# Agilent 1290 Infinity Flexible Cube

User Manual

Agilent Technologies

# Notices



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**CAUTION**

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**WARNING**

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

# In This Guide...

This manual covers the Agilent 1290 Infinity Flexible Cube (G4227A).

### 1 Introduction

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

### 2 Site Requirements and Specifications

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

### 3 Installing the Module

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

### 4 LAN Configuration

This chapter provides information on connecting the module to the Agilent Data System.

### 5 Using the Module

This chapter provides information on how to set up the Flexible Cube for an analysis and explains the basic settings.

### 6 Optimizing Lab Performance with Flexible Cube

This chapter provides information on how to optimize the Autosampler and the Flexible Cube for a minimum carryover and fastest cycle times.

### 7 Troubleshooting and Diagnostics

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

### 8 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.

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# Contents

# 1 Introduction



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

# Features

The Agilent 1290 Infinity Flexible Cube introduces an unprecedented flexibility to the Agilent 1290 Infinity System. It includes options to reduce carryover, and optionally you can add one or two valve heads to be able to use the G4226A HiP Autosampler as a multipurpose valve box.

The G4227A Flexible Cube is capable of reducing carryover to a minimum and maintains that level between the maintenance intervals of the Autosampler.

For specifications, see "Performance Specifications" on page 34.

**NOTE** This 1290 Infinity Flexible Cube has been introduced as part of the Agilent 1290 Infinity Liquid Chromatograph.

# Overview of the Module

The Agilent 1290 Infinity Flexible Cube comprises a flush pump that can deliver flow between 1 and 4 mL/min from 3 different solvent bottles. The system also includes slots so you can have one or, optionally, two valve drives. The standard version of the Agilent 1290 Infinity Flexible Cube supports the needle seat back flush and one valve drive. Another add-on option with a second valve drive is available.

# Flexible Cube Technical Capability

The Flexible Cube is added to the 1290 Infinity system to reduce carryover in the Autosampler. This is achieved by flushing the needle seat and rotor seal with up to 3 different solvents which may have different properties and solvent strengths.

The flush pump outlet capillary is connected to the port 4 of the autosampler, which normally holds the waste line. If the autosampler is in bypass mode the flush pump connects to the needle seat and can flush backwards through the needle seat into the waste line attached to the needle seat outlet port.

Besides chemistry effects of solvents and sample the Agilent 1290 Infinity Flexible Cube will not influence injection precision or accuracy of the Autosampler in use. The Flexible Cube is not part of the high pressure flow path.

**NOTE** The needle wash port and the needle seat back flushing function may generate large amount of waste. Make sure to have the waste tubing installed in the autosampler and a waste container with sufficient capacity available.

**Following the injection sequence, using a Flexible Cube, is described with regards to cleaning the sampler.**

**1** Mainpass

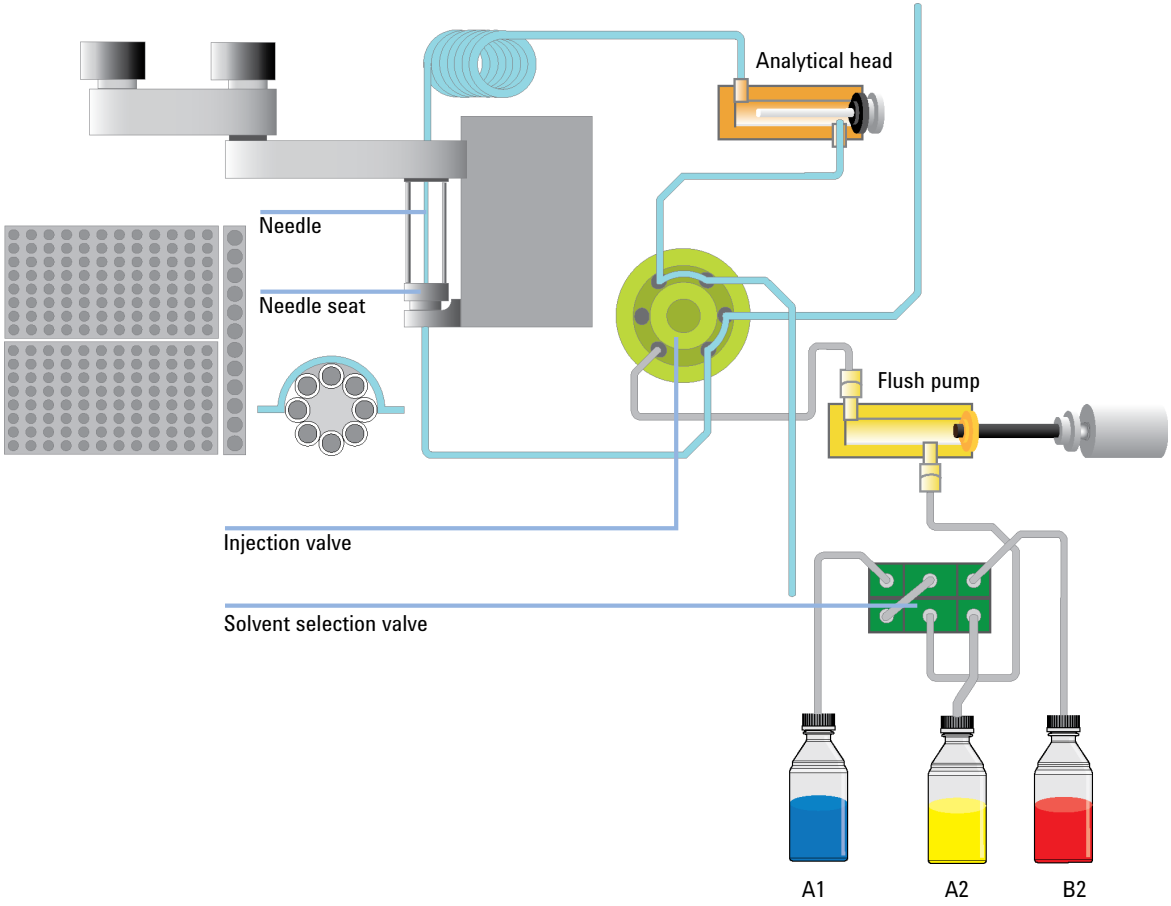



**Figure 1** Mainpass

The analytical pump is connected to the autosampler sampling loop, and the mobile phase is flowing through the autosampler injection loop continuously and thereby cleaning the insides of the tubings.

**2** Switch to Bypass

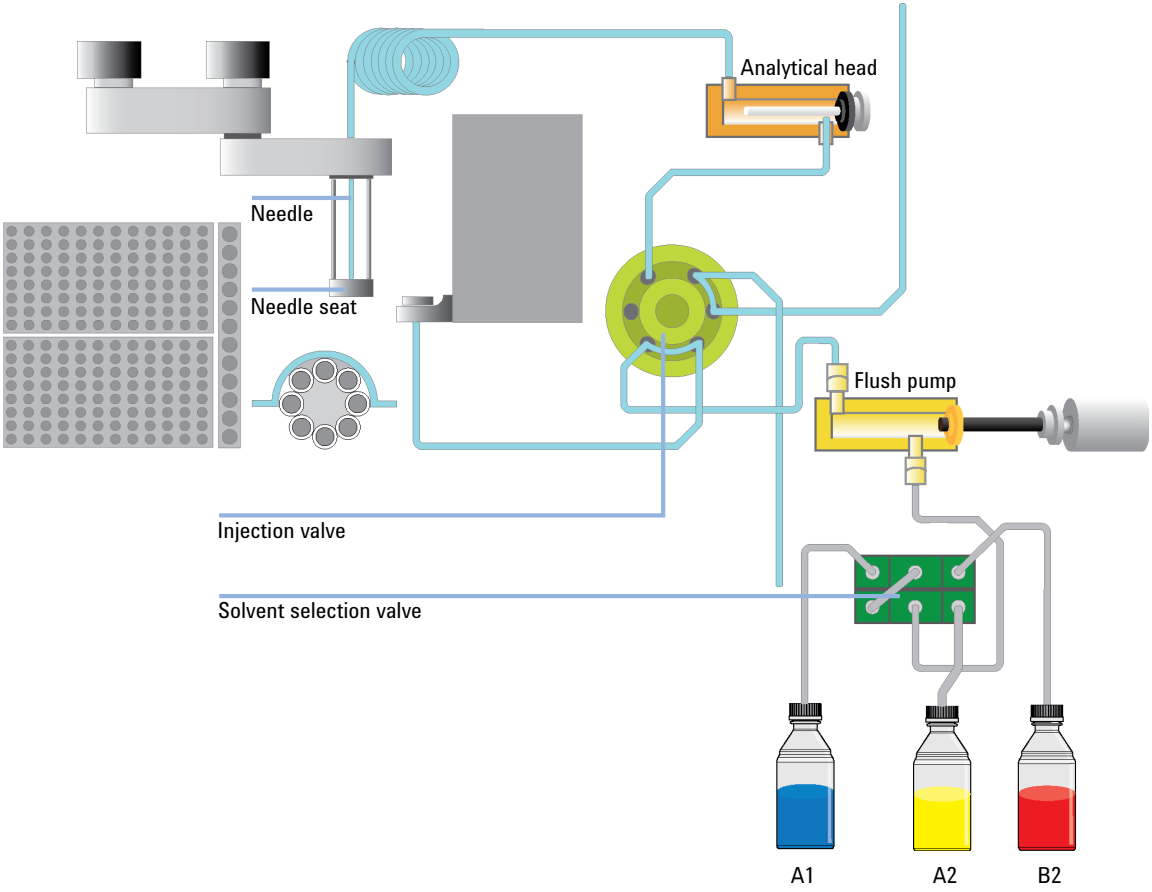



**Figure 2** Switch to Bypass

The injection valve is switched to bypass, removing the injection loop from the high pressure flow path and connecting the flush pump with the needle seat.

**3** Flush with dissolving solvent #1 (A2)

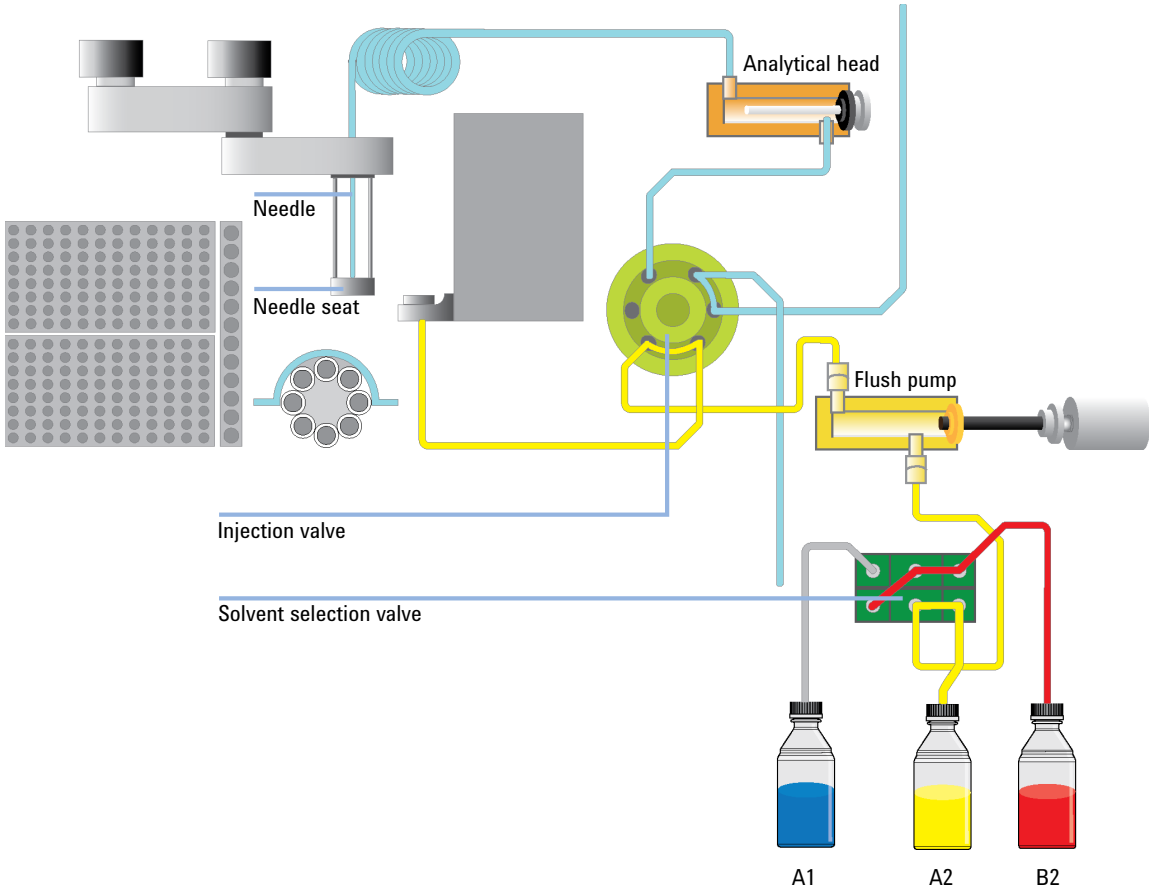



**Figure 3** Flush with dissolving solvent #1 (A2)

The first cleaning solvent available for flushing is normally of a high organic concentration with appropriate modifiers. This solvent should be able to dissolve most components of the sample, and thereby remove them from the Autosampler flow path.

**4** Flush with dissolving solvent #2 (B2)

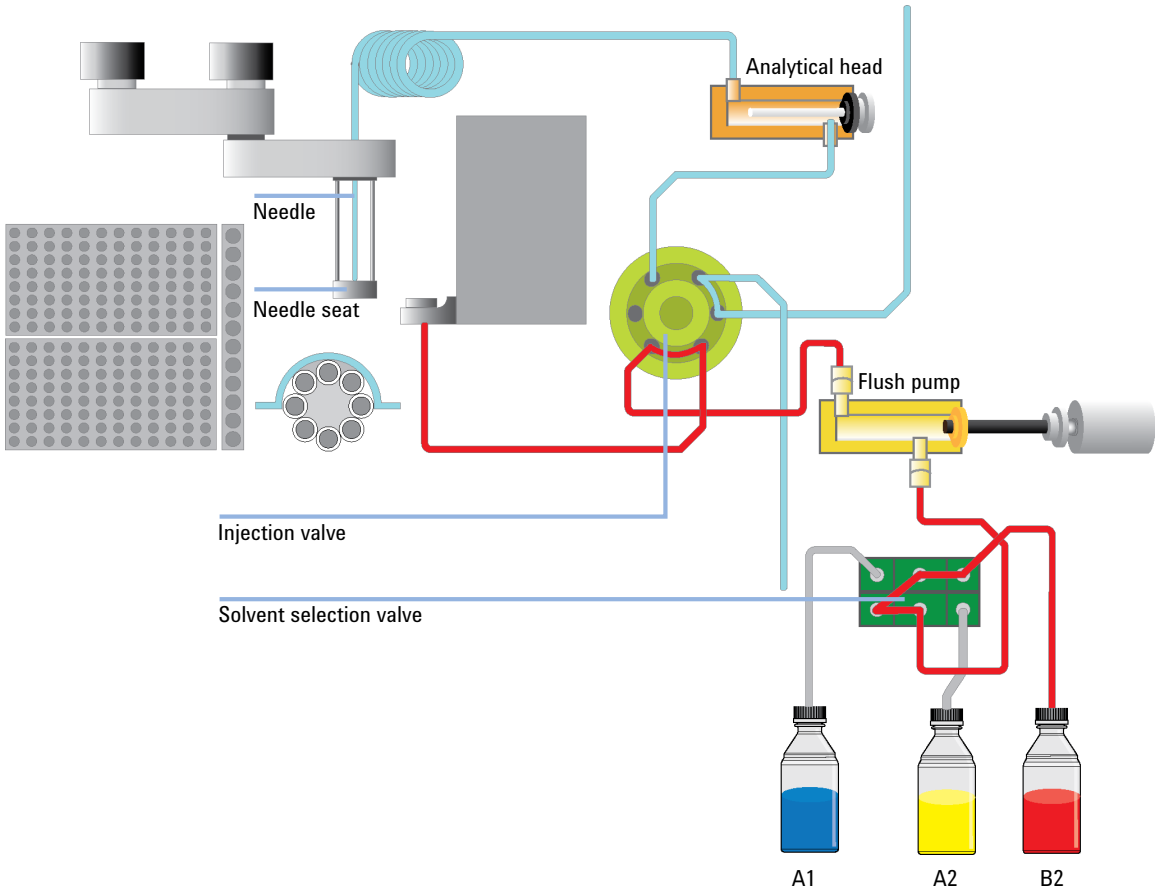



**Figure 4** Flush with dissolving solvent #2 (B2)

If this is not sufficient to reduce the carryover a dissolving solvent #2 may be used with either different modifiers and/or a really strong cleaning solvent.

**5** Flush with Starting condition (A1)

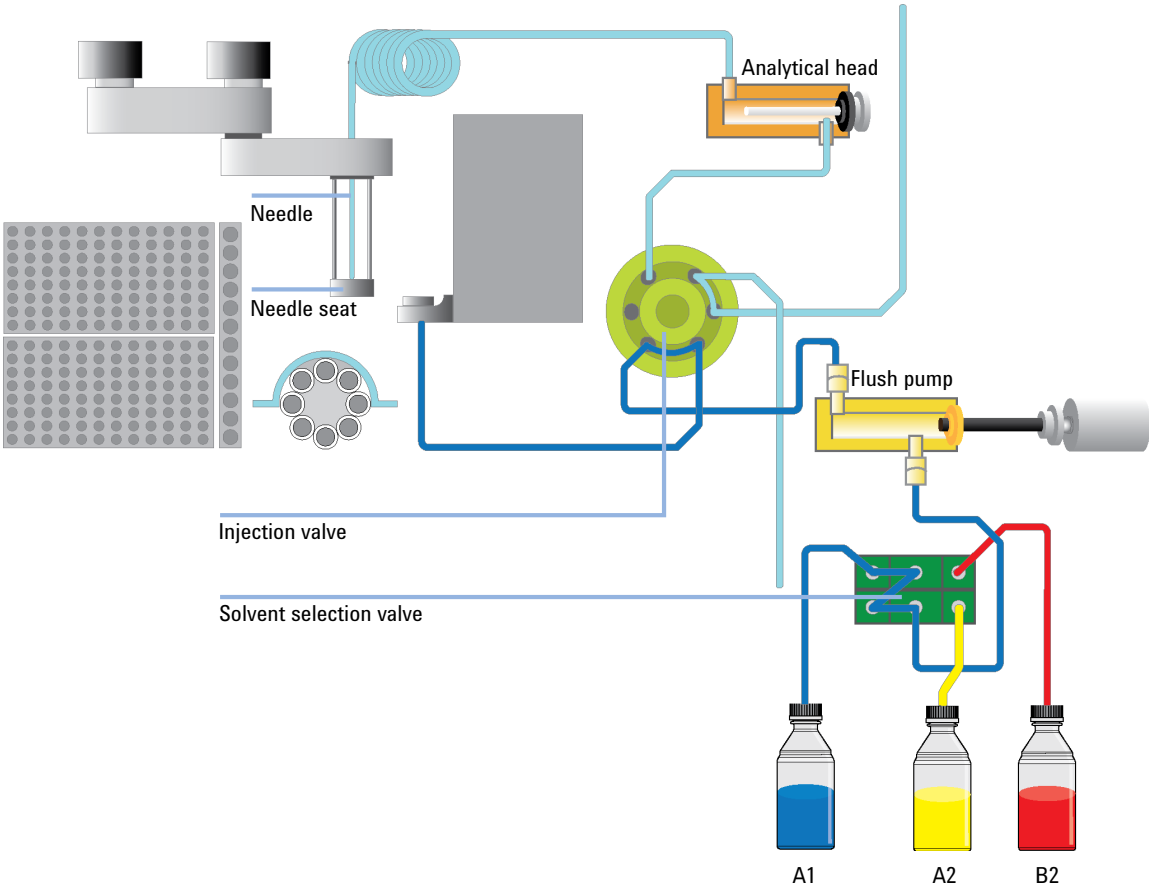



**Figure 5** Flush with Starting condition (A1)

Solvent #3 is always set for the final flush and should be the starting condition of the gradient or lower solution strength, as this solvent will be in the needle seat and seat capillary at the point of injection and might lead to reduced resolution if stronger elution strength than mobile phase.

**NOTE** Any flushing solvent used must be miscible with previous solvent. If this is not the case it can result in precipitations, blockages or reduced performance of the instrument.

**6** Switch back to Mainpass

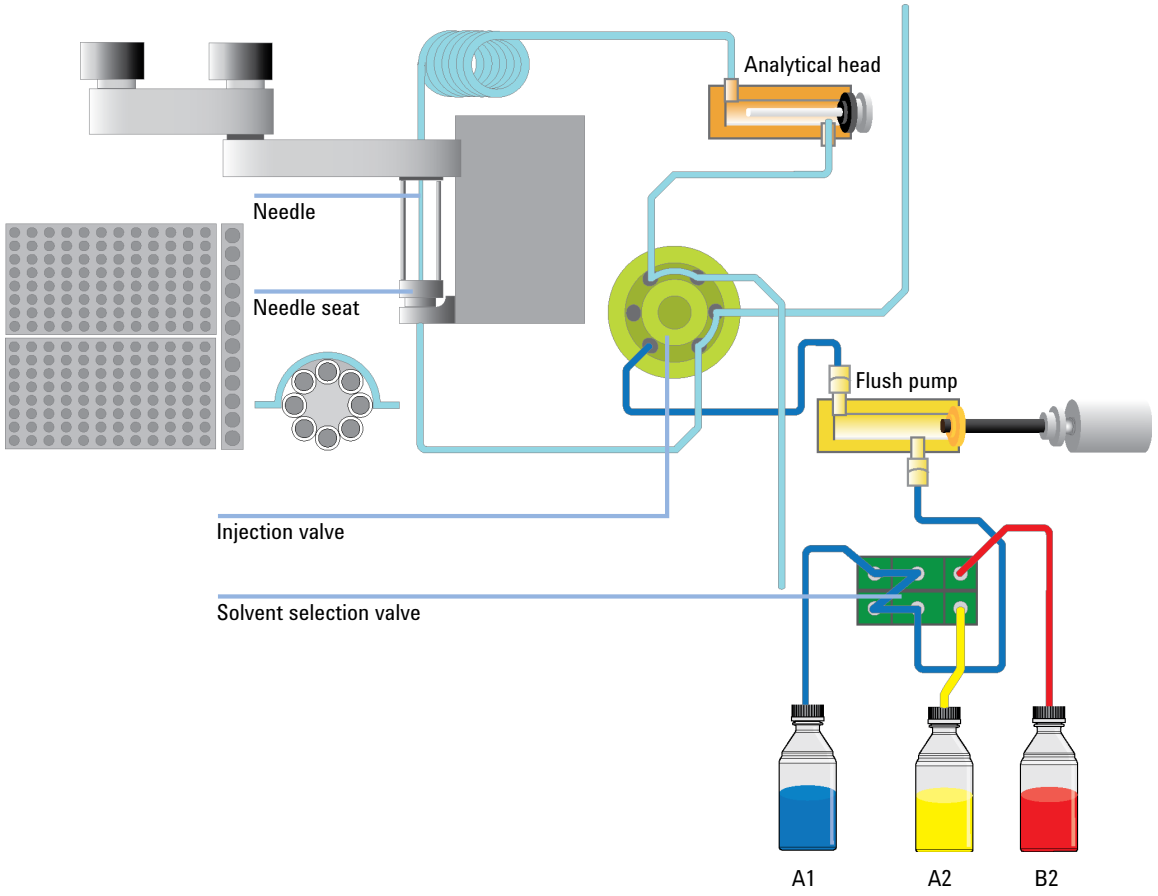



**Figure 6** Switch back to Mainpass

When the complete flushing procedure has finished the autosampler switches back to Mainpass operation and thereby introduce the sample to the flow path.

# Valve solution / Valve technique

Agilent 1200 Infinity Quick Change valves support a variety of challenging valve applications. The G4227A Flexible Cube hosts up to two valves (standard configuration one valve). Besides, Quick Change valves can be mounted in the external 1290 Infinity Valve Drive G1170A or in the 1290 Infinity TCC G1316C.

Examples of typical applications are:

- Dual and multiple column selection
- Sample enrichment and sample cleanup
- Alternating column regeneration
- Solvent selection

## Dual and Multi Column Selection

### Dual Column Selection

2 position/6 port valve head (G4231A/C) and 2 position/10 port valve head (G4232A/C)

Advantages:

- Increase productivity
- Higher instrument up-time
- Faster method scouting

Quickly change between two different stationary phases to check your separation selectivity, or use two identical stationary phases to have the second column immediately available after the first one loses efficiency, for example with complex matrices.

## Multi Column Selection

With the 6-column selector valve head (G4234A/C) and the capillary kit for Column Selection you can set up your system for use with up to 6 columns as displayed in Figure 7 on page 20. Or you can use the system with 5 columns and one flow path for flow injection analysis or for flushing the system. This setup allows you to switch between these columns for faster method development or method validation. The multi-column setup might also be used, if several operators are sharing system.

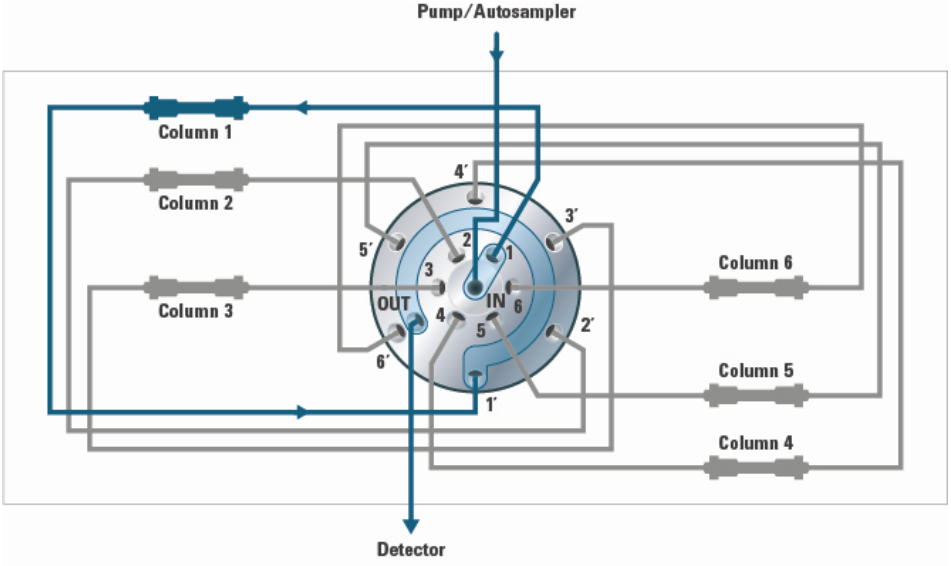



**Figure 7** Multiple Column Selection (Example of Schematic Setup for 6-Column Selector Valve Head)

## Sample Enrichment and Sample Cleanup

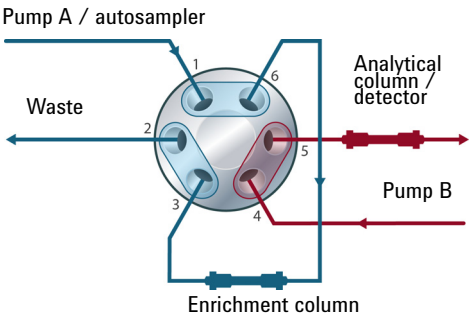
2 position/6 port valve head (G4231A/C) and 2 position/10 port valve head (G4232A/C)

Advantages:

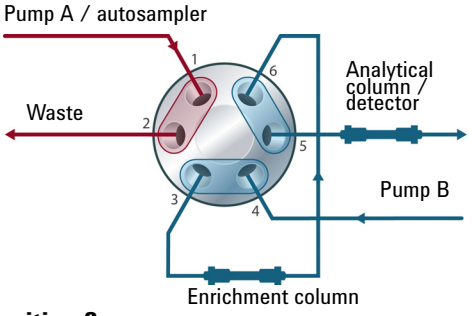
- Easy automation of sample preparation
- Higher reproducibility
- Increased productivity and sensitivity

Sample cleanup is essential for samples with complex matrices, such as biological fluids, food extracts and waste water. Before injection into an LC or LC/MS system, the sample matrix must be separated from the analytes of interest. Otherwise, contaminants can disrupt separation and detection or even damage the analytical column.

## Sample Enrichment

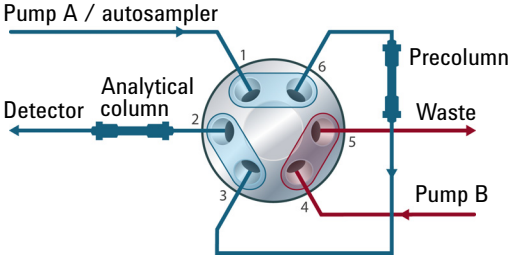



**Position 1**

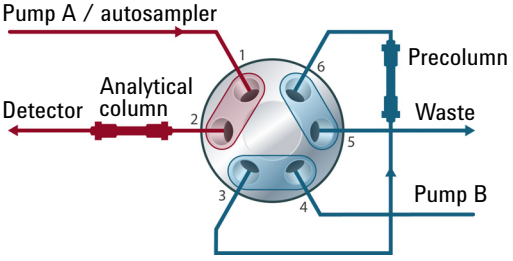



**Position 2**

## Sample Cleanup




**Position 1-6**




**Position 1-2**

## Enrichment methods

Enrichment methods are the technique of choice to obtain highest sensitivity and to remove the sample matrix in such applications as proteomics, drug metabolism and environmental trace analysis. The analytes are retained and concentrated onto the pre-column, while the sample matrix is passed to waste. After the valve switch, a second pump backflushes the analytes out of the pre-column onto the separation column. This allows injection of large volumes onto the pre-column, significantly expanding sensitivity in the range of ten to several thousands.

## Stripping methods

Stripping methods handle analytes and matrices in the opposite way to enrichment methods. Matrix components are retained on the pre-column while the analytes pass through to the separation column. After the valve switches, an additional pump backflushes the matrix components out of the pre-column to waste, while the analytes are separated on the main column. Backflushing prepares the pre-column for the next injection.

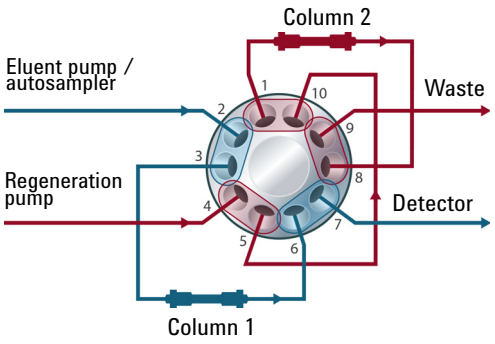
## Alternating Column Regeneration

Only 2 position/10 port valve head (G4232A/C)

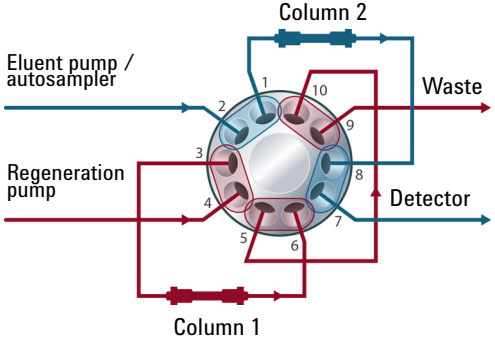
Advantages:

- High sample throughput
- Increased productivity
- High efficiency

Alternating column regeneration is a convenient way to increase the sample throughput. The Agilent 1200 Infinity Series 2 position/10 port valves can be used to increase the efficiency in laboratories running large amounts of samples. Gradient elution is a common technique for separation of complex samples in liquid chromatography, which requires column regeneration before the subsequent run is started. Using alternating column regeneration valuable time for the analysis is saved. Core of the alternating column regeneration is the Agilent 1200 Infinity Series 2 position/10 port valve, which allows simultaneous analysis on one column while a second identical column is flushed and equilibrated.




**Position 1**




**Position 2**

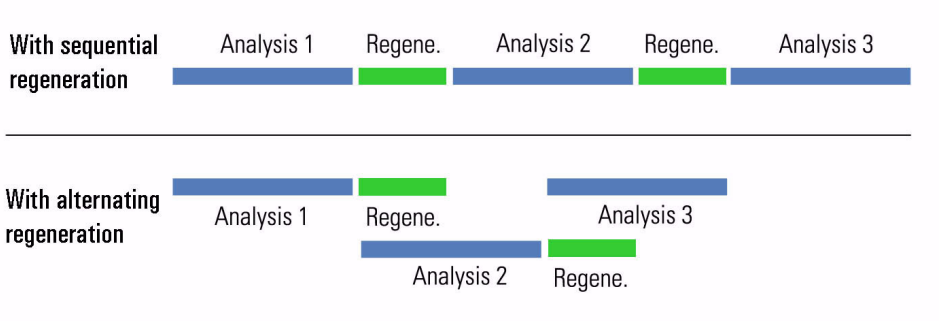



**Figure 8** Alternate Column Regeneration (Time Scheme)

## Solvent Selection

The 12ps/13pt solvent selection valve (G4235A) can be used for solvent selection (flow rate < 10 mL/min) as illustrated in Figure 9 on page 25. It offers automated access to 12 different eluents.

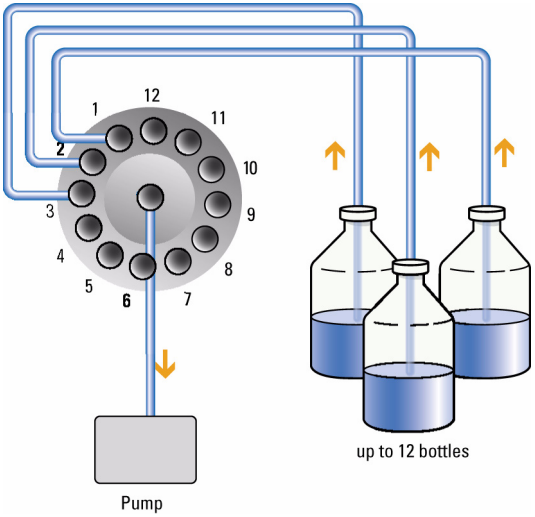



**Figure 9** Solvent Selection (Schematic Setup)

# Bio-inert Materials

For the Agilent 1260 Infinity Bio-inert LC system, Agilent Technologies uses highest quality materials in the flow path (also referred to as wetted parts), which are widely accepted by life scientists, as they are known for optimum inertness to biological samples and ensure best compatibility with common samples and solvents over a wide pH range. Explicitly, the complete flow path is free of stainless steel and free of other alloys containing metals such as iron, nickel, cobalt, chromium, molybdenum or copper, which can interfere with biological samples. The flow downstream of the sample introduction contains no metals whatsoever.

**Table 1** Bio-inert materials used in Agilent 1260 Infinity and Infinity II Systems

| Module | Material |
|---|---|
| Agilent 1260 Infinity Bio-inert Quaternary Pump (G5611A)<br>Agilent 1260 Infinity II Bio-inert Quaternary Pump (G5654A) | Titanium, gold, platinum-iridium, ceramic, ruby, PTFE, PEEK, sapphire |
| Agilent 1260 Infinity Bio-inert High-Performance Autosampler (G5667A)<br>Agilent 1260 Infinity II Bio-inert Multisampler (G5668A) | Upstream of sample introduction:<br>• Titanium, gold, PTFE, PEEK, ceramic<br>Downstream of sample introduction:<br>• PEEK, ceramic |
| Agilent 1260 Infinity Bio-inert Manual Injector (G5628A) | PEEK, ceramic |
| Agilent 1260 Infinity/Infinity II Bio-inert Analytical Fraction Collector (G5664A/B) | PEEK, ceramic, PTFE |
| **Bio-inert Flow Cells:** | |
| Standard flow cell bio-inert (G5615-60022), 10 mm, 13 µL, 120 bar (12 MPa)<br>*(for Agilent 1260 Infinity Diode Array Detectors G1315C/D and 1260 Infinity II G7165A Multiple Wavelength Detector and G7115A Diode Array Detector WR)* | PEEK, ceramic, sapphire, PTFE |
| Bio-inert flow cell (G5615-60005), 8 µL, 20 bar (pH 1–12)<br>*(for Agilent 1260 Infinity Fluorescence Detector FLD G1321B and 1260 Infinity II Fluorescence Detector Spectra G7121B)* | PEEK, fused silica, PTFE |
| Bio-inert heat-exchanger G5616-60050<br>*(for Agilent 1290 Infinity Thermostatted Column Compartment G1316C)*<br>Bio-inert Quick Connect Heat Exchanger (G7116-60041)<br>*(for Agilent 1260 Infinity II Multicolumn Thermostat G7116A)* | PEEK (steel cladded) |
| Bio-inert Valve heads | G4235A, G5631A, G5639A, G5632A: PEEK, ceramic ($Al_2O_3$ based) |
| Bio-inert Connection capillaries | Upstream of sample introduction:<br>• Titanium<br>Downstream of sample introduction:<br>• Agilent uses stainless steel cladded PEEK capillaries, which keep the flow path free of steel and provide pressure stability up to 600 bar. |

**NOTE**

To ensure optimum bio-compatibility of your Agilent 1260 Infinity Bio-inert LC system, do not include non-inert standard modules or parts to the flow path. Do not use any parts that are not labeled as Agilent “Bio-inert”. For solvent compatibility of these materials, see “Material Information” on page 80.

# 2
# Site Requirements and Specifications



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

# Site Requirements

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

## Power Considerations

The module power supply has wide ranging capability. It accepts any line voltage in the range described in Table 2 on page 33. Consequently there is no voltage selector in the rear of the module. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

**WARNING**

**Hazard of electrical shock or damage of your instrumentation**

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

➔ Connect your instrument to the specified line voltage only.

**WARNING**

**Electrical shock hazard**

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

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

➔ Do not open the cover.

➔ Do not operate the instrument and disconnect the power cable in case the cover has any signs of damage.

➔ Contact Agilent for support and request an instrument repair service.

**WARNING**

**Inaccessible power plug.**

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

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

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

## Power Cords

Country-specific power cords are available for the module. The female end of all power cords is identical. It plugs into the power-input socket at the rear. The male end of each power cord is different and designed to match the wall socket of a particular country or region.

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

**WARNING**

**Unintended use of power cords**

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

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

**WARNING**

**Absence of ground connection**

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

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

**WARNING**

**Electrical shock hazard**

**Solvents may damage electrical cables.**

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

## Bench Space

The module dimensions and weight (see Table 2 on page 33) allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 8 cm (3.1 inches) in the rear for air circulation and electric connections.

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

The module should be operated in a horizontal position.

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

## Condensation

**CAUTION** Condensation within the module

Condensation can damage the system electronics.

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

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

# Physical Specifications

**Table 2** Physical Specifications

| Type | Specification | Comments |
|---|---|---|
| Weight | 8.2 kg (18.1 lbs) | |
| Dimensions (height × width × depth) | 140 x 345 x 435 mm (5.5 x 13.5 x 17 inches) | |
| Line voltage | 100 – 240 V~, ± 10 % | Wide-ranging capability |
| Line frequency | 50 or 60 Hz, ± 5 % | |
| Power consumption | 80 VA / 45W / 154 BTU | Maximum |
| Ambient operating temperature | 4–55 °C (39–131 °F) | |
| Ambient non-operating temperature | -40 – 70 °C (-40 – 158 °F) | |
| Humidity | < 95 % r.h. at 40 °C (104 °F) | Non-condensing |
| Operating altitude | Up to 2000 m (6562 ft) | |
| Non-operating altitude | Up to 4600 m (15092 ft) | For storing the module |
| Safety standards: IEC, CSA, UL | Installation category II, Pollution degree 2 | For indoor use only. |

# Performance Specifications

**Table 3** Performance Specifications

| Type | Specification | Comment |
|---|---|---|
| Injection range | 0.1 – 20 µL<br>0.1 – 40 µL<br>0.1 – 100 µL<br>in 0.1 µL increments | With 20 µL loop installed<br>With 40 µL loop installed<br>With 100 µL loop installed<br>(as provided by G4226A sampler) |
| Precision | Precision of G4226A sampler will not be influenced | |
| Accuracy | Accuracy of G4226A sampler will not be influenced | |
| Sampler pressure range | Up to 1200 bar | |
| Flush types available | Needle seat back-flushing<br>Needle wash intern<br>Needle wash extern | by G4227A Flexible Cube<br>by G4226A sampler<br>by G4226A sampler |
| Pressure range of flush pump | Up to 50 bar | |
| Flow rate of flush pump | Up to 4 mL/min | |
| Number of solvents | Up to 3 solvents | |
| Sample viscosity range | 0.2 – 5 cp | |

**Table 3** Performance Specifications

| Type | Specification | Comment |
|---|---|---|
| Flush time | Flush time depends on method-parameters used, e.g. number of solvents and selected flush-duration. Flushing is done in parallel to running analysis.<br><br>Needle seat flush time to flush with 1 mL of solvent at maximum flow including solvent exchange typically requires 38 s. | |
| Carry over | Typically <0.001 % (10 ppm) | For measurement conditions, see [1], [2], [3], [4] |
| Control and data evaluation | Agilent ChemStation for LC<br>EZChrom Elite<br>Masshunter | OpenLAB CDS ChemStation Edition C.01.04<br>OpenLAB CDS EZChrom Edition A.04.04<br>Masshunter B.05.01 SP3 TOF & Q-TOF<br>Masshunter B.07.00 SP1 QQQ<br>Modules require Firmware Set C.06.5x or higher and LC/CE Driver Version A.02.06 |
| Local control | Agilent Instant Pilot (G4208A) | B.02.08 or later |
| Communications | Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, optional four external contact closures and BCD vial number output. | |

**Table 3** Performance Specifications

| Type | Specification | Comment |
|---|---|---|
| Safety and maintenance | Extensive diagnostics, error detection and display (through Control Module and ChemStation), leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas. | |
| GLP features | Early maintenance feedback (EMF) for continuous tracking of instrument usage with user-settable limits and feedback messages. Electronic records of maintenance and errors. | |
| Housing | All materials recyclable. | |

[1] Chromatographic conditions: Column: Agilent ZORBAX SB-C18, 2.1 x 50 mm 1.8 µm (827700-902); mobile phase: A: 0.1 % TFA in water, B: 0.1 % TFA in acetonitrile; isocratic : %B=35 %; flow rate: 0.5 mL/min; temperature: 30 °C

[2] Cleaning procedure: Wash solution: 2 min with water + 0.1 % TFA at 4 mL/min; needle wash with solvent A 15 s.

[3] UV-detection: Sample : 1200 ng/µl chlorhexidine (dissolved in mobile phase A), 1 µL injected and measured on G4212A DAD (10 mm cell); Wavelength: 257 nm +/- 4; ref. 360 nm +/- 16; slit 4 nm, 10 Hz

[4] MS-detection: Sample : 50 ng/µl chlorhexidine (dissolved in mobile phase A), 1 µL injected and measured on Agilent 6460 QQQ (in specified conditions); MRM 1: 505.5 → 170 (CE: 36 V); MRM 3: 505.5 → 201.2 (CE: 20 V); fragmentor: 150 V, delta EMV(+): 200 V

**Table 4** Specifications Agilent Quick Change Valve Heads

| Kit PN | Valve PN | Description | max. Pressure [bar] | Fittings | Port-Port Volume | Liquid Contact | pH Range |
|---|---|---|---|---|---|---|---|
| G4230A | 5067-4107 | 8 position/9 port valve head | 600 | 10-32 | 0.55 µL | PEEK, SST | 0-14[1] |
| G4231A | 5067-4282 | 2 position/6 port valve head | 800 | 10-32 | 0.51 µL | PEEK, SST | 0-14[1] |
| G4231C | 5067-4241 | 2 position/6 port valve head | 1300 | 10-32 | 0.26 µL | PEEK, SST | 0-14[1] |
| G4232A | 5067-4144 | 2 position/10 port micro valve head | 600 | M4 | 89.0 nL | PEEK, SST | 0-14[1] |
| G4232D | 5067-4240 | 2 position/10 port valve head | 1300 | 10-32 | 0.242 µL | PEEK, SST | 0-14[1] |
| G4234A | 5067-4284 | 6-column selector valve head | 800 | M4 | special[2] | PEEK, SST | 0-14[1] |
| G4234C | 5067-4273 | 6-column selector valve head | 1300 | M4 | special[2] | PEEK, SST | 0-14[1] |
| G4235A | 5067-4159 | 12 position/13 port valve head, bio-inert | 210 | 10-32 | 16.4 µL | PEEK, Ceramic | 0-14[1] |
| G5631A | 5067-4148 | 2 position/6 port valve head, bio-inert | 600 | 10-32 | 1.71 µL | PEEK, Ceramic | 0-14[1] |
| G5639A | 5067-4134 | 4-column selector valve head, bio-inert | 600 | 10-32 | special[2] | PEEK, Ceramic | 0-14[1] |

[1] incompatible with some mineral acids. For more information see Solvent Information.

[2] pre-column volume G4234A/C: 0.37 µL, G5639A: 0.81 µL; post column volume G4234A/C: 0.50µL, G5639A: 1.33 µL

# 3
# Installing the Module



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

# 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 shown below. For parts identification please check the illustrated parts breakdown in "Parts and Materials for Maintenance" on page 151. Please report any missing or damaged parts to your local Agilent Technologies sales and service office.

**Table 5** Flexible Cube Checklist

| Description | Quantity |
|---|---|
| Flexible Cube | 1 |
| Power Cable | 1 |
| User Manual | 1 |
| Flexible Cube Accessory Kit (see "Flexible Cube Accessory Kit" on page 155) | 1 |
| Second 1290 Infinity Flexible Cube Generic Valve Drive | optional |

**NOTE** For the valve drive the respective valve heads need to be ordered in addition.

# 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

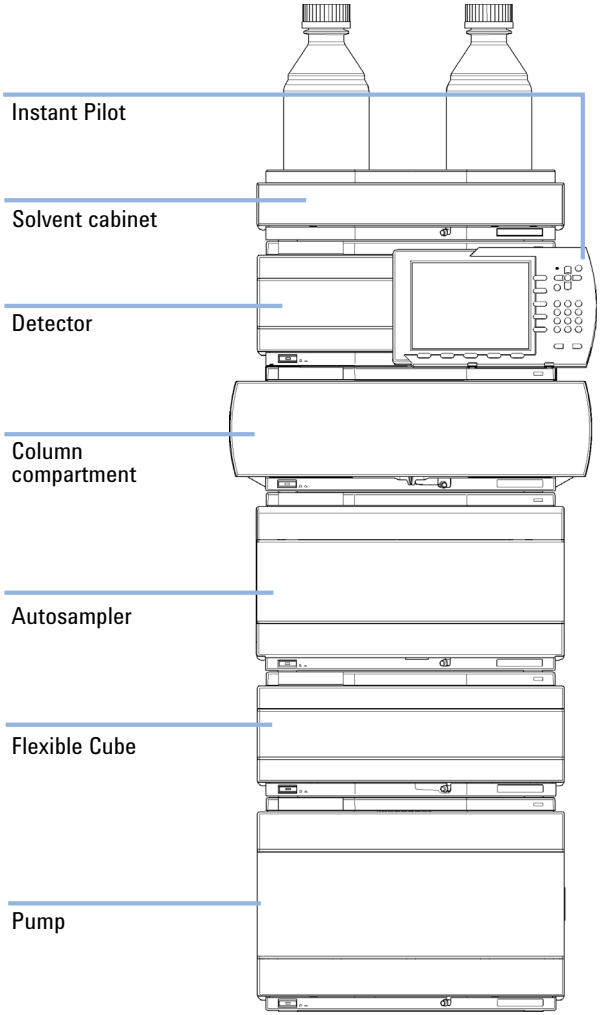



**Figure 10** Supported One Stack Configuration (Front View)

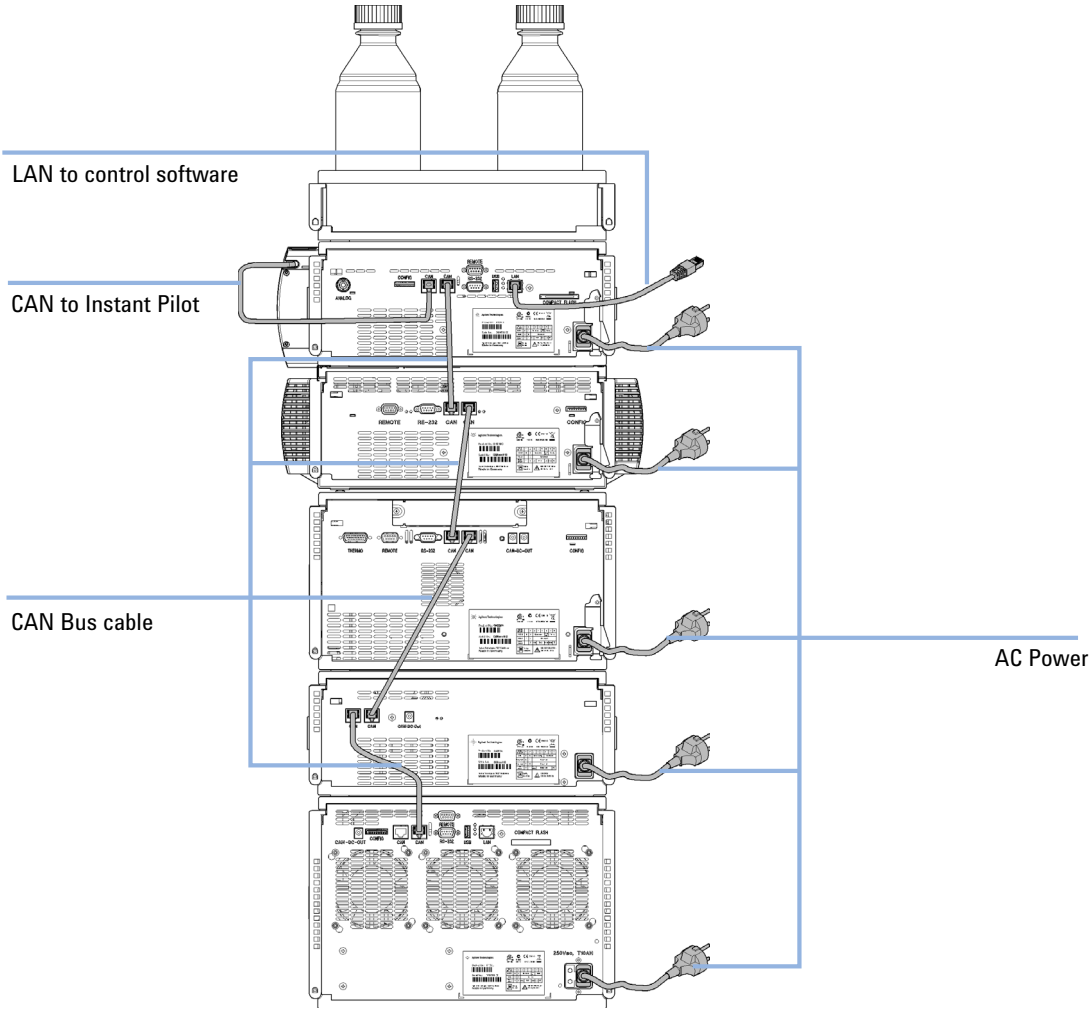



**Figure 11** Supported One Stack Configuration (Rear View)

# Supported Two Stack Configurations

## Two Stack Configuration (Standard)

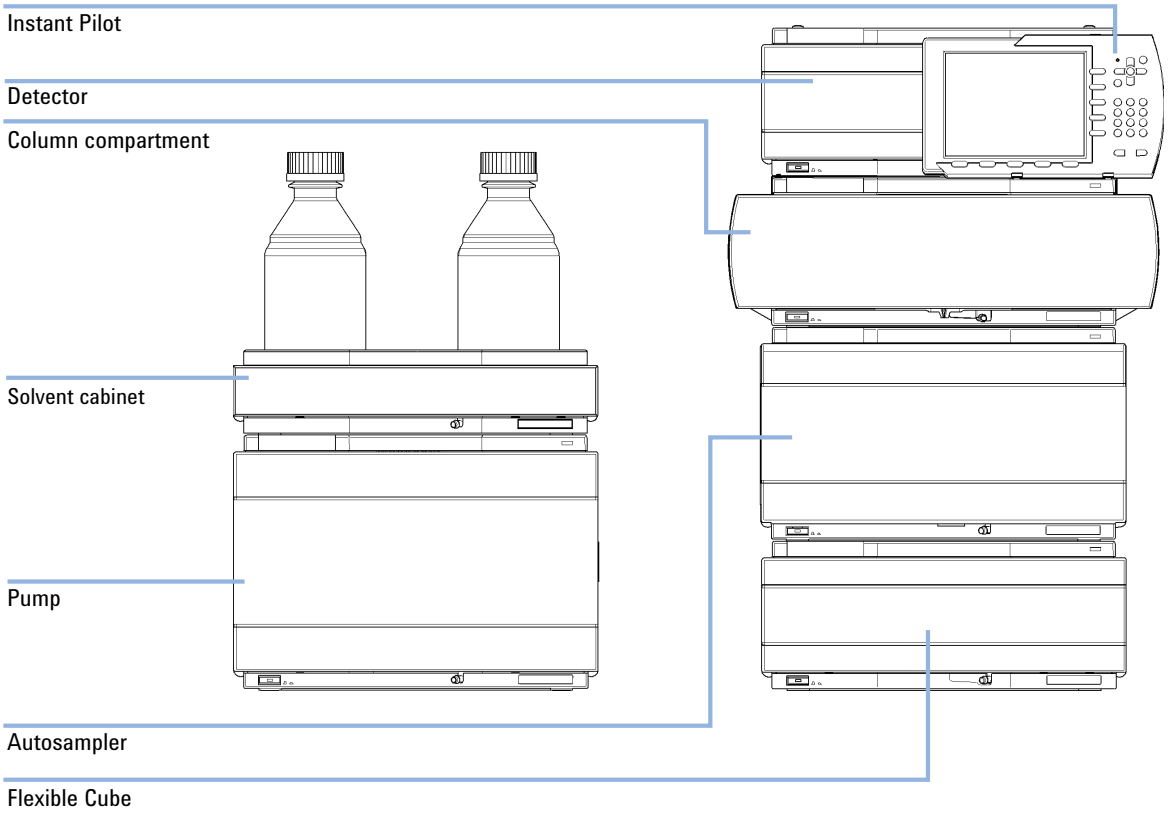



**Figure 12** Supported Two Stack Configuration Front View (Standard)

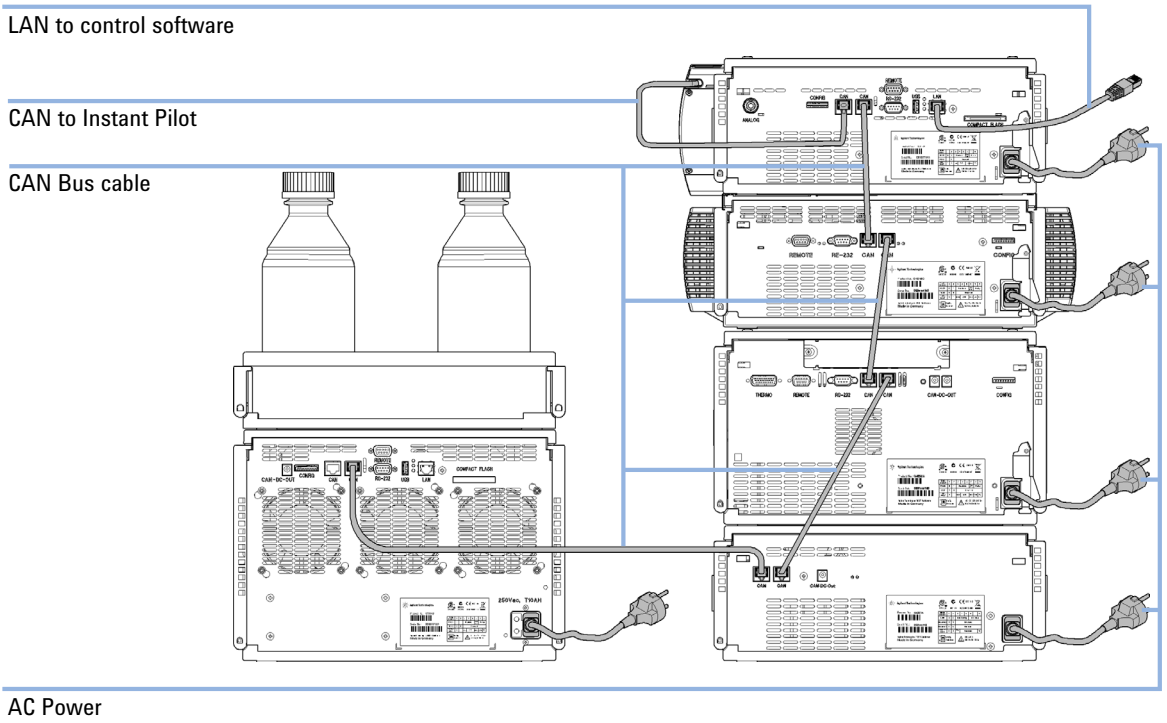



**Figure 13** Supported Two Stack Configuration Rear View (Standard)

## Two Stack Configuration (Thermostatted)

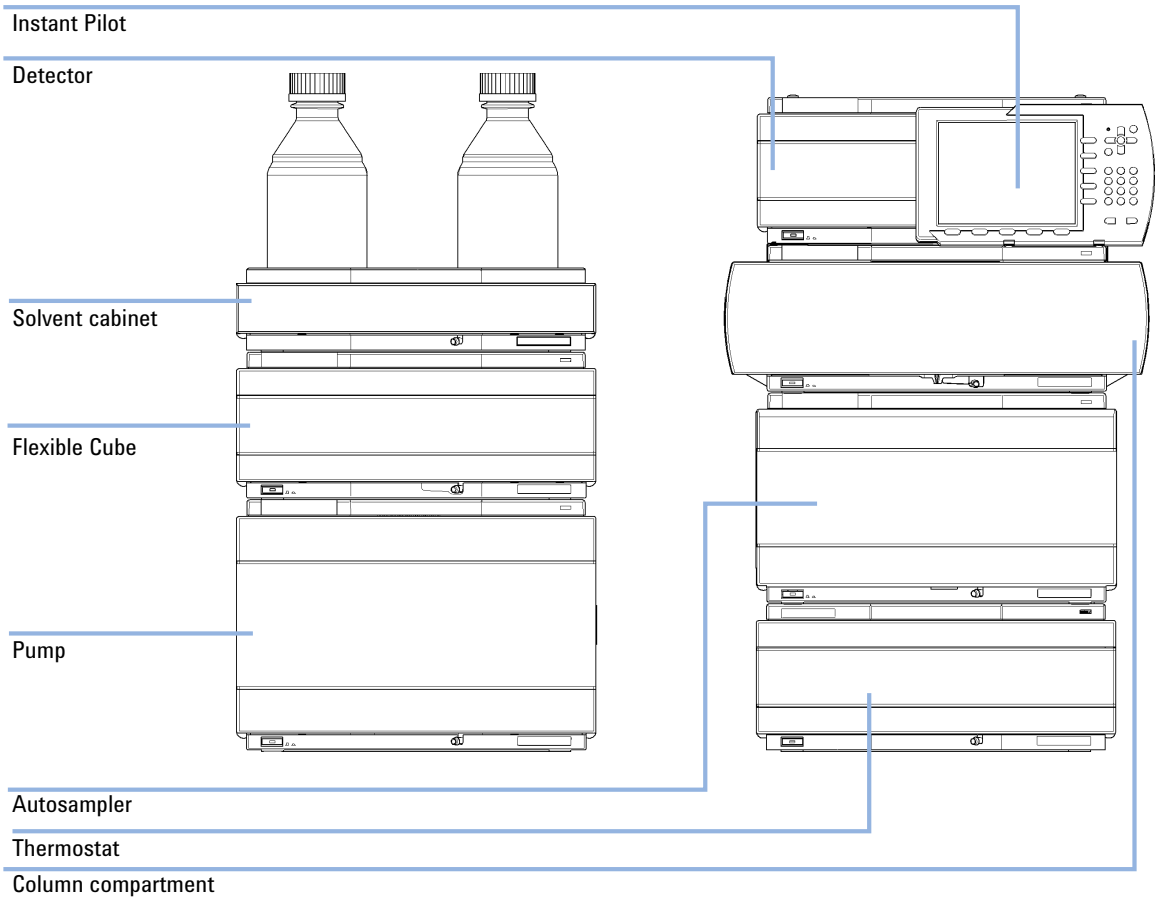



**Figure 14** Supported Two Stack Configuration Front View (Thermostatted)

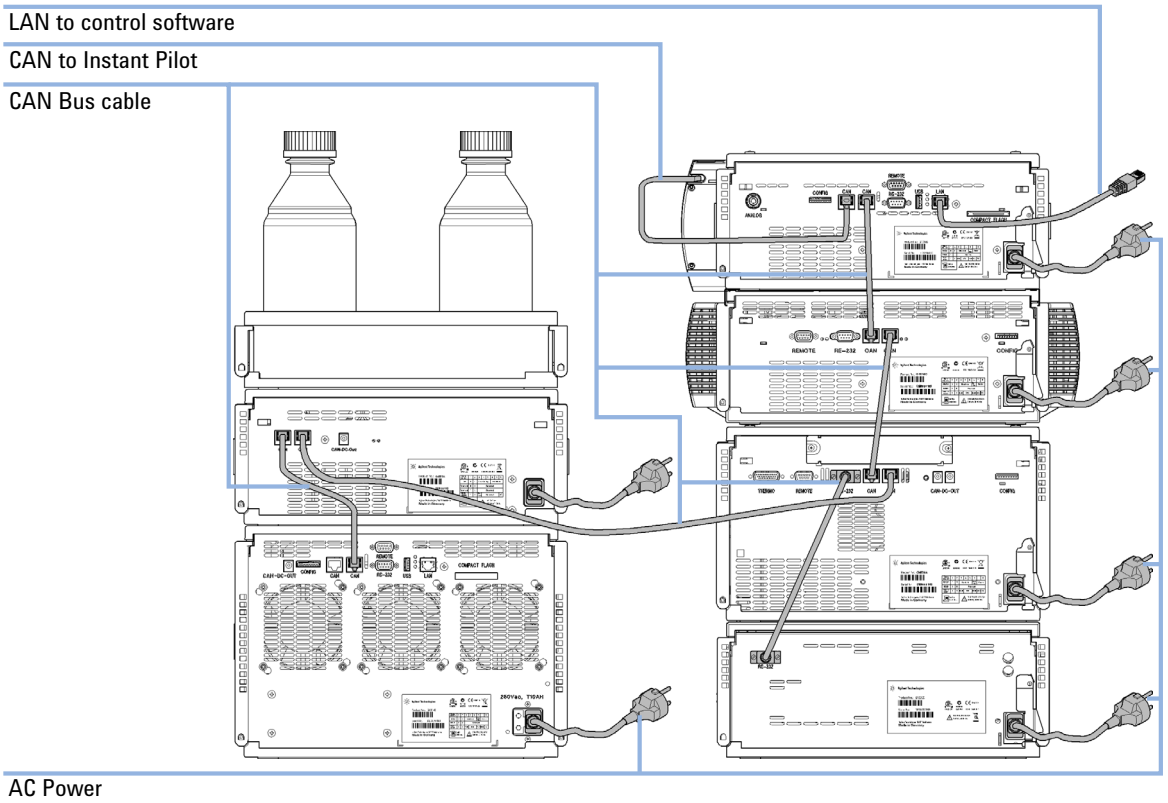



**Figure 15** Supported Two Stack Configuration Rear View (Thermostatted)

# Installing the Module

| Parts required | # | p/n | Description |
|---|---|---|---|
| | 1 | G4227-64013 | Agilent 1290 Infinity Flexible Cube |
| OR | 1 | G4227-64014 | Agilent 1290 Infinity Flexible Cube |
| | 1 | | Power cord |

**Software required** Data System and/or Instant Pilot G4208A with the appropriate revisions, see "Performance Specifications" on page 34.

**Preparations**
- Locate bench space
- Provide power connections
- Unpack the module

**WARNING**

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

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

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

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

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

1 Place the Flexible Cube in the stack, see "Optimizing the Stack Configuration" on page 42.

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

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

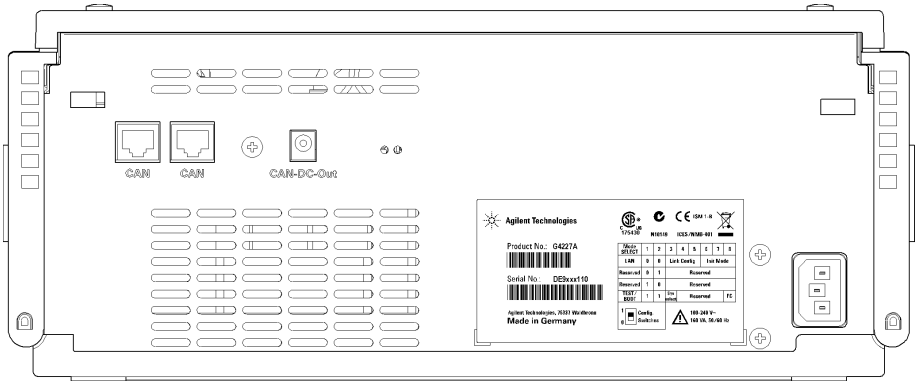



**Figure 16** Module rear view

4 Connect the CAN cable to other modules.

5 Turn on power by pushing the button at the lower left hand side of the module.

The status LED should be green.

**NOTE** The module is turned on when the line power switch is pressed and the green indicator lamp is illuminated. The module is turned off when the line power switch is protruding and the green light is off.

# Flow Connections to the Module for Lowest Carryover

| | | |
|---|---|---|
| **Parts required** | **p/n** | **Description** |
| | G4227-68705 | Flexible Cube Accessory Kit |

**Hardware required** System

**Software required** Data System and/or Instant Pilot G4208 with the appropriate revision, see "Performance Specifications" on page 34

**Preparations** Flexible Cube is installed in system.

**WARNING**

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

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

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

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

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

**CAUTION**

Over pressure in the capillary

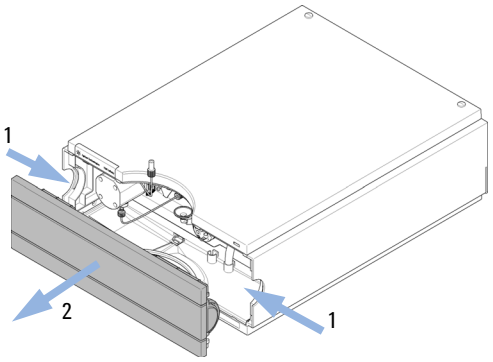
Damage to the flush pump

➔ Do not leave the Autosampler to Flexible Cube capillary installed if the Flexible Cube is not part of the Software configuration or if turned off during operation.

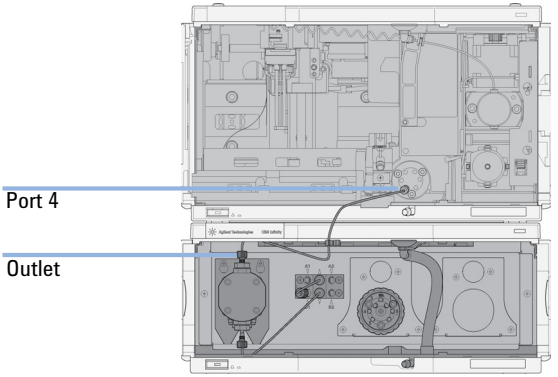
**NOTE**

This procedure shows the Flexible Cube outside of a system. In an Agilent 1290 Infinity Liquid Chromatograph, the Flexible Cube is located between a G4220A Binary pump (below) and the G4226A Autosampler (above), see "Optimizing the Stack Configuration" on page 42.

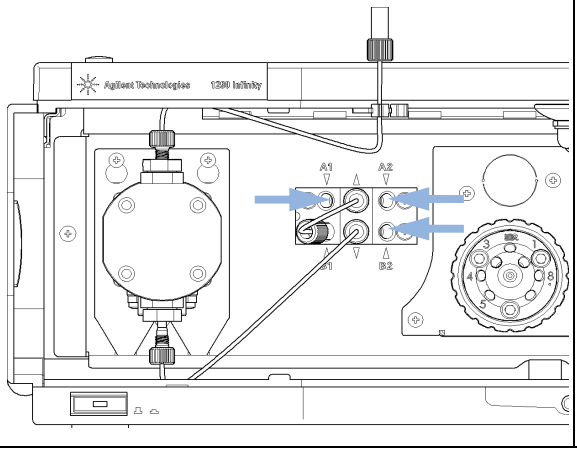
**1** Open the front cover by pressing the buttons on the side of the Autosampler and Flexible Cube modules.




**2** Install the capillary from the pump outlet into the port 4 of the autosampler injection valve.




**3** Install the bottle head assemblies into the solvent selection valve of the Flexible Cube.




**4** Install low restriction needle seat from accessory kit into autosampler (see autosampler manual - Maintenance section for procedure).

# Installing the Valve Heads

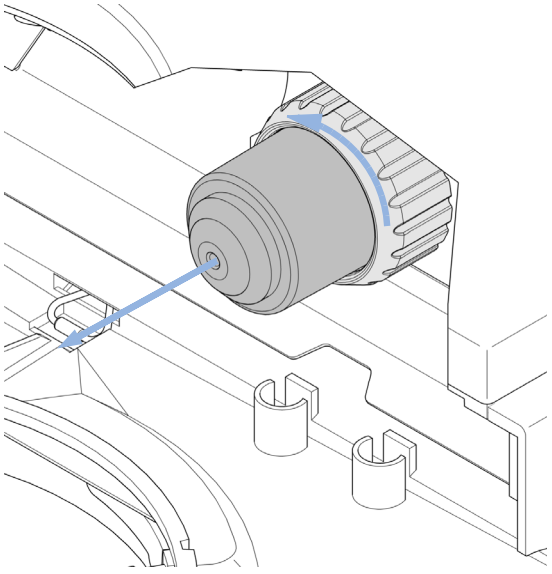
The valve drives are factory-installed in the Thermostatted Column Compartment, in the Flexible Cube, and in the 1290 Infinity Valve Drive. The valve heads are interchangeable and can be easily mounted.

At the first installation, the dummy valve has to be removed, see "Removing the Valve Dummy" on page 53. The valve heads can be installed by mounting the valve heads onto the valve drives and fastening the nut manually (do not use any tools).

Be sure that the guide pin snaps into the groove of the valve drive thread.

## Removing the Valve Dummy

1 To remove the valve dummy, loosen the nut manually.



# Installing the Valve Head and Connecting Capillaries


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

**CAUTION**

The valve actuator contains sensitive optical parts, which need to be protected from dust and other pollution. Pollution of these parts can impair the accurate selection of valve ports and therefore bias measurement results.

➔ Always install a valve head for operation and storage. For protecting the actuator, a dummy valve head can be used instead of a functional valve. Do not touch parts inside the actuator.

**CAUTION**

Column Damage or Bias Measurement Results

Switching the valve to a wrong position can damage the column or bias measurement results.

➔ Fit the lobe to the groove to make sure the valve is switched to the correct position.

**CAUTION**

Valve Damage

Using a low pressure valve on the high pressure side can damage the valve.

➔ When using multiple column compartments as part of a method development solution, make sure that the high pressure valve head is connected to the autosampler and the low pressure valve head is connected to the detector.

**CAUTION**

Sample degradation and contamination of the instrument

Metal parts in the flow path can interact with the bio-molecules in the sample leading to sample degradation and contamination.

➔ For bio-inert applications, always use dedicated bio-inert parts, which can be identified by the bio-inert symbol or other markers described in this manual.

➔ Do not mix bio-inert and non-inert modules or parts in a bio-inert system.

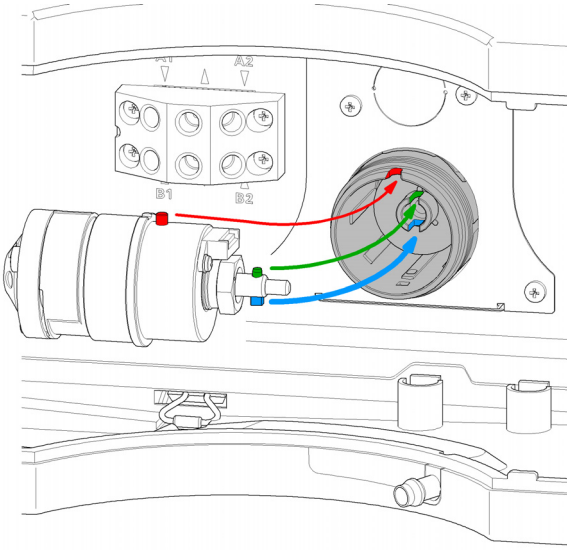
**NOTE**

The tag reader reads the valve head properties from the valve head RFID tag during initialization of the module. Valve properties will not be updated, if the valve head is replaced while the module is on. Selection of valve port positions can fail, if the instrument does not know the properties of the installed valve.

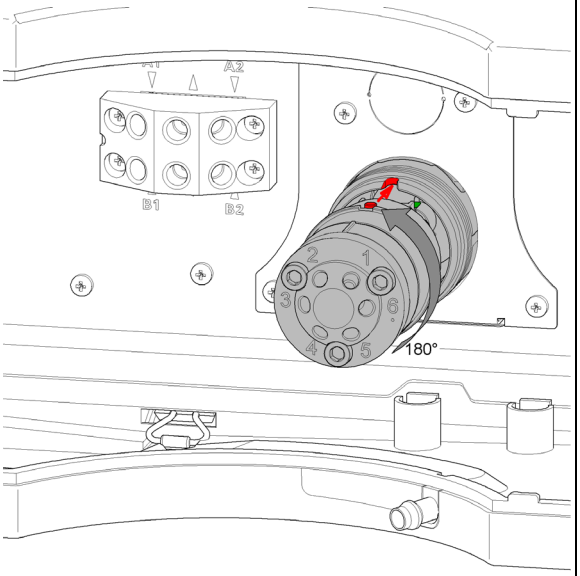
**NOTE**

To have the valve correctly recognized by the Flexible Cube you must have the module powered off for at least 10 s.

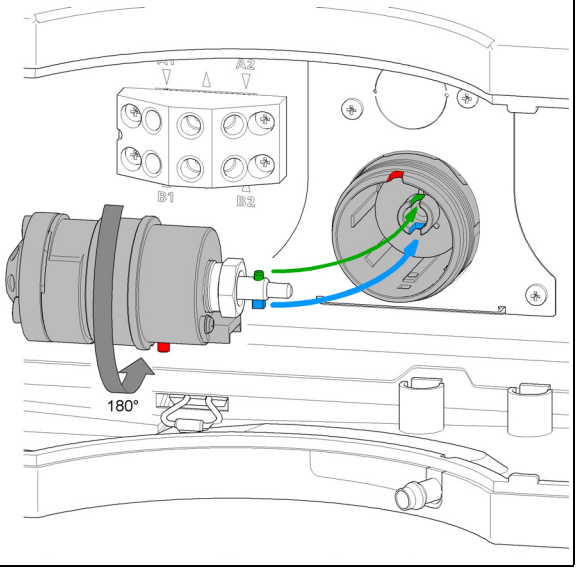
**1** The two different pins (blue & green) on the valve shaft must fit into the corresponding grooves of the actuator axis. The outside pin (red) must fit into the outside groove.



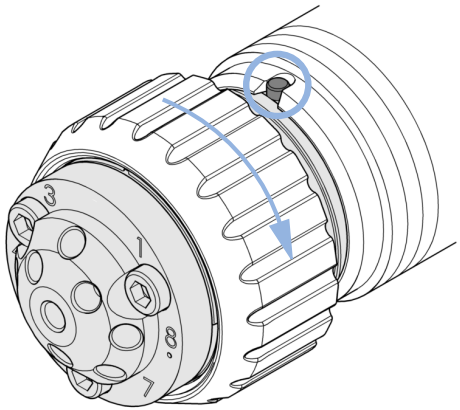

**2** It can be possible that you have to turn the valve head until the outside pin completely locks in. While turning the valve you should feel some resistance from the drive.




Otherwise the pins on the valve shaft are not properly fitted into the corresponding adapters on the valve drive.



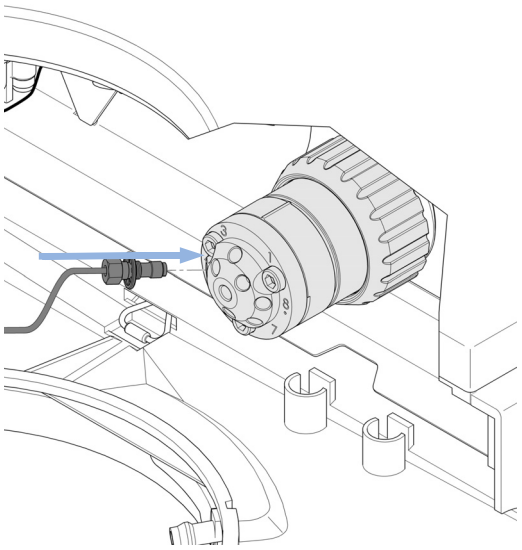
**3** When the outer pin is locked into the groove, manually screw the nut onto the valve head.



**NOTE**

Fasten the nut manually. Do not use any tools.

**4** Install all required capillary connections to the valve.



**5** Power on or power-cycle your module, so the valve head gets recognized during module initialization.

**NOTE**

Power Off the Infinity valve drive for at least 10 s.

# 4
# LAN Configuration



This chapter provides information on connecting the module to the Agilent Data System.

# LAN-Configuration

The G4227A Flexible Cube is a hosted module so it has neither an on-board LAN nor an interface slot for a LAN card. The connection to other modules is established via CAN. The G4212A Diode Array Detector is producing the most data in the stack, followed by the G4220A Binary Pump, and it is therefore highly recommended to use either of these modules for the LAN connection.

If there are no modules with on-board LAN in the stack, the LAN Card G1369C can be used for the hosted module.

**NOTE** The G1369C CAN must connect to CAN port of the module that hosts the LAN card (typically the detector). Then the hosted module CAN must connect to free CAN port of the system. All other combinations will not work.

# 5
# Using the Module



This chapter provides information on how to set up the Flexible Cube for an analysis and explains the basic settings.

# Instrument Configuration

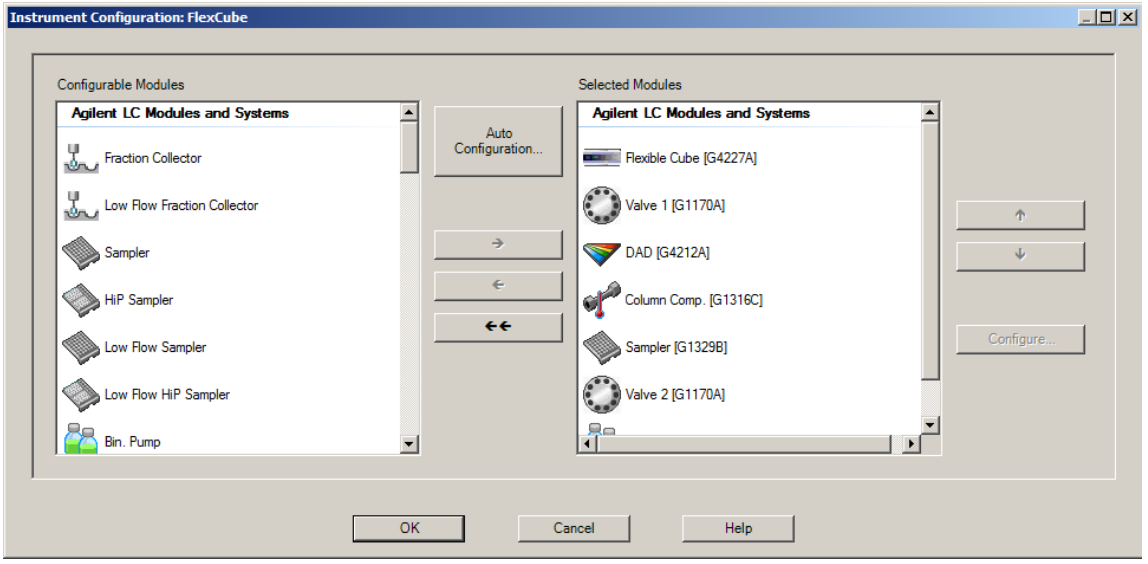



**Figure 17** Instrument configuration

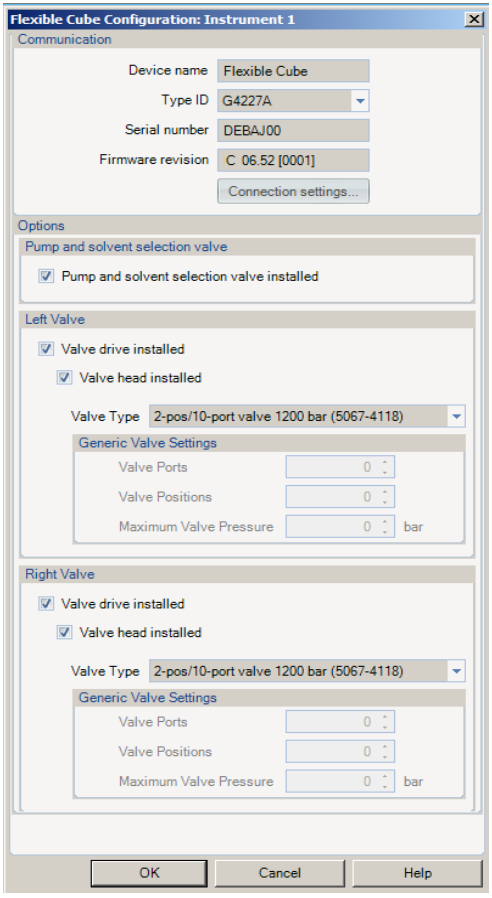



**Figure 18** Flexible Cube configuration

1 Configure your instrument by choosing Flexible Cube from the list of available modules.

2 Choose your valve drive(s)/valve head(s) from the list of configurable **Valve Types**.

**NOTE** If you choose the wrong valve configuration your system will show up in offline modus.

# Setting up the Flexible Cube with Agilent ChemStation

The setup of the Flexible Cube is shown with the Agilent ChemStation C.01.04. Depending on the controller (e.g. Agilent Instant Pilot, EZChrom Elite) the screens look different.

**NOTE** This section describes the Flexible Cube settings only. For information on the Agilent ChemStation or other 1290 Infinity modules refer to the corresponding documentation or the 1290 Infinity System Manual.

After successful load of the ChemStation, you should see the Flexible Cube module as an active item. If the Autosampler is linked to the Flexible Cube you will see this additional icon in the Autosampler GUI.

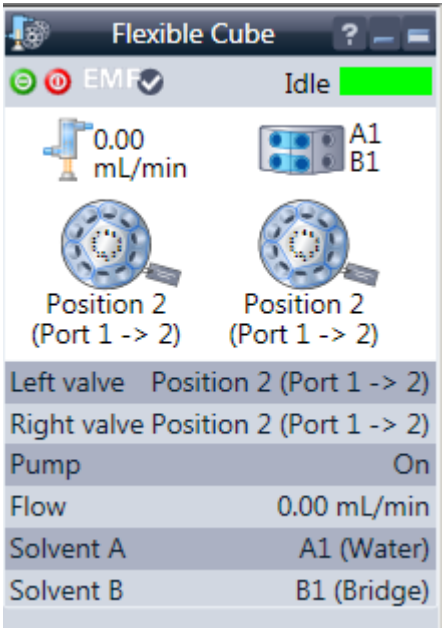



**Figure 19** ChemStation Method & Run Control - Flexible Cube GUI

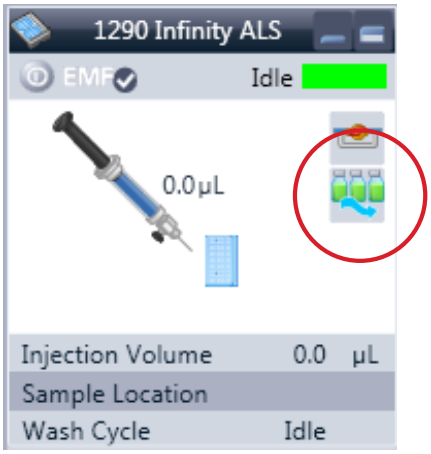
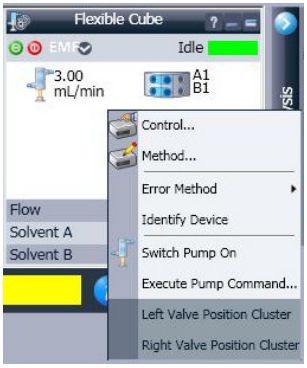



**Figure 20** ChemStation Method & Run Control - Autosampler GUI

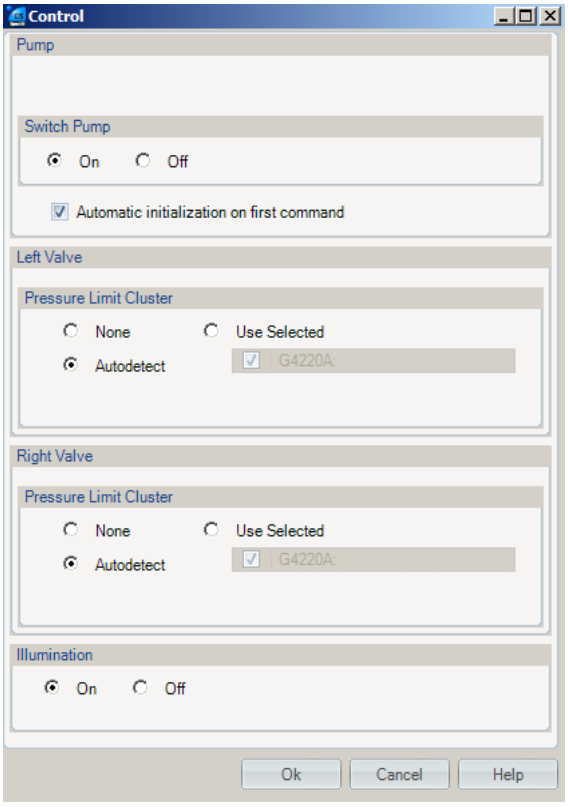
# The Flexible Cube User Interface




A right click in the *Active Area* of the Flexible Cube will open a menu

- show the **Control** user interface
- show the **Method** user interface
- **Error Method**
- **Identify Device**
- **Switch Pump On**
- **Execute Pump Command...**
- **Left Valve Position Cluster**
- **Right Valve Position Cluster**

## Control Settings




The **Pump** section enables you to switch the pump **On** or **Off**. **Automatic initialization on first command**: Mark this check box to ensure that the pump is initialized automatically when it is switched on.

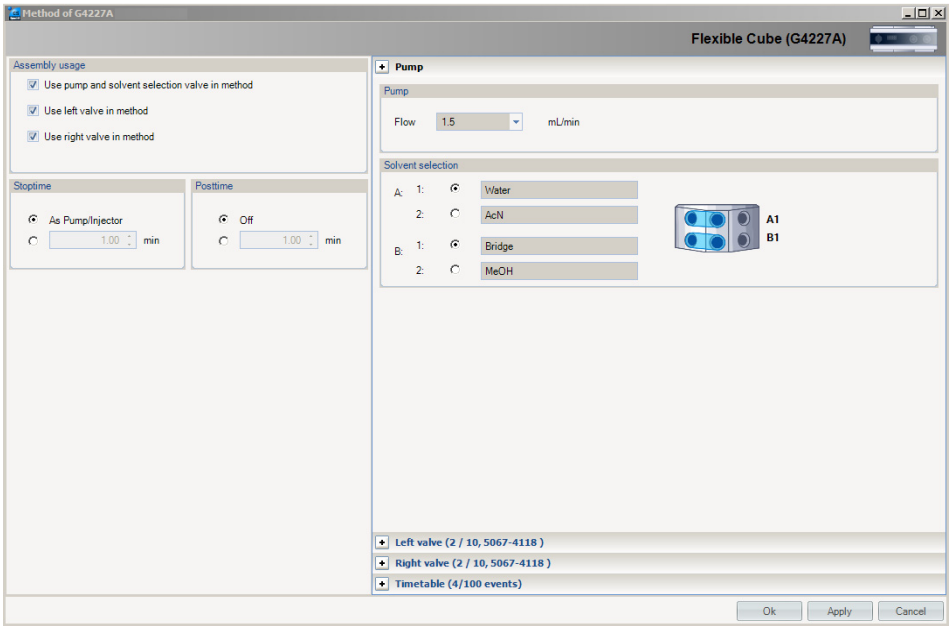
**Left valve/Pressure Limit Cluster**: Use this section to specify how the pressure limit for the cluster is to be determined.

- **None**: No cluster has been specified.
- **Use selected**: The pressure limit for the cluster is set to that of the selected cluster partner.
- **Autodetect**: The pressure limit for the cluster is set to that of the module with the lowest pressure limit.

**Right Valve/Pressure Limit Cluster**: see above

**Illumination**: Toggles the illumination of the Flexible Cube, **On** or **Off**.

## Method Parameter Settings




**Assembly Usage**:

- **Use pump and solvent selection valve in method**: Mark this check box to activate the parameters in the section of the method setup. When the check box is cleared, the parameters are inactive.
- **Use left valve in method**: Mark this check box to activate the parameters in the section of the method setup. When the check box is cleared, the parameters are inactive.
- **Use right valve in method**: Mark this check box to activate the parameters in the section of the method setup. When the check box is cleared, the parameters are inactive.

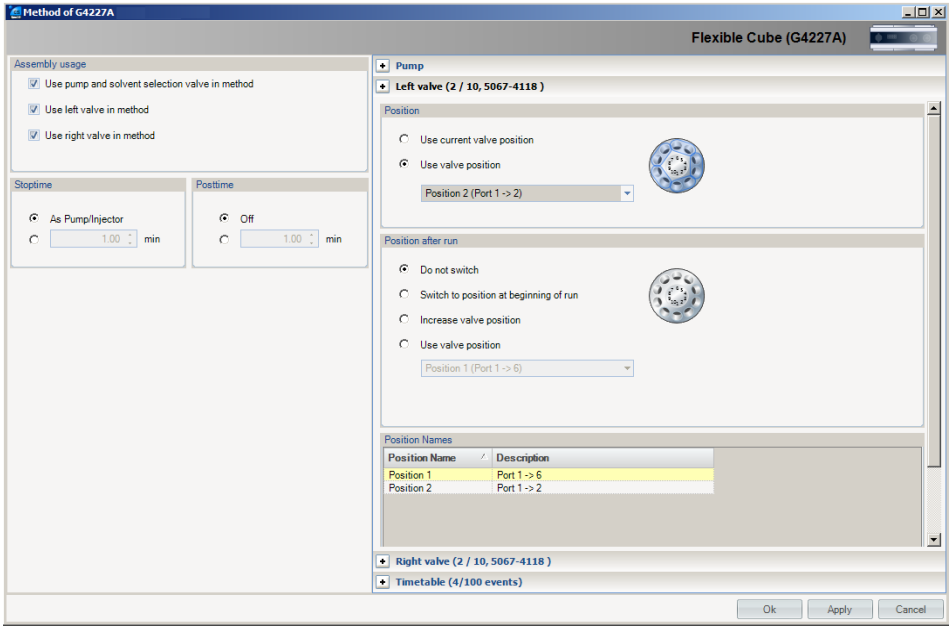
**Posttime**: Your instrument remains in a not ready state during the posttime to delay the start of the next analysis. You can use the **Posttime** to allow your column to equilibrate after changes in solvent composition (for example after gradient elution).

**Stoptime**: Stoptime enables you to set a time at which the Flexible Cube stops an analysis. If the Flexible Cube is used with other Agilent Modular LC modules, the Flexible Cube **Stoptime** stops the Flexible Cube only and does not stop any other modules.

**Pump**:

- **Flow**: Click the down-arrow and select the pump flow (in mL/min) from the list

**Solvent selection**: For each channel, you can select which of the two solvents to deliver. The text boxes allow you to type a brief description of the solvents.




**Left valve**:

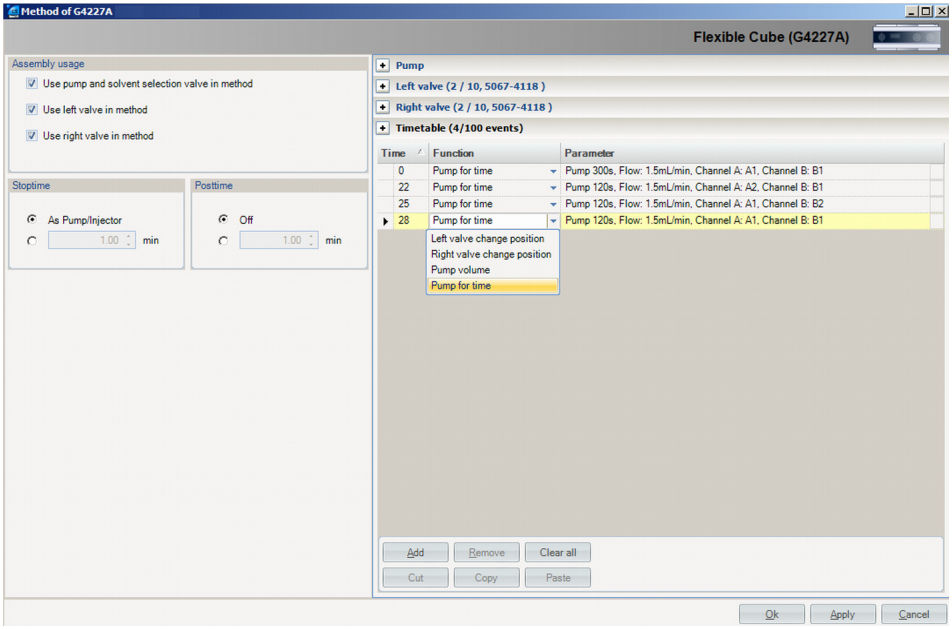
**Position**:

- **Use current valve position**: Uses the current position of the valve.
- **Use valve position**: Specifies a valve position other than the current one. Set the valve position by clicking the down arrow and selecting a position from the drop-down list.

**Position after run**: The **Position after run** section allows you to select the action to take at the end of the run. You can select from:

- **Do not switch**: Leaves the valve at its current position.
- **Switch to position at beginning of run**: Switches the valve to the position it was in at the start of the run.
- **Increase valve position**: Switches the valve to the next serial position.
- **Decrease valve position**: Switches the valve to the previous serial position.
- **Use valve position**: Switches the valve to the specified position. The available positions depend on the installed valve.

**Position Names**: For each valve position, you can specify a description that appears on the method report and in the instrument actuals.



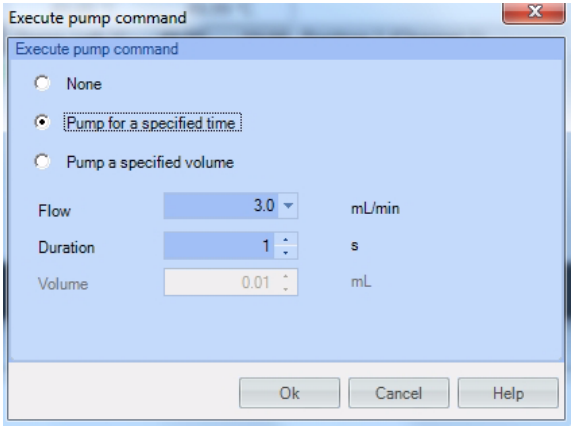

**Timetable**:

Use the **Timetable** to program changes in the Flexible Cube parameters during the analysis by entering a time in the **Time** field and appropriate values in the following fields of the timetable. The values in the Flexible Cube timetable change instantaneously at the time defined in the timetable.

The following parameters can be changed:

- **Left valve change position**: Enables you to change the valve position during a run. Changes in valve position are initiated at the specified time. You can select from:
  - **Increase valve position**: Switches the valve to the next position,
  - **Decrease valve position**: Switches the valve to the previous position,
  - **Use valve position**: Switches the valve to a position other than the current one. Set the valve position by clicking the down arrow and selecting a position from the drop-down list.
- **Right valve change position**: see above
- **Pump volume**: At the specified time, the pump delivers the specified volume of solvent.
- **Pump for time**: At the specified time, the pump is switched on for the specified time.

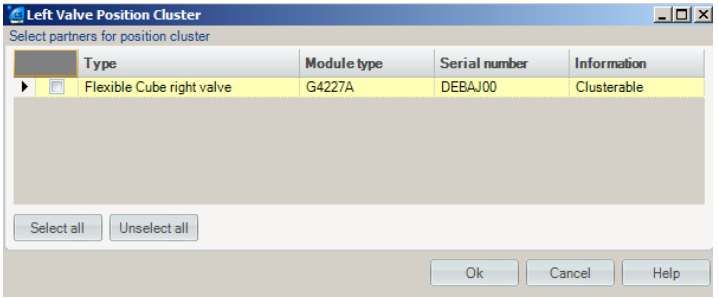
## Execute Pump Command




The **Execute pump command** dialog box allows you to set up and start the operation of the pump for a specified solvent volume or a specified time. You can select from:

- **None**: No pump command is executed.
- **Pump for a specified time**: The pump delivers the specified flow rate for the specified time.
- **Pump a specified volume**: The pump delivers the specified volume of solvent at the specified flow rate.
- **Flow**: Enter the required solvent flow rate (in mL/min) in this field. The **Flow** field is available only when **Pump for a specified time** or **Pump a specified volume** is selected.
- **Duration**: Enter the required duration of pumping (in seconds) in this field. The **Duration** field is available only when **Pump for a specified time** is selected.
- **Volume**: Enter the required volume of solvent to be delivered (in mL) in this field. The **Volume** field is available only when **Pump a specified volume** is selected.

## Left and Right Valve Position Cluster




This dialog box allows you to configure multiple valves to switch synchronously. It is available only if more than one valve has been configured. The table shows all valves that are available as position cluster partners. Mark the check boxes against those that you want to add to the position cluster.

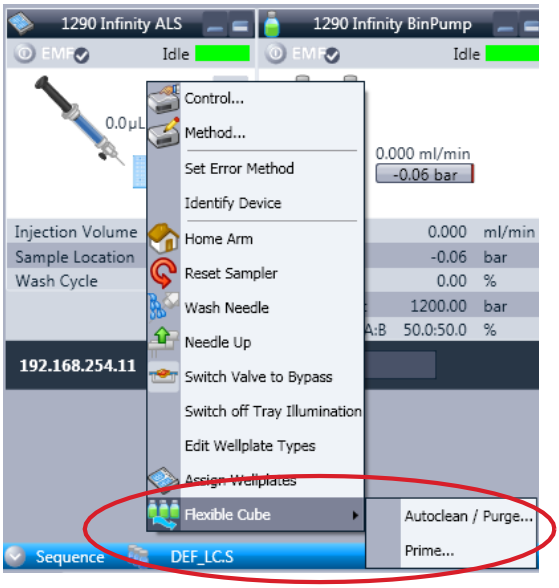
**Select all**: Selects all valves in the list as cluster partners.

**Unselect all**: Clears all selections.

**NOTE** If a position cluster has been defined but the method settings use one of the cluster partners, the module will remain in a Not Ready state.

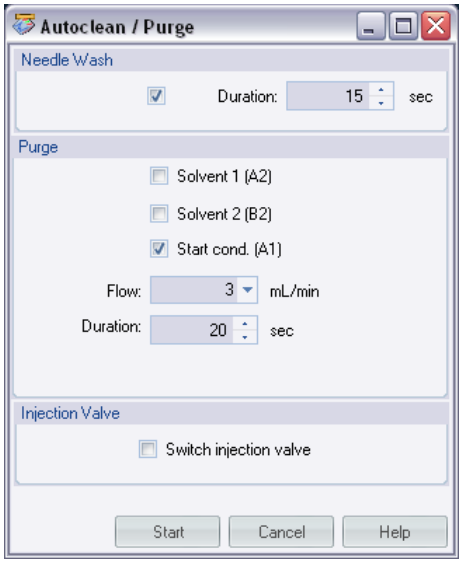
**NOTE** Best working practice: the master should always be the valve with the smallest number of ports. This avoids conflicts if different valve heads are used.

# The Flexible Cube User Interface in Autosampler GUI




A right-click into the *Active Area* will open a menu to

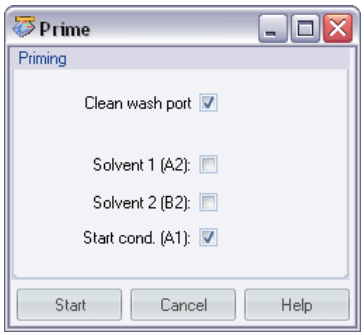
- Show the Control User Interface (special module settings)
- Show the Method User interface (same as via menu Instrument – Setup G4226A)
- And Flexible Cube specific items:
  - Autoclean / Purge
  - Prime




**Autoclean:**

The Autoclean function allows for a complete cleaning of the Autosampler. This process has been automated for ease of use and can be configured according to needs and setup.

- Needle Wash – Activate needle wash and setting of the wash time.
- Purge – Configure which solvents to use for needle seat back flushing and at what flow rate for how long.
- Injection valve – Can be selected for cleaning of the injection valve. This will switch the injection valve between mainpass and bypass a number of times.

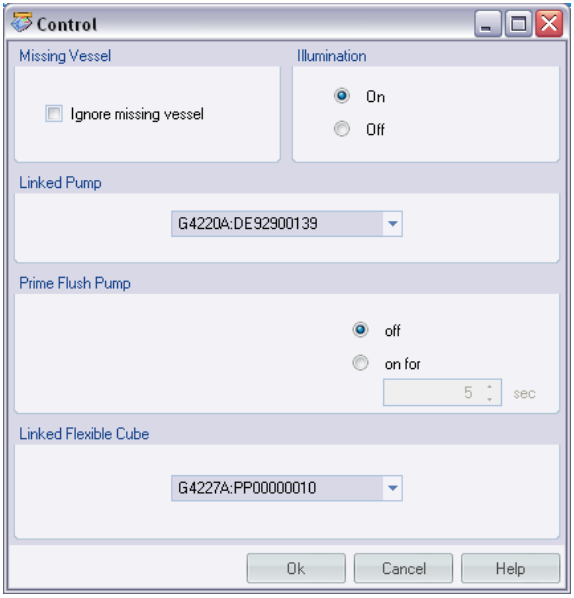



**Prime:**

Priming can be used when the flush lines have run dry or flush solvents have been changed. This feature primes the flush solvent inlet lines with fresh solvent.
It can be configured what solvent lines to prime and additionally the needle wash port can also be primed with solvent.

## Control Settings

These settings are available via right click on the Active Area of the ALS GUI.




**Linked Flexible Cube:**
To configure which Flexible Cube delivers flow to the Autosampler.
**Prime Flush Pump:**
Priming the Needle wash port for a given period of time.

**NOTE** If the Flexible Cube is linked with the pump, the flush pump and the solvent selection valve are blocked for other usage.

# Method Parameter Settings

These settings are available via **Menu > Instrument > Setup Agilent 1290 Infinity Autosampler** or via right click on the Active area.

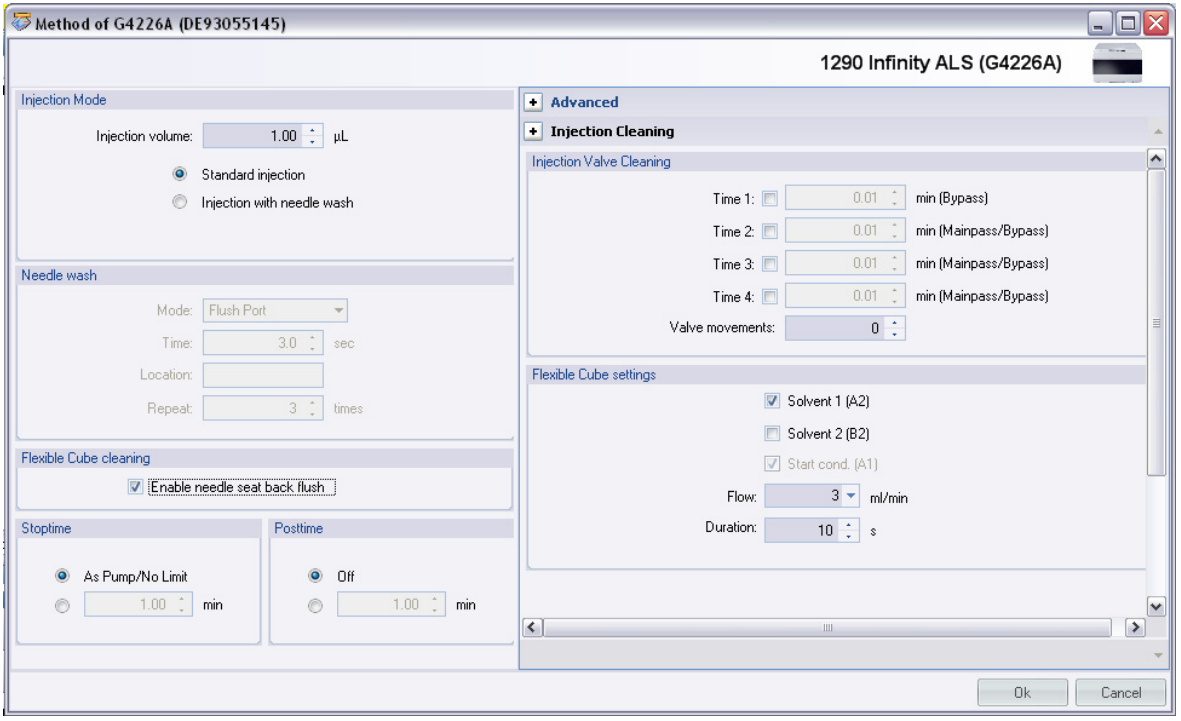
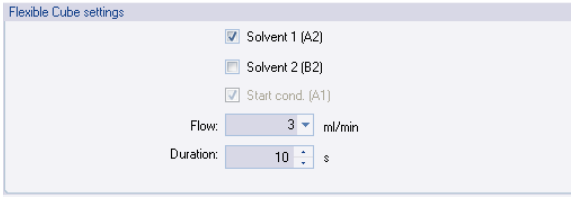



**Figure 21** Method Parameter Settings


**Flexible Cube cleaning**
In order to activate the Flexible Cube cleaning process the Enable needle seat back flush has to be checked.

**Flexible Cube settings**
The setup includes choosing what solvent to use. Note that the Start Cond. (A1) cannot be deselected. Additionally the flow rate and duration can be selected.

## Module Configuration

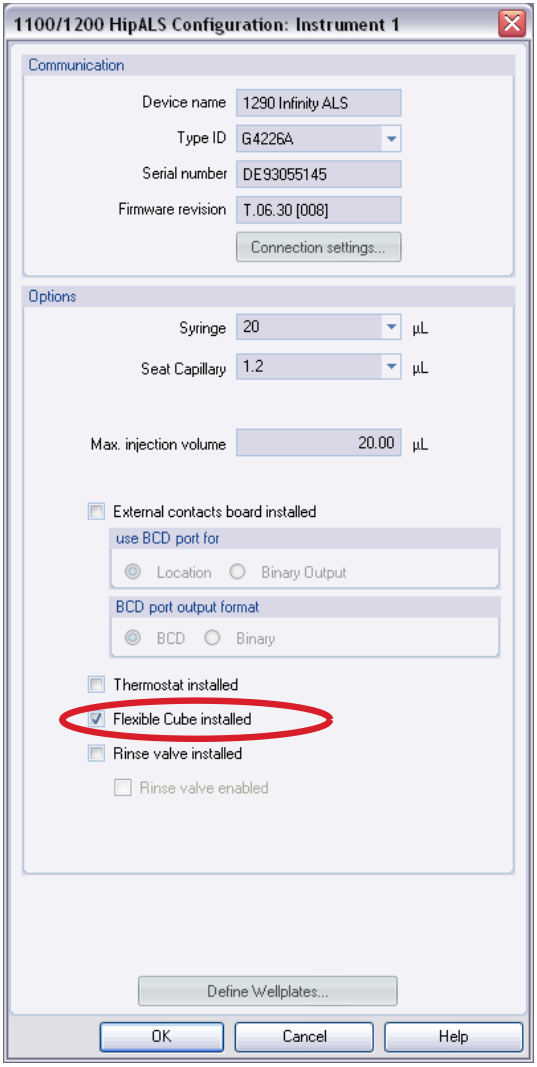
**CAUTION**

Over pressure in the capillary

Damage to the flush pump

➔ Do not leave the Autosampler to Flexible Cube capillary installed if the Flexible Cube is not part of the Software configuration or if turned off during operation.

These settings are available via menu **Instrument > More 1290 Infinity ALS > Control Configuration**.




**Options:**
Lists installed options for the G4226A Autosampler.
**Flexible Cube installed:**
If the **Flexible Cube** option is checked the **Flexible Cube cleaning** feature becomes activated in the **Method and Configuration** screens.

# Solvent Information

## Introduction

Observe the following recommendations on the use of solvents.

- Follow recommendations for avoiding the growth of algae, see "Algae Growth in HPLC Systems" on page 85.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.22 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials like flow cells, valve materials etc. and recommendations in subsequent sections.

## Material Information

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

### Disclaimer

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

## PEEK

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

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

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

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

## Polyimide

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

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

## Polyethylene (PE)

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

Polyethylene has a good stability for most common inorganic solvents including acids and bases in a pH range of 1 to 12.5. It is compatible with many

organic solvents used in chromatographic systems like methanol, acetonitrile and isopropanol. It has limited stability with aliphatic, aromatic and halogenated hydrocarbons, THF, phenol and derivatives, concentrated acids and bases. For normal phase applications, the maximum pressure should be limited to 200 bar.

### Tantalum (Ta)

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

### Stainless Steel (ST)

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

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

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

  This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol.
- Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, diisopropylether). Such ethers should be filtered through dry aluminium oxide which adsorbs the peroxides.
- Solutions of organic acids (acetic acid, formic acid, and so on) in organic solvents. For example, a 1 % solution of acetic acid in methanol will attack steel.
- Solutions containing strong complexing agents (for example, EDTA, ethylene diamine tetra-acetic acid).
- Mixtures of carbon tetrachloride with 2-propanol or THF.

### Titanium (Ti)

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

### Diamond-Like Carbon (DLC)

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

### Fused silica and Quartz ($SiO_2$)

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

### Gold

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

### Zirconium Oxide ($ZrO_2$)

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

### Platinum/Iridium

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

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

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

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

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

### Sapphire, Ruby and $Al_2O_3$-based ceramics

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

# 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 0.2 µm filters.
- Never leave mobile phase in the instrument for several days without flow.
- Always discard old mobile phase.
- Use the amber solvent bottle ( Solvent bottle, amber, 1000 mL (9301-6526)) supplied with the instrument for your aqueous mobile phase.
- If possible add a few mg/L sodium azide or a few percent organic solvent to the aqueous mobile phase.

# 6
# Optimizing Lab Performance with Flexible Cube



This chapter provides information on how to optimize the Autosampler and the Flexible Cube for a minimum carryover and fastest cycle times.

# Preparing the Autosampler and Flexible Cube

For best performance of the Autosampler with Flexible Cube

- Place solvent cabinet with the solvent bottles always on top (or at a higher level) of the Flexible Cube.
- It is recommended to purge the flush pump before starting a sequence, to ensure air free solvent in Autosampler capillaries
- When changing solvent bottles, prime the Flexible Cube to ensure purged solvent lines.
- Use separate solvent bottle for external needle wash in Autosampler.
- Use inlet filters for flush solvent bottles.
- It is recommended to sonicate solvent A1 which should be set to the chromatographic starting condition before use, to avoid generation of air bubbles.

# How to Achieve Lowest Carryover

Carryover is measured when residual peaks from a previous active-containing injection appear in a subsequent blank solvent injection. There will be carryover between active injections which may lead to erroneous results. The level of carryover is reported as the area of the peak in the blank solution expressed as a percentage of the area in the previous active injection.

Reducing the carryover is an important part during any method development process. The flush solvents and flush timing has to be adjusted to the sample solvent, sample components injected and the mobile phase in use.

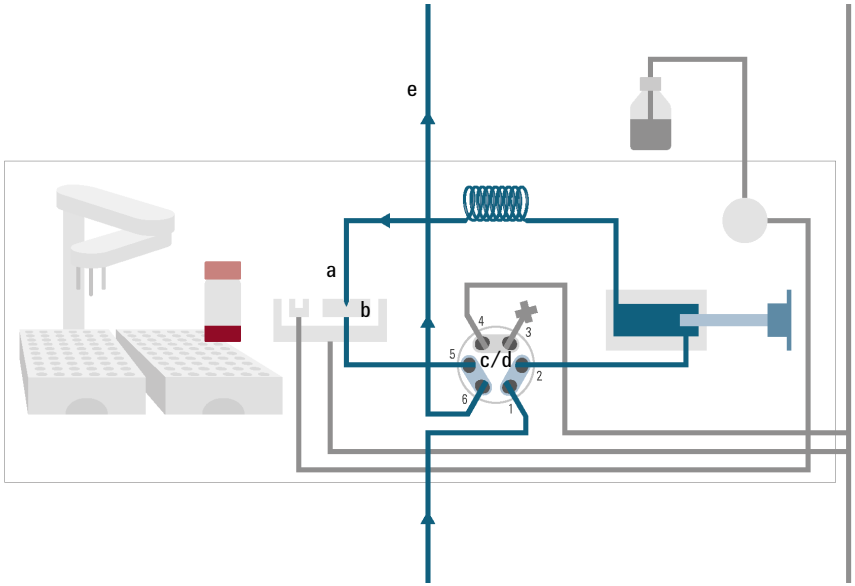



**Figure 22** Potential Sources of Carryover

| | |
|---|---|
| a | Adsorption to needle and capillary material or bad design. |
| b | Needle seat design, improper sealing, worn out. |
| c | Valve Rotor/Stator, bad design, wear. |
| d | Capillary fittings misadjusted (at all connections contaminated with the sample!). |
| e | Column related carryover (all fittings and connections of the column, packing, stationary phase-sample interaction). |

The Agilent 1290 Infinity Autosampler is optimized for lowest carryover by careful design of the flow path and use of materials in which sample adsorption is minimized. A carryover amount of 0.002 % should be achievable even when a triple quadrupole mass spectrometer is used as detector. Operating settings of the Autosampler allow the user to set appropriate parameters to minimize carryover in any application involving compounds liable to stick in the system.

The following functions of the Autosampler can be used to minimize carryover:

- Internal needle wash
- External needle wash
- Needle seat back flush
- Injection valve cleaning

The flow path, including the inside of the needle, is continuously flushed in normal operation, providing lowest carryover for most applications.

**NOTE** Not correctly applied fittings are the sole largest contributor to system carryover. Make sure to use correct fittings and to tighten the fittings correctly.

## Internal Needle Wash

Due to adsorption of sample compounds to the surface of the needle, sample discrimination and/or carryover effects can occur. This effect might be eliminated by having the entire gradient profile flow through the sampling loop of the Autosampler.

Automated delay volume reduction (ADVR) and overlapped injection will reduce the delay volume but will also reduce the internal flushing of the Autosampler needle and should not be used with analytes where sample discrimination might be a problem.

## External Needle Wash

Adsorption of sample compounds to the outer surface of the needle might lead to contamination of sample vial septa and needle seat. The outside of the needle can be washed using a wash vial in a specific location or the needle can be washed using the flush port. If a wash vial in a tray location specified by the user is chosen then this vial should have no septum and should contain a solvent suitable for washing the sample from the needle. The septum is not used to avoid wiping contamination off the needle on the downstream only to re-apply it on the upstroke. The needle can be dipped into the vial multiple times. This will be effective in removing a small degree of carryover but for more effective washing of the outside of the needle use the flush port. The flush port is located above and behind the needle seat and a peristaltic pump delivers the wash solvent. It has a volume of 0.68 mL and the peristaltic pump delivers 6 mL/min, which means the flush port volume is completely refilled with fresh solvent in 7 s. If the flush port is selected, the user can set how long the outside of the needle is to be washed with fresh solvent. This may be as low as two or three seconds in routine situations where carryover is less of a problem and 10 – 20 s for more complete washing. It is recommended that washing the outside of the needle in the flush port should be standard procedure to avoid contaminating the needle seat.

For samples where the outside of the needle cannot be cleaned sufficiently with water or alcohol from the flush pump use wash vials with an appropriate solvent. With an injector program several wash vials can be used for cleaning.

The flush port and its peristaltic pump and tubing should be regularly flushed to ensure the lowest carryover. For example, before using the system each day, prime the flush port for three minutes with appropriate solvent.

## Needle Seat Back Flush

Due to wear and tear in the needle seat and the rotor seal the carryover performance of the Autosampler is being reduced over time. To eliminate this effect, a back flushing of the needle seat can be used to restore performance.

If the needle seat or rotor seal becomes contaminated it has to be back-flushed by manually changing the flow connections. This is one of the tasks that can be automated using the Flexible Cube module.

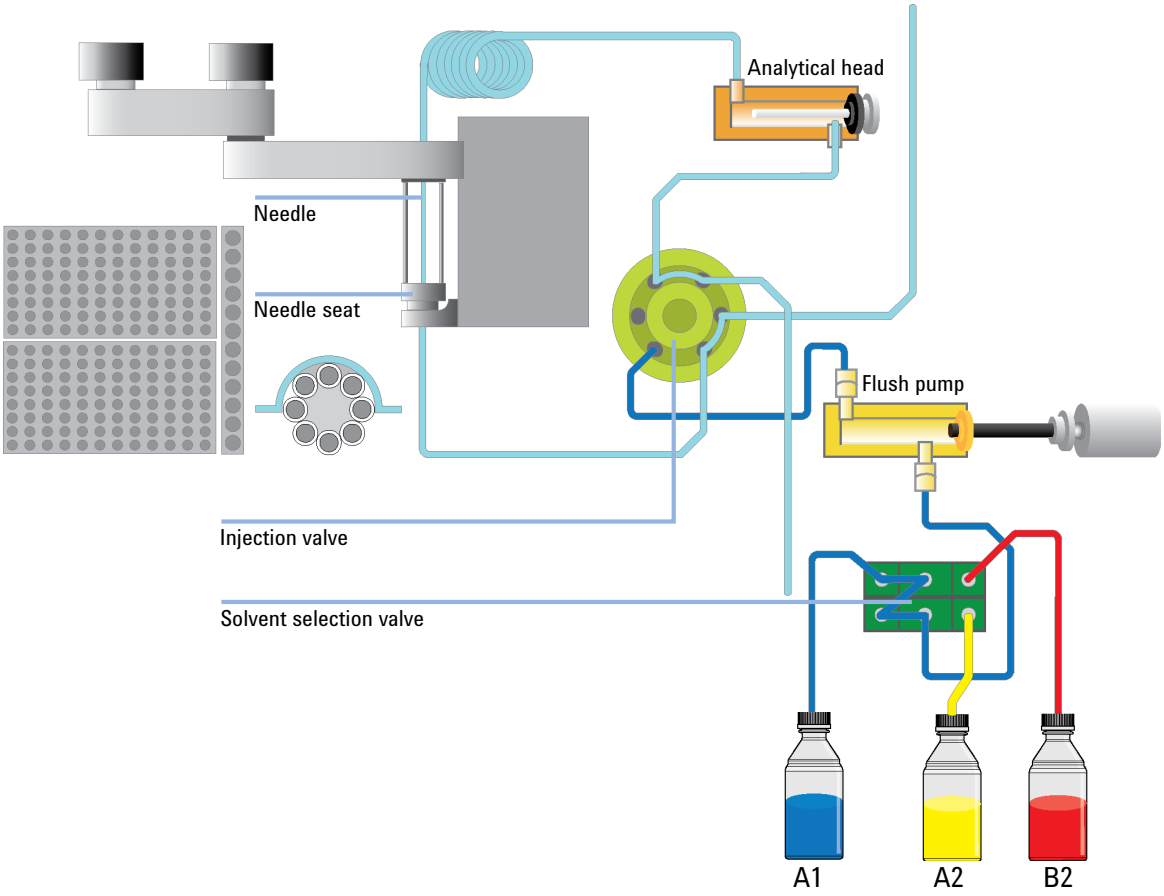



**Figure 23** Schematic of Autosampler with Flexible Cube Setup

If highly sticky compounds are analyzed and cannot be removed completely by an exterior needle wash they will contaminate the injector needle seat. To avoid the manual procedure of back flushing, the Flexible Cube can be introduced into the LC system. The Flexible Cube contains a single piston pump and up to three solvent selection lines. This setup allows flushing the needle seat backwards with three different solvents of different strength. The flushing procedure starts prior to the injection to remove residues from the last injection while the needle is drawing the sample and then flushed from the outside in the flush port. Thereby, it is recommended to start with the strong dissolving solvent #1 (A2) and if necessary to continue with stronger dissolving solvent #2 (B2). Prior to injection the seat and seat capillary should be flushed with solvent #3 (A1) to set it similar to chromatographic starting conditions.

To get the most efficient washing of the injection valve and needle seat, the flow rate chosen should be as high as possible. The flow rate might be restricted if using highly viscous wash solvents due to back pressure or if using a very low viscosity wash solvent due to jet stream effects. Recommended wash solution for most applications is a water methanol mixture, run at 4 mL/min flow rate.

The choice of dissolving solvents greatly depends on analyte and solvents in use. Normally the dissolving solvent #1 should be of a high organic concentration with appropriate modifiers. If this is not sufficient to reduce the carryover, a dissolving solvent #2 may be used with either different modifiers and/or a really strong cleaning solvent. Solvent #3 is always set for the final flush and should be the starting condition of the gradient or lower solution strength, as this solvent will be in the needle seat and seat capillary at the point of injection.

**NOTE** Any flushing solvent used must be miscible with previous solvent. If this is not the case it can result in precipitations, blockages or reduced performance of the instrument.

## Injection Valve Rinse

Cavitations created due to wear will have an effect on the carryover performance of the injection valve. By switching the valve back and forth these cavitations will be flushed and cleaned and long term carryover performance can be achieved.

**NOTE**

At each time, the valve is switched twice, from mainpass to bypass to mainpass. These additional switches must be taken into account when calculating the number of runs that can be executed until the rotor seal of the injection valve needs to be replaced (EMF). The rotor seal of the Autosampler has a lifetime of around 30000 switches.

When other measures have failed to eliminate carryover it might be that analyte is sticking inside the injector valve. The injector valve can be set to make additional switching movements to clean out the flow path in the valve if problems occur here with carryover.

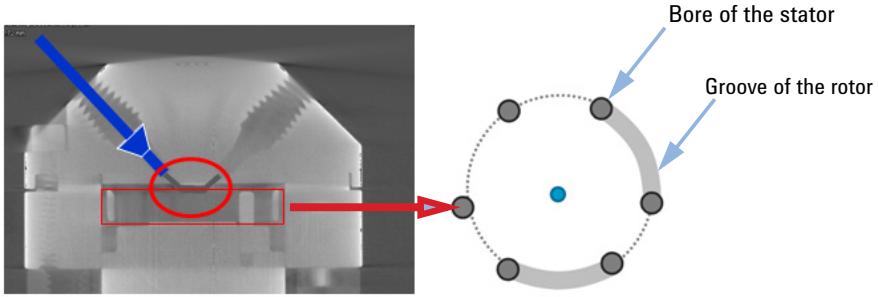



**Figure 24** The Problem Zone of the Injection Valve

If the problem compounds need a high percentage of organic phase for elution, it is recommended to switch the injection valve at the high percentage of organic phase after the last peak has eluted. It is also recommended to switch the injection valve again after the initial conditions for the mobile phase have stabilized. This ensures that the bypass groove in the rotor seal of the valve contains the gradient start conditions, which is especially important when using short narrow bore columns.

The Injection Valve Cleaning section allows you to specify the valve switching times anytime appropriate.

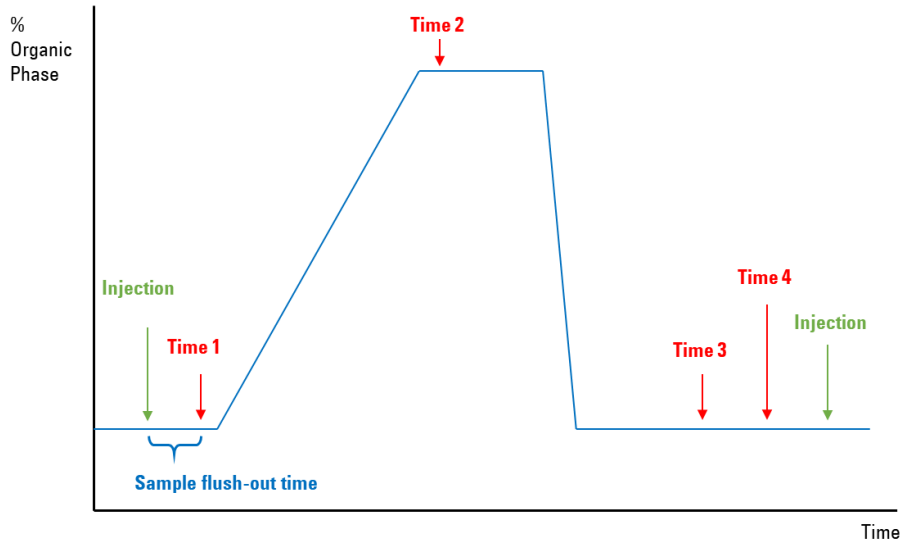



**Figure 25** Schematic representation of recommended valve switching times in the Injection Valve Cleaning procedure

Time points 1 to 4 are the times when the valve switches. The times must be specified in ascending order. You can also switch the times to off. Between the first and second, and second and third valve switches, a rinse is executed using the rinse volumes specified in the Injector Cleaning section.

### Injection Valve Movements

You specify the number of times that the injection valve switches from mainpass to bypass at times 2, 3 and 4 in the field. The maximum value is 2; default is 1.

| | |
|---|---|
| Time 1 | Valve switches directly after sample has been flushed out at high % water might be useful if sample is highly soluble in water. |
| Time 2 | Valve switches at high % organic phase to effectively remove sample from injection valve grooves, while avoiding sample retardation on the column. |
| Time 3 | Valve switches at low % organic phase to effectively remove organic solvent from injection valve groove. |
| Time 4 | Used to repeat valve switch 1, 2 or 3 in the case of extremely sticky sample or solvents. |

**NOTE** At each time, the valve is switched twice, from mainpass to bypass to mainpass. These additional switches must be taken into account when calculating the number of runs that can be executed until the rotor seal of the injection valve needs to be replaced (EMF).

### Calculation of Time 1

Time 1 = Sample flush-out factor * Total flush-out volume/Flow rate

Total flush-out volume = Injection volume + Seat capillary volume + Valve volume

# How to Achieve the Highest Throughput Using the Flexible Cube

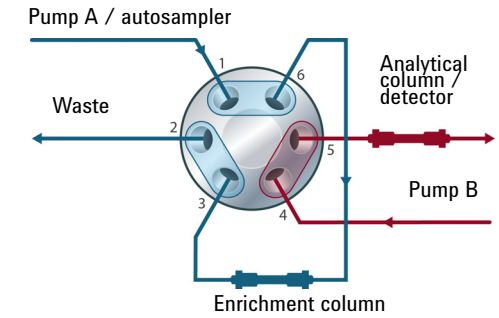
A high throughput of the system can still be achieved by using the high throughput features of the autosampler. Any wash cycle will increase the cycle time of the system. The shortest cycle times using the flush function of the Flexible Cube can be achieved when only flushing with solvent #3 (A1) set to the chromatographic starting conditions only. The volume which has to be flushed can be calculated by adding the volume of the autosampler valve and the volume of the autosampler seat capillary. With the known flow rate of the pump in the Flexible Cube the flushing time can be calculated with the desired factor to flush the volume once or multiple times. A minimum of 5 seconds is recommended in order to get solvent in the needle seat exchanged.

For sticky samples or if sample discrimination is a problem it can be necessary to use multiple solvents. This will increase the minimum cycle time achievable. Typically one strong dissolving solvent and a solvent set to the chromatographic starting conditions is sufficient, but in case of solubility issues between strong dissolving solvent and sample it might be necessary to use a second strong dissolving solvent. Typically a flushing time of the needle seat of about 15 s at 4 mL/min for each solvent is sufficient or at least a good starting condition.

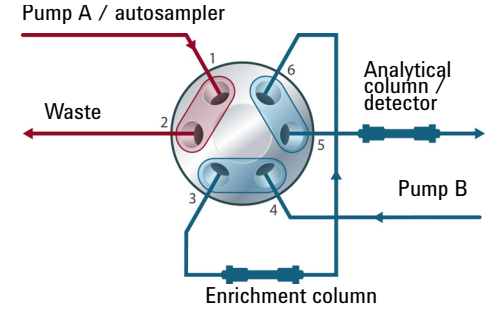
# How to Achieve Higher Injection Volumes

One way to achieve larger injections is to use a trapping column selected by a switching valve to capture and concentrate the injection before switching it, i.e. injecting it, onto an analytical column, see "Sample Enrichment" on page 98. The valve can be conveniently located in the thermostatted column compartment or in the flexible cube.

## Sample Enrichment




**Position 1**

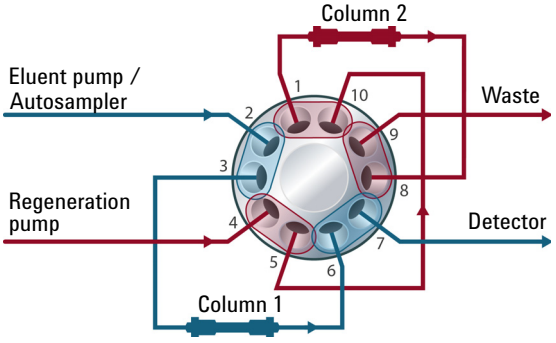



**Position 2**

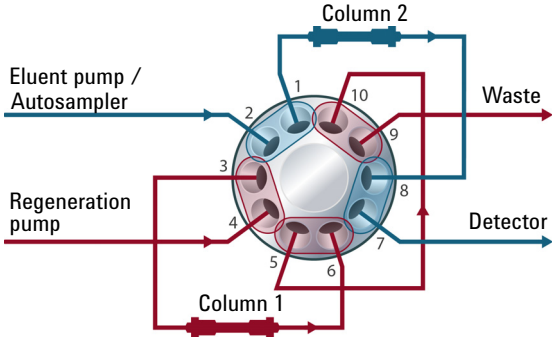
# How to Achieve High Throughput

The column equilibration step can be a significant part of the cycle time. Typically, the column needs flushing with three to five column volumes to stabilize it for the next injection. This can be 50 % or more of the separation time in some applications. It is an essential process but can be taken out of the cycle time by using automated alternating column regeneration. For this a 2 position/10 port valve head is required in the column compartment; a second analytical column, identical to the first one; and a second pump is needed.

As one column is being used in the separation run, the other column is being flushed with the starting composition of the mobile phase gradient and to start the next injection the newly re-equilibrated column is switched into the analytical flow path. The two columns then alternate in this way for the whole sequence of injections. The second pump is only required to flush an isocratic mixture through the column and so can be a simpler pump than the 1290 Infinity pumps. For instance a 1200 Series isocratic pump would be sufficient to perform this task. The setup is illustrated below.




**Position 1-10**




**Position 1-2**

# 7
# Troubleshooting and Diagnostics



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

# Overview of the Module's Indicators and Test Functions

## Status Indicators

The module is provided with two status indicators which indicate the operational state of the module. The status indicators provide a quick visual check of the operation of the module.

## Error Messages

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

## Test Functions

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

## Diagnostic Signals

The module has several signals (internal temperatures, voltages and currents of lamps) that can be used for diagnosing baseline problems. These can be added like normal signals in the Agilent ChemStation software.

# Status Indicators

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

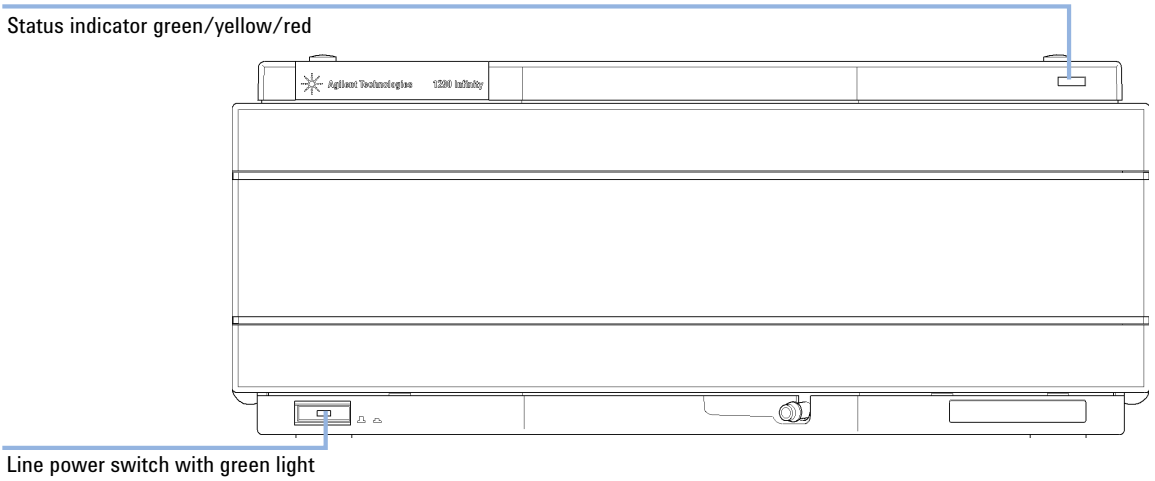



**Figure 26** Location of Status Indicators

## Power Supply Indicator

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

## Module Status Indicator

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

- When the status indicator is *OFF* (and power switch light is on), the module is in a *prerun* condition, and is ready to begin an analysis.
- A *green* status indicator, indicates the module is performing an analysis (*run* mode).
- A *yellow* indicator indicates a *not-ready* condition. The module is in a not-ready state when it is waiting for a specific condition to be reached or completed (for example, immediately after changing a set point), or while a self-test procedure is running.
- An *error* condition is indicated when the status indicator is *red*. An error condition indicates the module has detected an internal problem which affects correct operation of the module. Usually, an error condition requires attention (e.g. leak, defective internal components). An error condition always interrupts the analysis.

  If the error occurs during analysis, it is propagated within the LC system, i.e. a red LED may indicate a problem of a different module. Use the status display of your user interface for finding the root cause/module of the error.
- A *blinking* indicator indicates that the module is in resident mode (e.g. during update of main firmware).
- A *fast blinking* indicator indicates that the module is in a low-level error mode. In such a case try to re-boot the module or try a cold-start (see "Special Settings" on page 199. Then try a firmware update (see "Replacing Module Firmware" on page 150). If this does not help, a main board replacement is required.

# 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 106.
- 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 a chromatographic data system. Agilent Lab Advisor helps to manage the lab for high-quality chromatographic results by providing a detailed system overview of all connected analytical instruments with instrument status, Early Maintenance Feedback counters (EMF), instrument configuration information, and diagnostic tests. By the push of a button, a detailed diagnostic report can be generated. Upon request, the user can send this report to Agilent for a significantly improved troubleshooting and repair process.

The Agilent Lab Advisor software is available in two versions:

- Lab Advisor Basic
- Lab Advisor Advanced

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

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

The 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 Agilent InfinityLab LC Series instrument.

The tests and diagnostic features that are provided by the Agilent Lab Advisor software may differ from the descriptions in this manual. For details, refer to the Agilent Lab Advisor software help files.

# 8
# Error Information



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

# What Are Error Messages

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

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

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

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

# General Error Messages

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

## Timeout

**Error ID: 0062**

The timeout threshold was exceeded.

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

# Shutdown

**Error ID: 0063**

An external instrument has generated a shutdown signal on the remote line.

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

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

## Remote Timeout

**Error ID: 0070**

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

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

## Lost CAN Partner

**Error ID: 0071**

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

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

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

## Leak Sensor Short

**Error ID: 0082**

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

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

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

## Leak Sensor Open

**Error ID: 0083**

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

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

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

## Compensation Sensor Open

**Error ID: 0081**

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

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

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

## Compensation Sensor Short

**Error ID: 0080**

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

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

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

## Fan Failed

**Error ID: 0068**

The cooling fan in the module has failed.

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

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

| Probable cause | Suggested actions |
|---|---|
| **1** Fan cable disconnected. | Please contact your Agilent service representative. |
| **2** Defective fan. | Please contact your Agilent service representative. |
| **3** Defective main board. | Please contact your Agilent service representative. |

## Leak

**Error ID: 0064**

A leak was detected in the module.

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

| Probable cause | Suggested actions |
|---|---|
| **1** Loose fittings. | Ensure all fittings are tight. |
| **2** Broken capillary. | Exchange defective capillaries. |

## Open Cover

**Error ID: 0205**

The top foam has been removed.

| Probable cause | Suggested actions |
|---|---|
| 1 Foam not activating the sensor. | Please contact your Agilent service representative. |
| 2 Defective sensor or main board. | 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.

| Probable cause | Suggested actions |
|---|---|
| 1 The top foam was removed during operation. | Please contact your Agilent service representative. |
| 2 Foam not activating the sensor. | Please contact your Agilent service representative. |

# Module Error Messages

These error messages are specific for the Flexible Cube.

## Flexible Cube has a leakage

**Error ID: 4726**

A leak was detected in the module.

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

| Probable cause | Suggested actions |
|---|---|
| **1** Loose fitting | Ensure all fittings are tight |
| **2** Broken tubing | Exchange defective tubing |

## Flexible Cube fan failed

**Error ID: 4727**

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 period of time, the error message is generated.

| Probable cause | Suggested actions |
|---|---|
| **1** Fan cable disconnected | Please contact your Agilent service representative. |
| **2** Defective fan | Please contact your Agilent service representative. |
| **3** Defective main board | Please contact your Agilent service representative. |

## Pump failed at ejecting or at initializing

**Error ID:**

The stepper motor of the flush pump did not reach its end position.

If the flush pump is pumping against a restriction it will lose steps and thereby loose the position. It will then not be able to reach its home position, and an error message is generated.

| Probable cause | Suggested actions |
|---|---|
| **1** Blocked needle seat | Replace blocked needle seat |
| **2** Tubing not correctly installed | Configure tubing to position 4 of injection valve. |
| **3** Flexible Cube not configured in software | Configure Flexible Cube correctly |
| **4** Defective flush pump | Please contact your Agilent service representative |

## Valve failed to switch or didn't initialize

**Error ID:**

Lost steps of the valve encoder.

The valve drive has lost its position information and is not able to initialize.

| Probable cause | Suggested actions |
|---|---|
| 1 Valve drive mechanically blocked or defect | • Check installation of valve head.<br>• Please contact your Agilent service representative. |

## Initialization of Valve Failed

**Error ID: 24000**

During the initialization process the motor of the valve drive moves to some special positions depending on the installed valve head. A failure in this process means either that the movement couldn't be performed properly or it was not noticed correctly by the sensor.

| Probable cause | Suggested actions |
|---|---|
| 1 Mechanical problems. Friction too high or blockages on the valve drive's motor or on the valve head. | • Check valve head for correct installation<br>• Try to identify the source of trouble by installing a different valve head if possible.<br>• Contact your Agilent Service representative. |
| 2 Defect Sensor on the Valve Drive Motor | • Check valve head for correct installation<br>• Try to identify the source of trouble by installing a different valve head if possible.<br>• Contact your Agilent Service representative. |

## Valve Switching Failed

**Error ID: 24001**

The valve drive was not able to operate the valve head correctly. Either due to mechanical reasons or the movement couldn't be detected correctly.

| Probable cause | Suggested actions |
|---|---|
| 1 Mechanical problems. Friction too high or blockages on the valve drive's motor or on the valve head. | • Check valve head for correct installation<br>• Try to identify the source of trouble by installing a different valve head if possible.<br>• Contact your Agilent Service representative. |
| 2 Defect Sensor on the Valve Drive Motor | • Check valve head for correct installation<br>• Try to identify the source of trouble by installing a different valve head if possible.<br>• Contact your Agilent Service representative. |

## Valve Tag Violation

**Error ID: 24006**

The valve drive identified a different valve head than it had identified during the last initialization.

| Probable cause | Suggested actions |
|---|---|
| 1 A valve head has been exchanged (hot-plugged) while the valve drive was still powered on. | Change the valve head. It is important to have the valve switched off for at least 10 s after or before a new valve head has been installed. |

**NOTE**

Soft power-down power supply of the valve drive.

Whenever you want to power cycle the valve drive for a re-boot, it needs to be powered off for at least 10 seconds.

## Pressure Cluster Partner Missing

The connection from the valve drive to a defined pressure cluster partner is lost.

| Probable cause | Suggested actions |
|---|---|
| **1** Communication issues | Check the CAN cable connections of the modules. |
| **2** Configuration mismatch | Check and correct if necessary the valve configuration and presence of defined pressure cluster partner. |

## Position Cluster Partner Missing

| Probable cause | Suggested actions |
|---|---|
| **1** Communication issues | Check the CAN cable connections of the modules. |
| **2** Configuration mismatch | Check and correct if necessary the valve configuration and presence of defined position cluster partner. |

# 9
# Test Functions



This chapter describes the tests for the module.

# Introduction

All tests are described based on the Agilent Lab Advisor Software B.02.08 or higher. Other user interfaces may not provide any test or just a few.

**Table 6** Available Tests in Agilent Lab Advisor

| Test | Comment |
|---|---|
| **Pressure Test** | For valves |

In Agilent Instrument Utilities, Agilent ChemStation, and Agilent Instant Pilot no tests are available for the Flexible Cube.

For details on the use of the interface refer to the interface documentation.

# Pressure Test

For running a **Pressure Test**, please refer to the corresponding pump manual. The **Pressure Test** may be used for testing the tightness of a valve installed in the TCC or Flexible Cube.

**CAUTION**

Wrong use of **Pressure Test** may damage valve.

The current implementation of the **Pressure Test** automatically uses the maximum pressure generated by the pump used in the system.

➔ Do not use the test for modules having a lower maximum pressure than the pump as this will damage the valve. For example do not use 400 bar valve in a TCC or Flexible Cube in combination with a 600 bar pump.

# 10
# Maintenance and Repair



This chapter describes the maintenance of the module.

# Introduction to Maintenance

Figure 27 on page 126 shows the main user accessible assemblies of the Agilent 1290 Infinity Flexible Cube. These parts can be accessed from the front (simple repairs) and don't require to remove the Flexible Cube from the system stack.

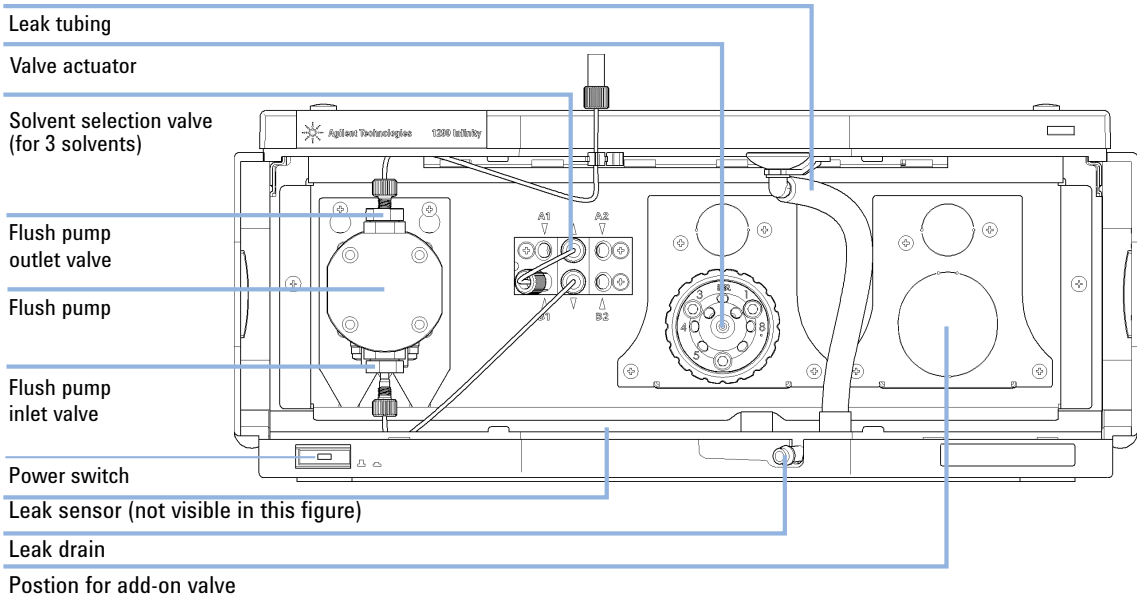



**Figure 27** Front of the Flexible Cube

# Warnings and Cautions

**WARNING**

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

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

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

---

**WARNING**

**Electrical shock**

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

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

---

**WARNING**

**Personal injury or damage to the product**

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

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

---

**CAUTION**

Safety standards for external equipment

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

---

# Overview of Maintenance

The following pages describe maintenance procedures (simple repairs) that can be done without opening the main cover.

**Table 7** Maintenance Procedures

| Procedure | Typical Frequency | Notes |
|---|---|---|
| "Exchange Flush Pump Inlet Valve" on page 130 | When leaking | |
| "Exchange Flush Pump Outlet Valve" on page 132 | When leaking | |
| "Exchange Valve Rotor Seal" on page 134 | If damaged, blocked or leaking | Run **Pressure Test** for verification |
| "Installing the Capillaries" on page 143 | When new application requires a change | |
| "Replacing Valve Heads" on page 139 | If the valve performance shows indication of leakage or wear | |
| "Replacing Module Firmware" on page 150 | If required | |

**NOTE** Preventive maintenance is usually not necessary; only for the rotor seal!

# 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.

# Exchange Flush Pump Inlet Valve

**When** If the Inlet valve shows signs of malfunction.

**Tools required**

| p/n | Description |
|---|---|
| 8710-1924 | Open-end wrench 14 mm |

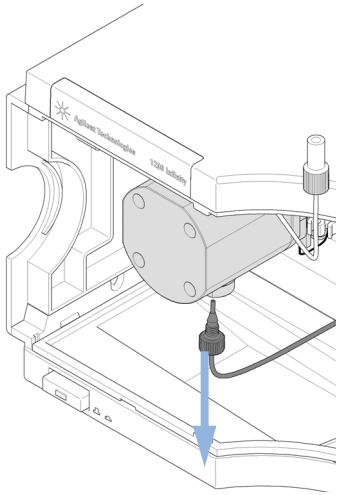
**Parts required**

| p/n | Description |
|---|---|
| 5067-4717 | Inlet valve<br>for flush pump |

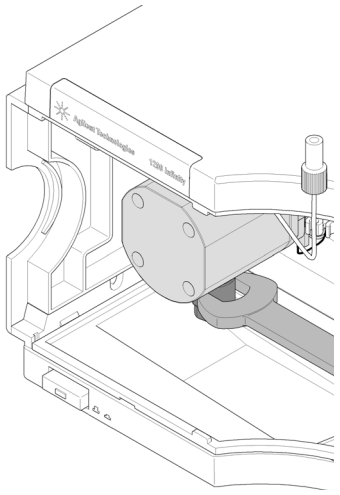
**Preparations**

- In order to avoid leaks, place the solvent bottles at or below the level of the pump head.
- Open the front door of the module.

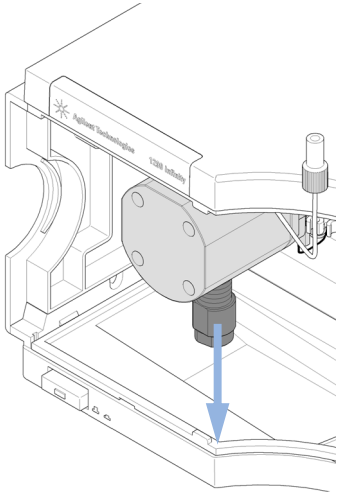
**1** Disconnect the finger tight fitting of the Inlet capillary at the bottom of the Flush pump.



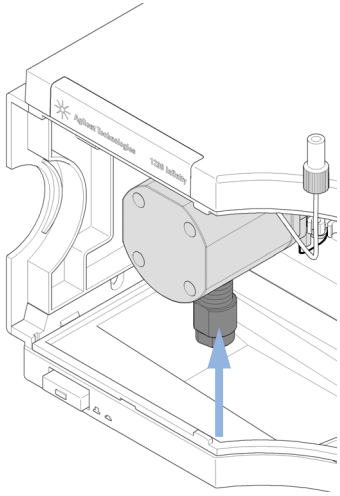
**2** With a 14 mm wrench on the flange closest to the pump head, unscrew the valve.



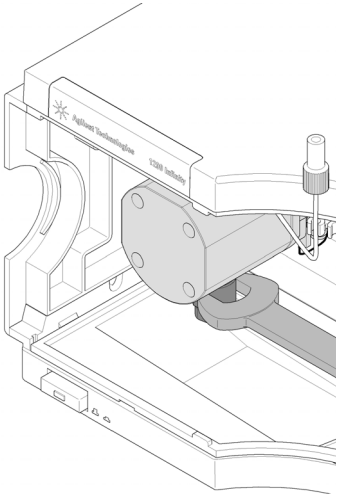
**3** Remove the valve by moving it downwards.



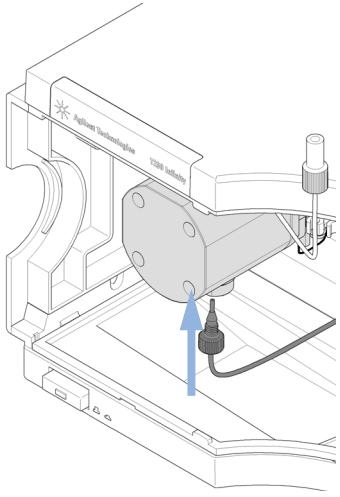
**4** Insert the new valve.



**5** Tighten the valve with a 14 mm wrench attached to the flange closest to the pump head.



**6** Reconnect the finger tight fitting at the inlet of the flush pump.



**7** Close the front cover and prime the flush pump before use to warrant trouble free usage.

# Exchange Flush Pump Outlet Valve

**When** If the Outlet valve shows signs of malfunction.

**Tools required**

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

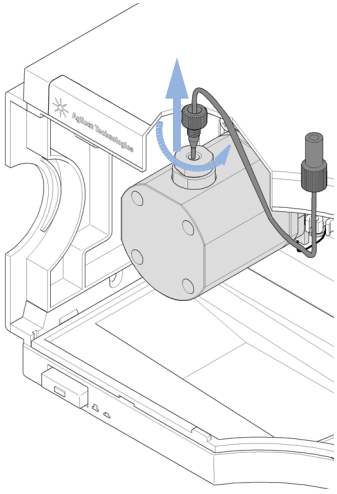
**Parts required**

| p/n | Description |
|---|---|
| 5067-4716 | Outlet valve<br>for flush pump |

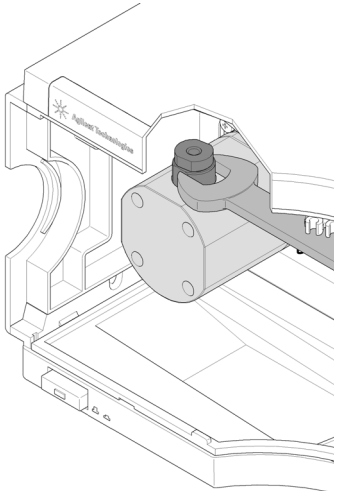
**Preparations**

- In order to avoid leaks, place the solvent bottles at or below the level of the pump head.
- Open the front door of the module.

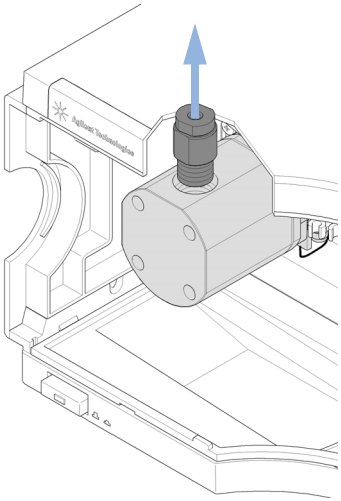
**1** With a ¼ inch wrench disconnect the capillary at the top of the Outlet valve.



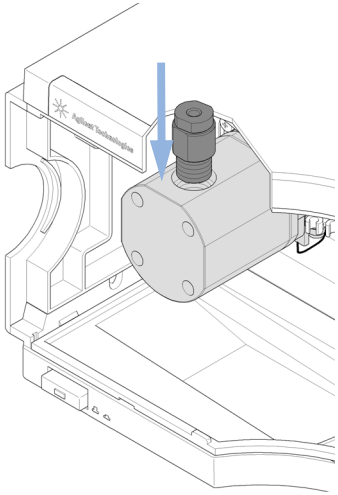
**2** With a 14 mm wrench on the flange closest to the pump head, unscrew the valve.



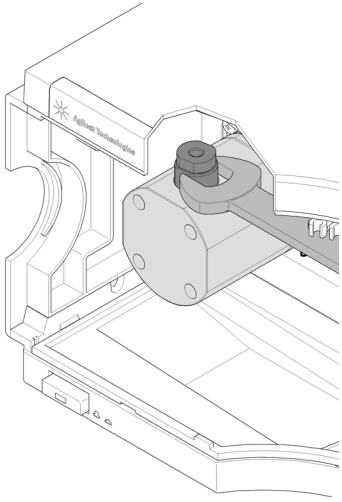
**3** Remove the valve by lifting it upwards.



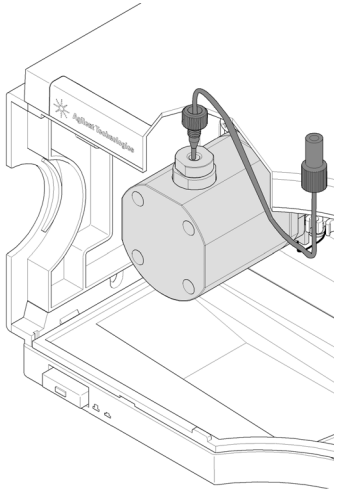
**4** Insert the new valve.



**5** Tighten the valve with a 14 mm wrench attached to the flange closest to the pump head.



**6** Reconnect the capillary with a ¼ inch wrench at the outlet of the flush pump.



**7** Close the front cover and prime the flush pump before use to warrant trouble free usage.

# Exchange Valve Rotor Seal

**When** When rotor seal is visibly damaged, blocked or leaks.

**Tools required**

| p/n | Description |
|---|---|
| 8710-0510 | Open-end wrench 1/4 — 5/16 inch |
| 8710-2394 | Hex key 9/64 inch 15 cm long T-handle |

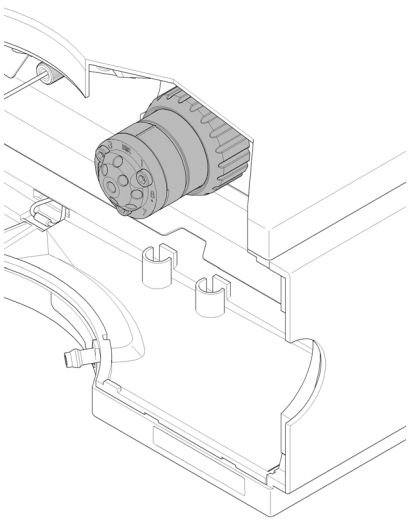
**Parts required**

| p/n | Description |
|---|---|
| Part number depending on valve head in use | Rotor seal |

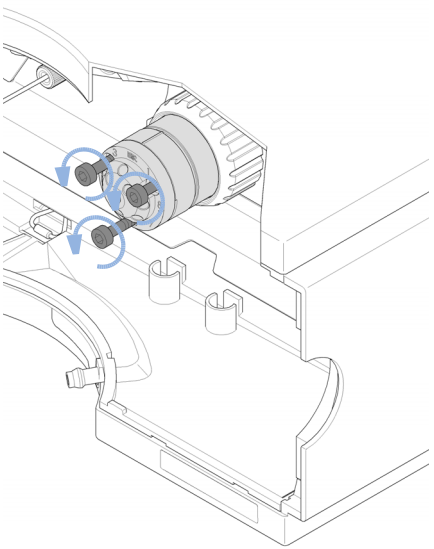
**Preparations**

- In order to avoid leaks, place the solvent bottles at or below the level of the pump head.
- Open the front door of the module.

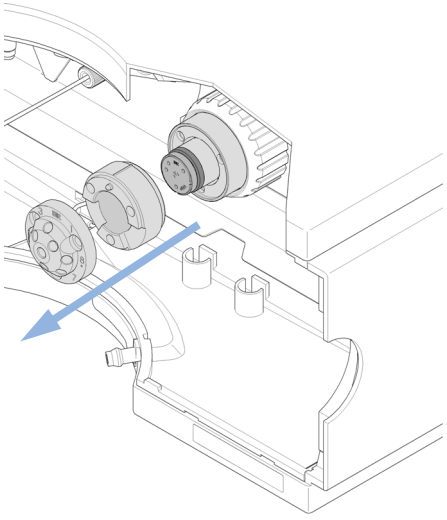
**1** Remove all capillaries from the valve head.



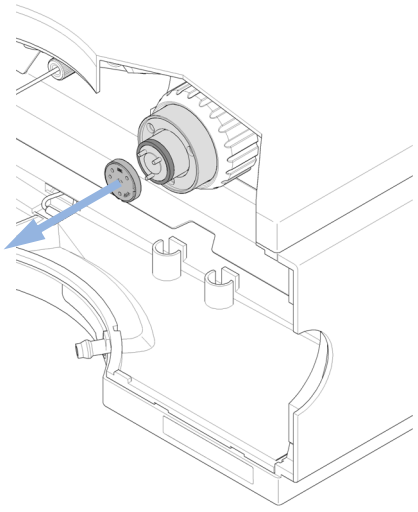
**2** With a 9/64 inch hex key unscrew the stator screws.



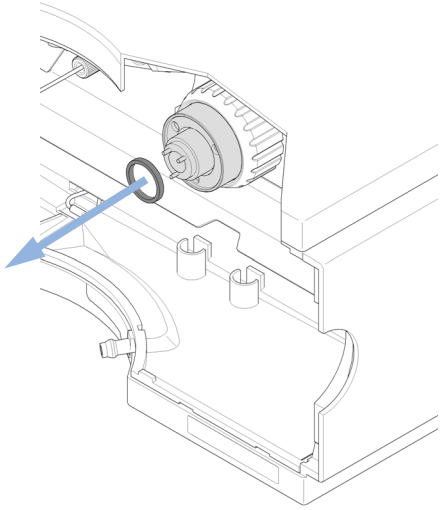
**3** Remove the stator head and the stator ring.



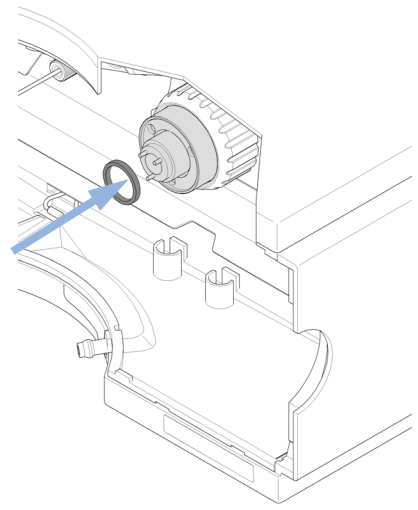
**4** Remove the rotor seal.



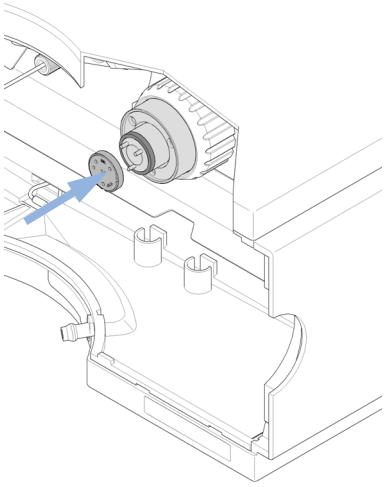
**5** Remove the isolation seal.



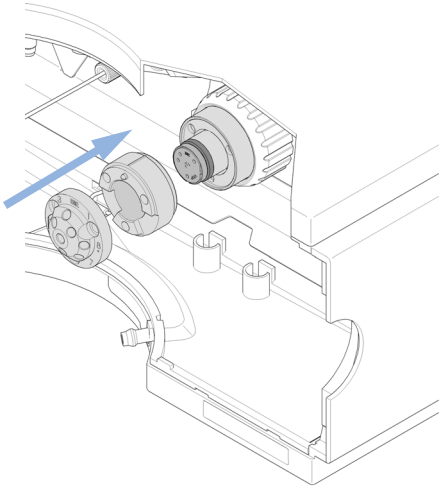
**6** Replace the isolation seal.



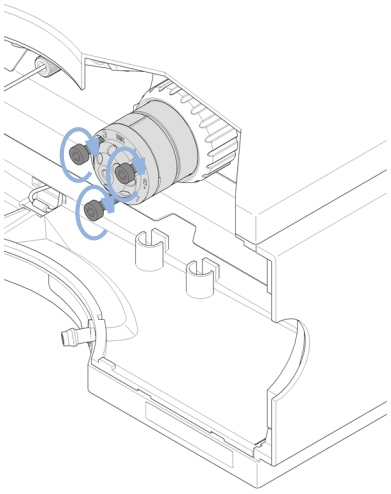
**7** Install new rotor seal.



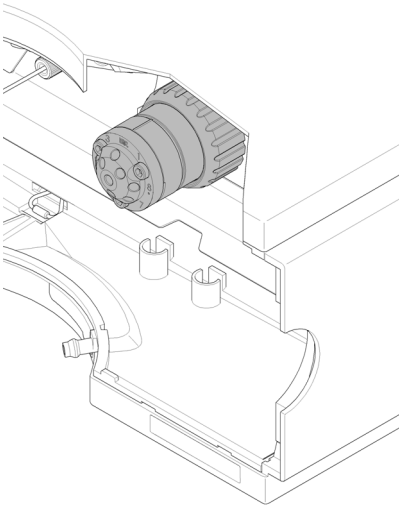
**8** Install the stator head and the stator ring.



**9** With a 9/64 inch hex key alternately tighten the stator screws.



**10** Reinstall all capillaries to the valve head depending on the type and usage of the valve.



**11** Close the front cover and prime the flush pump before use to warrant trouble free usage.

# Replacing Parts of the Valve Head

For details about the needed parts and orientation please refer to "Parts and Materials for Maintenance" on page 151.

### Disassembling and reassembling the valve head


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

**When**

Stator head: Scratches and damage on the inner surface, blockages

Stator face assy: When visibly scratched, or when the valve performance shows indication of leakage or wear

Rotor seal assy: After approximately 10000 to 20000 switches, or when the valve performance shows indication of leakage or wear

**Tools required**

**Description**

Hex key

**WARNING**

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

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

➔ Be sure that no solvent can drop out of the solvent connections when removing them from your valve head.

➔ 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.

1 Use the Hex Key to open and remove the Stator Screws from the Stator Head.

2 Carefully disassemble the necessary Valve Head parts to gain access to the one you want to replace. While doing so please observe the orientation of the parts.

3 Independent of the part you want to replace always inspect all parts for signs of damage.

4 Replace the proposed part.

**NOTE** Always mind the correct orientation of the parts and avoid to touch their surfaces.

5 Turn each of the screws an equal amount until they are finger-tight, then tighten them for another half turn.

# Replacing Valve Heads

Several optional valve heads are available, which can be installed and exchanged easily.

Micro valves offer small internal volumes for minimum peak broadening, ideal for low flow rates in the nL/min and µL/min range.


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

| Parts required | # | p/n | Description |
|---|---|---|---|
| | 1 | 5067-4107 | 8 position/9 port valve head, 600 bar |
| OR | 1 | 5067-4282 | 2 position/6 port valve head, 800 bar |
| OR | 1 | 5067-4241 | 2 position/6 port valve head, 1300 bar |
| OR | 1 | 5067-4144 | 2 position/10 port micro valve head, 600 bar |
| OR | 1 | 5067-4240 | 2 position/10 port valve head, 1300 bar |
| OR | 1 | 5067-4284 | 6-column selector valve head, 800 bar |
| OR | 1 | 5067-4273 | 6-column selector valve head, 1300 bar |
| OR | 1 | 5067-4148 | 2 position/6 port valve head, 600 bar, bio-inert |
| OR | 1 | 5067-4134 | 4-column selector valve head, 600 bar, bio-inert |
| OR | 1 | 5067-4159 | 12 position/13 port selector valve head, 210 bar, bio-inert |

**WARNING**

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

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

➔ Be sure that no solvent can drop out of the solvent connections when removing them from your valve head.

➔ 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.

**CAUTION**

Valve Damage

Using a low pressure valve on the high pressure side can damage the valve.

➔ When using multiple column compartments as part of a method development solution, make sure that the high pressure valve head is connected to the autosampler and the low pressure valve head is connected to the detector.

**NOTE**

For details, please refer to the InfinityLab LC Method Development Solutions User Guide (01200-90301).

**CAUTION**

Column Damage or Bias Measurement Results

Switching the valve to a wrong position can damage the column or bias measurement results.

➔ Fit the lobe to the groove to make sure the valve is switched to the correct position.

**CAUTION**

The valve actuator contains sensitive optical parts, which need to be protected from dust and other pollution. Pollution of these parts can impair the accurate selection of valve ports and therefore bias measurement results.

➔ Always install a valve head for operation and storage. For protecting the actuator, a dummy valve head (part of Transportation Lock Kit (G1316-67001 )) can be used instead of a functional valve. Do not touch parts inside the actuator.

**NOTE** The tag reader reads the valve head properties from the valve head RFID tag during initialization of the module. Valve properties will not be updated, if the valve head is replaced while the module is on.

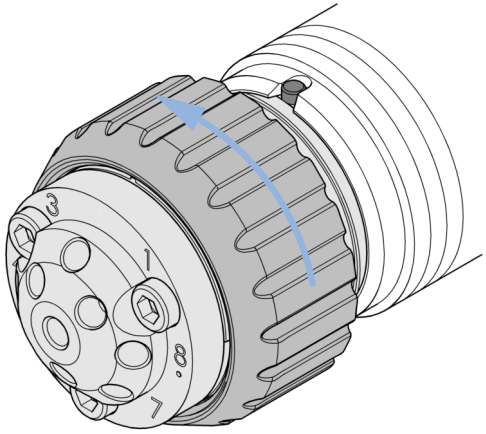
Selection of valve port positions can fail, if the instrument does not know the properties of the installed valve.

**NOTE** To have the valve correctly recognized by the Agilent Infinity Valve Drive you must have the valve drive powered off for at least 10 seconds.

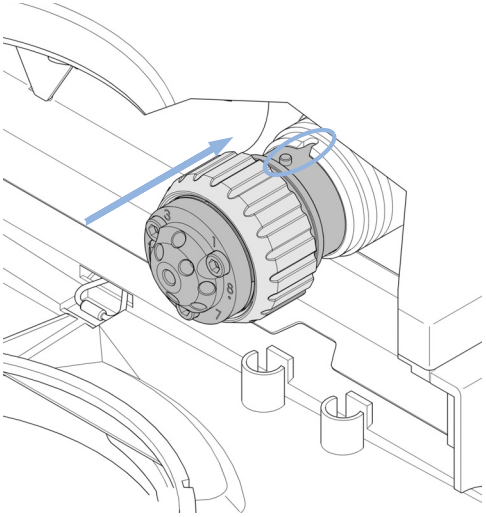
**1** Switch off the module.

**2** Remove all capillary connections from the valve head

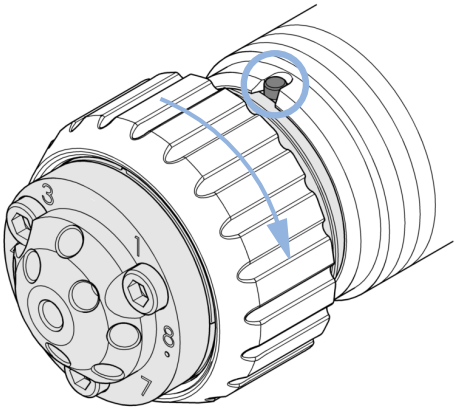
**3** Unscrew the valve head.



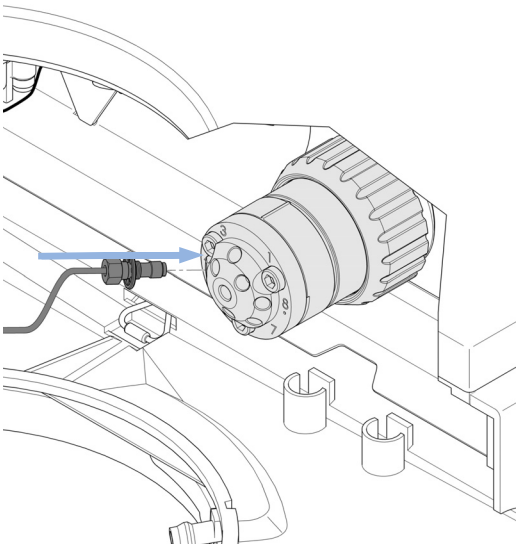
**4** Put the new valve head onto the valve drive such that the lobe fits to the groove (see also "Installing the Valve Heads" on page 53).



**5** Screw the valve head onto the valve drive using the union nut (see also "Installing the Valve Head and Connecting Capillaries" on page 54.



**6** Install all required capillary connections to the valve head.



**7** Switch on the module.

# Installing the Capillaries

The 2 position/10 port valve can be used here in the same way as a 2 position/6 port valve; just follow the re-routing diagram below. The red arrows mean that you have to take the according installation diagram of the 2 position/6 port valve (Figure 29 on page 145, Figure 30 on page 146, Figure 31 on page 147) but mount, for example, the capillary connected to port 6 of the 2 position/6 port valve to port 2 of the 2 position/10 port valve. The ports 1 and 8 have to be connected with a 120 mm length capillary (0.12 mm i.d. or 0.17 mm i.d. depending on the capillary kit) (5067-4652) and the ports 9 and 10 need to be plugged with Plastic fittings (0100-1259).

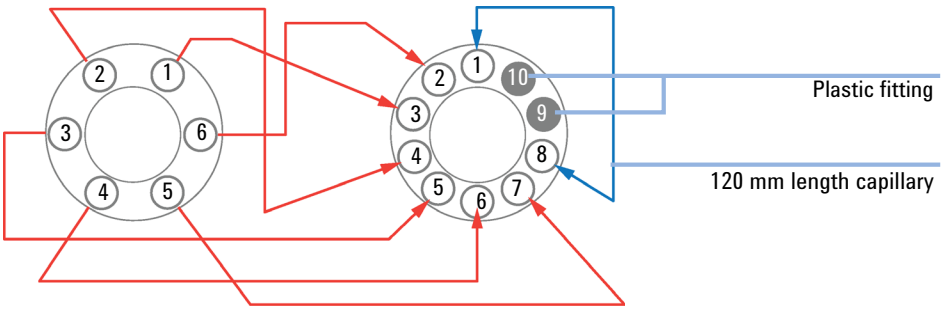



**Figure 28** Re-routing of 2 position/10 port valve to match 2 position/6 port valve

| Parts required | p/n | Description |
|---|---|---|
| | G4231C | 2 positon/6 port valve |
| | G4232D | 2 position/10 port valve |
| | 0100-1259 | Plastic fittings |
| | 0890-1713 | Waste tubing, 2 m |
| | 5067-4647 | Capillary ST 0.12 mm x 340 mm S/SX |
| | 5067-4648 | Capillary ST 0.17 mm x 700 mm S/SX |
| | 5067-4649 | Capillary ST 0.12 mm x 90 mm S/SX |
| | 5067-4650 | Capillary ST 0.12 mm x 150 mm SL/SX |
| | 5067-4651 | Capillary ST 0.12 mm x 280 mm SL/SX |
| | 5067-4652 | Capillary ST 0.12 mm x 120 mm SX/SX |
| | 5067-4653 | Capillary ST 0.12 mm x 200 mm S/SX |

**Preparations** Identify the required capillaries for your set up

**NOTE** Use outmost care to avoid any void volumes caused by poor connections.

1 Install the capillaries depending on your application. Following configurations are available for listed applications. Please choose your appropriate configuration from this list:

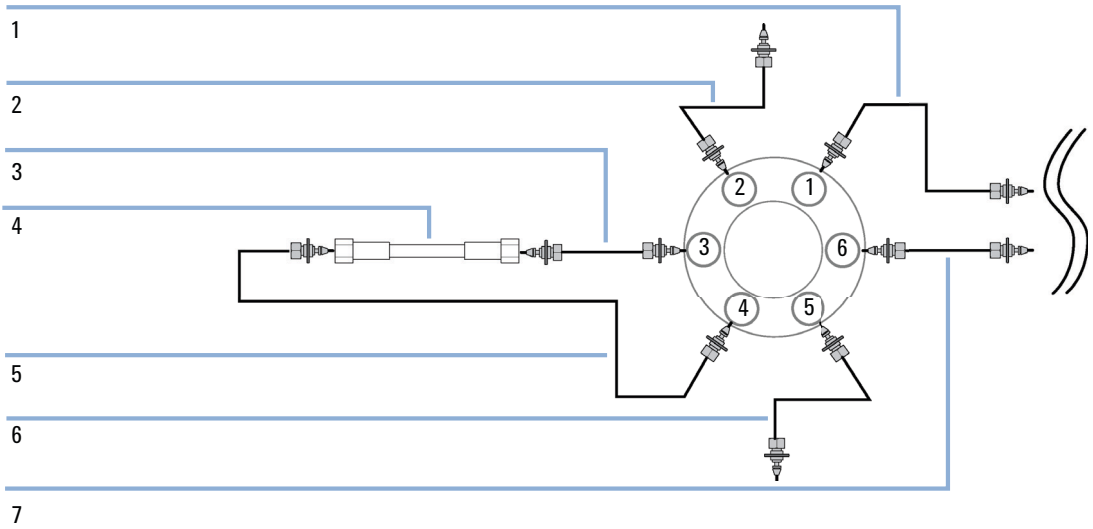



**Figure 29** Installing the capillaries for a dual-column selection set-up (column at the second position omitted)

| | |
|---|---|
| 1 | 150 mm capillary (column length up to 100 mm), 280 mm capillary (column length > 100 mm) from column<br>Not pre-swaged on the column side! |
| 2 | 200 mm capillary to detector |
| 3 | 150 mm capillary (column length up to 100 mm, 280 mm capillary (column length > 100 mm) from column<br>Not pre-swaged on the column side! |
| 4 | Column |
| 5 | 90 mm capillary to column |
| 6 | 340 mm capillary from autosampler and loading pump |
| 7 | 90 mm capillary to column |
| | Pos. 1: Connection between ports 1-6, 4-5, 2-3, active column 1 = left<br>Pos. 2: Connection between ports 1-2, 3-4, 5-6, active column 2 = right<br>Example shows setup with flow directed from bottom to top.<br>Flow direction from top to bottom needs switch of connected capillaries at ports 5 and 2. Also column inlet connections needed to be switched with outlet connections. Port 4 to 3 and 6 to 1.) |

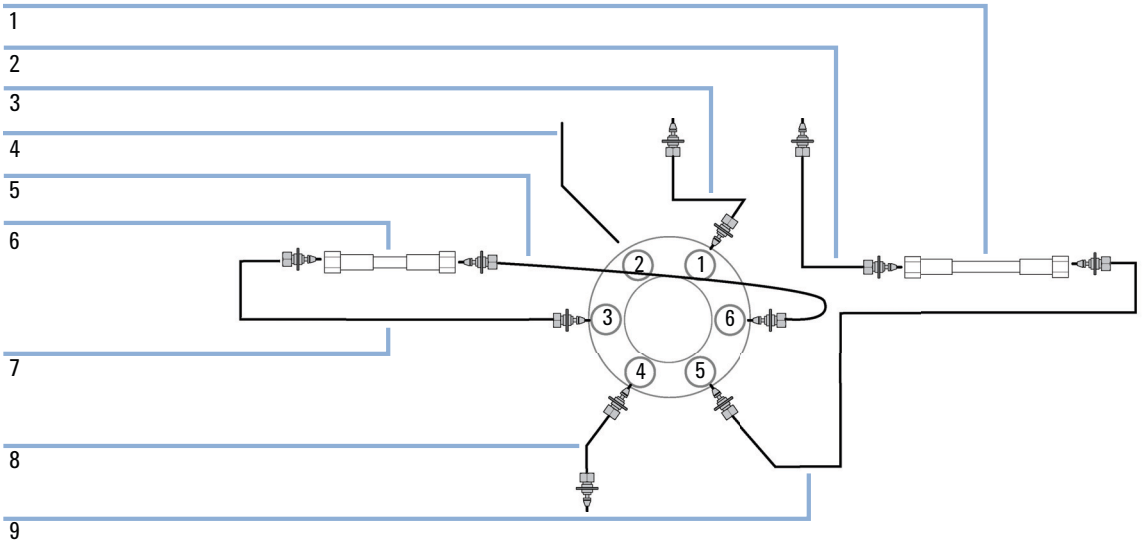



**Figure 30** Installing the capillaries for a sample enrichment set-up

| | |
|---|---|
| 1 | **Analytical column** |
| 2 | 280 mm capillary (column length > 100 mm) from analytical column to detector<br>Not pre-swaged on the column side! |
| 3 | 340 mm capillary from autosampler and loading pump |
| 4 | To waste |
| 5 | 150 mm capillary (column length up to 100 mm), 280 mm capillary (column length > 100 mm) from enrichtment column<br>Not pre-swaged on the column side! |
| 6 | **Enrichment column** |
| 7 | 90 mm capillary to column |
| 8 | 700 mm (0.17 mm ID) from analytical pump |
| 9 | 90 mm capillary to column |
| | Pos.1: Connection between ports 1-6 , 4-5, 2-3 , active column 1 = left (enrichment column)<br>Pos. 2: Connection between ports 1-2, 3-4, 5-6 active column 2 = right (analytical colum) |

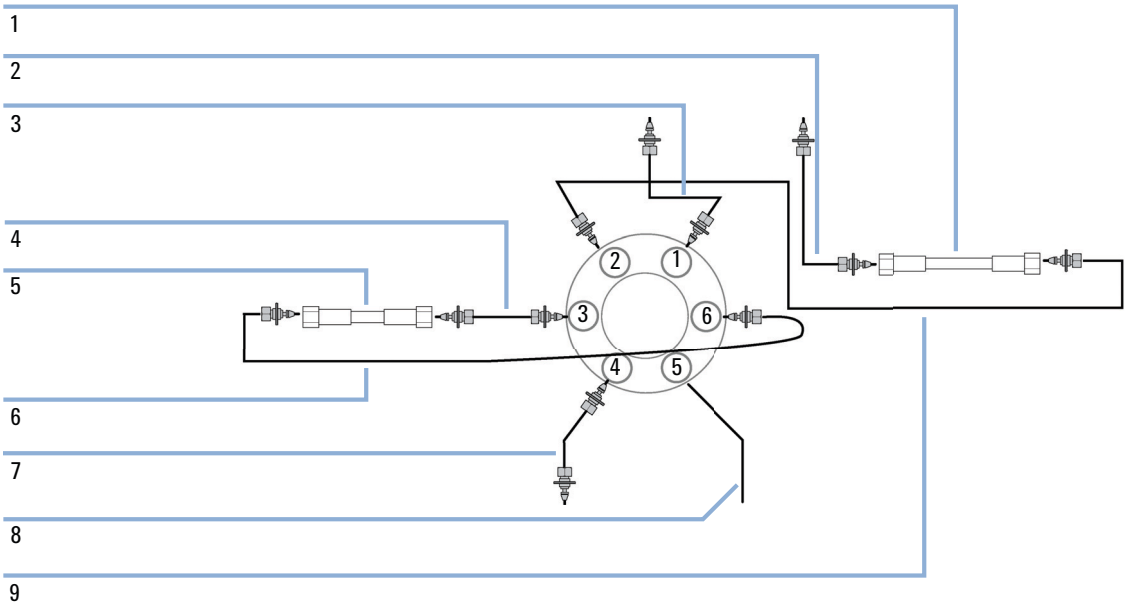



**Figure 31** Installing the capillaries for a sample clean-up set-up

| | |
|---|---|
| 1 | **Analytical column** |
| 2 | 280 mm capillary (column length > 100 mm) from analytical column to detector<br>Not pre-swaged on the column side! |
| 3 | 340 mm capillary from autosampler and loading pump |
| 4 | 150 mm capillary (column length up to 100 mm), 280 mm capillary (column length > 100 mm) from pre-column<br>Not pre-swaged on column-side! |
| 5 | **Pre-column** |
| 6 | 90 mm capillary to pre-column |
| 7 | 700 mm capillary (0.17 mm ID) from analytical pump |
| 8 | To waste |
| 9 | 90 mm capillary to analytical column |
| | Pos. 1: Connection between ports 1-6, 4-5, 2-3, active column 1 = left (enrichment column)<br>Pos. 2: Connection between ports 1-2, 3-4, 5-6, active column 2 = right (analytical colum) |

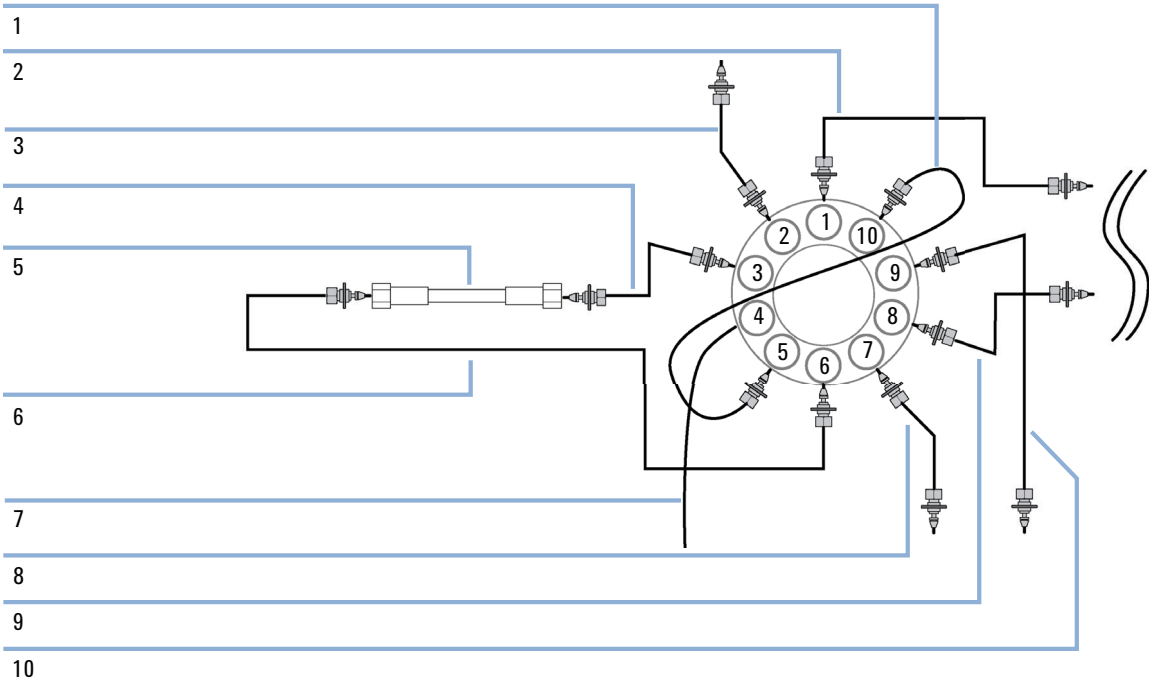



**Figure 32** Installing the capillaries for alternating column regeneration (column at the second position omitted)

| | |
|---|---|
| 1 | Valve-Valve connector, 120 mm capillary |
| 2 | 150 mm capillary (column length up to 100 mm), 280 mm capillary (column length > 100 mm) from column<br>Not pre-swaged on the column side! |
| 3 | 200 mm capillary to detector |
| 4 | 150 mm capillary (column length up to 100 mm), 280 mm capillary (column length > 100 mm) from column<br>Not pre-swaged on the column side! |
| 5 | Column |
| 6 | 90 mm capillary to column |
| 7 | To waste |
| 8 | From autosampler |
| 9 | 90 mm capillary to column |
| 10 | 700 mm capillary (0.17 mm ID) from regeneration pump |
| | Pos. 1: Connection between ports 1-10, 2-3, 4-5, 6-7, 8-9, active column 1 = left / regenerating column = right<br>Pos. 2: Connection between ports 1-2, 3-4, 5-6, 7-8, 9-10, active column 2 = right / regenerating column = left |

2 Connect the capillaries connected directly to a column and fasten them immediately with a spanner.

3 Finger-tighten all remaining capillaries.

4 Fasten all fittings with a spanner.

5 Starting from position one through six (ten, respectively), fasten the fittings on the valve head.

6 Fasten all fittings on attached modules (autosampler, detector, additional pumps). Fit all unused valve ports with a plastic plug.

7 Place the capillaries that go to another module or waste into the capillary guides to prevent squeezing them when closing the front cover.

8 Stow any excess lengths of the capillaries.

9 Perform a final leak-check.

# 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**

| | Description |
|---|---|
| | LAN/RS-232 Firmware Update Tool |
| OR | Agilent Lab Advisor software |
| OR | Instant Pilot G4208A<br>(only if supported by module) |

**Parts required**

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

**Preparations**

Read update documentation provided with the Firmware Update Tool.

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

1 Download the required module firmware, the latest LAN/RS-232 FW Update Tool and the documentation from the Agilent web.
   - http://www.agilent.com/en-us/firmwareDownload?whid=69761

2 For loading the firmware into the module follow the instructions in the documentation.

*Module Specific Information*

There is no specific information for this module.

# 11
# Parts and Materials for Maintenance



This chapter provides information on parts and material required for the module.

# Parts overview

| Item | p/n | Description |
|---|---|---|
| 1 | 5067-4717 | Inlet valve |
| 2 | 5067-4716 | Outlet valve |
| 3 | G4280-67304 | Solvent selection valve to flush pump tubing |
| 4 | 5067-4680 | Tubing Kit 600 mm; 130 bar |
| 5 | 5067-4697 | Solvent selection valve bridge tubing |

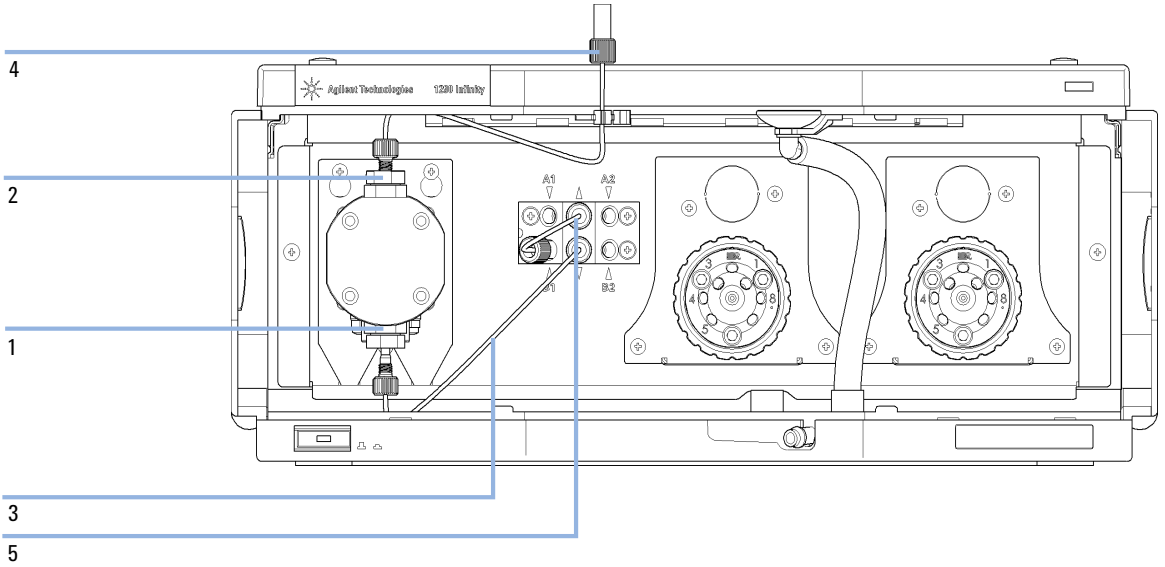



**Figure 33** Parts overview

# Capillaries

| Item | p/n | Description |
|---|---|---|
| 1 | 5067-4680 | Tubing Kit 600 mm; 130 bar |
| 2 | G4280-67304 | Solvent selection valve to flush pump tubing |
| 3 | 5067-4697 | Solvent selection valve bridge tubing |

# Accessory Kits

## Tool Kit G7120-68708

# Flexible Cube Accessory Kit

The Flexible Cube Accessory Kit (G4227-68705) contains some accessories and tools needed for installation and repair of the module.

| p/n | Description |
|---|---|
| 0100-1816 | Fitting Waste Tube to Purge Valve |
| 0890-2207 | Tubing/Sleeving-Flex |
| 5067-4680 | Tubing Kit 600 mm; 130 bar |
| 5181-1519 | CAN cable, Agilent module to module, 1 m |
| 9301-6524 | Solvent bottle, clear, 1000 mL |
| G4220-60007 | Bottle Head Assembly |
| G4226-87012 | Needle seat |
| 5043-0909 | Tubing-Flex PE, 3 m |

# Valve Options Overview

This overview gives a summary of the main parts and assemblies. More details are available with each valve option in this chapter.

**Table 8** Agilent Quick Change Valve Heads

| Kit description[1] | Valve head | Rotor seal | Stator heads |
|---|---|---|---|
| G4230A<br>Method development valves kit [2] | 5067-4107<br>8 position/9 port valve head, 600 bar | 5067-4111, PEEK | 5068-0001 |
| G4231C<br>2 position/6 port valve head | 5067-4241<br>2 position/6 port valve head, 1300 bar | 5068-0207, PEEK | 5068-0006 |
| G4231A<br>2 position/6 port valve head | 5067-4282<br>2 position/6 port valve head, 800 bar | 0101-1409, PEEK | 0101-1417 |
| G4232D<br>2 position/10 port valve head | 5067-4240<br>2 position/10 port valve head, 1300 bar | 5068-0205, PEEK | 5068-0011 |
| G4232A<br>2 position/10 port valve head | 5067-4144<br>2 position/10 port micro valve head, 600 bar | 0101-1415, PEEK | 0101-1421 |
| G4234A<br>6-column selector valve head | 5067-4284<br>6-column selector valve head, 800 bar | 5068-0298, PEEK | 5068-0241 |
| G4234C<br>6-column selector valve head | 5067-4273<br>6-column selector valve head, 1200 bar | 5068-0242, PEEK | 5068-0241 |

[1] Valve kits include the valve head, optional capillary kits, manual, access material and installation and familiarization service. For more details refer to the 'Parts and Material' section.

[2] G4230A includes 2 x 8 position/9 port valve head, 600bar.

**Table 9** Agilent Quick Change Valve heads (Bio-inert)

| Kit description | Valve head | Rotor seal | Stator heads |
|---|---|---|---|
| G5631A<br>2 position/6 port valve head, bio-inert | 5067-4148<br>2 position/6 port valve head, 600 bar, bio-inert | 0101-1409<br>rotor seal, bio-inert | 5068-0060<br>stator head, bio-inert<br>0100-1851<br>stator face assy, bio-inert |
| G4235A<br>12 position/13 port valve head, bio-inert | 5067-4159<br>12 position/13 port, 210 bar, bio-inert | 0101-1288<br>rotor seal and stator face kit, bio-inert | 5068-0097<br>stator head, bio-inert[1] |
| G5639A<br>4-column selector valve head, bio-inert | 5067-4134<br>4-column selector, 600 bar, bio-inert | 5068-0045<br>rotor seal, bio-inert | 5068-0044<br>stator head, bio-inert |

[1] kit with stator face and rotor seal

# 2 Position/6 Port Valve Head 800 bar, 5067-4282

| Item | p/n | Description |
|---|---|---|
| 1 | 1535-4857 | Stator screws, 10/Pk |
| 2 | 0101-1417 | Stator head |
| 3 | 0101-1409 | Rotor Seal, PEEK |
| 4 | 1535-4045 | Bearing ring |

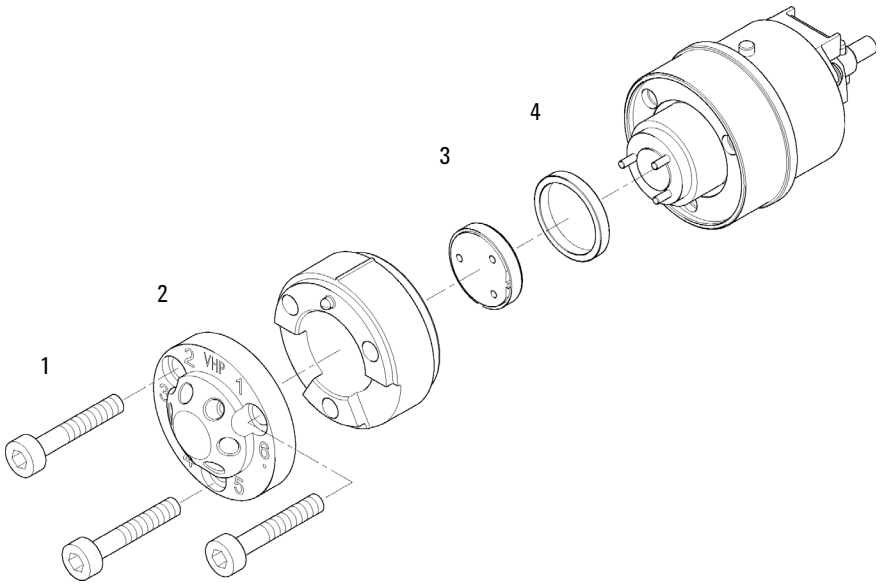



**Figure 34** Column Switching Valve Parts (5067-4282)

# 2 Position/6 Port Valve Head 1300 bar, 5067-4241

| Item | p/n | Description |
|---|---|---|
| 1 | 1535-4857 | Stator screws |
| 2 | 5068-0006 | Stator head |
| 3 | 5068-0207 | Rotor Seal (PEEK) |
| 4 | 1535-4045 | Bearing ring |

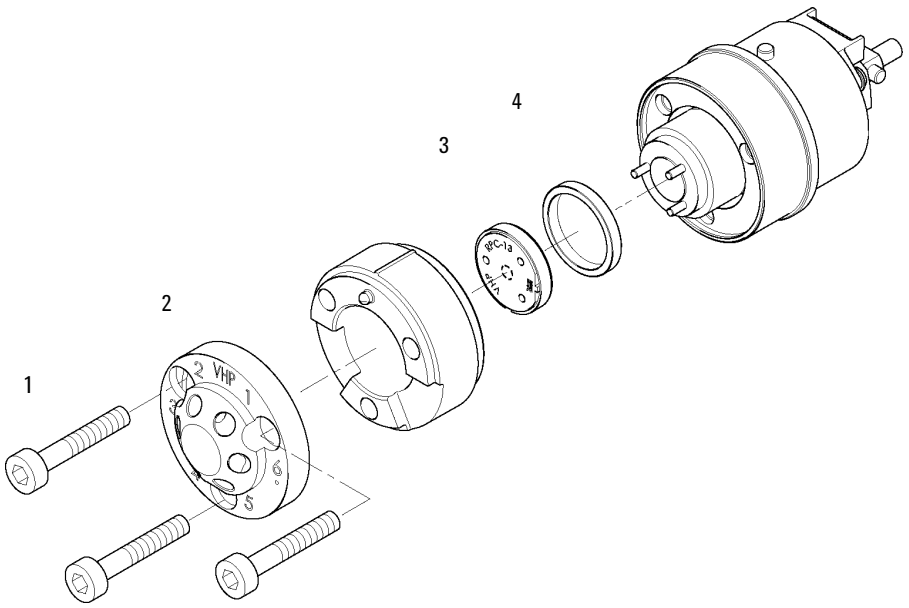



**Figure 35** Column Switching Valve Parts (5067-4241)

# 2 Position/6 Port Valve Head 600 bar (Bio-inert), 5067-4148


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

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0020 | Stator Screws, 10/pack |
| 2 | 5068-0060 | Bio-inert stator head |
| 3 | 0100-1851 | Stator face, ceramic |
| 4 | 0101-1409 | Rotor Seal, PEEK |
| 5 | 1535-4045 | Bearing ring |

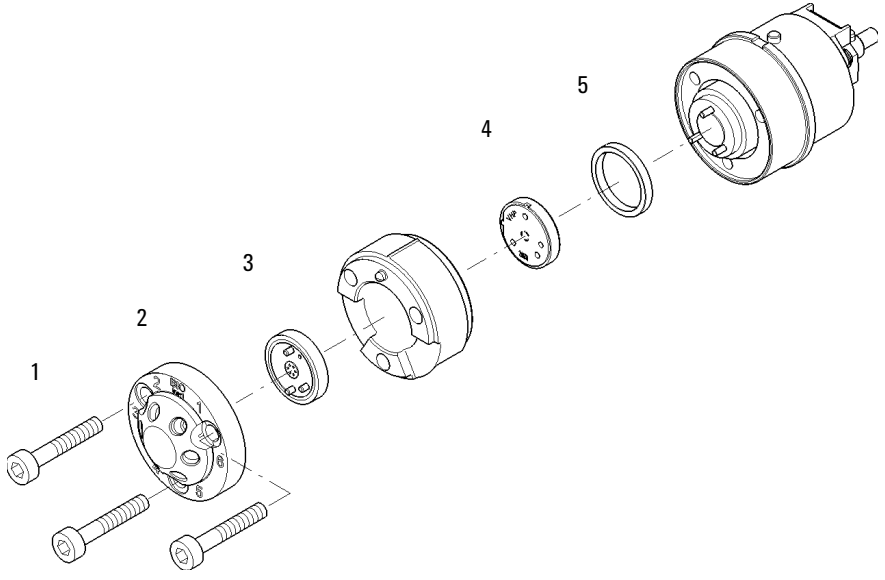



**Figure 36** Column Switching Valve Parts (5067-4148)

# 2 Position/10 Port Micro Valve Head 600 bar, 5067-4144

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0054 | Stator screws, 10/Pk |
| 2 | 0101-1421 | Stator Head |
| 3 | 0101-1415 | Rotor Seal, PEEK |
| 4 | 1535-4045 | Bearing ring |

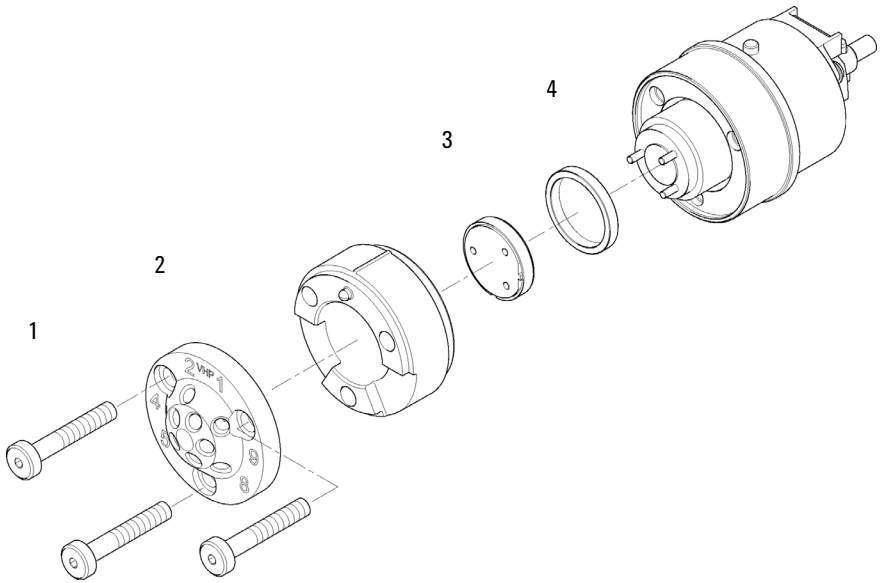



**Figure 37** Column Switching Valve Parts (5067-4144)

# 2 Position/10 Port Valve Head 1300 bar, 5067-4240

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0019 | Stator screws |
| 2 | 5068-0011 | Stator head |
| 3 | 5068-0205 | Rotor Seal (PEEK) |
| 4 | 1535-4045 | Bearing ring |

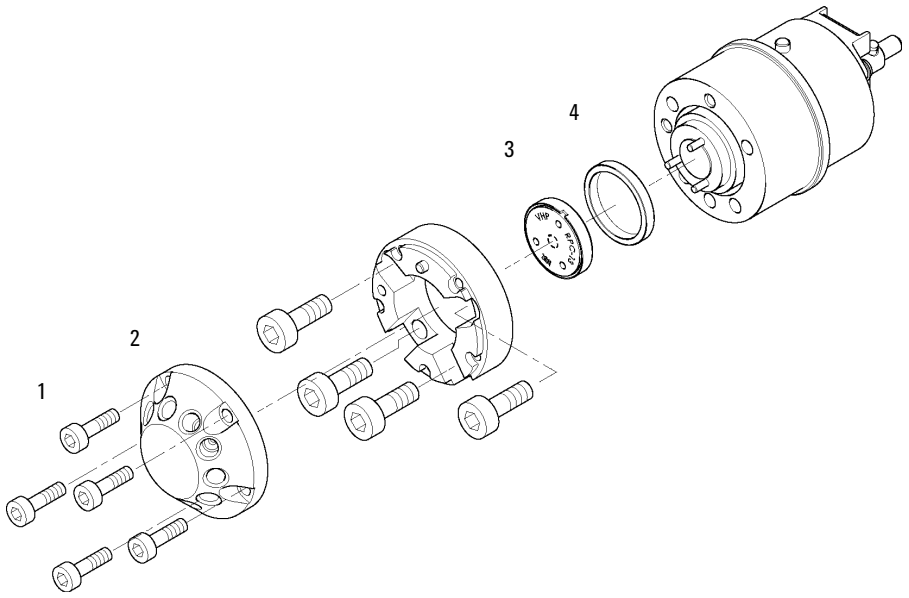



**Figure 38** Column Switching Valve Parts (5067-4240)

# 8 Position/9 Port Valve Head 600 bar, 5067-4107

| Item | p/n | Description |
|---|---|---|
| 1 | 1535-4857 | Stator screws |
| 2 | 5068-0001 | Stator head |
| 3 | 5067-4111 | Rotor Seal, PEEK |
| 4 | 1535-4045 | Bearing ring |

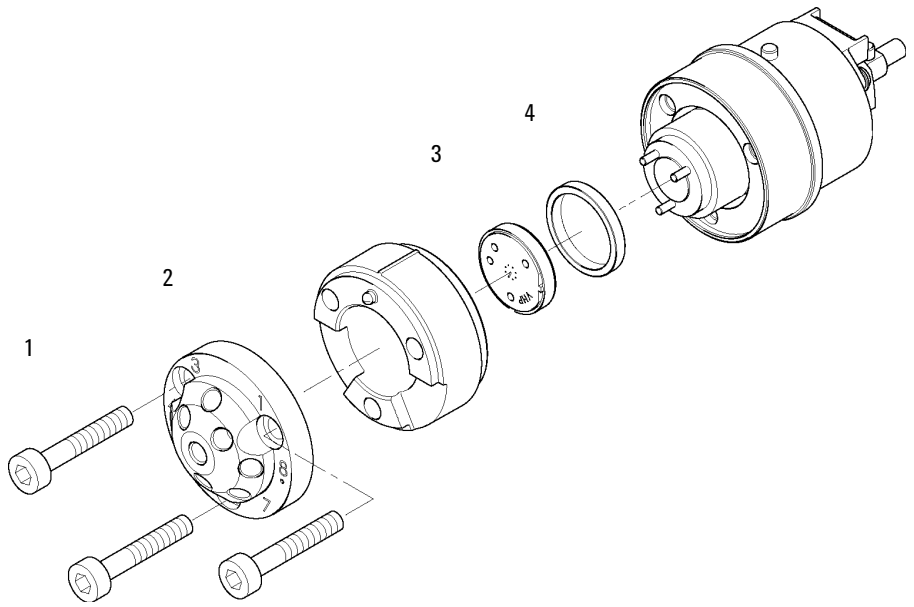



**Figure 39** Column Switching Valve Parts (5067-4107)

# 4-Column Selector Valve Head 600 bar (Bio-inert), 5067-4134


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

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0059 | Stator screws |
| 2 | 5068-0044 | Bio-inert stator head |
| 3 | 5068-0093 | Stator face assy |
| 4 | 5068-0045 | Bio-inert rotor seal, PEEK |
| 5 | 1535-4045 | Bearing ring |

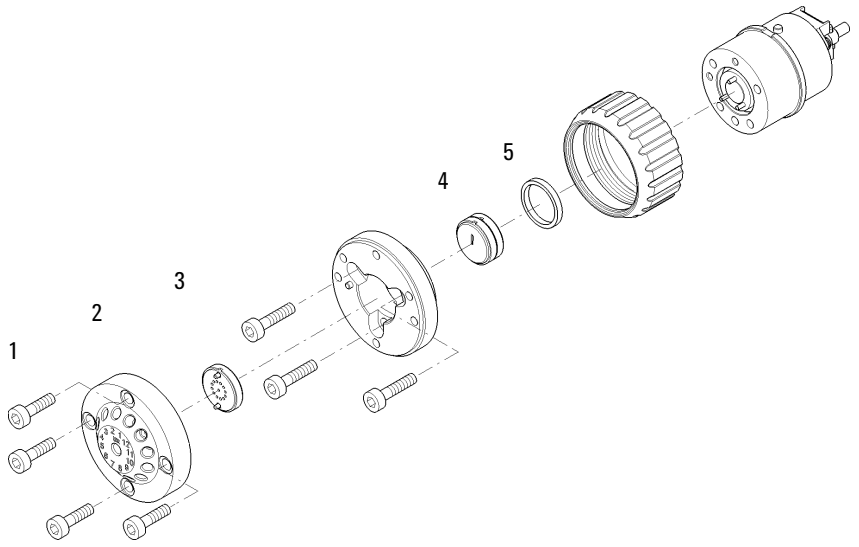



**Figure 40** Column Switching Valve Parts (5067-4134)

# 6-Column Selector Valve Head 800 bar, 5067-4284

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0089 | Stator screws |
| 2 | 5068-0241 | Stator Head |
| 3 | 5068-0298 | Rotor Seal (PEEK) |
| 4 | 1535-4045 | Bearing ring |

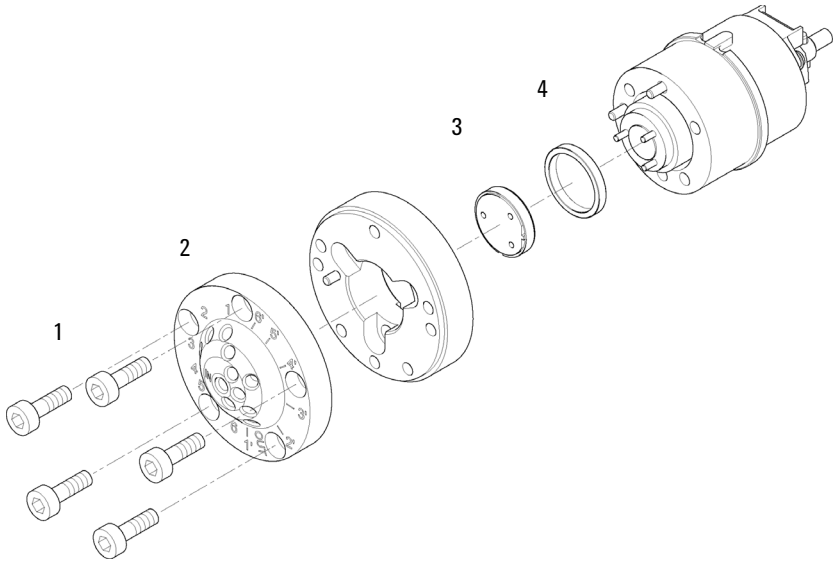



**Figure 41** Column Switching Valve Parts (5067-4284)

# 6-Column Selector Valve Head 1300 bar, 5067-4273

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0089 | Stator screws |
| 2 | 5068-0241 | Stator Head |
| 3 | 5068-0242 | Rotor Seal (PEEK) |
| 4 | 1534-4045 | Bearing ring |

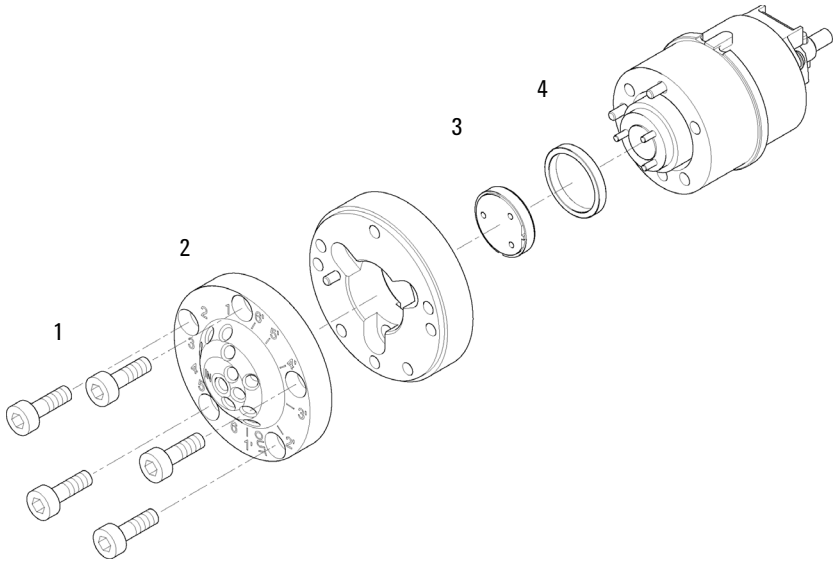



**Figure 42** Column Switching Valve Parts (5067-4273)

# 12 Position/13 Port Valve Head 210 bar (Bio-inert), 5067-4159


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

| Item | p/n | Description |
|---|---|---|
| 1 | 5068-0059 | Stator screws |
| 2 | 5068-0097 | Bio-inert stator head |
| 3 | 0101-1288 | Bio-inert rotor seal and stator face seal, kit |
| 4 | 1535-4045 | Bearing ring |

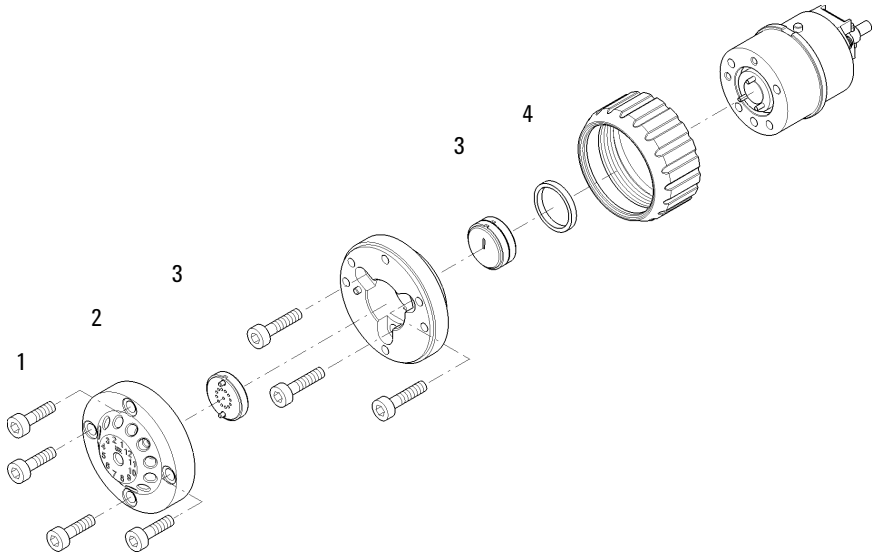



**Figure 43** Column Switching Valve Parts (5067-4159)

# 12
# Identifying Cables



This chapter provides information on cables used with the 1290 series of HPLC modules.

# Cable Overview

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

### Analog cables

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

### Remote cables

| p/n | Description |
|---|---|
| 03394-60600 | Agilent module to 3396A Series I integrators |
| | 3396 Series II / 3395A integrator, see details in section "Remote Cables" on page 174 |
| 03396-61010 | Agilent module to 3396 Series III / 3395B integrators |
| 5061-3378 | Remote Cable |
| 01046-60201 | Agilent module to general purpose |

### BCD cables

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

### CAN cables

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

### LAN cables

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

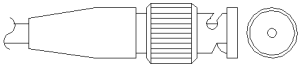
### External Contact Cable

| p/n | Description |
|---|---|
| G1103-61611 | General Purpose Cable |

### RS-232 cables

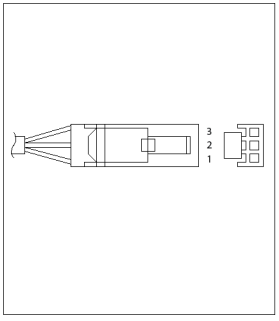
| p/n | Description |
|---|---|
| RS232-61601 | RS-232 cable, 2.5 m<br>Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It is also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9. |
| 5181-1561 | RS-232 cable, 8 m |

# Analog Cables

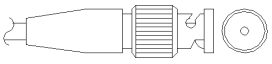


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

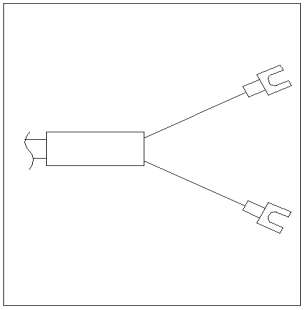
## Agilent Module to 3394/6 Integrators

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

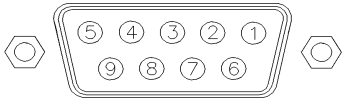
## Agilent Module to BNC Connector

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

## Agilent Module to General Purpose

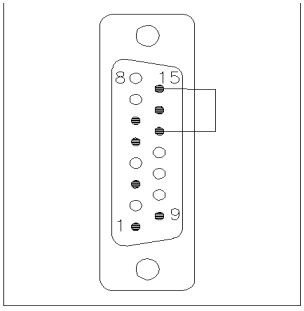
| p/n 01046-60105 | Pin | Pin Agilent module | Signal Name |
|---|---|---|---|
|  | 1 | | Not connected |
| | 2 | Black | Analog - |
| | 3 | Red | Analog + |

# Remote Cables




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

## Agilent Module to 3396A Integrators

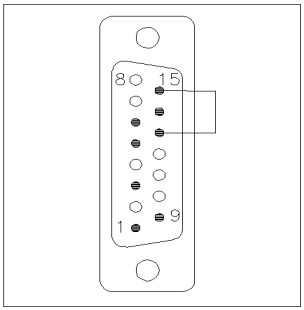
| p/n 03394-60600 | Pin 3396A | Pin Agilent module | Signal Name | Active (TTL) |
|---|---|---|---|---|
|  | 9 | 1 - White | Digital ground | |
| | NC | 2 - Brown | Prepare run | Low |
| | 3 | 3 - Gray | Start | Low |
| | NC | 4 - Blue | Shut down | Low |
| | NC | 5 - Pink | Not connected | |
| | NC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



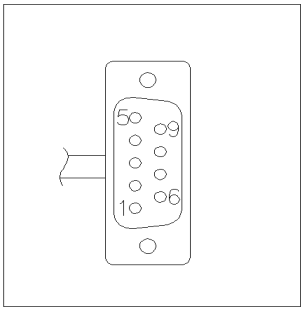
## Agilent Module to 3396 Series II / 3395A Integrators

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

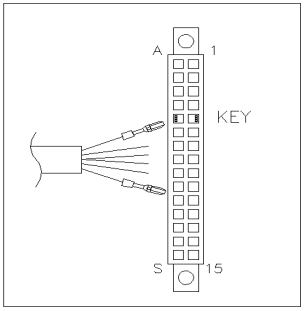
## Agilent Module to 3396 Series III / 3395B Integrators

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

## Agilent Module to Agilent 35900 A/D Converters

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

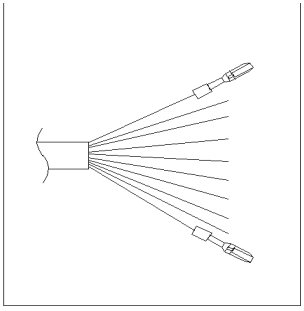
## Agilent Module to General Purpose

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

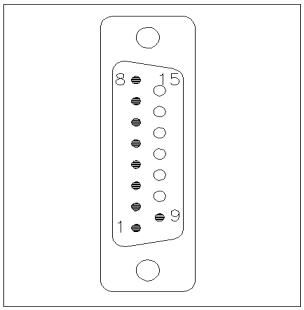
# BCD Cables


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

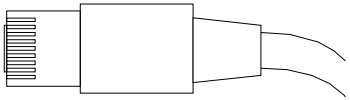
## Agilent Module to General Purpose

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

## Agilent Module to 3396 Integrators

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

# CAN/LAN Cables



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

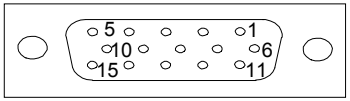
### CAN Cables

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

### LAN Cables

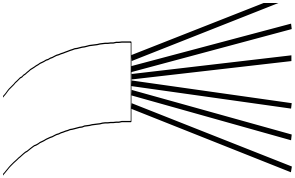
| p/n | Description |
|---|---|
| 5023-0203 | Cross-over network cable, shielded, 3 m (for point to point connection) |
| 5023-0202 | Twisted pair network cable, shielded, 7 m (for point to point connection) |

# External Contact Cable




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

## Agilent Module Interface Board to general purposes

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

# Agilent Module to PC

| p/n | Description |
|---|---|
| RS232-61601 | RS-232 cable, 2.5 m<br>Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It is also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9. |
| 5181-1561 | RS-232 cable, 8 m |

# Agilent 1200 Module to Printer

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

# 13
# Hardware Information



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

# Firmware Description

The firmware of the instrument consists of two independent sections:

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

## Resident System

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

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

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

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

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

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

**NOTE**

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

Main and resident firmware must be from the same set.

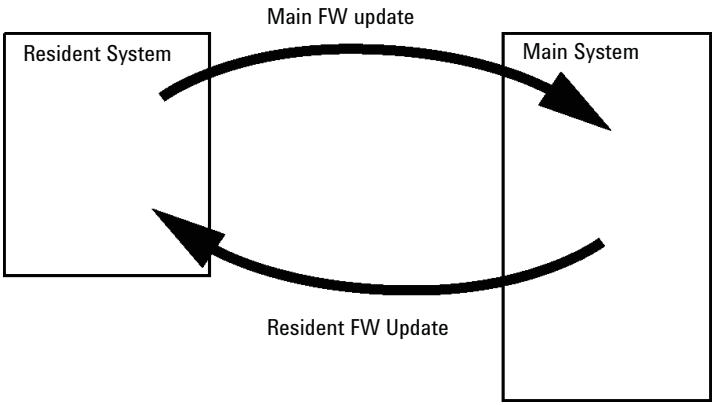



**Figure 44** Firmware Update Mechanism

**NOTE**

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

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

All this specific information is described in the documentation provided with the firmware update tools.

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

- http://www.agilent.com/en-us/firmwareDownload?whid=69761

# Electrical Connections

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

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

# Rear view of the module

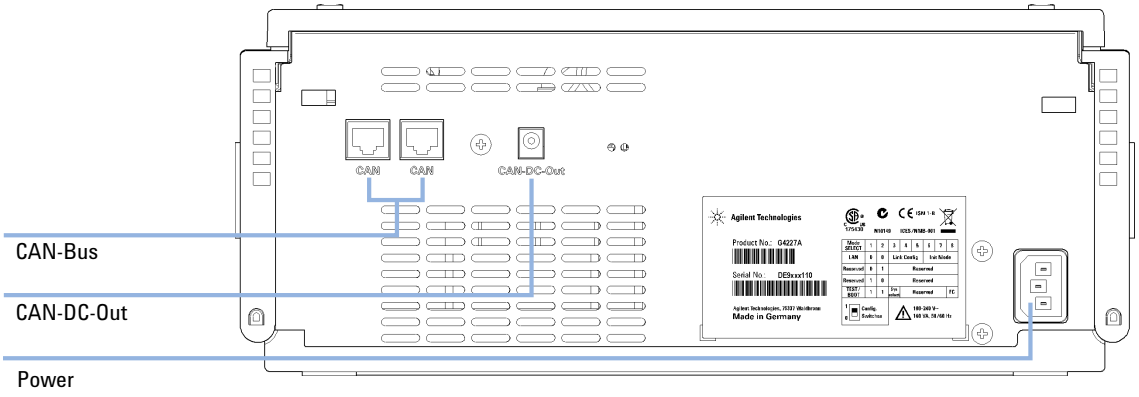



**Figure 45** Rear view of the Flexible Cube

# Interfaces

The Agilent 1200 Infinity Series modules provide the following interfaces:

**Table 10** Agilent 1200 Infinity Series Interfaces

| Module | CAN | LAN/BCD (optional) | LAN (on-board) | RS-232 | Analog | APG Remote | Special |
|---|---|---|---|---|---|---|---|
| **Pumps** | | | | | | | |
| G1310B Iso Pump<br>G1311B Quat Pump<br>G1311C Quat Pump VL<br>G1312B Bin Pump<br>K1312B Bin Pump Clinical Ed.<br>G1312C Bin Pump VL<br>1376A Cap Pump<br>G2226A Nano Pump<br>G5611A Bio-inert Quat Pump | 2 | Yes | No | Yes | 1 | Yes | |
| G4220A/B Bin Pump<br>G4204A Quat Pump | 2 | No | Yes | Yes | No | Yes | CAN-DC- OUT for CAN slaves |
| G1361A Prep Pump | 2 | Yes | No | Yes | No | Yes | CAN-DC- OUT for CAN slaves |
| **Samplers** | | | | | | | |
| G1329B ALS<br>G2260A Prep ALS | 2 | Yes | No | Yes | No | Yes | THERMOSTAT for G1330B/K1330B |
| G1364B FC-PS<br>G1364C FC-AS<br>G1364D FC-µS<br>G1367E HiP ALS<br>K1367E HiP ALS Clinical Ed.<br>G1377A HiP micro ALS<br>G2258A DL ALS<br>G5664A Bio-inert FC-AS<br>G5667A Bio-inert Autosampler | 2 | Yes | No | Yes | No | Yes | THERMOSTAT for G1330B/K1330B<br>CAN-DC- OUT for CAN slaves |
| G4226A ALS | 2 | Yes | No | Yes | No | Yes | |

**Table 10** Agilent 1200 Infinity Series Interfaces

| Module | CAN | LAN/BCD (optional) | LAN (on-board) | RS-232 | Analog | APG Remote | Special |
|---|---|---|---|---|---|---|---|
| **Detectors** | | | | | | | |
| G1314B VWD VL<br>G1314C VWD VL+ | 2 | Yes | No | Yes | 1 | Yes | |
| G1314E/F VWD<br>K1314F Clinical Ed. | 2 | No | Yes | Yes | 1 | Yes | |
| G4212A/B DAD<br>K4212B DAD Clinical Ed. | 2 | No | Yes | Yes | 1 | Yes | |
| G1315C DAD VL+<br>G1365C MWD<br>G1315D DAD VL<br>G1365D MWD VL | 2 | No | Yes | Yes | 2 | Yes | |
| G1321B FLD<br>K1321B FLD Clinical Ed.<br>G1321C FLD | 2 | Yes | No | Yes | 2 | Yes | |
| G1362A RID | 2 | Yes | No | Yes | 1 | Yes | |
| G4280A ELSD | No | No | No | Yes | Yes | Yes | EXT Contact<br>AUTOZERO |
| **Others** | | | | | | | |
| G1170A Valve Drive | 2 | No | No | No | No | No | 1 |
| G1316A/C TCC<br>K1316C TCC Clinical Ed. | 2 | No | No | Yes | No | Yes | |
| G1322A DEG<br>K1322A DEG Clinical Ed. | No | No | No | No | No | Yes | AUX |
| G1379B DEG | No | No | No | Yes | No | Yes | |
| G4225A DEG<br>K4225A DEG Clinical Ed. | No | No | No | Yes | No | Yes | |

**Table 10** Agilent 1200 Infinity Series Interfaces

| Module | CAN | LAN/BCD (optional) | LAN (on-board) | RS-232 | Analog | APG Remote | Special |
|---|---|---|---|---|---|---|---|
| G4227A Flex Cube | 2 | No | No | No | No | No | CAN-DC- OUT for CAN slaves [1] |
| G4240A CHIP CUBE | 2 | Yes | No | Yes | No | Yes | CAN-DC- OUT for CAN slaves THERMOSTAT for G1330A/B (NOT USED), K1330B |

[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 a LAN card (e.g. Agilent G1369B/C LAN Interface) or they have an on-board LAN interface (e.g. detectors G1315C/D DAD and G1365C/D MWD). This interface allows the control of the module/system via a PC with the appropriate control software. Some modules have neither on-board LAN nor an interface slot for a LAN card (e.g. G1170A Valve Drive or G4227A Flexible Cube). These are hosted modules and require a Host module with firmware B.06.40 or later or with additional G1369C LAN Card.

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

## 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 11** RS-232C Connection Table

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

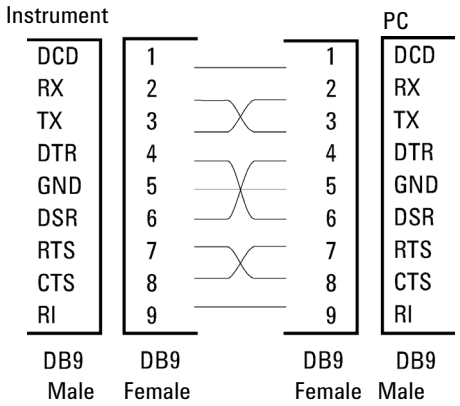



**Figure 46** RS-232 Cable

## 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 12** Remote Signal Distribution

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

## Special Interfaces

There is no special interface for this module.

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

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

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

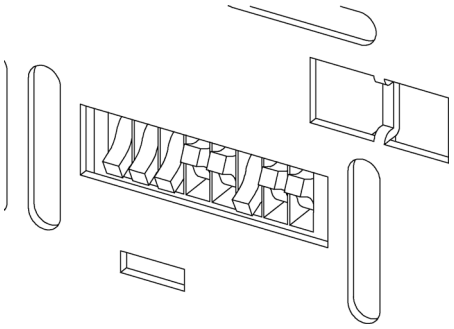


**Figure 47** Configuration switch (settings depend on configured mode)

All modules without on-board LAN:

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

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

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

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

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

**Table 13** 8-bit Configuration Switch (without on-board LAN)

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

**NOTE** The LAN settings are done on the LAN Interface Card G1369B/C. Refer to the documentation provided with the card.

## Communication Settings for RS-232C

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

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

**Table 14** Communication Settings for RS-232C Communication (without on-board LAN)

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

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

**Table 15** Baudrate Settings (without on-board LAN)

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

**Table 16** Data Bit Settings (without on-board LAN)

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

**Table 17** Parity Settings (without on-board LAN)

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

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

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

# Special Settings

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

## Boot-Resident

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

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

**Table 18** Boot Resident Settings (without on-board LAN)

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

## Forced Cold Start

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

**CAUTION**

Loss of data

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

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

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

**Table 19** Forced Cold Start Settings (without on-board LAN)

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

# Instrument Layout

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

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

# Early Maintenance Feedback

Maintenance requires the exchange of components 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.

# 14
# Appendix



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

# General Safety Information

## Safety Symbols

**Table 20** Safety Symbols

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

**WARNING**

**A WARNING**

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

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

**CAUTION**

A CAUTION

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

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

## 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.

# The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC)

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

**NOTE**

Do not dispose of in domestic household waste

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

# Radio Interference

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

# Index

## T



## U



## V



## W

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# In This Book

This manual contains technical reference information about the Agilent 1290 Infinity Flexible Cube G4227A.

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



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