Agilent

Agilent InfinityLab LC Series Preparative Binary Pumps

User Manual

Notices

Manual Part Number

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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 following modules:

- Agilent 1260 Infinity II Preparative Binary Pump (G7161A)
- Agilent 1290 Infinity II Preparative Binary Pump (G7161B)

1 Introduction

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

2 Site Requirements and Specifications

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

3 Using the Pump

This chapter explains the operational parameters of the module.

4 Optimizing Performance

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

5 Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

6 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.

7 Maintenance

This chapter describes the maintenance of the module.

8 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

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This chapter provides information on cables used with the modules.

10 Hardware Information

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

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This chapter provides information on connecting the module to the Agilent ChemStation PC.

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

Contents

1 Introduction

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

G7161A Preparative Binary Pump

Product Description

The 1260 Infinity II Preparative Binary Pump is an affordable high-pressure gradient pump for LC purification. This pump has been designed and tested for reverse-phase solvents and engineered for continuous use to provide reliable and rugged performance through a dual-piston, rapid-refill design. It delivers flow from 1 to 50 mL/min and is ideally suited for a broad range of semi-preparative applications using conventional columns up to 30 mm id.

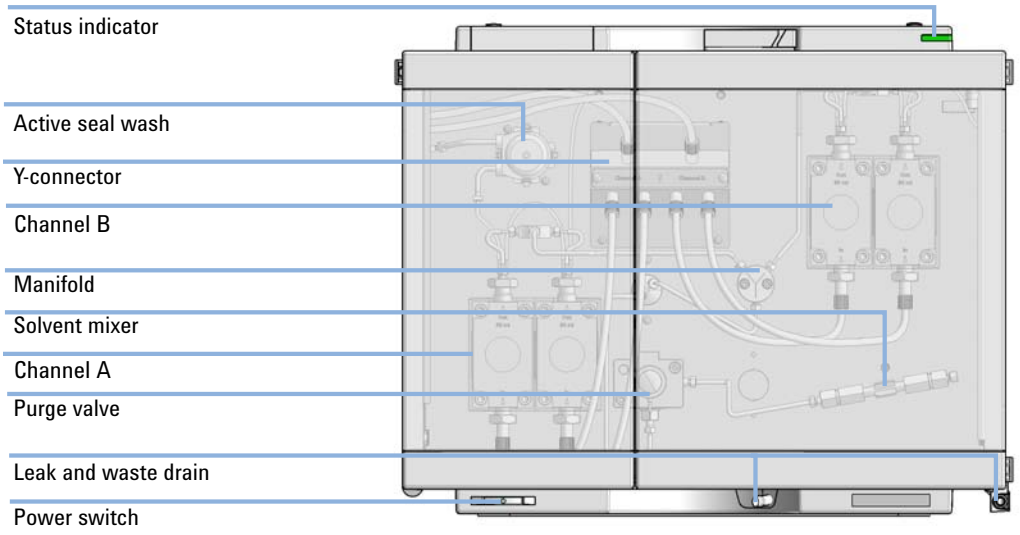


Figure 1 Overview of the pump

Features

Purification efficiency

- Outstanding retention time stability for routine operation

Instrument efficiency

- Dynamic flow range up to 50 mL/min at 420 bar for semi-preparative applications
- Outstanding binary gradient compositional accuracy across a wide dynamic flow range

Laboratory efficiency

- Upper and lower pressure limits with automatic cutoff for increased safety in the event of column blockage or leakage
- Automated seal wash for extended seal lifetime

G7161B Preparative Binary Pump

Product Description

The 1290 Infinity II Preparative Binary Pump is an affordable high-pressure gradient pump for LC purification. This pump has been designed and tested for reverse-phase solvents and engineered for continuous use to provide reliable and rugged performance through a dual-piston, rapid-refill design. It delivers flow from 1 to 200 mL/min and is ideally suited for a broad range of semi-preparative applications using conventional columns up to 50 mm id.

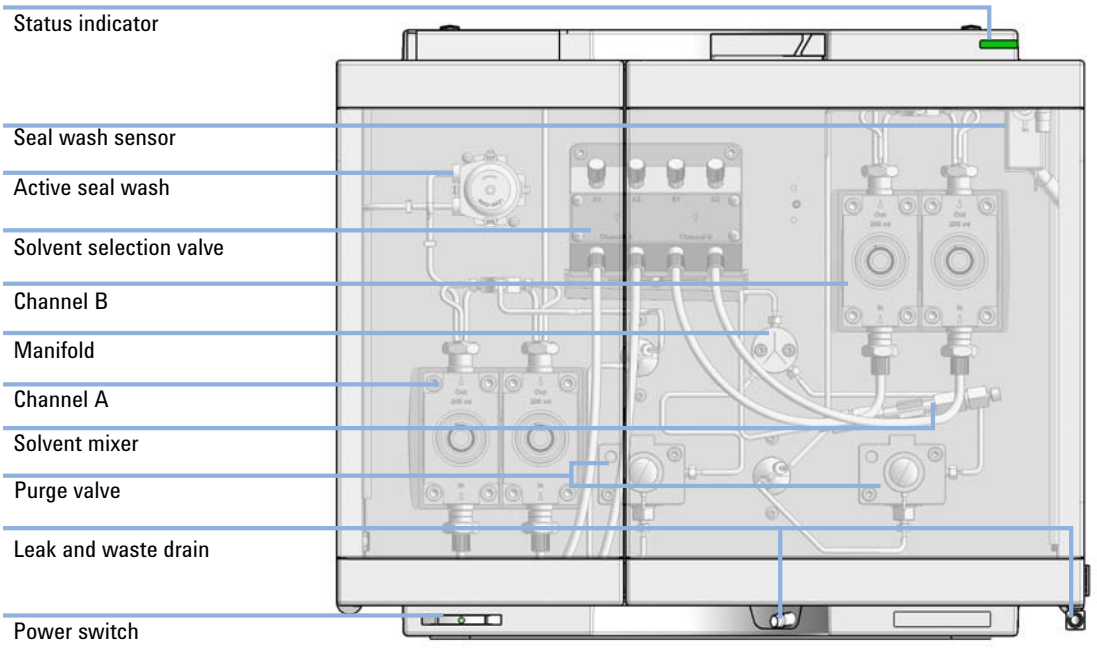


Figure 2 Overview of the pump

Features

Purification efficiency

- Outstanding retention time stability for routine operation

Instrument efficiency

- Exchangeable pump heads deliver maximum efficiency and performance across the entire flow range
- Dynamic flow range up to 50 mL/min at 600 bar using the analytical to preparative pump head
- Dynamic flow range up to 200 mL/min using the preparative pump head
- Outstanding binary gradient compositional accuracy across a wide dynamic flow range

Laboratory efficiency

- Upper and lower pressure limits with automatic cutoff for increased safety in the event of column blockage or leakage
- Built-in active seal-wash for increased uptime

Flow Reduction

Flow Reduction when Column Switching

In a pressure cluster hosted by a Preparative Binary Pump, the flow reduction feature protects the instrument and column from pressure spikes caused by a switching valve by reducing the flow rate before switching the valve.

The flow reduction sequence is as follows:

1. A valve switch command is issued by the user or method.
2. The flow rate is reduced to zero mL/min at the rate defined in the **Flow ramp down** setting (default: 600 mL/min/min) of the active method.
3. When the flow rate reaches zero mL/min the pump sends a signal to the valve that it is safe to switch.
4. The valve switches and sends a signal to the pump when it is at its new position.
5. The flow rate is increased to the current set point defined in the **Flow ramp up** setting (default: 600 mL/min/min) of the active method.

NOTE

The time taken to complete the valve switch will be increased if lower flow ramp values are used.

Flow Reduction for Pump Protection (G7161B only)

The flow reduction feature protects the pump against running dry at high flow for extended periods.

The protection mechanism is triggered if the flow rate is 150 mL/min or higher and the pressure is below 20 bar for 1 min. The flow rate is then reduced to 50.00 mL/min, but the solvent composition remains unchanged. The status LED on the pump is yellow while the flow reduction is in force. In the driver dashboard, the status bar is yellow (**Not Ready**), and the tooltip of the status bar displays **Flow Limit**. The extended module tile in the dashboard displays the source of the limit as **Protect**.

To clear the flow reduction feature, either set the flow rate for the respective channel to 50 mL/min or less, or turn the pump off.

Pump Principle

Pump Principle of the 1260 Infinity II Preparative Binary Pump (G7161A): The solvent flow leaving the two pump heads on each channel is combined by a t-piece before passing through the manifold, which combines the flow from both pump channels. From the manifold, the combined flow is routed to a pressure sensor, then into the purge valve from which the flow goes through the mixer and onto the next module (normally injection valve or sampling device).

Pump Principle of the 1290 Infinity II Preparative Binary Pump (G7161B): The solvent flow leaving each pump head is combined by a t-piece, then passed through a pressure sensor and then into a purge valve before being combined at the manifold, which combines the flow from both channels. The flow then passes through the mixer and onto the next module (normally injection valve or sampling device).

Gradients are formed by the pump by combining the flow from both pump head channels at high pressure, minimizing the need for degassing. To avoid outgassing in the detector-cell, a back pressure regulating device is recommended for applications that demand it.

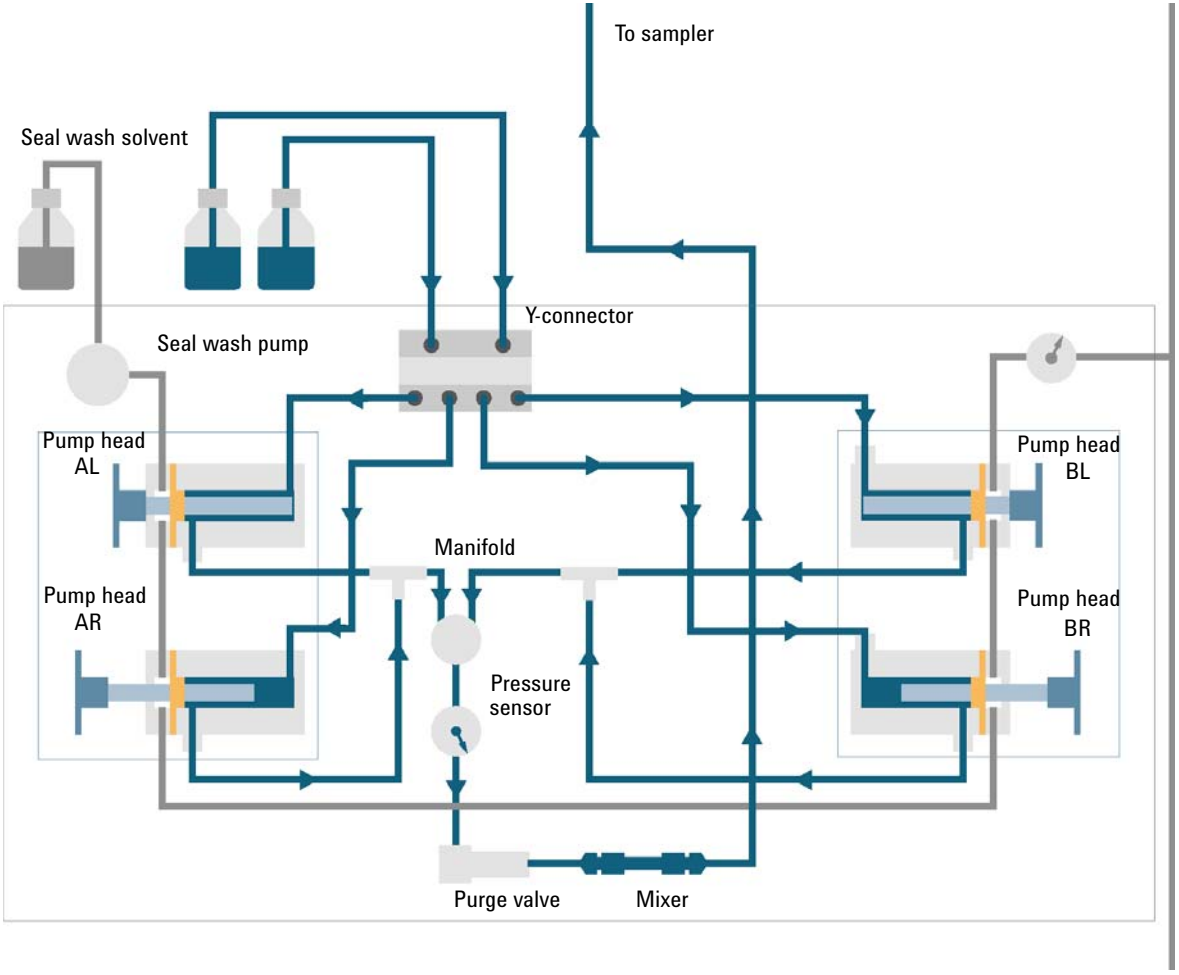


Figure 3 Hydraulic path of the pump (G7161A)

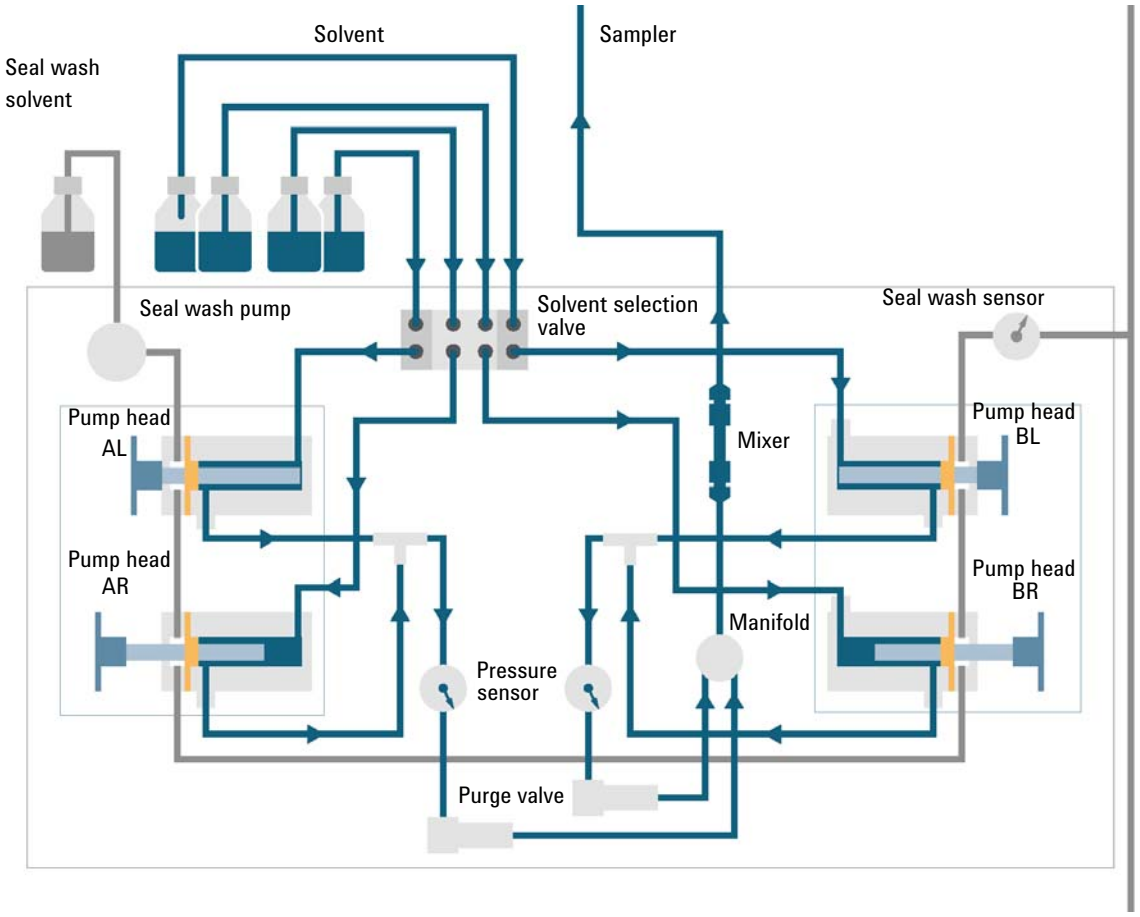
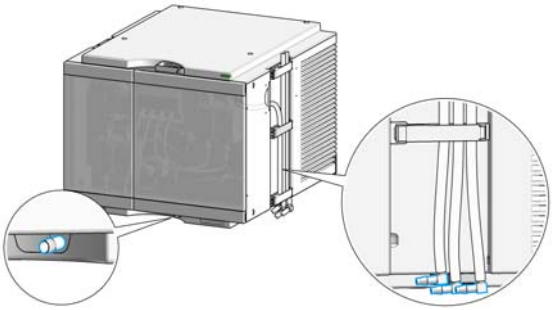


Figure 4 Hydraulic path of the pump (G7161B)

Leak and Waste Handling

1 The figure below shows the leak and waste drain outlets of the module.



NOTE

Each module must have its own waste line. Waste lines cannot be combined.

Leak Sensor

CAUTION

Solvent incompatibility

The solvent DMF (dimethyl formamide) leads to corrosion of the leak sensor. The material of the leak sensor, PVDF (polyvinylidene fluoride), is incompatible with DMF.

✓ **Do not use DMF.**

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 1 on page 24. 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

Electrical shock hazard

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

The cover protects users from personal injuries, for example electrical shock.

- ✓ **Do not open the cover.**
- ✓ **Do not operate the instrument and disconnect the power cable in case the cover has any signs of damage.**
- ✓ **Contact Agilent for support and request an instrument repair service.**

WARNING

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

Country-specific power cords are available for 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.

Agilent makes sure that your instrument is shipped with the power cord that is suitable for your particular country or region.

WARNING

Unintended use of power cords

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

- ✓ **Never use a power cord other than the one that Agilent shipped with this instrument.**
- ✓ **Never use the power cords that Agilent Technologies supplies with this instrument for any other equipment.**
- ✓ **Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.**

WARNING

Absence of ground connection

The absence of ground connection can lead to electric shock or short circuit.

- ✓ **Never operate your instrumentation from a power outlet that has no ground connection.**

WARNING

Electrical shock hazard

Solvents may damage electrical cables.

- ✓ **Prevent electrical cables from getting in contact with solvents.**
- ✓ **Exchange electrical cables after contact with solvents.**

Bench Space

The module dimensions and weight (see Table 1 on page 24) 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.

WARNING

Heavy weight

The module is heavy.

- ✓ **Carry the module at least with 2 people.**
- ✓ **Avoid back strain or injury by following all precautions for lifting heavy objects.**
- ✓ **Ensure that the load is as close to your body as possible.**
- ✓ **Ensure that you can cope with the weight of your load.**

Condensation

CAUTION

Condensation within the module

Condensation can 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.**

Thermal Equilibration

CAUTION

Inadequate Thermal Equilibration

Inadequate equilibration can cause damage to the system.

- ✓ **Ensure the pump is kept at operating conditions for 24 hours before switching it on.**

Physical Specifications

Table 1 Physical Specifications

Type	Specification	Comments
Weight	27.2 kg	
Dimensions (height × width × depth)	320 x 396 x 436 mm (12.6 x 15.6 x 17.2 inches)	
Line voltage	100 – 240 V~, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	350 VA, 320 W	
Ambient operating temperature	4 – 40 °C (39 – 104 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 95 % r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 3000 m (9842 ft)	
Non-operating altitude	Up to 4600 m (15092 ft)	For storing the module
Safety standards: IEC, EN, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Performance Specifications

Performance Specifications (G7161A)

Table 2 Agilent 1260 Infinity II Preparative Binary Pump (G7161A) Performance Specifications

Feature	Specification	Comment
Settable flow range	0.01 – 50 mL/min, in 0.01 mL/min increments	
Pressure operating range	Up to 42 MPa (420 bar, 6092 psi)	
Compressibility compensation	Pre-defined or user-settable, 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	
Settable composition range	0 – 100 % in 0.1 % increments	
Recommended composition range	5 – 95 % or 50 µL/min per channel, whichever is greater	
Flow accuracy[1]	<±1.0 %	Flow rate 1 – 50 mL/min, using 100 % Channel A or B with Water or MeOH
Composition accuracy[1]	±1.0 % from 5 – 95 %	Flow rate 1 – 50 mL/min, using Water/Water + Tracer
Flow precision[1]	≤0.3 % RSD or ≤0.1 min SD whichever is greater, based on retention time at constant room temperature	Caffeine using premixed 85 % Water/15 % Acetonitrile **1** ZORBAX SB-C18 4.6x50 mm, 5 µm for 1 and 5 mL/min **2** ZORBAX SB-C18 Prep HT 21.2x50 mm, 5 µm for 20 mL/min **3** Agilent Prep-C18 30x50 mm, 5 µm for 42 mL/min

Table 2 Agilent 1260 Infinity II Preparative Binary Pump (G7161A) Performance Specifications

Feature	Specification	Comment
Composition precision[1]	≤0.3 % RSD or ≤0.1 min SD whichever is greater, based on retention time at constant room temperature	Prep LC Standard #1 (5190-6886) from 2 – 98 % Acetonitrile **1** ZORBAX SB-C18 4.6x50 mm, 5 µm for 1 and 5 mL/min **2** ZORBAX SB-C18 Prep HT 21.2x50 mm, 5 µm for 20 mL/min **3** Agilent Prep-C18 30x50 mm, 5 µm for 42 mL/min
Active Seal Wash	Included	
Instrument Control	LC & CE Drivers A.02.17 or above Instrument Control Framework (ICF) A.02.04 or above Lab Advisor software B.02.10 or above	For details about supported software versions refer to the compatibility matrix of your version of the LC and CE Drivers
Communications	Controller-area network (CAN), Local Area Network (LAN), Extended remote interface (ERI), USB, ready, start, stop and shutdown signals, external leak sensor.	
Safety features and maintenance	Extensive diagnostics, error detection and display through included Agilent LabAdvisor, leak detection, safe leak handling, leak output signal for shutdown of the pumping system. Low voltage in major maintenance areas.	

Table 2 Agilent 1260 Infinity II Preparative Binary Pump (G7161A) Performance Specifications

Feature	Specification	Comment
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	

[1] Using freshly prepared degassed mobile phase.

Performance Specifications (G7161B)

Table 3 Agilent 1290 Infinity II Preparative Binary Pump (G7161B) Performance Specifications

Feature	Specification	Comment
Settable flow range	*50 mL head:*0.01 – 50 mL/min, in 0.01 mL/min increments *200 mL head:*0.01 – 200 mL/min, in 0.01 mL/min increments	
Recommended Flow range	*50 mL head:* ≥ 1 mL/min *200 mL head:* ≥ 4 mL/min	
Pressure operating range	*50 mL head:*60 MPa (600 bar, 8702 psi) up to 50 mL/min *200 mL head:*42 MPa (420 bar, 6092 psi) up to 150 mL/min with linear ramp down to 30 MPa (300 bar, 4350 psi) at 200 mL/min	
Compressibility compensation	Pre-defined or user-settable, 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	
Settable composition range	0 – 100 % in 0.1 % increments	
Recommended composition range	*50 mL head:*2 – 98 % or 20 µL/min per channel, whichever is greater *200 mL head:*2 – 98 % or 80 µL/min per channel, whichever is greater	

Table 3 Agilent 1290 Infinity II Preparative Binary Pump (G7161B) Performance Specifications

Feature	Specification	Comment
Flow accuracy[1]	<±1.0 %	*50 mL head:* Flow rate 1 – 50 mL/min, *200 mL head:* Flow rate 4 – 150 ml/min using 100 % Channel A or B with Water or MeOH
Composition accuracy[1]	±1.0 % from 2 – 98 %	*50 mL head:* Flow rate 1 – 50 mL/min, *200 mL head:* Flow rate 4 – 200 mL/min using Water/Water + Tracer
Flow precision[1]	≤0.3 % RSD or ≤0.1 min SD whichever is greater, based on retention time at constant room temperature	*50 mL head:* Caffeine using premixed 85 % Water/15 % Acetonitrile at 1, 5, 20, 42 mL/min *200 mL head:* Caffeine using premixed 85 % Water/15 % Acetonitrile at 4, 20, 80 and 118 mL/min. Caffeine using premixed 70 % Water/30 % Acetonitrile at 177 mL/min.
Composition precision[1]	≤0.3 % RSD or ≤0.1 min SD whichever is greater, based on retention time at constant room temperature	*50 mL head:* at 1, 5, 20, 42 mL/min *200 mL head:* at 4, 20, 80, 118 and 177 mL/min Using Prep LC Standard #1 (5190-6886) (1:4), gradient from 2 – 98 % B (A: Water + 0.1 % FA, B: ACN + 0.1 % FA)
Active Seal Wash	Included with sensor	
Instrument Control	LC & CE Drivers A.02.18 or above Instrument Control Framework (ICF) A.02.04 or above Lab Advisor software B.02.10 or above	For details about supported software versions refer to the compatibility matrix of your version of the LC and CE Drivers

Table 3 Agilent 1290 Infinity II Preparative Binary Pump (G7161B) Performance Specifications

Feature	Specification	Comment
Communications	Controller-area network (CAN), Local Area Network (LAN), Extended remote interface (ERI), USB, ready, start, stop and shutdown signals, external leak sensor.	
Safety features and maintenance	Extensive diagnostics, error detection and display through included Agilent Lab Advisor, 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	

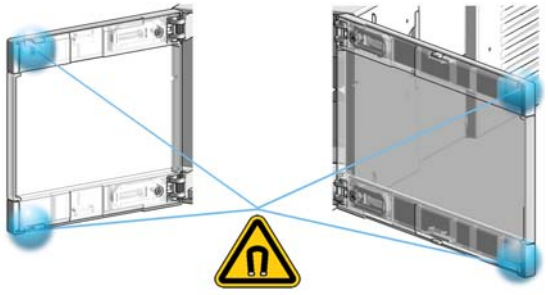
[1] Using freshly prepared degassed mobile phase.

3 Using the Pump

This chapter explains the operational parameters of the module.

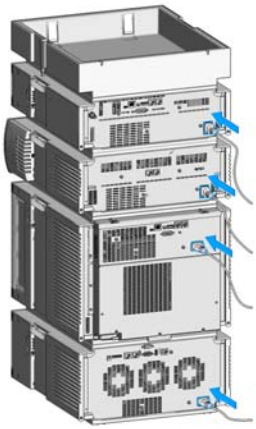
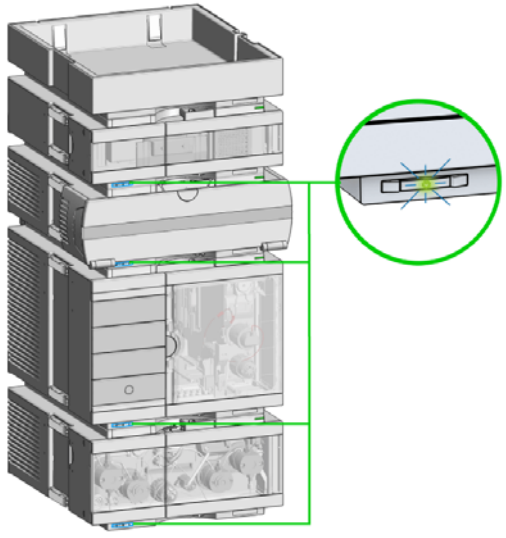
Magnets

1 Magnets in doors of pumps, autosamplers, detectors, and fraction collectors.

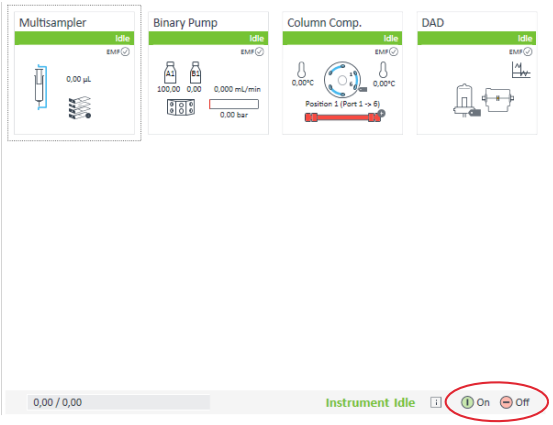


Turn on/off

This procedure exemplarily shows an arbitrary LC stack configuration.

1 	2  Power switch: On

3 Turn instrument **On/Off** with the control software.



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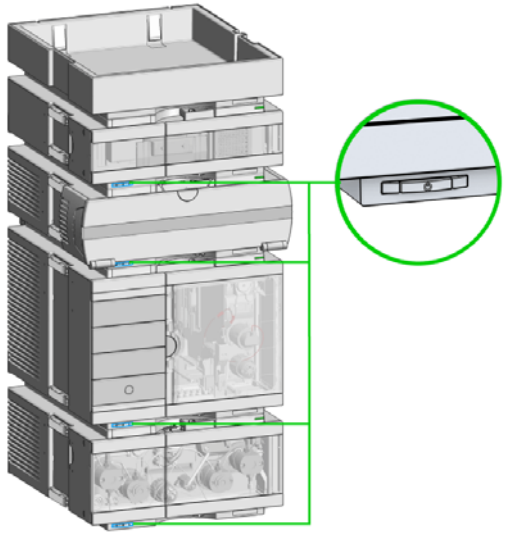
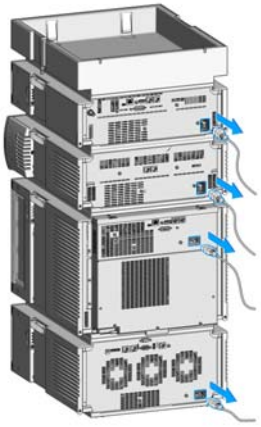


Power switch: Off

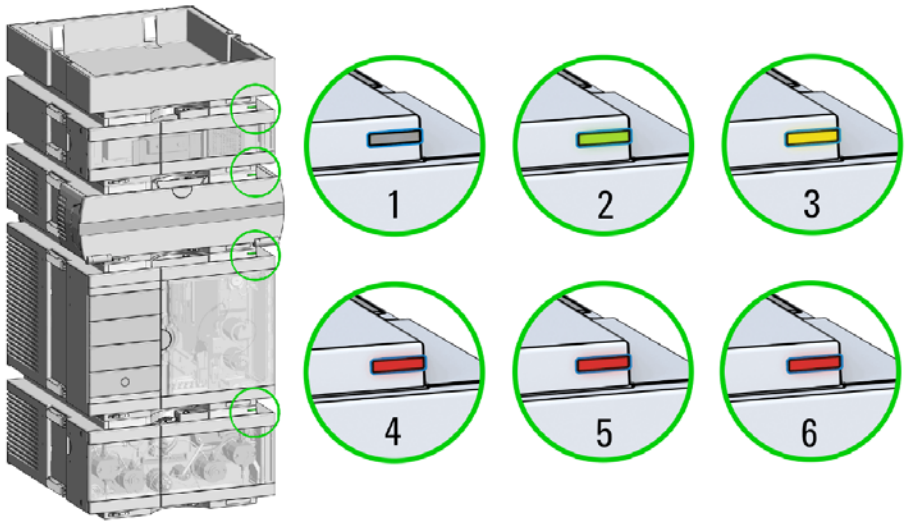
5



Status Indicators

This procedure exemplarily shows an arbitrary LC stack configuration.

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



Status indicators

1. Idle
2. Run mode
3. Not-ready. Waiting for a specific pre-run condition to be reached or completed.
4. Error mode - interrupts the analysis and requires attention (for example a leak or defective internal components).
5. Resident mode (blinking) - for example during update of main firmware.
6. Bootloader mode (fast blinking). Try to re-boot the module or try a cold-start. Then try a firmware update.

Best Practices

Regular Inspections

- Inspect the inlet/waste tubing and exchange them if they are worn out or show visible signs of damage.
- Prevent blocking of solvent inlet filters (never use the pump without solvent inlet filters). Growth of algae should be avoided.
- Flush the pump once a week with neat HPLC grade solvent (such as water or ACN) for about 5 min at a flow of 5 mL/min for each channel.
- Exchange components on a regular basis, for details refer to the *Preventive Maintenance Checklist*.

Power-up / Shut-down

- Power up
  - Check that the power cord is plugged in and that the correct power is provided.
  - Check that the pump is connected via CAN with other modules and a PC
  - Check for unusual sounds or smells upon powering up a pump
- Shut down
  - When using buffer solutions, flush the system with plenty of water to remove all buffer solution from the entire system, before switching it OFF, or before changing to an organic solvent.
  - Use recommended solvents to store the system.

Prime the Pump

NOTE

Always organic channel first, water channel second.

1 Attach the 50 mL syringe (in Accessory Kit) to the waste port of purge valve.
2 Open the purge valve.
3 Turn on one channel with 5 mL/min (100 % A or B).
4 Pull the syringe and hold it until all the tubing and heads within the active channel are filled.
5 Close the purge valve, detach and empty the syringe if required.
6 Repeat step 2-5 for the other channel if needed.

Prepare the pump

- Before using the pump, ensure the pump is properly primed and purged in order to avoid damage.
- Flush the pump extensively, when changing to a new solvent, and use an intermediate when switching between normal phase and reverse phase solvents.
- Confirm that the pump and the rest of the system are completely leak tight by performing the **Leak Test**.
- The system pressure must be higher than 20 bar at the pump outlet for optimum performance of the pump.
- Make sure to have a stable pressure and detector baseline.
- Always use the seal wash function.

Using the Pump

- For the generation of gradients, make sure that none of the channels delivers less than a minimum flow rate of 50 µL/min at any time during the gradient run, in order to achieve best performance.
- Always use a flow ramp when changing flow rates, especially if there is a large change. A ramp is a linear change from the current flow rate to the new flow rate, over the set duration.

  If the flow rate ramp-up is very rapid or the outlet plumbing is suddenly blocked, for instance by the operation of the sample inject valve, a pressure spike well in excess of the set pressure limit may be generated.
- For optimum performance it is recommended to use freshly prepared degassed mobile phase.
- When solvent reservoirs are located below the pump it is recommended to degas the mobile phase to prevent out-gassing of dissolved gas.

Purging the Pump

When the solvents have been exchanged or the pumping system has been turned off for a certain time (for example, overnight) oxygen will re-diffuse into the solvent channel between the solvent reservoir and the pump. Solvents containing volatile ingredients will slightly lose these. Therefore purging of the pumping system is required before starting an application.

Table 4 Choice of Priming Solvents for Different Purposes

Activity	Solvent	Comments
After an installation	Isopropanol	Best solvent to flush air out of the system
When switching between reverse phase and normal phase (both times)	Isopropanol	Isopropanol is miscible with both normal phase and reverse phase solvents.
After an installation	Ethanol or Methanol	Alternative to Isopropanol (second choice) if no Isopropanol is available
To clean the system when using buffers	Bidistilled water	Best solvent to re-dissolve buffer crystals
After a solvent change	Bidistilled water	Best solvent to re-dissolve buffer crystals
Before turning off system for an extended period of time	Organic or 10 % isopropanol in water	

NOTE It is recommended not to exceed 50 mL/min flow rate when purging.

To purge the pump in LabAdvisor:

1. Prepare each channel with the appropriate purge solvents.
2. Select **Purge Pump** from the **Tool Selection** screen.
3. In the **Purge Configuration** dialog box, if necessary, select the channel(s) that you want to purge.
4. For each selected channel, select a **Flow** and a purge **Time.**

5 Close the **Purge Configuration** dialog box. When the request to open the purge valve appears, open the purge valve on the pump, then click to close the message box.

During purging, the **General** tab shows the current channel that is being purged, and the remaining purge time.

The **Signals** tab shows a plot of pressure against time for the complete purge cycle.

6 When the purge time has elapsed and the request to close the purge valve appears, close the purge valve on the pump, then click to close the message box.

The pump purge process is complete.

Solvent Information

Introduction

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 49.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.22 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.

Materials in Flow Path

Following materials are used in the flow path of this module:

Part	Materials
Bottle Head Assy	SST frit, PTFE, PEEK
Ultra clean tubings[1]	PFA (tubings), PEEK (fittings)
Passive inlet valve	SST, sapphire (1290), ruby, PEEK, ZrO_2-based Ceramic
Outlet valve	SST, sapphire (1290), ruby, PEEK, ZrO_2-based Ceramic
Mixer	SST
Pump head	SST, Titanium
Pistons	ZrO_2-based ceramic
Piston/wash seals	PTFE, SST, UHMW-PE
Pressure sensor	SST
Inline filter	SST/PEEK
Purge valve	SST, PEEK ST
Capillaries/fittings	SST/ETFE/PEEK ELS (conductive)
Tubing	PTFE
Solvent Selection Valve (1290 only)	PEEK, FFKM

[1] Ultra clean tubings are available for the use with high-end MS detectors. They are also compatible to THF.

The Agilent Infinity II Preparative Pump has been designed and tested for reversed phase solvents and applications.

Material Information

Materials in the flow path are carefully selected based on Agilent's experiences in developing highest quality instruments for HPLC analysis over several decades. These materials exhibit excellent robustness under typical HPLC conditions. For any special condition, please consult the material information section or contact Agilent.

Disclaimer

Subsequent data was collected from external resources and is meant as a reference. Agilent cannot guarantee the correctness and completeness of such information. Data is based on compatibility libraries, which are not specific for estimating the long-term life time under specific but highly variable conditions of UHPLC systems, solvents, solvent mixtures and samples. Information can also not be generalized due to catalytic effects of impurities like metal ions, complexing agents, oxygen etc. Apart from pure chemical corrosion, other effects like electro corrosion, electrostatic charging (especially for non-conductive organic solvents), swelling of polymer parts etc. need to be considered. Most data available refers to room temperature (typically 20 – 25 °C, 68 – 77 °F). If corrosion is possible, it usually accelerates at higher temperatures. If in doubt, please consult technical literature on chemical compatibility of materials.

PEEK

PEEK (Polyether-Ether Ketones) combines excellent properties regarding biocompatibility, chemical resistance, mechanical and thermal stability. PEEK is therefore the material of choice for UHPLC and biochemical instrumentation.

It is stable in the specified pH range (for the Bio-inert LC system: pH 1 – 13, see bio-inert module manuals for details), and inert to many common solvents.

There is still a number of known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulphuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogenes or aequous halogene solutions, phenol and derivatives (cresols, salicylic acid etc.).

When used above room temperature, PEEK is sensitive to bases and various organic solvents, which can cause it to swell. Under such conditions normal PEEK capillaries are very sensitive to high pressure. Therefore Agilent uses stainless steel cladded PEEK capillaries in bio-inert systems. The use of stainless steel cladded PEEK capillaries keeps the flow path free of steel and ensures pressure stability to at least 600 bar. If in doubt, consult the available literature about the chemical compatibility of PEEK.

Polyimide

Agilent uses semi-crystalline polyimide for rotor seals in valves and needle seats in autosamplers. One supplier of polyimide is DuPont, which brands polyimide as Vespel, which is also used by Agilent.

Polyimide is stable in a pH range between 1 and 10 and in most organic solvents. It is incompatible with concentrated mineral acids (e.g. sulphuric acid), glacial acetic acid, DMSO and THF. It is also degraded by nucleophilic substances like ammonia (e.g. ammonium salts in basic conditions) or acetates.

Polyethylene (PE)

Agilent uses UHMW (ultra-high molecular weight)-PE/PTFE blends for yellow piston and wash seals, which are used in 1290 Infinity pumps, 1290 Infinity II pumps, the G7104C and for normal phase applications in 1260 Infinity pumps.

Polyethylene has a good stability for most common inorganic solvents including acids and bases in a pH range of 1 to 12.5. It is compatible with many organic solvents used in chromatographic systems like methanol, acetonitrile and isopropanol. It has limited stability with aliphatic, aromatic and halogenated hydrocarbons, THF, phenol and derivatives, concentrated acids and bases. For normal phase applications, the maximum pressure should be limited to 200 bar.

Tantalum (Ta)

Tantalum is inert to most common HPLC solvents and almost all acids except fluoric acid and acids with free sulfur trioxide. It can be corroded by strong bases (e.g. hydroxide solutions > 10 %, diethylamine). It is not recommended for the use with fluoric acid and fluorides.

Stainless Steel (ST)

Stainless steel is inert against many common solvents. It is stable in the presence of acids and bases in a pH range of 1 to 12.5. It can be corroded by acids below pH 2.3. It can also corrode in following solvents:

- Solutions of alkali halides, their respective acids (for example, lithium iodide, potassium chloride, and so on) and aqueous solutions of halogens.
- 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, diisopropylether). 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.

Titanium (Ti)

Titanium is highly resistant to oxidizing acids (for example, nitric, perchloric and hypochlorous acid) over a wide range of concentrations and temperatures. This is due to a thin oxide layer on the surface, which is stabilized by oxidizing compounds. Non-oxidizing acids (for example, hydrochloric, sulfuric and phosphoric acid) can cause slight corrosion, which increases with acid concentration and temperature. For example, the corrosion rate with 3 % HCl (about pH 0.1) at room temperature is about 13 µm/year. At room temperature, titanium is resistant to concentrations of about 5 % sulfuric acid (about pH 0.3). Addition of nitric acid to hydrochloric or sulfuric acids significantly reduces corrosion rates. Titanium is sensitive to acidic metal chlorides like $FeCl_3$ or $CuCl_2$. Titanium is subject to corrosion in anhydrous methanol, which can be avoided by adding a small amount of water (about 3 %). Slight corrosion is possible with ammonia > 10 %.

Diamond-Like Carbon (DLC)

Diamond-Like Carbon is inert to almost all common acids, bases and solvents. There are no documented incompatibilities for HPLC applications.

Fused silica and Quartz (SiO_2)

Fused silica is used in Max Light Cartridges. Quartz is used for classical flow cell windows. It is inert against all common solvents and acids except hydrofluoric acid and acidic solvents containing fluorides. It is corroded by strong bases and should not be used above pH 12 at room temperature. The corrosion of flow cell windows can negatively affect measurement results. For a pH greater than 12, the use of flow cells with sapphire windows is recommended.

Gold

Gold is inert to all common HPLC solvents, acids and bases within the specified pH range. It can be corroded by complexing cyanides and concentrated acids like aqua regia.

Zirconium Oxide (ZrO_2)

Zirconium Oxide is inert to almost all common acids, bases and solvents. There are no documented incompatibilities for HPLC applications.

Platinum/Iridium

Platinum/Iridium is inert to almost all common acids, bases and solvents. There are no documented incompatibilities for HPLC applications.

Fluorinated polymers (PTFE, PFA, FEP, FFKM, PVDF)

Fluorinated polymers like PTFE (polytetrafluorethylene), PFA (perfluoroalkoxy), and FEP (fluorinated ethylene propylene) are inert to almost all common acids, bases, and solvents. FFKM is perfluorinated rubber, which is also resistant to most chemicals. As an elastomer, it may swell in some organic solvents like halogenated hydrocarbons.

TFE/PDD copolymer tubings, which are used in all Agilent degassers except G1322A/G7122A, are not compatible with fluorinated solvents like Freon, Fluorinert, or Vertrel. They have limited life time in the presence of Hexafluoroisopropanol (HFIP). To ensure the longest possible life with HFIP, it is best to dedicate a particular chamber to this solvent, not to switch solvents, and not to let dry out the chamber. For optimizing the life of the pressure sensor, do not leave HFIP in the chamber when the unit is off.

The tubing of the leak sensor is made of PVDF (polyvinylidene fluoride), which is incompatible with the solvent DMF (dimethyl formamide).

Sapphire, Ruby and Al_2O_3-based ceramics

Sapphire, ruby and ceramics based on aluminum oxide Al_2O_3 are inert to almost all common acids, bases and solvents. There are no documented incompatibilities for HPLC applications.

Solvent Handling

Handling of Buffers

The following recommendations should be observed when using buffer solutions:

- Buffers and aqueous solutions are possible sources of algae contamination, for avoiding related problems, please read "Algae Growth in HPLC Systems" on page 49.
- Filter buffer solutions to avoid increased wear or blockages that are caused by undissolved crystals. Always use solvent inlet filters.
- Avoid conditions where mixing of buffers and organic solvents may cause precipitation, as this impairs the reproducibility of chromatographic experiments and may also reduce the system life time. For example in reversed phase chromatography, avoid buffers (especially phosphate buffers) with a concentration higher than 20 mmol/L. For phosphate buffers, avoid compositions containing more than 65 % acetonitrile or other organic solvents.
- Use a minimum flow rate of 50 µL/min or 1 % composition per solvent channel (whatever is greater) to avoid cross-flow. Cross-flow can be caused by micro leaks in pump heads and can result in buffer precipitation in pump heads, channel blocking, or reduced pump head life time through wear of seals and pistons.
- Consider using an inline filter.
- Never leave buffers in a system without flow. Before shutting down a system, flush it extensively with warm water to avoid clogging of valves, capillaries, or flow cells or reducing the life time of your column. If the system is not used for some time, for example more than a day depending on lab temperature, fill all solvent lines with organic solvent or water with at least 10 % isopropanol.
- Regularly maintain the LC system.

Handling of Acetonitrile

Acetonitrile is a solvent that is frequently used in reversed-phase chromatography. Despite of its common use, it can be a source of issues if not handled correctly.

When using acetonitrile:

- Use high-quality solvents from renowned suppliers.
- Use fresh solvents and filter them.
- Minimize exposure to light and air/oxygen.
- Choose a bottle size which fits to your application and usage.
- Acids accelerate solvent aging. If possible avoid such additives or refresh solvents more frequently.
- Pure acetonitrile ages faster. If your application allows, add about 5 % water and adjust gradient compositions.
- Do not leave acetonitrile in unused systems to avoid aging. If not in use, flush all solvent lines with a mixture of water and 10 % isopropanol.

Handling of Acids

Acids can corrode stainless steel and other materials in the flow path of LC systems. For stainless steel, the minimum pH is 2.3 for corrosive acids and pH 1 for non-corrosive acids.

Please note that for non-volatile acids like phosphoric acid or perchloric acid concentrations increase after evaporation of water. This means that originally diluted acids can damage parts over time, e.g. because of liquid, which has left the solvent path through micro leaks. Such systems should be flushed regularly with pure water and may require shorter maintenance cycles. Using the seal wash function should be considered for protecting pump heads.

Please also refer to *TechNote 01200-90090*, which can be downloaded from our website **www.agilent.com**.

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 the followng problems:

- 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.
- Plugging of small-pore, high-pressure solvent filters, usually placed before the injector, resulting in high system pressure.
- Blockage of PTFE frits, leading to increased system pressure.
- Plugging of column filters, giving high system pressure.
- Dirty flow cell windows of detectors, 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 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, 1000 mL (9301-6526)) 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.

Agilent Local Control Modules

Agilent 1200 Infinity Series Instant Pilot G4208A

The Agilent 1200 Infinity Series Instant Pilot controller gives you complete control, system monitoring, signal plotting and diagnostic capabilities for a virtually unlimited number of LC system modules. It is connected to the LC system with a CAN cable for power supply and communication.

Features:

- Complete local control and monitoring of an Agilent 1200 Series, 1260 Infinity and 1290 Infinity system or a single module from a single point. However, not for Agilent 1220 Compact LC.
- Mixed system configurations supported, e.g. 1200 Series, 1200 Series SL- and 1100 Series.
- Excellent readability and usability by large colored display with background light, high resolution and contrast.
- Convenient, ergonomic operation either handheld or at the stack with newly developed, secure attachment.
- Handheld or attached to a module in a stack to facilitate operator preferences.

The 1200 Infinity Series Instant Pilot provides:

- Easy automation – recalibration intervals and multi-method sequences satisfy the most stringent automation routines.
- Transfer and archiving of methods, sequences and logbooks via standard USB memory sticks.
- Factory installed software – flat dialog structure, user configurable interface, enhanced sequence engine, for example with wait for baseline stabilization, diagnosis with passed/failed.
- GLP – System logbook and module log-books record errors, unusual events and maintenance activities for GLP traceability.

4 Optimizing Performance

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

Delay Volume and Extra-Column Volume

The *delay volume* is defined as the system volume between the point of mixing in the pump and the top of the column.

The *extra-column volume* is defined as the volume between the injection point and the detection point, excluding the volume in the column.

Delay Volume

In gradient separations, this volume causes a delay between the mixture changing in the pump and that change reaching the column. The delay depends on the flow rate and the delay volume of the system. In effect, this means that in every HPLC system there is an additional isocratic segment in the gradient profile at the start of every run. Usually the gradient profile is reported in terms of the mixture settings at the pump and the delay volume is not quoted even though this will have an effect on the chromatography. This effect becomes more significant at low flow rates and small column volumes and can have a large impact on the transferability of gradient methods. It is important, therefore, for fast gradient separations to have small delay volumes, especially with narrow bore columns (e.g., 2.1 mm i.d.) as often used with mass spectrometric detection.

The delay volume in a system includes the volume in the pump from the point of mixing, connections between pump and autosampler, volume of the flow path through the autosampler and connections between autosampler and column.

How to Achieve Higher Resolution

Increased resolution in a separation will improve the qualitative and quantitative data analysis, allow more peaks to be separated or offer further scope for speeding up the separation. This section explains how resolution can be increased by examining the following points:

- Optimize selectivity
- Smaller particle-size packing
- Longer Columns
- Shallower gradients, faster flow

Resolution between two peaks is described by the resolution equation:

$$Rs = \frac{1}{4}\sqrt{N}\,\frac{(\alpha - 1)}{\alpha}\,\frac{(k_2 + 1)}{k_2}$$

where

- R_s=resolution,
- N=plate count (measure of column efficiency),
- α=selectivity (between two peaks),
- k_2=retention factor of second peak (formerly called capacity factor).

The term that has the most significant effect on resolution is the selectivity, α, and practically varying this term involves changing the type of stationary phase (C18, C8, phenyl, nitrile etc.), the mobile phase and temperature to maximize the selectivity differences between the solutes to be separated. This is a substantial piece of work which is best done with an automated method development system which allows a wide range of conditions on different columns and mobile phases to be assessed in an ordered scouting protocol. This section considers how to get higher resolution with any chosen stationary and mobile phases. If an automated method development system was used in the decision on phases it is likely that short columns were used for fast analysis in each step of the scouting.

The resolution equation shows that the next most significant term is the plate count or efficiency, N, and this can be optimized in a number of ways. N is inversely proportional to the particle size and directly proportional to the length of a column and so smaller particle size and a longer column will give a higher plate number. The pressure rises with the inverse square of the particle size and

proportionally with the length of the column. Resolution increases with the square root of N so doubling the length of the column will increase resolution by a factor of 1.4. What is achievable depends on the viscosity of the mobile phase as this relates directly to the pressure. Methanol mixtures will generate more back pressure than acetonitrile mixtures. Acetonitrile is often preferred because peak shapes are better and narrower in addition to the lower viscosity but methanol generally yields better selectivity (certainly for small molecules less than about 500 Da). The viscosity can be reduced by increasing the temperature but it should be remembered that this can change the selectivity of the separation. Experiment will show if this leads to increase or decrease in selectivity. As flow and pressure are increased it should be remembered that frictional heating inside the column will increase and that can lead to slightly increased dispersion and possibly a small selectivity change both of which could be seen as a reduction in resolution. The latter case might be offset by reducing the temperature of the thermostat by a few degrees and again experiment will reveal the answer.

The van Deemter curve shows that the optimum flow rate through an STM column is higher than for larger particles and is fairly flat as the flow rate increases. Typical, close to optimum, flow rates for STM columns are: 2 ml/min for 4.6 mm i.d.; and 0.4 ml/min for 2.1 mm i.d. columns.

In isocratic separations, increasing the retention factor, k, results in better resolution because the solute is retained longer. In gradient separations the retention is described by k^* in the following equation:

$$k^* = \frac{t_G}{\Delta\%B} \cdot \frac{F}{V_m} \cdot \frac{100}{S}$$

where:

- k^* = mean k value,
- t_G= time length of gradient (or segment of gradient) (min),
- F = flow (ml/min),
- V_m = column delay volume,
- Δ%B = change in fraction of solvent B during the gradient,
- S = constant (ca. 4-5 for small molecules).

This shows that k and hence resolution can be increased by having a shallower gradient (2 to 5 %/min change is a guideline), higher flow rate and a smaller volume column. This equation also shows how to speed up an existing gradient – if the flow is doubled but the gradient time is halved, k^* remains constant and the separation looks the same but happens in half the time. Recently published research has shown how a shorter STM column (at temperatures above 40 °C) can generate higher peak capacity than a longer STM column by virtue of running it faster. (Refer to *Petersson et al., J.Sep.Sci, 31, 2346-2357, 2008, Maximizing peak capacity and separation speed in liquid chromatography*).

Using Solvent Calibration Tables

RC.NET based Agilent graphical user interfaces (ChemStation, EZChrom Elite, OpenLab etc.) include data for commonly used solvents in Preparative HPLC. This data is used for optimum pump control in order to ensure best flow and composition accuracy.

If your solvent is not available in the user interface please select the next appropriate solvent, such as **Aqueous** for solvent mixtures with at least 50 % water, which have similar properties as pure water. For other solvents with high organic percentage, **Methanol** gives a good approximation.

5 Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

User Interfaces

- Depending on the user interface, the available tests and the screens/reports may vary.
- Preferred tool should be Agilent Lab Advisor Software, see "Agilent Lab Advisor Software" on page 59.
- The Agilent OpenLAB ChemStation C.01.03 and above do not include any maintenance/test functions.
- Screenshots used within these procedures are based on the Agilent Lab Advisor Software.

Agilent Lab Advisor Software

The Agilent Lab Advisor Software is a standalone product that can be used with or without a chromatographic data system. Agilent Lab Advisor helps to manage the lab for high-quality chromatographic results by providing a detailed system overview of all connected analytical instruments with instrument status, Early Maintenance Feedback counters (EMF), instrument configuration information, and diagnostic tests. By the push of a button, a detailed diagnostic report can be generated. Upon request, the user can send this report to Agilent for a significantly improved troubleshooting and repair process.

The Agilent Lab Advisor software is available in two versions:

- Lab Advisor Basic
- Lab Advisor Advanced

Lab Advisor Basic is included with every Agilent 1200 Infinity Series and Agilent InfinityLab LC Series instrument.

The Lab Advisor Advanced features can be unlocked by purchasing a license key, and include real-time monitoring of instrument actuals, all various instrument signals, and state machines. In addition, all diagnostic test results, calibration results, and acquired signal data can be uploaded to a shared network folder. The Review Client included in Lab Advisor Advanced allows to load and examine the uploaded data no matter on which instrument it was generated. This makes Data Sharing an ideal tool for internal support groups and users who want to track the instrument history of their analytical systems.

The tests and diagnostic features that are 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.

Pump Leak Rate Test

The Pump Leak Rate Tests is a diagnostic test to check the integrity and tightness of the pump components. The test is started from the **Services & Diagnostics** section in the Agilent Lab Advisor Software.

The test is first evaluating the tightness from the outlet valve downstream to the purge valve. The pistons are positioned; afterwards the purge valve is switched to the closed position. By moving the secondary piston into the pump chamber the system is pressurized to 400 bar. The flow rate to keep the pressure stable is the corresponding leak rate. The second part of the test is designed to Preparations:

The Pump Leak Rate Tests is a diagnostic test to check the integrity and tightness of the pump components:

- Evaluating the tightness from the outlet valve downstream to the purge valve

  The pistons are positioned; afterwards the purge valve is switched to the closed position. By moving the secondary piston into the pump chamber the system is pressurized.
- Verifying the tightness along the piston.

  Any irregularity on the piston surface (for example, scratches or deposits) will be detected. During this test all components from the inlet valve downstream to the blocked purge valve are tested. Now the primary piston is moving to deliver and generate pressure but the secondary is retracting. The pressure is kept constant. The process is repeated for the second pump head.

1. Flush the system with HPLC grade water for several minutes from any solvent channel.
2. Start the **Pump Leak Rate Test** from Lab Advisor.
3. Choose the channel with HPLC grade water and if you want to include or skip an additional purging step.
4. Click **OK** and follow the instructions.

   The test runs automatically without any further user interaction.

Figure 5 Pump leak rate test (example)

Troubleshooting the Pump Leak Rate Test

Secondary Leak

- Leak between the outlet valve and purge valve
  - Check for visible leaks on fittings and connectors
    - Connector not fixed / tight enough
    - Connector damaged
    - Leaky filter frit assembly
  - Remove the seal wash tubes from the support ring and check for leak into the seal wash path
    - Main seal leaking/damaged
    - Piston damaged
  - Remove waste lines from the purge valve
    - Damage to rotor seal and/or stator head
- Outlet valve not properly assembled
  - Re-tighten the outlet valve
    - Check the position of the gold seal

Dynamic Leak

- Air in the primary pump chamber
  - Check for air in the solvent inlet lines and the Tuning signal
    - Purge the lines, Prime and Condition the pump head
- Abort due to over pressure
  - Check solvent and solvent settings
    - Purge and condition the pump head with water
- Leak in Inlet Valve
  - Check for moving air bubbles in tubing directly to the Inlet Valve
    - Purge the lines with water to remove dirt
    - Knock at the valve, clean or replace it

- Outlet valve not properly assembled
  - Re-tighten the outlet valve
    - Check the position of the gold seal
- Leaky piston seals and/or position dependent leaks on the piston
  - Remove the SW tubes from the support ring and check for leaks
  - Replace the piston seals and clean the pistons
    - Ensure that seals are lubricated when pushed in
    - Use abrasive mesh >5000 grit

6 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.

If an error occurs outside a method run, other modules will not be informed about this error. If it occurs within a method run, all connected modules will get a notification, all LEDs get red and the run will be stopped. Depending on the module type, this stop is implemented differently. For example, for a pump the flow will be stopped for safety reasons. For a detector, the lamp will stay on in order to avoid equilibration time. Depending on the error type, the next run can only be started, if the error has been resolved, for example liquid from a leak has been dried. Errors for presumably single time events can be recovered by switching on the system in the user interface.

Special handling is done in case of a leak. As a leak is a potential safety issue and may have occurred at a different module from where it has been observed, a leak always causes a shutdown of all modules, even outside a method run.

In all cases, error propagation is done via the CAN bus or via an APG/ERI remote cable (see documentation for the APG/ERI interface).

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 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.
3 Power switch assembly defective	Please contact your Agilent service representative.
4 Cable or contact problem.	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 Power Switch 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.
4 Power switch assembly defective	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.

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.

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.

Module Error Messages

Solvent Zero Counter

Error ID: 2055

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

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

Pressure Above Upper Limit

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 flow path. 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 Flow rate too high.	Reduce the flow rate.
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.	• 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 main board.	Please contact your Agilent service representative.

Pressure Signal Missing

Error ID: 2016

The pressure signal is missing.

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

Probable cause	Suggested actions
1 Pressure sensor disconnected	Please contact your Agilent service representative.
2 Defective pressure sensor	Please contact your Agilent service representative.

Temperature Limit Exceeded

Error ID: 2517

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 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

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 (passive or active) inlet valve.	Exchange the (passive or active) inlet valve.
3	Blocked outlet valve.	Exchange the outlet 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.

Encoder Missing

Error ID: 2046, 2050, 2510

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.

Pump Head Missing

Error ID: 2202, 2212

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.

Initialization Failed

Error ID: 2207, 2217

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

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

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

7 Maintenance

This chapter describes the maintenance of the module.

Introduction to Maintenance

The figures below show the main user accessible assemblies of the preparative binary pumps. These parts can be accessed from the front (simple repairs) and don't require to remove the pump from the system stack.

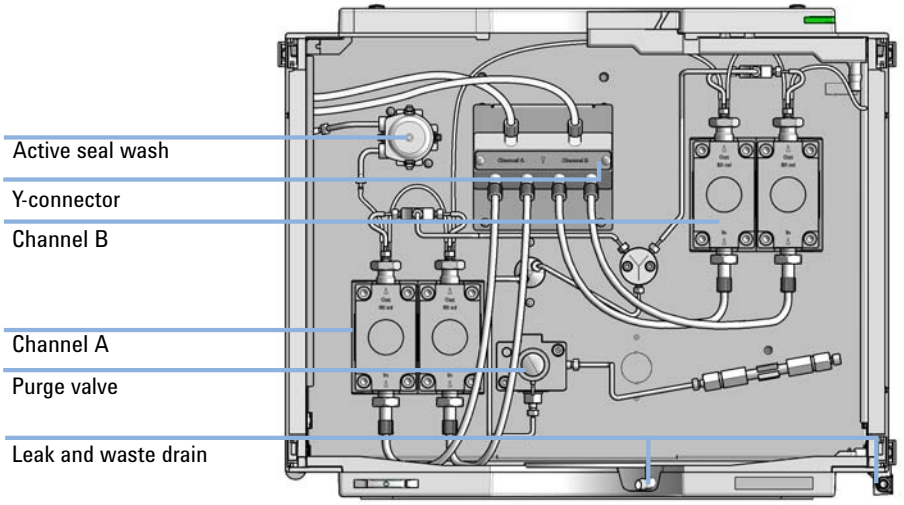


Figure 6 **Maintenance Parts (G7161A)**

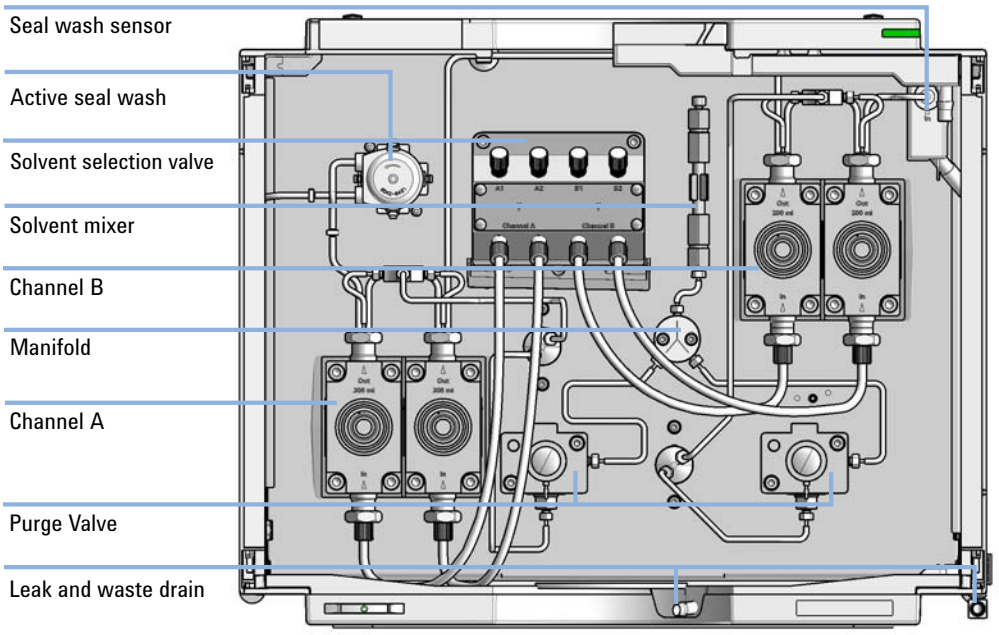


Figure 7 Maintenance Parts (G7161B), Solvent mixer vertical

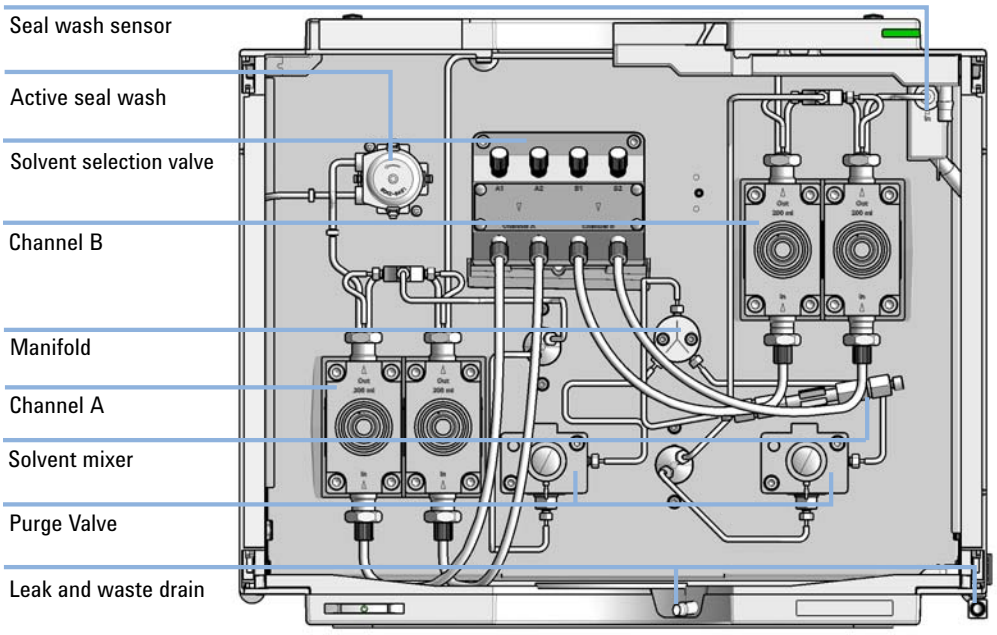


Figure 8 Maintenance Parts (G7161B), Solvent mixer horizontal

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.**

WARNING

Heavy weight

The module is heavy.

- ✓ **Carry the module at least with 2 people.**
- ✓ **Avoid back strain or injury by following all precautions for lifting heavy objects.**
- ✓ **Ensure that the load is as close to your body as possible.**
- ✓ **Ensure that you can cope with the weight of your load.**

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

The following pages describe maintenance (simple repairs) of the module that can be carried out without opening the main cover.

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.**

Install Fittings and Capillaries

WARNING

Solvent can spray under high pressure.

✓ **Observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing), when opening flow path.**

CAUTION

Deformation of fittings and seals

Liquid drops under high pressure act like solid parts. Tightening connections under high pressure can deform or destroy fittings and seals.

✓ **Never tighten flow connections under pressure.**

NOTE

The lifetime of a fitting depends on how firmly it has been tightened; firm tightening reduces the lifetime.

If fitting has been overtightened, replace it.

1 Install fittings and capillaries.
2 Tighten fittings and capillaries.

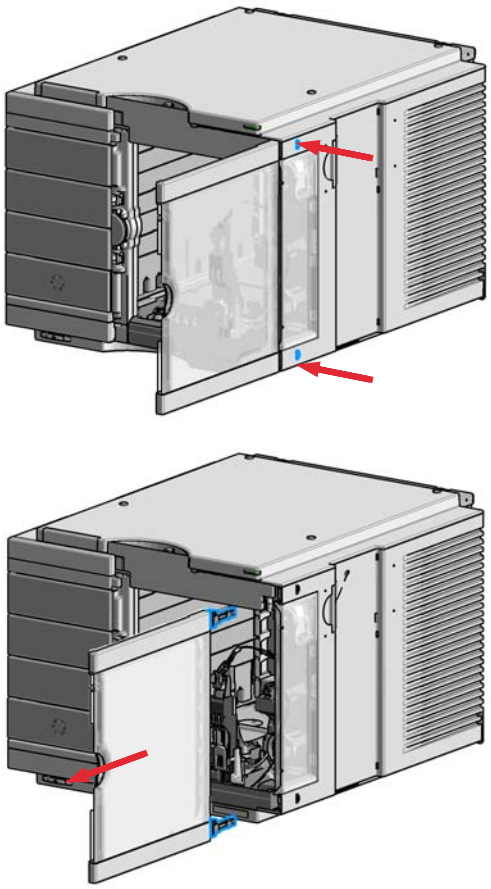
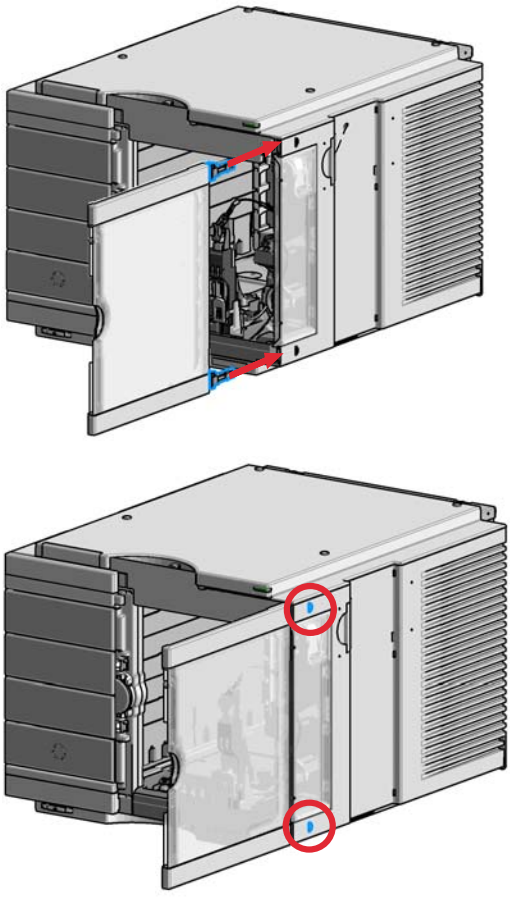
Remove and Install Doors

Parts required	p/n	Description
	5067-6216	Door Assembly R
	5067-6217	Door Assembly L

NOTE

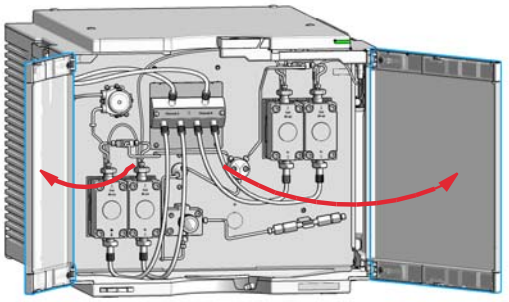
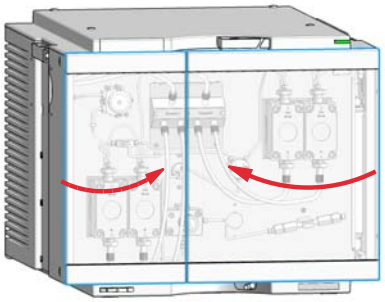
The figures shown in this procedure exemplarily show the Infinity II Multisampler module.

The principle of how to remove and/or install doors works in the same way for all Infinity II modules.

1 Press the release buttons and pull the front door out. 	**2** For the Installation of the front door. Insert the hinges into their guides and move the door in until the release buttons click into their final position. 

Open and Close Doors

When To gain access to the front of the module as required for any maintenance procedure.

1 Open the doors. 	**2** Close the doors. 

Replace the Manifold

When In case of problems with the Manifold.

Parts required	**p/n**	**Description**
	G7161-20019	Manifold

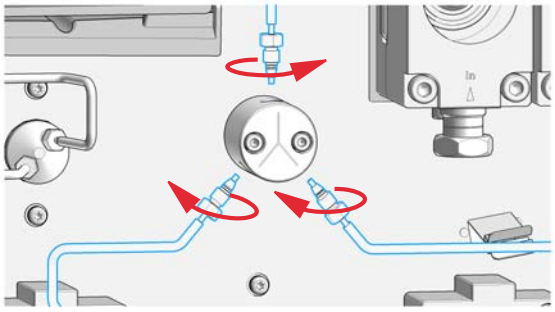
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

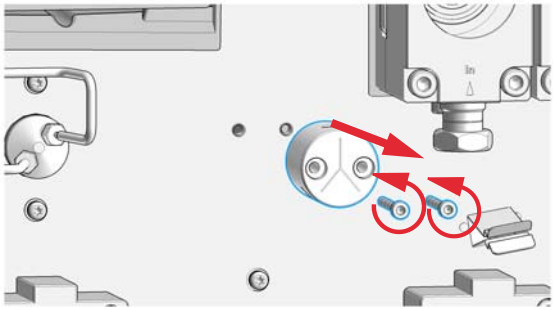
3 Power off the system.

4 Open the doors.

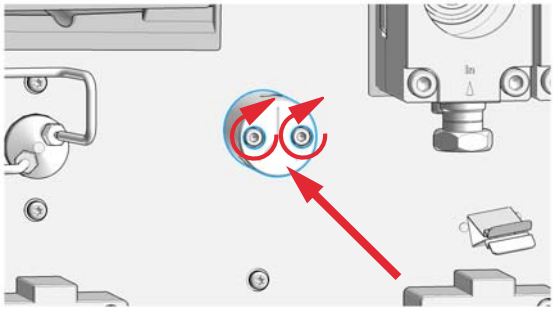
5 Remove tubing connections between the manifold and the pump head, and remove the inlet tubing line.



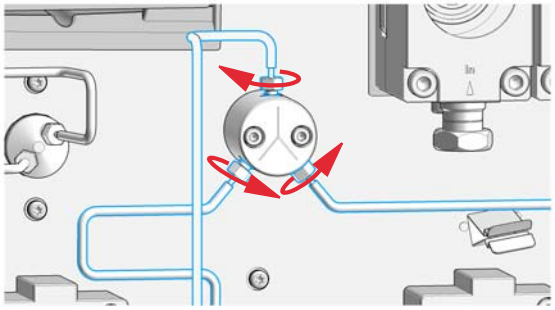
6 Unscrew and remove the manifold.



7 Install a new manifold with screws.



8 Install tubing connections between the manifold and the pump head, and install the inlet tubing line.



Next Steps:

9 Make sure all capillary and tubing connections are reconnected and tight.

10 Insert solvent filters into solvent reservoirs.

11 Power on the system.

12 Purge the system.

13 Close the doors.

Replace the Y-Connector (G7161A)

Parts required	p/n	Description
	5067-6651	Y-connector assembly

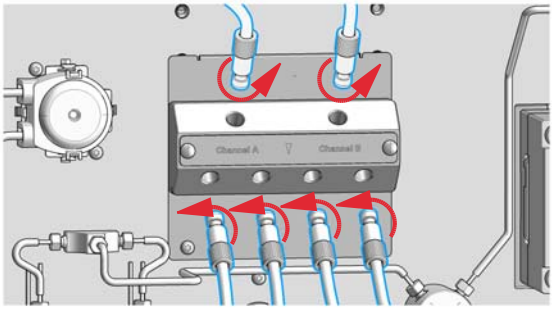
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

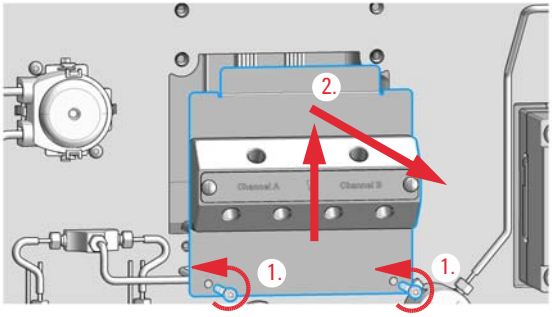
3 Power off the system.

4 Open the doors.

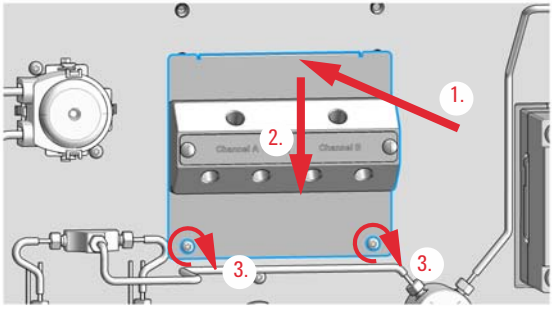
5 Remove the tubings from the Y-Connector.



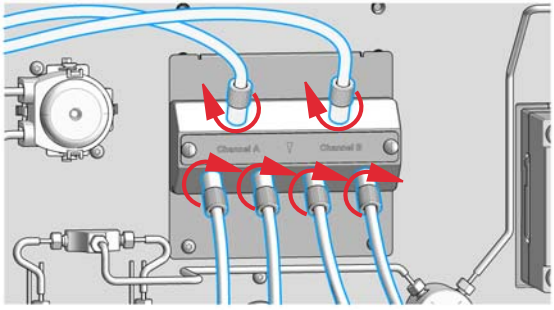
6 Unscrew the fixing screws (1.), lift (2.), and remove the Y-Connector.



7 Install the Y-Connector (1., 2.), and fix it with the screws (3.).



8 Connect tubings to the Y-Connector.



Next Steps:

9 Make sure all capillary and tubing connections are reconnected and tight.

10 Insert solvent filters into solvent reservoirs.

11 Power on the system.

12 Purge the system.

13 Close the doors.

Replace the Solvent Selection Valve (G7161B)

Parts required	p/n	Description
	G7161-60017	Solvent Selection Valve

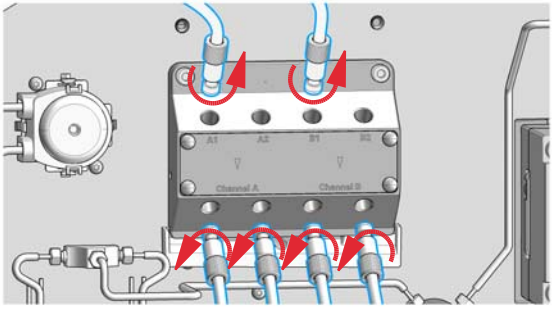
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

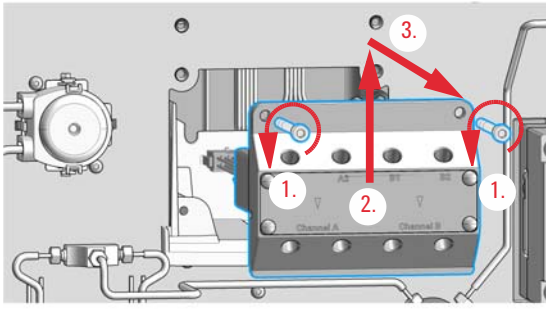
3 Power off the system.

4 Open the doors.

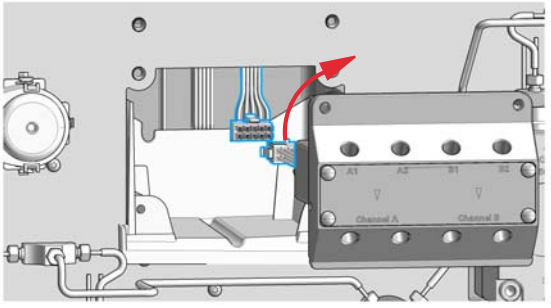
5 Remove tubings of the solvent selection valve.



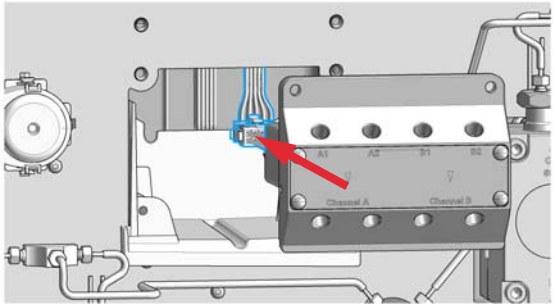
6 Unscrew the fixing screws (1.), lift (2.) and remove (3.) the solvent selection valve.



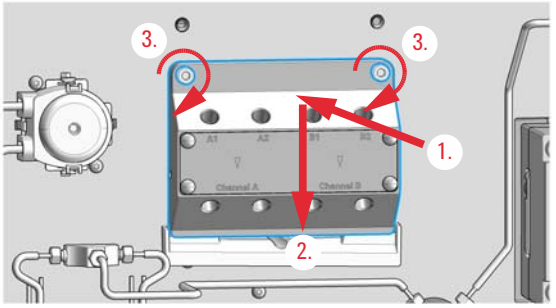
7 Disconnect the cable of the solvent selection valve.



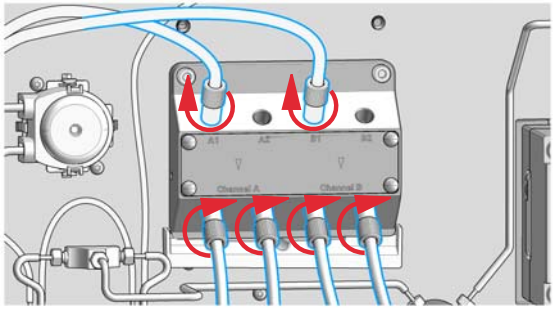
8 Connect the cable of the new solvent selection valve.



9 Install the solvent selection valve (1., 2.) and fix it with the screws (3.).



10 Connect tubings to the solvent selection valve.



Next Steps:

11 Make sure all capillary and tubing connections are reconnected and tight.

12 Insert solvent filters into solvent reservoirs.

13 Power on the system.

14 Purge the system.

15 Close the doors.

Replace the Solvent Mixer

Parts required	p/n	Description
	G1312-87330	Mixer

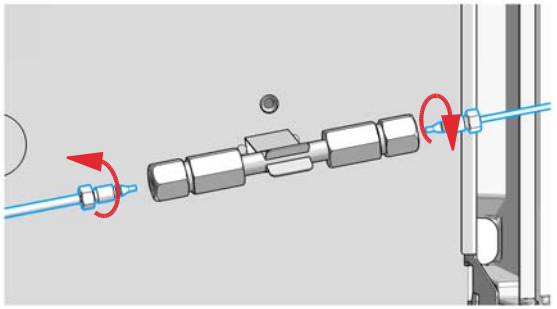
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

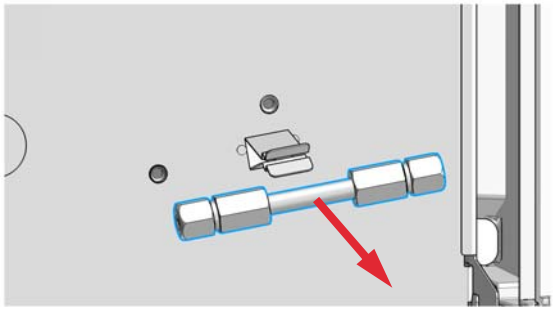
3 Power off the system.

4 Open the doors.

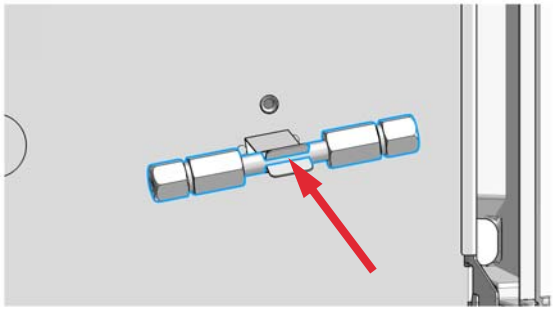
5 Remove the capillaries from the solvent mixer.



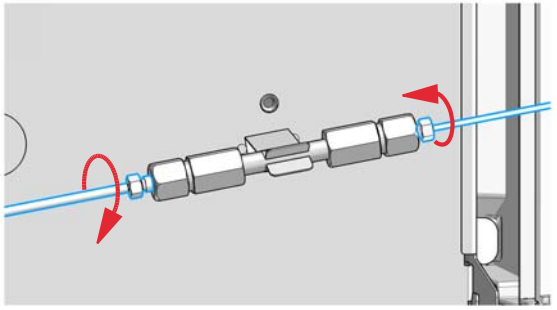
6 Remove the solvent mixer.



7 Install the solvent mixer.



8 Install the capillaries to the solvent mixer.



Next Steps:

9 Make sure all capillary and tubing connections are reconnected and tight.

10 Insert solvent filters into solvent reservoirs.

11 Power on the system.

12 Purge the system.

13 Close the doors.

Replace the Seal Wash Pump

When In case of wear of the seal wash pump

Parts required

p/n	Description
5065-4445	Peristaltic pump with Pharmed tubing
5065-9978	Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m

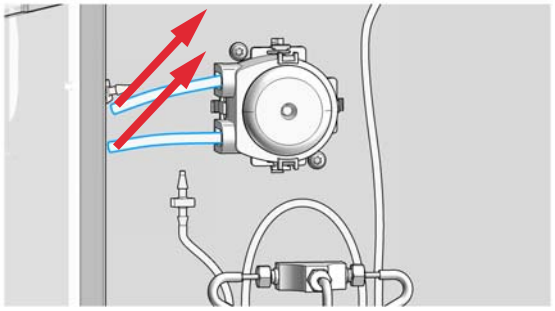
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

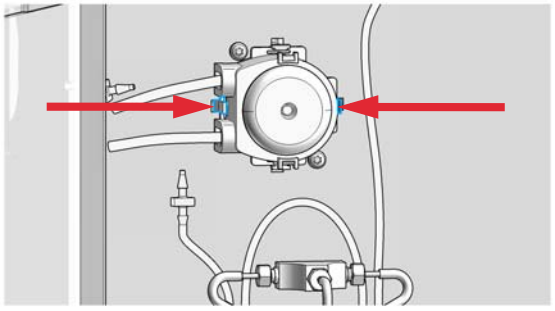
3 Power off the system.

4 Open the doors.

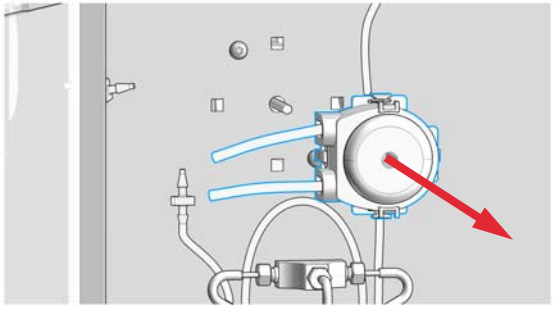
5 Remove the flow connections from and to the seal wash pump.



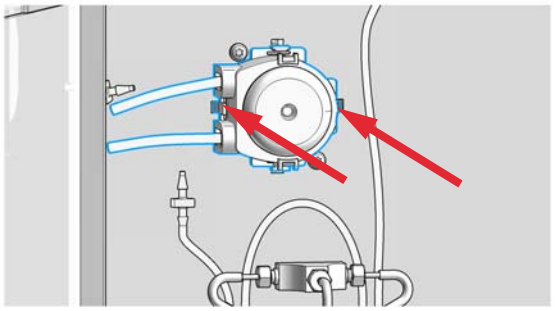
6 Press the clips.



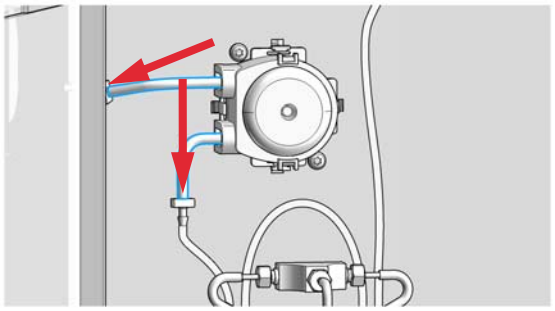
7 Pull the pump to the front.



8 Insert the pump clips to the holes in the pump housing.



9 Fix the seal wash tubings to the peristaltic pump inlet and from the peristaltic pump outlet to the primary pump head inlet.



Next Steps:

10 Make sure all capillary and tubing connections are reconnected and tight.

11 Insert solvent filters into solvent reservoirs.

12 Power on the system.

13 Purge the system.

14 Close the doors.

Replace the Seal Wash Sensor

Parts required	p/n	Description
	5067-5950	Seal Wash Sensor Assembly

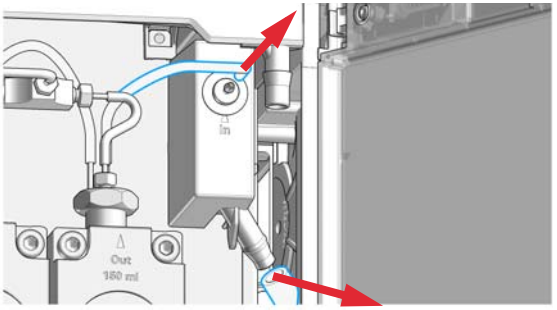
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

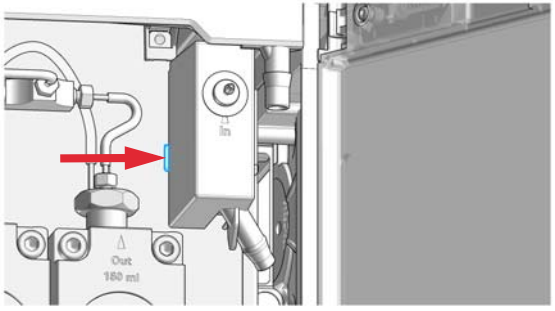
3 Power off the system.

4 Open the doors.

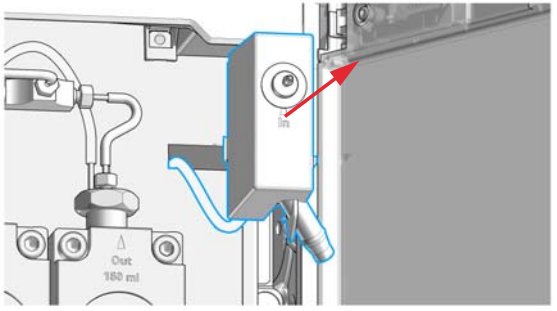
5 Remove the tubing of the seal wash sensor.



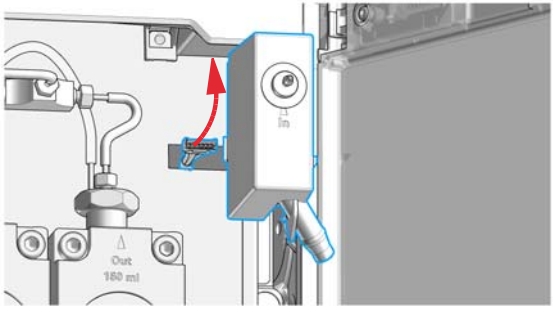
6 Push the clip to loosen the seal wash sensor.



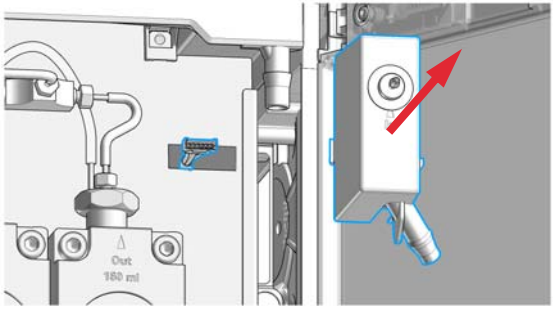
7 Pull out the seal wash sensor.



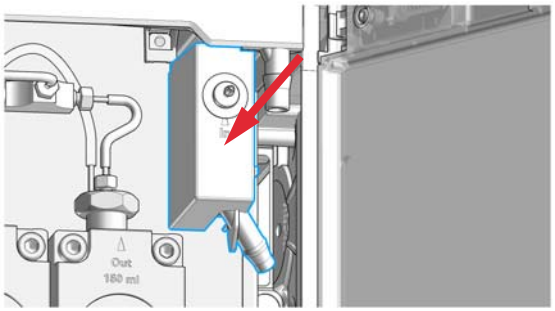
8 Disconnect the seal wash sensor cable.



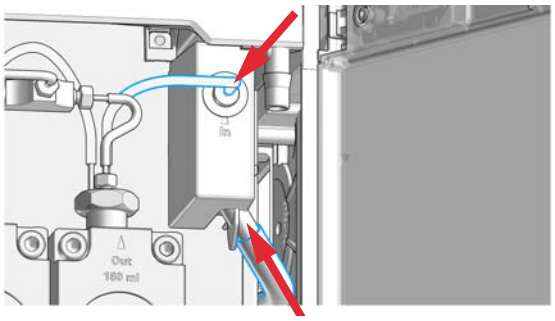
9 Remove the seal wash sensor.



10 Reconnect and install the seal wash sensor.



11 Connect the tubing of the seal wash sensor.



Next Steps:

12 Make sure all capillary and tubing connections are reconnected and tight.

13 Insert solvent filters into solvent reservoirs.

14 Power on the system.

15 Purge the system.

16 Close the doors.

Replace the Purge Valve

When In case of problems with the purge valve

Tools required	**p/n**	**Description**
	8710-0510	Open-end wrench 1/4 — 5/16 inch
	8710-1924	Open-end wrench 14 mm

Parts required	**p/n**	**Description**
	G7161-60300	Purge Valve

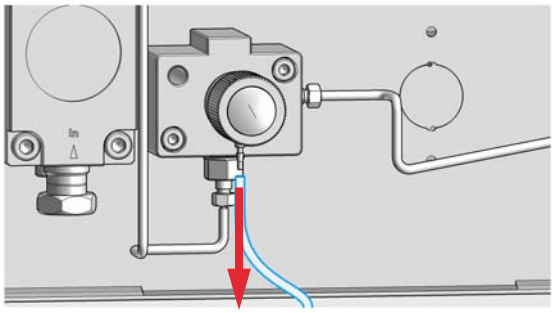
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

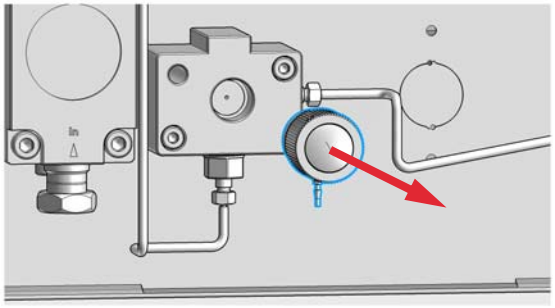
3 Power off the system.

4 Open the doors.

5 Disconnect the waste tube from the purge valve.



6 Using a 14 mm wrench unscrew the purge valve and remove it.

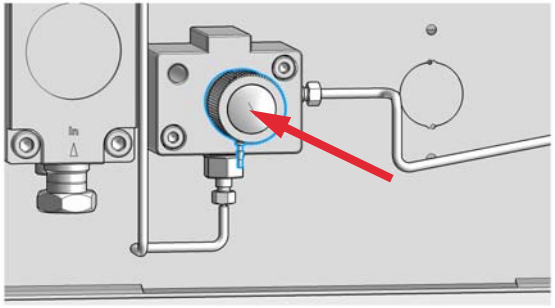


CAUTION

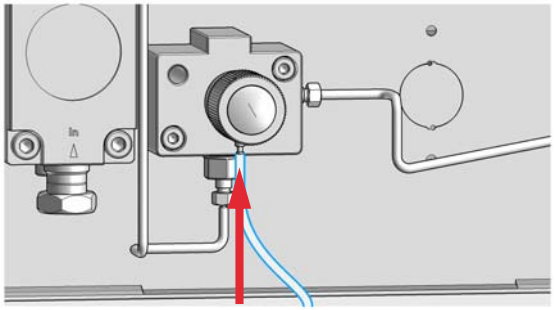
Damage to the purge valve

- ✓ **Do not lift the pump using the purge valve as a handle, it might get leaky.**
- ✓ **Do not try to turn the purge valve into the correct position when already fixed to the pump. The rubber o-ring might break.**
- ✓ **Anticipate the correct position of the connections before tightening the valve.**

7 Insert the purge valve and fix it with a 14 mm wrench.



8 Reconnect the waste tube to the purge valve.



Next Steps:

9 Make sure all capillary and tubing connections are reconnected and tight.

10 Insert solvent filters into solvent reservoirs.

11 Power on the system.

12 Purge the system.

13 Close the doors.

Replace the Purge Valve Adapter and the Filter

When In case of problems with the purge valve

Parts required	**p/n**	**Description**
	G7161-60300	Purge Valve
		Purge Valve Adapter

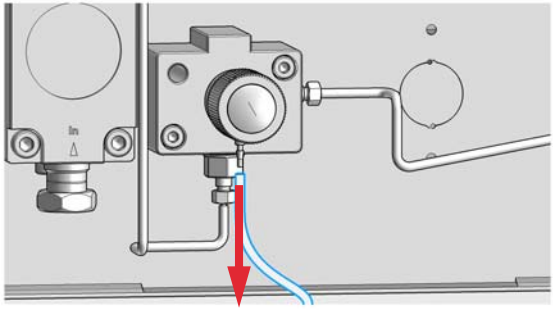
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

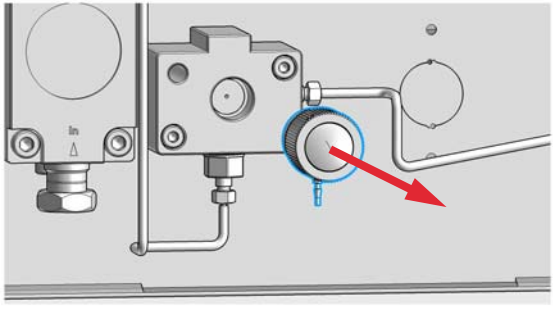
3 Power off the system.

4 Open the doors.

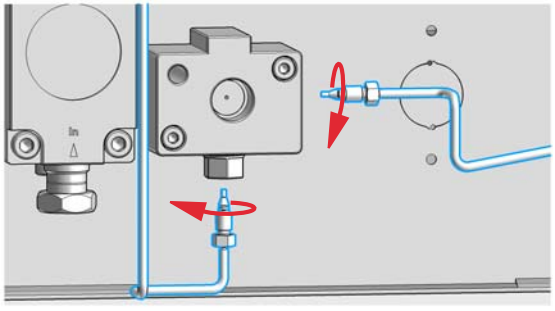
5 Disconnect the waste tube from the purge valve.



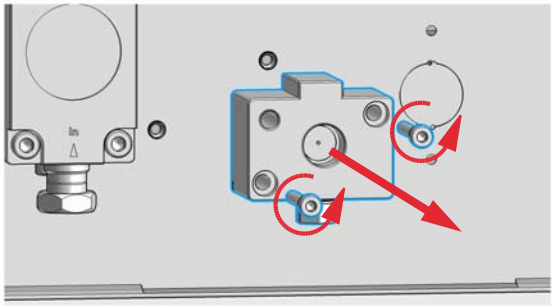
6 Using a 14 mm wrench unscrew the purge valve and remove it.



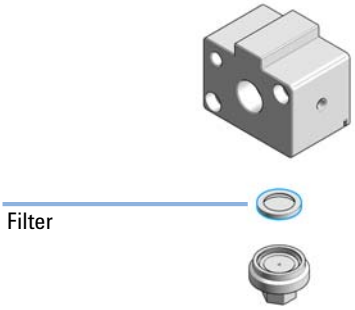
7 Remove all capillary connections from the purge valve adapter.



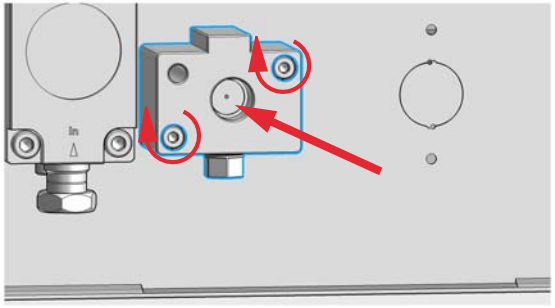
8 Unscrew and remove the purge valve adapter by pulling it to the front.



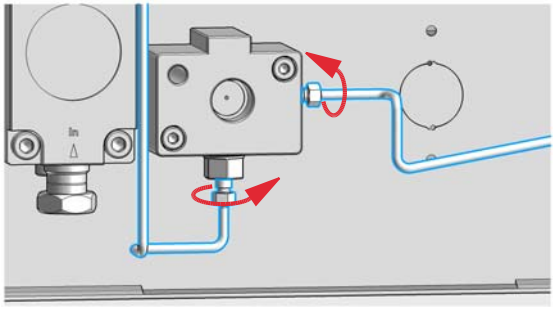
9 Replace the filter of the purge valve adapter.



10 Install the new purge valve adapter with the screws.



11 Install all flow connections.

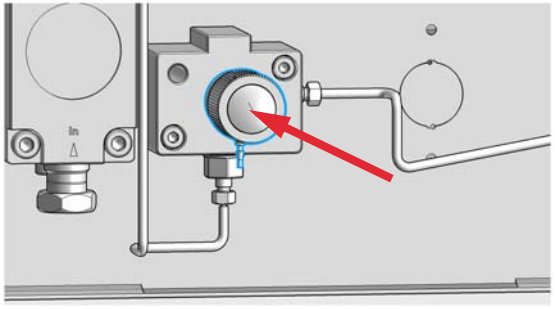


CAUTION

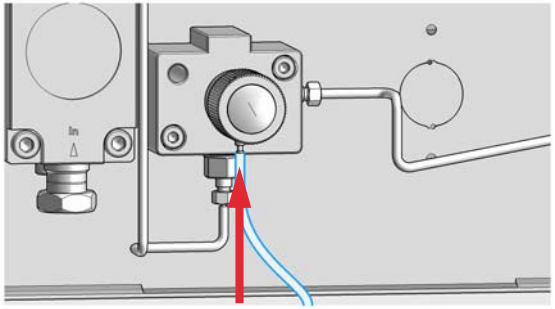
Damage to the purge valve

- ✓ **Do not lift the pump using the purge valve as a handle, it might get leaky.**
- ✓ **Do not try to turn the purge valve into the correct position when already fixed to the pump. The rubber o-ring might break.**
- ✓ **Anticipate the correct position of the connections before tightening the valve.**

12 Insert the purge valve and fix it with a 14 mm wrench.



13 Reconnect the waste tube to the purge valve.



Next Steps:

14 Make sure all capillary and tubing connections are reconnected and tight.

15 Insert solvent filters into solvent reservoirs.

16 Power on the system.

17 Purge the system.

18 Close the doors.

Replace the Inlet Valve Cartridge

When If Inlet valve is defective.

Tools required

Description
Wrench, 17 mm

Parts required

	#	p/n	Description
	1	5067-6642	Check valves, 50 mL head
OR	1	G7161-60052	Check valves, 200 mL head

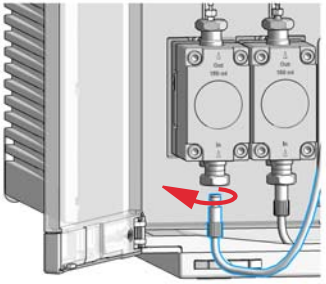
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

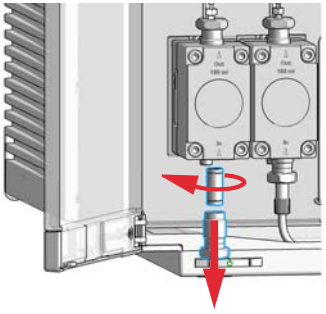
3 Power off the system.

4 Open the doors.

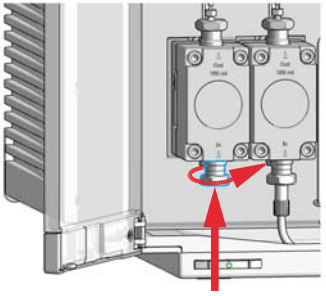
5 Unscrew the tubing at the inlet valve.



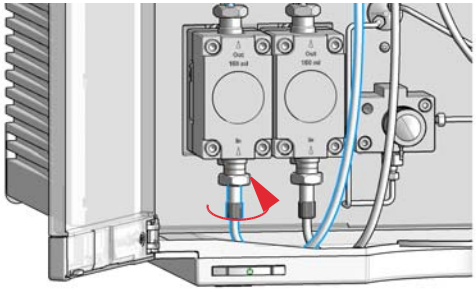
6 With a 17 mm wrench, unscrew the inlet valve adapter and remove it.



7 Replace the cartridge, install inlet valve adapter and tighten it with a wrench (17 mm).



8 Attach the inlet tubing at the inlet valve.



Next Steps:

9 Make sure all capillary and tubing connections are reconnected and tight.

10 Insert solvent filters into solvent reservoirs.

11 Power on the system.

12 Purge the system.

13 Close the doors.

Release a Stuck Inlet Valve

When If inlet valve is stuck, or if pump is not generating pressure after being turned off for an extended period of time.

NOTE Before the system is turned off for an extended period of time, it should be flushed with at least 10 % isopropanol to prevent inlet valves from getting stuck.

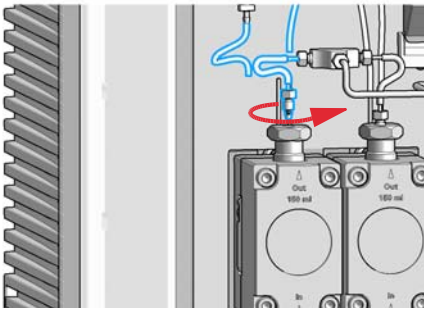
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

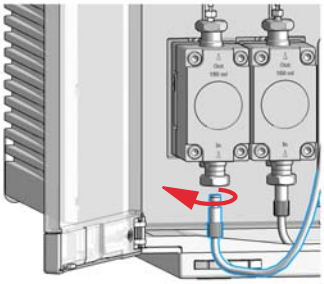
3 Power off the system.

4 Open the doors.

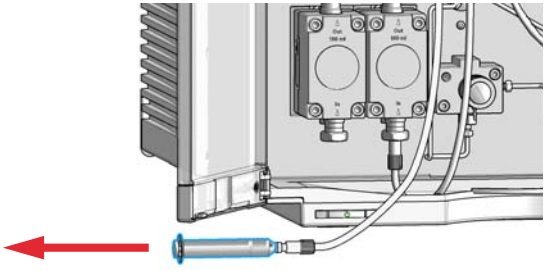
5 Remove the capillary connection from the outlet of the secondary pump head.



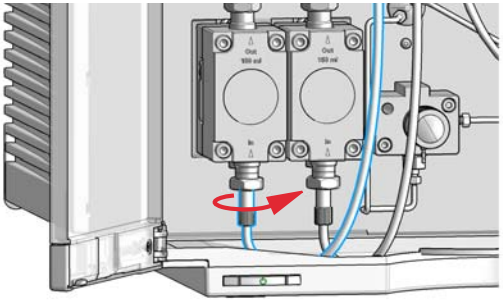
6 Unscrew the tubing at the inlet valve.



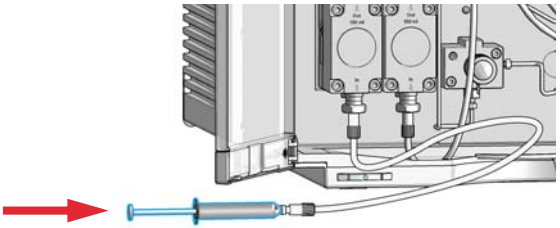
7 Attach a Luer lock syringe with adapter to the tubing and fill it with solvent.



8 Reconnect tubing to inlet valve.

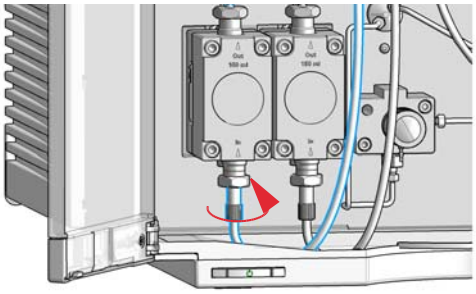


9 Push solvent with syringe until it comes out at the top of the High Pressure Filter Assembly.



10 Detach the syringe and reconnect the tubing.

11 Reinstall the capillary connection to the High Pressure Filter Assembly.



Next Steps:

12 Make sure all capillary and tubing connections are reconnected and tight.

13 Insert solvent filters into solvent reservoirs.

14 Power on the system.

15 Purge the system.

16 Close the doors.

Replace the Outlet Valve

When If Outlet valve is defective.

Parts required	**#**	**p/n**	**Description**
	1	5067-6642	Check valves, 50 mL head
OR	1	G7161-60052	Check valves, 200 mL head

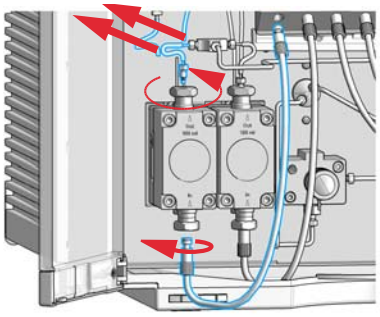
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

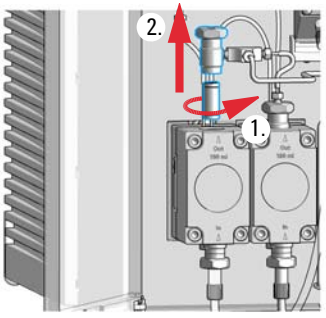
3 Power off the system.

4 Open the doors.

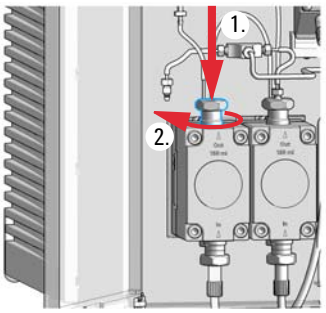
5 Remove all tubings and capillaries from the pump head assembly (seal wash tubes, IN and OUT capillaries).

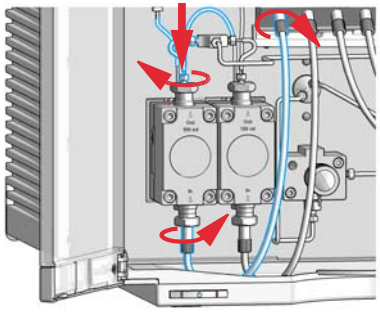


6 Unscrew the outlet valve with a 17 mm wrench (1.) and remove it (2.).



7 Insert the outlet valve into the pump head (1.). Close the outlet valve (2.).



8 Reconnect all hydraulic connections. 	**Next Steps:** **9** Make sure all capillary and tubing connections are reconnected and tight. **10** Insert solvent filters into solvent reservoirs. **11** Power on the system. **12** Purge the system. **13** Close the doors.

Remove the Pump Head Assembly

One pump head assembly consists of two pump heads, which are removed one at a time.

This procedure describes the replacement of the left pump head assembly (channel A). Similarly, the right pump head assembly (channel B) can be replaced.

Tools required	p/n	Description
	G7120-68708	HPLC System Tool Kit-Infinity-II

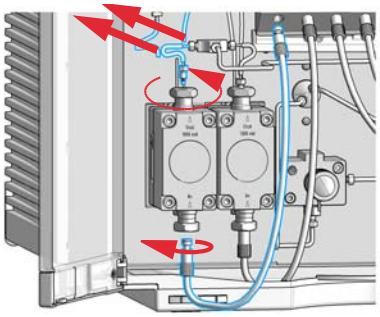
1 Lift up solvent filters in solvent reservoirs to avoid leakages.

2 Open the purge valve.

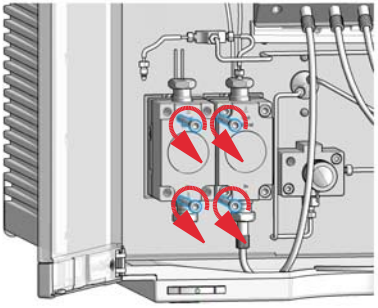
3 Power off the system.

4 Open the doors.

5 Remove all tubings and capillaries from the pump head assembly (seal wash tubes, IN and OUT capillaries).



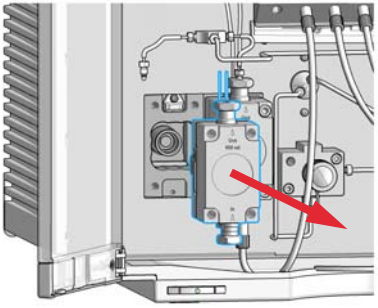
6 Open the four screws holding the pump head assembly.



NOTE

Open the screws step by step, not screw by screw.

7 Remove the first half of the pump head assembly.

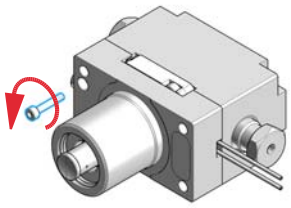
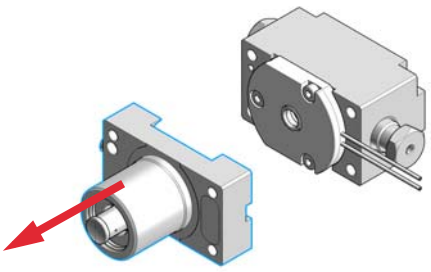
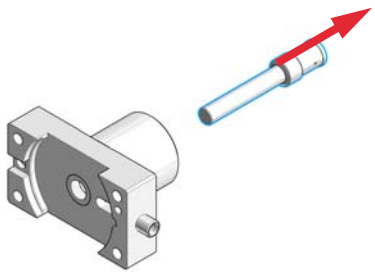
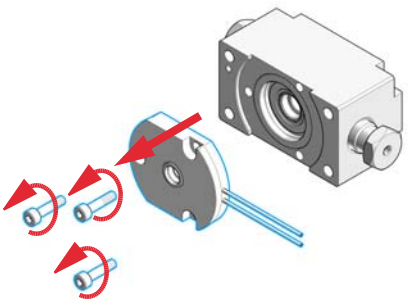


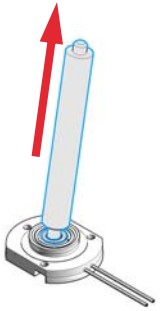
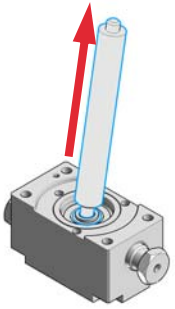
8 Repeat these steps for the second half of the pump head assembly.

Pump Head Maintenance

Disassemble Pump Heads

NOTE Seals must be exchanged and pistons must be cleaned in both pump head assemblies.

1 Remove the pump head screw from the back of the pump head. 	**2** Open the pump head and remove the piston housing from the pump chamber. 
3 Remove the piston from the piston housing by pulling it out of the seal holder with a finger. 	**4** Remove the seal holder from the pump chamber. 

5 Using the steel side of the insert tool, remove the wash seal from the support ring. 	**6** Using the steel side of the insert tool, remove the pump seal from the pump head assembly. 

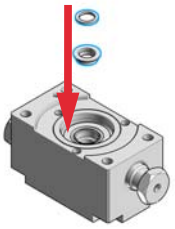
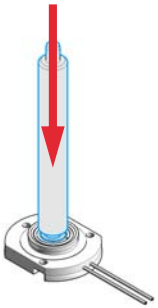
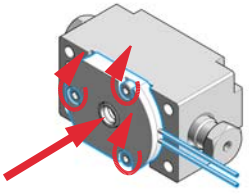
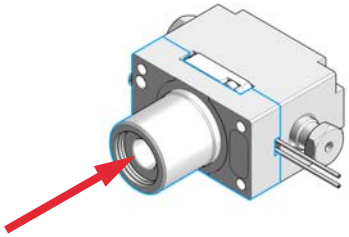
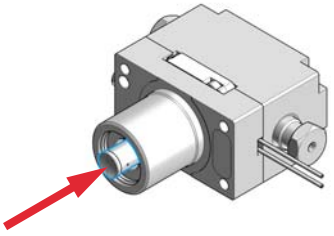
Next Steps:

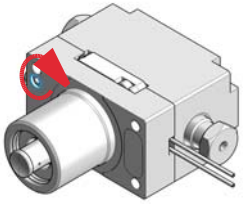
7 Clean the piston with abrasive paper.

8 Rinse the pump head parts and the piston with isopropanol.

Assemble Pump Heads

NOTE Seals must be exchanged in all pump heads.

1 Lubricate all pump head parts and seals with isopropanol.	**2** Using the plastic side of the insert tool, insert a new seal into the pump head. 
3 Using the plastic side of the insert tool, insert the new wash seal into the seal holder. 	**4** Place the seal holder onto the pump housing. 
5 Place the pump housing on top of the piston housing. 	**6** Insert the piston and carefully press it into the seal. 

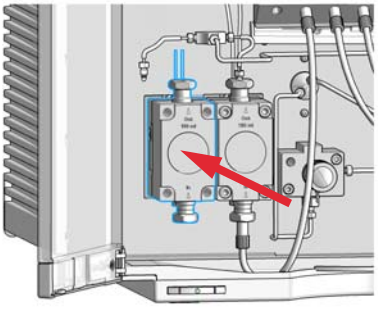
7 Tighten the pump head screw. 	

Install the Pump Head Assembly

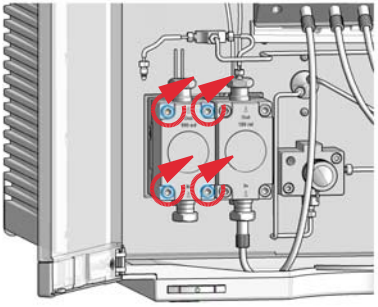
Tools required	p/n	Description
	G7120-68708	HPLC System Tool Kit-Infinity-II
	G4220-20013	4 mm hex bit
	G4220-20015	Adapter ¼ in square to hex

1 Bring the pump drive to the maintenance position using the Lab Advisor user interface: Go to **Service & Diagnostics> Remove/Install Pump Head** and follow instructions given on the screen. Both pump drives must be retracted.

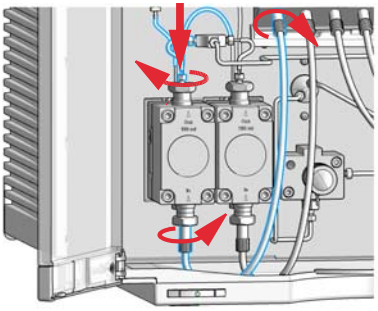
2 Mount the pump head to the module.



3 Install the new pump head assembly by tightening the screws step by step.



4 Install all tubings and capillaries to the pump head assembly (seal wash tubes, IN and OUT capillaries).



Next Steps:

5 Make sure all capillary and tubing connections are reconnected and tight.

6 Insert solvent filters into solvent reservoirs.

7 Power on the system.

8 Purge the system.

9 Close the doors.

10 Perform a Pump Leak Rate Test.

Replace 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 party control software requires a special version.

Tools required

Description
Agilent Lab Advisor software

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 FW Update Tool and the documentation from the Agilent web.
   http://www.agilent.com/en-us/firmwareDownload?whid=69761
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.

Prepare the Pump Module for Transport

When If the module shall be transported or shipped.

Preparations Flush both solvent channels with isopropanol.

WARNING

Heavy weight

The module is heavy.

- ✓ **Carry the module at least with 2 people.**
- ✓ **Avoid back strain or injury by following all precautions for lifting heavy objects.**
- ✓ **Ensure that the load is as close to your body as possible.**
- ✓ **Ensure that you can cope with the weight of your load.**

CAUTION

Mechanical damage

- ✓ **For shipping the module, insert the Protective Foam to protected the module from mechanical damage.**
- ✓ **Be careful not to damage tubing or capillary connections while inserting the module in the Protective Foam.**

1. Flush system with appropriate storage solution, for example 20 % isopropanol in water.
2. Remove solvent inlets from solvent reservoirs. Disconnect the solvent tubing from the inlet of primary pump heads for both solvent channels. Use a syringe for removing liquid from the solvent tubings between solvent reservoir, Y-connector (G7161A)/solvent selection valve (G7161B), and pump inlets. Switch the solvent selection valve if applicable.
3. Remove tubing and capillary connections to other modules and the solvent cabinet. Remove tubing plugs.
4. You may keep internal tubing and capillary connections.
5. Remove cable connections to other modules. Remove the module from the stack.

6 Carefully insert the Protective Foam to the front part of the instrument. Do not damage any tubing or capillary connections.

7 Close the front cover.

8 For transport or shipment, put the module and accessory kit to the original shipment box.

8 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

Overview of Maintenance Parts (G7161A)

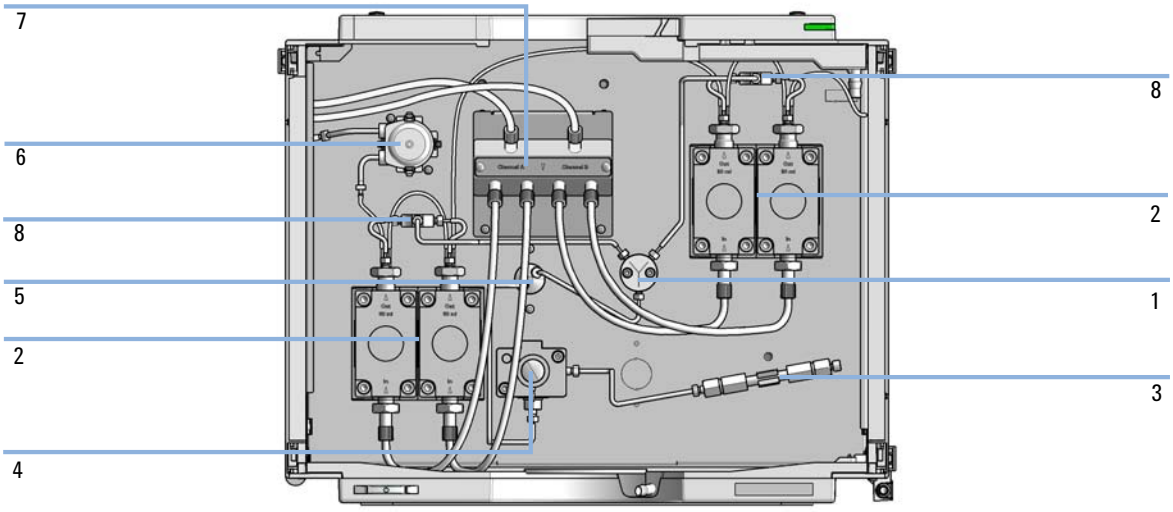


Figure 9 Maintenance parts (G7161A)

Item	p/n	Description
1	G7161-20019	Manifold
2	G7161-60023	Pump Head Kit 50 mL
3	G1312-87330	Mixer
4	G7161-60300	Purge Valve
5	5067-1527	Pressure sensor
6	5065-4445	Peristaltic pump with Pharmed tubing
7	5067-6651	Y-connector assembly
8	5023-2626	T-piece

Overview of Maintenance Parts (G7161B)

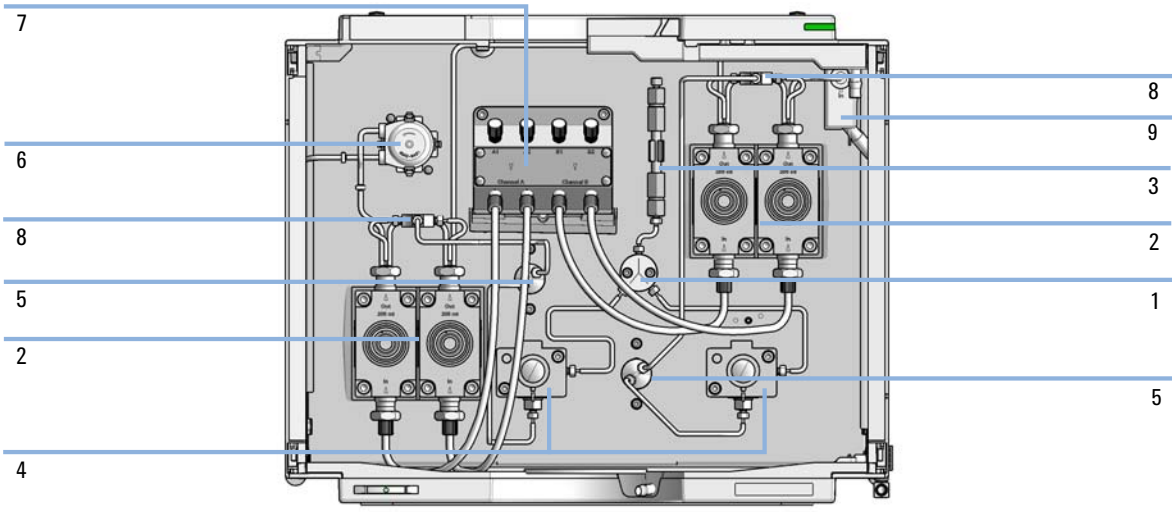


Figure 10 Maintenance parts (G7161B)

Item	p/n	Description
1	G7161-20019	Manifold
2	G7161-60023	Pump Head Kit 50 mL
OR	G7161-60021	Pump Head Kit 200 mL
3	G1312-87330	Mixer
4	G7161-60300	Purge Valve
5	5067-1527	Pressure sensor
6	5065-4445	Peristaltic pump with Pharmed tubing
7	G7161-60017	Solvent Selection Valve
8	5023-2626	T-piece
9	5067-5950	Seal Wash Sensor Assembly

Flow Connections (G7161A)

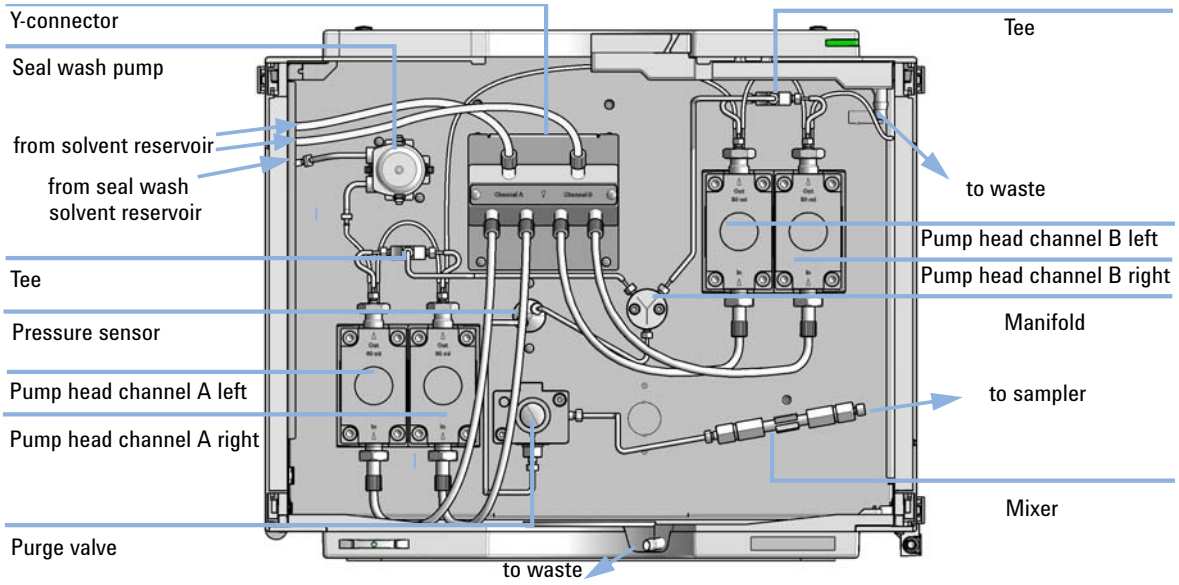


Figure 11 Flow connections of the 1260 Infinity II Preparative Binary Pump

Flow Connections (G7161B)

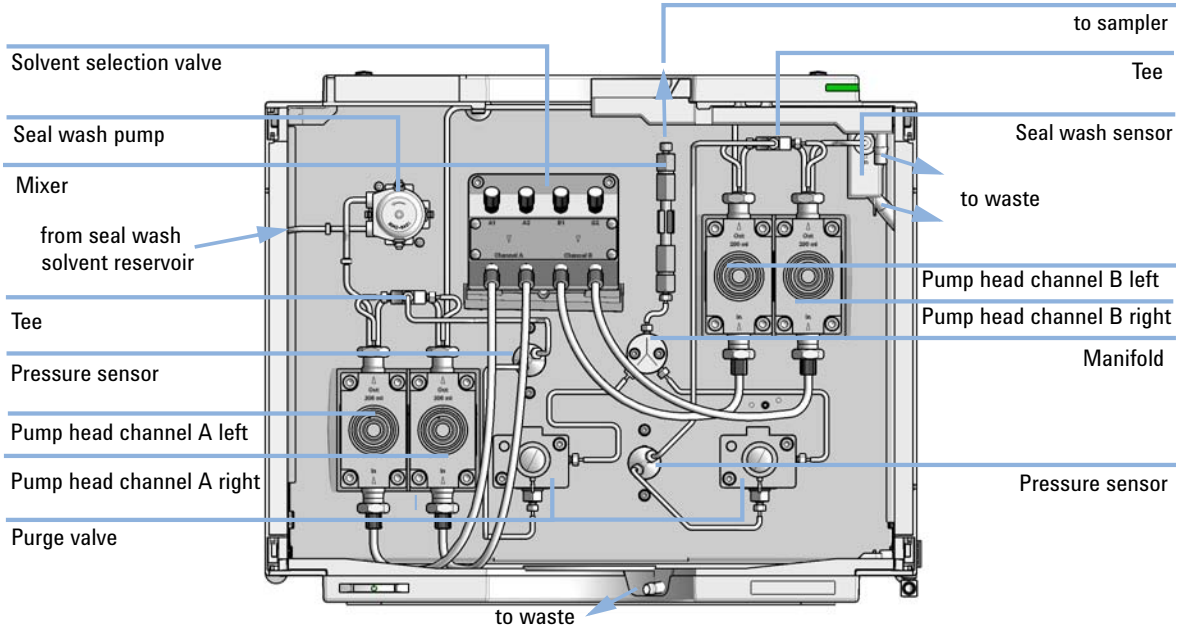
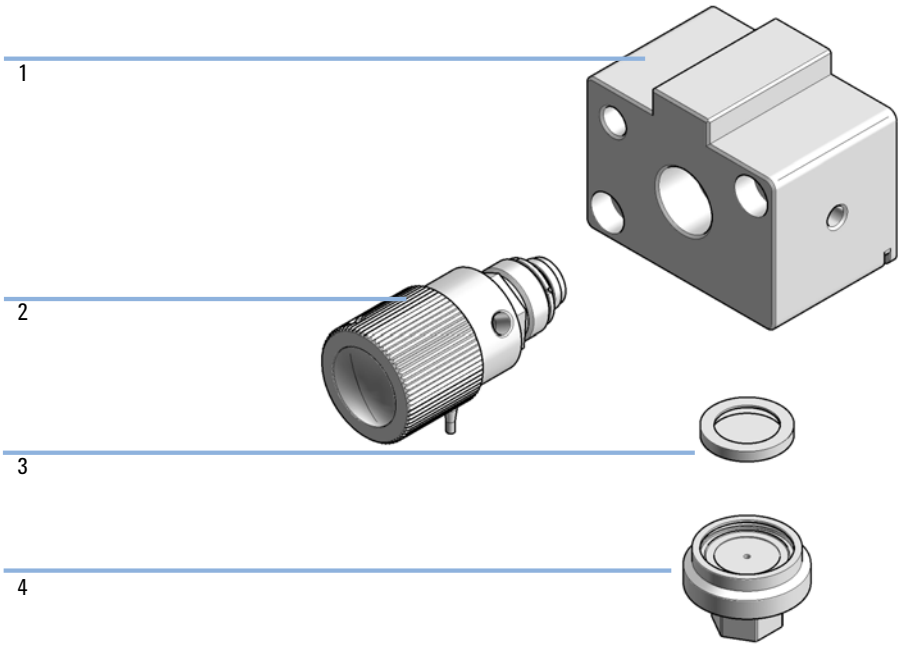


Figure 12 Flow connections of the 1290 Infinity II Preparative Binary Pump

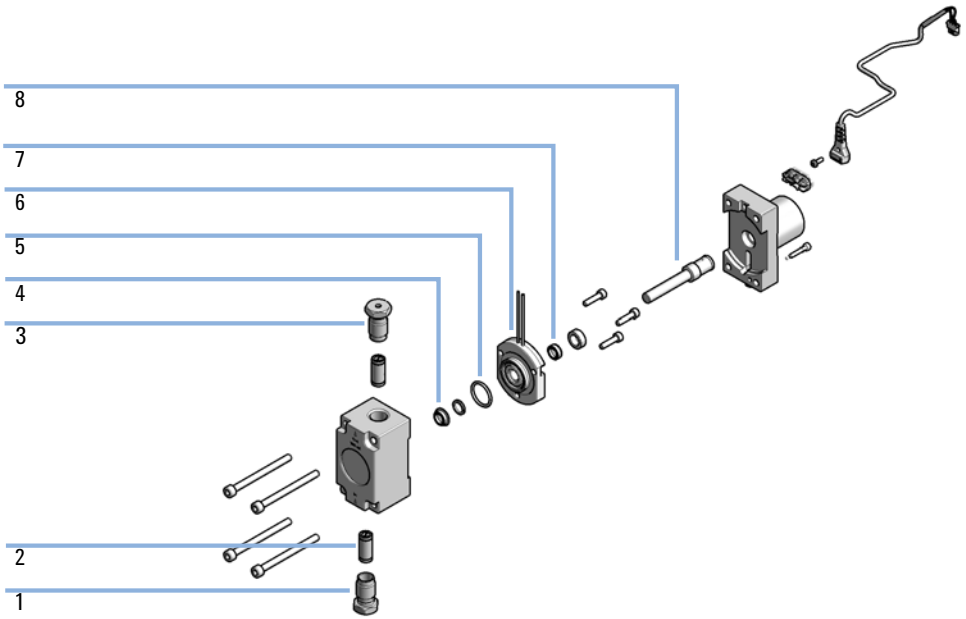
Purge Valve



Item	p/n	Description
	G7161-60300	Purge Valve
1		Filter purge adapter
2	G7111-60061	Purge valve
3	5022-2192	Filter frit 2 µm
4	G1361-44601	Filter screw

Pump Heads

Pump Head Assembly Parts



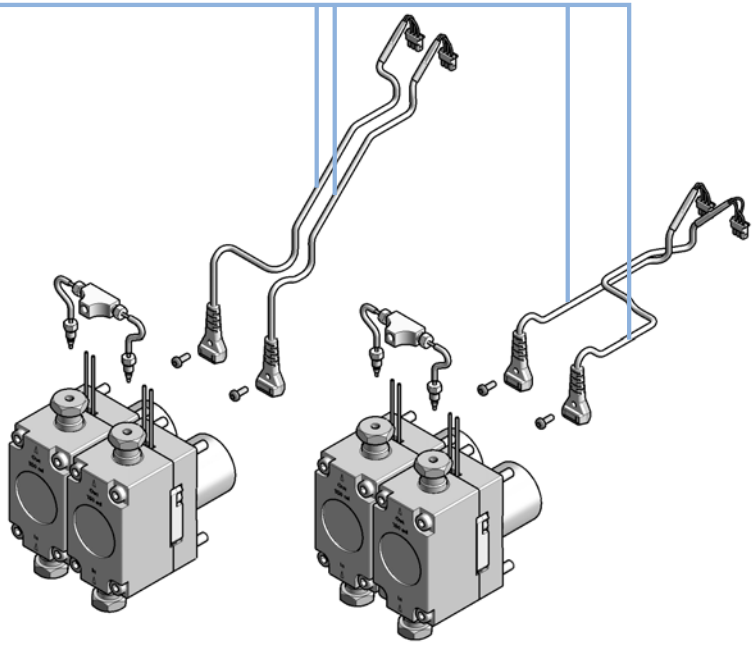
Assembly parts for 50 mL pump head:

Item	p/n	Description
1	G7161-20083	Inlet Check Valve Holder
2	5067-6642	Check valves, 50 mL head
3	G1361-25202	Valve Adapter long out
4	5067-4299	High pressure PE Seals
5	0905-1994	O-ring
6		Backup assembly
7	5067-6587	High pressure PE Wash Seals
8	G7161-60005	Piston Assembly 5 mm 50 mL pump head
8	G7161-60028	Piston Assembly 8 mm 200 mL pump head

Assembly parts for 200 mL pump head:

Item	p/n	Description
1	G7161-60052	Check valves, 200 mL head
2	G1361-25203	Valve Adapter long in
3	G1361-25202	Valve Adapter long out
4	5067-6589	High pressure PE Seals 200 mL head
5	0905-1993	O-ring 200 mL head
6		Backup assembly 200 mL head
7	5067-6588	High pressure PE Wash Seals 200 mL head
8	G7161-60005	Piston Assembly 5 mm 50 mL pump head
8	G7161-60028	Piston Assembly 8 mm 200 mL pump head

1



Item	p/n	Description
1	5188-8030	Tag Reader

Accessory Kit

#	p/n	Description
2	5043-1013	Tubing Clip
1	5181-1519	CAN cable, Agilent module to module, 1 m
3	5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
3	5500-1155	Tube Connector, 90 degree, ID 6.4
3	5500-1169	Y Tube Connector ID 6.4
1	5043-1372	Tubing Connector Leak 3-1
1	9222-0519	Bag, plastic
1	5067-5967	Tubing Clip Tube Connector
2	5043-1373	Tubing Connector Leak Cap
1	5043-1471	Fitting Handle
1	G1311-90107	Algae note
1	5067-6661	Seal exchange pin
1	0890-1764	Silicone rubber tubing 1 mm i.d. (3 m)
1	8710-2435	Wrench, open end, 14 / 17 mm
2	0890-1195	Flexible sleeving 1.45 mm/2.5 mm, PTFE
1	5500-1340	Priming Syringe 50 mL
1	G7161-81611	Capillary, Manifold-Mixer vertical
1	5500-1445	Capillary ST 0.94x1450 SX-SX
1	5500-1447	Capillary ST 0.94x60 SI
1	5067-5403	UHP fitting
1	5043-0915	Fitting mounting tool
1	0100-1818	TEE, LOW DEAD VOLUME

HPLC System Tool Kit

9 Identifying Cables

This chapter provides information on cables used with the 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 35900A A/D converter
01046-60105	Analog cable (BNC to general purpose, spade lugs)

Remote cables

p/n	Description
5188-8029	ERI to general purpose
5188-8044	Remote Cable ERI – ERI
5188-8045	Remote Cable APG – ERI
5188-8059	ERI-Extension-Cable 1.2 m
5061-3378	Remote Cable to 35900 A/D converter
01046-60201	Agilent module to general purpose
5188-8057	Fraction Collection ERI remote Y-cable

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)

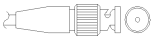
RS-232 cables (not for FUSION board)

p/n	Description
RS232-61601	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 is 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

USB cables

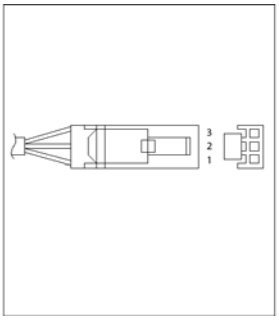
p/n	Description
5188-8050	USB A M-USB Mini B 3 m (PC-Module)
5188-8049	USB A F-USB Mini B M OTG (Module to Flash Drive)

Analog Cables

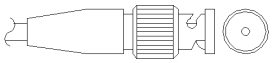


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

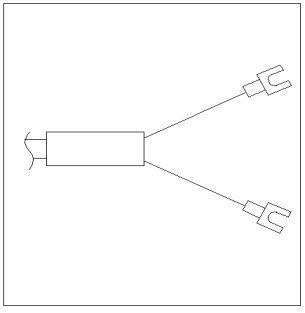
Agilent Module to 35900 A/D converters

p/n 35900-60750	35900	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 +

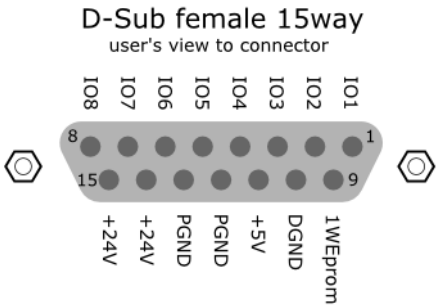
Agilent Module to General Purpose

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

Remote Cables

ERI (Enhanced Remote Interface)

- 5188-8029 ERI to general purpose (D-Sub 15 pin male - open end)
- 5188-8044 ERI to ERI (D_Sub 15 pin male - male)
- 5188-8059 ERI-Extension-Cable 1.2 m (D-Sub15 pin male / female)

p/n 5188-8029	pin	Color code	Enhanced Remote	Classic Remote	Active (TTL)
	1	white	IO1	START REQUEST	Low
	2	brown	IO2	STOP	Low
	3	green	IO3	READY	High
	4	yellow	IO4	POWER ON	High
	5	grey	IO5	NOT USED	
	6	pink	IO6	SHUT DOWN	Low
	7	blue	IO7	START	Low
	8	red	IO8	PREPARE	Low
	9	black	1wire DATA		
	10	violet	DGND		
	11	grey-pink	+5V ERI out		
	12	red-blue	PGND		
	13	white-green	PGND		
	14	brown-green	+24V ERI out		
	15	white-yellow	+24V ERI out		
	NC	yellow-brown			

- 5188-8045 ERI to APG (Connector D_Subminiature 15 pin (ERI), Connector D_Subminiature 9 pin (APG))

p/n 5188-8045	Pin (ERI)	Signal	Pin (APG)	Active (TTL)
	10	GND	1	
	1	Start Request	9	Low
	2	Stop	8	Low
	3	Ready	7	High
	5	Power on	6	High
	4	Future	5	
	6	Shut Down	4	Low
	7	Start	3	Low
	8	Prepare	2	Low
	Ground	Cable Shielding	NC	

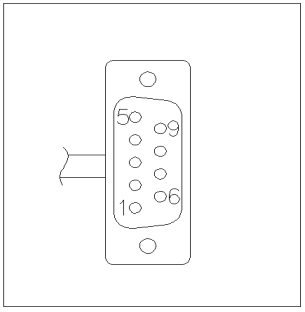
- 5188-8057 ERI to APG and RJ45 (Connector D_Subminiature 15 pin (ERI), Connector D_Subminiature 9 pin (APG), Connector plug Cat5e (RJ45))

Table 5 5188-8057 ERI to APG and RJ45

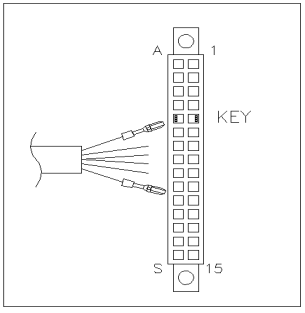
p/n 5188-8057	Pin (ERI)	Signal	Pin (APG)	Active (TTL)	Pin (RJ45)
					
	10	GND	1		5
	1	Start Request	9	High	
	2	Stop	8	High	
	3	Ready	7	High	
	4	Fraction Trig-ger	5	High	4
	5	Power on	6	High	
	6	Shut Down	4	High	
	7	Start	3	High	
	8	Prepare	2	High	
	Ground	Cable Shielding	NC		

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.

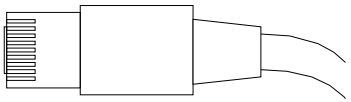
Agilent Module to Agilent 35900 A/D Converters

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

CAN/LAN Cables



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

CAN Cables

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

LAN Cables

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

Agilent Module to PC

p/n	Description
RS232-61601	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 is 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

USB

To connect a USB Flash Drive use a USB OTG cable with Mini-B plug and A socket.

p/n	Description
5188-8050	USB A M-USB Mini B 3 m (PC-Module)
5188-8049	USB A F-USB Mini B M OTG (Module to Flash Drive)

10 Hardware Information

This chapter describes the module 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, USB and RS- 232)
- memory management
- ability to update the firmware of the 'main system'

Main System

Its properties are:

- the complete communication capabilities (CAN, LAN, USB and RS- 232)
- 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/ERI 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 with the Agilent Lab Advisor software with files on the hard disk (latest version should be used).

Required tools, firmware and documentation are available from the Agilent web:
http://www.agilent.com/en-us/firmwareDownload?whid=69761

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

- PPPP is the product number, for example, 1315B for the G1315B DAD,
- R the firmware revision, for example, A for G1315B or B for the G1315C DAD,
- VVV is the revision number, for example 650 is revision 6.50,
- 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.

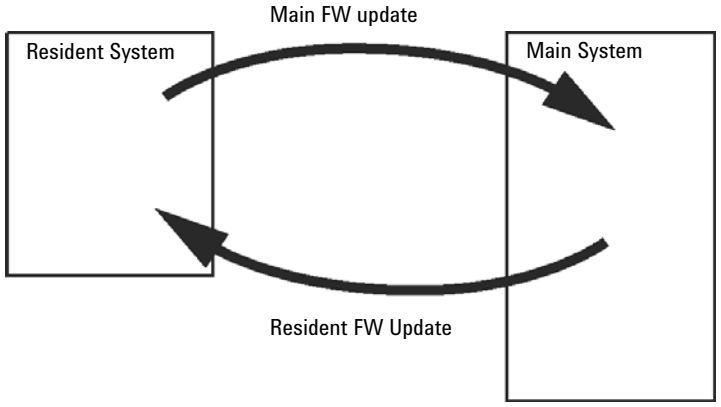


Figure 13 Firmware Update Mechanism

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 is used and the feature set of the original one is lost. After re-branding (e.g. from G1314B to G1314C), the original feature set is available again.

All this specific information is 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.agilent.com/en-us/firmwareDownload?whid=69761**

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 REMOTE connector may be used in combination with other analytical instruments from Agilent Technologies if you want to use features such as start, stop, common shut down, prepare, and so on.
- With the appropriate software, the RS-232C connector may be used to control the module from a computer through a RS-232C connection. This connector is activated and can be configured with the configuration switch.
- The power input socket accepts a line voltage of 100 – 240 VAC ± 10 % with a line frequency of 50 or 60 Hz. Maximum power consumption varies by module. There is no voltage selector on your module because the power supply has wide-ranging capability. There are no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

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

Serial Number Information

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

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

Rear view of the module

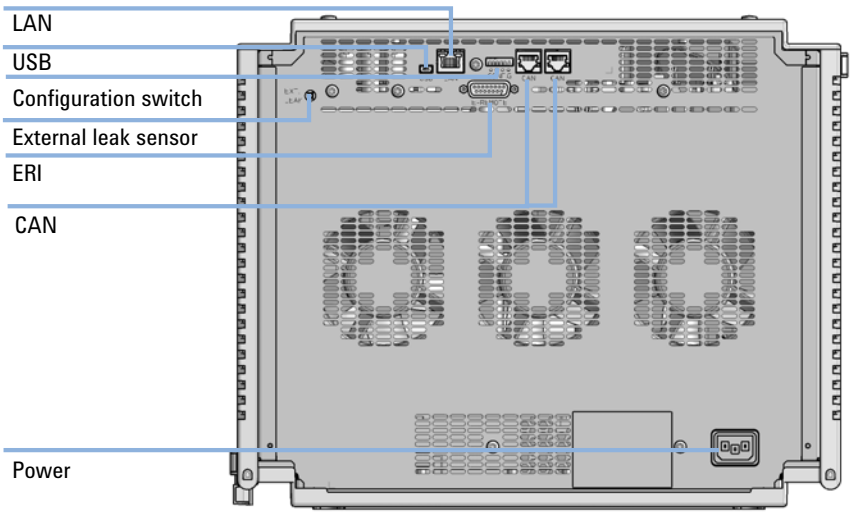


Figure 14 Rear view of the module

Interfaces

The Agilent InfinityLab LC Series modules provide the following interfaces:

Table 6 Agilent InfinityLab LC Series Interfaces

Module	CAN	USB	LAN (on-board)	RS-232	Analog	APG (A) / ERI (E)	Special
Pumps							
G7104A/C	2	No	Yes	Yes	1	A	
G7110B	2	Yes	Yes	No	No	E	
G7111A/B, G5654A	2	Yes	Yes	No	No	E	
G7112B	2	Yes	Yes	No	No	E	
G7120A	2	No	Yes	Yes	1	A	
G7161A/B	2	Yes	Yes	No	No	E	
Samplers							
G7129A/B/C	2	Yes	Yes	No	No	E	
G7167B/C, G5667A	2	Yes	Yes	No	No	E	
G7157A	2	Yes	Yes	No	No	E	
Detectors							
G7114A/B	2	Yes	Yes	No	1	E	
G7115A	2	Yes	Yes	No	1	E	
G7117A/B/C	2	Yes	Yes	No	1	E	
G7121A/B	2	Yes	Yes	No	1	E	
G7162A/B	2	Yes	Yes	No	1	E	
G7165A	2	Yes	Yes	No	1	E	

Table 6 Agilent InfinityLab LC Series Interfaces

Module	CAN	USB	LAN (on-board)	RS-232	Analog	APG (A) / ERI (E)	Special
Fraction Collectors							
G7158B	2	Yes	Yes	No	No	E	
G7159B	2	Yes	Yes	No	No	E	
G7166A	2	No	No	No	No	No	Requires a host module with on-board LAN with minimum FW B.06.40 or C.06.40, or with additional G1369C LAN Card
G1364E/F, G5664B	2	Yes	Yes	No	No	E	THERMOSTAT for G1330B
Others							
G7116A/B	2	No	No	No	No	No	Requires a HOST module via CAN
G7122A	No	No	No	Yes	No	A	
G7170B	2	No	No	No	No	No	Requires a host module with on-board LAN with minimum FW B.06.40 or C.06.40, or with additional G1369C LAN Card

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
- USB (Universal Series Bus) 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 a 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. Some modules have neither on-board LAN nor an interface slot for a LAN card (e.g. G1170A Valve Drive or G4227A Flexible Cube). These are hosted modules and require a Host module with firmware B.06.40 or later or with additional G1369C LAN Card.

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.

USB

The USB interface replaces the RS-232 Serial interface in new FUSION generation modules. For details on USB refer to "USB (Universal Serial Bus)" on page 157.

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.

Remote (ERI)

The ERI (Enhanced Remote Interface) 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.

It 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 7 ERI signal distribution

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

Special Interfaces

There is no special interface for this module.

ERI (Enhanced Remote Interface)

ERI replaces the AGP Remote Interface that is used in the HP 1090/1040/1050/1100 HPLC systems and Agilent 1100/1200/1200 Infinity HPLC modules. All new InfinityLab LC Series products using the FUSION core electronics use ERI. This interface is already used in the Agilent Universal Interface Box 2 (UIB2)

ERI Description

The ERI interface contains eight individual programmable input/output pins. In addition, it provides 24 V power and 5 V power and a serial data line to detect and recognize further add-ons that could be connected to this interface. This way the interface can support various additional devices like sensors, triggers (in and out) and small controllers, etc.

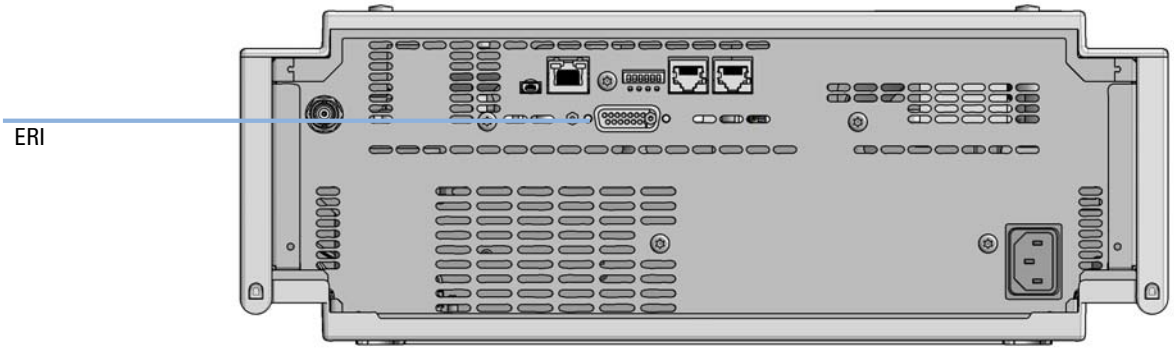
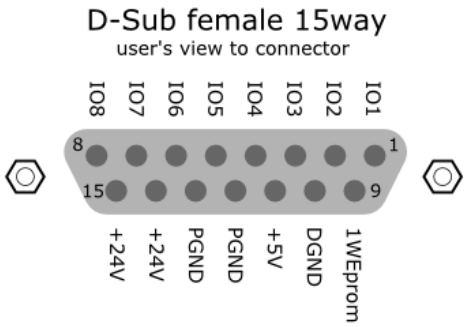


Figure 15 Location of the ERI interface (example shows a G7114A/B VWD)



Pin	Enhanced Remote
1	IO 1 (START REQUEST)
2	IO 2 (STOP)
3	IO 3 (READY)
4	IO 4 (POWER ON)
5	IO 5 (NOT USED)
6	IO 6 (SHUT DOWN)
7	IO 7 (START)
8	IO 8 (PREPARE)
9	1 wire DATA
10	DGND
11	+5 V ERI out
12	PGND
13	PGND
14	+24 V ERI out
15	+24 V ERI out

IO (Input/Output) Lines

- Eight generic bi-directional channels (input or output).
- Same as the APG Remote.
- Devices like valves, relays, ADCs, DACs, controllers can be supported/controlled.

1-Wire Data (Future Use)

This serial line can be used to read out an EPROM or write into an EPROM of a connected ERI-device. The firmware can detect the connected type of device automatically and update information in the device (if required).

5V Distribution (Future Use)

- Available directly after turn on oft the hosting module (assures that certain base functionality of the device can be detected by firmware).
- For digital circuits or similar.
- Provided 500 mA maximum.
- Short-circuit proof with automatic switch off (by firmware).

24V Distribution (Future Use)

- Available by firmware command (defined turn on/off).
- For devices that need higher power
  - Class 0: 0.5 A maximum (12 W)
  - Class 1: 1.0 A maximum (24 W)
  - Class 2: 2.0 A maximum (48 W)
- Class depends on hosting module's internal power overhead.
- If a connected device requires more power the firmware detects this (overcurrent detection) and provides the information to the user interface.
- Fuse used for safety protection (on board).
- Short circuit will be detected through hardware.

USB (Universal Serial Bus)

USB (Universal Serial Bus) - replaces RS232, supports:

- a PC with control software (for example Agilent Lab Advisor)
- USB Flash Disk

Setting the 6-bit Configuration Switch

The 6-bit configuration switch is located at the rear of the module with FUSION electronics. Switch settings provide configuration parameters for LAN and instrument specific initialization procedures.

All modules with FUSION electronics:

- Default is ALL switches DOWN (best settings).
  - Default IP address for LAN 192.168.254.11
- For specific LAN modes switches 4-5 must be set as required.
- For boot resident/cold start modes switches 1+2 or 6 must be UP.

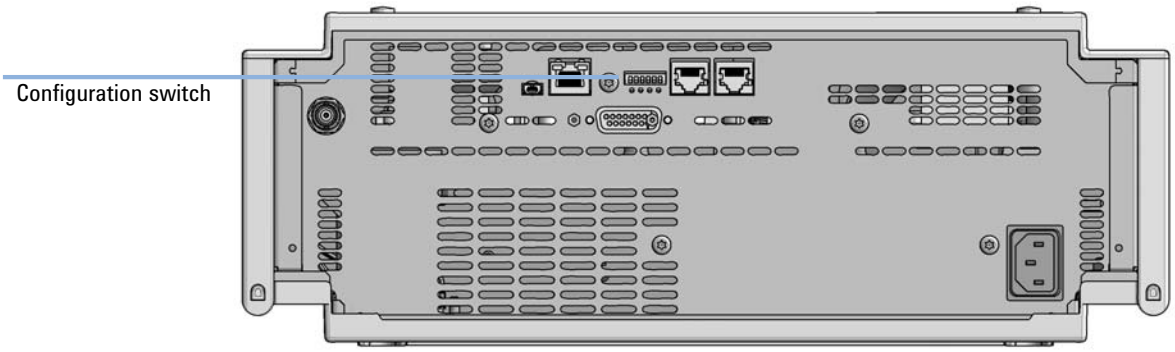


Figure 16 Location of Configuration switch (example shows a G7114A/B VWD)

Table 8 6-bit Configuration Switch

	Mode	Function/Setting				
	Switch 1	**Switch 2**	**Switch 3**	**Switch 4**	**Switch 5**	**Switch 6**
COM[1]	**0**	n.a.[2]	n.a.	LAN Init Mode		n.a.
Use Default IP Address[3]		0	0	0	0	0
Use Stored IP Address		0	0	0	1	0
Use DHCP to request IP Address[4]		0	0	1	0	0
Test	**1**	**System**	**n.a.**	**n.a.**	**n.a.**	**ColdStart**
Boot Main System / Keep Data		0	0	0	0	0
Boot Resident System / Keep Data		1	0	0	0	0
Boot Main System / Revert to Default Data		0	0	0	0	1
Boot Resident System / Revert to Default Data		1	0	0	0	1

1 When selecting mode COM, settings are stored to non-volatile memory. When selecting mode TEST, COM settings are taken from non-volatile memory.

2 not assigned - Always keep these switches on position '0' (off)

3 Default IP Address is 192.168.254.11

4 Host Name will be the MAC address.

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.

11 LAN Configuration

This chapter provides information on connecting the module to the Agilent ChemStation PC.

What You Have to Do First

The module has an on- board LAN communication interface.

NOTE This chapter is generic and may show figures that differ from your module. The functionality is the same.

1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear of the module underneath the configuration switch (see Figure 18 on page 163).

Figure 17 MAC-Label

2 Connect the instrument's LAN interface (see Figure 18 on page 163) to
- the PC network card using a crossover network cable (point-to-point) or
- a hub or switch using a standard LAN cable.

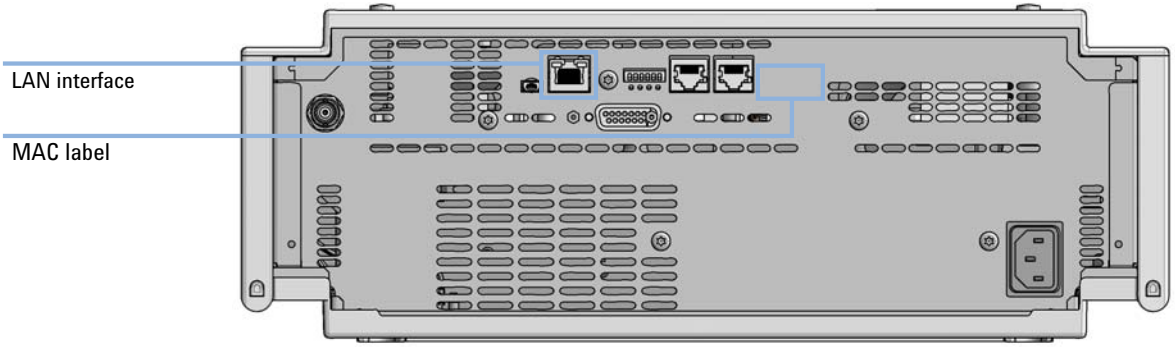


Figure 18 Location of LAN interfaces and MAC label

TCP/IP parameter configuration

To operate properly in a network environment, the LAN interface must be configured with valid TCP/IP network parameters. These parameters are:

- IP address
- Subnet Mask
- Default Gateway

The TCP/IP parameters can be configured by the following methods:

- by automatically requesting the parameters from a network-based DHCP Server (using the so-called Dynamic Host Configuration Protocol). This mode requires a LAN-onboard Module or a G1369C LAN Interface card, see "Setup (DHCP)" on page 169
- by manually setting the parameters using Telnet
- by manually setting the parameters using the Local Controller

The LAN interface differentiates between several initialization modes. The initialization mode (short form 'init mode') defines how to determine the active TCP/IP parameters after power-on. The parameters may be derived non-volatile memory or initialized with known default values. The initialization mode is selected by the configuration switch, see Table 9 on page 166.

Configuration Switches

The configuration switch can be accessed at the rear of the module.

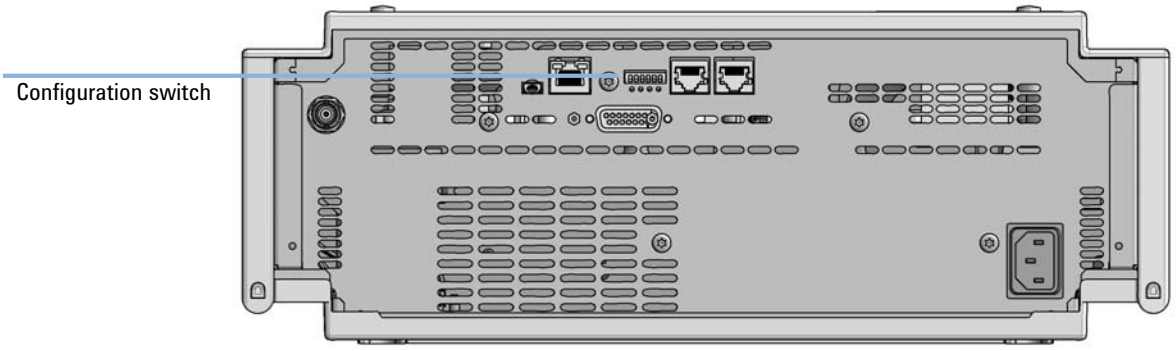


Figure 19 Location of Configuration switch (example shows a G7114A/B VWD)

The module is shipped with all switches set to OFF, as shown above.

NOTE

To perform any LAN configuration, SW1 and SW2 must be set to OFF.

Initialization Mode Selection

The following initialization (init) modes are selectable:

Table 9 Initialization Mode Switches

	SW1	SW2	SW3	SW4	SW5	SW6	Init Mode
	0	0	0	0	0	0	Use Default IP Address
	0	0	0	0	1	0	Use Stored IP Address
	0	0	0	1	0	0	Use DHCP
	Note: The setting '0' (down) is essential.						

Default IP address for LAN is 192.168.254.11.

DHCP address is the module's LAN MAC address.

Using Stored

When initialization mode **Using Stored** is selected, the parameters are taken from the non-volatile memory of the module. The TCP/IP connection will be established using these parameters. The parameters were configured previously by one of the described methods.

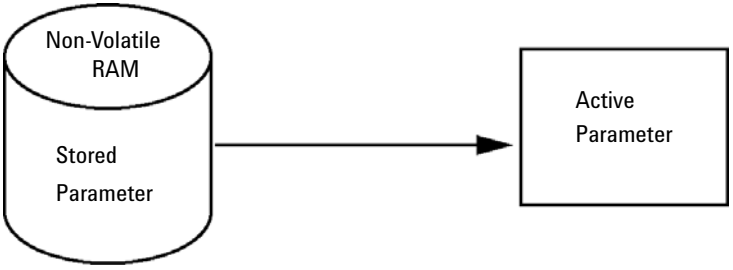


Figure 20 Using Stored (Principle)

Using Default

When **Using Default** is selected, the factory default parameters are taken instead. These parameters enable a TCP/IP connection to the LAN interface without further configuration, see Table 10 on page 167.

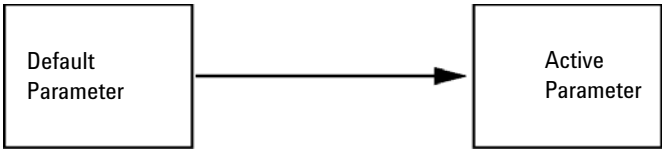


Figure 21 Using Default (Principle)

NOTE

Using the default address in your local area network may result in network problems. Take care and change it to a valid address immediately.

Table 10 Using Default Parameters

IP address:	192.168.254.11
Subnet Mask:	255.255.255.0
Default Gateway	not specified

Since the default IP address is a so-called local address, it will not be routed by any network device. Thus, the PC and the module must reside in the same subnet.

The user may open a Telnet session using the default IP address and change the parameters stored in the non-volatile memory of the module. He may then close the session, select the initialization mode Using Stored, power-on again and establish the TCP/IP connection using the new parameters.

When the module is wired to the PC directly (e.g. using a cross-over cable or a local hub), separated from the local area network, the user may simply keep the default parameters to establish the TCP/IP connection.

NOTE

In the **Using Default** mode, the parameters stored in the memory of the module are not cleared automatically. If not changed by the user, they are still available, when switching back to the mode Using Stored.

Dynamic Host Configuration Protocol (DHCP)

General Information (DHCP)

The Dynamic Host Configuration Protocol (DHCP) is an auto configuration protocol used on IP networks. The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and “B”-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

When the initialization mode “DHCP” is selected, the card tries to download the parameters from a DHCP Server. The parameters obtained become the active parameters immediately. They are not stored to the non-volatile memory of the card.

Besides requesting the network parameters, the card also submits its hostname to the DHCP Server. The hostname equals the MAC address of the card, e.g. *0030d3177321*. It is the DHCP server's responsibility to forward the hostname/address information to the Domain Name Server. The card does not offer any services for hostname resolution (e.g. NetBIOS).

Figure 22 DHCP (Principle)

NOTE

1. It may take some time until the DHCP server has updated the DNS server with the hostname information.
2. It may be necessary to fully qualify the hostname with the DNS suffix, e.g. *0030d3177321.country.company.com*.
3. The DHCP server may reject the hostname proposed by the card and assign a name following local naming conventions.

Setup (DHCP)

The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and "B"-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

1 Note the MAC address of the LAN interface (provided with G1369C LAN Interface Card or Main Board). This MAC address is on a label on the card or at the rear of the main board, e.g. *0030d3177321*.

On the Local Controller the MAC address can be found under **Details** in the LAN section.

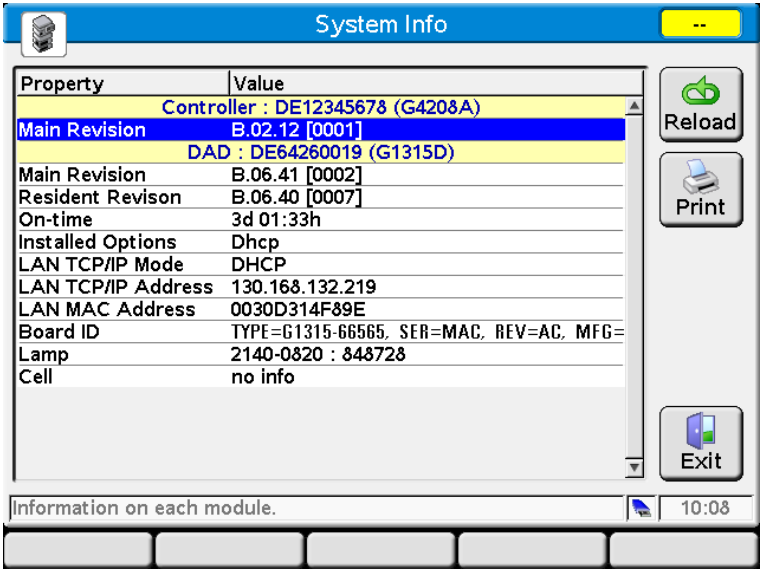


Figure 23 LAN Setting on Instant Pilot

2 Set the Configuration Switch to DHCP either on the G1369C LAN Interface Card or the main board of above mentioned modules.

Table 11 G1369C LAN Interface Card (configuration switch on the card)

SW 4	SW 5	SW 6	SW 7	SW 8	Initialization Mode
ON	OFF	OFF	OFF	OFF	DHCP

Table 12 LC Modules with 8-bit configuration switch (B-firmware) (configuration switch at rear of the instrument)

SW 6	SW 7	SW 8	Initialization Mode
ON	OFF	OFF	DHCP

3 Turn on the module that hosts the LAN interface.

4 Configure your Control Software (e.g. OpenLAB CDS ChemStation Edition, Lab Advisor, Firmware Update Tool) and use MAC address as host name, e.g. *0030d3177321*.

The LC system should become visible in the control software (see Note in section "General Information (DHCP)" on page 168).

Manual Configuration

Manual configuration only alters the set of parameters stored in the non-volatile memory of the module. It never affects the currently active parameters. Therefore, manual configuration can be done at any time. A power cycle is mandatory to make the stored parameters become the active parameters, given that the initialization mode selection switches are allowing it.

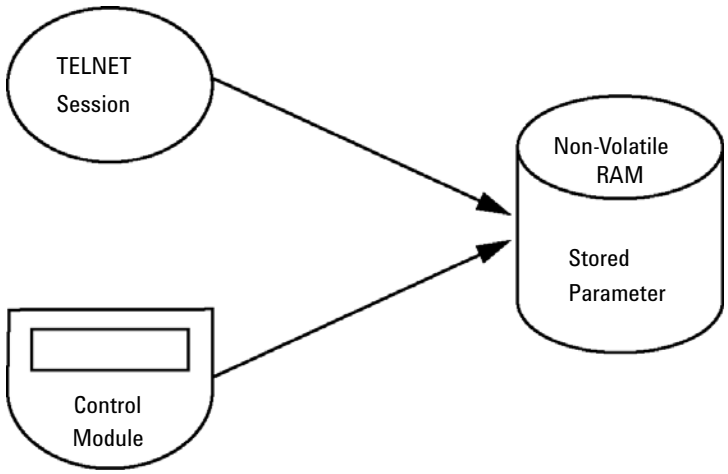


Figure 24 Manual Configuration (Principle)

With Telnet

Whenever a TCP/IP connection to the module is possible (TCP/IP parameters set by any method), the parameters may be altered by opening a Telnet session.

1 Open the system (DOS) prompt window by clicking on Windows **START** button and select **"Run..."**. Type "cmd" and press OK.

2 Type the following at the system (DOS) prompt:

- `c:\>telnet <IP address>` or
- `c:\>telnet <host name>`

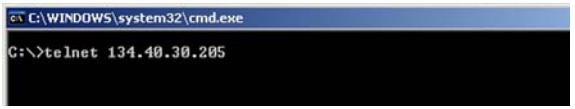


Figure 25 Telnet - Starting a session

where <IP address> may be the assigned address from a Bootp cycle, a configuration session with the Handheld Controller, or the default IP address (see "Configuration Switches" on page 165).

When the connection was established successfully, the module responds with the following:

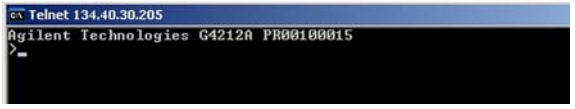


Figure 26 A connection to the module is made

3 Type
? and press enter to see the available commands.

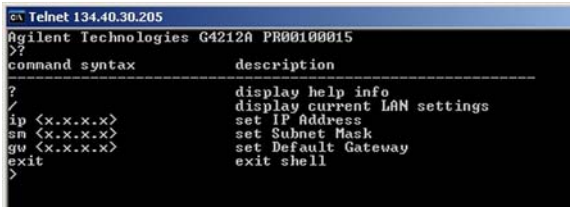


Figure 27 Telnet Commands

Table 13 Telnet Commands

Value	Description
?	displays syntax and descriptions of commands
/	displays current LAN settings
ip <x.x.x.x>	sets new ip address
sm <x.x.x.x>	sets new subnet mask
gw <x.x.x.x>	sets new default gateway
exit	exits shell and saves all changes

4 To change a parameter follows the style:

- parameter value, for example:
  `ip 134.40.28.56`

  Then press [Enter], where parameter refers to the configuration parameter you are defining, and value refers to the definitions you are assigning to that parameter. Each parameter entry is followed by a carriage return.

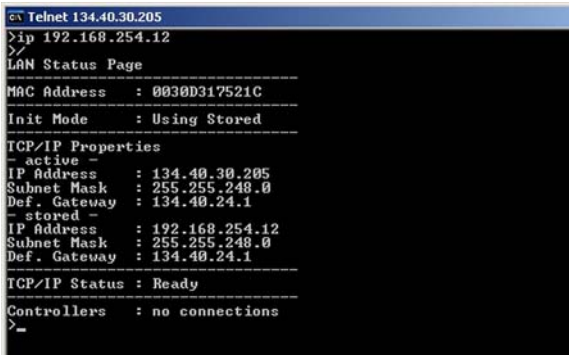
5 Use the "/" and press Enter to list the current settings.

Figure 28 Telnet - Current settings in "Using Stored" mode

information about the LAN interface
MAC address, initialization mode
Initialization mode is Using Stored
active TCP/IP settings

TCP/IP status - here ready
connected to PC with controller software (e.g. Agilent ChemStation), here not connected

6 Change the IP address (in this example 192.168.254.12) and type "/" to list current settings.



change of IP setting to
Initialization mode is Using Stored

active TCP/IP settings

stored TCP/IP settings in non-volatile memory

connected to PC with controller software (e.g. Agilent ChemStation), here not connected

Figure 29 Telnet - Change IP settings

7 When you have finished typing the configuration parameters, type `exit` and press **Enter** to exit with storing parameters.

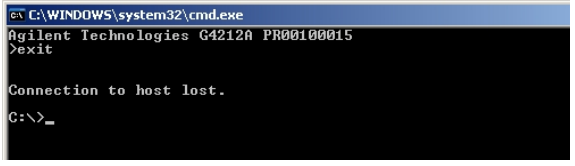


Figure 30 Closing the Telnet Session

NOTE If the Initialization Mode Switch is changed now to "Using Stored" mode, the instrument will take the stored settings when the module is re-booted. In the example above it would be 192.168.254.12.

12 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.

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Before Applying Power

WARNING

Wrong voltage range, frequency or cabling

Personal injury or damage to the instrument

- ✓ **Verify that the voltage range and frequency of your power distribution matches to the power specification of the individual instrument.**
- ✓ **Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.**
- ✓ **Make all connections to the unit before applying power.**

NOTE

Note the instrument's external markings described under "Safety Symbols" on page 181.

Ground the Instrument

WARNING

Missing electrical ground

Electrical shock

- ✓ **If your product is provided with a grounding type power plug, the instrument chassis and cover must be connected to an electrical ground to minimize shock hazard.**
- ✓ **The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.**

Ground Solvent Lines

WARNING

Missing electrical ground

Electrical shock, fire, explosion

- ✓ **Never use solvent guiding tubes, capillaries, and fittings other than the ones supplied by Agilent Technologies for use in preparative systems.**

Do Not Operate in an Explosive Atmosphere

WARNING

Presence of flammable gases or fumes

Explosion hazard

- ✓ **Do not operate the instrument in the presence of flammable gases or fumes.**

Do Not Remove the Instrument Cover

WARNING

Instrument covers removed

Electrical shock

- ✓ **Do Not Remove the Instrument Cover**
- ✓ **Only Agilent authorized personnel are allowed to remove instrument covers. Always disconnect the power cables and any external circuits before removing the instrument cover.**

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure that safety features are maintained.

In Case of Damage

WARNING

Damage to the module

Personal injury (for example electrical shock, intoxication)

- ✓ **Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.**

Solvents

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.**
- ✓ **Do not use solvents with an auto-ignition temperature below 200 °C (392 °F). Do not use solvents with a boiling point below 56 °C (133 °F).**
- ✓ **Avoid high vapor concentrations. Always keep the temperature in the sample compartment at least 25 K below the boiling point of the solvent used.**
- ✓ **Do not operate the instrument in an explosive atmosphere.**
- ✓ **Do not use solvents of ignition Class IIC according IEC 60079-20-1 (for example, carbon disulfide).**
- ✓ **Reduce the volume of substances to the minimum required for the analysis.**
- ✓ **Never exceed the maximum permissible volume of solvents (8 L) in the solvent cabinet. Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for solvent cabinet.**
- ✓ **Ground the waste container.**
- ✓ **Regularly check the filling level of the waste container. The residual free volume in the waste container must be large enough to collect the waste liquid.**
- ✓ **To achieve maximal safety, regularly check the tubing for correct installation.**

NOTE

For details, see the usage guideline for the solvent cabinet. A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available in the Agilent Information Center or via the Internet.

Safety Symbols

Table 14 Symbols

	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.
	The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up.
	Sample Cooler unit is designed as vapor-compression refrigeration system. Contains fluorinated greenhouse gas (refrigerant) according to the Kyoto protocol. For specifications of refrigerant, charge capacity, carbon dioxide equivalent (CDE), and global warming potential (GWP) see instrument label.
	Flammable Material For Sample Thermostat which uses flammable refrigerant consult Agilent Information Center / User Manual before attempting to install or service this equipment. All safety precautions must be followed.
	Confirms that a manufactured product complies with all applicable European Community directives. The European Declaration of Conformity is available at: **http://regulations.corporate.agilent.com/DoC/search.htm**
	Manufacturing date.
	Power symbol indicates On/Off. The apparatus is not completely disconnected from the mains supply when the power switch is in the Off position
	Pacemaker Magnets could affect the functioning of pacemakers and implanted heart defibrillators. A pacemaker could switch into test mode and cause illness. A heart defibrillator may stop working. If you wear these devices keep at least 55 mm distance to magnets. Warn others who wear these devices from getting too close to magnets.

Table 14 Symbols

	Magnetic field Magnets produce a far-reaching, strong magnetic field. They could damage TVs and laptops, computer hard drives, credit and ATM cards, data storage media, mechanical watches, hearing aids and speakers. Keep magnets at least 25 mm away from devices and objects that could be damaged by strong magnetic fields.
	Indicates a pinching or crushing hazard
	Indicates a piercing or cutting hazard.

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.**

Waste Electrical and Electronic Equipment (WEEE) Directive

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

NOTE

Do not dispose of in domestic household waste

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

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)

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http://www.agilent.com

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In This Book

This manual contains technical reference information about the Agilent 1290 Infinity II Preparative Binary Pump (G7161B) and the Agilent 1260 Infinity II Preparative Binary Pump (G7161A).

The manual describes the following:

- introduction and specifications,
- using and optimizing,
- troubleshooting and diagnose,
- maintenance,
- parts identification,
- hardware information,
- safety and related information.

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