



Agilent InfinityLab LC Series
1260 Infinity II Isocratic and Quaternary Pumps

User Manual



Notices

Document Information

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Safety Notices

CAUTION

A **CAUTION** 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 damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

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:

- Agilent 1260 Infinity II Isocratic Pump (G7110B),
- Agilent 1260 Infinity II Quaternary Pump VL (G7111A),
- Agilent 1260 Infinity II Quaternary Pump (G7111B), and
- Agilent 1260 Infinity II Bio-inert Pump (G5654A).

1 Introduction

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

2 Site Requirements and Specifications

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

3 Using the Pump

This chapter provides information for optimized usage of the module.

4 Optimizing Performance

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

5 Troubleshooting and Diagnostics

This chapter gives an overview about the troubleshooting and diagnostic features and the different user interfaces.

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 Test Functions and Calibration

This chapter describes the tests for the module.

8 Maintenance

This chapter describes the maintenance of the module.

9 Parts for Maintenance

This chapter provides information on parts for maintenance.

10 Identifying Cables

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

11 Hardware Information

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

12 LAN Configuration

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

13 Appendix

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

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

Introduction to the Pump

The Pumps comprise one pump head unit with an optional solvent cabinet, a vacuum degasser (optional for the isocratic pump), and a multi-channel gradient valve (MCGV) for quaternary pumps, or an optional solvent selection valve (SSV) for isocratic pumps. The combination of the pump head assembly and high-speed proportioning MCGV with a possible connection up to four different solvents in quaternary pumps provides gradient generation by low pressure mixing. The combination of the pump head assembly and SSV in isocratic pump provides opportunity to make a choice between three different solvents. A solvent cabinet provides enough space for eight one-liter bottles. The Active Seal Wash (ASW) and Active Inlet Valve (AIV) options are available for quaternary pumps when concentrated buffer solutions are used. The Bio-inert pump is optimized for these conditions, thus is always equipped with ASW and AIV.

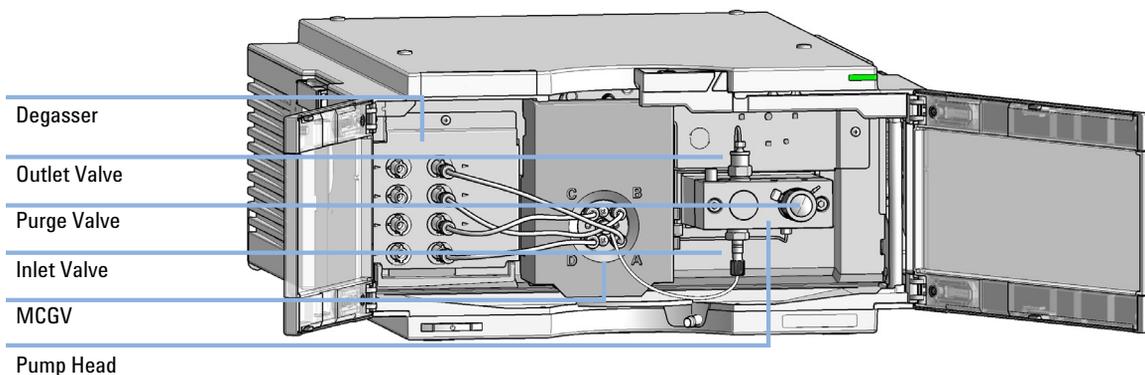


Figure 1 Overview of the pump

G7110B Isocratic Pump

Product Description

The Agilent 1260 Infinity II Isocratic Pump is ideal for demanding QA/QC tasks and routine applications. It maintains virtually pulse-free and stable solvent flows. The dual floating, precise servo-controlled pistons in the delivery mechanism adjust the stroke volume according to your chosen flow rate.

The optional integrated degasser and solvent selection valve offers increased ease-of-use and method flexibility.

The pump can deliver a broad range of pressures up to a maximum 600 bar, giving you the flexibility to use small particle size columns, longer columns or alternative higher viscosity solvents.

The Agilent 1260 Infinity II Isocratic Pump is the ideal pump for GPC/SEC applications where run-to-run and day-to-day precision in retention times is crucial.

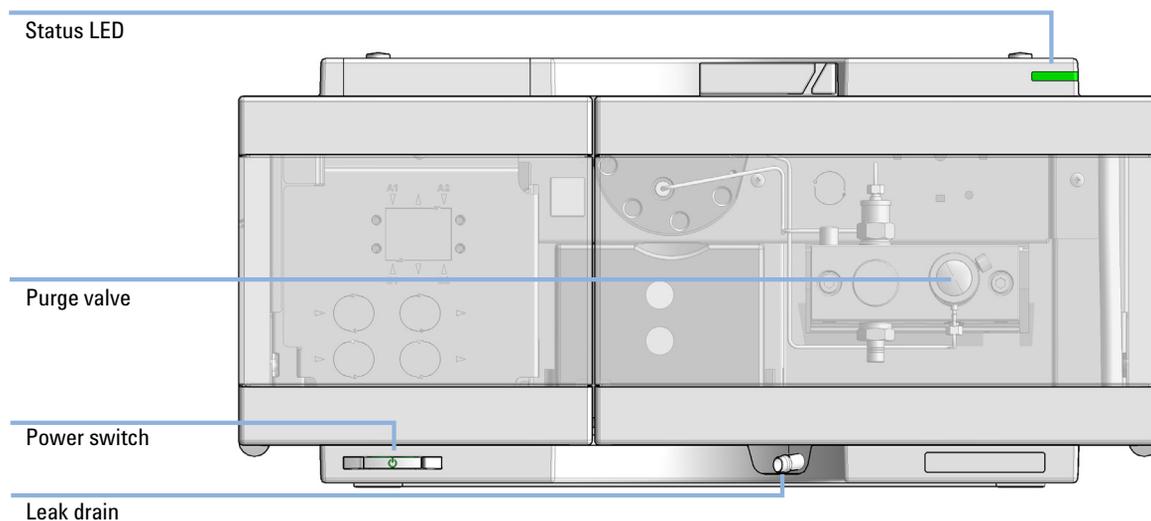


Figure 2 Overview of the pump

Features

- *Higher resolution and increased throughput* with the new standard 600 bar pressure for modern LC columns.
- *Low operating and maintenance costs* - due to excellent instrument uptime.
- *Future proof* - your investment is protected since you can upgrade to a quaternary pump if required.
- *Versatile wide flow range* – from 0.2 mL/min to 10 mL/min for analytical and semi-preparative separations and purifications.
- *Fast and easy maintenance* - front access to all maintenance parts means you can change components quickly without having to disassemble the instrument.
- *Longevity and low operating costs* - robust materials (stainless steel, titanium, gold, ruby, sapphire, ceramics, PEEK and PTFE) withstand the most demanding applications and keep your pump functioning for years. Our optional seal wash for high-salt mobile phases keeps maintenance to a minimum and reduces operating costs.

G7111A Quaternary Pump VL

Product Description

The Agilent 1260 Infinity II Quaternary Pump VL has an extended power range, delivering pressures up to 400 bar. At these high pressures you can use smaller particle size columns and get higher resolution and faster separations. It maintains virtually pulse-free, well mixed and stable solvent flows. Its dual floating, precise servo-controlled pistons adjust the stroke volume according to your chosen flow rate.

Offering access to up to four solvents, the Agilent 1260 Infinity II Quaternary Pump VL provides the greatest flexibility in automated solvent blending and is recommended for a wide range of research and routine applications (especially in the food, environmental and pharmaceutical sectors) as well as for method development.

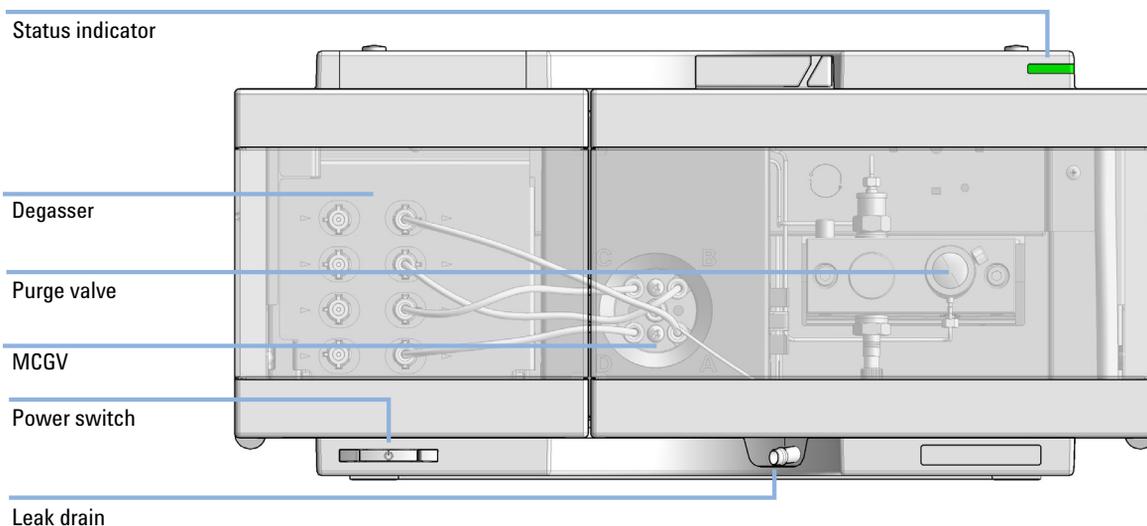


Figure 3 Overview of the pump

Features

- *Higher resolution, faster separations* - the maximum pressure of 400 bar allows you to use smaller particle size columns, longer columns and/or higher viscous solvents as an alternative to acetonitrile.
- *Analytical and semi-preparative purifications* - the wide flow range (up to 10 mL/min) perfectly supports standard and semi-preparative applications. The perfect choice for 4.6 mm and 3.0 mm id columns.
- *Quicker experiments* - the pump offers convenient access to up to four solvents for isocratic or gradient analysis which can really speed up method development, preparation of mobile phases and system flushing.
- *Easy, fast and secure transfer of methods* from HPLC to sub-2-micron columns.
- *Integrated degasser*
- *Longevity and low operating costs* - robust materials (stainless steel, titanium, gold, ruby, sapphire, ceramics, PEEK and PTFE) withstand the most demanding applications and keep your pump functioning for years. Our optional seal wash for high-salt mobile phases keeps maintenance to a minimum and reduces operating costs.

G7111B Quaternary Pump

Product Description

The Agilent 1260 Infinity II Quaternary Pump has an extended power range, delivering pressures up to 600 bar. At these high pressures you can use smaller particle size columns and get higher resolution and faster separations. It maintains virtually pulse-free, well mixed and stable solvent flows. Its dual floating, precise servo-controlled pistons adjust the stroke volume according to your chosen flow rate.

Offering access to up to four solvents, the Agilent 1260 Infinity II Quaternary Pump provides the greatest flexibility in automated solvent blending and is recommended for a wide range of research and routine applications (especially in the food, environmental and pharmaceutical sectors) as well as for method development.

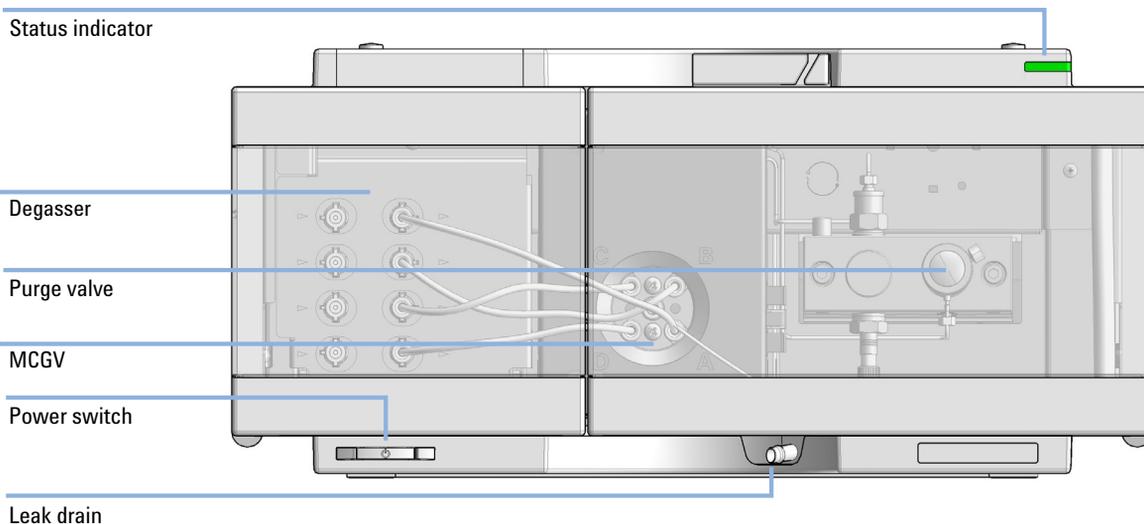


Figure 4 Overview of the pump

Features

- *Higher resolution, faster separations* - the maximum pressure of 600 bar allows you to use smaller particle size columns, longer columns and/or higher viscous solvents as an alternative to acetonitrile.
- *Analytical and semi-preparative purifications* - the wide flow range (up to 10 mL/min) perfectly supports standard and semi-preparative applications. The perfect choice for 4.6 mm and 3.0 mm id columns.
- *Quicker experiments* - the pump offers convenient access to up to four solvents for isocratic or gradient analysis which can really speed up method development, preparation of mobile phases and system flushing.
- *Easy, fast and secure transfer of methods* from HPLC to sub-2-micron columns.
- *Integrated degasser*
- *Longevity and low operating costs* - robust materials (stainless steel, titanium, gold, ruby, sapphire, ceramics, PEEK and PTFE) withstand the most demanding applications and keep your pump functioning for years. Our optional seal wash for high-salt mobile phases keeps maintenance to a minimum and reduces operating costs.

G5654A Bio-inert Pump

Product Description

The 1260 Infinity II Bio-Inert Pump is the pump of choice for all your biological and extreme pH applications. The titanium-based pump offers highest corrosion resistance against high salt concentration (2 M) and offers a handling of a wide pH range (1 – 13, short term 14). It features a pressure range of up to 600 bar and a flow rate up to 10 mL/min (at 200 bar). Which enables the use of almost any column: conventional, sub-2 μm particle, or superficially porous columns.

Together with the Agilent Bio-HPLC column portfolio for SEC and IEX, the highest resolution per time is achieved for protein and NBE characterization. The Agilent Buffer Advisor software allows fast pH scouting and easy buffer/solvent preparation in ion exchange chromatography.

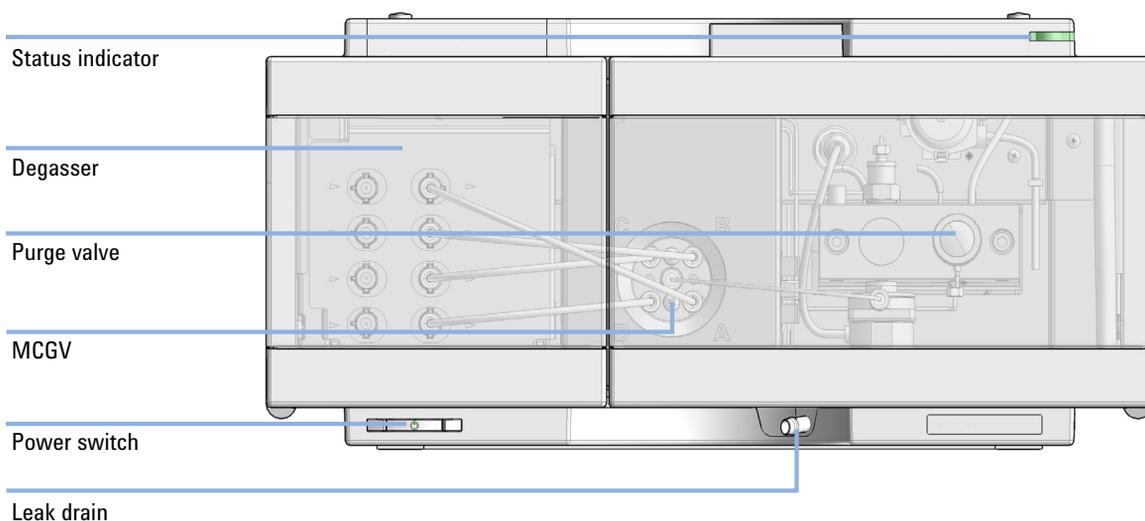


Figure 5 Overview of the Bio-inert Pump

Features

- *Titanium pump* - for highest corrosion resistance against high salt concentrations and harsh cleaning procedures
- *Steel and iron-free wetted parts in solvent delivery unit* - ensure the integrity of bio-molecules and minimize unwanted surface interactions while increasing column life-time
- *High salt tolerance (2 M) and wide pH range (1 – 13, short term 14)* - for increased flexibility
- *Flow rates up to 10 mL/min* - enable power ranges from lowest pressure for traditional bio-purification columns up to high pressure STM analytical bio-columns
- Active seal wash and quaternary solvent blending included
- Comes with *Agilent Buffer Advisor software* - for faster pH scouting and easy buffer/solvent preparation in ion exchange chromatography

Overview of the Hydraulic Path

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

In the quaternary pumps, degassing of the solvents is done in a built-in vacuum degasser. Solvent compositions are generated on the low-pressure side by an MCGV.

The pump assembly includes a pump head with an inlet valve and an outlet valve. A damping unit is connected between the two piston chambers. A purge valve including a PTFE frit is fitted at the pump outlet for convenient priming of the pump head.

Hydraulic Path

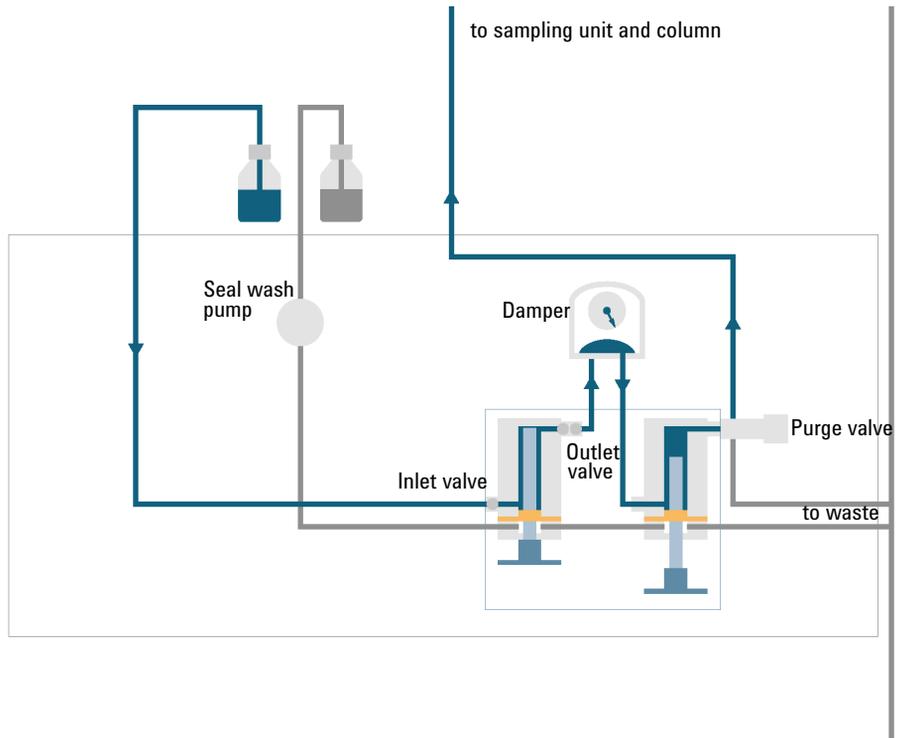


Figure 6 Hydraulic path of the isocratic pump

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Overview of the Hydraulic Path

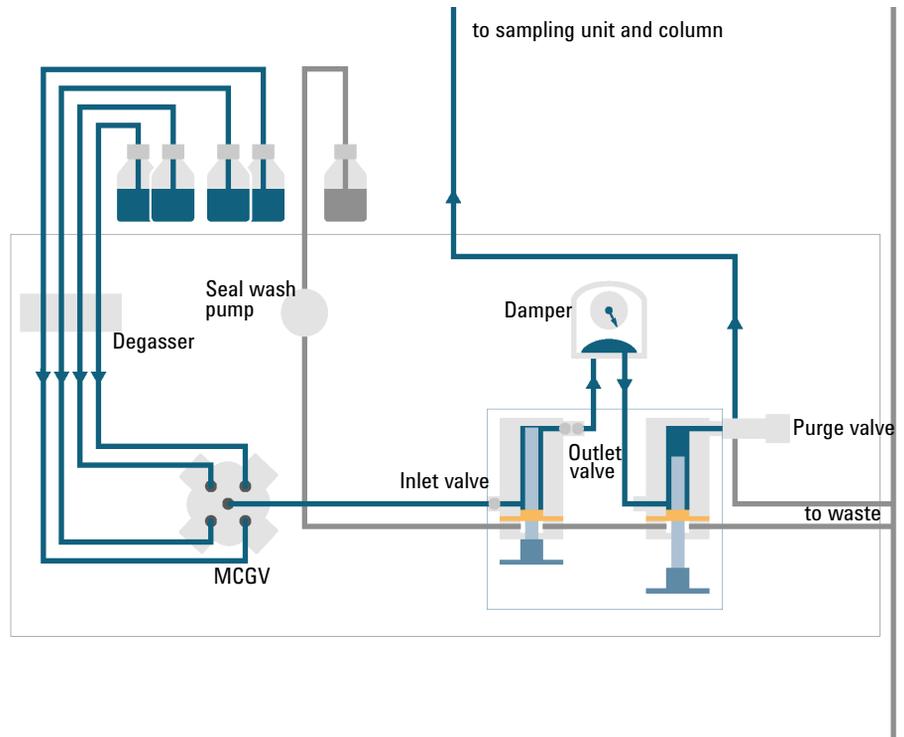


Figure 7 Hydraulic Path of the Quaternary Pump and Bio-inert Pump

How Does the Pump Work?

In the quaternary pump, the liquid runs from the solvent reservoir through the degasser to the MCGV and from there to the inlet valve.

For the isocratic pump, the solvent bottle is directly connected to the inlet valve.

The pump assembly comprises two substantially identical piston/chamber units. Both piston/chamber units comprise a ball-screw drive and a pump head with one sapphire piston for reciprocating movement in it.

A servo-controlled variable reluctance motor drives the two ball screw drives in opposite directions. The gears for the ball-screw drives have different circumferences (ratio 2:1) allowing the first piston to move at twice the speed of the second piston. The solvent enters the pump head close to the bottom limit and leaves it at its top. The outer diameter of the piston is smaller than the inner diameter of the pump head chamber allowing the solvent to fill the gap in between. The first piston has a stroke volume in the range of 20 – 100 μL depending on the flow rate. The microprocessor controls all flow rates in a range of 1 $\mu\text{L}/\text{min}$ – 10 mL/min . The inlet of the first pumping unit is connected to the inlet valve.

The outlet of the first piston/chamber unit is connected through the outlet valve and the damping unit to the inlet of the second piston/chamber unit. The outlet of the purge valve assembly is then connected to the following chromatographic system.

Introduction

Overview of the Hydraulic Path

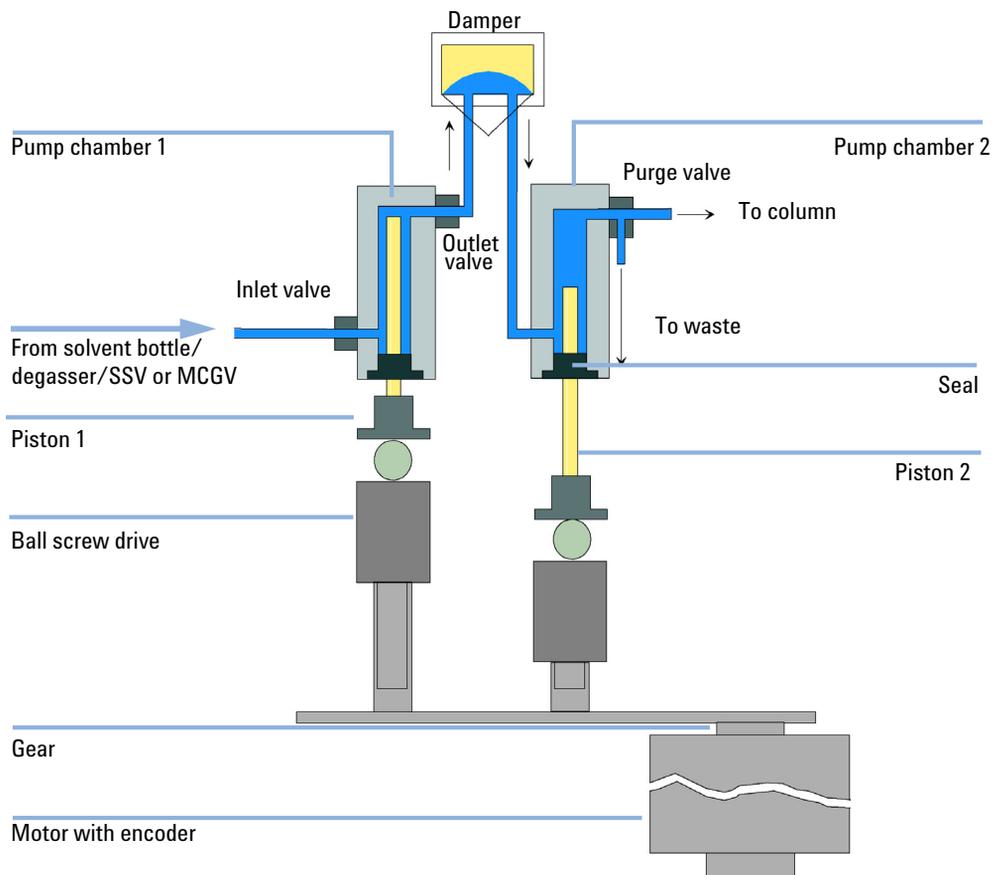


Figure 8 Principle of the Pump

Introduction

Overview of the Hydraulic Path

When turned on, the pump runs through an initialization procedure to determine the upper dead position of the first piston. The first piston moves slowly upwards into the mechanical stop of the pump chamber and from there it moves back for a defined distance. The controller stores this piston position in memory. After this initialization the pump starts operation with the set parameters. The inlet valve opens and the down-moving piston draws solvent into the first pump chamber. At the same time, the second piston moves upwards delivering to the system. After a controller-defined stroke length that depends on the flow rate the drive motor is stopped and the inlet valve closes. The motor direction is reversed and moves the first piston up until it reaches the stored upper limit and at the same time the second piston moves downwards. Then the sequence starts again moving the pistons up and down between the two limits. During the up movement of the first piston, the solvent in the pump chamber is pressed through the outlet valve into the second pump chamber. The second piston draws in half of the volume displaced by the first piston and the remaining half volume is directly delivered to the system. During the drawing stroke of the first piston, the second piston delivers the drawn volume to the system.

Quaternary pumps: For solvent compositions from the solvent bottles A, B, C, D the controller divides the length of the intake stroke in certain fractions in which the gradient valve connects the specified solvent channel to the pump input.

For specifications, see:

- isocratic pump: [“Performance Specifications Agilent 1260 Infinity II Isocratic Pump \(G7110B\)”](#) on page 39
- quaternary pumps:
 - [“Performance Specifications Agilent 1260 Infinity II Quaternary Pump \(G7111B\)”](#) on page 43
 - [“Performance Specifications Agilent 1260 Infinity II Quaternary Pump VL \(G7111A\)”](#) on page 41
- Bio-inert pump: [“Performance Specifications Agilent 1260 Infinity II Bio-inert Pump \(G5654A\)”](#) on page 45

How Does Compressibility Compensation Work?

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

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

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

How Does Variable Stroke Volume Work?

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

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

The module uses a processor-controlled spindle system for driving its pistons. The normal stroke volume is optimized for the selected flow rate. Small flow rates use a small stroke volume while higher flow rates use a higher stroke volume.

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

Leak and Waste Handling

The Agilent InfinityLab LC Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.

The solvent cabinet is designed to store a maximum volume of 8 L solvent. The maximum volume for an individual bottle stored in the solvent cabinet should not exceed 2 L. For details, see the usage guideline for the Agilent Infinity II Solvent Cabinets (a printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet).

All leak plane outlets are situated in a consistent position so that all Infinity and Infinity II modules can be stacked on top of each other. Waste tubes are guided through a channel on the right hand side of the instrument, keeping the front access clear from tubes.

The leak plane provides leak management by catching all internal liquid leaks, guiding them to the leak sensor for leak detection, and passing them on to the next module below, if the leak sensor fails. The leak sensor in the leak plane stops the running system as soon as the leak detection level is reached.

Solvent and condensate is guided through the waste channel into the waste container:

- from the detector's flow cell outlet
- from the Multisampler needle wash port
- from the Sample Cooler or Sample Thermostat (condensate)
- from the pump's Seal Wash Sensor (if applicable)
- from the pump's Purge Valve or Multipurpose Valve

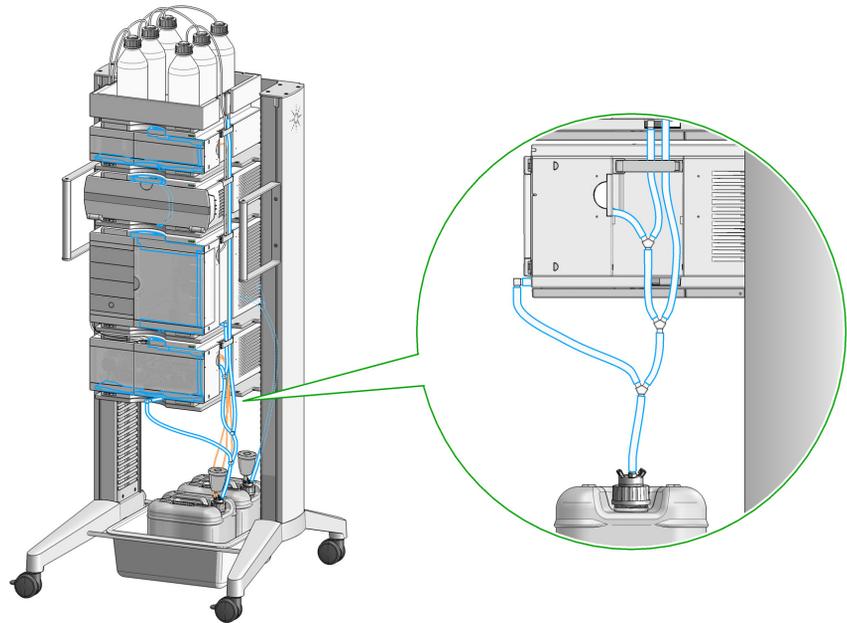


Figure 9 Infinity II Leak Waste Concept (Flex Bench installation)

Introduction

Leak and Waste Handling

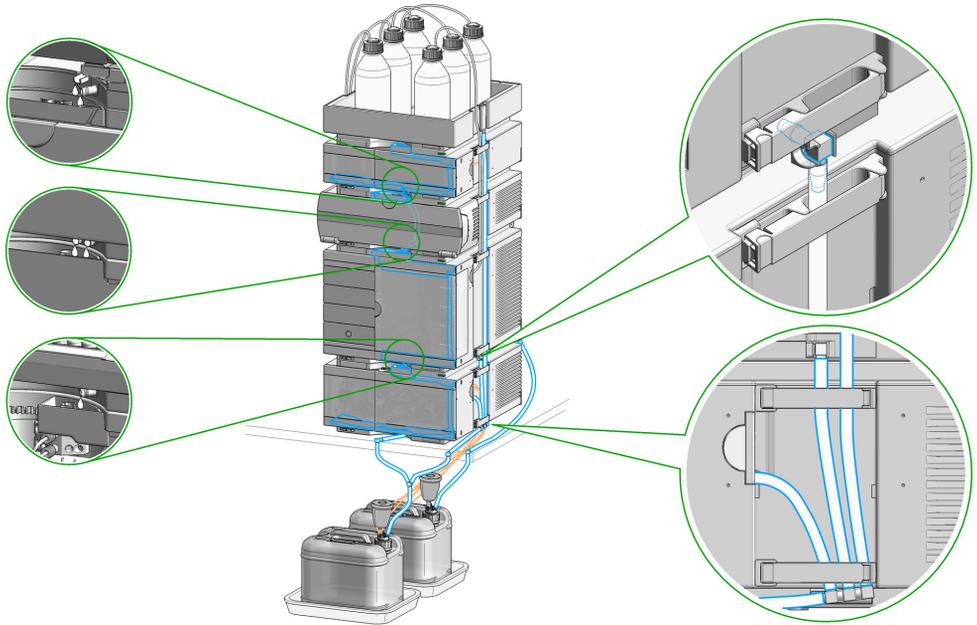


Figure 10 Infinity II Single Stack Leak Waste Concept (bench installation)

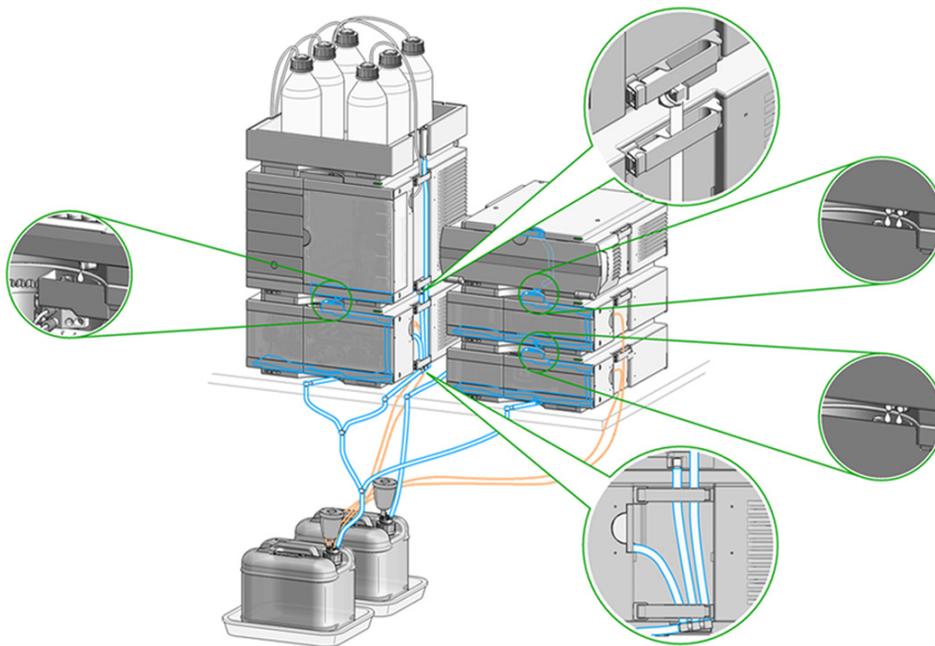


Figure 11 Infinity II Two Stack Leak Waste Concept (bench installation)

The waste tube connected to the leak plane outlet on each of the bottom instruments guides the solvent to a suitable waste container.

Leak Sensor

CAUTION

Solvent incompatibility

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

- ✓ Do not use DMF as mobile phase.
- ✓ Check the leak sensor regularly for corrosion.

Waste Concept

- 1 Agilent recommends using the 6 L waste can with 1 Stay Safe cap GL45 with 4 ports (5043-1221) for optimal and safe waste disposal. If you decide to use your own waste solution, make sure that the tubes don't immerse in the liquid.





2

Site Requirements and Specifications

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Performance Specifications 39

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 35. 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 35) 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.

NOTE

Agilent recommends that you install the HPLC instrument in the InfinityLab Flex Bench rack. This option helps to save bench space as all modules can be placed into one single stack. It also allows to easily relocate the instrument to another lab.

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.

Physical Specifications

Physical Specifications Agilent 1260 Infinity II Isocratic Pump (G7110B)

Table 1 Physical Specifications G7110B

Type	Specification	Comments
Weight	14.5 kg (32 lbs)	
Dimensions (height x width x depth)	180 x 396 x 436 mm (7.1 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	80 VA, 65 W	
Ambient operating temperature	4–55 °C (39–131 °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)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Physical Specifications Agilent 1260 Infinity II Quaternary Pump VL (G7111A)

Table 2 Physical Specifications G7111A

Type	Specification	Comments
Weight	14.5 kg (32 lbs)	
Dimensions (height x width x depth)	180 x 396 x 436 mm (7.1 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	80 VA, 65 W	
Ambient operating temperature	4–55 °C (39–131 °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)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Physical Specifications Agilent 1260 Infinity II Quaternary Pump (G7111B)

Table 3 Physical Specifications G7111B

Type	Specification	Comments
Weight	14.5 kg (32 lbs)	
Dimensions (height x width x depth)	180 x 396 x 436 mm (7.1 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	80 VA, 65 W	
Ambient operating temperature	4–55 °C (39–131 °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)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Physical Specifications Agilent 1260 Infinity II Bio-inert Pump (G5654A)

Table 4 Physical Specifications G5654A

Type	Specification	Comments
Weight	14.7 kg (32 lbs)	
Dimensions (height x width x depth)	180 x 396 x 436 mm (7.1 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	80 VA, 65 W	
Ambient operating temperature	4–55 °C (39–131 °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	Overvoltage category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Performance Specifications

Performance Specifications Agilent 1260 Infinity II Isocratic Pump (G7110B)

Table 5 Performance Specifications G7110B

Type	Specification	Comments
Hydraulic system	Dual piston in series pump with servo-controlled variable stroke drive, power transmission by gears and ball screws, floating pistons	
Flow range	Settable: 0.001 – 10 mL/min Recommended: 0.2 – 10.0 mL/min	Set points in 0.001 mL/min increments For use with flow rates below 500 μ L/min a vacuum degasser is required.
Flow precision	≤ 0.07 % RSD, or < 0.02 min SD, whichever is greater	Based on retention time at constant temperature
Flow accuracy	± 1 % or 10 μ L/min, whichever is greater	Pumping degassed H ₂ O at 10 MPa (100 bar, 1450 psi)
Pressure operating range	Up to 60 MPa (600 bar, 8702 psi) up to 5 mL/min Up to 20 MPa (200 bar, 2901 psi) up to 10 mL/min	
Pressure pulsation	< 2 % amplitude (typically < 1.3 %), or < 0.3 MPa (3 bar, 44 psi), whichever is greater	At 1 mL/min isopropanol, at all pressures > 1 MPa (10 bar, 145 psi)
Compressibility compensation	User-selectable, based on mobile phase compressibility	
Recommended pH range	1.0 – 12.5	Solvents with pH < 2.3 should not contain acids which attack stainless steel
Integrated degassing unit	Optional Number of channels: 2 Internal volume per channel: 1.5 mL	

Site Requirements and Specifications

Performance Specifications

Table 5 Performance Specifications G7110B

Type	Specification	Comments
Instrument Control	LC & CE Drivers A.02.14 or above Instrument Control Framework (ICF) A.02.04 or above InfinityLab LC Companion (G7108AA) with firmware D.07.25 or above Instant Pilot (G4208A) with firmware B.02.20 or above Lab Advisor B.02.08 or above	For details about supported software versions refer to the compatibility matrix of the LC & CE Drivers version in use
Communication	Controller Area Network (CAN) Enhanced Remote Interface (ERI) Local Area Network (LAN) Universal Serial Bus (USB)	
Safety and maintenance	Extensive diagnostics, error detection and display through 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	Safety Data Sheet in SAP: 4093-3577 Rev. A

NOTE

For use with flow rates below 500 $\mu\text{L}/\text{min}$ a vacuum degasser is required.

Performance Specifications Agilent 1260 Infinity II Quaternary Pump VL (G7111A)

Table 6 Performance Specifications G7111A

Type	Specification	Comments
Hydraulic system	Dual piston in series pump with servo-controlled variable stroke drive, power transmission by gears and ball screws, floating pistons	
Flow range	Settable: 0.001 – 10 mL/min Recommended: 0.2 – 10.0 mL/min	Set points in 0.001 mL/min increments
Flow precision	≤ 0.07 % RSD, or ≤ 0.02 min SD, whichever is greater	based on retention time at constant temperature
Flow accuracy	± 1 % or 10 μ L/min whichever is greater	Pumping degassed H ₂ O at 10 MPa (100 bar, 1450 psi)
Pressure operating range	Up to 40 MPa (400 bar, 5802 psi) up to 5 mL/min Up to 20 MPa (200 bar, 2901 psi) up to 10 mL/min	
Pressure pulsation	< 2 % amplitude (typically < 1.3 %), or < 0.3 MPa (3 bar, 44 psi), whichever is greater	At 1 mL/min isopropanol, at all pressures > 1 MPa (10 bar, 145 psi)
Compressibility compensation	User-selectable, based on mobile phase compressibility	
Recommended pH range	1.0 – 12.5	Solvents with pH < 2.3 should not contain acids which attack stainless steel
Gradient formation	Low pressure quaternary mixing/gradient capability using proprietary high-speed proportioning valve	
Delay volume	600 – 900 μ L, dependent on back pressure	Measured with water at 1 mL/min (water/water with tracer)
Composition range	Settable: 0 – 100 % Recommended: 5 – 95 % or 10 μ L/min per channel, whichever is greater	In 0.1 % increments

Site Requirements and Specifications

Performance Specifications

Table 6 Performance Specifications G7111A

Type	Specification	Comments
Composition precision	< 0.2 % RSD or < 0.04 min SD, whichever is greater	At 1 mL/min; based on retention time at constant temperature
Integrated degassing unit	Number of channels: 4 Internal volume per channel: 1.5 mL	
Instrument Control	LC & CE Drivers A.02.14 or above Instrument Control Framework (ICF) A.02.04 or above InfinityLab LC Companion (G7108AA) with firmware D.07.25 or above Instant Pilot (G4208A) with firmware B.02.20 or above Lab Advisor software B.02.08 or above	For details about supported software versions refer to the compatibility matrix of the LC & CE Drivers version in use
Communication	Controller Area Network (CAN) Local Area Network (LAN) Enhanced Remote Interface (ERI) Universal Serial Bus (USB)	
Safety and maintenance	Extensive diagnostics, error detection and display through 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	

Performance Specifications Agilent 1260 Infinity II Quaternary Pump (G7111B)

Table 7 Performance Specifications G7111B

Type	Specification	Comments
Hydraulic system	Dual piston in series pump with servo-controlled variable stroke drive, power transmission by gears and ball screws, floating pistons	
Flow range	Settable: 0.001 – 10 mL/min Recommended: 0.2 – 10.0 mL/min	Set points in 0.001 mL/min increments
Flow precision	≤0.07 % RSD, or ≤0.02 min SD, whichever is greater	Based on retention time at constant temperature
Flow accuracy	± 1 % or 10 µL/min, whichever is greater	Pumping degassed H ₂ O at 10 MPa (100 bar, 1450 psi)
Pressure operating range	Up to 60 MPa (600 bar, 8702 psi) up to 5 mL/min Up to 20 MPa (200 bar, 2901 psi) up to 10 mL/min	
Pressure pulsation	< 2 % amplitude (typically < 1.3 %), or < 0.3 MPa (3 bar, 44 psi), whichever is greater	At 1 mL/min isopropanol, at all pressures > 1 MPa (10 bar, 145 psi)
Compressibility compensation	User-selectable, based on mobile phase compressibility	
Recommended pH range	1.0 – 12.5	Solvents with pH < 2.3 should not contain acids which attack stainless steel
Gradient formation	Low pressure quaternary mixing/gradient capability using proprietary high-speed proportioning valve	
Delay volume	600 – 900 µL, dependent on back pressure	Measured with water at 1 mL/min (water/water with tracer)
Composition range	Settable: 0 – 100 % Recommended: 5 – 95 % or 10 µL/min per channel, whichever is greater, under recommended flow rate conditions	In 0.1 % increments

Site Requirements and Specifications

Performance Specifications

Table 7 Performance Specifications G7111B

Type	Specification	Comments
Composition precision	< 0.2 % RSD or < 0.04 min SD, whichever is greater	At 1 mL/min; based on retention time at constant temperature
Integrated degassing unit	Number of channels: 4 Internal volume per channel: 1.5 mL	
Instrument Control	LC & CE Drivers A.02.14 or above Instrument Control Framework (ICF) A.02.04 or above InfinityLab LC Companion (G7108AA) with firmware D.07.25 or above Instant Pilot (G4208A) with firmware B.02.20 or above Lab Advisor software B.02.08 or above	For details about supported software versions refer to the compatibility matrix of the LC & CE Drivers version in use
Communication	Controller Area Network (CAN) Local Area Network (LAN) Extended Remote Interface (ERI) Universal Serial Bus (USB)	
Safety and maintenance	Extensive diagnostics, error detection and display through 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	

Performance Specifications Agilent 1260 Infinity II Bio-inert Pump (G5654A)

Table 8 Performance Specifications G5654A

Type	Specification
Hydraulic system	Dual piston in series pump with proprietary servo-controlled variable stroke drive, floating pistons and active inlet valve, integrated 4-channel degassing unit
Settable flow range	0.001 – 10 mL/min, in 0.001 mL/min increments
Flow precision	< 0.07 % RSD, or <0.02 min SD whichever is greater, based on retention time at constant room temperature
Flow accuracy	± 1 % or 10 µL/min whichever is greater
Pressure	Operating range up to 60 MPa (600 bar, 8700 psi) up to 5 mL/min Operating range up to 20 MPa (200 bar, 2950 psi) up to 10 mL/min
Pressure pulsation	< 2 % amplitude (typically < 1.3 %), at 1 mL/min isopropanol, at all pressures > 1 MPa (10 bar)
Compressibility compensation	User-selectable, based on mobile phase compressibility
Recommended pH range	1 – 13, short term 14 ¹
Gradient formation	Low pressure quaternary mixing/gradient capability using proprietary high-speed proportioning valve
Delay volume	600 – 900 µL, dependent on back pressure.
Settable composition range	0 – 100 % in 0.1 % increments
Composition precision	< 0.2 % RSD or < 0.04 min SD, whichever is greater, at 1 mL/min; based on retention time at constant room temperature
Instrument Control	Lab Advisor B.02.08 or above LC and CE Drivers A.02.14 or above For details about supported software versions refer to the compatibility matrix of your version of the LC and CE Drivers
Local Control	Agilent Instant Pilot (G4208A) B.02.20 or above
Communications	Controller-area network (CAN), USB Extended Remote Interface: ready, start, stop and shut-down signals
Materials in flowpath	Titanium, Gold, Platinum-Iridium, Sapphire, PEEK, PTFE, Ruby, Ceramic, FEP, PFA
Active seal wash	Included

¹ For solvent compatibility, refer to section "Solvent information" in the manual for the Agilent 1260 Infinity Bio-inert LC System.

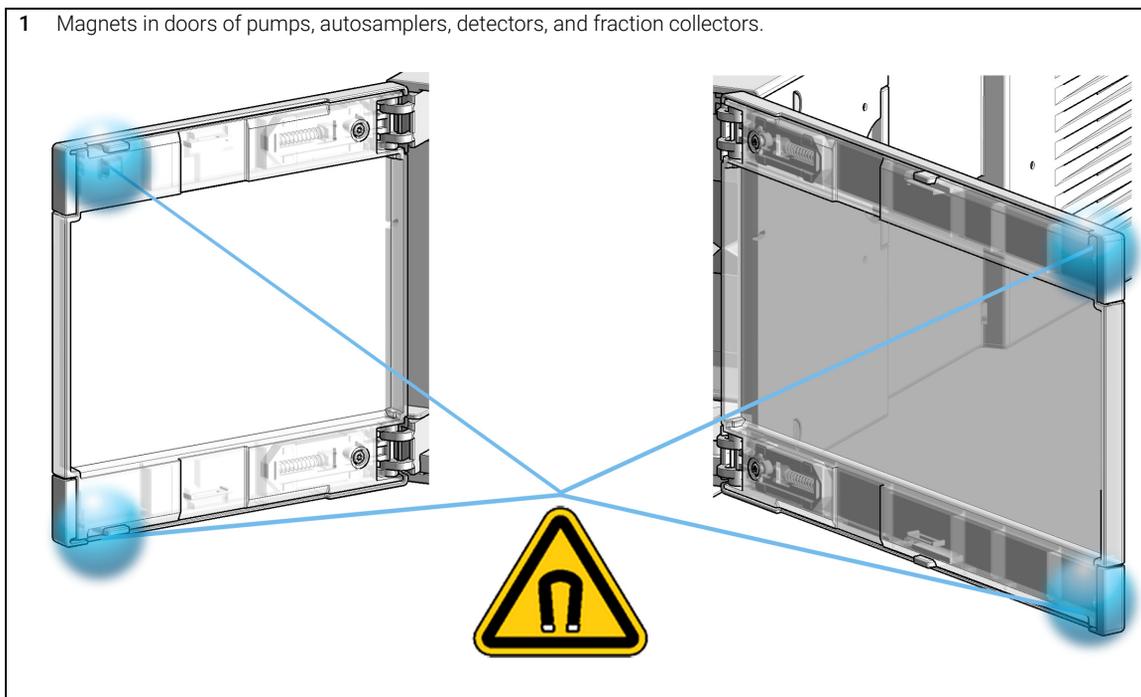
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This chapter provides information for optimized usage of the module.

Magnets

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

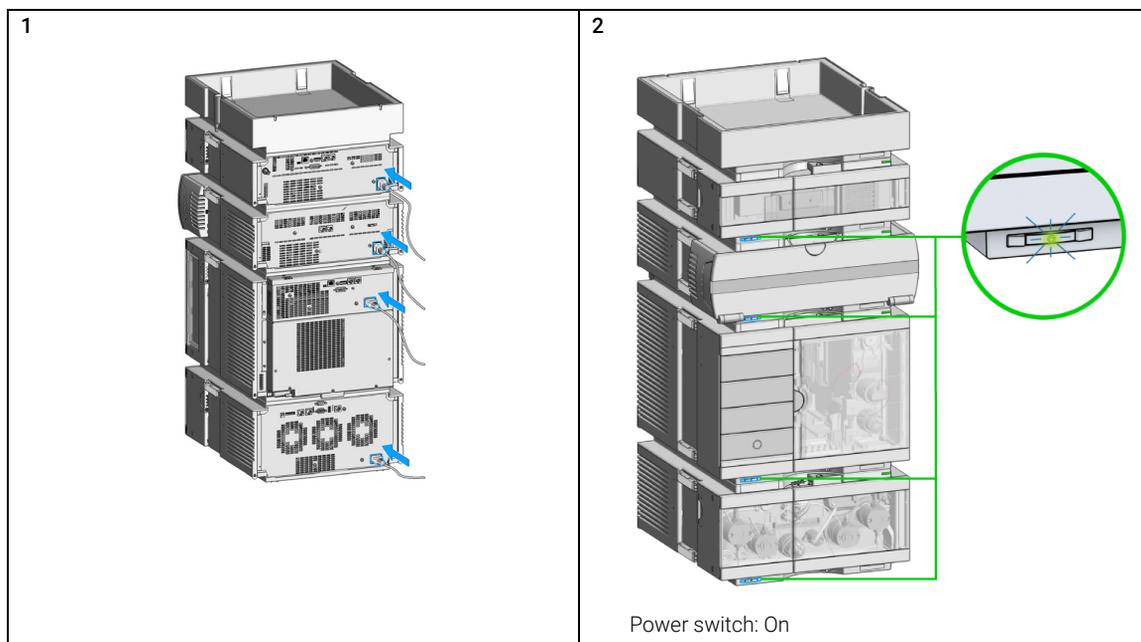


Using the Pump

Turn on/off

Turn on/off

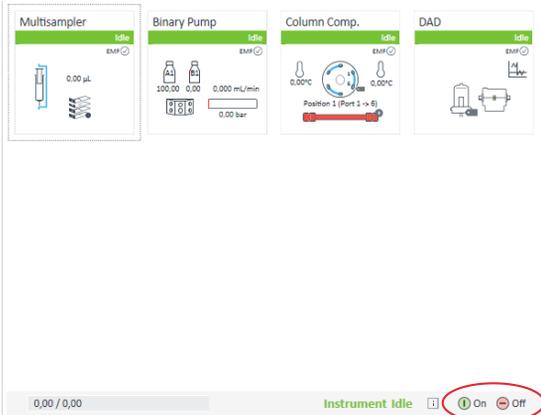
This procedure exemplarily shows an arbitrary LC stack configuration.



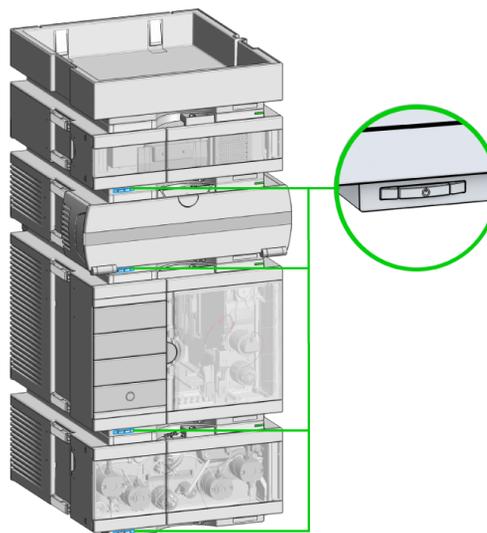
Using the Pump

Turn on/off

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

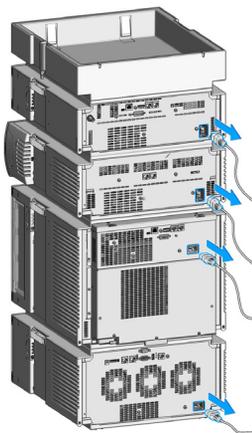


4



Power switch: Off

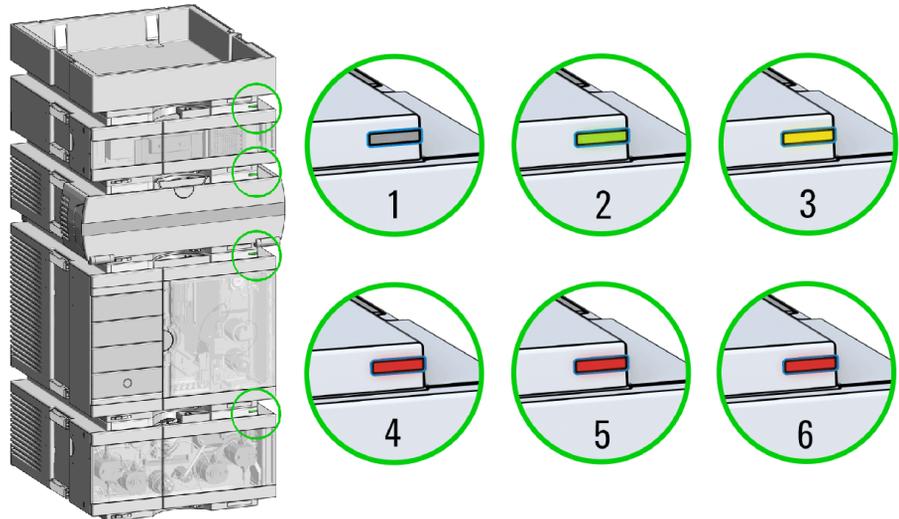
5



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

Daily / Weekly tasks

Daily tasks

- Replace mobile phase based on water/buffer.
- Replace organic mobile phase latest every second day.
- Check seal wash solvent.

Weekly Tasks

- Change seal wash solvent (10 % isopropanol in water) and bottle.
- If applications with salts were used, flush all channels with water and remove possible salt deposits manually.
- Inspect solvent filters for dirt or blockages. Exchange if no flow is coming out of the solvent line when removed from the degasser inlet.

Power up / Shut-down the pump

Power up the pump

- Use new or different mobile phase (as required).
- Purge pump heads with 2.5 – 3 mL/min for 5 min.
- Stabilize the system by running for 10 – 20 min.

Long-term shut-down of the system

- Flush system with water to remove buffer.
- Remove all samples from the sampler and store according to good laboratory practice.
- Use recommended solvents to store the system.
- Power off the system.

Prepare the pump

Purge

Use the Purge function to:

- fill the pump,
- exchange a solvent,
- remove air bubbles in tubes and pump heads.

Seal wash

Seal Wash guarantees a maximum seal life time. Use Seal Wash:

- When using buffers with elevated salt concentrations
- When using volatile solvents with non-volatile additives

CAUTION

Contaminated seal wash solvent

- ✓ Do not recycle seal wash solvent to avoid contamination.
- ✓ Weekly exchange seal wash solvent.

How to deal with solvents

- Use clean bottles only.
- Exchange water-based solvents daily.
- Select solvent volume to be used up within 1 – 2 days.
- Use only HPLC-grade solvents and water filtered through 0.2 µm filters.
- Label bottles correctly with bottle content, and filling date / expiry date.
- Use solvent inlet filters.
- Reduce risk of algae growth: use brown bottles for aqueous solvents, avoid direct sunlight.

Select channels for Multi-Channel Gradient Valve (MCGV)

- Use lower channels (A and/or D) for buffer solutions.
- Regularly flush all MCGV channels with water to remove possible salt deposits.
- Check compatibility of buffers and organic solvents to avoid precipitation.

Leak and Waste Handling

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. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.
- ✓ 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.

For details on correct installation, see separate installation documentation.

Waste Concept

- 1 Agilent recommends using the 6 L waste can with 1 Stay Safe cap GL45 with 4 ports (5043-1221) for optimal and safe waste disposal. If you decide to use your own waste solution, make sure that the tubes don't immerse in the liquid.



Hints for Successful Use of the Pump

- Always place the solvent cabinet with the solvent bottles on top of the quaternary pump (or at a higher level).
- When using salt solutions and organic solvents in the quaternary pump it is recommended to connect the salt solution to one of the bottom gradient valve ports and the organic solvent to one of the upper gradient valve ports. It is best to have the organic channel directly above the salt solution channel. Regular flushing of all MCGV channels with water is recommended to remove all possible salt deposits in the valve ports.
- Before operating the quaternary pump, flush the pump and vacuum degasser. This is especially recommended if it has been turned off for some time (for example, overnight) and volatile solvent mixtures are used in the channels.
- Prevent blocking of solvent inlet filters. Never use the pump without solvent inlet filter. Prevent the growth of algae, see [“Prevent Blocking of Solvent Filters”](#) on page 75).
- Regularly check the purge valve frit and column frit. A blocked purge valve frit can be identified by a black or yellow surface, deposits or by a pressure greater than 10 bar, when pumping distilled water at a rate of 5 mL/min with an open purge valve.
- When using the quaternary pump at low flow rates (for example, 0.2 mL/min) check all 1/16-inch fittings for any signs of leaks.
- Whenever exchanging the pump seals the purge valve frit should be exchanged, too.
- When using buffers or other salt solutions, flush the system with water before switching it off. The seal wash option should be used when salt concentrations of 0.1 M or higher will be used for long time periods.
- Check the pump pistons for scratches when changing the piston seals. Scratched pistons will cause micro leaks and will decrease the lifetime of the seal.
- Pressurize the system according to the wear in procedure after changing the piston seals (see [“Maintenance of a Pump Head Without Seal Wash Option”](#) on page 143).
- Consider recommendations given in the solvent information section, see [“Solvent Information”](#) on page 65.

Setting up the Pump with the G4208A Instant Pilot

Generic operation of the G4208A Instant Pilot is covered in the Agilent Instant Pilot G4208A User's Guide (G4208-90006). Details about setting up module specific parameters can be found in the Instant Pilot online help.

The pump parameters are described in detail in ["Overview"](#) on page 57.

Setting up the Pump with the Instrument Control Interface

Overview

The instrument control interface offers the parameters described in the following sections, and can usually be accessed through Agilent instrument control software. For details, please see manuals and online help of respective user interfaces.

Instrument Configuration

Use the **Instrument Configuration** dialog box to examine and, if necessary, modify your instrument configuration. The **Configurable Modules** panel contains a list of all modules available for configuration. The **Selected Modules** panel contains the list of configured modules.

Auto Configuration: Under **Communication settings**, select either the **Host Name** option or the **IP address** option and enter the appropriate value for the host computer to enable automatic detection of the hardware configuration. The system configures the instrument automatically with no further manual configuration necessary.

The Quaternary Pump configuration parameters are in two sections:

- **Communication**
- **Options**

Communication: The parameters in this dialog box are detected automatically during autoconfiguration.

- **Device name,**
- **Type ID,**
- **Serial number,**
- **Firmware revision,**
- Button **Connection settings**

Options:

- **Pressure Unit:**
select the pressure units from the drop-down list (bar, psi or MPa).
- **Seal wash installed:**
This check box is marked to indicate that an optional seal wash has been detected during autoconfiguration.

Please refer to the online help of your user interface for more detailed information.

The Pump User Interface (Dashboard Panel)

Module Graphic

The items in the pump graphic have the following meaning and function:



The level of solvent in the bottle is denoted by the gray area. When the solvent level falls below the specified volume, the area turns yellow.



When the bottle is empty, the area turns red. Clicking the solvent bottle displays the **Bottle Fillings** dialog box. The tooltip for the bottle shows the solvent name.



Indicates that the ISET option is installed but with no active method (light gray) or installed and active (dark gray).



The pressure setpoints. The red line shows the current maximum pressure limit; the gray area shows the current pressure (also shown as text).

The current solvent flow rate (in mL/min) is displayed above the pressure display.

Using the Pump

Setting up the Pump with the Instrument Control Interface

Instrument Signals

The following pump signals are displayed:

Table 9 Pump signals (isocratic pump)

Flow	The current solvent flow rate (in mL/min).
Pressure	The current pump pressure (in bar, psi or MPa, see “Instrument Configuration” on page 57).
Ripple	The current ripple (in %).
Pressure Limit	The current maximum pressure limit.

Table 10 Pump signals (quaternary pump)

Flow	The current solvent flow rate (in mL/min).
Pressure	The current pump pressure (in bar, psi or MPa, see “Instrument Configuration” on page 57).
Ripple	The current ripple (in %).
Pressure Limit	The current maximum pressure limit.
Composition A:B	The contributions of channels A and B to the current solvent composition.
Composition C:D	The contributions of channels C and D to the current solvent composition.

Context Menu

The context menu of the dashboard panel contains the following commands:

	Control	Displays the pump's Control dialog box.
	Method	Displays the pump's Method Setup dialog box.
	Set Error Method	Sets the method that is loaded if an error occurs to the method that is currently available in the hardware.
	Identify Device	Causes the LED on the front of the module to blink for a few seconds.
	Switch Pump On/Off	Toggles the status of the pump, on or off.
	Bottle Fillings	Displays the Bottle Fillings dialog box.

Control Settings

The pump control parameters are in three sections:

- **Pump**
- **Seal Wash**
- **Automatic Turn On**

Table 11 Pump control parameters

Parameter	Limits	Description
Pump		Enables you to switch the pump On , Off or to a Standby condition. In the Standby condition, the pump motor is still active, and when the pump is switched on again, does not need to be re-initialized.
Seal Wash		The seal wash can be set up to be run once (Single wash) or periodically (Periodic). <ul style="list-style-type: none"> • Off: no seal wash is used. • Single wash: the seal will be purged for a specified time. • Periodic: a periodic wash will be applied for a defined period in minutes. The option is available only when the pump has seal wash capability. The seal wash capability is detected by the module itself. If seal wash is installed, it is recommended to use it in order to increase the primary seal lifetime.
Automatic Turn On		Module can be turned on at a specified date/time. This feature can only be used if the module power switch is turned on.

Method Parameter Settings

The pump method setup parameters are in eight sections:

- **Flow**
- **Solvent(s)**
- **Stoptime**
- **Posttime**
- **Pressure Limits**
- **Timetable**
- **Advanced**

Table 12 Method parameters

Parameter	Limits	Description
Flow	≤200 bar: 0.0 – 10.00 mL/min in steps of 0.001 > 200 bar: 0.0 – 5.00 mL/min in steps of 0.001.	The flow is the rate of movement of eluent along the column. It is important that the flow rate is kept constant to ensure precise retention time, and peak measurements. Variations in flow rate can occur as a result of the following: partial failure of the pumping system, air in the pumping system, a change in the mobile phase viscosity, or a temperature change.
Solvent(s)		<i>Isocratic Pump:</i> The text box allows you to type a brief description of the solvent. <i>Quaternary Pump:</i> You can set the percentages of solvents B, C, and D to any value from 0 through 100 %. Solvent A always delivers the remaining volume: 100 - (%B + %C + %D). The check boxes allow you to turn on the solvent channels (checked) or off (cleared). The text boxes allow you to type a brief description of each of the solvents.
Stoptime	0.01 – 99999 minor As Injector/No Limit (an infinite run time).	The stoptime sets a time limit for your analysis. After the stoptime, all gradients are stopped and the pump parameters return to their initial values. The pump can be used as a stoptime master for the complete analytical system. The pump also stops the detectors if they have a No Limit stoptime setting. If no limit is given, a method will have to be stopped manually.
Posttime	0.01 – 99999 minor Off (0.0 min).	Your instrument remains in a not ready state during the posttime to delay the start of the next analysis. You can use the Posttime to allow your column to equilibrate after changes in solvent composition (for example after gradient elution).
Pressure Limits	Max: 600 bar (8700 psi) for flow rates up to 5 mL/min. 200 bar (2900 psi) for flow rates > 5 mL/min. Min: any value between 0 and the upper pressure limit setting.	Sets the maximum and minimum pressure limits for the pump. <ul style="list-style-type: none"> • Max is the maximum pressure limit at which the pump will switch itself off, protecting the analytical system against overpressure. • Min is the minimum limit at which the pump will switch itself off. For example, if any solvent reservoir is empty, this setting prevents system damage by pumping air.
Timetable		See "Timetable Settings" on page 64
Advanced		See "Advanced Settings" on page 63

Advanced Settings

The pump advanced method setup parameters are in four sections:

- **Minimum Stroke**
- **Compressibility**
- **Maximum Flow Gradient**
- **Primary Channel** (Quaternary Pump only)

Table 13 Advanced method parameters

Parameter	Limits	Description
Minimum Stroke	20 – 100 μ L	The Stroke Volume is used for optimizing between performance of the module and seal life time. For performance a low stroke volume is beneficial, as it divides disturbances into smaller packages, but a larger volume is extending the life time of the pump seals. If Automatic is activated, the pump tries to achieve an optimized stroke volume for best performance and lowest ripple.
Compressibility	40·10 ⁻⁶ – 150·10 ⁻⁶ . Default compressibility value: 100·10 ⁻⁶	The compressibility of the mobile phase has an effect on the performance of the pump. For best flow accuracy and mixing performance, you can set the parameter according to the mobile phase being used.
Maximum Flow Gradient	0.1 – 100 mL/min/min Default value: 100 mL/min/min	You can set a limit on the rate of change of the solvent flow to protect your analytical column.
Primary Channel (Quaternary pump only)		Using Automatic is recommended. The primary channel can be specified as A to D for optimizing highly specific methods. It is split up to deliver the first and last solvent package created by the MCGV in order to optimize composition precision. The primary channel does not change during a gradient, as long as the channel is used. Using Automatic chooses the channel with the highest percentage at start conditions before a gradient.

Timetable Settings

Use the **Timetable** to program changes in the pump parameters during the analysis by entering a time in the **Time** field and appropriate values in the following fields of the timetable. Changes in flow rate occur linearly from either time zero or the time of the last defined change; other parameters change instantaneously at the time defined in the timetable.

Show **Advanced Timetable** toggles the timetable display between standard mode and advanced mode.

The following parameters can be changed:

- **Change Contacts**
- **Change Flow**
- **Change Max. Pressure Limit**
- **Change Solvent Composition** - You can only use solvents, which have been enabled in the solvents section.
- **Function centric view** - This checkbox allows you displaying parameter changes instead of a time table.

Solvent Information

Observe the following recommendations on the use of solvents.

- Follow the recommendations for avoiding the growth of algae, see “[Algae Growth in HPLC Systems](#)” on page 74
- 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 such as 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:

Table 14 Materials in flow path (G7110B, G7111A, G7111B)

Part	Materials
Degasser chamber	TFE/PDD Copolymer, PFA (internal tubings), PEEK (inlets), FEP (tubings), ETFE (fittings)
MCGV	SST, PTFE, PEEK, FEP, PFA, ceramic, sapphire, ruby
Passive inlet valve	SST, gold, sapphire, ruby, ceramic, PTFE
Active inlet valve	SST, gold, sapphire, ruby, ceramic, PTFE
Outlet valve	SST, gold, ruby, ZrO ₂ -based ceramic, tantalum
Adapter	SST, gold
Pump head (body)	SST
Pistons	Sapphire
Piston seals/wash seals	PTFE, SST (reversed phase) or UHMW-PE, SST (normal phase)
Pressure sensor	SST
Purge valve	SST, gold, PTFE, ceramic
Damping unit	SST, gold
Capillaries/fittings	SST
Tubings	PTFE

Table 15 Materials in flow path (G5654A)

Part	Materials
Degasser chamber	TFE/PDD Copolymer, PFA (internal tubings), PEEK (inlets), FEP (tubings), ETFE (fittings)
MCGV	Platinum-iridium, titanium, PTFE, PEEK, FEP, PFA, ceramic, sapphire, ruby
Active inlet valve	Platinum-iridium, titanium, gold, sapphire, ruby, ceramic, PTFE
Outlet valve	Titanium, gold, ruby, ZrO ₂ -based ceramic, tantalum
Adapter	Titanium, gold
Pump head (body)	Titanium
Pistons	Sapphire
Piston seals/wash seals	PTFE, gold
Pressure sensor	Titanium
Purge valve	Titanium, gold, PTFE, ceramic
Damping unit	Titanium, gold
Capillaries/fittings	Titanium
Tubings	PTFE

Bio-inert Materials

For the Bio-inert LC system, Agilent Technologies uses highest-quality materials in the flow path (also referred to as wetted parts), which are widely accepted by life science scientists, as they are known for optimum inertness to biological samples and ensure best compatibility with common samples and solvents over a wide pH range. Explicitly, the complete flow path is free of stainless steel and free of other alloys containing metals such as iron, nickel, cobalt, chromium, molybdenum, or copper, which can interfere with biological samples. The flow downstream of the sample introduction contains no metals whatsoever.

Table 16 Used Bio-inert materials

Module	Materials
Agilent 1260 Infinity II Bio-inert Pump (G5654A)	Titanium, gold, platinum-iridium, ceramic, ruby, PTFE, PEEK
Agilent 1260 Infinity II Bio-inert Multisampler (G5668A)	Upstream of sample introduction: <ul style="list-style-type: none"> • Titanium, gold, PTFE, PEEK, ceramic Downstream of sample introduction: <ul style="list-style-type: none"> • PEEK, ceramic
Agilent 1260 Infinity II Bio-inert Manual Injector (G5628A)	PEEK, ceramic
Agilent 1260 Infinity II Bio-inert Analytical Fraction Collector (G5664B)	PEEK, ceramic, PTFE
Bio-inert Flow Cells:	
Standard flow cell bio-inert, 10 mm, 13 μ L, 120 bar (12 MPa) for MWD/DAD, includes 0890-1763 – 0.18 x 1500 mm PEEK capillary and 5063-6591 – PEEK fittings (G5615-60022) (for Agilent 1260 Infinity II DAD G7115A, and MWD G7165A)	PEEK, ceramic, sapphire, PTFE
Bio-inert flow cell, 8 μ L, 20 bar (pH 1–12), includes and PEEK fittings (G5615-60005) (for Agilent 1260 Infinity II FLD G7121A/B)	PEEK, fused silica, PTFE
Bio-inert Heat Exchangers, Valves and Capillaries:	
Quick Connect Heat Exchanger Bio-inert (G7116-60041) (for Agilent 1260 Infinity II Multicolumn Thermostat G7116A)	PEEK (steel-cladded)
Bio-inert Valve heads (G4235A, G5631A, G5632A, G5639A)	PEEK, ceramic (Al_2O_3 based)
Bio-inert Connection capillaries	Upstream of sample introduction: <ul style="list-style-type: none"> • Titanium Downstream of sample introduction: <ul style="list-style-type: none"> • Agilent uses stainless-steel-cladded PEEK capillaries, which keep the flow path free of steel and provide pressure stability up to 600 bar.

NOTE

To ensure optimum biocompatibility of your Agilent 1260 Infinity II Bio-inert LC system, do not include non-inert standard modules or parts to the flow path. Do not use any parts that are not labeled as Agilent “Bio-inert”. For solvent compatibility of these materials, see “General Information about Solvent/Material Compatibility” on page 68.

General Information about Solvent/Material Compatibility

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 also cannot 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 nonconductive 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.

MP35N

MP35N is a nonmagnetic, nickel-cobalt-chromium-molybdenum alloy demonstrating excellent corrosion resistance (for example, against nitric and sulfuric acids, sodium hydroxide, and seawater) over a wide range of concentrations and temperatures. In addition, this alloy shows exceptional resistance to high-temperature oxidation. Due to excellent chemical resistance and toughness, the alloy is used in diverse applications: dental products, medical devices, nonmagnetic electrical components, chemical and food processing equipment, marine equipment. Treatment of MP35N alloy samples with 10 % NaCl in HCl (pH 2.0) does not reveal any detectable corrosion. MP35N also demonstrates excellent corrosion resistance in a humid environment. Although the influence of a broad variety of solvents and conditions has been tested, users should keep in mind that multiple factors can affect corrosion rates, such as temperature, concentration, pH, impurities, stress, surface finish, and dissimilar metal contacts.

Polyphenylene Sulfide (PPS)

Polyphenylene sulfide has outstanding stability even at elevated temperatures. It is resistant to dilute solutions of most inorganic acids, but it can be attacked by some organic compounds and oxidizing reagents. Nonoxidizing inorganic acids, such as sulfuric acid and phosphoric acid, have little effect on polyphenylene sulfide, but at high concentrations and temperatures, they can still cause material damage. Nonoxidizing organic chemicals generally have little effect on polyphenylene sulfide stability, but amines, aromatic compounds, and halogenated compounds may cause some swelling and softening over extended periods of time at elevated temperatures. Strong oxidizing acids, such as nitric acid (> 0.1 %), hydrogen halides (> 0.1 %), peroxy acids (> 1 %), or chlorosulfuric acid degrade polyphenylene sulfide. It is not recommended to use polyphenylene sulfide with oxidizing material, such as sodium hypochlorite and hydrogen peroxide. However, under mild environmental conditions, at low concentrations and for short exposure times, polyphenylene sulfide can withstand these chemicals, for example, as ingredients of common disinfectant solutions.

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 are still some known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulfuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogens or aqueous halogen solutions, phenol and derivatives (cresols, salicylic acid, and so on).

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 sensitive to high pressure. Therefore, Agilent uses stainless steel clad PEEK capillaries in bio-inert systems. The use of stainless steel clad PEEK capillaries keeps the flow path free of steel and ensures pressure stability up to 600 bar. If in doubt, consult the available literature about the chemical compatibility of PEEK.

Using the Pump

Solvent Information

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.

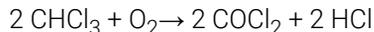
Tantalum (Ta)

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 (SST)

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 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:



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, diisopropyl ether). Such ethers should be filtered through dry aluminum 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, ethylenediaminetetraacetic acid).
- Mixtures of carbon tetrachloride with isopropanol or THF.

Using the Pump

Solvent Information

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 $\mu\text{m}/\text{year}$. 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.

Using the Pump

Solvent Information

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 (dimethylformamide).

Sapphire, Ruby, and Al₂O₃-based ceramics

Sapphire, ruby, and ceramics based on aluminum oxide Al₂O₃ are inert to almost all common acids, bases, and solvents. There are no documented incompatibilities for HPLC applications.

Algae Growth in HPLC Systems

The presence of algae in HPLC systems can cause many problems that may be incorrectly diagnosed as instrument or application problems. Algae grow in aqueous media, preferably in a pH range from 4 to 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 following 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.

Prevent Blocking of Solvent Filters

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

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

NOTE

Never use the system without solvent filter installed.

Normal Phase Applications

Current passive inlet valves and outlet ball valves used with 1260 and 1290 Infinity pumps do not work well with applications using non-polar solvents as for normal phase applications (e.g. hexane, heptane and CO₂). With such applications, pressure drops could be observed. They are a result of particles electrostatically charging up in insulating solvents and sticking to the balls inside the valves, such that the valves do not close properly any more after some time of use (can be hours).

For normal phase applications, a second type of valves is available, which has a design based on the existing one for 1260 and 1290 Infinity valves. These valves use a new material for valve balls, which is a conductive ceramic and replaces non-conductive ruby balls. The balls do not charge up electrostatically and show good performance in normal phase.

The valves are marked with N for non-polar or normal phase.

Agilent recommends using these valves for (and only for) normal phase applications.

CAUTION

Corrosion of valves

Normal phase balls/valves corrode quickly in aqueous solutions and acids (at or below pH 7).

- ✓ **Do not use normal phase valves in applications running with aqueous solutions.**

The N-Valves have been tested successfully in using hexane at pressures below 100 bar; heptane can be used as a substitute for neurotoxic hexane.

Using the Pump

Normal Phase Applications

Seals for Normal Phase Applications

For running normal phase applications on 1200 Infinity Series pumps, yellow PE seals are required, which exist as piston seals and wash seals. Seal wash is very uncommon for normal phase applications (no buffers needed), but wash seals are needed for seal wash pump heads.

1290 Infinity pumps use PE seals by default. In combination with ceramic pistons, PE seals are used for both reversed phase (1200 bar) and normal phase applications.

1260 Infinity pumps use sapphire pistons and black PTFE piston and wash seals by default (600 bar). Such PTFE seals create small wear particles in normal phase applications, which can clog valves and other parts in the flow path.

PE seals have a limited life time when used with normal phase solvents and sapphire pistons. Agilent recommends a maximum pressure of 200 bar for this combination, which shall also be applied for pressure tests.

Choice of Normal Phase Valves and Seals

Table 17 Recommended valves and seals for normal phase applications

	1260 Infinity	1290 Infinity
Inlet valves	1260 Infinity Inlet Valve Type N (G1312-60166)	1290 Infinity Inlet Valve Type N (G4220-60122) 1290 Infinity Quat Inlet Valve Type N (G4204-60122)
Outlet valves	Outlet Valve Type N/SFC (G1312-60167)	1290 Infinity Outlet Valve Type N (G4220-60128)
Seals	PE seals (pack of 2) (0905-1420) Wash Seal PE (0905-1718)	



4

Optimizing Performance

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Operational Hints for the Multi Channel Gradient Valve (MCGV) 81

When to use the Seal Wash Function 82

Choosing the Right Pump Seals 83

Optimize the Compressibility Compensation Setting 84

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

Using the Degasser

The quaternary pump has a built-in degasser, which should always be included to the flow path.

Operational Hints for the Vacuum Degasser

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

Operational Hints for the Multi Channel Gradient Valve (MCGV)

In a mixture of salt solutions and organic solvent the salt solution might be well dissolved in the organic solvent without showing precipitations. However in the mixing point of the gradient valve, at the boundary between the two solvents, micro precipitation is possible. Gravity forces the salt particles to fall down. Normally the A channel of the valve is used for the aqueous/salt solution and the B channel of the pump is used for the organic solvent. If used in this configuration the salt will fall back into the aqueous solution and will be dissolved. When using the pump in a different configuration (e.g., D - salt solution, A - organic solvent) the salt can fall into the port of the organic solvent and may lead to performance problems.

NOTE

When using salt solutions and organic solvents it is recommended to connect the salt solution to one of the bottom ports of the MCGV and the organic solvent to one of the upper gradient valve ports. It is best to have the organic channel directly above the salt solution channel. Regular flushing with water of all MCGV channels is recommended to remove all possible salt deposits in the valve ports.

NOTE

Precipitations formed during the mixing of buffers and organic solvents which do not dissolve salts may cause a loss of pump performance (flow/retention time stability), a blockage or internal leak of the pump. Avoid the use of such solvent combinations, as they can cause irreproducible chromatographic results.

The use of an Inline filter (G1311-60006) can avoid or reduce such effects by filtering crystals and re-dissolving them over time.

When to use the Seal Wash Function

Highly concentrated buffer solutions will reduce the lifetime of the seals and pistons in your pump. The seal wash function allows to maintain the seal lifetime by flushing the back side of the seal with a wash solvent.

The seal wash function is strongly recommended when buffer concentrations of 0.1 M or higher will be used for long time periods in the pump.

The seal wash function comprises a support ring, secondary seal, gasket and seal holder for both piston sides. Place a wash bottle filled with 90 % water / 10 % isopropanol above the pump in the solvent cabinet and guide the SW waste into the waste bottle underneath the LC stack. The peristaltic pump moves a flow through the pump head removing all possible buffer crystals from the back of the pump seal. This mixture prevents growth of algae or bacteria in the wash bottle and reduces the surface tension of the water.

Choosing the Right Pump Seals

The standard seal for the pump can be used for most applications. However applications that use normal phase solvents (for example, hexane) are not suited for the standard seal and require a different seal when used for a longer time in the pump.

For applications that use normal phase solvents (for example, hexane) we recommend using polyethylene pump seals (PE seals (pack of 2) (0905-1420)) and Wash Seal PE (0905-1718). For normal phase applications, these seals have less abrasion compared to the standard seals.

NOTE

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

Optimize the Compressibility Compensation Setting

The compressibility compensation default setting is 100×10^{-6} /bar for the pump. This setting represents an average value. Under normal conditions the default setting typically reduces the pressure pulsation to values below 1 % of system pressure that are sufficient for most applications and for all gradient analyses. The compressibility settings can be optimized by using the values for the various solvents described in [Table 18](#) on page 85. If the solvent in use is not listed in the compressibility tables, when using isocratic mixtures of solvents and if the default settings are not sufficient for your application the following procedure can be used to optimize the compressibility settings.

NOTE

When using mixtures of solvents it is not possible to calculate the compressibility of the mixture by interpolating the compressibility values of the pure solvents used in that mixture or by applying any other calculation. In these cases the following empirical procedure has to be applied to optimize your compressibility setting.

Inappropriate settings would mainly affect retention times of peaks eluted at the beginning of a gradient. Therefore optimize settings for the solvent at the beginning of the gradient. For mixtures containing up to 50 % water, use compressibility settings of water.

- 1 Start the pump with the required flow rate.
- 2 Before starting the optimization procedure, the flow must be stable. Check the tightness of the system with the pressure test.
- 3 Your pump must be connected to a data system or Instant Pilot with which the pressure and %-ripple can be monitored, or connect an external measurement device to the analog pressure output (see [“Electrical Connections”](#) on page 202)
- 4 Starting with a compressibility setting of $40 \cdot 10^{-6}$ /bar increase the value in steps of 10. Re-zero the signal display as required. The compressibility compensation setting that generates the smallest pressure ripple is the optimum value for your solvent composition. If ChemStation (classic view) is used and the ripple shown is positive, then the compressibility setting should be decreased. If it is negative, it should be increased.

Optimizing Performance

Optimize the Compressibility Compensation Setting

Table 18 Solvent Compressibility

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

¹ Please check section "Solvent Information" for compatibility to your specific LC system.



5 Troubleshooting and Diagnostics

User Interfaces 87

Agilent Lab Advisor Software 88

This chapter gives an overview about the troubleshooting and diagnostic features and the different user interfaces.

User Interfaces

Depending on the user interface, the available tests vary. Some descriptions are only available in the service manual.

Table 19 Test functions available vs. user interface

Test	Instant Pilot G4208A	Agilent Lab Advisor
System Pressure Test	Yes	Yes
Pump Leak Rate Test	No	Yes

Agilent Lab Advisor Software

The Agilent Lab Advisor Software (basic license, shipped with an Agilent LC pump) 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. With 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 optional Agilent Maintenance Wizard Add-on provides an easy-to-use, step-by-step multimedia guide for performing preventive maintenance on Agilent 1200 Infinity LC Series instrument.

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.

6 Error Information

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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 6 of the Enhanced Remote Interface (ERI) 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 <i>Service Manual</i> 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.	<ul style="list-style-type: none"> 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 mainboard in another module.	Switch off the system. Restart the system, and determine which module or modules are not recognized by the system.

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 mainboard.

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

Leak Sensor Open

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.

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.

Compensation Sensor Open

Error ID: 0081

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

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

Probable cause	Suggested actions
1 Loose connection between the power switch board and the mainboard.	Please contact your Agilent service representative.
2 Defective power switch assembly.	Please contact your Agilent service representative.

Compensation Sensor Short

Error ID: 0080

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

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

Probable cause	Suggested actions
1 Defective power switch assembly.	Please contact your Agilent service representative.
2 Loose connection between the power switch board and the mainboard.	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 mainboard to monitor the fan speed. If the fan speed falls below a certain limit for a certain length of time, the error message is generated.

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

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

Probable cause	Suggested actions
1 Fan cable disconnected.	Please contact your Agilent service representative.
2 Defective fan.	Please contact your Agilent service representative.
3 Defective mainboard.	Please contact your Agilent service representative.
4 Improperly positioned cables or wires obstructing fan blades.	Please contact your Agilent service representative.

ERI Messages

Error ID: 11120 (+5 V) , 11121 (+25 V)

The ERI (Enhanced Remote Interface) provides two error events related to over current situations on the +5 V and +24 V lines.

Probable cause	Suggested actions
1 The load on the ERI is too high.	Reduce the load.

Module Error Messages

These errors are pump specific.

Solvent Zero Counter

Error ID: 2055, 2524

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

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

Pressure Above Upper Limit

Error ID: 2014, 2500

The system pressure has exceeded the upper pressure limit.

Probable cause	Suggested actions
1 Upper pressure limit set too low.	Ensure the upper pressure limit is set to a value suitable for the analysis.
2 Blockage in the flowpath (after the damper).	Check for blockage in the 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 Defective damper.	Please contact your Agilent service representative.
4 Defective mainboard.	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.	<ul style="list-style-type: none"> • Make sure that the degasser is in flow path and works correctly. Purge the module. • Ensure solvent inlet filters are not blocked.
3 Leak.	<ul style="list-style-type: none"> • Inspect the pump head, capillaries and fittings for signs of a leak. • Purge the module. Run a pressure test to determine whether the seals or other module components are defective.
4 Defective damper.	Please contact your Agilent service representative.
5 Defective mainboard.	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 damper connector.

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

MCGV Fuse

Error ID: 2043

Valve Fuse 0: Channels A and B

Valve Fuse 1: Channels C and D

The gradient valve in the quaternary pump has drawn excessive current causing the electronic fuse to open.

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

AIV Fuse

Error ID: 2044

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

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

Valve Failed (MCGV)

Error ID: 2040

Valve 0 Failed: valve A

Valve 1 Failed: valve B

Valve 2 Failed: valve C

Valve 3 Failed: valve D

One of the valves of the multi-channel gradient valve has failed to switch correctly.

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

Probable cause	Suggested actions
1 Gradient valve disconnected.	Ensure the gradient valve is connected correctly.
2 Connection cable (inside instrument) not connected.	Please contact your Agilent service representative.
3 Connection cable (inside instrument) defective.	Please contact your Agilent service representative.
4 Gradient valve defective.	Exchange the gradient valve.

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 mainboard.	Please contact your Agilent service representative.

Servo Restart Failed

Error ID: 2201, 2211

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

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

Probable cause	Suggested actions
1 Mechanical blockage of the module.	Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
2 Disconnected or defective cable.	Please contact your Agilent service representative.
3 Blocked (passive or active) inlet valve.	Exchange the (passive or active) inlet valve.
4 Defective pump drive assembly.	Please contact your Agilent service representative.
5 Defective mainboard.	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.

Index Limit

Error ID: 2203, 2213

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

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

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

Index Adjustment

Error ID: 2204, 2214

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

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

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

Index Missing

Error ID: 2205, 2215, 2505

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

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

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

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 mainboard.	Please contact your Agilent service representative.

Wait Timeout

Error ID: 2053

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

Possible Reasons for a Wait Timeout:

- Pressure not reached.
- Pump channel A did not reach the delivery phase.
- Pump channel B did not reach the delivery phase.
- Pump channel A did not reach the take-in phase.
- Pump channel B did not reach the take-in phase.
- Solvent volume not delivered within the specified time.

Probable cause	Suggested actions
1 Purge valve open.	Ensure that purge valve is closed.
2 Leak at fittings, purge valve, active inlet valve, outlet valve or piston seals.	<ul style="list-style-type: none"> • Ensure pump components are seated correctly. If there are still signs of a leak, exchange the appropriate seal (purge valve, active inlet valve, outlet valve, piston seal). • Exchange defective capillaries.
3 Flow changed after starting test.	Ensure correct operating condition for the special application in use.
4 Defective pump drive assembly.	Please contact your Agilent service representative.

Degasser: signal fail

Error ID: 2243, 8016

The pump board gets no or wrong pressure signals from the built-in degasser:

- No valid pressure signal is shown during startup of the degasser
- Measured pressure is higher than 32000 hPa

Probable cause	Suggested actions
1 Degasser sensor defect.	Please contact your Agilent service representative.
2 Degasser sensor not connected to mainboard.	Please contact your Agilent service representative.

Degasser: Vacuum cannot be maintained

Error ID: 8014

Pressure in degasser vacuum chamber exceeds 180 mbar limit during normal operation.

Probable cause	Suggested actions
1 Liquid in degasser tubing.	Please contact your Agilent service representative.
2 Leak in degasser tubing or chamber.	Please contact your Agilent service representative.
3 Degasser vacuum pump defective.	Please contact your Agilent service representative.

Degasser: limit not reached

Error ID: 2244, 8053

Degasser is not ready within 8 min after startup, because the pressure inside the vacuum chamber exceeds 120 mbar.

Probable cause	Suggested actions
1 Liquid in degasser tubing.	Please contact your Agilent service representative.
2 Leak in degasser tubing or chamber.	Please contact your Agilent service representative.
3 Degasser vacuum pump defect.	Please contact your Agilent service representative.

SSV Protection circuit triggered

Error ID: 2049

The protection circuit of SSV has switched OFF the valve. During initialization, the processor checks the presence of the SSV connector. If a defective valve or a wrong connection is detected the error message is generated.

Probable cause	Suggested actions
1 Wrong valve connected.	Check if the correct valve is connected to the correct port.
2 Defective Solvent Selection Valve.	Change the Solvent Selection Valve.
3 Defective mainboard.	Please contact your Agilent service representative.



7

Test Functions and Calibration

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This chapter describes the tests for the module.

Introduction

Following tests are available in Lab Advisor:

- **System Pressure Test**
- **Leak Rate Test**

All four pumps are available with LabAdvisor B.02.08.

System Pressure Test

Introduction

The **System Pressure Test** is used for checking the tightness of the LC system and identifying leaks between the pump and a position in the flow path following the pump blocked by a blank nut.

System requirements

Minimum software revisions:

- Lab Advisor B.02.08

Minimum firmware revision: D.07.01.

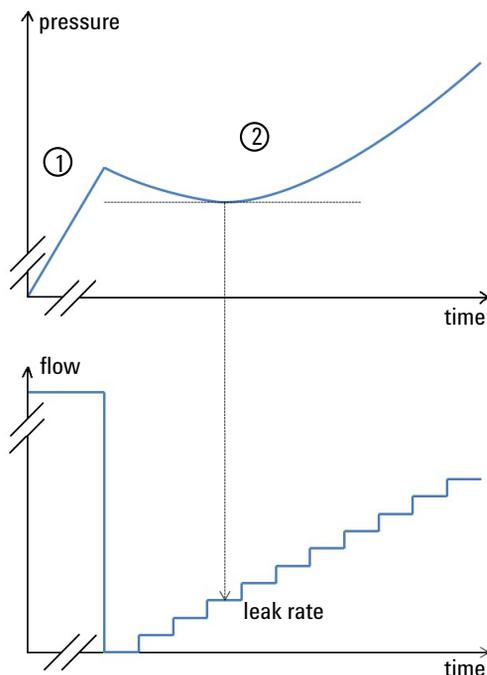
Test Principle

A solvent can be chosen from available solvent channels and a maximum pressure can be defined at which the test will be run. In contrast to older revisions of this test, any solvent can be used.

Before the test, the pump and system are flushed with solvent in order to remove air bubbles, as air bubbles are compressed during the test and therefore would appear as leaks. Using a degasser is highly recommended. Then the flow path is blocked by a blank nut at any position between the purge valve and the column outlet.

Test Functions and Calibration

System Pressure Test



In the first phase of the test, the pump delivers flow at a rate of 200 $\mu\text{L}/\text{min}$ until a pressure of 50 bar below the defined maximum pressure is reached. In the second phase, the pump delivers a small flow which is increased stepwise. If there is a leak in the system, the pressure will drop initially, as the low flow cannot compensate the leak flow. As soon as the pump flow rate exceeds the leak flow rate, the pressure will increase again and the test is stopped at about 20 bar below the maximum pressure. The point in phase 2, where the lowest pressure is reached and stays constant for a short time corresponds to the leak rate, that is provided as a test result. A leak rate smaller than 3 $\mu\text{L}/\text{min}$ is good enough for operating the pump reliably.

Running the Test

Parts required	p/n	Description
	5067-6127 	Blank Nut SL

CAUTION

Damage to pressure sensitive parts

Even columns that are suitable for high pressures are sensitive to pressure drops that occur during this test.

- ✓ Do not include any pressure sensitive parts to the flow path and choose a maximum pressure that is compatible to your system. For example, do not include columns, a standard pressure flow cell (up to 20 bar) or a 400 bar autosampler to a 600 bar pressure test.

Running the test from the Agilent Lab Advisor

- 1 Select the **System Pressure Test** from the **Test Selection** menu.
- 2 Start the test and follow the instructions.

NOTE

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

“Evaluating the Results” on page 116 describes the evaluation and interpretation of the **System Pressure Test** results. For detailed instructions refer to the Agilent Lab Advisor software.

Evaluating the Results

The test fails, if the leak rate between pump and blank nut is higher than the limit of 5 $\mu\text{L}/\text{min}$.

If the **System Pressure Test** fails:

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

NOTE

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

If the test fails again, insert the blank nut at the outlet of the previous module in the stack (e.g. autosampler outlet if TCC has been tested before), and repeat the test. Exclude each module one by one to determine which module is leaking.

If the pump is determined to be the source of the leak, run the **Pump Leak Rate Test**.

Potential Causes of System Pressure Test Failure

System Pressure Test failed

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

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

Leak Rate Test

Introduction

The **Leak Rate Test** is used for verifying the internal tightness of the pump and helps identifying parts which may have caused a leak.

System requirements

Minimum software revisions:

- Lab Advisor B.02.08

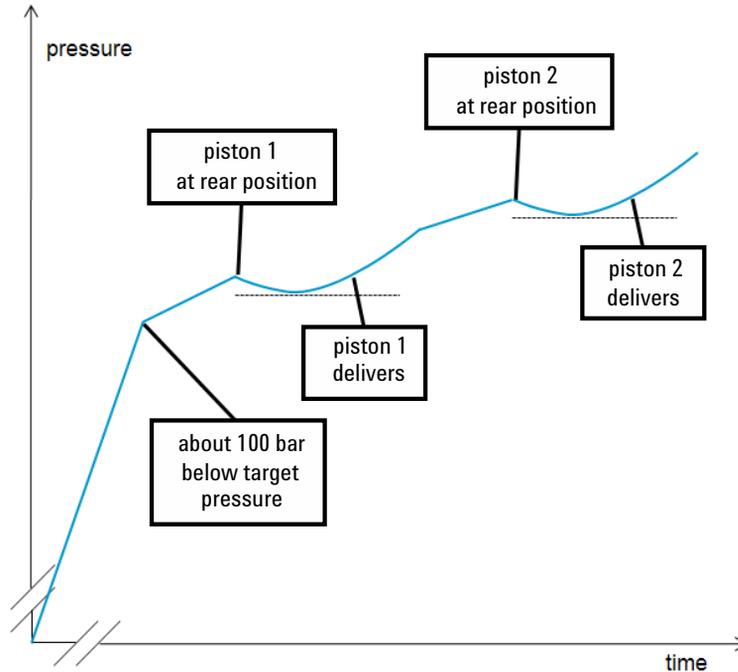
Minimum firmware revisions:

- D.07.01

Test Principle

A solvent can be chosen from available solvent channels and a maximum target pressure can be defined at which the test will be run. Typically, this is the maximum pressure specified for the pump. The test can be run with any solvent compatible to the pump.

Before the test, the pump is flushed with solvent in order to remove air bubbles, as air bubbles are compressed during the test and therefore would appear as leaks. Using a degasser is highly recommended.



Initially, the pressure is increased to about 100 bar below the target pressure, which has been set for the test.

Then piston 1 is brought to its rear position. An increasing flow is delivered by piston 1. In case of a leak, the pressure will drop initially as long as the flow rate delivered by the piston is lower than the leak rate. As soon as the flow rate of the piston exceeds the leak rate, the measured pressure will increase again. Therefore the minimum pressure of that curve segment corresponds to the flow and leak rate at that time and the leak rate is measured. Compare to the description of the system pressure test ("[System Pressure Test](#)" on page 113).

Subsequently, piston 2 is moved to its rear position, then piston 2 delivers and the measurement is done as described for piston 1.

For a binary pump (G1312B/C, G7112B, K1312B, G4782A), the test is run for both pump heads for channels A and B.

Running the Test

Parts required

p/n	Description
5067-6127 	Blank Nut SL

Running the test from the Agilent Lab Advisor

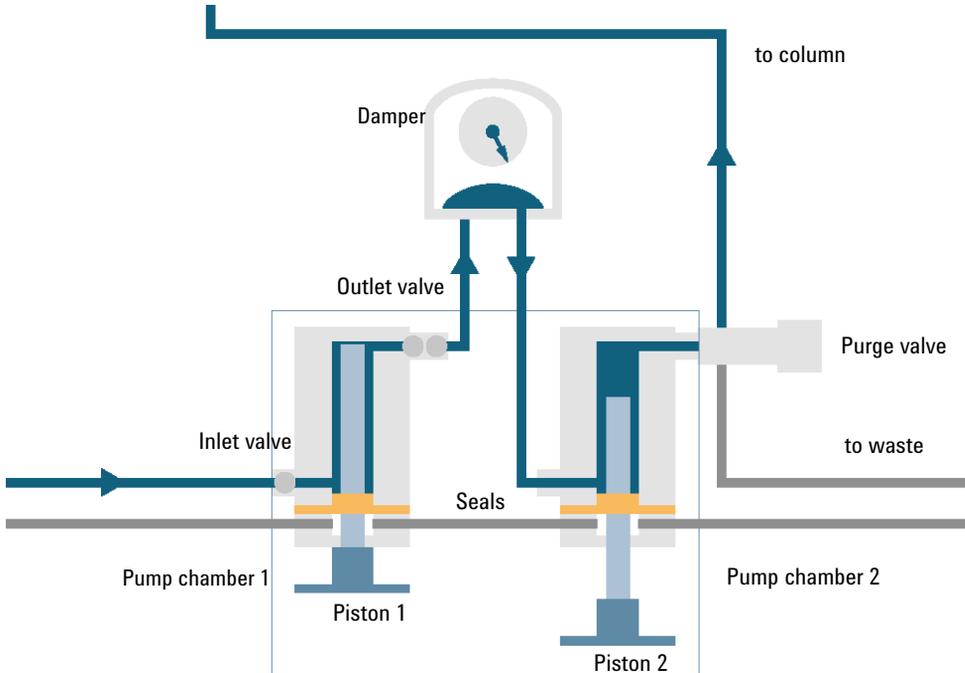
- 1 Select the **Leak Rate Test** from the **Test Selection** menu.
- 2 Start the test and follow the instructions.

NOTE

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

Evaluating the Results

Results of the leak rate test are the leak rates measured for pistons 1 and 2 as described for the test principle. If any of the leak rates exceeds $3 \mu\text{L}/\text{min}$, the test will fail.



Potential Causes of Leak Rate Test Failure

Secondary Leak

If a leak is found for movement of piston 2 (secondary leak), the following reasons are possible:

Probable cause	Suggested actions
1 System not flushed properly	Flush system for several minutes
2 Degassing efficiency is low	Check degasser performance
3 Purge valve not closed or defect	Check purge valve
4 Blank nut not installed tightly	Tighten or replace blank nut
5 Outlet valve leaking (read below)	Replace outlet valve
6 Leak at piston 2 or seal in chamber 2	Inspect piston, replace piston and/or seal

Primary Leak

If a leak is found for movement of piston 1 (primary leak), any leak described for piston movement 2 will cause a failure for piston 1 as well, as the liquid can move through the outlet valve to chamber 2. Such cases need to be identified as described before. Additionally, following causes are possible:

Probable cause	Suggested actions
1 Leak at piston 1 or seal in chamber 1	Inspect piston, replace piston and/or seal
2 Leak at inlet valve	Replace inlet valve or inlet valve cartridge (AIV only)

Internal Outlet Valve Leak

A leak of the outlet valve will be identified separately (internal outlet valve leak) by calculating the difference between leak rate 1 and leak rate 2. If the second leak rate is higher than the first one, this is due to a flow back through the outlet valve.

Probable cause	Suggested actions
1 Leak at outlet valve	Replace the part which has failed and re-run the test.

8 Maintenance

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This chapter describes the maintenance of the module.

Introduction to Maintenance and Repair

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

Warnings and Cautions

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

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

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

WARNING

Electrical shock

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

- ✓ Do not remove the cover of the module.
- ✓ Only certified persons are authorized to carry out repairs inside the module.

WARNING

Personal injury or damage to the product

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

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

CAUTION

Safety standards for external equipment

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

Overview of Maintenance and Repair

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

Table 20 Simple repair procedures

Procedure	Typical Frequency	Notes
"Checking and Replacing the Solvent Filter" on page 131	If solvent filter is blocked	Gradient performance problems, intermittent pressure fluctuations
"Exchange the Passive Inlet Valve" on page 132	If internally leaking	Pressure ripple unstable, run Leak Rate Test for verification
"Exchange the Active Inlet Valve (AIV) or its Cartridge" on page 160	If internally leaking	Pressure ripple unstable, run Leak Rate Test for verification
"Exchange the Outlet Valve" on page 134	If internally leaking	Pressure ripple unstable, run Leak Rate Test for verification
"Exchange the Purge Valve Frit or the Purge Valve" on page 136	If internally leaking	Solvent dripping out of waste outlet when valve closed
"Exchange the Purge Valve Frit or the Purge Valve" on page 136	If the frit shows indication of contamination or blockage	A pressure drop of > 10 bar across the frit (at a water flow of 5 mL/min with open purge valve) indicates blockage
"Maintenance of a Pump Head Without Seal Wash Option" on page 143	If pump performance indicates seal wear	Leaks at lower pump head side, unstable retention times, pressure ripple unstable - run Leak Rate Test for verification
Exchange pistons, see "Maintenance of a Pump Head Without Seal Wash Option" on page 143	If scratched	Seal life time shorter than usual - check pistons while changing the seals

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. Avoid using organic solvents for cleaning purposes. They can cause damage to plastic parts.

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.**

NOTE

A solution of 70 % isopropanol and 30 % water might be used if the surface of the module needs to be disinfected.

Remove and Install Doors

Parts required

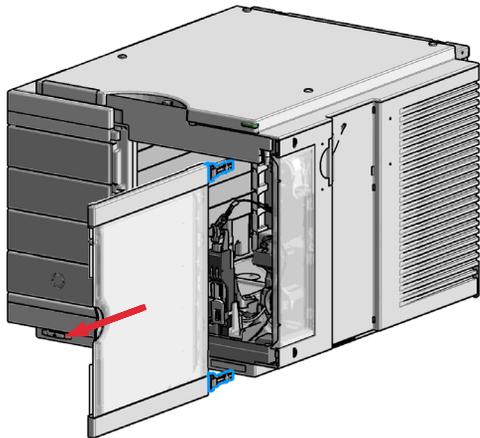
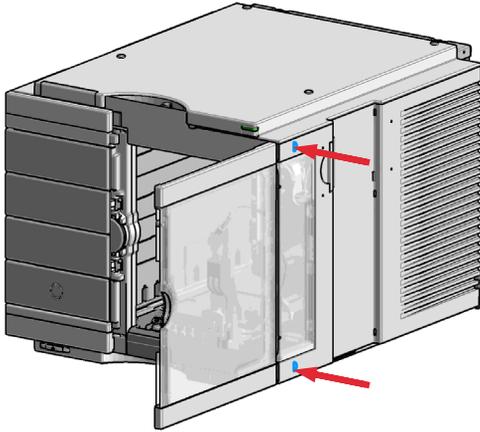
p/n	Description
5067-5746 	Door Assembly Infinity 180 Right
5067-5745 	Door Assembly Infinity 180 Left

NOTE

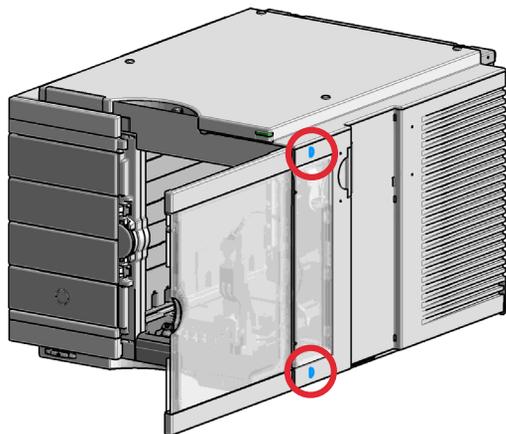
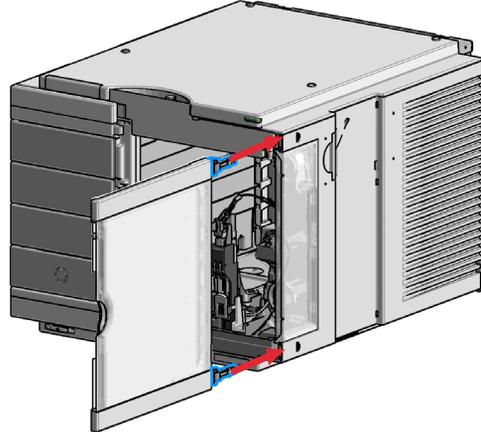
The figures shown in this procedure exemplarily show the Infinity II Multisampler module.

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.



Checking and Replacing the Solvent Filter

A functional solvent filter is essential for a good pump performance and for protecting the LC system.

When If solvent filter is blocked.

Parts required	p/n	Description
	5041-2168 E	Solvent inlet filter, 20 µm pore size

See “[Bottle Head Assembly](#)” on page 182 for related parts.

CAUTION

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

- ✓ Always filter solvents.
- ✓ Never use the module without solvent inlet filter.

NOTE

If the filter is in good condition the solvent will freely drip out of the solvent tube (hydrostatic pressure). If the solvent filter is partly blocked only very little solvent will drip out of the solvent tube.

- 1 Remove the solvent filter from the inlet filter adapter and replace it by a new one.

Exchange the Passive Inlet Valve

When If internally leaking (backflow)

Tools required	p/n	Description
	8710-1924 	Open-end wrench 14 mm
		Pair of tweezers
	5067-5688 	Torque wrench 1 – 25 Nm with 14 mm wrench

Parts required	#	p/n	Description
	1	G1312-60066 	Passive inlet valve 1220/1260
OR	1	G1312-60166 	1260 Infinity Inlet Valve Type N

Preparations

- Switch off the pump at the main power switch.
- Open the doors of the module.

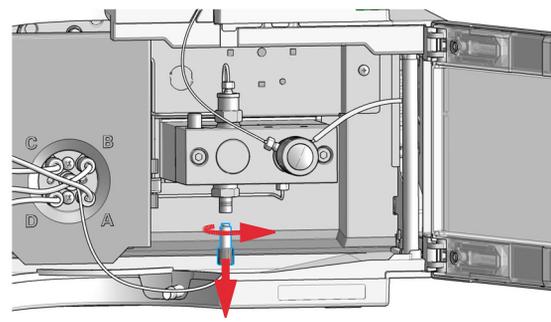
NOTE

This chapter is not applicable for G5654A Bio-inert pumps!

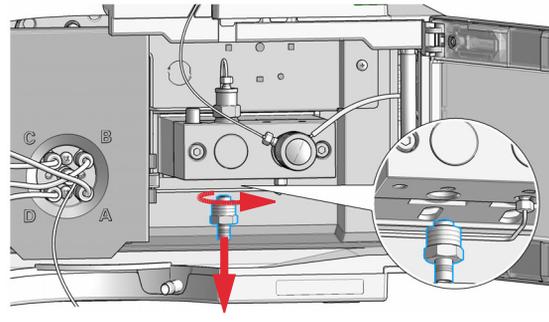
1 Disconnect the solvent inlet tube from the inlet valve.

NOTE

Beware of leaking solvents due to hydrostatic pressure.



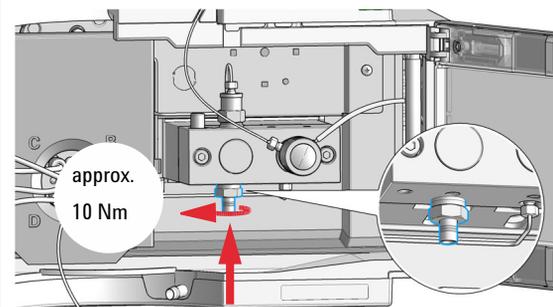
2 Using a 14 mm wrench loosen the passive inlet valve and remove the valve from the pump head.



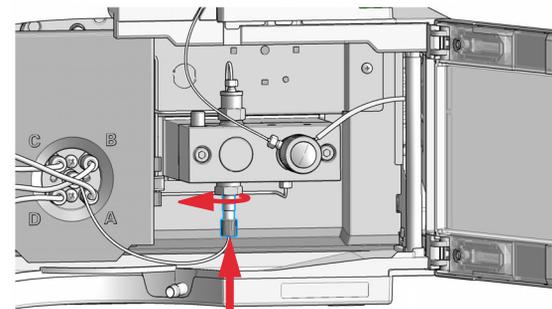
Maintenance

Exchange the Passive Inlet Valve

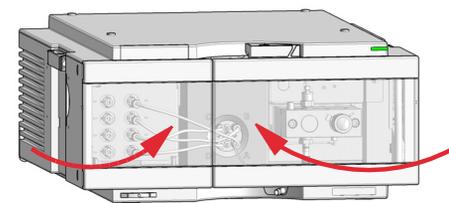
- 3** Insert the new valve into the pump head and tighten the valve using a torque wrench (approx. 10 Nm).



- 4** Reconnect the solvent inlet tube to the passive inlet valve.



- 5** Close the doors.



Exchange the Outlet Valve



For bio-inert modules use bio-inert parts only!

When If internally leaking

Tools required	p/n	Description
	8710-0510 	Open-end wrench 1/4 – 5/16 inch
	8710-1924 	Open-end wrench 14 mm
	5067-5688 	Torque wrench 1 – 25 Nm with 14 mm wrench

Parts required	#	p/n	Description
	1	G1312-60067 	Outlet valve
OR	1	G1312-60167 	Outlet valve (type N/SFC)
OR	1	G5611-60067 	Outlet Valve (Bio-Inert)

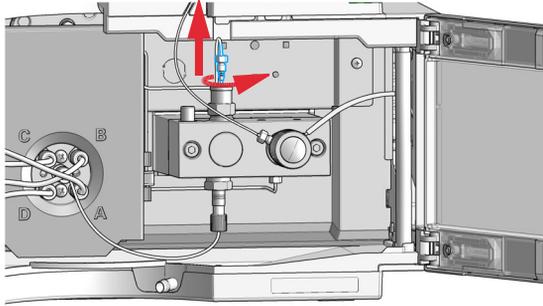
Preparations

- Switch off the pump at the main power switch.
- Open the doors of the module.

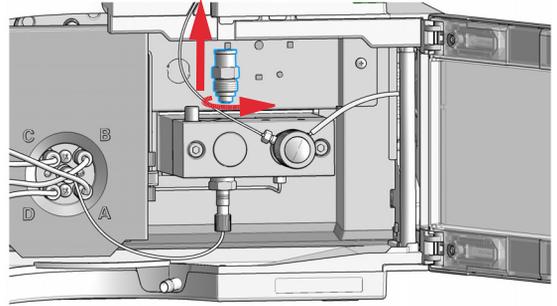
Maintenance

Exchange the Outlet Valve

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



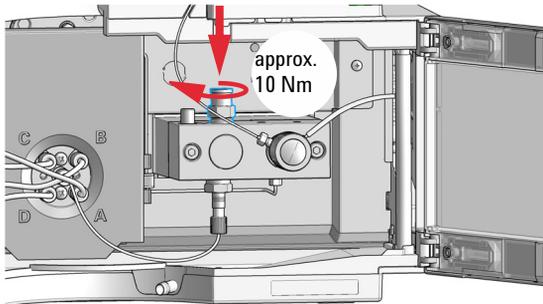
- 2 Using the 14 mm wrench loosen the valve and remove it from the pump body.



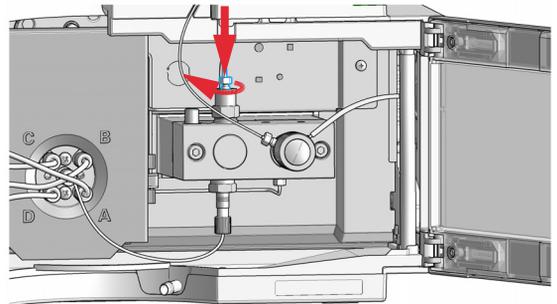
NOTE

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

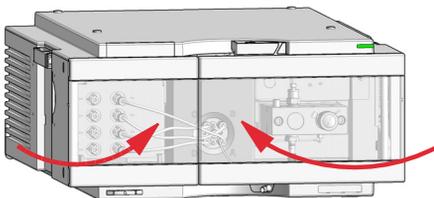
- 3 Reinstall the outlet valve and tighten it using a torque wrench set to approx. 10 Nm.



- 4 Reconnect the valve capillary to the outlet valve.



- 5 Close the doors.



Exchange the Purge Valve Frit or the Purge Valve



For bio-inert modules use bio-inert parts only!

When

- Frit – when piston seals are exchanged or when contaminated or blocked (pressure drop of > 10 bar across the frit at a flow rate of 5 mL/min of water with purge valve opened)
- Purge valve – if internally leaking

Tools required

p/n	Description
8710-0510 📄	Open-end wrench 1/4 – 5/16 inch
8710-1924 📄	Open-end wrench 14 mm
	Pair of tweezers
OR	Toothpick

Parts required

#	p/n	Description
1	G7111-60061 📄	Purge valve for G7110B, G7111A, and G7111B
1	G5611-60064 📄	Purge valve for G5654A (Bio-inert)
1	01018-22707 📄	PTFE frits (pack of 5)
1	5067-4728 📄	Seal cap (OPTIONAL)

Preparations

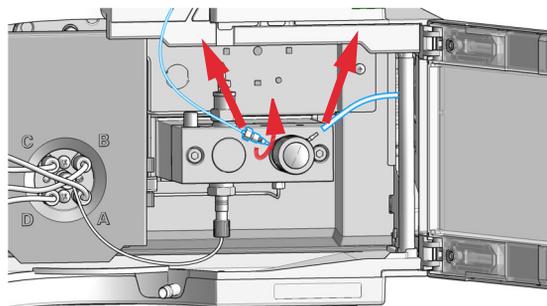
- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.

Exchange the Purge Valve Frit or the Purge Valve

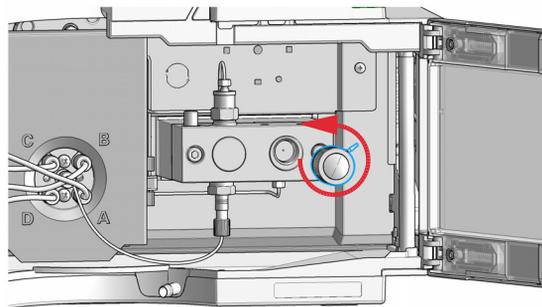
- 1 Using a 1/4 inch wrench disconnect the pump outlet capillary from the purge valve. Disconnect the waste tube.

NOTE

Beware of leaking solvents due to hydrostatic pressure.



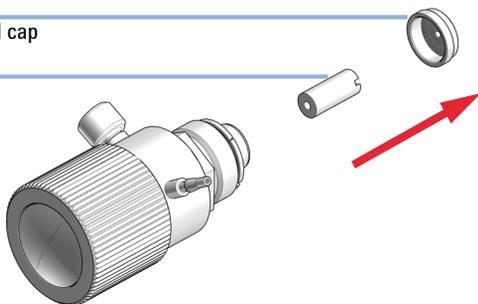
- 2 Using the 14 mm wrench unscrew the purge valve and remove it.



- 3 Remove the seal cap from the purge valve.

Seal cap

Frit

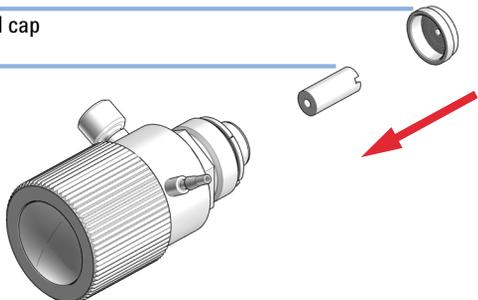


- 4 Using a pair of tweezers or a toothpick remove the frit.

- 5 Place a new frit into the purge valve with the orientation of the frit as shown below (slit in frit points to the front).

Seal cap

Frit



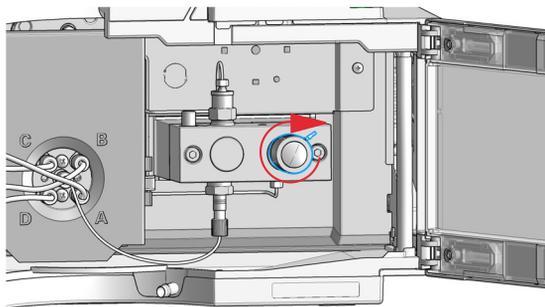
- 6 Reinstall the seal cap including the gold seal.

NOTE

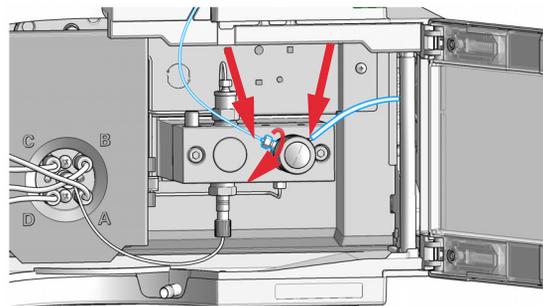
Before reinstallation always check the gold seal in the seal cap. A deformed seal cap should be exchanged.

CAUTION**Damage to the purge valve**

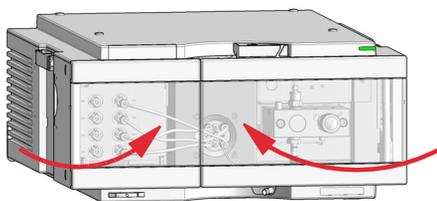
- ✓ Do not lift the pump using the purge valve as a handle, it might get leaky.
 - ✓ Do not try to turn the purge valve into the correct position when already fixed to the pump. The rubber o-ring might break.
 - ✓ Anticipate the correct position of the connections before tightening the valve.
- 7 Insert the purge valve into the pump head and fix it with a 14 mm wrench.



- 8 Reconnect the outlet capillary and the waste tubing.



- 9 Close the doors.



Replace the O-Ring on the Purge Valve

When If the original o-ring is damaged and needs to be replaced

Tools required

p/n	Description
8710-0510 E	Open-end wrench 1/4 – 5/16 inch
8710-1924 E	Open-end wrench 14 mm
	Pair of tweezers
	Toothpick

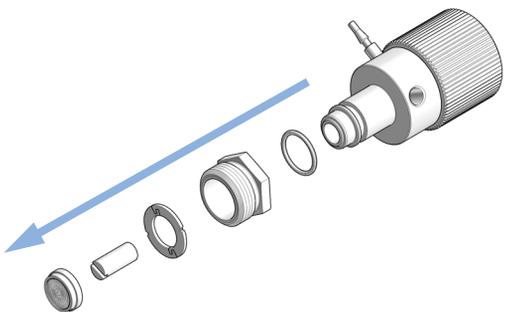
OR

Parts required

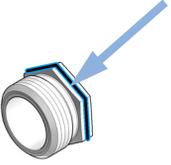
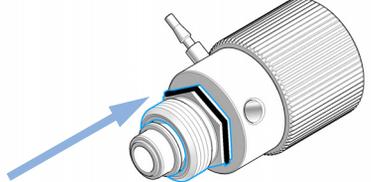
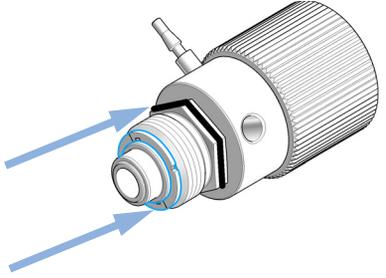
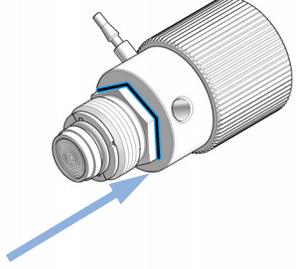
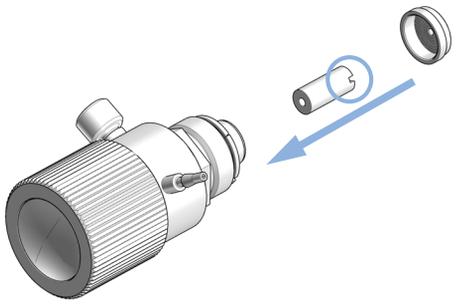
#	p/n	Description
1	5067-6595 E	1260 PV O-ring FKM 5/pack
1	01018-22707 E	PTFE frits (pack of 5) (OPTIONAL)
1	5067-4728 E	Seal cap (OPTIONAL)

Preparations

- Switch off pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.
- Remove the purge valve from the pump head.

<p>1 Disassemble the purge valve.</p> 	<p>2 Remove the old o-ring from the purge valve.</p> <p>3 Clean the purge valve parts.</p>
--	--

Replace the O-Ring on the Purge Valve

<p>4 Place the new o-ring on the Screw Purge Valve.</p> 	<p>5 Place the screw with o-ring on the Purge Valve Body.</p> 
<p>6 Place the mounting ring on the screw and push down the o-ring.</p> 	<p>7 Push the screw up and guide the o-ring into the gap.</p> 
<p>8 Place a new frit into the purge valve with the orientation of the frit as shown below (slit in frit points to the front). Reinstall the seal cap including the gold seal.</p>  <p>NOTE</p> <p>Before reinstallation always check the gold seal in the seal cap. A deformed seal cap should be exchanged.</p>	<p>9 Install the purge valve to the pump. Make sure not to turn the purge valve body when the screw is fixed to the pump. The o-ring will take damage.</p>

Remove the Pump Head Assembly

- When**
- Exchanging the seals
 - Exchanging the pistons
 - Exchanging seals of the seal wash function

Tools required	p/n	Description
	8710-0510 	Open-end wrench 1/4 – 5/16 inch
	5023-2524 	Hex Key Set + Driver

- Preparations**
- Switch off the pump at the main power switch and unplug the power cable.
 - Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.
 - Open the doors of the module.
 - If an active inlet valve is installed, disconnect the active inlet valve cable.

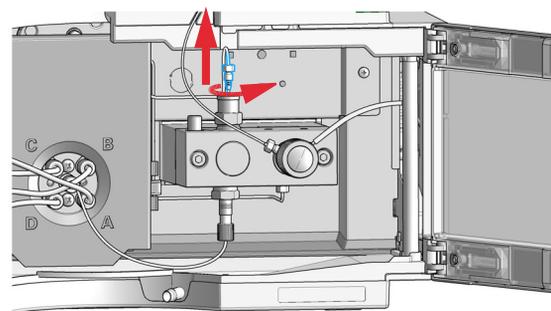
CAUTION

Damage of the pump drive

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

- ✓ **Never start the pump when the pump head is removed.**

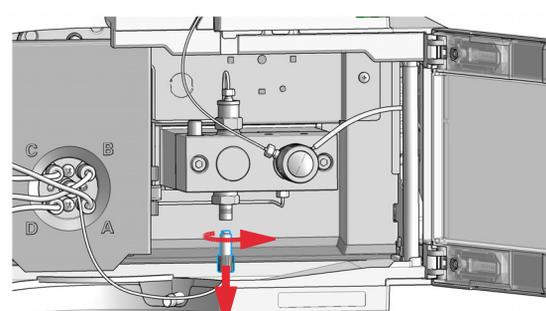
- 1** Using a 1/4 inch wrench disconnect the valve capillary from the outlet valve.



- 2** Disconnect the solvent inlet tube from the inlet valve.

NOTE

Beware of leaking solvents due to hydrostatic pressure.



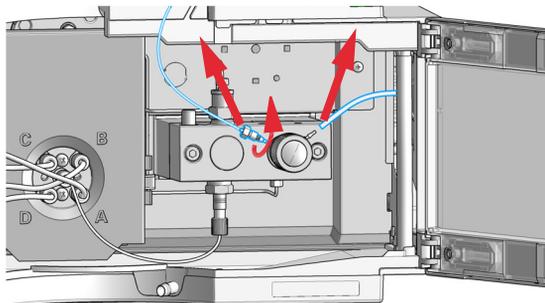
Maintenance

Remove the Pump Head Assembly

- 3** Using a 1/4 inch wrench disconnect the pump outlet capillary from the purge valve. Disconnect the waste tube.

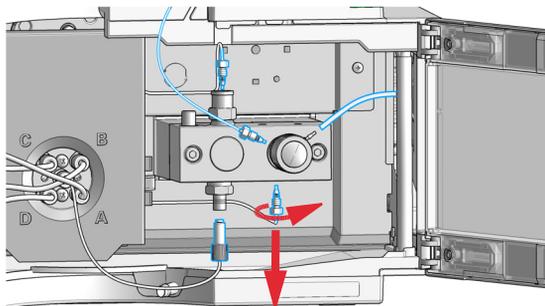
NOTE

Beware of leaking solvents due to hydrostatic pressure.

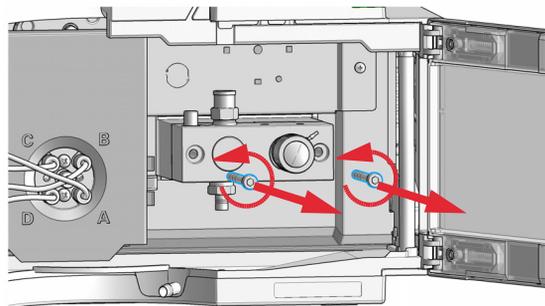


- 4** If applicable, remove tubings from the seal wash support rings.

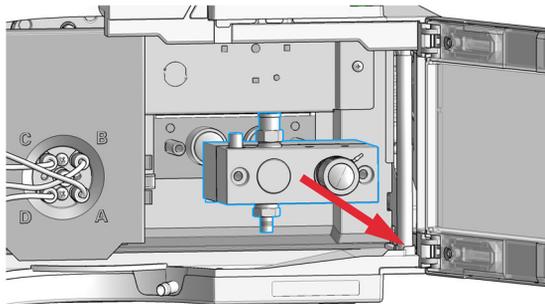
- 5** Remove the capillary at the bottom of the pump head.



- 6** Using a 4 mm hexagonal key, stepwise loosen the two pump head screws.



- 7** Remove the pump head from the pump drive.



Maintenance of a Pump Head Without Seal Wash Option

When In case of maintenance or pump head internal leaks.

Tools required

Description

Wrench 1/4 inch

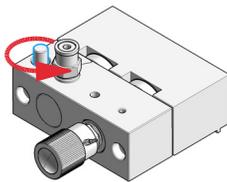
Hexagonal key, 4 mm

Parts required	#	p/n	Description
	1	01018-23702 📄	Insert tool
	1	5063-6589 📄	Piston seal PTFE, carbon filled, black (pack of 2), default
OR	1	0905-1420 📄	PE seals (pack of 2)
	1	5063-6586 📄	Sapphire piston, 100 µL
	1	8660-0852 📄	Abrasive mesh

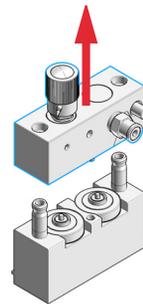
Preparations

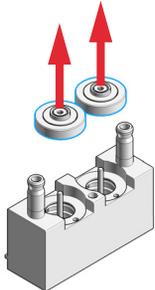
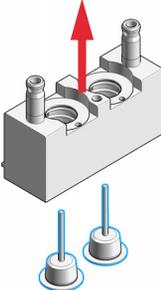
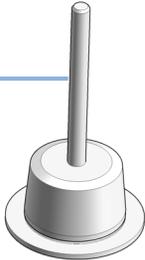
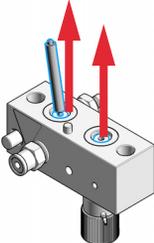
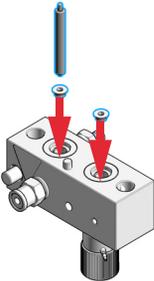
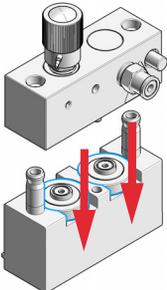
- Switch off the pump at the main power switch.
- Open the doors of the module.
- Remove the Pump Head Assembly.

1 Place the pump head on a flat surface. Loosen the lock screw (two turns).

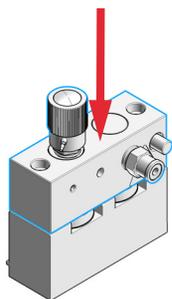


2 While holding the lower half of the assembly (piston housing), carefully pull the pump housing away from the piston housing.

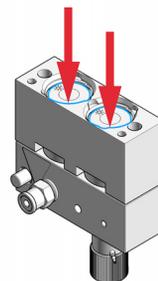


<p>3 Remove the support rings from the piston housing.</p> 	<p>4 Lift the housing away from the pistons.</p> 
<p>5 Check the piston surface and remove any deposits or layers: clean the piston surface with abrasive paper and rinse with 2-propanol. Replace piston if scratched.</p> <p>Piston Surface</p> 	<p>6 Using the steel side of the insert tool, carefully remove the seal from the pump housing.</p> 
<p>7 Using the plastic side of the insert tool, insert new seals into the pump head.</p> 	<p>8 Place the support rings on the piston housing. Note the correct position of the pins.</p> 

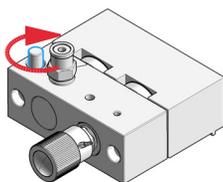
9 Place the pump housing onto the piston housing.



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



11 Tighten the lock screw.



12 Install the pump head, see "Reinstall the Pump Head Assembly" on page 151.

Maintenance of a Pump Head with Seal Wash Option



For bio-inert modules use bio-inert parts only!

When In case of maintenance or pump head internal leaks.

Tools required

Description
 Wrench 1/4 inch
 Hexagonal key, 4 mm

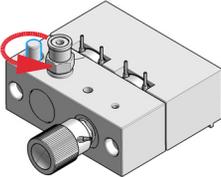
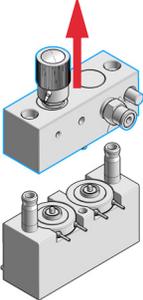
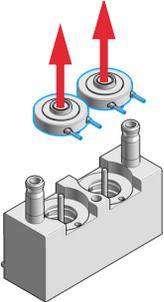
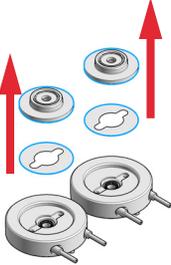
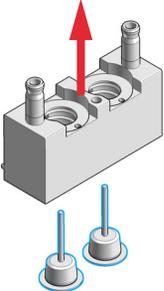
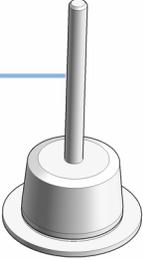
Parts required	#	p/n	Description
	1	01018-23702 [icon]	Insert tool
	1	0905-1175 [icon]	Wash seal (PTFE)
OR	1	0905-1718 [icon]	Wash Seal PE
OR	1	0905-1731 [icon]	Bio-Inert Wash Seal
	1	5062-2484 [icon]	Gasket, seal wash (pack of 6)
	1	5063-6589 [icon]	Piston seal PTFE, carbon filled, black (pack of 2), default
OR	1	G5611-21503 [icon]	Piston Seal PTFE (Bio-inert)
	1	0905-1420 [icon]	PE seals (pack of 2)
	1	5063-6586 [icon]	Sapphire piston, 100 µL
OR	1	5067-4695 [icon]	Sapphire piston (Bio-inert)
	1	8660-0852 [icon]	Abrasive mesh

Preparations

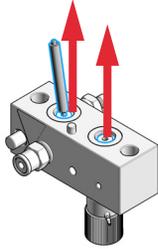
- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters for avoiding leakages.
- Remove the Pump Head Assembly.
- Remove the wash solvent tubings from the support ring inlet and outlet.

NOTE

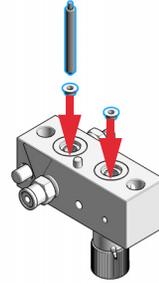
G5654A only: Seal Holder (Bio-inert) (G5611-60016) consists of two separate parts: seal holder and backup ring. Make sure to install the backup ring in the correct way as described below in order to avoid damaging the piston seals.

<p>1 Place the pump head on a flat surface. Loosen the lock screw (two turns).</p> 	<p>2 While holding the lower half of the assembly (piston housing), carefully pull the pump housing away from the piston housing.</p> 
<p>3 Remove the seal holder and the seal wash support rings from the piston housing.</p> 	<p>4 Remove the seal holder from the support ring assembly.</p> 
<p>5 Lift the housing away from the pistons.</p> 	<p>6 Check the piston surface and remove any deposits or layers: clean the piston surface with abrasive paper and rinse with 2-propanol. Replace piston if scratched.</p> 

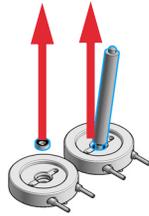
- 7** Using the steel side of the insert tool, carefully remove the seal from the pump housing.



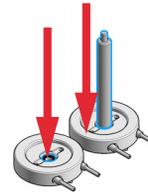
- 8** Using the plastic side of the insert tool, insert new seals into the pump head.



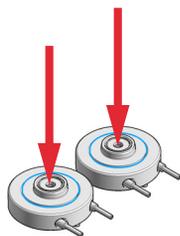
- 9** Using the steel side of the insert tool, remove the seal wash gasket and the wash seal from the support ring.



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



- 11** Place a seal wash gasket in the recess of the support ring. Use a matching orientation of gasket and support ring. Put the seal holder on top of the gasket.



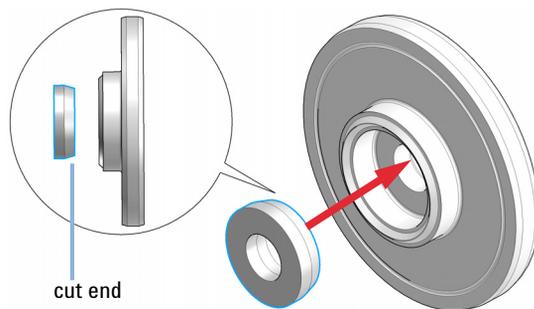
CAUTION

G5654A only: Seal life time

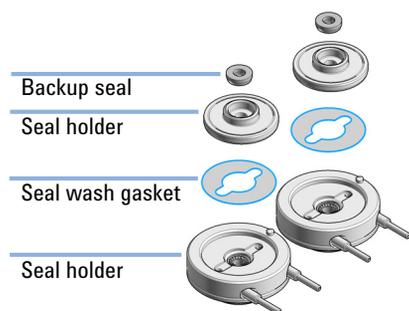
Wrongly inserting the backup ring will strongly reduce the life time of the seals and the pump head parts.

- ✓ **Note the correct installation of the backup ring inside the support ring.**

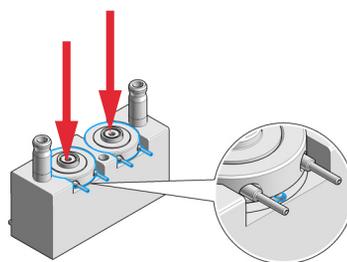
- 12** *G5654A only:* If the backup seal has been removed from the seal holder, insert it in the correct orientation. Please ensure that the cut end faces the seal holder.



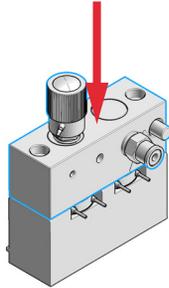
- 13** *G5654A only:* Place a seal wash gasket in the recess of the support ring. Use a matching orientation of gasket and support ring. Put the seal holder on top of the gasket.



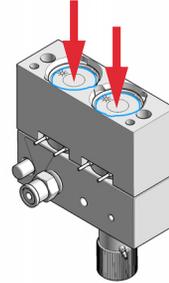
- 14** Place the support rings on the piston housing. Note the correct position of the pins on the support ring.



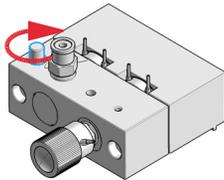
15 Place the pump housing onto the piston housing.



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



17 Tighten the lock screw.



18 Install the pump head, see "Reinstall the Pump Head Assembly" on page 151.

Reinstall the Pump Head Assembly

When When reassembling the pump

Tools required	p/n	Description
	5023-2524 	Hex Key Set + Driver
	5067-5688 	Torque wrench 1 – 25 Nm with 14 mm wrench
	G4220-20013 	4 mm hex bit
	G4220-20015 	Adapter ¼ in square to hex

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

CAUTION

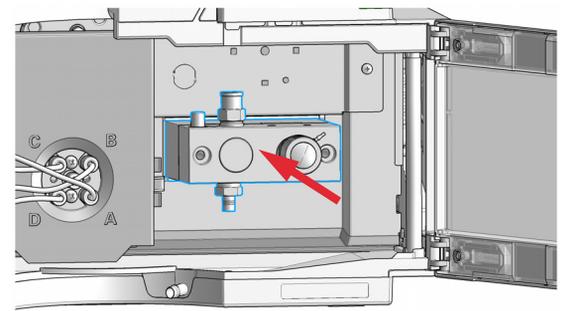
Damage of the pump drive

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

- ✓ Never start the pump when the pump head is removed.

1 If needed, apply a small amount of grease on the back of the screws. Normally, the grease added during manufacturing is sufficient for a long time.

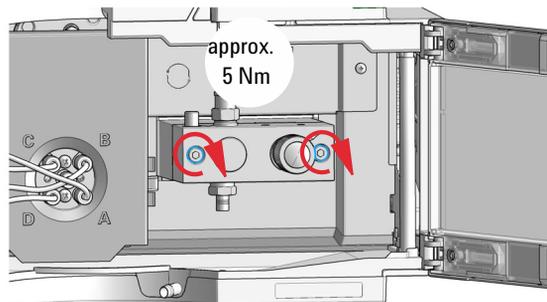
2 Slide the pump head assembly onto the pump drive.



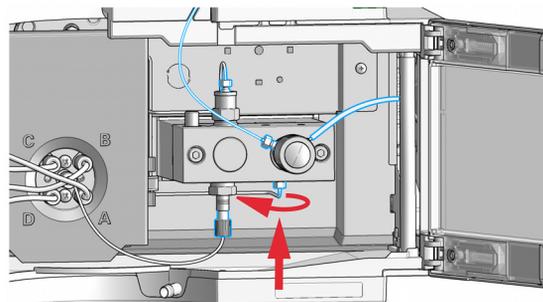
Maintenance

Reinstall the Pump Head Assembly

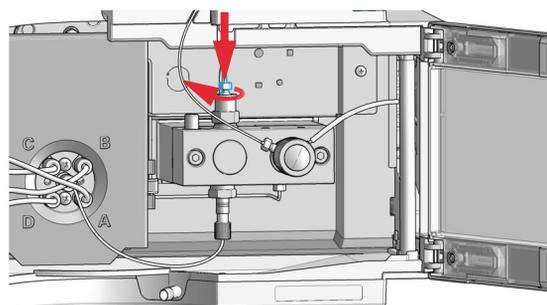
- 3** Insert the pump head screws and tighten them stepwise. First tighten the left screw, then the right screw, with a torque of approximately 5 Nm.



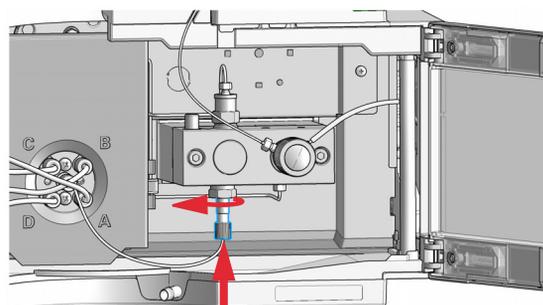
- 4** Install the capillary at the bottom of the pump head.



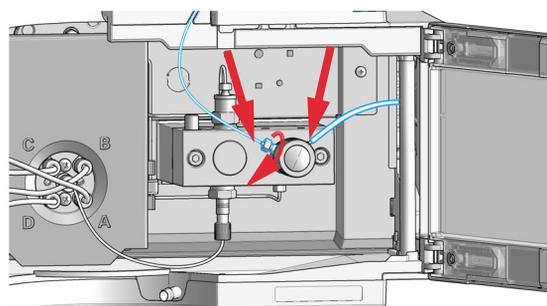
- 5** Reconnect the valve capillary to the outlet valve.



- 6** Reconnect the solvent inlet tube to the passive inlet valve.



- 7** Reconnect the outlet capillary and the waste tubing.

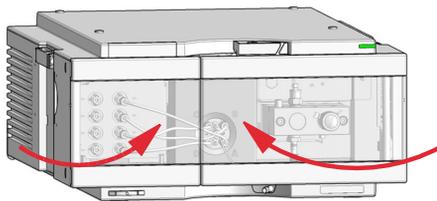


- 8** If installed, reconnect the active inlet valve cable to its connector.

Maintenance

Reinstall the Pump Head Assembly

9 Close the doors.



Next Steps:

- 10 If a standard seal has been installed, run the seal wear-in procedure, which includes a replacement of the purge valve frit ("Seal Wear-in Procedure" on page 154).
- 11 For the normal phase seal, the purge valve frit should be replaced, see "Exchange the Purge Valve Frit or the Purge Valve" on page 136.

Seal Wear-in Procedure

Parts required

p/n	Description
0100-1847 	Adapter AIV to solvent inlet tubes
5022-2159 	Restriction capillary

NOTE

Before replacing your solvent by isopropanol or replacing isopropanol by your solvent, consider solvent miscibility. For example, do not directly switch from buffers to isopropanol and vice versa.

- 1 Place a bottle with 100 mL of isopropanol in the solvent cabinet and put a tubing (including bottle head assembly) into the bottle.
- 2 If an active inlet valve is installed, screw the PEEK adapter 1/4-28 to 10-32 (0100-1847) to the AIV and connect the inlet tube from the bottle head directly to it.
- 3 Connect the Restriction capillary (5022-2159) to the purge valve. Connect its other end to a waste container.
- 4 Open the purge valve and purge the system for 5 min with isopropanol at a flow rate of 2 mL/min.
- 5 Close the purge valve and set the flow to a rate adequate to achieve a pressure of 350 bar. Pump 15 min at this pressure to wear in the seals. The pressure can be monitored using your instrument control software or tool.
- 6 Turn OFF the pump, slowly open the purge valve to release the pressure from the system, disconnect the restriction capillary and reinstall the bottle with the solvent for your application.
- 7 Rinse your system with the solvent used for your next application.
- 8 Replace the purge valve frit, see “Exchange the Purge Valve Frit or the Purge Valve” on page 136.

Exchange the Multi-Channel Gradient Valve (MCGV)



For bio-inert modules use bio-inert parts only!

Tools required

p/n	Description
8710-0899	Screwdriver Pozidrive Shaft

Parts required

#	p/n	Description
1	G1311-67701	Multi channel gradient valve (MCGV)
OR	1	G5611-67701 Multi-Channel Gradient Valve (MCGV) (Bio-inert)

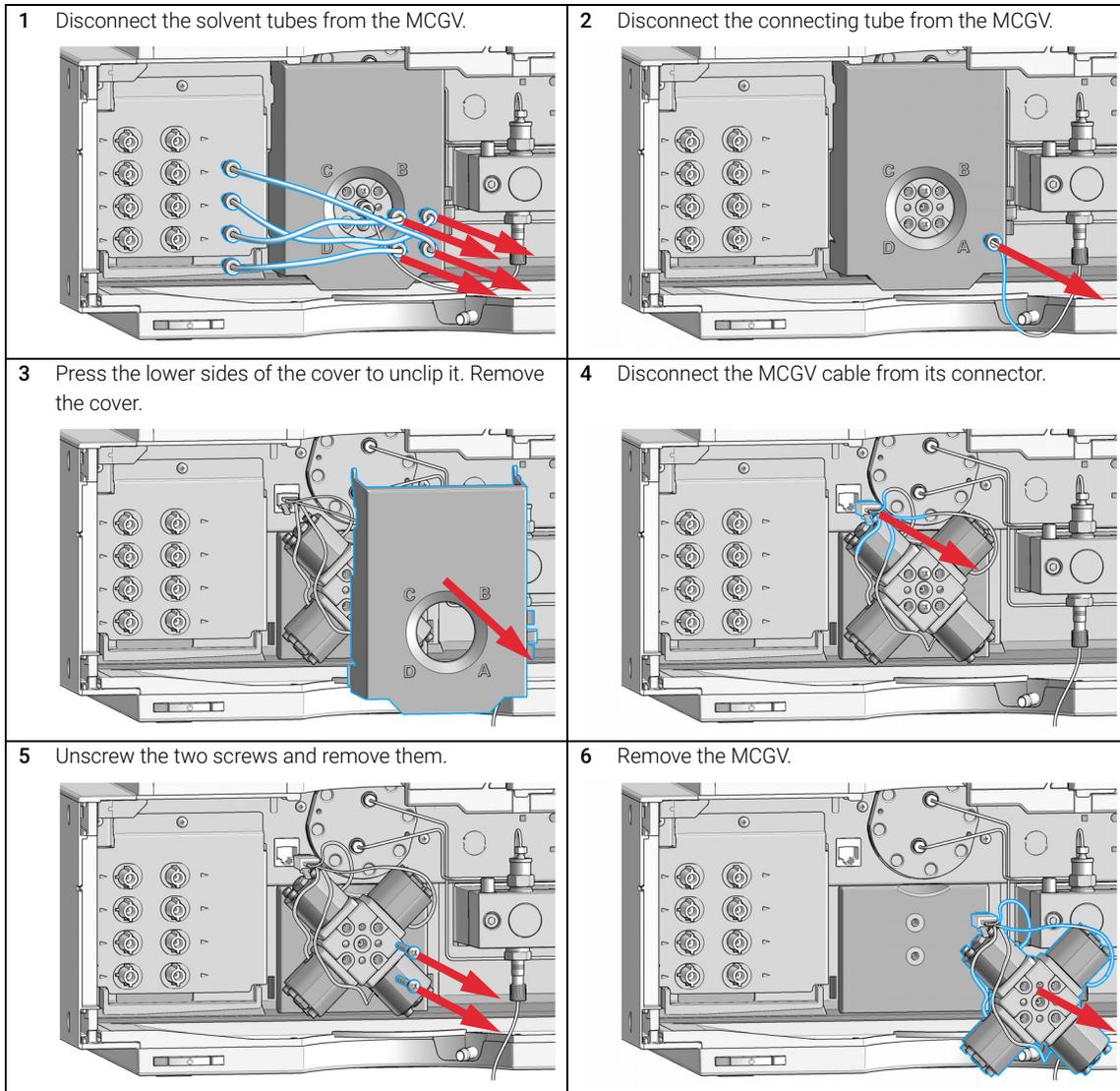
Preparations

- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.

NOTE

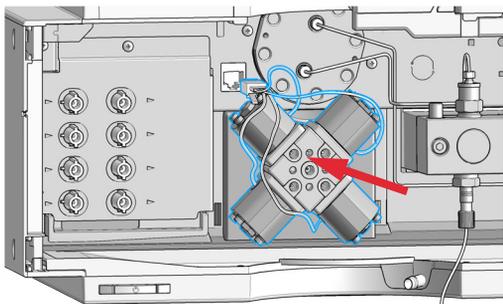
The life time of the multi-channel gradient valve can be increased by regularly flushing the valve, especially when using buffers. If using buffers, flush all channels of the valve with water to prevent precipitation of the buffer, otherwise salt crystals could drop into an unused channel and form plugs that may cause leaks of that channel. Such leaks will interfere with the general performance of the valve. When using buffers in combination with organic solvents, it is recommended to connect the aqueous solutions/buffers to one of the bottom ports (A and D) and the organic solvent to one of the upper gradient valve ports. It is best to have the organic channel directly above the buffer channel (e.g., A - buffer, B - organic solvent).

Exchange the Multi-Channel Gradient Valve (MCGV)

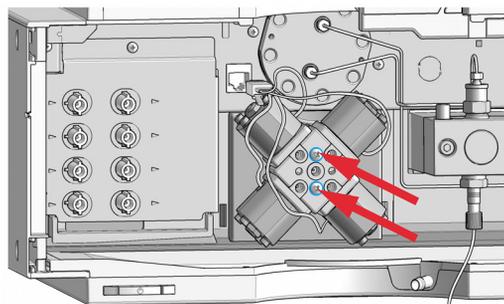


Exchange the Multi-Channel Gradient Valve (MCGV)

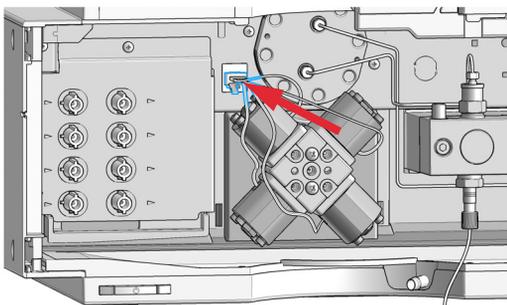
- 7** Place the new MCGV into position. Make sure that channel A of the MCGV is put at the bottom-right position.



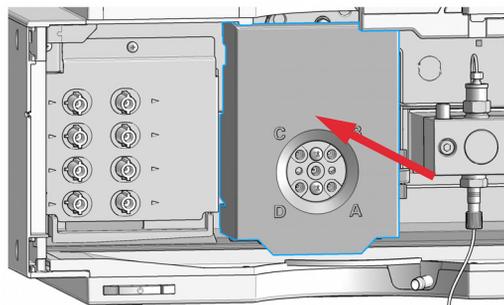
- 8** Tighten the two screws.



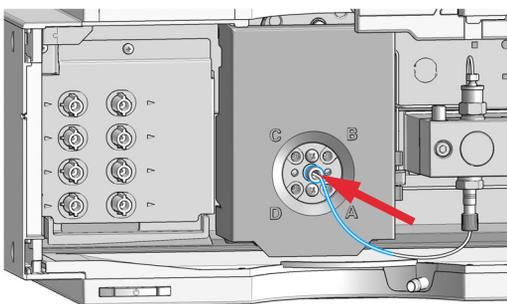
- 9** Connect the cable to its connector.



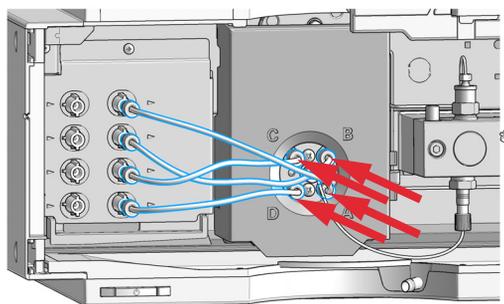
- 10** Install the MCGV cover.



- 11** Reconnect the tube from the inlet valve to the middle position of the MCGV.



- 12** Connect solvent tubes for channels A-D from the MCGV to the degasser outlets.



Replace the Solvent Selection Valve (Isocratic Pump)

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

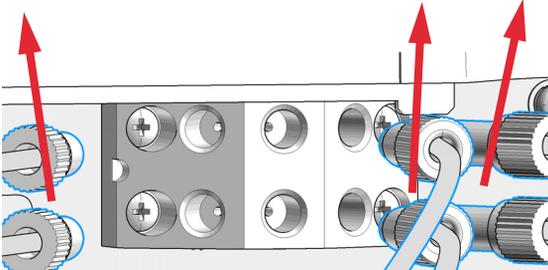
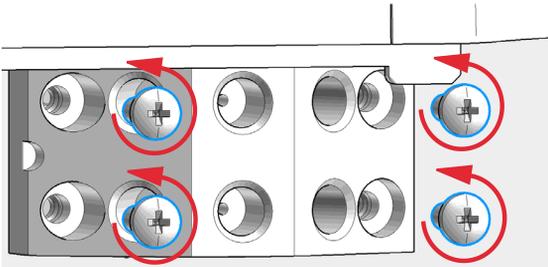
Tools required

p/n	Description
8710-0899 	Screwdriver Pozidrive Shaft

Parts required

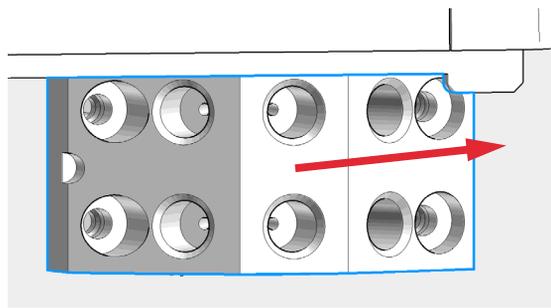
p/n	Description
5067-5895 	Solvent selection valve

Preparations Switch off the pump at the main power switch.

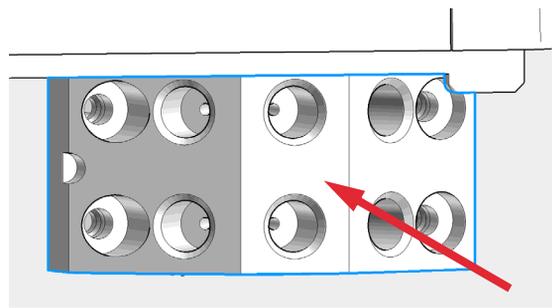
<p>1 Lift solvent bottles out of the solvent cabinet and place them on the table. Disconnect the solvent tubes from the solvent selection valve and empty the tubes into the bottles. Place the bottles back into the solvent cabinet.</p>	<p>2 Disconnect all tubings from the solvent selection valve.</p> 
<p>3 Using a screwdriver, loosen the holding screws of the valve holder.</p> 	<p>4 Carefully disconnect the valve cable at the SSV connector on the Z-Panel.</p> <p>5 Using a screwdriver, loosen the holding screws of the degasser front cover.</p>

Replace the Solvent Selection Valve (Isocratic Pump)

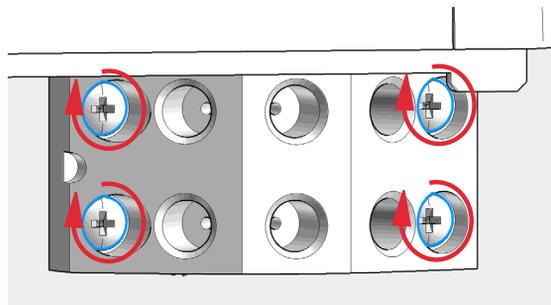
- 6 Carefully pull the valve with a cable out of the pump mainframe.



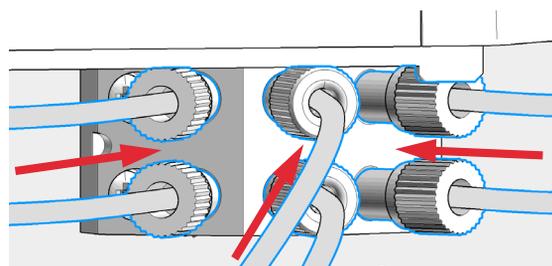
- 7 Exchange the defective solvent selection valve.



- 8 Tighten the screws of the degasser front cover and the valve holder.



- 9 Reconnect all tubings to the solvent selection valve.

**NOTE**

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

Exchange the Active Inlet Valve (AIV) or its Cartridge



For bio-inert modules use bio-inert parts only!

When If internally leaking (backflow)

Tools required

Description

Wrench, 14 mm

Pair of tweezers

Parts required

p/n	Description
G5699A [icon]	Active Inlet Valve Upgrade Kit
G1312-60025 [icon]	Active inlet valve body, without cartridge
G1312-60020 [icon]	Cartridge for active inlet valve 600 bar
G1311-67304 [icon]	Connecting tube
G1311-61601 [icon]	Active Inlet Valve Cable Assembly
0100-2298 [icon]	Adapter, PEEK int. 1/4-28 to ext. 10-32
G5611-60025 [icon]	Active Inlet Valve (AIV, Bio-inert), without cartridge
G5611-60020 [icon]	Cartridge for AIV (Bio-inert)

Preparations

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

Exchange the Active Inlet Valve (AIV) or its Cartridge

- 1 Unplug the active inlet valve cable from the connector.
- 2 Disconnect the solvent inlet tube from the inlet valve (be aware that solvent may leak out of the tube due to hydrostatic flow).
- 3 Unscrew the adapter from the active inlet valve.
- 4 Using a 14 mm wrench loosen the active inlet valve and remove the valve from the pump head.

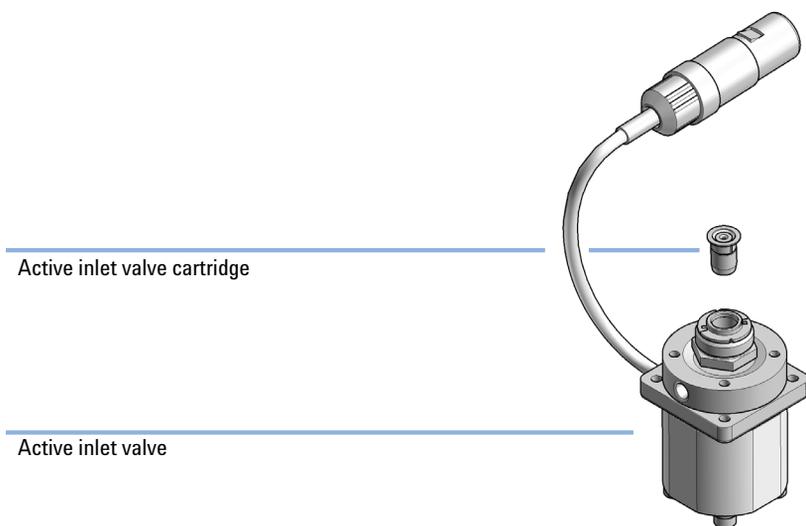


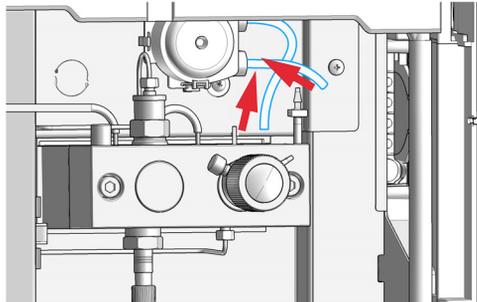
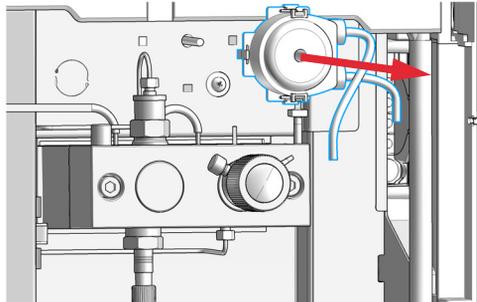
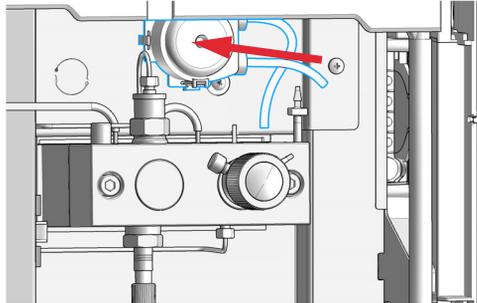
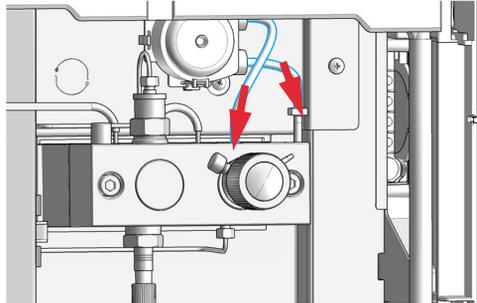
Figure 12 Active Inlet Valve Assembly

- 5 Using a pair of tweezers remove the valve cartridge from the actuator assembly.
- 6 Before inserting the new valve cartridge clean the area in the actuator assembly. Flush the cartridge area thoroughly with alcohol.
- 7 Insert a new cartridge into the actuator assembly (make sure the valve cartridge is completely inserted into the actuator assembly).
- 8 Insert the new valve into the pump head. Using the 14 mm wrench turn the nut until it is hand tight.
- 9 Position the valve such that the solvent inlet tube connection points towards the front.
- 10 Using the 14 mm wrench tighten the nut by turning the valve into its final position (not more than a quarter turn).
- 11 Reconnect the adapter at the active inlet valve.
- 12 Reconnect the solvent inlet tube to the adapter. Reconnect the active inlet valve cable to the connector in the Z-panel.
- 13 Purge the system with 30 mL of solvent in order to achieve a low pressure ripple.

Exchange the Seal Wash Cartridge

Parts required	p/n	Description
	5065-4445 	Peristaltic pump with PharMed tubing

- Preparations**
- Switch off pump at the main power switch.
 - Open the doors.

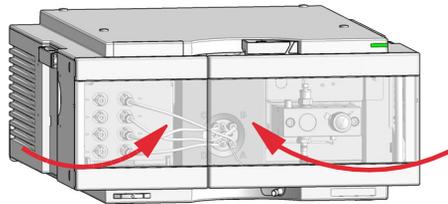
<p>1 Remove the wash solvent tubings from the support ring outlet and from the adapter leading to the waste bottle.</p> 	<p>2 Unclip the peristaltic pump cartridge from the module housing and remove it.</p> 
<p>3 Put the new peristaltic pump cartridge onto the rod of the pump motor and push the plastic clips into the module housing.</p> 	<p>4 Connect the peristaltic pump tubes to the support rings outlet and to the adapter leading to the waste bottle.</p> 

Replace Leak Handling System Parts

Parts required

p/n	Description
5043-0856 	Leak Adapter
5063-6527 	Tubing, Silicon Rubber, 1.2 m, ID/OD 6/9 mm approximately 85 mm required

- 1 Open the doors.
- 2 Press the Leak Adapter down and remove it together with the tubing.
- 3 Install the Leak Adapter by pressing it into the Main Cover.
- 4 Insert the Tubing (approximately 85 mm required for replacement) between Leak Adapter outlet and Leak Panel.
- 5 Close the doors.



Replacing the Module Firmware

When

The installation of newer firmware might be necessary

- if a newer version solves problems of older versions or
- to keep all systems on the same (validated) revision.

The installation of older firmware might be necessary

- to keep all systems on the same (validated) revision or
- if a new module with newer firmware is added to a system or
- if third party control software requires a special version.

Tools required

Description

Agilent Lab Advisor software

Parts required

Description

- | # | 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.
<https://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.

9

Parts for Maintenance

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This chapter provides information on parts for maintenance.

Accessory Kits

Accessory Kit G7111-68755

The Accessory Kit (G7111-68755) contains the following items:

#	p/n	Description
2	5043-1013 📄	Tubing Clip IF-II
1	5181-1519 📄	CAN cable, Agilent module to module, 1 m
1	5500-1246 📄	Capillary ST 0.17 mm x 500 mm SI/SI
1	5500-1217 📄	Capillary, ST, 0.17 mm x 900 mm SI/SX
3	5063-6527 📄	Tubing, Silicon Rubber, 1.2 m, ID/OD 6/9 mm
1	G1311-90107 📄	Algae note
3	5500-1169 📄	Y Tube Connector ID 6.4
3	5500-1155 📄	Tube Connector, 90 degree, ID 6.4
1	5043-1372 📄	Tubing Connector Leak 3-1
2	5043-1373 📄	Tubing Connector Leak Cap
2	0890-1195 📄	Flexible sleeving 1.45 mm/2.5 mm, PTFE

Accessory Kit G5654-68755



For bio-inert modules use bio-inert parts only!

The Accessory Kit (G5654-68755) contains the following items:

#	p/n	Description
2	5043-1013 📄	Tubing Clip IF-II
1	5181-1519 📄	CAN cable, Agilent module to module, 1 m
1	G5611-60502 📄	Capillary Ti 0.17 mm x 900 mm, L (Bio-inert)
1	5500-1264 📄	Capillary Ti 0.17 mm x 500 mm, SL/SLV
3	5063-6527 📄	Tubing, Silicon Rubber, 1.2 m, ID/OD 6/9 mm
1	G1311-90107 📄	Algae note
3	5500-1155 📄	Tube Connector, 90 degree, ID 6.4
2	5043-1373 📄	Tubing Connector Leak Cap
1	5043-1372 📄	Tubing Connector Leak 3-1
3	5500-1169 📄	Y Tube Connector ID 6.4
2	0890-1195 📄	Flexible sleeving 1.45 mm/2.5 mm, PTFE

Pump Head Assembly Without Seal Wash

The Pump Head 1200 SL without Seal Wash (G1312-60056) contains:

Item	p/n	Description
	1	5063-6586  Sapphire piston, 100 µL
	2	G1311-60002  Piston housing
	3	5067-1560  Support Ring SL, no seal wash
	4	5062-2484  Gasket, seal wash (pack of 6)
	5	5042-8952  Seal holder
	6	5063-6589  Piston seal PTFE, carbon filled, black (pack of 2), default
OR	0905-1420  PE seals (pack of 2)	
	7	G1311-25200  Pump chamber housing
	8	G1312-60066  Passive inlet valve 1220/1260
OR	G1312-60166  1260 Infinity Inlet Valve Type N	
		G1312-60025  Active inlet valve body, without cartridge (OPTIONAL)
		G1312-60020  Cartridge for active inlet valve 600 bar for G7110B and G7111B (OPTIONAL)
		5062-8562  Active Inlet Valve Cartridge (400 bar) for G7111A (OPTIONAL)
	9	G1312-60067  Outlet valve
OR	G1312-60167  Outlet valve (type N/SFC)	
	10	5042-1303  Lock screw
	11	G7111-60061  Purge valve for G7110B, G7111A, and G7111B
	12	0515-2118  Pump head screw (M5, 60 mm)

Parts for Maintenance**Pump Head Assembly Without Seal Wash**

The Pump Head 1200 SL without Seal Wash (G1312-60056) includes items 1-7, 10 and 12.

For piston seals, see “Choosing the Right Pump Seals” on page 83.

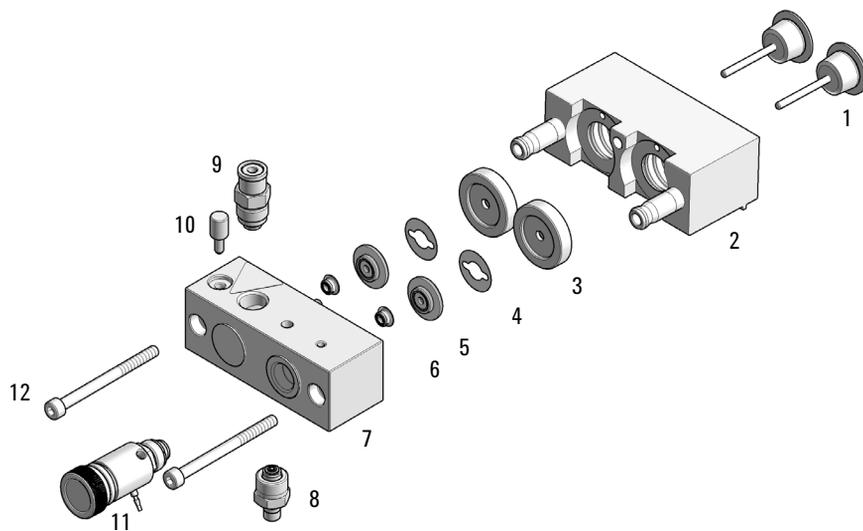


Figure 13 Pump head assembly without seal wash option

Pump Head Assembly with Seal Wash Option



For bio-inert modules use bio-inert parts only!

Pump head assembly with seal wash (G1312-60045) and Pump Head with Seal Wash Function (Bio-inert) (G5611-60165) contain:

Item	p/n	Description
1	5063-6586	Sapphire piston, 100 µL
OR	5067-4695	Sapphire piston (Bio-inert)
2	G1311-60002	Piston housing
OR	G1312-60062	Piston housing (incl. spring) (for Bio-inert pump head)
3	01018-60027	Support ring seal wash (OPTIONAL)
OR	G5611-63010	Support Ring with Seal Wash Function (Bio-inert)
	01018-23702	Insert tool
4	0905-1175	Wash seal (PTFE)
OR	0905-1718	Wash Seal PE
OR	0905-1731	Bio-Inert Wash Seal
5	5062-2484	Gasket, seal wash (pack of 6)
6	5042-8952	Seal holder
OR	G5611-60016	Seal Holder (Bio-inert) (including: Bio-inert seal keeper (G5611-26210), Backup Ring for Seal Holder (G4220-24013))
	G1398A	Active Seal Wash Option Upgrade (includes service)

Parts for Maintenance

Pump Head Assembly with Seal Wash Option

Item	p/n	Description
	G1398-60000 	Active Seal Wash Option Kit
7	5063-6589 	Piston seal PTFE, carbon filled, black (pack of 2), default
OR	0905-1420 	PE seals (pack of 2)
OR	G5611-21503 	Piston Seal PTFE (Bio-inert)
	5065-9978 	Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m for seal wash option
8	G1311-25200 	Pump chamber housing
OR	G5611-25260 	Pump Chamber Housing (Bio-inert)
9	G1312-60066 	Passive inlet valve 1220/1260
OR	G1312-60166 	1260 Infinity Inlet Valve Type N
	G1312-60025 	Active inlet valve body, without cartridge (OPTIONAL)
	G5611-60025 	Active Inlet Valve (AIV, Bio-inert), without cartridge
	G1312-60020 	Cartridge for active inlet valve 600 bar for G7110B, and G7111B (OPTIONAL)
	5062-8562 	Active Inlet Valve Cartridge (400 bar) for G7111A (OPTIONAL)
	G5611-60020 	Cartridge for AIV (Bio-inert)
10	5042-1303 	Lock screw
11	G1312-60067 	Outlet valve
OR	G1312-60167 	Outlet valve (type N/SFC)
OR	G5611-60067 	Outlet Valve (Bio-Inert)
12	G7111-60061 	Purge valve for G7110B, G7111A, and G7111B
	G5611-60064 	Purge valve for G5654A
13	0515-2118 	Pump head screw (M5, 60 mm)

Pump Head Assembly with Seal Wash Option

Item	p/n	Description
14	5065-4445 	Peristaltic pump with PharMed tubing
15	G1311-60161 	1220/1260 Seal Wash Pump Assembly see note below

The Pump head assembly with seal wash (G1312-60045) includes items 1-8, 10 and 13.

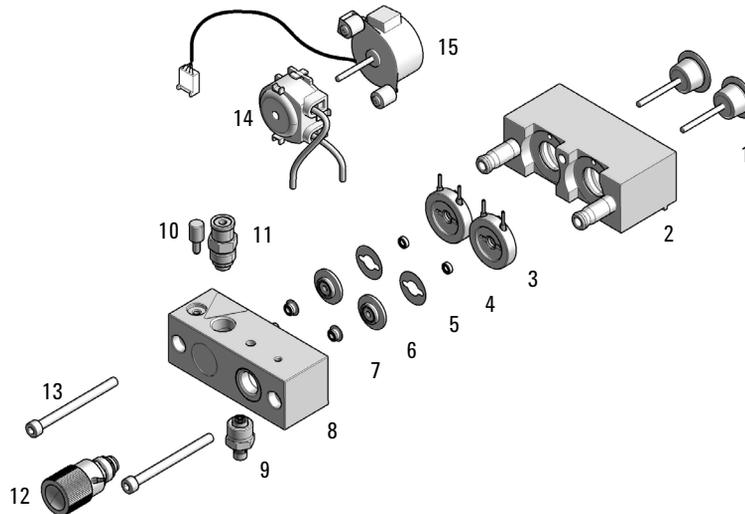


Figure 14 Pump Head with Seal Wash Option

Outlet Valve

p/n	Description
G1312-60067 	Outlet valve for G7110B, G7111A, and G7111B
G5611-60067 	Outlet Valve (Bio-Inert) for G5654A
G1312-60167 	Outlet Valve Type N/SFC for G7110B, G7111A, and G7111B

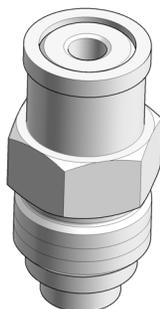


Figure 15 Outlet valve

Purge Valve Assembly



For bio-inert modules use bio-inert parts only!

Item	p/n	Description
1	G5611-60064 [E]	Purge valve for G5654A
1	G7111-60061 [E]	Purge valve for G7110B, G7111A, and G7111B
2	01018-22707 [E]	PTFE frits (pack of 5)
3	5067-4728 [E]	Seal cap

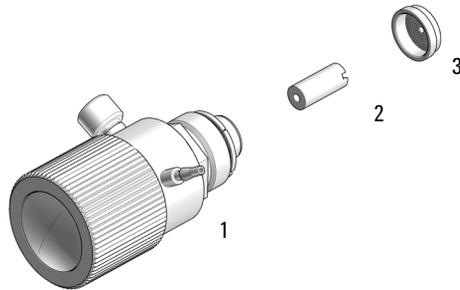


Figure 16 Purge Valve Assembly

Active Inlet Valve Assembly



For bio-inert modules use bio-inert parts only!

Item	p/n	Description
	G5699A	Active Inlet Valve Upgrade Kit includes service and the parts listed below
1	G1312-60025	Active inlet valve body, without cartridge
OR	G5611-60025	Active Inlet Valve (AIV, Bio-inert), without cartridge
2	G1312-60020	Cartridge for active inlet valve 600 bar
OR	5062-8562	Active Inlet Valve Cartridge (400 bar)
OR	G5611-60020	Cartridge for AIV (Bio-inert)
	G1311-67304	Connecting tube (needed for quaternary pump only)
	0100-2298	Adapter, PEEK int. 1/4-28 to ext. 10-32 (needed for isocratic pump only)

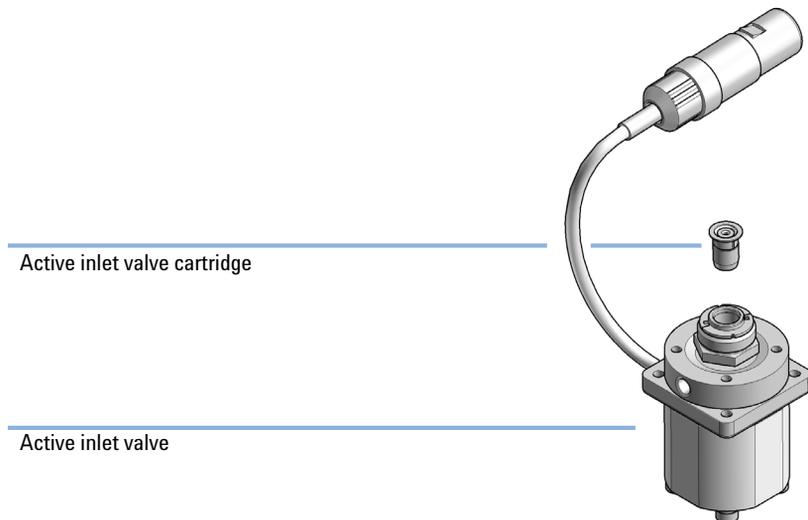


Figure 17 Active Inlet Valve Assembly

Parts for Maintenance

1260 Infinity II Max Uptime Kit

1260 Infinity II Max Uptime Kit

This kit will be sold optionally with the pump and is not essential for operation. You can reorder the individual parts.

#	p/n	Description
1	01018-22707 	PTFE frits (pack of 5)
1	0890-1763 	Capillary PEEK 0.18 mm x 1.5 m
3	5022-2184 	Union, stand LC flow, no fitting
2	5041-2168 	Solvent inlet filter, 20 µm pore size
1	5065-4426 	Colored finger-tight PEEK fittings, 10/PK
3	5500-1193 	InfinityLab Quick Turn Capillary ST 0.17 mm x 105 mm, long socket Quick Turn
1	5500-1217 	Capillary, ST, 0.17 mm x 900 mm SI/SX
2	5500-1246 	Capillary ST 0.17 mm x 500 mm SI/SI
2	5500-1250 	Capillary, ST, 0.17 mm x 120 mm SL/SL, long socket
1	8710-1930 	Plastic tubing cutter
1	8710-2391 	Rheotool socket wrench ¼ inch
1	5500-1191 	InfinityLab Quick Turn Capillary ST 0.12 mm x 280 mm, long socket
6	G7167-68703 	Fitting Intermediate Kit
1	G7111-90120 	Technical Note 1260 Infinity II Max Uptime Kit

1260 Infinity II Max Uptime Kit Bio

This kit will be sold optionally with the pump and is not essential for operation. You can reorder the individual parts.

#	p/n	Description
1	5043-0915 📄	Fitting mounting tool
1	01018-22707 📄	PTFE frits (pack of 5)
1	0890-1763 📄	PEEK tubing 0.18 mm x 1500 mm
3	5067-4741 📄	ZDV union (Bio-inert)
2	5041-2168 📄	Solvent inlet filter, 20 µm pore size
1	5065-4426 📄	Colored finger-tight PEEK fittings, 10/PK
1	G5611-60502 📄	Capillary Ti 0.17 mm x 900 mm, L (Bio-inert)
1	5500-1264 📄	Capillary Ti 0.17 mm x 500 mm, SL/SLV
1	G5667-81005 📄	Capillary PK/ST 0.17 mm x 500 mm, RLO/RLO (Bio-inert)
1	8710-1930 📄	Plastic tubing cutter
1	8710-2391 📄	Rheotool socket wrench ¼ inch
1	G5654-90130 📄	Technical Note 1260 Infinity II Max Uptime Kit Bio

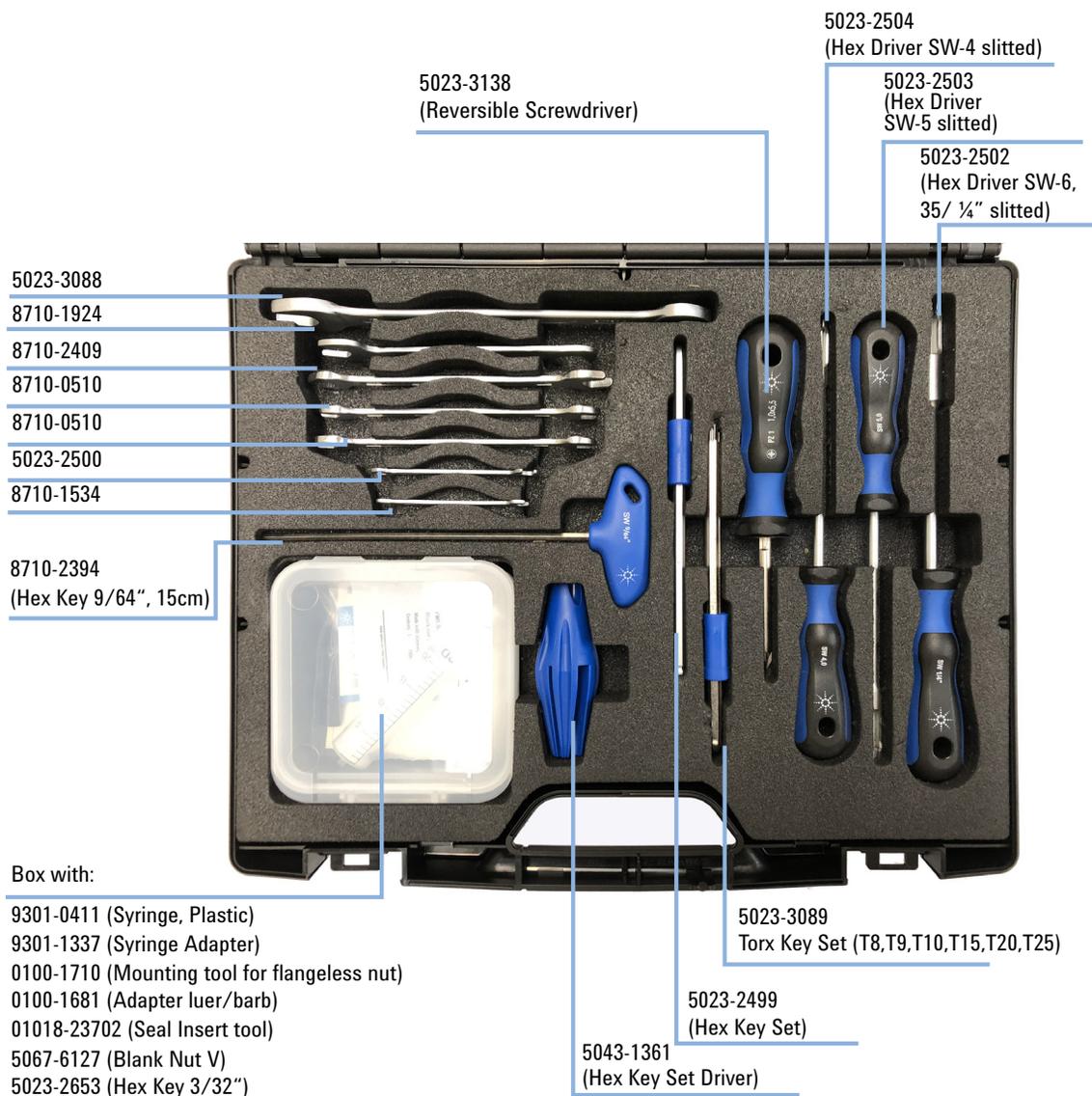
1260 Infinity II Low Dispersion Kit MCT

This kit will be sold optionally with the pump and is not essential for operation. You can reorder the individual parts.

The 1260 Infinity II Low Dispersion Kit (G7111-68708) contains:

p/n	Description
5500-1201 📄	Capillary ST 0.12 mm x 105 mm SL
5500-1157 📄	Capillary ST 0.12 mm x 500 mm SL/S
G7116-60015 📄	Quick Connect Heat Exchanger Standard
G7167-68703 📄	Fitting Intermediate Kit
G7111-90130 📄	Technical Note 1260 Infinity II Low Dispersion Kit MCT

HPLC System Tool Kit



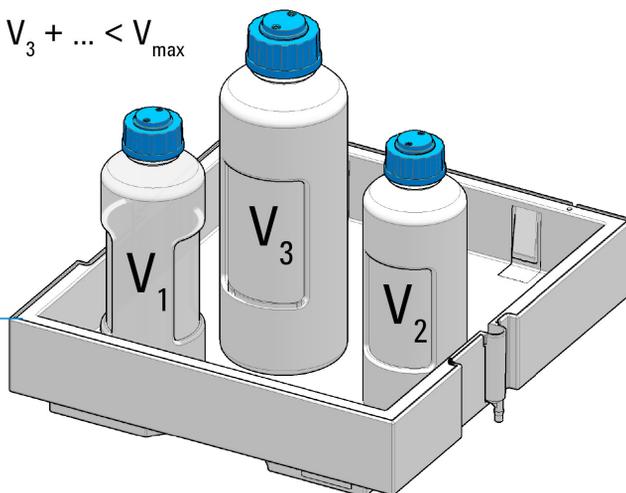
Solvent Cabinet

p/n	Description
5067-6871 	Solvent Cabinet Kit

 $V_{\max} = 8.1 \text{ L}$

$$V_1 + V_2 + V_3 + \dots < V_{\max}$$

5067-5760



For details refer to: Usage Guideline for the Solvent Cabinet (01200-90150)

Bottle Head Assembly

The Bottle Head Assembly (G7120-60007) contains:

p/n	Description
5063-6598 	Ferrules with lock ring (10/Pk)
5063-6599 	Tube screw (10/Pk)
	Wire marker
5062-2483 	Tube PTFE 1.5 mm x 5 m, 3 mm od
5062-8517 	Inlet filter adapter (4/Pk)
5041-2168 	Solvent inlet filter, 20 µm pore size

Hydraulic Path of the Quaternary Pump



For bio-inert modules use bio-inert parts only!

Item	#	p/n	Description
	1	G7111-81600	Capillary damper to inlet pump chamber
OR	1	G5654-81600	Capillary, Ti, damper to inlet valve for G5654A
	1	G7120-60007	Bottle Head Assembly (not shown)
	2	5067-5378	Connecting tube, MCGV to PIV
OR	1	G1311-67304	Connecting tube MCGV to AIV
	3	G7111-60100	Solvent Tubes including labels for connection degasser to MCGV
	4	G7111-81601	Capillary outlet valve to damper
OR	1	G5654-81601	Capillary, Ti, outlet valve to damper for G5654A
	5	5062-2461	Waste tube, 5 m (reorder pack)
	6	5500-1217	Capillary, ST, 0.17 mm x 900 mm SI/SX Pump to Vialsampler with ICC
OR	1	5500-1246	Capillary ST 0.17 mm x 500 mm SI/SI
OR	1	5500-1264	Capillary Ti 0.17 mm x 500 mm, SL/SLV for G5654A
	1	0100-1847	PEEK adapter 1/4-28 to 10-32 (Adapter AIV to solvent inlet tubes) (not shown)
	1	G1311-60006	Inline filter (not shown) (OPTIONAL)

Hydraulic Path of the Isocratic Pump

Item	p/n	Description
1	G7111-81600 [E]	Capillary damper to inlet pump chamber
2	5500-1217 [E]	Capillary, ST, 0.17 mm x 900 mm SI/SX Pump to Vialsampler with ICC
	5500-1246 [E]	Capillary ST 0.17 mm x 500 mm SI/SI
3	G7111-81601 [E]	Capillary outlet valve to damper
4	5062-2461 [E]	Waste tube, 5 m (reorder pack)
	G7120-60007 [E]	Bottle Head Assembly (not shown)
	G1311-60006 [E]	Inline filter (not shown) (OPTIONAL)

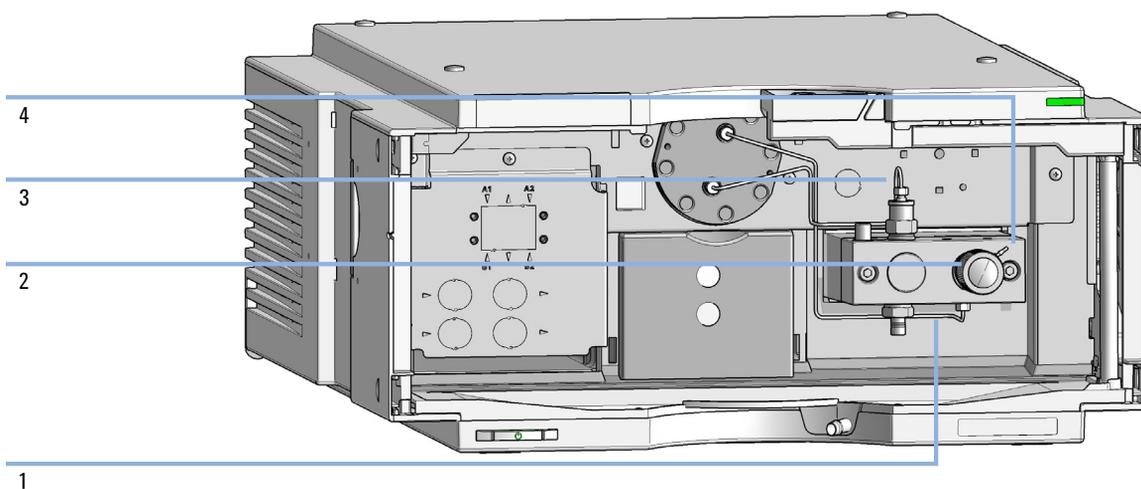


Figure 19 Hydraulic Flow Path of the Isocratic Pump



10

Identifying Cables

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

Cable Overview

NOTE

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

Analog cables

p/n	Description
35900-60750 📄	Agilent 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 +

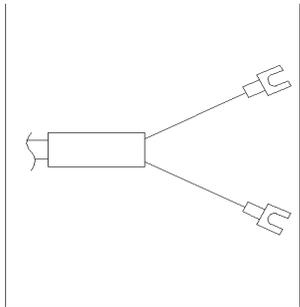
Agilent Module to BNC Connector

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

Identifying Cables

Analog Cables

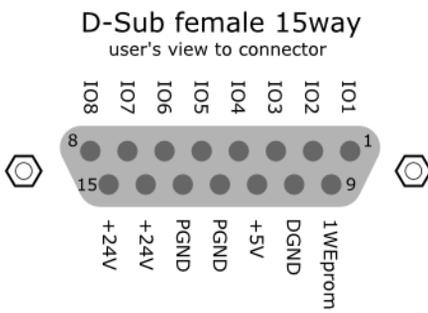
Agilent Module to General Purpose

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)
 <p>D-Sub female 15way user's view to connector</p>	1	white	IO1	START REQUEST	Low
	2	brown	IO2	STOP	Low
	3	green	IO3	READY	High
	4	yellow	IO4	PEAK DETECT	Low
	5	grey	IO5	POWER ON	High
	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			

NOTE

Configuration is different with old firmware revisions.

The configuration for IO4 and IO5 is swapped for modules with firmware lower than D.07.10.

NOTE

Peak Detection is used for LCMS systems connected with the Fraction Collection Remote Y-Cable (5188-8057).

Identifying Cables

Remote Cables

- 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 21 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 Trigger	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		

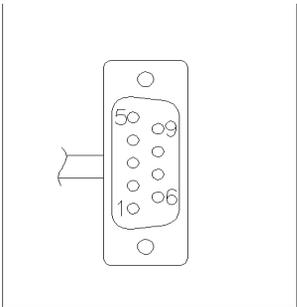


One end of these cables provides an Agilent Technologies APG (Analytical Products Group) remote connector to be connected to Agilent modules. The other end depends on the instrument to be connected to.

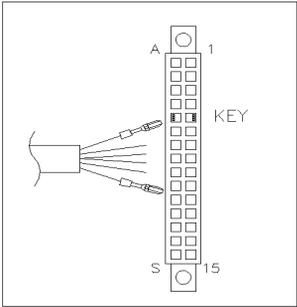
Identifying Cables

Remote Cables

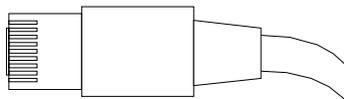
Agilent Module to Agilent 35900 A/D Converters

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 Cable



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

CAN Cables

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

LAN Cables

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

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

Agilent 1200 Module to Printer

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)

11

Hardware Information

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

Firmware Description

The firmware of the instrument consists of two independent sections:

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

Resident System

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

- the complete communication capabilities (CAN, LAN, 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: <https://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.

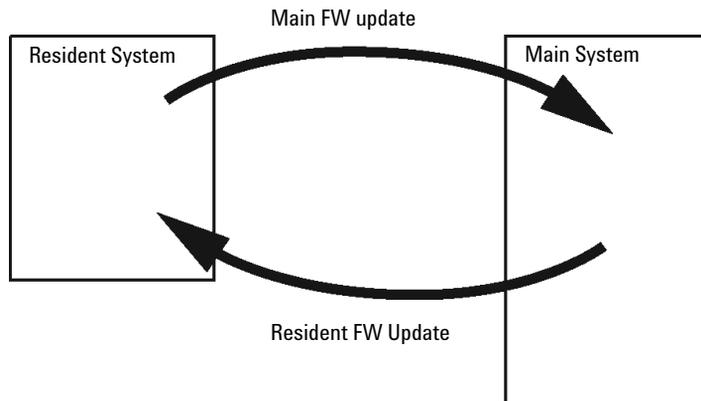


Figure 20 Firmware Update Mechanism

NOTE

Some modules are limited in downgrading due to their mainboard 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.

- <https://www.agilent.com/en-us/firmwareDownload?whid=69761>

Electrical Connections

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.
- The ERI/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 shutdown, prepare, and so on.
- With the appropriate software, the LAN connector may be used to control the module from a computer through a LAN connection. This connector is activated and can be configured with the configuration switch.
- With the appropriate software, the USB connector may be used to control the module from a computer through a USB connection.
- The power input socket accepts a line voltage of 100 – 240 VAC \pm 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.

Electric Shock

WARNING

Electric shock due to insufficient insulation of connected instruments
Personal injury or damage to the instrument

- ✓ **Any other instruments connected to this instrument shall be approved to a suitable safety standard and must include reinforced insulation from the mains.**

Rear View of the Module

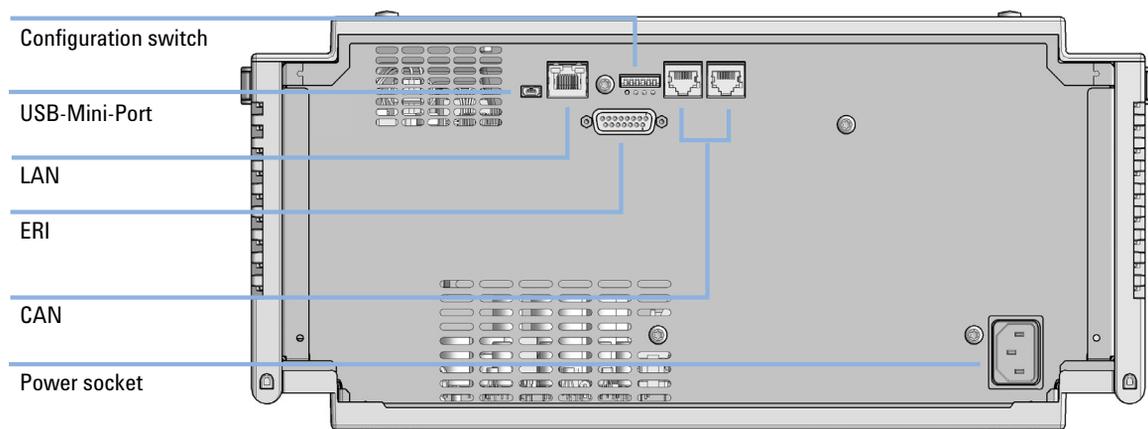


Figure 21 Rear view of the pump – electrical connections and label

Serial Number Information

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

CCXZZ00000	Format
CC	Country of manufacturing <ul style="list-style-type: none"> • 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

Interfaces

The Agilent InfinityLab LC Series modules provide the following interfaces:

Table 22 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, G7132A	2	No	Yes	Yes	1	A	
G7161A/B	2	Yes	Yes	No	No	E	
Samplers							
G7129A/B/C	2	Yes	Yes	No	No	E	
G7167A/B/C, G7137A, G5668A, G3167A	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 22 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							
G1170A	2	No	No	No	No	No	
G7116A/B	2	No	No	No	No	No	Requires a host module with on-board LAN or with additional G1369C LAN Card.
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 Serial 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 211.

Analog Signal Output

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

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 23 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.

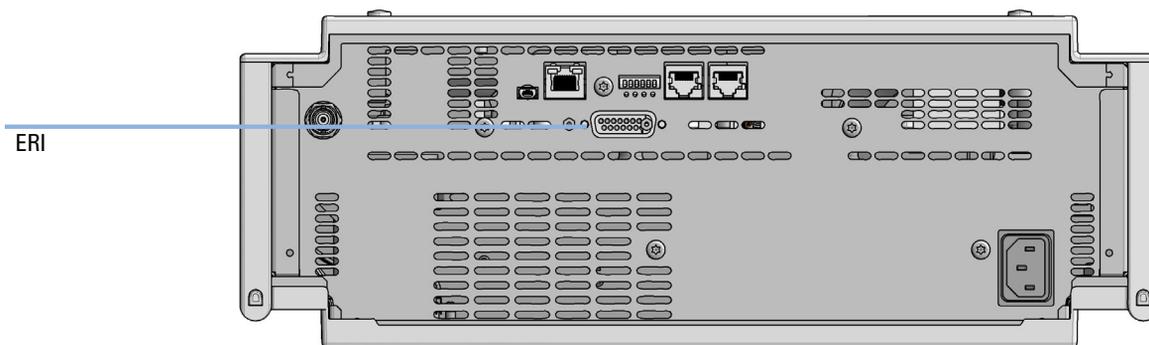


Figure 22 Location of the ERI interface (example shows a G7114A/B VWD)

	Pin	Enhanced Remote
<p>D-Sub female 15way user's view to connector</p> <p>IO1 IO2 IO3 IO4 IO5 IO6 IO7 IO8 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15</p> <p>1WEprom DGND +5V PGND PGND +24V +24V</p>	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 turning on the hosting module (assures that the firmware can detect certain basic functionality of the device).
- For digital circuits or similar.
- Provides 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.

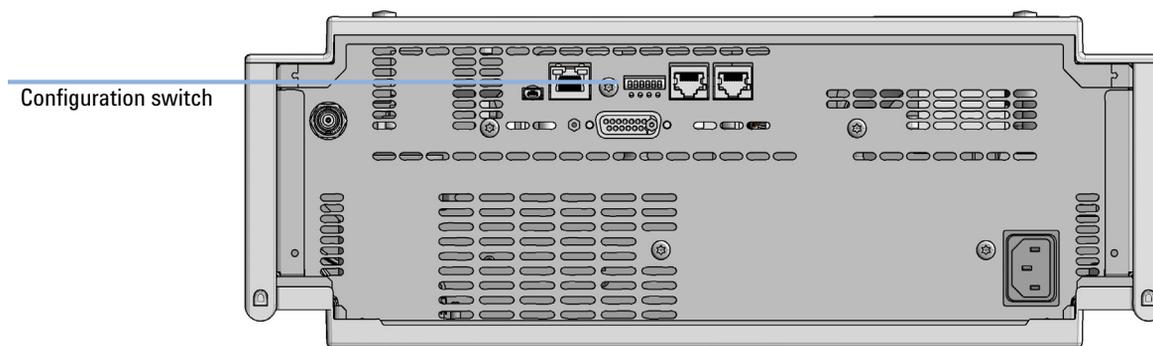


Figure 23 Location of Configuration switch (example shows a G7114A/B VWD)

Table 24 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.

Special Settings

Boot-Resident/Main

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

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

Forced Cold Start

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

- **Boot Main System / Revert to Default Data**
The instrument will boot to main mode and changes to the module's default parameter. May be also required to load resident firmware into the module.
- **Boot Resident System / Revert to Default Data**
The instrument will boot to resident mode and changes to the module's default parameter. May be also required to load main firmware into the module.

CAUTION

Loss of data

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

- ✓ **Save your methods and data before executing a forced cold start.**

If you use the following switch settings and power the instrument up again, it will start as described above.

Table 25 Boot Resident / Forced Coldstart

	SW1	SW2	SW3	SW4	SW5	SW6	Init Mode
	1	0	0	0	0	0	Boot Main System / Keep Data
	1	1	0	0	0	0	Boot Resident System / Keep Data
	1	0	0	0	0	1	Boot Main System / Revert to Default Data
	1	1	0	0	0	1	Boot Resident System / Revert to Default Data

Note: The setting '0' (down) is essential.

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.

Early Maintenance Feedback

Maintenance requires the exchange of components that are subject to wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of use of the module and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (EMF) feature monitors the use 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.

12

LAN Configuration

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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 25](#) on page 219).

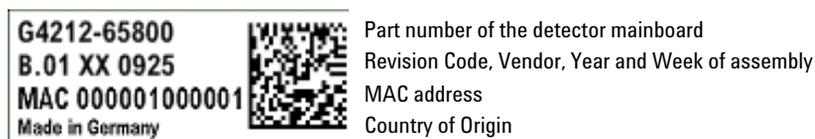


Figure 24 MAC-Label

- 2 Connect the instrument's LAN interface (see [Figure 25](#) on page 219) to
 - the PC network card using a crossover network cable (point-to-point) or
 - a hub or switch using a standard LAN cable.

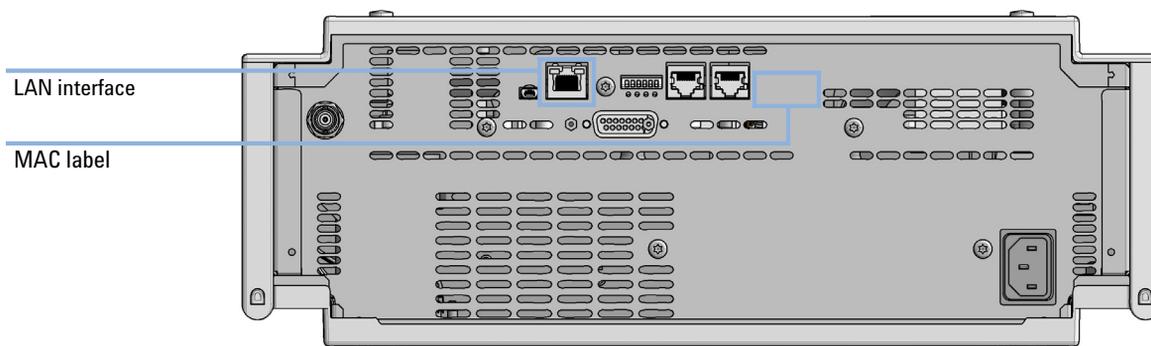


Figure 25 Location of LAN interfaces and MAC label

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 225
- 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 26](#) on page 222.

Configuration Switches

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

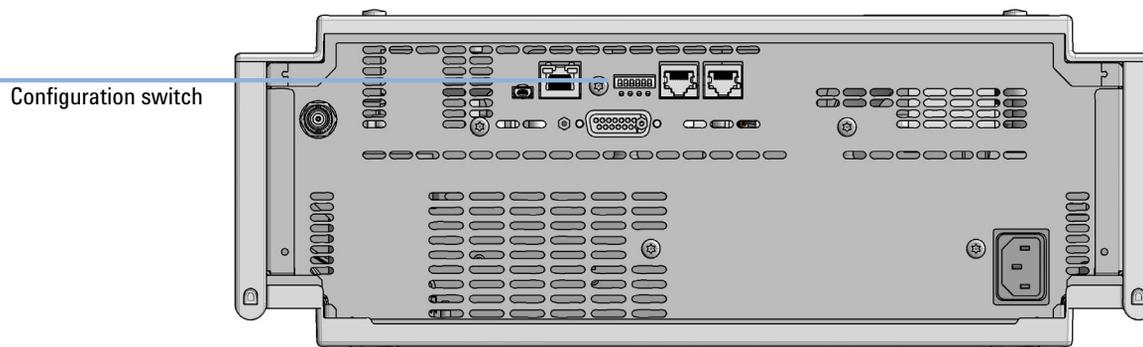


Figure 26 Location of Configuration switch (example shows a G7114A/B VWD)

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

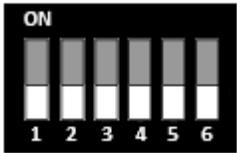
NOTE

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

Initialization Mode Selection

The following initialization (init) modes are selectable:

Table 26 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.

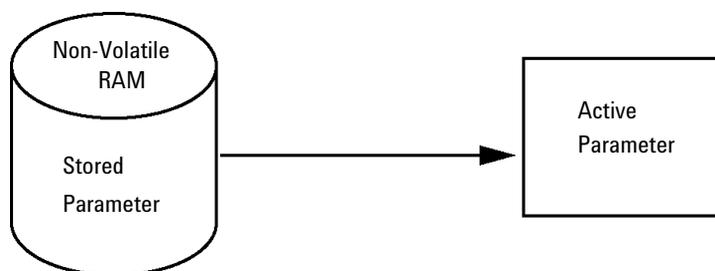


Figure 27 Using Stored (Principle)

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 27](#) on page 223.

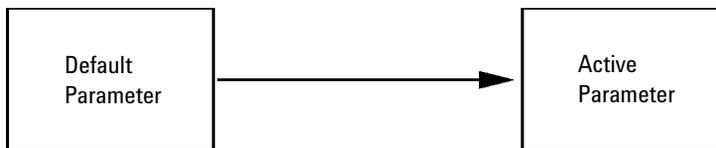


Figure 28 Using Default (Principle)

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 27 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 29 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.

- Note the MAC address of the LAN interface (provided with G1369C LAN Interface Card or mainboard). This MAC address is on a label on the card or at the rear of the mainboard, for example, *0030d3177321*.

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

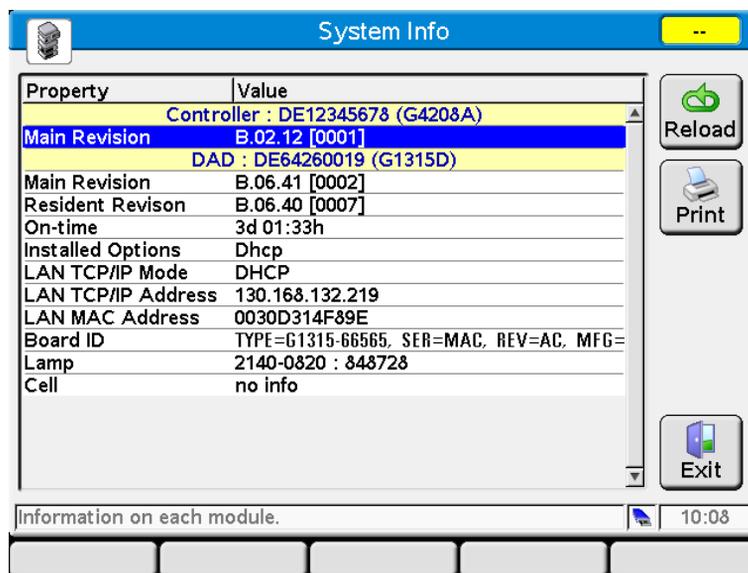


Figure 30 LAN Setting on Instant Pilot

LAN Configuration

Dynamic Host Configuration Protocol (DHCP)

- 2 Set the configuration switch to DHCP either on the G1369C LAN Interface Card or the mainboard of above mentioned modules.

Table 28 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 29 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 224).

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.

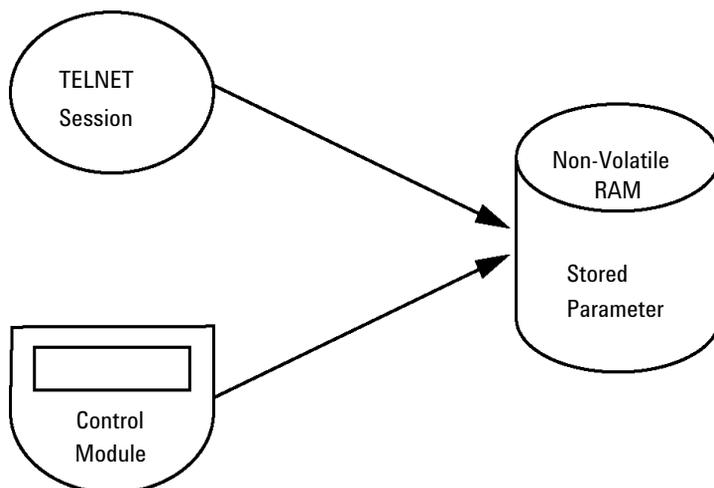


Figure 31 Manual Configuration (Principle)

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>

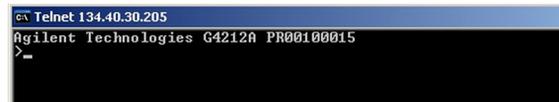


```
C:\WINDOWS\system32\cmd.exe
C:\>telnet 134.40.30.205
```

Figure 32 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 221).

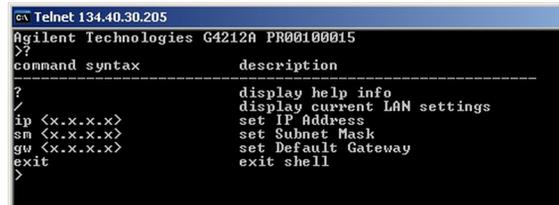
When the connection was established successfully, the module responds with the following:



```
Telnet 134.40.30.205
Agilent Technologies G4212A PR00100015
>_
```

Figure 33 A connection to the module is made

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



```

c:\ Telnet 134.40.30.205
Agilent Technologies G4212A PR00100015
>?
command syntax          description
-----
?                        display help info
/                        display current LAN settings
ip <x.x.x.x>             set IP Address
sm <x.x.x.x>             set Subnet Mask
gw <x.x.x.x>             set Default Gateway
exit                     exit shell
>

```

Figure 34 Telnet Commands

Table 30 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.

```

c:\ Telnet 134.40.30.205
>/
LAN Status Page
-----
MAC Address   : 0030D317521C
Init Mode    : Using Stored
-----
TCP/IP Properties
- active -
IP Address   : 134.40.30.205
Subnet Mask  : 255.255.248.0
Def. Gateway : 134.40.24.1
-----
TCP/IP Status : Ready
-----
Controllers  : no connections
>_

```

Figure 35 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.

```

c:\ Telnet 134.40.30.205
>ip 192.168.254.12
>/
LAN Status Page
-----
MAC Address   : 0030D317521C
Init Mode    : Using Stored
-----
TCP/IP Properties
- active -
IP Address   : 134.40.30.205
Subnet Mask  : 255.255.248.0
Def. Gateway : 134.40.24.1
- stored -
IP Address   : 192.168.254.12
Subnet Mask  : 255.255.248.0
Def. Gateway : 134.40.24.1
-----
TCP/IP Status : Ready
-----
Controllers  : no connections
>_

```

Figure 36 Telnet - Change IP 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

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

```

c:\WINDOWS\system32\cmd.exe
Agilent Technologies G4212A PR00100015
>exit

Connection to host lost.
C:\>_

```

Figure 37 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.

With the Instant Pilot (G4208A)

To configure the TCP/IP parameters before connecting the module to the network, the Instant Pilot (G4208A) can be used.

- 1 From the Welcome screen press the **More** button.
- 2 Select **Configure**.
- 3 Press the module button of the module that hosts the LAN interface (usually the detector).
- 4 Scroll down to the LAN settings.

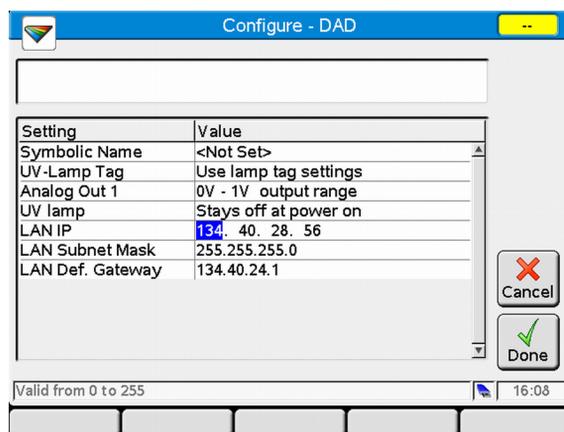


Figure 38 Instant Pilot - LAN Configuration (Edit mode)

- 5 Press the **Edit** button (only visible if not in Edit mode), perform the required changes and press the **Done** button.
- 6 Leave the screen by clicking **Exit**.

13

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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 237.

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.

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. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.
- ✓ 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 31 Symbols

	The apparatus is marked with this symbol when the user shall 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 31 Symbols

	<p>Magnetic field</p> <p>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.</p>
	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 <https://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

Sound pressure

Sound pressure $L_p < 70$ db(A) according to DIN EN ISO 7779

Schalldruckpegel

Schalldruckpegel $L_p < 70$ db(A) nach DIN EN ISO 7779

Agilent Technologies on Internet

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

<https://www.agilent.com>

In This Book

This manual contains technical information about the Agilent 1260 Infinity II Isocratic Pump (G7110B), the Agilent 1260 Infinity II Quaternary Pump VL (G7111A), the Agilent 1260 Infinity II Quaternary Pump (G7111B), and the Agilent 1260 Infinity II Bio-inert Pump (G5654A).

The manual describes the following:

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

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