Agilent 1290 Infinity Binary Pump

User Manual
Notices


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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.
This manual covers the Agilent 1290 Infinity Binary Pump (G4220A).

1 Introduction
This chapter gives an introduction to the pump, instrument overview and internal connectors.

2 Site Requirements and Specifications
This chapter provides information on environmental requirements, physical and performance specifications.

3 Installing the Module
This chapter gives information about the preferred stack setup for your system and the installation of your Agilent 1290 Infinity Binary Pump.

4 Using the Pump
This chapter explains the operational parameters of the Agilent 1290 Infinity Binary Pump.

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

6 Troubleshooting and Diagnostics
Overview about the troubleshooting and diagnostic features.

7 Error Information
This chapter describes the meaning of error messages, and provides information on probable causes and suggested actions how to recover from error conditions.
8 Test Functions and Calibrations

This chapter describes the tests for the module.

9 Maintenance

This chapter describes the maintenance of the Agilent 1290 Infinity Binary Pump.

10 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

11 Identifying Cables

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

12 Hardware Information

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

13 LAN Configuration

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

14 Appendix

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

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

The Binary pump is designed for highest performance, GLP compliance and easy maintenance. It includes the following features:

• Seal wash for continued high lifetime of pump seals for buffer applications.
• Solvent selection valve for method flexibility.
• Jet Weaver for optimum mixing performance with a minimum of delay volume.
• Automatic purge function for ease of use and unattended preparation of the system.
• Auto tuning of the delivery cycle for compensation of elasticity and solvent volume change effects (compressibility, thermal expansion, mixing contraction).
• Solvent selection for optimum flow and composition accuracy.
• Fast defill function for improved intake and delivery performance.
• Two pistons in series design for increased reliability.
• High resolution piston movement control for smooth and reliable motion.

For specifications, see Table 2 on page 24.

NOTE

This Binary pump has been introduced together with the Agilent 1290 Infinity Liquid Chromatograph.
Overview of the Binary Pump

The Agilent 1290 Infinity Binary Pump comprises two identical pumps integrated into one housing. Binary gradients are created by high-pressure mixing. A degassing unit is included for applications that require best flow stability, especially at low flow rates, for maximum detector sensitivity. The flow path of the pump has been optimized for minimal delay of gradients. Typical applications are high throughput methods with fast gradients on high resolution 2.1 mm columns. The pump is capable of delivering flow in the range of 0.05-5 mL/min against up to 1200 bar. A solvent selection valve allows forming binary mixtures (isocratic or gradient) from one of two solvents per channel. Active seal wash (optional) is available for use with concentrated buffer solutions.
Pump Principle

The Binary Pump is based on a two-channel, dual-piston in-series design which comprises all essential functions that a solvent delivery system has to fulfill. Metering of solvent and delivery to the high-pressure side are performed by two pump assemblies which can generate pressure up to 1200 bar.

Each channel comprises a pump assembly including independent pump drive for each piston, pump head, inlet valve, outlet valve, solvent heat exchanger and an outlet filter. The two channels are fed into a low-volume mixing groove in an automatic purge valve and a Jet Weaver mixer, with 35 or 100 µl volume can be added downstream for optimum mixing performance.

A system pressure sensor, for monitoring the pump pressure, is attached to the purge valve, normally connected in the B-channel of the pump, before the mixing groove, in order to minimize delay volumes.
Figure 1  The hydraulic path
In the user interface the solvent in use for each channel can be selected in order to get optimum flow and composition accuracy. Although selecting the right solvent is not required for low ripple, especially for composition accuracy across pressure it is vital for the compensation algorithm to use the right solvent properties. The density of the solvents is increased under the influence of pressure and a certain displaced solvent will expand again when the pressure is released, for example across the column. In order to achieve the correct volumetric flow while sample passes through the detector it is necessary to correct for density related flow inaccuracies in the pump module.

In order to always deliver the best possible pressure stability, the pump constantly tunes the delivery cycle for elasticity and dead volume effects. With this feature the pump is able to deliver a stable and accurate flow without requiring individual calibration settings. A further feature of the control and compensation algorithm is leak correction. With this it is even possible to compensate for minor leaks in primary pump chamber (inlet valve and seal), without the performance of the pump being affected.

To increase the robustness of the pump it uses a fast defill function which reduces the delivery time of the primary piston, thereby reducing the net effects of leaks considerably. Furthermore each pump channel has only two valves on its two pump heads which also reduce the potential of failures. In order to reduce stresses on the pump hardware, it uses a smooth motion control, which slowly increases or decreases the speed of the pistons to prevent shock movements. In order to be able to control these movements a high resolution encoder unit is attached to the pump drives which resolves a revolution into 65000 steps, and each step translates to a volume of about 300 pl.
System Overview

Leak and Waste Handling

The 1200 Infinity Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.
Figure 2  Leak and waste handling concept (overview - typical stack configuration as an example)
The solvent cabinet (1) is designed to store a maximum volume of 6 L solvent. The maximum volume for an individual bottle stored in the solvent cabinet should not exceed 2.5 L. For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets (a printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet).

The leak pan (2) (individually designed in each module) guides solvents to the front of the module. The concept covers also leakages on internal parts (e.g. the detector’s flow cell). The leak sensor in the leak pan stops the running system as soon as the leak detection level is reached.

The leak pan's outlet port (3, A) guides excessive overfill from one module to the next, as the solvent flows into the next module’s leak funnel (3, B) and the connected corrugated waste tube (3, C). The corrugated waste tube guides the solvent to the next lower positioned module’s leak tray and sensor.

The waste tube of the sampler’s needle wash port (4) guides solvents to waste.

The condense drain outlet of the autosampler cooler (5) guides condensate to waste.

The waste tube of the purge valve (6) guides solvents to waste.

The waste tube connected to the leak pan outlet on each of the bottom instruments (7) guides the solvent to a suitable waste container.
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System Overview
2 Site Requirements and Specifications

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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 Consideration

The module power supply has wide ranging capabilities and accepts any line voltage in the range mentioned in Table 1 on page 23. Consequently, there is no voltage selector in the rear of the module. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

**WARNING**

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

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

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

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

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

**WARNING**

Incorrect line voltage at the module

Shock hazard or damage of your instrument can result if the devices are connected to line voltage higher than specified.

➔ Connect your module to the specified line voltage.

**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**

**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**

**Unintended use of supplied 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**

**Power cords**

Solvents may damage electrical cables.

➔ Prevent electrical cables from getting in contact with solvents.

➔ Exchange electrical cables after contact with solvents.
2 Site Requirements and Specifications

Site Requirements

Bench Space

The module dimensions and weight (see Table 1 on page 23) allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 8 cm (3.1 inches) in the rear for air circulation and electric connections.

If the bench shall carry a complete HPLC system, make sure that the bench is designed to bear the weight of all modules.

The module should be operated in a horizontal position.

NOTE
Agilent recommends that you install the HPLC instrument in the A-Line 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

<table>
<thead>
<tr>
<th>Type</th>
<th>Specification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>21.8 kg (48 lbs)</td>
<td></td>
</tr>
<tr>
<td>Dimensions (height × width × depth)</td>
<td>240 x 345 x 435 mm (9.3 x 13.5 x 17 inches)</td>
<td></td>
</tr>
<tr>
<td>Line voltage</td>
<td>100 – 240 V~, ± 10 %</td>
<td>Wide-ranging capability</td>
</tr>
<tr>
<td>Line frequency</td>
<td>50 or 60 Hz, ± 5 %</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>350 VA / 270 W / 922 BTU</td>
<td>Maximum</td>
</tr>
<tr>
<td>Ambient operating temperature</td>
<td>4–55 °C (39–131 °F)</td>
<td></td>
</tr>
<tr>
<td>Ambient non-operating temperature</td>
<td>-40 – 70 °C (-40 – 158 °F)</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>&lt; 95 % r.h. at 40 °C (104 °F)</td>
<td>Non-condensing</td>
</tr>
<tr>
<td>Operating altitude</td>
<td>Up to 2000 m (6562 ft)</td>
<td></td>
</tr>
<tr>
<td>Non-operating altitude</td>
<td>Up to 4600 m (15092 ft)</td>
<td>For storing the module</td>
</tr>
<tr>
<td>Safety standards: IEC, CSA, UL</td>
<td>Installation category II, Pollution degree 2</td>
<td>For indoor use only.</td>
</tr>
</tbody>
</table>
## Specifications

### Table 2  Performance specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Specification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic system</td>
<td>Two dual pistons in series pumps with proprietary servo-controlled variable stroke design, power transmission by ball screws, smooth motion control of pistons for active damping.</td>
<td></td>
</tr>
<tr>
<td>Settable flow range</td>
<td>Setpoints 0.001—5 ml/min, in 0.001 ml/min increments.</td>
<td>Executed in 300 pl/step increments</td>
</tr>
<tr>
<td>Flow precision</td>
<td>≤0.07 % RSD or 0.005 min SD, whatever is greater (0.2—5.0 ml/min).</td>
<td>Based on retention time at constant room temperature.</td>
</tr>
<tr>
<td>Flow accuracy</td>
<td>±1 % or 10 µl/min, whatever is greater.</td>
<td>Pumping degassed H₂O at 10 MPa (100 bar)</td>
</tr>
<tr>
<td>Pressure operating range</td>
<td>Operating range up to 120 MPa (1200 bar), up to 2 ml/min, 80 MPa (800 bar) at 5 ml/min.</td>
<td></td>
</tr>
<tr>
<td>Pressure pulsation</td>
<td>&lt;1 % amplitude or &lt; 0.5 MPa (5 bar), whatever is greater.</td>
<td>At 1 ml/min water</td>
</tr>
<tr>
<td>Compressibility compensation</td>
<td>Automatic, pre-defined, based on mobile phase selection.</td>
<td></td>
</tr>
<tr>
<td>Gradient formation</td>
<td>High pressure binary mixing.</td>
<td></td>
</tr>
<tr>
<td>Delay volume</td>
<td>Jet Weaver V35: &lt;45 µl Jet Weaver V100: &lt;75 µl</td>
<td>JetWeaver generally recommended. For applications requiring lowest delay volumes, JetWeaver can be removed out of the flow path. Delay volume is then solely determined by the volume of the connection capillary.</td>
</tr>
<tr>
<td>Composition range</td>
<td>Settable range: 0 – 100 %</td>
<td>Recommended range: 1 – 99 % or 5 µl/min per channel, whatever is greater.</td>
</tr>
<tr>
<td>Composition precision</td>
<td>&lt;0.15 % RSD, or 0.01 min SD, whatever is greater.</td>
<td>0.2 —5.0 ml/min; based on retention time at constant room temperature</td>
</tr>
<tr>
<td>Composition accuracy</td>
<td>±0.35 % absolute (5 – 95 %, 0.2 – 5.0 ml/min)</td>
<td>Water/caffeine tracer</td>
</tr>
</tbody>
</table>
### Specifications

#### Solvent selection valve
- Default Standard part of the pump

#### Integrated degassing unit
- Number of channels: 2
- Internal volume per channel: 1.5 mL

#### Control
- Agilent ChemStation for LC (B.04.02 or above)
- EZChrom Elite (3.3.2 SP1 or above)
- OpenLAB (3.3.2 SP3)
- Masshunter (B.02.01 SP1 or above)

#### Local control
- Agilent Instant Pilot (G4208A) (B.02.08 or above)

#### Communications
- Controller-area network (CAN), RS232C, APG remote: ready, start, stop and shutdown signals, LAN

#### 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 continuos tracking of instrument usage in terms of purge valve switches 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 recyclable.

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<table>
<thead>
<tr>
<th>Type</th>
<th>Specification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent selection valve</td>
<td>Default</td>
<td>Standard part of the pump</td>
</tr>
<tr>
<td>Integrated degassing unit</td>
<td>Number of channels: 2&lt;br&gt;Internal volume per channel: 1.5 mL</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>Agilent ChemStation for LC (B.04.02 or above)&lt;br&gt; EZChrom Elite (3.3.2 SP1 or above)&lt;br&gt; OpenLAB (3.3.2 SP3)&lt;br&gt; Masshunter (B.02.01 SP1 or above)</td>
<td></td>
</tr>
<tr>
<td>Local control</td>
<td>Agilent Instant Pilot (G4208A) (B.02.08 or above)</td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>Controller-area network (CAN), RS232C, APG remote: ready, start, stop and shutdown signals, LAN</td>
<td></td>
</tr>
<tr>
<td>Safety and maintenance</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>GLP features</td>
<td>Early maintenance feedback (EMF) for continuos tracking of instrument usage in terms of purge valve switches and volume of pumped mobile phase with pre-defined and user settable limits and feedback messages. Electronic records of maintenance and errors.</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>All materials recyclable.</td>
<td></td>
</tr>
</tbody>
</table>
2 Site Requirements and Specifications

Specifications
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Installation of Seal Wash Function 46

This chapter gives information about the preferred stack setup for your system and the installation of your Agilent 1290 Infinity Binary Pump.
Unpacking the Module

Damaged Packaging

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

**CAUTION**

"Defective on arrival" problems

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

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

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

Delivery Checklist

Ensure all parts and materials have been delivered with your module. The delivery checklist is included to your shipment. For parts identification please check the illustrated parts breakdown in “Parts and Materials for Maintenance” on page 193. Please report any missing or damaged parts to your local Agilent Technologies sales and service office.
Optimizing the Stack Configuration

If your module is part of a complete Agilent 1290 Infinity Liquid Chromatograph, you can ensure optimum performance by installing the following configurations. These configurations optimize the system flow path, ensuring minimum delay volume.

For other possible configurations, please refer to the Agilent 1290 Infinity System Manual.

One Stack Configuration

Ensure optimum performance by installing the modules of the Agilent 1290 Infinity Binary LC System in the following configuration (See Figure 3 on page 30 and Figure 4 on page 31). This configuration optimizes the flow path for minimum delay volume and minimizes the bench space required.

The Agilent 1290 Infinity Binary Pump should always be installed at the bottom of the stack.
3 Installing the Module
Optimizing the Stack Configuration

Figure 3  Recommended stack configuration for 1290 Infinity (front view)
Figure 4  Recommended stack configuration 1290 Infinity (rear view)
Two Stack Configuration

In case the autosampler thermostat is added to the system, a two-stack configuration is recommended, which places both heavy modules (1290 Infinity pump and thermostat) at the bottom of each stack and avoids high stacks. Some users prefer the lower height of this arrangement even without the autosampler thermostat. A slightly longer capillary is required between the pump and autosampler. (See Figure 5 on page 32 and Figure 6 on page 33).

Figure 5  Recommended two stack configuration for 1290 Infinity (front view)
Figure 6  Recommended two stack configuration for 1290 Infinity (rear view)
Installation Information on Leak and Waste Handling

The Agilent 1200 Infinity Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.

**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.

➔ Never exceed the maximal permissible volume of solvents (6 L) in the solvent cabinet.

➔ Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

➔ Arrange the bottles as specified in the usage guideline for the solvent cabinet.

➔ A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet.

**NOTE**

**Recommendations for Solvent Cabinet**

For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.
Figure 7  Leak and waste handling (overview - typical stack configuration as an example)
3 Installing the Module
Installation Information on Leak and Waste Handling

1 Stack the modules according to the adequate stack configuration. The leak pan outlet of the upper module must be vertically positioned above the leak tray of the lower module, see Figure 7 on page 35.

2 Connect data and power cables to the modules, see section Installing the Module below.

3 Connect capillaries and tubes to the modules, see section Flow Connections to the module below or the relevant system manual.

**WARNING**

**Toxic, flammable and hazardous solvents, samples and reagents**

➔ Keep solvent path free from blockages.

➔ Keep the flow path closed (in case the pump in the system is equipped with a passive inlet valve, solvent may leak out due to hydrostatic pressure, even if your instrument is off).

➔ Avoid loops.

➔ Tubes must not sag.

➔ Do not bend tubes.

➔ Do not immerse tube end in waste liquid.

➔ Do not intubate tubes in other tubes.

➔ For correct tubing follow instructions on label attached to the module.
Figure 8  Warning label (illustration for correct waste tubing)

Warning
Attention
Warnung
Attenzione
Advertencia

Disconnect power cord before moving.
Débranchez le cordon secteur avant tout déplacement.
Entfernen Sie das Netzkiel bevor Sie das Gerät bewegen.
Scollegare il cavo di alimentazione prima di spostare lo strumento.
Desconectar el aparato de la red antes de moverlo.
3 Installing the Module
Removing the Transport Foam

Removing the Transport Foam

1. Open the front cover of the module.
2. Carefully remove the protective foam.
3. Close the front cover.
Installing the Pump

**Parts required**

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump</td>
</tr>
<tr>
<td>1</td>
<td>Power cord</td>
</tr>
<tr>
<td>1</td>
<td>Agilent Control Software and/or Instant Pilot G4208</td>
</tr>
</tbody>
</table>

**Preparations**

- Locate bench space
- Provide power connections
- Unpack the pump

1. Place the module on the bench in a horizontal position.
2. Ensure the power switch on the front of the module is OFF (switch stands out).

**Figure 9** Front of Binary Pump
3 Connect the power cable to the power connector at the back of the 1290 Infinity Binary Pump.

4 Connect the required interface cables to the rear of the 1290 Infinity Binary Pump.

NOTE
In an Agilent 1290 Infinity System, the individual modules are connected by CAN cables. An Agilent 1200 Series Instant Pilot can be connected to the CAN bus of any module. Connection to an Agilent data system is established through the built-in LAN port of the detector. The LAN port of the detector must be used as the detector generates the highest data rate of all modules. For more information about connecting the Instant Pilot or Agilent Data System, please refer to the respective user manual. For setting up the LAN access, see “LAN Configuration” on page 249.
5 Turn on the power by pushing the button at the lower left hand side of the module.

The power button stays pressed in and the status LED should be green.

**NOTE**

When the line power button stands out and the green light is off, the module is turned off.

**NOTE**

The module was shipped with default configuration settings. For changing these settings, refer to section *Setting the 8-bit configuration switch*. 
The pump is shipped with tubing and capillary connections installed between solvent selection valve, degassing unit, pump heads, pressure sensor, purge valve, Jet Weaver, and seal wash pump. This section describes the installation of additional flow connections.
Installing the Module

Flow Connections to the Pump

Parts required

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4220-68705</td>
<td>Accessory kit</td>
</tr>
<tr>
<td>1</td>
<td>G5067-1531</td>
<td>Solvent Cabinet Kit</td>
</tr>
</tbody>
</table>

Preparations

Pump is installed in the LC system.

**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.

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

**Figure 11** Removing the Front Cover
3 Installing the Module
Flow Connections to the Pump

2 Place the solvent cabinet on top of the module stack that includes the 1290 Infinity Binary Pump.

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

4 Install the shutoff valve panel at the top left corner of the instrument.

5 Connect the solvent tubes from the bottle head assemblies to the inlet connectors A1, A2, B1 and B2 of the solvent selection valves. Use the brown bottle for the aqueous solvent (usually channel A1).
6 Label the tubes accordingly using the supplied stickers and fix the tubes in the clips of solvent cabinet and 1290 Infinity Binary Pump.

7 Connect the outlet of the Jet Weaver to the autosampler.

8 Connect Waste tubes (G4220-67000) to the purge valve outlets at ports 5 and 6.

9 Connect the corrugated waste tube to the outlet of the leak panel.

10 Route the corrugated waste tube to a waste container.

11 Route drain tubes coming from modules on top of the pump through the pump.

12 Purge your system prior to the first use (see “Purging the Pump” on page 69).
Installation of Seal Wash Function

The 1290 Infinity Binary Pump has a built-in seal wash function, which is recommended when using buffers or other non-volatile solvents or additives that could deposit on pistons and seals. It is used for regularly cleaning these parts automatically.

1. Place a wash solvent reservoir into the solvent cabinet. A mixture of distilled water and isopropanol (90/10) is a good choice for many applications.
2. Put the solvent inlet tube into the solvent reservoir, close it and connect the tube to the seal wash pump.
3. Route the outlet of the wash tube into a waste container.
This chapter explains the operational parameters of the Agilent 1290 Infinity Binary Pump.
Magnets

1 This stack exemplarily shows the magnets' positions in the modules.
**Turn on/off**

1. Power switch

2. Power switch
   (1) On
   (2) Off

3. Power switch

---

*Agilent 1290 Infinity Binary Pump User Manual*
Status Indicators

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

   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.
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.

➔ The volume of substances should be reduced to the minimum required for the analysis.

➔ Do not operate the instrument in an explosive atmosphere.

➔ Never exceed the maximal permissible volume of solvents (6 L) in the solvent cabinet.

➔ Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

➔ Arrange the bottles as specified in the usage guideline for the solvent cabinet.

➔ A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet.

➔ Ground the waste container.

➔ The residual free volume in the appropriate waste container must be large enough to collect the waste liquid.

➔ Check the filling level of the waste container regularly.

➔ To achieve maximal safety, check the correct installation regularly.

➔ Do not use solvents with an auto-ignition temperature below 200 °C (392 °F).

---

**NOTE**

**Recommendations for Solvent Cabinet**

For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

For details on correct installation, see section *Installation Information on Leak and Waste Handling* in the service manual.
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.
- Run conditioning with composition of your application.

Weekly tasks

- Change seal wash solvent (10 % / 90 % isopropanol/water) and bottle.
- Flush all channels with water to remove salt deposits.
- Visually inspect solvent filters. Clean or exchange if necessary.

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.
- Condition pump heads for 10 – 20 min.

Long-term shut-down of the pump

- Flush system with water to remove buffer.
- Use recommended solvents to store the system.
- Power off the pump or system.
Prepare the pump

Purge

Use the Purge function to:

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

Condition

Use the Conditioning function:

- daily when starting the pump,
- to minimize pressure ripple by dissolving air bubbles in pump heads.

NOTE

Condition your complete system with solvents and composition of your application (for example 50%/50% A/B at 0.5 mL/min.

Seal wash

Using the seal wash function is recommended when using buffers or other non-volatile solvents or additives that could deposit on pistons and seals. The seal wash function regularly cleans these parts automatically.

Seal Wash Dialog in OpenLAB Software (1290 Infinity Pumps only):

- Seal Wash settings are NO method parameters
- Find dialog under Control
- On ERROR – seal wash is switched off
- At Power Off – seal wash is switched off
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.

Optional Inline Filter

The pump can be equipped with an additional inline filter (Inline Filter Assembly (5067-5407)) with a nominal filter pore size of 0.3 µL.

Advantages of the inline filter:
- Very small internal volume
- Specified for working at high pressures
- Possibility of back-flushing the filter

Using the inline filter is recommended:
- to protect the downstream system from blockages,
- for solvent combinations that can form precipitation after mixing,
- for applications running with buffers.
General hints for effective usage of the inline filter:
- filter solvents before usage,
- follow best practices,
- back-flush the filter weekly,
- exchange the filter frit on a regular basis.

**CAUTION**

Damage to the valve

➔ Use the filter flush mode only if the optional inline filter is installed.

See Technote G7167-90130 for further reference.
Preparing the Binary Pump

For best performance of the pump:

- Place solvent cabinet with the solvent bottles always on top (or at a higher level) of the pump.
- For optimum performance, use the built-in degasser. This is mandatory for flow rates below 0.5 mL/min and for configurations without Jet Weaver.
- When using the pump with vacuum degassing unit, flush the degassing unit with at least 5 mL per channel before operating the pump, especially when the pumping system had been turned off for a certain length of time (for example, overnight) and volatile solvent mixtures are used in the channels.
- Prevent blocking of solvent inlet filters (never use the pump without solvent inlet filters). Growth of algae should be avoided, see “Algae Growth in HPLC Systems” on page 58.
- Check pump outlet filters and column frit in regular time intervals. A blocked pump outlet filter can be identified by black, yellow or greenish layers on its surface.
- Whenever possible use a minimum flow rate of 5 µL/min per solvent channel to avoid crossflow of solvent into the unused pump channel.
- When using buffer solutions, flush the system with water before switching it off.
- The seal wash function should be used when buffer solutions with concentrations of 0.1 M or higher are being pumped for long periods of time.
- Never leave an unused pump with water in a channel for an extended period of time (2-3 days). Always flush with organic solvent or add 10 % isopropanol to water.
Algae Growth in HPLC Systems

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

Instrumental Problems Associated With Algae

Algae deposit and grow everywhere within the HPLC system causing:

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

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

Overview

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

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 Binary 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.

- **ISET installed:**
  This check box is marked to indicate that ISET is installed. Click **ISET Configurations** to open the **ISET Configuration** dialog box, which allows you to configure a sampler for the ISET emulation.

**Configure Solvent Type Catalogs:** Displays the **Solvent Type Catalogs** dialog box, which allows you to import and export solvent calibration data. See “Importing Solvent Calibration Tables” on page 88.

Please refer to the online help of your user interface for more detailed information.
4 Using the Pump
Setting up the Pump with the Instrument Control Interface

The Pump User Interface (Dashboard Panel)

Module Graphic

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

Indicates that an External Contacts board is installed.

The level of solvent in the bottle is denoted by the green area; when the solvent level falls below the specified volume, the area turns yellow; when the bottle is empty, the area turns red. Clicking on 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 (gray) or installed and active (orange). (G4220A only)

Indicates the presence of a solvent selection valve. Click the graphic to switch the valve; the animation shows when the valve is switched.

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

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

The following pump signals are displayed:

**Flow**  The current solvent flow rate (in mL/min).

**Pressure**  The current pump pressure (in bar, psi or MPa, see “Instrument Configuration” on page 60).

**Pressure Limit**  The current maximum pressure limit.

**Composition A:B**  The current solvent composition. When a solvent selection valve is fitted, the channels are shown in the graphic.

**Tuning**  The signal represents the current effort the pumpdrives have to take to maintain the current system status.

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.
- **Switch solvent selection Valve A**  allows you to switch the solvent inlet line for channel A from inlet line 1 to 2.
- **Bottle Fillings**  Displays the Bottle Fillings dialog box.
- **Prepare Pump**  Allows you to control the Purge, Condition or the Prime function.
- **Seal Wash Purge**  Allows you to refill the Seal Wash lines once the Seal Wash solvent has been changed.
Control Settings

The Binary Pump control parameters are in six sections:

- **Pump**
- **Seal Wash**
- **Automatic Turn On**
- **Purge**
- **Prime**
- **Conditioning**

### Table 3  Pump control parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump</strong></td>
<td></td>
<td>Enables you to switch the pump <strong>On</strong>, <strong>Off</strong> or to a <strong>Standby</strong> condition. In the <strong>Standby</strong> condition, the pump motor is still active, and when the pump is switched on again, does not need to be re-initialized.</td>
</tr>
<tr>
<td><strong>Automatic Turn On</strong></td>
<td></td>
<td>Module can be turned on at a specified date/time. This feature can only be used if the module power switch is turned on.</td>
</tr>
</tbody>
</table>
| **Purge**           | **Time:** 0 – 100.00 min in steps of 0.01. **Flow:** 0.000 – 5.000 mL/min for each channel, in steps of 0.001 (10.000 mL/min maximum). | Setup and activation of **Purge** parameters. The automatic purge valve can be used for purging the system. The process has been automated for ease of use.  
  - **Off**: Turns off the purge.  
  - **On**: The device is purged.  
  - **Purge Flow**, **Time** and **Composition** during purge have to be defined. As soon as the duration time of the purge ends, the module automatically switches to analytical conditions again. |
| **Prime**           |        | Select **On** to start priming, **Off** to turn priming off. The **Prime** function is helpful for filling empty solvent lines or if air has entered the pump heads. The module draws solvent, at high speed with all four pump drives simultaneously, and dispenses it against the waste position of the automatic purge valve. This is done 20 times, before the process comes to an end. |
| **Conditioning**    | at least 200 bar (> 500 bar is better). | Use this function if you see excessive pressure or composition ripple, and you are sure that the solvent type (aqueous/organic or specific solvent/solvent mix) is correctly set, and there is no evidence of leakage in the pump. Conditioning may be necessary if the pump may contain air, for example after running out of solvent, after a long period of standby or after service or repair. |
Method Parameter Settings

The Binary Pump method setup parameters are in eight sections:

- **Flow**
- **Solvents A and B**
- **Stoptime**
- **Posttime**
- **Pressure Limits**
- **Timetable**
- **Advanced**
- **External Contacts**

**Table 4  Method parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>0.00 – 5.00 mL/min in steps of 0.001. Recommended flow range: 0.05 – 5.00 mL/min.</td>
<td>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 partial failure of the pumping system, air in the pumping system, a change in the mobile phase viscosity or a temperature change.</td>
</tr>
<tr>
<td>Solvents A and B</td>
<td>For each channel, you can select which of the two solvents to deliver. You can set the percentage of solvent B to any value from 0 through 100%. Solvent A always delivers the remaining volume: 100 - %B. The solvent B check boxes allow you to turn the solvent B channels on (checked) or off (cleared). When the Use solvent types check box in the Compressibility section is checked (see “Advanced Settings” on page 67), you click the down arrow and select either a Generic solvent or a calibrated Solvent.</td>
<td></td>
</tr>
<tr>
<td>Stoptime</td>
<td>0.01 – 99999 min or As Injector/No Limit (an infinite run time).</td>
<td>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.</td>
</tr>
<tr>
<td>Posttime</td>
<td>0.01 – 99999 min or Off (0.0 min).</td>
<td>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).</td>
</tr>
</tbody>
</table>
4 Using the Pump
Setting up the Pump with the Instrument Control Interface

Table 4 Method parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limits</th>
<th>Description</th>
</tr>
</thead>
</table>
| Pressure Limits | \textbf{Max}: 1200 bar (17400 psi) for flow rates up to 2 mL/min. For flow rates between 2 mL/min and 5 mL/min, the maximum pressure ramps down to 800 bar (11600 psi). \textbf{Min}: any value between 0 and the upper pressure limit setting. | Sets the maximum and minimum pressure limits for the pump.  
- \textbf{Max} is the maximum pressure limit at which the pump will switch itself off, protecting the analytical system against over-pressure.  
- \textbf{Min} is the minimum limit at which the pump will switch itself off, for example, if any solvent reservoir is empty, this prevents system damage by pumping air. |
| Timetable       | See “Timetable Settings” on page 68         |                                                                             |
| Advanced        | See “Advanced Settings” on page 67          |                                                                             |
| External Contacts | The \textbf{External Contacts} section enables you to set up the switching of the external contacts. |                                                                             |

\textbf{NOTE}

The \textbf{External Contacts} section is present only when a BCD/external contacts board is installed.
Advanced Settings

The Binary Pump advanced method setup parameters are in three sections:

- **Minimum Stroke**
- **Compressibility**
- **Maximum Flow Gradient**

### Table 5  Advanced method parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limits</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Minimum Stroke** | 20 – 100 µL             | 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 the Jet Weaver geometry.  
**Synchronized**: Select this option to synchronize the strokes for both channels; the values for Channel B are set to the same as those for Channel A. This is done to avoid floating disturbances affecting instrument performance. |
| **Compressibility**|                         | 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.  
**Use solvent types**:  
- Clear this check box to display the compressibility fields, which allow you to enter compressibility values.  
- When the check box is selected, the compressibility fields are not displayed, and the enhanced compressibility calibration is enabled.  
Select the required calibrated solvents from the drop-down lists using the combo boxes in the **Solvents** section. |
| **Maximum Flow Gradient** | 1.000 – 1000.000 mL/min/min in steps of 0.001 mL/min/min  
Default value: 100.000 mL/min/min | You can set a limit on the rate of change of the solvent flow to protect your analytical column. You can set individual values for **Flow ramp up** and **Flow ramp down**. |
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.
Purging the Pump

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

1. Initiate a purge in the controlling software with a Purge flow set to 3 – 5 ml/min per channel.

2. Flush all tubes with at least 30 ml of solvent.

Table 6  Choice of Priming Solvents for Different Purposes

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

**NOTE**  The pump should never be used for priming/purging empty tubings (never let the pump run dry). Use a syringe to draw enough solvent for completely filling the tubings to the pump inlet before continuing to prime with the pump.
If the system has been run dry or air has diffused into the pump it might require additional steps to get rid of the air again. Following the procedure below will give the best and fastest results.

1. Change solvent to isopropanol on both channels.
2. Turn on the Prime function.
3. Purge the system with 10 ml, composition 50/50 and for 10 min.
4. Attach a column suitable for isopropanol and set the Max. pressure limit to the limit of the column.
5. Run the system at composition 50/50 and a flow rate that gives a pressure close to the limit of the column.
6. Observe the pressure fluctuations. The system is air free as soon as the pressure is stable.
7. Change solvents and column according to the analytical conditions and purge the system to change solvents.
Introduction

Observe the following recommendations on the use of solvents.

- Follow recommendations for avoiding the growth of algae, see “Algae Growth in HPLC Systems” on page 58.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.4 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials like flow cells, valve materials etc. and recommendations in subsequent sections.
# Materials in Flow Path

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

<table>
<thead>
<tr>
<th>Part</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degasser chamber</td>
<td>TFE/PDD copolymer, PFA (internal tubings); PEEK (inlets); FEP (tubings); ETFE (fittings)</td>
</tr>
<tr>
<td>Ultra clean tubings¹</td>
<td>PFA (tubings), PEEK (fittings)</td>
</tr>
<tr>
<td>Microfluidic structures²</td>
<td>SST</td>
</tr>
<tr>
<td>SSV</td>
<td>PEEK, FEP, PFA, Al₂O₃-based ceramic, ruby, sapphire, SST</td>
</tr>
<tr>
<td>Passive inlet valve</td>
<td>SST, gold, ruby, ZrO₂-based ceramic, tantalum</td>
</tr>
<tr>
<td>Outlet valve</td>
<td>SST, gold, ruby, ZrO₂-based ceramic, tantalum</td>
</tr>
<tr>
<td>Pump head</td>
<td>SST</td>
</tr>
<tr>
<td>Pistons</td>
<td>ZrO₂-based ceramic</td>
</tr>
<tr>
<td>Piston/wash seals</td>
<td>UHMW-PE, SST</td>
</tr>
<tr>
<td>Pressure sensor</td>
<td>SST</td>
</tr>
<tr>
<td>Automatic purge valve</td>
<td>Polyimide, SST, DLC</td>
</tr>
</tbody>
</table>

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

² Jet Weaver, Heat Exchanger
Material Information

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

Disclaimer

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

PEEK

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

It is stable in a pH range between 1 – 12, and inert to many common solvents.

There is still a number of known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulphuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogenes or aqueous halogene solutions, phenol and derivatives (cresols, salicylic acid etc.).
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 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 to many organic solvents used in chromatographic systems like methanol, acetonitrile and isopropanol. It has limited stability with aliphatic, aromatic and halogenated hydrocarbons, THF, phenol and derivatives, concentrated acids and bases. For normal phase applications, the maximum pressure should be limited to 200 bar.

**Tantalum (Ta)**

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

**Stainless Steel (ST)**

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

- Solutions of alkali halides, their respective acids (for example, lithium iodide, potassium chloride, and so on) and aqueous solutions of halogens.
• High concentrations of inorganic acids like nitric acid, sulfuric acid and organic solvents especially at higher temperatures (replace, if your chromatography method allows, by phosphoric acid or phosphate buffer which are less corrosive against stainless steel).

• Halogenated solvents or mixtures which form radicals and/or acids, for example:

\[
2 \text{CHCl}_3 + \text{O}_2 \rightarrow 2\text{COCl}_2 + 2\text{HCl}
\]

This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol.

• Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, di-isopropylether). Such ethers should be filtered through dry aluminium oxide which adsorbs the peroxides.

• Solutions of organic acids (acetic acid, formic acid, and so on) in organic solvents. For example, a 1% solution of acetic acid in methanol will attack steel.

• Solutions containing strong complexing agents (for example, EDTA, ethylene diamine tetra-acetic acid).

• Mixtures of carbon tetrachloride with 2-propanol or THF.

**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 (SiO₂)**

Fused silica is used in 1290 Infinity Flow Cells and capillaries. 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 (ZrO₂)

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

Platinum/Iridium

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

Fluorinated polymers (PTFE, PFA, FEP, FFKM)

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, 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.

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.
Solvent Handling

Handling of Buffers

The following recommendations should be observed when using buffer solutions:

- Buffers and aqueous solutions are possible sources of algae contamination, for avoiding related problems, please read “Algae Growth in HPLC Systems” on page 58.

- For buffer concentrations of 0.1 M or higher using the seal wash function periodically with a runtime of 0.3 min every 3 min is strongly recommended.

- Filter buffer solutions to avoid increased wear or blockages that are caused by undissolved crystals. Always use solvent inlet filters.

- Avoid conditions where mixing of buffers and organic solvents may cause precipitation, as this impairs the reproducibility of chromatographic experiments and may also reduce the system life time. For example in reversed phase chromatography, avoid buffers (especially phosphate buffers) with a concentration higher than 20 mmol/L. For phosphate buffers, avoid compositions containing more than 65 % acetonitrile or other organic solvents.

- Use a minimum flow rate of 5 µL/min or 1 % composition per solvent channel (whatever is greater) to avoid cross-flow. Cross-flow can be caused by micro leaks in pump heads and can result in buffer precipitation in pump heads, channel blocking, or reduced pump head life time through wear of seals and pistons.

- Consider using an inline filter, for example Inline filter (G1311-60006).

- Never leave buffers in a system without flow. Before shutting down a system, flush it extensively with warm water to avoid clogging of valves, capillaries, or flow cells or reducing the life time of your column. If the system is not used for some time, for example more than a day depending on lab temperature, fill all solvent lines with organic solvent or water with at least 10 % isopropanol.

- Regularly maintain the LC system.
Handling of Acetonitrile

Acetonitrile is a solvent that is frequently used in reversed-phase chromatography. Despite of its common use, it can be a source of issues if not handled correctly. Acetonitrile degrades through polymerization and such polymers can stick to surfaces in LC systems and e.g. cause issues with valve performance and therefore affect retention time precision. Polymers can also show up as background noise in MS detectors.

When using acetonitrile:

- Use high-quality solvents from renowned suppliers.
- Use fresh solvents and filter them.
- Minimize exposure to light and air/oxygen.
- Choose a bottle size which fits to your application and usage.
- Acids accelerate polymerization. If possible avoid such additives or refresh solvents more frequently.
- Pure acetonitrile polymerizes faster. If your application allows, add about 5% water and adjust gradient compositions.
- Do not leave acetonitrile in unused systems to avoid aging. If not in use, flush all solvent lines with a mixture of water and 10% isopropanol.
- In case of blocked valves, flush the system with hot water. Knock at valves, flush them (see “Releasing a Stuck Inlet Valve” on page 157) or ultrasonicate them, e.g. in methanol.

Handling of Acids

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

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

Current 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 and heptane). 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.

**Seals for Normal Phase Applications**

For running normal phase 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.

**NOTE**

Tetrahydrofuran (THF) is not compatible with PE seals. Black PTFE seals should be used with THF, even in 1290 Infinity pumps. In this case, use a maximum pressure of about 400 bar.


**Choice of Normal Phase Valves and Seals**

**Table 7**  Recommended valves and seals for normal phase applications

<table>
<thead>
<tr>
<th></th>
<th>1260 Infinity</th>
<th>1290 Infinity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet valves</strong></td>
<td>1260 Infinity Inlet Valve Type N (G1312-60166)</td>
<td>1290 Infinity Inlet Valve Type N (G4220-60122)</td>
</tr>
<tr>
<td></td>
<td>1290 Infinity Quat Inlet Valve Type N (G4204-60122)</td>
<td></td>
</tr>
<tr>
<td><strong>Outlet valves</strong></td>
<td>1260 Infinity Outlet Valve Type N/SFC (G1312-60167)</td>
<td>1290 Infinity Outlet Valve Type N (G4220-60128)</td>
</tr>
<tr>
<td><strong>Seals</strong></td>
<td>PE seals (pack of 2) (0905-1420)</td>
<td>Wash Seal PE (0905-1718)</td>
</tr>
</tbody>
</table>
This chapter gives hints on how to optimize the performance or use additional devices.
Delay Volume and Extra-Column Volume

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

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

Delay Volume

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

The delay volume in a system includes the volume in the pump from the point of mixing, connections between pump and autosampler, volume of the flow path through the autosampler and connections between autosampler and column.
How to Configure the Optimum Delay Volume

The physical delay volume of the pump depends primarily on the use of the Jet Weaver mixer. For UV detection the Jet Weaver should always be used but for mass spectrometric detection the user can decide to bypass the Jet Weaver in order to reduce the delay volume. This only makes sense for ultra-fast gradient operation (less than 0.5 min) or for use with very small volume columns. If the Jet Weaver is bypassed the connection tubing to the autosampler is routed directly from the purge valve.

Sometimes it may be advisable to increase the delay volume in the pump. Specifically this can be the case when UV detection is employed and a strongly UV-absorbing compound has been added to the mobile phase. This can have the effect of emphasizing any pump noise and the most common example is the use of trifluoroacetic acid (TFA) in the analysis of proteins and peptides. The effect can be mitigated by increasing the mixer volume.

The following different Jet Weaver configurations are available:

1. The Jet Weaver 35 µL/100 µL (G4220-60006) has two alternative volumes in the same unit. The switch from the lower volume, 35 µl, to the higher volume, 100 µl, is done by uninstalling it, turning it around from front to back and re-installing it, see “Changing configuration or replacing the Jet Weaver” on page 153. The mixing volume (and hence delay volume) is increased by 65 µl and the baseline performance with additives like TFA will be improved. The configuration of the Jet Weaver is logged automatically by an attached RFID tag.

2. The 380 µL Jet Weaver high performance mixer is optionally available for demanding applications, which use solvents in different channels (for example A versus B), that differ strongly in their UV/Vis absorption, for example by using trifluoroacetic acid (TFA) as a modifier, which has a high absorbance.

NOTE
Before disconnecting a Jet Weaver from the flow path, flush it with organic solvent. Avoid leaving water or buffers inside the Jet Weaver, which may cause the growth of microorganisms like algae or bacteria.
5 Optimizing Performance
How to Configure the Optimum Delay Volume

Solvent packages created by the pump may persist until the solvent reaches the detector flow cell. Absorption fluctuations can then show up as baseline noise, also referred to as mixing noise. Applications like impurity quantitation or lowest level compound detection require minimizing this noise. The 380 µL Jet Weaver strongly improves mixing and therefore reduces baseline noise and improves sensitivity in detection. Patented Agilent microfluidic technology offers high mixing performance at a low internal volume of 380 µL.
How to Achieve Higher Resolution

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

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

Resolution between two peaks is described by the resolution equation:

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

where

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

The term that has the most significant effect on resolution is the selectivity, $\alpha$, and practically varying this term involves changing the type of stationary phase (C18, C8, phenyl, nitrile etc.), the mobile phase and temperature to maximize the selectivity differences between the solutes to be separated. This is a substantial piece of work which is best done with an automated method development system which allows a wide range of conditions on different columns and mobile phases to be assessed in an ordered scouting protocol. This section considers how to get higher resolution with any chosen stationary and mobile phases. If an automated method development system was used in the decision on phases it is likely that short columns were used for fast analysis in each step of the scouting.
The resolution equation shows that the next most significant term is the plate count or efficiency, N, and this can be optimized in a number of ways. N is inversely proportional to the particle size and directly proportional to the length of a column and so smaller particle size and a longer column will give a higher plate number. The pressure rises with the inverse square of the particle size and proportionally with the length of the column. This is the reason that the 1290 Infinity LC system was designed to go to 1200 bar so that it can run sub-two-micron particles and column length can be increased to 100 mm or 150 mm. There are even examples of 100 mm and 150 mm columns linked to give 250 mm length. Resolution increases with the square root of N so doubling the length of the column will increase resolution by a factor of 1.4. What is achievable depends on the viscosity of the mobile phase as this relates directly to the pressure. Methanol mixtures will generate more back pressure than acetonitrile mixtures. Acetonitrile is often preferred because peak shapes are better and narrower in addition to the lower viscosity but methanol generally yields better selectivity (certainly for small molecules less than about 500 Da). The viscosity can be reduced by increasing the temperature but it should be remembered that this can change the selectivity of the separation. Experiment will show if this leads to increase or decrease in selectivity. As flow and pressure are increased it should be remembered that frictional heating inside the column will increase and that can lead to slightly increased dispersion and possibly a small selectivity change both of which could be seen as a reduction in resolution. The latter case might be offset by reducing the temperature of the thermostat by a few degrees and again experiment will reveal the answer.

The van Deemter curve shows that the optimum flow rate through an STM column is higher than for larger particles and is fairly flat as the flow rate increases. Typical, close to optimum, flow rates for STM columns are: 2 ml/min for 4.6 mm i.d.; and 0.4 ml/min for 2.1 mm i.d. columns.
In isocratic separations, increasing the retention factor, $k$, results in better resolution because the solute is retained longer. In gradient separations the retention is described by $k^*$ in the following equation:

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

where:

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

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

Importing Solvent Calibration Tables

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

If your solvent is not included to the software, please check the Agilent web site http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?whid=69761 for additional libraries (registration required), which also provides updates and optimized data.

If your solvent is neither available in the user interface nor in the library, please use generic solvents. "Generic aqueous" gives good results for most solvent mixtures with at least 50 % water, which have similar properties as pure water. For other solvents with high organic percentage, "Generic organic" gives a good approximation.

Importing Solvent Calibration in ChemStation

1. Go to menu Instrument > Instrument configuration.
2. In the Instrument Configuration screen choose your module and click Configure.
3. Click Configure Solvent Type Catalogs.
4. In Solvent Type Catalogs click Import.
5. Navigate to the location of the solvent calibration table and click Open.
6. The new solvent will now appear in the Solvent Type Catalogs.
7. The imported solvent is now available for selection as a solvent type, see Table 4 on page 65.
6 Troubleshooting and Diagnostics

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Agilent Lab Advisor Software 91

Overview about the troubleshooting and diagnostic features.
Available Tests vs User Interfaces

- Depending on the user interface, the available tests and the screens/reports may vary (see chapter "Test Functions and Calibrations").

- Preferred tool should be the Agilent Lab Advisor software, see “Agilent Lab Advisor Software” on page 91.

- The Agilent ChemStation may not include any maintenance/test functions.

- Screenshots used within these procedures are based on the Agilent Lab Advisor software.
Agilent Lab Advisor Software

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

The Agilent Lab Advisor software is available in two versions:

- Lab Advisor Basic
- Lab Advisor Advanced

Lab Advisor Basic is included with every Agilent 1200 Infinity Series and Infinity II Series pump.

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 and Infinity II Series instruments.

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 Troubleshooting and Diagnostics
Agilent Lab Advisor Software
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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 4 of the remote connector generates the error message.

**Probable cause**

1. Leak detected in another module with a CAN connection to the system.
2. Leak detected in an external instrument with a remote connection to the system.
3. Shut-down in an external instrument with a remote connection to the system.
4. The degasser failed to generate sufficient vacuum for solvent degassing.

**Suggested actions**

1. Fix the leak in the external instrument before restarting the module.
2. Fix the leak in the external instrument before restarting the module.
3. Check external instruments for a shut-down condition.
4. Check the vacuum degasser for an error condition. Refer to the *Service Manual* for the degasser or the pump that has the degasser built-in.
Remote Timeout

Error ID: 0070

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

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Not-ready condition in one of the instruments connected to the remote line.</td>
<td>Ensure the instrument showing the not-ready condition is installed correctly, and is set up correctly for analysis.</td>
</tr>
<tr>
<td>2  Defective remote cable.</td>
<td>Exchange the remote cable.</td>
</tr>
<tr>
<td>3  Defective components in the instrument showing the not-ready condition.</td>
<td>Check the instrument for defects (refer to the instrument’s documentation).</td>
</tr>
</tbody>
</table>
**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.

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

**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.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Defective leak sensor.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Leak sensor incorrectly routed, being pinched by a metal component.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Leak sensor not connected to the main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2  Defective leak sensor.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>3  Leak sensor incorrectly routed, being pinched by a metal component.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Loose connection between the power switch board and the main board</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2  Defective power switch assembly</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>3  Defective main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Defective power switch assembly</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2  Loose connection between the power switch board and the main board</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>3  Defective main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Fan Failed

Error ID: 0068

The cooling fan in the module has failed.

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

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

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Fan cable disconnected.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2  Defective fan.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>3  Defective main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Leak

Error ID: 0064

A leak was detected in the module.

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

Probable cause

1. Loose fittings.
2. Broken capillary.
3. Loose or leaking purge valve, inlet valve, or outlet valve.
4. Defective pump seals.

Suggested actions

1. Ensure all fittings are tight.
2. Exchange defective capillaries.
3. 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. Exchange the pump seals.

Open Cover

Error ID: 0205

The top foam has been removed.

Probable cause

1. Foam not activating the sensor.
2. Defective sensor or main board.

Suggested actions

1. Please contact your Agilent service representative.
2. Please contact your Agilent service representative.
## Cover Violation

**Error ID: 7461**

The top foam has been removed.

The sensor on the main board detects when the top foam is in place. If the foam is removed while the lamps are on (or if an attempt is made to switch on for example the lamps with the foam removed), the lamps are switched off, and the error message is generated.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  The top foam was removed during operation.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2  Foam not activating the sensor.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Pump Error Messages

These errors are pump specific.

Pressure of binary pump above upper limit

Error ID: 22014

The pressure has exceeded the upper pressure limit.

• Parameter: Measured pressure

Probable cause

1  Blockage in flow path after the pressure sensor.

2  Inappropriate settings (pressure limit, flow rate).

Suggested actions

• Check for blockages in the LC system, e.g. purge valve, Jet Weaver, degraded column, column frits, needle, needle seat, capillaries etc.

• Check for particles in the solvent.

• Decrease flow rate.

• Increase pressure limit.
### Pressure below lower limit

**Error ID: 22015**

The pressure has dropped below the lower limit.
- Parameter: None

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Leak</td>
<td>Check for leaks.</td>
</tr>
<tr>
<td>2 Bottle empty</td>
<td>Check bottle filling.</td>
</tr>
<tr>
<td>3 Wrong solvent (viscosity)</td>
<td>Check solvent.</td>
</tr>
<tr>
<td>4 Inappropriate setting</td>
<td>Check flow rate and lower pressure limit.</td>
</tr>
<tr>
<td>5 Column degradation</td>
<td>Replace column.</td>
</tr>
</tbody>
</table>

### Target pressure not reached for binary pump degasser

**Error ID: 22031**

The target pressure of the binary pump degasser has not been reached within the expected time.
- Parameter: Pressure in mbar

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Condensation in degasser chamber due to temperature fluctuation.</td>
<td>Equilibrate and restart module.</td>
</tr>
<tr>
<td>2 Degasser is defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
**Degasser's pressure limit violation**

**Error ID: 22032**

Pressure too far above the limit.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Leak in degasser chamber or degasser tubing.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Defect vacuum pump.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>3 Degasser chamber empty or connected to air.</td>
<td>Block unused degasser channels.</td>
</tr>
</tbody>
</table>

**Solvent counter exceeded limit**

**Error ID: 22055**

The counter for the solvent volume has exceeded the limit, which has been set in the user interface.

Parameter:
- Without Solvent Selection Valve:
  0 for channel A, 1 for channel B
- With Solvent Selection Valve:
  2 for channel A1, 3 for channel B1, 4 for channel A2, 5 for channel B2

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No solvent present.</td>
<td>Refill solvent bottle.</td>
</tr>
<tr>
<td>2 Inappropriate setting.</td>
<td>Check solvent counter setting in user interface.</td>
</tr>
</tbody>
</table>
Waste counter limit exceeded

Error ID: 22056

The counter for the waste volume has exceeded the limit, which has been set in the user interface.

- Parameter: None

Probable cause

1. The waste container is full.
2. Inappropriate setting for waste counter.

Suggested actions

- Empty waste container.
- Reset waste counter.
- Adjust waste counter limit.

Flow rate limit exceeded

Error ID: 22064

The flow rate of the binary pump has exceeded the limit, while the pump runs in pressure controlled mode, e.g. during a pressure test.

- Parameter: None

Probable cause

1. Leak
2. Bottle empty.
3. Shutoff valve closed.
4. Drift of pressure sensor (unlikely for short tests taking some minutes).

Suggested actions

- Check for leaks in the pump and flow path.
- Fill solvent bottle.
- Open shutoff valve.
- Replace pressure sensor.
Binary pump shutdown during analysis

**Error ID: 22065**

The binary pump has been shut down by the control software or control module during an analysis.

- Parameter: 0 for off, 1 for standby.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pump has been shut down.</td>
<td>Restart pump.</td>
</tr>
</tbody>
</table>

Reading the pump encoder tag failed

**Error ID: 22402**

Reading the pump encoder tag has failed.

- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Defect connection between encoder and main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Missing or defect tag Defect connection between tag and encoder.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
**Writing the pump encoder tag failed**

**Error ID: 22405**

Writing the pump encoder tag has failed.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Defect connection between encoder and main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Defect tag Defect connection between tag and encoder.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

**Pump drive blocked or encoder failed**

**Error ID: 22406**

Pump drive blocked or encoder failed.
- Parameter: None

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Blockage of the pump drive Drive encoder failed.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Drive current too low

Error ID: 22407

The current consumption of the pump drive is too low.

- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Drive motor defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Wrong/missing connection of pump drive to main board.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

Drive Encoder failed

Error ID: 22408

Drive encoder failed during pump drive calibration.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Internal error.</td>
<td>Contact Agilent support.</td>
</tr>
</tbody>
</table>
7 Error Information
Pump Error Messages

Drive current too high

Error ID: 22409

The current consumption of the pump drive is too high.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Blockage of system before pressure sensor.</td>
<td>Check for blockage of e.g. outlet valve filter frit, purge valve, heat exchanger.</td>
</tr>
<tr>
<td>2 Drive motor defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

Drive timeout

Error ID: 22410

Drive is blocked mechanically, fails during initialization.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Blockage of pump drive Drive motor defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Overcurrent of pump drive

**Error ID: 22411**

The current consumption of the pump drive is too high.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Blockage of system before pressure sensor.</td>
<td>Check for blockage of e.g. outlet valve filter frit, purge valve, heat exchanger.</td>
</tr>
<tr>
<td>2 Drive motor defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

Overcurrent of solvent selection valve (SSV)

**Error ID: 22412**

Overcurrent of solvent selection valve (SSV).
- Parameter: None

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Valve defect.</td>
<td>Replace the solvent selection valve.</td>
</tr>
</tbody>
</table>

Deliver underrun

**Error ID: 22413**

Internal error.
- Parameter: None

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Internal error.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Defect connection between main board and pump drive encoder

Error ID: 22414
Defect connection between main board and pump drive encoder.
• Parameter: 1 – 4 referring to pump drive

Probable cause  Suggested actions
1 Defect connection between main board and pump drive encoder. Please contact your Agilent service representative.
2 Defect encoder. Please contact your Agilent service representative.

Pump drive encoder defect

Error ID: 22415
Defect pump drive encoder.
• Parameter: 1 – 4 referring to pump drive

Probable cause  Suggested actions
1 Defect encoder. Please contact your Agilent service representative.
Purge valve failed

Error ID: 22417

Lost steps of the purge valve encoder.

- Parameter: None

Probable cause
1. Purge valve drive mechanically blocked or defect.

Suggested actions
- Check installation of purge valve head.
- Please contact your Agilent service representative.

Reading of purge valve tag failed

Error ID: 22420

Reading the purge valve tag failed.

- Parameter: None

Probable cause
1. Reading of purge valve tag failed.
2. Purge valve head tag defect or empty.
3. Purge valve tag reader is defect.

Suggested actions
- Check cable connection.
- Replace purge valve head.
- Please contact your Agilent service representative.
## Pump drive encoder rollover

**Error ID: 22424**

Invalid pump drive encoder signals have been detected.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pump drive encoder is defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

## Drive position limit

**Error ID: 22425**

Internal error.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Internal error.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

## Insufficient power of drive encoder LED

**Error ID: 22426**

Insufficient power of drive encoder LED.
- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pump drive encoder is defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Drive encoder error

Error ID: 22427- 22430

An error has occurred for the pump drive encoder.
• Parameter: 1 – 4 referring to pump drive

Probable cause | Suggested actions
--- | ---
1 Pump drive encoder is defect. | Please contact your Agilent service representative.

Writing the purge valve tag failed

Error ID: 22431

Writing the purge valve tag failed.
• Parameter: None

Probable cause | Suggested actions
--- | ---
1 Purge valve head tag defect. | Replace purge valve head.
2 Purge valve tag reader is defect. | Please contact your Agilent service representative.
Current of primary pump drive too high

Error ID: 22433

The current of the primary pump drive is too high.

- Parameter: 1 or 4 referring to pump drive.

Probable cause

1 Blockage of flow path between primary pump head and pressure sensor, e.g. of the heat exchanger.

2 Primary pump drive is defect.

Suggested actions

- Check for blockages in flow path.
- Please contact your Agilent service representative.

Current of secondary pump drive too high

Error ID: 22434

The current of the secondary pump drive is too high.

- Parameter: 2 or 3 referring to pump drive

Probable cause

1 Blockage of flow path between secondary pump head and pressure sensor, e.g. of the heat exchanger.

2 Secondary pump drive is defect.

Suggested actions

- Check for blockages in the flow path.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
**Unknown purge valve type**

Error ID: 22435

The type information of the purge valve is invalid.

- Parameter: None

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wrong valve head installed.</td>
<td>Check or replace purge valve head.</td>
</tr>
<tr>
<td>2 Valve head has invalid RFID tag content.</td>
<td>Check or replace purge valve head.</td>
</tr>
</tbody>
</table>

**Pump drive encoder error**

Error ID: 22437

The pump drive encoder has generated no signal.

- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pump drive encoder is defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

**Pump drive error**

Error ID: 22438, 22439

The pump drive failed during calibration.

- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pump drive motor defect or mechanically blocked.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Pump drive stroke blocked

Error ID: 22441

During initialization the pump defines the operation position of the pump drives and therefore the pistons. First the pump drive moves backwards to find a mechanical stop within the ball screw. Afterwards, pistons move forwards for finding the maximum available stroke volume. These values are expected within a pre-defined range. "Maximum stroke too short" means that the outer drive position is too close. This can be caused by a drive initialization without pump head or if the pump head has not been installed properly (screws are loose).

- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wiper shifted</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Pump head blocks piston movement</td>
<td>Replace, clean or repair pump head.</td>
</tr>
<tr>
<td>3 Pump drive motor is mechanically blocked.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>

Pump drive stop not found

Error ID: 22442

The maximum stroke is too long.

- Parameter: 1 – 4 referring to pump drive

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Suggested actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wiper shifted</td>
<td>Please contact your Agilent service representative.</td>
</tr>
<tr>
<td>2 Pump drive spindle is defect.</td>
<td>Please contact your Agilent service representative.</td>
</tr>
</tbody>
</table>
Pressure sensor calibration wrong or missing

Error ID: 22443

Pressure sensor calibration wrong or missing.
- Parameter: None

Probable cause
1. Pressure sensor calibration wrong or missing.

Suggested actions
- Replace pressure sensor.
- Please contact your Agilent service representative.

Seal wash pump was missing when tried to turn on

Error ID: 22499

The seal wash pump has not been detected (while being configured or detected before)

Probable cause
1. Defect cable connection to seal wash pump.
2. Defect seal wash pump motor.
3. Defective main board.

Suggested actions
- Check cable connection.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
7 Error Information
Pump Error Messages
This chapter describes the tests for the module.
Introduction

All tests are described based on the Agilent Lab Advisor Software B.01.04. Other user interfaces may not provide any test or just a few.

<table>
<thead>
<tr>
<th>Table 8</th>
<th>Interfaces and available test functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Comment</td>
</tr>
<tr>
<td>Agilent Instrument Utilities</td>
<td>Maintenance tests available</td>
</tr>
</tbody>
</table>
| Agilent Lab Advisor | All tests are available | • System pressure test  
| | | • Pump head leak test |
| Agilent ChemStation | No tests available  
| | Adding of pressure to chromatographic signals possible | • Pressure  
| | | • Pressure ripple  
| | | • Temperature main board |
| Agilent Instant Pilot | Some tests are available | • System pressure test  
| | | • Monitoring of values  
| | | • Pressure  
| | | • Pressure ripple  
| | | • Flow (in case of operating pressure) |

For details on the use of the interface refer to the interface documentation.
Pump Leak Rate Test

The Pump Leak Rate Tests is a diagnostic test to check the integrity and tightness of the pump components. The test is started from the Services & Diagnostics section of any 1290 Infinity or Infinity II pump in the Agilent Lab Advisor Software. The test is first evaluating the tightness from the outlet valve downstream to the purge valve. The pistons are positioned; afterwards the purge valve is switched to the closed position. By moving the secondary piston into the pump chamber the system is pressurized to 1000 bar. The flow rate to keep the pressure stable is the corresponding leak rate.

The second part of the test is designed to verify the tightness along the piston. Any irregularity on the piston surface (for example, scratches or deposits) will be detected. During this test all components from the inlet valve downstream to the blocked purge valve are included tested.

Now the primary piston is moving to deliver and generate pressure but the secondary is retracting. The pressure is kept constant at 800 bar. The process is repeated for the second pump head, if applicable.

**Preparations:**

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

The test runs automatically without any further user interaction.
Evaluation:
The result as well as the applied limits are displayed after the automatic evaluation. The limits are:

- The allowed leak limit for the secondary piston is $\leq 3 \, \mu L/min$
- The allowed leak limit for the primary piston is $\leq 30 \, \mu L/min$

A report can be displayed, saved or printed by opening it with the Print Result button at the lower right of the screen.

If the test does not pass, check the system for leaks or call a local Agilent representative.

Figure 14 on page 126 and Figure 15 on page 127 show a typical test run.
Figure 15  Dynamic (primary) Leak Test
Troubleshooting the Pump Leak Rate Test

**Secondary Leak > 3 µL/min**
- Leak between the OBV and automatic purge valve
  - Check for visible leaks on fittings and connectors
    - Connector not fixed / tight enough
    - Connector damaged
    - Leaky filter frit assembly
  - Remove the seal wash tubes from the support ring and check for leak into the seal wash path
    - Main seal leaking/damaged
    - Piston damaged
  - Remove waste lines from the automatic purge valve
    - Damage to rotor seal and/or stator head
- Outlet valve not properly assembled
  - Re-tighten the outlet valve
  - Check the position of the gold seal

**Dynamic Leak > 30 µL/min or Dynamic Leak Rate Test fails**
- Air in the primary pump chamber
  - Check for air in the solvent inlet lines and the Tuning signal
    - Purge the lines, Prime and Condition the pump head
- Abort due to over pressure
  - Check solvent and solvent settings
    - Purge and condition the pump head with water
- Leak in Inlet Valve
  - Check for moving air bubbles in tubing directly to the Inlet Valve
    - Purge the lines with water to remove dirt
    - Knock at the valve, clean or replace it
Test Functions and Calibrations

Pump Leak Rate Test

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

The System Pressure Test is performed to evaluate the leak tightness of the system up to the point where the system is capped off. The test is started from the Services & Diagnostics section of any 1290 Infinity or Infinity II pump in the Agilent Lab Advisor Software or from the G4208A Instant Pilot. Modules like pump, sampler, column compartments as well as accessories like valves or columns can be included into the flow path for this test.

Preparations:
1. Flush the system with HPLC grade water for several minutes from any solvent channel.
2. Start the System Pressure Test and choose the pressure you want to test the system with. Consider pressure limits of modules or accessories included into the flow path.
3. Choose the channel with HPLC grade water and if you want to include or skip an additional purging step.
4. Click OK and follow the instructions: Place a blank nut into the port up to which you want to test the leak tightness of the system.

The test runs automatically without any further user interaction.

Evaluation:
The result as well as the applied limits are displayed after the automatic evaluation. The limits are:
- For a pressure setting ≤1000 bar, the allowed leak limit is ≤5 µL/min
- For a pressure setting >1000 bar, the allowed leak limit is ≤15 µL/min

A report can be displayed, saved or printed by opening it with the Print Result button at the lower right of the screen.

If the test does not pass, check the system for leaks or call a local Agilent representative.

Figure 16 on page 131 shows a typical test run.
**Figure 16**  System Pressure Test
8 Test Functions and Calibrations
System Pressure Test
This chapter describes the maintenance of the Agilent 1290 Infinity Binary Pump.
Introduction to Maintenance

Figure 17 on page 134 shows the main user accessible assemblies of the Agilent 1290 Infinity Binary Pump. These parts can be accessed from the front (simple repairs) and don’t require to remove the pump from the system stack.

Figure 17  Maintenance Parts

Figure 18 on page 135 shows the flow connections between these main assemblies.
Recommended Interval for Preventive Maintenance

The recommended interval for preventive maintenance is:

- 150 L or 1 year (whichever comes first).

This recommendation is valid for LC instruments on which “typical” applications are running.

A “typical” application can be characterized as follows:

- pressure range 100 – 800 bar,
- flow rates 0.5 – 3.5 mL/min,
- typical solvents used in reversed phase LC.
9 Maintenance
Warnings and Cautions

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.
Safety standards for external equipment

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

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

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

**WARNING**

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

➔ Do not use an excessively damp cloth during cleaning.

➔ Drain all solvent lines before opening any connections in the flow path.
Installing Fittings and Capillaries

**WARNING**

**Solvent can spray under high pressure.**

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

---

**CAUTION**

Deformation of fittings and seals

Liquid drops under high pressure up to 1200 bar act like solid parts. Tightening connections under high pressure can deform or destroy fittings and seals.

➔ Never tighten flow connections under pressure.

---

**NOTE**

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

If fitting has been overtightened, replace it.

1. Install fittings and capillaries.
2. Tighten fittings and capillaries.
Replacing the Shutoff Valve Panel

When

If a shutoff valve is damaged or the panel needs to be removed for other repair procedures.

Parts required

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5067-4124</td>
<td>Shutoff valve</td>
</tr>
<tr>
<td>1</td>
<td>G4220-40004</td>
<td>Shutoff valve panel</td>
</tr>
<tr>
<td>2</td>
<td>G4220-60035</td>
<td>Tubing kit 140 mm, 2/pk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SSV to shutoff valve or degassing unit</td>
</tr>
</tbody>
</table>

Preparations

In order to avoid leaks, remove tubings from the solvent bottles.

1. Unscrew tubing connections between shutoff valves, solvent bottles and the solvent selection valve.
2. If a single valve shall be replaced, it can be pulled to the front for removing it from its mounting.
9 Maintenance
Replacing the Shutoff Valve Panel

3 Remove the shutoff valve panel by pulling it downwards.

4 After replacing the panel or after completion of other maintenance, re-install the panel and all flow connections.

A2  A1
B1  B2  A  B
A  B
Replacing the Pressure Sensor

When
No or invalid pressure signal

Tools required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8710-2412</td>
<td>Hex key 2.5 mm, 15 cm long, straight handle</td>
</tr>
<tr>
<td>8710-0510</td>
<td>Wrench open 1/4 — 5/16 inch</td>
</tr>
<tr>
<td></td>
<td>Screwdriver</td>
</tr>
</tbody>
</table>

Parts required

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4220-60001</td>
<td>Pressure sensor 1200 bar</td>
</tr>
</tbody>
</table>

Preparations
Turn off pump flow, switch off pump

NOTE
This procedure describes how to replace the pressure sensor.
In case the cable to the sensor shall be replaced as well, please contact your Agilent service representative.
9 Maintenance
Replacing the Pressure Sensor

1 Remove capillary connections between the pressure sensor and purge valve.

2 Remove the screws that fix the pressure sensor to the chassis.

3 Carefully pull out the pressure sensor for about 2 cm. Then unscrew the cable from the pressure sensor.

4 Connect the new pressure sensor to the pressure sensor connector.
5  Fix the pressure sensor to the instrument chassis.

6  Connect the capillaries from the valve to the pressure sensor: connect port 3 to the pressure sensor inlet and port 2 to the outlet.
Replacing the Inlet valve

When
If Inlet valve is defective.

Tools required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4220-20012</td>
<td>Wrench, 14 mm</td>
</tr>
<tr>
<td>G4220-20012</td>
<td>Torque wrench 2 – 25 Nm</td>
</tr>
</tbody>
</table>

Parts required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4220-60022</td>
<td>Inlet valve (primary pump head)</td>
</tr>
</tbody>
</table>

**NOTE**
For best performance and life time and for avoiding leaks, use a torque wrench set to 10 Nm for fixing the inlet valve.

1. Close the shut off valves to avoid solvent leaks.
2. Unscrew the tubing at the inlet valve.
3 With a 14 mm wrench, unscrew the inlet valve and remove it.

4 Install inlet valve and tighten it at 10 Nm with a torque wrench (14 mm).

5 Attach the inlet tubing at the inlet valve.

6 Open the shut off valves and purge the system to remove air.
Recovering the Outlet Valve

**When**

If Outlet valve is defective.

**Tools required**

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8710-0510</td>
<td>Wrench open 1/4 — 5/16 inch</td>
</tr>
<tr>
<td>8710-2603</td>
<td>Spanner-double open ended 12X14 mm Chrome</td>
</tr>
<tr>
<td>G4220-20012</td>
<td>Torque wrench 2 – 25 Nm</td>
</tr>
<tr>
<td>G4220-20041</td>
<td>Bit Torx 10x25 mm</td>
</tr>
</tbody>
</table>

**Parts required**

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4220-60028</td>
<td>Outlet valve (primary pump head)</td>
</tr>
<tr>
<td>G4220-20020</td>
<td>Internal gold seal for Outlet Valve</td>
</tr>
</tbody>
</table>

1. Close the shut off valves to avoid solvent leaks.
2. Lift up the capillary and remove it from the primary pump head.
3 A gold seal between outlet valve and heat exchanger capillary is used for a tight connection. The seal can be replaced separately as needed.

4 Unscrew the outlet valve with a 14 mm wrench.

5 Insert the outlet valve into the pump head. Using a torque wrench, set 10 Nm and close the outlet valve.

6 Insert the heat exchanger capillary into the outlet of the outlet valve. Using a torque wrench with a 2.5 mm hex bit, set 3 Nm and close the hex screw at the top of the outlet.
9 Maintenance
Replacing the Outlet Valve

7 Open the shut off valves and purge the system to remove air.
Replacing the Solvent Selection Valve (SSV)

When
In case of problems with the solvent selection valve

Parts required

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4280-60029</td>
<td>Solvent selection valve</td>
</tr>
<tr>
<td>4</td>
<td>G4220-60035</td>
<td>Tubing kit 140 mm, 2/pk SSV to shutoff valve or degassing unit</td>
</tr>
</tbody>
</table>

1. Close shut-off valve. Remove tubing connections between the SSV and the solvent shut-off valves and the SSV and the degassing unit inlets.

2. Push down the SSV panel for removing it.
3 Remove the connector by pushing up the small clip at the bottom of the connector.

4 Install a new SSV by inserting the connector and clipping the SSV panel to the module top panel. Then re-install all tubing connections, open shut-off valve and purge valve.
Changing configuration or replacing the Jet Weaver

When
For optimizing the pump configuration to mixing performance or low delay volumes/fast gradients, see chapter *Optimizing Performance*.

**Tools required**

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8710-0510</td>
<td>¼ inch wrench</td>
</tr>
<tr>
<td></td>
<td>3 mm hex key</td>
</tr>
</tbody>
</table>

**Parts required**

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4220-60006</td>
<td>Jet Weaver 35 µL/100 µL</td>
</tr>
<tr>
<td>1</td>
<td>G4220-60012</td>
<td>Jet Weaver 380 µL (OPTIONAL)</td>
</tr>
<tr>
<td>1</td>
<td>G4220-87000</td>
<td>Capillary ST 0.17 mm x 300 mm Valve to Jet Weaver</td>
</tr>
</tbody>
</table>
9 Maintenance
Changing configuration or replacing the Jet Weaver

1 Remove capillary connections from the Jet Weaver.

2 Remove the hex screws that fix the Jet Weaver to the pump housing.

**NOTE**
The standard Jet Weaver (Jet Weaver 35 µL/ 100 µL (G4220-60006)) has a front and a rear side with different internal volumes (35 / 100 µL) that are optimized for a low delay volume or best mixing performance. Please refer to recommendations in the Agilent 1290 Infinity System Manual.

The optional Jet Weaver (Jet Weaver 380 µL (G4220-60012)) is recommended for applications which are challenging with respect to mixing noise (e.g. TFA applications) and has just one side.
3. Install new Jet Weaver or flip the Jet Weaver for backside.

4. Reinstall the capillary connections.

The inlet at the bottom of the Jet Weaver is connected to the central port of the pump valve by a capillary (length 300 mm, 0.17 mm i.d.). The outlet at the top is connected to the autosampler.
9 Maintenance
Replacing the Seal Wash Pump

Replacing the Seal Wash Pump

When
In case of wear of the seal wash pump

Parts required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5042-8507</td>
<td>Peristaltic Pump for Seal Wash</td>
</tr>
</tbody>
</table>

Preparations
Remove the shutoff valve panel ("Replacing the Shutoff Valve Panel" on page 141) and flow connections from and to the seal wash pump

1. For removing the seal wash pump, press the clips (1) and pull the pump to the front (2).

2. Insert the pump clips to the holes in the binary pump housing.
Releasing a Stuck Inlet Valve

When

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

NOTE

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

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

2. Unscrew the tubing at the inlet valve.
9 Maintenance
Releasing a Stuck Inlet Valve

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

4 Reconnect tubing to inlet valve.

5 Unscrew tubing at degassing unit and attach the syringe to it.

6 Push solvent with syringe until it comes out at the top of the High Pressure Filter Assembly.
7 Detach the syringe and reconnect the tubing into the degassing unit.

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

9 Purge the system to remove air.
Remove the Pump Head Assembly

### Tools required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G7120-68708</td>
<td>HPLC System Tool Kit-Infinity-II</td>
</tr>
</tbody>
</table>

**NOTE**

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

One pump head assembly consists of two pump heads, which are both removed at the same time.

1. In Lab Advisor go to **Service & Diagnostics > Remove/Install Pump Head** and follow instructions given on the screen.
2. Close the shut-off valve of the respective pump channel.
### Remove the Pump Head Assembly

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Remove the flow connection between the degassing unit and the primary pump head inlet. Remove the capillary connection at the top of the secondary pump head to the pump valve. Remove the seal wash tubings. <strong>DO NOT REMOVE</strong> the capillary connection between the pump heads marked by the red X.</td>
</tr>
<tr>
<td>4</td>
<td>Loosen the inlet valve. Keep the inlet valve installed to the pump head assembly.</td>
</tr>
<tr>
<td>5</td>
<td>Counter the lock screw of the heat exchanger capillary while loosening the outlet valve. Keep the outlet valve installed to the pump head assembly.</td>
</tr>
<tr>
<td>6</td>
<td>Loosen the high pressure filter. Keep the filter installed to the pump head assembly.</td>
</tr>
</tbody>
</table>
9 Maintenance
Remove the Pump Head Assembly

7 Open the 4 screws holding the pump heads.

8 Remove the complete pump head assembly by holding it with both hands and pulling it to the front.

NOTE
Open all screws step by step, not screw by screw.

9 Remove the seal wash tubing interconnecting the two pump heads.
Pump Head Maintenance (Tool Free)

1290 Infinity II Flexible Pumps (G7104A) and 1290 Infinity II High Speed Pumps (G7120A) are equipped with LongLife Pump Heads.

LongLife Pump Heads offer a significantly increased lifetime of pistons and seals compared to other pump heads.

Maintenance of LongLife Pump Heads requires no special tool.

The following procedures explain the maintenance of LongLife Pump Heads.

Please refer to 1290 Infinity II Easy Maintenance Pump Head Technical Note (01200-90120) for instructions on maintenance of Easy Maintenance Pump Heads, or to Agilent 1290 Infinity Pump Head Maintenance Technical Note (G4220-90122) for instructions on maintenance of classical pump heads.
Disassemble Pump Heads

This procedure shows how to open the pump head assembly, exchange seals, and clean pistons.

Exchanging seals and cleaning pistons is exemplarily shown for the primary pump head, but works in the same way for the secondary pump head.

<table>
<thead>
<tr>
<th>Tools required</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G7120-68708</td>
<td>HPLC System Tool Kit-Infinity-II</td>
<td></td>
</tr>
<tr>
<td>5043-1400</td>
<td>Pump Head Holder</td>
<td></td>
</tr>
<tr>
<td>5067-6197</td>
<td>Seal Handling Device</td>
<td></td>
</tr>
<tr>
<td>5061-5896</td>
<td>Abrasive paper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Isopropanol</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE** Seals must be exchanged and pistons must be cleaned in both primary and secondary pump heads.

1. Counter the outlet valve while opening the lock screw of the heat exchanger capillary.
2. Remove the heat exchanger capillary by pushing the connector up and pulling it out of the valve.

**NOTE** A gold seal between outlet valve and heat exchanger capillary is used for a tight connection.
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Turn the pump head assembly upside down.</td>
</tr>
<tr>
<td>4</td>
<td>Remove the link plate by gently pulling it off the pump head assembly.</td>
</tr>
<tr>
<td>5</td>
<td>Remove the inlet valve and the outlet valve from the primary pump head.</td>
</tr>
<tr>
<td>6</td>
<td>Binary/High Speed Pumps only: Remove the high pressure filter from the secondary pump head.</td>
</tr>
</tbody>
</table>

**NOTE**

Clean the valves by sonication, if appropriate. A good cleaning solution is 50 % isopropanol in water.
9 Maintenance
Pump Head Maintenance (Tool Free)

7 Place the two pump heads in the Pump Head Holder.

8 Remove the pump head screws from the back of the pump heads.

9 Open the pump heads and remove the piston housings from the pump chambers.

10 Remove the piston by pressing it out of the seal holder with a finger.

11 Remove the seal holder from the spring housing.

12 Screw the pin of the seal handling device into the piston seal.
<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Pull out the Seal Handling Device with the piston seal in a straight movement with only gentle force.</td>
</tr>
<tr>
<td>14</td>
<td>Repeat for the other pump chamber.</td>
</tr>
<tr>
<td>15</td>
<td>Screw the pin of the seal handling device into the wash seal.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
<td>The seal holder has two different sides. The black backup ring is supporting the piston seal and must not be removed. The side with the backup ring has a bigger diameter and a sharp edge to hold the piston seal. The other side has no sharp edge and holds the smaller wash seal.</td>
</tr>
<tr>
<td>16</td>
<td>Pull out the Seal Handling Device with the wash seal in a straight movement with only gentle force.</td>
</tr>
</tbody>
</table>
9 Maintenance
Pump Head Maintenance (Tool Free)

17 Repeat for the other seal holder.

18 Clean the piston with abrasive paper.

19 Rinse pump heads and pistons with isopropanol.
Replace the Heat Exchanger

**Tools required**

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrench, 19 mm</td>
<td>5023-2501 Screwdriver Torx-T10</td>
</tr>
<tr>
<td>5067-5688</td>
<td>Torque wrench 1 – 25 Nm with 14 mm wrench</td>
</tr>
<tr>
<td>G4220-20013</td>
<td>4 mm hex bit</td>
</tr>
<tr>
<td>G4220-20015</td>
<td>Adapter ¼ in square to hex</td>
</tr>
<tr>
<td>G4220-20041</td>
<td>Bit Torx 10x25 mm</td>
</tr>
</tbody>
</table>

**Parts required**

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4220-81013 Heat Exchanger Channel A (secondary pump head only)</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td>G4220-81012 Heat Exchanger Channel B (secondary pump head only)</td>
<td></td>
</tr>
</tbody>
</table>

**Preparations**

- Remove the pump head assembly from the pump
- Remove the secondary pump head from the link plate

**CAUTION**

Loss of small spacer fitting

Inside the secondary pump head is a small spacer fitting, which can be dropped easily when removing the heat exchanger.

→ The heat exchanger does not need to be removed for pump head maintenance.

1. Remove the 19 mm screw at the front of the secondary pump head.
2. Remove the front plate.
### 9 Maintenance

#### Pump Head Maintenance (Tool Free)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Remove the screw at the bottom of the pump head. Do not drop the golden spacer fitting.</td>
</tr>
<tr>
<td><img src="image1.png" alt="Screw" /></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Lift out the heat exchanger.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Lift out heat exchanger" /></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>If removed, first insert the spacer fitting. Then insert the new heat exchanger to the opening in the pump head and lift it over the pins.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Pins" /></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Use the 19 mm screw for fixing the front plate.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Front plate" /></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Insert and fix the screw.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Screw" /></td>
<td>3 Nm</td>
</tr>
</tbody>
</table>
Assemble Pump Heads

This procedure shows how to exchange seals, and reassemble the pump head assembly.

Exchanging seals is exemplarily shown for the primary pump head, but works in the same way for the secondary pump head.

### Tools required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G7120-68708</td>
<td>HPLC System Tool Kit-Infinity-II</td>
</tr>
<tr>
<td>5067-5688</td>
<td>Torque wrench 1 – 25 Nm with 14 mm wrench</td>
</tr>
<tr>
<td>G4220-20013</td>
<td>4 mm hex bit</td>
</tr>
<tr>
<td>G4220-20015</td>
<td>Adapter ¼ in square to hex</td>
</tr>
<tr>
<td>G4220-20041</td>
<td>Bit Torx 10x25 mm</td>
</tr>
<tr>
<td>5043-1400</td>
<td>Pump Head Holder</td>
</tr>
<tr>
<td>5067-6197</td>
<td>Seal Handling Device</td>
</tr>
<tr>
<td></td>
<td>Isopropanol</td>
</tr>
</tbody>
</table>

### Parts required

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0905-1719</td>
<td>PE Seal</td>
</tr>
<tr>
<td>2</td>
<td>0905-1175</td>
<td>Wash seal (PTFE)</td>
</tr>
</tbody>
</table>

**NOTE**
Seals must be exchanged in both primary and secondary pump heads.
### 9 Maintenance
#### Pump Head Maintenance (Tool Free)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lubricate the seals, the seal holder, and the pump chambers with isopropanol.</td>
</tr>
<tr>
<td>2</td>
<td>Place the piston seal onto the designated nose of the Seal Handling Device. The metal spring of the piston seal must be visible.</td>
</tr>
<tr>
<td>3</td>
<td>Take care that the Seal Handling Device is seating flush and press the seal into the pump chamber.</td>
</tr>
<tr>
<td>4</td>
<td>Repeat for the other pump chamber.</td>
</tr>
</tbody>
</table>
5 Place the seal holder onto the pump chamber.

**NOTE**
Mind the correct orientation of the seal holder. The backup ring must face down.

6 Place the wash seal onto the designated nose of the Seal Handling Device. The metal spring of the wash seal must be visible.

**NOTE**
The Seal Handling Device has a cavity to fit over the pins of the seal wash tubings.

7 Take care that the Seal Handling Device is seating flush and press the wash seal into the seal holder.

8 Repeat for the other seal holder.
### Maintenance

#### Pump Head Maintenance (Tool Free)

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Remove the seal holders from the pump chambers.</td>
</tr>
<tr>
<td>10</td>
<td>Lubricate the piston with isopropanol and place it into the spring housing.</td>
</tr>
<tr>
<td>11</td>
<td>Place the seal holder onto the spring housing.</td>
</tr>
<tr>
<td>12</td>
<td>Place the assembled spring housings on top of the pump chambers.</td>
</tr>
</tbody>
</table>

**NOTE**

Mind the correct orientation: The backup ring must face upwards and the seal holder must sit correctly.

**NOTE**

Both spring housings are identical, there is no risk when mixing them, but make sure that the seal holder is oriented correctly.
13 Place the screws into the pump heads and loosely tighten them in a crosswise manner.

**NOTE**
The spring housing will tilt slightly when the first screw is hand tightened. Stop at this point and continue to tighten the three other screws in a crosswise manner.

14 Mind the correct orientation of the link plate and click it into place.

**NOTE**
The Pump Head Holder has a marker to illustrate the correct placement of the link plate. The link plate holds an identification tag; this has to be placed onto the correct position to be readable by the pump.

15 Tighten the pump head screws with a torque wrench set to 5 Nm in a crosswise manner.

**NOTE**
When the wrench clicks, the set torque is reached. Do not overtighten the screws.

16 Mount the pump head to the module. Do not fix the screws at this stage!
**9 Maintenance**

**Pump Head Maintenance (Tool Free)**

17 Screw in the inlet valve and the outlet valve and fix them with a torque wrench set to 10 Nm.

18 Binary/High Speed Pumps only: Screw in the high pressure filter and fix it with a torque wrench set to 16 Nm.

19 Remove the pump head from the module again.

20 Position the entrance slit for the heat exchanger capillary to face exactly to it, and then seat the heat exchanger capillary back into the outlet valve by moving it into the valve and pressing it down.

21 Counter the outlet valve and tighten the lock screw of the heat exchanger capillary with a torque wrench set to 3 Nm.

22 Attach the seal wash tubing interconnecting the two pump heads.
23 Insert the screws that later fix the pump head assembly to the module housing.
Install the Pump Head Assembly

Tools required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G7120-68708</td>
<td>HPLC System Tool Kit-Infinity-II</td>
</tr>
<tr>
<td>5067-5688</td>
<td>Torque wrench 1 – 25 Nm with 14 mm wrench</td>
</tr>
<tr>
<td>G4220-20013</td>
<td>4 mm hex bit</td>
</tr>
<tr>
<td>G4220-20015</td>
<td>Adapter ¼ in square to hex</td>
</tr>
</tbody>
</table>

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

2 Install the pump head assembly by fixing the 4 screws using a 4 mm hex key and a torque wrench, which are included to the 1290 Infinity Service Kit p/n 5067-4699 set to 5 Nm. Install screws step by step, not screw by screw.

CAUTION

Damage to the pump head
Using a wrong torque will damage the pump head.

For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.
Install flow connections.
- Connect the degassing unit outlet to the inlet of the primary pump head and the outlet of the secondary pump head to the inlet of the purge valve.
- Channel A (left pump head assembly) is connected to port 4, channel B (right pump head assembly) to port 1.

Next Steps:

4. Replace the seal wash tubes.
5. Open the shut-off valves.
6. Perform a Pump Leak Rate Test.
Replacing the Purge Valve Head

When

In case of problems with the purge valve

<table>
<thead>
<tr>
<th>Parts required</th>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>5067-4119</td>
<td>Purge valve head</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5067-4655</td>
<td>Capillary ST, 0.25 mm x 235 mm to pump head assemblies channel A and B (2x)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>G4220-87000</td>
<td>Capillary ST 0.17 mm x 300 mm Valve to Jet Weaver</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5067-4656</td>
<td>Capillary ST, 0.25 mm x 80 mm to pressure sensor (2x)</td>
</tr>
</tbody>
</table>

Preparations

Remove all capillary connections to the purge valve

**CAUTION**

Potential damage of valve head or malfunction of valve

When the pump is switched on, the valve tag is accessed (read/write) and used for correctly positioning the valve.

If the valve head is replaced while the pump is on, invalid information may be written to the valve head making it unusable, or positioning may be wrong resulting in wrong flow connections inside the valve potentially damaging parts.

➔ Switch off the pump before working on the purge valve.

**CAUTION**

Bias measurement results

The valve drive contains sensitive optical parts. Pollution of these parts can impair the accurate selection of valve ports and therefore bias measurement results.

➔ Protect the optical parts from dust and other pollutions.
1 Remove all capillary connections. Then unscrew the black union nut and remove the head of the purge valve by pulling it to the front.

2 Put the new valve head onto the valve drive such that the lobe fits to the groove. Screw the valve head onto the valve drive using the union nut.
9 Maintenance
Replacing the Purge Valve Head

3 Install all flow connections:
   - Port 1 is connected to the outlet of the secondary pump head of channel B
   - Port 2 is connected to the outlet of the pressure sensor
   - Port 3 is connected to the inlet of the pressure sensor
   - Port 4 is connected to the outlet of the secondary pump head of channel A
   - Ports 5 and 6 are connected to waste capillaries
   - The central port is connected to the Jet Weaver inlet
Replacing Parts of the High Pressure Filter Assembly

When

For removing blockages and leaks in the high pressure filter assembly. The filter frit in the outlet valve should be replaced regularly depending on the system usage.

Tools required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5067-5688</td>
<td>Torque wrench 1 – 25 Nm with 14 mm wrench</td>
</tr>
<tr>
<td>8710-0510</td>
<td>Wrench open 1/4 — 5/16 inch</td>
</tr>
</tbody>
</table>

Parts required

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5067-4728</td>
<td>Seal cap</td>
</tr>
<tr>
<td>01018-22707</td>
<td>PTFE frits (pack of 5)</td>
</tr>
</tbody>
</table>

CAUTION

Leakage or damaged connection

Opening the outlet of the primary pump head may cause leaks or damage the connection between the pump heads.

➔ Do not open the outlet of the primary pump head.

NOTE

This procedure describes replacements for channel A (left pump head assembly) and can be applied accordingly to channel B. In both cases, maintenance is done only at the secondary pump head outlet, which hosts the filter frit.

NOTE

When replacing a PTFE frit, consider replacing the seal cap as well in order to prevent leaks.
9 Maintenance
Replacing Parts of the High Pressure Filter Assembly

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

2. Use a 14 mm hex wrench for opening the filter assembly of the secondary pump head.

3. Replace the filter frit and seal cap as desired. Please note the correct orientation of the filter frit.

4. Re-install the filter assembly using the torque wrench (14 mm hex bit) set to 16 Nm.

Hole
Filter frit
Seal cap
Installing the Valve Rail Kit

When
This rail is needed for the installation of external valves

Tools required
Description
Pozidrive screwdriver #1

Parts required
<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5067-4634</td>
<td>Valve Rail Kit</td>
</tr>
</tbody>
</table>

NOTE
The rail can be installed on the left or right side of the pump. This procedure describes the installation on the left side and applies similarly to the right side.

1. The valve rail is fixed to the pump cover by 4 screws. The position of the lower screws is marked on the module cover. First tighten these screws, and then tighten the upper screws.
Replacing the Main Power Fuses

**When**
If the main power LED is off while the main power button is pressed (see ).

**Tools required**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat head screwdriver</td>
</tr>
</tbody>
</table>

**Parts required**

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2110-1004</td>
<td>Fuse 10 A t</td>
</tr>
</tbody>
</table>

**Preparations**
Switch off the instrument and unplug the main power cable.

**WARNING**

**Fire hazard**

**Using wrong fuses can result in fire hazard.**

→ For continued protection against fire hazard, replace line fuses only with the same type and ratings.

→ Only use the fuses specified for this instrument. The use of other fuses or materials is prohibited.

**NOTE**

There are more fuses inside the instrument.

If replacing the main power fuse does not resolve the issue, please contact your Agilent service representative.
1 Use a screwdriver for removing the main fuse carrier from the compartment next to the main power plug. Remove the fuse from the carrier.

2 Install the new fuse 10A to the carrier and insert the carrier to the fuse compartment.
Replacing Module Firmware

When

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

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

Tools required

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN/RS-232 Firmware Update Tool</td>
</tr>
<tr>
<td>OR Agilent Lab Advisor software</td>
</tr>
<tr>
<td>OR Instant Pilot G4208A</td>
</tr>
<tr>
<td>(only if supported by module)</td>
</tr>
</tbody>
</table>

Parts required # Description

1 Firmware, tools and documentation from Agilent web site

Preparations

Read update documentation provided with the Firmware Update Tool.

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

1 Download the required module firmware, the latest LAN/RS-232 FW Update Tool and the documentation from the Agilent web.

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.
Preparing the Pump Module for Transport

When

If the module shall be transported or shipped.

Parts required

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9301-0411</td>
<td>Syringe; Plastic</td>
</tr>
<tr>
<td>1</td>
<td>9301-1337</td>
<td>Syringe adapter</td>
</tr>
<tr>
<td>1</td>
<td>G4220-44000</td>
<td>Protective Foam</td>
</tr>
</tbody>
</table>

Preparations

Flush both solvent channels with isopropanol.

**CAUTION**

Mechanical damage

➔ For shipping the module, insert the Protective Foam to protect the module from mechanical damage.

➔ Be careful not to damage tubing or capillary connections while inserting the module in the Protective Foam.

1 Remove solvent inlets from solvent reservoirs. Disconnect the solvent tubing from the inlet of primary pump heads for both solvent channels. Use a syringe for removing liquid from the solvent tubings between solvent reservoir, shutoff valve panel, solvent selection valve, degassing unit and pump inlets. Switch the solvent selection valve if applicable.
9 Maintenance
Preparing the Pump Module for Transport

2. Remove tubing and capillary connections to other modules and the solvent cabinet. Remove tubing plugs.
3 Remove the shutoff valve panel by pulling it downwards.

4 You may keep internal tubing and capillary connections.

5 Remove cable connections to other modules. Remove the module from the stack.
9 Maintenance
Preparing the Pump Module for Transport

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

7 Close the front cover.

8 For transport or shipment, put the module and accessory kit to the original shipment box.
10 Parts and Materials for Maintenance

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  Pump Head Assembly Parts 200
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  Secondary Pump Head Parts 203
Purge Valve 204
Cover Parts 206
Leak Parts 208
Fuses 209
Accessory Kit 210
Tools 211
HPLC System Tool Kit 214

This chapter provides information on parts for maintenance.
Overview of Maintenance Parts

Figure 19  Overview of main assemblies
### Parts and Materials for Maintenance

#### Overview of Maintenance Parts

<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4220-60006</td>
<td>Jet Weaver 35 µL/100 µL</td>
</tr>
<tr>
<td></td>
<td>G4220-60012</td>
<td>Jet Weaver 380 µL (OPTIONAL)</td>
</tr>
<tr>
<td>2</td>
<td>G4280-60029</td>
<td>Solvent selection valve</td>
</tr>
<tr>
<td>3</td>
<td>5065-4445</td>
<td>Peristaltic pump with Pharmed tubing</td>
</tr>
<tr>
<td>4</td>
<td>G4220-60001</td>
<td>Pressure sensor 1200 bar</td>
</tr>
<tr>
<td>5</td>
<td>5067-4119</td>
<td>Purge valve head</td>
</tr>
<tr>
<td>6</td>
<td>G4220-60350</td>
<td>LongLife Pump Head Channel A</td>
</tr>
<tr>
<td>7</td>
<td>G4220-60360</td>
<td>LongLife Pump Head Channel B</td>
</tr>
</tbody>
</table>
Flow Connections

Figure 20  Flow connections of the pump
### Flow Connections

<table>
<thead>
<tr>
<th>Item</th>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>5067-4661</td>
<td>Tubing kit 270 mm for connection of degassing unit to inlet valve (set of 2 tubes)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>5067-4655</td>
<td>Capillary ST, 0.25 mm x 235 mm purge valve to pump head assemblies channel A and B, 2x</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>5067-4656</td>
<td>Capillary ST, 0.25 mm x 80 mm purge valve to pressure sensor, 2x</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>G4220-87000</td>
<td>Capillary ST 0.17 mm x 300 mm Valve to Jet Weaver</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>5065-4445</td>
<td>Peristaltic pump with Pharmed tubing</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5065-9978</td>
<td>Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>G4220-40004</td>
<td>Shutoff valve panel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5067-4124</td>
<td>Shutoff valve</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>G4220-60035</td>
<td>Tubing kit 140 mm, 2/pk SSV to shutoff valve or degassing unit</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>G4220-60007</td>
<td>Bottle Head Assembly</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>G4220-68070</td>
<td>Ultra Clean Tubing Kit (includes bottle head assemblies and tubing connections within the pump)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>G4220-60070</td>
<td>Tubing Kit 140 mm - Ultra Clean Tubing (tubes from SSV to shutoff valve or degassing unit to MCGV)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>G4220-60017</td>
<td>Bottle Head Assembly Ultra Clean Tubing (bottle heads and tubing to shutoff panel/degasser)</td>
</tr>
</tbody>
</table>
## Solvent Cabinet Kit

<table>
<thead>
<tr>
<th>Item</th>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>5067-4644</td>
<td>Solvent Cabinet Kit 1290 Infinity Pump includes the following parts:</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>5065-9981</td>
<td>Solvent cabinet 1200 Infinity, including all plastic parts</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>9301-1420</td>
<td>Solvent bottle, transparent</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>9301-1450</td>
<td>Solvent bottle, amber</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>5067-4124</td>
<td>Shutoff valve</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>G4220-60007</td>
<td>Bottle Head Assembly</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>G4220-60035</td>
<td>Tubing kit 140 mm, 2/pk SSV to shutoff valve or degassing unit</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>G4220-40004</td>
<td>Shutoff valve panel</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>5042-9967</td>
<td>Tubing clip (set of 5 clips)</td>
</tr>
</tbody>
</table>
Seal Wash Option

![Seal wash pump](image)

**Figure 21** Seal wash pump

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5065-4445</td>
<td>Peristaltic pump with Pharmed tubing</td>
</tr>
<tr>
<td>5065-9978</td>
<td>Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m</td>
</tr>
</tbody>
</table>
Pump Heads

The following pages contain parts information for LongLife Pump Heads. For parts information on other pump head types, please refer to 1290 Infinity II Easy Maintenance Pump Head Technical Note (01200-90120) and to Agilent 1290 Infinity Pump Head Maintenance Technical Note (G4220-90122).

Pump Head Assembly Parts

Figure 22  Pump head assembly parts
<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G4220-60660</td>
<td>Secondary Pump Head AY SW Easy Pendulum</td>
</tr>
<tr>
<td>2</td>
<td>G4220-60661</td>
<td>Primary Pump Head AY SW Easy Pendulum</td>
</tr>
<tr>
<td>3</td>
<td>G4204-60022</td>
<td>Inlet Valve 1290 Infinity Quaternary Pump</td>
</tr>
<tr>
<td>4</td>
<td>G4220-60028</td>
<td>Outlet valve (primary pump head)</td>
</tr>
<tr>
<td></td>
<td>G4220-20020</td>
<td>Internal gold seal for Outlet Valve (not shown)</td>
</tr>
<tr>
<td>5</td>
<td>5042-9966</td>
<td>Cap Outlet Valve</td>
</tr>
<tr>
<td>6</td>
<td>G1312-60001</td>
<td>Adapter</td>
</tr>
<tr>
<td>7</td>
<td>G4220-81013</td>
<td>Heat Exchanger</td>
</tr>
<tr>
<td>8</td>
<td>G4220-40001</td>
<td>Link Plate</td>
</tr>
<tr>
<td>9</td>
<td>0960-2971</td>
<td>RF Transponder</td>
</tr>
</tbody>
</table>
## Primary Pump Head Parts

Primary Pump Head AY SW Easy Pendulum (G4220-60661)

<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5067-5975</td>
<td>Plunger Assy ZRO2 Duct</td>
</tr>
<tr>
<td>2</td>
<td>0515-6154</td>
<td>Screw- Socket-HD-Cap Hex-Recess M5X0.8 40</td>
</tr>
<tr>
<td>3</td>
<td>G4220-60046</td>
<td>Preload-Support Assembly easy</td>
</tr>
<tr>
<td>4</td>
<td>0905-1175</td>
<td>Wash seal (PTFE)</td>
</tr>
<tr>
<td>5</td>
<td>G4220-60616</td>
<td>Seal Holder Integrated Assembly EASY</td>
</tr>
<tr>
<td>6</td>
<td>0905-1719</td>
<td>PE Seal</td>
</tr>
<tr>
<td>7</td>
<td>G4220-60533</td>
<td>Primary Head Assembly Q easy</td>
</tr>
</tbody>
</table>
Secondary Pump Head Parts

Secondary Pump Head AY SW Easy Pendulum (G4220-60660)

<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5067-5975</td>
<td>Plunger Assy ZRO2 Duct</td>
</tr>
<tr>
<td>2</td>
<td>0515-6154</td>
<td>Screw-Socket-HD-Cap Hex-Recess M5X0.8 40</td>
</tr>
<tr>
<td>3</td>
<td>G4220-60046</td>
<td>Preload-Support Assembly easy</td>
</tr>
<tr>
<td>4</td>
<td>0905-1175</td>
<td>Wash seal (PTFE)</td>
</tr>
<tr>
<td>5</td>
<td>G4220-60616</td>
<td>Seal Holder Integrated Assembly EASY</td>
</tr>
<tr>
<td>6</td>
<td>0905-1719</td>
<td>PE Seal</td>
</tr>
<tr>
<td>7</td>
<td>G4220-25513</td>
<td>Body Head Secondary easy</td>
</tr>
<tr>
<td>8</td>
<td>G4220-20001</td>
<td>Spacer Fitting</td>
</tr>
<tr>
<td>9</td>
<td>G4220-20028</td>
<td>Headless screw for 1290 Infinity pump heads</td>
</tr>
<tr>
<td>10</td>
<td>G4220-20000</td>
<td>LID</td>
</tr>
<tr>
<td>11</td>
<td>G4220-20003</td>
<td>Pump Head Screw</td>
</tr>
</tbody>
</table>
10 Parts and Materials for Maintenance

Purge Valve

Figure 23 Purge valve parts
<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5067-4119</td>
<td>Purge valve head</td>
</tr>
<tr>
<td>1</td>
<td>1535-4857</td>
<td>Stator screws</td>
</tr>
<tr>
<td>2</td>
<td>5068-0004</td>
<td>Purge Valve Stator</td>
</tr>
<tr>
<td>3</td>
<td>5068-0005</td>
<td>Purge Valve Rotor Seal, polyimide, 1200 bar</td>
</tr>
<tr>
<td>4</td>
<td>1535-4045</td>
<td>Bearing ring</td>
</tr>
</tbody>
</table>
Cover Parts

Figure 24  Cover Parts

Tubing grommet

Figure 25  Tubing plug and tubing grommet
## Parts and Materials for Maintenance

### Cover Parts

<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5067-4613</td>
<td>Cabinet Kit (Side Covers left/right, Top Cover, tubing Plug, Base Cover and Leak Seal)</td>
</tr>
<tr>
<td>2</td>
<td>5042-9949</td>
<td>Tubing Plug, Plastic</td>
</tr>
<tr>
<td></td>
<td>5042-9972</td>
<td>Tubing grommet</td>
</tr>
<tr>
<td>3</td>
<td>5067-4612</td>
<td>Front Cover 1290 Infinity Binary Pump</td>
</tr>
<tr>
<td>4</td>
<td>5067-4634</td>
<td>Valve Rail Kit</td>
</tr>
</tbody>
</table>
Leak Parts

Figure 26  Leak funnel

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5041-8388</td>
<td>Leak funnel</td>
</tr>
</tbody>
</table>
### Fuses

<table>
<thead>
<tr>
<th>Item</th>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2110-1004</td>
<td>Fuse 10 A t</td>
</tr>
</tbody>
</table>
## Accessory Kit

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4220-68705</td>
<td>Accessory kit</td>
</tr>
<tr>
<td>5042-9974</td>
<td>Tubing Flex (1.5 m)</td>
</tr>
<tr>
<td>8710-0510</td>
<td>Wrench open 1/4 — 5/16 inch</td>
</tr>
<tr>
<td>8710-1924</td>
<td>Wrench open 14 mm</td>
</tr>
<tr>
<td>5023-0240</td>
<td>Hex driver, ¼”, slitted</td>
</tr>
<tr>
<td>8710-2392</td>
<td>Hex key 4 mm15 cm long T-handle</td>
</tr>
<tr>
<td>9301-0411</td>
<td>Syringe; Plastic</td>
</tr>
<tr>
<td>9301-1337</td>
<td>Syringe adapter</td>
</tr>
<tr>
<td>5067-4657</td>
<td>Capillary ST, 0.17 mm x 300 mm Pump to Autosampler</td>
</tr>
<tr>
<td>5067-4658</td>
<td>SST Capillary 450 x 0.17 mm, Pump to Thermostatted Autosampler</td>
</tr>
<tr>
<td>0100-1710</td>
<td>Mounting Tool for Tubing Connections</td>
</tr>
<tr>
<td>G4220-67000</td>
<td>Waste tubes</td>
</tr>
<tr>
<td>8710-1534</td>
<td>Wrench, 4 mm both ends, open end</td>
</tr>
<tr>
<td>5065-9978</td>
<td>Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m for seal wash option</td>
</tr>
<tr>
<td>5181-1519</td>
<td>CAN cable, Agilent module to module, 1 m</td>
</tr>
<tr>
<td>01018-22707</td>
<td>PTFE frits (pack of 5)</td>
</tr>
<tr>
<td>01018-23702</td>
<td>Insert tool</td>
</tr>
<tr>
<td>5042-9972</td>
<td>Tubing grommet</td>
</tr>
</tbody>
</table>
## Tools

<table>
<thead>
<tr>
<th>Item</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5067-4699</td>
<td>1290 Infinity pump service kit</td>
</tr>
<tr>
<td>1</td>
<td>G4220-20012</td>
<td>Torque wrench 2 – 25 Nm</td>
</tr>
<tr>
<td>2</td>
<td>G4220-20013</td>
<td>4 mm hex bit</td>
</tr>
<tr>
<td>3</td>
<td>G4220-20014</td>
<td>2.5 mm Hex Bit</td>
</tr>
<tr>
<td>4</td>
<td>G4220-20015</td>
<td>Adapter ¼ in square to hex</td>
</tr>
<tr>
<td></td>
<td>5023-0285</td>
<td>Replacement kit for 1290 Infinity pump head alignment tool (piston/handle)</td>
</tr>
<tr>
<td></td>
<td>G4220-44000</td>
<td>Protective Foam</td>
</tr>
<tr>
<td></td>
<td>G6500-88888</td>
<td>Hexalobular Key Set</td>
</tr>
<tr>
<td></td>
<td>8710-0803</td>
<td>Wrench 9/16 inch, 7/16 inch</td>
</tr>
</tbody>
</table>

The 1290 Infinity pump service kit (5067-4699) includes pump head alignment tool and items 1 – 4.
10 Parts and Materials for Maintenance
Tools

Figure 27 Pump head alignment tool

Alignment piston

Tool handle

Figure 28 Replacement kit for 1290 Infinity pump head alignment tool (piston/handle)
Figure 29  HPLC System Tool Kit
HPLC System Tool Kit

The HPLC System Tool Kit (G4203-68708) contains some accessories and tools needed for installation and repair of the module.

<table>
<thead>
<tr>
<th>#</th>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0100-1681</td>
<td>Adapter syringe/seal wash tube</td>
</tr>
<tr>
<td>1</td>
<td>0100-1710</td>
<td>Mounting Tool for Tubing Connections</td>
</tr>
<tr>
<td>1</td>
<td>01018-23702</td>
<td>Insert tool</td>
</tr>
<tr>
<td>1</td>
<td>5023-0240</td>
<td>Hex driver, ¼”, slitted</td>
</tr>
<tr>
<td>1</td>
<td>8710-0060</td>
<td>Hex-key wrench, 9/64 inch</td>
</tr>
<tr>
<td>2</td>
<td>8710-0510</td>
<td>Wrench open 1/4 — 5/16 inch</td>
</tr>
<tr>
<td>1</td>
<td>8710-0641</td>
<td>Hex key set 1 – 5 mm</td>
</tr>
<tr>
<td>1</td>
<td>8710-0899</td>
<td>Pozidriv screwdriver</td>
</tr>
<tr>
<td>1</td>
<td>8710-1534</td>
<td>Wrench, 4 mm both ends, open end</td>
</tr>
<tr>
<td>1</td>
<td>8710-1924</td>
<td>Wrench open 14 mm</td>
</tr>
<tr>
<td>1</td>
<td>8710-2392</td>
<td>Hex key 4 mm 15 cm long T-handle</td>
</tr>
<tr>
<td>1</td>
<td>8710-2393</td>
<td>Hex key 1.5 mm, straight handle 10 cm</td>
</tr>
<tr>
<td>1</td>
<td>8710-2394</td>
<td>Hex key 9/64 inch 15 cm long T-handle</td>
</tr>
<tr>
<td>1</td>
<td>8710-2409</td>
<td>Wrench open end, 5/16 – 3/8 inch</td>
</tr>
<tr>
<td>1</td>
<td>8710-2411</td>
<td>Hex key 3 mm 12 cm long</td>
</tr>
<tr>
<td>1</td>
<td>8710-2412</td>
<td>Hex key 2.5 mm, 15 cm long, straight handle</td>
</tr>
<tr>
<td>1</td>
<td>8710-2438</td>
<td>Hex key 2.0 mm</td>
</tr>
<tr>
<td>1</td>
<td>8710-2509</td>
<td>Screwdriver Torx TX8</td>
</tr>
<tr>
<td>1</td>
<td>8710-2594</td>
<td>Double open end wrench 4 mm x 5 mm</td>
</tr>
<tr>
<td>1</td>
<td>9301-0411</td>
<td>Syringe, Plastic</td>
</tr>
<tr>
<td>1</td>
<td>9301-1337</td>
<td>Adapter syringe/solvent tube with fitting</td>
</tr>
</tbody>
</table>
11
Identifying Cables

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RS-232 Cable Kit  226
Agilent 1200 Module to Printer  227

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.

<table>
<thead>
<tr>
<th>Analog cables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p/n</td>
<td></td>
</tr>
<tr>
<td>35900-60750</td>
<td>Agilent module to 3394/6 integrators</td>
</tr>
<tr>
<td>35900-60750</td>
<td>Agilent 35900A A/D converter</td>
</tr>
<tr>
<td>01046-60105</td>
<td>Analog cable (BNC to general purpose, spade lugs)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remote cables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p/n</td>
<td></td>
</tr>
<tr>
<td>03394-60600</td>
<td>Agilent module to 3396A Series I integrators</td>
</tr>
<tr>
<td>03396-61010</td>
<td>Agilent module to 3396 Series III / 3395B integrators</td>
</tr>
<tr>
<td>5061-3378</td>
<td>Remote Cable</td>
</tr>
<tr>
<td>01046-60201</td>
<td>Agilent module to general purpose</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BCD cables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p/n</td>
<td></td>
</tr>
<tr>
<td>03396-60560</td>
<td>Agilent module to 3396 integrators</td>
</tr>
<tr>
<td>G1351-81600</td>
<td>Agilent module to general purpose</td>
</tr>
</tbody>
</table>
### CAN cables

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5181-1516</td>
<td>CAN cable, Agilent module to module, 0.5 m</td>
</tr>
<tr>
<td>5181-1519</td>
<td>CAN cable, Agilent module to module, 1 m</td>
</tr>
</tbody>
</table>

### LAN cables

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5023-0203</td>
<td>Cross-over network cable, shielded, 3 m (for point to point connection)</td>
</tr>
<tr>
<td>5023-0202</td>
<td>Twisted pair network cable, shielded, 7 m (for point to point connection)</td>
</tr>
</tbody>
</table>

### RS-232 cables

<table>
<thead>
<tr>
<th>p/n</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1530-60600</td>
<td>RS-232 cable, 2 m</td>
</tr>
<tr>
<td>RS232-61601</td>
<td>RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called &quot;Null Modem Cable&quot; 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.</td>
</tr>
<tr>
<td>5181-1561</td>
<td>RS-232 cable, 8 m</td>
</tr>
</tbody>
</table>
Analog cables

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

### Agilent Module to 3394/6 Integrators

<table>
<thead>
<tr>
<th>p/n 35900-60750</th>
<th>Pin 3394/6</th>
<th>Pin Agilent module</th>
<th>Signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Not connected</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Shield</td>
<td>Analog -</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Center</td>
<td>Analog +</td>
<td></td>
</tr>
</tbody>
</table>
### Agilent Module to BNC Connector

<table>
<thead>
<tr>
<th>p/n 8120-1840</th>
<th>Pin BNC</th>
<th>Pin Agilent module</th>
<th>Signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shield</td>
<td>Shield</td>
<td>Analog -</td>
</tr>
<tr>
<td></td>
<td>Center</td>
<td>Center</td>
<td>Analog +</td>
</tr>
</tbody>
</table>

### Agilent Module to General Purpose

<table>
<thead>
<tr>
<th>p/n 01046-60105</th>
<th>Pin</th>
<th>Pin Agilent module</th>
<th>Signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>Not connected</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Black</td>
<td>Analog -</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Red</td>
<td>Analog +</td>
</tr>
</tbody>
</table>
Remote Cables

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

### Agilent Module to 3396A Integrators

<table>
<thead>
<tr>
<th>p/n 03394-60600</th>
<th>Pin 3396A</th>
<th>Pin Agilent module</th>
<th>Signal Name</th>
<th>Active (TTL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1 - White</td>
<td>Digital ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>2 - Brown</td>
<td>Prepare run</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 - Gray</td>
<td>Start</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>4 - Blue</td>
<td>Shut down</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>5 - Pink</td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>6 - Yellow</td>
<td>Power on</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>5,14</td>
<td>7 - Red</td>
<td>Ready</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8 - Green</td>
<td>Stop</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>9 - Black</td>
<td>Start request</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>13, 15</td>
<td></td>
<td>Not connected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Agilent Module to 3396 Series II / 3395A Integrators

Use the cable Agilent module to 3396A Series I integrators (03394-60600) and cut pin #5 on the integrator side. Otherwise the integrator prints START; not ready.
## Agilent Module to 3396 Series III / 3395B Integrators

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

#### Remote Cables

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

### Agilent Module to General Purpose

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

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

### Agilent Module to General Purpose

<table>
<thead>
<tr>
<th>p/n G1351-81600</th>
<th>Wire Color</th>
<th>Pin Agilent module</th>
<th>Signal Name</th>
<th>BCD Digit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Green</td>
<td>1</td>
<td>BCD 5</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Violet</td>
<td>2</td>
<td>BCD 7</td>
<td>80</td>
</tr>
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<td>+ 5 V</td>
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## CAN/LAN Cable

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

### CAN Cables

<table>
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<tr>
<th>p/n</th>
<th>Description</th>
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<tbody>
<tr>
<td>5181-1516</td>
<td>CAN cable, Agilent module to module, 0.5 m</td>
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<td>5181-1519</td>
<td>CAN cable, Agilent module to module, 1 m</td>
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### LAN Cables

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<thead>
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<th>Description</th>
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<td>5023-0203</td>
<td>Cross-over network cable, shielded, 3 m (for point to point connection)</td>
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<tr>
<td>5023-0202</td>
<td>Twisted pair network cable, shielded, 7 m (for point to point connection)</td>
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## RS-232 Cable Kit

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<th>Description</th>
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<tr>
<td>G1530-60600</td>
<td>RS-232 cable, 2 m</td>
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<tr>
<td>RS232-61601</td>
<td>RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called &quot;Null Modem Cable&quot; 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.</td>
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<tr>
<td>5181-1561</td>
<td>RS-232 cable, 8 m</td>
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### Agilent 1200 Module to Printer

<table>
<thead>
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<th>p/n</th>
<th>Description</th>
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<td>5181-1529</td>
<td>Cable Printer Serial &amp; Parallel, is a SUB-D 9 pin female vs. Centronics connector on the other end (NOT FOR FW UPDATE). For use with G1323 Control Module.</td>
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</tbody>
</table>
11 Identifying Cables
Agilent 1200 Module to Printer
12

Hardware Information

Firmware Description 230
Electrical Connections 233
  Rear View of the Module 234
Interfaces 235
  Overview Interfaces 238
Setting the 8-bit Configuration Switch 242
  Special Settings 244
Instrument Layout 246
Early Maintenance Feedback 247

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

The firmware of the instrument consists of two independent sections:
- a non-instrument specific section, called *resident system*
- an instrument specific section, called *main system*

**Resident System**

This resident section of the firmware is identical for all Agilent 1100/1200/1220/1260/1290 series modules. Its properties are:
- the complete communication capabilities (CAN, LAN and RS-232C)
- memory management
- ability to update the firmware of the 'main system'

**Main System**

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

In addition the main system comprises the instrument functions that are divided into common functions like
- run synchronization through APG remote,
- error handling,
- diagnostic functions,
- or module specific functions like
  - internal events such as lamp control, filter movements,
  - raw data collection and conversion to absorbance.
**Firmware Updates**

Firmware updates can be done using the following tools (latest version should be used):

- Agilent Lab Advisor software with files on the hard disk (*)
- Firmware Update Tool with local files on the hard disk (*)
- Instant Pilot (G4208A) with files on a USB Flash Disk

(*) Required tools, firmware and documentation are available from the Agilent web: http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?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.
Some modules are limited in downgrading due to their main board version or their initial firmware revision. For example, a G1315C DAD SL cannot be downgraded below firmware revision B.01.02 or to a A.xx.xx.

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

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

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

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

**NOTE**

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

Rear View of the Module

Figure 31 Rear of Binary Pump
## Interfaces

The Agilent 1200 Infinity Series modules provide the following interfaces:

### Table 9  Agilent 1200 Infinity Series Interfaces

<table>
<thead>
<tr>
<th>Module</th>
<th>CAN</th>
<th>LAN/BCD (optional)</th>
<th>LAN (on-board)</th>
<th>RS-232</th>
<th>Analog</th>
<th>APG Remote</th>
<th>Special</th>
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<td>G1311C Quat Pump VL</td>
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<td>G1312B Bin Pump</td>
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<td>Yes</td>
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</table>

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## Hardware Information

### Interfaces

**Table 9  Agilent 1200 Infinity Series Interfaces**

<table>
<thead>
<tr>
<th>Module</th>
<th>CAN</th>
<th>LAN/BCD (optional)</th>
<th>LAN (on-board)</th>
<th>RS-232</th>
<th>Analog</th>
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| 2 | No | No | No | No | No | No | 1 |
| G1316A/C TCC |
| K1316C TCC Clinical Ed. |
| 2 | No | No | Yes | No | Yes |
| G1322A DEG |
| K1322A DEG Clinical Ed. |
| No | No | No | No | No | Yes | AUX |
| G1379B DEG |
| No | No | No | Yes | No | Yes |
| G4225A DEG |
| K4225A DEG Clinical Ed. |
| No | No | No | Yes | No | Yes | 1 |
Table 9  Agilent 1200 Infinity Series Interfaces

<table>
<thead>
<tr>
<th>Module</th>
<th>CAN</th>
<th>LAN/BCD (optional)</th>
<th>LAN (on-board)</th>
<th>RS-232</th>
<th>Analog</th>
<th>APG Remote</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4227A Flex Cube</td>
<td>2</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>CAN-DC- OUT for CAN slaves</td>
</tr>
<tr>
<td>G4240A CHIP CUBE</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>CAN-DC- OUT for CAN slaves THERMOSTAT for</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>G1330A/B (NOT USED), K1330B</td>
</tr>
</tbody>
</table>

1 Requires a HOST module with on-board LAN (e.g. G4212A or G4220A with minimum firmware B.06.40 or C.06.40) or with additional G1369C LAN Card

**NOTE**

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

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

CAN

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

LAN

The modules have either an interface slot for an LAN card (e.g. Agilent G1369B/C LAN Interface) or they have an on-board LAN interface (e.g. detectors G1315C/D DAD and G1365C/D MWD). This interface allows the control of the module/system via a PC with the appropriate control software. Some modules have neither on-board LAN nor an interface slot for a LAN card (e.g. G1170A Valve Drive or G4227A Flex 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.

RS-232C (Serial)

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

NOTE

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

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

The RS-232C is designed as DCE (data communication equipment) with a 9-pin male SUB-D type connector. The pins are defined as:
### Table 10  RS-232C Connection Table

<table>
<thead>
<tr>
<th>Pin</th>
<th>Direction</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In</td>
<td>DCD</td>
</tr>
<tr>
<td>2</td>
<td>In</td>
<td>RxD</td>
</tr>
<tr>
<td>3</td>
<td>Out</td>
<td>TxD</td>
</tr>
<tr>
<td>4</td>
<td>Out</td>
<td>DTR</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>In</td>
<td>DSR</td>
</tr>
<tr>
<td>7</td>
<td>Out</td>
<td>RTS</td>
</tr>
<tr>
<td>8</td>
<td>In</td>
<td>CTS</td>
</tr>
<tr>
<td>9</td>
<td>In</td>
<td>RI</td>
</tr>
</tbody>
</table>

#### Figure 32  RS-232 Cable
Analog Signal Output

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

APG Remote

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

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

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

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

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

**NOTE**

All common TTL circuits operate with a 5 V power supply. A TTL signal is defined as "low" or L when between 0 V and 0.8 V and "high" or H when between 2.0 V and 5.0 V (with respect to the ground terminal).
Table 11  Remote Signal Distribution

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

Special Interfaces

The module includes a DC-Out (24 VDC) power line that is intended to be used with certain modules that operate as CAN slaves, for example external valves. The line has a limited output of 0.5 A (1.7 A as of August 2011) and is self resetting.
Setting the 8-bit Configuration Switch

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

All modules with on-board LAN:
- Default is ALL switches DOWN (best settings).
  - Bootp mode for LAN and
  - 19200 baud, 8 data bit / 1 stop bit with no parity for RS-232
- For specific LAN modes switches 3-8 must be set as required.
- For boot/test modes switches 1+2 must be UP plus required mode.

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

*Figure 33*  Location of Configuration Switch (example shows a G4212A DAD)
To perform any LAN configuration, SW1 and SW2 must be set to OFF. For details on the LAN settings/configuration refer to chapter LAN Configuration.

Table 12 8-bit Configuration Switch (with on-board LAN)

<table>
<thead>
<tr>
<th>Mode</th>
<th>SW 1</th>
<th>SW 2</th>
<th>SW 3</th>
<th>SW 4</th>
<th>SW 5</th>
<th>SW 6</th>
<th>SW 7</th>
<th>SW 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Configuration</td>
<td>LAN</td>
<td>0</td>
<td>0</td>
<td>Link Configuration</td>
<td>Init Mode Selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto-negotiation</td>
<td>0</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>10 MBit, half-duplex</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MBit, full-duplex</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 MBit, half-duplex</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 MBit, full-duplex</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bootp</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bootp &amp; Store</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Using Stored</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHCP</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using Default</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEST</td>
<td>1</td>
<td>1</td>
<td>System</td>
<td>NVRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boot Resident System</td>
<td>1</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revert to Default Data (Coldstart)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:

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

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

NOTE: For explanation of "Boot Resident System" and "Revert to Default Data (Coldstart)" refer to "Special Settings" on page 244.
**Special Settings**

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

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

---

**Boot-Resident**

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

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

**Table 13**  Boot Resident Settings (On-board LAN)

<table>
<thead>
<tr>
<th>Mode Select</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
<th>SW8</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST/BOOT</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Forced Cold Start

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

**CAUTION**

Loss of data

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

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

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

**Table 14** Forced Cold Start Settings (On-board LAN)

<table>
<thead>
<tr>
<th>Mode Select</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
<th>SW8</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST/BOOT</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
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 which are subject to wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of usage of the module and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (EMF) feature monitors the usage of specific components in the instrument, and provides feedback when the user-selectable limits have been exceeded. The visual feedback in the user interface provides an indication that maintenance procedures should be scheduled.

EMF Counters

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

Using the EMF Counters

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

Setting the EMF Limits

The setting of the EMF limits must be optimized over one or two maintenance cycles. Initially the default EMF limits should be set. When instrument performance indicates maintenance is necessary, take note of the values displayed by the EMF counters. Enter these values (or values slightly less than the displayed values) as EMF limits, and then reset the EMF counters to zero. The next time the EMF counters exceed the new EMF limits, the EMF flag will be displayed, providing a reminder that maintenance needs to be scheduled.
12 Hardware Information
Early Maintenance Feedback
This chapter provides information on connecting the detector to the Agilent ChemStation PC.
What You Have to Do First

The module has an on-board LAN communication interface.

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 (see Figure 35 on page 251).
2 Connect the instrument's LAN interface (see Figure 35 on page 251) to
   - the PC network card using a crossover network cable (point-to-point)
   or
   - a hub or switch using a standard LAN cable.

Figure 35 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 BOOTP Server (using the so-called Bootstrap Protocol)
- 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 257
- by manually setting the parameters using Telnet
- by manually setting the parameters using the Instant Pilot (G4208A)

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 from a Bootp cycle, non-volatile memory or initialized with known default values. The initialization mode is selected by the configuration switch, see Table 16 on page 254.
Configuration Switch

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

![Configuration Switch](image)

**Figure 36** Location of Configuration Switch

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.

**Table 15** Factory Default Settings

<table>
<thead>
<tr>
<th>Link Configuration</th>
<th>speed and duplex mode determined by auto-negotiation, for details see “Link configuration selection” on page 259</th>
</tr>
</thead>
</table>

Agilent 1290 Infinity Binary Pump User Manual
LAN Configuration
Initialization mode selection

Initialization mode selection

The following initialization (init) modes are selectable:

Table 16 Initialization Mode Switches

<table>
<thead>
<tr>
<th>SW 6</th>
<th>SW 7</th>
<th>SW 8</th>
<th>Init Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>Using Stored</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>Using Default</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>DHCP (^1)</td>
</tr>
</tbody>
</table>

\(^1\) Requires firmware B.06.40 or above. Modules without LAN on board, see G1369C LAN Interface Card

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 37 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 17** on page 255.

![Figure 38 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>
<thead>
<tr>
<th><strong>Table 17</strong> Using Default Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP address:</td>
</tr>
<tr>
<td>Subnet Mask:</td>
</tr>
<tr>
<td>Default Gateway</td>
</tr>
</tbody>
</table>

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, and “B”-firmware (B.06.40 or above).

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).

![Image](DHCP_Principle.png)

**Figure 39**  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)

Software required

The modules in the stack must have at least firmware from set A.06.34 and the above mentioned modules B.06.40 or above (must from the same firmware set).

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

On the Instant Pilot the MAC address can be found under Details in the LAN section.

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

<table>
<thead>
<tr>
<th>Table 18</th>
<th>G1369C LAN Interface Card (configuration switch on the card)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW 4</td>
<td>SW 5</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>
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 256).

<table>
<thead>
<tr>
<th>SW 6</th>
<th>SW 7</th>
<th>SW 8</th>
<th>Initialization Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>DHCP</td>
</tr>
</tbody>
</table>
Link configuration selection

The LAN interface supports 10 or 100 Mbps operation in full- or half-duplex modes. In most cases, full-duplex is supported when the connecting network device - such as a network switch or hub - supports IEEE 802.3u auto-negotiation specifications.

When connecting to network devices that do not support auto-negotiation, the LAN interface will configure itself for 10- or 100-Mbps half-duplex operation.

For example, when connected to a non-negotiating 10-Mbps hub, the LAN interface will be automatically set to operate at 10-Mbps half-duplex.

If the module is not able to connect to the network through auto-negotiation, you can manually set the link operating mode using link configuration switches on the module.

### Table 20  Link Configuration Switches

<table>
<thead>
<tr>
<th>SW 3</th>
<th>SW 4</th>
<th>SW 5</th>
<th>Link Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>-</td>
<td>-</td>
<td>speed and duplex mode determined by auto-negotiation</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>manually set to 10 Mbps, half-duplex</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>manually set to 10 Mbps, full-duplex</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>manually set to 100 Mbps, half-duplex</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>manually set to 100 Mbps, full-duplex</td>
</tr>
</tbody>
</table>
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.

![Manual Configuration (Principle)](image)

**Figure 41** 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
G:\>telnet 134.40.27.95
```

**Figure 42**  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 Switch” on page 253).

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

```
$ C:\WINdows\SystEM32\cmd.exe - telnet 134.40.27.95
Agilent Technologies G1315C PP000000024
```

**Figure 43**  A connection to the module is made
3 Type
? and press enter to see the available commands.

```
C:\WINDOWS\system32\cmd.exe - telnet 134.40.27.95
```

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>displays help info</td>
</tr>
<tr>
<td>/</td>
<td>displays current LAN settings</td>
</tr>
<tr>
<td>ip &lt;x.x.x.x&gt;</td>
<td>sets IP Address</td>
</tr>
<tr>
<td>sm &lt;x.x.x.x&gt;</td>
<td>sets Subnet Mask</td>
</tr>
<tr>
<td>gw &lt;x.x.x.x&gt;</td>
<td>sets Default Gateway</td>
</tr>
<tr>
<td>exit</td>
<td>exits shell and saves all changes</td>
</tr>
</tbody>
</table>

**Figure 44** Telnet Commands

**Table 21** Telnet Commands

4 To change a parameter follows the style:

- parameter value, for example:
  
  **ip 134.40.27.230**

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. 

![Telnet - Current settings in "Using Stored" mode](image)

Figure 45  Telnet - Current settings in "Using Stored" mode

6 Change the IP address (in this example 134.40.27.99) and type “/” to list current settings.

![Telnet - Change IP settings](image)

Figure 46  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
When you have finished typing the configuration parameters, type `exit` and press `Enter` to exit with storing parameters.

![Figure 47 Closing the Telnet Session](image)

**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 134.40.27.99.
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 **DAD** button.
4. Scroll down to the LAN settings.

![Figure 48](Image)

**Figure 48** Instant Pilot - LAN Configuration

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**.
PC Setup for Local Configuration

This procedure describes the change of the TCP/IP settings on your PC to match the module’s default parameters in a local configuration (see also “Initialization mode selection” on page 254).

**Figure 49** Changing the TCP/IP settings of the PC
User Interface Software Setup

Install your user interface software according to the provided *User Interface Software Setup Guide.*
LAN Configuration
PC and User Interface Software Setup Setup
14 Appendix

General Safety Information 270
Radio Interference 274
Sound Emission 274
Agilent Technologies on Internet 274

This chapter provides addition information on safety, legal and web.
## General Safety Information

### Safety Symbols

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

**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**

**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.
General Safety Information

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

**WARNING**
Ensure the proper usage of the equipment.
The protection provided by the equipment may be impaired.

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

Safety Standards

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

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

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

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

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

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

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

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

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

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

Abstract


NOTE

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

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product.

Do not dispose off in domestic household waste

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

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

Test and Measurement

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

Sound Emission

Manufacturer’s Declaration

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

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

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

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http://www.agilent.com
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In This Book

This manual contains technical reference information about the Agilent 1290 Infinity Binary Pump G4220A:

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