Agilent 1290 Infinity Flexible Cube

User Manual

Agilent Technologies

Notices

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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 carry over 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.

9 Test Functions

This chapter describes the tests for the module.

10 Maintenance and Repair

This chapter describes the maintenance of the module.

11 Parts and Materials for Maintenance

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

12 Identifying Cables

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

13 Hardware Information

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

14 Appendix

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

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 carry over, and optionally you can add one or two valve pods to be able to use the G4226A HiP Autosampler as a multipurpose valve box.

The G4227A Flexible Cube is capable of reducing carry over 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 add one or two valve drives optionally. 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 as well as a delete option without any valve drive if the Flexible Cube is needed for carry over reduction only. Other options will follow later.

Flexible Cube Technical Capability

The Flexible Cube is added to the 1290 Infinity system to reduce carry over 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

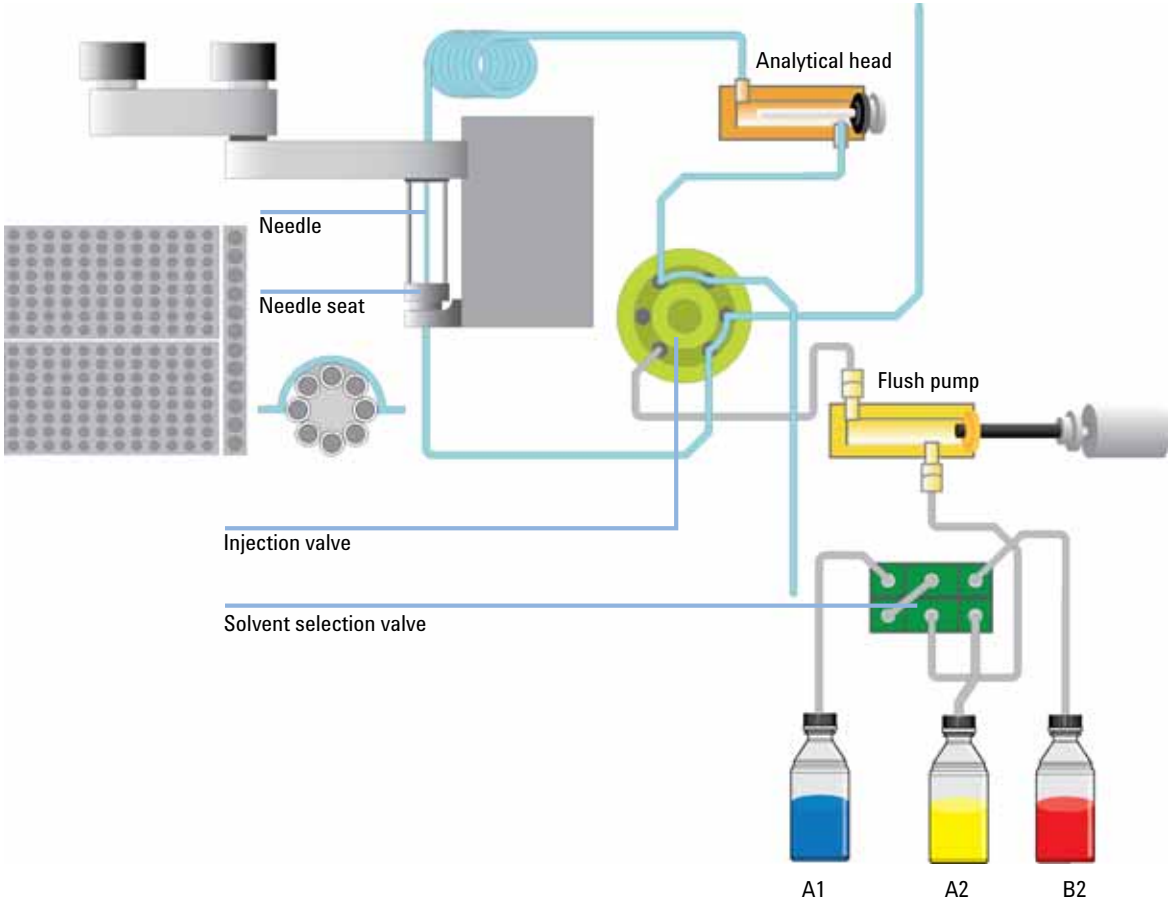


Figure 1 Mainpass

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

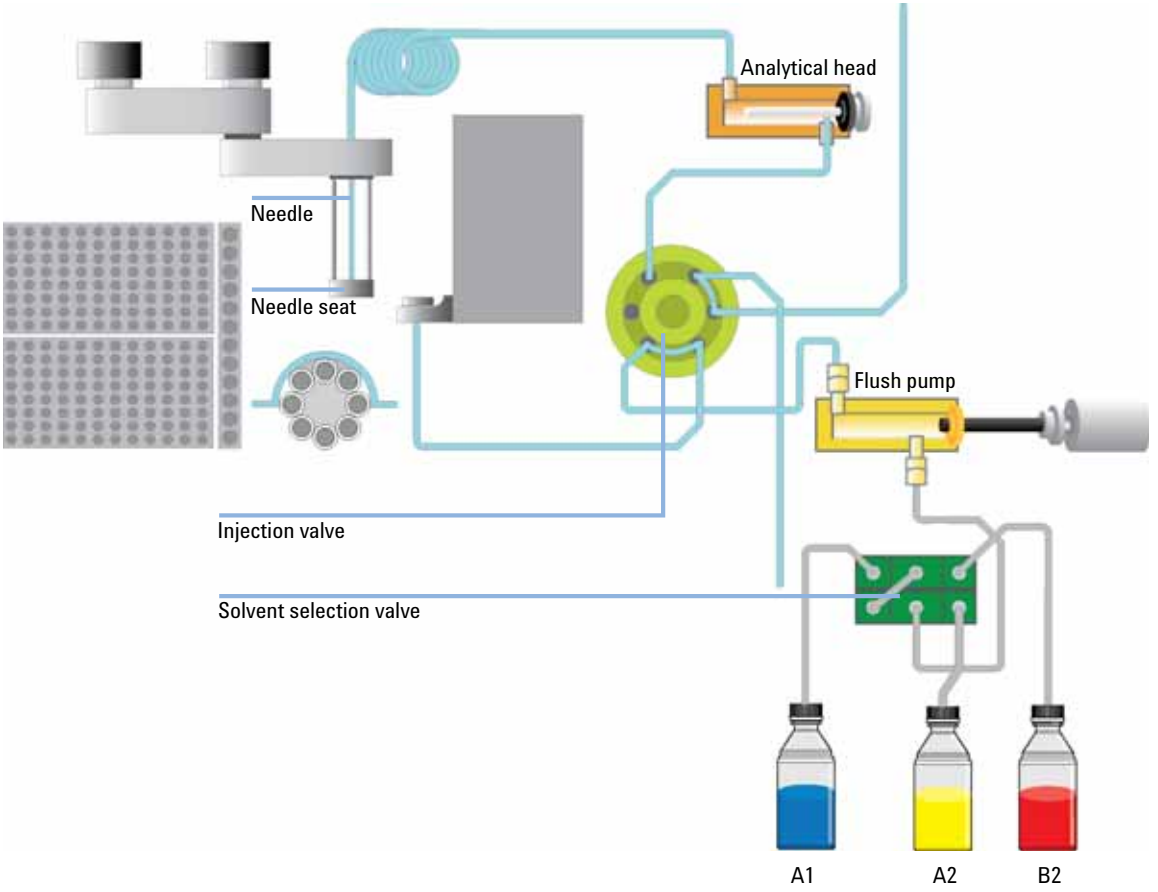


Figure 2 Switch to Bypass

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)

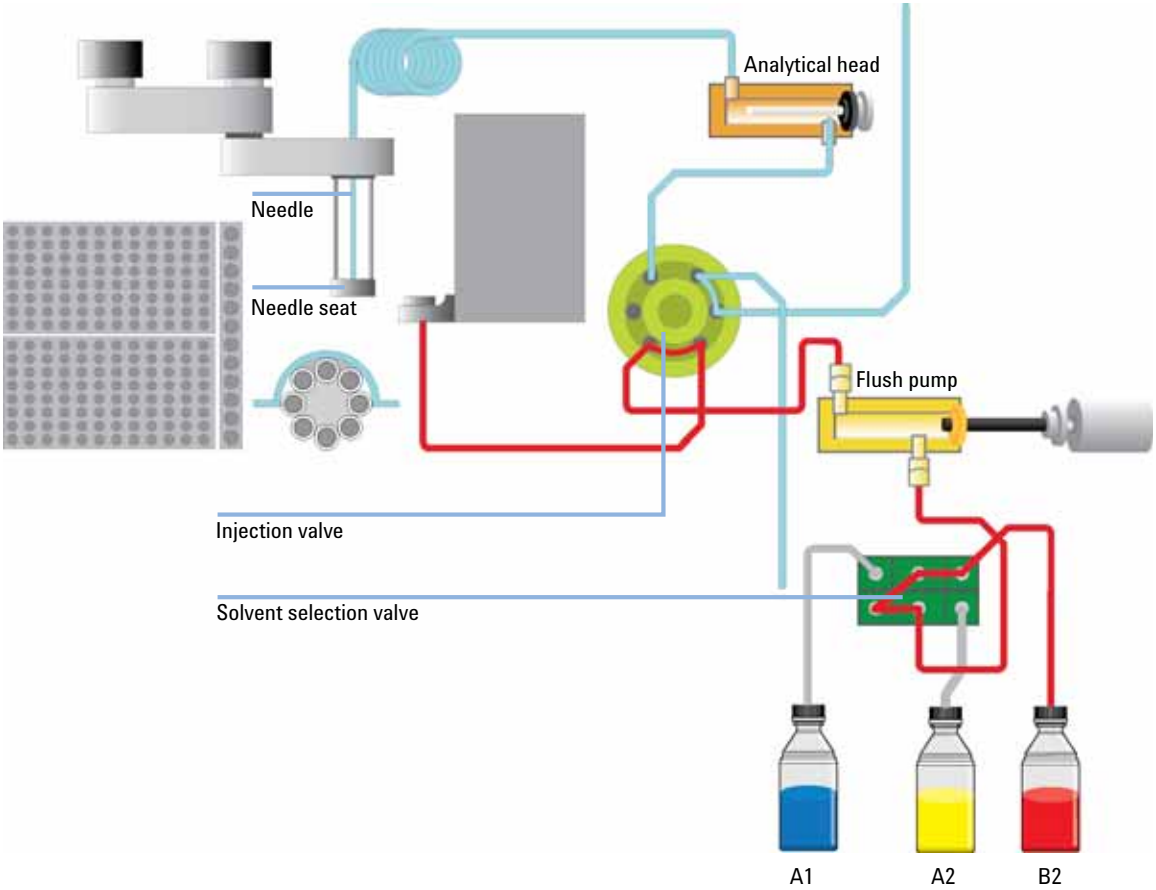


Figure 3 Flush with dissolving solvent #1 (A2)

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)

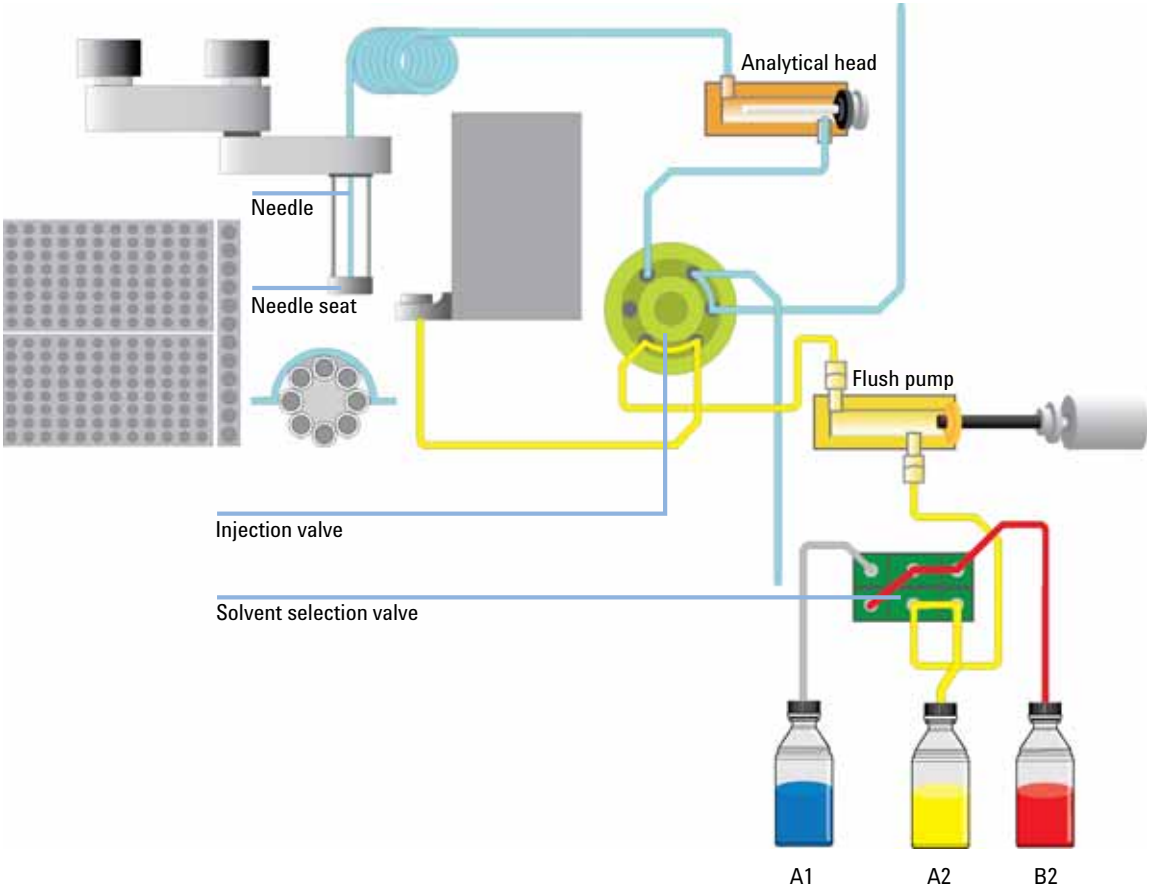


Figure 4 Flush with dissolving solvent #2 (B2)

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

5 Flush with Starting condition (A1)

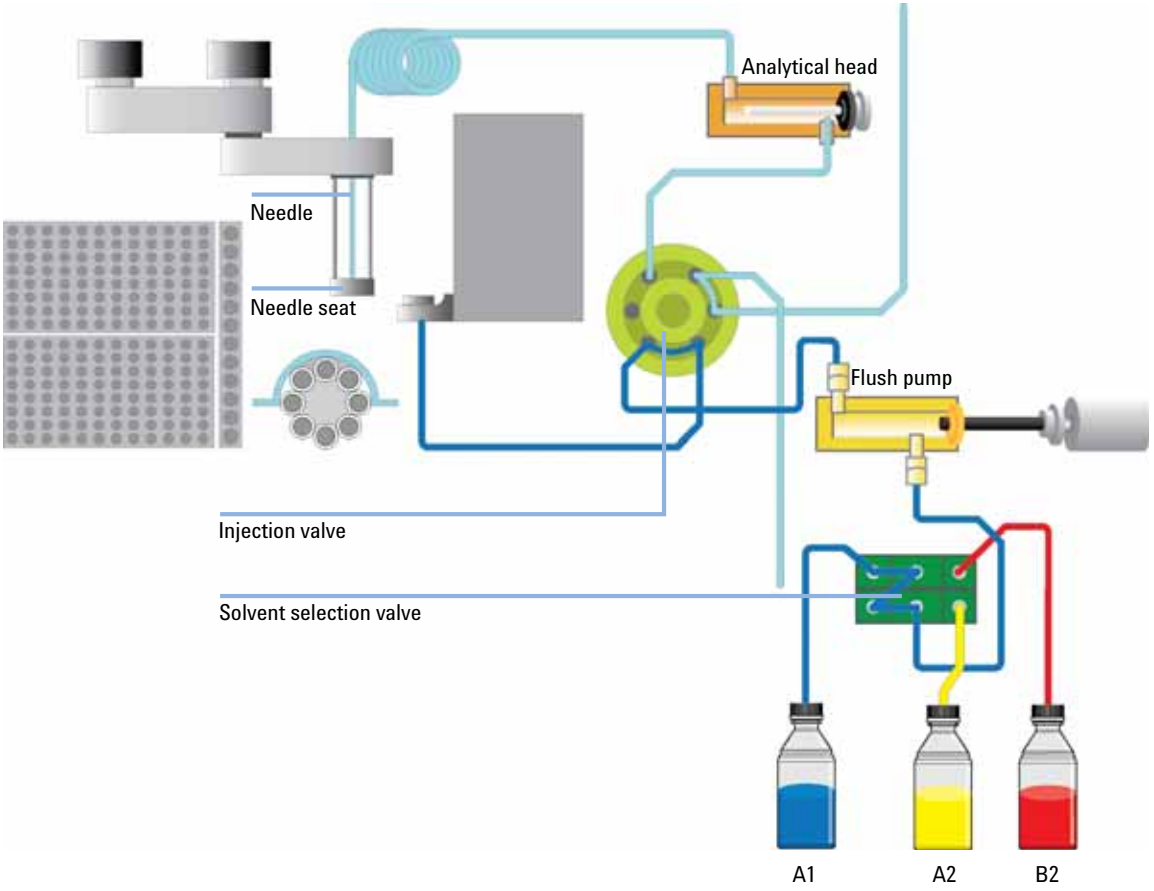


Figure 5 Flush with Starting condition (A1)

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

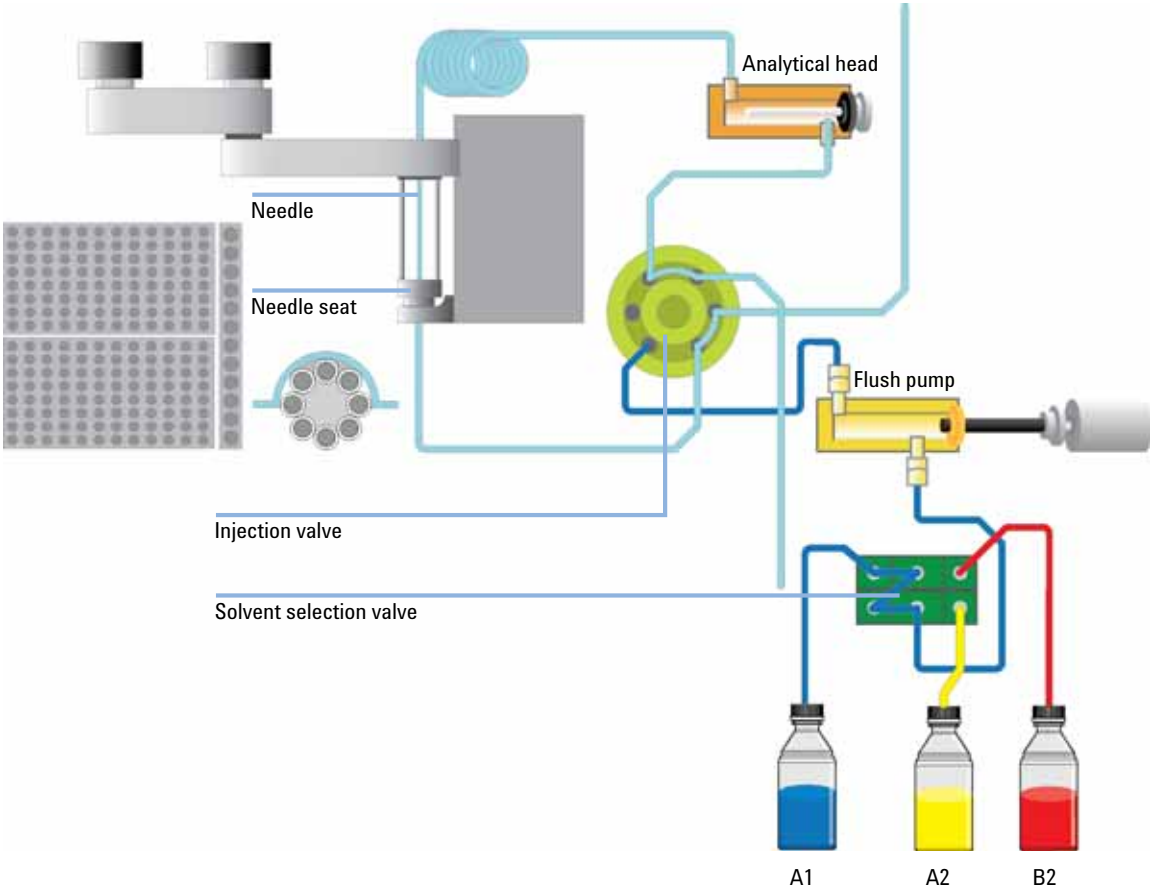


Figure 6 Switch back to Mainpass

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

2pos/6port valve (G4231A/B) and 2pos/10port valve (G4232A/B)

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 position selection valve (G4234A/B) 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.

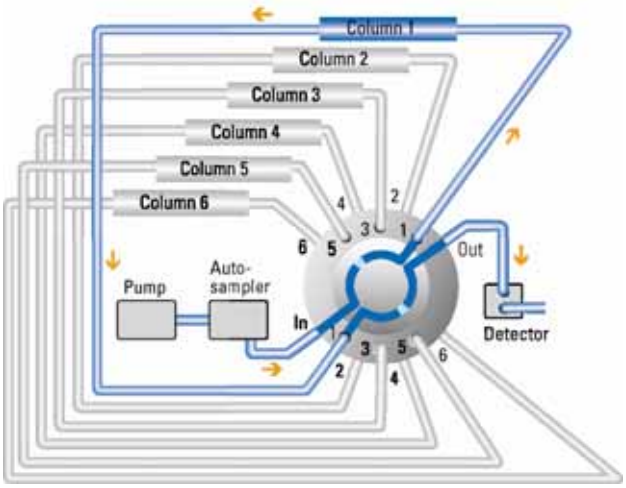


Figure 7 Multiple Column Selection (Example of Schematic Setup for 6 Column Selector)

Sample Enrichment and Sample Cleanup

2pos/6port valve (G4231A/B) and 2pos/10port valve (G4232A/B)

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 a 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.

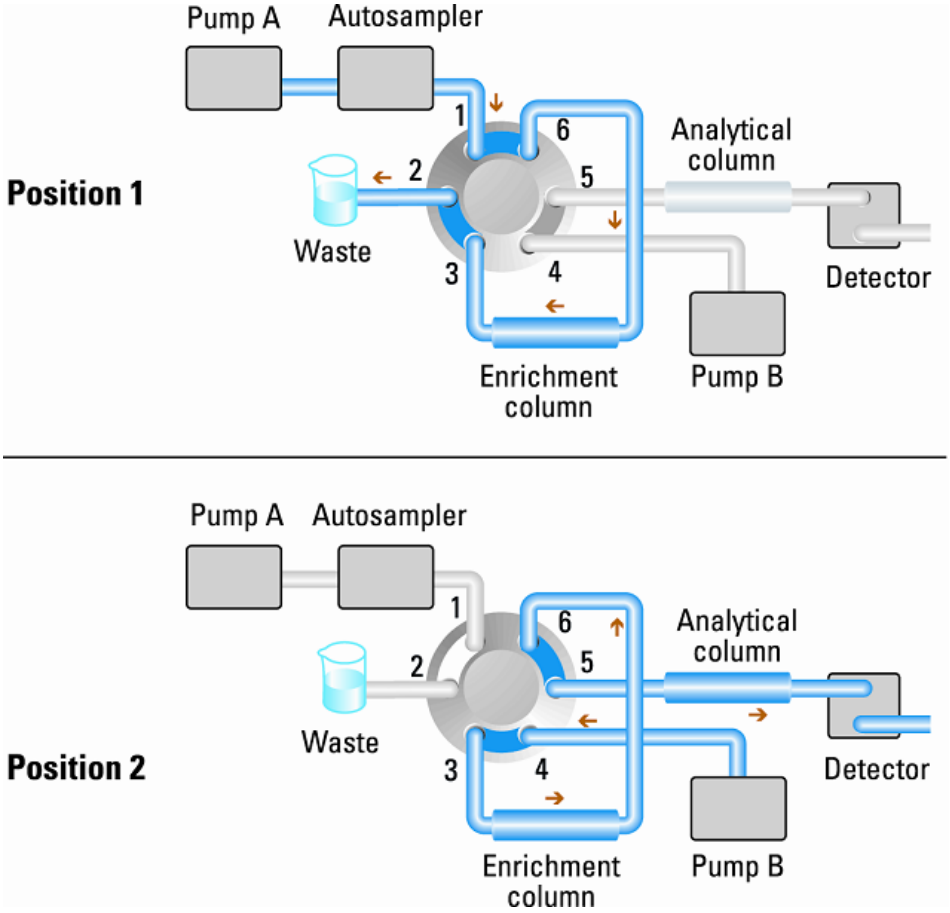


Figure 8 Sample enrichment

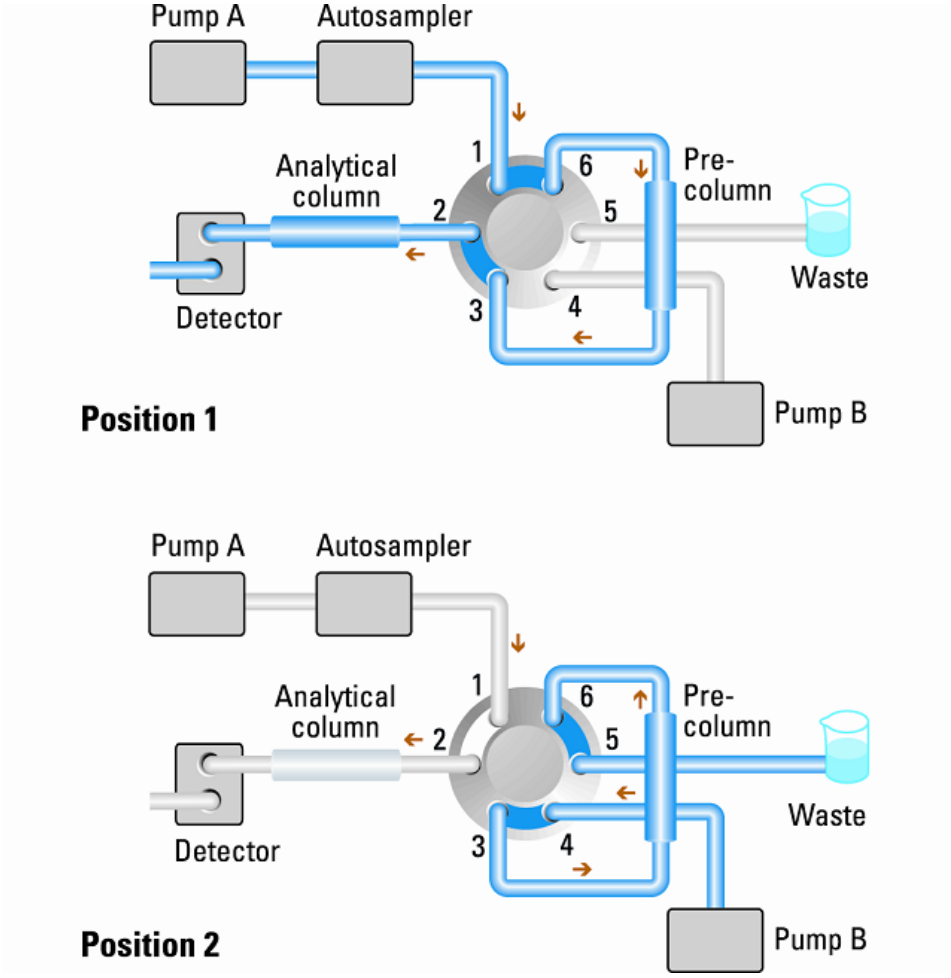


Figure 9 Sample clean-up

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 2pos/10port valve (G4232A/B)

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 valves, which allows simultaneous analysis on one column while a second identical column is flushed and equilibrated.

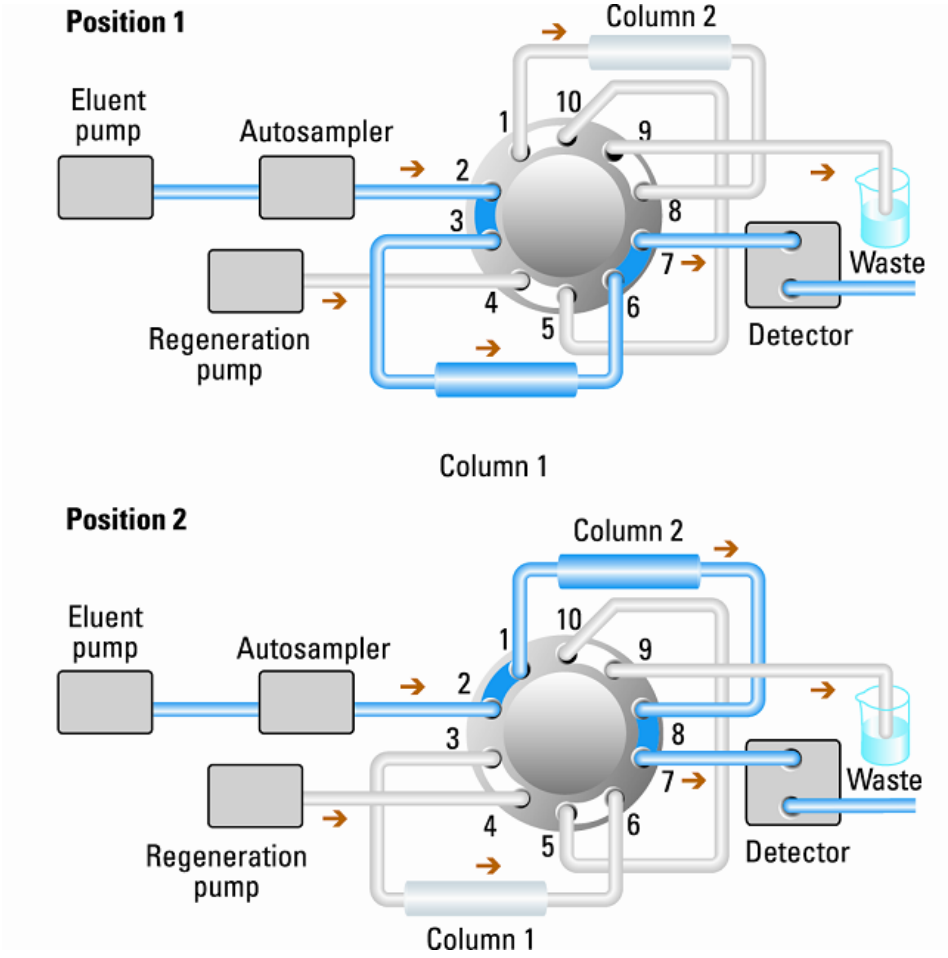


Figure 10 Alternating Column Regeneration

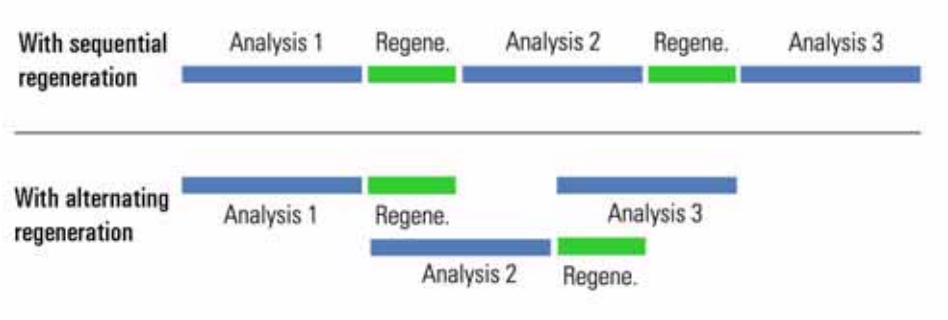


Figure 11 Alternate Column Regeneration (Time Scheme)

Solvent Selection

The 12pos/13port valve (G4235A) can be used for solvent selection (flow rate < 10 mL/min) as illustrated in Figure 12 on page 26. It offers automated access to 12 different eluents.

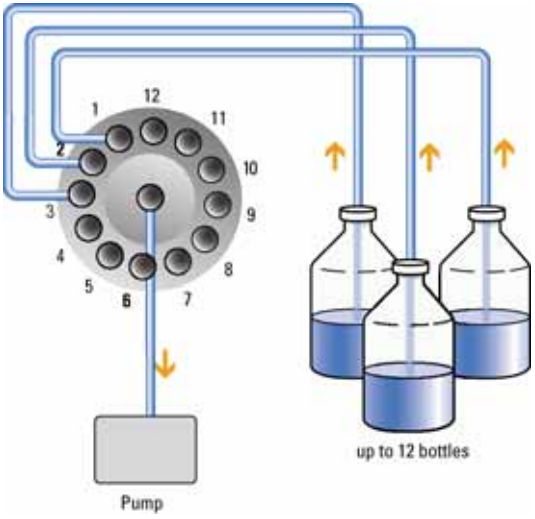


Figure 12 Solvent Selection (Schematic Setup)

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 Systems

Module	Materials
Agilent 1260 Infinity Bio-inert Quaternary Pump (G5611A)	Titanium, gold, platinum-iridium, ceramic, ruby, PTFE, PEEK
Agilent 1260 Infinity Bio-inert High-Performance Autosampler (G5667A)	Upstream of sample introduction: • Titanium, gold, PTFE, PEEK, ceramic Downstream of sample introduction: • PEEK, ceramic
Agilent 1260 Infinity Bio-inert Manual Injector (G5628A)	PEEK, ceramic
Agilent 1260 Infinity Bio-inert Analytical Fraction Collector (G5664A)	PEEK, ceramic, PTFE
Bio-inert Flow Cells:	
Standard flow cell bio-inert, 10 mm, 13 µL, 120 bar (12 MPa) for MWD/DAD, includes Capillary Kit Flow Cells BIO (p/n G5615-68755) (G5615-60022) (*for Agilent 1260 Infinity Diode Array Detectors DAD G1315C/D*)	PEEK, ceramic, sapphire, PTFE
Max-Light Cartridge Cell Bio-inert (10 mm, V(s) 1.0 µL) (G5615-60018) and Max-Light Cartridge Cell Bio-inert (60 mm, V(s) 4.0 µL) (G5615-60017) (*for Agilent 1200 Infinity Series Diode Array Detectors DAD G4212A/B*)	PEEK, fused silica
Bio-inert flow cell, 8 µL, 20 bar (pH 1–12) includes Capillary Kit Flow Cells BIO (p/n G5615-68755) (G5615-60005) (*for Agilent 1260 Infinity Fluorescence Detector FLD G1321B*)	PEEK, fused silica, PTFE

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

Module	Materials
Bio-inert heat-exchanger G5616-60050 (*for Agilent 1290 Infinity Thermostatted Column Compartment G1316C*)	PEEK (steel-cladded)
Bio-inert Valve heads	G4235A, G5631A, G5639A: PEEK, ceramic (Al_2O_3 based)
Bio-inert Connection capillaries	Upstream of sample introduction: • Titanium Downstream of sample introduction: • Agilent uses stainless-steel-cladded PEEK capillaries, which keep the flow path free of steel and provide pressure stability to more than 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 78.

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

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

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

➔ Always unplug the power cable before opening the cover.

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

CAUTION

Inaccessible power plug.

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

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

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

Power Cords

Different power cords are offered as options with the module. The female end of all power cords is identical. It plugs into the power-input socket at the rear. The male end of each power cord is different and designed to match the wall socket of a particular country or region.

WARNING

Absence of ground connection or use of unspecified power cord

The absence of ground connection or the use of unspecified power cord can lead to electric shock or short circuit.

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

➔ Never use a power cord other than the Agilent Technologies power cord designed for your region.

WARNING

Use of unsupplied cables

Using cables not supplied by Agilent Technologies can lead to damage of the electronic components or personal injury.

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

WARNING

Unintended use of supplied power cords

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

➔ Never use the power cords that Agilent Technologies supplies with this instrument for any other equipment.

Bench Space

The module dimensions and weight (see Table 2 on page 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.

Condensation

CAUTION

Condensation within the module

Condensation will damage the system electronics.

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

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

Physical Specifications

Table 2 Physical Specifications

Type	Specification	Comments
Weight	8.2 kg (18.1 lbs)	
Dimensions (height × width × depth)	345 x 435 x 140 mm (13.5 x 17 x 5.5 inches)	
Line voltage	100 – 240 VAC, ± 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 (-4 – 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 (15091 ft)	For storing the module
Safety standards: IEC, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

Performance Specifications

Table 3 Performance Specifications

Type	Specification	Comment
Injection range	0.1 – 20 µL 0.1 – 40 µL 0.1 – 100 µL in 0.1 µL increments	With 20 mL loop installed With 40 mL loop installed With 100 mL loop installed (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 Needle wash intern Needle wash extern	by G4227A Flexible Cube by G4226A sampler 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. 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 EZChrom Elite Masshunter	OpenLAB CDS ChemStation Edition C.01.04 OpenLAB CDS EZChrom Edition A.04.04 Masshunter B.05.01 TOF & Q-TOF Masshunter B.06.00 QQQ Modules require Firmware Set A/B/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/B	5067-4107	8 pos/9 port high pressure valve head	600	10-32	0.55 µL	PEEK, SST	0-14[1]
G4230B	5067-4121	8 pos/9 port UHP valve head	1200	10-32	0.55 µL	Vespel, SST	0-10[2]
G4231A	5067-4137	2 pos/6 port valve head	600	10-32	0.51 µL	PEEK, SST	0-14[1]
G4231B	5067-4117	2 pos/6 port UHP valve head	1200	10-32	0.51 µL	Vespel, SST	0-10[2]
G4232A	5067-4144	2 pos/10 port micro valve head	600	M4	89.0 nL	PEEK, SST	0-14[1]
G4232B	5067-4118	2 pos/10 port UHP valve head	1200	10-32	0.22 µL	Vespel, SST	0-10[2]
G4234A	5067-4146	6 pos/14 port valve head for column selection	600	M4	special[3]	PEEK, SST	0-14[1]
G4234B	5067-4142	6 pos/14 port UHP valve head for column selection	1200	M4	special[3]	Vespel, SST	0-10[2]
G4235A	5067-4159	12 pos/13 port selection valve head (bio-inert)	210	10-32	16.4 µL	PEEK, Ceramic	0-14[1]
G5631A	5067-4148	2 pos/6 port valve head (bio-inert)	600	10-32	1.71 µL	PEEK, Ceramic	0-14[1]
G5639A	5067-4134	4 pos/10 port valve head for column selection (bio-inert)	600	10-32	special[3]	PEEK, Ceramic	0-14[1]

1 incompatible with some mineral acids. For more information see Sovent Information.

2 Incompatible with concentrated mineral acids, compatible with pH less than 10, compatible with most organics, may experience swelling with some organics containing functional groups such as nitro benzene, at elevated temperatures.

3 pre-column volume G4234A/B: 0.51 µL, G5639A: 0.81 µL; post column volume G4234A/B: 1.28 µL, 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 161. 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
Standard Accessory Kit (see "HPLC System Tool Kit" on page 164)	1
Flexible Cube Accessory Kit (see "Flexible Cube Accessory Kit" on page 165)	1
Second 1290 Infinity Flexible Cube Generic Valve Drive	optional
No 1290 Infinity Flexible Cube Generic Valve Drives	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

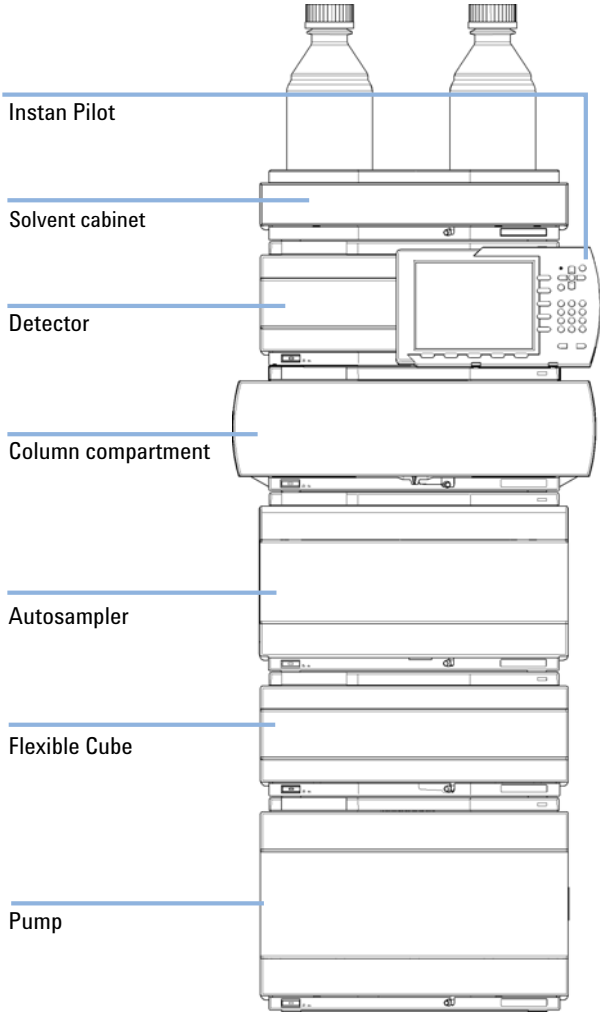


Figure 13 Supported One Stack Configuration (Front View)

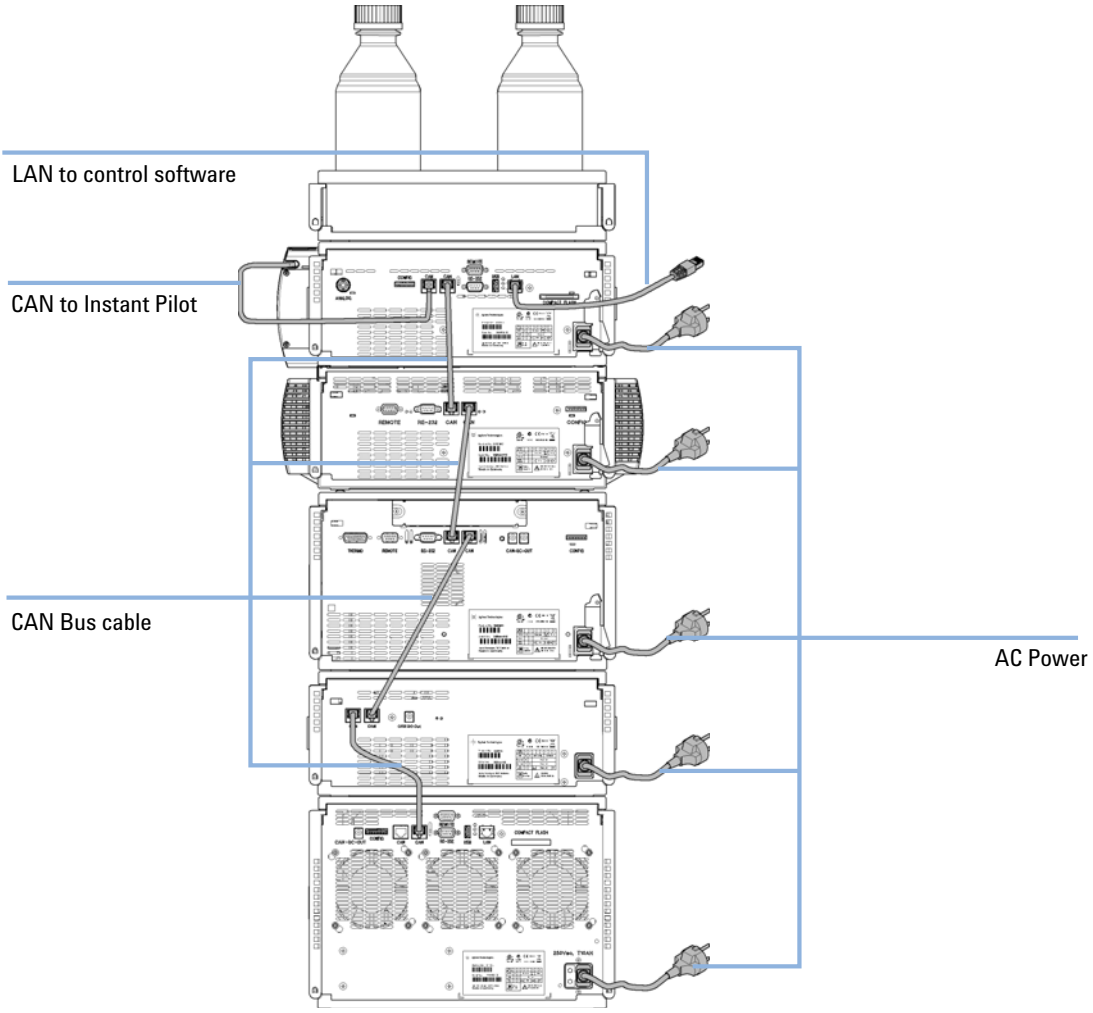


Figure 14 Supported One Stack Configuration (Rear View)

Supported Two Stack Configurations

Two Stack Configuration (Standard)

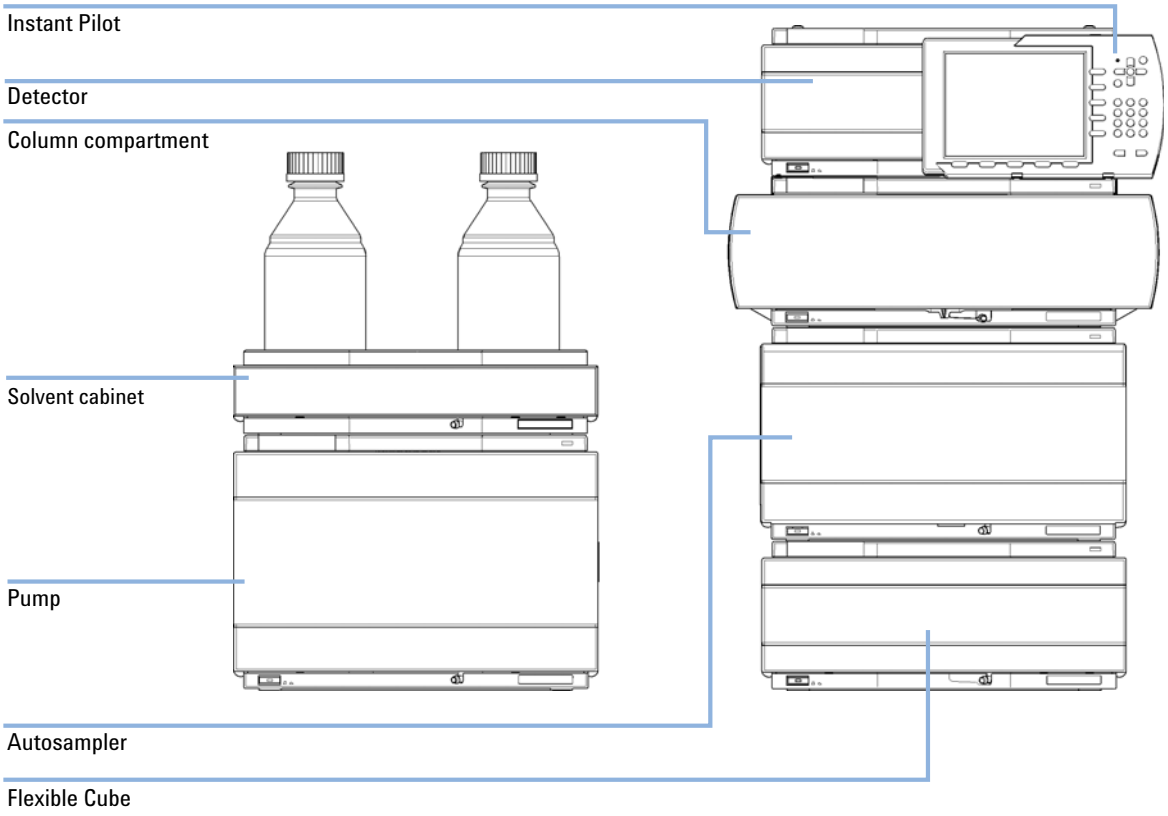


Figure 15 Supported Two Stack Configuration Front View (Standard)

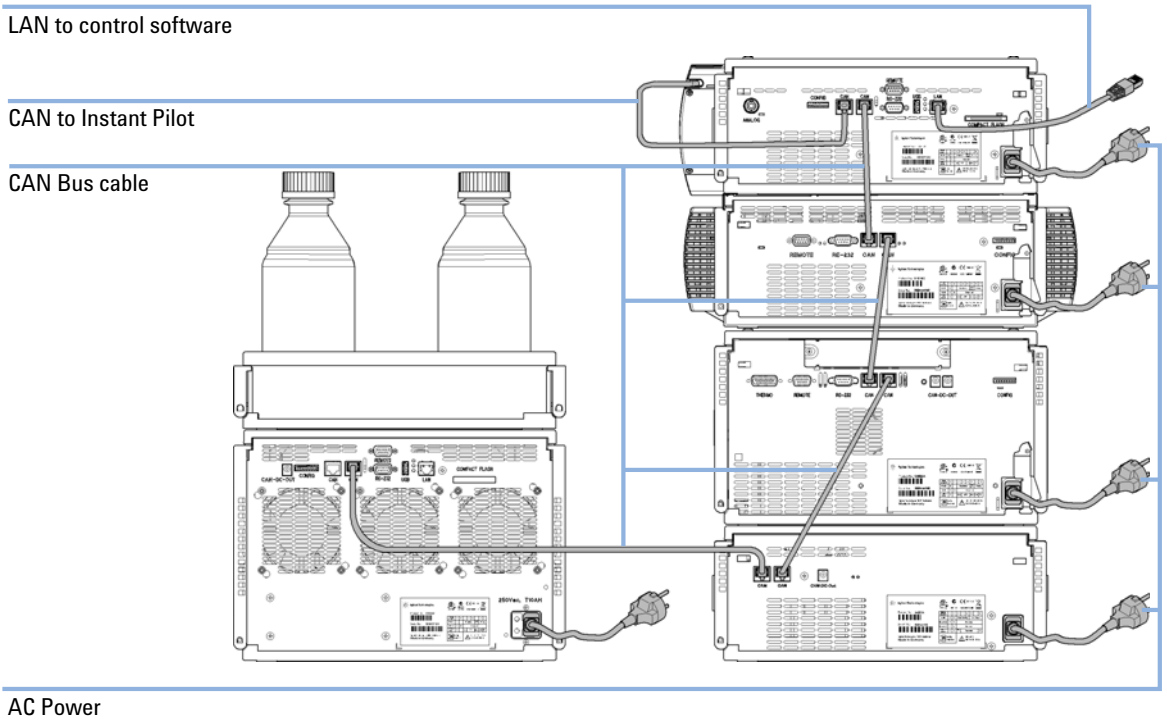


Figure 16 Supported Two Stack Configuration Rear View (Standard)

Two Stack Configuration (Thermostatted)

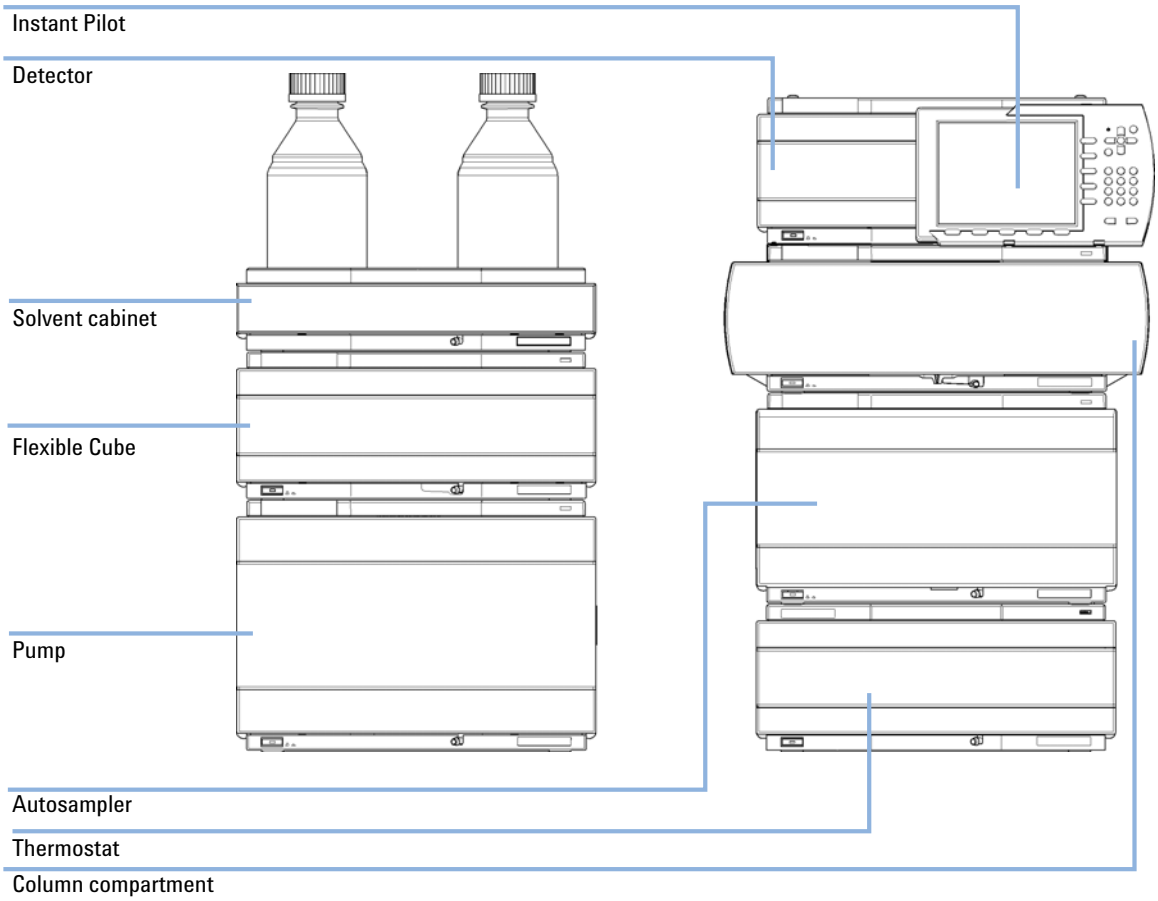


Figure 17 Supported Two Stack Configuration Front View (Thermostatted)

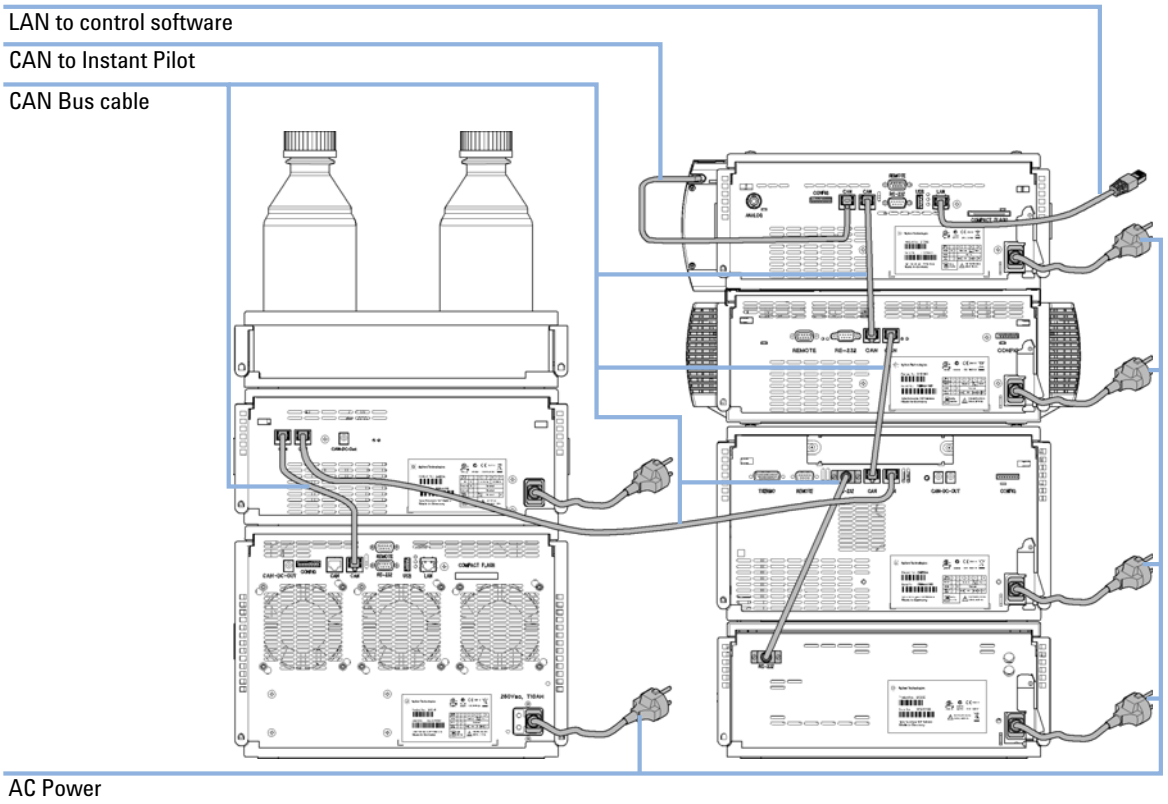


Figure 18 Supported Two Stack Configuration Rear View (Thermostatted)

Installing the Module

Parts required	**p/n**	**Description**
	G4227-64010	Agilent 1290 Infinity Flexible Cube
		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.

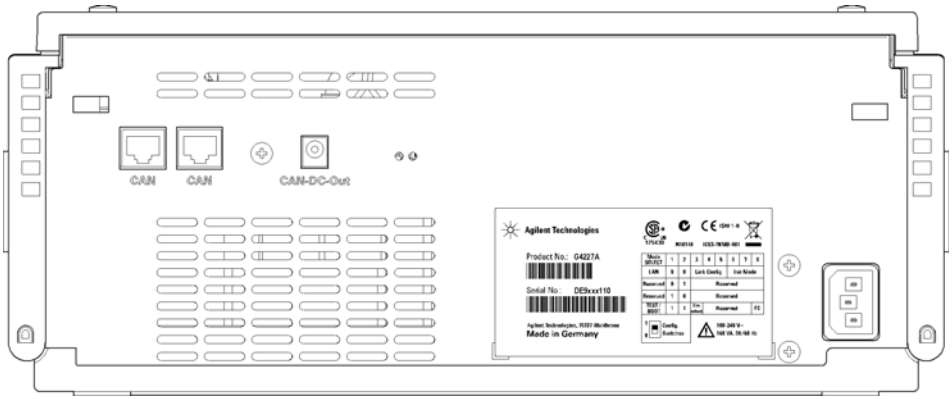


Figure 19 Module rear view

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 Carry Over

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

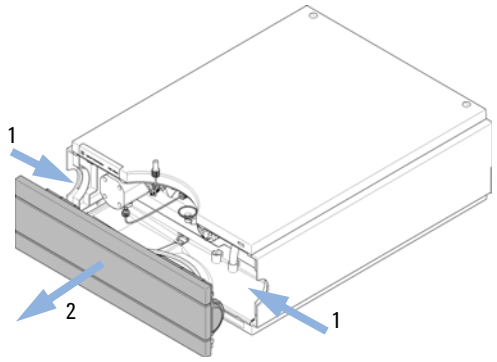
Damage to the flush pump

➔ 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.

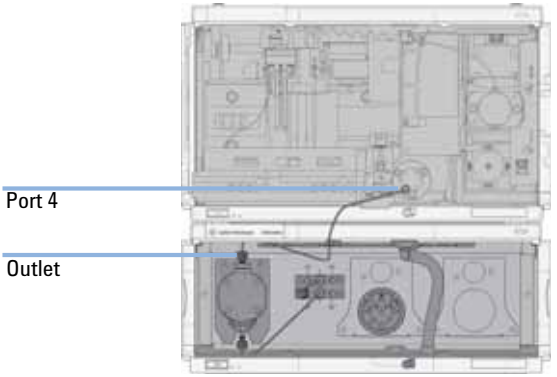
NOTE

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.

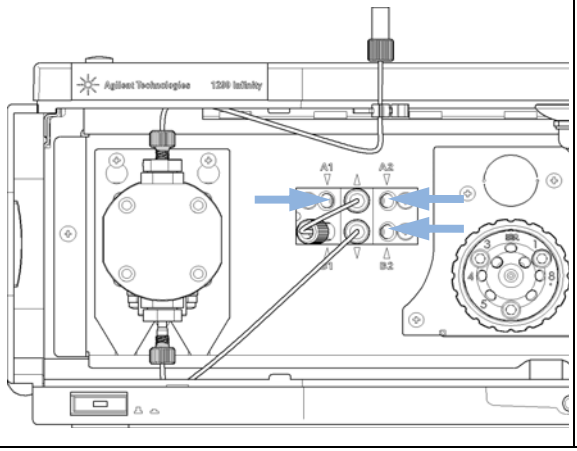
1 Open the front cover by pressing the buttons on the side of the Autosampler and Flexible Cube modules.



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

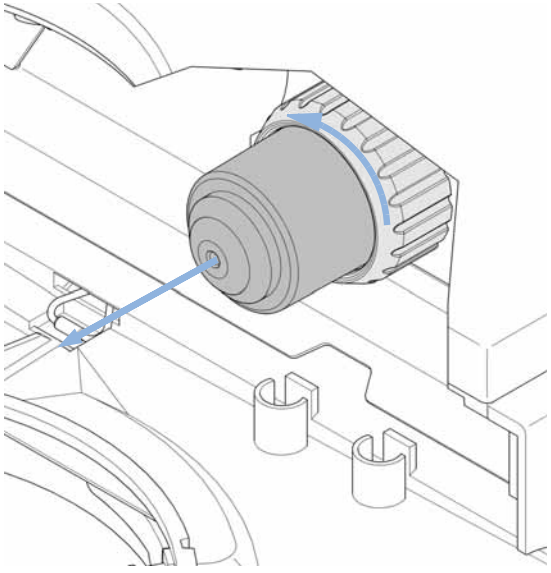
The valve drives are factory-installed in the Thermostatted Column Compartment, in the Flexible Cube, and in the 1290 Infinity Valve Drive. The valve heads are interchangeable and can be easily mounted.

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 pollutions. 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.

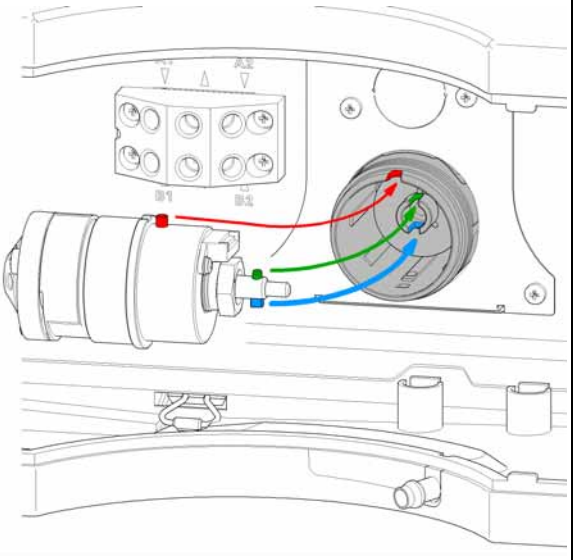
➔ For bio-inert applications, always use dedicated bio-inert parts, which can be identified by the bio-inert symbol or other markers described in this manual.

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

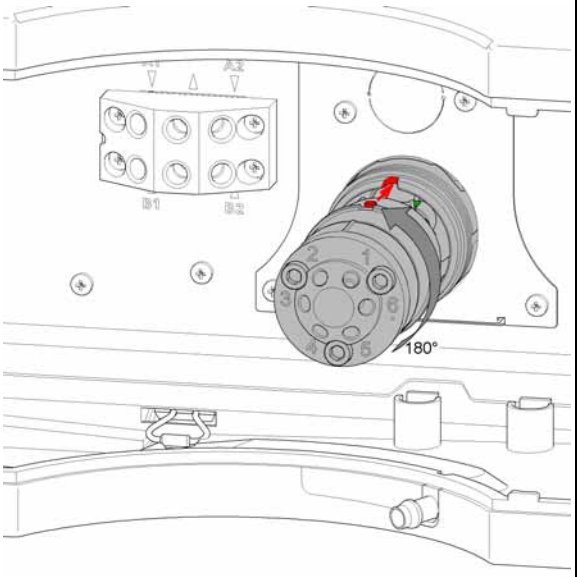
NOTE The tag reader reads the valve head properties from the valve head RFID tag during initialization of the module. Valve properties will not be updated, if the valve head is replaced while the module is on. Selection of valve port positions can fail, if the instrument does not know the properties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

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

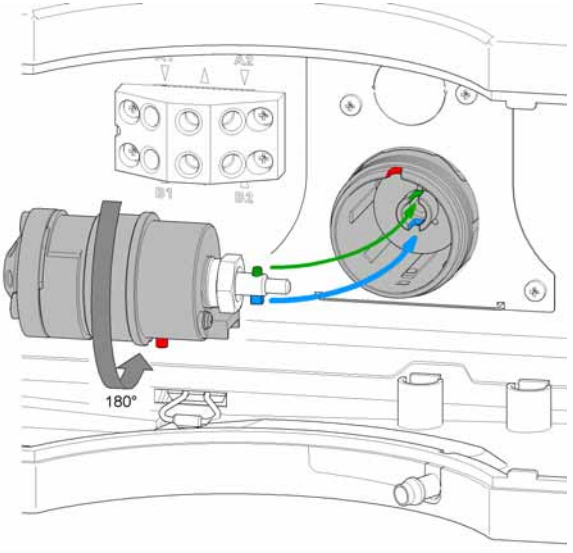
1 The two different pins (blue & green) on the valve shaft must fit into the corresponding grooves of the actuator axis. The outside pin (red) must fit into the outside groove.



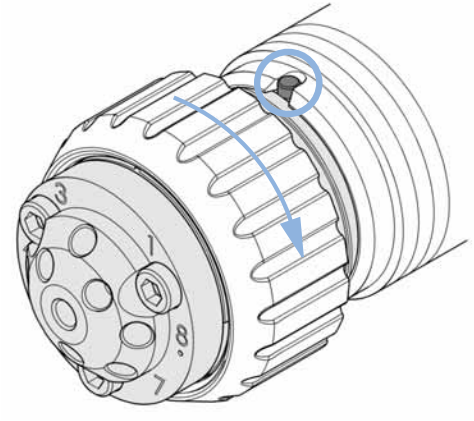
2 It can be possible that you have to turn the valve head until the outside pin completely locks in. While turning the valve you should feel some resistance from the drive.



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



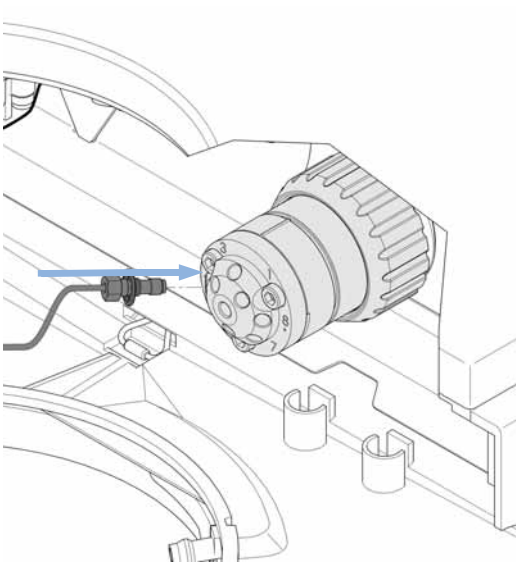
3 When the outer pin is locked into the groove, manually screw the nut onto the valve head.



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 with 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

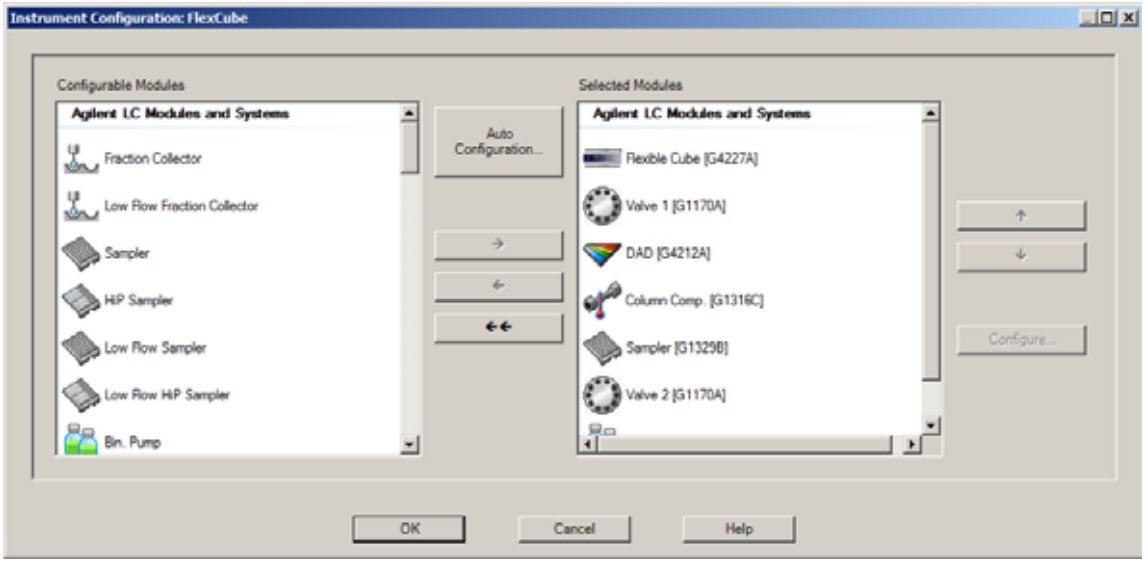


Figure 20 Instrument configuration

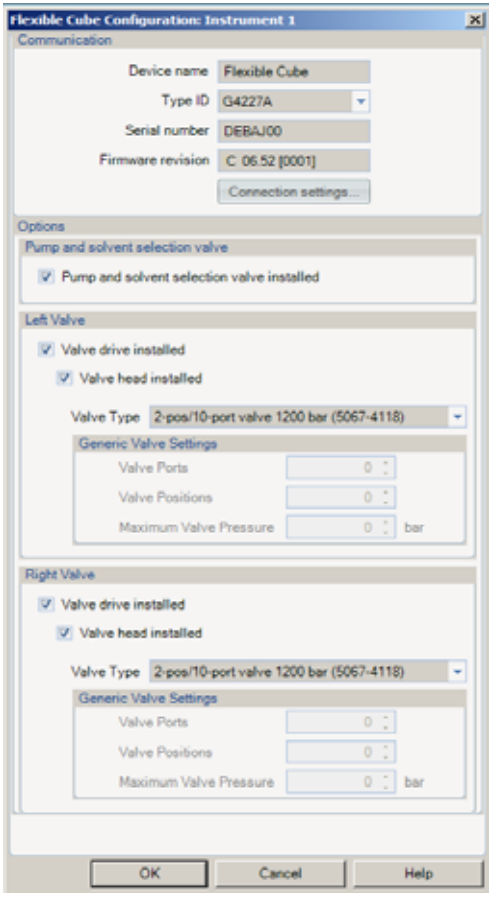


Figure 21 Flexible Cube configuration

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.

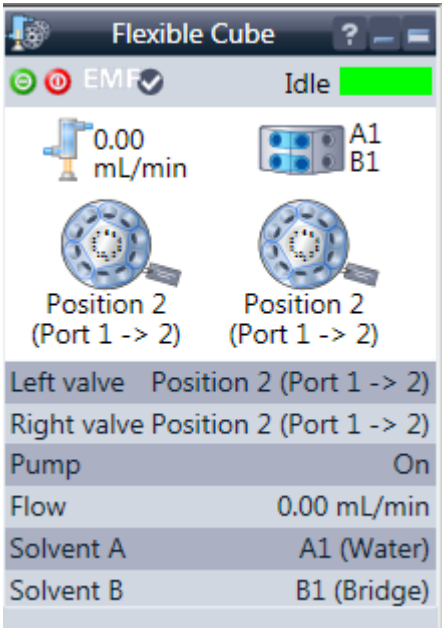


Figure 22 ChemStation Method & Run Control - Flex Cube GUI

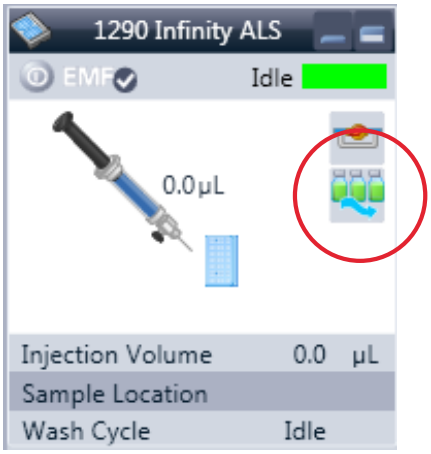


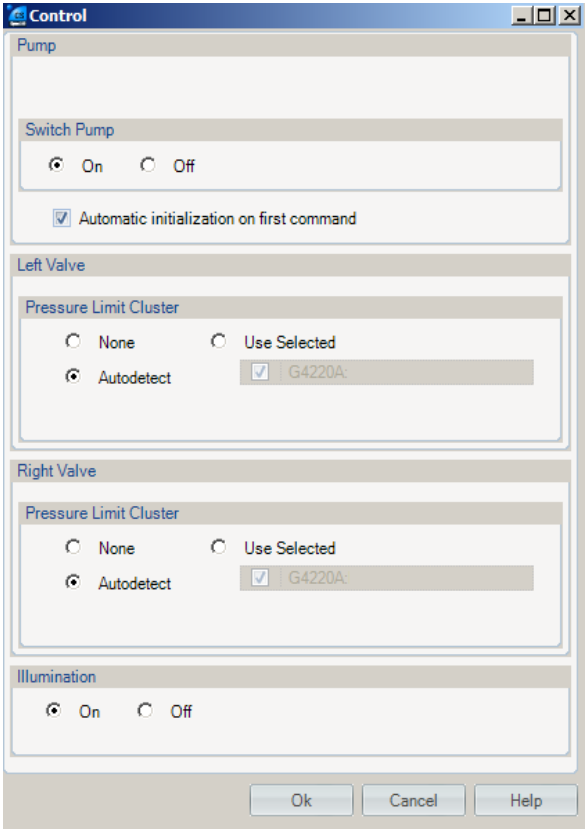
Figure 23 ChemStation Method & Run Control - Autosampler GUI

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.

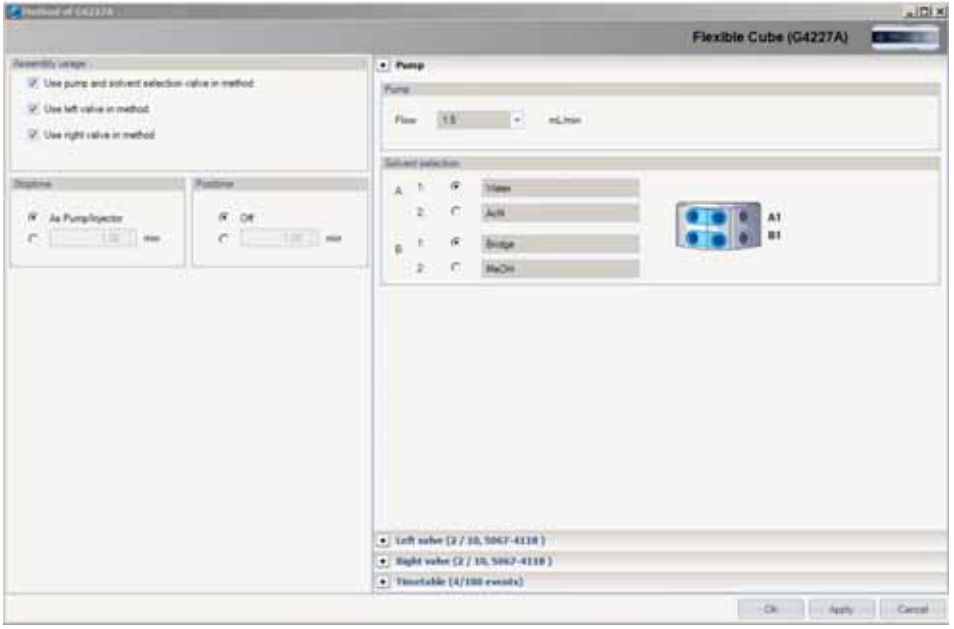
Left valve/**Pressure Limit Cluster**: Use this section to specify how the pressure limit for the cluster is to be determined.

- **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).

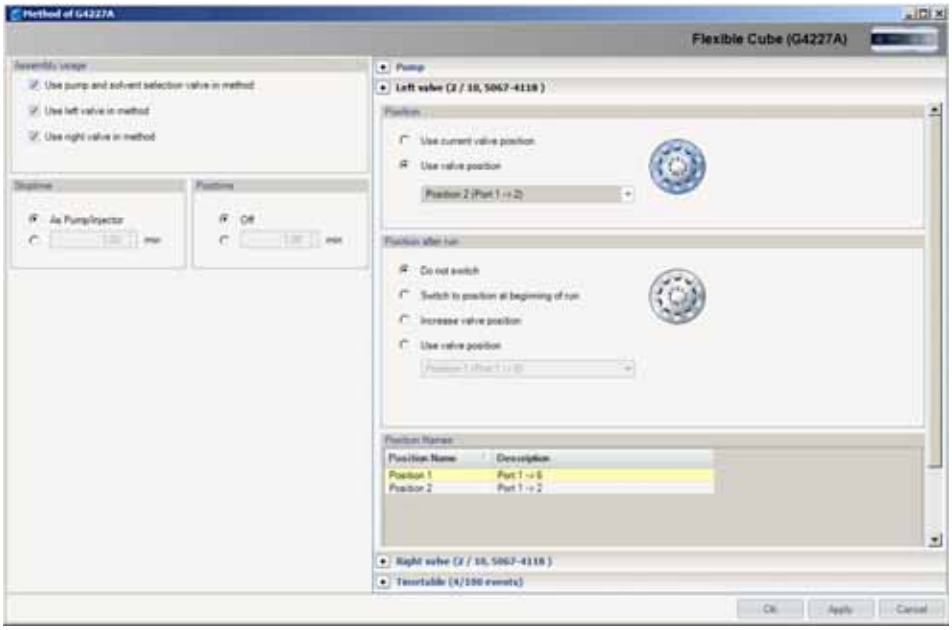
Stoptime: Stoptime enables you to set a time at which the flexible cube stops an analysis. If the flexible cube is used with other Agilent Modular

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:

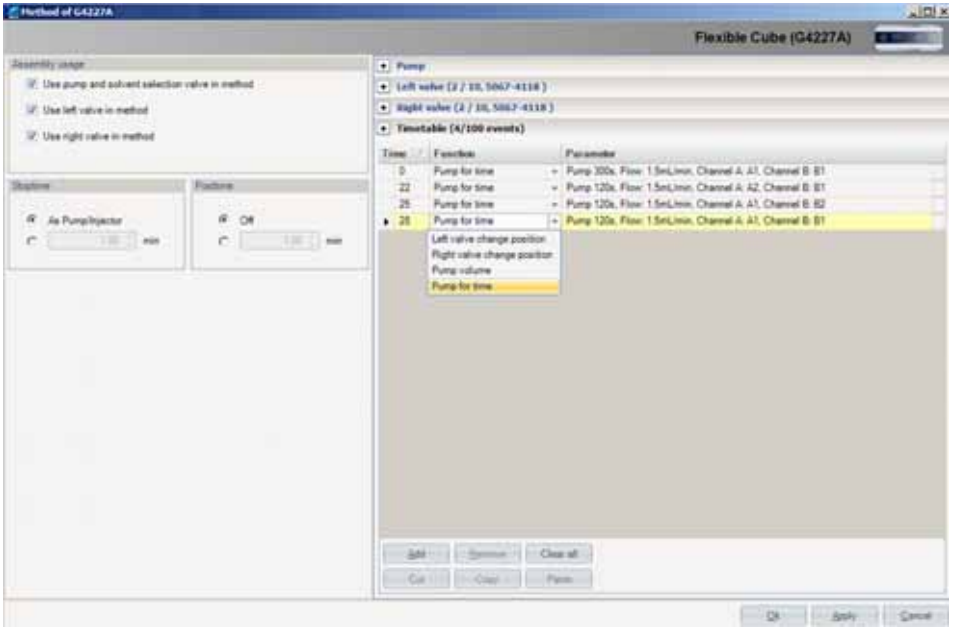
- **Use current valve position**: Uses the current position of the valve.
- **Use valve position**: Specifies a valve position other than the current one. Set the valve position by clicking the down arrow and selecting a position from the drop-down list.

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.

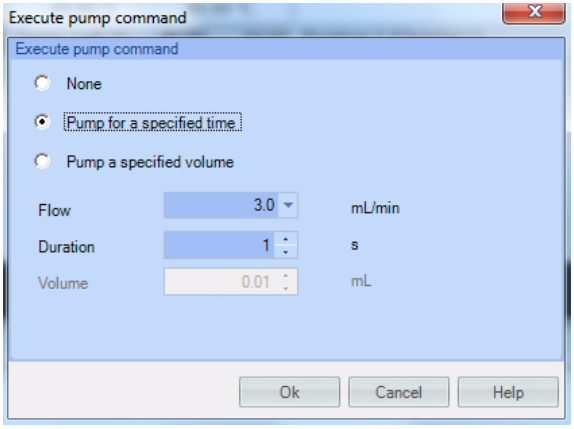
The following parameters can be changed:

- **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

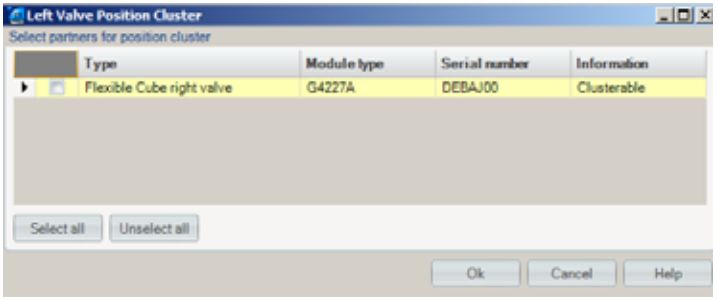


The **Execute pump command** dialog box allows you to set up and start the operation of the pump for a specified solvent volume or a specified time. You can select from:

- **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.

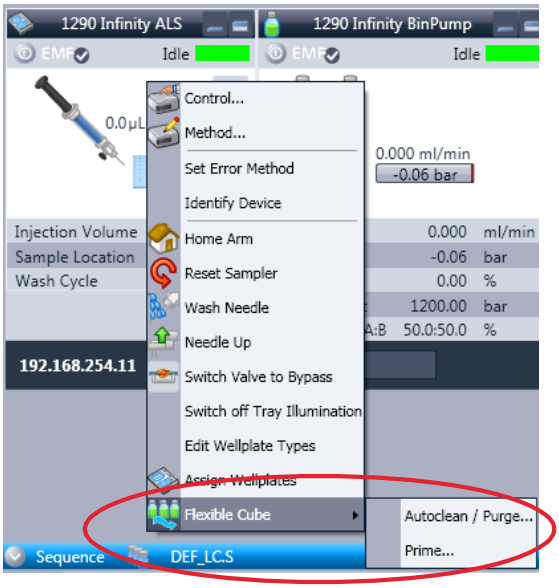
Select all: Selects all valves in the list as cluster partners.

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.

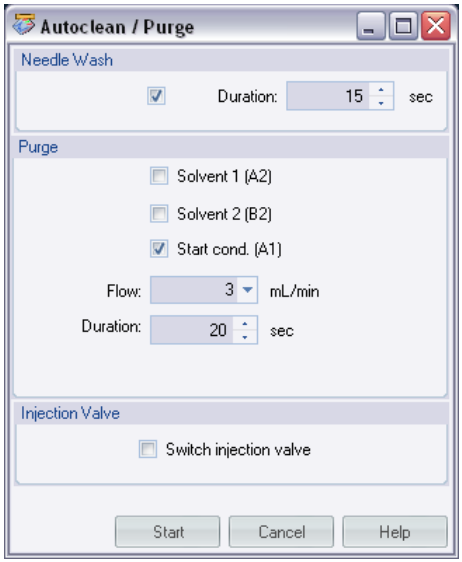
NOTE Best working practice: the master should always be the valve with the smallest number of ports. This avoids conflicts if different valve pods are used.

The Flexible Cube User Interface in Autosampler GUI



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

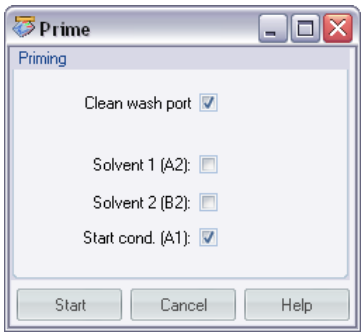
- Show the Control User Interface (special module settings)
- Show the Method User interface (same as via menu Instrument – Setup G4226A
- And Flexible Cube specific items:
  - Autoclean / Purge
  - Prime



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 with what flowrate 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.

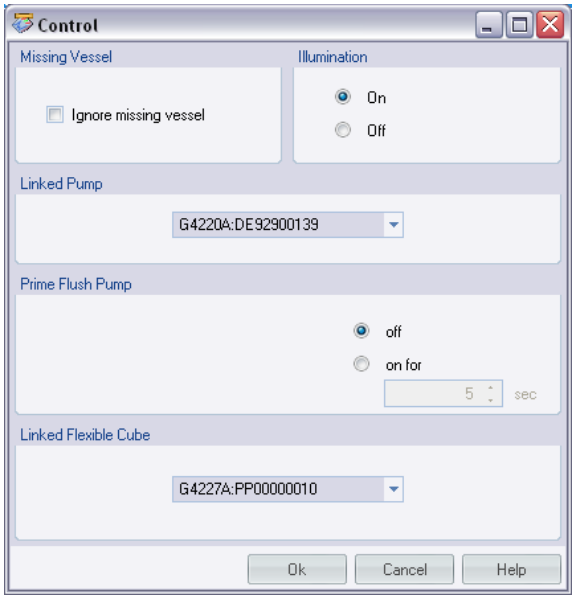


Prime:

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.

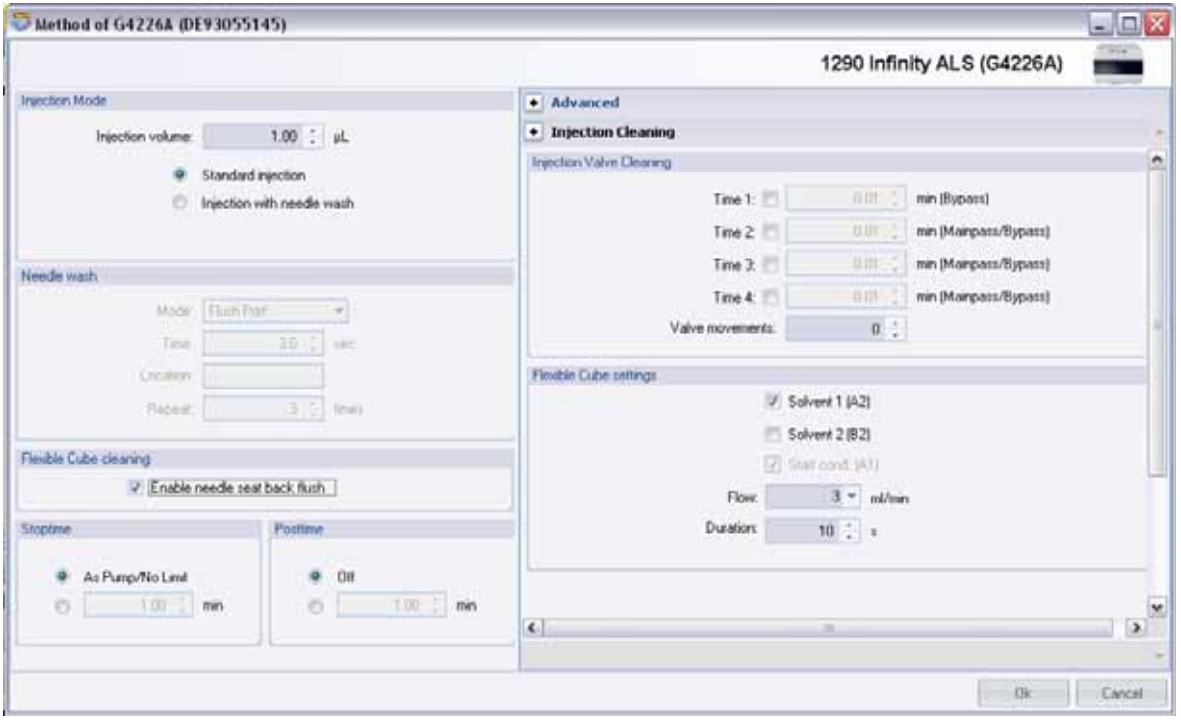


Figure 24 Method Parameter Settings

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

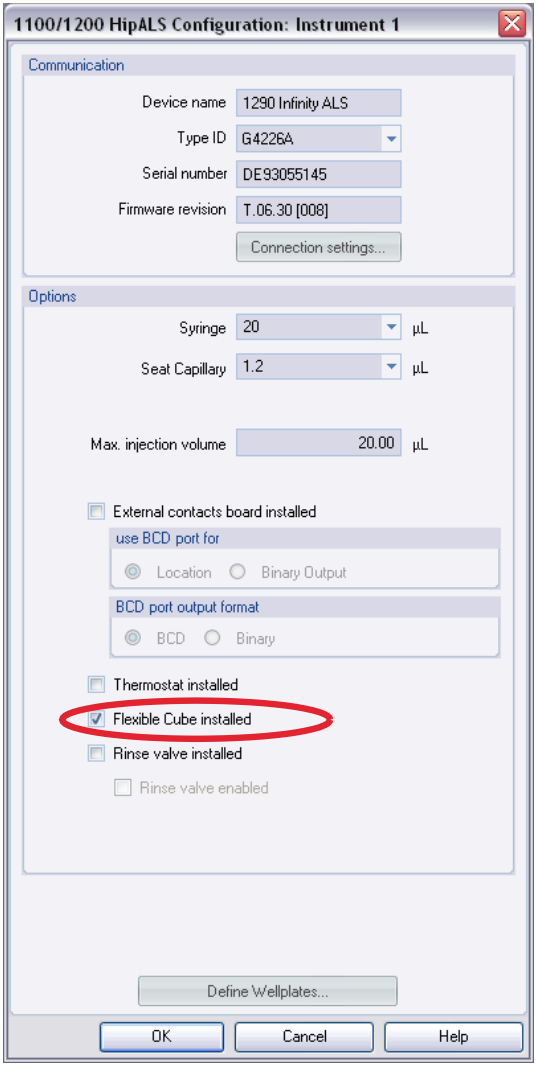
CAUTION

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** features 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 83.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.4 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials like flow cells, valve materials etc. and recommendations in subsequent sections.

Material Information

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

Disclaimer

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

PEEK

PEEK (Polyether-Ether Ketones) combines excellent properties with regard to chemical resistance, mechanical and thermal stability. It is stable in a pH range of 1 to 12.5 and inert to many common solvents. There are several known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO > 1 %, strong acids (nitric acid > 10 %, sulphuric acid > 10 %, trichloroacetic acid, sulfonic acids), 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.

Polyimide

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

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

Polyethylene (PE)

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

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

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 ì m/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 %.

Tantalum (Ta)

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

Stainless Steel (SST)

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

- Solutions of alkali halides, their respective acids (for example, lithium iodide, potassium chloride, and 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, di-isopropylether). Such ethers should be filtered through dry aluminium oxide which adsorbs the peroxides.
- Solutions of organic acids (acetic acid, formic acid, and so on) in organic solvents. For example, a 1 % solution of acetic acid in methanol will attack steel.
- Solutions containing strong complexing agents (for example, EDTA, ethylene diamine tetra-acetic acid).
- Mixtures of carbon tetrachloride with 2-propanol or THF.

Diamond-Like Carbon (DLC)

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

Fused silica and Quartz (SiO_2)

Fused silica is used in 1290 Infinity Flow Cells and capillaries. Quartz is used for classical flow cell windows. It is inert against all common solvents and acids except hydrofluoric acid and acidic solvents containing fluorides. It is corroded by strong bases and should not be used above pH 12 at room temperature. The corrosion of flow cell windows can negatively affect measurement results. For a pH greater than 12, the use of flow cells with sapphire windows is recommended.

Gold

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

Zirconium Oxide (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)

Fluorinated polymers like PTFE (polytetrafluorethen), PFA (perfluoroalkoxy) and FEP (fluorinated ethylene propylene) are inert to almost all common acids, bases and solvents. There are no documented incompatibilities for HPLC applications. FFKM is perfluorinated rubber, which is also resistant to most chemicals. As an elastomer, it may swell in some organic solvents like halogenated hydrocarbons.

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 about 0.2 µm filters.
- Never leave mobile phase in the instrument for several days without flow.
- Always discard old mobile phase.
- Use the amber solvent bottle (Solvent bottle, amber (9301-1450)) supplied with the instrument for your aqueous mobile phase.

- If possible add a few mg/l sodium azide or a few percent organic solvent to the aqueous mobile phase.

6 Optimizing Lab Performance with Flexible Cube

This chapter provides information on how to optimize the Autosampler and the Flexible Cube for a minimum carry over 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 #3 which should be set to the chromatographic starting condition before use, to avoid generation of air bubbles.

How to Achieve Lowest Carry Over

Carryover is measured when residual peaks from a previous active-containing injection appear in a subsequent blank solvent injection. There will be carry over 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 Carry over 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.

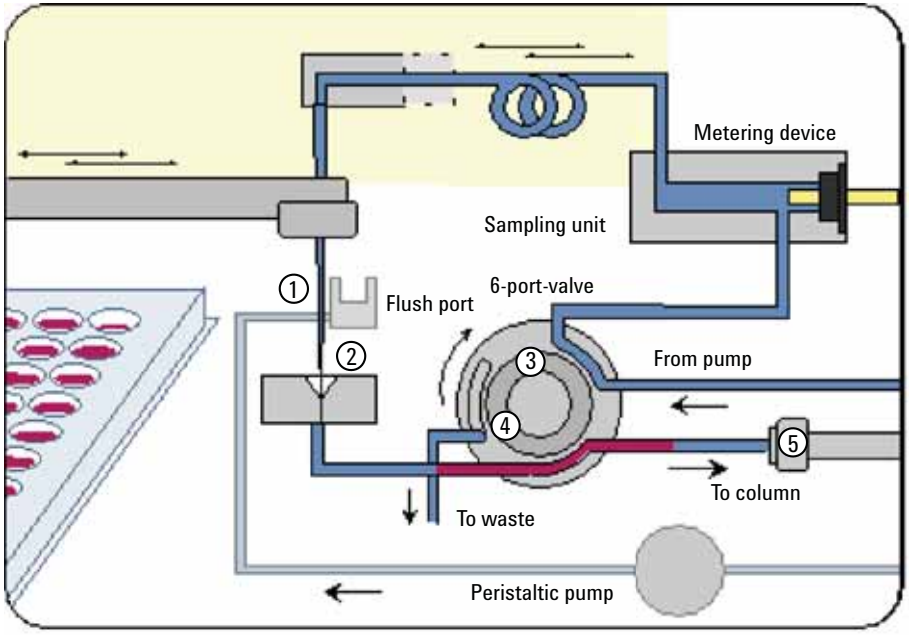


Figure 25 Potential Sources of Carry Over

1	Adsorption to needle and capillary material or bad design.
2	Needle seat design, improper sealing, worn out.
3	Valve Rotor / Stator, bad design, wear.
4	Capillary fittings misadjusted (at all connections contaminated with the sample!).
5	Column related carry-over (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 carry over. 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 carry over 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 carry over 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 will have to be back-flushed, by manually changing the flow connections, to clean it. This is one of the tasks that can be automated using the Flexible Cube module.

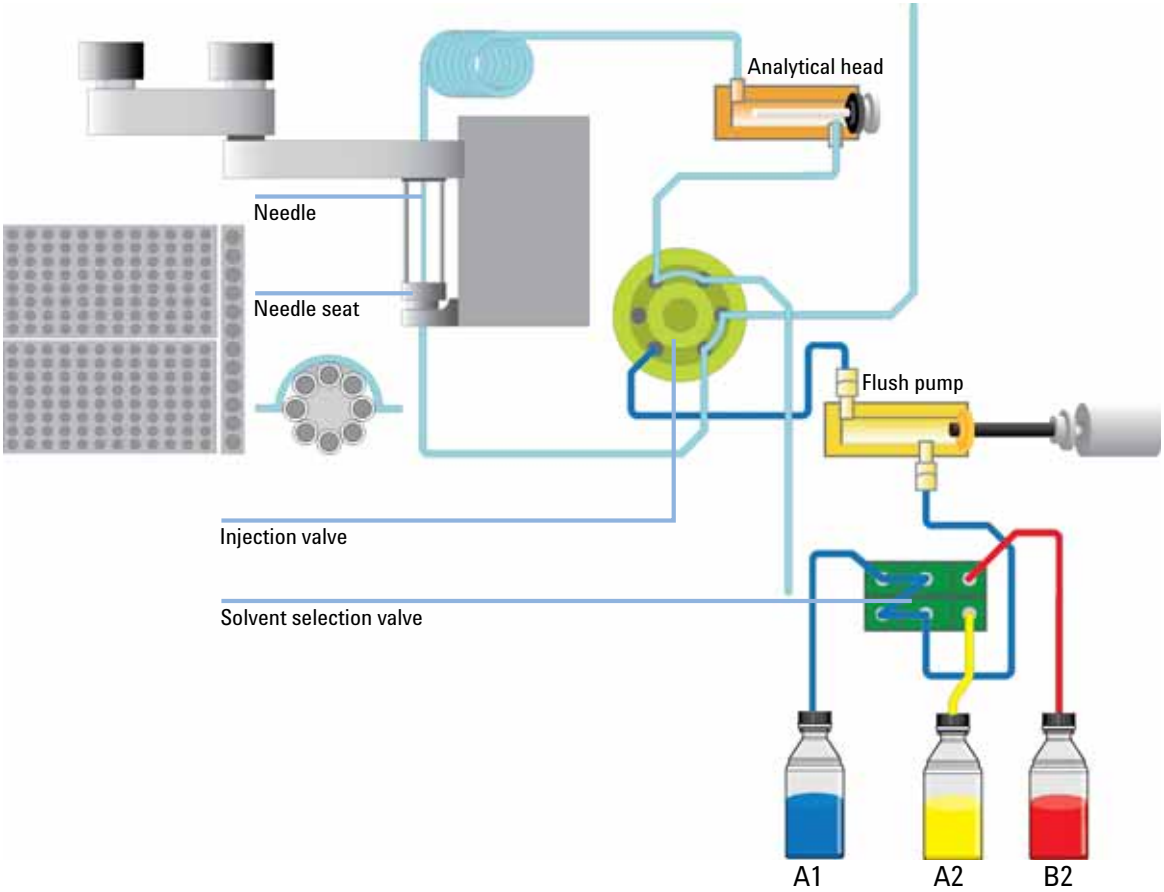


Figure 26 Schematic of Autosampler with Flexible Cube Setup

If compounds are analyzed which are highly sticky 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 valves. 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 and if necessary to continue with strong dissolving solvent #2. Prior to injection the seat and seat capillary should be flushed with solvent #3 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 carry over 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 carry over performance of the injection valve. By switching the valve back and forth these cavitations will be flushed and cleaned and long term carry over 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.

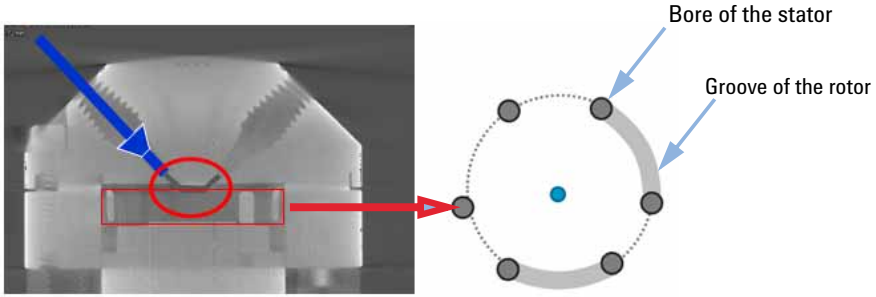
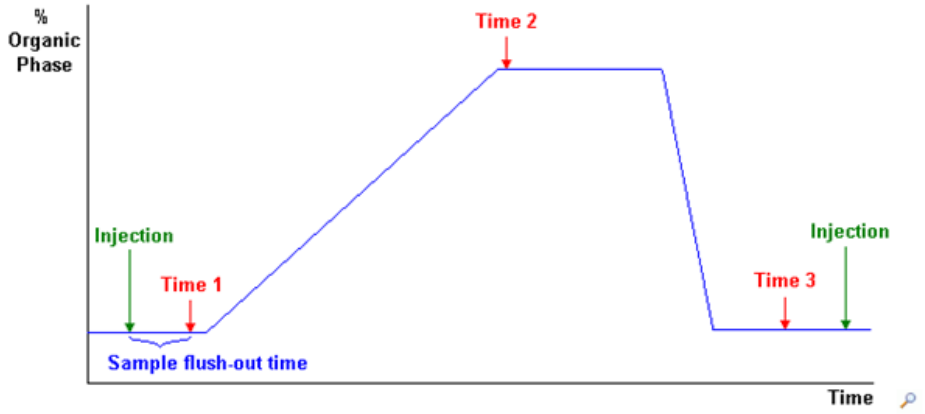


Figure 27 The Problem Zone of the Injection Valve

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.



Times 1 to 4 are the times when the valve switches, to bypass (for time 1) or to mainpass and bypass (for times 2, 3 and 4).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 switch directly after sample has been flushed out at high % water might be useful if sample is highly soluble in water.
Time 2	Valve switch at high % organic phase to effectively remove sample from injection valve grooves, while avoiding sample retardation on the column.
Time 3	Valve switch 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 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 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 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 Figure 28 on page 96. The valve can be conveniently located in the Thermostatted Column Compartment or in the Flexible Cube.

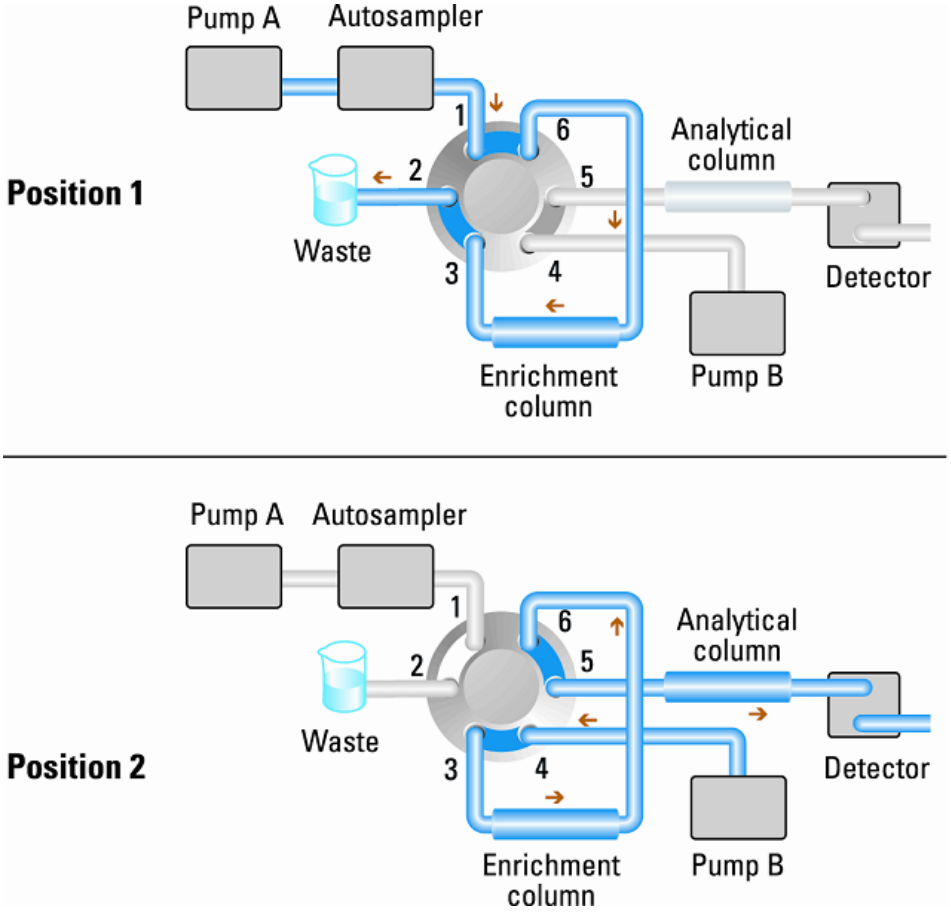


Figure 28 Sample enrichment

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 times the column volume to stabilize it ready for the next injection and 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 two-position ten-port, 1200 bar, valve head is required in the column compartment; a second analytical column, identical to the first; 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 in Figure 29 on page 98.

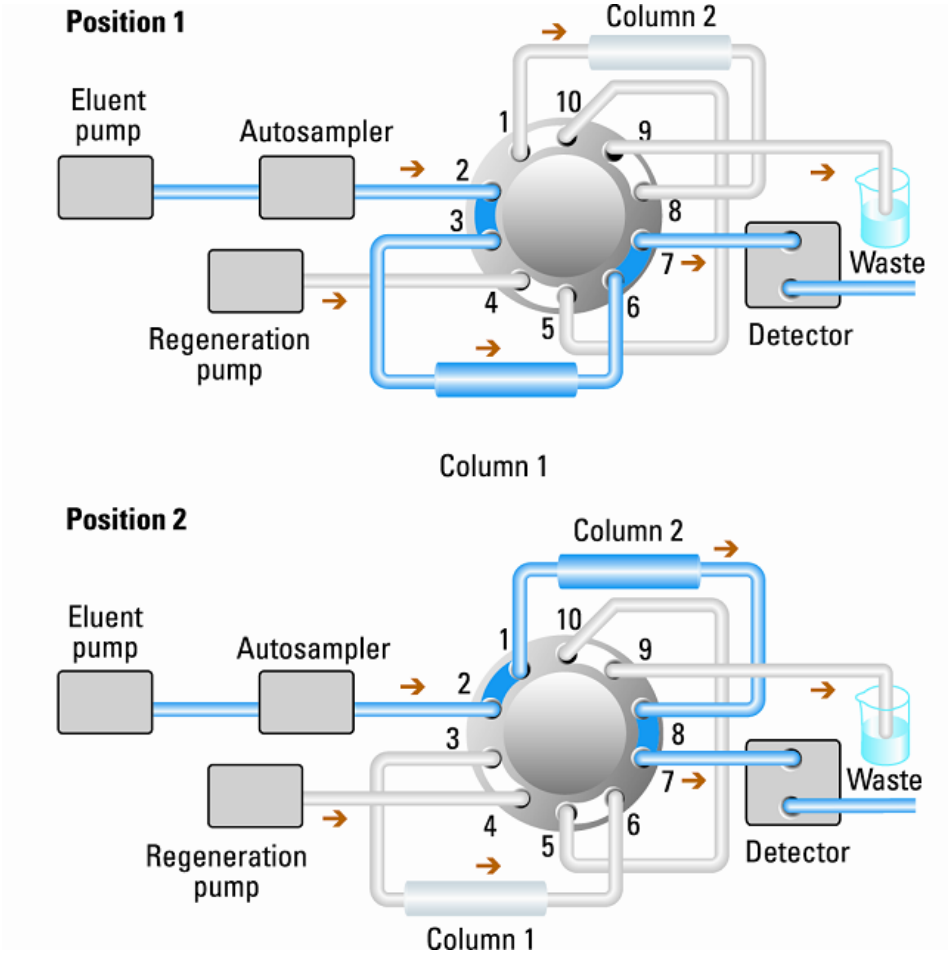


Figure 29 Alternating Column Regeneration

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 (prerun, run, and error states) of the module. The status indicators provide a quick visual check of the operation of the module.

Error Messages

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

Test Functions

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

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.

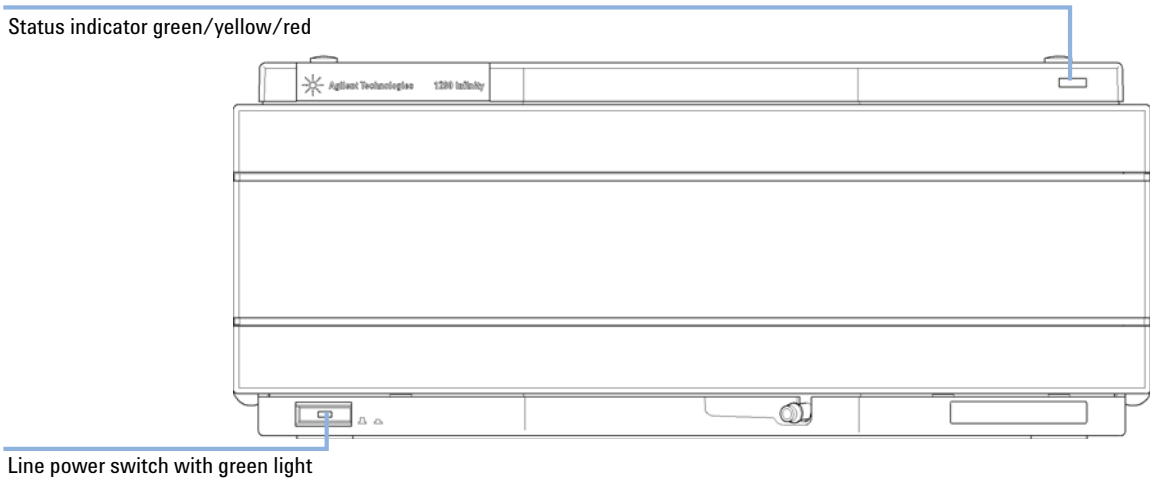


Figure 30 Location of Status Indicators

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 210. Then try a firmware update (see "Replacing Module Firmware" on page 159). 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 104.
- The Agilent ChemStation B.04.02 and above 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 data system. Agilent Lab Advisor software helps to manage the lab for high quality chromatographic results and can monitor in real time a single Agilent LC or all the Agilent GCs and LCs configured on the lab intranet.

Agilent Lab Advisor software provides diagnostic capabilities for all Agilent 1200 Infinity Series modules. This includes diagnostic capabilities, calibration procedures and maintenance routines for all the maintenance routines.

The Agilent Lab Advisor software also allows users to monitor the status of their LC instruments. The Early Maintenance Feedback (EMF) feature helps to carry out preventive maintenance. In addition, users can generate a status report for each individual LC instrument. The tests and diagnostic features as provided by the Agilent Lab Advisor software may differ from the descriptions in this manual. For details refer to the Agilent Lab Advisor software help files.

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

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 remote cable (see documentation for the APG 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.

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.

Probable cause	Suggested actions
2 Defective remote cable.	Exchange the remote cable.
3 Defective components in the instrument showing the not-ready condition.	Check the instrument for defects (refer to the instrument's documentation).

Lost CAN Partner

Error ID: 0071

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

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

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

Leak Sensor Short

Error ID: 0082

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

The current through the leak sensor is dependent on temperature. A leak is detected when solvent cools the leak sensor, causing the leak sensor

current to change within defined limits. If the current increases above the upper limit, the error message is generated.

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

Leak Sensor Open

Error ID: 0083

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

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

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

Compensation Sensor Open

Error ID: 0081

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

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

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

Compensation Sensor Short

Error ID: 0080

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

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

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

Fan Failed

Error ID: 0068

The cooling fan in the module has failed.

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

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 Dirty or defective sensor.	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.

Flexcube 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

Flexcube 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

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

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. • 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 • Try to identify the source of trouble by installing a different valve head if possible. • Contact your Agilent Service representative.
2 Defect Sensor on the Valve Drive Motor	• Check valve head for correct installation • Try to identify the source of trouble by installing a different valve head if possible. • 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 • Try to identify the source of trouble by installing a different valve head if possible. • Contact your Agilent Service representative.
2 Defect Sensor on the Valve Drive Motor	• Check valve head for correct installation • Try to identify the source of trouble by installing a different valve head if possible. • 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.02.01 or higher. Other user interfaces may not provide any test or just a few.

Table 6 Available Tests in Agilent Lab Advisor

Test	Comment
Flush pump delivery test	For Flex Cube flush pump
Pressure Test	For valves

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

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

Flush Pump Delivery Test

The test determines if the flush pump is capable of delivering the required pressure to flush the needle seat. The test uses the pressure sensor of the 1290 Infinity binary pump to verify the maximum pressure the flush pump can deliver. The flush pump will run against a dead end and therefore produce an audible noise that is normal. It produces an error that will be visible in the logbook and will show on the Instant Pilot screen, also this is normal. The error is automatically restored as soon as the test finishes.

When	In case of a suspected defective flush pump
Software required	Agilent Lab Advisor Software B.01.04 or higher
Preparations	G4220A/B Binary Pump must be present.

1 Start Agilent Lab Advisor test screen

2 Click on G4227A in **Module View**

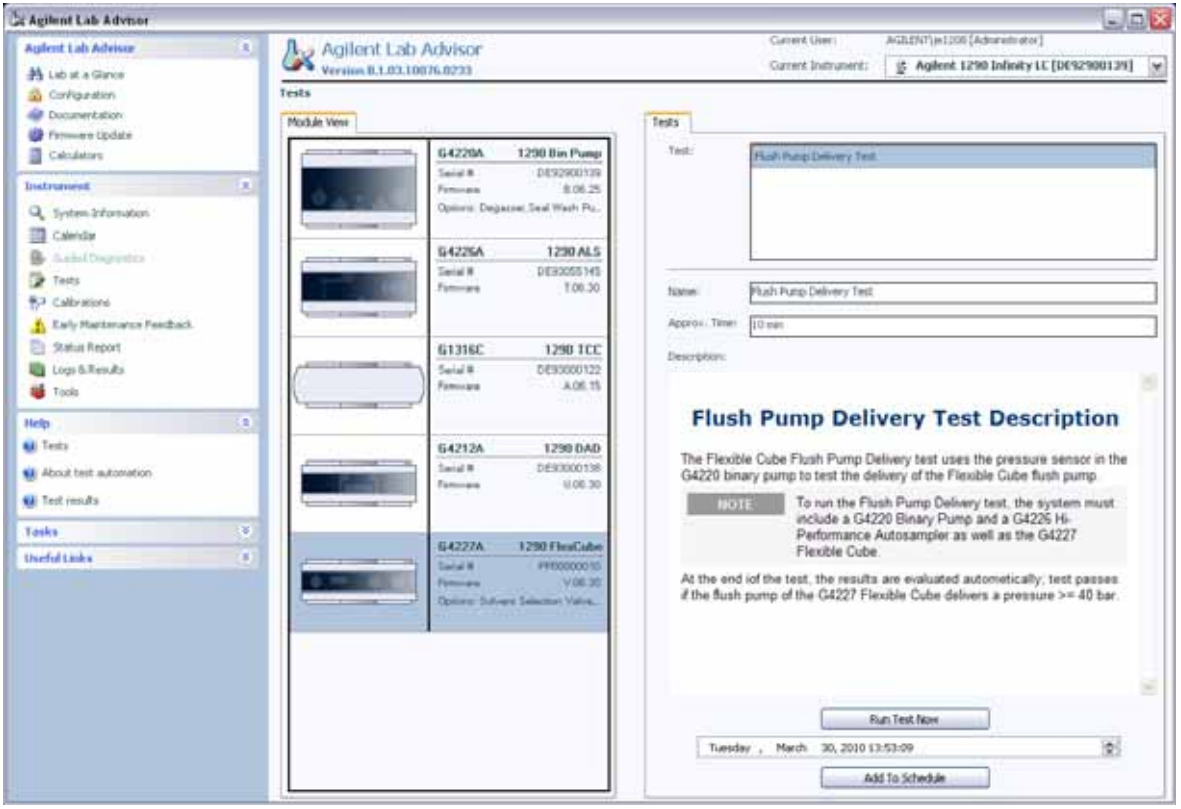


Figure 31 Lab Advisor – Test screen

3 Select **Flush Pump Delivery Test**

4 Click **Run Test Now**

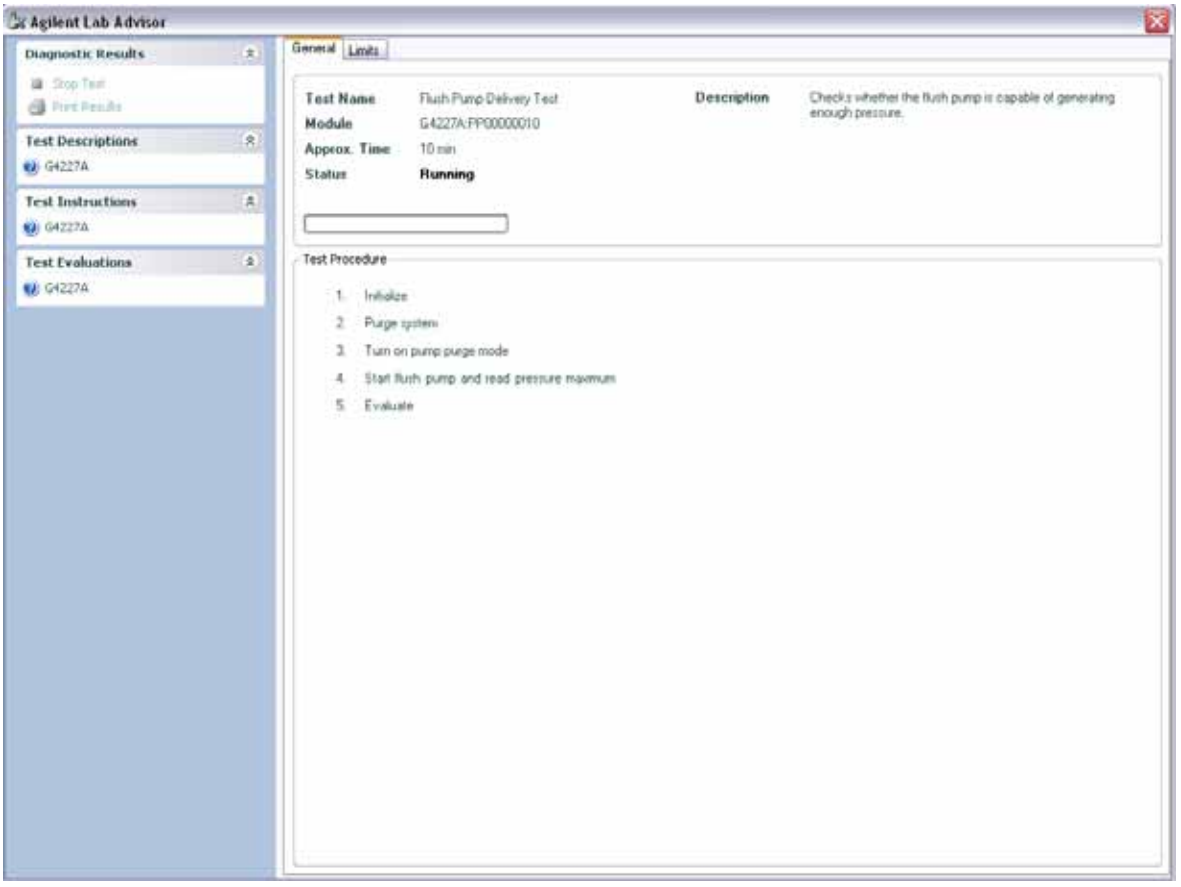


Figure 32 Flush pump delivery test– Test started

5 The Flush pump delivery test uses the pressure sensor in the G4220A Binary pump to measure the maximum pressure the flush pump is able to achieve. For this the Flexible Cube to Autosampler capillary has to be reconnected from injection valve port 4 to port 6.

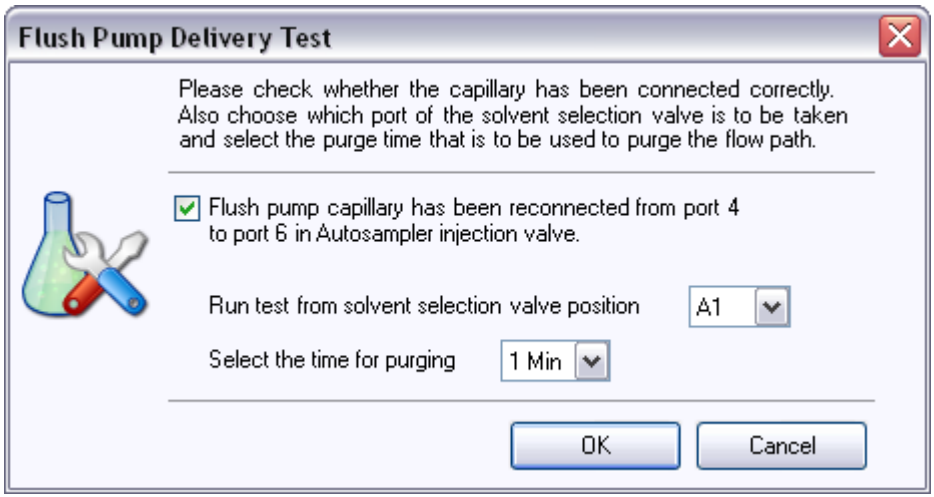


Figure 33 **Flush pump delivery test** – Initial setup dialog

6 Click **OK**

During the test, the flush pump delivers at 3 mL/min against the blocked line to the G4220A Binary pump. The test is looking for the maximum pressure the flush pump can generate before it errors out. The pressure increase can be observed in the signals tab.

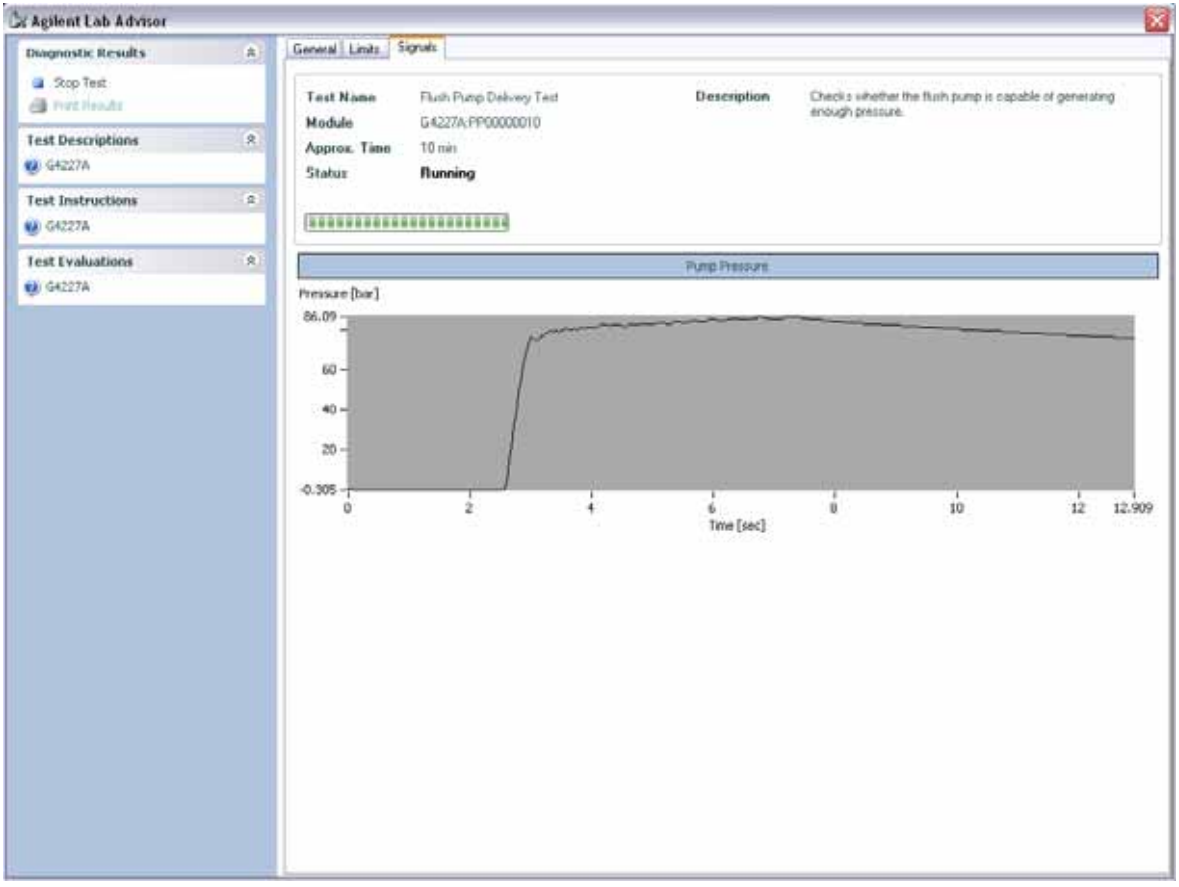


Figure 34 Flush pump delivery test – **Signals** screen

The maximum pressure the flush pump should be able to generate during the test should be above 40 bar.

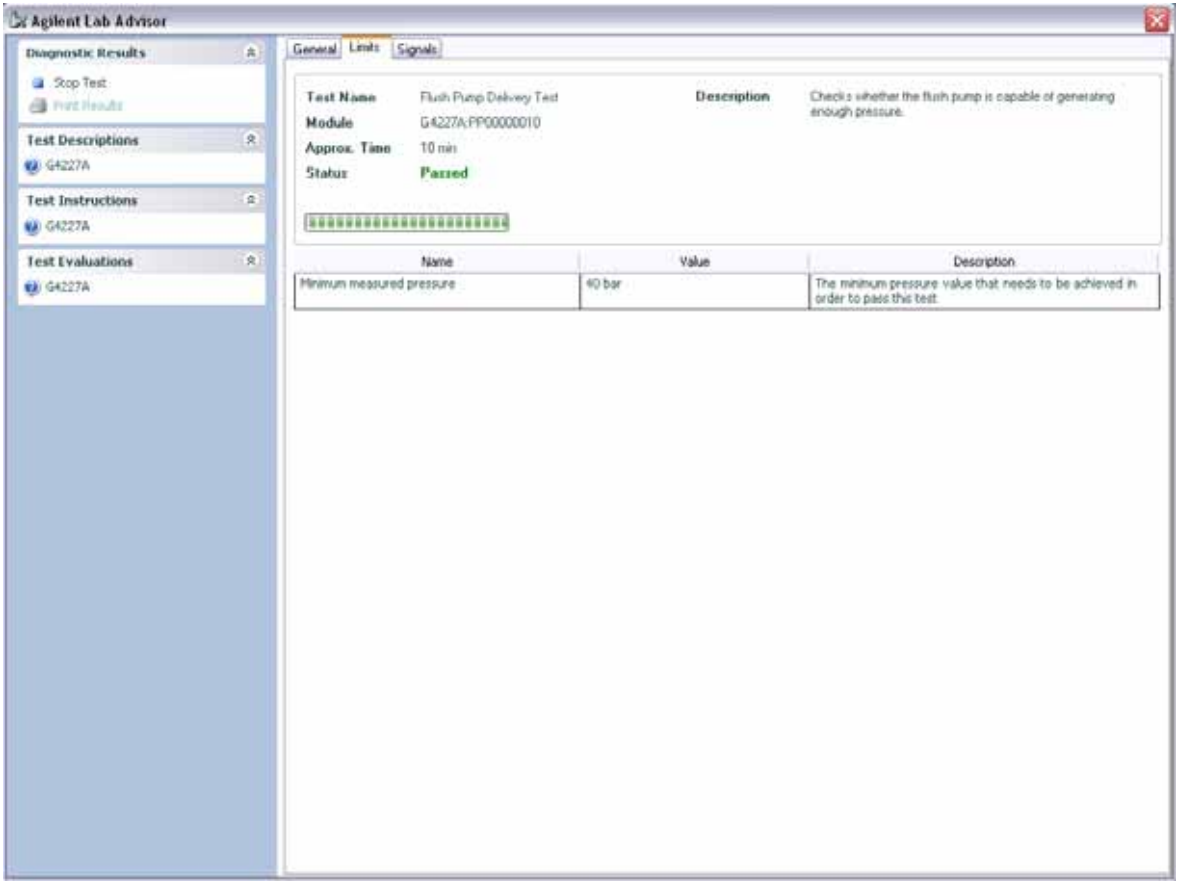
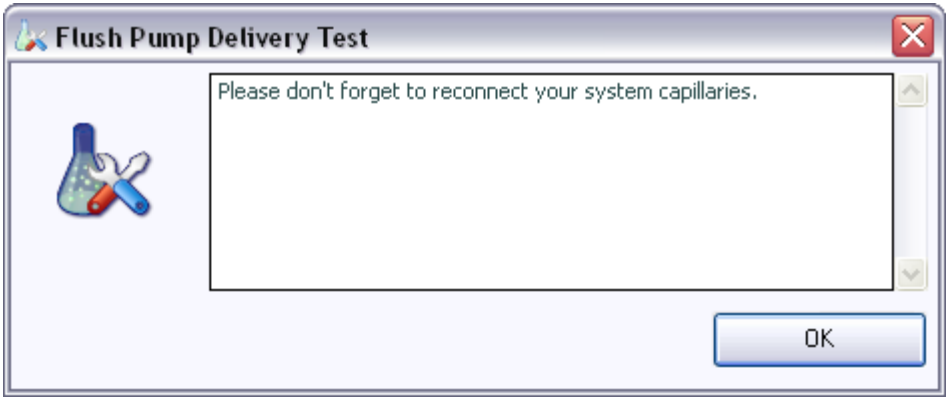


Figure 35 Flush pump delivery test – Limits

At the end of the **Flush pump delivery test**, the capillary connection should be restored. The Flexible Cube to Autosampler capillary should be removed from the injection valve port 6 and reconnected to the port 4.



7 After reconnection of your system capillaries click **OK**

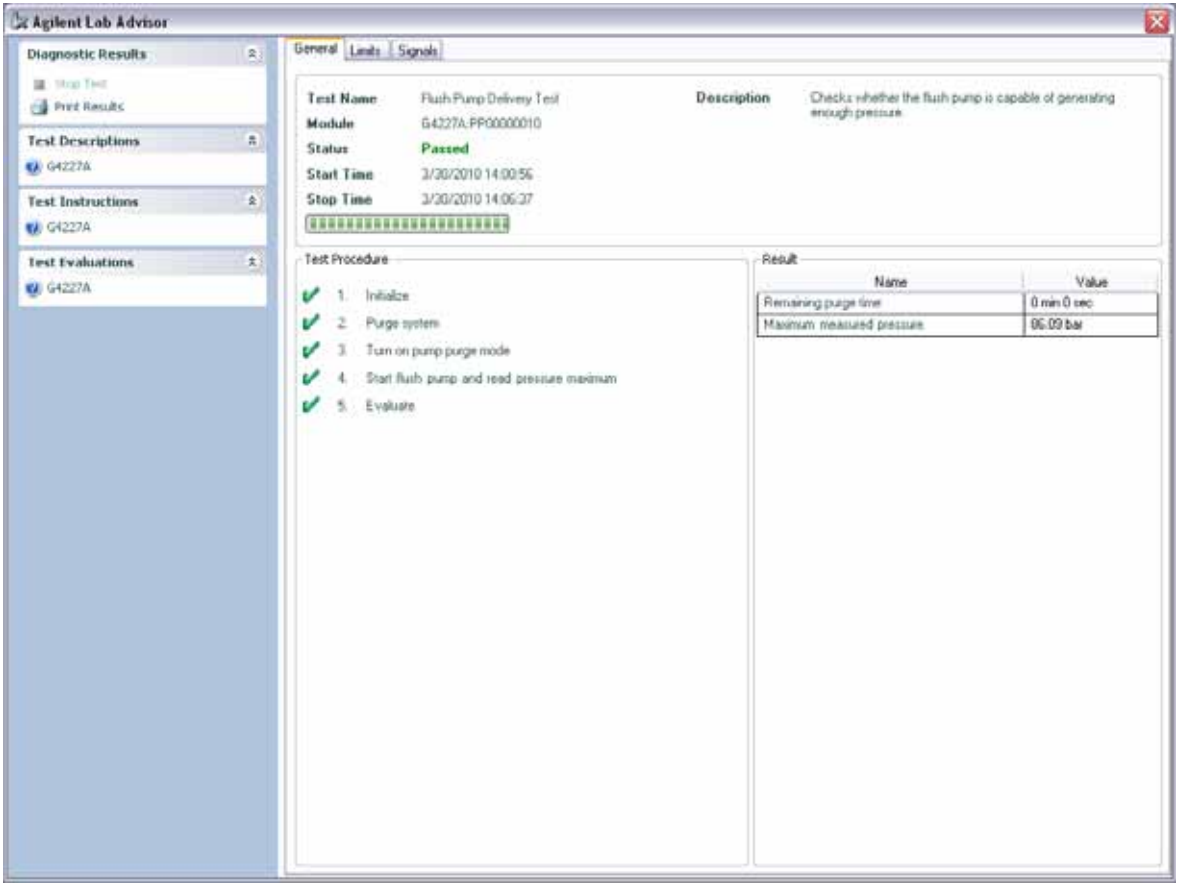
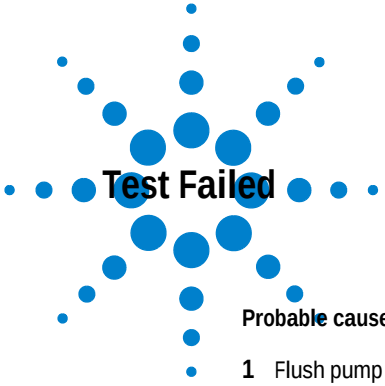


Figure 36 Flush pump delivery test – Test **Passed**



Test Failed

Probable cause	Suggested actions
1 Flush pump solvent inlet filter blocked	Change solvent inlet filters.
2 No solvent in flush pump bottle	Check for sufficient solvent amount available
3 Solvent lines not configured correctly	Check for correct setup of solvent bottles.
4 Defective flush pump	Replace the flush pump

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 Flex 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 Flex Cube in combination with a 600 bar pump (e.g. G1312B Binary Pump).

10
Maintenance and Repair

This chapter describes the maintenance of the module.

Introduction to Maintenance

Figure 37 on page 134 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.

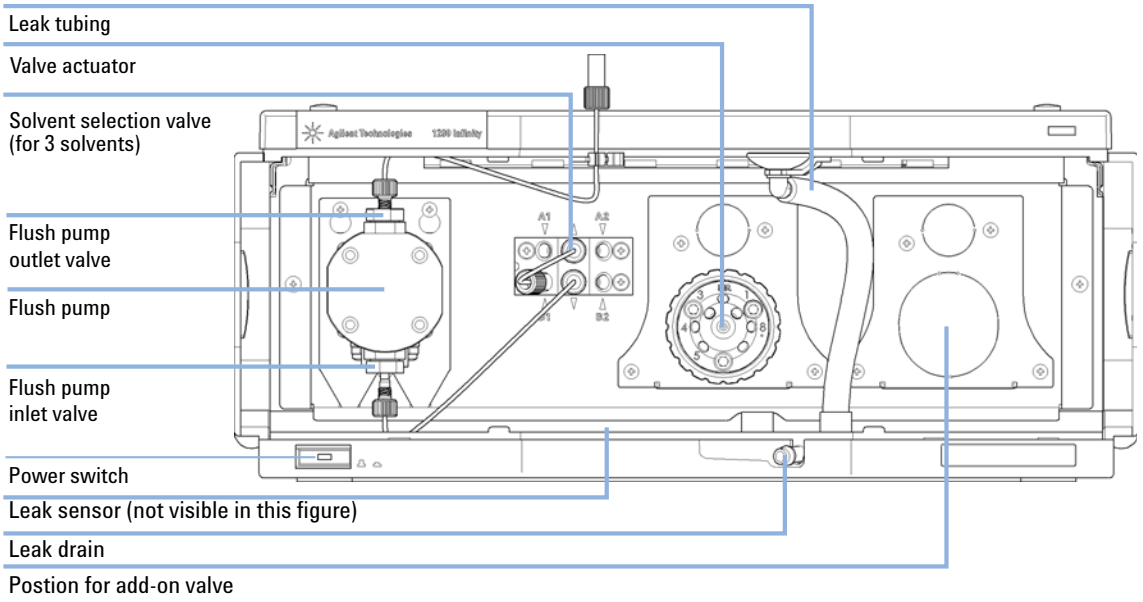


Figure 37 Front of the Flexible Cube

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 139	When leaking	Run **Flush pump delivery test** for verification
"Exchange Flush Pump Outlet Valve" on page 141	When leaking	Run **Flush pump delivery test** for verification
"Exchange Valve Rotor Seal" on page 143	If damaged, blocked or leaking	Run **Pressure Test** for verification
"Installing the Capillaries" on page 152	When new application requires a change	
"Replacing Valve Heads" on page 148	If the valve performance shows indication of leakage or wear	
"Replacing Module Firmware" on page 159	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 Flush pump delivery test fails or if the Inlet valve show signs of malfunction.

Tools required

p / n	Description
8710-1924	Wrench open 14 mm

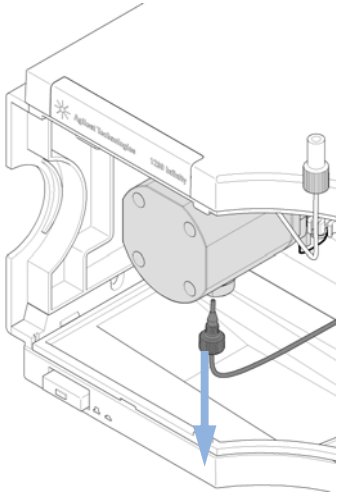
Parts required

p / n	Description
5067-4717	Inlet valve

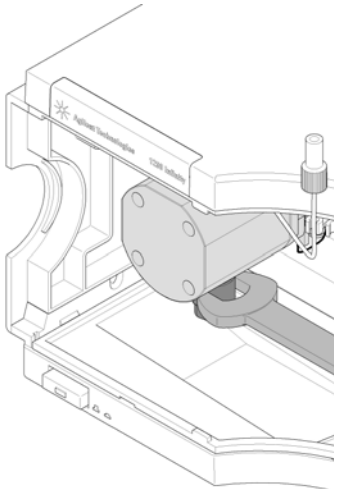
Preparations

- 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.

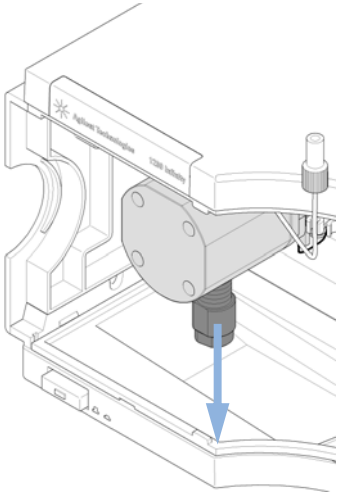
1 Disconnect the finger tight fitting of the Inlet capillary at the bottom of the Flush pump.



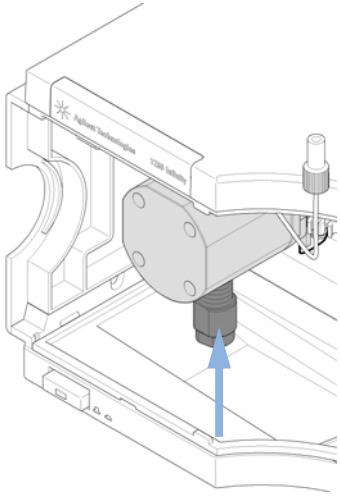
2 With a 14 mm wrench on the flange closest to the pump head, unscrew the valve.



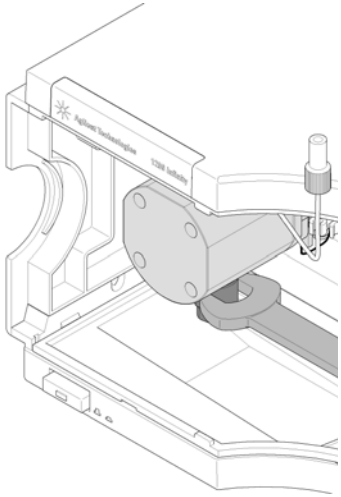
3 Remove the valve by moving it downwards.



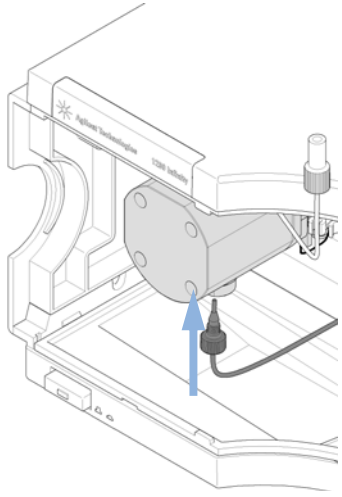
4 Insert the new valve.



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 Flush pump delivery test fails or if the Outlet valve show signs of malfunction.

Tools required

p/n	Description
8710-0510	Wrench open 1/4 — 5/16 inch
8710-1924	Wrench open 14 mm

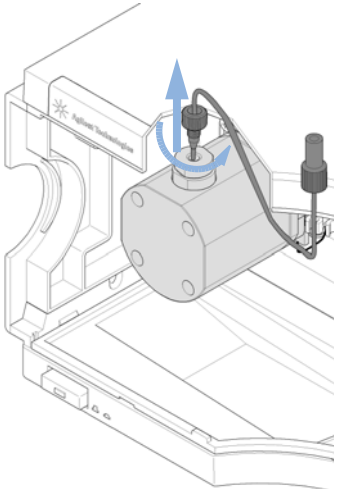
Parts required

p/n	Description
5067-4716	Outlet valve

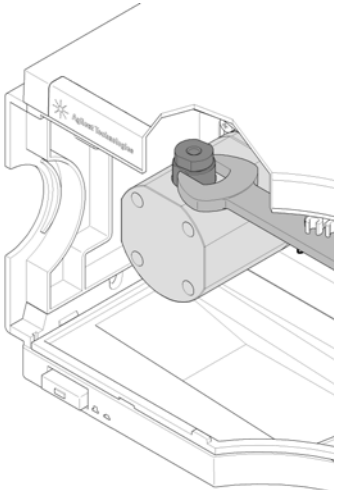
Preparations

- 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.

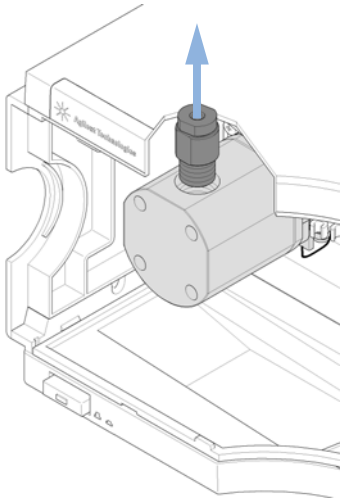
1 With a ¼ inch wrench disconnect the capillary at the top of the Outlet valve.



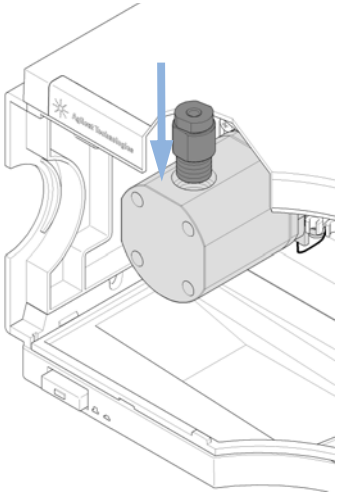
2 With a 14 mm wrench on the flange closest to the pump head, unscrew the valve.



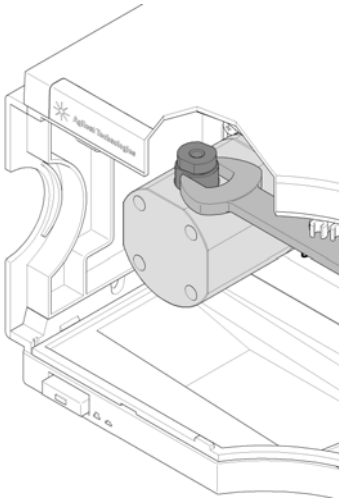
3 Remove the valve by lifting it upwards.



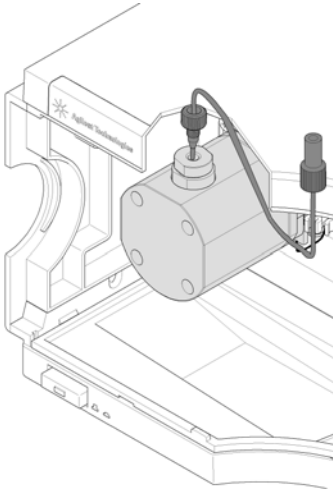
4 Insert the new valve.



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	Wrench open 1/4 — 5/16 inch
8710-2394	Hex key 9/64 inch 15 cm long T-handle

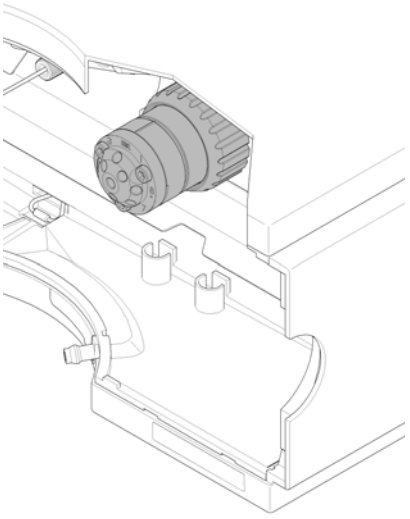
Parts required

p/n	Description
Part number depending on valve pod in use	Rotor seal

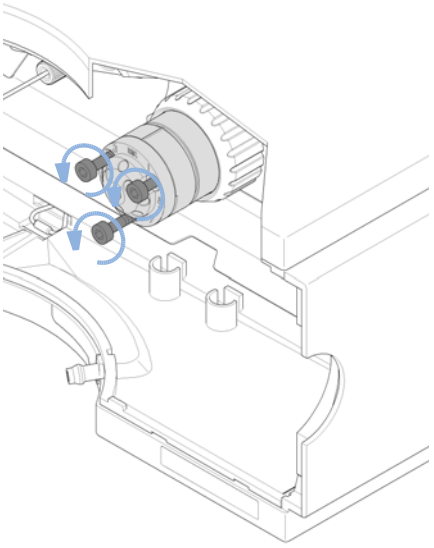
Preparations

- 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.

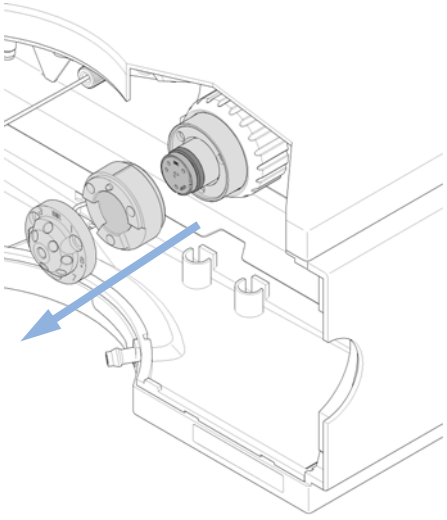
1 Remove all capillaries from the valve head.



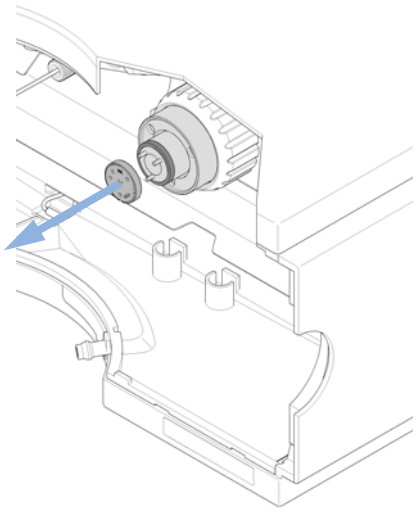
2 With a 9/64 inch hex key unscrew the stator screws.



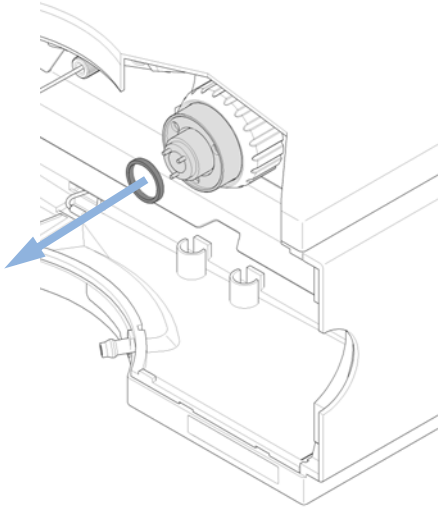
3 Remove the stator head and the stator ring.



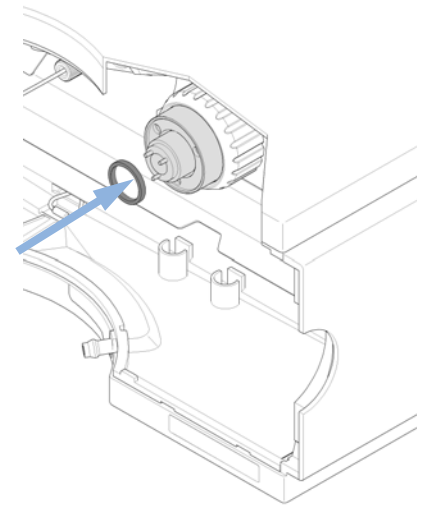
4 Remove the rotor seal.



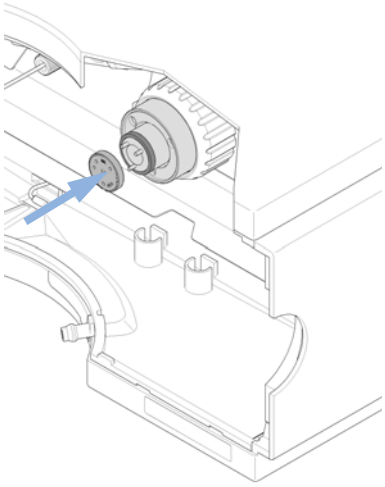
5 Remove the Isolation seal.



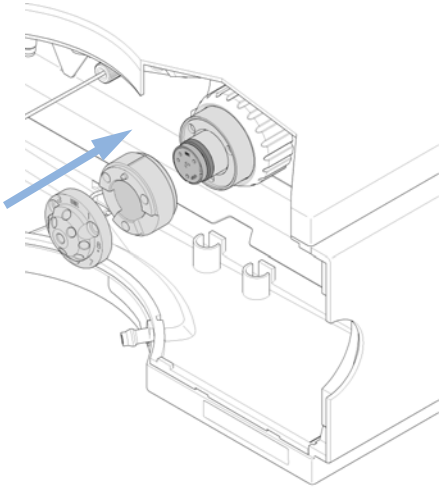
6 Replace the Isolation seal.



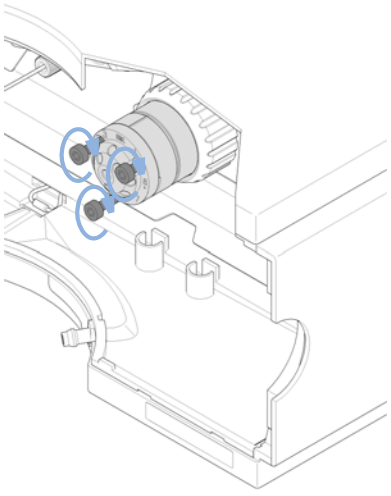
7 Install new rotor seal.



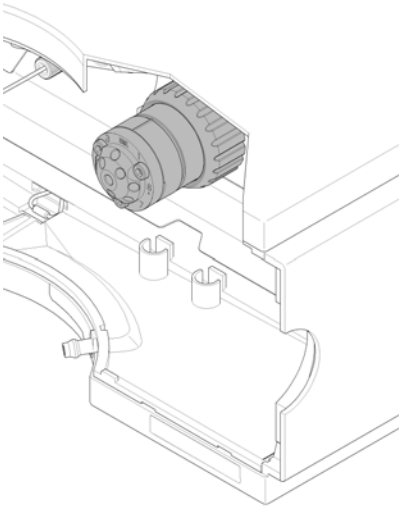
8 Install the stator head and the stator ring.



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 161.

Disassembling and reassembling the valve head

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

When

Stator head: Scratches and damages 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 injections, 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	5067-4121	8 pos/9 port valve head high pressure (1200 bar)
OR	1	5067-4107	Valve Head 8 Position/9 Port, 600 bar
OR	1	5067-4137	Valve Head 2 Postion / 6 Port, 600 bar
OR	1	5067-4117	2 pos/6 port ultra high pressure (1200 bar) valve head
OR	1	5067-4144	Micro Valve Head 2 Position / 10 Port, 600 bar
OR	1	5067-4118	2 pos/10 port ultra high pressure (1200 bar) valve head
OR	1	5067-4146	Valve head 6 column selector (600 bar)
OR	1	5067-4142	Valve head 6 column selector (1200 bar)
OR	1	5067-4148	Bio-inert valve head 2 pos/6 port (600 bar)
OR	1	5067-4134	Bio-inert valve head 4 column selector (600 bar)
OR	1	5067-4159	Bio-inert selector valve 12 position/13 port (210 bar)

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 Agilent 1200 Infinity Series Method Development System - System Manual (G4230-90002).

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 pollutions. 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.

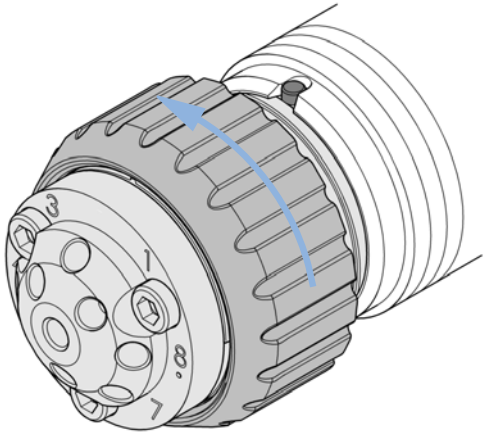
NOTE

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.

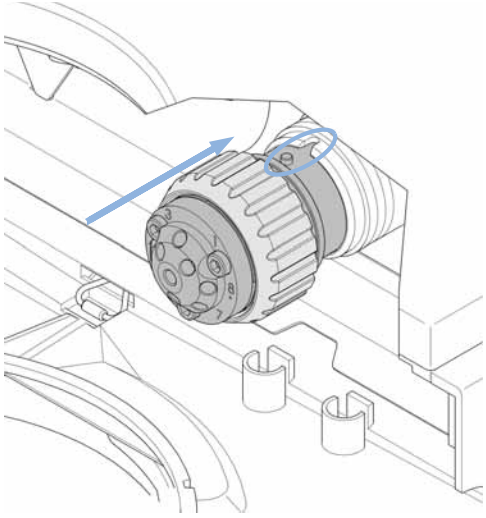
1 Switch off the module.

2 Remove all capillary connections from the valve head

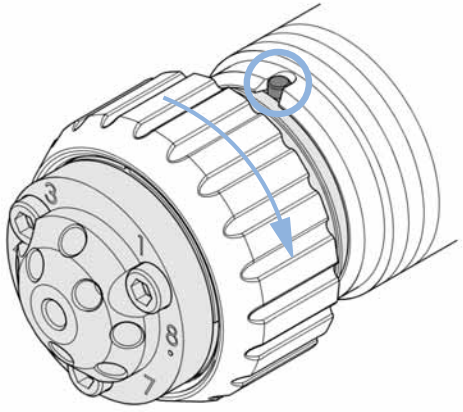
3 Unscrew the valve head.

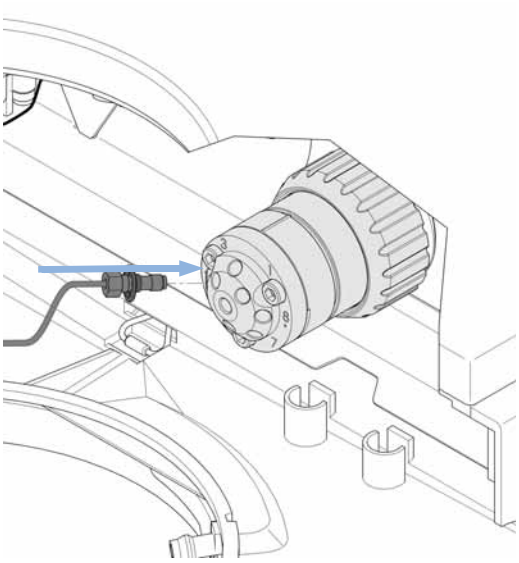


4 Put the new valve head onto the valve drive such that the lobe fits to the groove (see also "Installing the Valve Heads" on page 53).



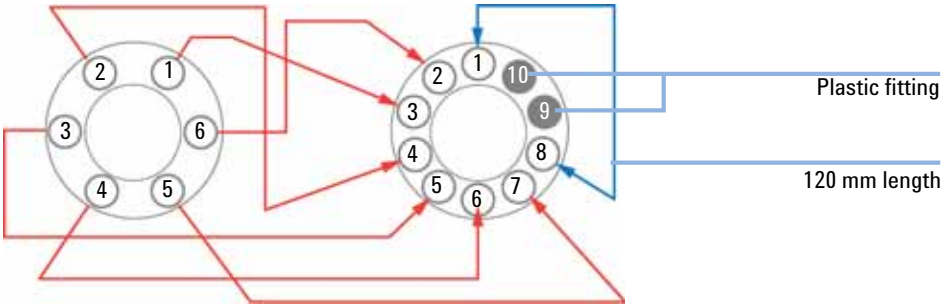
5 Screw the valve head onto the valve drive using the union nut (see also "Installing the Valve Head and Connecting Capillaries" on page 54.



6 Install all required capillary connections to the valve head. 	**7** Switch on the module.

Installing the Capillaries

The 2pos/10port valve can be used here in the same way as a 2pos/6port valve; just follow the re-routing diagram below. The red arrows mean that you have to take the according installation diagram of the 2pos/6port valve (Figure 38 on page 153, Figure 39 on page 155, Figure 40 on page 156) but have to mount for example the capillary connected to port 6 of the 2pos/6port valve at port 2 of the 2pos/10port 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).



Parts required

p/n	Description
G4231B	2pos/6port valve
G4232B	2pos/10port valve
0100-1259	Plastic fittings
0890-1713	Waste tubing
5067-4647	SST-Capillary 340 x 0.12 mm ps ps 1sh 1xlg
5067-4648	SST-Capillary 700 x 0.17 mm ps ps 1sh 1xlg
5067-4649	SST-Capillary 90 x 0.12 mm ps ps 1sh 1xlg
5067-4650	SST-Capillary 150 x 0.12 mm ns ps 1lg 1xlg
5067-4651	SST-Capillary 280 x 0.12 mm ns ps 1lg 1xlg
5067-4652	SST-Capillary 120 x 0.12 mm ps ps 1xlg 1xlg
5067-4653	SST-Capillary 200 x 0.12 mm ps ps 1sh 1xlg

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:

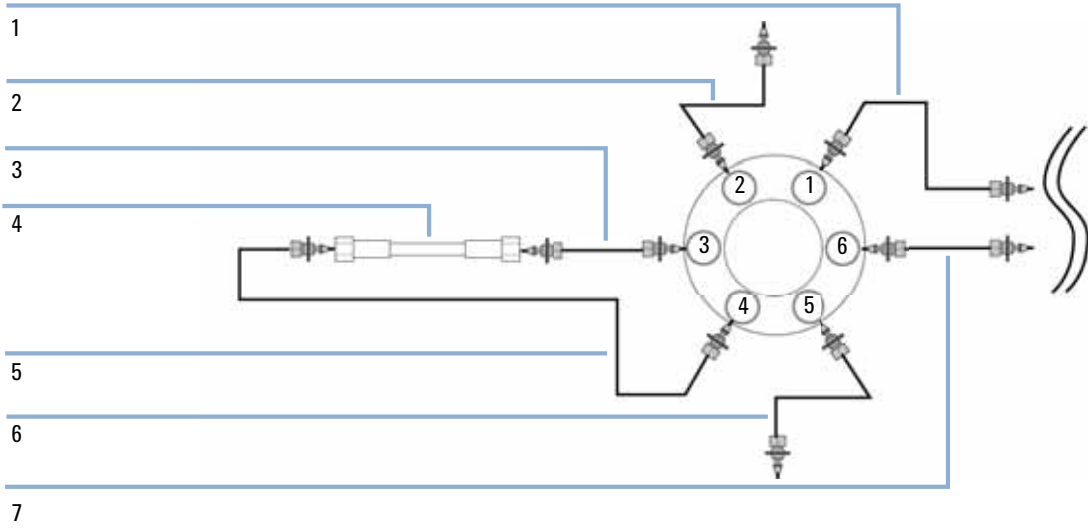


Figure 38 Installing the capillaries for a dual-column selection set-up (column of the second position omitted)

1	150 mm length (column length up to 100 mm), 280 mm length (column length > 100 mm) From column Not pre-swaged on column-side!
2	200 mm length to detector
3	150 mm length (column length up to 100 mm, 280 mm length (column length > 100 mm) From column Not pre-swaged on column-side!
4	90 mm length capillary
5	Column
6	90 mm length capillary
7	90 mm length capillary to column
	Pos. 1: Connection between ports 1-6, 4-5, 2-3, active column 1 = left Pos. 2: Connection between ports 1-2, 3-4, 5-6, active column 2 = right Example shows setup with flow directed from bottom to top. 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.)

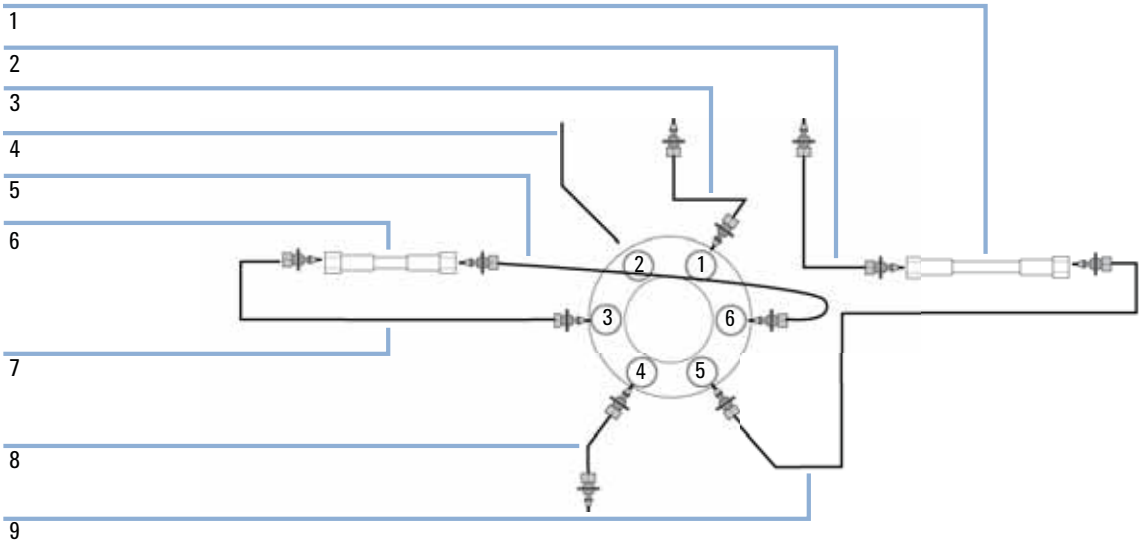


Figure 39 Installing the capillaries for a sample enrichment set-up

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

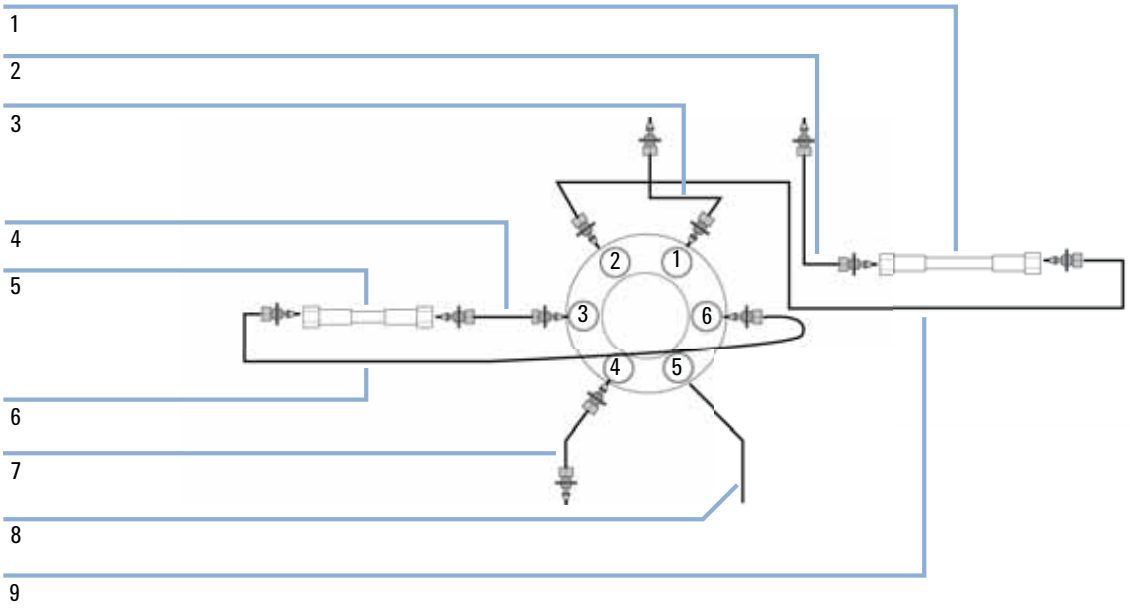


Figure 40 Installing the capillaries for a sample clean-up set-up

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

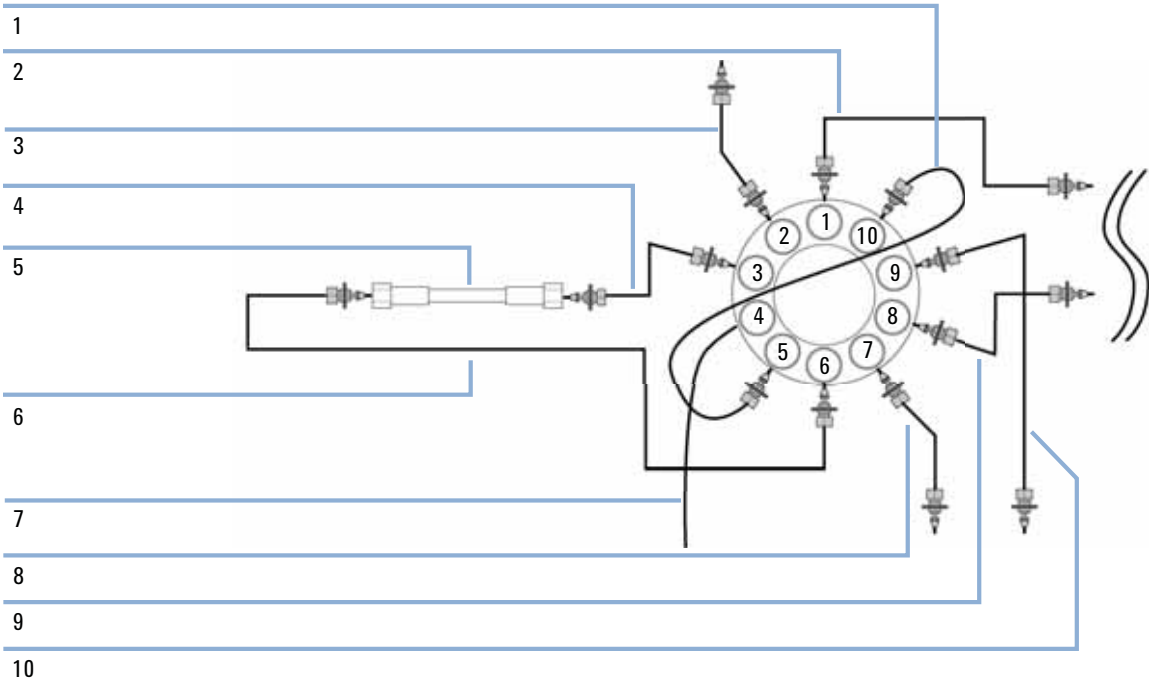


Figure 41 Installing the capillaries for alternating column regeneration (column of the second position omitted)

1	Valve-Valve connector, 120 mm length
2	150 mm length (column length up to 100 mm), 280 mm length (column length > 100 mm) From column Not pre-swaged on column-side!
3	200 mm length to detector
4	150 mm length (column length up to 100 mm), 280 mm length (column length > 100 mm) From column Not pre-swaged on column-side!
5	Column
6	90 mm length capillary to column
7	To waste
8	From autosampler
9	700 mm length (0.17 mm ID) from regeneration pump
10	90 mm length capillary
	Pos. 1: Connection between ports 1-10, 2-3, 4-5, 6-7, 8-9, active column 1 = left / regenerating column = right 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 Diagnostic Software
OR	Instant Pilot G4208A (only if supported by module)

Parts required

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

Preparations

Read update documentation provided with the Firmware Update Tool.

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

1 Download the required module firmware, the latest LAN/RS-232 FW Update Tool and the documentation from the Agilent web.
   - http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?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

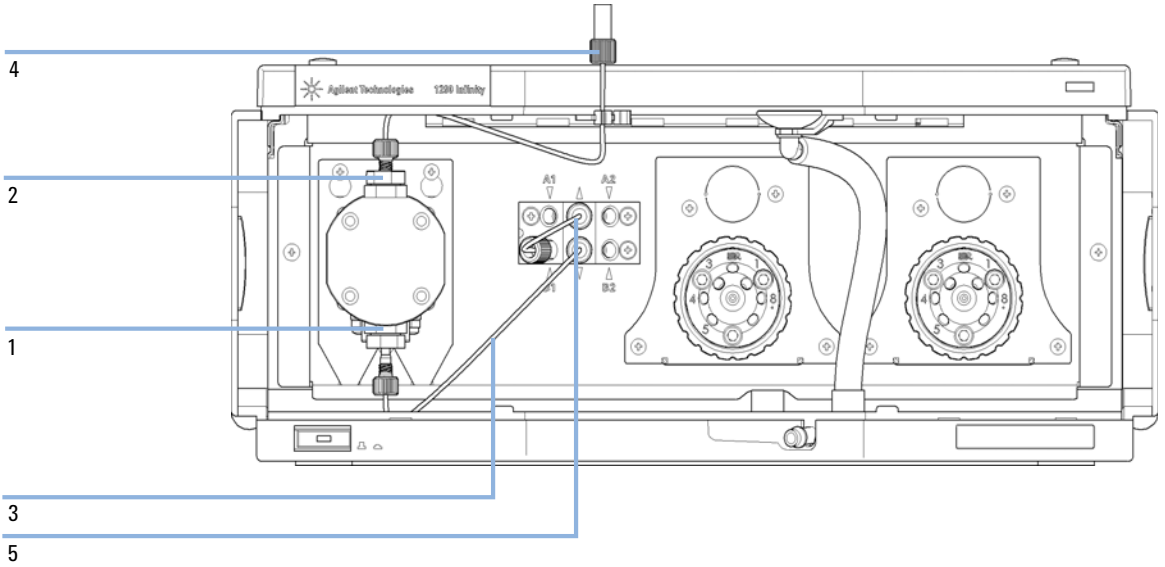


Figure 42 Parts overview

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

HPLC System Tool Kit

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

p/n	Description
0100-1681	Adapter syringe/seal wash tube
0100-1710	Mounting Tool for Tubing Connections
01018-23702	Insert tool
5023-0240	Hex driver, ¼", slitted
8710-0060	Hex-key wrench, 9/64 inch
8710-0510 (2x)	Wrench open 1/4 — 5/16 inch
8710-0641	Hex key set 1 – 5 mm
8710-0899	Pozidriv screwdriver
8710-1534	Wrench, 4 mm both ends, open end
8710-1924	Wrench open 14 mm
8710-2392	Hex key 4 mm15 cm long T-handle
8710-2393	Hex key 1.5 mm, straight handle 10 cm
8710-2394	Hex key 9/64 inch 15 cm long T-handle
8710-2409	Wrench open end, 5/16 – 3/8 inch
8710-2411	Hex key 3 mm12 cm long
8710-2412	Hex key 2.5 mm, 15 cm long, straight handle
8710-2438	Hex key 2.0 mm
8710-2509	Screwdriver Torx TX8
8710-2594	Double open end wrench 4 mm

p/n	Description
9301-0411	Syringe, Plastic
9301-1337	Adapter syringe/solvent tube with fitting

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
9301-1420	Solvent bottle, transparent
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
Method development valves kit (G4230A)[2]	Valve Head 8 Position/9 Port, 600 bar (5067-4107)	Rotor Seal, PEEK (5067-4111)	Stator head (5068-0001)
Method development valves kit (G4230B)[2]	8 pos/9 port valve head high pressure (1200 bar) (5067-4121)	Rotor seal (Vespel) (5068-0002)	Stator head (5068-0001)
2pos/6port valve (G4231B)	2 pos/6 port ultra high pressure (1200 bar) valve head (5067-4117)	Rotor seal (Vespel) (5068-0008)	Stator head (5068-0006)
2pos/6port valve (G4231A)	Valve Head 2 Postion / 6 Port, 600 bar (5067-4137)	Rotor Seal, PEEK (0101-1409)	Stator head (0101-1417)
2pos/10port valve (G4232B)	2 pos/10 port ultra high pressure (1200 bar) valve head (5067-4118)	Rotor seal (Vespel) (5068-0012)	Stator head (5068-0011)
2pos/10port valve (G4232A)	Micro Valve Head 2 Position / 10 Port, 600 bar (5067-4144)	Rotor Seal, PEEK (0101-1415)	Stator Head (0101-1421)
6 column selector valve (G4234A)	Valve head 6 column selector (600 bar) (5067-4146)	Rotor seal, PEEK (5068-0076)	Stator Head (5068-0077)
6 column selector (G4234B)	Valve head 6 column selector (1200 bar) (5067-4142)	Rotor seal (Vespel) (5068-0067)	Stator Head (5068-0077)

[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 8Pos/9Port 600bar valve heads. G4230B includes 1x 8Pos/9Port 600bar and 1x 8Pos/9Port 1200bar valve head.

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

Kit description	Valve head	Rotor seal	Stator heads
2pos/6port valve, bio-inert (G5631A)	Bio-inert valve head 2 pos/6 port (600 bar) (5067-4148)		
12pos/13port valve, bio-inert (G4235A)	Bio-inert selector valve 12 position/13 port (210 bar) (5067-4159)	Bio-inert rotor seal and stator face kit (0101-1288)	Bio-inert stator head (5068-0097)[1]
4 column selector valve, bio-inert (G5639A)	Bio-inert valve head 4 column selector (600 bar) (5067-4134)	Bio-inert rotor seal, PEEK (5068-0045)	Bio-inert stator head (5068-0044)

[1] kit with stator face and rotor seal

2 Pos / 6 Port Valve Head 600 bar

Item	p / n	Description
	5067-4137	Valve Head 2 Postion / 6 Port, 600 bar
1	1535-4857	Stator screws, 10 / Pk
2	0101-1417	Stator head
3	0101-1409	Rotor Seal, PEEK
4	1535-4045	Bearing ring

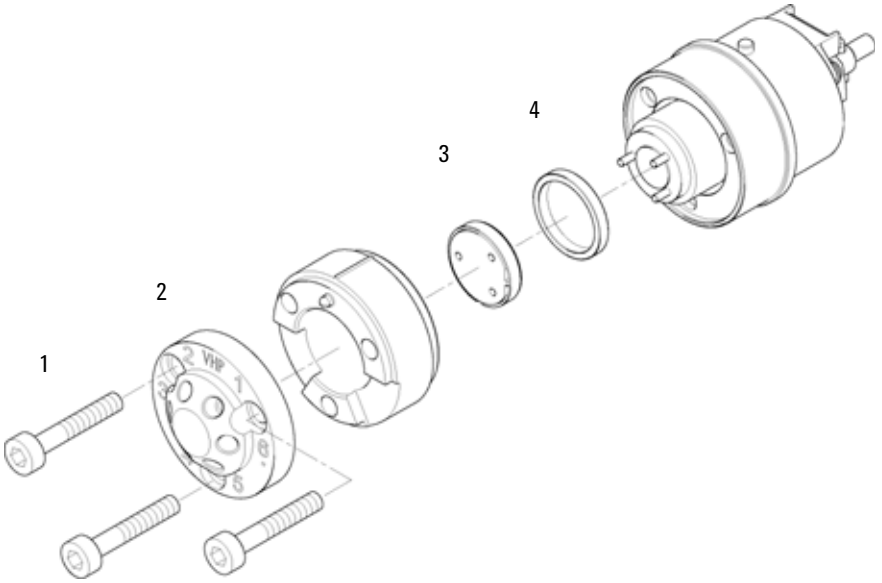


Figure 43 Column Switching Valve Parts (5067-4137)

2 Pos / 6 Port Ultra High Pressure Valve Head 1200 bar

Item	p / n	Description
	5067-4117	2 pos / 6 port ultra high pressure (1200 bar) valve head
1	1535-4857	Stator screws
2	5068-0006	Stator head
3	5068-0008	Rotor seal (Vespel)
4	1535-4045	Bearing ring

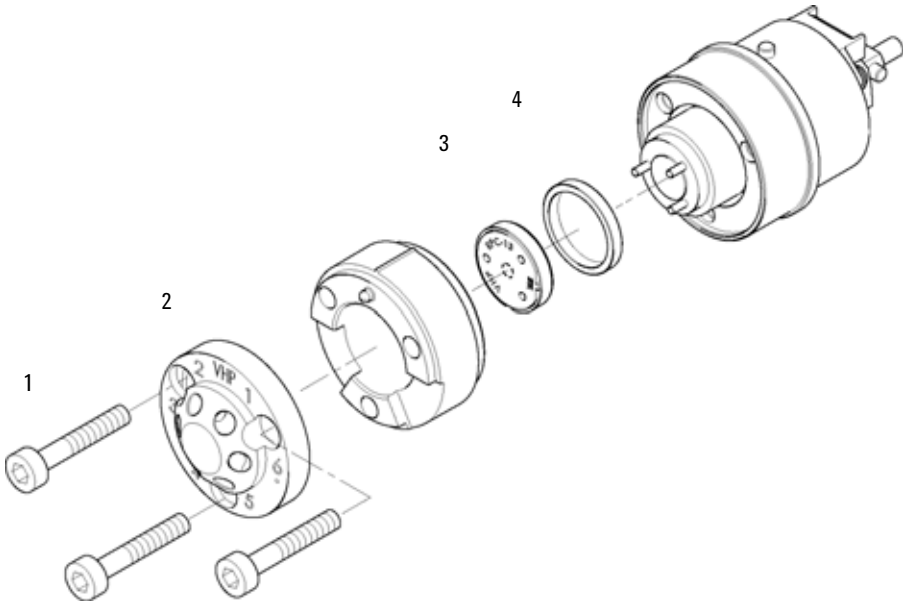


Figure 44 Column Switching Valve Parts (5067-4117)

2 Pos / 6 Port Valve Head 600 bar (Bio-inert)

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

Item	p / n	Description
	5067-4148	Bio-inert valve head 2 pos / 6 port (600 bar)
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

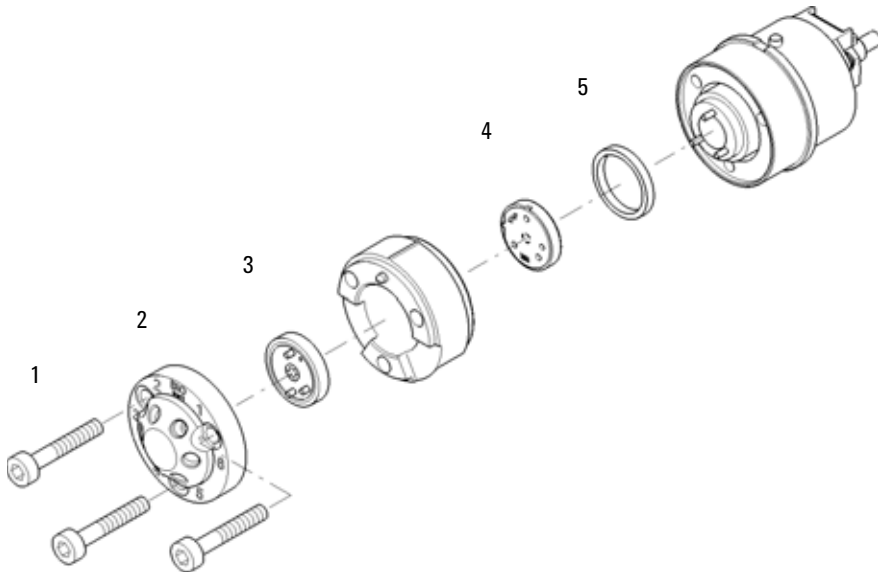


Figure 45 Column Switching Valve Parts

2 Pos / 10 Port Micro Valve Head 600 bar

Item	p / n	Description
	5067-4144	Micro Valve Head 2 Position / 10 Port, 600 bar
1	5068-0054	Stator screws, 10 / Pk
2	0101-1421	Stator Head
3	0101-1415	Rotor Seal, PEEK
4	1535-4045	Bearing ring

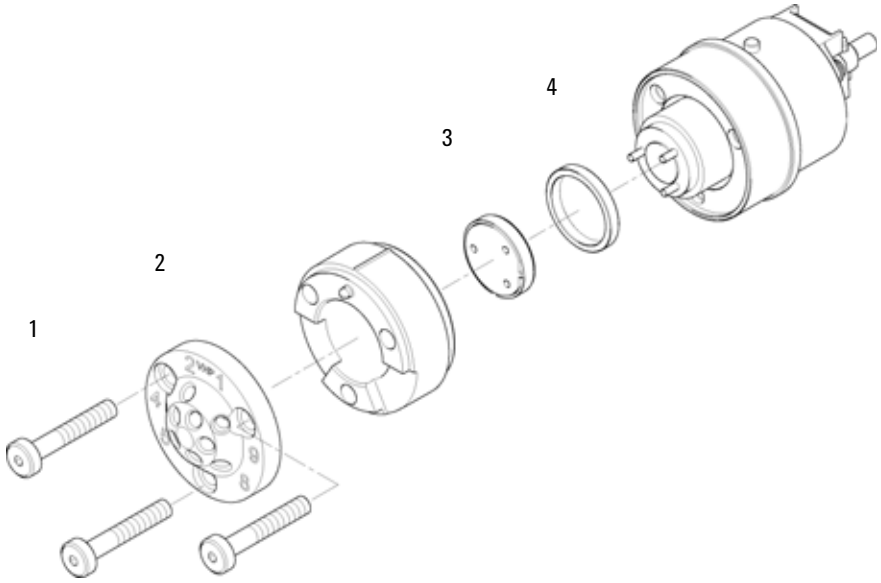


Figure 46 Column Switching Valve Parts (5067-4144)

2 Pos / 10 Port Ultra High Pressure Valve Head 1200 bar

Item	p / n	Description
	5067-4118	2 pos / 10 port ultra high pressure (1200 bar) valve head
1	5068-0019	Stator screws
2	5068-0011	Stator head
3	5068-0012	Rotor seal (Vespel)
4	1535-4045	Bearing ring

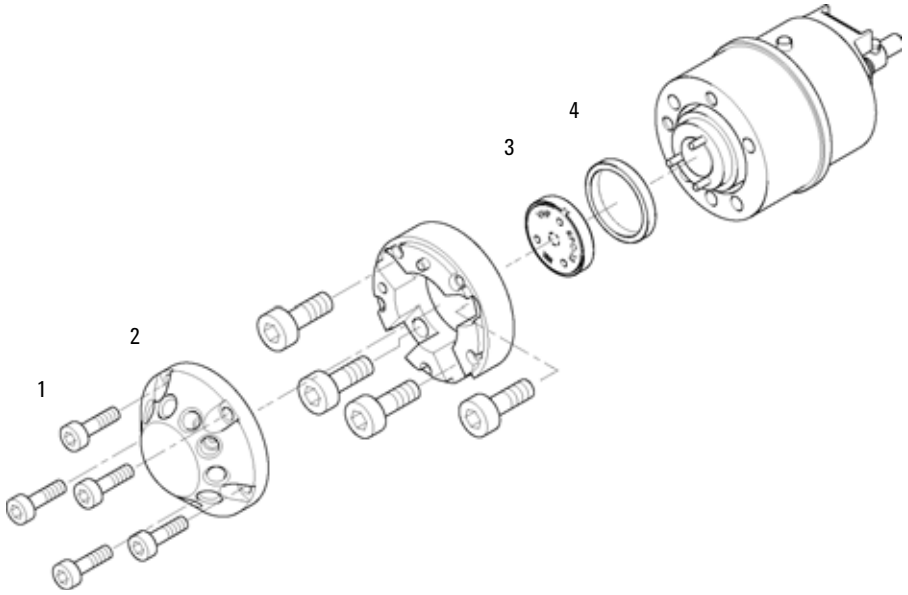


Figure 47 Column Switching Valve Parts (5067-4118)

8 Pos / 9 Port Valve Head 600 bar

Item	p / n	Description
	5067-4107	Valve Head 8 Position / 9 Port, 600 bar
1	1535-4857	Stator screws
2	5068-0001	Stator head
3	5067-4111	Rotor Seal, PEEK
4	1535-4045	Bearing ring

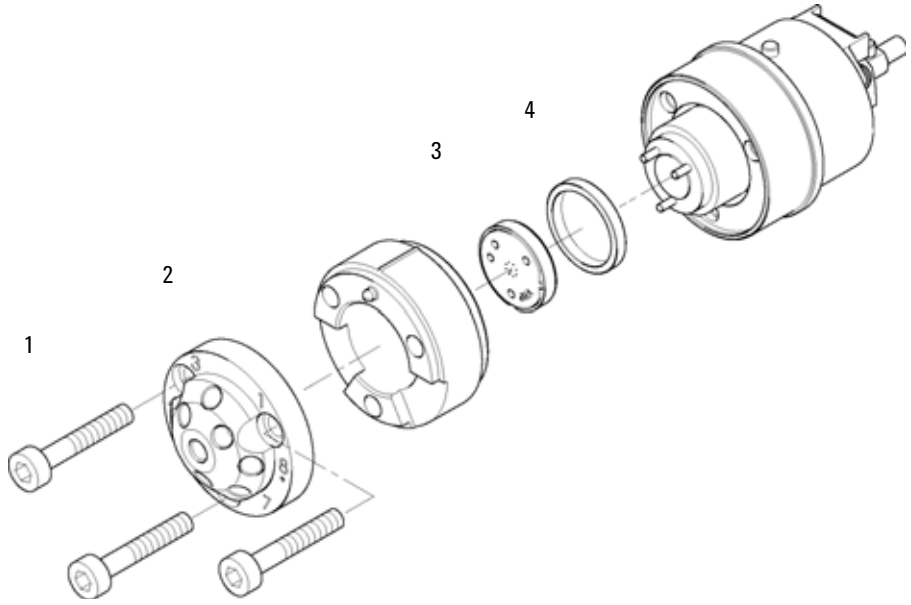


Figure 48 Column Switching Valve Parts (5067-4107)

8 Pos / 9 Port Ultra High Pressure Valve Head 1200 bar

Item	p / n	Description
	5067-4121	8 pos / 9 port valve head high pressure (1200 bar)
1	1535-4857	Stator screws
2	5068-0001	Stator head
3	5068-0002	Rotor seal (Vespel)
4	1535-4045	Bearing ring

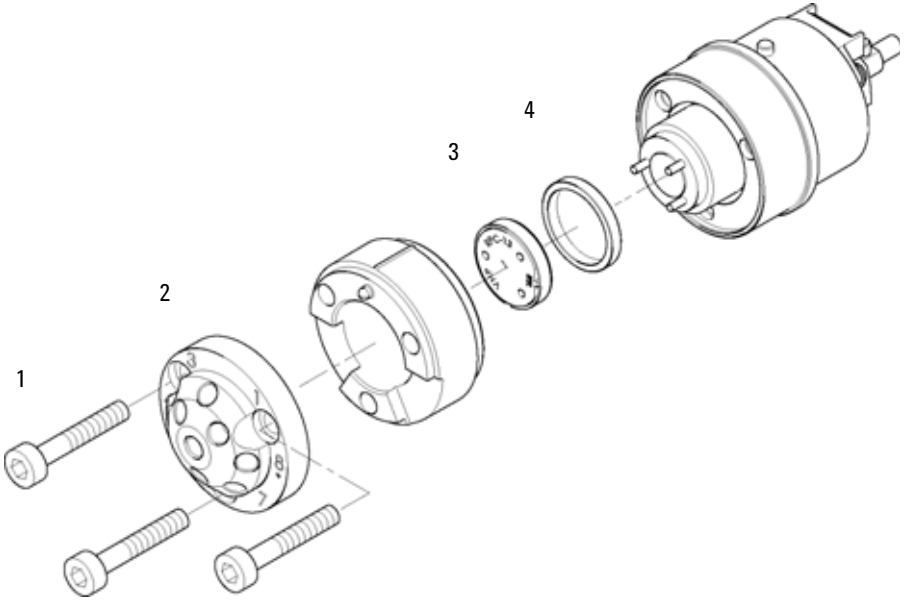


Figure 49 Column Switching Valve Parts (5067-4121)

Valve Head 4 Column Selector 600 bar (Bio-inert)

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

Item	p/n	Description
	5067-4134	Bio-inert valve head 4 column selector (600 bar)
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

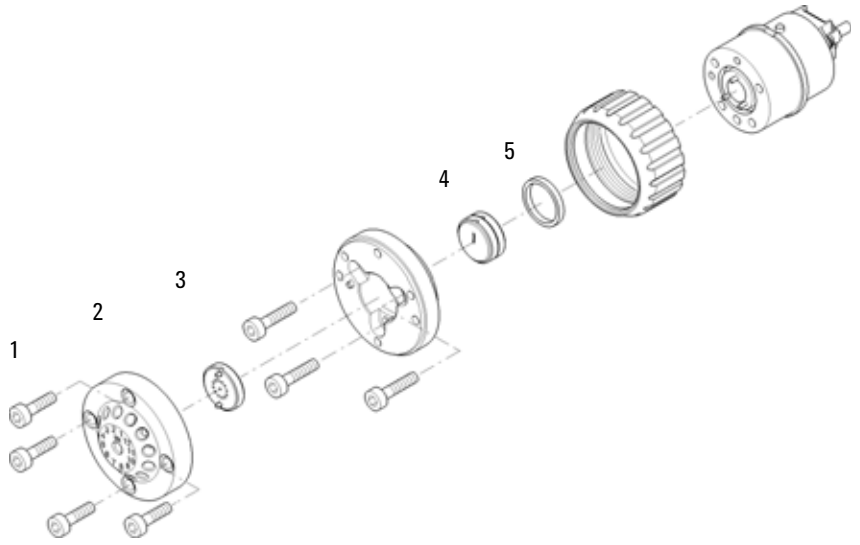


Figure 50 Column Switching Valve Parts

Valve Head 6 Column Selector 600 bar

Item	p/n	Description
	5067-4146	Valve head 6 column selector (600 bar)
1	5068-0089	Stator screws
2	5068-0077	Stator Head
3	5068-0076	Rotor seal, PEEK
4	1535-4045	Bearing ring

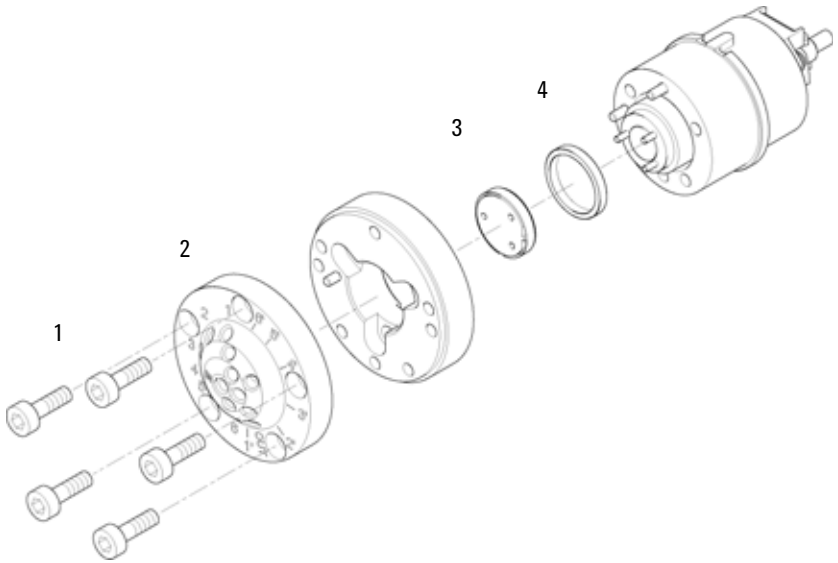


Figure 51 Column Switching Valve Parts

Valve Head 6 Column Selector 1200 bar

Item	p/n	Description
	5067-4142	Valve head 6 column selector (1200 bar)
1	5068-0089	Stator screws
2	5068-0077	Stator Head
3	5068-0067	Rotor seal (Vespel)
4	1534-4045	Bearing ring

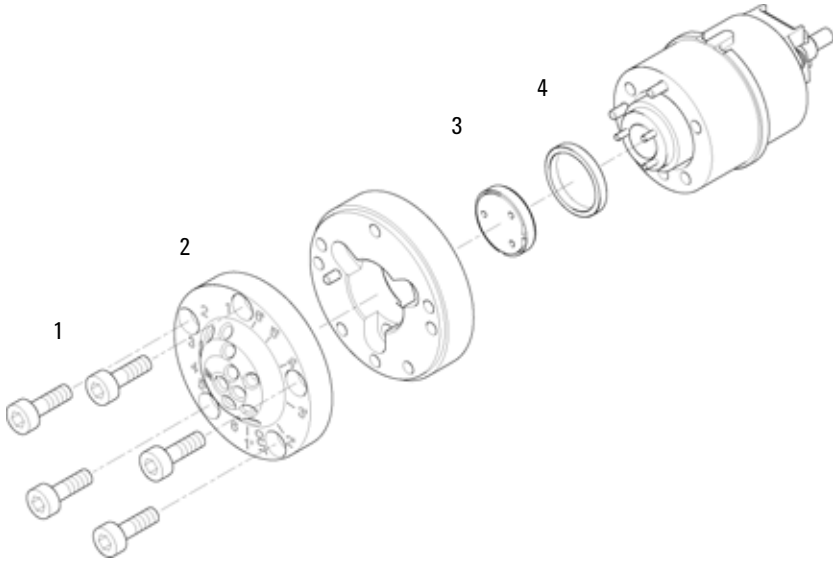


Figure 52 Column Switching Valve Parts

12 Pos / 13 Port Valve Head 210 bar (Bio-inert)

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

Item	p / n	Description
	5067-4159	Bio-inert selector valve 12 position / 13 port (210 bar)
1	5068-0059	Stator screws
2	5068-0097	Bio-inert stator head
3	0101-1288	Bio-inert rotor seal and stator face kit
4	1535-4045	Bearing ring

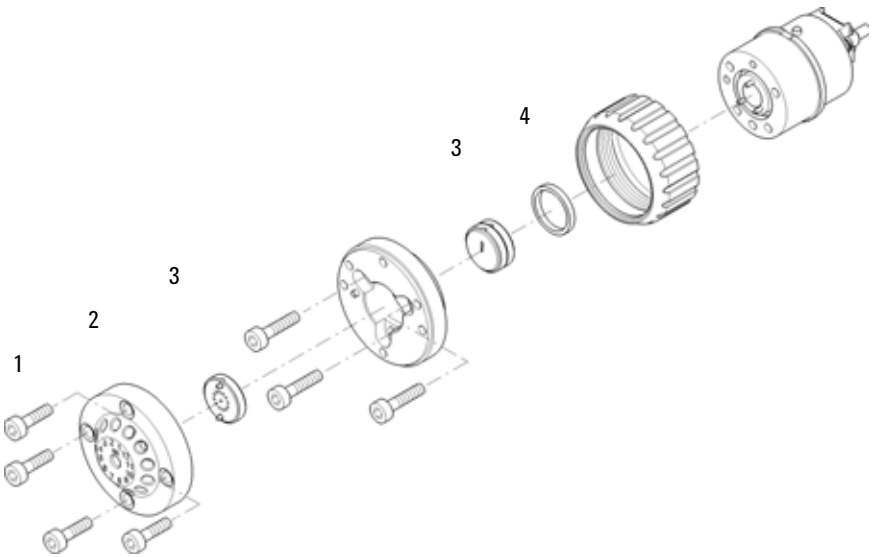


Figure 53 Column Switching Valve Parts

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 184
03396-61010	Agilent module to 3396 Series III / 3395B integrators
5061-3378	Remote Cable
01046-60201	Agilent module to general purpose

BCD cables

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

CAN cables

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

LAN cables

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

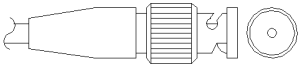
External Contact Cable

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

RS-232 cables

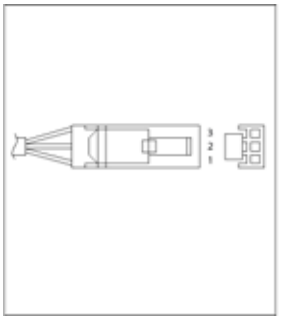
p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9.
5181-1561	RS-232 cable, 8 m

Analog Cables

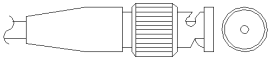


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

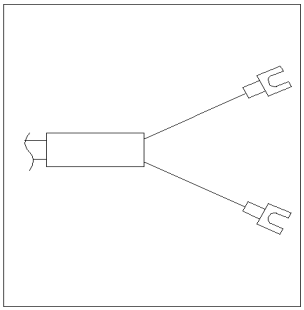
Agilent Module to 3394/6 Integrators

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

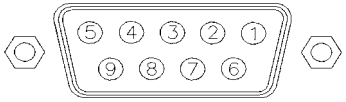
Agilent Module to BNC Connector

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

Agilent Module to General Purpose

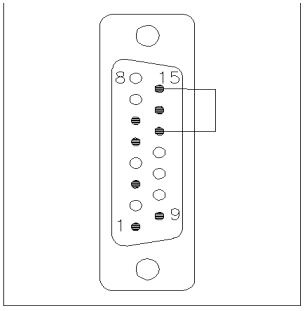
p/n 01046-60105	Pin	Pin Agilent module	Signal Name
	1		Not connected
	2	Black	Analog -
	3	Red	Analog +

Remote Cables



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

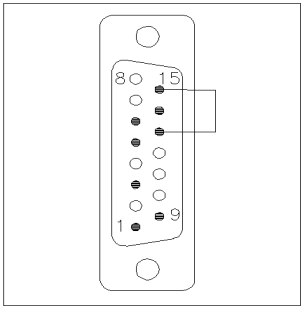
Agilent Module to 3396A Integrators

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

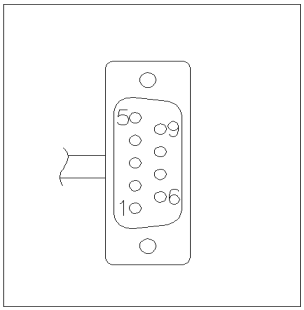
Agilent Module to 3396 Series II / 3395A Integrators

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

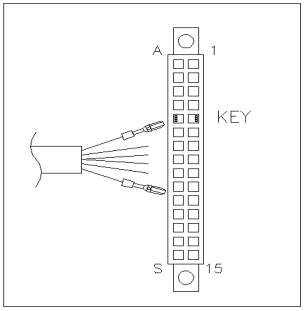
Agilent Module to 3396 Series III / 3395B Integrators

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

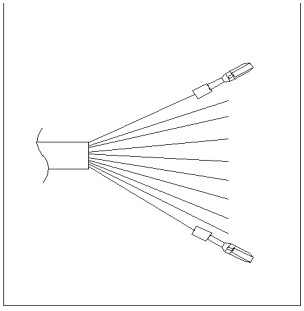
Agilent Module to General Purpose

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

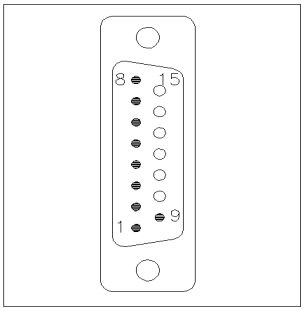
BCD Cables

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

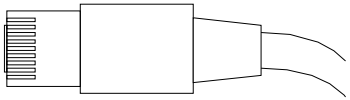
Agilent Module to General Purpose

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.

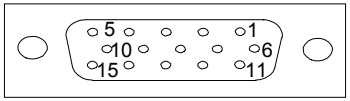
CAN Cables

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

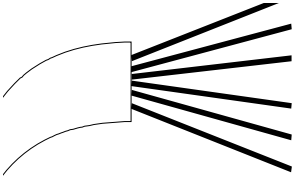
p / n	Description
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5023-0202	Twisted pair network cable, shielded, 7 m (for point to point connection)

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
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9.
5181-1561	RS-232 cable, 8 m

Agilent 1200 Module to Printer

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

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 using your user interface:

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

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

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

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

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

XXX is the build number of the firmware.

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

NOTE

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

Main and resident firmware must be from the same set.

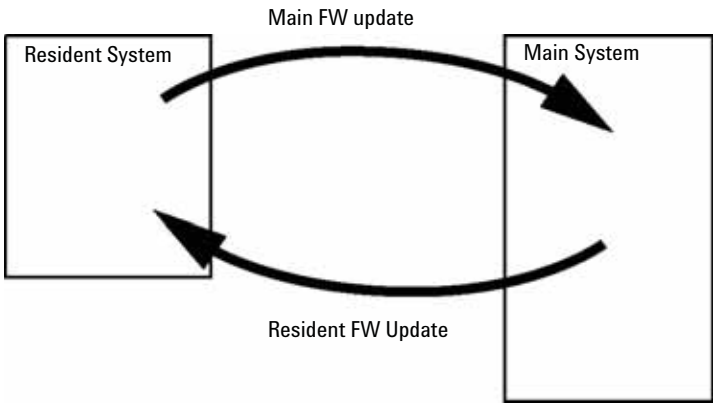


Figure 54 Firmware Update Mechanism

NOTE

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

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

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

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

- http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?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

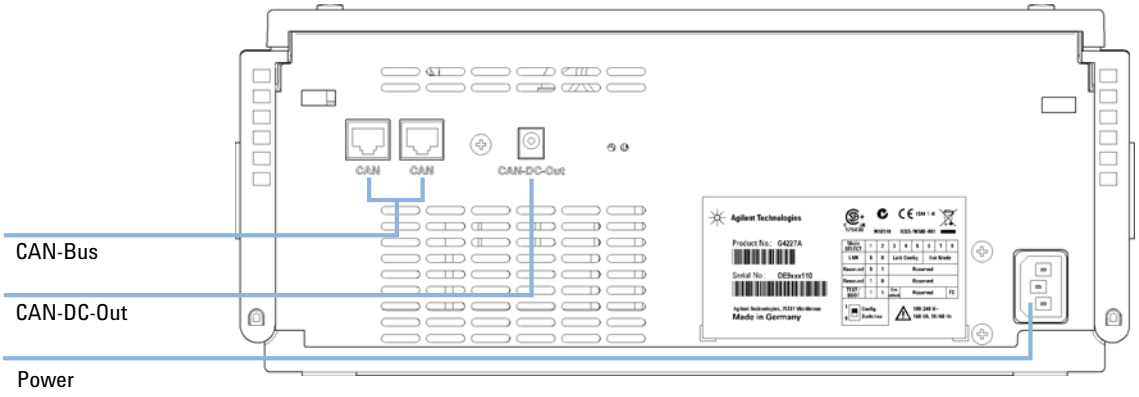


Figure 55 Rear view of the Flexible Cube

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 G1311B Quat Pump G1311C Quat Pump VL G1312B Bin Pump G1312C Bin Pump VL 1376A Cap Pump G2226A Nano Pump G5611A Bio-inert Quat Pump	2	Yes	No	Yes	1	Yes	
G4220A / B Bin Pump 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 G2260A Prep ALS	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B
G1364B FC-PS G1364C FC-AS G1364D FC-µS G1367E HiP ALS G1377A HiP micro ALS G2258A DL ALS G5664A Bio-inert FC-AS G5667A Bio-inert Autosampler	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B CAN-DC- OUT for CAN slaves
G4226A ALS	2	Yes	No	Yes	No	Yes	

Table 10 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN / BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
Detectors							
G1314B VWD VL G1314C VWD VL+	2	Yes	No	Yes	1	Yes	
G1314E / F VWD	2	No	Yes	Yes	1	Yes	
G4212A / B DAD	2	No	Yes	Yes	1	Yes	
G1315C DAD VL+ G1365C MWD G1315D DAD VL G1365D MWD VL	2	No	Yes	Yes	2	Yes	
G1321B FLD	2	Yes	No	Yes	2	Yes	
G1362A RID	2	Yes	No	Yes	1	Yes	
G4280A ELSD	No	No	No	Yes	Yes	Yes	EXT Contact AUTOZERO
Others							
G1170A Valve Drive	2	No	No	No	No	No	[1]
G1316A / C TCC	2	No	No	Yes	No	Yes	
G1322A DEG	No	No	No	No	No	Yes	AUX
G1379B DEG	No	No	No	Yes	No	Yes	
G4225A DEG	No	No	No	Yes	No	Yes	
G4227A Flex Cube	2	No	No	No	No	No	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)

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

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

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

Overview Interfaces

CAN

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

LAN

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

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

RS-232C (Serial)

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

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

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

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

Table 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

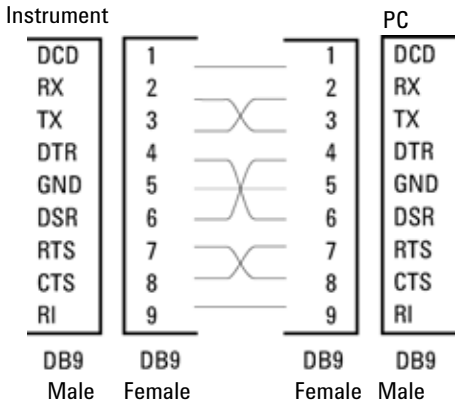


Figure 56 RS-232 Cable

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.

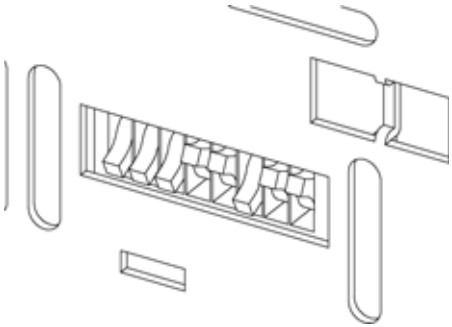


Figure 57 Configuration switch (settings depend on configured mode)

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 column compartment supports only hardware handshake (CTS/RTR).

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

Table 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	1	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

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 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.

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)

Abstract

The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), adopted by EU Commission on 13 February 2003, is introducing producer responsibility on all Electric and Electronic appliances from 13 August 2005.

NOTE

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

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

Do not dispose off in domestic household waste

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

Radio Interference

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

Test and Measurement

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

Sound Emission

Manufacturer's Declaration

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

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

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

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Rev. B

Agilent Technologies

Index

D

E

F

G

H

I

L

M

N

O

P

R

S

T

U

V

W

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.