen Entladung (ESD) eingehalten werden.

- **The following error message is displayed:**

```
Encoder index not found
```

  1. Turn off the GS50 by pressing the main power switch.
  2. Verify that the cables connected to the DSP card in slot 1 of the GS50 electronics chassis are fully seated (see Figure 2-5).
  3. Turn on the GS50 again. If the encoder index error message reappears, contact Dionex for assistance.

- **Electrical cables improperly installed**

  1. Place the pump in **LOCAL** mode, **DIRECT CONTROL** (see Section 2.8). 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. Turn off the GS50 power by pressing the power switch.
     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 out the mechanical chassis drawer a few inches.
     d. Locate the distribution card on the top of the mechanical chassis. Check that all electrical cables are seated correctly in their connectors on the card. The cables are identified by printed labels on the card.
     e. Push the mechanical chassis drawer back in place, being careful not to pinch the cables. Tighten the drawer lock.
     f. Turn on the power.

4.4 Liquid Leaks/Leak Alarm

- **Defective piston seal**

  1. Replace the piston seal (see Section 5.2).
  2. Check all connections between the eluent reservoirs and the pump heads. Tighten the fitting connections just enough to stop the leak.

- **Leaking check valves**

  Replace the check valves (see Section 5.1).

- **Proportioning valve leaks**

  Tighten loose fittings. If there are no loose fittings, replace the valve (see Section 5.5).

Overtightening the fitting connections may strip the threads in the proportioning valve block. If this happens, the entire proportioning valve assembly must be replaced (see Section 5.5).

- **Waste valve knob leaks**

  Replace the O-ring (P/N 055752). See Section 5.4 for instructions.

- **Excessive system backpressure**

  If the system backpressure is substantially higher than the normal operating backpressure for the currently configured system (including the column), tubing may be plugged or overtightened. Follow the procedure below to isolate segments of the flow path and determine the source(s) of the high backpressure.

  1. Remove the pump outlet tubing at the injection valve.
  2. Press **Off/On** to turn on the pump. Set the flow rate to 1.0 mL/min and record the backpressure.
  3. One at a time, reconnect each component (tubing, fittings, etc.) of the flow path. If reconnecting a component causes a sharp increase in backpressure, replace the component. Replace as many components as necessary to resume operation at the standard operating backpressure.

4.5 Noisy Pump Motor

- **Excessive pressure or worn motor**

  As the pump motor ages, it typically becomes noisier and a slapping or clanking sound (which becomes louder as pressure increases) is audible. However, if the motor noise *suddenly* becomes much louder, contact Dionex Technical Support for assistance.

- **DSP card current limit has been exceeded**

  Turn on the GS50 by pressing the main power switch. Check the DSP (digital signal processing) card in slot 1 of the GS50 electronics chassis (see Figure 2-5). Note the three small LEDs in the upper left corner of the DSP card bulkhead; if the bottom LED is flashing in time with the pump strokes, the current limiter is being activated. (The built-in current limiter protects the motor and motor drive.)

  As the pump motor ages, it is normal for the current limit to be activated more frequently. However, if the current limit is being activated even at low flow rates and/or low pressures, contact Dionex Technical Support for assistance.

4.6 Vacuum Degas Assembly Does Not Run

- **Vacuum degas assembly is not installed**

  Go to the **PUMP OPTIONS** screen (see Section C.1.8) and verify that the **DEGAS PUMP OPTION** field is set to **YES**. If the field is set to **NO,** the vacuum degas assembly is not installed.

- **DEGAS OPTIONS screen settings incorrect**

  Go to the **DEGAS OPTIONS** screen (see Section C.1.6). If the **DEGAS PUMP** field is set to **ALWAYS OFF**, select **BY SETTING** and then enter the cycle duration and frequency times.

- **Electrical cables improperly installed**

  Follow the steps below to manually test the vacuum degas assembly.

  1. Go to the **DEGAS PUMP CALIBRATION AND STATUS** screen (see Section C.3.3). Press a **Select** button to toggle the **RDY** field to **CAL** and press **Enter**.

2. The pump should turn on and run for the cycle duration time specified on the **DEGAS OPTIONS** screen (see Section C.1.6). If it does not, verify that the cables connected to the pump in the GS50 electronics chassis (see Figure 2-5) and mechanical chassis are connected correctly.

   a. Turn off the GS50 power by pressing the power switch.

   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 out the mechanical chassis drawer a few inches.

   d. Locate the distribution card on top of the mechanical chassis. Check that all electrical cables are seated correctly in their connectors on the card. The cables are identified by printed labels on the card.

      If the connections are correct, either the distribution card or the vacuum degas assembly may need to be replaced. Contact Dionex Technical Support for assistance.

   e. Push the mechanical chassis drawer back in place, being careful not to pinch the cables. Tighten the drawer lock.

   f. Turn on the power.

4.7 Vacuum Degas Assembly Calibration Fails

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

```
Vacuum degas pump is not present or degas
circuitry is malfunctioning.
```

```
Vacuum Degas Fails
```

Follow the procedure below to verify that the cable to the vacuum degas assembly is connected to the distribution card.

1. Turn off the GS50 power by pressing the power switch.
2. 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).
3. Pull out the mechanical chassis drawer a few inches.
4. The distribution card is on the top of the mechanical chassis. Locate the vacuum degas assembly connector (labeled **VAC PUMP**) near the right rear corner of the card. Make sure the cable is fully seated in the connector.
5. Push the mechanical chassis drawer back in place, being careful not to pinch any of the cables. Tighten the drawer lock.
6. Turn on the power.
7. Go to the **DEGAS PUMP CALIBRATION AND STATUS** screen and retry the calibration (see Section C.3.3). If the message appear again, the degas assembly may need to be replaced. Contact Dionex Technical Support for assistance.

4.8 Vacuum Degas Assembly Low Vacuum

The GS50 monitors the vacuum degas reading at 1-minute intervals. If the vacuum degas is less than the monitoring value, the degas pump turns on. If the vacuum reading is 2000 counts or more less than the monitoring value when the degas pump turns off, the following message appears:

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

Go to the **DEGAS OPTIONS** screen (see Section C.1.6). Increase the **CYCLE DURATION** time and/or decrease the **TIME BETWEEN CYCLES**. If this does not resolve the problem, the vacuum degas assembly may need to be replaced. Contact Dionex Technical Support for assistance.

4.9 Relays or TTLs Inoperative

- **Incorrectly installed cables**

  Make sure the cables between the appropriate relay function and the input or output unit are connected to the correct slots (see Appendix D).

- **TTL input-related error**

  1. The cables may be installed incorrectly. Verify that ground wires are connected to ground (-) pins and signal wires are connected to signal (+) pins. For complete installation instructions, see Section D.3.
  2. The TTL input mode selected on the **TIME FUNCTION IN** screen (see Section C.1.9) must match the signal type output by the device connected to the GS50. Check the user's manual for the device to verify that the correct signal type is selected.
  3. A programming error occurred in the device sending the signal. Refer to the user's manual for the device for troubleshooting assistance.

- **TTT/Relay output-related error**

  1. The cables may be installed incorrectly. Verify that ground wires are connected to ground (-) pins and signal wires are connected to signal (+) pins. For complete installation instructions, see Section D.3.

2. A programming error occurred in the device sending the signal. Refer to the user's manual for the device for troubleshooting assistance.
3. The device being triggered may require a TTL input, not a relay. Connect the device to a GS50 TTL output (see Appendix D).

4.10 TTL2 Output Inoperative

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

```
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 can be used to control the power to a Self-Regenerating Suppressor (SRS). To use TTL2 for another function, set the **TTL2 OUTPUT USAGE** field to **NORMAL** (see Section C.1.8).

4.11 Poor Chromatographic Reproducibility

- **Liquid leaks**

  1. Check for leaks from the piston seals. Replace the piston seal on any head with a leak (see Section 5.2).
  2. Check for leaks throughout the remainder of the system, including the check valves, injection valve, and columns. Tighten or replace fittings as needed.

- **Pump not primed**

  Prime the pump (see Section B.2.7).

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

  Before beginning operation, attach a syringe to the priming valve (see Figure B-4) and draw at least 2.5 mL of the new eluent (20 mL if the vacuum degas assembly is installed) through the liquid lines.

- **Malfunctioning proportioning valve**

  Replace the proportioning valve assembly (see Section 5.5).

- **Malfunctioning check valves**

  Clean and/or replace the check valves (see Section 5.1).

- **Insufficient mixing**

  1. Some mobile phases are difficult to mix. If you notice shifting retention times or an unstable baseline, install an additional mixer (see Section 2.4.3).
  2. The gradient mixer may be dirty or contaminated. Install a new mixer (see Section 2.4.3).

- **Contaminated mobile phase**

  1. Clean all eluent reservoirs thoroughly (inside and out) with deionized water and let them air dry. If a reservoir still seems dirty, or if there is a slimy film on the interior, following the cleaning procedure in the *Pressurizable Reservoir Installation Instructions*.
  2. Replace all end-line filters (P/N 045987) (see Section 3.1.2).
  3. Prepare new stock solution.
  4. Prepare fresh mobile phase. To ensure their purity, prepare all mobile phases with spectro-grade solvents, reagent-grade chemicals, and ASTM Type I (or better) filtered and deionized water.

- **Problem unrelated to the pump**

  1. The mobile phase was prepared at the wrong concentration or prepared with impure chemicals/solvents or water. To ensure their purity, prepare all mobile phases with spectro-grade solvents, reagent-grade chemicals, and ASTM Type I (or better) filtered and deionized water.
  2. The column may be the source of the problem. Refer to the column manual for troubleshooting assistance.
  3. The injection valve may be the source of the problem. Refer to the chromatography module operator's manual for troubleshooting assistance.

4.12 Noisy Baseline

- **Eluents not filtered**

  Install an end-line filter (P/N 045987) on the end of each eluent line, inside the reservoir. Verify that the end of each filter extends to the bottom of the reservoir and that each filter is submerged in eluent. For more details, see Section 3.1.2.

- **Pump not properly primed**

  Prime the pump (see Section B.2.7).

- **Pressure ripple needs to be calibrated**

  Go to the **CALIBRATION MENU**, select the **PRESSURE RIPPLE CALIBRATION** screen, and run the pressure ripple calibration sequence (see Section 3.1.6).

- **Piston seal is damaged**

  If the piston seal is damaged, it allows liquid leaks. Leaks are usually visible, and thus are easily detected. If there is leakage in any of the locations described below, the piston seal is damaged and should be replaced (see Section 5.2).

  If the piston seal wash assembly is in use: Leaks are not visible when the piston seal wash assembly is in use.

  If the piston seal wash assembly is not in use (for example, because the flush bottle is empty): Check for leaks near the drain tube on the bottom of each pump head.

5 • Service

This chapter describes GS50 Gradient Pump service and repair procedures that the user can perform. All procedures not included here, including electronics-related repair procedures, must be performed by Dionex personnel. For assistance, contact Dionex Technical Support. In the U.S., call 1-800-346-6390. Outside the U.S., call the nearest Dionex office.

Before replacing any part, refer to the troubleshooting information in Section 4 to isolate the cause of the problem.

IMPORTANT **Substituting non-Dionex parts may impair GS50 performance, thereby voiding the product warranty. Refer to the warranty statement in the Dionex Terms and Conditions for more information.**

5.1 Cleaning and Replacing the Check Valves

A dirty check valve causes erratic flow rates and pressures; it may also cause the pump to lose prime and/or be difficult to reprime.

1. Turn off the main power switch, to ensure that you do not unintentionally start the GS50.
2. Disconnect the tube fittings from the inlet and outlet check valve housings on the primary pump head (see Figure 5-1).
3. Use a 1/2-inch wrench to loosen both check valve housings. Remove the check valve housings and cartridges from the pump head. Carefully remove the check valve cartridges from the housings.
4. Place the check valve housings and cartridges in a beaker with methanol. Sonicate or agitate the parts for several minutes.
5. Rinse each check valve housing and cartridge thoroughly with filtered deionized water.

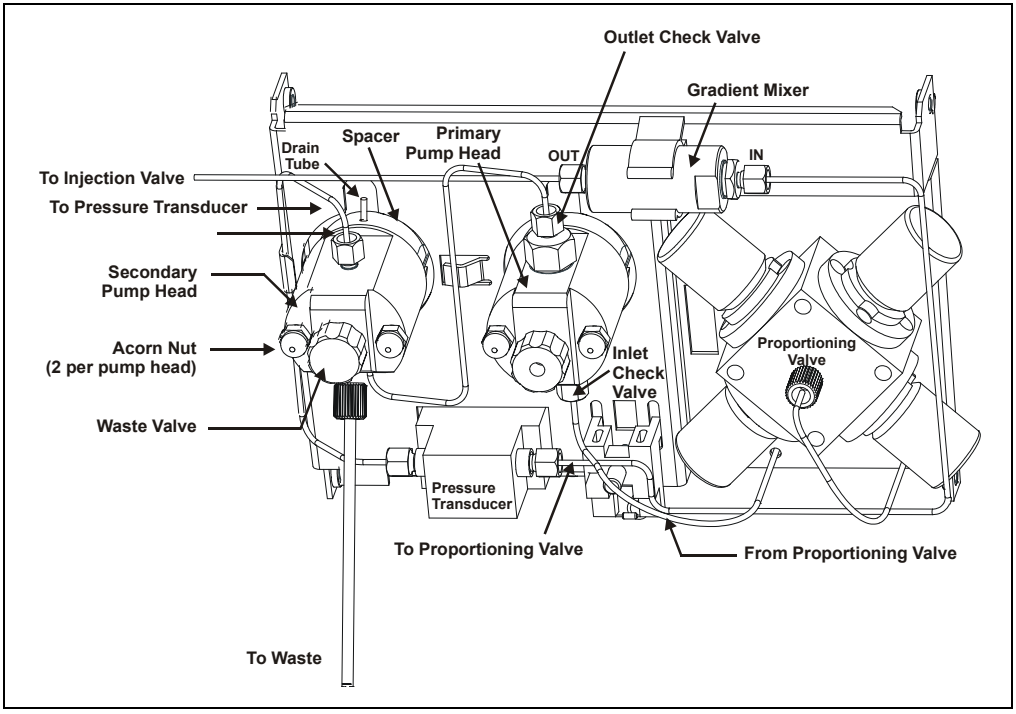


Figure 5-1. Pump Heads and Liquid Lines

6. The *inlet* check valve assembly housing has a 1/4-28 port. Replace the cartridge in the inlet check valve housing, making sure the double-hole end of the cartridge is visible.

   The *outlet* check valve assembly housing has a 10-32 port. Replace the cartridge in the outlet check valve housing, making sure the single-hole end of the cartridge is visible. Liquid flows through the check valve in the large single hole and out the small double holes.

   NOTE The pump will not operate properly unless the cartridge is installed in the housing in the correct orientation.

7. Reinstall the check valves. Be sure to install the inlet check valve on the bottom of the primary pump head and the outlet check valve on the top of the head. Tighten the check valves fingertight, and then use a wrench to tighten an additional one-quarter to one-half turn. Tighten a *little more* only if the valve leaks.

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

8. Reconnect the liquid lines. Turn on the GS50 main power.
9. Prime the pump (see Section B.2.7).

   If you cannot prime the pump and all other possible causes of the problem have been eliminated, replace the check valve (inlet check valve assembly, P/N 047660; outlet check valve assembly, P/N 047657).

   After replacing the check valve assembly, go to the **USAGE LOG** screen (see Section C.2.4). Move the cursor to the **VALVES IN USE** field and press **Enter** to reset the field to 0 cycles.

5.2 Replacing a Piston Seal and Piston Rinse Seal

A damaged piston seal allows leakage past the piston, as well as leakage from the seal wash housing. The pump may be difficult to prime, flow rates may be unstable, and there may be baseline noise.

Removing the Head and Piston

1. Turn off the main power switch, to ensure that you do not unintentionally start the GS50.
2. Disconnect all tubing connections to the pump head.
3. Remove the two acorn nuts and washers from the pump head (see Figure 5-1).
4. Carefully disengage the head from the piston by pulling the head straight off, and away from, the studs.

Lateral motion while disengaging the pump head from the piston may break the piston.

Un mouvement latéral pendant la séparation de la tête et du piston peut casser le piston.

Vermeiden Sie Seitwärtsbewegungen, wenn Sie den Kopf vom Kolben lösen. Andernfalls kann der Kolben brechen.

5. Place the head (front end down) on a clean work surface and lift off the spacer to expose the piston seal (see Figure 5-2 or Figure 5-3).
6. The piston does not come off as part of the pump head assembly because it is captured by a magnetic retention system. After removing the pump head, hold the shaft of the piston (near the base), tilt the piston slightly, and pull the piston away from the pump.

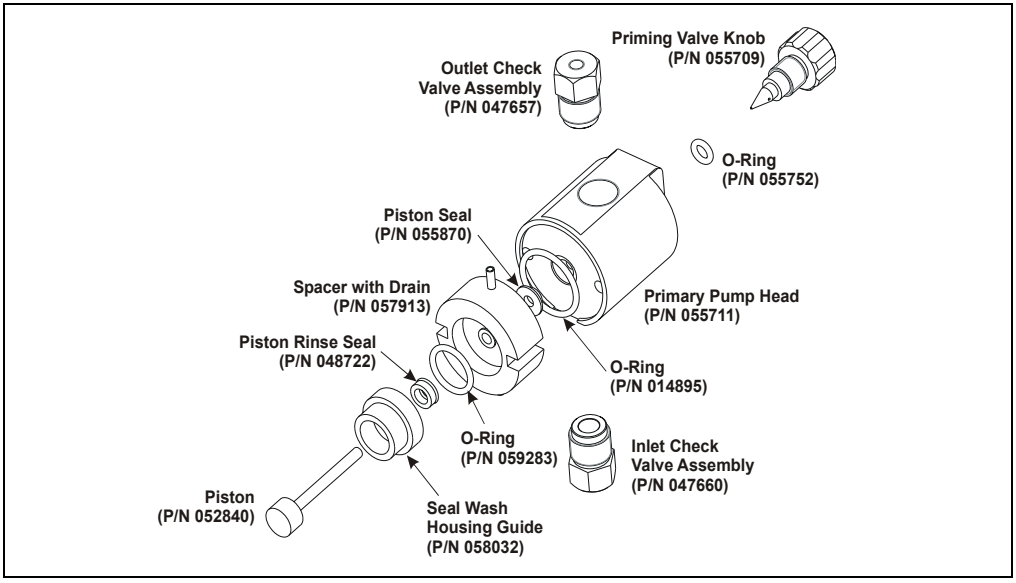


Figure 5-2. Primary Pump Head

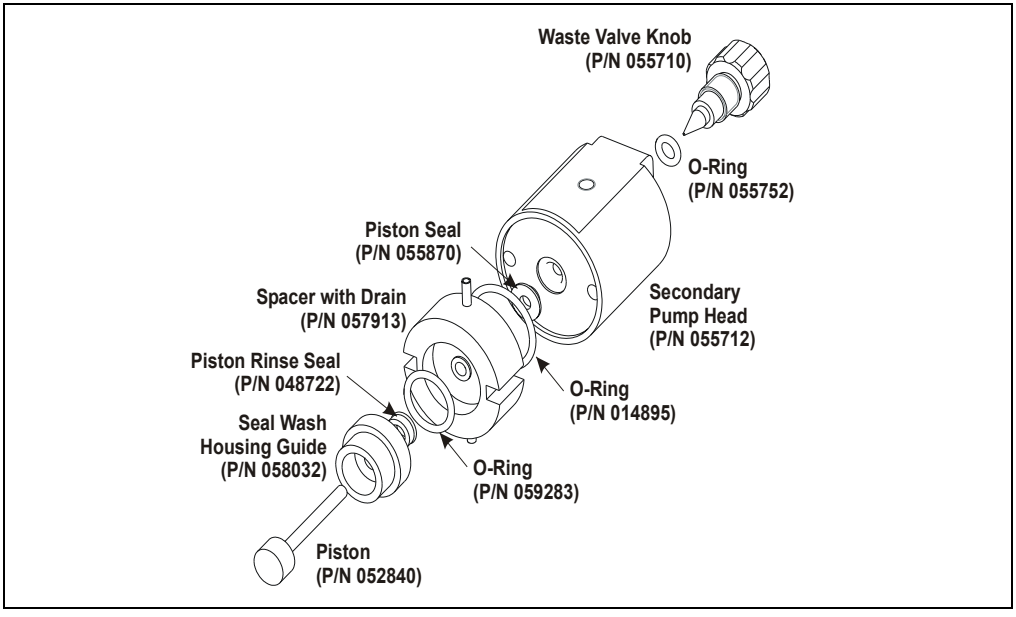
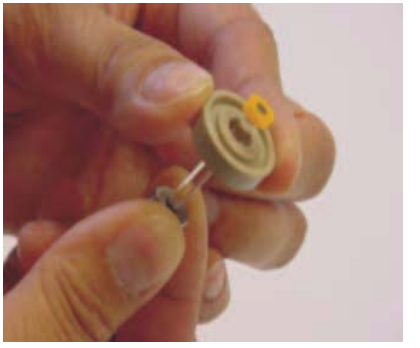


Figure 5-3. Secondary Pump Head

Installing the New Piston Rinse Seal

1. Remove the seal wash guide from the spacer to expose the piston rinse seal and O-ring. Remove the O-ring.
2. Remove the old piston rinse seal from the guide as follows:
   a. Hold the guide with the flat side facing up.
   b. To dislodge the piston rinse seal, gently insert the shaft of the piston through the small hole in the center of the guide (see photo below).



   c. Pull the seal off the end of the piston shaft and remove the piston from the guide.
3. Hold the new piston rinse seal (P/N 048722) with the grooved side facing up.
4. Using your fingertip, gently press the piston rinse seal into the guide until the edge of the seal is below the surface of the guide.

IMPORTANT **The piston rinse seal is made of soft plastic. Do not press on the seal with anything hard or sharp, including your fingernail. If the seal is nicked or gouged, it will not seal properly and may result in leaks.**

5. Place the new O-ring (P/N 059283) into the groove in the guide.
6. Remove the O-ring from the groove in the flat side of the spacer and replace it with the new O-ring (P/N 014895).
7. In one hand, hold the guide with the O-ring and piston rinse seal facing up (this prevents the O-ring from falling out). In the other hand, hold the spacer with the cavity facing down.
8. Gently press the guide into the cavity in the spacer until it is fully seated.

Removing the Piston Seal from the Head

1. Fill the head cavity with deionized water by injecting the liquid through either the piston opening or the inlet check valve.
2. Reinsert the piston approximately 1/8 inch into the seal.
3. If this is the *primary* pump head, install a 10-32 fitting plug (P/N 042772) on the outlet check valve. Tighten the plug.

   If this is the *secondary* pump head, install a 10-32 fitting plug (P/N 042772) in both the inlet and outlet ports. Tighten the plugs.
4. Push the piston into the head. (This should hydraulically unseat the seal from the head.) Remove the piston and pull off the seal.

   NOTE If the piston seal is not removed, make sure the 10-32 fitting plug(s) are tight and add more water. Make sure the head contains no air bubbles, and then repeat Steps 2 and 4.
5. Remove the 10-32 fitting plug(s).

Installing the New Piston Seal

1. Open the priming valve knob (primary pump head) or waste valve knob (secondary pump head) by turning the knob one-quarter to one-half turn counterclockwise.
2. Push the piston through the spacer and then through the new seal. Insert the piston and seal into the pump head until the seal makes contact with the bottom of the counterbore. Remove the piston.

   NOTE If necessary, lubricate the seal with a small amount of isopropyl alcohol to facilitate insertion.
3. To seat the seal, push down on the spacer until it is flush with the head. A clicking sound indicates that the seal is correctly seated.
4. Close the priming valve knob or waste valve knob.

Reinstalling the Head and Piston

Dionex recommends reinstalling the head and piston as a single assembly, so that the piston centers itself onto the magnetic follower.

1. Hold the assembled spacer and stud with the drain tubes aligned vertically and press the spacer into the head until it is flush with the indented surface of the head.
2. Insert the piston so that 1/4 inch of the shaft is exposed. This ensures that the magnet in the follower picks up the piston. (The follower is the rod that holds the piston in place as it moves in and out of the pump head assembly.)
3. Reinstall the head and piston. Place the washers and acorn nuts on the studs, and use a wrench to tighten the acorn nuts evenly (12 in-lb torque).

Completing the Procedure

1. Reconnect all liquid lines to the pump head.
2. Turn on the main power switch.
3. Open the eluent valve.
4. Prime the pump (see Section B.2.7).

5.3 Pump Piston Replacement

Continued leaking of the piston seal after installation of a new seal (assuming the pump head is tight) indicates a dirty or scratched pump head and/or a broken piston.

1. Turn off the main power switch, to ensure that you do not unintentionally start the GS50.
2. Disconnect the tube fittings to the pump head with the defective piston (see Figure 5-1).
3. Remove the two acorn nuts and washers from the pump head (see Figure 5-1).
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 studs.

Lateral motion while disengaging the pump head from the piston may break the piston.

Un mouvement latéral pendant la séparation de la tête et du piston peut casser le piston.

Vermeiden Sie Seitwärtsbewegungen, wenn Sie den Kopf vom Kolben lösen. Andernfalls kann der Kolben brechen.

NOTE The piston is not removed with the rest of the pump head assembly because it is captured by a magnetic retention system.

5. After removing the pump head, hold the shaft of the piston (near the base), tilt the piston slightly, and pull the piston away from the pump.
6. Replace the piston (P/N 052840) and piston seal (P/N 055870).

7. Dionex recommends reinstalling the head and piston as a single assembly, so that the piston centers itself.
    a. Check that the piston rinse seal and O-ring are seated in the seal wash housing guide. Press the seal wash housing guide into the head until it is flush with the indented surface of the head.
    b. Insert the piston into the head so that one-quarter inch of the shaft is exposed. This ensures that the magnet in the follower picks up the piston. (The follower is the rod that holds the piston in place as it moves in and out of the pump head assembly.)
    c. Reinstall the head and piston. Place the washers and acorn nuts on the studs, and use a wrench to tighten the acorn nuts evenly (12 in-lb torque).
8. Reconnect the tube fittings to the pump head.
9. Turn on the main power switch.
10. Prime the pump (see Section B.2.7).

5.4 Waste Valve or Priming Valve O-Ring Replacement

A damaged O-ring causes leakage around the base of the waste valve or priming valve knob.

1. Turn off the main power switch, to ensure that you do not unintentionally start the GS50.
2. To remove the waste valve or priming valve from the pump head (see Figure 5-1), turn the appropriate knob counterclockwise until it is loose, and then pull the knob straight out of the cavity in the pump head.
3. If the O-ring is removed with the valve knob in Step 2, pull the O-ring off the end of the knob (see Figure 5-4).

   If the O-ring is not removed with the valve knob, insert a thin object *without sharp surfaces* into the cavity in the pump head and carefully pull out the O-ring. **Do not scratch the cavity.**

IMPORTANT **Scratches in the cavity will cause leaks around the base of the knob while the pump is being primed.**

4. Slide a new O-ring (P/N 055752) over the end of the valve.
5. To reinstall the valve containing the new O-ring, turn the knob clockwise and then tighten fingertight.

NOTE **It is normal to encounter resistance after several rotations of the knob because the O-ring is being pushed into the cavity of the pump head.**

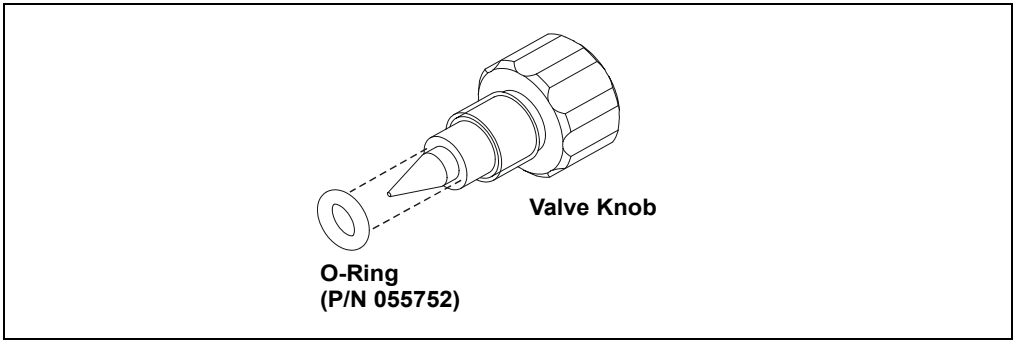


Figure 5-4. Waste Valve or Priming Valve O-Ring Replacement

5.5 Proportioning Valve Assembly Replacement

A defective eluent proportioning valve can cause the following problems: leaks, nonreproducible eluent compositions (which may cause retention time shifts), and flow restrictions (which may cause high backpressure).

1. Turn off the main power switch, to ensure that you do not unintentionally start the GS50.
2. If the eluent reservoirs are pressurized, turn off the pressure and allow the reservoirs to vent.
3. Follow these steps to disconnect the electrical connector for the proportioning valve assembly from the distribution card.
    a. Using a Phillips screwdriver, remove the screw that secures the mechanical chassis drawer to the enclosure. The screw is on the lower left side of the chassis, below the secondary pump head (see the label on the inside of the lower door).
    b. Pull out the mechanical chassis drawer a few inches.
    c. The distribution card is located on the top of the mechanical chassis. Locate the electrical connector labeled **VALVES** at the front of the card. Disconnect the connector from the card.
4. Disconnect the liquid line from the outlet of the proportioning valve assembly (see Figure 5-5).
5. Loosen the screws securing the proportioning valve assembly to the bulkhead. Pull the valve assembly forward and disconnect the eluent lines on the inlet. Remove the valve assembly from the bulkhead.
6. Thread the bundle of electrical lines from the new valve assembly (P/N 046203) through the bulkhead and up to the distribution card. Connect the valve electrical connector to the **VALVES** connector on the distribution card.

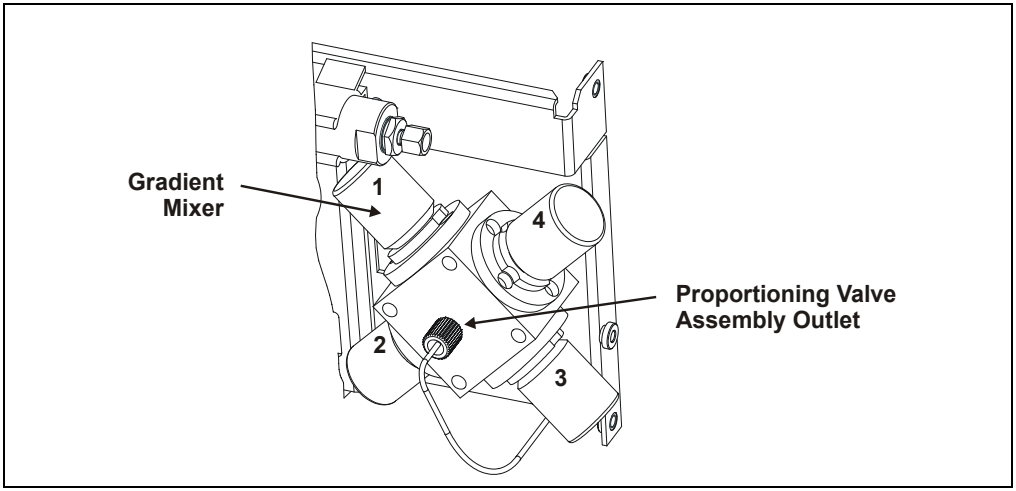


Figure 5-5. Eluent Proportioning Valve Assembly

7. Connect the eluent lines to the new valve assembly. Make sure eluent lines A through D are in the appropriate valve ports. Connect eluent line A to the port marked #1, eluent B to the port marked #2, and so on.

CAUTION

Tighten liquid connections to the proportioning valves no more than fingertight plus one-quarter turn. Overtightening or crossthreading the valve fittings may strip the threads in the block.

8. Align the new valve assembly as shown in Figure 5-5 and mount it to the bulkhead. Tighten the screws.
9. Push the mechanical chassis drawer back in place. Make sure the cables are not pinched and then reinstall the drawer lock screw.
10. Attach the liquid line from the inlet of the primary pump head (see Figure 5-1).
11. Prime the pump (see Section B.2.7).

5.6 Changing Main Power Fuses

1. Turn off the main power switch.

DANGER

HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the GS50.

DANGER

HAUTE TENSION—Débranchez le cordon d'alimentation principal de sa source et du panneau arrière du GS50.

ACHTUNG

HOCHSPANNUNG—Ziehen Sie das Netzkabel aus der Steckdose und der Netzbuchse auf der Rückseite des GS50.

2. The fuse holder is part of the main power receptacle on the GS50 rear panel (see Figure 5-6). Note the recessed lock located on each side of the fuse holder.

   Using a small screwdriver, push each lock toward the center to release it. When both locks are released and the fuse holder pops out slightly, pull the fuse holder straight out of its compartment.

3. Replace the two fuses in the holder with new IEC 127 fast-blow fuses rated 3.15 amps (P/N 054745). Dionex recommends always replacing both fuses at the same time.

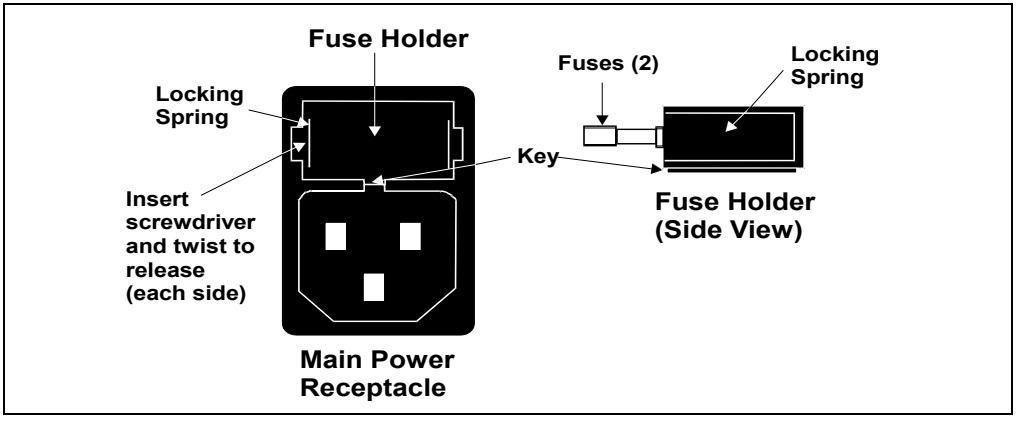


Figure 5-6. Main Power Fuse Holder

4. Reinsert the fuse holder into its compartment. Apply enough pressure evenly against the holder to engage the two locks; when both locks are engaged, the holder is flush against the panel.
5. Reconnect the main power cord and turn on the power.

5.7 Changing the GS50 Delay Volume (Optional)

The GS50 is plumbed at the factory to ensure a low delay volume (<400 µL). Section 5.7 explains how to modify the GS50 plumbing to obtain the standard delay volume of <800 µL. Increasing the delay volume will improve mixing noise at flow rates of 1.0 mL/min and above.

The replumbing procedure requires two simple changes:

- Replacement of the tubing assembly installed between the eluent proportioning valve and the primary pump head.
- Replacement of the gradient mixer.

The standard delay volume conversion kit (P/N 056968) contains all the parts required for this procedure.

Standard Delay Volume Conversion Kit

Part Number	Item	Quantity
055878	Tubing Assembly, 0.8-mm (0.030-in) ID	1
043275	10-32 Fitting Bolt	2
043276	Ferrule Fitting	2
054044	GM-5 Gradient Mixer	1
055860	Component Clip, 3/4 inch	1
045796	Screw, M3 x 8	1
045691	Washer	1

Conversion procedure

1. Turn off the main power switch, to ensure that you do not unintentionally start the GS50.
2. Using a Phillips screwdriver, remove the screw that secures the mechanical chassis drawer to the enclosure. The screw is on the lower left side of the chassis, below the secondary pump head (see the label on the inside of the lower door). Pull out the drawer approximately 15 cm (6 in).
3. Remove the tubing assembly installed between the proportioning valve and the primary pump head (see Figure 5-7).
    a. Disconnect the tubing connected to the inlet check valve housing.
    b. Push the tubing through the small opening in the bulkhead near port 2 of the proportioning valve.
    c. Disconnect the tubing connected to the proportioning valve outlet and push the tubing through the small opening in the bulkhead near port 3 of the proportioning valve.
    d. Remove the tubing assembly from the drawer and set it aside.

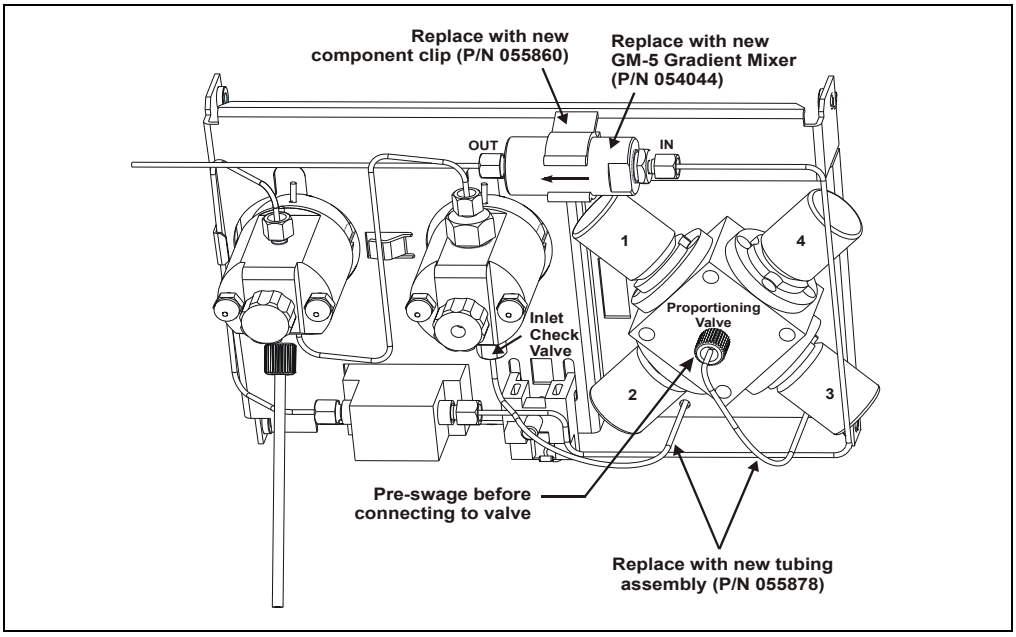


Figure 5-7. Replumbing the GS50 to Change the Delay Volume

4. Install the new tubing assembly:
    a. Locate the tubing assembly, as well as the two 1/4-28 fittings (P/N 052230) and two ferrule fittings (P/N 052231) included in the package with the tubing.
    b. From the rear of the bulkhead, insert one end of the new tubing assembly through the opening near port 2 and feed the tubing through the opening.
    c. Install a 1/4-28 fitting and a ferrule fitting on this end of the tubing. Connect the tubing to the inlet check valve housing.
    d. From the rear of the bulkhead, insert the other end of the tubing assembly through the opening near port 3 and feed the tubing through the opening.
    e. Install a 1/4-28 fitting and a ferrule fitting on this end of the tubing. Insert the tubing into the drain port on the secondary pump head and tighten to pre-swage (i.e., compress) the ferrule. (This will improve the connection to the proportioning valve.)
    f. Remove the tubing from the drain port, connect it to the proportioning valve outlet, and tighten fingertight.
5. Disconnect the inlet and outlet lines from the gradient mixer currently installed in the pump. Set the mixer aside.
6. Remove the hardware (component clip, washer, and screw) that secured the gradient mixer to the bulkhead.
7. Install the new component clip, washer, and screw.
8. Remove the plug from each end of the new gradient mixer and install the mixer in the clip. Connect the inlet and outlet lines to the mixer.
9. Push the mechanical chassis drawer back in place, making sure the cables are not pinched. Reinstall the drawer lock screw.
10. Prime the pump (see Section B.2.7).

NOTE **Store the tubing assembly, gradient mixer, and mounting hardware removed from the GS50 in a safe place. If it is ever necessary to return the pump to the low delay volume, these parts must be reinstalled.**

A • Specifications

A.1 Physical

Dimensions	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 (2.5 in) clearance required behind the module
Weight	19 kg (42 lb)
Decibel Level	60 db (“A WEIGHTING” setting)

A.2 Environmental

Operating Temperature	10 to 50 °C (50 to 104 °F)
Operating Humidity	5% to 95% relative humidity (noncondensing)

A.3 Electrical

Main Power Requirements	100 to 240 Vac, 50/60 Hz; 2.5 amps. No manual adjustment is required; the GS50 power supply is main voltage auto-sensing.
Fuse Requirements	Two 3.15 amp fast-blow IEC 127 fuses (P/N 954745)

A.4 Display and Keypad

Display	Liquid crystal with adjustable backlighting.
Keypad	26-button pad for entering commands and numeric values for screen parameters.

A.5 Hydraulics

Eluent Selection	Four different eluent components; each eluent can be proportioned from 0% to 100%
Pump	Dual-piston (in series), variable speed, 100 µL per revolution
Settable Flow Range	0.0 mL/min, or from 0.05 to 5.0 mL/min in increments of 0.01 mL/min. Note: The GS50 is optimized for operation at 1.5 mL/min or less.
Proportioning Type	Low pressure
Compositional Range	0% to 100% in 0.1% increments
Gradient Linearity	Four concave, four convex, one linear
Flow Accuracy	<1% of set value or ± 2 µL/min, whichever is greater
Flow Precision	<0.2%
Compositional Accuracy	<± 1%
Operating Pressure	35 MPa (5000 psi), maximum
High Pressure Limit	691 kPa to 35 MPa (100 to 5000 psi) in increments of 0.1 MPa (14 psi); trips instantaneously
Low Pressure Limit	0 to 34 MPa (0 to 4900 psi) in increments of 0.1 MPa (14 psi); a start-up delay prevents false tripping
Delay Volume	Low delay volume: <400 µL Standard delay volume: <800 µL
Pressure Ripple	<1% at 13.8 MPa (2000 psi) and 1.0 mL/min

A.6 Control Modes

Remote Limited remote operation via TTL-input logic level and TTL-output and Relay contact closures *or* full remote programming and control via the Dionex DX-LAN interface.

Local (Front Panel) *Methods:* Stores up to 100 separate methods (00 through 99); the actual number depends on available memory. Each method can contain up to 50 separate steps.
Storage: Nonvolatile memory protects against the loss of programs when the pump is turned off or if there is a power failure.

A.7 Vacuum Degas Assembly (Optional)

Channels 4-channel degas chamber (with degas membranes)

Pump Dual-stage diaphragm vacuum pump

Materials Wetted materials, PEEK, PTFE

B • Installation

B.1 Facility Requirements

- Make sure the GS50 installation site meets the electrical and environmental specifications in Appendix A.
- Install the GS50 on a sturdy workbench at a height that ensures convenient viewing of the front panel display.

Lift the GS50 only from the bottom or side surfaces of the module. Lifting by the front doors will damage the door hinges. Use caution when lifting the module: it weighs 19 kg (42 lb).

Ne soulevez le GS50 que par le fond ou les côtés. Son soulèvement par la porte du panneau avant endommagera les charnières de la porte. Soyez prudent lorsque vous soulevez le GS50: il pèse 19 kg.

Wenn Sie den GS50 anheben oder bewegen möchten, greifen Sie bitte unter den Boden oder heben Sie das Gerät an den Seiten an. Heben Sie das Gerät nicht an der Vordertür an. Dadurch können die Türangeln beschädigt werden. Seien Sie vorsichtig, wenn Sie den GS50 anheben. Das Gerät wiegt 19 kg.

- Allow at least 6 cm (2.5 in) of free space behind the GS50 for connections and ventilation.
- House eluents at least 20 cm (8 in) above the GS50 in an EO1 Eluent Organizer (P/N 044125) or in built-in eluent containment (for example, the reservoir container of the LC25 Chromatography Oven).

B.2 Installation Instructions

NOTE The GS50 Ship Kit (P/N 061222) contains several items needed to install the pump. Locate the Ship Kit before beginning the installation.

B.2.1 Power Connection

SHOCK HAZARD—To avoid electrical shock, use a grounded receptacle. Do not operate the GS50 or connect it to AC power mains without an earthed ground connection.

The power supply cord is used as the main disconnect device. Make sure the socket-outlet is located near the GS50 and is easily accessible.

Operation at AC input levels outside of the specified operating voltage range may damage the GS50.

DANGER D'ÉLECTROCUTION—Pour éviter toute électrocution, il faut utiliser une prise de courant avec prise de terre. Ne l'utilisez pas et ne le branchez pas au secteur C.A. sans utiliser de branchement mis à la terre.

Le cordon d'alimentation principal est utilisé comme dispositif principal de débranchement. Veillez à ce que la prise de base soit située/installée près du module et facilement accessible.

STROMSCHLAGGEFAHR—Zur Vermeidung von elektrischen Schlägen ist eine geerdete Steckdose zu verwenden. Das Gerät darf nicht ohne Erdung betrieben bzw. an Wechselstrom angeschlossen werden.

Das Netzkabel ist das wichtigste Mittel zur Stromunterbrechung. Stellen Sie sicher, daß sich die Steckdose nahe am Gerät befindet und leicht zugänglich ist.

The GS50 power supply is auto-sensing; thus, no adjustment is required to select the line voltage. There are two ways to control power to the GS50:

- On/off control from the GS50

  To implement: Connect a modular power cord (IEC 320 C13) from the GS50 main power receptacle (see Figure B-1) to a grounded, single-phase power source. Use the GS50 power switch actuator to turn the pump on and off.

- Control from the LC30 Chromatography Oven

  To implement: Locate one of the IEC jumper cables (P/N 960748) provided in the LC30 Ship Kit. Connect the jumper cable from the GS50 main power receptacle (see Figure B-1) to an IEC auxiliary receptacle on the LC30 rear panel. Leave the GS50 power switch on continuously and use the LC30 main power switch to turn the pump on and off.

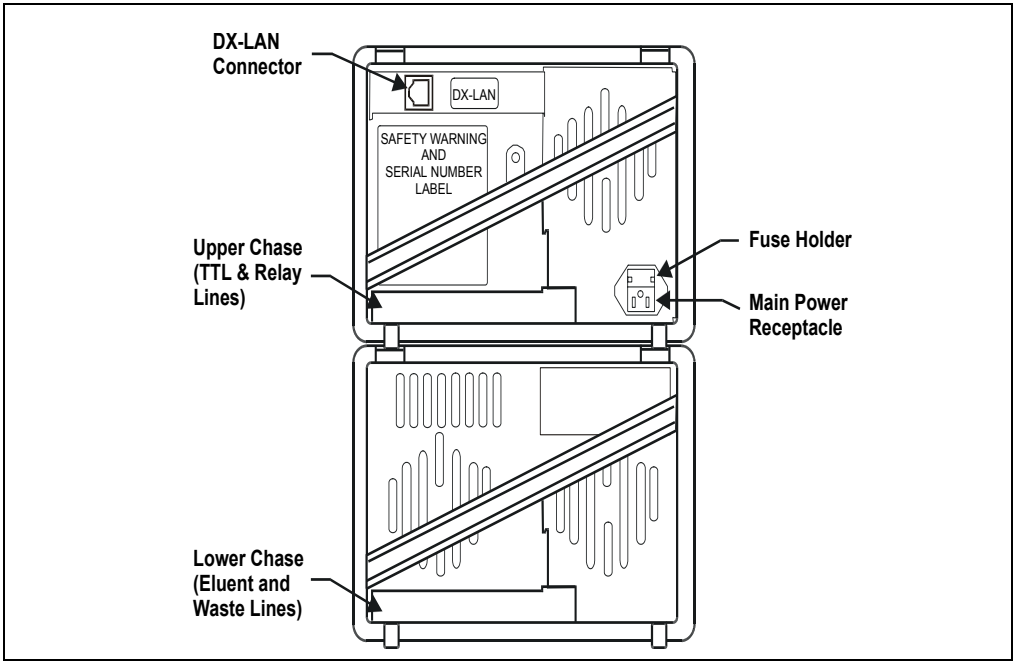


Figure B-1. GS50 Rear Panel Connections

B.2.2 Electronics Chassis Connections

Connections to the GS50 electronics chassis vary, depending on which Dionex chromatography module is being connected to the pump. For instructions, refer to the appropriate section below.

LC30 Connections

1. Route the RJ-11 serial cable from the rear of the LC30 Chromatography Oven through the GS50 upper chase (see Figure B-1). Connect the cable to the **LC COMM** connector in slot 1 of the GS50 electronics chassis (see Figure B-2).
2. Route the solenoid valve cable from the rear of the LC30 through the GS50 upper chase. Connect the cable to the **LC AIR** connector in slot 1 (see Figure B-2).

NOTE Do not connect the LC30 to the LC LEAK connector in slot 1; the oven contains internal leak control electronics.

LC25 Connections

Route the electronics injection valve cable from the rear of the LC25 Chromatography Oven through the GS50 upper chase (see Figure B-1). Connect the cable to the **LC AIR** connector in slot 1 of the GS50 electronics chassis (see Figure B-2).

NOTE Do not connect the LC25 to the LC LEAK connector in slot 1; the oven contains internal leak control electronics.

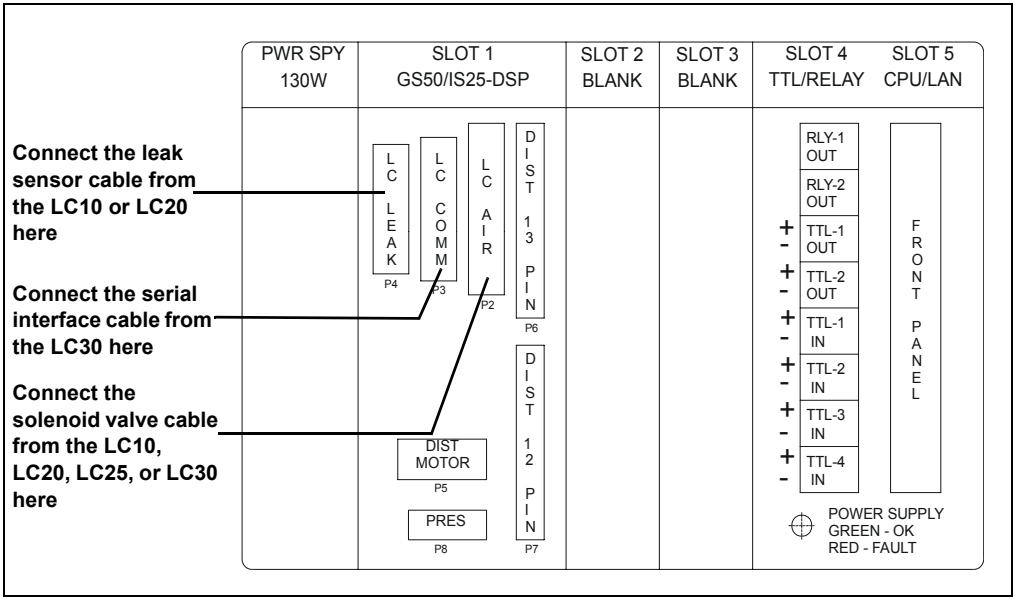


Figure B-2. GS50 Electronics Chassis
(Located behind pump upper door)

LC10 or LC20 Connections

1. Route the leak sensor cable from the rear of the LC10 Chromatography Organizer or LC20 Chromatography Enclosure through the GS50 upper chase (see Figure B-1). Connect the cable to the **LC LEAK** connector in slot 1 of the GS50 electronics chassis (see Figure B-2).
2. Route the solenoid valve cable from the rear of the LC10 or LC20 through the GS50 upper chase. Connect the cable to the **LC AIR** connector in slot 1 (see Figure B-2).

NOTE Refer to Appendix E for TTL and Relay installation instructions.

B.2.3 DX-LAN Interface (Optional)

The DX-LAN interface enables the GS50 to communicate with a host computer running either Chromeleon or PeakNet 6 software. The interface also includes the CPU/LAN card (see Figure B-2) installed in the GS50 at the factory.

1. Install the "combo" 10BASE-T Ethernet hub (P/N 057398) on a workbench or on the wall. For installation instructions and site requirements, refer to the installation guide shipped with the hub.
2. Plug the 10BASE-T DX-LAN cable (P/N 960281) into a 10BASE-T port on the front panel of the hub.

IMPORTANT **The 10BASE-T DX-LAN cable is a Category 5 unshielded twisted-pair cable. Do not substitute a cable of an inferior grade. Failure to use the correct cable will cause the pump to lose communication with the host computer.**

3. Connect the other end of the cable into the 10BASE-T DX-LAN connector on the GS50 rear panel (see Figure B-1).
4. Connect a 10BASE-T cable (P/N 960281) from a 10BASE-T port on the hub to the 10BASE-T port on the host computer's internal DX-LAN card. If the connection is via port 8 on the hub, set the Normal/Uplink push button to Normal.

NOTE **For installation instructions for the internal DX-LAN card, refer to *Installing the Chromeleon IC System* (Document No. 031883) or *Installing the Dionex PeakNet 6 System* (Document No. 031631).**

IMPORTANT **When using 10BASE-T cabling, you must install a hub. If you simply plug the 10BASE-T cable from the pump into the connector on the host computer's DX-LAN card, the connection will either not work or will be unreliable.**

Cascading Hubs

Cascading (connecting two or more hubs together via their 10BASE-T ports) increases the number of ports or the number of users supported on the network. For instructions on how to cascade hubs, refer to the installation guide shipped with the hub.

B.2.4 Waste Lines

Two waste lines are installed at the factory and routed to the GS50 rear panel.

- One waste line exits the waste valve on the secondary pump head.
- One waste line exits the leak drain.

A third waste line is installed at the user site when the piston seal wash assembly is connected (see Section B.2.6).

Place the free ends of the waste lines into one waste container. To maintain a positive siphon, position the waste container below the level of the GS50.

NOTE For proper drainage, the leak drain line and seal wash line should remain above the liquid level in the waste container.

B.2.5 Eluent Line Connections

Eluent Inlet Line Connections

Eluent lines A through D are plumbed to the GS50 at the factory. To complete the installation, attach the free end of each line to the corresponding eluent reservoir.

Eluent Outlet Line Connections

Connect the tubing exiting the GM-4 Gradient Mixer to the injection valve (see Figure 5-1).

NOTE Although the GS50 does not *require* pressurized reservoirs, degassed eluents and pressurized reservoirs are important when using eluents that are manually degassed or eluents that are sensitive to carbonate (NaOH) contamination. For a list of

pressurizable reservoirs available from Dionex, see Section 2.6.

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

N'utilisez pas le réservoir en plastique de 2 litres (N/P 044129) pour le dégazage à vide hors ligne d'éluants. Le réservoir n'a pas été conçu à cette fin.

Verwenden Sie den 2-Liter Plastikbehälter (Bestell-Nr. 044129) nicht zum Offline Vakkum-Entgasen von Eluenten. Der Behälter ist dafür nicht ausgelegt.

B.2.6 Piston Seal Wash Connections (Optional)

The GS50 includes a piston seal wash assembly intended to continuously rinse the back of the piston seals to remove salt crystals and prolong the life of the seals. Follow the steps below to set up the seal wash function.

1. Fill a flush bottle with either deionized water or a combination of deionized water and 10% or 20% isopropyl alcohol. (Isopropyl alcohol will inhibit bacterial growth in the water.)
2. Place the flush bottle above the GS50. (During operation, gravity will maintain flow through the pump heads.)
3. The flush solution is carried to the piston seal wash assembly and out to waste via clear 1.5-mm (0.06-in) ID tubing (P/N 055847). Locate this tubing in the GS50 Ship Kit and cut the tubing into three unequal pieces in the following lengths:
   - 117 cm (46 in)
   - 152 cm (60 in)
   - 15 cm (6 in)

4. Install the tubing as follows (see Figure B-3):
   a. Push the 117-cm (46-in) piece of clear tubing onto the drain tube on the bottom of the *secondary* pump head. Place the free end of this tubing in the flush bottle. Make sure the end of the tubing is near the bottom of the bottle.
   b. Push the 152-cm (60-in) piece of clear tubing onto the drain tube on the top of the *primary* pump head. This is the waste line. Route this waste line through the lower tubing chase and out the back of the GS50.
   c. Push the 15-cm (6-in) piece of clear tubing over the drain tube on the top of the *secondary* pump head. Push the other end of the tubing over the drain tube on the bottom of the *primary* pump head.
   d. Place a 10 mL syringe (P/N 054578) at the end of the waste line, press the syringe against the line to form a seal, and draw out all of the air. This begins the siphoning action.

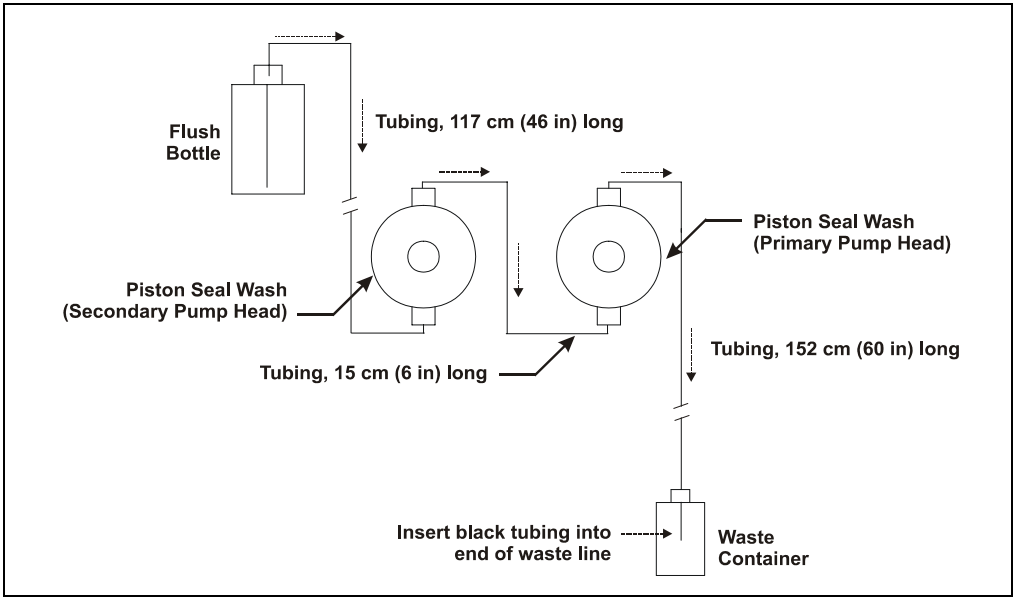


Figure B-3. Piston Seal Wash Flow Schematic

e. Push approximately 5 cm (2 in) of black 0.25-mm (0.01-in) ID tubing (P/N 057057) into the end of the waste line.

NOTE The black tubing creates a flow restriction. Assuming a height difference of about 76 cm (30 in) between the flush bottle and the waste container, this setup provides a flow of one drop of flush solution every 5 to 30 seconds.

f. Place the end of the waste line in a waste container.

NOTE For proper drainage, the waste line exit should remain above the liquid level in the waste container.

This completes the piston seal wash installation. Periodically refill the flush bottle and empty the waste container as required.

B.2.7 Priming the Pump

Section B.2.7 describes three ways to prime the pump. The first two procedures, *Priming with a Syringe* and *Priming with the* ***Prime*** *Button*, are standard procedures. If these are ineffective, try the third procedure, *Priming with Isopropyl Alcohol*.

Priming with a Syringe

NOTE Priming with a syringe is recommended after changing eluents, or when eluent lines are empty.

1. Go to the **MAIN** screen (see Section C.1.2). Check that the operating fields are set to **LOCAL** and **DIRECT CNTRL**.

   If **REMOTE** or **METHOD** is currently selected, move the cursor to the appropriate field, press **Select** ∆ or **Select** ∇ to toggle to the correct setting, and press **Enter** or a cursor arrow button.

2. Move the cursor to the desired eluent. Enter 100 (to select 100% of the eluent) and press **Enter** or a cursor arrow button.

3. Connect a 10 mL syringe (P/N 054578) to the luer port in the priming valve on the primary pump head (see Figure B-4).

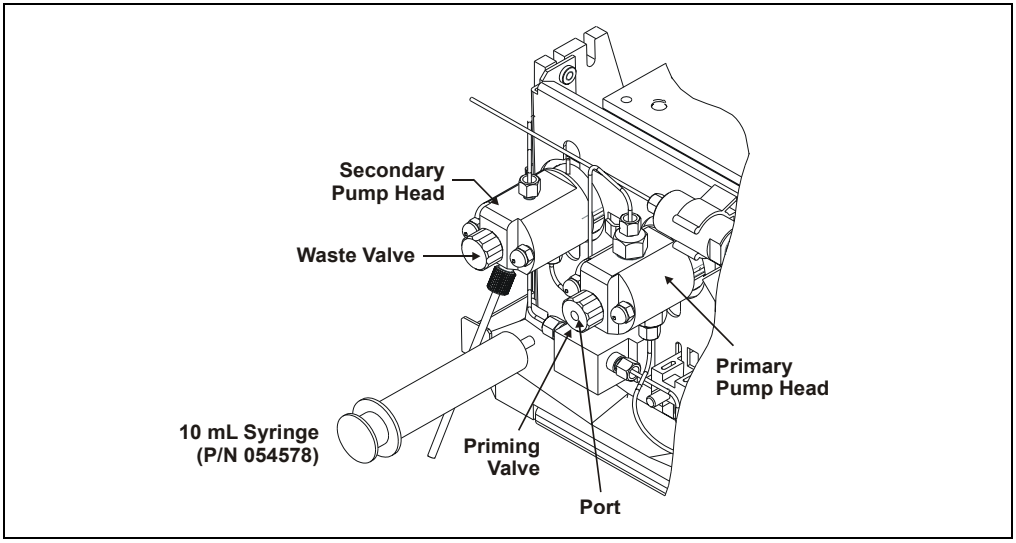


Figure B-4. Priming the Pump

4. Open the waste valve on the secondary pump head (see Figure B-4) by turning the knob one-quarter to one-half turn counterclockwise. Opening the valve directs the eluent flow path to waste and eliminates backpressure.

   NOTE If the eluent is pressurized, liquid flows into the syringe as soon as the priming valve is opened in Step 5. Do not pressurize above 55 kPa (8 psi).

5. Open the priming valve by turning it one-quarter to one-half turn counterclockwise.
6. Press **Off/On** to turn on the pump motor.
7. If the eluent is not pressurized, loosen the cap on the eluent reservoir or make sure there is a vent to the reservoir.
8. Draw the syringe back to begin pulling eluent through the flow path. It may take several syringe draws to remove all air or previous eluents from the tubing.

   NOTE If the vacuum degas assembly is installed, draw an additional 17 mL of eluent through the pump head.

9. Return to Step 2. Select another eluent and repeat the priming procedure.
10. After priming the manifold with each eluent, close the priming valve. **Do not overtighten.**
11. Press **Off/On** to turn off the pump motor. The pump is now ready for operation.

Priming with the Prime Button

1. Go to the **MAIN** screen (see Section C.1.2). Check that the operating fields are set to **LOCAL** and **DIRECT CNTRL**.

   If **REMOTE** or **METHOD** is currently selected, move the cursor to the appropriate field, press **Select** Δ or **Select** ∇ to toggle to the correct setting, and press **Enter** or a cursor arrow button.

2. Set the eluent to 100% of the line to be primed. Press **Enter** or a cursor arrow button.

3. Check that the priming valve on the primary pump head is closed (see Figure B-4).

4. Open the waste valve on the secondary pump head (see Figure B-4) by turning the knob one-quarter to one-half turn counterclockwise. Opening the valve directs the eluent flow path to waste and eliminates backpressure.

5. Press **Prime** on the GS50 front panel. The pump begins pumping at approximately 2.5 mL/min.

   NOTE The vacuum degas assembly contains 17 mL of eluent. If the degas assembly is installed, prime the GS50 for at least 7 minutes more than usual; this ensures that all air and previous eluent are purged from each channel (A, B, C, and D) of the degas assembly.

6. Continue priming the GS50 until all air and previous eluents are purged and no air bubbles can be seen exiting the waste line. If the eluent manifold has not been primed, allow several extra minutes for the eluent to pass through the pump.

7. Press **Prime** again to return to the flow rate selected for the analysis.

8. Close the waste valve. **Do not overtighten.** The pump is now ready for operation.

Priming with Isopropyl Alcohol

NOTE **Prime the pump heads with isopropyl alcohol only if the two standard priming procedures (see previous sections) are unsuccessful.**

1. Connect a 10 mL syringe (P/N 054578) filled with isopropyl alcohol (IPA) to the luer port in the primary pump head (see Figure B-4).
2. Open the waste valve on the secondary pump head (see Figure B-4) by turning the knob one-quarter to one-half turn counterclockwise.
3. Press **Off/On** to turn on the pump motor.
4. Open the priming valve on the primary pump head (see Figure B-4) by turning it one-quarter to one-half turn counterclockwise.
5. Use the syringe to slowly push alcohol through the pump. (If the operating backpressure is high, this requires more force.)

NOTE **Be careful not to push any air trapped in the syringe through the pump. Check the waste line from the secondary pump head to verify that there are no air bubbles and that alcohol is traveling down the waste line.**

6. Close the priming valve. **Do not overtighten.** Disconnect the syringe from the priming valve.
7. Let the pump run for several minutes, to purge alcohol from the pump heads, and then press **Prime** and flush the heads with the desired eluent.

Isopropyl alcohol may damage some columns. Be sure to thoroughly rinse the alcohol from the pump before going on to Step 8.

8. Close the waste valve. **Do not overtighten.**
9. Select the flow rate required for the application.
10. Press **Off/On** to turn off the pump motor. The pump is now ready for operation.

B.3 Automatic SRS Power Control (Optional)

TTL connections can be used to automatically switch off the power to a Self-Regenerating Suppressor (SRS) when the pump flow stops. In this setup, the GS50 sends a TTL signal to the detector and then, after a 5-minute delay, the detector shuts off the SRS power. The 5-minute delay allows momentary flow interruptions without disturbing the SRS.

Follow the procedure below to implement automatic SRS power control.

1. Go to the GS50 **PUMP OPTIONS** screen and set **TTL2 OUTPUT USAGE** to **0 FLOW** (see Figure B-5).

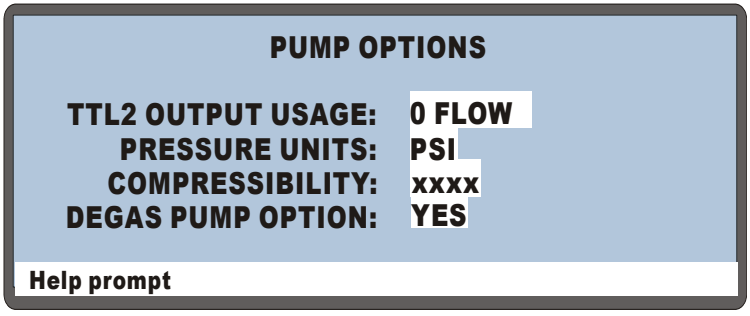


Figure B-5. Pump Options Screen

2. Go to the detector **TTL FUNCTION IN** screen and assign TTL3 to **SRS OFF/ON**.
3. In the GS50 Ship Kit (P/N 061222), locate one pair of twisted black and red wires (P/N 043598) and two green TTL connector plugs (P/N 921019).
4. Insert the twisted wires into the plugs: The signal wire (red) goes on the top of each plug and the ground wire (black) goes on the bottom of each plug.
5. Plug one end of the cable into **TTL2 OUT** on the GS50. (The TTL connectors are located behind the upper door.) Route the cable through the upper chase of the GS50 and into the upper chase of the detector (see Figure B-6). Plug the other end into **TTL3 IN** on the detector; be sure to maintain the wire orientation described in Step 4.

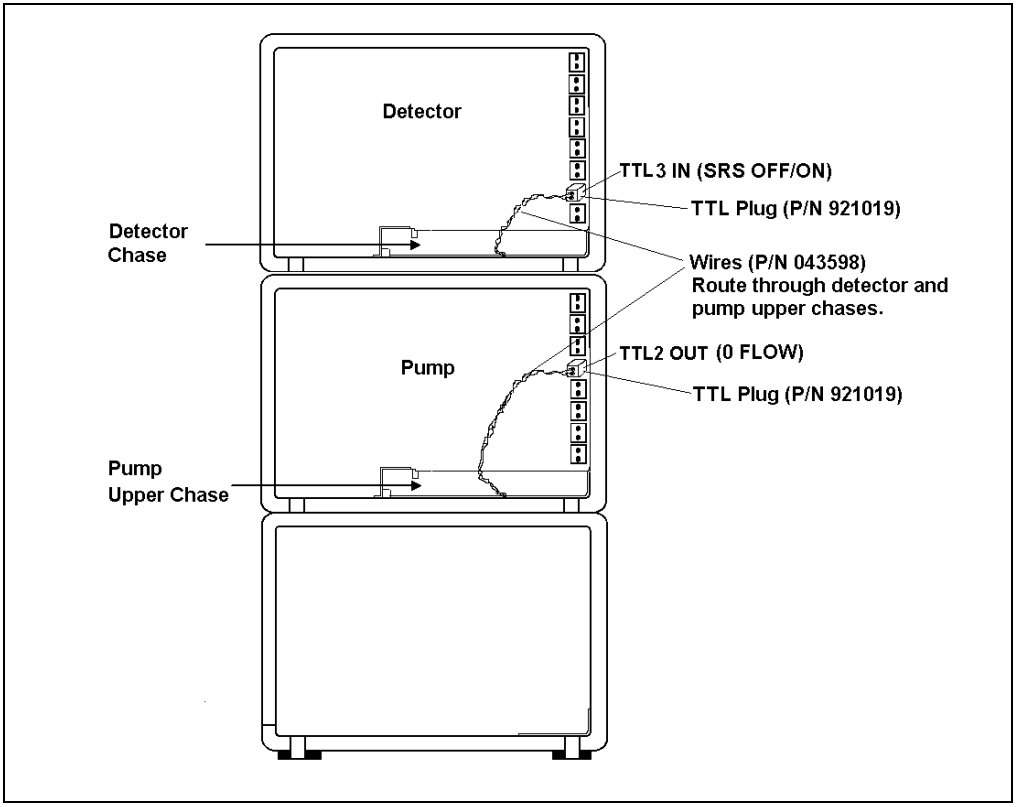


Figure B-6. TTL Connections for SRS Power Control
(Detector and pump front views without front doors)

C • User Interface

This appendix describes and illustrates all of the screens that can be displayed on the GS50 front panel. There are three types of screens: operational, diagnostic, and calibration (see Figure C-1).

- *Operational* screens allow the user to create, edit, and run methods that control pump operation, as well as select default parameters.
- *Diagnostic* screens allow the user to access diagnostic information and tests.
- *Calibration* screens allow the user to calibrate pump functions (flow rate, pressure offset, etc.).

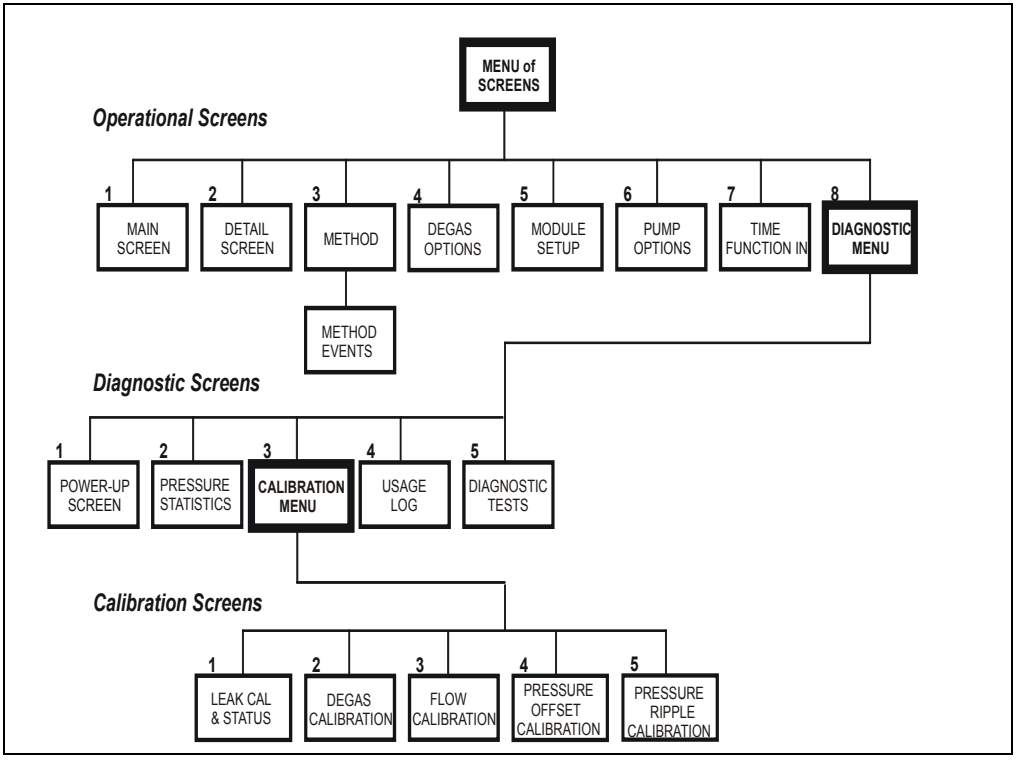


Figure C-1. GS50 Menu Structure

C.1 Operational Screens

C.1.1 Menu of Screens

The **MENU of SCREENS** provides top-level access to the menu structure.

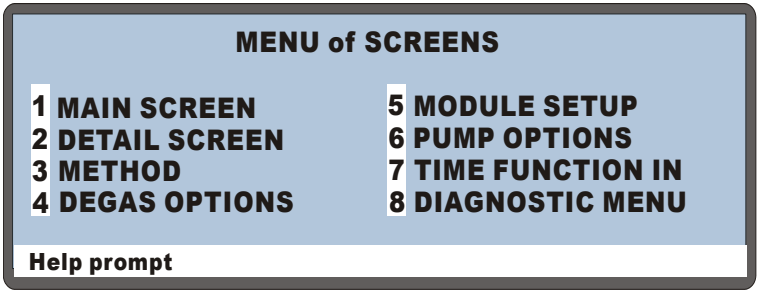


Figure C-2. Menu of Screens

NOTE **You cannot select the DEGAS OPTIONS screen unless the vacuum degas assembly (see Section 2.5) is installed.**

There are two ways to view a screen option:

- Press the numeric button on the GS50 front panel keypad that corresponds to the screen number on the menu. For example, press 3 to select and display the **METHOD** screen.
- Move the cursor to the field containing the screen number and press **Enter**.

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

C.1.2 Main Screen

The **MAIN** screen is displayed automatically after the GS50 power is turned on. Use the **MAIN** screen to:

- Select basic operating parameters (in Direct control mode) or display the status of basic operating parameters programmed on the **METHOD** screen (in Method control mode).
- Select the operating mode and control mode.
- Select the method number to run.

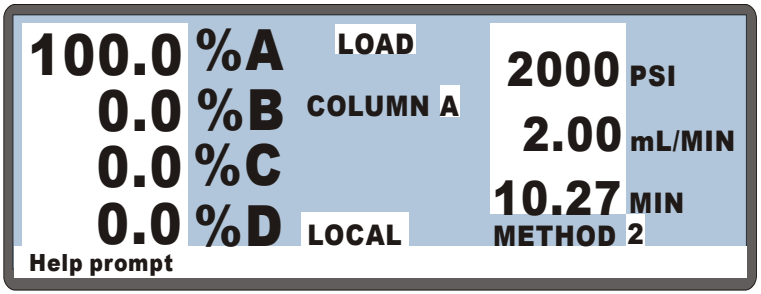


Figure C-3. Main Screen

%A–%D — Displays the percentage of each eluent (A, B, C, and D) currently in use. The pump cannot run unless the eluent percentages total 100%.

LOAD/INJECT — Selects the position of the injection valve: load or inject.

COLUMN — Selects the active column (A or B) in the chromatography module. Note that Column B is available only when a column switching valve is installed.

PSI (MPa, BAR) — Displays the system backpressure in psi, MPa, or bar. Select the unit of measure on the **PUMP OPTIONS** screen (see Section C.1.8).

mL/MIN — Displays the eluent flow rate through the pump in milliliters per minute.

MIN

Displays the total elapsed time that the method clock has been running. When a new elapsed time is entered, the method settings corresponding to the new time take effect.

LOCAL/ REMOTE

Selects the operating mode:

- Local mode is used when full control from the GS50 front panel is needed.
- Remote mode is used when Chromeleon or PeakNet 6 is controlling the GS50. In this mode, operation from the GS50 front panel is disabled. There are two ways to clear Remote mode: select the **Disconnect** command from the software *or* turn off the pump power briefly and then turn it on again.

METHOD #

In Method control, enter the method number to run in this field.

C.1.3 Detail Screen

Use the **DETAIL** screen to:

- Display detailed information about the status of GS50 operating parameters. This screen displays all the information shown on the **MAIN** screen (see Section C.1.2), as well as some additional parameters.
- Set several parameters for Direct Control operation.

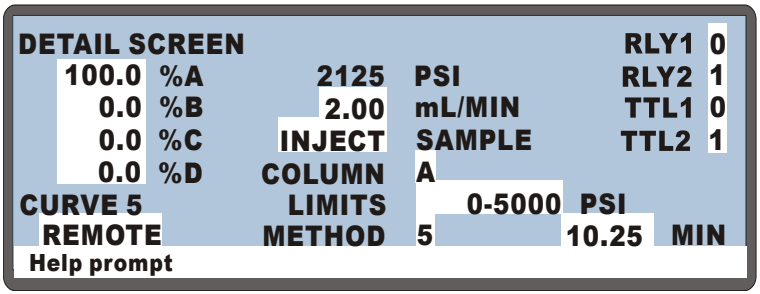


Figure C-4. Detail Screen

RLY1
RLY2
TTL1
TTL2

Provides Relay and TTL control of other devices. In Direct control, select 1 (on) or 0 (off). In Method control, program the Relay and TTL fields from the **METHOD** screen (see Section C.1.4). See Appendix D for a description of Relay and TTL control.

CURVE

Indicates the gradient curve specified in the current method step. See Section 2.8.3 for an explanation of curve types.

LIMIT

Selects the low pressure and high pressure limits in psi, MPa, or bar. See Section 3.1.5 for guidelines for selecting pressure limits.

C.1.4 Method Screen

Use the **METHOD** screen to:

- Enter the number of the method to create or edit.
- Specify operating parameters for the method.
- Enter the number the method is saved to.

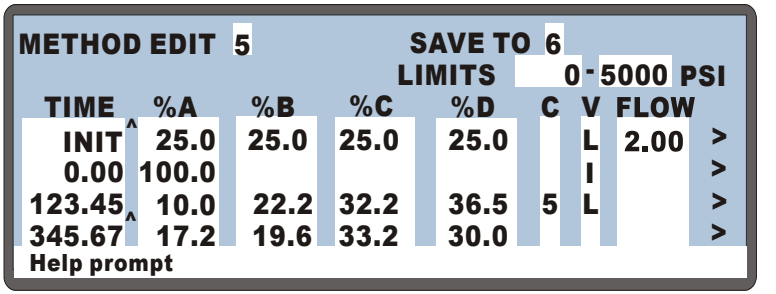


Figure C-5. Method Screen

NOTE **In some fields (%A, %B, %C, %D, C, V, and FLOW), a "blank" field indicates that the parameter for the previous step remains in effect.**

METHOD EDIT — The method number (0 through 99) to edit.

SAVE TO — The method number (0 through 99) to save the current method to.

LIMITS — The low and high pressure limits in psi, MPa, or bar. Select the unit of measure on the **PUMP OPTIONS** screen (see Section C.1.8). See Section 3.1.5 for guidelines for selecting pressure limits.

TIME — The elapsed time for each method step. Every method begins with the **INIT** (initial) step, followed by the **TIME = 0.00** step. Each additional entry under **TIME** indicates the elapsed time at which user-specified conditions (eluent percentage, curve number, flow rate, etc.) occur.

%A–%D	The percentage of each eluent occurring at the start of the step. The total of all eluents must equal 100% or the pump cannot run.
C	The gradient curve type (0 through 9) to use when moving from the previous step to the current step. See Section 2.8.3 for an explanation of curve types.
V	The position of the injection valve: load or inject.
FLOW	The flow rate (from 0.5 to 5.0 mL/min, or 0) through the pump. The flow rate is adjustable in increments of 0.01 mL/min. The GS50 is optimized for operation at 1.5 mL/min or less.
∨	The ∨ symbol next to the bottom time entry indicates that it is followed by at least one more step. Move the cursor to the entry and press the down arrow to see the additional step(s).
^	The ^ symbol next to the top time entry indicates that it is preceded by at least one more step. Move the cursor to the entry and press the up arrow to see the additional step(s).
>	The **>** symbol at the end of the line indicates a lateral extension to the line. Move the cursor to the end of the line and press the right arrow to display the **METHOD** events screen (see Section C.1.5).

C.1.5 Method Events Screen

NOTE The METHOD events screen can be accessed only from the METHOD screen (see Section C.1.4).

Use the **METHOD** events screen to view the column selection and TTL/Relay output parameters for each method step.

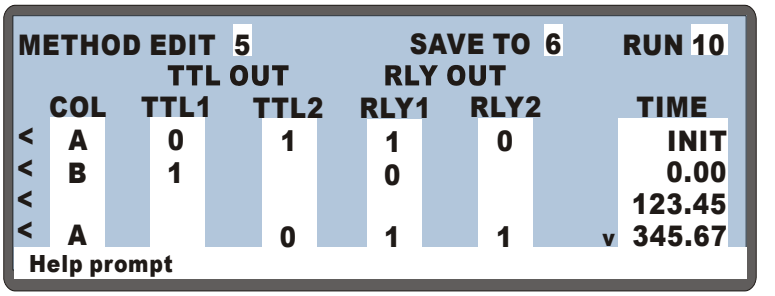


Figure C-6. Method Events Screen

COLUMN — Selects the active column (A or B) in the chromatography module. Column B is available only when a column switching valve is installed.

TTL1
TTL2
RLY1
RLY2 — Provides TTL and Relay control of other devices. Select 1 (on) or 0 (off). See Appendix D for a description of TTL and Relay control.

C.1.6 Degas Options

NOTE **You cannot select the DEGAS OPTIONS screen from the MENU of SCREENS unless the vacuum degas assembly (see Section 2.5) is installed.**

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

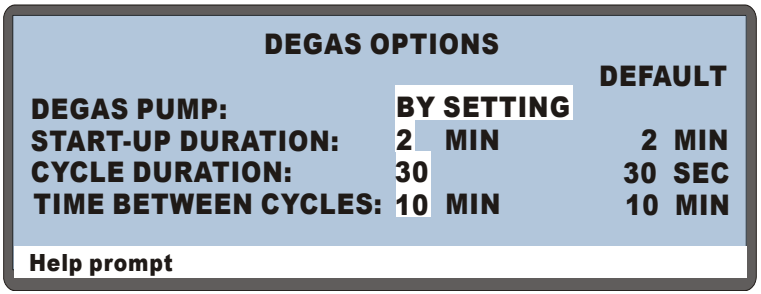


Figure C-7. Degas Options Screen

DEGAS PUMP — Specifies how the vacuum degas pump operates.

- **BY SETTING**: The degas pump runs according to the timing aspects selected on the **DEGAS OPTIONS** screen.
- **MONITOR**: The degas pressure reading determines whether the degas pump is turned on or off. When the degas pump turns on, it runs for the selected **CYCLE DURATION** time (see below).
- **ALWAYS OFF**: The degas pump is always off.
- **ALWAYS ON**: The degas pump is always on (this setting is reserved for test purposes by Dionex Service Representatives.

START-UP DURATION — The length of time (2 to 5 minutes) the degas pump runs after the GS50 power is turned on.

CYCLE DURATION — The length of time (0 to 120 seconds) the degas pump runs during each cycle.

TIME BETWEEN CYCLES The length of time (1 to 99 minutes) between degas cycles.

NOTE The DEGAS PUMP CALIBRATION AND STATUS screen displays the degas threshold value (see Section C.3.3).

The GS50 monitors the vacuum degas reading at 1-minute intervals. If the reading is at, or below, the calibration threshold value, the following message is displayed:

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

If this message appears, increase the **CYCLE DURATION** time and/or decrease the **TIME BETWEEN CYCLES**. If this does not eliminate the problem, contact Dionex Technical Support.

C.1.7 Module Setup

Use the **MODULE SETUP** screen to select display options.

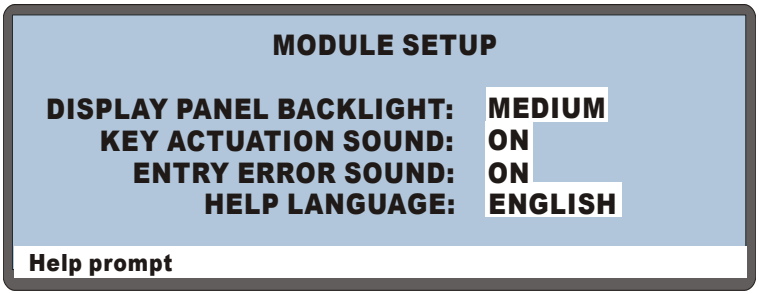


Figure C-8. Module Setup Screen

DISPLAY PANEL BACKLIGHT	Sets the brightness of the display panel backlight to low, medium, or high.
KEY ACTUATION SOUND	Enables and disables the beep that occurs when a front panel key is pressed.
ENTRY ERROR SOUND	Enables and disables the beep that occurs when a wrong entry is made.
HELP LANGUAGE	Selects the language for Help and error messages: English or Japanese.

C.1.8 Pump Options

Use the **PUMP OPTIONS** screen to select default operating parameters for the GS50.

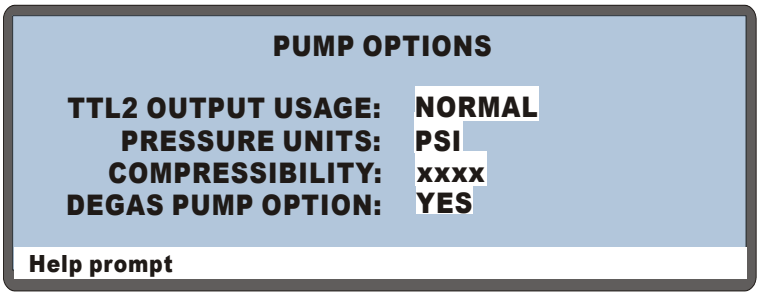


Figure C-9. Pump Options Screen

TTL2 OUTPUT USAGE
Specifies the active state of the TTL2 output signal. **NORMAL** defines TTL2 as a regular TTL output programmed in a method.
0 FLOW can be used to automatically switch off the power to the Self-Regenerating Suppressor (SRS) when the pump flow stops. For instructions on how to set up this function, see Section B.3.

PRESSURE UNITS
Sets the unit of measure for pressure: psi, MPa, or bar.

COMPRESS-IBILITY
Sets the eluent compressibility factor, a feature that helps to optimize the solvent flow stability. The settable range is 0 to 2500 counts; the default, 460 counts, is optimized for deionized water.

DEGAS PUMP OPTION
Indicates whether the optional vacuum degas assembly is installed (see Section 2.5).

C.1.9 Time Function In

Use the **TIME FUNCTION IN** screen to:

- Display GS50 functions that can be controlled via TTL input from another device.
- Select a TTL signal mode for each function.

See Appendix D for more information about TTL-controlled functions and connections.

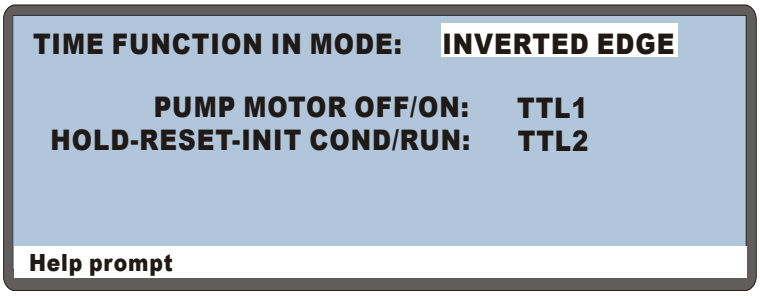


Figure C-10. Time Function In Screen

MODE — Selects the signal mode (**NORMAL EDGE**, **INVERTED EDGE**, **NORMAL PULSE**, or **INVERTED PULSE**) that corresponds to the signal type of the controlling device.
The default mode, **NORMAL EDGE**, is compatible with the TTL output signals provided by Dionex modules.

C.2 Diagnostic Screens

C.2.1 Diagnostic Menu

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

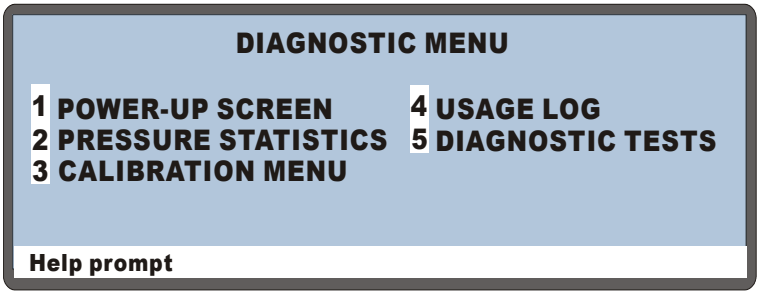


Figure C-11. Diagnostic Menu

There are two ways to view a screen option:

- Press the numeric button on the GS50 front panel keypad that corresponds to the screen number on the menu. For example, press 3 to select and display the **CALIBRATION MENU**.
- Move the cursor to the field containing the screen number and press **Enter**.

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

C.2.2 Power-Up Screen

NOTE The POWER-UP screen is displayed briefly when the GS50 power is turned on.

Use the **POWER-UP** screen to check the revision levels of the DSP BIOS, main DSP code, Moduleware, and BIOS installed in the GS50, as well as the ID (identification) number of the DX-LAN (if connected). An asterisk indicates which DSP code is currently running.

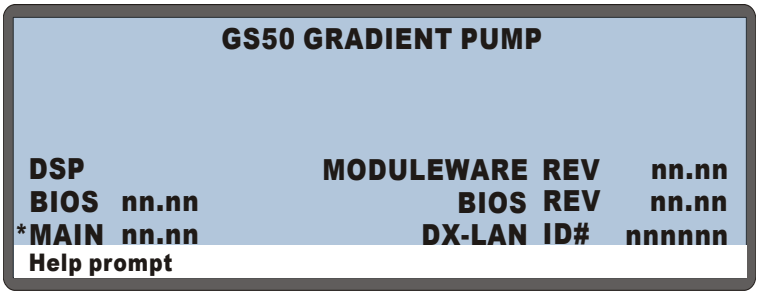


Figure C-12. Power-Up Screen

C.2.3 Pressure Statistics

Use the **PRESSURE STATISTICS** screen to view statistical data about the pressure transducer (see Section 2.4.2). The status values are updated while the screen is displayed.

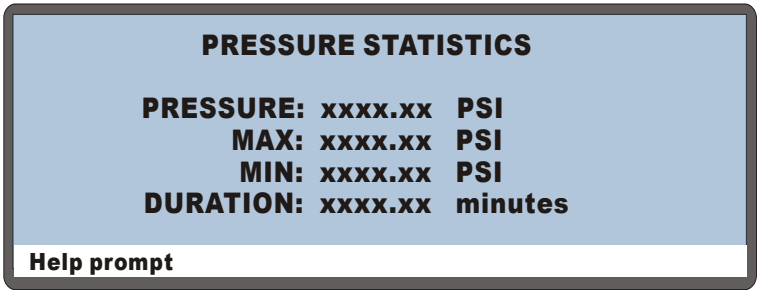


Figure C-13. Pressure Statistics Screen

If a method is running while the **PRESSURE STATISTICS** screen is displayed, the following message appears:

```
Active Method Lowers MIN/MAX Resolution
```

To obtain more accurate readings, abort the method, select the Direct control mode, and go to the **PRESSURE STATISTICS** screen again.

PRESSURE — The measured pressure from the pressure transducer.

MAX — The maximum pressure value for the duration of the test.

MIN — The minimum pressure value for the duration of the test.

DURATION — The duration of the test. Testing starts when the screen is opened; to terminate the test, press **Menu**. To restart the test, press **Reset**; this sets the duration to 0 and sets all status values to the current pressure.

NOTE For a description of the CALIBRATION MENU, refer to Section C.3.

C.2.4 Usage Log

Use the **USAGE LOG** screen to check for how long certain GS50 components have been in use. The status is updated in real time.

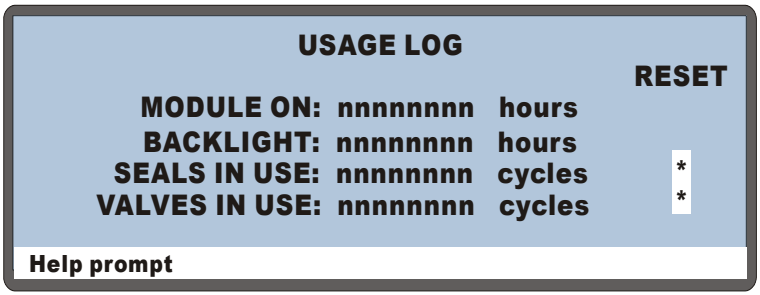


Figure C-14. Usage Log Screen

MODULE ON — Reports the total time the GS50 has been powered up in its lifetime.

BACKLIGHT — Reports the total time the display backlight has been on in its lifetime.

SEALS IN USE — Reports the total number of pump cycles that the piston seals have gone through. Reset this field to 0 after servicing or replacing the piston seals.

VALVES IN USE — Reports the total number of pump cycles that the check valves have been actuated. Reset this field to 0 after servicing or replacing the check valves.

RESET — Resets the **SEALS IN USE** or **VALVES IN USE** counter to 0. Move the cursor to the corresponding asterisk (*) field and press **Enter**. Reset the counter for the seals and valves to 0 after servicing or replacing these parts.

C.2.5 Diagnostic Tests

Use the **DIAGNOSTIC TESTS** screen to test the GS50 electronics components.

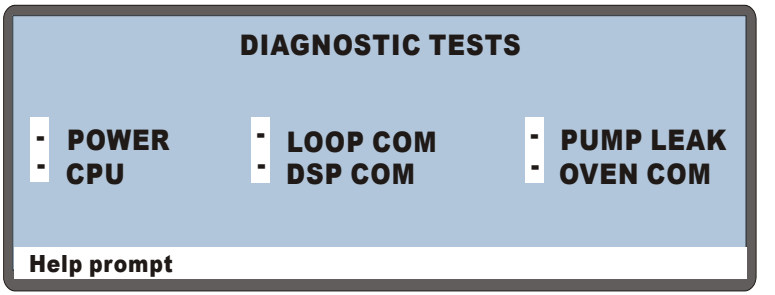


Figure C-15. Diagnostic Tests Screen

When the GS50 power is turned on, some of the electronics tests run automatically. To run a test manually, position the cursor in the edit field next to the test name, press a **Select** button to select the asterisk (*), and press **Enter**. The table below explains the test status indicators.

Character	Test Status
_	Test did not run
>	Test is in progress
P	Test passed
F	Test failed

POWER Checks that the DC power supplies are within 5% tolerance.

CPU Checks the CPU internal configuration and Moduleware checksum.

LOOP COM Checks the serial communication hardware, using a loop-back cable.

DSP COM	Checks communication between the pump CPU and the DSP (digital signal processor) hardware.
PUMP LEAK	Checks the GS50 leak sensor hardware for a correct, open circuit, or short circuit condition.
OVEN COM	Checks communication between the GS50 and the LC30 Chromatography Oven.
EXTERNAL LEAK	Checks the leak sensor hardware in the LC10 Chromatography Organizer or LC25 Chromatography Oven.

C.3 Calibration Screens

C.3.1 Calibration Menu

The **CALIBRATION MENU** lists the calibration screens. To display the menu, select option 3 on the **DIAGNOSTIC MENU**.

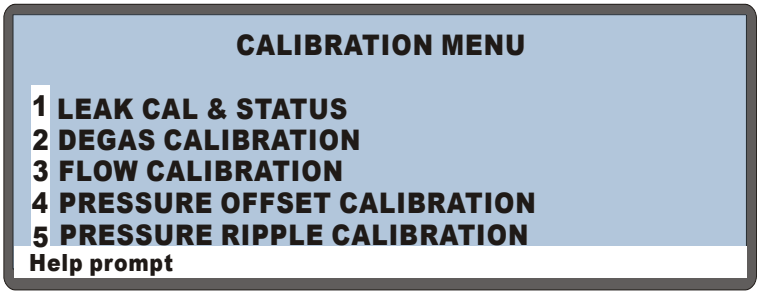


Figure C-16. Calibration Menu

NOTE **You cannot select the DEGAS CALIBRATION screen unless the vacuum degas assembly (see Section 2.5) is installed.**

There are two ways to view a screen option:

- Press the numeric button on the GS50 front panel keypad that corresponds to the screen number on the menu. For example, press 3 to select and display the **FLOW CALIBRATION** screen.
- Move the cursor to the field containing the screen number and press **Enter**.

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

C.3.2 Leak Sensor Calibration and Status

Use the **LEAK SENSOR CALIBRATION AND STATUS** screen to check the status of leak sensor parameters and to calibrate the sensor(s).

- The **PUMP** column displays the status of the GS50 leak sensor.
- The **EXTERNAL** column displays the status of the leak sensor in the chromatography module. If no chromatography module is connected to the GS50, the **EXTERNAL** fields display **NONE**.

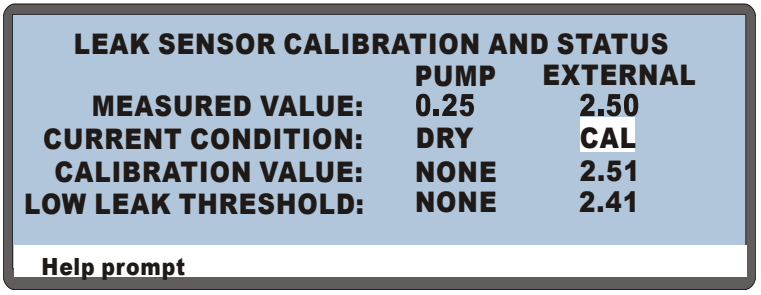


Figure C-17. Leak Sensor Calibration and Status

MEASURED VALUE — The current measured voltage from the leak sensor.

CURRENT CONDITION — The current condition of the leak sensor: dry, wet, or err (error). The error condition indicates an open or short circuit.
To calibrate the sensor, press a **Select** button to select **CAL** and press **Enter**. The current measured value becomes the new dry calibration value.

CALIBRATION VALUE — The value saved when the leak sensor was last calibrated.

LOW LEAK THRESHOLD — The minimum voltage reading interpreted as meaning that the leak sensor is dry; a reading below this voltage indicates that the sensor is wet.

C.3.3 Degas Pump Calibration and Status

NOTE **You cannot select the DEGAS PUMP CALIBRATION screen unless the vacuum degas assembly (see Section 2.5) is installed.**

Use the **DEGAS PUMP CALIBRATION** screen to check the current pressure reading of the vacuum degas assembly and calibrate the degas assembly.

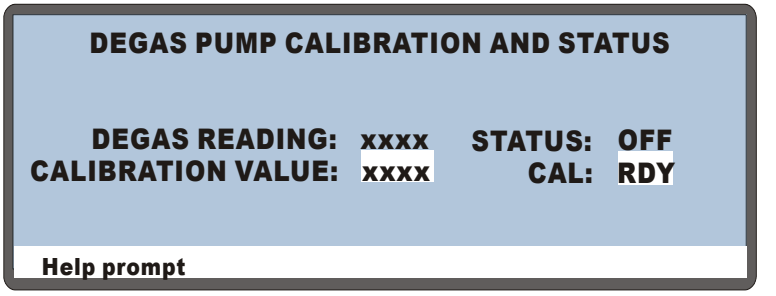


Figure C-18. Degas Pump Calibration and Status Screen

DEGAS READING	Reports the current degas pressure reading.
CALIBRATION VALUE	Reports the calibration value recorded when the vacuum degas assembly was last calibrated.
STATUS	Reports whether the vacuum degas assembly is on or off.
CAL	To calibrate the vacuum degas assembly, press a **Select** button to select **CAL** and then press **Enter**.

C.3.4 Flow Calibration

Use the **FLOW CALIBRATION** screen to recalibrate the pump. After running the flow calibration sequence, wait at least 15 minutes for the pump to re-equilibrate before verifying the flow accuracy.

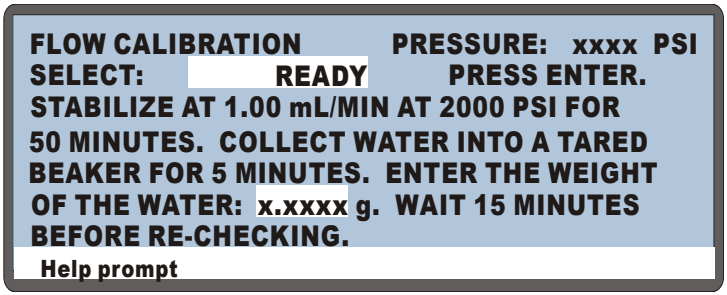


Figure C-19. Flow Calibration Screen

SELECT — To start the flow calibration sequence, toggle the field from **READY** to **STANDARD CAL** and press **Enter**. The pump runs at 1.0 mL/min during calibration.

PRESSURE — Reports the current pump pressure in psi, MPa, or bar. Select the pressure unit from the **PUMP OPTIONS** screen (see Section C.1.8).

WEIGHT OF THE WATER — After calibration, enter the measured weight of the water pumped into the beaker in this field.

C.3.5 Pressure Offset Calibration

Use the **PRESSURE OFFSET CALIBRATION** screen to calibrate the pump pressure offset.

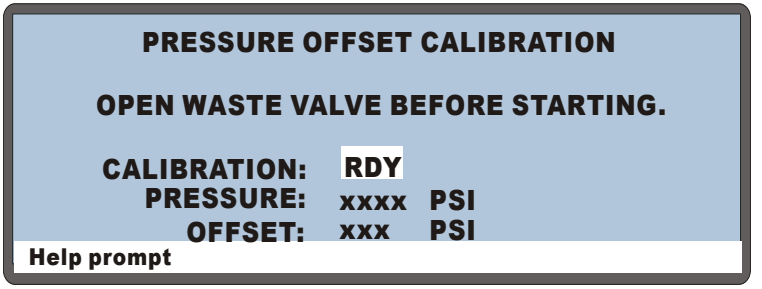


Figure C-20. Pressure Offset Calibration Screen

CALIBRATION — To begin the pressure offset calibration, toggle the field from **RDY** to **CAL** and press **Enter**. After confirming that the pump is off, open the waste valve (see Figure 2-6) by turning the knob one-quarter to one-half turn counterclockwise.

PRESSURE — The current pressure reading from the transducer.

OFFSET — The calibrated offset value.

C.3.6 Pressure Ripple Calibration

Use the **PRESSURE RIPPLE CALIBRATION** screen to calibrate the pressure ripple. For more details, see Section 3.1.6.

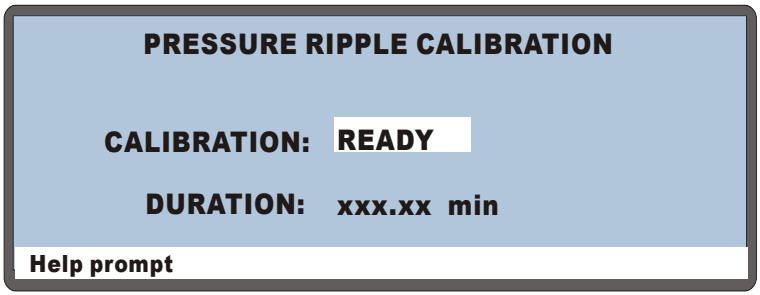


Figure C-21. Pressure Ripple Calibration Screen

CALIBRATION

- **CALIBRATE**: To start a pressure ripple calibration sequence, toggle the field from **READY** to **CALIBRATE** and press **Enter**. During calibration, the pump runs at the currently selected flow rate (or at 1.0 mL/min, if the selected flow rate is zero).
  Notes: (a) The **Menu** button is disabled while the calibration sequence is running. (b) To terminate a calibration sequence, toggle the field to **READY** and press **Enter**.
- **GET DATA**: Updates the pressure ripple data with the latest operating ripple data.
- **DEFAULTS**: Sets the pressure ripple data to the factory default values; these are the theoretical values for pump operation at 1.0 mL/min with 15 MPa (2200 psi) of backpressure.

DURATION

Reports the time remaining until the calibration sequence is finished. At a flow rate of 1.0 mL/min, it takes about 13 minutes to run the calibration sequence.

D • TTL and Relay Control

The strip of eight 2-pin connectors on the GS50 electronics chassis provides two relay outputs, two TTL outputs, and four TTL inputs (see Figure D-1).

NOTE Before connecting the GS50 to a non-Dionex device, check the user's manual for the device to verify that it is compatible with the GS50 TTL and relay signals.

- If necessary, connect the outputs to the TTL or relay inputs of a device to trigger functions in the connected device.
- If necessary, connect the inputs to a device to trigger two pump functions: pump motor on/off and method clock on/off.

For a description of TTL and relay output operation or TTL input operation, respectively, see Section D.1 or Section D.2. For instructions on how to connect the GS50 TTLs and relays to other devices, see Section D.3.

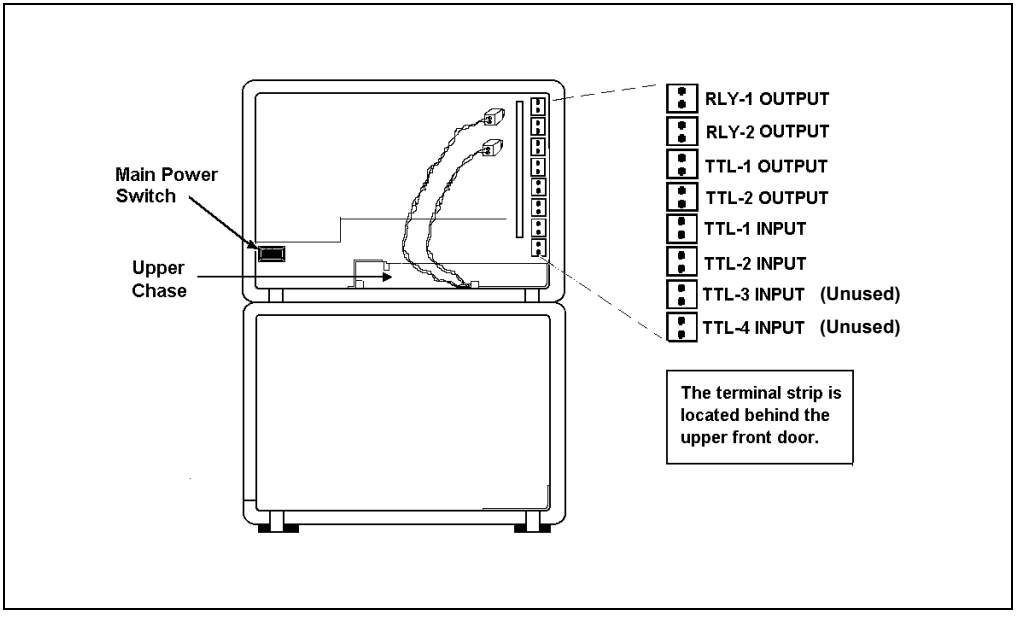


Figure D-1. TTL/Relay Connector Strip (GS50 front view without upper door)

D.1 TTL and Relay Output Operation

The GS50 provides two TTL outputs and two relay contacts for the control of functions in external devices. For example, the external device might be an integrator, autosampler, or another Dionex module.

After connecting the TTL and Relay outputs (see Section D.3), toggle the output states on and off from either the **DETAIL** screen (see Section C.1.3) or the **METHOD** events screen (see Section C.1.5).

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

For example, when TTL2 is connected to the Load relay on the Dionex AS40 Autosampler, setting TTL2 to 1, as shown in Figure D-2, sends a signal to the AS40 to start the load cycle.

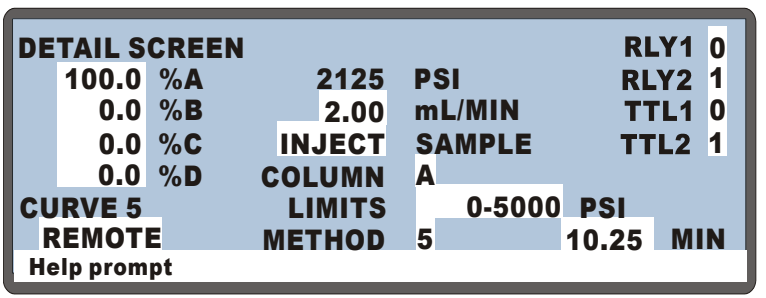


Figure D-2. Detail Screen

D.2 TTL Input Operation

The two TTL inputs can be connected to devices capable of providing TTL output signals. The signal from the connected devices can trigger the following functions in the GS50:

- **TTL input 1** turns the pump motor on and off.
- **TTL input 2** turns the pump method clock on (Run) and off (Hold/Reset). Hold/Reset resets the method clock to zero and executes the **INIT** conditions, although the method cannot run unless the pump motor is on.

D.2.1 TTL Input Signal Modes

The GS50 TTL inputs respond to four different types of device output signals. The default signal mode, normal edge, is compatible with the output signals provided by Dionex modules. If the device connected to the GS50 outputs a different signal type, select the appropriate mode from the **TIME FUNCTION IN** screen (see Figure D-3).

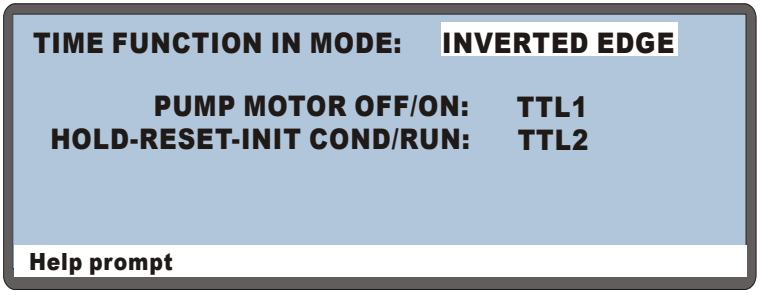


Figure D-3. Time Function In Screen

There are four input signal modes:

- *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 D-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 operates 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 on the motor.

  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 ms. The action of the GS50 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.

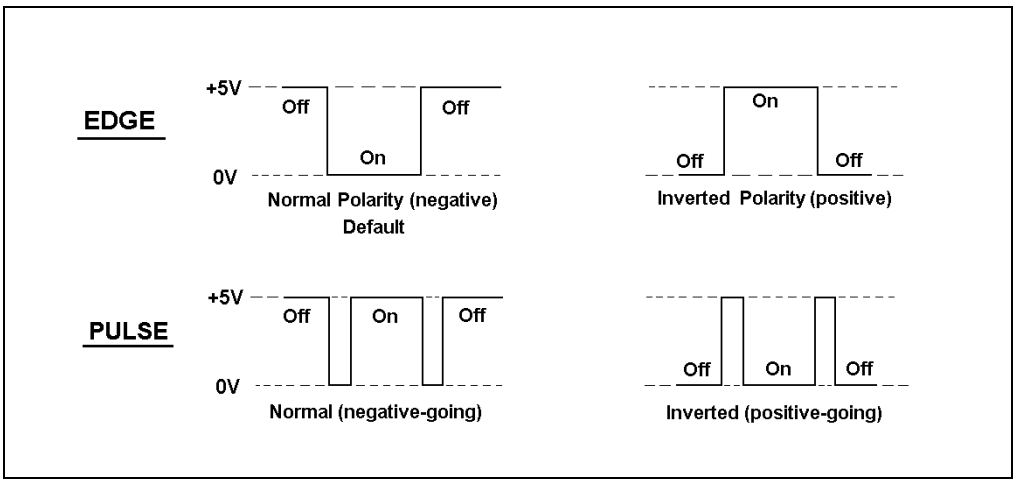


Figure D-4. TTL and Relay Input Signal Modes

D.3 TTL and Relay Connections

The TTL/relay connector strip is on the electronics chassis, behind the upper door of the GS50 enclosure (see Figure D-1). Each 2-pin connector includes a signal pin and a ground pin.

1. Locate the twisted pairs of wires (P/N 043598) and 2-pin connector plugs (P/N 921019) provided in the GS50 Ship Kit (P/N 061222). Attach a 2-pin plug to each end of the twisted pair of wires to be connected.

   NOTE The signal wire must be on the top of each plug and the ground wire must be on the bottom of each plug.

2. Connect these plugs to the TTL or relay connectors on the GS50 and the other instrument(s) as needed for the application. Be sure to connect signal wires to signal (+) pins and ground wires to return (-) pins. If necessary, remove wires from the 2-pin plugs and reinsert them in the correct positions. Section D.3.1 shows example connections.
3. Route the wires from the GS50 electronics chassis through the upper chase to the rear panel.

D.3.1 Example Connections

Figure D-5 shows an example of TTL/relay connections for a Dionex system connected to an AS40 Automated Sampler. Refer to the AS40 operator's manual for details.

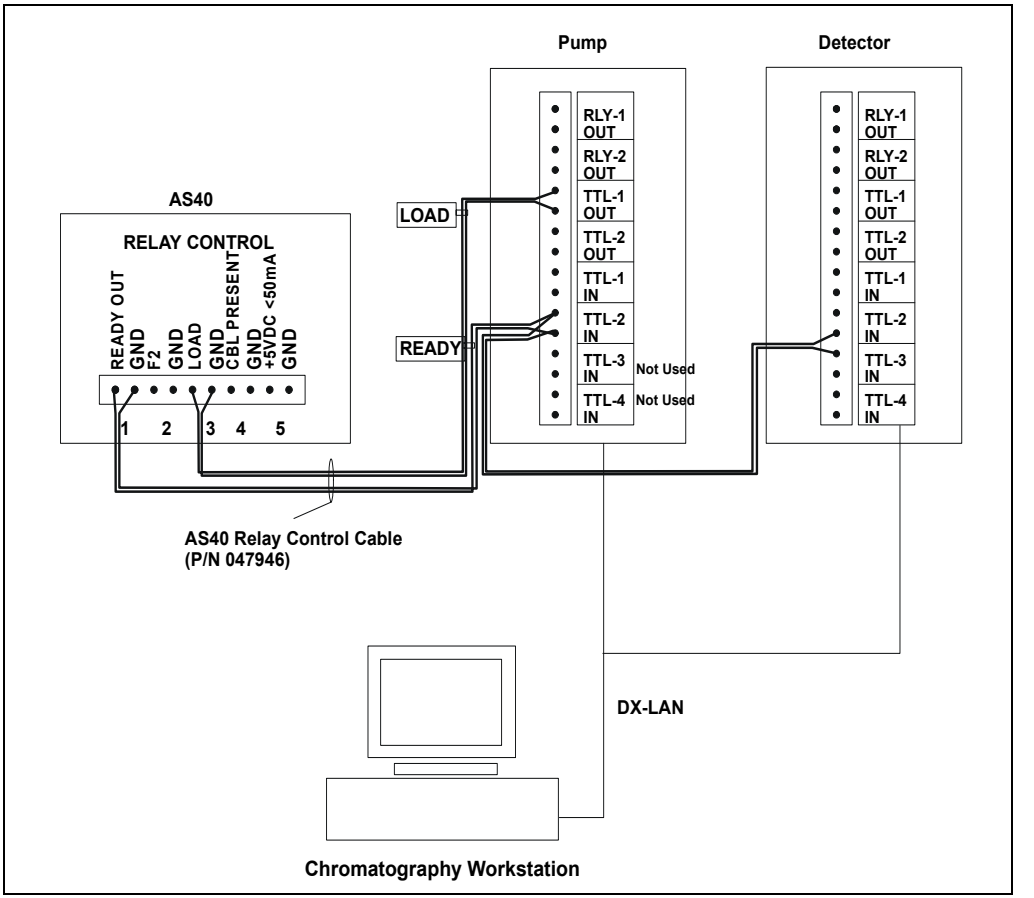


Figure D-5. Example TTL and Relay Connections: AS40

E • Reordering Information

Part Number	Item	Quantity
	Primary Pump Head Components	
052840	Piston	1
058032	Seal Wash Housing Guide	1
048722	Piston Rinse Seal	1
059283	O-Ring	1
057913	Spacer with Drain	1
014895	O-Ring	1
055870	Piston Seal	1
047660	Inlet Check Valve Assembly	1
047657	Outlet Check Valve Assembly	1
055711	Primary Pump Head	1
055709	Priming Valve Knob	1
055752	Priming Valve Knob O-Ring	1
	Secondary Pump Head Components	
052840	Piston	1
058032	Seal Wash Housing Guide	1
048722	Piston Rinse Seal	1
059283	O-Ring	1
057913	Spacer with Drain	1
014895	O-Ring	1
055870	Piston Seal	1
055712	Secondary Pump Head	1
055710	Waste Valve Knob	1
055752	Waste Valve Knob O-Ring	1
046203	Eluent Proportioning Valve Assembly	1
049136	GM-4 Gradient Mixer	1
044126	Glass Reservoir (shatterproof plastic coating), 1 Liter	1

Part Number	Item	Quantity
044127	Glass Reservoir (shatterproof plastic coating), 2 Liters	1
044128	Plastic Reservoir, 1 Liter	1
044129	Plastic Reservoir, 2 Liters	1
045987	Filter, End-Line	1
046594	Pressure Regulator (for gas supply line to reservoirs)	1
042772	Fitting Plug, 10-32	1
054578	Syringe, 10 mL	1
954745	3.15 Amp Fuse (Fast-Blow IEC 127)	1
921019	2-Pin TTL/Relay Connector	1
043598	Twisted Wire Assembly	2 m (8 ft)

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