Agilent 1260 Infinity Binary Pump

User Manual

Agilent Technologies

Notices

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76337 Waldbronn

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CAUTION

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Contents

1 Introduction to the Binary Pump 7

Instrument and Operation 8
Overview of the Hydraulic Path 14
Early Maintenance Feedback 20
Instrument Layout 21
Electrical Connections 22
Interfaces 24
Setting the 8-bit Configuration Switch 30

2 Site Requirements and Specifications 37

Site Requirements 38
Physical Specifications 41
Performance Specifications 42

3 Installing the Pump 45

Unpacking the Binary Pump 46
Optimizing the Stack Configuration 48
Installing the Binary Pump 55
Flow Connections with Solvent Selection Valve 58
Flow Connections without Solvent Selection Valve 61
Priming the System 64

4 Using the Pump 69

Hints for Successful Use of the Binary Pump 70
Setting up the Pump with the G4208A Instant Pilot 72
Setting up the Pump with Agilent ChemStation 73
Early Maintenance Feedback (EMF) 82

5 Optimizing Performance 85

Prevent Blocking of Solvent Filters 86
When to Use a Vacuum Degasser 88
When to Use the Active Seal Wash Option 89
When to Use Alternative Seals 90
When to Use the Low volume mixer 91
When to Remove Damper and Mixer 92
How to Optimize the Compressibility Compensation Setting 95

6 Error Messages 99

What Are Error Messages 101
General Error Messages 102
Module Error Messages 108

7 Troubleshooting and Diagnostics 121

Overview of the Module's Indicators and Test Functions 122
Status Indicators 124
User Interfaces 126
Agilent Lab Advisor Software 127

8 Tests Functions and Calibration 129

Pressure Test Description 130
Pump Test 134
Binary Pump Solvent Calibration 136
Pump Elasticity Calibration 138

9 Diagnostic Signals 141

Analog Pressure Output 142
Diagnostic Signals in the ChemStation Software 143
Early Maintenance Feedback (EMF) 144

10 Maintenance 147

Introduction to Maintenance and Repair 148
Warnings and Cautions 149
Cleaning the Module 150
Overview of Maintenance and Simple Repairs 151
Maintenance Procedures 152
Exchanging the Purge Valve Frit or the Purge Valve 154
Removing the Pump Head Assembly 156
Disassembling the pump head 158
Exchanging the Pump Seals 159
Seal Wear-in Procedure 161
Exchanging the Pistons 162
Exchanging the Wash Seals 163
Reinstalling the Pump Head Assembly 165
Exchanging the Inlet Valve 167
Exchanging the Outlet Valve 169
Installation of the Solvent Selection Valve Upgrade Kit 171
Exchanging the Solvent Selection Valve 174
Installing the Active Seal Wash Option 177
Exchanging the Optional Interface Board 182
Replacing Module Firmware 183

11 Parts and Materials for Maintenance 185

Bottle Head Assembly 186
Hydraulic Path with Solvent Selection Valve 188
Hydraulic Path without Solvent Selection Valve 190
Pump Head Assembly Without Seal Wash 192
Pump Head Assembly with Seal Wash Option 194
Outlet Valve 196
Purge Valve Assembly 197
Active Inlet Valve Assembly 198
Accessory Kit 199
Active Seal Wash Option 201
G1316B SL Capillary System Kit 202
Solvent Cabinet 204
Preventive Maintenance Kit G1312-68750 206

12 Identifying Cables 207

Cable Overview 208
Analog Cables 210
Remote Cables 212
BCD Cables 215
CAN/LAN Cables 217
External Contact Cable 218
RS-232 Cables 219
Agilent 1200 Module to Printer 220

13 Appendix 221

General Safety Information 222
The Waste Electrical and Electronic Equipment Directive 225
Lithium Batteries Information 226
Radio Interference 227
Sound Emission 228
Solvent Information 229
Agilent Technologies on Internet 230

1 Introduction to the Binary Pump

Instrument and Operation 8
- Instrument Layout 8
- Principle of Operation 9
- Optimization Features 12

Overview of the Hydraulic Path 14

Early Maintenance Feedback 20

Instrument Layout 21

Electrical Connections 22
- Serial Number Information (ALL) 23
- Rear view of the module 23

Interfaces 24
- Overview Interfaces 26

Setting the 8-bit Configuration Switch 30
- Communication Settings for RS-232C 33
- Special Settings 35

This chapter gives an introduction to the module, instrument overview and internal connectors

Instrument and Operation

Instrument Layout

The Binary Pump comprises two identical pumps integrated into one housing. Binary gradients are created by high-pressure mixing. An optional degasser is available for applications that require best flow stability, especially at low flow rates, for maximum detector sensitivity. Pulse damper and mixer can be bypassed for low flowrate applications or whenever a minimal transient volume is desirable. Typical applications are high throughput methods with fast gradients on high resolution 2.1 mm columns. The pump is capable of delivering flow in the range of 0.1 – 5 mL/min against up to 600 bar. A solvent selection valve (optional) allows to form binary mixtures (isocratic or gradient) from one of two solvents per channel. Active seal wash (optional) is available for use with concentrated buffer solutions.

The industrial design of the module incorporates several innovative features. It uses Agilent's E-PAC concept for the packaging of electronics and mechanical assemblies. This concept is based upon the use of expanded polypropylene (EPP) foam plastic spacers in which the mechanical and electronic boards components of the module are placed. This pack is then housed in a metal inner cabinet which is enclosed by a plastic external cabinet. The advantages of this packaging technology are:

- virtual elimination of fixing screws, bolts or ties, reducing the number of components and increasing the speed of assembly/disassembly,
- the plastic layers have air channels molded into them so that cooling air can be guided exactly to the required locations,
- the plastic layers help cushion the electronic and mechanical parts from physical shock, and
- the metal inner cabinet shields the internal electronics from electromagnetic interference and also helps to reduce or eliminate radio frequency emissions from the instrument itself.

Principle of Operation

The binary pump is based on a two-channel, dual-piston in-series design which comprises all essential functions that a solvent delivery system has to fulfill. Metering of solvent and delivery to the high-pressure side are performed by two pump assemblies which can generate pressure up to 600 bar.

Each channel comprises a pump assembly including pump drive, pump head, active inlet valve with replaceable cartridge and outlet valve. The two channels are fed into a low-volume mixing chamber which is connected via a restriction capillary coil to a damping unit and a mixer. A pressure sensor monitors the pump pressure. A purge valve with integrated PTFE frit is fitted to the pump outlet for convenient priming of the pumping system.

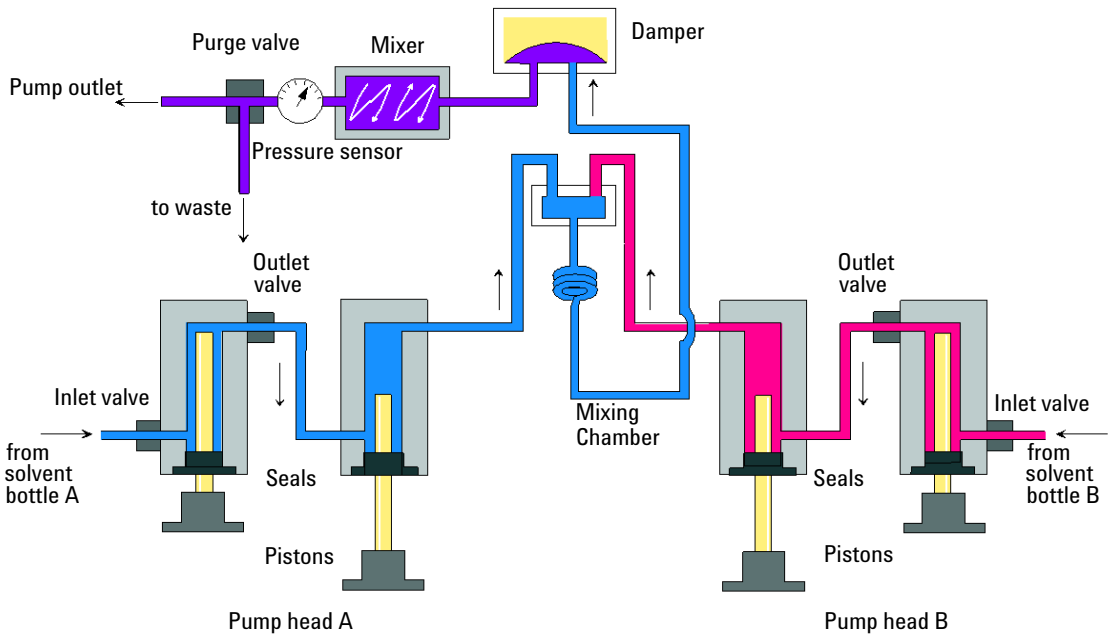


Figure 1 The Hydraulic Path of the Binary Pump with Damper and Mixer

Damper and mixer can be bypassed for lowest delay volume of the binary pump. This configuration is recommended for low flow rate applications with steep gradients, see the Rapid Resolution System Manual .

Figure 1 on page 9 illustrates the flow path in low delay volume mode. For instructions on how to change between the two configurations, see "Convert the Binary Pump to Low Delay Volume Mode" on page 93.

NOTE Bypassing the mixer while the damper remains in line is not a supported configuration and may lead to undesired behavior of the binary pump.

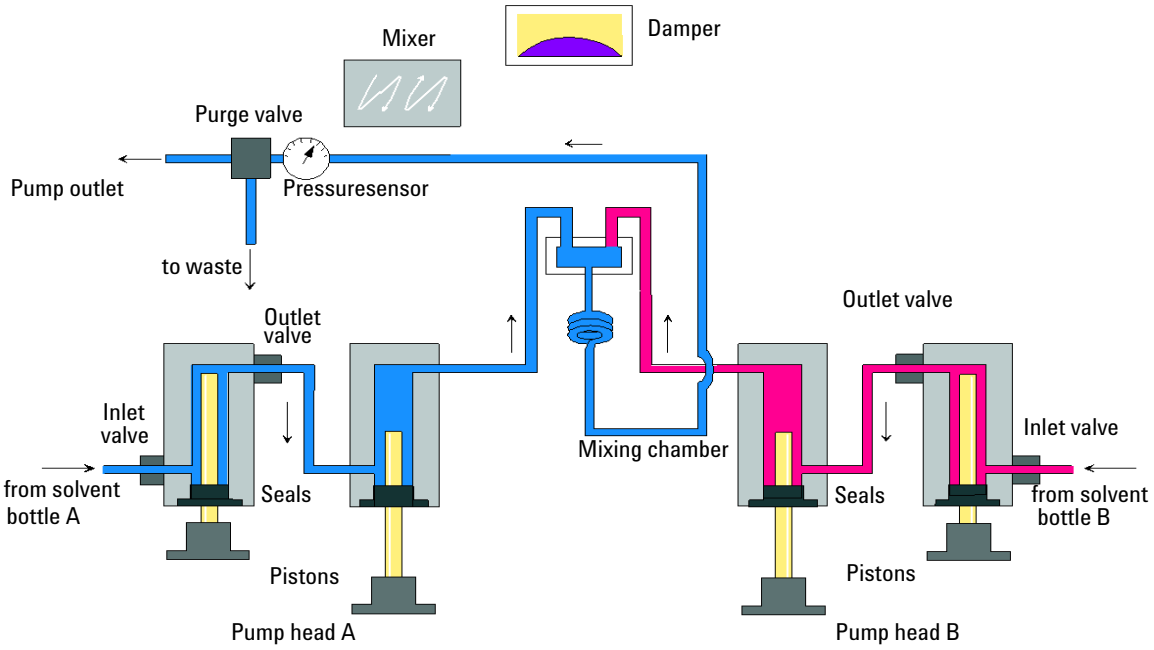


Figure 2 The Hydraulic Path of the Binary Pump with Bypassed Damper and Mixer

Table 1 Pump Details

Delay volume	From mixing point to pump outlet, dependent on back pressure (120 µL without damper and mixer, 600 – 800 µL with damper and mixer)
Materials in contact with mobile phase	
Pump head	SST, gold, sapphire, ceramic
Active inlet valve	SST, sapphire, ruby, ceramic, PTFE
Outlet valve	SST, gold, sapphire, ruby, tantalum
Adapter	SST, gold
Purge valve	SST, gold, PTFE, ceramic
Damping unit	Gold, SST

For pump specifications, see "Performance Specifications" on page 42.

Optimization Features

What is Pump Elasticity Compensation?

The flow path of the pump consists of pump chambers, sapphire pistons, polymer seals, stainless steel tubing of different dimension, pressure sensor, and so forth. All of these parts deform when pressurized. The sum of this deformation is called pump elasticity. The performance of the pump is greatly enhanced by correcting for this elasticity.

The *Pump Elasticity Calibration* calculates correction factors to compensate for the individual elasticity of the pump that was calibrated. The elasticity is different for every pump and may change with the replacement of parts in the flow path, e.g. pump seals.

All Binary Pumps SL are elasticity calibrated at the factory and require recalibration only after preventive maintenance or major repairs to the flow path. Replacement of capillaries or PTFE frits are not considered a major repair.

What is Solvent Compressibility Compensation?

Although the compressibility of liquids is orders of magnitude lower then the compressibility of gases, a noticeable volume error is seen when typical chromatographic solvents are compressed to operating pressures as high as 600 bar. In addition, the compressibility changes with pressure, temperature and the amount of dissolved gas. In order to minimize the influence of the latter, the use of a vacuum degasser is mandatory for high precision delivery of liquids. Unfortunately, the influence of the temperature on compressibility is non-linear and cannot be calculated.

The Agilent Binary Pump SL features a new multi point compressibility calibration. The compressibility of a solvent is determined at different pressures from 0 - 600 bar and stored in an XML file. This file can be distributed to other pumps because the solvent compressibility is independent from the pump.

The Binary Pump SL and ChemStation come with predetermined solvent compressibility data for the most common HPLC solvents like water, acetonitrile, methanol, etc. Users can calibrate their own solvent mixtures with the help of an easy to use calibration procedure in the Agilent LC Diagnostic software.

NOTE A correct pump elasticity calibration is an essential prerequisite for successful solvent compressibility calibrations! Solvent compressibility calibrations acquired with a miscalibrated pump will work, but they are not transferable to other pumps!

How Does Variable Stroke Volume Work?

The smaller the solvent volume in the pump chamber is, the faster it can be recompressed to operating pressure. The Binary Pump SL allows to manually or automatically adjust the pump stroke volume of the first piston in the range of 20 - 100 µL. Due to the compression of the solvent volume in the first pump chamber, each piston stroke of the pump will generate a small pressure pulsation, influencing the flow ripple of the pump. The amplitude of the pressure pulsation is mainly dependent on the stroke volume and the compressibility compensation for the solvent in use. Small stroke volumes generate less pressure pulsation than larger stroke volumes at the same flow rate. In addition, the frequency of the pressure pulsation will be higher. This will decrease the influence of flow pulsations on quantitative results.

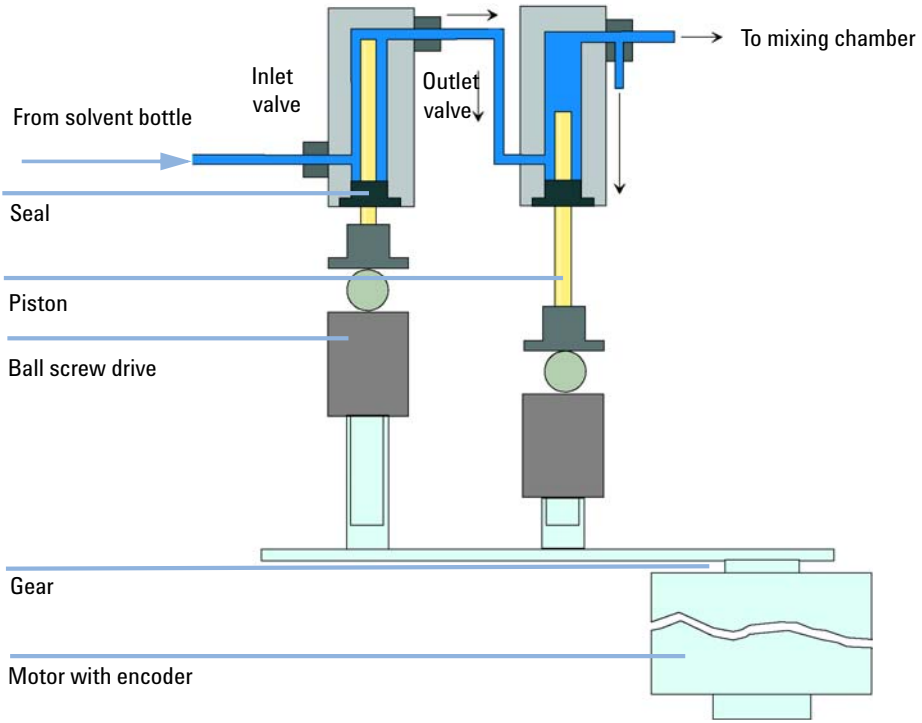
In gradient mode, smaller stroke volume results in less flow ripple and improves the composition ripple.

The Binary Pump SL uses a processor-controlled ball screw system to drive its pistons. The normal stroke volume is optimized for the selected flow rate. Small flow rates use a small stroke volume while higher flow rates use a higher stroke volume.

The stroke volume for the pump is by default set to AUTO mode. This means that the stroke is optimized for the flow rate in use. A change to larger stroke volumes is possible but not recommended.

Overview of the Hydraulic Path

The solvent from the bottle in the solvent cabinet enters the pump through an active inlet valve. Each side of the binary pump comprises two substantially identical pump units. Both pump units comprise aball-screw drive and a pump head with two sapphire pistons for reciprocating movement.



A servo-controlledvariable reluctance motor drives the two ball-screw drives in opposite directions. The gears for the ball-screw drives have different circumferences (ratio 2:1) allowing the first piston to move at double the speed of the second piston. The solvent enters the pump heads close to the bottom limit and leaves it at its top. The outer diameter of the piston is smaller than the inner diameter of the pump-head chamber allowing the solvent to fill the gap in between. The first piston has a stroke volume in the range of 20 µL to 100 µL depending on the flow rate. The microprocessor controls all flow rates in a range of 1 µL/min to 5 mL/min. The inlet of the first pumping unit is connected to the active inlet valve which is processor-controlled opened or closed allowing solvent to be drawn into the first pump unit.

The outlet of the first pump chamber is connected by a 500 µL absorber capillary to the second pump chamber. The outlets of the second chambers of both pump channels joined via a small mixing chamber. A coiled restriction capillary connects the mixing chamber via a pressure pulse damper, a mixer and a pressure sensor to the purge valve assembly. The outlet of the purge valve assembly is then connected to the attached chromatographic system.

When turned on, the pump runs through an initialization procedure to determine the upper dead center of the first piston of both pump channels. The first piston moves slowly upwards to the mechanical stop of the pump head and from there it moves back a predetermined path length. The controller stores this piston position in memory. After this initialization the pump starts operation with the set parameters for the two pump channels.

The active inlet valve is opened and the down moving piston draws solvent into the first pump head. At the same time the second piston is moving upwards delivering into the system. After a controller defined stroke length (depending on the flow rate) the drive motors are stopped and the active inlet valve is closed. The motor direction is reversed and moves the first piston up until it reaches the stored upper limit and at the same time moving the second piston downwards.

Then the sequence starts again moving the pistons up and down between the two limits. During the delivery stroke of the first piston the solvent in the pump head is pressed through the outlet ball valve into the second pumping unit. The second piston draws in half of the volume displaced by the first piston and the remaining half volume is directly delivered into the system. During the drawing stroke of the first piston, the second piston delivers the drawn volume into the system.

Delay volume	From mixing point to pump outlet, dependent on back pressure 120 µL without damper and mixer, 600 – 800 µL with damper and mixer
Materials in contact with mobile phase	
Pump head	SST, gold, sapphire, ceramic
Active inlet valve	SST, sapphire, ruby, ceramic, PTFE
Outlet valve	SST, gold, sapphire, ruby, tantalum
Adapter	SST, gold
Purge valve	SST, gold, PTFE, ceramic
Damping unit	Gold, SST

For pump specifications, see "Performance Specifications" on page 42.

What is Pump Elasticity Compensation?

The flow path of the pump consists of pump chambers, sapphire pistons, polymer seals, stainless steel tubing of different dimension, pressure sensor, and so forth. All of these parts deform when pressurized. The sum of this deformation is called pump elasticity.

Let us look at a practical example: Piston 1 draws solvent at ambient pressure. The movement direction is reversed and the piston 1 now compresses the solvent until the operating pressure of the HPLC system is reached. The outlet ball valve opens, and solvent is pumped by piston 1 into pump chamber 2. Due to two factors, the solvent volume that is delivered into the system at high pressure is smaller than it is supposed to be:

1 The solvent is compressible

2 The pump has a certain elasticity which causes it's internal volume to increase with pressure.

In order to compensate for these two influences, their absolute value must be known.

Since the properties of pure water are very well documented, it's compressibility can be preset. When pumping water, any deviations from the theoretical pressure profile during solvent recompression are caused by the elasticity of the pump.

The *Pump Elasticity Calibration*calculates correction factors to compensate for the individual elasticity of the pump that was calibrated. The elasticity is different for every pump and may change with the replacement of parts in the flow path, e.g. pump seals.

All binary pumps are elasticity calibrated at the factory and require recalibration only after preventive maintenance or major repairs to the flow path. Replacement of capillaries or PTFE frits are not considered a major repair.

How Does Compressibility Compensation Work?

Although the compressibility of liquids is orders of magnitude lower then the compressibility of gases, a noticeable volume error is seen when typical chromatographic solvents are compressed to operating pressures as high as 600 bar. In addition, the compressibility changes with pressure, temperature and the amount of dissolved gas. In order to minimize the influence of the latter, the use of a vacuum degasser is mandatory for high precision delivery of liquids. Unfortunately, the influence of the temperature on compressibility is non-linear and cannot be calculated.

The Agilent 1260 Infinity Binary Pump features a new multi point compressibility calibration. The compressibility of a solvent is determined at different pressures from 0 – 600 bar and stored in an XML file. This file can be distributed to other pumps because the solvent compressibility is independent from the pump.

The binary pump and ChemStation come with predetermined solvent compressibility data for the most common HPLC solvents like water, acetonitrile, methanol, etc. Users can calibrate their own solvent mixtures with the help of an easy to use calibration procedure in the Agilent Lab Advisor software.

Let us use the practical example from the last section once again to understand how compressibility compensation works:

Piston 1 draws solvent at ambient pressure. The movement direction is reversed and piston 1 now compresses the solvent until the operating pressure of the HPLC system is reached. The outlet ball valve opens, and solvent is pumped by piston 1 into pump chamber 2.

Without any compensation, the delivered volume at operating pressure would be too low. In addition, it would take a noticeable amount of time to recompress the solvent to operating pressure. During this time frame, no

solvent would be delivered into the system and as a result a high pressure fluctuation (known as *pressure ripple*) would be observed.

When both solvent compressibility at the current operating pressure and pump elasticity are known, the pump can automatically correct for the missing volume by drawing the appropriate larger solvent volume at ambient pressure and speed up the piston during the recompression phase in the first pump chamber. As a result, the pump delivers the accurate volume with any (calibrated) solvent at any pressure at a greatly reduced pressure ripple. For applications that require lowest transition volume of the pump, damper and mixer can be bypassed.

For compatibility with older methods from G1312A binary pumps, the old one-point compressibility compensation is available, too. However, since the compressibility is a non-linear function, one single compressibility value per solvent will only give good results at one particular pressure (which is at 200 bar for the G1312A binary pump).

CAUTION

Incorrect pump elasticity calibration.

Solvent compressibility calibrations acquired with a miscalibrated pump will work, but they are not transferable to other pumps. A correct pump elasticity calibration is an essential prerequisite for successful solvent compressibility calibrations.

➔ Calibrate the pump elasticity correctly.

How Does Variable Stroke Volume Work?

The smaller the solvent volume in the pump chamber is, the faster it can be recompressed to operating pressure. The binary pump allows to manually or automatically adjust the pump stroke volume of the first piston in the range of 20 – 100 µL. Due to the compression of the solvent volume in the first pump chamber, each piston stroke of the pump will generate a small pressure pulsation, influencing the flow ripple of the pump. The amplitude of the pressure pulsation is mainly dependent on the stroke volume and the compressibility compensation for the solvent in use. Small stroke volumes generate less pressure pulsation than larger stroke volumes at the same flow rate. In addition, the frequency of the pressure pulsation will be higher. This will decrease the influence of flow pulsations on quantitative results.

In gradient mode, smaller stroke volume results in less flow ripple and improves the composition ripple.

The binary pump uses a processor-controlled ball screw system to drive its pistons. The normal stroke volume is optimized for the selected flow rate. Small flow rates use a small stroke volume while higher flow rates use a higher stroke volume.

The stroke volume for the pump is by default set to AUTO mode. This means that the stroke is optimized for the flow rate in use. A change to larger stroke volumes is possible but not recommended.

Early Maintenance Feedback

Maintenance requires the exchange of components which are subject to wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of usage of the module and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (**EMF**) feature monitors the usage of specific components in the instrument, and provides feedback when the user-selectable limits have been exceeded. The visual feedback in the user interface provides an indication that maintenance procedures should be scheduled.

EMF Counters

EMF counters increment with use and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. Some counters can be reset to zero after the required maintenance procedure.

Using the EMF Counters

The user-settable **EMF** limits for the **EMF Counters** enable the early maintenance feedback to be adapted to specific user requirements. The useful maintenance cycle is dependent on the requirements for use. Therefore, the definition of the maximum limits need to be determined based on the specific operating conditions of the instrument.

Setting the EMF Limits

The setting of the **EMF** limits must be optimized over one or two maintenance cycles. Initially the default **EMF** limits should be set. When instrument performance indicates maintenance is necessary, take note of the values displayed by the **EMF counters**. Enter these values (or values slightly less than the displayed values) as **EMF** limits, and then reset the **EMF counters** to zero. The next time the **EMF counters** exceed the new **EMF** limits, the **EMF** flag will be displayed, providing a reminder that maintenance needs to be scheduled.

Instrument Layout

The industrial design of the module incorporates several innovative features. It uses Agilent's E-PAC concept for the packaging of electronics and mechanical assemblies. This concept is based upon the use of expanded polypropylene (EPP) layers of foam plastic spacers in which the mechanical and electronic boards components of the module are placed. This pack is then housed in a metal inner cabinet which is enclosed by a plastic external cabinet. The advantages of this packaging technology are:

- virtual elimination of fixing screws, bolts or ties, reducing the number of components and increasing the speed of assembly/disassembly,
- the plastic layers have air channels molded into them so that cooling air can be guided exactly to the required locations,
- the plastic layers help cushion the electronic and mechanical parts from physical shock, and
- the metal inner cabinet shields the internal electronics from electromagnetic interference and also helps to reduce or eliminate radio frequency emissions from the instrument itself.

Electrical Connections

- The CAN bus is a serial bus with high speed data transfer. The two connectors for the CAN bus are used for internal module data transfer and synchronization.
- One analog output provides signals for integrators or data handling systems.
- The interface board slot is used for external contacts and BCD bottle number output or LAN connections.
- The REMOTE connector may be used in combination with other analytical instruments from Agilent Technologies if you want to use features such as start, stop, common shut down, prepare, and so on.
- With the appropriate software, the RS-232C connector may be used to control the module from a computer through a RS-232C connection. This connector is activated and can be configured with the configuration switch.
- The power input socket accepts a line voltage of 100 – 240 VAC ± 10 % with a line frequency of 50 or 60 Hz. Maximum power consumption varies by module. There is no voltage selector on your module because the power supply has wide-ranging capability. There are no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

NOTE Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

Serial Number Information (ALL)

The serial number information on the instrument labels provide the following information:

CCXZZ00000	Format
CC	Country of manufacturing (DE Germany)
X	Alphabetic character A-Z (used by manufacturing)
ZZ	Alpha-numeric code 0-9, A-Z, where each combination unambiguously denotes a module (there can be more than one code for the same module)
00000	Serial number

Rear view of the module

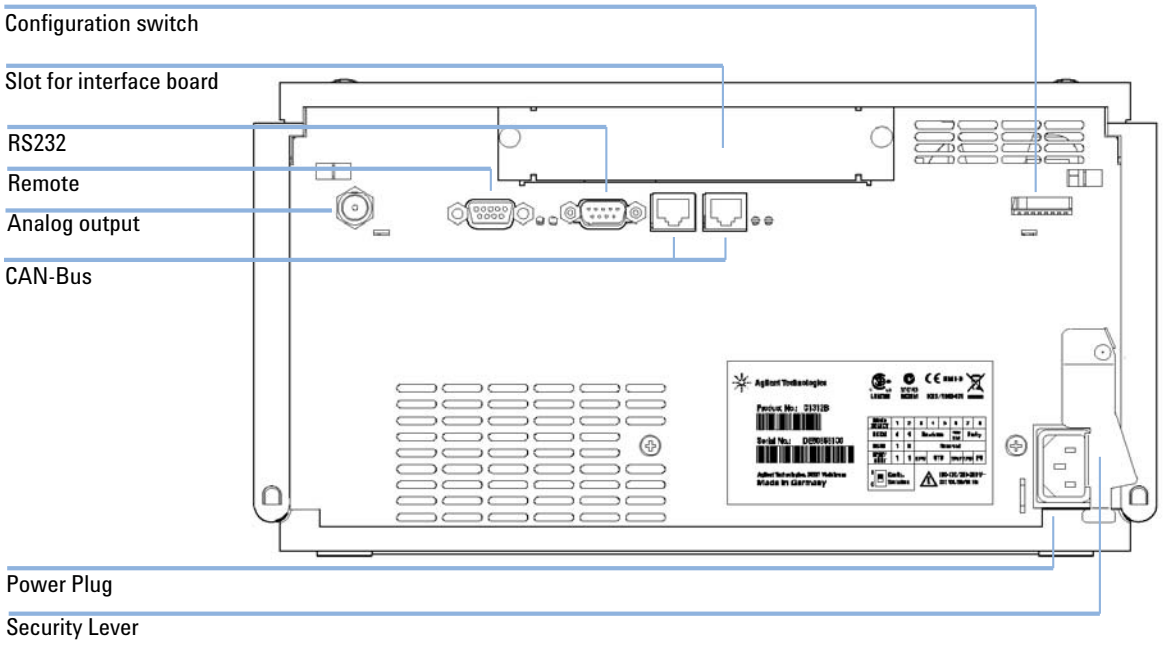


Figure 3 Electrical Connections to the Binary Pump

Interfaces

The Agilent 1200 Infinity Series modules provide the following interfaces:

Table 2 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN/BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
Pumps							
G1310B Iso Pump G1311B Quat Pump G1311C Quat Pump VL G1312B Bin Pump G1312C Bin Pump VL 1376A Cap Pump G2226A Nano Pump	2	Yes	No	Yes	1	Yes	
G4220A/B Bin Pump	2	No	Yes	Yes	No	Yes	
G1361A Prep Pump	2	Yes	No	Yes	No	Yes	CAN-DC- OUT for CAN slaves
Samplers							
G1329B ALS G2260A Prep ALS	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B
G1364B FC-PS G1364C FC-AS G1364D FC-µS G1367E HiP ALS G1377A HiP micro ALS G2258A DL ALS	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B CAN-DC- OUT for CAN slaves
G4226A ALS	2	Yes	No	Yes	No	Yes	
Detectors							
G1314B VWD VL G1314C VWD VL+	2	Yes	No	Yes	1	Yes	
G1314E/F VWD	2	No	Yes	Yes	1	Yes	

Table 2 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN/BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
G4212A/B DAD	2	No	Yes	Yes	1	Yes	
G1315C DAD VL+ G1365C MWD G1315D DAD VL G1365D MWD VL	2	No	Yes	Yes	2	Yes	
G1321B FLD G1362A RID	2	Yes	No	Yes	1	Yes	
G4280A ELSD	No	No	No	Yes	Yes	Yes	EXT Contact AUTOZERO
Others							
G1316A/C TCC	2	No	No	Yes	No	Yes	
G1322A DEG	No	No	No	No	No	Yes	AUX
G1379B DEG	No	No	No	Yes	No	No	AUX
G4227A Flex Cube	2	No	No	No	No	No	
G4240A CHIP CUBE	2	Yes	No	Yes	No	Yes	CAN-DC- OUT for CAN slaves THERMOSTAT for G1330A/B (NOT USED)

NOTE The detector (DAD/MWD/FLD/VWD/RID) is the preferred access point for control via LAN. The inter-module communication is done via CAN.

- CAN connectors as interface to other modules
- LAN connector as interface to the control software
- RS-232C as interface to a computer
- REMOTE connector as interface to other Agilent products
- Analog output connector(s) for signal output

Overview Interfaces

CAN

The CAN is inter-module communication interface. It is a 2-wire serial bus system supporting high speed data communication and real-time requirement.

LAN

The modules have either an interface slot for an LAN card (e.g. Agilent G1369A/B LAN Interface) or they have an on-board LAN interface (e.g. detectors G1315C/D DAD and G1365C/D MWD). This interface allows the control of the module/system via a connected PC with the appropriate control software.

NOTE If an Agilent detector (DAD/MWD/FLD/VWD/RID) is in the system, the LAN should be connected to the DAD/MWD/FLD/VWD/RID (due to higher data load). If no Agilent detector is part of the system, the LAN interface should be installed in the pump or autosampler.

RS-232C (Serial)

The RS-232C connector is used to control the module from a computer through RS-232C connection, using the appropriate software. This connector can be configured with the configuration switch module at the rear of the module. Refer to *Communication Settings for RS-232C*.

NOTE There is no configuration possible on main boards with on-board LAN. These are pre-configured for

- 19200 baud,
- 8 data bit with no parity and
- one start bit and one stop bit are always used (not selectable).

The RS-232C is designed as DCE (data communication equipment) with a 9-pin male SUB-D type connector. The pins are defined as:

Table 3 RS-232C Connection Table

Pin	Direction	Function
1	In	DCD
2	In	RxD
3	Out	TxD
4	Out	DTR
5		Ground
6	In	DSR
7	Out	RTS
8	In	CTS
9	In	RI

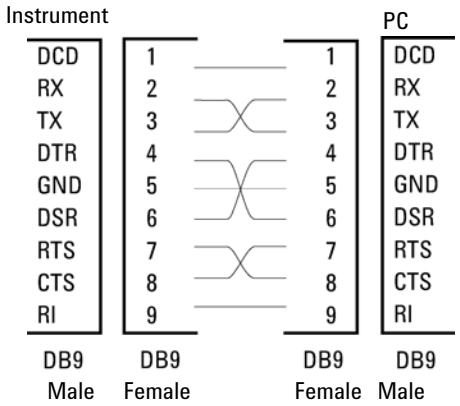


Figure 4 RS-232 Cable

Analog Signal Output

The analog signal output can be distributed to a recording device. For details refer to the description of the module's main board.

APG Remote

The APG Remote connector may be used in combination with other analytical instruments from Agilent Technologies if you want to use features as common shut down, prepare, and so on.

Remote control allows easy connection between single instruments or systems to ensure coordinated analysis with simple coupling requirements.

The subminiature D connector is used. The module provides one remote connector which is inputs/outputs (wired- or technique).

To provide maximum safety within a distributed analysis system, one line is dedicated to **SHUT DOWN** the system's critical parts in case any module detects a serious problem. To detect whether all participating modules are switched on or properly powered, one line is defined to summarize the **POWER ON** state of all connected modules. Control of analysis is maintained by signal readiness **READY** for next analysis, followed by **START** of run and optional **STOP** of run triggered on the respective lines. In addition **PREPARE** and **START REQUEST** may be issued. The signal levels are defined as:

- standard TTL levels (0 V is logic true, + 5.0 V is false),
- fan-out is 10,
- input load is 2.2 kOhm against + 5.0 V, and
- output are open collector type, inputs/outputs (wired- or technique).

NOTE All common TTL circuits operate with a 5 V power supply. A TTL signal is defined as "low" or L when between 0 V and 0.8 V and "high" or H when between 2.0 V and 5.0 V (with respect to the ground terminal).

Table 4 Remote Signal Distribution

Pin	Signal	Description
1	DGND	Digital ground
2	PREPARE	(L) Request to prepare for analysis (for example, calibration, detector lamp on). Receiver is any module performing pre-analysis activities.
3	START	(L) Request to start run / timetable. Receiver is any module performing run-time controlled activities.
4	SHUT DOWN	(L) System has serious problem (for example, leak: stops pump). Receiver is any module capable to reduce safety risk.
5		Not used
6	POWER ON	(H) All modules connected to system are switched on. Receiver is any module relying on operation of others.
7	READY	(H) System is ready for next analysis. Receiver is any sequence controller.
8	STOP	(L) Request to reach system ready state as soon as possible (for example, stop run, abort or finish and stop injection). Receiver is any module performing run-time controlled activities.
9	START REQUEST	(L) Request to start injection cycle (for example, by start key on any module). Receiver is the autosampler.

Special Interfaces

Some modules have module specific interfaces/connectors. They are described in the module documentation.

Setting the 8-bit Configuration Switch

Setting the 8-bit Configuration Switch (On-Board LAN)

The 8-bit configuration switch is located at the rear of the module. Switch settings provide configuration parameters for LAN, serial communication protocol and instrument specific initialization procedures.

All modules with on-board LAN, e.g. G1315/65C/D, G1314D/E/F, G4212A/B, G4220A:

- Default is ALL switches DOWN (best settings) - Bootp mode for LAN.
- For specific LAN modes switches 3-8 must be set as required.
- For boot/test modes switches 1+2 must be UP plus required mode.

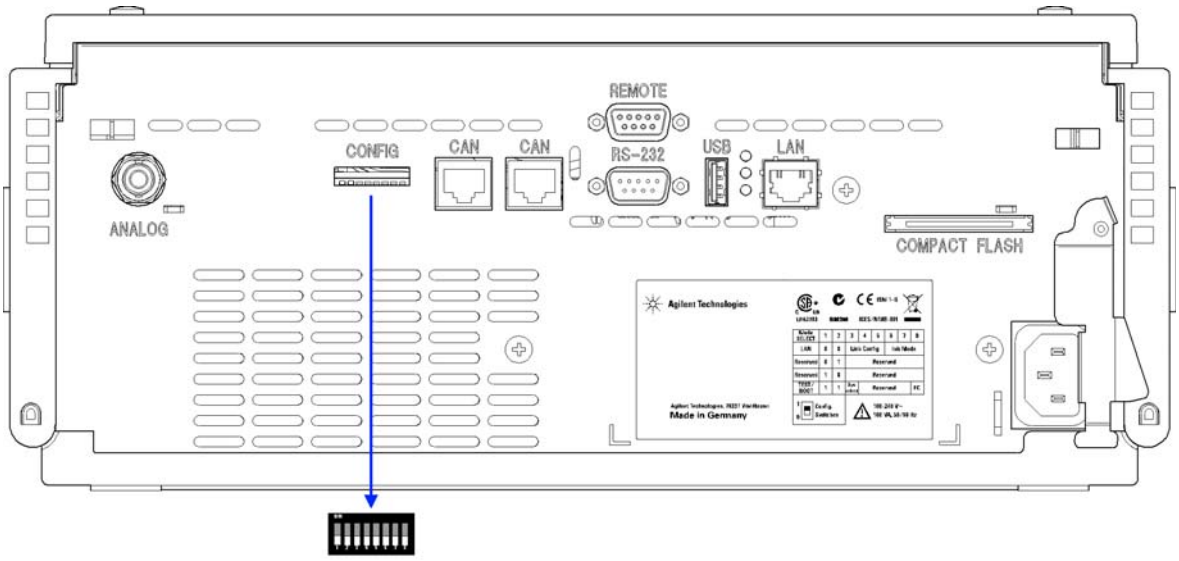


Figure 5 Location of Configuration Switch (example shows a G4212A DAD)

NOTE To perform any LAN configuration, SW1 and SW2 must be set to OFF. For details on the LAN settings/configuration refer to chapter LAN Configuration.

Table 5 8-bit Configuration Switch (with on-board LAN)

	Mode		Function					
	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
LAN	*0*	*0*	Link Configuration			Init Mode Selection		
Auto-negotiation			*0*	x	x	x	x	x
10 MBit, half-duplex			1	*0*	*0*	x	x	x
10 MBit, full-duplex			1	*0*	1	x	x	x
100 MBit, half-duplex			1	1	*0*	x	x	x
100 MBit, full-duplex			1	1	1	x	x	x
Bootp			x	x	x	*0*	*0*	*0*
Bootp & Store			x	x	x	*0*	*0*	1
Using Stored			x	x	x	*0*	1	*0*
Using Default			x	x	x	*0*	1	1
TEST	1	1	System					NVRAM
Boot Resident System			1					x
Revert to Default Data (Coldstart)			x	x	x			1

Legend:

0 (switch down), 1 (switch up), x (any position)

NOTE When selecting the mode TEST, the LAN settings are: Auto-Negotiation & Using Stored.

NOTE For explanation of "Boot Resident System" and "Revert to Default Data (Coldstart)" refer to "Special Settings" on page 35.

Setting the 8-bit Configuration Switch (without On-Board LAN)

The 8-bit configuration switch is located at the rear of the module.

Modules that do not have their own LAN interface (e.g. the TCC) can be controlled through the LAN interface of another module and a CAN connection to that module.

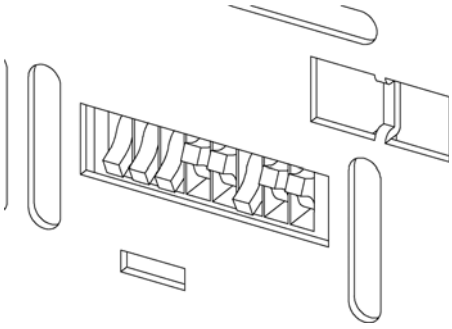


Figure 6 Configuration switch (settings depend on configured mode)

All modules without on-board LAN:

- default is ALL DIPS DOWN (best settings) - Bootp mode for LAN
- for boot/test modes DIPS 1+2 must be UP plus required mode

Switch settings provide configuration parameters for GPIB address, serial communication protocol and instrument specific initialization procedures.

NOTE With the introduction of the Agilent 1260 Infinity, all GPIB interfaces have been removed. The preferred communication is LAN.

NOTE The following tables represent the configuration switch settings for the modules without on-board LAN only.

Table 6 8-bit Configuration Switch (without on-board LAN)

Mode Select	1	2	3	4	5	6	7	8
RS-232C	0	1	Baudrate			Data Bits	Parity	
Reserved	1	0	Reserved					
TEST/BOOT	1	1	RSVD	SYS		RSVD	RSVD	FC

NOTE The LAN settings are done on the LAN Interface Card G1369A/B. Refer to the documentation provided with the card.

Communication Settings for RS-232C

The communication protocol used in the column compartment supports only hardware handshake (CTS/RTR).

Switches 1 in down and 2 in up position define that the RS-232C parameters will be changed. Once the change has been completed, the column instrument must be powered up again in order to store the values in the non-volatile memory.

Table 7 Communication Settings for RS-232C Communication (without on-board LAN)

Mode Select	1	2	3	4	5	6	7	8
RS-232C	0	1	Baudrate			Data Bits	Parity	

Use the following tables for selecting the setting which you want to use for RS-232C communication. The number 0 means that the switch is down and 1 means that the switch is up.

Table 8 Baudrate Settings (without on-board LAN)

Switches			Baud Rate	Switches			Baud Rate
3	**4**	**5**		**3**	**4**	**5**	
0	0	0	9600	1	0	0	9600
0	0	1	1200	1	0	1	14400
0	1	0	2400	1	1	0	19200
0	1	1	4800	1	1	1	38400

Table 9 Data Bit Settings (without on-board LAN)

Switch 6	Data Word Size
0	7 Bit Communication
1	8 Bit Communication

Table 10 Parity Settings (without on-board LAN)

Switches		Parity
7	8	
0	0	No Parity
1	0	Odd Parity
1	1	Even Parity

One start bit and one stop bit are always used (not selectable).

Per default, the module will turn into 19200 baud, 8 data bit with no parity.

Special Settings

The special settings are required for specific actions (normally in a service case).

NOTE The tables include both settings for modules – with on-board LAN and without on-board LAN. They are identified as LAN and no LAN.

Boot-Resident

Firmware update procedures may require this mode in case of firmware loading errors (main firmware part).

If you use the following switch settings and power the instrument up again, the instrument firmware stays in the resident mode. It is not operable as a module. It only uses basic functions of the operating system for example, for communication. In this mode the main firmware can be loaded (using update utilities).

Table 11 Boot Resident Settings (without on-board LAN)

	Mode Select	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
LAN	TEST/BOOT	1	1	1	0	0	0	0	0
No LAN	TEST/BOOT	1	1	0	0	1	0	0	0

Forced Cold Start

A forced cold start can be used to bring the module into a defined mode with default parameter settings.

CAUTION

Loss of data

Forced cold start erases all methods and data stored in the non-volatile memory. Exceptions are diagnosis and repair log books which will not be erased.

➔ Save your methods and data before executing a forced cold start.

If you use the following switch settings and power the instrument up again, a forced cold start has been completed.

Table 12 Forced Cold Start Settings (without on-board LAN)

	Mode Select	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
LAN	TEST/BOOT	1	1	0	0	0	0	0	1
No LAN	TEST/BOOT	1	1	0	0	1	0	0	1

2
Site Requirements and Specifications

Site Requirements 38
Physical Specifications 41
Performance Specifications 42

This chapter provides information about site requirements and specifications for the binary pump.

Site Requirements

A suitable environment is important to ensure optimal performance of the instrument.

Power Considerations

The module power supply has wide ranging capability. It accepts any line voltage in the range described in Table 13 on page 41. Consequently there is no voltage selector in the rear of the module. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

WARNING

Hazard of electrical shock or damage of your instrumentation

can result, if the devices are connected to a line voltage higher than specified.

➔ Connect your instrument to the specified line voltage only.

WARNING

Module is partially energized when switched off, as long as the power cord is plugged in.

Repair work at the module can lead to personal injuries, e.g. electrical shock, when the cover is opened and the module is connected to power.

➔ Always unplug the power cable before opening the cover.

➔ Do not connect the power cable to the instrument while the covers are removed.

CAUTION

Unaccessable power plug.

In case of emergency it must be possible to disconnect the instrument from the power line at any time.

➔ Make sure the power connector of the instrument can be easily reached and unplugged.

➔ Provide sufficient space behind the power socket of the instrument to unplug the cable.

Power Cords

Different power cords are offered as options with the module. The female end of all power cords is identical. It plugs into the power-input socket at the rear. The male end of each power cord is different and designed to match the wall socket of a particular country or region.

WARNING

Absence of ground connection or use of unspecified power cord

The absence of ground connection or the use of unspecified power cord can lead to electric shock or short circuit.

➔ Never operate your instrumentation from a power outlet that has no ground connection.

➔ Never use a power cord other than the Agilent Technologies power cord designed for your region.

WARNING

Use of unsupplied cables

Using cables not supplied by Agilent Technologies can lead to damage of the electronic components or personal injury.

➔ Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

WARNING

Unintended use of supplied power cords

Using power cords for unintended purposes can lead to personal injury or damage of electronic equipment.

➔ Never use the power cords that Agilent Technologies supplies with this instrument for any other equipment.

Bench Space

The module dimensions and weight (see Table 13 on page 41) allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 8 cm (3.1 inches) in the rear for air circulation and electric connections.

If the bench should carry an Agilent system, make sure that the bench is designed to bear the weight of all modules.

The module should be operated in a horizontal position.

Condensation

CAUTION

Condensation within the module

Condensation will damage the system electronics.

➔ Do not store, ship or use your module under conditions where temperature fluctuations could cause condensation within the module.

➔ If your module was shipped in cold weather, leave it in its box and allow it to warm slowly to room temperature to avoid condensation.

Physical Specifications

Table 13 Physical Specifications

Type	Specification	Comments
Weight	15.5 kg (34 lbs)	
Dimensions (height × width × depth)	180 x 345 x 435 mm (7 x 13.5 x 17 inches)	
Line voltage	100 – 240 VAC, ± 10%	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5%	
Power consumption	220 VA, 74 W / 253 BTU	Maximum
Ambient operating temperature	0–55 °C (32–131 °F)	
Ambient non-operating temperature	-40–70 °C (-4–158 °F)	
Humidity	< 95%, at 25–40 °C (77–104 °F)	Non-condensing
Operating Altitude	Up to 2000 m (6562 ft)	
Non-operating altitude	Up to 4600 m (15091 ft)	For storing the module
Safety standards: IEC, CSA, UL	Installation Category II, Pollution Degree 2	For indoor use only.

Performance Specifications

Table 14 Performance Specifications of the Agilent 1260 Infinity Binary Pump (G1312B)

Type	Specification	Comments
Hydraulic system	Two dual piston in series pumps with proprietary servo-controlled variable stroke drive, floating piston design	
Setable flow range	Dual piston in series pump with proprietary servo-controlled variable stroke drive, floating pistons	
Flow range	0.05 – 5.0 mL/min	
Flow precision	< 0.07 % RSD or < 0.02 min SD, whatever is greater	based on retention time at constant room temperature
Flow accuracy	± 1 % or 10 µL/min, what ever is greater, pumping degassed H_2O at 10 MPa	measured with water
Pressure	Operating range 0 – 60 MPa (0 – 600 bar, 0 – 8700 psi) up to 5 mL/min	
Pressure pulsation	< 2 % amplitude (typically < 1.3 %), or < 3 bar at 1 mL/min isopropanol, at all pressures > 10 bar (147 psi) *Low delay volume configuration:* < 5 % amplitude (typically < 2 %)	at 1 mL/min water
Compressibility compensation	Automatic, pre-defined, based on mobile phase compressibility	
Recommended pH range	1.0 – 12.5 , solvents with pH < 2.3 should not contain acids which attack stainless steel	
Gradient formation	High-pressure binary mixing	
Delay volume	*Standard delay volume configuration:* 600 – 800 µL, dependent on back pressure (includes 400 µL mixer) *Low delay volume configuration:* 120 µL	measured with water

Table 14 Performance Specifications of the Agilent 1260 Infinity Binary Pump (G1312B)

Type	Specification	Comments
Composition range	settable range: 0 – 100 % recommended range: 1 – 99 % or 5 µL/min per channel, whatever is greater	
Composition precision	< 0.15 % RSD or < 0.04 min SD whichever is greater	at 1 mL/min
Composition accuracy	± 0.35 % absolute	(water/caffeine tracer)
Control	Agilent ChemStation for LC (32-bit) G4208A Handheld Controller EZ Chrom Elite	Revision B.02.00 or above
Analog output	For pressure monitoring, 1.33 mV/bar, one output	
Communications	Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, LAN optional	

NOTE

For use with flow rates below 500 µl/min or for use without damper and mixer a vacuum degasser is required.

All specification measurements are done with degassed solvents.

3 Installing the Pump

Unpacking the Binary Pump 46
Optimizing the Stack Configuration 48
Installing the Binary Pump 55
Flow Connections with Solvent Selection Valve 58
Flow Connections without Solvent Selection Valve 61
Priming the System 64
- Initial Priming 64
- Regular Priming 66
- Changing Solvents 67

This chapter gives information about the preferred stack setup for your system and the installation of your binary pump.

Unpacking the Binary Pump

Damaged Packaging

If the delivery packaging shows signs of external damage, please call your Agilent Technologies sales and service office immediately. Inform your service representative that the instrument may have been damaged during shipment.

CAUTION

"Defective on arrival" problems

If there are signs of damage, please do not attempt to install the module. Inspection by Agilent is required to evaluate if the instrument is in good condition or damaged.

➔ Notify your Agilent sales and service office about the damage.

➔ An Agilent service representative will inspect the instrument at your site and initiate appropriate actions.

Delivery Checklist

Compare the delivery checklist with the contents of the shipping boxes to ensure completeness of the shipment. The contents lists is shown below. For parts identification check the illustrated parts breakdown in "Parts and Materials for Maintenance" on page 185. Please report missing or damaged parts to your local Agilent Technologies sales and service office.

p/n	Description
	Binary Pump
G1312-67500	Calibration capillary assembly
	LabAdvisor DVD
G1312-68700	1200 Binary Pump SL Start up Kit
0100-1681	Syringe adapter luer/barb
9301-0411	Syringe, Plastic
5067-1531	Solvent Cabinet Kit 1290 of Infinity Binary Pump, complete
5067-1532	Solvent cabinet (2 bottles, for pumps without solvent selection valve)
9301-1450	Solvent bottle, amber
9301-1420	Solvent bottle, transparent
827700-902	Column: Agilent ZORBAX SB-C18, 2.1 x 50 mm1.8 µm
827975-902	Column: SB-C18, 4.6x50 mm, 1.8 µm, 600 bar
927975-902	Column: Eclipse XDB-C18, 4.6x50 mm, 1.8 µm, 600 bar
	Power cord
G1312-68755	Accessory Kit
G1312-68765	Accessory Kit

Optimizing the Stack Configuration

1200 RRLC System in Standard Delay Volume Configuration

This configuration is typically used when using 4.6 mm and 3.0 mm ID columns. It is optimized for high flow rates and maximum sensitivity.

For a more detailed help on configuring your instrument, refer to RRLC system configurator A.01.01 CD-ROM (p/n 01200-60001).

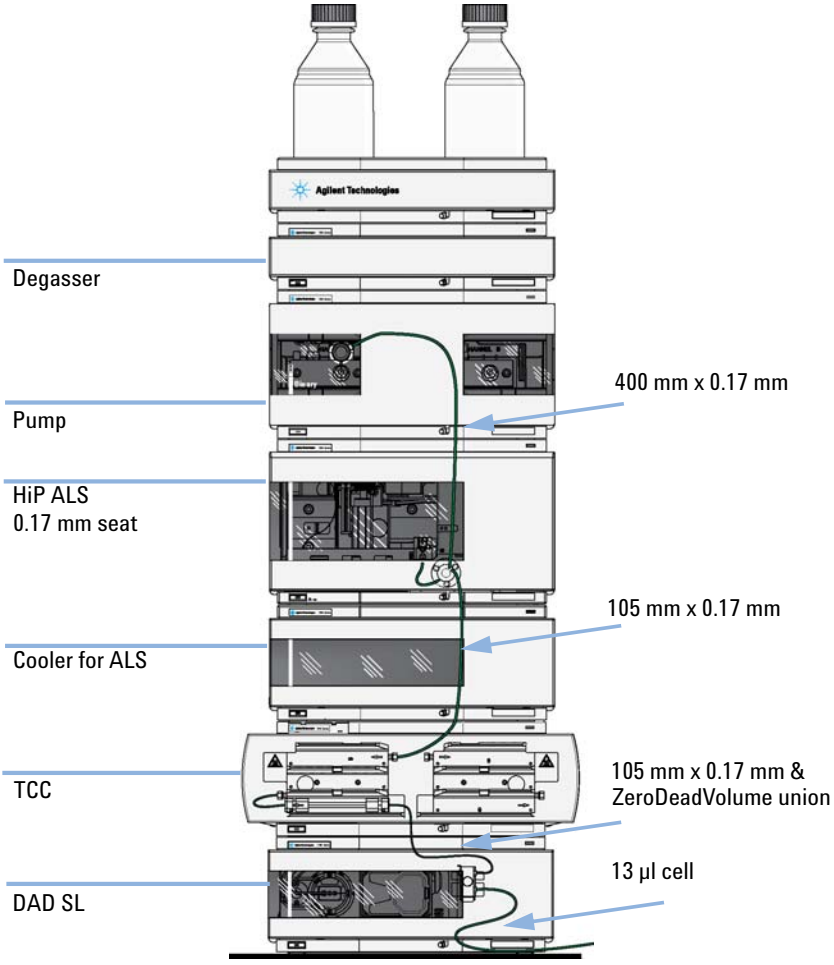


Figure 7 1200 RRLC system in standard delay volume configuration for 4.6 mm & 3.0 mm id columns

1200 RRLC in Medium Delay Volume Configuration

This setup is used for best Signal to noise ratio using 2.1 mm and 3.0 mm columns.

For a more detailed help on configuring your instrument, refer to the RRLC system configurator A.01.01 CD-ROM (p/n 01200-60001).

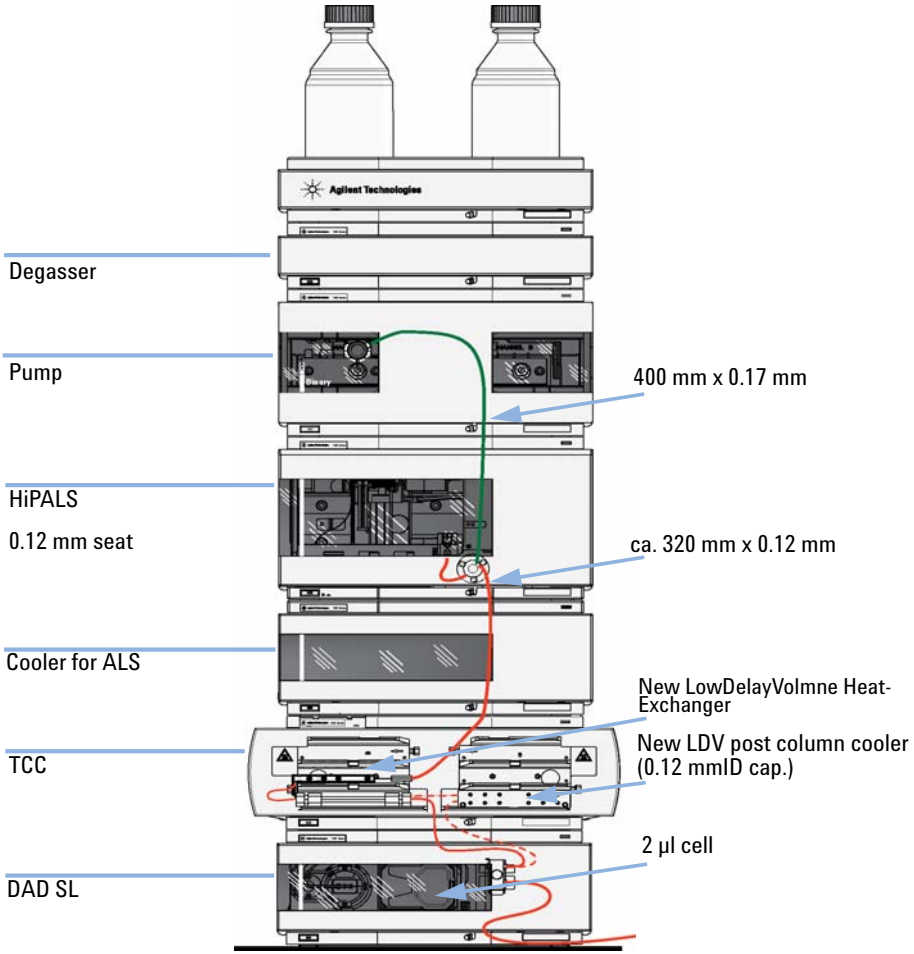


Figure 8 1200 RRLC system in low delay volume configuration for 2.1 mm & 3.0 mm id columns

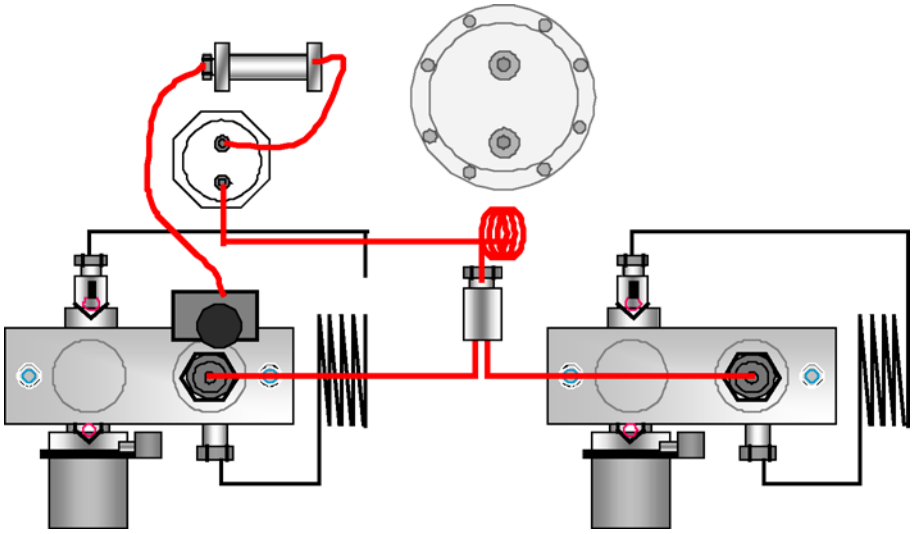


Figure 9 Binary Pump SL in medium delay volume configuration

1200 RRLC in Low Delay Volume Configuration

In this configuration the RRLC is optimized for speed with the 2.1 mm columns.

For a more detailed help on configuring your instrument, refer to the RRLC system configurator A.01.01 CD-ROM (p/n 01200-60001).

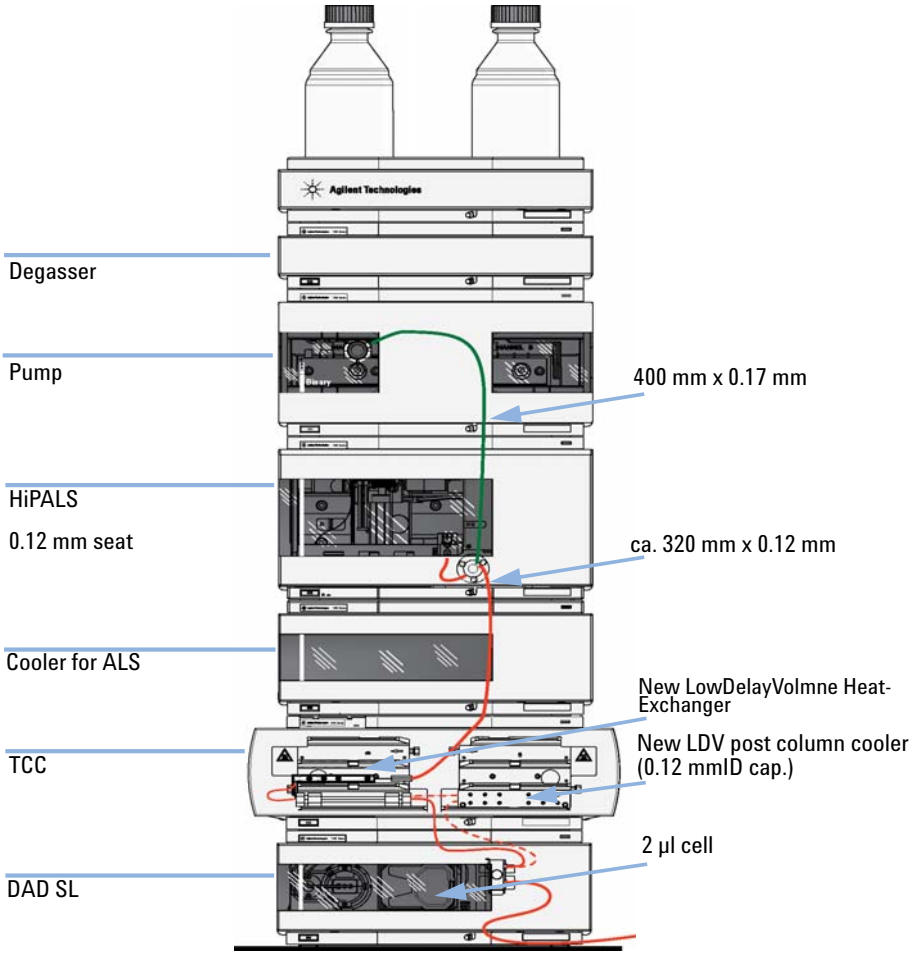


Figure 10 1200 RRLC system in low delay volume configuration for 2.1 mm & 3.0 mm id columns

1200 RRLC in Low Delay Volume Configuration with Post Column Cooler

This configuration is usually used for short 2.1 mm and 3.0 mm columns optimized for high flow rates.

For a more detailed help on configuring your instrument, refer to the RRLC system configurator A.01.01 CD-ROM (p/n 01200-60001).

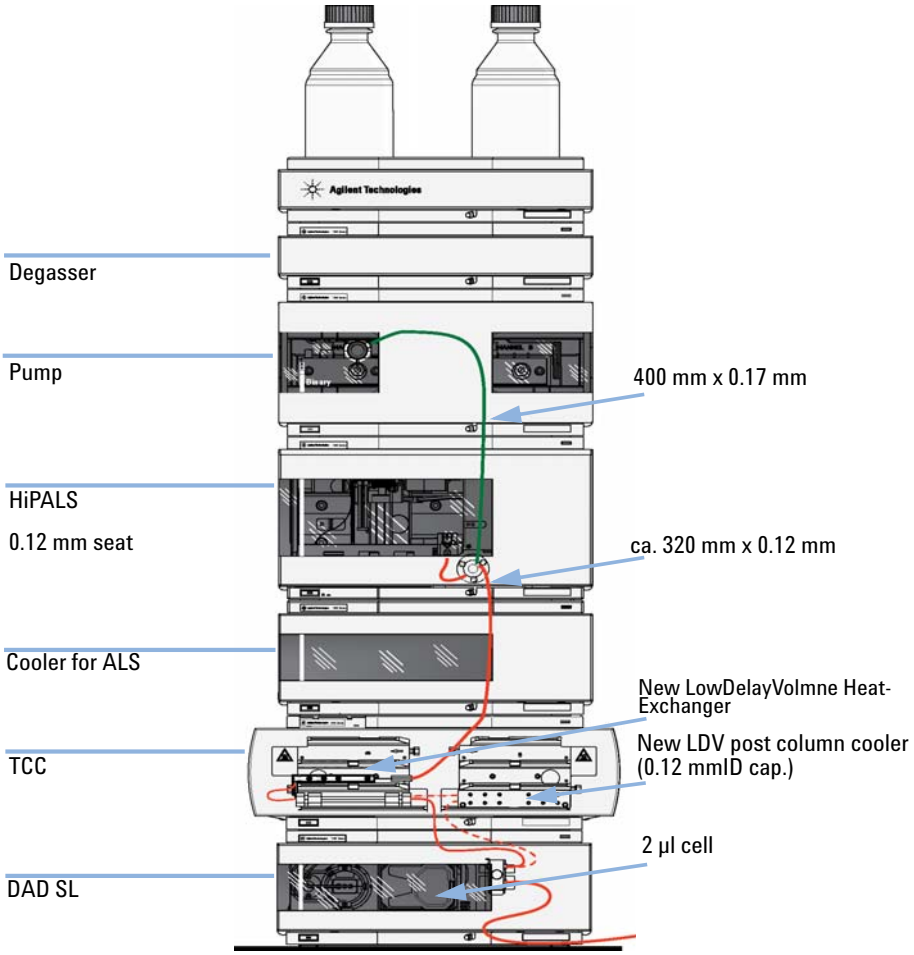


Figure 11 1200 RRLC system in low delay volume configuration for 2.1 mm & 3.0 mm id columns

1200 RRLC in Low Delay Volume Configuration with Automated Column Regeneration and MS

This is the recommended setup to achieve minimum cycle time using MS detection.

For a more detailed help on configuring your instrument, refer to the RRLC system configurator A.01.01 CD-ROM (p/n 01200-60001).

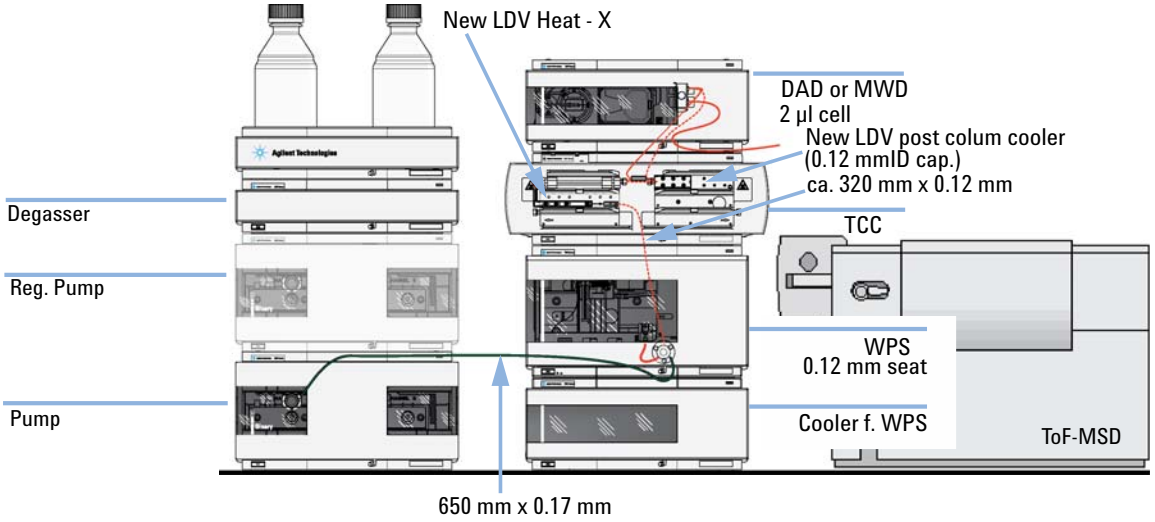


Figure 12 1200 RR with Automated column regeneration and TOF in low delay volume configuration

Installing the Binary Pump

Parts required

#	p/n	Description
1		Pump
1		Data System
1	G4208A	Instant Pilot
1		Power cord

For other cables see text below and "Cable Overview" on page 208.

Preparations

- Locate bench space.
- Provide power connections.
- Unpack the module.

WARNING

Module is partially energized when switched off, as long as the power cord is plugged in.

Repair work at the module can lead to personal injuries, e.g. shock hazard, when the cover is opened and the module is connected to power.

➔ Make sure that it is always possible to access the power plug.

➔ Remove the power cable from the instrument before opening the cover.

➔ Do not connect the power cable to the Instrument while the covers are removed.

CAUTION

"Defective on arrival" problems

If there are signs of damage, please do not attempt to install the module. Inspection by Agilent is required to evaluate if the instrument is in good condition or damaged.

➔ Notify your Agilent sales and service office about the damage.

➔ An Agilent service representative will inspect the instrument at your site and initiate appropriate actions.

1 Place the module on the bench in a horizontal position.

2 Ensure the power switch on the front of the pump is OFF (switch stands out).

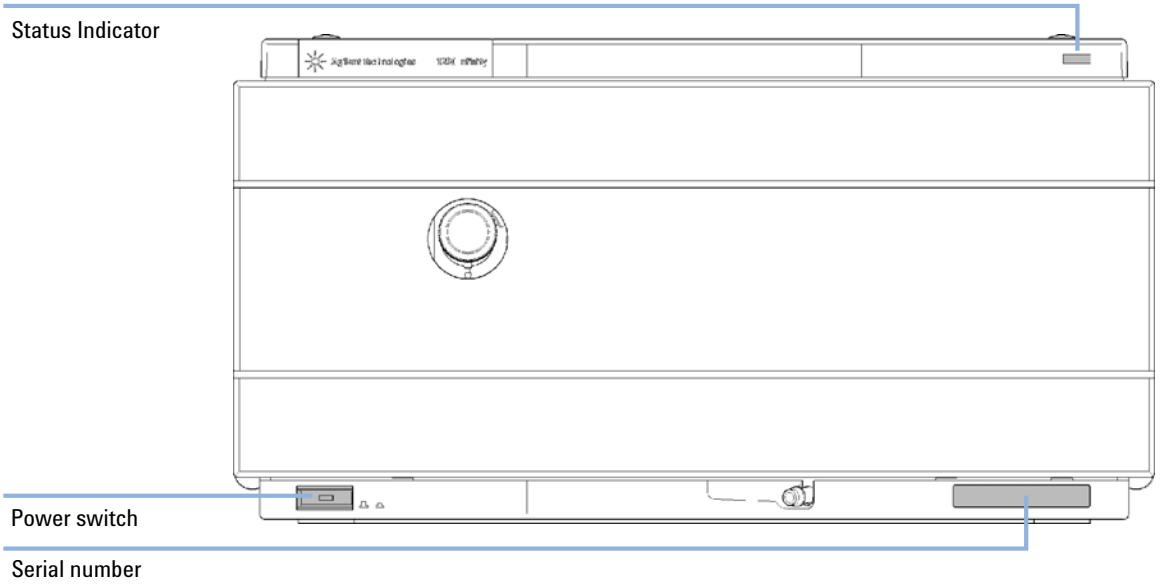


Figure 13 Front of Binary Pump

3 At the rear of the module move the security lever to its maximum right position.

4 Connect the power cable to the power connector at the rear of the module.

The security lever will prevent that the cover is opened while the power cord is connected to the module.

5 Connect the required interface cables to the rear of the module.

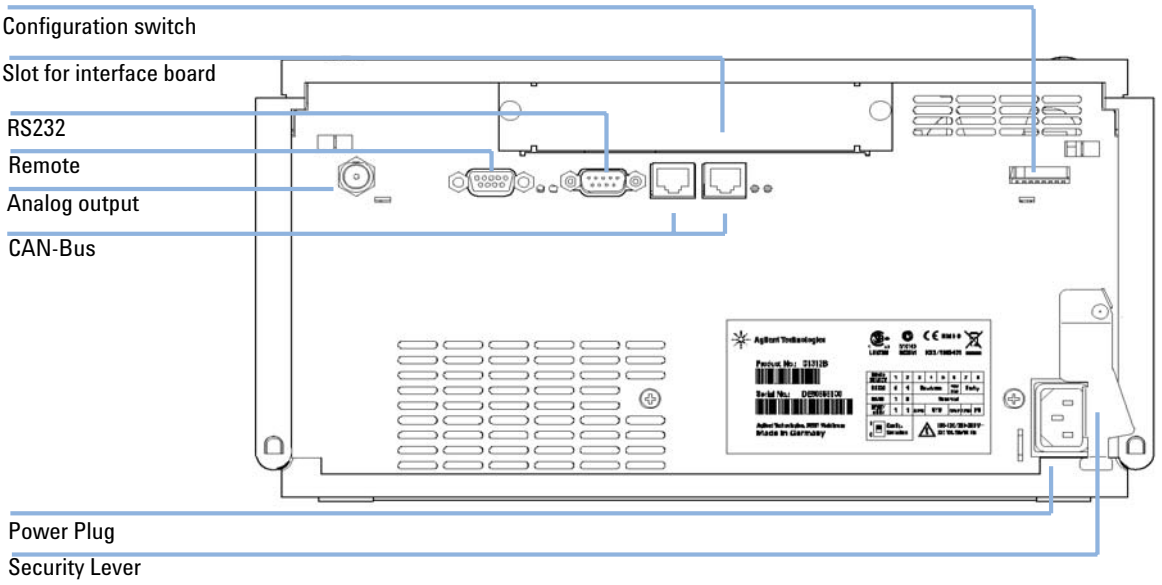


Figure 14 Rear of the Binary Pump

6 Connect the capillary, solvent tubes and waste tubings (see "Flow Connections with Solvent Selection Valve" on page 58 or "Flow Connections without Solvent Selection Valve" on page 61).

7 Press the power switch to turn on the module.

NOTE The power switch stays pressed in and a green indicator lamp in the power switch is on when the module is turned on. When the line power switch stands out and the green light is off, the module is turned off.

8 Purge the pump (see "Initial Priming" on page 64).

Flow Connections with Solvent Selection Valve

Parts required	#	p/n	Description
	1		Other modules
	1	G1312-68755	Accessory Kit
	1	G1312-68765	Accessory Kit
	2		wrenches 1/4 - 5/16 inch for capillary connections

Preparations Pump is installed in the LC system

WARNING

When opening capillary or tube fittings solvents may leak out.

The handling of toxic and hazardous solvents and reagents can bear health risks.

➔ Please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.

1 Remove the front cover by pressing the snap fasteners on both sides.

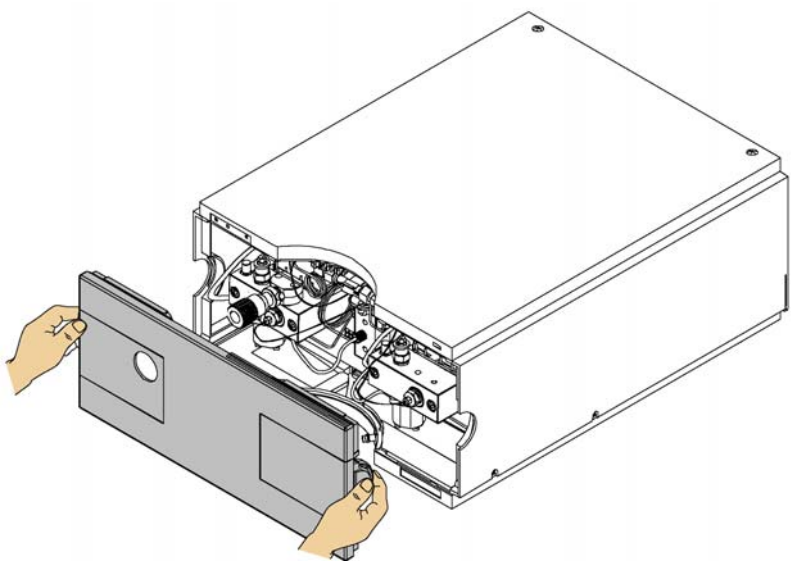


Figure 15 Removing the Front Cover

2 If available, place the online degasser on top of the pump.

3 Place the solvent cabinet on top of the module.

4 Set the four bottles into the solvent cabinet and screw a bottle head assembly onto each bottle.

5 Connect the solvent tubes from the bottle head assemblies to the inlet connectors A1, A2, B1 and B2 of the solvent selection valve. Make sure to use the brown bottle for the aqueous solvent (usually channel A1).

6 Label the tubes accordingly using the supplied stickers and fix the tubes in the clips of solvent cabinet and binary pump.

7 Hold the waste tubing with a piece of sandpaper and push it onto the purge valve outlet. Place the end into your waste system.

8 If the pump is not part of an Agilent 1260 Infinity system stack or placed on the bottom of a stack, connect the corrugated waste tube to the waste outlet of the pump leak handling system.

9 Connect the pump outlet capillary (pump to injection device) to the outlet of the purge valve.

10 Purge your system prior to the first use (see “Initial Priming” on page 64).

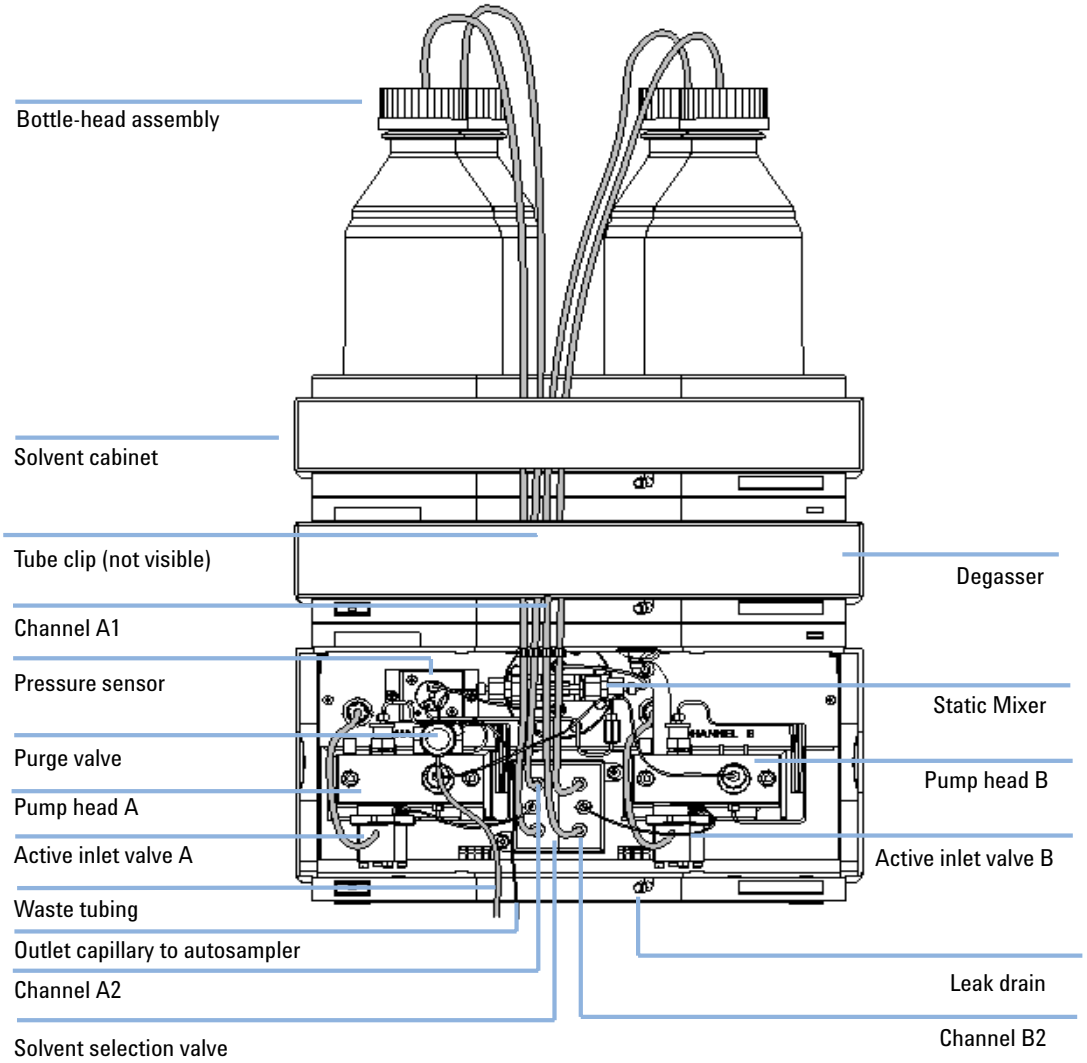


Figure 16 Binary Pump with Solvent Selection Valve

Flow Connections without Solvent Selection Valve

Parts required	#	p/n	Description
	1		Other modules
	1	G1312-68755	Accessory Kit
	1	G1312-68765	Accessory Kit
	2		wrenches 1/4 - 5/16 inch for capillary connections

Preparations Pump is installed in the LC system

WARNING

When opening capillary or tube fittings solvents may leak out.

The handling of toxic and hazardous solvents and reagents can bear health risks.

➔ Please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.

1 Remove the front cover by pressing the snap fasteners on both sides.

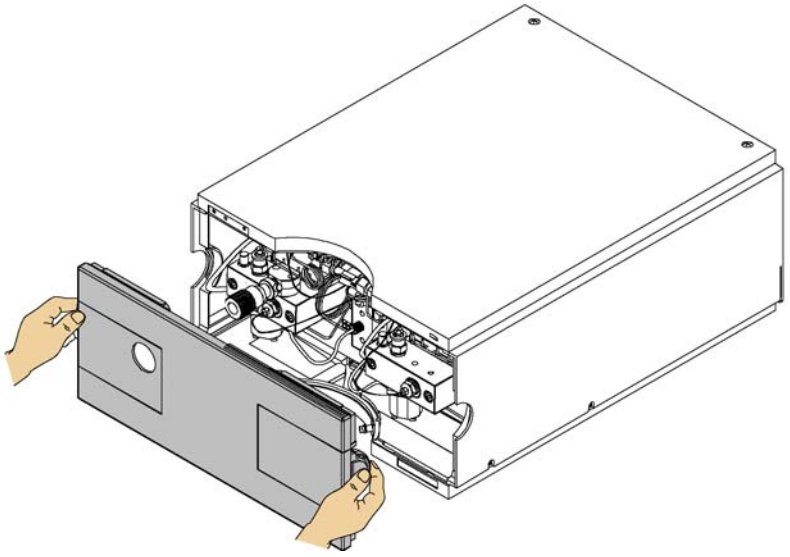


Figure 17 Removing the Front Cover

2 Place the solvent cabinet on top of the module.

3 Place the bottles into the solvent cabinet and place a bottle head assembly into each bottle.

4 Connect the solvent tubes from the bottle head assemblies to the inlet adapters of the active inlet valves. Fix the tubes in the clips of solvent cabinet and binary pump.

5 Hold the waste tubing with a piece of sandpaper and push it onto the purge valve outlet. Place the end into your waste system.

6 If the pump is not part of an Agilent 1260 Infinity system stack or placed on the bottom of a stack, connect the corrugated waste tube to the waste outlet of the pump leak handling system.

7 Connect the pump outlet capillary (pump to injection device) to the outlet of the purge valve.

8 Purge your system before first use (see "Initial Priming" on page 64).

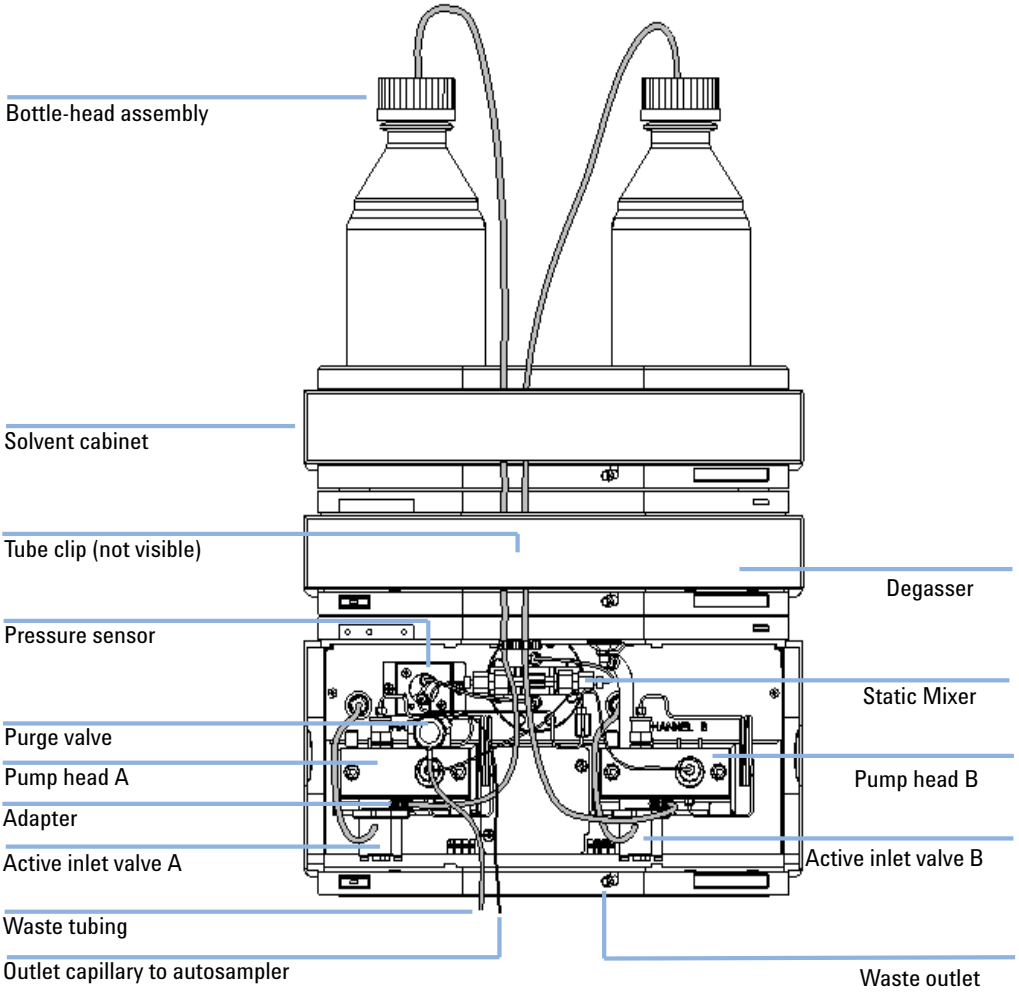


Figure 18 Flow Connection of Binary Pump without Solvent Selection Valve

Priming the System

Initial Priming

When

Before a new degasser or new solvent tubing can be used, it is necessary to prime the system. Isopropanol (IPA) is recommended as priming solvent due to its miscibility with nearly all HLPC solvents and its excellent wetting properties.

Parts required

#	Description
1	Isopropanol

Preparations

Connect all modules hydraulically as described in the respective module manuals.

Fill each solvent bottle with 100 mL isopropanol

Switch the system on

WARNING

When opening capillary or tube fittings solvents may leak out.

The handling of toxic and hazardous solvents and reagents can bear health risks.

➔ Please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.

NOTE

The purge tool of the LabAdvisor or Instrument Utilities can be used for automatically purging the pump.

NOTE

If the pump is not able to aspirate the solvent from the bottles, a syringe can be used to draw the solvent manually through tubing and degasser.

NOTE When priming the vacuum degasser with a syringe, the solvent is drawn through the degasser tubes very quickly. The solvent at the degasser outlet will therefore not be fully degassed. Pump for approximately 10 minutes at your desired flow rate before starting an analysis. This will allow the vacuum degasser to properly degas the solvent in the degasser tubes.

1. Open the purge valve of the pump
2. Set the flow rate to 5 mL/min.
3. Select channel A1
4. Turn the flow on
5. Observe if the solvent in the tubing of channel A1 is advancing towards the pump. If it isn't, disconnect the solvent tubing from the solvent selection valve, attach a syringe with a syringe adapter and pull the liquid through the degasser. Reattach the tubing to the solvent selection valve.
6. Pump 30 mL isopropanol to remove residual air bubbles.
7. Switch to the next solvent channel and repeat steps 5 and 6 until all channels have been purged.
8. Turn the flow off and close the purge valve.

Regular Priming

When When the pumping system has been turned off for a certain time (for example, overnight) air will rediffuse into the solvent channel between the vacuum degasser and the pump. Solvents containing volatile ingredients will slightly lose these if left in the degasser without flow for a prolonged period of time.

Preparations Switch the system on

NOTE The purge tool of the LabAdvisor or Instrument Utilities can be used for automatically purging the pump.

1. Open the purge valve of your pump by turning it counterclockwise and set the flow rate to 5 mL/min.
2. Flush the vacuum degasser and all tubes with at least 10 mL of solvent.
3. Repeat step 1 and 2 for the other channel(s) of the pump.
4. Set the required composition and flow rate for your application and close the purge valve.
5. Pump for approximately 10 minutes before starting your application.

Changing Solvents

When

When the solvent of a channel is to be replaced by another solvent that is not compatible (solvents are immiscible or one solvent contains a buffer) it is necessary to follow the procedure below to prevent clogging of the pump by salt precipitation or residual liquid droplets in parts of the system.

Parts required

#	Description
1	Purging solvent(s), see Table 15 on page 68

Preparations

Remove the column and replace it by a ZDV fitting.

Prepare bottles with appropriate intermediate solvents (see Table 15 on page 68)

1 If the channel is not filled with a buffer, proceed to step 4.

2 Place the solvent intake filter into a bottle of water.

3 Flush the channel at a flow rate suitable for the installed tubing (typically 3-5 mL/min) for 10 min.

4 Modify the flow path of your system as required for your application. For delay volume optimization see the Rapid Resolution System manual.

CAUTION

Buffer salt of aqueous buffers may precipitate in residual isopropanol.

Capillaries and filter may be cloged by precipitating salt.

➔ Don't perform steps 5 to 7 for channels run with aqueous buffer as solvent.

5 Replace the solvent bottle by a bottle of isopropanol.

6 Flush the channel at a flow rate suitable for the installed tubing (typically 3-5 mL/min) for 5 min.

7 Swap the bottle of isopropanol with a bottle of solvent for your application.

8 Repeat steps 1 to 7 for the other channel(s) of the pump.

9 Install the desired column, set the required composition and flow rate for your application and equilibrate the system for approx. 10 minutes prior to starting a run.

Table 15 Choice of Priming Solvents for Different Purposes

Activity	Solvent	Comments
After an installation When switching between reverse phase and normal phase (both times)	Isopropanol Isopropanol	Best solvent to flush air out of the system Miscible with almost all solvents
After an installation	Ethanol or methanol	Alternative to isopropanol (second choice) if no isopropanol is available
To clean the system when using buffers After changing aqueous solvents	HPLC grade water HPLC grade water	Best solvent to re-dissolve buffer crystals Best solvent to re-dissolve buffer crystals
After the installation of normal phase seals (P/N 0905-1420)	Hexane + 5% isopropanol	Good wetting properties

4
Using the Pump

Hints for Successful Use of the Binary Pump 70
Setting up the Pump with the G4208A Instant Pilot 72
Setting up the Pump with Agilent ChemStation 73
- Overview 73
- Setup of Basic Pump Parameters 73
- Pump Control 75
- Pump Auxiliary Parameters 77
- Data Curves 79
- Bottle Filling 80

Early Maintenance Feedback (EMF) 82
- EMF Counters 82
- Using the EMF Counters 83

This chapter explains the operational parameters of the binary pump.

Hints for Successful Use of the Binary Pump

- Place solvent cabinet with the solvent bottles always on top (or at a higher level) of the pump.
- When using the binary pump without vacuum degasser, shortly degas your solvents (for example, water vacuum pump for 15 – 30 s in an appropriate vessel) before using them in the pump. If possible apply solvent conditions that will decrease the gas solubility over time (for example, warming up the solvents).
- The use of avacuum degasser is mandatory for flow rates below 0.5 mL/min and for configurations without damper and mixer.
- When using the binary pump with vacuum degasser, flush the degasser with at least 5 mL per channel before operating the pump, especially when the pumping system had been turned off for a certain length of time (for example, overnight) and volatile solvent mixtures are used in the channels (see "Regular Priming" on page 66).
- Prevent blocking of solvent inlet filters (never use the pump without solvent inlet filters). Growth of algae should be avoided (see "Prevent Blocking of Solvent Filters" on page 86).
- Check purge valve frit and column frit in regular time intervals. A blocked purge valve frit can be identified by black, yellow or greenish layers on its surface or by a pressure greater than 10 bar when pumping distilled water at a rate of 5 mL/min with an open purge valve.
- Whenever possible use a minimum flow rate of 5 µL/min per solvent channel to avoid crossflow of solvent into the unused pump channel.
- Whenever exchanging the pump seals, the purge valve frit should be exchanged, too.
- When using buffer solutions, flush the system with water before switching it off. The seal wash option should be used when buffer solutions with concentrations of 0.1 M or higher are being pumped for long periods of time.
- Check the pump plungers for scratches, grooves and dents when changing the piston seals. Damaged plungers cause micro leaks and will decrease the lifetime of the seals.

- After changing the plunger seals, apply the seal wear-in procedure (see "Exchanging the Pump Seals" on page 159).
- Place the aqueous solvent on channel A and the organic solvent on channel B. The default compressibility settings are set accordingly.

Setting up the Pump with the G4208A Instant Pilot

Generic operation of the G4208A Instant Pilot is covered in the Instant Pilot User's Guide, part number G4208-90000. Details about setting up module specific parameters can be found in the Instant Pilot online help.

The pump parameters are described in depth in "Overview" on page 73.

Setting up the Pump with Agilent ChemStation

Overview

Most of these panels can be accessed in two different ways: Pulling down the **Instrument** menu or left-clicking on the icon the GUI.

Setup of Basic Pump Parameters

The most important parameters of the pump are grouped in the **Set up Pump** panel. Open it either from the **Instrument** menu or by left-clicking the pump icon in the graphical user interface (GUI).

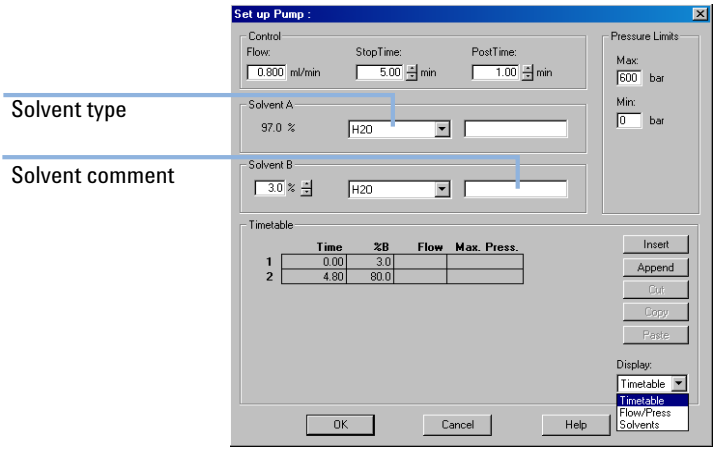


Figure 19 **Set up Pump** Panel

Table 16 Parameters of the Set up Pump Panel

Parameter	Limits	Description
• **Flow**	0.001 – 5 mL/min	Total flow rate of the pump. See "When to Remove Damper and Mixer" on page 92 for pump hardware modifications to achieve lowest delay volume.
• **Stop Time**	0.01 min - no limit	The stop time of the pump usually controls the run time of the whole LC system. Use **no limit** to stop the run manually (useful for method development).
• **Post Time**	off - 99999 min	Time between the end of a run and the start of the next. Used for column equilibration after a gradient.
• **Pressure Limits**	**Max**: 0 – 600 bar **Min**: 0 – 600 bar	**Max** must be bigger than **Min**! Set max pressure to the maximum operating pressure of your column. A min pressure setting of e.g. 10 bar will turn off your pump automatically when running out of solvent. A smarter way, however, is to use the bottle fillings function (see "Bottle Filling" on page 80).
• **Solvent A**	0 – 100 %	Although channel A can be set to 0 %, it cannot be turned off. This channel should be used for the aqueous phase (water).
• **Solvent B**	off - 100 %	The percentage of channel B is automatically complemented by channel A to give 100 %.
• (Solvent type)	H_2O, ACN, MeOH, IPA	Select the solvent you are using in the respective solvent channel from the drop-down list. In case your solvent is not listed, perform a solvent compressibility calibration (see "Running the Solvent Compressibility Calibration" on page 137. For details on solvent compressibility see "Binary Pump Solvent Calibration" on page 136
• (Solvent Comment)		Free text field for a description of the solvent. This description will show up in method printouts, etc.
• **Timetable**	max. number of lines depends on free space in pump memory.	Use the timetable to build solvent gradients, flow gradients, or combinations of both. Gradients are always linear. Use multiple timetable entries to mimic exponential or parabolic gradients.
• **Display**		There are three ways to display the timetable: • in tabular form • as flow/pressure graph • as solvent percentage plot Values can only be changed in tabular view.

Pump Control

The **Pump Control** panel is used to turn the pump on and off, operate the optional seal wash pump and define an error method.

CAUTION

Upon initialization, the pump ignores the **Maximum Flow Gradient** value (see Table 17 on page 78).

This can result in a rapid and uncontrolled pressure increase.

➔ To prevent harm to the column, open the purge valve until the initialization is finished.

1 Open menu **Instrument > More Pump > Control** or click on the pump icon in the GUI.

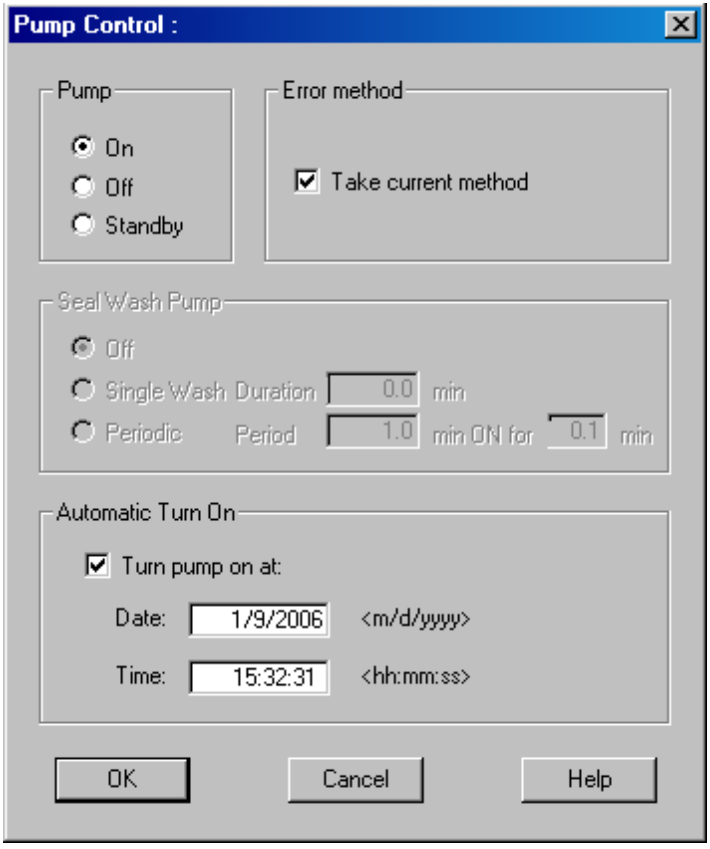


Figure 20 **Pump Control** Panel

The pump group enables you to switch the pump **On**, **Off** or to **Standby**. In **Standby**, the pump motor is still energized. When the pump is switched on again, it does not re-initialize.

Pump Auxiliary Parameters

The parameters in this panel are pre-set to fit most applications. Adjustments should only be made when required. The **Pump Auxiliary** panel can be accessed by the menu via **Instrument > More Pump > Auxilary**or by left-clicking the pump icon in the GUI.

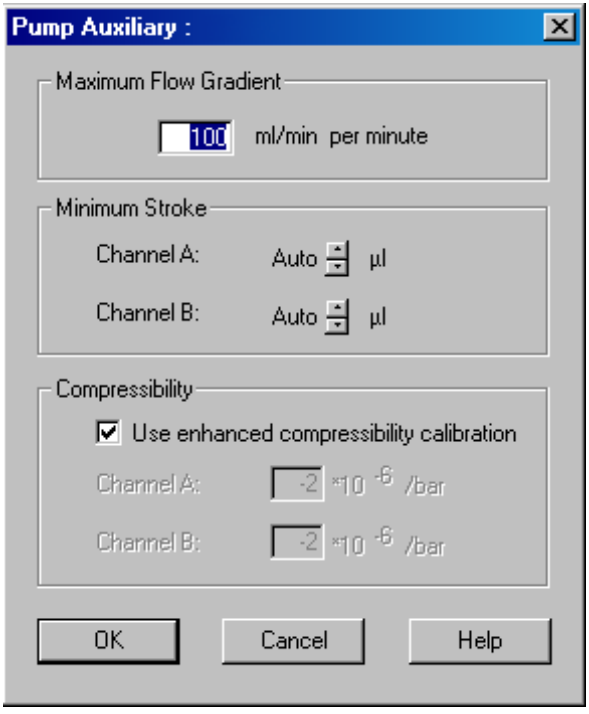


Figure 21 **Pump Auxiliary** Parameter Panel

Table 17 Parameters of the **Pump Auxiliary** Panel

Parameter	Limits	Description
• **Maximum Flow Gradient**	0.1 - 100 mL/min^2 default: 100 mL/min^2	With this parameter flow rate changes can be ramped up and down slowly to avoid pressure shocks to the column. The default value is 100 ml/min^{2}which in fact turns the function off. Caution! The flow is shut off immediately when the pump switched to standby. When the pump is turned **On** from the **Off** status, the pump drive initializes, thereby ignoring the maximum flow gradient setting. Depending on system delay volume and flow restriction, the system pressure may rise very quickly to a high value. To protect your column from damage, it is suggested to open the purge valve during initialization.
• **Minimum Stroke**	20 µL - 100 µL default: Auto	The volume one pump piston delivers per stroke. Generally, a smaller stroke volume results in lower pump ripple. The **Auto** setting adjusts the strokes dynamically to the lowest possible value. The strokes can be set individually for pump heads A and B.
• **Compressibility**	0 - 150 E10^{-6}bar or enhanced compressibility calibration default: use enhanced comp. calibration	It is highly recommended to tick the **Use enhanced compressibility calibration** box. This forces the pump to use either stored solvent compressibility data or user generated compressibility parameters from solvent compressibility calibrations. For legacy support, the solvent compressibility can still be set manually for each channel when the box is unticked.

Data Curves

The binary pump provides the possibility to store operational data in the data file of the Agilent data system.

Solvent percentage for each channel, pump flow and pressure are stored when the respective boxes are ticked.

Access the **Pump Data Curves** panel either from the **Instrument > More Pump > Data Curves** menu or by left-clicking the pump icon in the GUI.

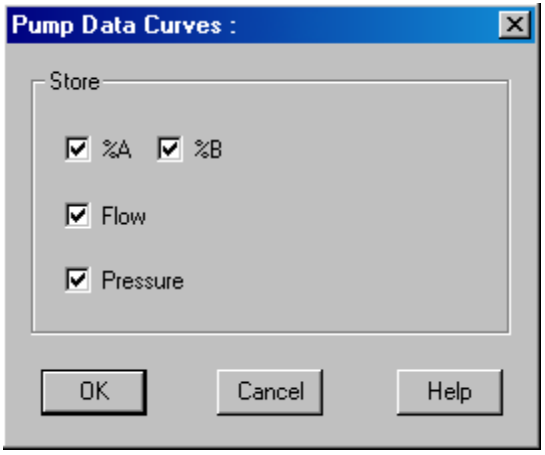


Figure 22 Data Curves Panel

NOTE The pressure data curve is *generated* from the pressure sensor readings, while %A, %B and flow are *calculated* from the method settings of the pump.

Bottle Filling

The pump offers a powerful feature to monitor the liquid level in the solvent bottles. With total bottle volume and initial filling volume set correctly, the pump subtracts the displaced volume continuously from the initial value and reacts before the system runs dry or an analysis is corrupted.

CAUTION

The bottle filling feature will fail if multiple channels are fed from one solvent bottle!

➔ In that case implement a minimum pressure limit (see Table 16 on page 74) to avoid that the pump runs dry when solvents are empty,

1 Open menu **Instrument > More Pump > Bottle Filling** or click on the solvent bottles below the pump icon in the GUI.

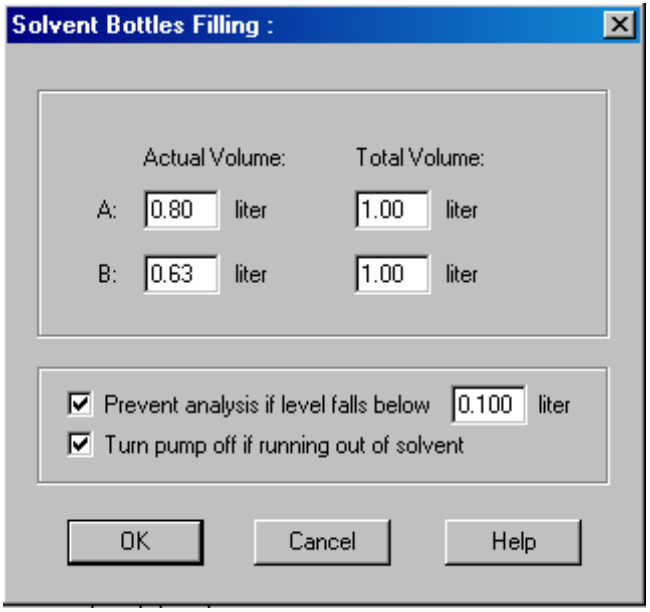


Figure 23 Bottle Filling Panel

Table 18 Bottle Filling Parameters

Parameter	Limits	Description
• **Total Volume**	0 – 1000 L default: 0 L	Enter the total capacity of the solvent vessel in this box. Mind that the dimension is Liters!
• **Actual Volume**	0 – 1000 L default: 0 L	After filling the solvent bottles, enter the actual volumes into these boxes. The **Actual Volume** must not be larger than the **Total Volume** of the bottle.
• **Prevent analysis.....**	default: turned off	When ticked, the pump won't start a new run if the solvent level in one or more bottles is below the given value. When setting this parameter, consider the size and shape of the solvent vessel and make sure the pump does not draw air when coming close to the limit.
• **Turn pump off...**	default: turned off	When ticked, the pump will turn off before air is aspirated. However, the residual solvent volume has been calculated for 1 L solvent bottles and may be too small for large bottles or other vessels.

Early Maintenance Feedback (EMF)

Maintenance requires the exchange of components in the flow path which are subject to mechanical wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of usage of the instrument and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (**EMF**) feature monitors the usage of specific components in the instrument, and provides feedback when the user-settable limits have been exceeded. The visual feedback in the user interface provides an indication that maintenance procedures should be scheduled.

EMF Counters

The binary pump provides a series of EMF counters for the left and right pump heads. Each counter increments with pump use, and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. Each counter can be reset to zero after maintenance has been done. The binary pump provides the following EMF counters:

- liquimeter pump A,
- seal wear pump A,
- liquimeter pump B, and
- seal wear pump B.

Liquimeters

The liquimeters display the total volume of solvent pumped by the left and right pump heads since the last reset of the counters. Both liquimeters can be assigned an EMF (maximum) limit. When the limit is exceeded, the EMF flag in the user interface is displayed.

Seal Wear Counters

The seal wear counters display a value derived from pressure and flow (both contribute to seal wear). The values increment with pump usage until the counters are reset after seal maintenance. Both seal wear counters can be assigned an EMF (maximum) limit. When the limit is exceeded, the EMF flag in the user interface is displayed.

Using the EMF Counters

The user-settable EMF limits for the EMF counters enable the early maintenance feedback to be adapted to specific user requirements. The wear of pump components is dependent on the analytical conditions, therefore, the definition of the maximum limits need to be determined based on the specific operating conditions of the instrument.

Setting the EMF Limits

The setting of the EMF limits must be optimized over one or two maintenance cycles. Note the pumped volumes and the seal wear values of both pump heads when symptoms of excessive seal wear are observed. Perform pump maintenance and enter the noted EMF values minus a safety margin of 10 % as new EMF limits. Reset the EMF counters to zero. The next time the EMF counters exceed the new EMF limits, the EMF flag will be displayed at the appropriate time, providing a reminder that maintenance needs to be scheduled

5 Optimizing Performance

Prevent Blocking of Solvent Filters 86
Checking the Solvent Filters 86
Cleaning the Solvent Filters 87
When to Use a Vacuum Degasser 88
Operational Hints for the Vacuum Degasser 88
When to Use the Active Seal Wash Option 89
When to Use Alternative Seals 90
When to Use the Low volume mixer 91
When to Remove Damper and Mixer 92
Convert the Binary Pump to Low Delay Volume Mode 93
How to Optimize the Compressibility Compensation Setting 95
Solvent Compressibility Calibration 95
Optimization of Legacy Compressibility Settings 96

This chapter gives information on how to optimize the performance of the Binary Pump under special operational conditions.

Prevent Blocking of Solvent Filters

Contaminated solvents or algae growth in the solvent bottle will reduce the lifetime of the solvent filter and will influence the performance of the module. This is especially true for aqueous solvents or phosphate buffers (pH 4 to 7). The following suggestions will prolong lifetime of the solvent filter and will maintain the performance of the module.

- Use a sterile, if possible amber, solvent bottle to slow down algae growth.
- Filter solvents through filters or membranes that remove algae.
- Exchange solvents every two days or refilter.
- If the application permits add 0.0001-0.001M sodium azide to the solvent.
- Place a layer of argon on top of your solvent.
- Avoid exposure of the solvent bottle to direct sunlight.

NOTE Never use the system without solvent filter installed.

Checking the Solvent Filters

The solvent filters are located on the low-pressure side of the binary pump. A blocked filter therefore does not necessarily affect the high pressure readings of the pump. The pressure readings cannot be used to check whether the filters are blocked or not. If the solvent cabinet is placed on top of the binary pump, the filter condition can be checked in the following way:

Remove the solvent inlet tube from the inlet port of the solvent selection valve or the adapter at the active inlet valve. If the filter is in good condition, the solvent will freely drip out of the solvent tube (due to hydrostatic pressure). If the solvent filter is partly blocked only very little solvent will drip out of the solvent tube.

WARNING

When opening capillary or tube fittings solvents may leak out.

The handling of toxic and hazardous solvents and reagents can bear health risks.

➔ Please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.

Cleaning the Solvent Filters

- Remove the blocked solvent filter from the bottle-head assembly and place it in a beaker with concentrated nitric acid (35%) for one hour.
- Thoroughly flush the filter with HPLC-grade water (remove all nitric acid, some capillary columns can be damaged by nitric acid).
- Replace the filter.

NOTE

Never use the system without solvent filter installed.

When to Use a Vacuum Degasser

The binary pump does not necessarily require degassing. However, for the following conditions a vacuum degasser is mandatory:

- Your detector is used with maximum sensitivity in the low UV wavelength range,
- Your application requires highest injection precision, or
- Your application requires highest retention-time reproducibility (flow rates below 0.5 mL/min).
- The binary pump is used with bypassed damper and mixer.

Operational Hints for the Vacuum Degasser

If you are using the vacuum degasser for the first time, if the vacuum degasser was switched off for any length of time (for example, overnight), or if the vacuum degasser chambers are empty, you have to prime the vacuum degasser before running an analysis. Priming is usually done by pumping at a high flow rate (3 – 5 mL/min). Alternatively, a syringe can be used to draw the solvent through the (empty) degasser if the pump does not aspirate the solvent by itself. For details see "Initial Priming" on page 64.

For more information see the Agilent 1260 Infinity Standard Degasser User Manual (p/n G1322-90012).

When to Use the Active Seal Wash Option

Concentrated buffer solutions will reduce the lifetime of the seals and plungers in your binary pump. The active seal wash option allows to maintain the seal lifetime by flushing the low pressure side of the seals with a wash solvent.

The seal wash option is strongly recommended if buffer concentrations of 0.1 M or higher are used regularly with the pump.

The active seal wash option kit can be ordered by quoting Active Seal Wash Option kit (p/n G1312-68721).

The seal wash option comprises a peristaltic pump, secondary seals, gaskets, seal keepers and tubing for both pump heads. A bottle of premixed water/isopropanol (90/10 vol%) is placed in the solvent cabinet and connected to the peristaltic pump as described in the technical note that comes with the active seal wash kit.

Always use a mixture of HPLC-grade water (90 %) and isopropanol (10 %) as wash solvent. This mixture prevents bacteria growth in the wash bottle and reduces the surface tension of the water.

The operation of the peristaltic pump can be controlled from the data system or the Instant Pilot.

NOTE The binary pump comes with pre-installed seal wash capable support rings. When the user decides to use seal wash it is recommended to replace the secondary seals and gaskets by new ones to ensure tightness.

For information on the installation of the continuous seal wash option refer to the *Service Manual*.

When to Use Alternative Seals

The standard seals for the binary pump can be used for most applications. However, normal phase applications (for example, hexane) are not compatible with the standard seals. They cause extremely high abrasion and significantly shorten seal life time.

For the use with normal phase applications special polyethylene pistons seals (yellow color, PE seals (pack of 2) (p/n 0905-1420)) are available. These seals have less abrasion compared to the standard seals.

WARNING

The seal wear-in procedure causes problems to the normal phase seals (yellow).

They will be destroyed by the procedure.

➔ DO NOT apply the seal wear-in procedure performed to normal phase seals.

1 Remove the standard seals from the pump head ("Exchanging the Pump Seals" on page 159).

2 Install normal phase seals.

NOTE

Polyethylene seals have a limited pressure range of 0–200 bar. When used above 200 bar, their lifetime will be significantly reduced.

When to Use the Low volume mixer

The low volume mixer is designed for use with the Rapid Resolution LC system in low delay volume mode. This configuration is typically used for 2.1 mm ID, 1.8µm particle size columns, where emphasis is put on S/N ratio. The low volume mixer helps mixing gradients starting with a low concentration of organic solvents, which can cause noise on the baseline. The maximum benefit of the mixer is achieved using the mixer together with FW revisions A.06.06 or higher.

When to Remove Damper and Mixer

The binary pump is equipped with a pressure pulsation damper and a static mixer. The total delay volume of the pump is 600 – 800 µL (depending on system pressure). The mixer has a volume of 400 µL.

For applications that require lowest delay volume (e.g. fast gradient methods or gradient applications with low flow rates), damper and mixer can be bypassed.

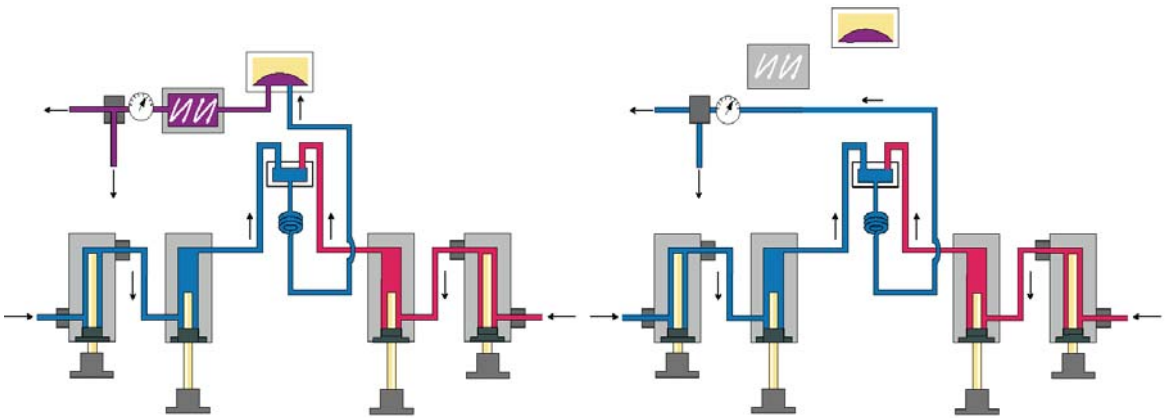


Figure 24 Flow Path Modifications of the Binary Pump

Convert the Binary Pump to Low Delay Volume Mode

The binary pump is delivered in standard configuration (damper and mixer connected). This paragraph shows how to bypass damper and mixer and convert the pump to low delay volume mode.

Configurations where only damper or mixer are disconnected while the other part is still in line are not supported by Agilent Technologies.

Tools required

Wrench 1/4 – 5/16 inch

Wrench, 14 mm

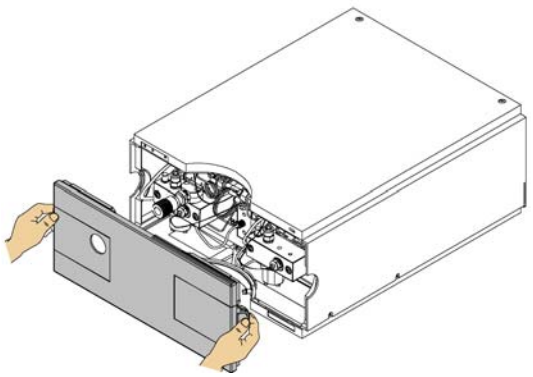
Hex driver open, 1/4 inch

Preparations

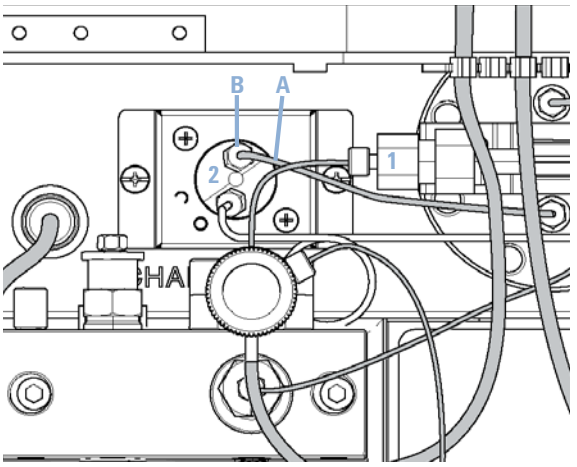
Flush the system (water if buffers were used, otherwise isopropanol).

Turn the flow off.

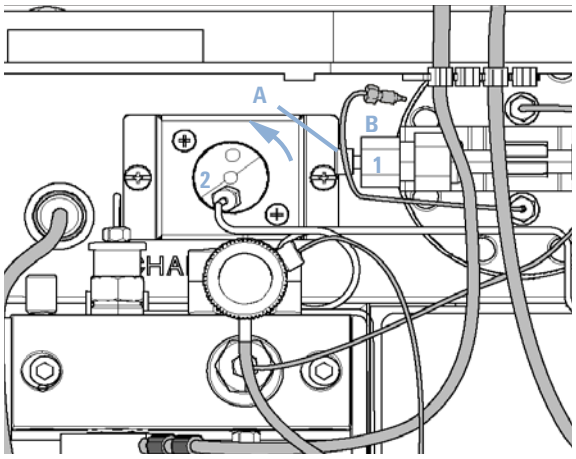
1 Remove the front cover by pressing the clip fastener on both sides of the cover.



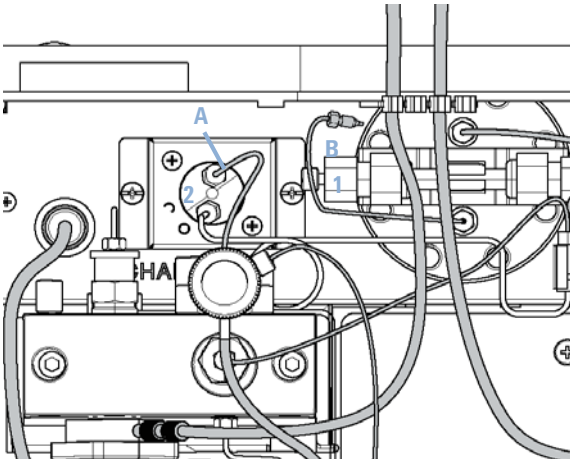
2 Use the 1/4 inch hex driver to remove fitting *B* from port *2* of the pressure sensor.



3 Fold capillary end *B* away. It remains unconnected.Disconnect fitting *A* from outlet *1* of the mixer.



4 Connect fitting *A* to port *2* of the pressure sensor. Seal port *1* of the mixer with a plastic blank nut.



How to Optimize the Compressibility Compensation Setting

When a solvent is metered at ambient pressure and compressed to a higher pressure, the volume decreases. This is due to an effect known as solvent compressibility. Solvent compressibility is a non-linear function of pressure and temperature. It is unique to every solvent.

In order to deliver the desired flow accurately at all pressures, Agilent pumps use a compressibility compensation. Usually, an average compressibility value for the solvent is used across the whole pressure range of the pump.

The G1312B Binary Pump SL introduces a new compressibility compensation concept . The compressibility of a solvent is determined at different pressures between 0 – 600 bar. The pump uses the obtained non-linear function to select the correct compressibility value for the actual pump pressure.
Compressibility data for the most common solvents is readily available in the pump firmware.

The compensation algorithm is so powerful that the damper and mixer can be removed from the pump flow path at low flow rate while the pressure ripple and composition ripple remain at low levels.

For method compatibility reasons, the legacy compressibility compensation is still available.

Solvent Compressibility Calibration

Unlisted or premixed solvents can be calibrated with the Solvent Compressibility Calibration function. For a detailed description, see “Binary Pump Solvent Calibration” on page 136.

Optimization of Legacy Compressibility Settings

The compressibility compensation default settings are 50×10^{-6} /bar (best for most aqueous solutions) for pump head A and 115×10^{-6} /bar (to suit organic solvents) for pump head B. The settings represent average values for aqueous solvents (A side) and organic solvents (B side). Therefore it is always recommended to use the aqueous solvent on the A side of the pump and the organic solvent on the B side. Under normal conditions, the default settings reduce the pressure pulsation to below 2 % of system pressure, which is sufficient for most applications. If the compressibility values for the solvents used differ from the default settings, it is recommended to change the compressibility values accordingly. Compressibility settings can be optimized by using the values for various solvents described in Table 19 on page 97. If the solvent in use is not listed in the compressibility table, when using premixed solvents and if the default settings are not sufficient for your application, the following procedure can be used to optimize the compressibility settings:

1. Start channel A of the binary pump with the required flow rate.
2. Before starting the optimization procedure, the flow must be stable. Use degassed solvent only. Check the tightness of the system with the pressure test (see "Pressure Test Description" on page 130).
3. Your pump must be connected to an Agilent data system or Instant Pilot, the pressure- and %-ripple can be monitored with one of these instruments, otherwise connect a signal cable between the pressure output of the isocratic pump and a recording device (for example, 339X integrator) and set following parameters.

   Zero 50 % Att 2^3 Chart Speed 10 cm/min
4. Start the recording device in plot mode.
5. Starting with a compressibility setting of 10×10^{-6} /bar, increase the value in steps of 10. Re-zero the integrator as required. The compressibility compensation setting that generates the smallest pressure ripple is the optimum value for your solvent composition.
6. Repeat step 1 through step 5 for the B channel of your binary pump.

Table 19 Solvent Compressibility

Solvent (pure)	Compressibility (10^{-6}/bar)
Acetone	126
Acetonitrile	115
Benzene	95
Carbon tetrachloride	110
Chloroform	100
Cyclohexane	118
Ethanol	114
Ethyl acetate	104
Heptane	120
Hexane	150
Isobutanol	100
Isopropanol	100
Methanol	120
1-Propanol	100
Toluene	87
Water	46

6 Error Messages

What Are Error Messages 101
General Error Messages 102
- Timeout 102
- Shut-Down 102
- Remote Timeout 103
- Synchronization Lost 103
- Leak 104
- Leak Sensor Open 104
- Leak Sensor Short 105
- Compensation Sensor Open 105
- Compensation Sensor Short 106
- Fan Failed 106
- Open Cover 107

Module Error Messages 108
- Restart Without Cover 108
- Zero Solvent Counter 108
- Pressure Above Upper Limit 109
- Pressure Below Lower Limit 109
- Pressure Signal Missing 110
- Valve Failed 110
- Missing Pressure Reading 111
- Pump Configuration 111
- Selection-Valve Fuse 112
- Inlet-Valve Fuse 112
- Temperature Out of Range 113
- Temperature Limit Exceeded 113
- Motor-Drive Power 114
- Encoder Missing 115

Inlet-Valve Missing 115
Servo Restart Failed 116
Pump Head Missing 117
Index Limit 117
Index Adjustment 118
Index Missing 118
Stroke Length 119
Initialization Failed 119
Electronic fuse of SSV 120

This chapter gives a complete overview over all error messages of the binary pump.

What Are Error Messages

Error messages are displayed in the user interface when an electronic, mechanical, or hydraulic (flow path) failure occurs which requires attention before the analysis can be continued (for example, repair, or exchange of consumables is necessary). In the event of such a failure, the red status indicator at the front of the module is switched on, and an entry is written into the module logbook.

General Error Messages

Timeout

The timeout threshold was exceeded.

Probable cause	Suggested actions
1 The analysis was completed successfully, and the timeout function switched off the module as requested.	Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required.
2 A not-ready condition was present during a sequence or multiple-injection run for a period longer than the timeout threshold.	Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required.

Shut-Down

An external instrument has generated a shut-down signal on the remote line.

The module continually monitors the remote input connectors for status signals. A LOW signal input on pin 4 of the remote connector generates the error message.

Probable cause	Suggested actions
1 Leak detected in another module with a CAN connection to the system.	Fix the leak in the external instrument before restarting the module.
2 Leak detected in an external instrument with a remote connection to the system.	Fix the leak in the external instrument before restarting the module.
3 Shut-down in an external instrument with a remote connection to the system.	Check external instruments for a shut-down condition.
4 The degasser failed to generate sufficient vacuum for solvent degassing.	Check the vacuum degasser for an error condition. Refer to the *Service Manual* for the degasser or the 1260 pump that has the degasser built-in.

Remote Timeout

A not-ready condition is still present on the remote input. When an analysis is started, the system expects all not-ready conditions (for example, a not-ready condition during detector balance) to switch to run conditions within one minute of starting the analysis. If a not-ready condition is still present on the remote line after one minute the error message is generated.

Probable cause	Suggested actions
1 Not-ready condition in one of the instruments connected to the remote line.	Ensure the instrument showing the not-ready condition is installed correctly, and is set up correctly for analysis.
2 Defective remote cable.	Exchange the remote cable.
3 Defective components in the instrument showing the not-ready condition.	Check the instrument for defects (refer to the instrument's documentation).

Synchronization Lost

During an analysis, the internal synchronization or communication between one or more of the modules in the system has failed.

The system processors continually monitor the system configuration. If one or more of the modules is no longer recognized as being connected to the system, the error message is generated.

Probable cause	Suggested actions
1 CAN cable disconnected.	• Ensure all the CAN cables are connected correctly. • Ensure all CAN cables are installed correctly.
2 Defective CAN cable.	Exchange the CAN cable.
3 Defective main board in another module.	Switch off the system. Restart the system, and determine which module or modules are not recognized by the system.

Leak

A leak was detected in the module.

The signals from the two temperature sensors (leak sensor and board-mounted temperature-compensation sensor) are used by the leak algorithm to determine whether a leak is present. When a leak occurs, the leak sensor is cooled by the solvent. This changes the resistance of the leak sensor which is sensed by the leak-sensor circuit on the main board.

Probable cause	Suggested actions
1 Loose fittings.	Ensure all fittings are tight.
2 Broken capillary.	Exchange defective capillaries.
3 Loose or leaking purge valve, inlet valve, or outlet valve.	Ensure pump components are seated correctly. If there are still signs of a leak, exchange the appropriate seal (purge valve, inlet valve, outlet valve).
4 Defective pump seals.	Exchange the pump seals.

Leak Sensor Open

The leak sensor in the module has failed (open circuit).

The current through the leak sensor is dependent on temperature. A leak is detected when solvent cools the leak sensor, causing the leak-sensor current to change within defined limits. If the current falls outside the lower limit, the error message is generated.

Probable cause	Suggested actions
1 Leak sensor not connected to the main board.	Please contact your Agilent service representative.
2 Defective leak sensor.	Please contact your Agilent service representative.
3 Leak sensor incorrectly routed, being pinched by a metal component.	Please contact your Agilent service representative.

Leak Sensor Short

The leak sensor in the module has failed (short circuit).

The current through the leak sensor is dependent on temperature. A leak is detected when solvent cools the leak sensor, causing the leak-sensor current to change within defined limits. If the current increases above the upper limit, the error message is generated.

Probable cause	Suggested actions
1 Defective flow sensor.	Please contact your Agilent service representative.
2 Leak sensor incorrectly routed, being pinched by a metal component.	Please contact your Agilent service representative.

Compensation Sensor Open

The ambient-compensation sensor (NTC) on the main board in the module has failed (open circuit).

The resistance across the temperature compensation sensor (NTC) on the main board is dependent on ambient temperature. The change in resistance is used by the leak circuit to compensate for ambient temperature changes. If the resistance across the sensor increases above the upper limit, the error message is generated.

Probable cause	Suggested actions
1 Defective main board.	Please contact your Agilent service representative.

Compensation Sensor Short

The ambient-compensation sensor (NTC) on the main board in the module has failed (short circuit).

The resistance across the temperature compensation sensor (NTC) on the main board is dependent on ambient temperature. The change in resistance is used by the leak circuit to compensate for ambient temperature changes. If the resistance across the sensor falls below the lower limit, the error message is generated.

Probable cause	Suggested actions
1 Defective main board.	Please contact your Agilent service representative.

Fan Failed

The cooling fan in the module has failed.

The hall sensor on the fan shaft is used by the main board to monitor the fan speed. If the fan speed falls below a certain limit for a certain length of time, the error message is generated.

This limit is given by 2 revolutions/second for longer than 5 seconds.

Probable cause	Suggested actions
1 Fan cable disconnected.	Please contact your Agilent service representative.
2 Defective fan.	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.
4 Improperly positioned cables or wires obstructing fan blades.	Ensure the fan is not mechanically blocked.

Open Cover

The top foam has been removed.

The sensor on the main board detects when the top foam is in place. If the foam is removed, the fan is switched off, and the error message is generated.

	Probable cause	Suggested actions
1	The top foam was removed during operation.	Reinstall the top foam.
2	Foam not activating the sensor.	Please contact your Agilent service representative.
3	Dirty or defective sensor.	Please contact your Agilent service representative.
4	Rear of the module is exposed to strong direct sunlight.	Ensure that the rear of module is not directly exposed to strong sunlight.

Module Error Messages

Restart Without Cover

The module was restarted with the top cover and foam open.

The sensor on the main board detects when the top foam is in place. If the module is restarted with the foam removed, the module switches off within 30 s, and the error message is generated.

Probable cause	Suggested actions
1 The module started with the top cover and foam removed.	Please contact your Agilent service representative.
2 Rear of the module is exposed to strong direct sunlight.	Ensure that the rear of module is not directly exposed to strong sunlight.

Zero Solvent Counter

The error message is triggered if the remaining volume in a solvent bottle falls below the set limit.

Probable cause	Suggested actions
1 Volume in bottle below specified volume.	Refill bottles and reset solvent counters.
2 Incorrect setting.	Make sure the set solvent volume matches the actual bottle filling and set the shutoff limit to a reasonable value (e.g. 100 mL for 1 L bottles)

Pressure Above Upper Limit

The system pressure has exceeded the upper pressure limit.

Probable cause	Suggested actions
1 Upper pressure limit set too low.	Ensure the upper pressure limit is set to a value suitable for the analysis.
2 Blockage in the flowpath (after the damper).	Check for blockage in the flowpath. The following components are particularly subject to blockage: inline filter frit, needle (autosampler), seat capillary (autosampler), sample loop (autosampler), column frits and capillaries with small internal diameters (e.g. 50 µm ID).
3 Blockage in the flowpath (after the damper).	Check for blockage in the flowpath.
4 Defective damper.	Please contact your Agilent service representative.
5 Defective main board.	Please contact your Agilent service representative.

Pressure Below Lower Limit

The system pressure has fallen below the lower pressure limit.

Probable cause	Suggested actions
1 Lower pressure limit set too high.	Ensure the lower pressure limit is set to a value suitable for the analysis.
2 Air bubbles in the mobile phase.	• Ensure solvents are degassed. Purge the module. • Ensure solvent inlet filters are not blocked.
3 Leak.	• Inspect the pump head, capillaries and fittings for signs of a leak. • Purge the module. Run a pressure test to determine whether the seals or other module components are defective.
4 Defective damper.	Please contact your Agilent service representative.
5 Defective main board.	Please contact your Agilent service representative.

Pressure Signal Missing

The pressure signal of the damper is missing.

The pressure signal of the damper must be within a specific voltage range. If the pressure signal is missing, the processor detects a voltage of approximately -120mV across the damper connector.

Probable cause	Suggested actions
1 Damper disconnected.	Please contact your Agilent service representative.
2 Defective damper.	Please contact your Agilent service representative.

Valve Failed

Valve 0 Failed: valve A1

Valve 1 Failed: valve A2

Valve 2 Failed: valve B2

Valve 3 Failed: valve B1

One of the solvent selection valves in the module failed to switch correctly.

The processor monitors the valve voltage before and after each switching cycle. If the voltages are outside expected limits, the error message is generated.

Probable cause	Suggested actions
1 Solvent selection valve disconnected.	Please contact your Agilent service representative.
2 Connection cable (inside instrument) not connected.	Please contact your Agilent service representative.
3 Connection cable (inside instrument) defective.	Please contact your Agilent service representative.
4 Solvent selection valve defective.	Exchange the solvent selection valve.

Missing Pressure Reading

The pressure readings read by the pump ADC (analog-digital converter) are missing.

The ADC reads the pressure signal of from the damper every 1ms. If the readings are missing for longer than 10 seconds, the error message is generated.

Probable cause	Suggested actions
1 Damper disconnected.	Please contact your Agilent service representative.
2 Defective damper.	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Pump Configuration

At switch-on, the pump has recognized a new pump configuration.

The binary pump is assigned its configuration at the factory. If the active-inlet valve and pump encoder of channel B are disconnected, and the binary pump is rebooted, the error message is generated.

Probable cause	Suggested actions
1 Active-inlet valve and pump encoder of channel B disconnected.	Reconnect the active-inlet valve and pump encoder of channel B.

Selection-Valve Fuse

Valve Fuse 0: Channels A1 and A2

Valve Fuse 1: Channels B1 and B2

One of the solvent-selection valves in the module has drawn excessive current causing the selection-valve electronic fuse to open.

Probable cause	Suggested actions
1 Defective solvent selection valve.	Restart the pump. If the error message appears again, exchange the solvent selection valve.
2 Defective connection cable (front panel to main board).	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Inlet-Valve Fuse

Inlet-Valve Fuse 0: Pump channel A

Inlet-Valve Fuse 1: Pump channel B

One of the active-inlet valves in the module has drawn excessive current causing the inlet-valve electronic fuse to open.

Probable cause	Suggested actions
1 Defective active inlet valve.	Restart the module. If the error message appears again, exchange the active inlet valve.
2 Defective connection cable (front panel to main board).	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Temperature Out of Range

Temperature Out of Range 0: Pump channel A

Temperature Out of Range 1: Pump channel B

One of the temperature sensor readings in the motor-drive circuit are out of range.

The values supplied to the ADC by the hybrid sensors must be between 0.5 V and 4.3 V. If the values are outside this range, the error message is generated.

Probable cause	Suggested actions
1 Defective main board.	Please contact your Agilent service representative.

Temperature Limit Exceeded

Temperature Limit Exceeded 0: Pump channel A

Temperature Limit Exceeded 1: Pump channel B

The temperature of one of the motor-drive circuits is too high.

The processor continually monitors the temperature of the drive circuits on the main board. If excessive current is being drawn for long periods, the temperature of the circuits increases. If the temperature exceeds the upper limit, the error message is generated.

Probable cause	Suggested actions
1 High friction (partial mechanical blockage) in the pump drive assembly.	Ensure the capillaries and frits between the pump head and damper inlet are free from blockage.
2 Partial blockage of the flowpath in front of the damper.	Ensure the outlet valve is not blocked.
3 Defective pump drive assembly.	Please contact your Agilent service representative.
4 Defective main board.	Please contact your Agilent service representative.

Motor-Drive Power

Motor-Drive Power: Pump channel A

B: Motor-Drive Power: Pump channel B

The current drawn by the pump motor exceeded the maximum limit.

Blockages in the flow path are usually detected by the pressure sensor in the damper, which result in the pump switching off when the upper pressure limit is exceeded. If a blockage occurs before the damper, the pressure increase cannot be detected by the pressure sensor and the module will continue to pump. As pressure increases, the pump drive draws more current. When the current reaches the maximum limit, the module is switched off, and the error message is generated.

	Probable cause	Suggested actions
1	Flow path blockage in front of the damper.	Ensure the capillaries and frits between the pump head and damper inlet are free from blockage.
2	Blocked outlet valve.	Exchange the outlet valve.
3	High friction (partial mechanical blockage) in the pump drive assembly.	Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
4	Defective pump drive assembly.	Please contact your Agilent service representative.
5	Defective main board.	Please contact your Agilent service representative.
6	Restriction capillary blocked at pre-mixing union.	Exchange restriction capillary.

Encoder Missing

Encoder Missing: Pump channel A

B: Encoder Missing: Pump channel B

The optical encoder on the pump motor in the module is missing or defective.

The processor checks the presence of the pump encoder connector every 2 seconds. If the connector is not detected by the processor, the error message is generated.

Probable cause	Suggested actions
1 Defective or disconnected pump encoder connector.	Please contact your Agilent service representative.
2 Defective pump drive assembly.	Please contact your Agilent service representative.

Inlet-Valve Missing

Inlet-Valve Missing: Pump channel A

B: Inlet-Valve Missing: Pump channel B

The active-inlet valve in the module is missing or defective.

The processor checks the presence of the active-inlet valve connector every 2 seconds. If the connector is not detected by the processor, the error message is generated.

Probable cause	Suggested actions
1 Disconnected or defective cable.	Please contact your Agilent service representative.
2 Disconnected or defective connection cable (front panel to main board).	Please contact your Agilent service representative.
3 Defective active inlet valve.	Exchange the active inlet valve.

Servo Restart Failed

Servo Restart Failed: Pump channel A

B: Servo Restart Failed: Pump channel B

The pump motor in the module was unable to move into the correct position for restarting.

When the module is switched on, the first step is to switch on the C phase of the variable reluctance motor. The rotor should move to one of the C positions. The C position is required for the servo to be able to take control of the phase sequencing with the commutator. If the rotor is unable to move, or if the C position cannot be reached, the error message is generated.

Probable cause	Suggested actions
1 Disconnected or defective cable.	Please contact your Agilent service representative.
2 Mechanical blockage of the module.	Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
3 Defective pump drive assembly.	Please contact your Agilent service representative.
4 Defective main board.	Please contact your Agilent service representative.

Pump Head Missing

Pump Head Missing: Pump channel A

B: Pump Head Missing: Pump channel B

The pump-head end stop in the pump was not found.

When the pump restarts, the metering drive moves forward to the mechanical end stop. Normally, the end stop is reached within 20 seconds, indicated by an increase in motor current. If the end point is not found within 20 seconds, the error message is generated.

Probable cause	Suggested actions
1 Pump head not installed correctly (screws not secured, or pump head not seated correctly).	Install the pump head correctly. Ensure nothing (e.g. capillary) is trapped between the pump head and body.
2 Broken piston.	Exchange the piston.

Index Limit

Index Limit: Pump channel A

B: Index Limit: Pump channel B

The time required by the piston to reach the encoder index position was too short (pump).

During initialization, the first piston is moved to the mechanical stop. After reaching the mechanical stop, the piston reverses direction until the encoder index position is reached. If the index position is reached too fast, the error message is generated.

Probable cause	Suggested actions
1 Irregular or sticking drive movement.	Remove the pump head, and examine the seals, pistons, and internal components for signs of wear, contamination or damage. Exchange components as required.
2 Defective pump drive assembly.	Please contact your Agilent service representative.

Index Adjustment

Index Adjustment: Pump channel A

B: Index Adjustment: Pump channel B

The encoder index position in the module is out of adjustment.

During initialization, the first piston is moved to the mechanical stop. After reaching the mechanical stop, the piston reverses direction until the encoder index position is reached. If the time to reach the index position is too long, the error message is generated.

Probable cause	Suggested actions
1 Irregular or sticking drive movement.	Remove the pump head, and examine the seals, pistons, and internal components for signs of wear, contamination or damage. Exchange components as required.
2 Defective pump drive assembly.	Please contact your Agilent service representative.

Index Missing

Index Missing: Pump channel A

B: Index Missing: Pump channel B

The encoder index position in the module was not found during initialization.

During initialization, the first piston is moved to the mechanical stop. After reaching the mechanical stop, the piston reverses direction until the encoder index position is reached. If the index position is not recognized within a defined time, the error message is generated.

Probable cause	Suggested actions
1 Disconnected or defective encoder cable.	Please contact your Agilent service representative.
2 Defective pump drive assembly.	Please contact your Agilent service representative.

Stroke Length

Stroke Length: Pump channel A

B: Stroke Length: Pump channel B

The distance between the lower piston position and the upper mechanical stop is out of limits (pump).

During initialization, the module monitors the drive current. If the piston reaches the upper mechanical stop position before expected, the motor current increases as the module attempts to drive the piston beyond the mechanical stop. This current increase causes the error message to be generated.

Probable cause	Suggested actions
1 Defective pump drive assembly.	Please contact your Agilent service representative.

Initialization Failed

Initialization Failed: Pump channel A

B: Initialization Failed: Pump channel B

The module failed to initialize successfully within the maximum time window.

A maximum time is assigned for the complete pump-initialization cycle. If the time is exceeded before initialization is complete, the error message is generated.

Probable cause	Suggested actions
1 Blocked passive inlet valve.	Exchange the inlet valve.
2 Defective pump drive assembly.	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Electronic fuse of SSV

The electronic fuse protecting the solvent selection valve electronics has blown.

Probable cause	Suggested actions
1 Recoverable error of the SSV electronic.	Restart module, the electronic fuse can recover. If not, contact Agilent service.
2 Short cut of SSV/cable	Replace cable between board and SSV

7
Troubleshooting and Diagnostics

Overview of the Module's Indicators and Test Functions 122
Status Indicators 124
Power Supply Indicator 124
Module Status Indicator 125
User Interfaces 126
Agilent Lab Advisor Software 127

Overview of the troubleshooting and diagnostic features.

Overview of the Module's Indicators and Test Functions

Status Indicators

The module is provided with two status indicators which indicate the operational state (prerun, run, and error states) of the module. The status indicators provide a quick visual check of the operation of the module.

Error Messages

In the event of an electronic, mechanical or hydraulic failure, the module generates an error message in the user interface. For each message, a short description of the failure, a list of probable causes of the problem, and a list of suggested actions to fix the problem are provided (see chapter Error Information).

Test Functions

A series of test functions are available for troubleshooting and operational verification after exchanging internal components (see Tests and Calibrations).

Compressibility Calibration

Solvent compressibility is a function of solvent type and pressure. In order to optimize flow accuracy and pressure ripple, the compressibility of the solvent must be considered. The binary pump firmware contains compressibility parameters for most commonly used solvents. A compressibility calibration function is available to generate compressibility data for unlisted solvents (see "Binary Pump Solvent Calibration" on page 136). The compressibility data are stored in an XML file and can be transferred to other G1312B pumps.

Elasticity Calibration

Various parts in the flow path of the binary pump have a certain elasticity which needs to be compensated to obtain the lowest pressure-, flow- and composition ripple possible. This is done by running an elasticity calibration after maintenance and major repairs. For details see "Pump Elasticity Calibration" on page 138.

Diagnostic Signals

The pump has several signals (pressure, voltages and piston movement) that can be used for diagnosing pressure stability, composition and flow problems (see).

Status Indicators

Two status indicators are located on the front of the module. The lower left indicates the power supply status, the upper right indicates the module status.

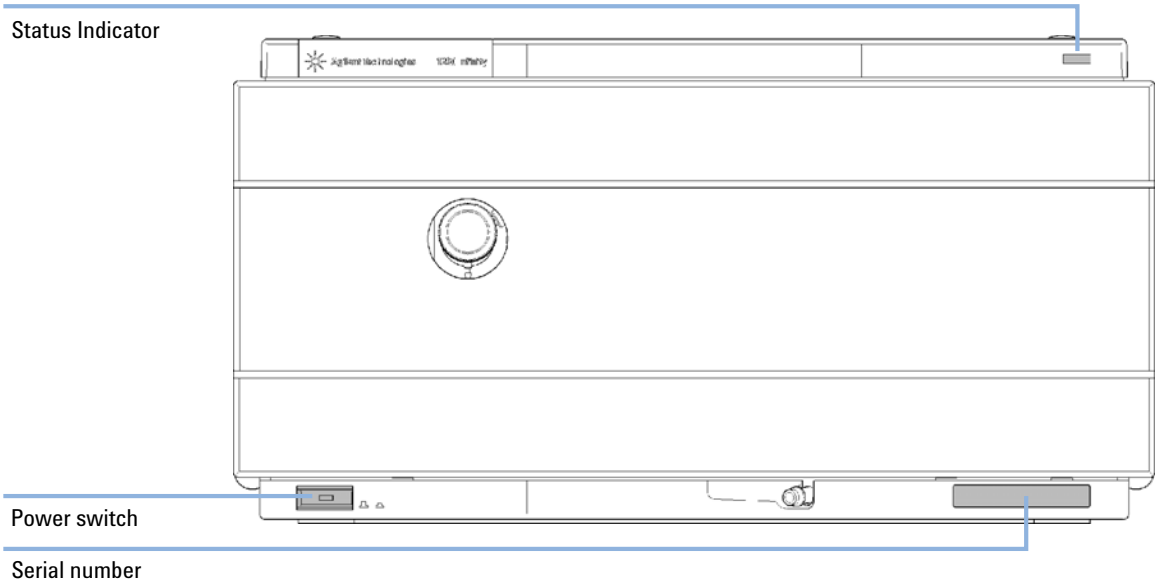


Figure 25 Location of Status Indicators

Power Supply Indicator

The power supply indicator is integrated into the main power switch. When the indicator is illuminated (*green*) the power is *ON*.

Module Status Indicator

The module status indicator indicates one of six possible module conditions:

- When the status indicator is *OFF* (and power switch light is on), the module is in a *prerun* condition, and is ready to begin an analysis.
- A *green* status indicator, indicates the module is performing an analysis (*run* mode).
- A *yellow* indicator indicates a *not-ready* condition. The module is in a not-ready state when it is waiting for a specific condition to be reached or completed (for example, immediately after changing a set point), or while a self-test procedure is running.
- An *error* condition is indicated when the status indicator is *red*. An error condition indicates the module has detected an internal problem which affects correct operation of the module. Usually, an error condition requires attention (e.g. leak, defective internal components). An error condition always interrupts the analysis.
- A *red-blinking* (modules with on-board LAN) or *yellow-blinking* (modules without on-board LAN) indicator indicates that the module is in resident mode (e.g. during update of main firmware).
- A *fast red-blinking* (modules with on-board LAN) or *fast yellow-blinking* (modules without on-board LAN) indicator indicates that the module is in boot loader mode (e.g. during update of main firmware). In such a case try to re-boot the module or try a cold-start.

User Interfaces

Depending on the user interface, the available tests vary. Some descriptions are only available in the Service Manual.

Test	ChemStation	Instant Pilot G4208A	Agilent LabAdvisor
Pressure Test	No	Yes	Yes
Pump Test	No	No	Yes
Solvent compressibility calibration	No	No	Yes
Pump elasticity calibration	No	No	Yes

Agilent Lab Advisor Software

The Agilent Lab Advisor software is a standalone product that can be used with or without data system. Agilent Lab Advisor software helps to manage the lab for high quality chromatographic results and can monitor in real time a single Agilent LC or all the Agilent GCs and LCs configured on the lab intranet.

Agilent Lab Advisor software provides diagnostic capabilities for all Agilent 1200 Infinity Series modules. This includes diagnostic capabilities, calibration procedures and maintenance routines for all the maintenance routines.

The Agilent Lab Advisor software also allows users to monitor the status of their LC instruments. The Early Maintenance Feedback (EMF) feature helps to carry out preventive maintenance. In addition, users can generate a status report for each individual LC instrument. The tests and diagnostic features as provided by the Agilent Lab Advisor software may differ from the descriptions in this manual. For details refer to the Agilent Lab Advisor software help files.

This manual provides lists with the names of Error Messages, Not Ready messages, and other common issues.

8
Tests Functions and Calibration

Pressure Test Description 130
- Positioning the Blank Nut 131
- Running the Pressure Test 131
- Evaluating the Results 132

Pump Test 134
- Running the Pump Test 135
- Evaluating the Results 135

Binary Pump Solvent Calibration 136
- Running the Solvent Compressibility Calibration 137

Pump Elasticity Calibration 138
- Running the Pump Elasticity Calibration 139

This chapter explains all test functions that are available for the binary pump.

Pressure Test Description

Description

The pressure test is a quick built-in test designed to demonstrate the leak tightness of the system. The test involves monitoring the flow profile while the pump delivers against a blank nut. The result is presented as the leak rate of the module and provides information about the leak tightness of the system between the outlet ball valves of the pump and the blank nut.

NOTE The blank nut can be positioned anywhere between the purge valve of the pump and the detector inlet to pressure test the desired part of the system.

CAUTION Blank nut placed at the outlet of flow cell

The applied pressure may cause permanent leaks or bursting of the flow cell.

➔ Never include the flow cell in the pressure test.

Step 1

The test begins with the initialization of both pump heads. After initialization, the pump is starting the compression phase and the required flow rate is constantly monitored and adjusted. The pump continues to pump until a system pressure of around 600 bar is reached.

Step 2

When the system pressure reaches 600 bar, the pump continues to pump at a flow rate that keeps the pressure constant. The flow that is needed to keep the pressure constant is directly translated into a leak rate.

Positioning the Blank Nut

If a specific component is suspected of causing a system leak, place the blank nut immediately before the suspected component, then run the **Pressure Test** again. If the test passes, the defective component is located after the blank nut. Confirm the diagnosis by placing the blank nut immediately after the suspected component. The diagnosis is confirmed if the test fails.

Running the Pressure Test

Running the test from the Agilent Lab Advisor application

When The test should be used when problems with small leaks are suspected, or after maintenance of flow path components (e.g., pump seals, injection seal) to prove pressure tightness up to 600 bar

Tools required
- Wrench 1/4 - 5/16 inch
- 1/16 inch blank nut

Preparations Place two bottles of HPLC-grade water in channels A and B (A1 and B1 if the pump is equipped with a solvent selection valve)

NOTE Make absolutely sure that all parts of the flow path that are part of the test are very thoroughly flushed with water before starting to pressurize the system! Any trace of other solvents or the smallest air bubble inside the flow path definitely will cause the test to fail!

1 Select the pressure test from the test selection menu.

2 Start the test and follow the instructions.

NOTE Make sure to release the pressure by opening the purge valve when the test has finished completed. Otherwise the pump may generate an overpressure error.

Evaluating the Results

The sum of all leaks between the pump and the blank nut will add up to the total leak rate. Note that small leaks may cause the test to fail, but solvent may not be seen leaking from a module.

NOTE Please notice the difference between an *error* in the test and a *failure* of the test! An *error* is caused by the abnormal termination during the operation of the test whereas a *failure* of a test indicates that the test results were not within the specified limits.

If the pressure test fails:

- Ensure all fittings between the pump and the blank nut are tight. Repeat the pressure test.

NOTE Often it is only a damaged blank nut itself (poorly shaped from overtightening) that causes the test to fail. Before investigating on any other possible sources of failure make sure that the blank nut you are using is in good condition and properly tightened!

- If the test fails again, insert the blank nut at the outlet of the previous module in the stack (e.g. autosampler, port 6 of the injection valve), and repeat the pressure test. Exclude each module one by one to determine which module is leaking.
- If the pump is determined to be the source of the leak, run the pump test to identify the defective pump component.

Potential Causes of Pressure Test Failure

After isolating and fixing the cause of the leak, repeat the pressure test to confirm the system is pressure tight.

Table 20 Potential Cause (Pump)

Potential Cause (Pump)	Corrective Action
Purge valve open.	Close the purge valve.
Loose or leaky fitting.	Tighten the fitting or exchange the capillary.
Damaged pump seals or plungers.	Run the pump test to identify the defective component.
Loose purge valve.	Tighten the purge valve nut (14 mm wrench).

Table 21 Potential Cause (Autosampler)

Potential Cause (Autosampler)	Corrective Action
Loose or leaky fitting.	Tighten or exchange the fitting or capillary.
Rotor seal (injection valve).	Exchange the rotor seal.
Damaged metering seal or plunger.	Exchange the metering seal. Check the plunger for scratches. Exchange the plunger if required.
Needle seat.	Exchange the needle seat.

Table 22 Potential Cause (Column Compartment)

Potential Cause (Column Compartment)	Corrective Action
Loose or leaky fitting.	Tighten or exchange the fitting or capillary.
Rotor seal (column switching valve).	Exchange the rotor seal.

Pump Test

Description

The pump test provides a fast and accurate way to verify proper hydraulic operation of the binary pump. Problems related to defective valves, seals or pistons can be diagnosed and usually the defective part is identified.

Step 1

The system is setup with water on both channels and a restriction capillary is attached to the outlet of the pump. Pump head A is delivering at 1 mL/min. The pressure signal is monitored and overlaid with the piston movement plot. The pressure pattern and the slope of the pressure signal are evaluated for the delivery strokes of both pistons.

Step 2

The procedure from step 1 is repeated on pump head B.

Step 3

The data from step 1 and 2 are evaluated. In case test failed, a conclusion about the defective part is made.

Running the Pump Test

Running the test from the Agilent Lab Advisor

When The test should be used to prove proper operation of the binary pump after repairs or when a the pressure test (see "Pressure Test Description" on page 130) determined a problem with the pump.

Tools required Wrench 1/4 - 5/16 inch

Parts required

#	Description
G1312-67500	Calibration capillary assembly

Preparations Place two bottles of HPLC-grade water in channels A and B (A1 and B1 if the pump is equipped with a solvent selection valve)

NOTE Make absolutely sure that the pump is very thoroughly flushed with water before starting the test! Any trace of other solvents or the smallest air bubble inside the flow path definitely will cause the test to generate misleading results!

1 Select the pump test from the test selection menu.

2 Start the test and follow the instructions.

NOTE Make sure to release the pressure by opening the purge valve when the test has finished completed. Otherwise the pump may generate an overpressure error.

Evaluating the Results

Refer to the help file of the Agilent Lab Advisor for further details.

Binary Pump Solvent Calibration

Description

Each solvent or solvent mixture has unique compressibility at different pressures. In order to deliver accurate flow with minimal pressure- and composition ripple over the full operational pressure range, it is necessary that the pump compensates precisely for the compressibility of the solvents in use.

The binary pump comes with compressibility parameters for the most common HPLC solvents and solvent mixtures. If a solvent is not available in the list of pre-calibrated solvents, the solvent compressibility calibration allows the appropriate compressibility data to be generated.

Technical background

The solvent compressibility calibration relies on an accurate elasticity calibration of the pump. With a proper elasticity calibration in place, the pump is switched into pressure control mode. A restriction capillary is connected to the purge valve outlet. By varying the flow rate, the pump maintains a certain pressure. The pump optimizes the compressibility value of the solvent until the lowest possible pump ripple is reached. The pump increases the flow rate and adjusts the pressure to the next calibration step where the pump ripple is minimized again. This process is repeated until solvent compressibility data for the whole operating pressure range of the pump are available.

The compressibility data set for this solvent is stored in an XML-file in C:\Documents and Settings\<username>\Application Data\Agilent Technologies\Agilent Lab Advisor\2.02.0.0\data\. It can be shared with other G1312B pumps via the controlling data system.

Running the Solvent Compressibility Calibration

Running the Solvent Compressibility Calibration from the Agilent Lab Advisor

When

If a solvent is not available in the list of pre-calibrated solvents, the solvent compressibility calibration allows to generate appropriate compressibility data.

Tools required

Wrench 1/4 - 5/16 inch

Parts required

#	Description
G1312-67500	Calibration capillary assembly

Preparations

Place a bottles with solvent to be calibrated in channel A (resp. A1 if a solvent selection valve is installed).

CAUTION

Avoid inaccurate pump elasticity calibration.

This would lead into invalid and not-portable solvent compressibility data.

➔ Make sure to perform accurate pump elasticity calibration.

NOTE

Make absolutely sure that the pump is very thoroughly flushed with the solvent to be calibrated before starting the procedure! Any trace of other solvents or the smallest air bubble inside the flow path definitely will cause the calibration to fail!

1 Select the solvent from the test selection menu.

2 Start the test and follow the instructions.

NOTE

Make sure to release the pressure by opening the purge valve when the test has finished completed. Otherwise the pump may generate an overpressure error.

Pump Elasticity Calibration

Description

The flow path components of the Binary Pump SL pump have an inherent and pressure dependent elasticity which differs from pump to pump. When this elasticity/pressure function is known, a correction algorithm can be applied. This results in significantly improved pump performance in low delay volume mode (damper and mixer bypassed).

The pump elasticity calibration uses a solvent with well known properties (HPLC-grade water) to determine the pump elasticity over the entire operating pressure range and stores the calibration values in the non-volatile RAM of the pump mainboard.

The initial calibration is done at the factory. It only needs to be repeated after replacement of major pump parts (mainboard, pump drive). The test allows to define which pump head will be calibrated.

NOTE Results of the pump elasticity calibration rely on known compressibility parameters for pure water. If the water is not HPLC-grade, not well degassed or degasser and pump are not flushed properly, the pump elasticity calibration will fail. The pump elasticity calibration has to be performed for each pump head individually.

CAUTION Incorrect pump elasticity calibration.

Solvent compressibility calibrations acquired with a miscalibrated pump will work, but they are not transferable to other pumps. A correct pump elasticity calibration is an essential prerequisite for successful solvent compressibility calibrations.

➔ Calibrate the pump elasticity correctly.

Running the Pump Elasticity Calibration

Running the Pump Elasticity Calibration from the Agilent LC Diagnostic Software

When The initial calibration is done at the factory. It only needs to be repeated after replacement of major pump parts (mainboard, pump drive).

Tools required Wrench 1/4 - 5/16 inch

Parts required

#	Description
G1312-67500	Calibration capillary assembly

Preparations Place all bottle heads in to a bottle of HPLC-grade water.

NOTE Make absolutely sure that the pump is very thoroughly flushed with the solvent to be calibrated before starting the procedure! Any trace of other solvents or the smallest air bubble inside the flow path definitely will cause the calibration to fail!

NOTE If a solvent selection valve is installed flush all four solvent channels to avoid that air from a dry solvent intake tube is drawn into the flow path upon initialization.

1. Select the pump elasticity calibration from the test selection menu.
2. Start the test and follow the instructions.

NOTE Make sure to release the pressure by opening the purge valve when the test has finished completed. Otherwise the pump may generate an overpressure error.

9
Diagnostic Signals

Analog Pressure Output 142
Description 142
Diagnostic Signals in the ChemStation Software 143
Directly Accessible Signals 143
Hidden Signals 143
Early Maintenance Feedback (EMF) 144
EMF Counters 144
Using the EMF Counters 145

This chapter explains all diagnostic signals and counter of the Binary Pump SL.

Analog Pressure Output

Description

A BNC connector at the rear of the Binary Pump SL provides the reading of the pressure sensor as analog value with a resolution of 1.33 mV/bar. The maximum reading of 660 bar equals 800 mV. The signal is available in real time and can be fed into an appropriate recording device (e.g. integrator or strip chart recorder) for troubleshooting purposes.

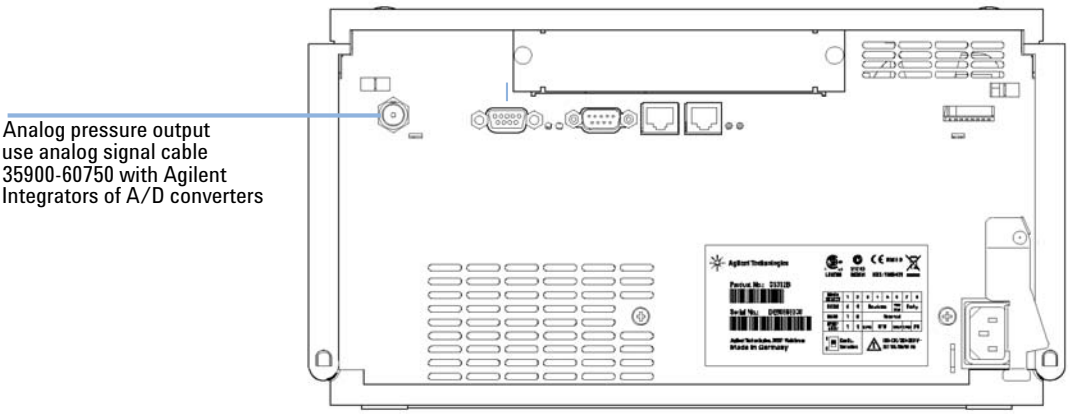


Figure 26 Location of Analog Output Connector

Diagnostic Signals in the ChemStation Software

Directly Accessible Signals

In ChemStation, the following instrument parameters are accessible during data acquisition and can be stored in the data file:

- actual pump pressure
- solvent composition (gradient)

Hidden Signals

Piston Movement

When overlaid with the pump pressure signal, this function allows to diagnose valve problems. However, it is recommended to use the pump test (see "Pump Test" on page 134) instead as it is optimized for use with the Binary Pump SL.

The piston movement signal needs to be turned on by typing the following command into the ChemStation command line:

lpmpdiagmode 1

ChemStation resets this function upon bootup. It is necessary to turn it back on every time ChemStation is restarted. If needed, the function can be manually disabled by typing the command below into the ChemStation command line.

lpmpdiagmode 0

Early Maintenance Feedback (EMF)

Components in the flow path are subject to mechanical wear or stress and require regular maintenance. Ideally, the frequency at which components are exchanged should be based on the intensity of usage of the instrument and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (EMF) feature monitors the usage of specific components in the instrument, and provides feedback when the user-settable limits are exceeded. The visual feedback in the user interface indicates when maintenance procedures should be scheduled.

EMF Counters

The Binary Pump SL provides a series of EMF counters for the left and right pump heads. Each counter increments with pump use and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. Each counter can be reset to zero after maintenance has been done. The Binary Pump SL provides the following EMF counters:

- liquimeter pump A,
- seal wear pump A,
- liquimeter pump B, and
- seal wear pump B.

Liquimeters

The liquimeters display the total volume of solvent pumped by the left and right pump heads since the last reset of the counters. Both liquimeters can be assigned an EMF (maximum) limit. When the limit is exceeded, the EMF flag in the user interface is displayed.

Seal Wear Counters

The seal wear counters display a value derived from pressure and pumped volume (both contribute to seal wear). The values increment with pump usage until the counters are reset after seal maintenance. Both seal wear counters can be assigned an EMF (maximum) limit. When the limit is exceeded, the EMF flag in the user interface is displayed.

Using the EMF Counters

The use of the EMF counter is described in "Early Maintenance Feedback (EMF)" on page 82

10 Maintenance

Introduction to Maintenance and Repair 148
Warnings and Cautions 149
Cleaning the Module 150
Overview of Maintenance and Simple Repairs 151
Maintenance Procedures 152
Exchanging the Purge Valve Frit or the Purge Valve 154
Removing the Pump Head Assembly 156
Disassembling the pump head 158
Exchanging the Pump Seals 159
Seal Wear-in Procedure 161
Exchanging the Pistons 162
Exchanging the Wash Seals 163
Reinstalling the Pump Head Assembly 165
Exchanging the Inlet Valve 167
Exchanging the Outlet Valve 169
Installation of the Solvent Selection Valve Upgrade Kit 171
Exchanging the Solvent Selection Valve 174
Installing the Active Seal Wash Option 177
Exchanging the Optional Interface Board 182
Replacing Module Firmware 183

This chapter describes the maintenance of the module.

Introduction to Maintenance and Repair

The pump is designed for easy repair. The most frequent repairs such as piston seal replacement and purge valve frit exchange can be done from the front side without removing the pump from the system stack. These repairs are described in “Overview of Maintenance and Simple Repairs” on page 151 .

Warnings and Cautions

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

The handling of solvents, samples and reagents can hold health and safety risks.

- ➔ When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor and follow good laboratory practice.
- ➔ The amount of substances should be reduced to the minimal volume required for the analysis.
- ➔ Do not operate the instrument in an explosive atmosphere.

WARNING

Electrical shock

Repair work at the module can lead to personal injuries, e.g. shock hazard, when the cover is opened.

- ➔ Do not remove the metal top cover of the module. No serviceable parts inside.
- ➔ Only certified persons are authorized to carry out repairs inside the module.

WARNING

Personal injury or damage to the product

Agilent is not responsible for any damages caused, in whole or in part, by improper use of the products, unauthorized alterations, adjustments or modifications to the products, failure to comply with procedures in Agilent product user guides, or use of the products in violation of applicable laws, rules or regulations.

- ➔ Use your Agilent products only in the manner described in the Agilent product user guides.

CAUTION

Safety standards for external equipment

- ➔ If you connect external equipment to the instrument, make sure that you only use accessory units tested and approved according to the safety standards appropriate for the type of external equipment.

Cleaning the Module

The module case should be kept clean. Cleaning should be done with a soft cloth slightly dampened with water or a solution of water and mild detergent. Do not use an excessively damp cloth as liquid may drip into the module.

WARNING

Liquid dripping into the electronic compartment of your module.

Liquid in the module electronics can cause shock hazard and damage the module.

➔ Do not use an excessively damp cloth during cleaning.

➔ Drain all solvent lines before opening any fittings.

Overview of Maintenance and Simple Repairs

Figure 27 on page 151 shows the main user accessible assemblies of the binary pump. The pump heads and its parts do require normal maintenance (for example, seal exchange) and can be accessed from the front (simple repairs). Replacement of valve cartridges or filters don't require to remove the pump from the system stack.

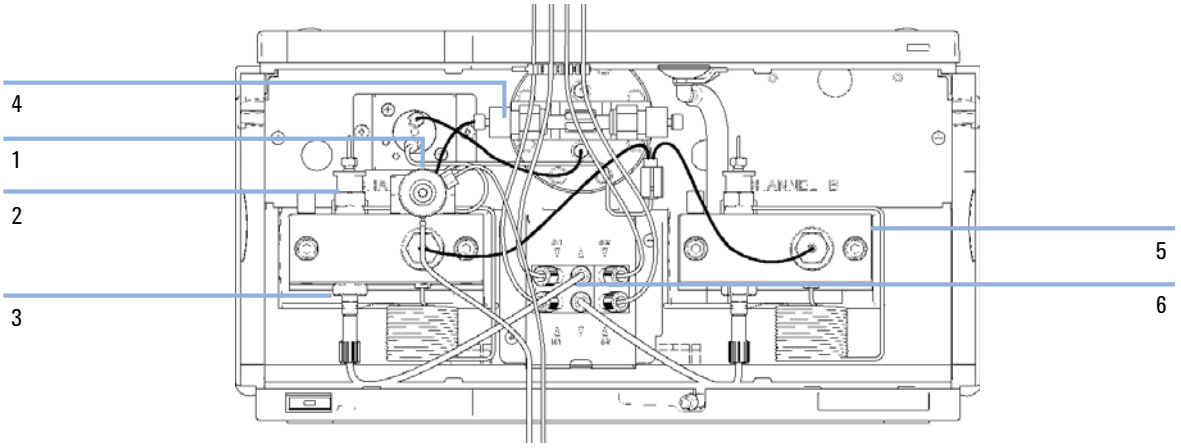


Figure 27 Overview of Maintenance and Simple Repair Procedures

1	Purge valve "Exchanging the Purge Valve Frit or the Purge Valve" on page 154
2	Outlet valve "Exchanging the Outlet Valve" on page 169
3	Passive inlet valve
4	Delay volume reduction
5	Pump head "Removing the Pump Head Assembly" on page 156
6	Solvent selection valve "Exchanging the Solvent Selection Valve" on page 174

Maintenance Procedures

The procedures described in this section can be done with the binary pump in place in the system stack.

Table 23 Maintenance Procedures

Procedure	Typical Frequency	Notes
"Exchanging the Purge Valve Frit or the Purge Valve" on page 154	Yearly, or if the frit shows indication of contamination or blockage	A pressure drop of > 10 bar across the frit (5 mL/min H_2O with purge valve open) indicates blockage
"Removing the Pump Head Assembly" on page 156	During yearly maintenance	Necessary to get access to pump seals and plungers.
"Disassembling the pump head" on page 158	During yearly maintenance	Necessary to get access to pump seals and plungers.
"Exchanging the Pump Seals" on page 159	Yearly, or if pump performance indicates seal wear	Leaks at lower pump head side, unstable retention times, pressure ripple unstable — run pump test for verification
"Exchanging the Pistons" on page 162	If scratched or if dents are visible	Seal life time shorter than normally expected — check plungers while changing the seals
"Exchanging the Wash Seals" on page 163	Yearly	Only necessary when Seal Wash Option is installed. Leaks at lower pump head side, loss of wash solvent

Table 24 Simple Repair Procedures

Procedure	Typical Frequency	Notes
"Exchanging the Purge Valve Frit or the Purge Valve" on page 154	If internally leaking	Solvent dripping out of waste outlet when valve is closed
"Exchanging the Inlet Valve" on page 167	If leaking externally If solenoid is defective	Error messages "Inlet Valve Fuse" or "Inlet Valve Missing"
"Exchanging the Outlet Valve" on page 169	If internally leaking	Pressure ripple unstable, run leak test for verification
"Exchanging the Solvent Selection Valve" on page 174	If internally leaking If solenoid is defective	Cross port flow Error message "Valve Failed"
Installing the Active Seal Wash Option (*see Service Manual*).	When upgrading to Active Seal Wash	Recommended if buffers of > 0.1M are used regularly.

Exchanging the Purge Valve Frit or the Purge Valve

When

Frit - when plunger seals are exchanged or when contaminated or blocked (pressure drop of > 10 bar across the frit at a flow rate of 5 mL/min of H_20 with purge valve opened)

Purge valve - if purge valve cannot be closed leak tight

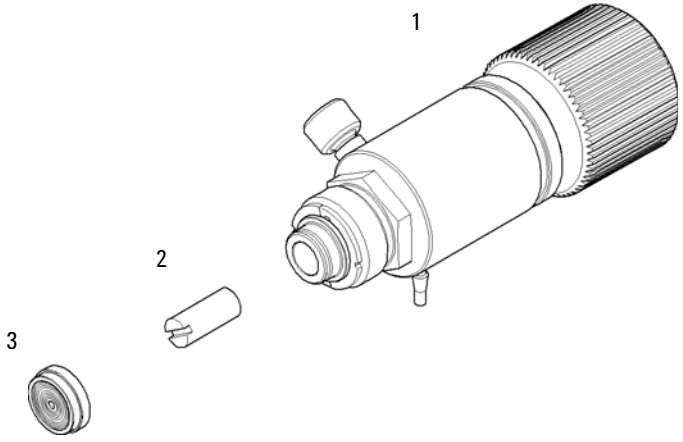
Tools required

- Wrench 1/4 inch
- Wrench 14 mm
- Pair of tweezers or toothpick

Parts required

#	p/n	Description
1	01018-22707	PTFE frit (pack of 5)
1	G1312-60061	Purge valve assembly

1. Using a 1/4 inch wrench disconnect the pump outlet capillary at the purge valve.
2. Disconnect the waste tube. Beware of leaking solvents due to hydrostatic pressure.
3. Using the 14 mm wrench, unscrew the purge valve and remove it from the purge valve holder.
4. Remove the plastic cap with the gold seal from the purge valve.
5. Use a pair of tweezers or a toothpick to remove the frit.



1	Valve body (Purge valve assembly (p/n G1312-60061))
2	PTFE frit (pack of 5) (p/n 01018-22707)
3	Seal cap (p/n 5067-4728)

6 Place a new frit into the purge valve with the slit facing the seal cap.

7 Replace the seal cap.

8 Insert the purge valve into the purge valve holder and orient he waste outlet nozzle downward as shown below.

9 Tighten the purge valve and reconnect outlet capillary and waste tubing.

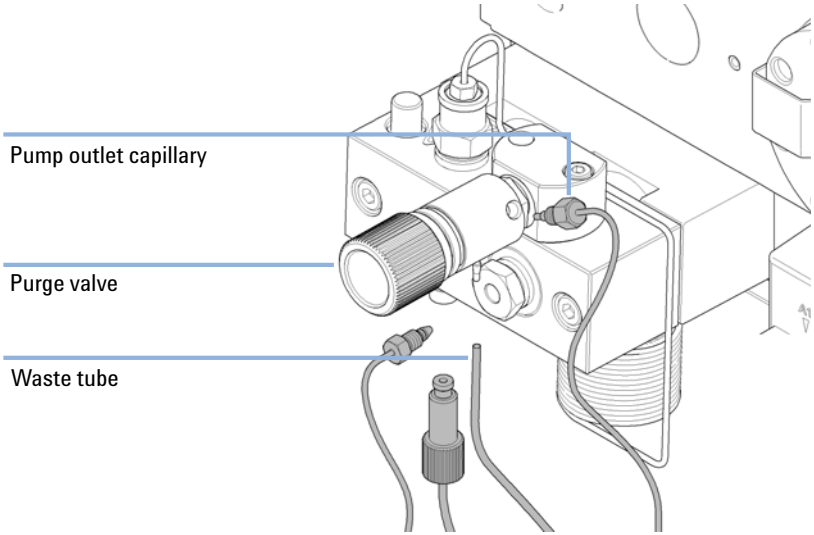


Figure 28 Exchanging the Purge Valve

Removing the Pump Head Assembly

When

- Exchanging pump seals
- Exchanging pistons
- Exchanging seals of the seal wash option

Tools required

Wrench 1/4 inch

3-mm hexagonal key

4-mm hexagonal key

1/4 inch slitted socket wrench

Preparations

Switch off the pump at the main power switch

CAUTION

Make sure that the pump head is not removed.

This may damage the pump drive.

➔ Never start the pump when the pump head is removed.

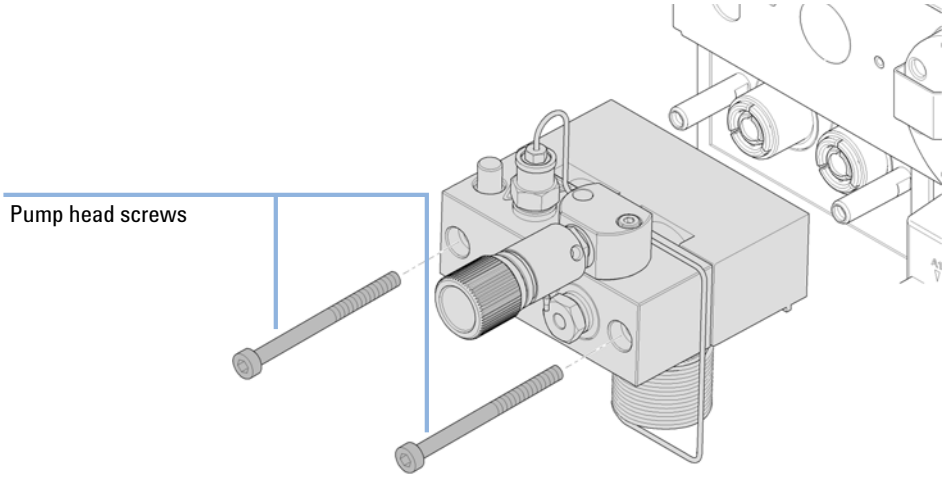
NOTE

Both pump head assemblies use the same internal components. In addition, pump head A is fitted with the purge valve. The following procedure describes the removal and disassembly of pump head A (left). For pump head B (right) proceed in the same way and skip steps that deal with the purge valve.

1 Remove the front cover.

2 2. Disconnect the capillaries at the back of the purge valve holder, the pump head adapter and the tube at the inlet valve. Beware of leaking solvents.

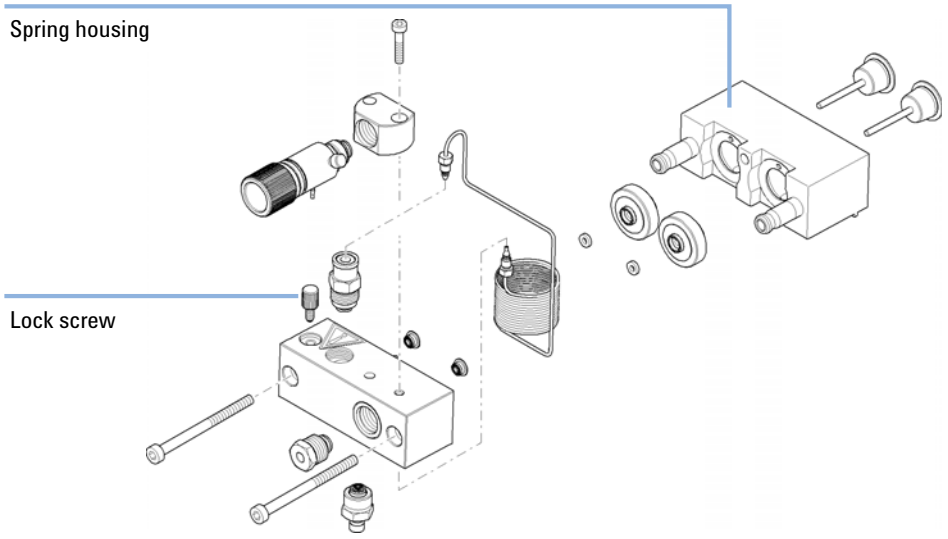
3 Using a 4-mm hexagonal key stepwise loosen and remove the two pump head screws.



4 Using a 3-mm hexagonal key loosen the purge valve holder and remove it from pump head body.

Disassembling the pump head

1 Place the pump head with the front face onto a bench.
2 Open the two hex screws on the rear side with a 3 mm hex driver.
3 Open the PEEK lock screw two to three turns.
4 Pull the spring housing up and remove it from the pump head.



Exchanging the Pump Seals

When

Seals leaking, if indicated by the results of the pump test (check both pump heads individually!)

Tools required

- Wrench 1/4 inch
- 3-mm hexagonal key
- 4-mm hexagonal key
- Insert tool

Parts required

#	p/n	Description
1	0905-1503	Piston seal PTFE, carbon filled, black (pack of 2), default
1	0905-1420	PE seals (pack of 2)
1	5022-2159	Restriction capillary

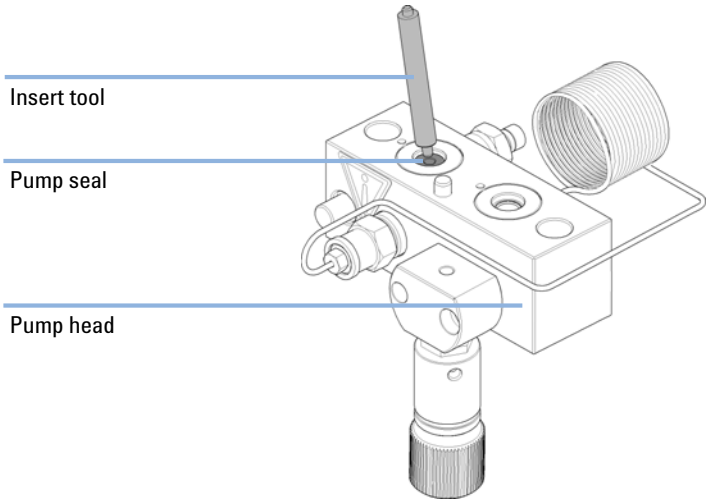
Preparations

Switch off the pump at the main power switch

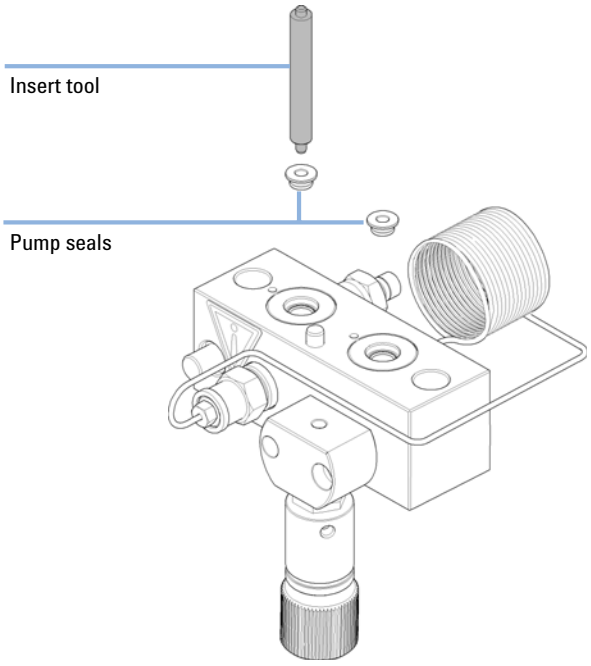
Remove the front cover to have access to the pump mechanics

1 Disassemble the pump head assembly, see "Disassembling the pump head" on page 158.

2 Use the insert tool to carefully remove the seal from the pump head.



3 Using the insert tool insert the new seals into the pump head and press them firmly in position.



4 Reassemble the pump head assembly (see “Reinstalling the Pump Head Assembly” on page 165).

NOTE Reset the seal wear counter and liquimeter in the Agilent Lab Advisor.

Seal Wear-in Procedure

NOTE This procedure is required for standard seals only (part no. 5063-6589), but it will definitely damage the normal phase application seals (part no. 0905-1420).

1. Put a bottle with 100 ml of isopropanol in the solvent cabinet and place the solvent intake filter of the pump head you want to wear in into this bottle.
2. Screw the PEEK adapter (part no. 0100-1847) onto the Active Inlet Valve and connect the inlet tube directly to it.
3. Connect the restriction capillary (part no. 5022-2159) to the purge valve. Put its other end into a waste container.
4. Open the purge valve and purge the system for 5 minutes with isopropanol at a flow rate of 2 mL/min.
5. Close the purge valve, set the flow to a value that gives a pressure of 350 bar. Pump 15 min at this pressure to wear the seals in. The pressure can be monitored on the analog output connector of the pump, with the Instant Pilot, chromatographic data system or any other controlling device connected to your pump.
6. Turn the pump *Off*, slowly open the purge valve to release the pressure from the system, disconnect the restriction capillary and reconnect the outlet capillary to the purge valve. Reconnect the intake tubing to the solvent selection valve and the connecting tube from solvent selection valve (if installed) to the AIV.
7. Purge your system with the solvent used for your next application.

Exchanging the Pistons

When When scratched

Tools required
- 3-mm hexagonal key
- 4-mm hexagonal key

Parts required

#	p/n	Description
1	5063-6586	Piston

Preparations
- Switch off the pump at the main power switch
- Remove the front cover to have access to the pump mechanics
- "Removing the Pump Head Assembly" on page 156
- "Disassembling the pump head" on page 158

1 Check the plunger surface and remove any deposits or layers. Most suitable is polishing of the plunger rod with toothpaste. Replace the plunger if scratched of if dents are visible.

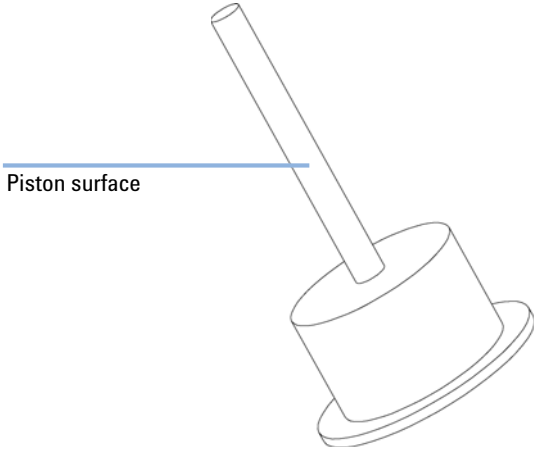


Figure 29 Plunger

NOTE The best way to inspect a piston is to hold it up and watch e.g. a light bulb though the piston rod. The transparent sapphire acts as a very strong magnifier and even smallest surface abnormalities become visible.

Exchanging the Wash Seals

Tools required

- hexagonal key3-mm
- 4-mm hexagonal key
- Insert tool
- Small flat-head screwdriver

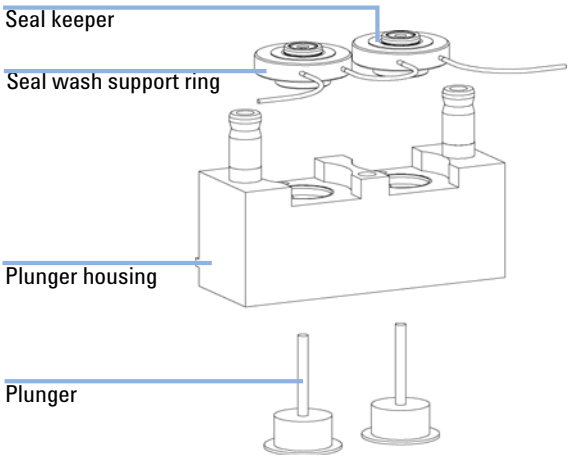
Parts required

#	p/n	Description
1	0905-1175	Wash seal
1	5062-2484	Gasket, seal wash (pack of 6)

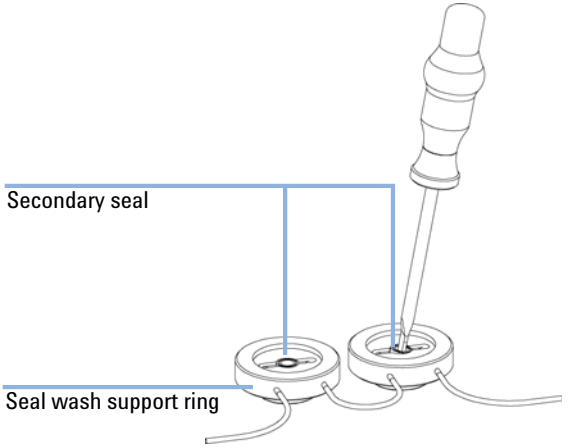
Preparations

- Switch off the pump at the main power switch
- Remove the front cover to have access to the pump mechanics
- "Removing the Pump Head Assembly" on page 156
- "Disassembling the pump head" on page 158

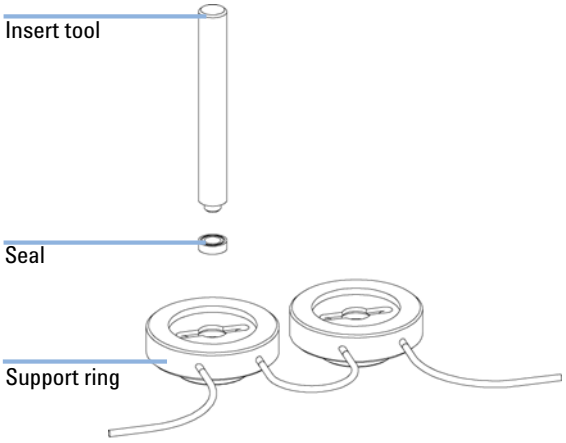
1 Remove the seal keeper and the seal wash support rings from the plunger housing. Remove the seal keeper from the support ring assembly.



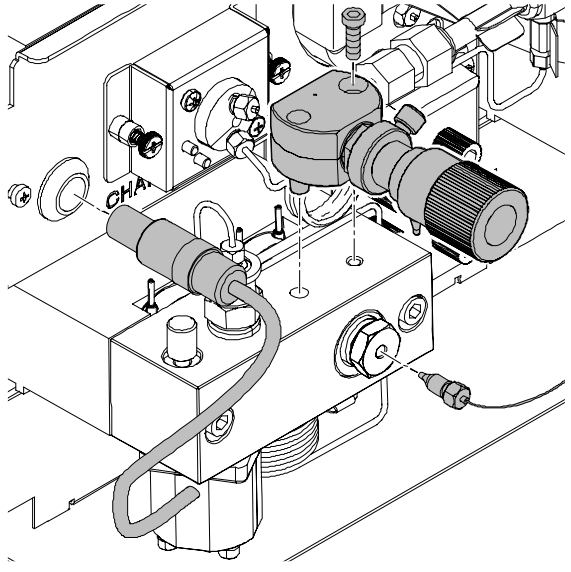
2 Using the blade of a flat head screwdriver remove seal wash gasket and the secondary seal from the support ring.



3 Using the insert tool press the seal (spring pointing upwards) into the recess of the support ring. Place a seal wash gasket in the recess of the support ring and replace the seal keeper.



4 Reassemble the pump head assembly (see "Reinstalling the Pump Head Assembly" on page 165).



Reinstalling the Pump Head Assembly

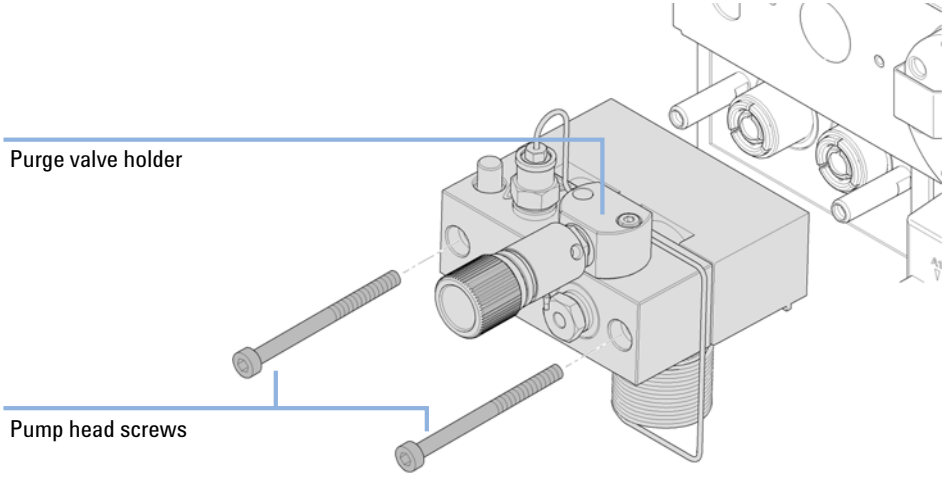
When When reassembling the pump

Tools required
- 3-mm hexagonal key
- 4-mm hexagonal key

Parts required

#	p/n	Description
1	79846-65501	Pump head grease

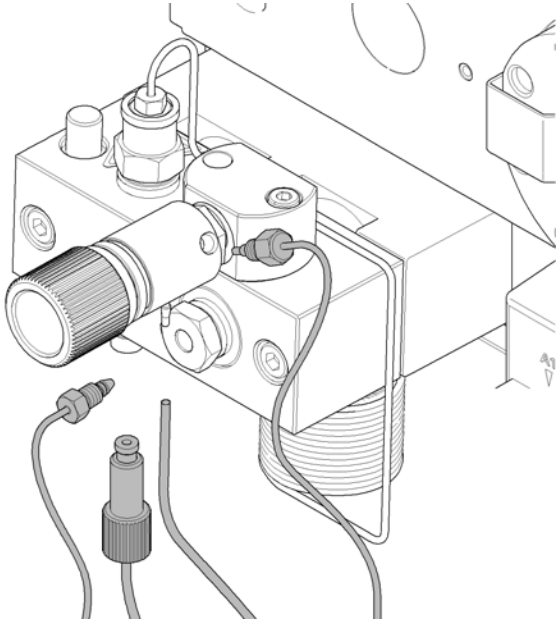
1 Slide the pump head assembly onto the pump drive.



2 Using a 4 mm hexagonal key tighten the pump head screws stepwise with increasing torque.

3 Using a 3 mm hexagonal key fix the purge valve holder to the pump head.

4 Reconnect the tubing and capillaries to the connector.



Exchanging the Inlet Valve

When If internally or externally leaking.

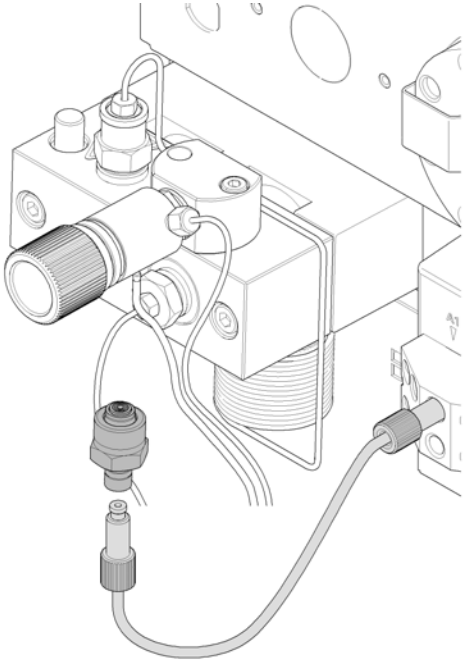
Tools required Wrench 14 mm

Parts required

#	Description
G1312-60066	Passive inlet valve

Preparations Switch off the pump at the main power switch

1. Remove the front cover.
2. Disconnect the solvent inlet tube at the inlet valve (beware of leaking solvents).
3. Using a 14-mm wrench, loosen the inlet valve and remove the valve from the pump head.



4 Screw the valve into the pump head. Using the 14 mm wrench turn the nut until it is hand tight.

5 Using the 14 mm wrench tighten the valve (do not over tighten).

6 Reinstall the front cover.

NOTE

After an exchange of the valve it may be required to pump several mL of the solvent used in the current application before the flow stabilizes at a pressure ripple as low as it used to be when the system was still working properly.

Exchanging the Outlet Valve

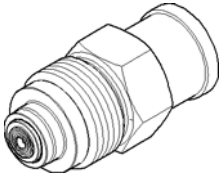
When	if leaking internally
Tools required	tools:wrench 1/4 - 5/16 inchWrench 1/4 inch Wrench 14 mm
Parts required	**#** **Description** G1312-60067 Outlet valve, complete
Preparations	Switch off the pump at the main power switch

NOTE Before exchanging the outlet valve you can try to clean it in an ultrasonic bath. Remove the gold seal and put the plastic cap back on to protect the sealing surface from scratches. Place the valve in upright position (sitting on the plastic cap) in a small beaker with premixed water/isopropanol (50/50). Sonicate for 5 to 10 minutes. Replace the gold seal.

1 Using a 1/4 inch wrench disconnect the valve capillary from the outlet valve.

2 Unscrew the valve with the 14 mm wrench and remove it from the pump body.

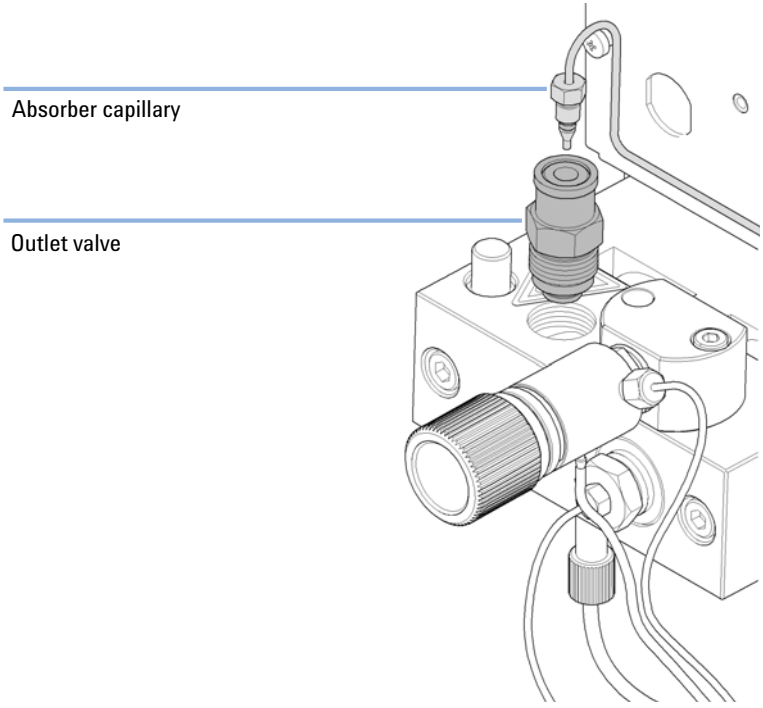
3 In case you are only sonicating the valve, check the plastic cap and the gold seal for damage.



NOTE Check the gold seal. It should be exchanged when heavily deformed. Inspect the cap and replace it with a new one if cracks are visible.

4 Reinstall the outlet valve and tighten it.

5 Reconnect the valve capillary.



Installation of the Solvent Selection Valve Upgrade Kit

A solvent selection valve allows you choosing between 4 different solvents that can be used with a binary pump. The valve switches between two solvents A1 and A2 for channel A of the left pump head and two solvents B1 and B2 for channel B of the right pump head.

When Applicable modules: This kit is compatible to the 1260 Binary Pumps G1312B and G1312C.

Tools required Screwdriver Pozidriv #1

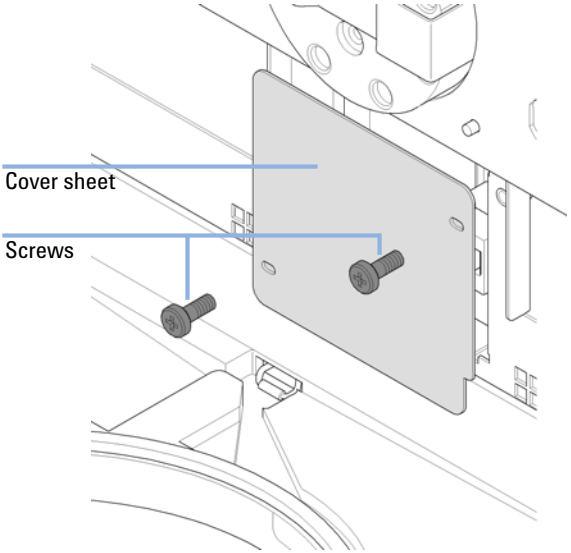
Parts required

#	Description
G1381-60000	Solvent Selection Valve Upgrade Kit

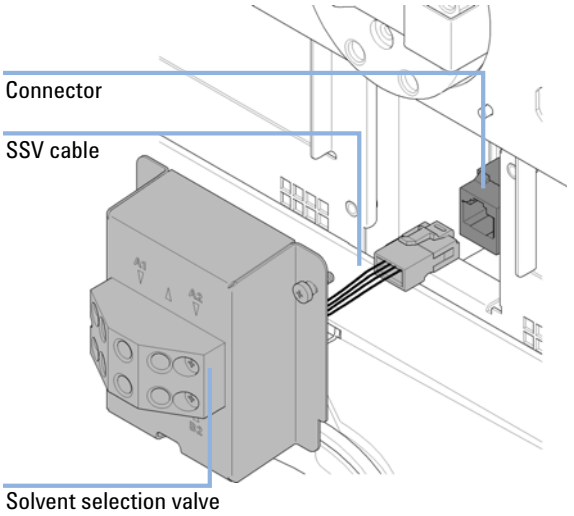
Preparations If required, remove solvent tubes from the inlet valves.

NOTE The figures below show a Binary Pump G1312B. The kit can be used similarly for the Binary Pump G1312C. Figures show passive inlet valves. If the pump uses active inlet valves, they can be used similarly.

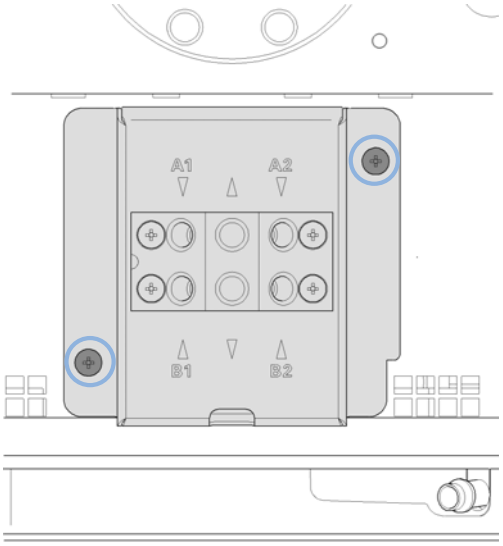
1 Remove the front cover sheet by removing both screws.



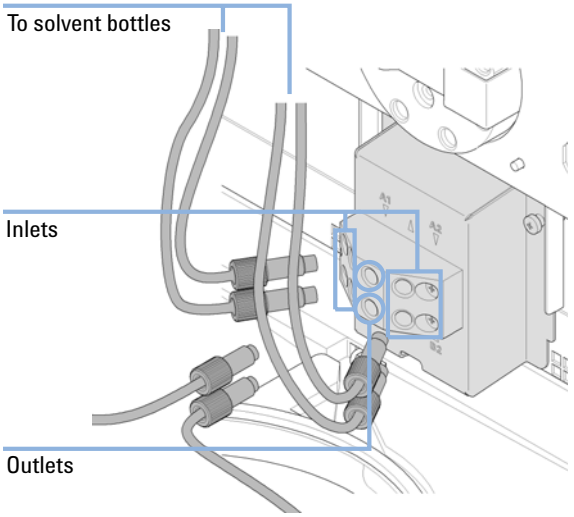
2 Plug in the connector of the solvent selection valve



3 Install the Solvent selection assembly by fixing both indicated screws.



4 Connect the outlet for solvent A (upper row) to the inlet valve of the left pump head. Connect the outlet for solvent B (lower row) to the inlet valve of the right pump head. Put the solvent bottles into the solvent cabinet. Connect the bottle heads of solvents A1 and A2 to the inlets in the upper row, see labels on valve assembly. Connect the bottle heads of solvents B1 and B2 to the inlets in the lower row, see labels on valve assembly.



For controlling the solvent selection valve, please refer to the online help or user manual of your control software.

Exchanging the Solvent Selection Valve

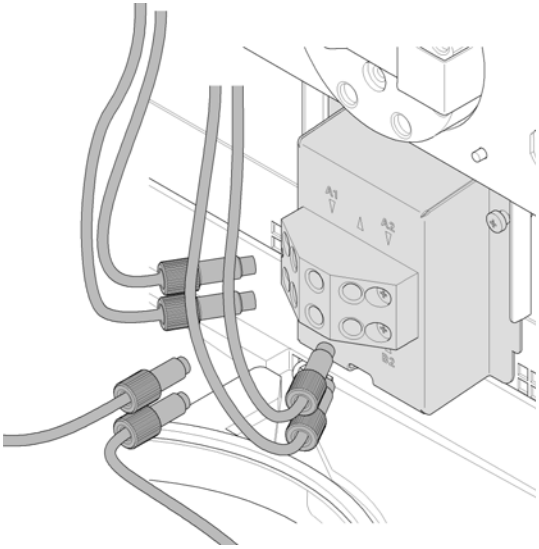
When If leaking internally (croossflow between the ports), or if one of the channels is blocked

Tools required Screwdriver Pozidriv #1

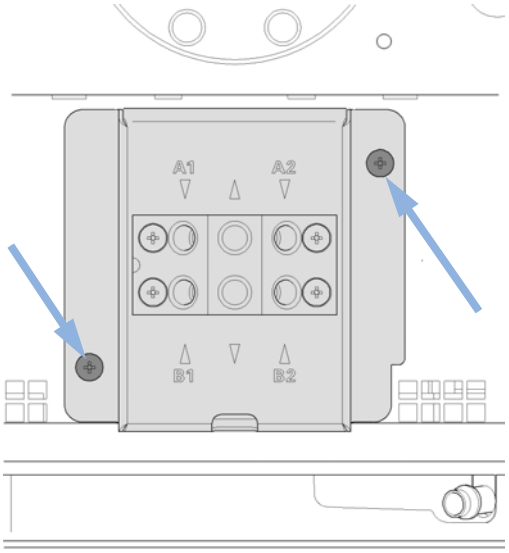
Parts required

#	Description
G1381-60000	Solvent Selection Valve Upgrade Kit

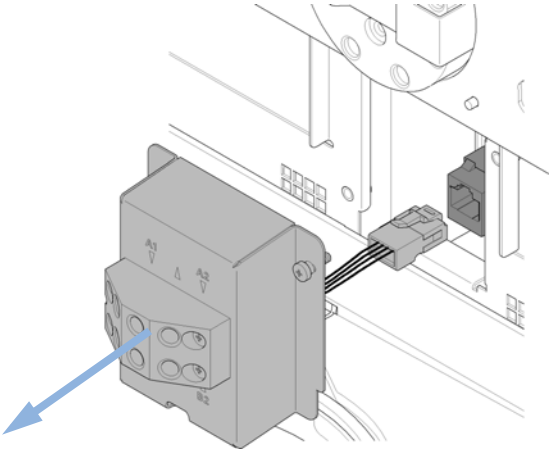
Preparations Switch off the pump at the main power switch

1 Lift solvent bottles out of the solvent cabinet and place them on the table. Disconnect the solvent tubes from the solvent selection valve and empty the tubes into the bottles. Place the bottles back into the solvent cabinet.	**2** Disconnect all tubings from the solvent selection valve. 

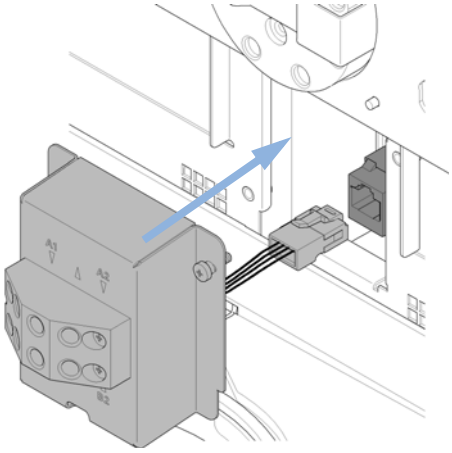
3 Using a Pozidriv screwdriver #1 loosen the holding screws of the valve holder.



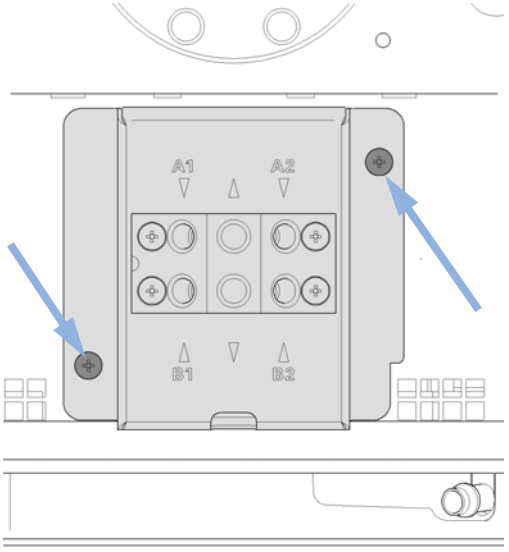
4 Carefully pull the valve holder out and disconnect the valve cable at the connector.

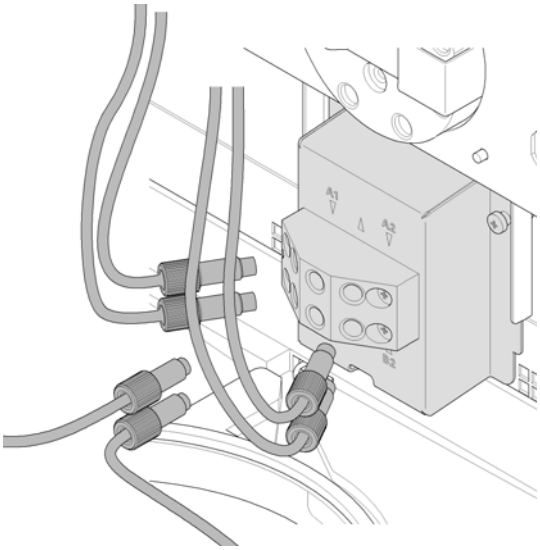


5 Exchange the defective solvent selection valve.



6 Tighten the screws of the valve holder.



7 Reconnect all tubings to the solvent selection valve. 	

NOTE After an exchange of the valve it may be required to pump several mL of solvent before the flow stabilizes at a pressure ripple as low as it used to be when the system was still working properly.

Installing the Active Seal Wash Option

When When using concentrated buffers (> 0.1 M)

Tools required
- 4-mm hexagonal key
- Screwdriver Pozidrive #1

Parts required

#	p/n	Description
1	G1312-68721	Active Seal Wash Option kit

Preparations
- Switch off the pump at the main power switch
- Remove the front cover
- Remove the top cover and foam

1 By using a screwdriver remove the metal plug in the z-panel.

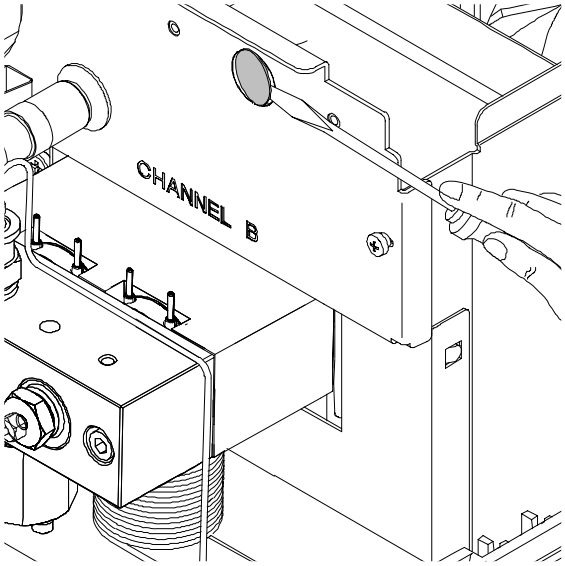


Figure 30 Removing the Metal Plug from the Z-Plane

2 Insert the socket, delivered with the Seal Wash pump assembly, into the hole on the z-panel.

3 Guide the wire of the active seal wash assembly through the hole and screw it onto the z-panel.

4 Guide the wire over the fan and plug the connector onto the mainboard connector P7.

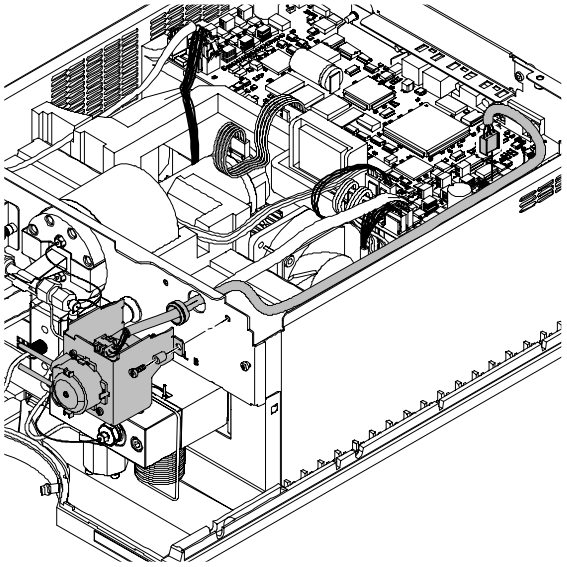


Figure 31 Mounting the Seal Wash Pump

5 Replace the foam and top cover.

6 Disconnect all capillaries and tubes from the pump head and disconnect the active inlet valve cable.

7 Using a 4-mm hexagonal key stepwise loosen and remove the two pump head screws and remove the pump head from the pump drive

8 Place the pump head on a flat surface. Loosen the lock screw (two revolutions) and while holding the lower half of the assembly carefully pull the pump head away from the plunger housing.

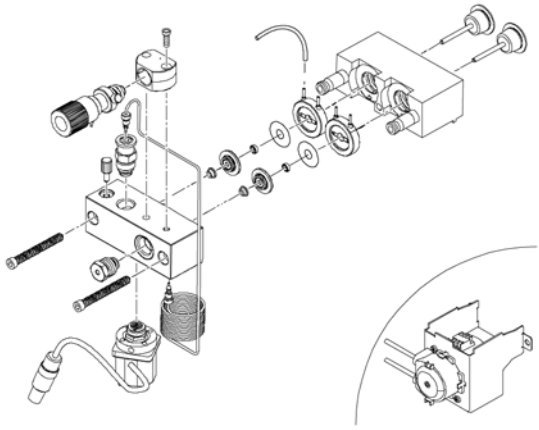


Figure 32 Exploded Diagram of the Pump Head with Seal Wash

9 Remove the support rings from the plunger housing and lift the housing away from the plungers.

10 Replace the seal wash seals and the film gaskets of the support rings.

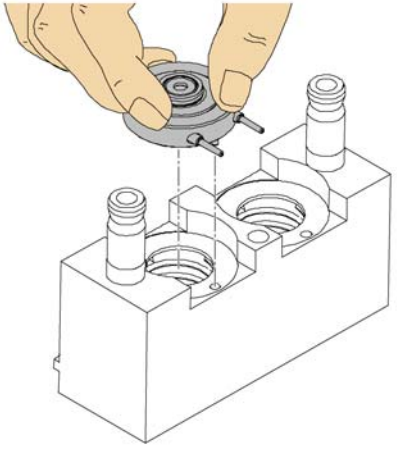


Figure 33 Inserting the active seal wash support rings

11 Place the support rings on the plunger housing (plungers not installed) and snap the pump head and plunger housing together.

12 Insert the plungers and carefully press them into the seal.

13 Tighten the lock screw.

14 Slide the pump head assembly onto the metering drive. Apply a small amount of pump head grease (part no. 79846-65501) to the pump head screws and the balls of the spindle drive. Tighten the pump head screws stepwise with increasing torque until they are tight.

15 Reconnect all capillaries, tubes and the active inlet valve cable to its connector

16 Route the wash tubings as shown in inlet tube into a bottle filled with a mixture of distilled water and isopropanol (90/10) and place the bottle in the solvent cabinet.

17 Route the outlet of the wash tube back into the wash solvent bottle.

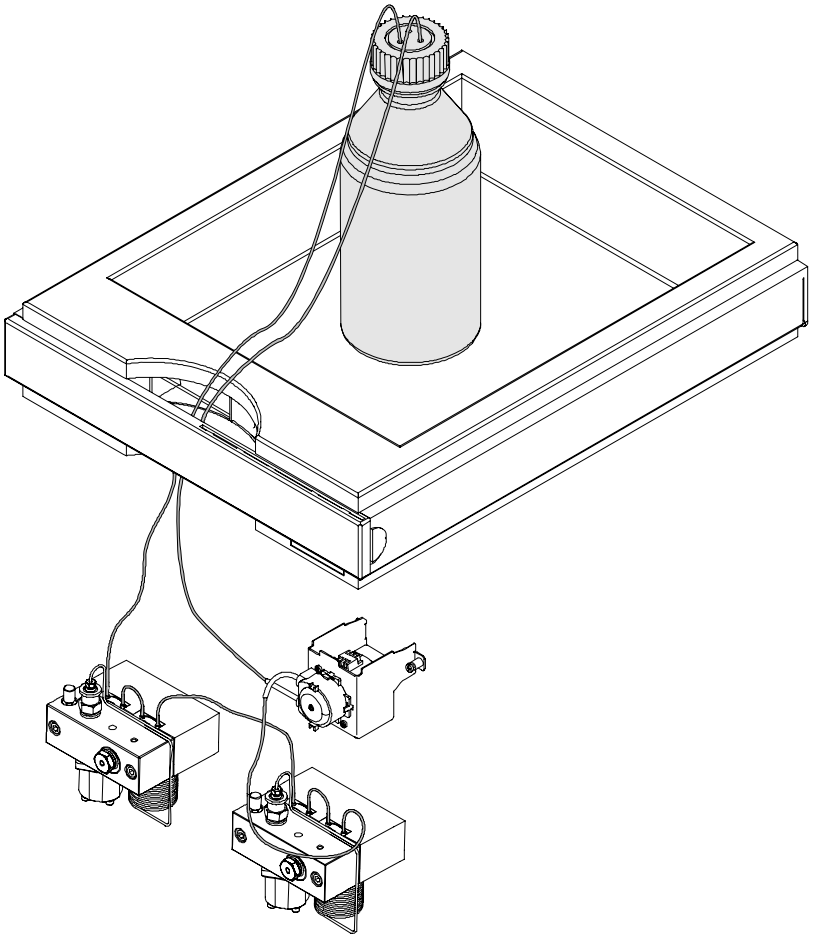


Figure 34 Routing of Active Seal Wash Tubing

Exchanging the Optional Interface Board

When Board defective

Parts required

#	Description
1	BCD (Interface) board

CAUTION

Electronic boards and components are sensitive to electrostatic discharge (ESD).

ESD can damage electronic boards and components.

➔ In order to prevent damage always use an ESD protection when handling electronic boards and components.

1 Switch OFF the module at the main power switch. Unplug the module from main power.

2 Disconnect cables from the interface board connectors.

3 Loosen the screws. Slide out the interface board from the module.

4 Install the new interface board. Secure the screws.

5 Reconnect the cables to the board connector

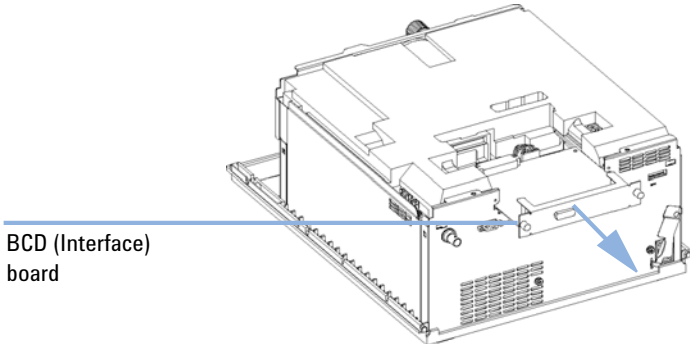


Figure 35 Exchanging the Interface Board

Replacing Module Firmware

When

The installation of newer firmware might be necessary
- if a newer version solves problems of older versions or
- to keep all systems on the same (validated) revision.

The installation of older firmware might be necessary
- to keep all systems on the same (validated) revision or
- if a new module with newer firmware is added to a system or
- if third part control software requires a special version.

Tools required

- LAN/RS-232 Firmware Update Tool or
- Agilent Diagnostic Software
- Instant Pilot G4208A (only if supported by module)

Parts required

#	Description
1	Firmware, tools and documentation from Agilent web site

Preparations

Read update documentation provided with the Firmware Update Tool.

To upgrade/downgrade the module's firmware carry out the following steps:

1 Download the required module firmware, the latest LAN/RS-232 FW Update Tool and the documentation from the Agilent web.
   - http://www.chem.agilent.com/scripts/cag_firmware.asp.

2 To load the firmware into the module follow the instructions in the documentation.

Module Specific Information

Table 25 Module Specific Information (G1312B)

	G1312B Binary pump SL
Initial firmware	A.06.01
Compatibility with 1100 / 1200 series modules	When using the G1312B in a system, all other modules must have firmware revision A.06.01 / B.01.01 or above (main and resident). Otherwise the communication will not work.
Conversion to / emulation of G1367C	Special emulation mode firmware is available for conversion to G1312A. A.05.01/03, A.05.06/10, A.05.11/12 and A.06.01 are available as emulation mode firmware. If an emulation mode firmware is installed the resident firmware must also be downgraded.

11
Parts and Materials for Maintenance

Bottle Head Assembly 186
Hydraulic Path with Solvent Selection Valve 188
Hydraulic Path without Solvent Selection Valve 190
Pump Head Assembly Without Seal Wash 192
Pump Head Assembly with Seal Wash Option 194
Outlet Valve 196
Purge Valve Assembly 197
Active Inlet Valve Assembly 198
Accessory Kit 199
Active Seal Wash Option 201
G1316B SL Capillary System Kit 202
Solvent Cabinet 204
Preventive Maintenance Kit G1312-68750 206

This chapter lists all parts and tools that are required for maintenance.

Bottle Head Assembly

Item	p/n	Description
1	9301-1450	Solvent bottle, amber
2	9301-1420	Solvent bottle, transparent
3	G1311-60003	Bottle-head assembly
4	5063-6598	Ferrules with lock ring (10x)
5	5063-6599	Tube screw (10x)
6	5062-2483	Solvent tubing, 5 m
7	5062-8517	Inlet filter adapter (pack of 4)
8	5041-2168	Solvent inlet filter, 20 µm

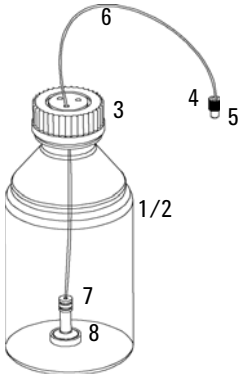


Figure 36 Bottle-Head Assembly Parts

Hydraulic Path with Solvent Selection Valve

Item	p/n	Description
1	G1322-67300	Kit of 4 solvent tubes for connection degasser to SSV including labels
2	G1312-60000	Solvent selection valve (PN gives half of a complete solvent selection block)
	5041-8365	Blank plug for unused SSV channels
3	G1311-67304	Connecting tube, SSV to AIV
	G1312-60066	Passive inlet valve
4	G1312-60025	Active inlet valve body (optional), without cartridge
5	G1312-60065	Pump Head with Seal Wash
6	G1312-60067	Outlet valve, complete
7	G1312-87300	Absorber capillary
8	G1312-67302	Mixing capillary
9	G1312-87301	Restriction capillary (mixing capillary to pressure sensor)
10	5067-1527	Pressure sensor
11	G1312-87305	Capillary SSL, 0.17 x 150 mm (pressure sensor to damper)
12	G1312-60031	Damper
13	G1312-87330	Mixer
14	G1312-87306	Capillary SSL, 0.17 x 105 mm (connections to solvent mixer)
	G1312-04100	Bracket for solvent mixer
15	G1312-60061	Purge valve assembly
	5042-8507	Seal wash pump cartridge (silicone tubing)
	5065-9978	Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m, for seal wash option
16	G1312-87303	SS Capillary 400 x 0.17 mm, m/m, ps/ps
	G1312-87304	SST capillary 700 mm, 0.17 mm i.d., 1/32 - 1/32
17	5062-2461	Waste tube, 5 m (reorder pack)

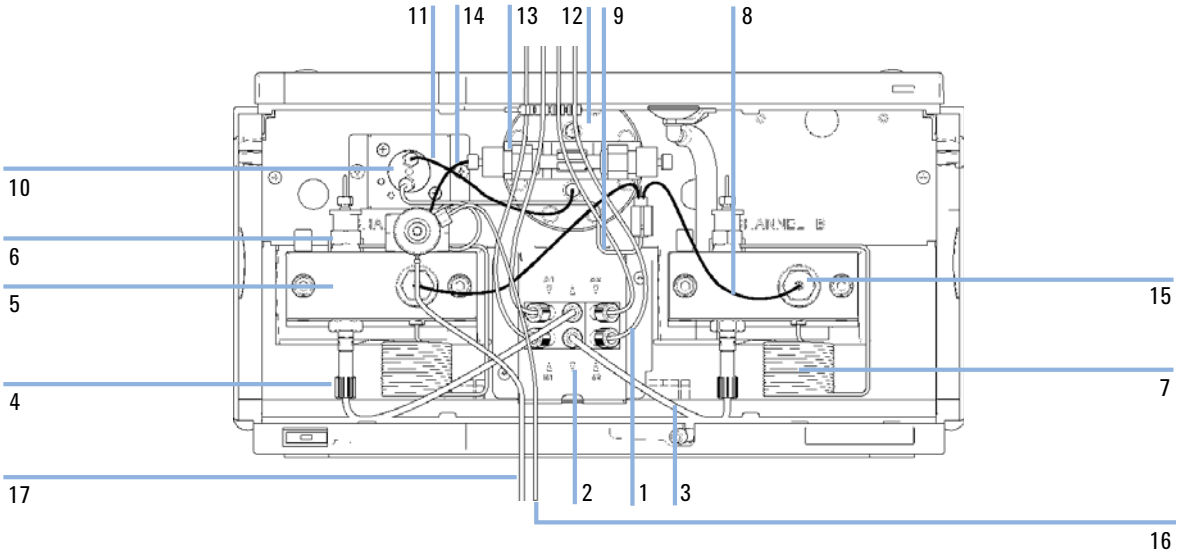


Figure 37 Hydraulic Path with Solvent Selection Valve

Hydraulic Path without Solvent Selection Valve

Item	p/n	Description
1	G1322-67300	Kit of 4 solvent tubes for connection degasser to SSV including labels
2	0100-1847	Adapter AIV to solvent inlet tubes
	G1312-60066	Passive inlet valve
3	G1312-60025	Active inlet valve body (optional), without cartridge
4	G1312-60064	Pump Head without Seal Wash
5	G1312-60067	Outlet valve, complete
6	G1312-87300	Absorber capillary
7	G1312-67302	Mixing capillary
8	G1312-87301	Restriction capillary (mixing capillary to pressure sensor)
9	5067-1527	Pressure sensor
10	G1312-87305	Capillary SSL, 0.17 x 150 mm (pressure sensor to damper)
11	G1312-60031	Damper
12	G1312-87330	Mixer
13	G1312-87306	Capillary SSL, 0.17 x 105 mm (connections to solvent mixer)
	G1312-04100	Bracket for solvent mixer
14	G1312-60061	Purge valve assembly
15	G1312-87303	SS Capillary 400 x 0.17 mm, m/m, ps/ps
	G1312-87304	SST capillary 700 mm, 0.17 mm i.d., 1/32 - 1/32
16	5062-2461	Waste tube, 5 m (reorder pack)
17	5042-8507	Seal wash pump cartridge (silicone tubing)
18	5065-9978	Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m, for seal wash option

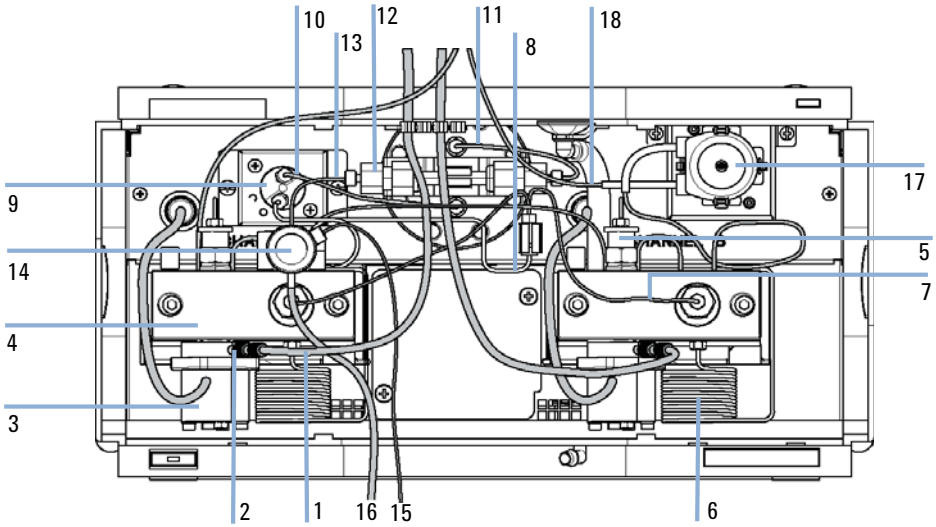


Figure 38 Hydraulic Path with Solvent Selection Valve, with Active Seal Wash

Pump Head Assembly Without Seal Wash

Item	p/n	Description
1	5067-4695	Sapphire piston (default)
2	G1312-60062	Piston housing (incl. spring)
3	G4220-63015	Support Ring without Seal Wash
4	G4220-24013	Backup Ring for Support Ring
5	G1312-87300	Absorber capillary
6	0905-1503	Piston seal PTFE, carbon filled, black (pack of 2), default
7	G1312-25260	Pump housing
8	0515-0175	Mounting screw for manual purge valve holder, M4, 20 mm long
9	G1312-23200	Holder for manual purge valve
10	G1312-60061	Purge valve assembly
11	G1312-60067	Outlet valve, complete
12	5042-1303	Screw lock
13	G1312-60066	Passive inlet valve
14	G1312-23201	Adapter
15	0515-2118	Screw M5, 60 mm long

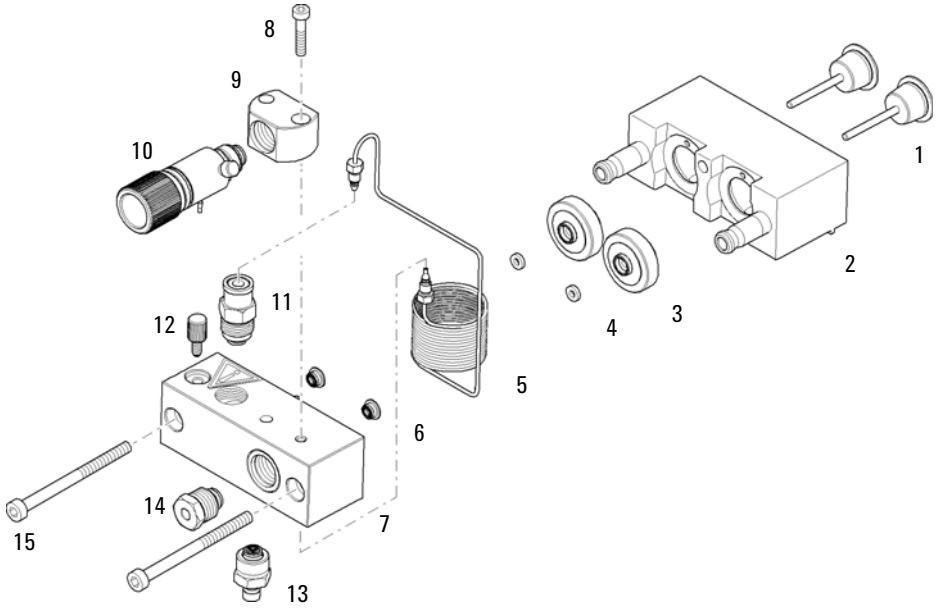


Figure 39 Pump Head Assembly Without Seal Wash

Pump Head Assembly with Seal Wash Option

Item	p/n	Description
1	5065-9953	Seal wash pump assembly
	5042-8507	Seal wash pump cartridge
2	5067-4695	Sapphire piston (default)
3	G1312-60062	Piston housing (incl. spring)
4	G4220-63010	Support Ring (Seal Wash)
5	0905-1175	Wash seal
6	01018-07102	Gasket (Seal wash)
7	G4220-26210	Seal Holder
8	G4220-24013	Backup Ring for Seal Holder
9	G1312-87300	Absorber capillary
10	0905-1503	Piston seal PTFE, carbon filled, black (pack of 2), default
11	0515-0175	Mounting screw for manual purge valve holder, M4, 20 mm long
12	G1312-23200	Holder for manual purge valve
13	G1312-60061	Purge valve assembly
14	G1312-60067	Outlet valve, complete
15	5042-1303	Screw lock
16	G1312-25260	Pump housing
17	G1312-60066	Passive inlet valve
18	G1312-23201	Adapter
19	0515-2118	Screw M5, 60 mm long

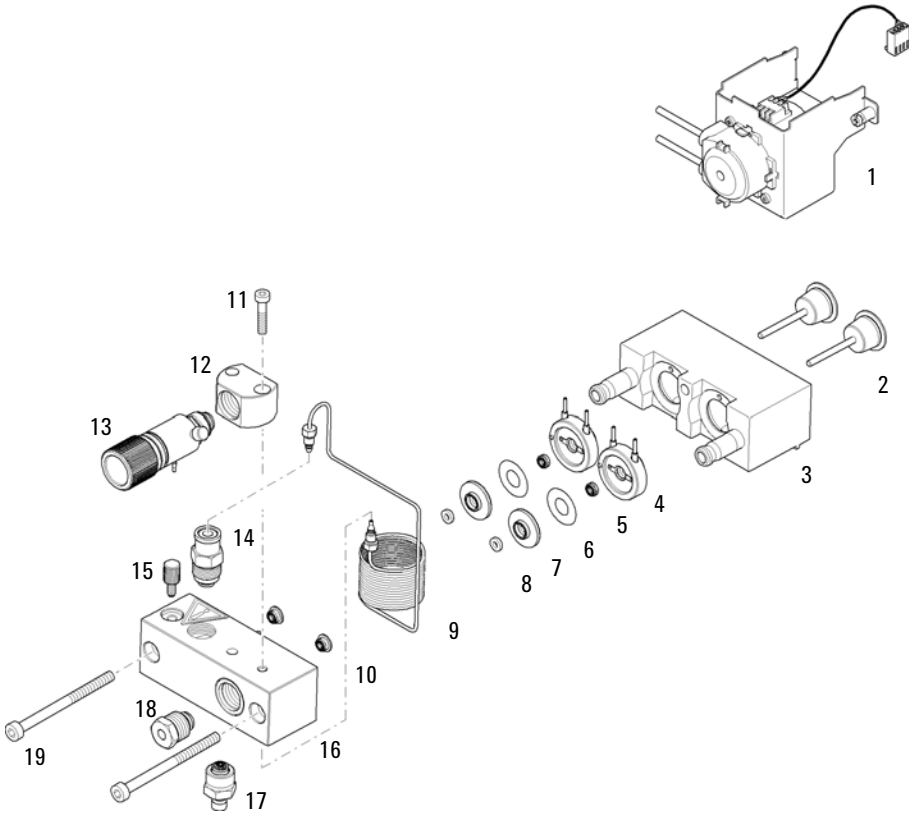


Figure 40 Pump Head Assembly With Seal Wash Option

Outlet Valve

p/n	Description
G1312-60067	Outlet valve, complete

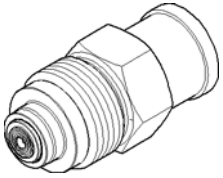
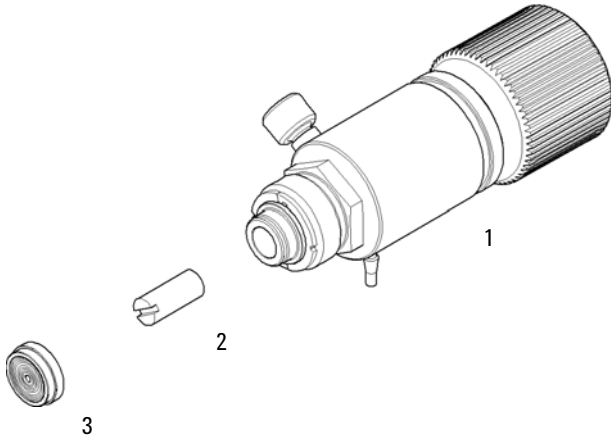


Figure 41 Outlet Valve

Purge Valve Assembly

Item	p/n	Description
1	G1312-60061	Purge valve assembly
2	01018-22707	PTFE frit (pack of 5)
3	5067-4728	Seal cap



Active Inlet Valve Assembly

Item	p/n	Description
1	G1312-60025	Active inlet valve body
2	G1312-60020	Cartridge for active inlet valve 600bar

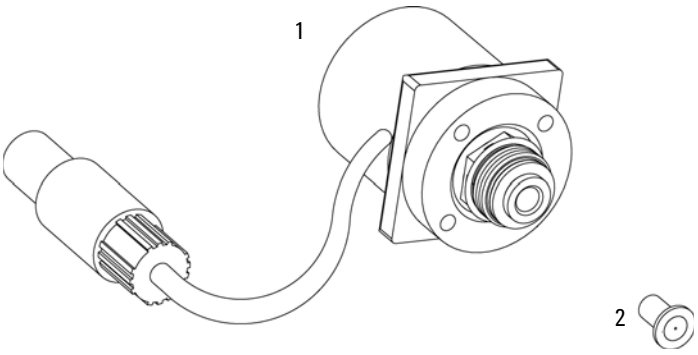


Figure 42 Active Inlet Valve Assembly

Accessory Kit

Accessory Kit (p/n G1312-68755)

p/n	Description
0890-1195	Drain tube
5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
5181-1519	CAN cable, Agilent module to module, 1 m
5988-8453EN	Capillary/fitting starter kit brochure
9222-0519	Bag, plastic
G1312-87303	SS Capillary 400 x 0.17 mm, m/m, ps/ps
G1312-87304	SST capillary 700 mm, 0.17 mm i.d., 1/32 - 1/32
01200-60001	RRLC system configurator A.01.01 CD-ROM
G1311-90107	Algae note
5042-9954 (4x)	Tubing clip (2x), re-order 4/pk
G1311-60003 (2x)	Bottle-head assembly

Accessory Kit

Accessory Kit (p/n G1312-68765)

p/n	Description
0890-1195	Drain tube
5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
5181-1519	CAN cable, Agilent module to module, 1 m
5988-8453EN	Capillary/fitting starter kit brochure
9222-0519	Bag, plastic
G1312-87303	SS Capillary 400 x 0.17 mm, m/m, ps/ps
G1312-87304	SST capillary 700 mm, 0.17 mm i.d., 1/32 - 1/32
01200-60001	RRLC system configurator A.01.01 CD-ROM
G1311-90107	Algae note
5042-9954 (4x)	Tubing clip (2x), re-order 4/pk
G1311-60003 (4x)	Bottle-head assembly

Active Seal Wash Option

Active Seal Wash Option kit (p/n G1312-68721)

p/n	Description
5065-9953	Seal wash pump assembly
5042-8507	Seal wash pump cartridge (silicone tubing)
0905-1175	Secondary seal (pre-installed in support rings)
5062-2484	Gasket, seal wash (pack of 6)
0890-1764	Silicone rubber tubing 1 mm i.d. (3 m)
5063-6589 (2x)	Standard seals (pack of 2)
01018-2370	Seals insert tool

G1316B SL Capillary System Kit

p/n	Description
G1316-83200	Carrier for Heater and Cooler
G1316-80002	Heater long-up (0.12 mm i.d., 1.6 µL internal volume)
G1316-80003	Heater long-down (0.12 mm i.d., 1.6 µL internal volume)
G1316-80004	Post-column cooler, (0.12 mm i.d., 1.5 µL internal volume)
G1316-68716	Capillary System Kit

For items * see also “Heater and Cooler Devices for G1316B” in the G1316B User Manual.

p/n	Description
G1367-87303	Seat capillary (150 mm, 0.12 mm i.d.)
G1315-87339	DAD Heat Exchanger Capillary 310 mm, 0.12 mm i.d.
G1316-87319	SST Capillary 340 mm, 0.12 mm i.d., m/m
G1316-87318	SST Capillary 300 mm, 0.12 mm i.d., m/m
G1316-87317	SST Capillary 210 mm, 0.12 mm i.d., m/m
G1316-87316	SST Capillary 170 mm, 0.12 mm i.d., m/m
G1316-87315	SST Capillary 130 mm, 0.12 mm i.d., m/f
G1316-87314	SST Capillary 90 mm, 0.12 mm i.d., m/f
G1316-87313	SST capillary 70 mm, 0.12 mm i.d., male/female
G1316-87312	SST capillary 50 mm, 0.12 mm i.d., male/female
G1316-87327	SST Capillary 170 mm, 0.12 mm i.d., m/f
G1316-87309	SST Capillary 500 mm, 0.12 mm i.d., m/m
G1315-87307	SST Capillary 500 mm, 0.12 mm i.d., m/m

Solvent Cabinet

Item	p/n	Description
1	5065-9981	Solvent cabinet, including all plastic parts
2	5042-8901	Name plate
3	5065-9954	Front panel, solvent cabinet
4	5042-8907	Leak pan, solvent cabinet
5	9301-1450	Solvent bottle, amber
6	9301-1420	Solvent bottle, transparent
7	G1311-60003	Bottle-head assembly

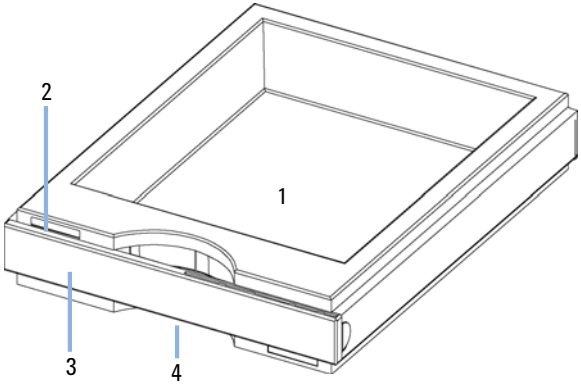


Figure 43 Solvent Cabinet Parts (1)

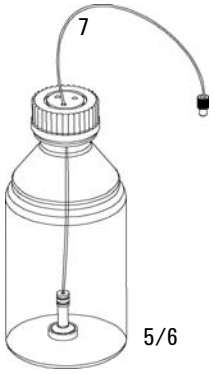


Figure 44 Solvent Cabinet Parts (2)

Preventive Maintenance Kit G1312-68750

Description	ea.
Pump seal	4
Wash seal	4
Gold seal, outlet	3
Cap	3
Gasket, wash seal	6
PTFE frits	5

12
Identifying Cables

Cable Overview 208
Analog Cables 210
Remote Cables 212
BCD Cables 215
CAN/LAN Cables 217
External Contact Cable 218
RS-232 Cables 219
Agilent 1200 Module to Printer 220

This chapter provides information on cables.

Cable Overview

NOTE Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

Analog cables

p/n	Description
35900-60750	Agilent module to 3394/6 integrators
35900-60750	Agilent 35900A A/D converter
01046-60105	Analog cable (BNC to general purpose, spade lugs)

Remote cables

p/n	Description
03394-60600	Agilent module to 3396A Series I integrators
	3396 Series II / 3395A integrator, see details in section "Remote Cables" on page 212
03396-61010	Agilent module to 3396 Series III / 3395B integrators
5061-3378	Agilent module to Agilent 35900 A/D converters (or HP 1050/1046A/1049A)
01046-60201	Agilent module to general purpose

BCD cables

p/n	Description
03396-60560	Agilent module to 3396 integrators
G1351-81600	Agilent module to general purpose

CAN cables

p/n	Description
5181-1516	CAN cable, Agilent module to module, 0.5 m
5181-1519	CAN cable, Agilent module to module, 1 m

LAN cables

p/n	Description
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5023-0202	Twisted pair network cable, shielded, 7 m (for point to point connection)

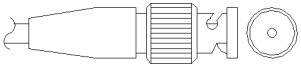
External Contact Cable

p/n	Description
G1103-61611	External contact cable - Agilent module interface board to general purposes

RS-232 cables

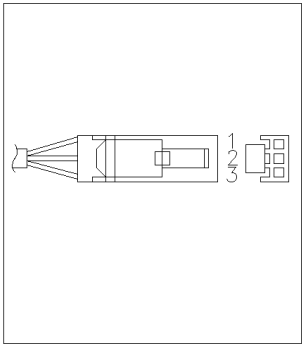
p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61600	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9.
5181-1561	RS-232 cable, 8 m

Analog Cables

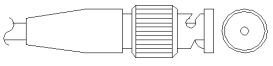


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

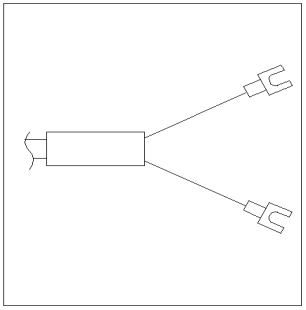
Agilent Module to 3394/6 Integrators

p/n 35900-60750	Pin 3394/6	Pin Agilent module	Signal Name
	1		Not connected
	2	Shield	Analog -
	3	Center	Analog +

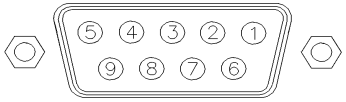
Agilent Module to BNC Connector

p/n 8120-1840	Pin BNC	Pin Agilent module	Signal Name
	Shield	Shield	Analog -
	Center	Center	Analog +

Agilent Module to General Purpose

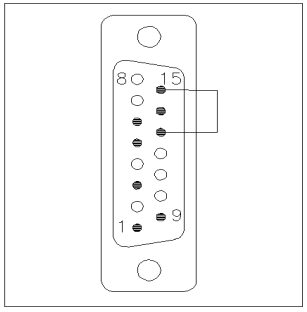
p/n 01046-60105	Pin 3394/6	Pin Agilent module	Signal Name
	1		Not connected
	2	Black	Analog -
	3	Red	Analog +

Remote Cables



One end of these cables provides a Agilent Technologies APG (Analytical Products Group) remote connector to be connected to Agilent modules. The other end depends on the instrument to be connected to.

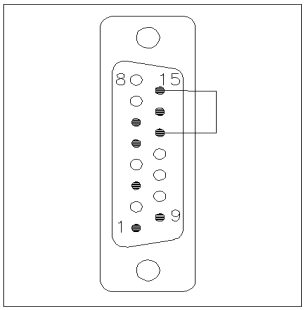
Agilent Module to 3396A Integrators

p/n 03394-60600	Pin 3394	Pin Agilent module	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	5,14	7 - Red	Ready	High
	1	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low
	13, 15		Not connected	

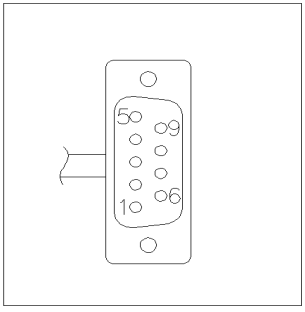
Agilent Module to 3396 Series II / 3395A Integrators

Use the cable Agilent module to 3396A Series I integrators (p/n 03394-60600) and cut pin #5 on the integrator side. Otherwise the integrator prints START; not ready.

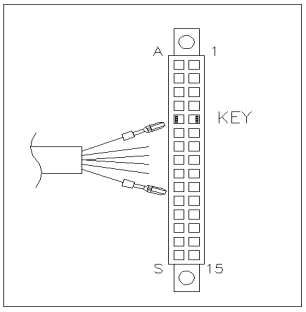
Agilent Module to 3396 Series III / 3395B Integrators

p/n 03396-61010	Pin 33XX	Pin Agilent module	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	14	7 - Red	Ready	High
	4	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low
	13, 15		Not connected	

Agilent Module to Agilent 35900 A/D Converters

p/n 5061-3378	Pin 35900 A/D	Pin Agilent module	Signal Name	Active (TTL)
	1 - White	1 - White	Digital ground	
	2 - Brown	2 - Brown	Prepare run	Low
	3 - Gray	3 - Gray	Start	Low
	4 - Blue	4 - Blue	Shut down	Low
	5 - Pink	5 - Pink	Not connected	
	6 - Yellow	6 - Yellow	Power on	High
	7 - Red	7 - Red	Ready	High
	8 - Green	8 - Green	Stop	Low
	9 - Black	9 - Black	Start request	Low

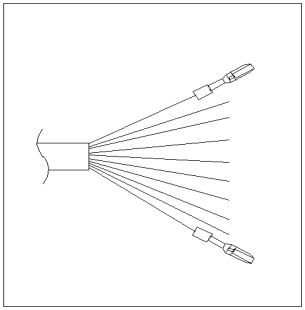
Agilent Module to General Purpose

p/n 01046-60201	Pin Universal	Pin Agilent module	Signal Name	Active (TTL)
		1 - White	Digital ground	
		2 - Brown	Prepare run	Low
		3 - Gray	Start	Low
		4 - Blue	Shut down	Low
		5 - Pink	Not connected	
		6 - Yellow	Power on	High
		7 - Red	Ready	High
		8 - Green	Stop	Low
		9 - Black	Start request	Low

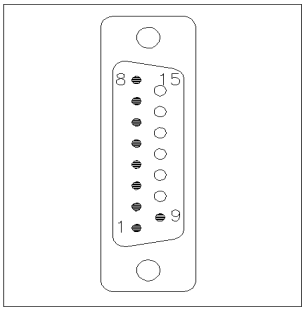
BCD Cables

One end of these cables provides a 15-pin BCD connector to be connected to the Agilent modules. The other end depends on the instrument to be connected to

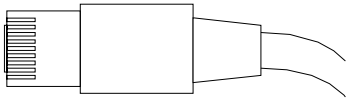
Agilent Module to General Purpose

p/n G1351-81600	Wire Color	Pin Agilent module	Signal Name	BCD Digit
	Green	1	BCD 5	20
	Violet	2	BCD 7	80
	Blue	3	BCD 6	40
	Yellow	4	BCD 4	10
	Black	5	BCD 0	1
	Orange	6	BCD 3	8
	Red	7	BCD 2	4
	Brown	8	BCD 1	2
	Gray	9	Digital ground	Gray
	Gray/pink	10	BCD 11	800
	Red/blue	11	BCD 10	400
	White/green	12	BCD 9	200
	Brown/green	13	BCD 8	100
	not connected	14		
	not connected	15	+ 5 V	Low

Agilent Module to 3396 Integrators

p/n 03396-60560	Pin 3396	Pin Agilent module	Signal Name	BCD Digit
	1	1	BCD 5	20
	2	2	BCD 7	80
	3	3	BCD 6	40
	4	4	BCD 4	10
	5	5	BCD0	1
	6	6	BCD 3	8
	7	7	BCD 2	4
	8	8	BCD 1	2
	9	9	Digital ground	
	NC	15	+ 5 V	Low

CAN/LAN Cables



Both ends of this cable provide a modular plug to be connected to Agilent modules CAN or LAN connectors.

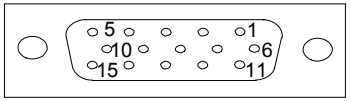
CAN Cables

p/n	Description
5181-1516	CAN cable, Agilent module to module, 0.5 m
5181-1519	CAN cable, Agilent module to module, 1 m

LAN Cables

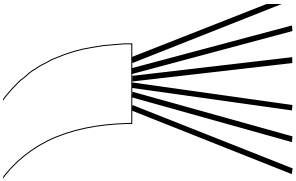
p/n	Description
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5023-0202	Twisted pair network cable, shielded, 7 m (for point to point connection)

External Contact Cable



One end of this cable provides a 15-pin plug to be connected to Agilent modules interface board. The other end is for general purpose.

Agilent Module Interface Board to general purposes

p/n G1103-61611	Color	Pin Agilent module	Signal Name
	White	1	EXT 1
	Brown	2	EXT 1
	Green	3	EXT 2
	Yellow	4	EXT 2
	Grey	5	EXT 3
	Pink	6	EXT 3
	Blue	7	EXT 4
	Red	8	EXT 4
	Black	9	Not connected
	Violet	10	Not connected
	Grey/pink	11	Not connected
	Red/blue	12	Not connected
	White/green	13	Not connected
	Brown/green	14	Not connected
	White/yellow	15	Not connected

RS-232 Cables

p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61600	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9.
5181-1561	RS-232 cable, 8 m

Agilent 1200 Module to Printer

p/n	Description
5181-1529	Cable Printer Serial & Parallel, is a SUB-D 9 pin female vs. Centronics connector on the other end (NOT FOR FW UPDATE). For use with G1323 Control Module.

13
Appendix

General Safety Information 222
The Waste Electrical and Electronic Equipment Directive 225
Lithium Batteries Information 226
Radio Interference 227
Sound Emission 228
Solvent Information 229
Agilent Technologies on Internet 230

This appendix provides general safety and environmental information.

General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING

Ensure the proper usage of the equipment.

The protection provided by the equipment may be impaired.

➔ The operator of this instrument is advised to use the equipment in a manner as specified in this manual.

Safety Standards

This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

Operation

Before applying power, comply with the installation section. Additionally the following must be observed.

Do not remove instrument covers when operating. Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices connected to it must be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any intended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, and so on) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Some adjustments described in the manual, are made with power supplied to the instrument, and protective covers removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided whenever possible. When inevitable, this has to be carried out by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or make any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged, even though the instrument has been disconnected from its source of supply. Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing and adjusting.

When working with solvents please observe appropriate safety procedures (e.g. goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet by the solvent vendor, especially when toxic or hazardous solvents are used.

Safety Symbols

Table 26 Safety Symbols

Symbol	Description
	The apparatus is marked with this symbol when the user should refer to the instruction manual in order to protect risk of harm to the operator and to protect the apparatus against damage.
	Indicates dangerous voltages.
	Indicates a protected ground terminal.
	Indicates eye damage may result from directly viewing the light produced by the deuterium lamp used in this product.
	The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up.

WARNING

A WARNING

alerts you to situations that could cause physical injury or death.

➔ Do not proceed beyond a warning until you have fully understood and met the indicated conditions.

CAUTION

A CAUTION

alerts you to situations that could cause loss of data, or damage of equipment.

➔ Do not proceed beyond a caution until you have fully understood and met the indicated conditions.

The Waste Electrical and Electronic Equipment Directive

Abstract

The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), adopted by EU Commission on 13 February 2003, is introducing producer responsibility on all electric and electronic appliances starting with 13 August 2005.

NOTE

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category:

With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a Monitoring and Control Instrumentation product.

NOTE

Do not dispose off in domestic household waste

To return unwanted products, contact your local Agilent office, or see www.agilent.com for more information.

Lithium Batteries Information

WARNING

Lithium batteries may not be disposed-off into the domestic waste. Transportation of discharged Lithium batteries through carriers regulated by IATA/ICAO, ADR, RID, IMDG is not allowed.

Danger of explosion if battery is incorrectly replaced.

➔ Discharged Lithium batteries shall be disposed off locally according to national waste disposal regulations for batteries.

➔ Replace only with the same or equivalent type recommended by the equipment manufacturer.

WARNING

Lithiumbatteri - Eksplosionsfare ved fejlagtig håndtering.

Udskiftning må kun ske med batteri af samme fabrikat og type.

➔ Lever det brugte batteri tilbage til leverandøren.

WARNING

Lithiumbatteri - Eksplosionsfare.

Ved udskiftning benyttes kun batteri som anbefalt av apparatfabrikanten.

➔ Brukt batteri returneres appararleverandoren.

NOTE

Bij dit apparaat zijn batterijen geleverd. Wanneer deze leeg zijn, moet u ze niet weggooien maar inleveren als KCA.

Radio Interference

Cables supplied by Agilent Technologies are screened to provide optimized protection against radio interference. All cables are in compliance with safety or EMC regulations.

Test and Measurement

If test and measurement equipment is operated with unscreened cables, or used for measurements on open set-ups, the user has to assure that under operating conditions the radio interference limits are still met within the premises.

Sound Emission

Manufacturer's Declaration

This statement is provided to comply with the requirements of the German Sound Emission Directive of 18 January 1991.

This product has a sound pressure emission (at the operator position) < 70 dB.

- Sound Pressure Lp < 70 dB (A)
- At Operator Position
- Normal Operation
- According to ISO 7779:1988/EN 27779/1991 (Type Test)

Solvent Information

Observe the following recommendations on the use of solvents.

- Brown glass ware can avoid growth of algae.
- Small particles can permanently block capillaries and valves. Therefore always filter solvents through 0.2 µm filters.
- Avoid the use of the following steel-corrosive solvents:
  - Solutions of alkali halides and their respective acids (for example, lithium iodide, potassium chloride, and so on),
  - High concentrations of inorganic acids like sulfuric acid and nitric acid, especially at higher temperatures (if your chromatography method allows, replace by phosphoric acid or phosphate buffer which are less corrosive against stainless steel),
  - Halogenated solvents or mixtures which form radicals and/or acids, for example:

    $2CHCl_3 + O_2 \rightarrow 2COCl_2 + 2HCl$

    This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol,
  - Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, di-isopropylether) such ethers should be filtered through dry aluminium oxide which adsorbs the peroxides,
  - Solvents containing strong complexing agents (e.g. EDTA),
  - Mixtures of carbon tetrachloride with 2-propanol or THF.

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Index

8

8-bit configuration switch
  on-board LAN 30
  without On-Board LAN 32

A

absorber capillary 15
active inlet valve 198
Active seal wash, seal wash, active 8
active seal wash 89
adapter 62
Agilent Diagnostic software 127
Agilent Lab Advisor software 127
Agilent Lab Advisor 127, 131
Agilent
  on internet 230
algae growth 86
algae 70, 229
alternative seal material 90
ambient operating temperature 41
ambient non-operating temperature 41
analog signal output 43
analog signal 27
analog
  cable 210
apg remote 28
assembly
  bottle head 186
AUTO mode 19
AUTO, pump stroke 13

B

ball-screw drive 14
battery
  safety information 226
BCD
  board 182
  cable 215
bench space 40
blank nut, 1/16 inch 131
blockage 114
bottle head assembly 186, 186
buffer application 70
buffer solutions 8

C

cable
  analog 210
  BCD 215
  CAN 217
  external contact 218
  interface 57
  LAN 217
  remote 212
  RS-232 219
cables
  analog 208
  BCD 208
  CAN 209
  external contact 209
  LAN 209
  overview 208
  remote 208
  RS-232 209
CAN
  cable 217
capillary
  absorber 15
cleaning 150
Communication settings
  RS-232C 33
compensation sensor open 105
compensation sensor short 106
compensation, compressibility 42
composition accuracy 43
composition precision 43
composition range 43
composition ripple 136
compressibility calibration 122, 136
compressibility compensation 42, 95
condensation 40
configuration
  low flow rates 70
connections
  flow 58, 61
control and data evaluation 43

D

damaged parts 47
damper
  when to remove 92
data evaluation and control 43
defect on arrival 46
degreaser spray 163
delay volume 16
delay volume 11, 42, 92
delivery checklist 47
design 9
diagnostic signals 123
Diagnostic software 127
dimensions 41
dual-piston in-series design 9

E

early maintenance feedback 82
elasticity calibration 123
electrical connections
  descriptions of 22
electronic waste 225
electrostatic discharge (ESD) 182
EMF counter 144
EMF flag 144
EMF counters
  (maximum) limit 82
  liquimeter 82
  seal wear 83
  setting limits 83
  usage 83
EMF flag 82
EMF limits 83
EMF
  early maintenance feedback 20
encoder missing 115
error messages
  fan failed 106
  overpressure 131, 135, 137, 139
error messages
  compensation sensor open 105
  compensation sensor short 106
  encoder missing 115
  ignition without cover 107, 107
  index adjustment 118
  index limit 117
  index missing 118
  initialization failed 119
  inlet-valve fuse 112
  inlet-valve missing 115
  leak sensor open 104
  leak sensor short 105
  leak 104
  missing pressure reading 111
  motor drive power 114
  pressure above upper limit 109
  pressure below lower limit 109
  pump head missing 117
  remote timeout 103
  selection valve failed 110
  selection-valve fuse 112
  servo restart failed 116
  shut-down 102
  stroke length 119
  synchronization lost 103
  temperature limit exceeded 113
  temperature out of range 113
  timeout 102
error
  zero solvent counter 108
exchanging
  inlet valve 153, 167
  interface board 182
  outlet valve sieve 169
  outlet valve sieve 153
  outlet valve 153, 169
  pistons 152, 162
  pump seals 159
  pump seals 152
  purge valve frit 153, 153
  purge valve 153, 153
  solvent selection valve 174
  wash seals 163, 177
  wash seals 152
external contact
  cable 218

F

fan failed 106
features
  instrument layout 8
filter
  solvent inlet 70
firmware
  updates 183, 183
  upgade/downgrade 183
  upgrade/downgrade 183
flow accuracy 42
flow connections 58, 61
flow precision 42
flow range 8
  operational 42
  setable 42
flow rate
  minimum 70
frequency range 41

G

gas solubility 70
gradient formation 42

H

hexagonal key, 3 mm 156, 162, 165
hexagonal key, 3 mm 163
hexagonal key, 4 mm 156, 162, 165
hexagonal key, 4 mm 163
high-pressure mixing 8
hints for successful use 70
humidity 41
hydraulic path with solvent selection valve 188
hydraulic path without solvent selection valve 190
hydraulic system 42

I

index limit 117
index adjustment 118
index missing 118
initialization failed 119
initialization 15
injection precision 88
inlet valve body 153
inlet valve 167

inlet-valve fuse 112
inlet-valve missing 115
insert tool 163
installation
  bench space 40
instrument layout 21
interface board 182
interface cable 57
interfaces 24
internet 230
introduction to the pump 8

L

LAN
  cable 217
leak sensor open 104
leak sensor short 105
leak 104
line frequency 41
line voltage 41
liquimeter 82, 144, 160
lithium batteries 226

M

main assemblies, overview 151
maintenance procedures 144
maintenance procedures 82
maintenance
  feedback 20
  replacing firmware 183, 183
message
  ignition without cover 107, 107
  remote timeout 103
minimum flow rate 70
missing pressure reading 111
missing parts 47
mixer 9
  when to remove 92
motor-drive power 114

N

non-operating altitude 41
non-operating temperature 41

O

operating Altitude 41
operating temperature 41
outlet valve 153, 169, 196
overpressure error 131, 135, 137, 139

P

packaging
  damaged 46
parts identification
  cables 207
parts
  active inlet valve 198
  bottle head assembly 186
  damaged 47
  hydraulic path with solvent selection valve 188
  hydraulic path without solvent selection valve 190
  missing 47
  outlet valve 196
performance
  specifications 42
pH range 42
physical specifications 41
piston 14, 152, 162
plunger 14
power supply indicator 124
power consideration 38
power consumption 41
power cords 39
power switch 56
pressure above upper limit 109
pressure below lower limit 109
pressure pulsation 13
pressure range 90
pressure pulsation 18, 96
pressure ripple 136
pressure test
  results 135
pressure
  operating range 42
  pulsation 42
priming
  with a pump 66
PTFE frit 153, 153
pulsation
  pressure 13, 18
pump elasticity calibration 139
pump head missing 117
pump seals
  for normal phase solvents 90
pump stroke
  AUTO mode 13
pump seals
  alternative material 90
purge valve 70, 153, 153

R

radio interference 227
reassembling the pump head 165
recommended pH range 42
remote
  cable 212
remove damper and mixer 92
removing the pump head 156
repair procedures 152
repairs
  definition of 148
  introduction 148
  replacing firmware 183, 183
  warnings and cautions 148

restart without cover 108
results
pressure test 132
pressure test 135
ripple
composition 136
pressure 136
RS-232C
cable 219
communication settings 33

S

safety class I 222
safety information
lithium batteries 226
safety
general information 222
standards 41
symbols 224
sapphire piston 14
screwdriver pozidriv #1 156
screwdriver pozidriv #1 163, 174
screwdriver, flat-head 163
seal wash
wash solvent 89
when to use 89
seal wear counter 145
seal wear counter 160
seal wear 83
seals
alternative material 90
normal phase 90
security lever 56
selection valve failed 110
selection-valve fuse 112
serial number
information 23
servo restart failed 116
setable flow range 42
shut-down 102
sieve 153, 169
simple repair procedures 152
site requirements 37
power cords 39
snap fastener 59, 62
solubility, gas 70
solvent cabinet 59
solvent compressibility calibration 136, 137
solvent filters
cleaning 87
solvent inlet filter 70
solvent selection valve 8, 174
solvent cabinet 70
solvent filters
checking 86
prevent blocking 86
solvent selection valve 58
solvents 229
sonic bath 169
sound emission 228
special interfaces 29
special settings
boot-resident 35
forced cold start 36
specification
physical 41
specifications
analog signal output 43
communications 43
control and data evaluation 43
performance 42
status indicator 125
stroke volume 13
stroke length 119
stroke volume 15, 18
synchronization lost 103

T

temperature limit exceeded 113
temperature out of range 113
temperature sensor 104
test functions 122
tests
pressure test results 132
pump elasticity calibration 139
running the pressure test 131
solvent compressibility calibration 136, 137
timeout 102
tools
blank nut, 1/16 inch 131
screwdriver pozidriv #1 156
screwdriver pozidriv #1 174
wrench 1/4 inch, slitted socket 156
wrench 1/4 - 5/16 inch 131
wrench 14 mm 169
wrench 1/4 - 5/16 inch 135, 137, 139
troubleshooting
error messages 101, 122
status indicators 122, 124

U

unpacking the pump 46

V

vacuum degasser 8, 43, 70, 70
operational hints 88
when to use 88
valve
inlet valve, replacement 153
solvent selection 174
variable reluctance motor 15
variable stroke volume 13
variable stroke volume 18
voltage range 41

W

wash seals 163
wash seals 152
wash solvent 89
waste
    electrical and electronic
    equipment 225
WEEE directive 225
weight 41
wrench 1/4 - 5/16 inch 131, 135, 137, 139
wrench 1/4 inch, slitted socket 156
wrench 1/4 inch 154
wrench 14 mm 154, 167, 169

Z

zero solvent counter 108

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In This Book

This manual contains technical reference information about the Agilent 1260 Infinity Binary Pump G1312B. The manual describes the following:

- introduction,
- site requirements and specifications,
- installing the pump,
- using the binary pump,
- optimizing performance,
- troubleshooting and diagnostics,
- maintenance,
- parts and materials for maintenance,
- identifying cables,
- appendix.

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