Agilent 1260 Infinity Binary Pump VL

User Manual

Agilent Technologies

Notices

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CAUTION

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

In This Guide...

This manual covers the Agilent 1260 Infinity Quaternary Pump VL (G1311C).

1 Introduction

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

2 Site Requirements and Specifications

This chapter provides information on environmental requirements, physical and performance specifications.

3 Installing the Pump

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

4 Using the Binary Pump

This chapter provides information for optimized usage of the binary pump.

5 Optimizing Performance

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Overview about the troubleshooting and diagnostic features.

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Contents

1 Introduction

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

Introduction to the Binary Pump

The binary pump comprises two identical pumps integrated into one housing. It provides gradient generation by high-pressure mixing. Degassing is not included but a vacuum degasser is available as a separate product for applications that require best flow stability especially at low flow rates or maximum detector sensitivity. This is most likely required to run small internal diameter columns (2 mm and 1 mm i.d.) which require low flow rates. A solvent selection valve (optional) will allow to select a binary mixture (isocratic and gradient) from four independent solvent bottles. An active seal wash (optional) is available when the pump is used with concentrated buffer solutions.

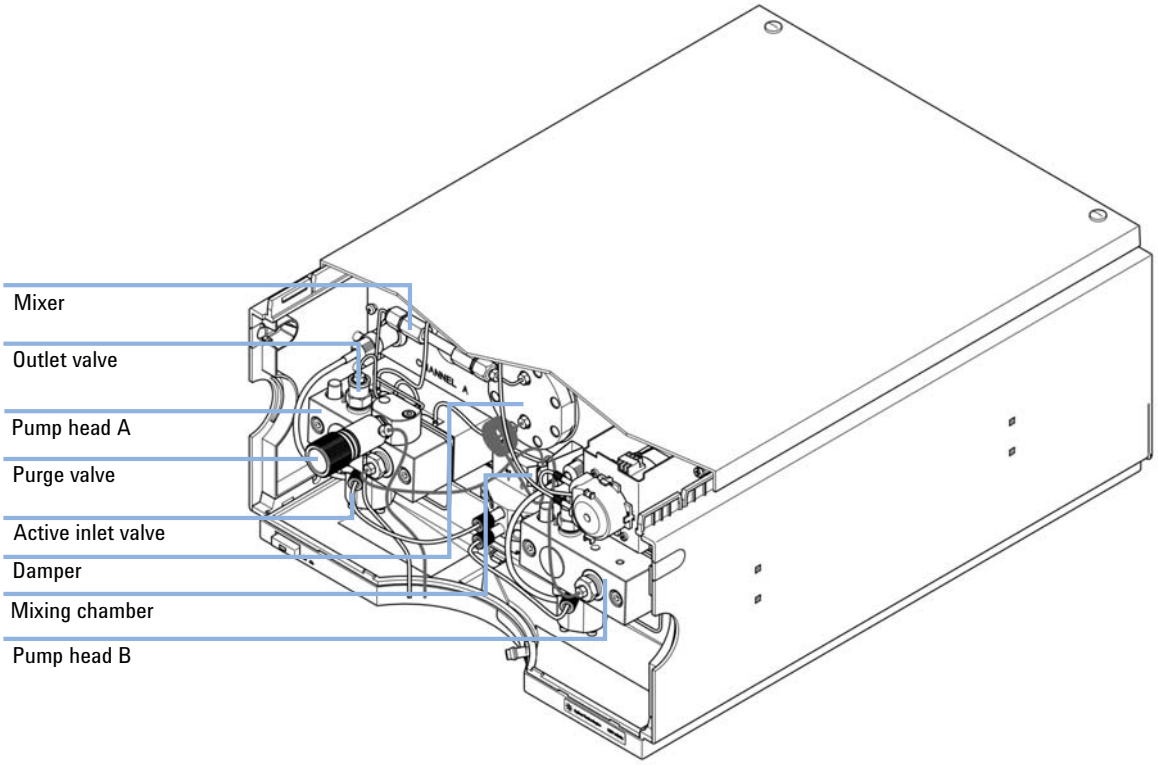


Figure 1 Overview of the binary pump

Overview of the Binary Pump

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 400 bar.

Each channel comprises a pump assembly including pump drive, pump head, active inlet valve which has a replaceable cartridge, and outlet valve. Both channels are connected in a low-volume mixing chamber which is connected by a capillary coil to a damping unit and a mixer. A purge valve including a PTFE frit is fitted at the pump outlet for convenient priming of the pumping system.

A seal wash (optional) is available when the pump is used with buffer solutions.

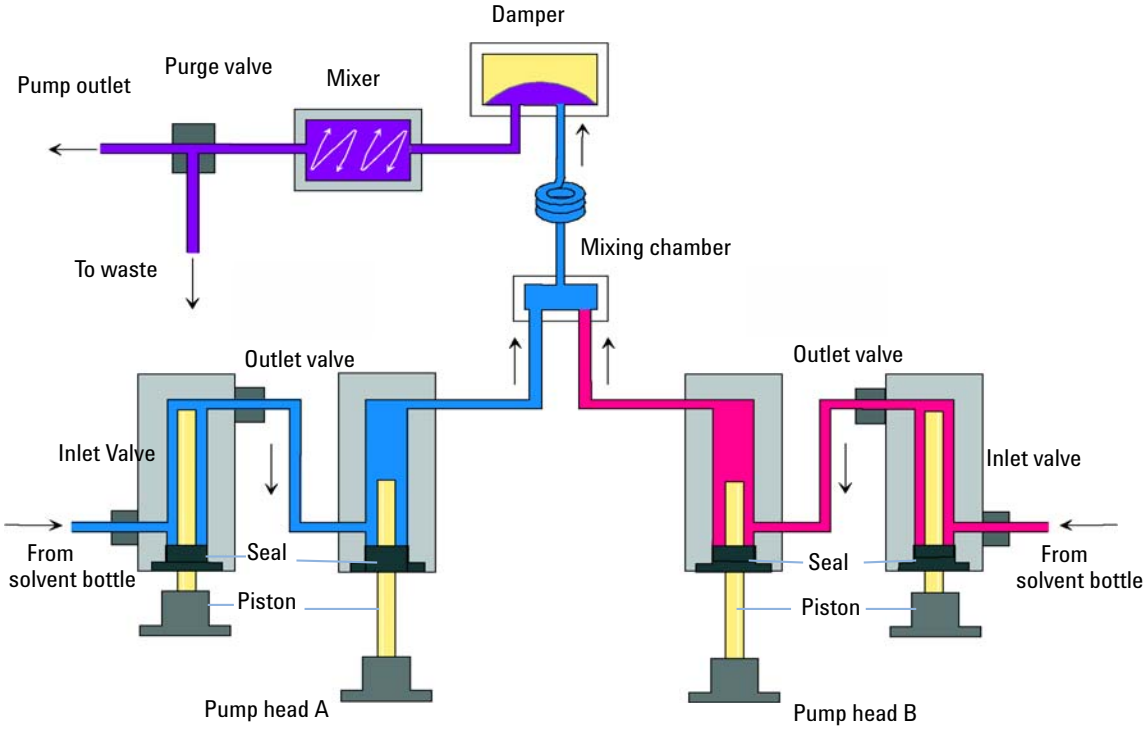


Figure 2 The Hydraulic Path

How Does the Binary Pump Work?

The liquid runs from the solvent reservoir through an active inlet valve. Each side of the binary pump comprises two substantially identical pump units. Both pump units comprise a ball-screw drive and a pump head with two sapphire pistons for reciprocating movement.

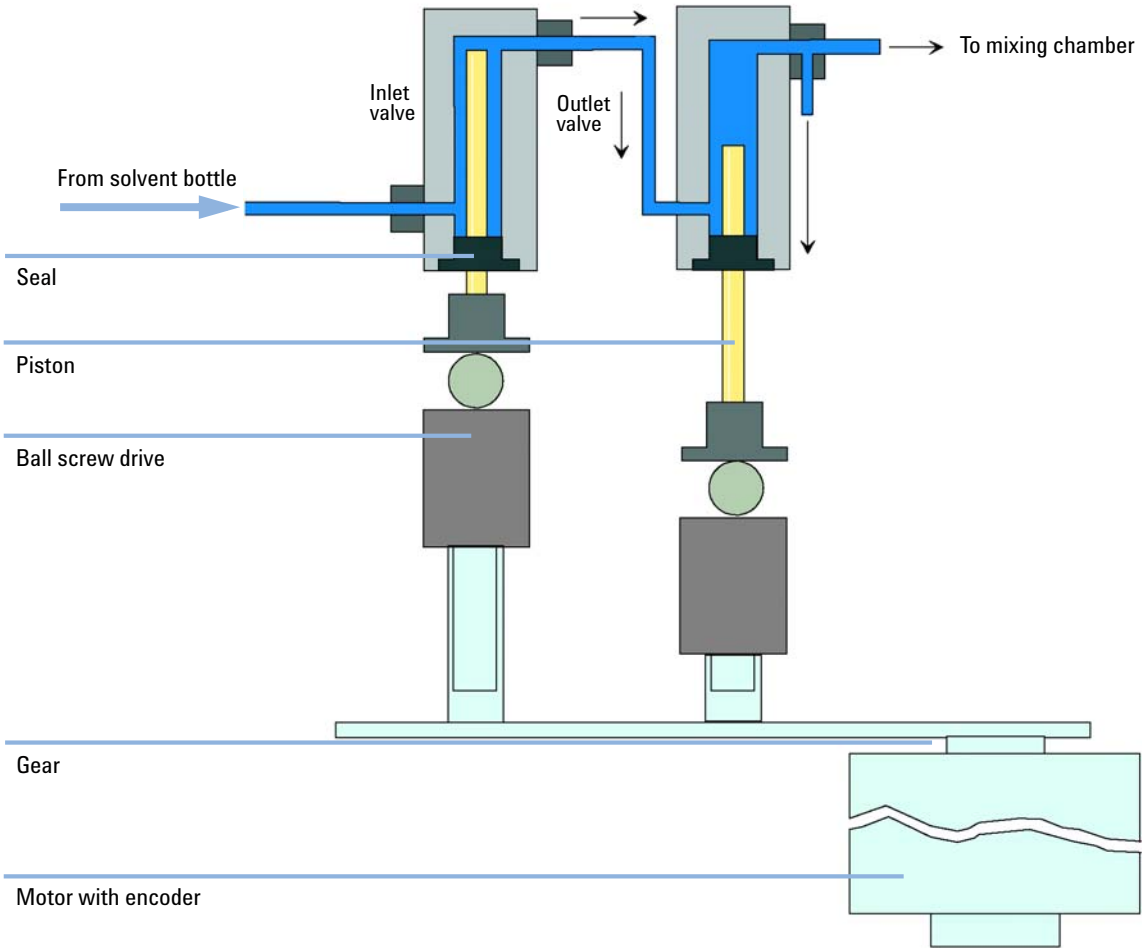


Figure 3 Principle of Pump Unit

A servo-controlled variable 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 pump unit is connected directly to the second pump unit. The outlet of the second pump unit is connected via a small mixing chamber, a coil and the damping unit to the purge valve assembly. The outlet of the purge valve assembly is then connected to the following 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 upward movement 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.

Table 1 Pump Details

Delay volume	From mixing point to pump outlet, dependent on back pressure (180 – 480 µL without mixer, 600 – 900 µL with mixer)
Materials in contact with mobile phase	
Pump head	SST, gold, sapphire, ceramic
Active inlet valve	SST, sapphire, ruby, ceramic, PTFE
Outlet ball 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 24.

How Does Compressibility Compensation Work?

The compressibility of the solvents in use will affect retention-time stability when the back pressure in the system changes (for example, ageing of column). In order to minimize this effect, the pump provides a compressibility compensation feature which optimizes the flow stability according to the solvent type. The compressibility compensation is set to a default value and can be changed through the user interface.

Without a compressibility compensation the following will happen during a stroke of the first piston. The pressure in the piston chamber increases and the volume in the chamber will be compressed depending on backpressure and solvent type. The volume displaced into the system will be reduced by the compressed volume.

With a compressibility value set the processor calculates a compensation volume, that is depending on the backpressure in the system and the selected compressibility. This compensation volume will be added to the normal stroke volume and compensates the previous described *loss* of volume during the delivery stroke of the first piston.

How Does Variable Stroke Volume Work?

Due to the compression of the pump-chamber volume each piston stroke of the pump will generate a small pressure pulsation, influencing the flow stability of the pump. The amplitude of the pressure pulsation depends mainly on the stroke volume and the compressibility compensation for the solvent in use. Small stroke volumes generate pressure pulsations of smaller amplitude than higher stroke volumes at the same flow rate. In addition, the frequency of the pressure pulsations is higher. This decreases the influence of flow pulsations on quantitative results.

In gradient mode smaller stroke volumes result in a lower flow ripple improve composition ripple.

The module uses a processor-controlled spindle system for driving 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.

By default, the stroke volume for the pump is 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.

2
Site Requirements and Specifications

This chapter provides information on environmental requirements, physical and performance specifications.

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 2 on page 23. 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

The 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

Inaccessible 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 2 on page 23) 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 shall carry a complete HPLC 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 2 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	4–55 °C (41–131 °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 3 Performance Specification Agilent 1260 Infinity Binary Pump VL (G1312C)

Type	Specification	Comments
Hydraulic system	Two dual piston in series pumps with servo-controlled variable stroke drive, floating pistons	
Setable flow range	Set points 0.001 – 5 mL/min, in 0.001 mL/min increments	
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 whatever is greater, pumping degassed H_2O at 10 MPa (100 bar)	
Pressure operating range	Operating range up to 40 MPa (400 bar, 5880 psi) up to 5 mL/min	
Pressure pulsation	< 2 % amplitude (typically < 1.3 %), or < 0.3 MPa (3 bar) whatever is greater, at 1 mL/min isopropanol, at all pressures > 1 MPa (10 bar, 147 psi)	
Compressibility compensation	User-selectable, 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	600 – 900 µL (includes 400 µL mixer), dependent on back pressure	

Table 3 Performance Specification Agilent 1260 Infinity Binary Pump VL (G1312C)

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, whatever is greater, at 0.2 and 1 mL/min; based on retention time at constant room temperature	
Composition accuracy	± 0.5 % absolute	(water/caffeine tracer)
Control	Agilent control software (e.g. ChemStation, EZChrom, OL, MassHunter)	
Local control	Agilent Instant Pilot	
Analog output	For pressure monitoring, 2 mV/bar, one output	
Communications	Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, LAN optional	
Safety and maintenance	Extensive diagnostics, error detection and display through Agilent LabAdvisor, leak detection, safe leak handling, leak output signal for shutdown of the pumping system. Low voltage in major maintenance areas.	
GLP features	Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of seal wear and volume of pumped mobile phase with pre-defined and user settable limits and feedback messages. Electronic records of maintenance and errors	
Housing	All materials are recyclable	

NOTE For use with flow rates below 500 µL/min a vacuum degasser is required.

3 Installing the Pump

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

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

Ensure all parts and materials have been delivered with the pump. For checking the completeness of your specific shipment, please use the list included in your shipment. To aid in parts identification, please refer to "Parts for Maintenance" on page 161. Please report missing or damaged parts to your local Agilent Technologies sales and service office.

p/n	Description
G1312C	Agilent 1260 Infinity Binary Pump VL
G4203-68708	HPLC System Tool Kit (OPTIONAL)
G4201-68707	HPLC Starter Kit incl. 0.17 mm i.d. cap (OPTIONAL)
G4202-68707	HPLC Starter Kit incl. 0.12 mm i.d. cap (OPTIONAL)
G1369C	Interface board (LAN) (OPTIONAL)
G4800-64500	Agilent 1200 Infinity Series User Documentation DVD (OPTIONAL) not orderable (OPTIONAL)
G1311-60003 (2x)	Bottle-head assembly
959961-902	Column Eclipse Plus C18, 4.6 x 100 mm, 3.5 µm (OPTIONAL)
699975-902	Column Poroshell 120 EC-C18, 4.6 x 50 mm, 2.7 µm (OPTIONAL)
883975-902	Column SB-C18, 4.6 x 150 mm, 5 µm (OPTIONAL)
G1312-90302	Agilent 1260 Infinity Binary LC Optimization Guide not orderable
5067-4770	Solvent Cabinet Kit (OPTIONAL)
M8500A	Lab Advisor incl. license (OPTIONAL)
	Power cord

NOTE Items identified as "optional" are additional accessories. They are not included in the standard scope of delivery.

NOTE Items identified as "not orderable" can be downloaded from the Agilent website http://www.agilent.com.

NOTE Either one of the three columns listed will be part of the delivery (as ordered).

Accessory Kit

Accessory Kit (p/n G1311-68755)

p/n	Description
5062-2461	Waste tube, 5 m (reorder pack)
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
G1329-87300	StS Capillary 0.17 mm, 900 mm, pump to thermostatted autosampler
G1312-87303	StS Capillary 0.17 mm, 400 mm, pump to injector
5042-9954	Tubing clip (2x), re-order 4/pk

Optimizing the Stack Configuration

If your module is part of a complete Agilent 1260 Infinity Liquid Chromatograph, you can ensure optimum performance by installing the following configurations. These configurations optimize the system flow path, ensuring minimum delay volume.

One Stack Configuration

Ensure optimum performance by installing the modules of the Agilent 1260 Infinity LC System in the following configuration (See Figure 4 on page 32 and Figure 5 on page 33). This configuration optimizes the flow path for minimum delay volume and minimizes the bench space required.

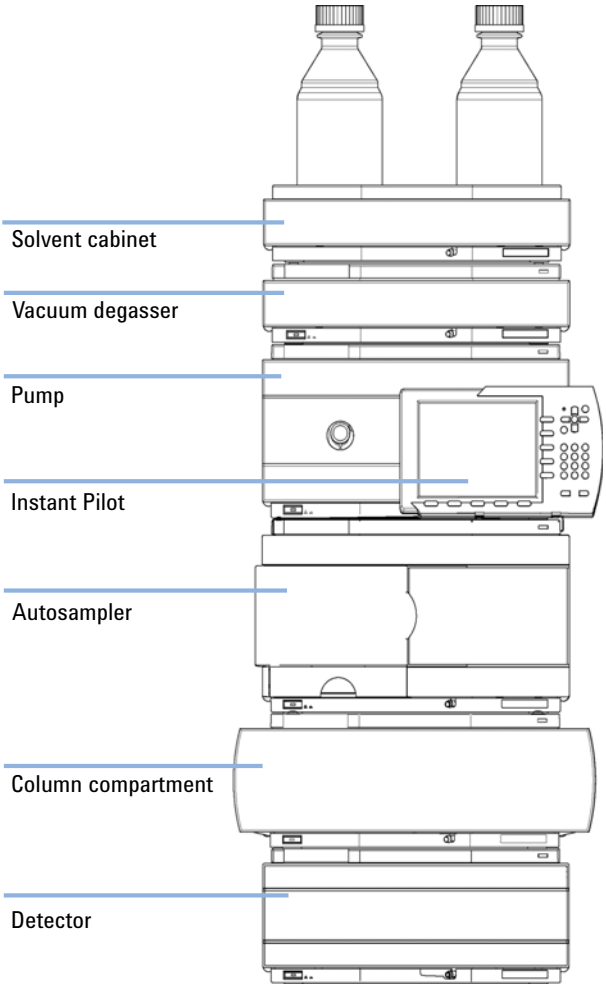


Figure 4 Recommended Stack Configuration for 1260 Infinity (Front View)

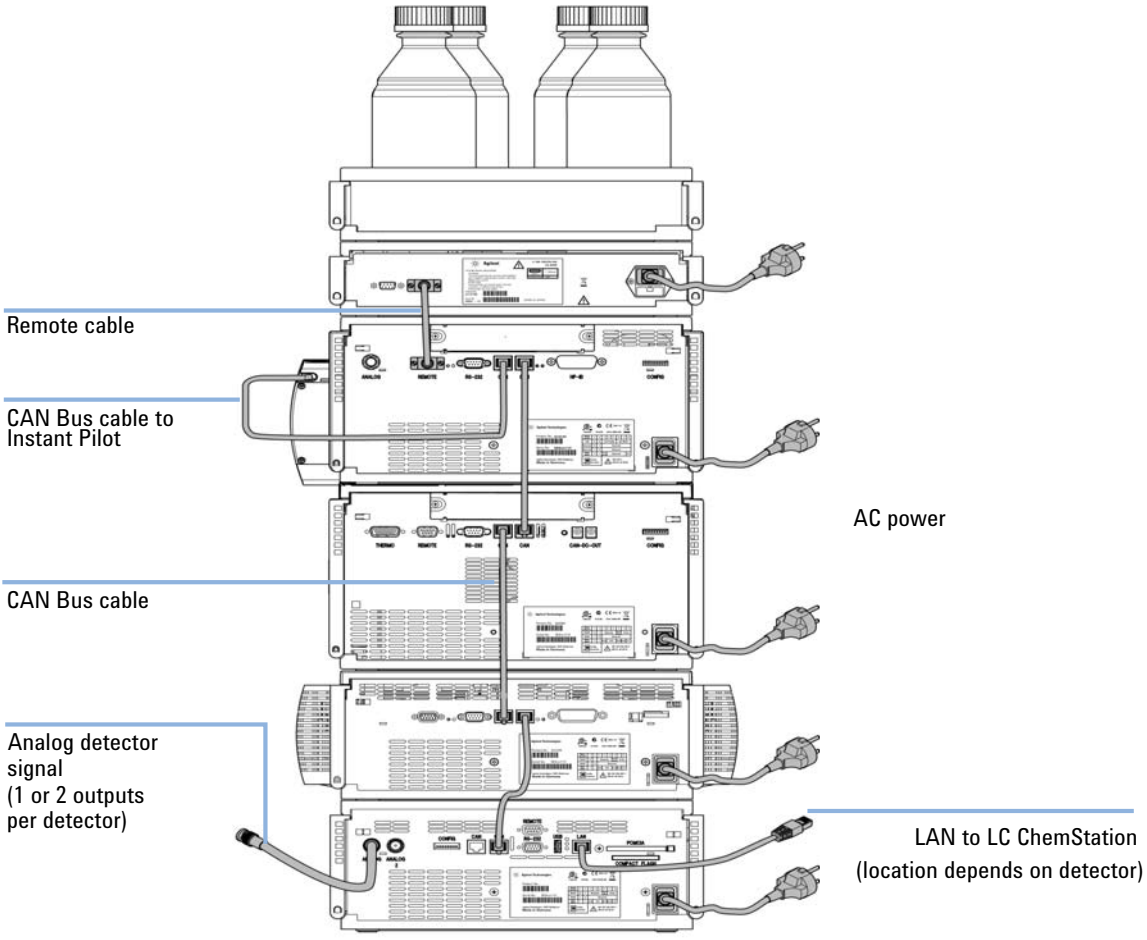


Figure 5 Recommended Stack Configuration for 1260 Infinity (Rear View)

Two Stack Configuration

To avoid excessive height of the stack when the autosampler thermostat is added to the system it is recommended to form two stacks. Some users prefer the lower height of this arrangement even without the autosampler thermostat. A slightly longer capillary is required between the pump and autosampler. (See Figure 6 on page 34 and Figure 7 on page 35).

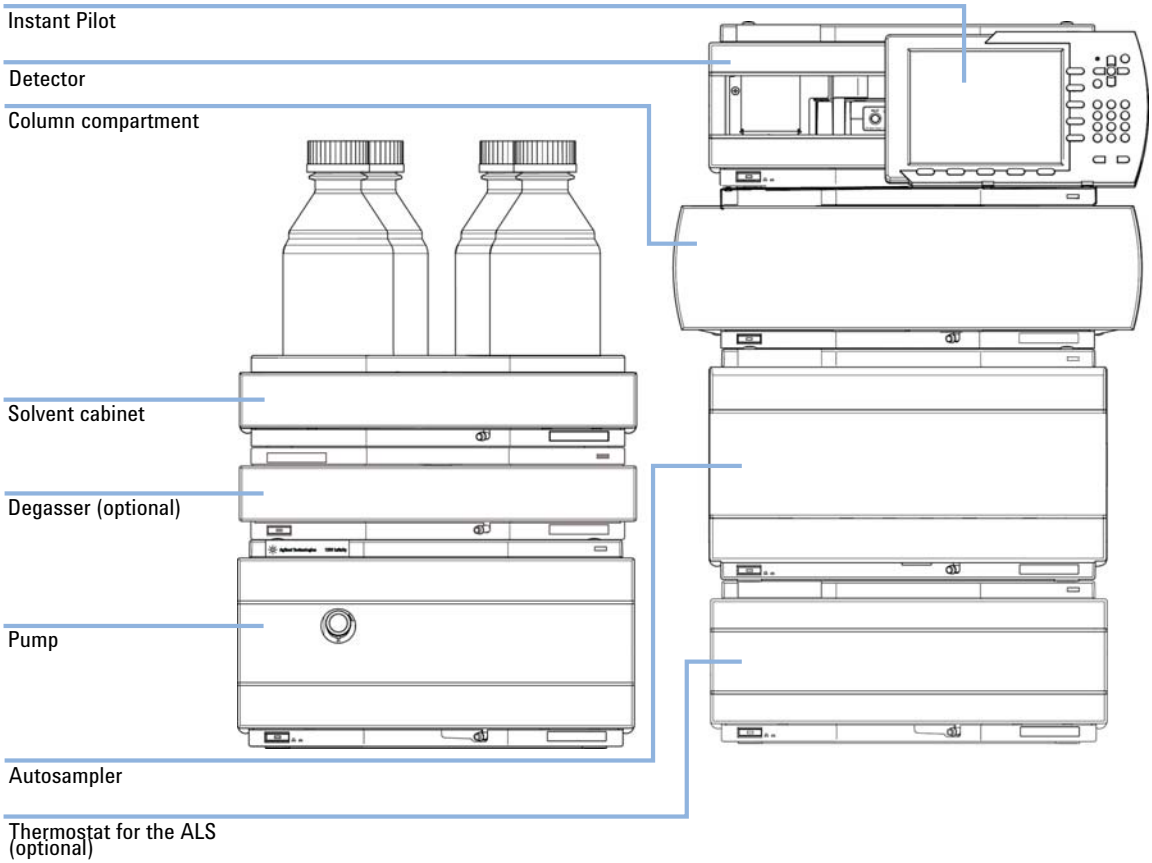


Figure 6 Recommended Two Stack Configuration for 1260 Infinity (Front View)

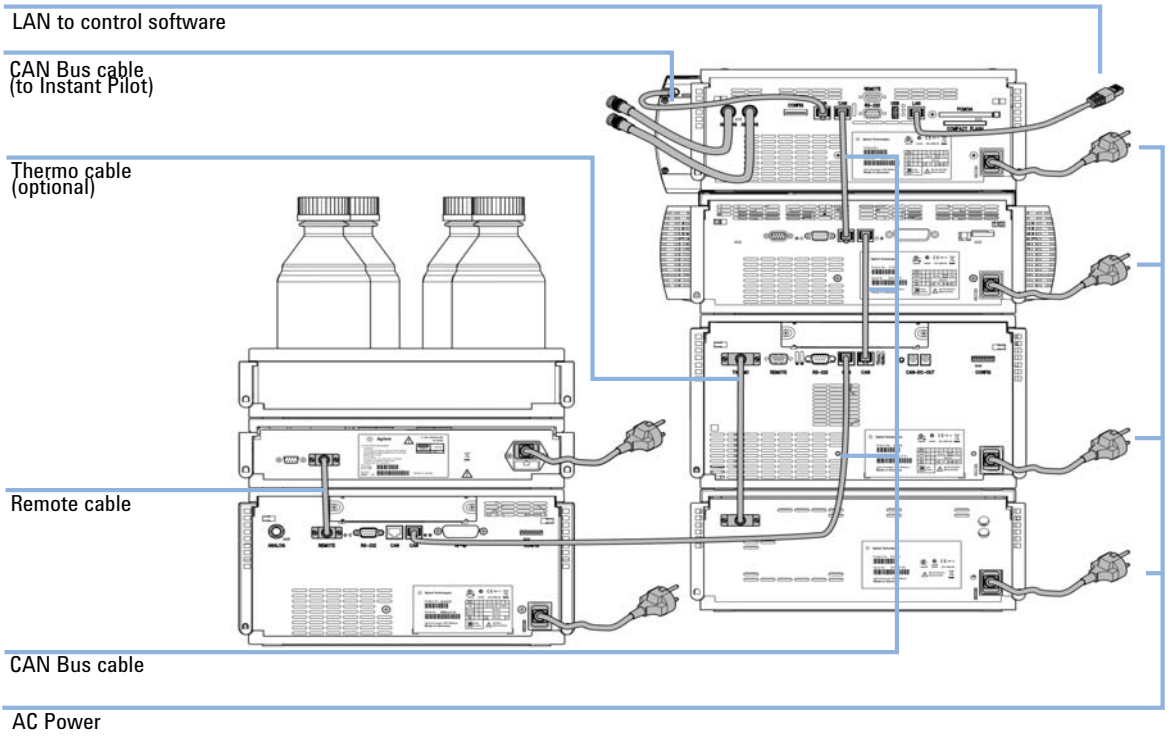


Figure 7 Recommended Two Stack Configuration for 1260 Infinity (Rear View)

Installing the Binary Pump

Parts required

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

For other cables see text below and "Cable Overview" on page 178.

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 switches on the front of the modules are OFF (switches stand out).

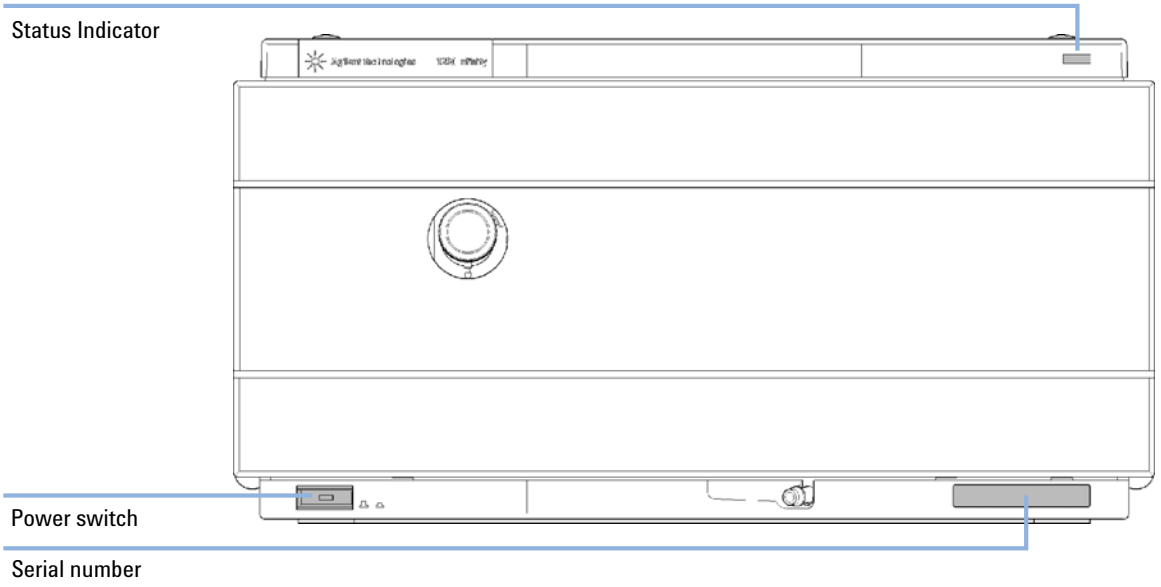


Figure 8 Front of Binary Pump

3 At the rear of the binary pump 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 binary pump, see "Connecting Modules and Control Software" on page 39.

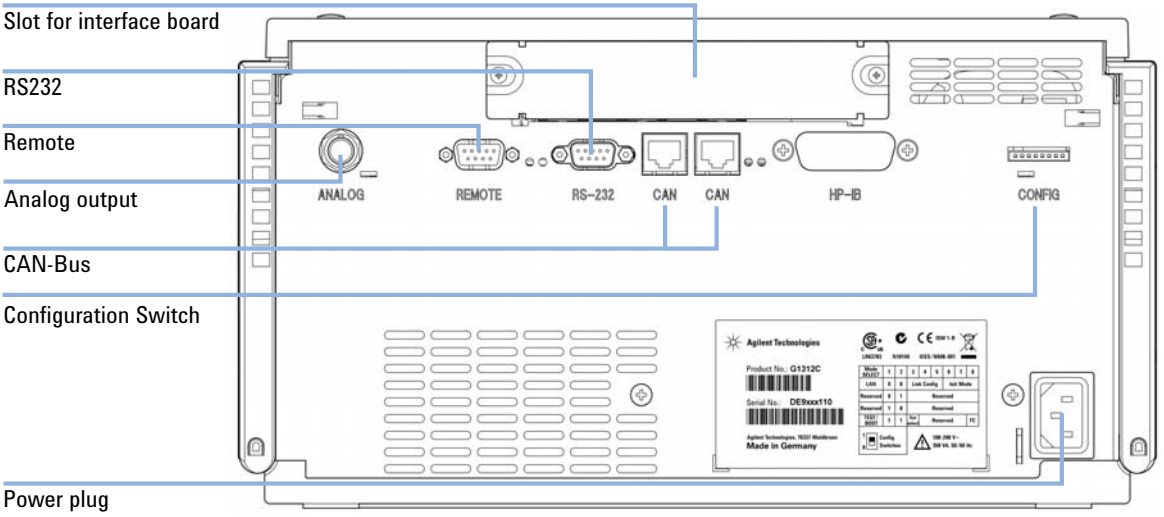


Figure 9 Rear of the Binary Pump

6 Connect the capillary, solvent tubes and waste tubings (see "Flow Connections of the Binary Pump with Optional Solvent Selection Valve" on page 42 or "Flow Connections of the Binary Pump Without Solvent Selection Valve" on page 45).

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 binary pump (see "Initial Priming" on page 48).

NOTE The pump was shipped with default configuration settings. To change these settings, see "Setting the 8-bit Configuration Switch (without On-board) LAN" on page 204.

Connecting Modules and Control Software

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.

Connecting Agilent 1260 Infinity Modules

1. Place the individual modules in a stack configuration as shown in Figure 4 on page 32.
2. Ensure the power switches on the front of the modules are OFF (switches stand out).
3. Plug a CAN cable into the CAN connector at the rear of the respective module (except vacuum degasser).
4. Connect the CAN cable to the CAN connector of the next module, see Figure 5 on page 33.
5. Press in the power switches to turn on the modules.

Connecting an Agilent 1260 Infinity Vacuum Degasser

1. Place the vacuum degasser in the stack of modules as shown in Figure 4 on page 32.
2. Ensure the power switch at the front of the vacuum degasser is OFF (switch stands out).
3. Plug an APG cable into the APG remote connector at the rear of the degasser.
4. Connect the APG cable to the APG remote connector of the pump, see Figure 5 on page 33.
5. Press in the power switch to turn on the vacuum degasser.

NOTE The AUX output is intended for troubleshooting. It provides a DC voltage in the range of 0 – 1 V which is proportional to the vacuum level in the degasser chambers.

Connecting Control Software and/or G4208 A Instant Pilot

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

NOTE Usually the detector is producing the most data in the stack, followed by the pump, and it is therefore highly recommended to use either of these modules for the LAN connection.

1 Ensure the power switches on the front of the modules in the stack are OFF (switches stand out).
2 If there are no other 1260 with LAN port in the HPLC stack, install a G1369B LAN board into the extension slot of the pump.
3 Connect the LAN enabled module with a LAN cable to the data system.
4 Plug the CAN connector of the Instant Pilot into any available CAN port of the 1260 system.
5 Plug a CAN cable into the CAN connector of the Instant Pilot.

NOTE The Standard Degasser must not be connected to LAN or CAN as its connector is for diagnostic use only.

6 Connect the CAN cable to the CAN connector of one of the modules.
7 Press in the power switches to turn on the modules.

NOTE The Agilent control software can also be connected to the system through a LAN cable, which requires the installation of a LAN-board. For more information about connecting the Instant Pilot or Agilent control software refer to the respective user manual.
"Interfaces" on page 197 provides information on how to connect external hardware.

Flow Connections of the Binary Pump with Optional Solvent Selection Valve

Parts required	#	p/n	Description
	1		Other modules
	1	G1311-68755	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 carry health risks.

➔ Observe appropriate safety procedures (for example, wear 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.

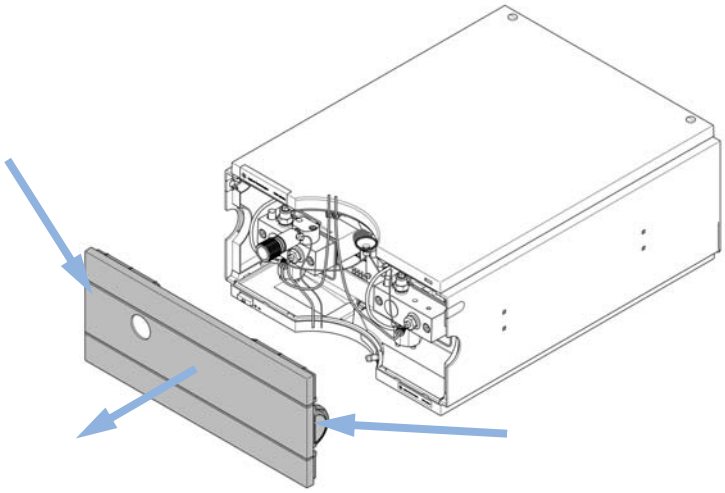


Figure 10 Removing the Front Cover

2 Place the solvent cabinet on top of the module.

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

4 Connect the solvent tubes from the bottle head assemblies to the inlet connectors A1, A2, B1 and B2 of the solvent selection valve and label the tubes accordingly. Fix the tubes in the clips of solvent cabinet and binary pump.

5 Using a piece of sanding paper, connect the waste tubing to the purge valve and place it into your waste system.

6 If the binary 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 outlet capillary (binary pump to injection device) to the outlet of the purge valve.

8 Prime your system before first use (see "Initial Priming" on page 48).

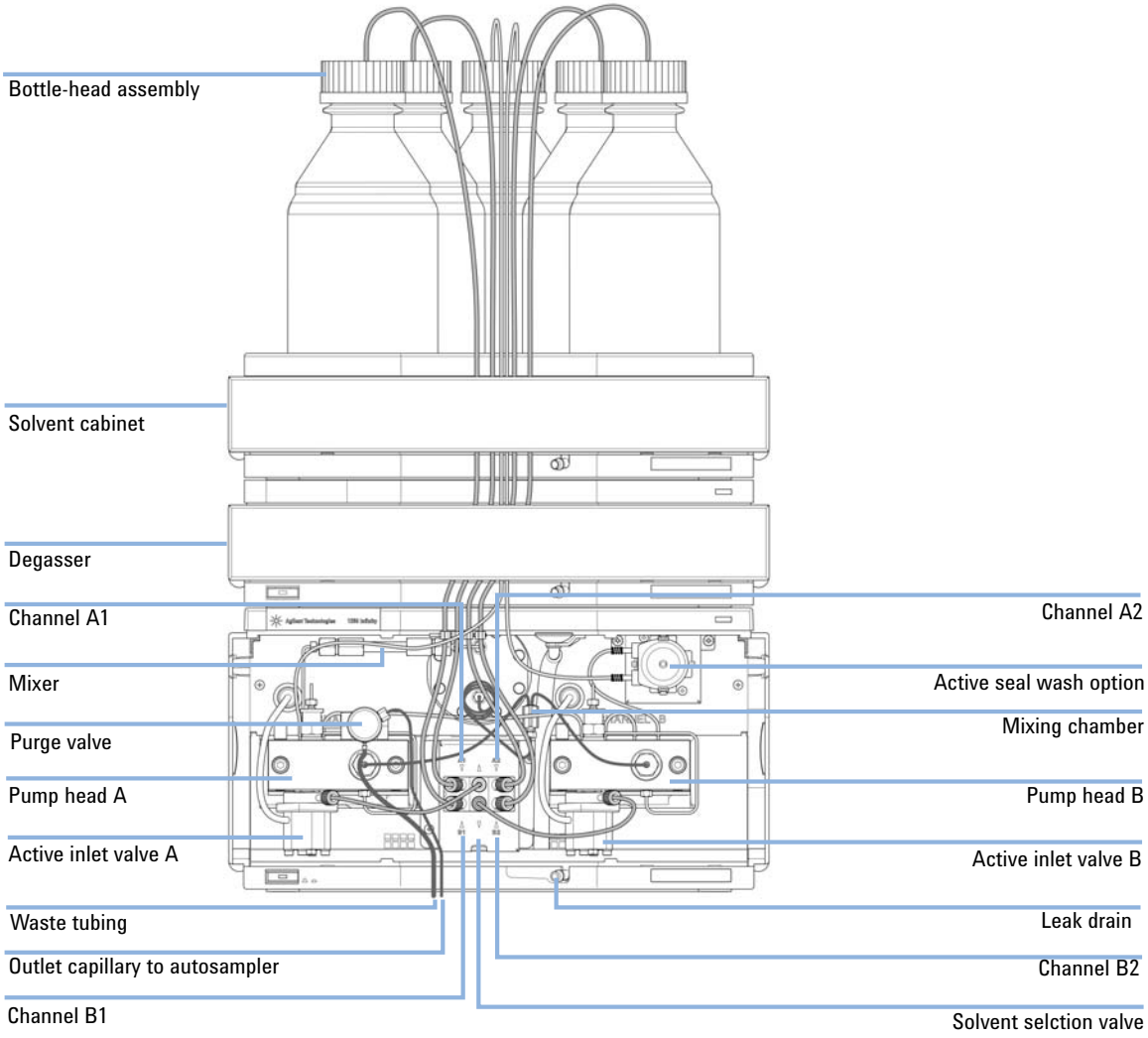


Figure 11 Binary Pump with Solvent Selection Valve

Flow Connections of the Binary Pump Without Solvent Selection Valve

Parts required	#	p/n	Description
	1		Other modules
	1	G1311-68755	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 carry health risks.

➔ Observe appropriate safety procedures (for example, wear 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.

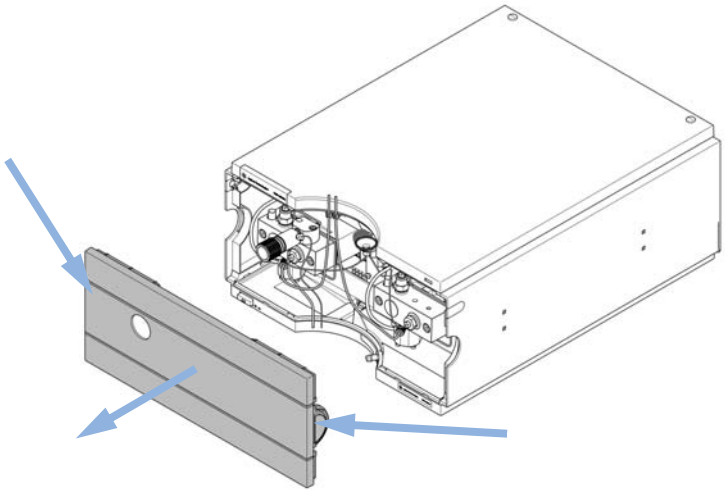


Figure 12 Removing the Front Cover

2 Place the solvent cabinet on top of the binary pump.

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 Using a piece of sanding paper, connect the waste tubing to the purge valve and place it into your waste system.

6 If the binary 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 outlet capillary (binary pump to injection device) to the outlet of the purge valve.

8 Purge your system before first use (see "Initial Priming" on page 48).

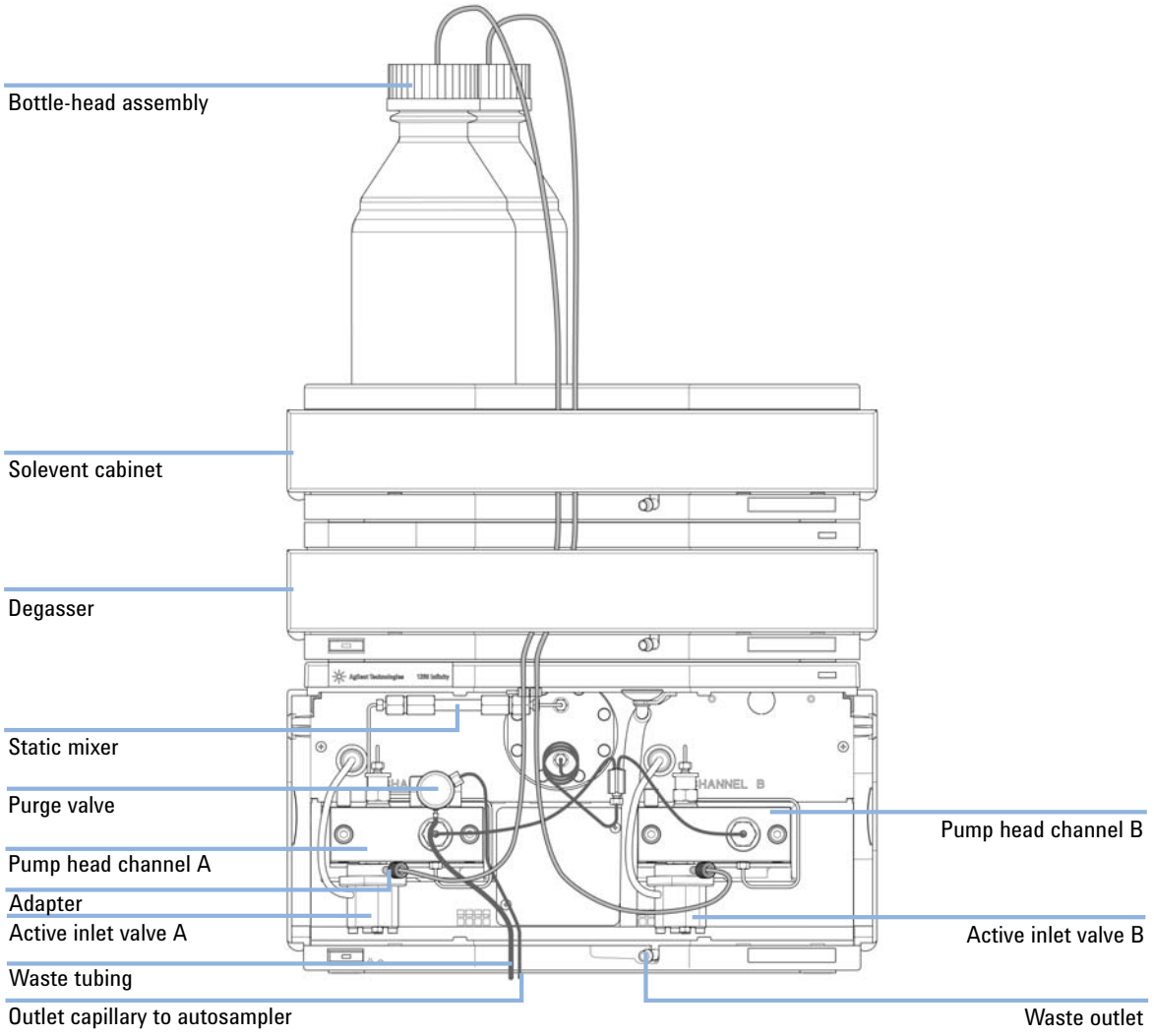


Figure 13 Flow Connection of Binary Pump Without Solvent Selection Valve

Priming the System

Initial Priming

When

Before a degasser or solvent tubing can be used, it is necessary to prime the system. Isopropanol is recommended as priming solvent due to its miscibility with nearly all HPLC 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 carry health risks.

➔ Observe appropriate safety procedures (for example, wear 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 to purge the pump automatically.

NOTE

If the pump is not able to draw in the solvent from the bottles, use a syringe to move 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. If solvents containing volatile components are left in the degasser without flow for a prolonged period, there will be a slight loss of the volatile components.

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

#	p/n	Description
1		Purging solvent(s), see Table 4 on page 52
1	5022-2184	Union ZDV

Preparations

Remove the column and replace it by a ZDV fitting.

Prepare bottles with appropriate intermediate solvents (see Table 4 on page 52)

1 If the channel is not filled with 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 clogged by precipitating salt.

➔ Flush solvent lines containing high concentration of salts first with water before introducing organic solvent.

➔ Do not perform steps 5 to 7 for channels running 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 4 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 (PE seals (pack of 2) (p/n 0905-1420))	Hexane + 5 % isopropanol	Good wetting properties

4
Using the Binary Pump

This chapter provides information for optimized usage 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 by putting the solvent to a suitable container and applying a vacuum pressure for some time. If possible apply solvent conditions that will decrease the gas solubility over time (for example, warming up the solvents).
- The use of a vacuum 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 50).
- 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 and Algae Growth" on page 64).
- 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 in low delay volume configuration and 20 bar in standard configuration 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 pistons for scratches, grooves and dents when changing the piston seals. Damaged pistons cause micro leaks and will decrease the lifetime of the seals.
- After changing the piston seals, apply the seal wear-in procedure (see "Seal Wear-in Procedure" on page 147).
- 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 Agilent Instant Pilot G4208A User's Guide (p/n G4208-90006). Details about setting up module specific parameters can be found in the Instant Pilot online help.

The pump parameters are described in detail in “Overview” on page 56.

Setting up the Agilent 1260 Infinity Binary Pump VL G1312C with the Instrument Control Interface

Overview

Parameters described in following sections is offered by the instrument control interface and can usually be accessed through Agilent instrument control software. For details, please refer to manuals and online help of respective user interfaces.

Setup of Basic Pump Parameters

The most important parameters of the pump are listed in Table 5 on page 57.

Table 5 Basic pump parameters

Parameter	Limits	Description
• **Flow**	0.001 – 5 mL/min	Total flow rate of the pump. The optimum flow rate range is 0.1 to 5 mL/min, see "Performance Specifications" on page 24.
• **Stop Time**	0.01 min - no limit	The stop time of the pump usually controls the run time of the whole LC system, which is the time during which data is acquired and saved to data files. The stop time does not stop the pump flow etc. 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 – 400 bar **Min**: 0 – 400 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 60).
• **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 %.
• **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 can be switched between following states: **On**, **Off** or to **Standby**. In **Standby**, the pump motor is still controlled. When the pump is switched on from standby, it does not re-initialize.

CAUTION

Upon initialization, the pump ignores the Maximum Flow Gradient value.

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.

The optional seal wash pump can be controlled by either switching it off, using it for a single time or specifying frequency and duration of periodic wash intervals.

Auxiliary Pump Parameters

The auxiliary pump parameters are pre-set to fit most applications. Adjustments should only be made when required. Table 6 on page 59 shows the available auxiliary parameters with their default values.

CAUTION

Upon initialization, the pump ignores the Maximum Flow Gradient value.

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.

Table 6 Auxiliary pump parameters

Parameter	Limits	Description
• **Maximum Flow Gradient**	0.1 – 100 mL/min² default: 100 mL/min²	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/min² which in fact turns the function off.
• **Minimum Stroke**	20 – 100 µL default: Auto	The volume one pump piston delivers per stroke. In general, 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**	0-150·10^{-6} /bar default: 50·10^{-6} /bar	The compressibility defines the volume change of a compressed liquid. This parameter is used for the pump control and is required for minimizing pressure fluctuations and optimizing flow and composition precision and accuracy. For details, please refer to "How to Optimize the Compressibility Compensation Setting" on page 72.

Data Curves

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

- Solvent percentage for each channel,
- pump flow,
- pressure

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.

For details, please refer to the online help or manual of your instrument control software.

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 consumed volume continuously from the initial value and stops the pump and method/sequence execution before the system runs dry or an analysis is corrupted.

CAUTION The bottle filling feature fails if multiple solvent inlets are put into one solvent bottle!

➔ In that case implement a minimum pressure limit (see Table 5 on page 57) to avoid that the pump runs dry when solvents are empty.

Table 7 on page 61 lists the available bottle filling parameters.

Table 7 Bottle Filling Parameters

Parameter	Limits	Description
• **Total Volume**	0 – 1000 L default: 0 L	This is the capacity (maximum possible volume) in liter of the solvent bottle. In combination with the actual volume, this parameter is used for calculating and displaying the relative liquid level.
• **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: unchecked	If this option is checked, the pump won't start a new run if the solvent level in one or more bottles is below the minimum volume. Enter a minimum volume in liter, which considers the position of the solvent inlet and size/shape of the solvent bottle such that no air is drawn if the actual volume gets close to this limit.
• **Turn pump off...**	default: unchecked	If this option is checked, 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.

Solvent Information

Observe the following recommendations on the use of solvents.

- Follow recommendations for avoiding the growth of algae, see "Algae Growth in HPLC Systems" on page 65
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.4 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials like flow cells, valve materials etc. and recommendations in subsequent sections.

Solvent compatibility for stainless steel in standard LC systems

Stainless steel is inert against many common solvents. It is stable in the presence of acids and bases in the pH range specified for standard HPLC (pH 1 – 12.5). It can be corroded by acids below pH 2.3 . In general following solvents may cause corrosion and should be avoided with stainless steel:

- Solutions of alkali halides, their respective acids (for example, lithium iodide, potassium chloride, and so on) and aequous solutions of halogenes
- High concentrations of inorganic acids like nitric acid, sulfuric acid and organic solvents especially at higher temperatures (replace, if your chromatography method allows, 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:

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

  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.

- Solutions of organic acids (acetic acid, formic acid, and so on) in organic solvents. For example, a 1 % solution of acetic acid in methanol will attack steel.
- Solutions containing strong complexing agents (for example, EDTA, ethylene diamine tetra-acetic acid).
- Mixtures of carbon tetrachloride with 2-propanol or THF.

Prevent Blocking of Solvent Filters and Algae Growth

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 – 0.001 M 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.

Algae Growth in HPLC Systems

The presence of algae in HPLC systems can cause a variety of problems that may be incorrectly diagnosed as instrument or application problems. Algae grow in aqueous media, preferably in a pH range of 4-8. Their growth is accelerated by buffers, for example phosphate or acetate. Since algae grow through photosynthesis, light will also stimulate their growth. Even in distilled water small-sized algae grow after some time.

Instrumental Problems Associated With Algae

Algae deposit and grow everywhere within the HPLC system causing:

- Blocked solvent filters or deposits on inlet or outlet valves resulting in unstable flow, composition or gradient problems or a complete failure of the pump.
- Small pore high pressure solvent filters, usually placed before the injector to plug resulting in high system pressure.
- PTFE frits blockage leading to increased system pressure.
- Column filters to plug giving high system pressure.
- Flow cell windows of detectors to become dirty resulting in higher noise levels (since the detector is the last module in the flow path, this problem is less common).

How to Prevent and-or Reduce the Algae Problem

- Always use freshly prepared solvents, especially use demineralized water which was filtered through about 0.2 µm filters.
- Never leave mobile phase in the instrument for several days without flow.
- Always discard old mobile phase.
- Use the amber solvent bottle (Solvent bottle, amber (p/n 9301-1450)) supplied with the instrument for your aqueous mobile phase.
- If possible add a few mg/l sodium azide or a few percent organic solvent to the aqueous mobile phase.

5 Optimizing Performance

This chapter gives hints on how to optimize the performance or use additional devices.

When to Use a Vacuum Degasser

The pump does not necessarily require degassing. But for the following conditions the vacuum degasser is recommended:

- if your detector is used with maximum sensitivity in the low UV wavelength range,
- if your application requires highest injection precision, or
- if your application requires highest retention-time reproducibility (mandatory at flow rates below 0.5 mL/min).

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 lines are empty, you should prime the vacuum degasser before running an analysis.

The vacuum degasser can be primed either by drawing solvent through the degasser with a syringe or by pumping with the pump.

Priming the degasser with a syringe is recommended, when:

- vacuum degasser is used for the first time, or vacuum tubes are empty, or
- changing to solvents that are immiscible with the solvent currently in the vacuum tubes.

Priming the vacuum degasser by using the pump at high flow rate (3 – 5 mL/min) is recommended, when:

- pump was turned off for a length of time (for example, during night) and volatile solvent mixtures are used, or
- solvents have been changed.

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 pistons 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 holders 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.

NOTE In order to avoid accumulation of buffer salts or impurities, regularly replace the washing solution using fresh solvents.

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

For adding a seal-wash option, please contact your local Agilent Technologies service representative.

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 ("Maintenance of a Pump Head without Seal Wash" on page 137)

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 Remove the Static Mixer

The binary pump is equipped with a static mixer. The total delay volume of the pump is 600 – 900 µl. The mixer has a volume of 420 µl.

The static mixer and both connecting capillaries can be replaced by a small capillary (G1312-67301) under the following conditions:

- the delay volume of the pump should be reduced to a minimum for fastest gradient response, and
- the detector is used at medium or low sensitivity.

NOTE Removing the mixer will result in an increase of the composition ripple and higher detector noise.

How to Optimize the Compressibility Compensation Setting

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 values (below 1 % of system pressure) that will be 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 8 on page 73. 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 "Description" on page 112).
3. Your pump must be connected to a data system or Instant Pilot with which the pressure and %-ripple can be monitored, or connect an external measurement device to the analog pressure output (see "Electrical Connections" on page 195)
4. Start the recording device with the 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.

Table 8 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 Repeat step 1 on page 72 through step 5 on page 72 for the B channel of your binary pump.

6
Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

Overview of the Pump'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).

Pressure Test

The **Pressure Test** is a quick test designed to determine the pressure tightness of the system (i.e. the high pressure flow path between pump and column). After exchanging flow path components (e.g. pump seals or injection seal), use this test to verify the system is pressure tight, see "Pressure Test" on page 112.

Leak Test

The **Leak Test** is a diagnostic test designed to determine the pressure tightness of the pump components. When a problem with the pump is suspected, use this test to help troubleshoot the pump and its pumping performance, see "Leak Test" on page 117.

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.

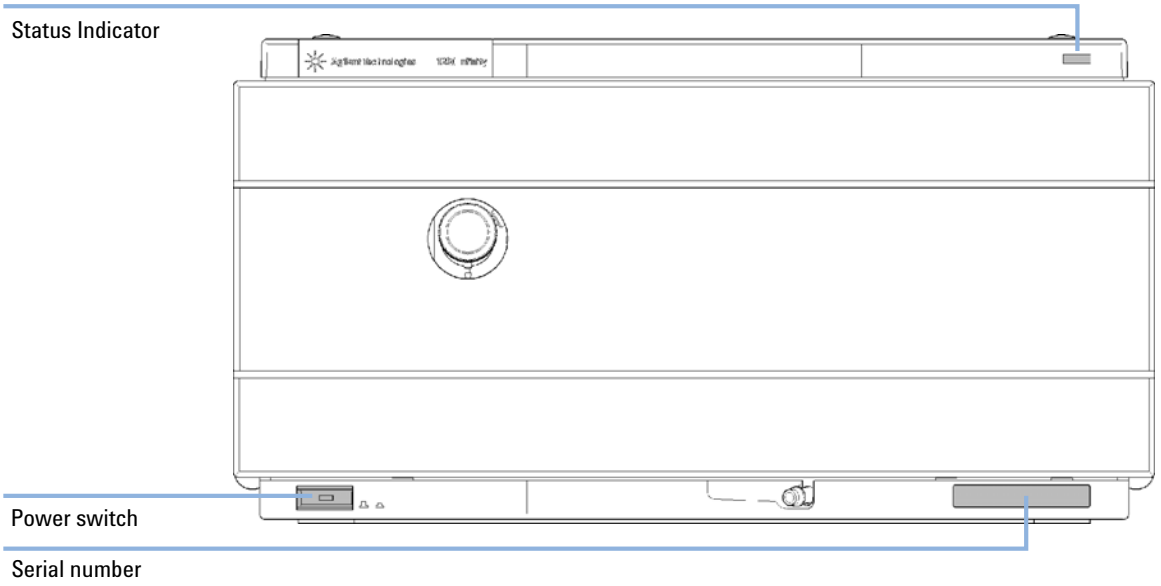


Figure 14 Location of Status Indicators

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.

  If the error occurs during analysis, it is propagated within the LC system, i.e. a red LED may indicate a problem of a different module. Use the status display of your user interface for finding the root cause/module of the error.
- A *blinking* indicator indicates that the module is in resident mode (e.g. during update of main firmware).
- A *fast blinking* indicator indicates that the module is in a low-level error mode. In such a case try to re-boot the module or try a cold-start (see "Special Settings" on page 207. Then try a firmware update (see "Replacing the Module Firmware" on page 160). If this does not help, a main board replacement is required.

User Interfaces

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

Table 9 Test Functions available vs. User Interface

Test	Instant Pilot G4208A	Agilent Lab Advisor
Pressure Test	Yes	Yes
Leak Test	Yes	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.

The Instrument Utilities is a basic version of the Lab Advisor with limited functionality required for installation, use and maintenance. No advanced repair, troubleshooting and monitoring functionality is included.

7 Error Information

This chapter describes the meaning of error messages, and provides information on probable causes and suggested actions how to recover from error conditions.

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

General error messages are generic to all Agilent series HPLC modules and may show up on other modules as well.

Timeout

Error ID: 0062

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.

Shutdown

Error ID: 0063

An external instrument has generated a shutdown 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

Error ID: 0070

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).

Lost CAN Partner

Error ID: 0071

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 Sensor Short

Error ID: 0082

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 leak sensor.	Please contact your Agilent service representative.
2 Leak sensor incorrectly routed, being pinched by a metal component.	Please contact your Agilent service representative.

Leak Sensor Open

Error ID: 0083

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.

Compensation Sensor Open

Error ID: 0081

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

Error ID: 0080

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

Error ID: 0068

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.

Depending on the module, assemblies (e.g. the lamp in the detector) are turned off to assure that the module does not overheat inside.

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.	Please contact your Agilent service representative.

Leak

Error ID: 0064

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.

Open Cover

Error ID: 0205

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.	Please contact your Agilent service representative.
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

Error ID: 2502

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.

Solvent Zero Counter

Error ID: 2055, 2524

Pump firmware version A.02.32 and higher allow to set solvent bottle fillings in the data system. If the volume level in the bottle falls below the specified value the error message appears when the feature is configured accordingly.

Probable cause	Suggested actions
1 Volume in bottle below specified volume.	Refill bottles and reset solvent counters.
2 Incorrect setting.	Make sure the limits are set correctly.

Pressure Above Upper Limit

Error ID: 2014, 2500

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 Defective damper.	Please contact your Agilent service representative.
4 Defective main board.	Please contact your Agilent service representative.

Pressure Below Lower Limit

Error ID: 2015, 2501

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.	• Make sure that the degasser is in flow path and works correctly. 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

Error ID: 2016

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 -120 mV 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

Error ID: 2040

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

Error ID: 2054

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 s, 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

Error ID: 2060

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

The pump is assigned its configuration at the factory. If the active-inlet valve and pump encoder of channel B are disconnected, and the pump is rebooted, the error message is generated. *However, the pump will function as an isocratic pump in this configuration*. The error message reappears after each switch-on.

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.

Electronic Fuse of SSV

Error ID: 2049

Following errors can only occur, if a solvent selection valve is used. The internal number in the error message is linked either to channels A or B as shown in the following table:

Valve Fuse 0: Channels A1 and A2

Valve Fuse 1: Channels B1 and B2

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

	Probable cause	Suggested actions
1	Defective solvent selection valve.	Restart the capillary 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.
4	1200 Series solvent selection valve installed.	Replace by 1260 solvent selection valve.

AIV Fuse

Error ID: 2044

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

Error ID: 2517

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

Error ID: 2517

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.	Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
2 Partial blockage of the flowpath in front of the damper.	Ensure the outlet ball 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

Error ID: 2041, 2042

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 active inlet valve.	Exchange the active inlet valve.
3	Blocked outlet ball valve.	Exchange the outlet ball valve.
4	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.
5	Defective pump drive assembly.	Please contact your Agilent service representative.
6	Defective main board.	Please contact your Agilent service representative.
7	Restriction capillary blocked at pre-mixing union.	Exchange restriction capillary.

Encoder Missing

Error ID: 2046, 2050, 2510

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 s. 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

Error ID: 2048, 2052

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 s. If the connector is not detected by the processor, the error message is generated.

Probable cause	Suggested actions
1 Disconnected or defective cable.	Ensure the pins of the active inlet valve connector are not damaged. Ensure the connector is seated securely.
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

Error ID: 2201, 2211

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 Blocked active inlet valve.	Exchange the active inlet valve.
3 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.
4 Defective pump drive assembly.	Please contact your Agilent service representative.
5 Defective main board.	Please contact your Agilent service representative.

Pump Head Missing

Error ID: 2202, 2212

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 s, indicated by an increase in motor current. If the end point is not found within 20 s, 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

Error ID: 2203, 2213

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

Error ID: 2204, 2214

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

Error ID: 2205, 2215, 2505

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

Error ID: 2206, 2216

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

Error ID: 2207, 2217

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 active inlet valve.	Exchange the active inlet valve.
2 Defective pump drive assembly.	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Wait Timeout

Error ID: 2053

When running certain tests in the diagnostics mode or other special applications, the pump must wait for the pistons to reach a specific position, or must wait for a certain pressure or flow to be reached. Each action or state must be completed within the timeout period, otherwise the error message is generated.

Possible Reasons for a Wait Timeout:

· Pressure not reached.

· Pump channel A did not reach the delivery phase.

· Pump channel B did not reach the delivery phase.

· Pump channel A did not reach the take-in phase.

· Pump channel B did not reach the take-in phase.

· Solvent volume not delivered within the specified time.

Probable cause	Suggested actions
1 Purge valve open.	Ensure that purge valve is closed.
2 Leak at fittings, purge valve, active inlet valve, outlet valve or piston seals.	• Ensure pump components are seated correctly. If there are still signs of a leak, exchange the appropriate seal (purge valve, active inlet valve, outlet valve, piston seal). • Exchange defective capillaries.
3 Flow changed after starting test.	Ensure correct operating condition for the special application in use.
4 Defective pump drive assembly.	Please contact your Agilent service representative.

Electronic fuse of SSV

Error ID: 2049

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

8
Test Functions and Calibration

This chapter describes the tests for the module.

Pressure Test

Description

The pressure test is a quick, built-in test designed to demonstrate the pressure-tightness of the system. The test involves monitoring the pressure profile while the binary pump runs through a predefined pumping sequence. The resulting pressure profile provides information about the pressure tightness of the system.

Step 1

The test begins with the initialization of both pumpheads. After initialization, pistons A1 and B1 are both at the top of their stroke. Next, pump A begins pumping solvent with a flow rate of 510 µL/min and stroke of 100 µL. The binary pump continues to pump until a system pressure of 390 bar bar is reached.

NOTE For this test channel A is active, which is directly connected to chamber 2 in channel B, see Figure 2 on page 12. To test the pressure tightness of the pump use the leak test, see "Description" on page 117.

Step 2

When the system pressure reaches 390 bar bar, the binary pump switches off. The pressure drop from this point onwards should be no more than 2 bar/min.

Positioning the Blank Nut

To test the complete system's pressure tightness, the blank nut should be positioned at the column compartment outlet (or the outlet of the last module before the detector).

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

When

If problems with small leaks are suspected After maintenance of flow-path components (e.g., pump seals, injection seal) to prove pressure tightness up to 400 bar

Tools required

Description
Wrench, 1/4 inch

Parts required

#	p/n	Description
1	01080-83202	Blank nut
1		500 mL Isopropanol

Preparations

Place a bottle of LC-grade isopropanol in the solvent cabinet and connect it to channel A (or channel A2 if solvent selection valve is installed).

NOTE

Make absolutely sure that all parts of the flow path that are part of the test are flushed very thoroughly with isopropanol 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!

Running the test from the Agilent Lab Monitor & Diagnostic Software

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 slowly opening the purge valve when the test has finished.

"System Pressure Test failed" on page 116 describes the evaluation and interpretation of the pressure test results.

For detailed instructions refer to the Agilent Lab Monitor & Diagnostic Software.

Evaluating the Results

The sum of all leaks between the pump and the blank nut will be indicated by a pressure drop of >2 bar/minute at the plateau. 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** means that during the operation of the test there was an abnormal termination. If a test **failed**, this means that the results of the test 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 a failure of the test. Before investigating 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 (eg. 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 leak test.

Potential Causes of Pressure Test Failure

System Pressure Test `failed`

The test will fail, if the sum of all leaks in the system (pump, autosampler or column compartment and connections) exceeds the test limit. After isolating and fixing the cause of the leak, repeat the **System Pressure Test** to confirm the system is pressure tight.

	Probable cause	Suggested actions
1	Purge valve open.	Close the purge valve.
2	Loose or leaky fittings.	Tighten the fitting or exchange the capillary.
3	Pump: Damaged pump seals or pistons.	Run the **Leak Rate Test** to confirm the leak.
4	Loose purge valve.	Tighten the purge valve nut (14 mm wrench).
5	Autosampler: Loose or leaky fitting.	Tighten or exchange the fitting or capillary.
6	Autosampler: Rotor seal (injection valve).	Exchange the rotor seal.
7	Autosampler: Damaged metering seal or piston.	Exchange the metering seal. Check the piston for scratches. Exchange the piston if required.
8	Autosampler: Needle seat.	Exchange the needle seat.
9	Column compartment: Loose or leaky fitting.	Tighten or exchange the fitting or capillary.
10	Column compartment: Rotor seal in optional valve.	Exchange the rotor seal.

Leak Test

Description

The leak test is a built-in troubleshooting test designed to demonstrate the leak-tightness of the binary pump. The test involves monitoring the pressure profile as the binary pump runs through a predefined pumping sequence. The resulting pressure profile provides information about the pressure tightness and operation of the binary pump components (see Figure 2 on page 12).

Ramp 1

The test begins with the initialization of both pumps. After initialization, pistons A1 and B1 are both at the top of their stroke. Next, the pump begins pumping solvent with a flow rate of 150 µL/min, stroke of 100 µL, and a composition of 51 % A, 49 % B. Both pumps deliver for one complete pump cycle. At the end of this step, pistons A1 and B1 are at the top of their stroke.

Ramp 2

The pump continues pumping solvent with a flow rate of 150 µL/min. Channel A delivers for one pump cycle (first, piston A2 delivers, then piston A1), followed by channel B (piston B2, then piston B1), both channels with a stroke of 20 µL.

Ramp 3

Just before the start of the first plateau, piston A2 delivers with a flow rate of 50 µL/min for approximately 8 s.

Plateau 1

At plateau 1, piston A2 delivers with a flow rate of 3 µL/min for 30 s.

Ramp 4

Piston B2 delivers 50 µL/min for approximately 8 s.

Plateau 2

Piston B2 delivers with a flow rate of 3 µL/min for 30 s.

Ramp 5

Piston A1 delivers 50 µL/min for approximately 8 s.

Plateau 3

Piston A1 delivers with a flow rate of 3 µL/min for 30 s.

Ramp 6

Piston B1 delivers 50 µL/min for approximately 7 s.

Plateau 4

Piston B1 delivers with a flow rate of 3 µL/min for approximately 30 s. At the end of the fourth plateau, the test is finished and the pump switches off.

Running the Leak Test

When If problems with the pump are suspected

Tools required

Description
Wrench, 1/4 inch

Parts required

#	p/n	Description
1	G1313-87305	Restriction Capillary
1	01080-83202	Blank nut
1		500 mL Isopropanol

Preparations Place two bottles of LC-grade isopropyl alcohol in channels A and B. If a solvent selection valve is installed, place the LC grade isopropanol in channels A2 and B2.

NOTE Make absolutely sure that all parts of the flow path that are part of the test are very thoroughly flushed with isopropanol 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!

Running the test from the Agilent Lab Advisor

1. Select the **Leak Test** from the **Test Selection** menu.
2. Start the test and follow the instructions.

NOTE Make sure to release the pressure by slowly opening the purge valve when the test has finished.

"Evaluating the Results" on page 120 describes the evaluation and interpretation of the leak test results.

Detailed instructions are provided in the Lab Advisor Software.

Evaluating the Results

Defective or leaky components in the pump head lead to changes in the **Leak Test** pressure plot. Typical failure modes are described below.

NOTE Please notice the difference between an *error* in the test and a *failure* of the test! An *error* means that during the operation of the test there was an abnormal termination. If a test *failed*, this means that the results of the test were not within the specified limits.

NOTE Often it is only the damaged blank nut itself (poorly shaped from overtightening) that causes a failure of the test. 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!

No pressure increase or minimum pressure of plateau 1 not reached

Probable cause	Suggested actions
1 Pump not running.	Check the logbook for error messages.
2 Purge valve open.	Close the purge valve, and restart the test.
3 Wrong solvent-line connections to solvent selection valve.	Ensure the solvent lines from the degasser to the solvent selection valve are connected correctly.
4 Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
5 Large leaks (visible) at the pump seals.	Exchange the pump seals.
6 Large leaks (visible) at active inlet valve, outlet valve, or purge valve.	Ensure the leaky components are installed tightly. Exchange the component if required.

Pressure limit not reached but plateaus horizontal or positive

Probable cause	Suggested actions
1 Degasser and pump channels A and/or B not flushed sufficiently (air in the channels).	Purge the degasser and pump channels thoroughly with isopropanol under pressure (use the restriction capillary).
2 Wrong solvent.	Install isopropanol. Purge the degasser and pump channels thoroughly.

All plateaus negative

Probable cause	Suggested actions
1 Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
2 Loose purge valve.	Tighten the purge valve (14 mm wrench).
3 Leaky mixer (if installed).	Tighten the mixer fittings and nuts.
4 Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
5 Loose pump head screws in channel A or B.	Ensure the pump head screws in channels A and B are tight.
6 Leaking seal or scratched piston in channel A2 or B2.	Exchange the pump seals in both channels. Check the pistons for scratches. Exchange if scratched.
7 Leaking outlet valve in channel A or B.	Exchange the outlet valve.
8 Leaky damper.	Exchange damper.

First plateau negative or unstable, and at least one other plateau positive

Probable cause	Suggested actions
1 Leaking outlet valve in channel A.	Clean the outlet valve in channel A. Ensure the sieve in the outlet valves are installed correctly. Tighten the outlet valve.
2 Loose pump head screws in channel A.	Ensure the pump head screws in channel A are tight.
3 Leaking seal or scratched piston in channel A2.	Exchange the pump seals in channel A. Check the piston for scratches. Exchange if scratched.

Second plateau negative or unstable, and at least one other plateau positive

Probable cause	Suggested actions
1 Leaking outlet valve in channel B.	Clean the outlet valve in channel B. Ensure the sieve in the outlet valves are installed correctly. Tighten the outlet valve.
2 Loose pump head screws in channel B.	Ensure the pump head screws in channel B are tight.
3 Leaking seal or scratched piston in channel B2.	Exchange the pump seals in channel B. Check the piston for scratches. Exchange if scratched.

Third plateau negative or unstable and at least one other plateau positive

Probable cause	Suggested actions
1 Air in channel A or new seals not yet seated.	Flush channel A thoroughly with isopropanol under pressure (use restriction capillary).
2 Loose active inlet valve in channel A.	Tighten the active inlet valve in channel A (14 mm wrench). Do not overtighten!
3 Loose pump head screws in channel A.	Ensure the pump head screws in channel A are tight.
4 Loose outlet valve in channel A.	Ensure the sieve in the outlet valve is installed correctly. Tighten the outlet valve.
5 Leaking seal or scratched piston in channel A1.	Exchange the pump seals in channel A. Check the pistons for scratches. Exchange if scratched.
6 Defective active inlet valve in channel A.	Exchange the active inlet valve in channel A.

Fourth plateau negative or unstable and at least one other plateau positive

Probable cause	Suggested actions
1 Air in pump chamber of channel B or seals not yet seated.	Flush channel B thoroughly with isopropanol under pressure (restriction capillary).
2 Loose active inlet valve in channel B.	Tighten the active inlet valve in channel B (14mm wrench). Do not overtighten!
3 Loose pump head screws in channel B.	Ensure the pump head screws in channel B are tight.
4 Loose outlet valve in channel B.	Ensure the sieve in the outlet valve is installed correctly. Tighten the outlet valve.
5 Leaking seal or scratched piston in channel B1.	Exchange the pump seals in channel B. Check the pistons for scratches. Exchange if scratched.
6 Defective active inlet valve in channel B.	Exchange the active inlet valve in channel B.

9 Maintenance

This chapter describes the maintenance of the module.

Introduction to Maintenance and Repair

The module is designed for easy repair. The most frequent repairs such as piston seal change and purge valve frit change can be done from the front of the module with the module in place in the system stack.

These repairs are described in "Simple Repairs" on page 130

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 volume of substances should be reduced to the minimum 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 cover of the module.

➔ 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.

Overview of Maintenance

Figure 15 on page 128 shows the main 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).

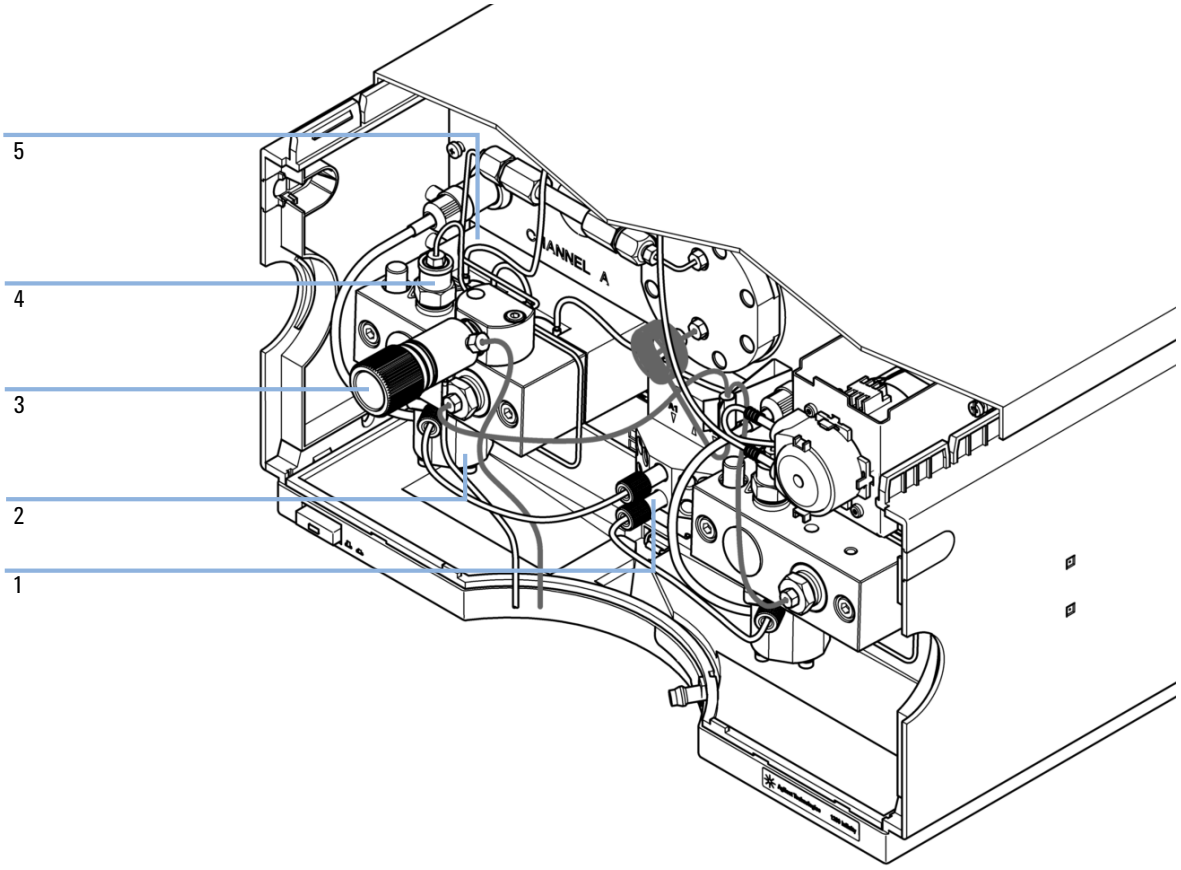


Figure 15 Overview of Maintenance Procedures

1	Solvent selection valve, see "Installation of the Solvent Selection Valve Upgrade Kit" on page 154
2	Active inlet valve, see "Exchanging the Active Inlet Valve or its Cartridge" on page 148
3	Purge valve, see "Exchanging the Purge Valve Frit or the Purge Valve" on page 133
4	Outlet valve, see "Exchanging the Outlet Valve" on page 152
5	Pump head, see "Maintenance of a Pump Head without Seal Wash" on page 137 or "Maintenance of a Pump Head with Seal Wash" on page 141

Simple Repairs

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

Table 10 Simple Repair Procedures

Procedure	Typical Condition	Notes
"Checking and Cleaning the Solvent Filter" on page 132	If solvent filter is blocked	Gradient performance problems, intermittent pressure fluctuations
"Exchanging the Active Inlet Valve or its Cartridge" on page 148	If internally leaking	Pressure ripple unstable, run leak test for verification
"Exchanging the Outlet Valve" on page 152	If internally leaking	Pressure ripple unstable, run leak test for verification
"Exchanging the Purge Valve Frit or the Purge Valve" on page 133	If internally leaking	Solvent dripping out of waste outlet when valve closed
"Exchanging the Purge Valve Frit or the Purge Valve" on page 133	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
"Exchanging the Solvent Selection Valve" on page 156	If internally leaking	Error messages "Valve failed" or "Valve Fuse" are generated
Exchanging the pump seals, see "Maintenance of a Pump Head without Seal Wash" on page 137 or "Maintenance of a Pump Head with Seal Wash" on page 141	If pump performance indicates seal wear	Leaks at lower pump head side, unstable retention times, pressure ripple unstable — run leak test for verification
Exchanging pistons, see "Maintenance of a Pump Head without Seal Wash" on page 137 or "Maintenance of a Pump Head with Seal Wash" on page 141.	If scratched	Seal life time shorter than normally expected — check plungers while changing the seals
Exchanging the wash seals, see "Maintenance of a Pump Head with Seal Wash" on page 141	When seals show indication of leaks	Leaks at lower pump head side, loss of wash solvent
"Exchanging the Optional Interface Board" on page 159	If defective	Error condition, indicated by red status indicator

Cleaning the Module

To keep the module case clean, use a soft cloth slightly dampened with water, or a solution of water and mild detergent.

WARNING **Liquid dripping into the electronic compartment of your module can cause shock hazard and damage the module**

➔ Do not use an excessively damp cloth during cleaning.

➔ Drain all solvent lines before opening any connections in the flow path.

Checking and Cleaning the Solvent Filter

When If solvent filter is blocked

Parts required

Description
Concentrated nitric acid (35 %)
LC grade water
Beaker

Preparations Remove solvent inlet tube from the adapter at the AIV

CAUTION

Small particles can permanently block the capillaries and valves of the module.

Damage of the module.

➔ Always filter solvents.

➔ Never use the module without solvent inlet filter.

NOTE

If the filter is in good condition the solvent will freely drip out of the solvent tube (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 carry health risks.

➔ Observe appropriate safety procedures (for example, wear 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 Filter

1 Remove the blocked solvent filter from the bottle-head assembly and place it in a beaker with concentrated nitric acid (35%) for one hour.

2 Thoroughly flush the filter with LC grade water (remove all nitric acid, some columns can be damaged by concentrated nitric acid; check with pH indicator).

3 Reinstall the filter.

Exchanging the Purge Valve Frit or the Purge Valve

When

- Frit – when piston 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 water with purge valve opened)
- Purge valve – if internally leaking

Tools required

p/n	Description
8710-0510	Wrench open 1/4 — 5/16 inch
8710-1924	Wrench open 14 mm
	Pair of tweezers
OR	Toothpick

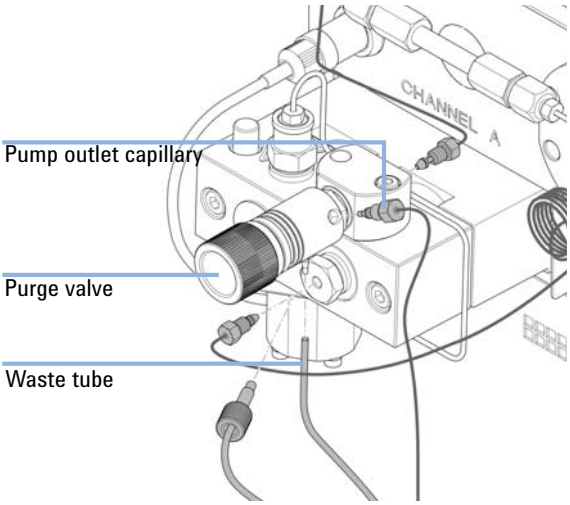
Parts required

#	p/n	Description
1	01018-22707	PTFE frits (pack of 5)
1	G1312-60061	Purge valve 1260
1	5067-4728	Seal cap (OPTIONAL)

Preparations

- Switch off pump at the main power switch
- Remove the front cover
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.

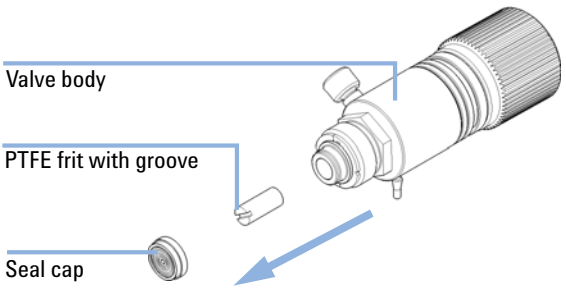
1 Using a 1/4 inch wrench disconnect the pump outlet capillary from the purge valve. Disconnect the waste tube. Beware of leaking solvents due to hydrostatic pressure.



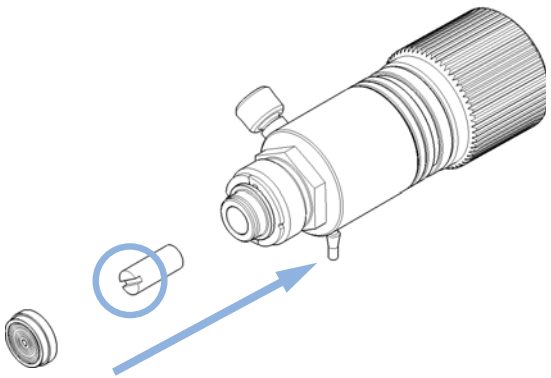
2 Using the 14 mm wrench, unscrew the purge valve and remove it from the purge valve holder.

3 Remove the seal cap from the purge valve.

4 Using a pair of tweezers or a toothpick remove the frit.



5 Place a new frit into the purge valve with the orientation of the frit as shown below (slit in frit points to the front). Reinstall the seal cap including the gold seal.



NOTE

Before reinstallation always check the gold seal in the seal cap. A deformed seal cap should be exchanged.

Next Steps:

6 Insert the purge valve into the purge valve holder and orient the waste outlet nozzle downward.

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

Removing the Pump Head Assembly

When

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

Tools required

p/n	Description
8710-0510	Wrench open 1/4 — 5/16 inch
8710-2411	Hex key 3 mm12 cm long
8710-2392	Hex key 4 mm15 cm long T-handle
5023-0240	Hex driver, ¼", slitted

Preparations

Switch off the pump at the main power switch

CAUTION

Damage of the pump drive

Starting the pump when the pump head is removed may damage the pump drive.

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

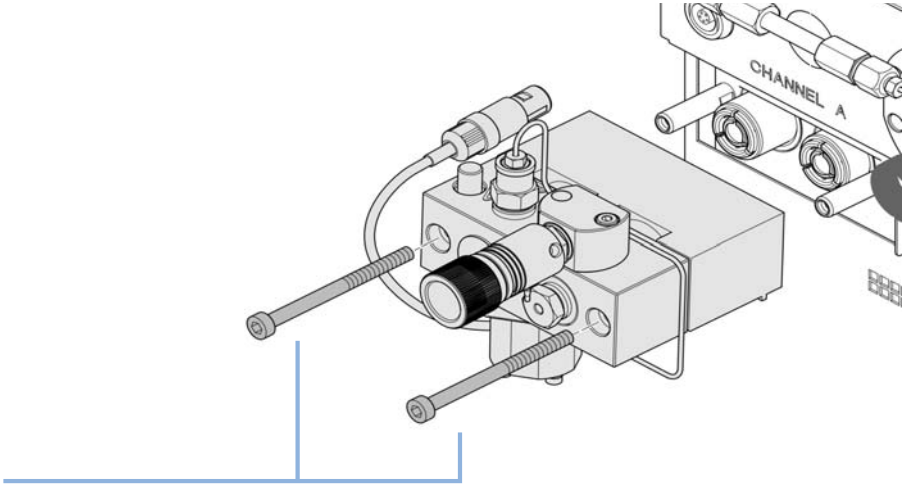
NOTE

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

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



Maintenance of a Pump Head without Seal Wash

When In case of maintenance or pump head internal leaks

Tools required

p/n	Description
8710-0510	Wrench open 1/4 — 5/16 inch
8710-2411	Hex key 3 mm12 cm long
8710-2392	Hex key 4 mm15 cm long T-handle
01018-23702	Insert tool

Parts required

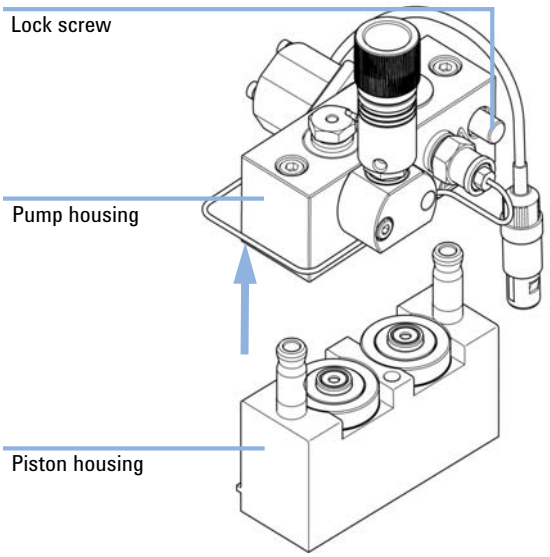
	#	p/n	Description
	1	5063-6589	Piston seal PTFE, carbon filled, black (pack of 2), default
OR	1	0905-1420	PE seals (pack of 2)
	1	5063-6586	Sapphire piston

Preparations

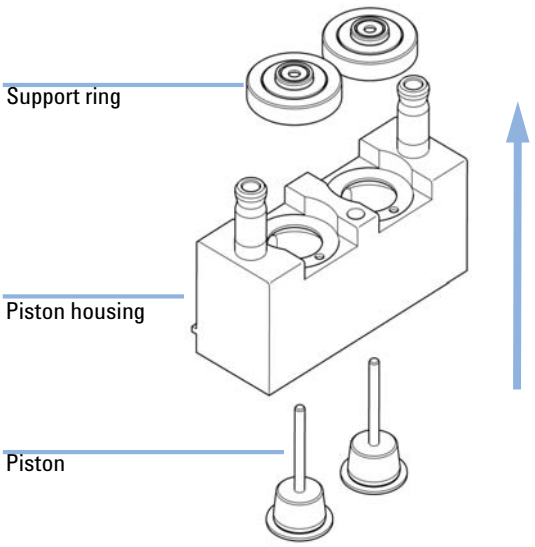
- Switch off the pump at the main power switch
- Remove the front cover to have access to the pump mechanics
- Remove the pump head, see "Removing the Pump Head Assembly" on page 135

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.

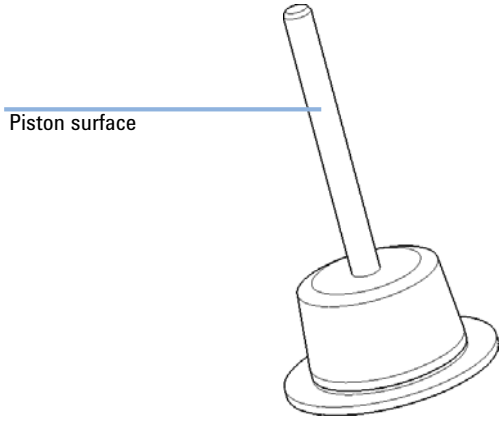
1 Place the pump head on a flat surface. Loosen the lock screw (two turns) and while holding the lower half of the assembly (piston housing) carefully pull the pump housing away from the piston housing.



2 Remove the support rings from the piston housing and lift the housing away from the pistons.



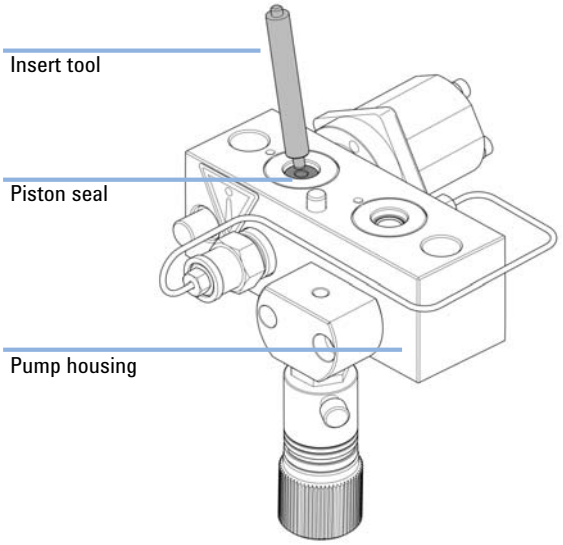
3 Check the piston surface and remove any deposits or layers. Most suitable is polishing of the piston rod with toothpaste. Replace the piston if scratched or if dents are visible.



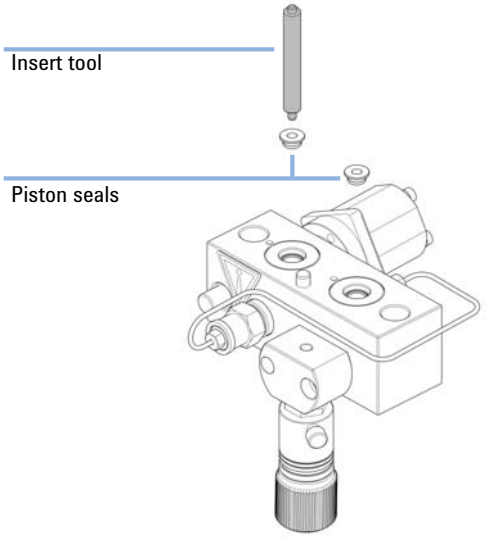
NOTE

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

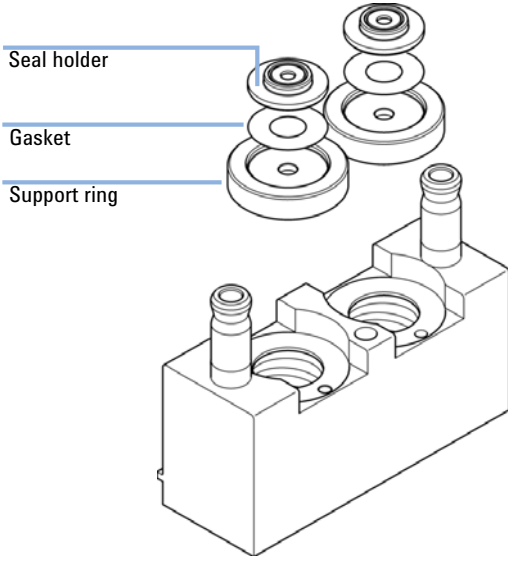
4 Using the steel side of the insert tool carefully remove the seal from the pump housing. Remove wear retainers, if still present.



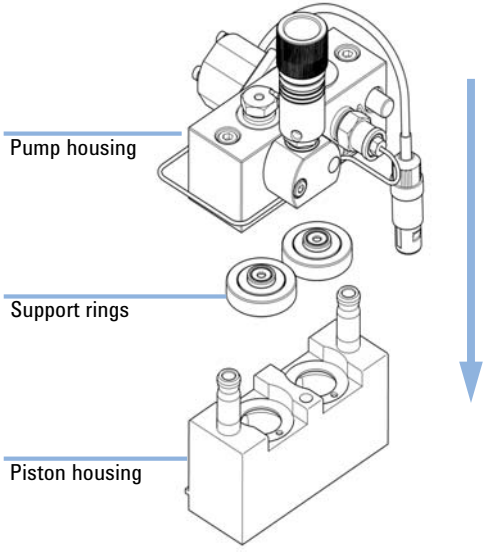
5 Using the plastic side of the insert tool insert the new seals into the pump head and press them firmly in position.



6 Place a seal wash gasket in the recess of the support ring. Put the seal holder on top of the gasket.



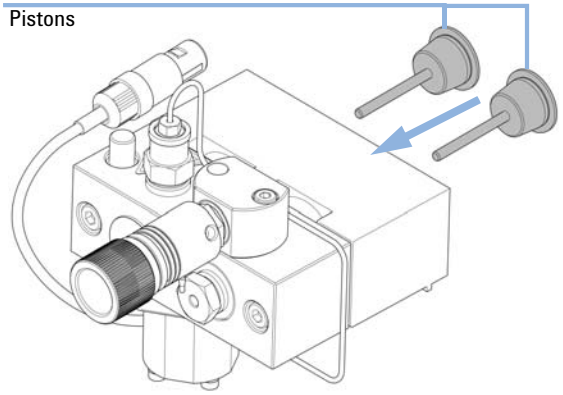
7 Reassemble the pump head assembly. Note the correct position of the pin on the support ring.



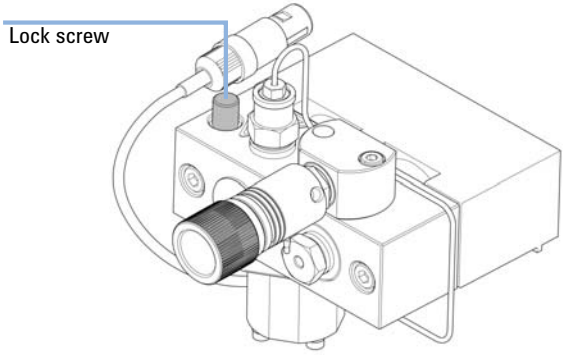
NOTE

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

8 Insert the pistons and carefully press them into the seals.



9 Tighten the lock screw.



Next Steps:

10 Reinstall the pump head assembly, see "Reinstalling the Pump Head Assembly" on page 145.

11 If a standard seal has been installed, run the seal wear-in procedure, see "Seal Wear-in Procedure" on page 147.

12 For the normal phase seal, the purge valve frit should be replaced, see "Exchanging the Purge Valve Frit or the Purge Valve" on page 133.

Maintenance of a Pump Head with Seal Wash

When In case of maintenance or pump head internal leaks

Tools required

p/n	Description
8710-2411	Hex key 3 mm12 cm long
8710-2392	Hex key 4 mm15 cm long T-handle
01018-23702	Insert tool
	Screwdriver, small flat head

Parts required

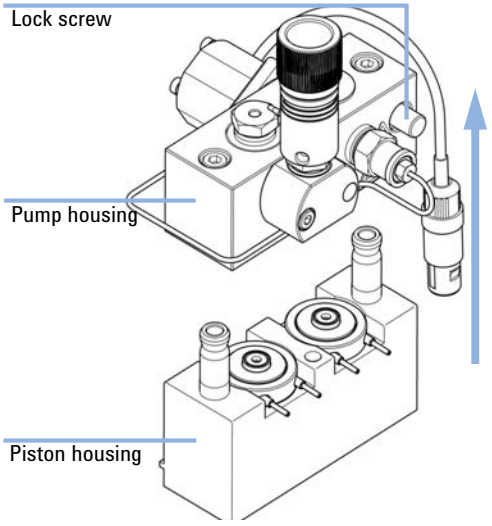
p/n	Description
0905-1175	Wash seal (PTFE)
5062-2484	Gasket, seal wash (pack of 6)
5063-6586	Sapphire piston

Preparations

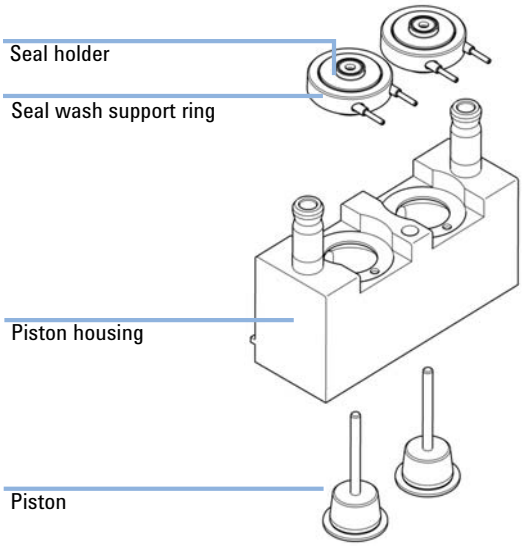
- Switch off the pump at the main power switch.
- Remove the front cover to have access to the pump mechanics.
- "Removing the Pump Head Assembly" on page 135.

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.

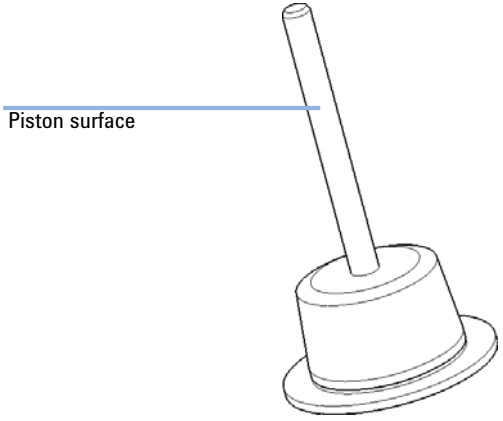
1 Place the pump head on a flat surface. Loosen the lock screw (two turns) and while holding the lower half of the assembly (piston housing) carefully pull the pump housing away from the piston housing.



2 Remove the seal holder and the seal wash support rings from the piston housing. Remove the seal holder from the support ring assembly.



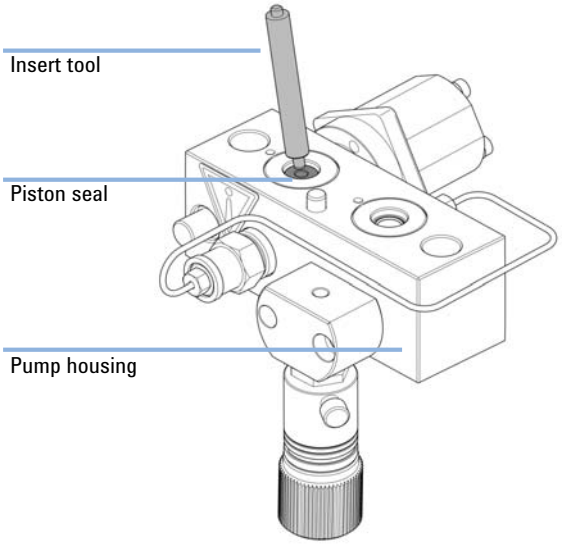
3 Check the piston surface and remove any deposits or layers. Most suitable is polishing of the piston rod with toothpaste. Replace the piston if scratched or if dents are visible.



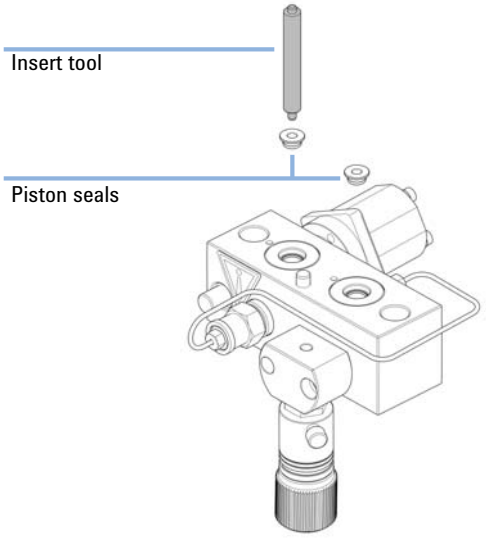
NOTE

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

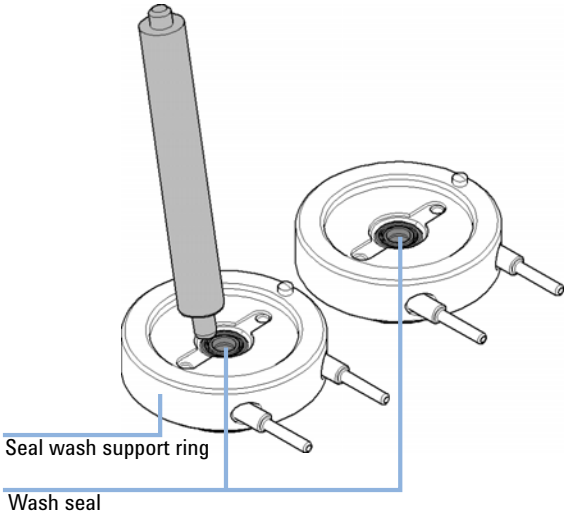
4 Using the steel side of the insert tool carefully remove the seal from the pump housing. Remove wear retainers, if still present.



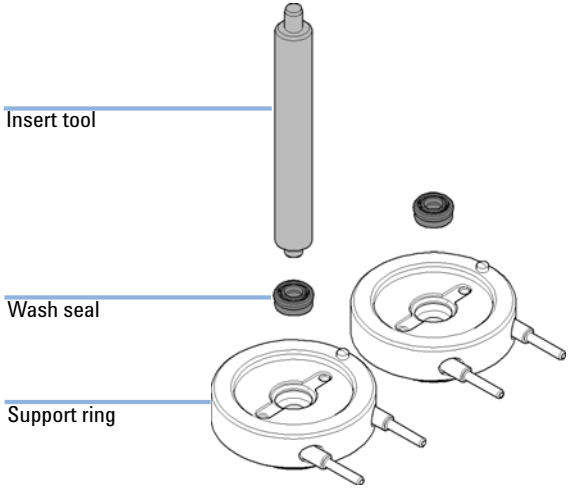
5 Using the plastic side of the insert tool insert the new seals into the pump head and press them firmly in position.



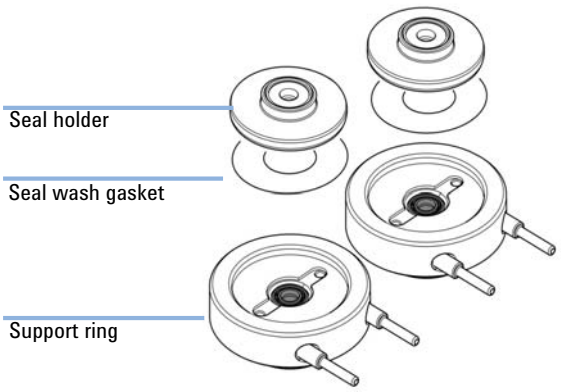
6 Using the steel side of the insert tool remove the seal wash gasket and the wash seal from the support ring. The removed seal will be damaged and cannot be re-used!



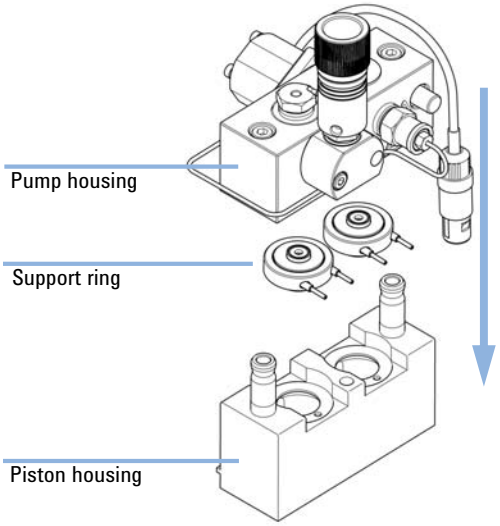
7 Using the plastic side of the insert tool press the new wash seal (spring pointing upwards) into the recess of the support ring.



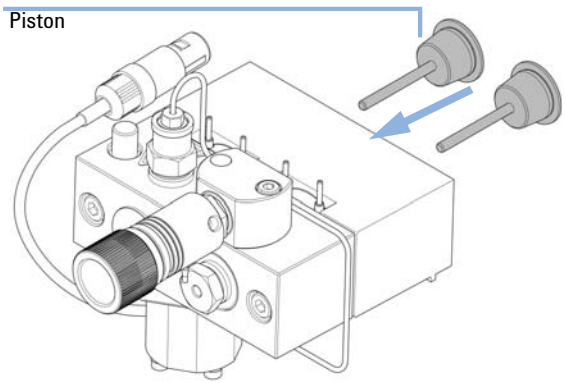
8 Place a seal wash gasket in the recess of the support ring. Put the seal holder on top of the gasket.



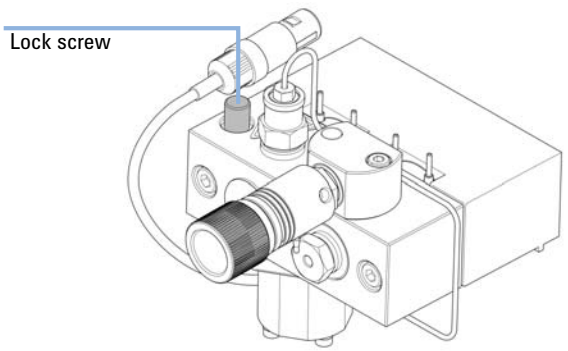
9 Place the support rings on the piston housing (pistons not installed) and snap the pump housing and piston housing together. Note the correct position of the pin on the support ring.



10 Insert the pistons and carefully press them into the seals.



11 Tighten the lock screw.



12 Reinstall the pump head assembly, see "Reinstalling the Pump Head Assembly" on page 145.

Reinstalling the Pump Head Assembly

When When reassembling the pump

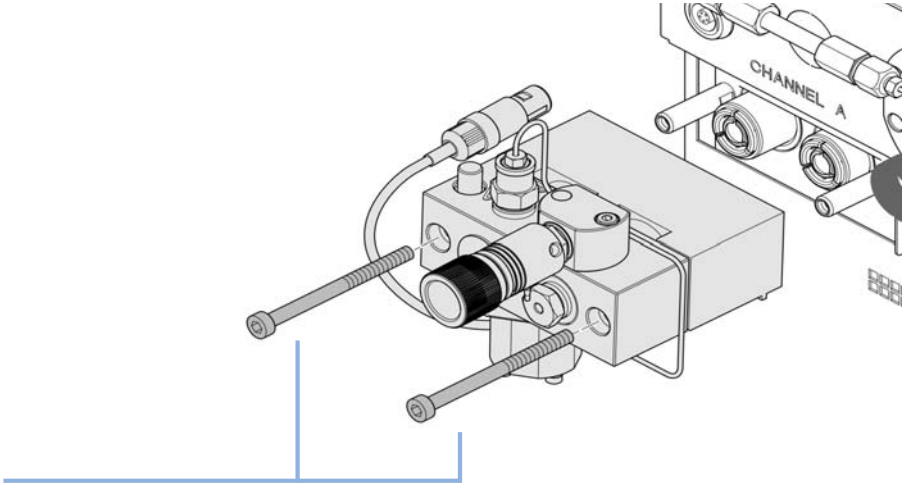
Tools required

p/n	Description
8710-2411	Hexagonal key, 3 mm
	Hexagonal key, 4 mm

Parts required

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

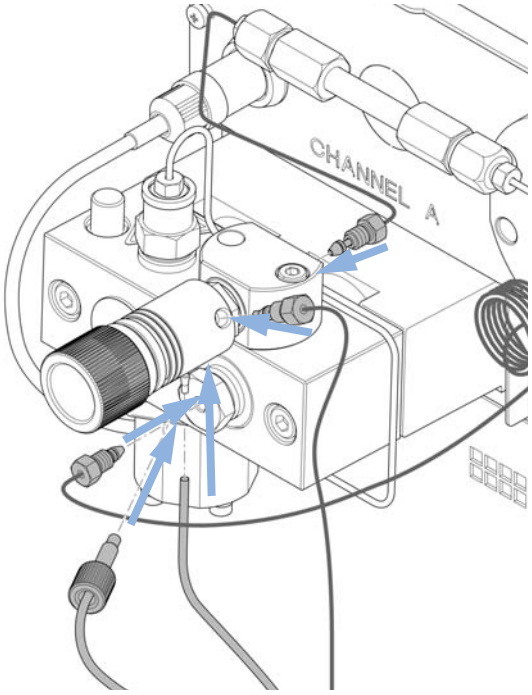
1 Slide the pump head assembly onto the pump drive.



Pump head screws

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

3 Reconnect the capillaries at the back of the purge valve holder, the pump head adapter and the tube at the active inlet valve. Reconnect the active inlet valve connector.



Seal Wear-in Procedure

CAUTION

Seal damage

This procedure is required for black PTFE seals (standard applications, p/n 5063-6589), but it will damage the yellow PE seals (normal phase applications, p/n 0905-1420).

➔ Do not run the seal wear-in procedure if PE seals are installed in the pumphead.

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 1/4-28 to 10-32 (p/n 0100-1847) onto the active inlet valve and connect the inlet tube from the bottle head directly to it.
3. Connect the Restriction capillary (p/n 5022-2159) to the purge valve. Connect its other end to a waste container.
4. Open the purge valve and purge the system for 5 min 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 OFF the pump, 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 the solvent selection valve (if installed) to the AIV.
7. Purge your system with the solvent used for your next application.

Exchanging the Active Inlet Valve or its Cartridge

When If internally leaking (backflow)

Tools required

Description
Wrench, 14 mm

Parts required

p/n	Description
G1312-60025	Active inlet valve body, without cartridge
G1312-60020	Cartridge for active inlet valve 600 bar

Preparations

- Switch off pump at the main power switch and unplug the power cable.
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.

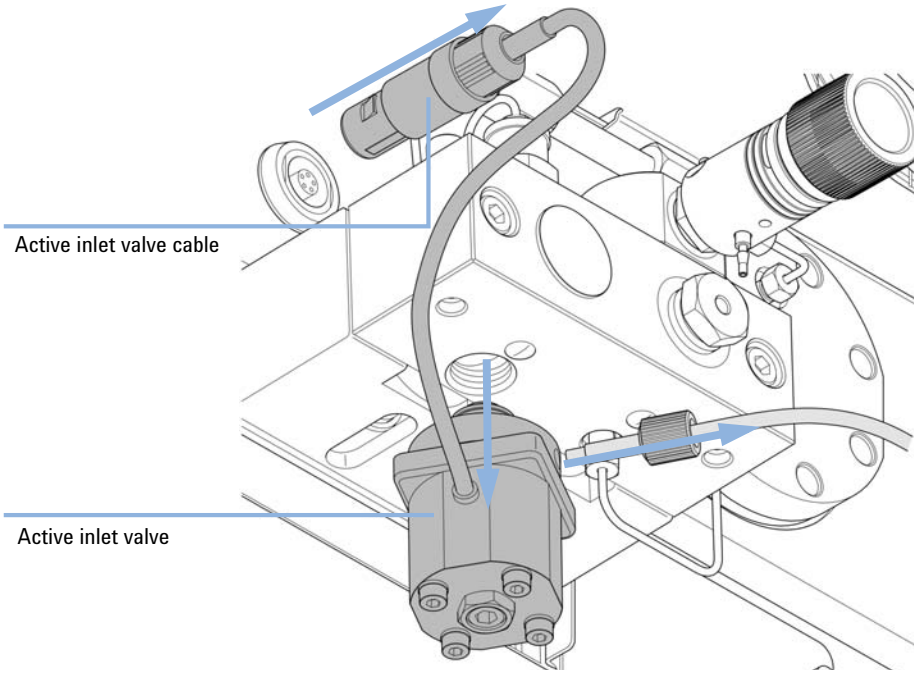
1 Remove the front cover.

2 Unplug the active inlet valve cable from the connector.

3 Disconnect the solvent inlet tube at the inlet valve (beware of leaking solvents).

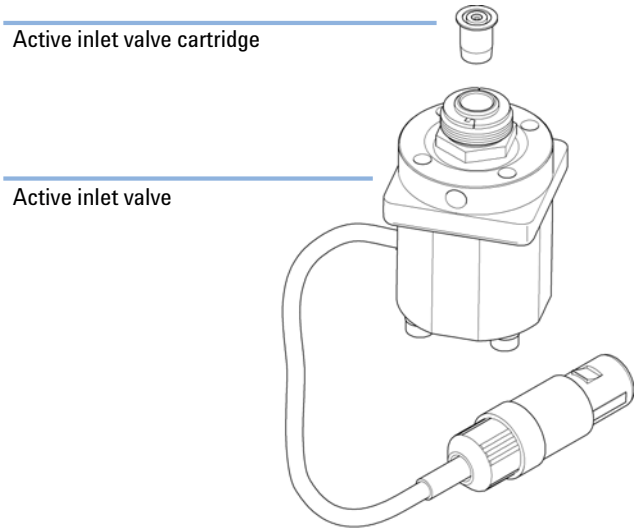
NOTE Binary pumps without solvent selection valve (SSV) have an adapter installed between the solvent line and the active inlet valve (AIV). Disconnect the solvent tubes at the adapter and remove the adapter from the AIV.

4 Using a 14 mm wrench loosen the active inlet valve and remove the valve from pump head.



5 Using a pair of tweezers, remove the valve cartridge from the defective active inlet valve.

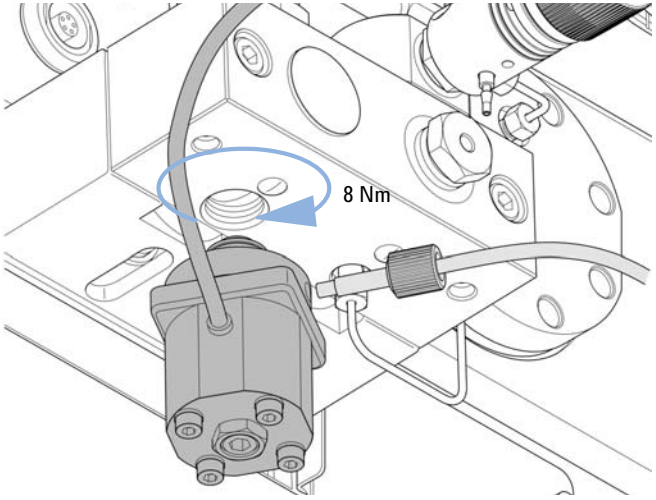
6 Push the cartridge into the new active inlet valve.



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

8 Position the valve such that the solvent inlet tube connection points towards the front.

9 Tighten the nut by turning the valve in its final position using a torque wrench (8 Nm).



10 Reconnect the Active Inlet Valve cable to the connector at the Z-panel and the inlet tube to the valve.

11 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

Description
Wrench, 1/4 - 1/5 inch
Wrench 1/4 inch
Wrench, 14 mm

Parts required

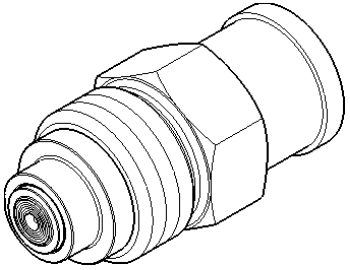
p/n	Description
G1312-60067	Outlet valve 1220/1260

Preparations Switch off the pump at the main power switch

1 Using a ¼ inch wrench disconnect the absorber capillary from the outlet valve.

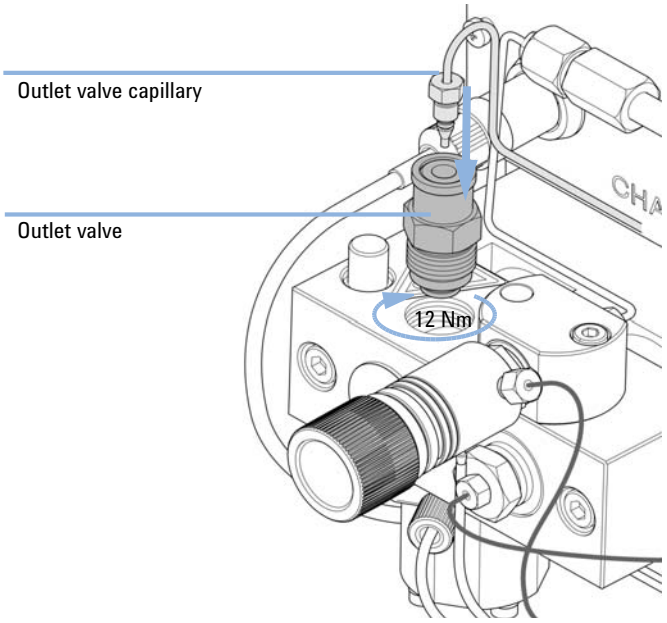
2 Unscrew the valve with the 14 mm wrench and remove it from the pump body.

3 Do not disassemble the outlet valve, as this can damage the valve.



4 Reinstall the outlet valve and tighten it using a torque wrench (12 Nm).

5 Reconnect the capillary at the outlet valve.



Installation of the Solvent Selection Valve Upgrade Kit

A solvent selection valve allows you to choose between four 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 Infinity Binary Pumps G1312B and G1312C.

Tools required

Description
Screwdriver Pozidriv #1

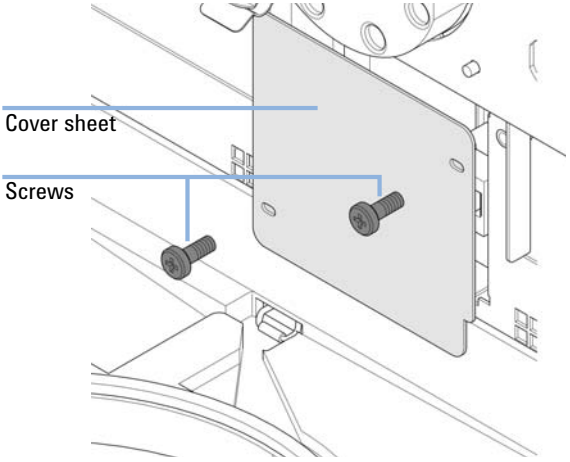
Parts required

p/n	Description
G1381-60000	Solvent Selection Valve Upgrade Kit

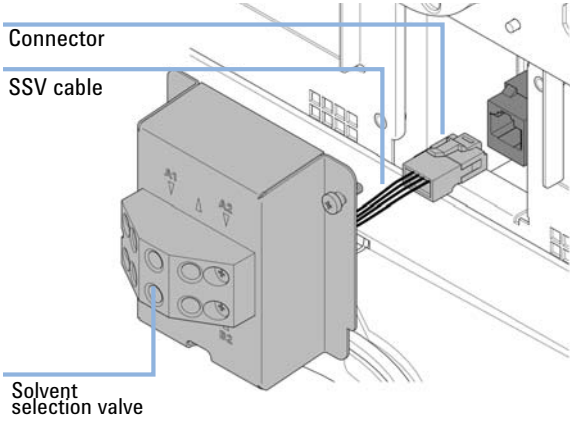
Preparations If required, remove solvent tubes from the inlet valves.

NOTE The figures below show a Binary Pump G1312B. The kit can be used similarly for the Binary Pump G1312C.

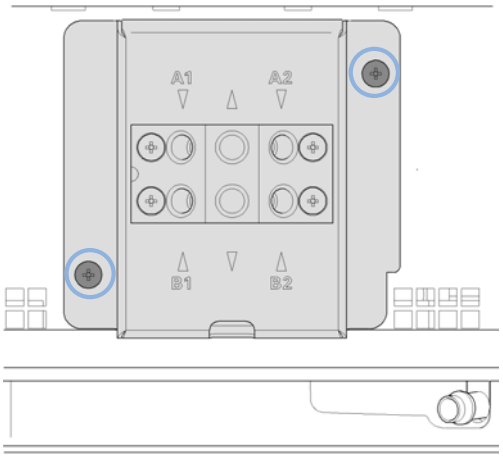
1 Remove the front cover sheet by removing both screws.



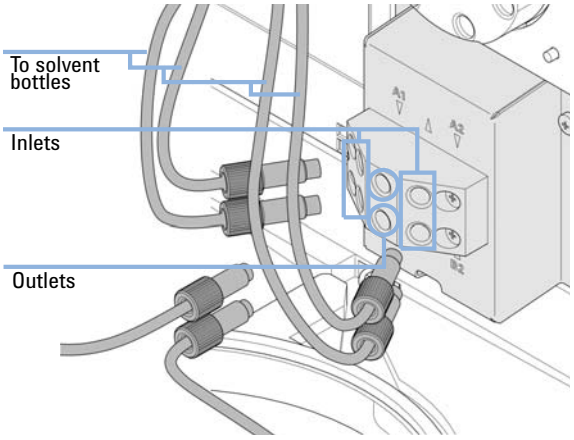
2 Plug in the connector of the solvent selection valve



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

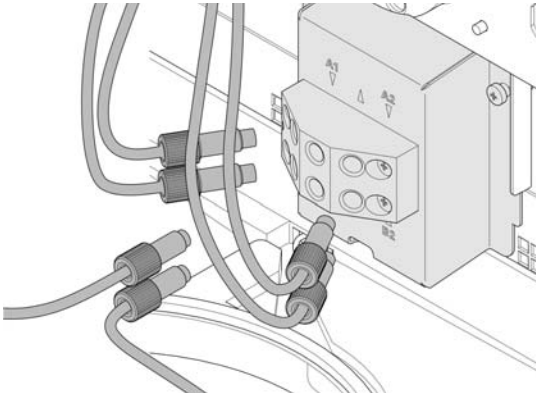
Tools required

p/n	Description
8710-0899	Screwdriver, Pozidriv #1

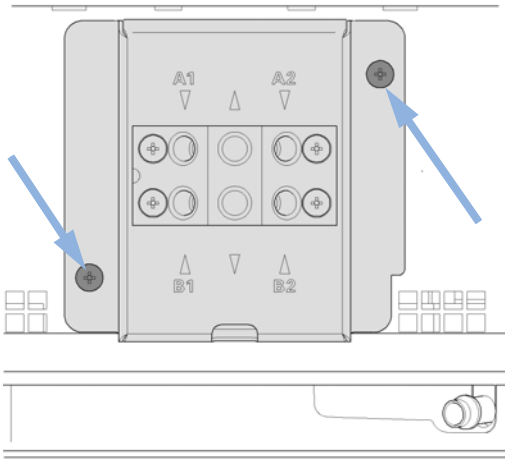
Parts required

p/n	Description
G1381-60000	Solvent Selection Valve Upgrade Kit

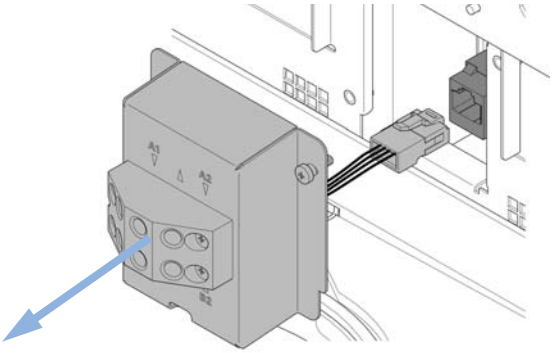
Preparations Switch off the pump at the main power switch

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. 

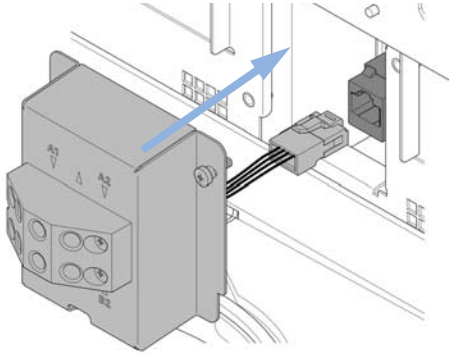
3 Using a Pozidriv screwdriver #1 loosen the holding screws of the valve holder.



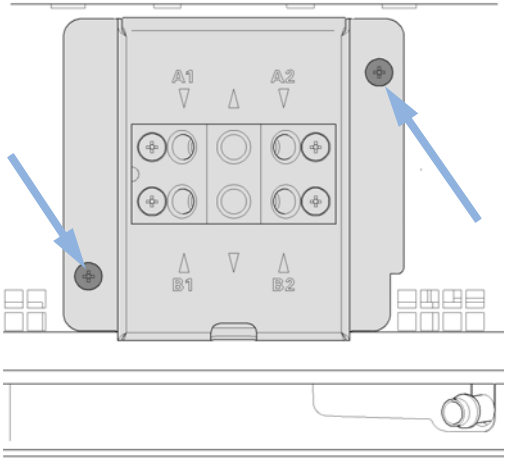
4 Carefully pull the valve holder out and disconnect the valve cable at the connector.

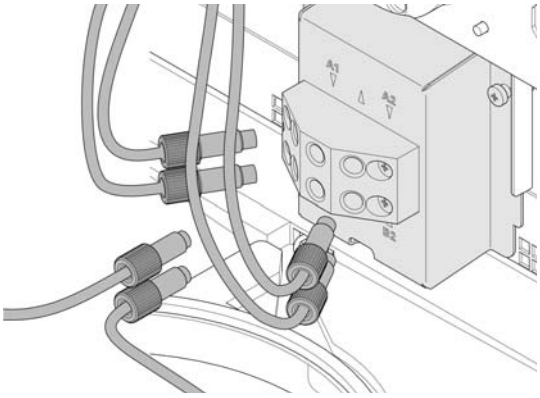


5 Exchange the defective solvent selection valve.



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.

Exchanging the Optional Interface Board

When Board defective

Parts required

#	Description
1	BCD (Interface) board

Preparations

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

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 Disconnect cables from the interface board connectors.

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

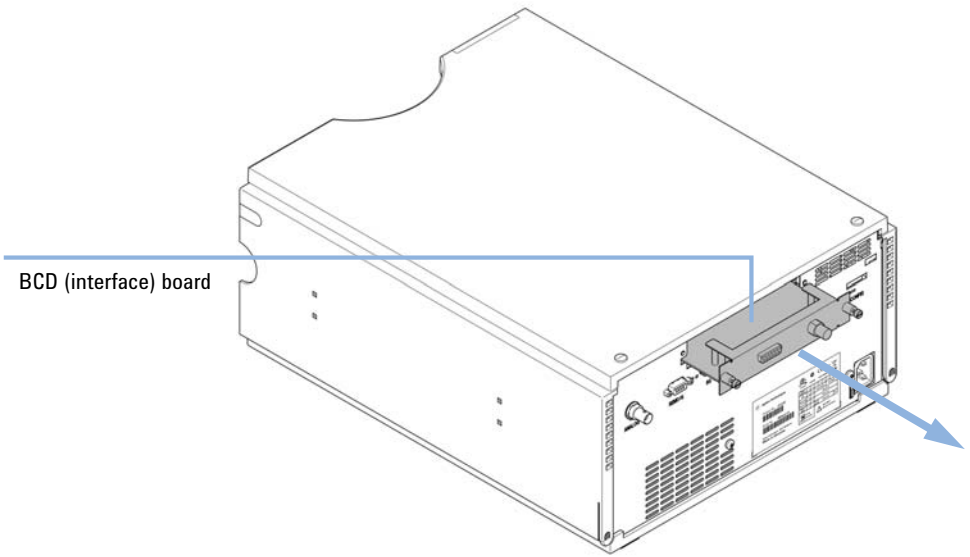


Figure 16 Exchanging the Interface Board

3 Install the new interface board. Secure the screws.

4 Reconnect the cables to the board connector

Replacing the 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

	Description
	LAN/RS-232 Firmware Update Tool
OR	Agilent Diagnostic Software
OR	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. For loading the firmware into the module follow the instructions in the documentation.

Module Specific Information

There is no specific information for this module.

10
Parts for Maintenance

This chapter provides information on parts for maintenance.

Pump Head Assembly Without Seal Wash

Item	p/n	Description
1	5063-6586	Sapphire piston
2	G1311-60002	Piston housing
3	5067-1560	Support Ring SL, no seal wash
4	5062-2484	Gasket, seal wash (pack of 6)
5	5042-8952	Seal holder
6	G1312-67300	Capillary, outlet valve to piston 2
7	5063-6589	Piston seal PTFE, carbon filled, black (pack of 2), default
8	G1311-25200	Pump chamber housing
9	0515-0175	Mounting screw for manual purge valve holder, M4, 20 mm long
10	G1312-23200	Holder for manual purge valve
11	G1312-60061	Purge valve 1260
12	G1312-60067	Outlet valve 1220/1260
13	5042-1303	Lock screw
14	G1312-60025	Active inlet valve body, without cartridge
	G1312-60020	Cartridge for active inlet valve 600 bar
15	G1312-23201	Adapter
16	0515-2118	Pump head screw (M5, 60 mm)

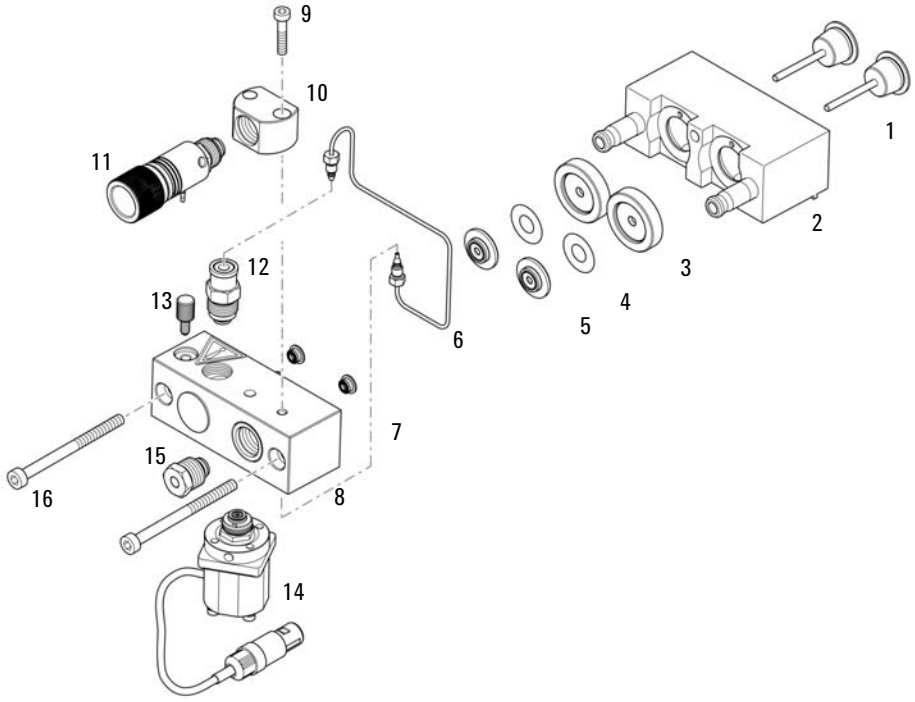


Figure 17 Pump Head Assembly Without Seal Wash

Pump-Head Assembly with Seal Wash

Item	p/n	Description
1	5065-9953	Seal wash pump assembly
	5042-8507	Peristaltic pump cartridge, silicone tubing
2	5063-6586	Sapphire piston
3	G1311-60002	Piston housing
4	01018-60027	Support ring seal wash
	0890-1764	Tubing (seal wash)
5	0905-1175	Wash seal (PTFE)
6	5062-2484	Gasket, seal wash (pack of 6)
7	5042-8952	Seal holder
8	G1312-67300	Capillary, outlet valve to piston 2
9	5063-6589	Piston seal PTFE, carbon filled, black (pack of 2), default
10	G1311-25200	Pump chamber housing
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 1260
14	G1312-60067	Outlet valve 1220/1260
15	5042-1303	Lock screw
16	G1312-60025	Active inlet valve body, without cartridge
	G1312-60020	Cartridge for active inlet valve 600 bar
17	G1312-23201	Adapter
18	0515-2118	Pump head screw (M5, 60 mm)

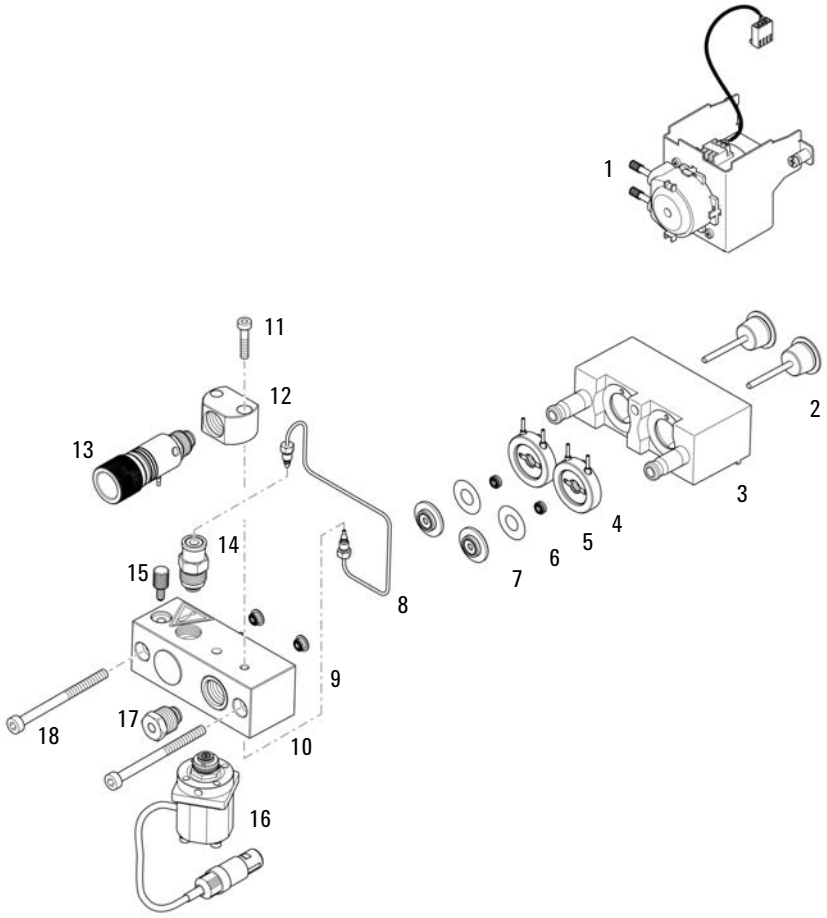


Figure 18 Pump head assembly with seal wash option

Outlet Valve

p/n	Description
G1312-60067	Outlet valve 1220/1260

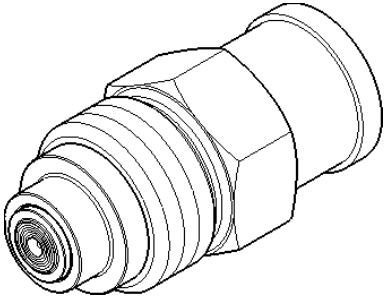


Figure 19 Outlet Valve

Purge Valve Assembly

Item	p/n	Description
1	G1312-60061	Purge valve 1260
2	01018-22707	PTFE frits (pack of 5)
3	5067-4728	Seal cap

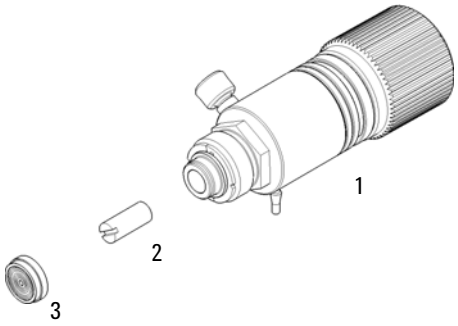


Figure 20 Purge Valve Assembly

Active Inlet Valve Assembly

Item	p/n	Description
1	G1312-60025	Active inlet valve body, without cartridge
2	G1312-60020	Cartridge for active inlet valve 600 bar

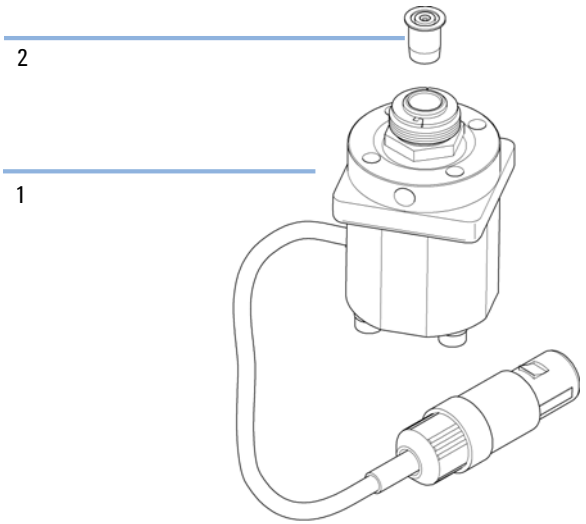


Figure 21 Active Inlet Valve Assembly

Accessory Kit

Accessory Kit (p/n G1311-68755)

p/n	Description
5062-2461	Waste tube, 5 m (reorder pack)
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
G1329-87300	StS Capillary 0.17 mm, 900 mm, pump to thermostatted autosampler
G1312-87303	StS Capillary 0.17 mm, 400 mm, pump to injector
5042-9954	Tubing clip (2x), re-order 4/pk

Active Seal Wash Option

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

p/n	Description
5065-9953	Seal wash pump assembly
5042-8507	Peristaltic pump cartridge, silicone tubing
0905-1175	Secondary seal (pre-installed in support rings)
5062-2484	Gasket, seal wash (pack of 6)
5065-9978	Silicone tubing, 1 mm i.d., 3 mm o.d., 5 m, re-order number
5063-6589	Standard seals (pack of 2)
01018-23702	Insert tool

Solvent Cabinet

Item	p/n	Description
1	5067-4770	Solvent Cabinet Kit
2	5043-0207	Name plate 1260
3	5065-9954	Front panel, solvent cabinet
4	5042-8907	Leak pan, solvent cabinet
5	9301-1420	Solvent bottle, transparent
6	9301-1450	Solvent bottle, amber
7	G1311-60003	Bottle-head assembly

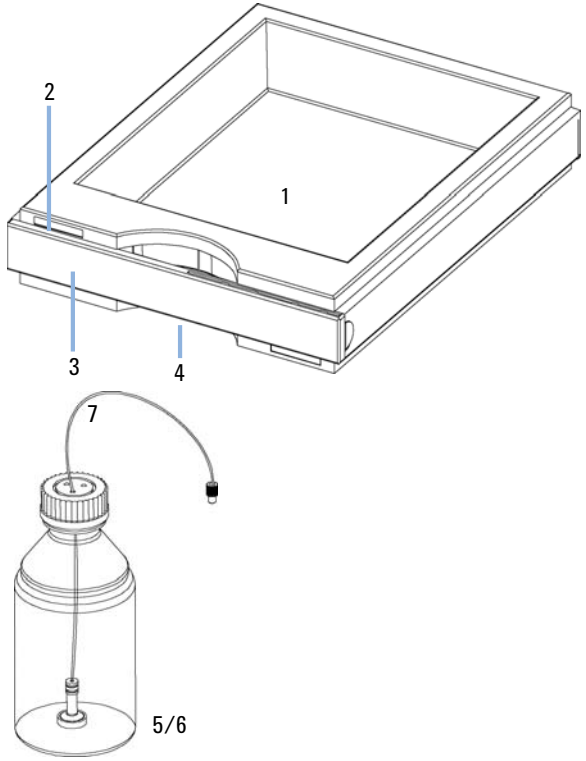


Figure 22 Solvent Cabinet Parts

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 (10/Pk)
5	5063-6599	Tube screw (10/Pk)
6	5062-2483	Solvent tubing, 5 m
7	5062-8517	Inlet filter adapter (4/Pk)
8	5041-2168	Solvent inlet filter, 20 µm pore size

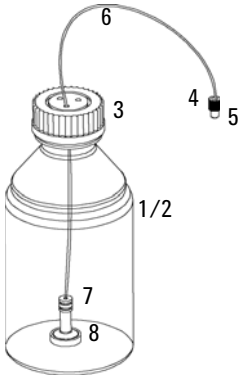


Figure 23 Bottle-Head Assembly Parts

Hydraulic Path with Solvent Selection Valve

	Item	p/n	Description
	1	G1312-67307	Capillary, damper to mixer
	2	G1312-87330	Mixer
	3	G1312-67308	Capillary, mixer to purge valve
	4	G1312-67300	Capillary, outlet valve to piston 2
	5	G1312-67304	Capillary, mixing chamber to damper inlet
	6	G1312-67302 (2x)	Capillary, channel A and B pump head outlet to mixing chamber (included)
	7	G1311-67304	Connection tube
	8	5062-2461	Waste tube, 5 m (reorder pack)
	9	G1312-67305	Outlet capillary, pump to injector
OR	9	G1329-87300	Capillary, pump to thermostattable autosampler
		G1312-67301	Capillary, damper to purge valve Capillary needed when pump used without mixer installed
		G1311-60003	Bottle-head assembly

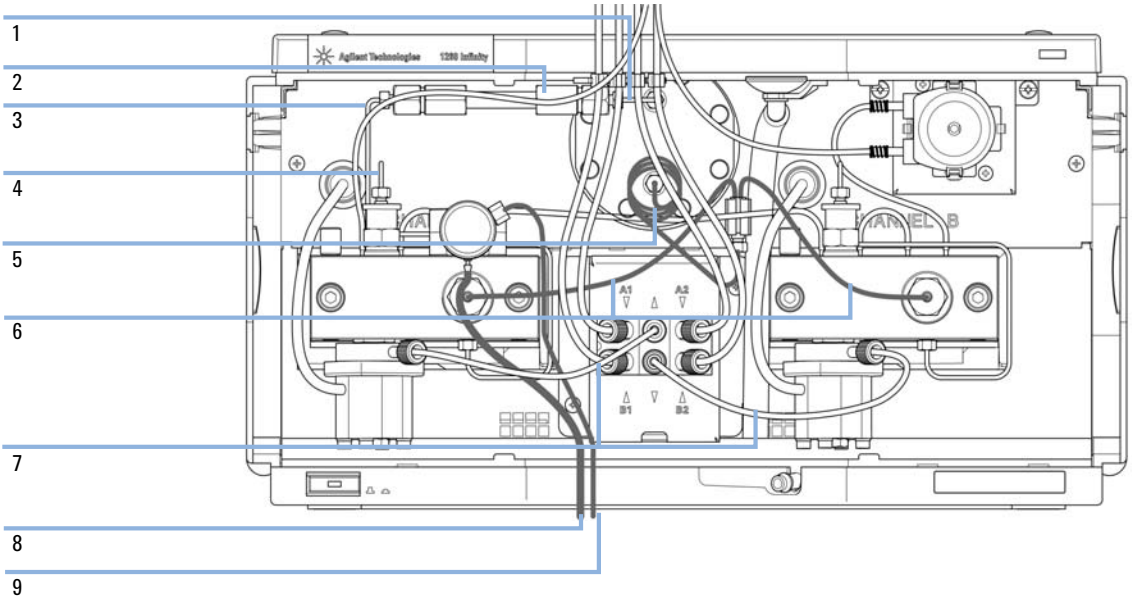


Figure 24 Hydraulic path with solvent selection valve and active seal wash option

Hydraulic Path without Solvent Selection Valve

	Item	p/n	Description
	1	G1311-60003	Bottle-head assembly
	2	G1312-67307	Capillary, damper to mixer
	3	G1312-87330	Mixer
	4	G1312-67308	Capillary, mixer to purge valve
	5	G1312-67300	Capillary, outlet valve to piston 2
	6	G1312-67304	Capillary, mixing chamber to damper inlet
	7	G1312-67302 (2x)	Capillary, channel A and B pump head outlet to mixing chamber (included)
	8	0100-1847	PEEK adapter 1/4-28 to 10-32 (Adapter AIV to solvent inlet tubes)
	9	5062-2461	Waste tube, 5 m (reorder pack)
	10	G1312-67305	Outlet capillary, pump to injector
OR	10	G1329-87300	Capillary, pump to thermostattable autosampler
		G1312-67301	Capillary, damper to purge valve Capillary needed when pump used without mixer installed

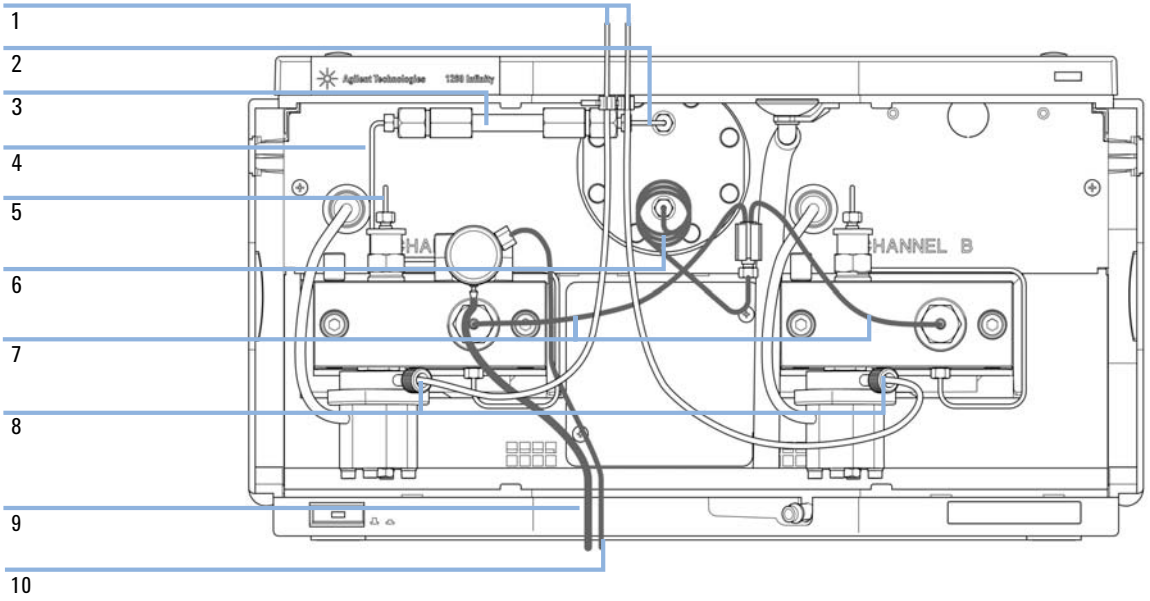


Figure 25 Hydraulic Path without Solvent Selection Valve

11
Identifying Cables

This chapter provides information on cables used with the Agilent 1200 Infinity Series modules.

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 182
03396-61010	Agilent module to 3396 Series III / 3395B integrators
5061-3378	Remote Cable
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)

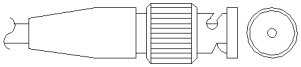
External Contact Cable

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

RS-232 cables

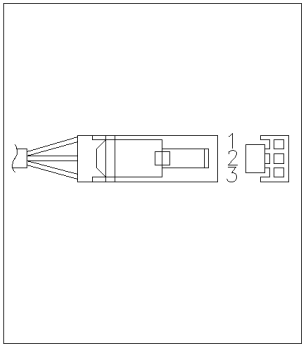
p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61600	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between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

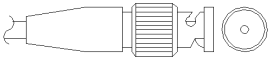


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

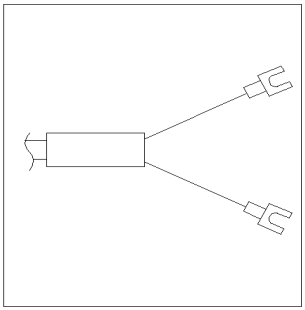
Agilent Module to 3394/6 Integrators

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 +

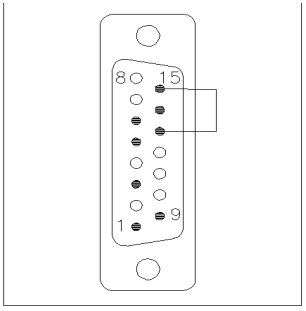
Agilent Module to General Purpose

p/n 01046-60105	Pin	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.

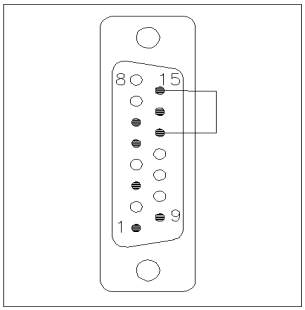
Agilent Module to 3396A Integrators

p/n 03394-60600	Pin 3396A	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	

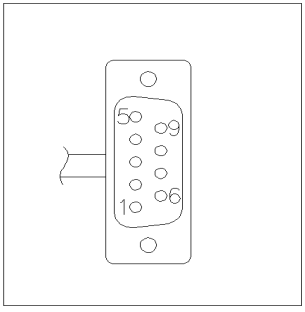
Agilent Module to 3396 Series II / 3395A Integrators

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.

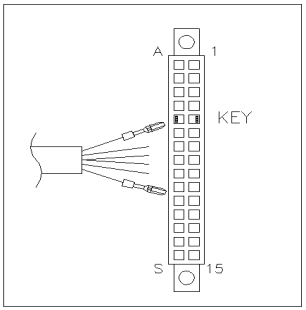
Agilent Module to 3396 Series III / 3395B Integrators

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

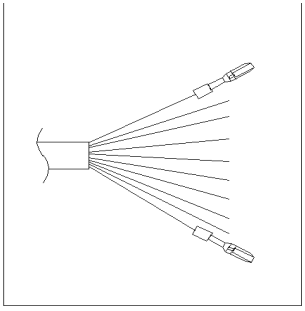
Agilent Module to General Purpose

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

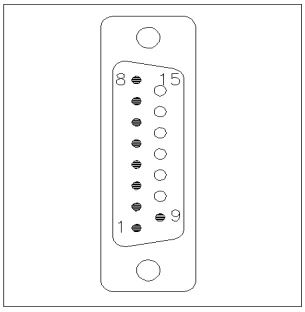
BCD Cables

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

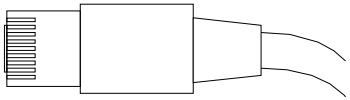
Agilent Module to General Purpose

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 Cable



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

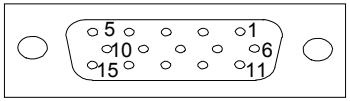
CAN Cables

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

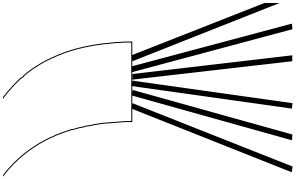
p/n	Description
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5023-0202	Twisted pair network cable, shielded, 7 m (for point to point connection)

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

Agilent Module to PC

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.

12
Hardware Information

This chapter describes the pump in more detail on hardware and electronics.

Firmware Description

The firmware of the instrument consists of two independent sections:

- a non-instrument specific section, called *resident system*
- an instrument specific section, called *main system*

Resident System

This resident section of the firmware is identical for all Agilent 1100/1200/1220/1260/1290 series modules. Its properties are:

- the complete communication capabilities (CAN, LAN and RS-232C)
- memory management
- ability to update the firmware of the 'main system'

Main System

Its properties are:

- the complete communication capabilities (CAN, LAN and RS-232C)
- memory management
- ability to update the firmware of the 'resident system'

In addition the main system comprises the instrument functions that are divided into common functions like

- run synchronization through APG remote,
- error handling,
- diagnostic functions,
- or module specific functions like
  - internal events such as lamp control, filter movements,
  - raw data collection and conversion to absorbance.

Firmware Updates

Firmware updates can be done using your user interface:

- PC and Firmware Update Tool with local files on the hard disk
- Instant Pilot (G4208A) with files from a USB Flash Disk
- Agilent Lab Advisor software B.01.03 and above

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

PPPP is the product number, for example, 1315AB for the G1315A/B DAD,

R the firmware revision, for example, A for G1315B or B for the G1315C DAD,

VVV is the revision number, for example 102 is revision 1.02,

XXX is the build number of the firmware.

For instructions on firmware updates refer to section *Replacing Firmware* in chapter *"Maintenance"* or use the documentation provided with the *Firmware Update Tools*.

NOTE

Update of main system can be done in the resident system only. Update of the resident system can be done in the main system only.

Main and resident firmware must be from the same set.

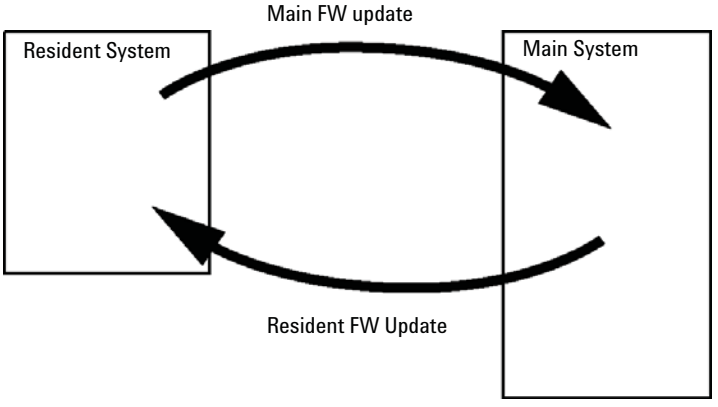


Figure 26 Firmware Update Mechanism

NOTE

Some modules are limited in downgrading due to their main board version or their initial firmware revision. For example, a G1315C DAD SL cannot be downgraded below firmware revision B.01.02 or to a A.xx.xx.

Some modules can be re-branded (e.g. G1314C to G1314B) to allow operation in specific control software environments. In this case the feature set of the target type are use and the feature set of the original are lost. After re-branding (e.g. from G1314B to G1314C), the original feature set is available again.

All these specific informations are described in the documentation provided with the firmware update tools.

The firmware update tools, firmware and documentation are available from the Agilent web.

- http://www.chem.agilent.com/EN-US/SUPPORT/DOWNLOADS/FIRMWARE/Pages/LC.aspx

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.

Rear View of the Module

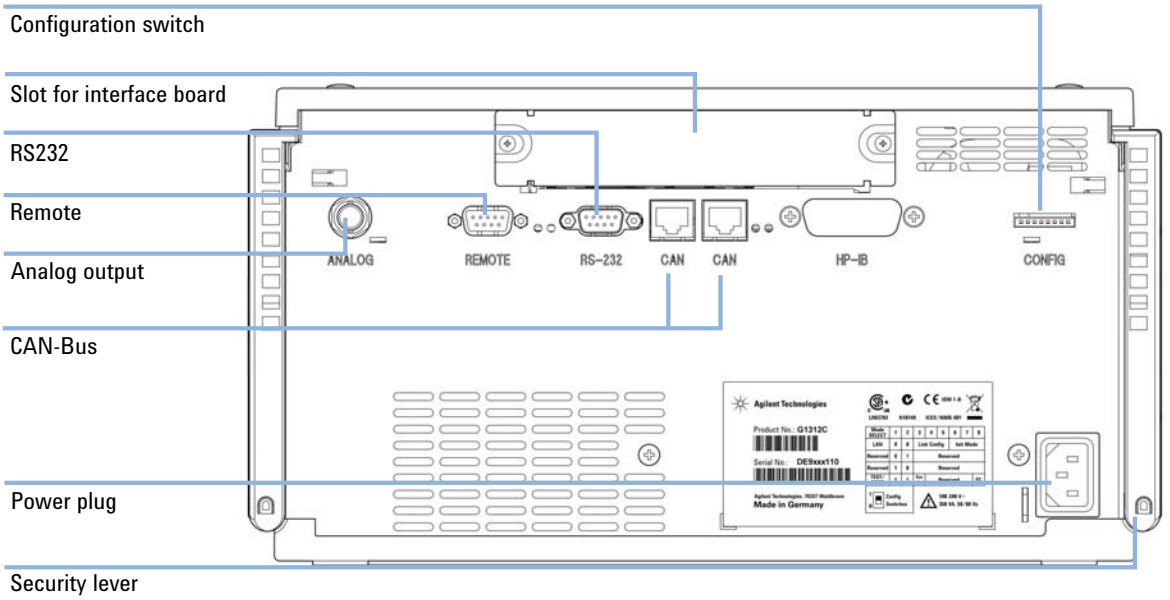


Figure 27 Electrical connections to the binary pump

NOTE The GPIB interface has been removed with the introduction of the 1260 Infinity modules.

Interfaces

The Agilent 1200 Infinity Series modules provide the following interfaces:

Table 11 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 G5611A Bio-inert Quat 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 G5664A Bio-inert FC-AS G5667A Bio-inert Autosampler	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B CAN-DC- OUT for CAN slaves
G4226A ALS	2	Yes	No	Yes	No	Yes	

Table 11 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN/BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
Detectors							
G1314B VWD VL G1314C VWD VL+	2	Yes	No	Yes	1	Yes	
G1314E/F VWD	2	No	Yes	Yes	1	Yes	
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							
G1170A Valve Drive	2	No	No	No	No	No	Requires a HOST module with on-board LAN (e.g. G4212A or G4220A with minimum firmware B.06.40 or C.06.40) or with additional G1369C LAN Card
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	Yes	
G4225A DEG	No	No	No	Yes	No	Yes	
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 G1369B/C 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 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 12 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

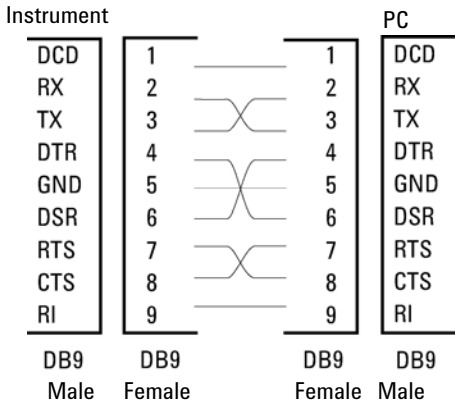


Figure 28 RS-232 Cable

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 13 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 (without On-board) LAN

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

This module does not have its own on-board LAN interface. It can be controlled through the LAN interface of another module, and a CAN connection to that module.

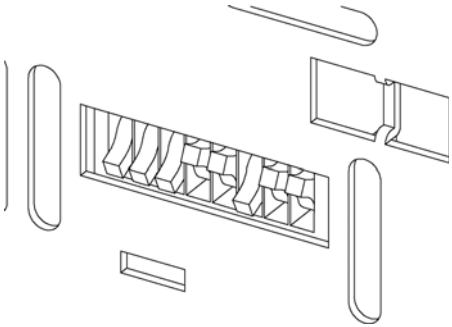


Figure 29 Configuration switch (settings depend on configured mode)

All modules without on-board LAN:

- default should be ALL DIPS DOWN (= best settings)
  - Bootp mode for LAN and
  - 19200 baud, 8 data bit / 1 stop bit with no parity for RS-232
- DIP 1 DOWN and DIP 2 UP allows special RS-232 settings
- for boot/test modes DIPS 1+2 must be UP plus required mode

NOTE For normal operation use the default (best) settings.

Switch settings provide configuration parameters for 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 14 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 G1369B/C. 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 15 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 16 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 17 Data Bit Settings (without on-board LAN)

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

Table 18 Parity Settings (without on-board LAN)

Switches		Parity
7	8	
0	0	No Parity
0	1	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).

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 19 Boot Resident Settings (without on-board LAN)

Mode Select	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
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 calibration settings, 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 20 Forced Cold Start Settings (without on-board LAN)

Mode Select	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
TEST/BOOT	1	1	0	0	1	0	0	1

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Appendix

This chapter provides addition information on safety, legal and web.

General Safety 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, observe appropriate safety procedures (for example, 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 21 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.

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)

Agilent Technologies on Internet

For the latest information on products and services visit our worldwide web site on the Internet at:

http://www.agilent.com

Select Products/Chemical Analysis

It will provide also the latest firmware of the modules for download.

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In This Book

This manual contains technical reference information about the Agilent 1260 Infinity Binary Pump VL (G1312C). The manual describes the following:

- introduction,
- requirements,
- installation,
- configuring the pump,
- using the pump,
- optimizing performance,
- troubleshooting and diagnostics,
- maintenance,
- parts and materials,
- identifying cables,
- hardware information
- safety.

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