



Agilent 1260 Infinity Standard Autosampler

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 Book

This manual covers the Agilent 1260 Infinity Standard Autosampler (G1329B).

1 Introduction to the Autosampler (ALS)

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

2 Site Requirements and Specifications

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

3 Installing the Autosampler

This chapter provides information on unpacking, checking on completeness, stack considerations and installation of the module.

4 Using the Autosampler

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

5 Optimizing Performance

This chapter provides information on how to optimize the module.

6 Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

7 Error Information

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

8 Maintenance

This chapter describes the maintenance of the module.

9 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

10 Identifying Cables

This chapter provides information on cables used with the module.

11 Hardware Information

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

12 Appendix

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

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



Introduction to the Autosampler (ALS)

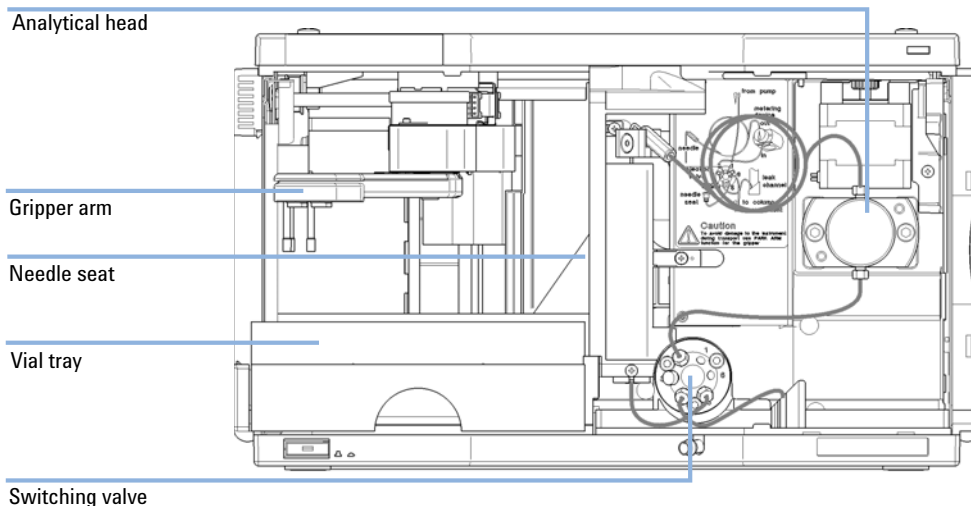


Figure 1 Overview of the Autosampler

The Agilent 1260 Infinity autosampler is designed for use with other modules of the Agilent 1200 Infinity Series, 1200 Series and 1100 Series LC, or with other LC systems if adequate remote control inputs and outputs are available. The autosamplers are controlled by the Agilent Instant Pilot (G4208A) or by Agilent control software (OpenLAB CDS, ChemStation for LC, EZChrom Elite etc.).

Three sample-rack sizes are available for the autosampler. The standard full-size rack holds 100 × 1.8 mL vials, while the two half-size racks provide space for 40 × 1.8 mL vials and 15 × 6 mL vials respectively. Any two half-size rack trays can be installed in the autosampler simultaneously. A specially designed sample-rack holding 100 × 1.8 mL vials is available for use with thermostatted autosamplers. The half-size racks trays are not designed for an optimal heat transfer when they are used with a thermostatted autosampler.

The autosampler's transport mechanism uses an X-Z-Theta movement to optimize vial pick-up and return. A gripper arm picks up the vials and positions them below the sampling unit. The gripper transport mechanism and sampling unit are driven by motors. Movement is monitored by optical sensors and optical encoders to ensure correct operation. The metering device is always flushed after injection to ensure minimum carry-over. The standard analytical head of the metering device provides injection volumes from 0.1 – 100 μL and can be operated at up to 600 bar. A head with extended volume is available for injection volumes from 0.1 – 900 μL and can be operated up to 400 bar (G1329B) or 200 bar (G1329A).

The six-port injection valve unit (only 5 ports are used) is driven by a high-speed hybrid stepper motor. During the sampling sequence, the valve unit bypasses the autosampler, and directly connects the flow from the pump to the column. During injection and analysis, the valve unit directs the flow through the autosampler. This ensures that all the sample is completely injected into the column. Any sample residue is removed from the metering device and from the needle before the next sampling sequence begins.

For applications that require control of the vial temperature, the module can be combined with the Agilent 1290 Infinity Thermostat (G1330B). The combination of the autosampler with the thermostat is called a "thermostatted autosampler". For more details refer to the documentation of the 1290 Infinity Thermostat.

Sampling Sequence

The autosampler processor continuously monitors the movements of the autosampler components during the sampling sequence. The processor defines specific time windows and mechanical ranges for each movement. If a specific step of the sampling sequence can't be completed successfully, an error message is generated.

During the sampling sequence the solvent bypasses the autosampler via the injection valve. The gripper arm selects the sample vial, either from a static sample rack, or from external vial positions. The gripper arm places the sample vial below the injection needle. The required volume of sample is drawn into the sample loop by the metering device. Sample is applied to the column when the injection valve returns to the mainpass position at the end of the sampling sequence.

The sampling sequence occurs in the following order:

- 1** The injection valve switches to the bypass position.
- 2** The piston of the metering device moves to the initialization position.
- 3** The gripper arm moves from the home position, and selects the vial. At the same time, the needle lifts out of the seat.
- 4** The gripper arm places the vial below the needle.
- 5** The needle lowers into the vial.
- 6** The metering device draws the defined sample volume.
- 7** The needle lifts out of the vial.
- 8** If the automated needle wash is selected (see [“Using the Automated Needle Wash”](#) on page 46), the gripper arm replaces the sample vial, positions the wash vial below the needle, lowers the needle into the vial, then lifts the needle out of the wash vial.
- 9** The gripper arm checks if the safety flap is in position.
- 10** The gripper arm replaces the vial, and returns to the home position. Simultaneously, the needle lowers into the seat.
- 11** The injection valve switches to the mainpass position.

Injection Sequence

Before the start of the injection sequence, and during an analysis, the injection valve is in the mainpass position (Figure 2 on page 13). In this position, the mobile phase flows through the autosamplers metering device, sample loop, and needle, ensuring all parts in contact with sample are flushed during the run, thus minimizing carry-over.

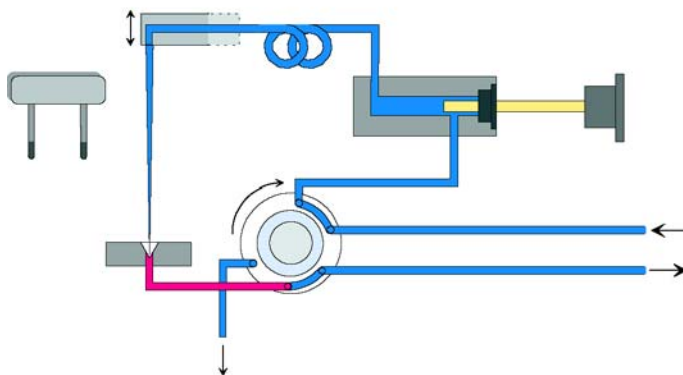


Figure 2 Mainpass Position

When the sample sequence begins, the valve unit switches to the bypass position (Figure 3 on page 13). Solvent from the pump enters the valve unit at port 1, and flows directly to the column through port 6.

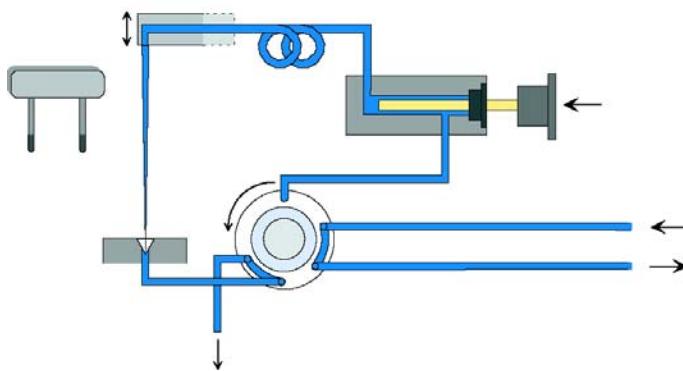


Figure 3 Bypass Position

1 Introduction to the Autosampler (ALS)

Introduction to the Autosampler (ALS)

Next, the needle is raised, and the vial is positioned below the needle. The needle moves down into the vial, and the metering unit draws the sample into the sample loop (Figure 4 on page 14).

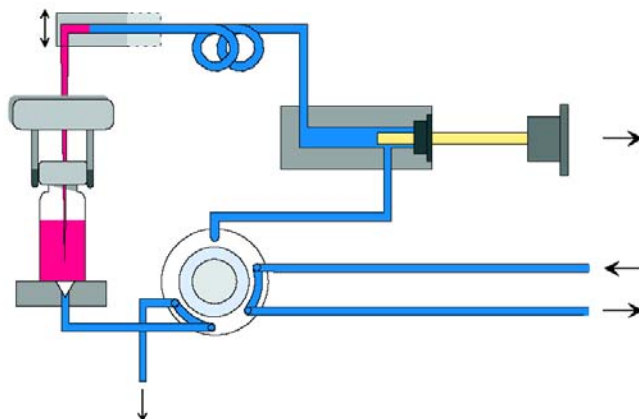


Figure 4 Drawing the Sample

When the metering unit has drawn the required volume of sample into the sample loop, the needle is raised, and the vial is replaced in the sample tray. The needle is lowered into the needle seat, and the injection valve switches back to the mainpass position, flushing the sample onto the column (Figure 5 on page 14).

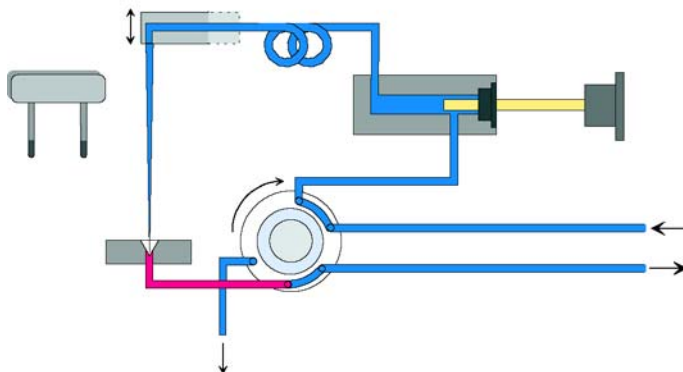


Figure 5 Mainpass Position (Sample Injection)

Sampling Unit

The sampling unit comprises three main assemblies: needle drive, metering device, and injection valve.

NOTE

The replacement sampling unit excludes the injection valve and metering head assemblies.

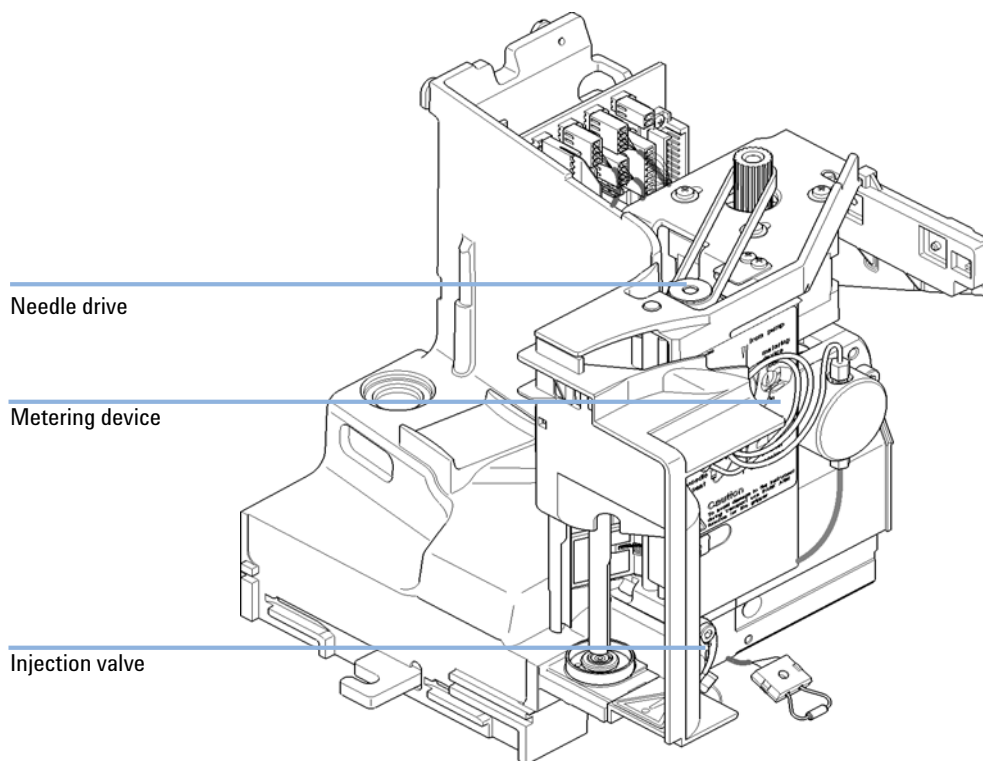


Figure 6 Autosampler Sampling Unit

Needle-Drive

The needle movement is driven by a stepper motor connected to the spindle assembly by a toothed belt. The circular motion of the motor is converted to linear motion by the drive nut on the spindle assembly. The upper and lower needle positions are detected by reflection sensors on the sampling unit flex board, while the needle-in-vial position is determined by counting the motor steps from the upper needle-sensor position.

Analytical head

The analytical head is driven by the stepper motor connected to the drive shaft by a toothed belt. The drive nut on the spindle converts the circular movement of the spindle to linear motion. The drive nut pushes the sapphire piston against the tension of the spring into the analytical head. The base of the piston sits on the large bearing of the drive nut, which ensures the piston is always centered. A ceramic ring guides the movement of the piston in the analytical head. The home position of the piston is sensed by an infra-red sensor on the sampling unit flex board, while the sample volume is determined by counting the number of steps from the home position. The backward movement of the piston (driven by the spring) draws sample from the vial.

Table 1 Analytical Head Technical Data

	Standard (100 µL)	Extended Volume (900 µL)
Number of steps	15000	15000
Volume resolution	7 nL/motor step	60 nL/motor step
Maximum stroke	100 µL	900 µL
Pressure limit	600 bar	400 bar (G1329B) 200 bar (G1329A)
Piston material	Sapphire	Sapphire

Injection-Valve

The two-position 6-port injection valve is driven by a stepper motor. Only five of the six ports are used (port 3 is not used). A lever/slider mechanism transfers the movement of the stepper motor to the injection valve. Two microswitches monitor the switching of the valve (bypass and mainpass end positions).

No valve adjustments are required after replacing internal components.

Table 2 Injection-Valve Technical Data

	Autosampler
Motor type	4 V, 1.2 A stepper motor
Seal material	PEEK
Stator material	None
Number of ports	6
Switching time	< 150 ms

Transport Assembly

The transport unit comprises an X-axis slide (left-right motion), a Z-axis arm (up-down motion), and a gripper assembly (rotation and vial-gripping).

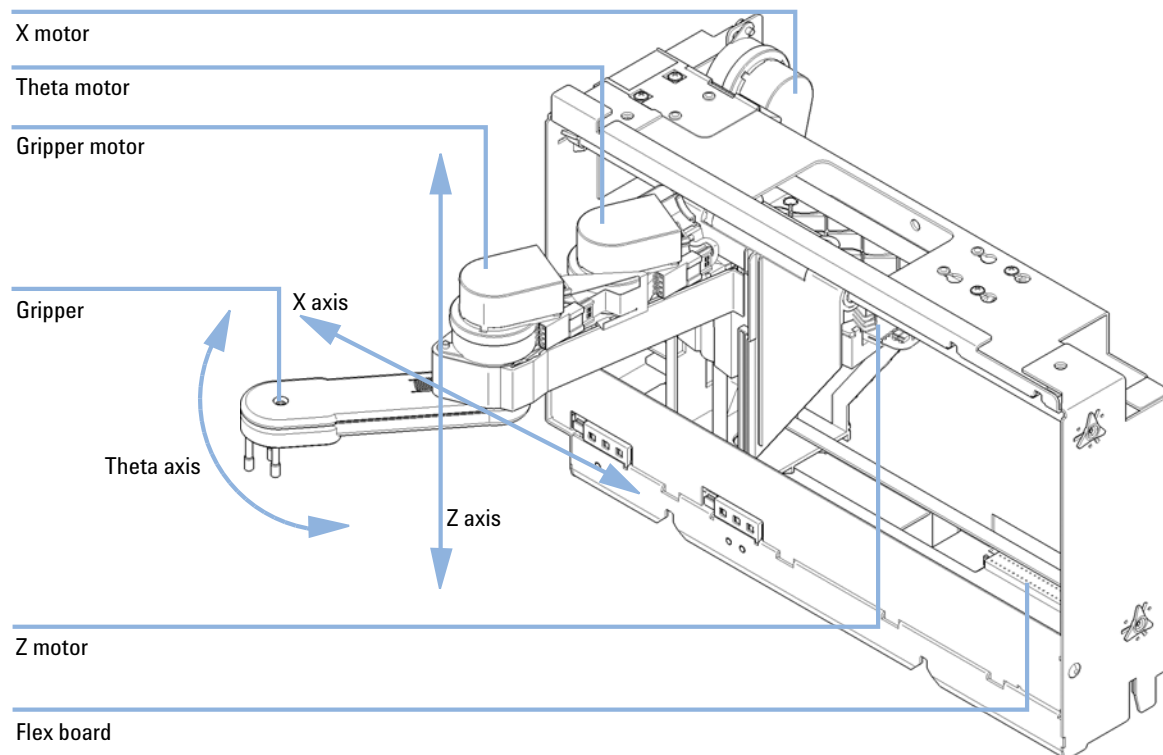


Figure 7 Transport Assembly

The transport assembly uses four stepper motors driven in closed-loop mode for accurate positioning of the gripper assembly. The rotational movement of the motors is converted to linear motion (X- and Z-axes) by toothed belts connected to the drive spindles. The rotation (theta axes) of the gripper assembly is transferred from the motor by a toothed belt and series of gears. The opening and closing of the gripper fingers are driven by a stepper motor linked by a toothed belt to the planetary gearing inside the gripper assembly.

The stepper motor positions are determined by the optical encoders mounted onto the stepper-motor housing. The encoders monitor the position of the motors continually, and correct for position errors automatically (e.g. if the gripper is accidentally moved out of position when loading vials into the vial tray). The initialization positions of the moving components are sensed by reflection sensors mounted on the flex board. These positions are used by the processor to calculate the actual motor position. An additional six reflection sensors for tray recognition are mounted on the flex board at the front of the assembly.

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Introduction to the Autosampler (ALS)



2 Site Requirements and Specifications

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Physical Specifications [25](#)

Performance Specifications Standard Autosampler [26](#)

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



Site Requirements

Site Requirements

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

Power Consideration

The autosampler power supply has wide-ranging capability (see [Table 3](#) on page 25). Consequently there is no voltage selector in the rear of the autosampler. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

The thermostatted autosampler comprises two modules, the standard autosampler and the thermostat (G1330B). Both modules have a separate power supply and a power plug for the line connections. The two modules are connected by a control cable and both are turned on by the autosampler module.

CAUTION

Damaged electronics

Disconnecting or reconnecting the sampler to thermostat cable when the power cords are connected to either of the two modules will damage the electronics of the modules.

- Make sure the power cords are unplugged before disconnecting or reconnecting the sampler to thermostat cable.

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.

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 autosampler can be placed on almost any laboratory bench (for dimensions and weight see [Table 3](#) on page 25). The instrument requires an additional 2.5 cm (1.0 inch) of space on either side, and approximately 8 cm (3.1 inch) at the rear for the circulation of air, and room for electrical connections. Ensure the autosampler is installed in a horizontal position.

If a complete Agilent 1200 Infinity Series LC is to be installed on the bench, make sure that the bench is designed to carry the weight of all the modules. For a complete system including the thermostatted autosampler it is recommended to position the modules in two stacks, see [“Optimizing the Stack Configuration”](#) on page 29. Make sure that in this configuration there is 25 cm (10 inch) space on either side of the thermostatted autosampler for the circulation of air.

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 3 Physical Specifications

Type	Specification	Comments
Weight	14.2 kg (32 lbs)	
Dimensions (height × width × depth)	200 × 345 × 435 mm (8 × 13.5 × 17 inches)	
Line voltage	100 – 240 VAC, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	300 VA / 200 W / 683 BTU	Maximum
Ambient operating temperature	0–55 °C (32–131 °F)	See warning “ Hot rear panel ” on page 25
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 95 % r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 2000 m (6562 ft)	
Non-operating altitude	Up to 4600 m (15091 ft)	For storing the module
Safety standards: IEC, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

WARNING

Hot rear panel

Using the module at high environmental temperatures may cause the rear panel to become hot.

→ Do not use the module at environmental temperatures higher than 50 °C (122 °F)

Performance Specifications Standard Autosampler

Table 4 Performance Specifications Agilent 1260 Infinity Standard Autosampler (G1329B)

Type	Specification
Pressure	Operating range 0 - 60 MPa (0 - 600 bar, 0 - 8850 psi)
GLP features	Early maintenance feedback (EMF), electronic records of maintenance and errors
Communications	Controller-area network (CAN), RS232C, APG-remote standard, optional four external contact closures and BCD vial number output
Safety features	Leak detection and safe leak handling, low voltages in maintenance areas, error detection and display
Injection range	0.1 - 100 μ L in 0.1 μ L increments (recommended 1 μ L increments) Up to 1500 μ L with multiple draw (hardware modification required)
Replicate injections	1 – 99 from one vial
Precision	Typically < 0.25 % RSD of peak areas from < 5 μ L to 100 μ L Typically < 1 % RSD of peak areas from 1 μ L to 5 μ L
Minimum sample volume	1 μ L from 5 μ L sample in 100 μ L microvial, or 1 μ L from 10 μ L sample in 300 μ L microvial
Carryover	Typically < 0.1 %, < 0.05 % with external needle cleaning
Sample viscosity range	0.2 – 50 cp
Sample capacity	100 \times 2 mL vials in 1 tray 40 \times 2 mL vials in $\frac{1}{2}$ tray 15 \times 6 mL vials in $\frac{1}{2}$ tray (Agilent vials only)
Injection cycle time	50 s for draw speed 200 μ L/min, ejection speed 200 μ L/min, injection volume 5 μ L
Metering device	Metering pump in high pressure flow path



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This chapter provides information on unpacking, checking on completeness, stack considerations and installation of the module.



Unpacking the Autosampler

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 129.

Please report any missing or damaged parts to your local Agilent Technologies sales and service office.

Table 5 Agilent 1260 Infinity Standard Autosampler

Description	Quantity
Autosampler	1
Power Cable	1
User Documentation DVD	1

Optimizing the Stack Configuration

If your autosampler is part of a system, you can ensure optimum performance by installing the autosampler in the stack in the position shown in [Figure 8](#) on page 29 and [Figure 9](#) on page 30. [Figure 10](#) on page 31 and [Figure 11](#) on page 31 show the configuration recommended for a thermostatted autosampler. These configurations optimize the system flow path, ensuring minimum delay volume.

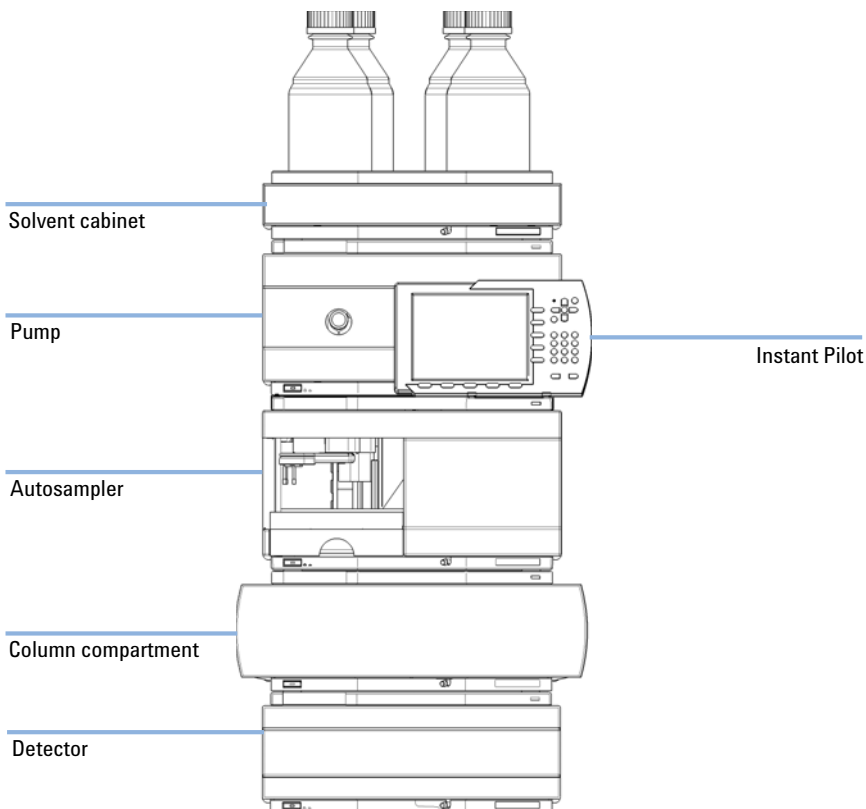


Figure 8 Recommended Stack Configuration for an Autosampler (Front View)

3 Installing the Autosampler

Optimizing the Stack Configuration

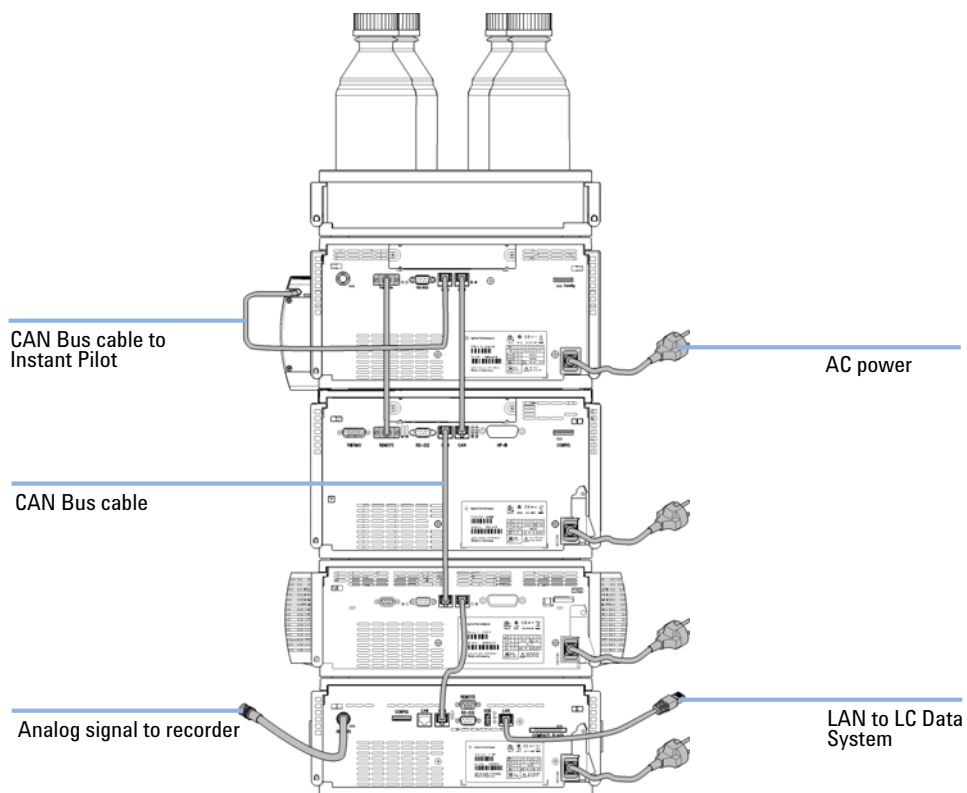


Figure 9 Recommended Stack Configuration for an Autosampler (Rear View)

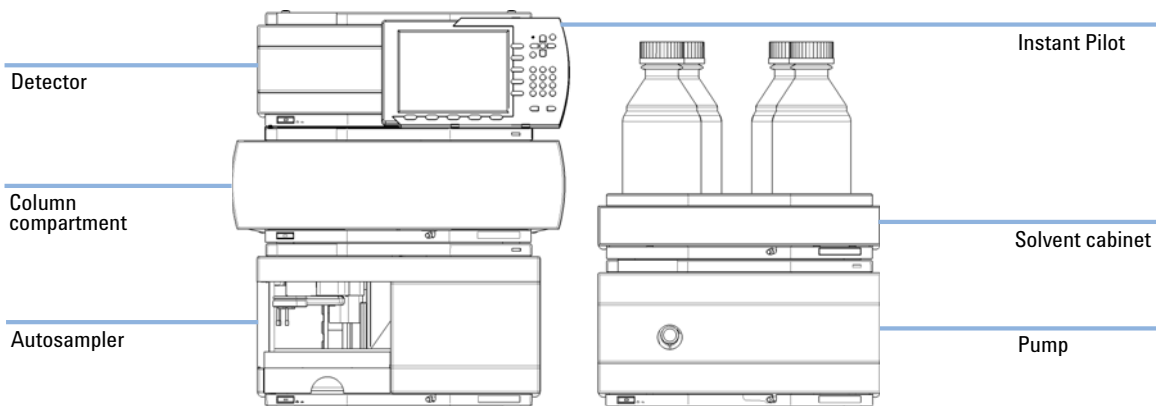


Figure 10 Recommended Stack Configuration for a thermostatted ALS (Front View)

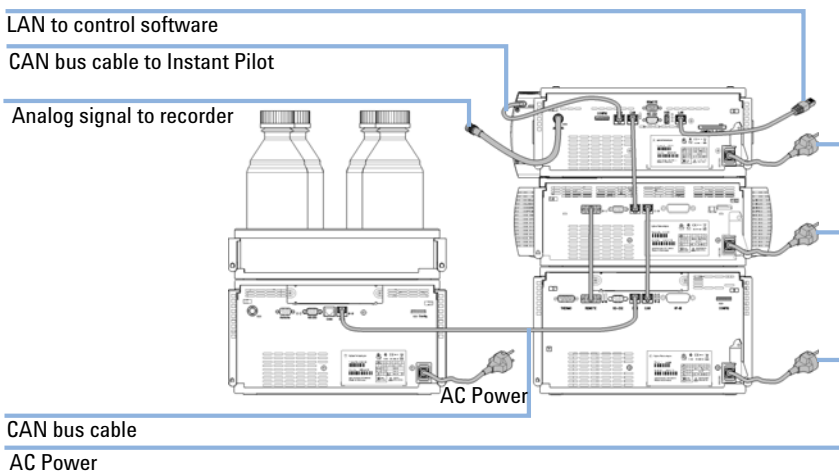


Figure 11 Recommended Stack Configuration for a thermostatted ALS (Rear View)

Installing the Autosampler

Parts required	#	Description
	1	Sampler
	1	Power cord

Software required Agilent Data System and/or Instant Pilot G4208A.

- Preparations**
- Locate bench space
 - Provide power connection
 - Unpack the Sampler

WARNING

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

Risk of stroke and other personal injury. Repair work at the module can lead to personal injuries, e. g. shock hazard, when the module cover is opened and the instrument is connected to power.

- Never perform any adjustment, maintenance or repair of the module with the top cover removed and with the power cord plugged in.
- The security lever at the power input socket prevents that the module cover is taken off when line power is still connected. Never plug the power line back in when cover is removed.

WARNING

Personal injury

To avoid personal injury, keep fingers away from the needle area during autosampler operation.

- Do not bend the safety flap away from its position, or attempt to remove the safety cover.
- Do not attempt to insert or remove a vial from the gripper when the gripper is positioned below the needle.

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.

- 1 Install the LAN interface board in the sampler (if required).
- 2 Remove the adhesive tape which covers the front door.
- 3 Remove the front door and remove the transport protection foam.
- 4 Place the Autosampler on the bench or in the stack as recommended in "Optimizing the Stack Configuration" on page 29.
- 5 Ensure the power switch at the front of the Autosampler is OFF.
- 6 Connect the power cable to the power connector at the rear of the sampler.
- 7 Connect the CAN cable to the other modules.
- 8 If an Agilent ChemStation is the controller, connect the LAN connector to the LAN interface.
- 9 Connect the APG remote cable (optional) for all instruments other than Agilent 1200 Infinity Series.
- 10 Turn ON power by pushing the button at the lower left hand side of the sampler.

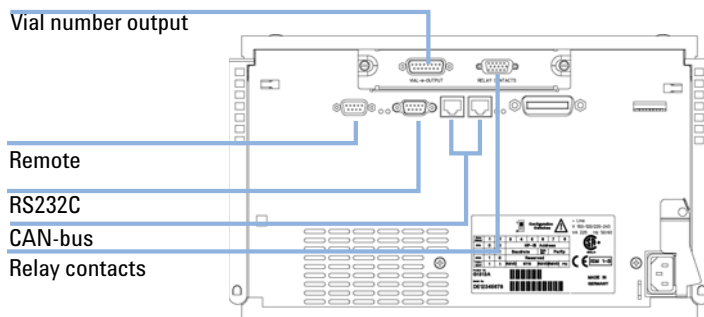


Figure 12 Cable Connections

3 Installing the Autosampler

Installing the Autosampler

NOTE

If the front cover is not installed the autosampler is in a not ready condition and operation is inhibited.

NOTE

The sampler is turned ON when the line power switch is pressed and the green indicator lamp is illuminated. The detector is turned OFF when the line power switch is protruding and the green light is OFF.

Flow Connections

Tools required	Description Parts from the HPLC Tool-Kit
Parts required	Description Parts from the Accessory kit
Preparations	<ul style="list-style-type: none"> • Sampler is installed in the LC system

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

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

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

-
- 1 Connect the pump outlet capillary to port 1 of the injection valve.
 - 2 Connect column-compartment inlet capillary to port 6 of the injection valve.
 - 3 Connect the corrugated waste tube to the solvent waste from the leak plane.
 - 4 Ensure that the waste tube is positioned inside the leak channel.

NOTE

Do not extend the waste capillary of the autosampler. The siphoning effect might empty the complete seat capillary introducing air into the system.

3 Installing the Autosampler

Flow Connections

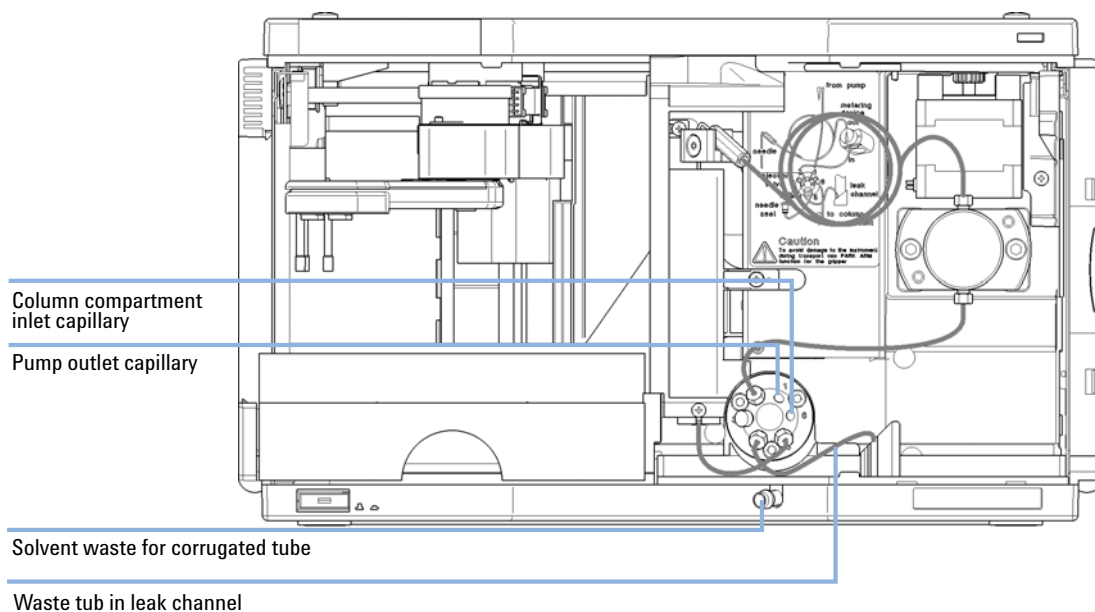


Figure 13 Hydraulic Connections

Installing the Sample Tray

- 1 Open the front door.
- 2 Load the sample tray with sample vials as required.
- 3 Slide the sample tray into the autosampler so that the rear of the sample tray is seated firmly against the rear of the sample-tray area.
- 4 Press the front of the sample tray down to secure the tray in the autosampler.

NOTE

If the thermostatted autosampler tray pops out of position the air channel adapter is not inserted correctly.

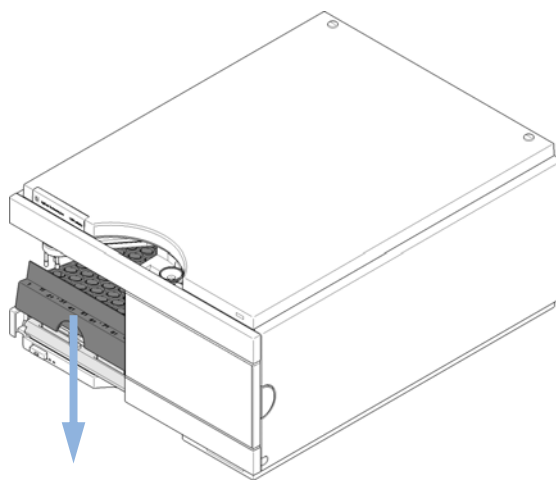


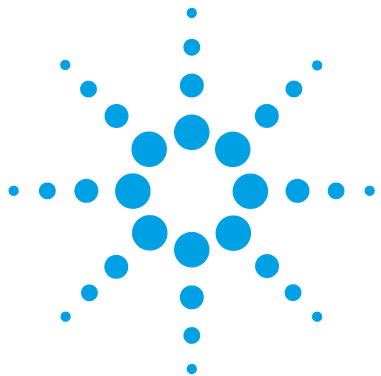
Figure 14 Installing the Sample Tray

Transporting the Autosampler

When moving the autosampler around the laboratory, no special precautions are needed. However, if the autosampler needs to be shipped to another location via carrier, ensure:

- The transport assembly is parked, see [“Park Arm”](#) on page 63;
- The vial tray is secured.

If the autosampler is to be shipped to another location, the transport assembly must be moved to the park position to prevent mechanical damage should the shipping container be subjected to excessive shock. Also, ensure the vial tray is secured in place with suitable packaging, otherwise the tray may become loose and damage internal components.



4 Using the Autosampler

Sample Trays 40

Choice of Vials and Caps 42

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



Sample Trays

Supported trays for the module:

p/n	Description
G1313-44510	Tray for 100 x 2 mL vials
G1313-44513	Halftray for 15 x 6 mL vials
G1313-44512	Halftray for 40 x 2 mL vials
G1329-60011	Thermostatable tray for 100 x 2 mL vials

Half-Tray Combinations

Half-trays can be installed in any combination enabling both 2 mL-and 6 mL-vials to be used simultaneously.

Numbering of Vial Positions

The standard 100-vial tray has vial positions 1 to 100. However, when using two half-trays, the numbering convention is slightly different. The vial positions of the right-hand half tray begin at position 101 as follows:

Left-hand 40-position tray: 1 - 40

Left-hand 15-position tray: 1–15

Right-hand 40-position tray: 101–140

Right-hand 15-position tray: 101–115

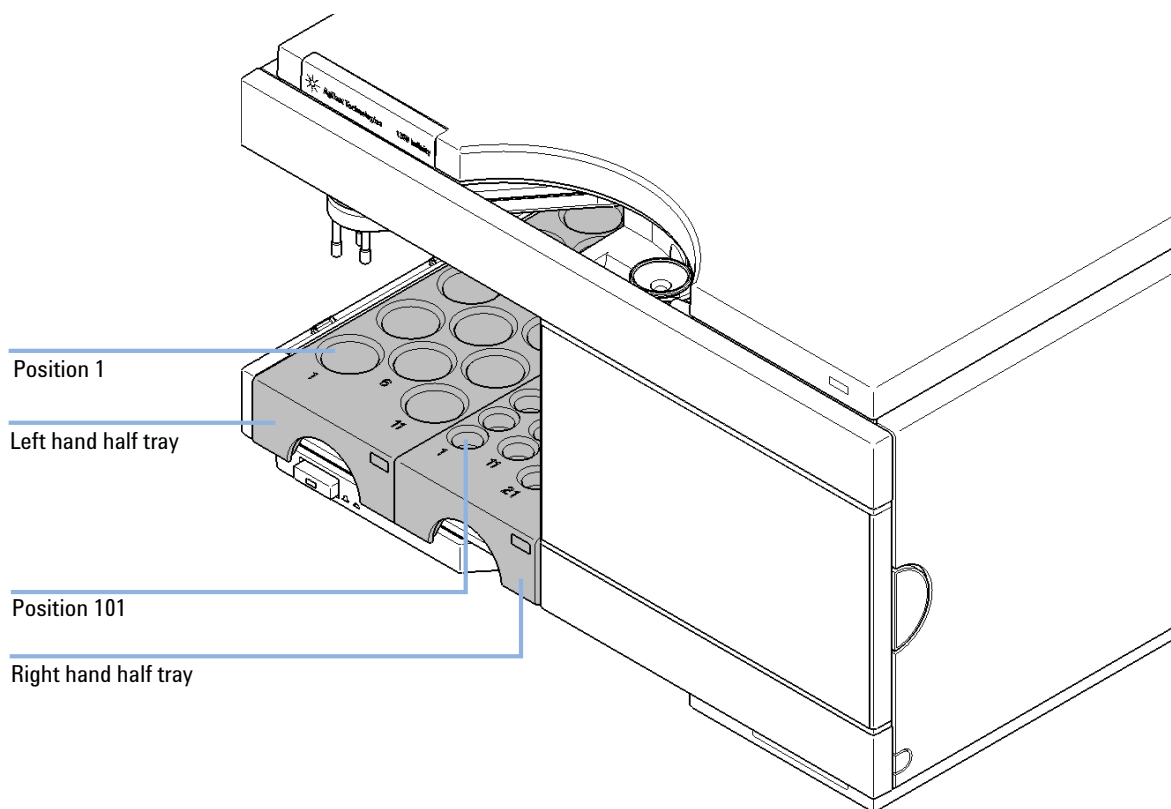


Figure 15 Numbering of Tray Positions

Choice of Vials and Caps

List of Compatible Vials and Caps

For reliable operation vials used with the autosampler must not have tapered shoulders or caps that are wider than the body of the vial. The vials in “[Crimp Top Vials](#)” on page 42, “[Snap Top Vials](#)” on page 43 and “[Screw Top Vials](#)” on page 43 and caps in “[Crimp Caps](#)” on page 44, “[Snap Caps](#)” on page 44 and “[Screw Caps](#)” on page 44 (shown with their Part numbers) have been successfully tested using a minimum of 15,000 injections with the autosampler.

Crimp Top Vials

p/n	Description
5181-3375	Crimp Top Vial, 2 mL, clear glass, 100/Pack
5183-4491	Crimp Top Vial, 2 mL, clear glass, 1000/Pack
5182-0543	Crimp Top Vial, 2 mL, clear glass, write-on spot, 100/Pack
5183-4492	Crimp Top Vial, 2 mL, clear glass, write-on spot, 1000/Pack
5183-4494	Crimp Top Vial, 2 mL, clear glass, write-on spot, 100/Pack (silanized)
5181-3376	Crimp Top Vial, 2 mL, amber glass, write-on spot, 100/Pack
5183-4493	Crimp Top Vial, 2 mL, amber glass, write-on spot, 1000/Pack
5183-4495	Crimp Top Vial, 2 mL, amber glass, write-on spot, 100/Pack (silanized)
5182-0567	Crimp Top Vial, 1 mL, polypropylene, wide opening, 100/Pack
5183-4496	Crimp Top Vial, 1 mL, polypropylene, wide opening, 100/Pack (silanized)
9301-0978	crimp top vial, 0.3 mL, polypropylene, wide opening, 1000/pack

Snap Top Vials

p/n	Description
5182-0544	Snap Top Vial, 2 mL, clear glass, 100/Pack
5183-4504	Snap Top Vial, 2 mL, clear glass, 1000/Pack
5183-4507	Snap Top Vial, 2 mL, clear glass, 100/Pack (silanized)
5182-0546	Snap Top Vial, 2 mL, clear glass, write-on spot, 100/Pack
5183-4505	Snap Top Vial, 2 mL, clear glass, write-on spot, 1000/Pack
5183-4508	Snap Top Vial, 2 mL, clear glass, write-on spot, 100/Pack (silanized)
5182-0545	Snap Top Vial, 2 mL, amber glass, write-on spot, 100/Pack
5183-4506	Snap Top Vial, 2 mL, amber glass, write-on spot, 1000/Pack
5183-4509	Snap Top Vial, 2 mL, amber glass, write-on spot, 100/Pack (silanized)

Screw Top Vials

p/n	Description
5182-0714	Screw Cap Vials, 2 mL, clear glass, 100/Pack
5183-2067	Screw Top Vial, 2 mL, clear glass, 1000/Pack
5183-2070	Screw Top Vial, 2 mL, clear glass, 100/Pack (silanized)
5182-0715	Screw Top Vial, 2 mL, clear glass, write-on spot, 100/Pack
5183-2068	Screw Top Vial, 2 mL, clear glass, write-on spot, 1000/Pack
5183-2071	Screw Top Vial, 2 mL, clear glass, write-on spot, 100/Pack (silanized)
5182-0716	Screw Cap Vial, 2 mL, amber glass, write-on spot, 100/pk
5183-2069	Screw Top Vial, 2 mL, amber glass, write-on spot, 1000/Pack
5183-2072	Screw Top Vial, 2 mL, amber glass, write-on spot, 100/Pack (silanized)

Crimp Caps

p/n	Description
5181-1210	Crimp Cap, silver aluminum, septum (clear PTFE/red rubber), 100/Pack
5183-4498	Crimp Cap, silver aluminum, septum (clear PTFE/red rubber), 1000/Pack
5181-1215	Crimp Cap, blue aluminum, septum (clear PTFE/red rubber), 100/Pack
5181-1216	Crimp Cap, green aluminum, septum (clear PTFE/red rubber), 100/Pack
5181-1217	Crimp Cap, red aluminum, septum (clear PTFE/red rubber), 100/Pack

Snap Caps

p/n	Description
5182-0550	Snap Cap, clear polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-3458	Snap Cap, blue polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-3457	Snap Cap, green polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-3459	Snap Cap, red polypropylene, septum (clear PTFE/red rubber), 100/Pack

Screw Caps

p/n	Description
5182-0717	Screw Cap, blue polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-0718	Screw Cap, green polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-0719	Screw Cap, red polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-0720	Screw Cap, blue polypropylene, septum (clear PTFE/silicone), 100/Pack
5182-0721	Screw Cap, green polypropylene, septum (clear PTFE/silicone), 100/Pack
5182-0722	Screw Cap, red polypropylene, septum (clear PTFE/silicone), 100/Pack



5 Optimizing Performance

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This chapter provides information on how to optimize the module.



Optimization for Lowest Carry-over

Several parts of an injection system can contribute to carry-over:

- needle outside
- needle inside
- needle seat
- sample loop
- seat capillary
- injection valve

The autosampler continuous flow-through design ensures that sample loop, needle inside, seat capillary, and the mainpass of the injection valve is always in the flow line. These parts are continuously flushed during an isocratic and also during a gradient analysis. The residual amount of sample remaining on the outside of the needle after injection may contribute to carry-over in some instances. When using small injection volumes or when injecting samples of low concentration immediately after samples of high concentration, carry-over may become noticeable. Using the automated needle wash enables the carry-over to be minimized and prevents also contamination of the needle seat.

Using the Automated Needle Wash

The automated needle wash can be programmed either as “injection with needle wash” or the needle wash can be included into the injector program. When the automated needle wash is used, the needle is moved into a wash vial after the sample is drawn. By washing the needle after drawing a sample, the sample is removed from the surface of the needle immediately.

Uncapped Wash Vial

For best results, the wash vial should contain solvent in which the sample components are soluble, and the vial should *not* be capped. If the wash vial is capped, small amounts of sample remain on the surface of the septum, which may be carried on the needle to the next sample.

Injector Program with Needle Wash

The injector program includes the command NEEDLE WASH. When this command is included in the injector program, the needle is lowered once into the specified wash vial before injection.

For example:

```
1 DRAW 5 µl
2 NEEDLE WASH vial 7
3 INJECT
```

Line 1 draws 5 µl from the current sample vial. Line 2 moves the needle to vial 7. Line 3 injects the sample (valve switches to main pass).

Using an Injector Program

The process is based on a program that switches the bypass groove of the injection valve into the flow line for cleaning. This switching event is performed at the end of the equilibration time to ensure that the bypass groove is filled with the start concentration of the mobile phase. Otherwise the separation could be influenced, especially if microbore columns are used.

For example:

Outside wash of needle in vial 7 before injection

Injector program:

Draw x.x (y) µl from sample

NEEDLE WASH vial 7

Inject

Wait (equilibration time - see text above)

Valve bypass

Wait 0.2 min

Valve mainpass

Valve bypass

Valve mainpass

NOTE

Overlapped injection together with additional injection valve switching is not possible.

General Recommendation to Lowest Carry-over

- For samples where needle outside cannot be cleaned sufficiently with water or alcohol use wash vials with an appropriate solvent. Using an injector program and several wash vials can be used for cleaning.

In case the needle seat has got contaminated and carry-over is significantly higher than expected, the following procedure can be used to clean the needle seat:

- Go to **MORE INJECTOR** and set needle to home position.
- Pipette an appropriate solvent on to the needle seat. The solvent should be able to dissolve the contamination. If this is not known use 2 or 3 solvents of different polarity. Use several milliliters to clean the seat.
- Clean the needle seat with a tissue and remove all liquid from it.
- **RESET** the injector.

Fast Injection Cycle and Low Delay Volume

Short injection cycle times for high sample throughput is one of the most important requirements in analytical laboratories. In order to shorten cycle times, you can:

- shorten the column length
- use high flow rates
- apply a steep gradient

Having optimized these parameters, further reduction of cycle times can be obtained using the overlapped injection mode.

Overlapped Injection Mode

In this process, as soon as the sample has reached the column, the injection valve is switched back to bypass and the next injection cycle starts but waits with switching to mainpass until the actual run is finished. You gain the sample preparation time when using this process.

Switching the valve into the bypass position reduces the system delay volume, the mobile phase is directed to the column without passing sample loop, needle and needle seat capillary. This can help to have faster cycle times especially if low flow rates have to be used like it is mandatory in narrow bore and micro bore HPLC.

NOTE

Having the valve in bypass position can increase the carry-over in the system.

The injection cycle times also depend on the injection volume. In identically standard condition, injecting 100 µl instead of 1 µl, increase the injection time by approximately 8 sec. In this case and if the viscosity of the sample allows it, the draw and eject speed of the injection system has to be increased.

NOTE

For the last injection of the sequence with overlapped injections it has to be considered that for this run the injection valve is not switched as for the previous runs and consequently the injector delay volume is not bypassed. This means the retention times are prolonged for the last run. Especially at low flow rates this can lead to retention time changes which are too big for the actual calibration table. To overcome this it is recommended to add an additional “blank” injection as last injection to the sequence.

General Recommendations for Fast Injection Cycle Times

As described in this section, the first step to provide short cycle times are optimizing the chromatographic conditions. If this is done the autosampler parameter should be set to:

- Overlapped injection mode
- Increase of draw and eject speed for large injection volumes
- Add at last run a blank, if overlapped injection is used

To reduce the injection time, the detector balance has to be set to OFF.

Precise Injection Volume

Injection Volumes Less Than 2 μL

When the injection valve switches to the BYPASS position, the mobile phase in the sample loop is depressurized. When the syringe begins drawing sample, the pressure of the mobile phase is decreased further. If the mobile phase is not degassed adequately, small gas bubbles may form in the sample loop during the injection sequence. When using injection volumes $< 2 \mu\text{L}$, these gas bubbles may affect the injection-volume precision. For best injection-volume precision with injection volumes $< 2 \mu\text{L}$, use of an Agilent 1260 Infinity degasser is recommended to ensure the mobile phase is adequately degassed. Also, using the automated needle wash (see [“Optimization for Lowest Carry-over”](#) on page 46) between injections reduces carry-over to a minimum, further improving the injection volume precision.

Draw and Eject Speed

Draw Speed

The speed at which the metering unit draws sample out of the vial may have an influence on the injection volume precision when using viscous samples. If the draw speed is too high, air bubbles may form in the sample plug, affecting precision. The default draw speed is 200 $\mu\text{L}/\text{min}$. This speed is suitable for the majority of applications, however, when using viscous samples, set the draw speed to lower speed for optimum results. A DRAW statement in an injector program also uses the draw speed setting which is configured for the autosampler.

Eject Speed

The default eject speed setting is 200 $\mu\text{L}/\text{min}$. When using large injection volumes, setting the eject speed to a higher value speeds up the injection cycle by shortening the time the metering unit requires to eject solvent at the beginning of the injection cycle (when the piston returns to the home position).

An EJECT statement in an injector program also uses the eject speed setting which is configured for the autosampler. A faster eject speed shortens the time required to run the injector program. When using viscous samples, a high eject speed should be avoided.

Choice of Rotor Seal

Vespel™ Seal (for standard valves only)

The standard seal has sealing material made of Vespel. Vespel is suitable for applications using mobile phases within the pH range of 2.3 to 9.5, which is suitable for the majority of applications. However, for applications using mobile phases with pH below 2.3 or above 9.5, the Vespel seal may degrade faster, leading to reduced seal lifetime.

Tefzel™ Seal (for standard valve only)

For mobile phases with pH below 2.3 or above 9.5, or for conditions where the lifetime of the Vespel seal is drastically reduced, a seal made of Tefzel is available. Tefzel is more resistant than Vespel to extremes of pH, however, is a slightly *softer* material. Under normal conditions, the expected lifetime of the Tefzel seal is shorter than the Vespel seal, however, Tefzel may have the longer lifetime under more extreme mobile phase conditions.

PEEK Seal (for preparative injection valve only)

The preparative injection valve has a sealing material made of PEEK. This material has high chemical resistance and versatility. It is suitable for application using mobile phases within a pH between 1 and 14.

This seal is also used for the G1329B module.

NOTE

Strong oxidizing acids such as concentrated nitric and sulfuric acids are not compatible with PEEK.

5 Optimizing Performance

Choice of Rotor Seal



6 Troubleshooting and Diagnostics

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Overview about the troubleshooting and diagnostic features.



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).

Maintenance Functions

The maintenance functions position the needle arm, gripper assembly, and metering device for easy access when doing maintenance (see [“Maintenance Functions”](#) on page 59).

Tray Alignment

Tray alignment is required after repair of internal components, or after a firmware update. The procedure aligns the gripper arm correctly to ensure the positioning of the gripper arm is correct for all vials (see [“Tray Alignment”](#) on page 65).

Step Commands

The step functions provide the possibility to execute each step of the sampling sequence individually. The step functions are used primarily for troubleshooting, and for verification of correct autosampler operation after repair (see [“ALS Step Commands”](#) on page 66).

Status Indicators

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

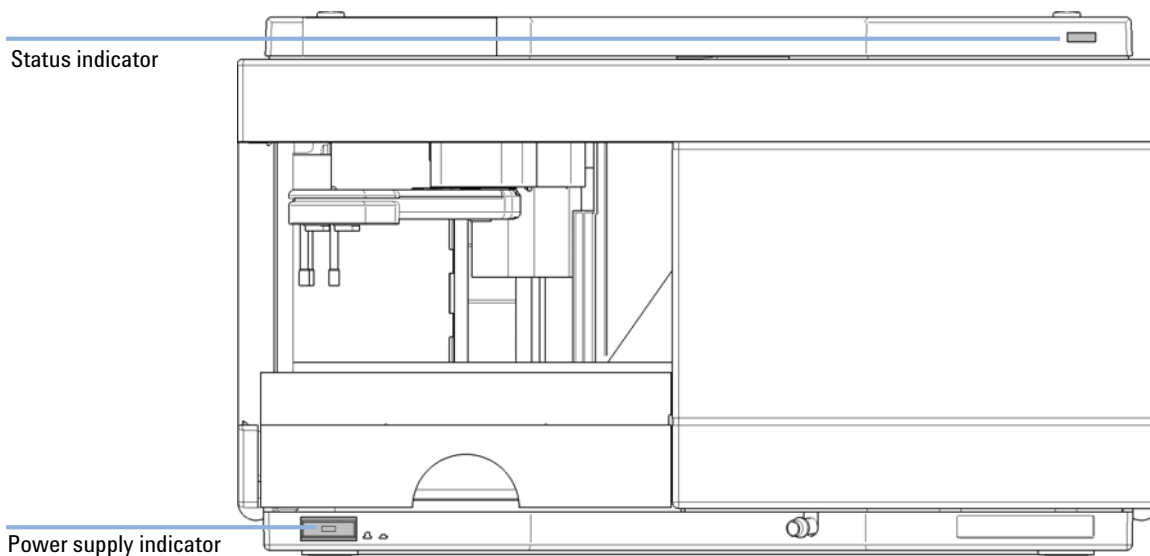


Figure 16 Location of Status Indicators

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 169. Then try a firmware update (see “[Replacing the Module’s Firmware](#)” on page 127). If this does not help, a main board replacement is required.

Maintenance Functions

Certain maintenance procedures require the needle arm, metering device, and gripper assembly to be moved to specific positions to enable easy access to components. The maintenance functions move these assemblies into the appropriate maintenance position. In the Data System the ALS maintenance positions can be selected from the **Maintenance** menu in the **Diagnosis** display.

User Interface

The functions for the control software are:

Change Needle:

moves the safety flap away from the needle, and positions the needle arm for easy access to the needle and needle seat.

Change Piston:

relieves the tension on the metering spring (draws the piston to the outer position), enabling easy disassembly of the metering head assembly).

Park Arm:

secures the gripper arm to the park position behind the sampling unit. ready for transport or shipping of the autosampler.

Home:

moves the tray arm to its home position for better access and exchange of the trays.

Change Gripper:

The change gripper function moves the gripper to the front of the autosampler enabling easy access to the gripper release mechanism.

Change Needle

WARNING

For needle exchange, the needle arm moves down automatically when the front cover is removed.

Risk of personal injury due to moving needle.

→ Keep fingers away from the needle area during needle movement.

The change-needle/seat function moves the safety flap out of position, and positions the needle for easy exchange and alignment of the needle and needle seat.

User Interface

The commands for the Data System are:

NOTE

The autosampler front cover must be in place when Start and End are selected.

Start

Moves the safety flap away from the needle, and positions the needle approximately 15 mm above the needle seat.

Needle Up

Press function key couple of times to move the needle arm up in 2 mm steps.

Needle Down

Press function key couple of times to move the needle arm down in 2 mm steps. The lowest position (end position) is used to align the needle at the correct position in the needle seat.

End

Completes the procedure by moving the gripper arm to the home position, and releasing the safety flap.

Using the Change Needle Function

- 1 Ensure the front cover is installed.
- 2 Select **Start** to move the needle arm to the maintenance position.
- 3 Remove the front cover.

NOTE

Do not remove the front cover until the needle arm is in its maintenance position. Removing the cover while the needle arm is activated may lock up the system.

- 4 Exchange the needle or needle seat (see [“Exchanging the Needle-Seat Assembly”](#) on page 114 and [“Exchanging the Needle Assembly”](#) on page 111).
- 5 Replace the front cover.
- 6 Select **End** to complete the procedure.

Change Piston

The change-piston function draws the piston away from the home position, relieving the tension on the spring. In this position, the analytical head assembly can be removed and reinstalled easily after maintenance.

User Interface

The commands for the control software are:

Start

Draws the piston away from the home position, relieving the tension on the spring.

End

Repositions the piston at the home position.

Using the Change Seal Function

- 1 Select **Start** to move the piston to the maintenance position.
- 2 Exchange the metering seal (see [“Exchanging the Gripper Arm”](#) on page 124).
- 3 Select **End** to move the piston back to the home position.

Park Arm

User Interface

In the control software the Park Arm command is part of the ALS maintenance positions that can be selected from the Maintenance menu in the Diagnosis display.

The commands for the control software are:

Park Arm

moves the gripper arm to the park position.

Home

moves the gripper arm out of the park position to the home position.

To prepare autosampler for transportation

The park arm function moves the gripper and transport slider to the home position behind the sampling unit, and lowers the gripper arm into the park position where the transport assembly is secured against a mechanical stop. The autosampler can be switched OFF after parking the arm.

When

Before transporting or shipping the autosampler.

CAUTION

Unsecured Transportation of Autosampler

Unsecured transportation of the autosampler may result in mechanical damage to the gripper and transport slider.

→ Always secure the arm in the park position.

NOTE

Before parking the gripper arm, ensure there is no vial in the gripper. Use the **Release Gripper** function to remove the vial.

- 1 Select **Park Arm**.
- 2 When the arm is in the park position, the autosampler is ready for shipment, and can be switched OFF.

Change Gripper

The change gripper function moves the gripper to the front of the autosampler enabling easy access to the gripper release mechanism.

User Interface

The commands for the control software are:

Start

Moves the transport assembly and gripper arm to the position required to change the gripper arm.

End

Repositions the transport assembly and gripper arm to the home position.

Using the Change Seal Function

- 1 Select **Start** to move the gripper arm to the maintenance position.
- 2 Exchange the gripper arm (see [“Exchanging the Gripper Arm”](#) on page 124).
- 3 Select **End** to move the gripper arm to the home position.

Tray Alignment

Tray alignment is required to compensate for small deviations in positioning of the gripper which may occur after disassembling the module for repair.

The tray alignment procedure uses several tray positions as reference points. Because the tray is a rectangle, a two-point alignment is sufficient to correct all other vial positions within the tray. On completion of the procedure, the corrected gripper positions are stored in the instrument firmware.

ALS Step Commands

Each movement of the sampling sequence can be done under manual control. This is useful during troubleshooting, where close observation of each of the sampling steps is required to confirm a specific failure mode or verify successful completion of a repair.

Each injector step command actually consists of a series of individual commands that move the autosampler components to predefined positions, enabling the specific step to be done.

Table 6 Injector step commands

Step	Action	Comments
Valve Bypass	Switches injection valve to the bypass position.	
Plunger Home	Moves the plunger to the home position.	
Needle Up	Lifts the needle arm to the upper position.	Command also switches the valve to bypass if it is not already in that position.
Vial to Seat	Moves the selected vial to the seat position.	Command also lifts the needle to the upper position.
Needle into Sample	Lowere the needle into the sample.	Command also positions the vial at the seat, and lifts the needle to the upper position.
Draw	Metering device draws the defined injection volume.	Command also positions the vial at the seat, lifts the needle, and lowers the needle into vial. Command can be done more than once (maximum draw volume of 100 µL cannot be exceeded). Use Plunger Home to reset the metering device.
Needle Up	Lifts the needle out of the vial.	Command also switches the valve to bypass if it is not already in that position.
Vial to Tray	Returns the selected vial to the tray position.	Command also lifts the needle to the upper position.

Table 6 Injector step commands

Step	Action	Comments
Needle into Seat	Lowere the needle arm into the seat.	Command also returns the vial to the tray position.
Valve Mainpass	Switches the injection valve to the mainpass position.	
Reset	Resets the injector.	

Troubleshooting

If the autosampler is unable to perform a specific step due to a hardware failure, an error message is generated. You can use the injector steps to do the injection sequence, while observing how the instrument responds. [Table 7](#) on page 68 summarizes the injector steps, and lists the associated error messages and probable causes of step failures.

Table 7 Step Failures

Step Function	Probable Failure Modes
Bypass	Valve already in bypass. Valve not connected. Defective injection valve.
Piston Home	Defective or dirty sensor on the sampling-unit flex board. Defective metering-drive motor.
Needle Up	Needle already in the upper position. Defective or dirty sensor on the sampling-unit flex board. Sticking needle-arm assembly. Defective needle-drive motor.
Vial to Seat	No vial in selected position. Vial already in seat position. Defective transport assembly motors. Sticking transport assembly. Defective gripper assembly. Gripper not aligned (see “Tray Alignment” on page 65).
Draw	Sum of all draw volumes exceeds 100µl. Defective metering-drive motor.
Needle Up	Needle already in the upper position. Needle already in the upper position. Defective or dirty sensor on the sampling-unit flex board. Sticking needle-arm assembly. Defective needle-drive motor.

Table 7 Step Failures

Step Function	Probable Failure Modes
Vial to Tray	Defective transport assembly motors. Sticking transport assembly. Defective gripper assembly. Gripper not aligned (see “Tray Alignment” on page 65).
Needle Down	Needle already in the lower position. Defective or dirty sensor on the sampling-unit flex board. Sticking needle-arm assembly. Defective needle-drive motor.
Mainpass	Valve already in mainpass. Valve not connected. Defective injection valve.
Needle Up/Mainpass	Blockage in the sample loop or needle (no solvent flow). Needle already in the upper position. Defective or dirty sensor on the sampling-unit flex board. Sticking needle-arm assembly. Defective needle-drive motor. Valve already in mainpass. Valve not connected. Defective injection valve.

Troubleshooting Guide for the Sample Transport Assembly

This troubleshooting guide is meant to help you diagnose and repair autosampler problems.

In general, autosampler problems can be divided into three categories.

- 1 Intermittent lock-ups with or without vial in the gripper fingers with error messages

Many times the sampler is being used very heavily.

- **motor overtemp** (0 or 1 or 2 or 3)
- **movement failed** (0 or 1 or 2 or 3)
- **missing vial**

- 2 Jittery (shaky) movement in X and/or theta axes and/or when the needle goes through the gripper arm into the vial with error messages

- **motor overtemp** (0 or 2)
- **movement failed** (0 or 2)

- 3 Poor alignment, seen during vial pickup and vial replacement and/or when the needle hits the gripper arm with error messages

- **motor overtemp** (0 or 2 or 3)
- **movement failed** (0 or 2 or 3)
- **missing vial**

NOTE

Motor 0=X; 1=Z; 2=Theta; 3=Gripper.

Intermittent lock-ups with or without vial in the gripper fingers

With error messages

- **motor overtemp** (0 or 1 or 2 or 3)
- **movement failed** (0 or 1 or 2 or 3)
- **missing vial**

WARNING

Personal damage, damage to the module

- Some of these procedures require a trained service engineer. Persons who are not qualified **MUST NOT** perform these procedures.

NOTE

When a motor over temperature message has occurred, the sampler must be turned OFF for about 10 minutes to allow the motor to cool down.

- 1 Check the vials and the caps.

For reliable operation, vials used with the autosampler must not have tapered shoulders or caps that are wider than the body of the vial. For more details see the *service note G1313-017*.

- 2 Very heavy usage - use a macro.

A pre-sequence macro, `inj_rset.mac` will automatically reset the sampler at the start of a sequence (ChemStation).

- 3 Reset the sampler alignment to default value.

Reset tray alignment, and transport alignment is possible with the Control Module and the ChemStation. To reset the transport alignment with the ChemStation, enter following command in the command line.

```
Print sendmodule$(lals, "tray:align 0.00,0.00")
```

4 Check the tension of the belts.

For this use the **ALS Torque Verification** in LabAdvisor and measure the torque for each axis.

Table 8

Typical ranges	Theta (both) 30-50
	X-axis (both) 50-90
	Z-axis (both) 90-130
	Gripper open 30-65
	Gripper closed maximum 30

NOTE

If the Gripper open/closed torque is not in the range, proceed with step 5 on page 72. If the theta or X torque is not in the range, proceed with step 6 on page 72 (if you think you can adjust the torque), otherwise proceed with step 7 on page 72.

5 Exchange the gripper arm assembly (part number G1313-60010).

6 Adjust the belts tension.

- If the measured torque value is too low, the belt needs to be tightened.
- If the measured torque value is too high, the belt needs to be loosened.

For this, slide the motor (X or theta) on the holder bracket in the appropriate direction and test the tension with the **ALS Torque Verification** in LabAdvisor. Repeat this steps until the values are in the appropriate torque range.

7 If these measures don't resolve the problem, it is necessary to exchange the transport assembly or the main board. To do this, please contact your Agilent service representative.

Jittery (shaky) movement in X and/or theta axes and/or when the needle goes through the gripper arm into the vial

With Error messages

- **motor overtemp** (0 or 2)
- **movement failed** (0 or 2)

WARNING

Personal damage, damage to the module

→ Some of these procedures require a trained service engineer. Persons who are not qualified **MUST NOT** perform these procedures.

NOTE

When a motor over temperature message has occurred, the sampler must be turned OFF for about 10 minutes to allow the motor to cool down.

1 Check the cleanliness of the transport rods (X-axis) and clean them.

NOTE

DO NOT lubricate the transport rod.

2 Lubricate the X-gear.

Friction can result in the belt slipping on the gear so that the position of the belt teeth towards the gear changes.

To avoid this, apply some grease from the sample transport repair kit to the X-motor-gear.

NOTE

Do not use other grease as the one in the kit and carefully follow the instruction from the technical note.

3 Check the tension of the belts.

For this use the **ALS Torque Verification** in LabAdvisor and measure the torque for theta and X-axis.

Table 9

Typical ranges	Theta (both) 30-50
	X-axis (both) 50-90

- If the theta or X torque is not in the range, proceed with step 4 on page 74 (if you think you can adjust the torque). Otherwise proceed with step 6 on page 74.

4 Adjust the belts tension.

- If the measured torque value is too low, the belt needs to be tightened.
- If the measured torque value is too high, the belt needs to be loosened.

For this, slide the motor (X or theta) on the holder bracket in the appropriate direction and test the tension with the **ALS Torque Verification** in LabAdvisor. Repeat this steps until the values are in the appropriate torque range.

5 Reset the sampler alignment to default value.

Reset tray alignment, and transport alignment is possible with the Control Module and the ChemStation. To reset the transport alignment with the ChemStation, enter following command in the command line.

Print sendmodule\$(lals, "tray:align 0.00,0.00")

6 If these measures don't resolve the problem, it is necessary to exchange the transport assembly or the main board. To do this, please contact your Agilent service representative.

Poor alignment

With Error messages

- **motor overtemp** (0 or 2 or 3)
- **movement failed** (0 or 2 or 3)

WARNING

Personal damage, damage to the module

→ Some of these procedures require a trained service engineer. Persons who are not qualified **MUST NOT** perform these procedures.

NOTE

When a motor over temperature message has occurred, the sampler must be turned OFF for about 10 minutes to allow the motor to cool down.

- 1 Reset the sampler alignment to default value.

Reset tray alignment, and transport alignment is possible with the Control Module and the Chemstation. To reset the transport alignment with the Chemstation enter following command in the command line:

```
Print sendmodule$(lals, "tray:align 0.00,0.00")
```

- 2 Lubricate the X-gear.

Friction can result in the belt slipping on the gear so that the position of the belt teeth towards the gear changes. To avoid this, apply some grease from the sample transport repair kit to the X-motor-gear.

NOTE

Do not use other grease as the one in the kit and carefully follow the instruction from the technical note.

- 3** Check the tension of the belts.
- For this use the **ALS Torque Verification** in LabAdvisor and measure the torque for each axis.

Table 10

Typical ranges	Theta (both) 30-50
	X-axis (both) 50-90
	Z-axis (both) 90-130
	Gripper open 30-65
	Gripper closed maximum 30

- 4** Exchange Gripper assembly (G1313-60010).
- For exchange procedure see [“Exchanging the Gripper Arm”](#) on page 124.
- 5** If these measures don't resolve the problem, it is necessary to exchange the transport assembly or the main board. To do this, please contact your Agilent service representative.

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.



7 Error Information

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

What are Error Messages

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

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

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

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

General Error Messages

Timeout

Error ID: 0062

The timeout threshold was exceeded.

Probable cause

- 1 The analysis was completed successfully, and the timeout function switched off the module as requested.
- 2 A not-ready condition was present during a sequence or multiple-injection run for a period longer than the timeout threshold.

Suggested actions

Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required.

Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required.

Shutdown

Error ID: 0063

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

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

Probable cause

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

Suggested actions

Fix the leak in the external instrument before restarting the module.

Fix the leak in the external instrument before restarting the module.

Check external instruments for a shut-down condition.

Check the vacuum degasser for an error condition. Refer to the *Service Manual* for the degasser or the 1260 pump that has the degasser built-in.

Remote Timeout

Error ID: 0070

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

Probable cause

- 1 Not-ready condition in one of the instruments connected to the remote line.
- 2 Defective remote cable.
- 3 Defective components in the instrument showing the not-ready condition.

Suggested actions

- Ensure the instrument showing the not-ready condition is installed correctly, and is set up correctly for analysis.
- Exchange the remote cable.
- 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

- 1 CAN cable disconnected.
- 2 Defective CAN cable.
- 3 Defective main board in another module.

Suggested actions

- Ensure all the CAN cables are connected correctly.
 - Ensure all CAN cables are installed correctly.
- Exchange the CAN cable.
- Switch off the system. Restart the system, and determine which module or modules are not recognized by the system.

Leak

Error ID: 0064

A leak was detected in the module.

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

Probable cause

- 1 Loose fittings.
- 2 Broken capillary.
- 3 Leaking rotor seal or needle seat.
- 4 Defective metering seal.

Suggested actions

- Ensure all fittings are tight.
- Exchange defective capillaries.
- Exchange the rotor seal or seat capillary.
- Exchange the metering seal.
- *Make sure the leak sensor is thoroughly dry before restarting the autosampler.*

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

- 1 Leak sensor not connected to the main board.
- 2 Defective leak sensor.
- 3 Leak sensor incorrectly routed, being pinched by a metal component.

Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

Leak Sensor Short

Error ID: 0082

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

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

Probable cause

- Defective leak sensor.
- Leak sensor incorrectly routed, being pinched by a metal component.

Suggested actions

- Please contact your Agilent service representative.
- 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

- Defective main board.

Suggested actions

- 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

- 1 Defective main board.

Suggested actions

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.

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

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

Probable cause

- 1 Fan cable disconnected.
- 2 Defective fan.
- 3 Defective main board.

Suggested actions

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Open Cover

Error ID: 0205

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, the fan is switched off, and the error message is generated.

Probable cause

- 1 The top foam was removed during operation.
- 2 Foam not activating the sensor.
- 3 Defective sensor or main board.

Suggested actions

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Restart Without Cover

Error ID: 2502

The module was restarted with the top cover and foam open.

The sensor on the main board detects when the top foam is in place. If the module is restarted with the foam removed, the module switches off within 30 s, and the error message is generated.

Probable cause

- 1 The module started with the top cover and foam removed.

Suggested actions

Please contact your Agilent service representative.

Autosampler Error Messages

Front door open

Error ID: 4350

A sensor on the flex board measures the contact to the magnet in the front door. If there is no contact and you try to start operation, the error message is generated.

Probable cause

- 1** The door is not in place, bent or the magnet is misplaced.
- 2** The sensor on the flex board is defective.

Suggested actions

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Arm Movement Failed

Error ID: 4002

The transport assembly was unable to complete a movement in one of the axes.

The processor defines a certain time window for the successful completion of a movement in any particular axis. The movement and position of the transport assembly is monitored by the encoders on the stepper motors. If the processor does not receive the correct position information from the encoders within the time window, the error message is generated.

See figure [Figure 7](#) on page 18 for axes identification.

- **Arm Movement 0 Failed:** X-axis.
Arm Movement 1 Failed: Z-axis.
Arm Movement 2 Failed: Theta (gripper rotation).
Arm Movement 3 Failed: Gripper (gripper fingers open/close).

Probable cause	Suggested actions
1 Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
2 High friction in the transport assembly.	Please contact your Agilent service representative.
3 Defective motor assembly.	Please contact your Agilent service representative.
4 Defective sample transport assembly flex board.	Please contact your Agilent service representative.
5 Defective main board.	Please contact your Agilent service representative.

Valve to Bypass Failed

Error ID: 4014, 4701

The injection valve failed to switch to the bypass position.

The switching of the injection valve is monitored by two microswitches on the valve assembly. The switches detect the successful completion of the valve movement. If the valve fails to reach the bypass position, or if the microswitch does not close, the error message is generated.

Probable cause

- 1 Defective injection valve.
- 2 Defective main board.

Suggested actions

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Valve to Mainpass Failed

Error ID: 4015

The injection valve failed to switch to the mainpass position.

The switching of the injection valve is monitored by two microswitches on the valve assembly. The switches detect the successful completion of the valve movement. If the valve fails to reach the mainpass position, or if the microswitch does not close, the error message is generated.

Probable cause

- 1 Defective injection valve.
- 2 Defective main board.

Suggested actions

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Needle Up Failed

Error ID: 4017

The needle arm failed to move successfully from the seat or out of the vial to the upper position.

The upper position of the needle arm is monitored by a position sensor on the sampling unit flex board. The sensor detects the successful completion of the needle movement to the upper position. If the needle fails to reach the end point, or if the sensor fails to recognize the needle arm movement, the error message is generated.

Probable cause

- 1 Defective or dirty position sensor.
- 2 Defective motor.
- 3 Sticking spindle assembly.
- 4 Defective main board.

Suggested actions

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Needle Down Failed

Error ID: 4018

The needle arm failed to move down into the needle seat.

The lower position of the needle arm is monitored by a position sensor on the sampling unit flex board. The sensor detects the successful completion of the needle movement to the needle seat position. If the needle fails to reach the end point, or if the sensor fails to recognize the needle arm movement, the error message is generated.

Probable cause

- 1** Needle installed incorrectly, or wrong needle type (too long).
- 2** Defective or dirty position sensor.
- 3** Defective motor.
- 4** Sticking spindle assembly.
- 5** Defective main board.

Suggested actions

Ensure the correct needle type is used, and installed correctly.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Missing Vial

Error ID: 4019, 4034, 4541, 4706

No vial was found in the position defined in the method or sequence.

When the gripper arm picks a vial out of the sample tray, the processor monitors the gripper motor encoder. If a vial is present, the closing of the gripper fingers is limited by the vial. However, if no vial is present, the gripper fingers close too far. This is sensed by the processor (encoder position), causing the error message to be generated.

Probable cause

Suggested actions

- | | |
|--|--|
| 1 No vial in the position defined in the method or sequence. | Install the sample vial in the correct position, or edit the method or sequence accordingly. |
| 2 Incorrect gripper alignment. | Align gripper. |
| 3 Defective gripper assembly (defective gripper fingers or belt). | Exchange the gripper assembly. |
| 4 Defective transport assembly flex board. | Please contact your Agilent service representative. |

Initialization Failed

Error ID: 4020

The autosampler failed to complete initialization correctly.

The autosampler initialization procedure moves the needle arm and transport assembly to their home positions in a predefined sequence. During initialization, the processor monitors the position sensors and motor encoders to check for correct movement. If one or more of the movements is not successful, or is not detected, the error message is generated.

Probable cause	Suggested actions
1 Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
2 Defective sampling unit flex board.	Please contact your Agilent service representative.
3 Defective transport assembly flex board.	Please contact your Agilent service representative.
4 Defective sampling unit motor.	Please contact your Agilent service representative.
5 Defective main board.	Please contact your Agilent service representative.

Metering Home Failed

Error ID: 4054, 4704

The metering piston has failed to move back to the home position.

The home position sensor on the sampling unit flex board monitors the home position of the piston. If the piston fails to move to the home position, or if the sensor fails to recognize the piston position, the error message is generated.

Probable cause

- 1 Dirty or defective sensor.
- 2 Broken piston.
- 3 Defective metering-drive motor.
- 4 Defective main board.

Suggested actions

- Please contact your Agilent service representative.
- Exchange the metering piston and seal.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

Motor Temperature

Error ID: 4027, 4040, 4261, 4451

One of the motors of the transport assembly has drawn excessive current, causing the motor to become too hot. The processor has switched OFF the motor to prevent damage to the motor.

See figure [Figure 7](#) on page 18 for motor identification.

- **Motor 0 temperature:** X-axis motor.
- Motor 1 temperature:** Z-axis motor.
- Motor 2 temperature:** Theta (gripper rotation) motor.
- Motor 3 temperature:** Gripper motor (motor for gripper fingers).

The processor monitors the current drawn by each motor and the time the motor is drawing current. The current drawn by the motors is dependent on the load on each motor (friction, mass of components etc.). If the current drawn is too high, or the time the motor draws current is too long, the error message is generated.

Probable cause	Suggested actions
1 Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
2 High friction in the transport assembly.	Please contact your Agilent service representative.
3 Motor belt tension too high.	Switch OFF the autosampler at the power switch. Wait at least 10 min before switching on again.
4 Defective motor.	Please contact your Agilent service representative.
5 Defective transport assembly flex board.	Please contact your Agilent service representative.

Initialization with Vial

Error ID: 4028

The autosampler attempted to initialize with a vial still in the gripper.

During initialization, the autosampler checks correct operation of the gripper by closing and opening the gripper fingers while monitoring the motor encoder. If a vial is still in the gripper when initialization is started, the gripper fingers cannot close causing the error message to be generated.

Probable cause

- 1 Vial still in gripper.

Suggested actions

Remove the vial using the **Release Vial** function in the user interface. Reinitialize the autosampler.

Safety Flap Missing

Error ID: 4032

The safety flap was not detected.

Before the needle moves down into the needle seat to inject sample, the safety flap locks into position. Next, the gripper checks the safety flap by trying to move the safety flap away from the needle. If the gripper is able to move beyond the safety flap position (safety flap not in position), the error message is generated.

Probable cause

- 1 Safety flap missing or broken.

Suggested actions

Please contact your Agilent service representative.

Vial in Gripper

Error ID: 4033

The gripper arm attempted to move with a vial still in the gripper.

During specific stages of the sampling sequence, no vial should be held by the gripper. The autosampler checks if a sample vial is stuck in the gripper by closing and opening the gripper fingers while monitoring the motor encoder. If the gripper fingers are unable to close, the error message is generated.

Probable cause

- 1 Vial still in gripper.

Suggested actions

Remove the vial using the **Release Vial** function in the user interface. Reinitialize the autosampler.

Missing Wash Vial

Error ID: 4035, 4542, 4707

The wash vial programmed in the method was not found.

When the gripper arm picks a vial out of the sample tray, the processor monitors the gripper motor encoder. If a vial is present, the closing of the gripper fingers is limited by the vial. However, if no vial is present, the gripper fingers close too far. This is sensed by the processor (encoder position), causing the error message to be generated.

Probable cause

- 1 No wash vial in the position defined in the method.

Suggested actions

Install the wash vial in the correct position, or edit the method accordingly.

Invalid Vial Position

Error ID: 4042

The vial position defined in the method or sequence does not exist.

The reflection sensors on the transport assembly flex board are used to automatically check which sample trays are installed (coding on tray). If the vial position does not exist in the current sample tray configuration, the error message is generated.

Probable cause

- 1 Incorrect tray or trays installed.
- 2 Incorrect vial positions defined in the method or sequence.
- 3 Tray recognition defective (dirty sample tray or defective transport assembly flex board).

Suggested actions

- Install the correct trays, or edit the method or sequence accordingly.
- Check method settings vs. installed tray.
- Ensure the coding surfaces of the sample tray are clean (located at the rear of the sample tray). If this does not solve the problem, replace the transport assembly.

7 Error Information

Autosampler Error Messages



8 Maintenance

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This chapter describes the maintenance of the module.



Introduction to Maintenance

The module is designed for easy maintenance. Maintenance can be done from the front with module in place in the system stack.

NOTE

There are no serviceable parts inside.

Do not open the module.

Cautions and Warnings

WARNING

Personal injury or damage to the product

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

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

WARNING

Sharp metal edges

Sharp-edged parts of the equipment may cause injuries.

- To prevent personal injury, be careful when getting in contact with sharp metal areas.
-

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.
-

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.
-

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.
-

NOTE

The electronics of the autosampler will not allow operation of the autosampler when the top cover and the top foam are removed. A safety light switch on the main board will inhibit the operation of the fan immediately. Voltages for the other electronic components will be turned off after 30 seconds. The status lamp will light up red and an error will be logged into the logbook of the user interface. Always operate the autosampler with the top covers in place.

Updating the Firmware

The Modules are fitted with FLASH EPROMS. These EPROMS enable you to update the instrument firmware from the LabAdvisor, Instant Pilot (G4208A), LC Firmware Tool. See also [“Replacing the Module’s Firmware”](#) on page 127.

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.
-

Safety Flap, Flex Board

It is strongly recommended that the exchange of the safety flap, and flex board is done by Agilent-trained service personnel.

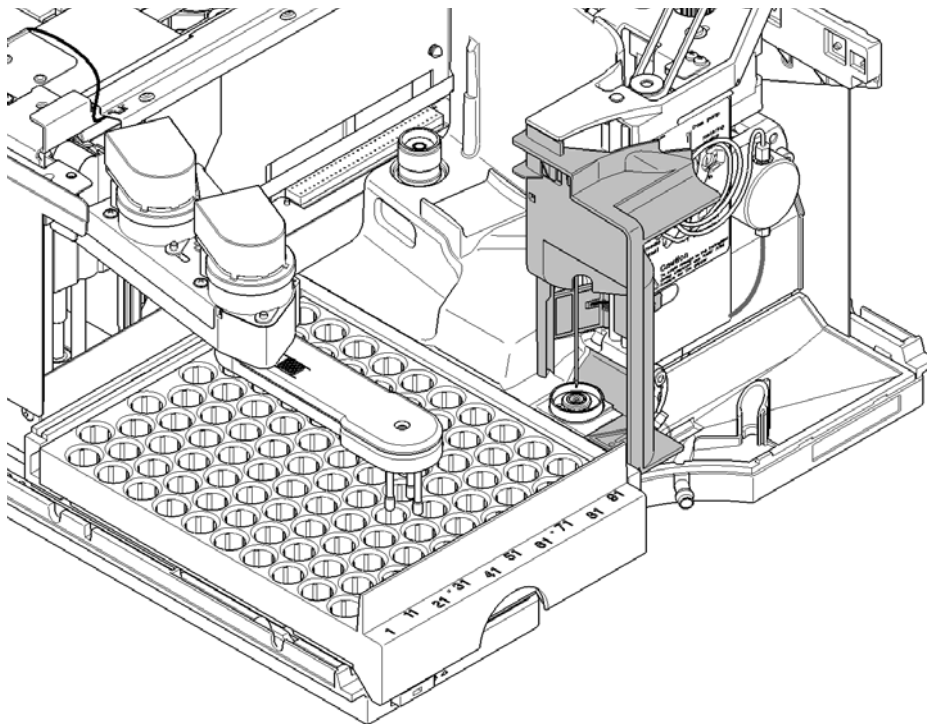


Figure 17 Safety Flap

Transport Assembly Parts

The adjustment of the motors, and the tension on the drive belts are important for correct operation of the transport assembly. It is strongly recommended that exchange of drive belts, and the gripper assembly is done by Agilent-trained service personnel. There are no other field-replaceable parts in the transport assembly. If any other component is defective (flex board, spindles, plastic parts) the complete unit must be exchanged.

Maintenance Functions

Certain maintenance procedures require the needle arm, metering device, and gripper assembly to be moved to specific positions to enable easy access to components. The maintenance functions move these assemblies into the appropriate maintenance position. For details, refer to “[Maintenance Functions](#)” on page 59.

Simple Repairs

The procedures described in this section can be done with the autosampler in place in the stack. You will do some of these procedures on a more frequent basis.

Table 11 Maintenance Procedures

Procedure	Typical Frequency	Time Required	Notes
Exchanging the needle assembly	When needle shows indication of damage or blockage	15 minutes	See “Exchanging the Needle Assembly” on page 111
Exchanging the seat assembly	When the seat shows indication of damage or blockage	10 minutes	See “Exchanging the Needle-Seat Assembly” on page 114
Exchanging the rotor seal	After approximately 30000 to 40000 injections, or when the valve performance shows indication of leakage or wear	30 minutes	See “Exchanging the Rotor Seal” on page 116
Exchanging the metering seal	When autosampler reproducibility indicates seal wear	30 minutes	See “Exchanging the Metering Seal and Piston” on page 120
Exchanging the gripper arm	When the gripper arm is defective	10 minutes	See “Exchanging the Gripper Arm” on page 124

Exchanging the Needle Assembly

When When the needle is visibly damaged
When the needle is blocked

Tools required **Description**
Wrench, 1/4 inch (supplied in HPLC Tool-Kit)
Hexagonal key, 2.5 mm (supplied in HPLC Tool-Kit)
Pair of pliers

Parts required	#	p/n	Description
	1	G1313-87201	Needle assembly
OR	1	G1313-87202	Needle assembly (900 µL)

Preparations

- Select **Start** in the maintenance function **Change Needle** (see “[Change Needle](#)” on page 60).
- When the needle is positioned approx.15 mm above the needle seat, remove the front cover.

WARNING

Personal injury

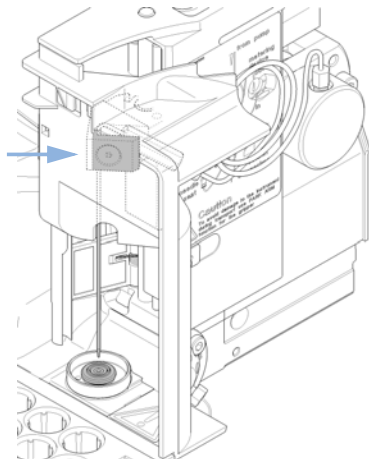
To avoid personal injury, keep fingers away from the needle area during autosampler operation.

- Do not bend the safety flap away from its position, or attempt to remove the safety cover.
- Do not attempt to insert or remove a vial from the gripper when the gripper is positioned below the needle.

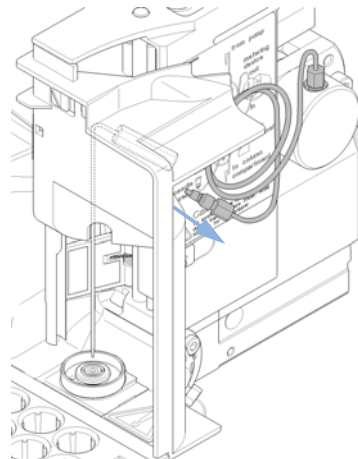
8 Maintenance

Exchanging the Needle Assembly

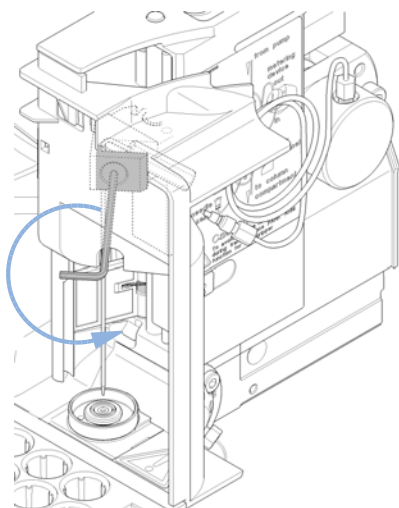
- 1** Select **Needle Down** until the needle screw is aligned with the hole in the safety cover.



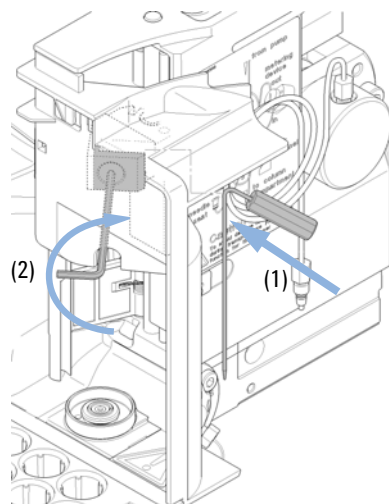
- 2** Remove the sample-loop fitting from the needle fitting.



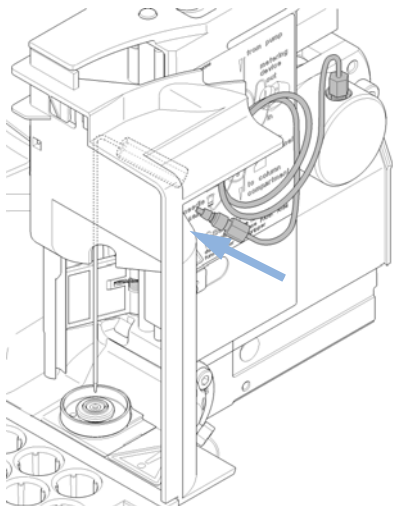
- 3** Loosen the fixing screw, and lift out the needle.



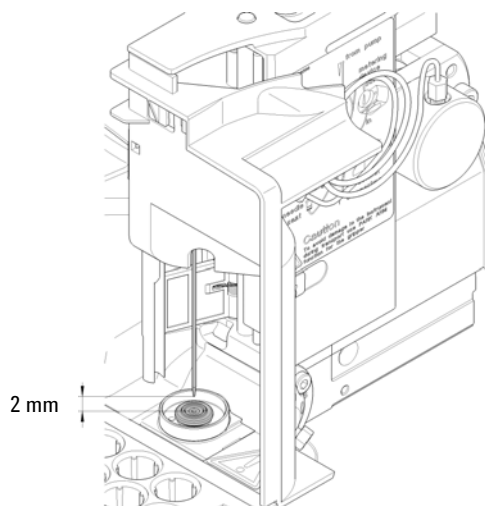
- 4** Insert the new needle (1). Align the needle in the seat, then tighten the screw firmly (2).



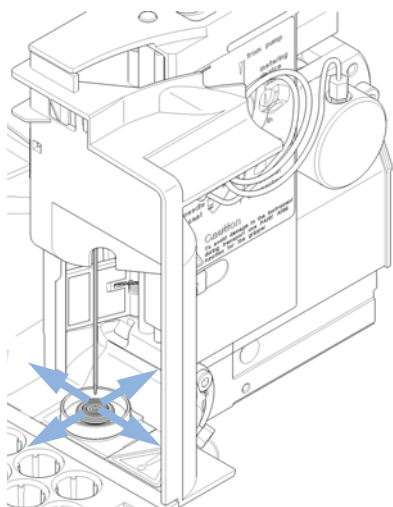
- 5** Reconnect the sample-loop fitting to the needle fitting.



- 6** Use **Needle Up** to lift the needle to a position approximately 2 mm above the seat.



- 7** Ensure the needle is aligned with the seat.



Next Steps:

- 8** On completion of this procedure: Install the front cover.
9 Select **End** in the maintenance function **Change Needle** (see “[Change Needle](#)” on page 60).

Exchanging the Needle-Seat Assembly

When When the seat is visibly damaged
When the seat capillary is blocked

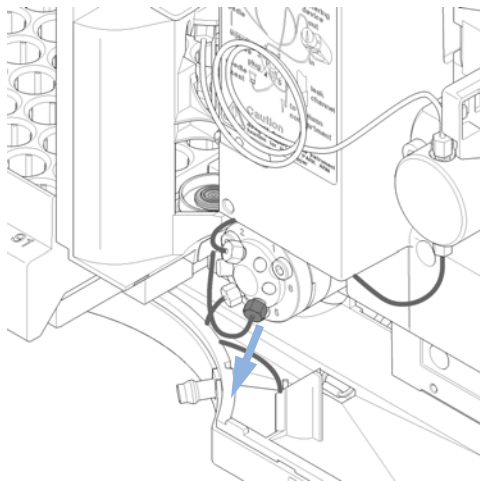
Tools required **Description**
Wrench, 1/4 inch (supplied in HPLC Tool-Kit)
Screwdriver, flat-head

Parts required	#	p/n	Description
	1	G1329-87017	Needle-seat assy (0.17 mm i.d. 2.3 µL)
OR	1	G1329-87012	Needle-seat assy (0.12 mm i.d. 1.2 µL)

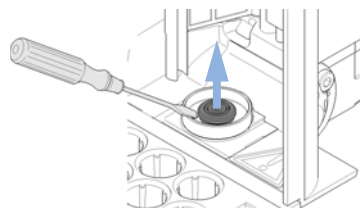
Preparations

- Select **Start** in the maintenance function **Change Needle** (see “Change Needle” on page 60).
- Remove the front cover.
- Use the **Needle Up** command in the **Change Needle** function to lift the needle an addition 1 cm.

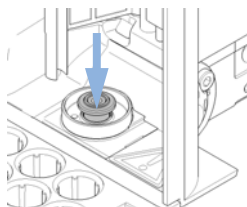
1 Disconnect the seat-capillary fitting from the injection valve (port 5).



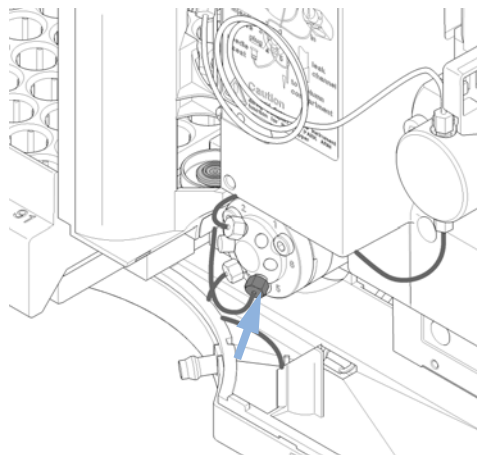
2 Use a small flat-head screwdriver to ease out the needle seat.



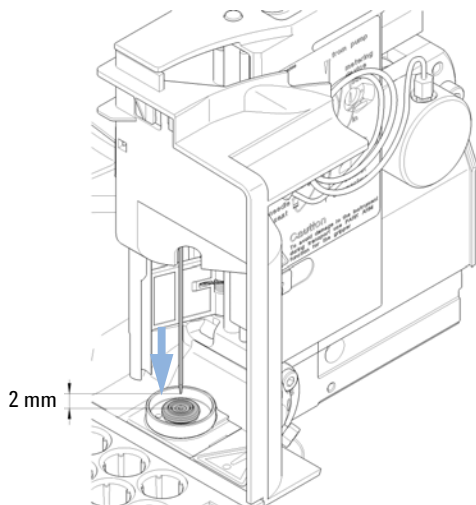
- 3** Insert the new needle-seat assembly. Press the seat firmly into position.



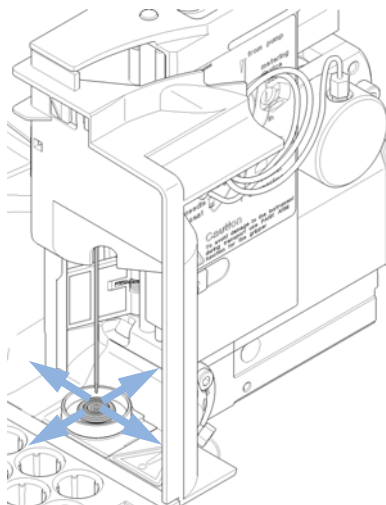
- 4** Connect the seat-capillary fitting to port 5 of the injection valve.



- 5** Use **Down** to position the needle approximately 2 mm above the seat.



- 6** Ensure the needle is aligned with the seat. If required, bend the needle slightly until the needle is aligned correctly.



Next Steps:

- 7** On completion of this procedure: Install the front cover.
- 8** Select **End** in the maintenance function **Change Needle** (see “Change Needle” on page 60).

Exchanging the Rotor Seal

When	Poor injection-volume reproducibility Leaking injection valve		
Tools required	Description Wrench, 1/4 inch (supplied in HPLC Tool-Kit) Hexagonal key, 9/64 inch (supplied in HPLC Tool-Kit)		
Parts required	#	p/n	Description
	1	0100-1853	Rotor seal (Vespel)
	1	0100-1849	Rotor seal (Tefzel)
	1	0101-1416	Rotor seal (PEEK)
Preparations	<ul style="list-style-type: none">Remove front cover.Remove the leak tubing (if necessary).		

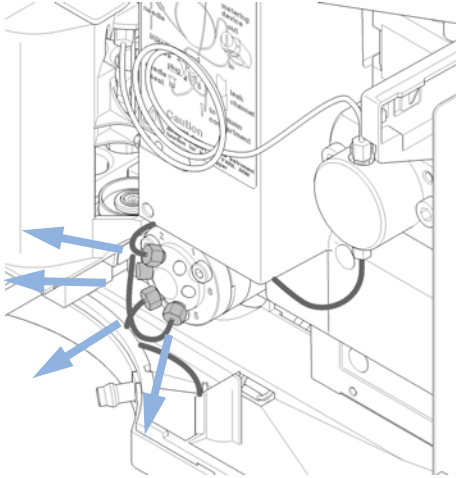
CAUTION

Removing the stator head

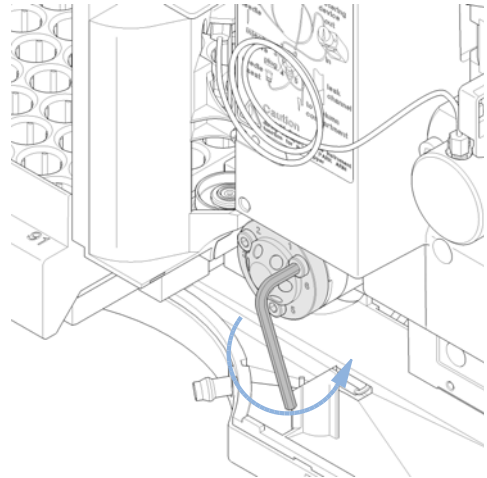
The stator face is held in place by the stator head. When you remove the stator head, the stator face can fall out of the valve.

→ Carefully handle the valve to prevent damage to the stator face

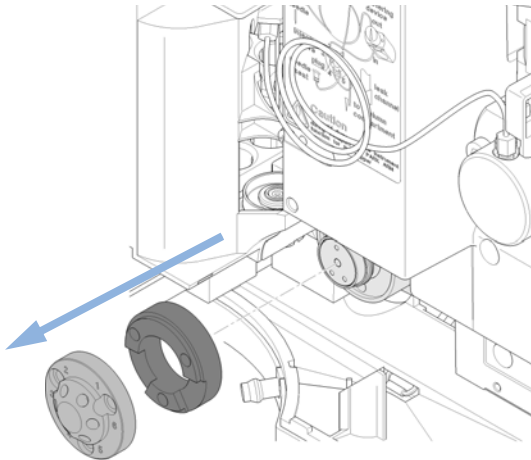
- 1** Remove all capillary fittings from the injection-valve ports.



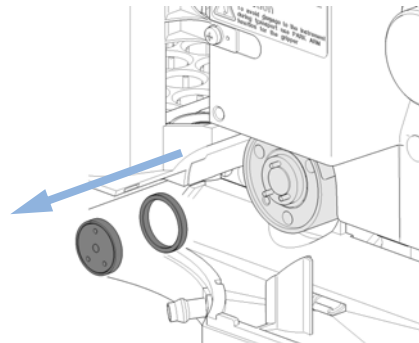
- 2** Loosen each fixing bolt two turns at a time. Remove the bolts from the head.



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



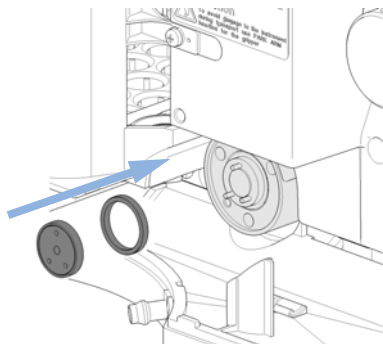
- 4** Remove the rotor seal and isolation seal.



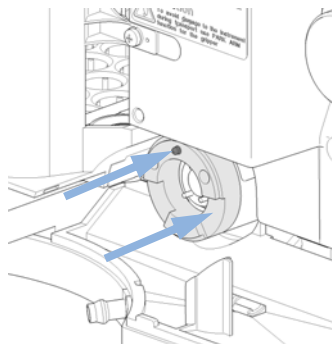
8 Maintenance

Exchanging the Rotor Seal

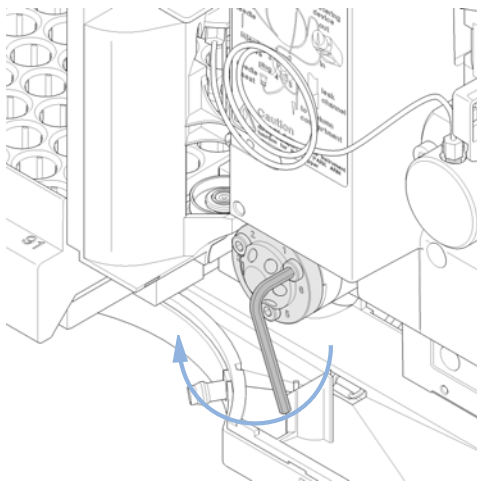
- 5** Install the new rotor seal and isolation seal. Ensure the metal spring inside the isolation seal faces towards the valve body.



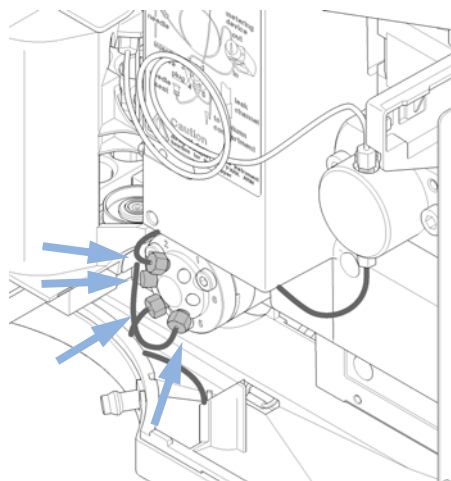
- 6** Install the stator ring with the short of the two pins facing towards you at the 12 O'Clock position. Ensure the ring sits flat on the valve body.



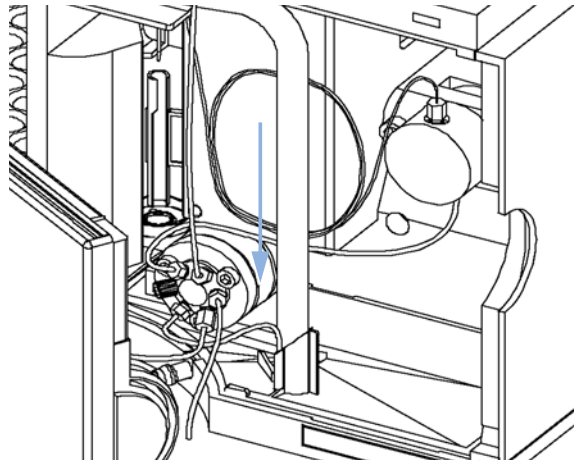
- 7** Install stator head. Tighten the bolts alternately two turns at a time until the stator head is secure.



- 8** Reconnect the pump capillaries to the valve ports (see Hydraulic Connections).



- 9** Slide the waste tube into the waste holder in the leak tray.

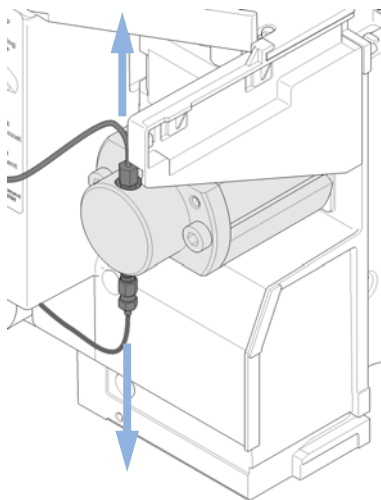


- 10** On completion of this procedure: Install the front cover.

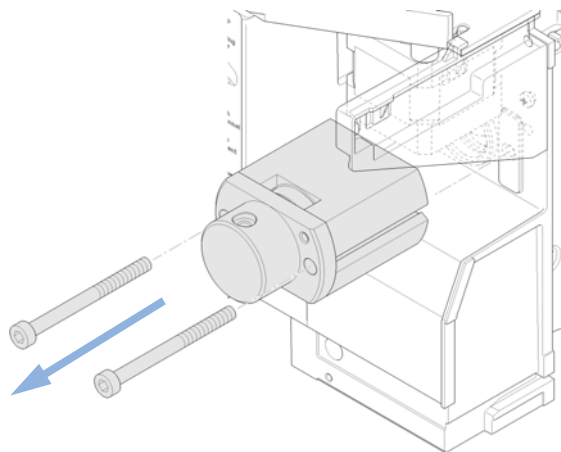
Exchanging the Metering Seal and Piston

When	Poor injection-volume reproducibility Leaking metering device		
Tools required	p/n	Description	
		Wrench, 1/4 inch (supplied in HPLC Tool-Kit)	
		Hexagonal key, 4 mm (supplied in HPLC Tool-Kit)	
	8710-2411	Hexagonal key, 3 mm (supplied in HPLC Tool-Kit)	
Parts required	#	p/n	Description
	1	5063-6589	Metering seal (pack of 2) for 100 µL analytical head
	1	0905-1294	Metering seal (pack of 1) for 900 µL analytical head
	1	5063-6586	Sapphire piston (only if scratched or contaminated)
	1	5062-8587	Metering piston for 900 µL analytical head (only if scratched or contaminated)
Preparations	<ul style="list-style-type: none"> • Select Start in the maintenance function Change piston (see “Change Piston” on page 62). • Remove the front cover. 		

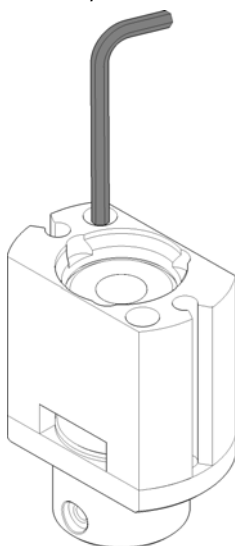
- 1** Remove the two capillaries from the metering-head assembly.



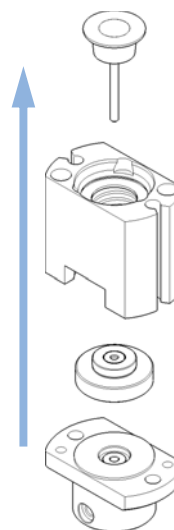
- 2** Remove the two fixing bolts, and pull the head assembly away from the sampler. Notice that the closed side of the metering head faces upwards.



- 3** Remove the two fixing bolts from the base of the metering head assembly.



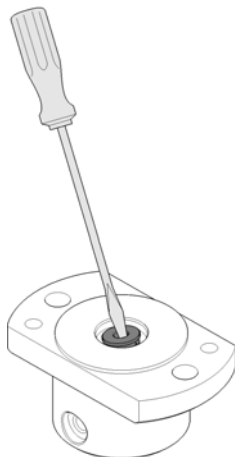
- 4** Disassemble the metering head assembly.



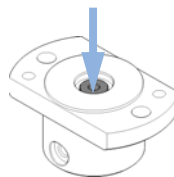
8 Maintenance

Exchanging the Metering Seal and Piston

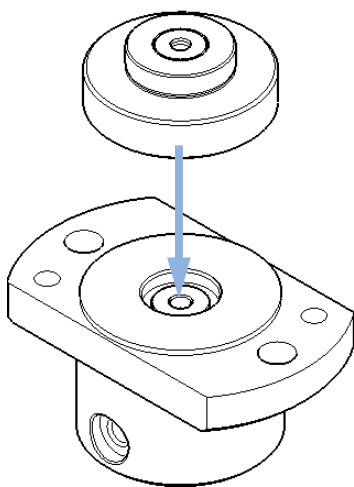
- 5** Use a small screwdriver to carefully remove the seal. Clean the chamber with lint-free cloth. Ensure all particular matter is removed.



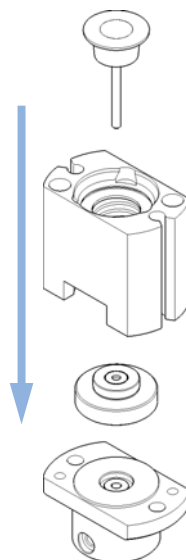
- 6** Install the new seal. Press the seal firmly into position.



- 7** Place the piston guide on top of the seal.

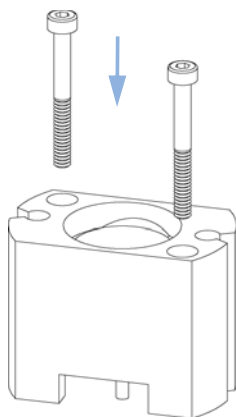


- 8** Reassemble the metering head assembly. Carefully insert the piston into the base. The closed side of the metering head must be on the same side as the lower one of the two capillary drillings.

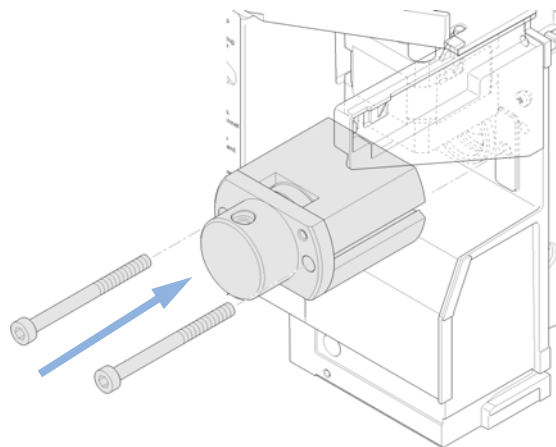


Exchanging the Metering Seal and Piston

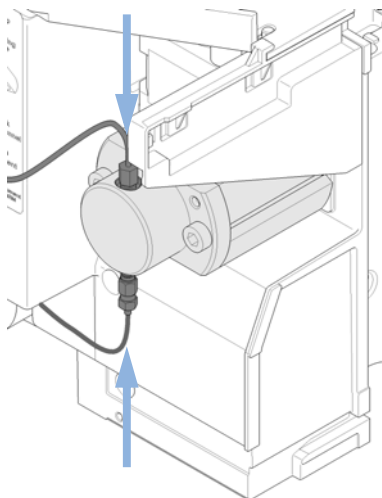
- 9** Install the fixing bolts. Tighten the bolts securely.



- 10** Install the metering head assembly in the autosampler. Ensure the large hole in the metering head is facing downwards.



- 11** Reinstall the capillaries.



Next Steps:

- 12** On completion of this procedure: Install the front cover.
- 13** Select **End** in the maintenance function **Change piston** (see “Change Piston” on page 62).

Exchanging the Gripper Arm

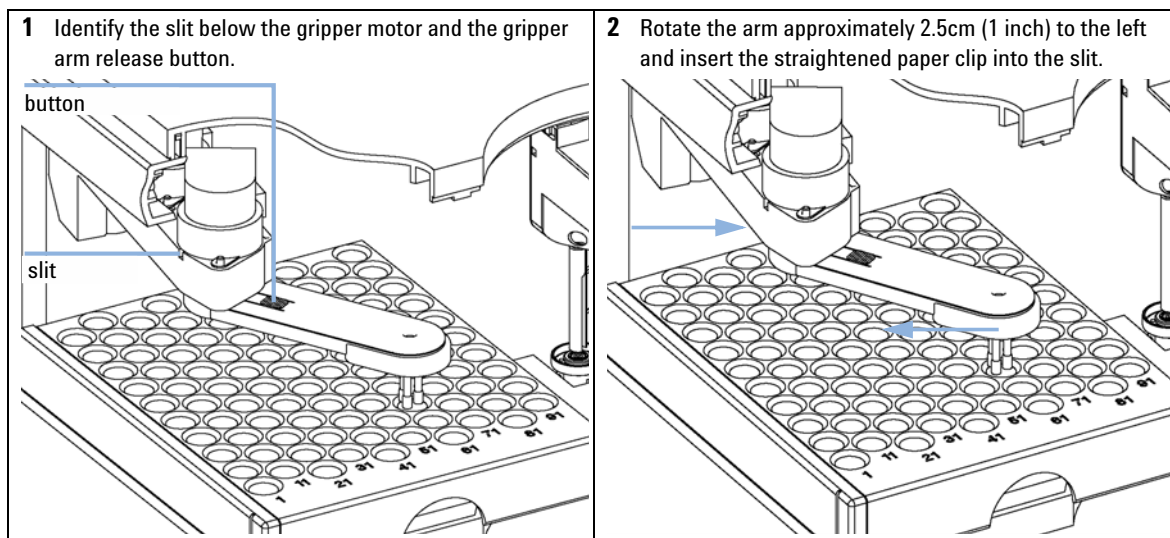
When Defective gripper arm

Tools required **Description**
Straightened paper clip.

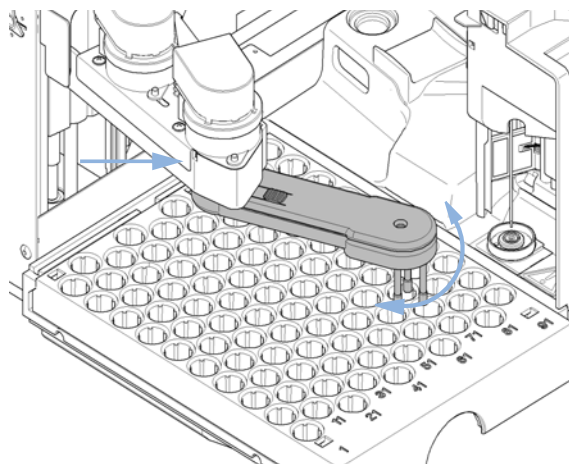
Parts required	#	p/n	Description
	1	G1313-60010	Gripper assembly

Preparations

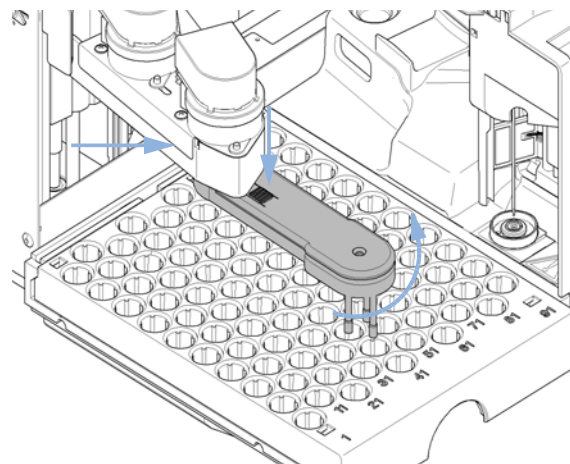
- Select **Start** in the maintenance function **Change Gripper** (see “[Change Gripper](#)” on page 65).
- Turn off the power to the autosampler.
- Remove the front cover.



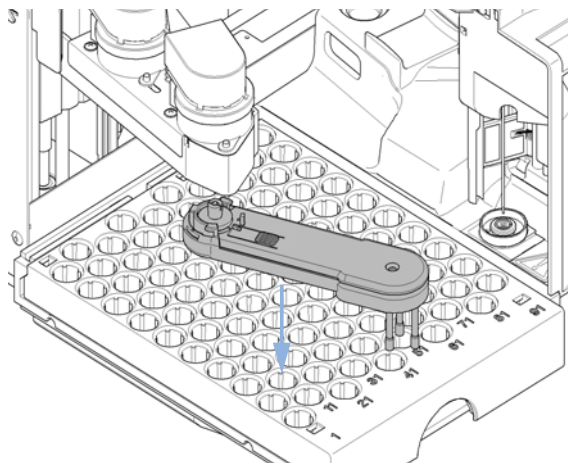
- 3** Rotate the gripper arm slowly from left to right and apply a gentle pressure to the paper clip. The clip will engage on an internal catch and the rotation of the arm will be blocked.



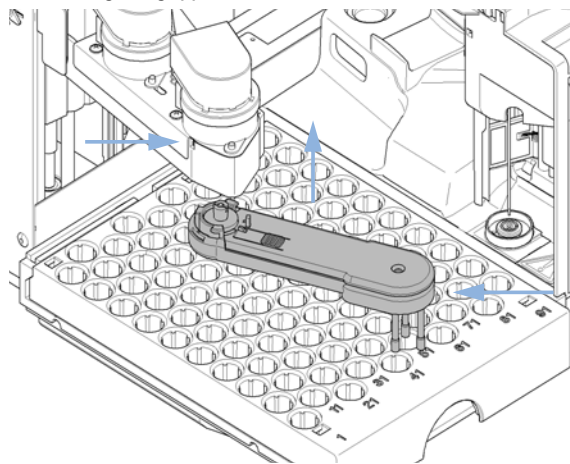
- 4** Hold the paper clip in place, press the gripper release button and rotate the gripper arm to the right.



- 5** The gripper arm will come off.



- 6** Replace the gripper arm by holding the paper clip in place, pushing the gripper arm into the holder and rotating the gripper arm to the left.



Next Steps:

- 7** On completion of this procedure: Install the front cover.
8 Turn the power to the autosampler ON.

Exchanging the Interface Board

When At installation or when defective.

Tools required **Description**
Screwdriver, flat-head

Parts required **#** **Description**
1 Interface board.

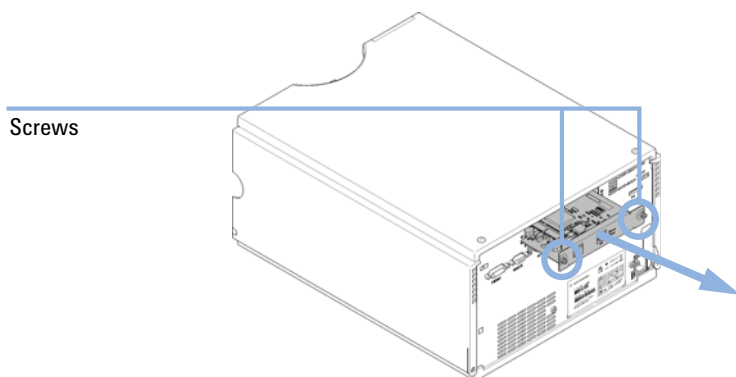
CAUTION

Electronic boards are sensitive to electrostatic discharge (ESD) and should be handled with care so as not to damage them. Touching electronic boards and components can cause electrostatic discharge.

ESD can damage electronic boards and components.

→ Be sure to hold the board by the edges and do not touch the electrical components. Always use an ESD protection (for example, an ESD wrist strap) when handling electronic boards and components.

- 1** Switch OFF the autosampler at the main power switch.
- 2** Disconnect cables from the interface board connectors.
- 3** Loosen the screws. Slide out the interface board from the autosampler.
- 4** Install the interface board. Secure the screws.
- 5** Reconnect the cables to the board connectors.



Replacing the Module's Firmware

When

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

Tools required

Description

- LAN/RS-232 Firmware Update Tool
- OR
- Agilent Lab Advisor software
- OR
- Instant Pilot G4208A
(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.

8 Maintenance

Replacing the Module's Firmware



9

Parts and Materials for Maintenance

Main Assemblies	130
Analytical-Head Assembly	132
Vial Trays	134
Standard Autosampler Accessory Kit	136
Maintenance Kit	137
Injection Upgrade Kit	138
Multi-Draw Kit	139
External Tray	140

This chapter provides information on parts for maintenance.



Main Assemblies

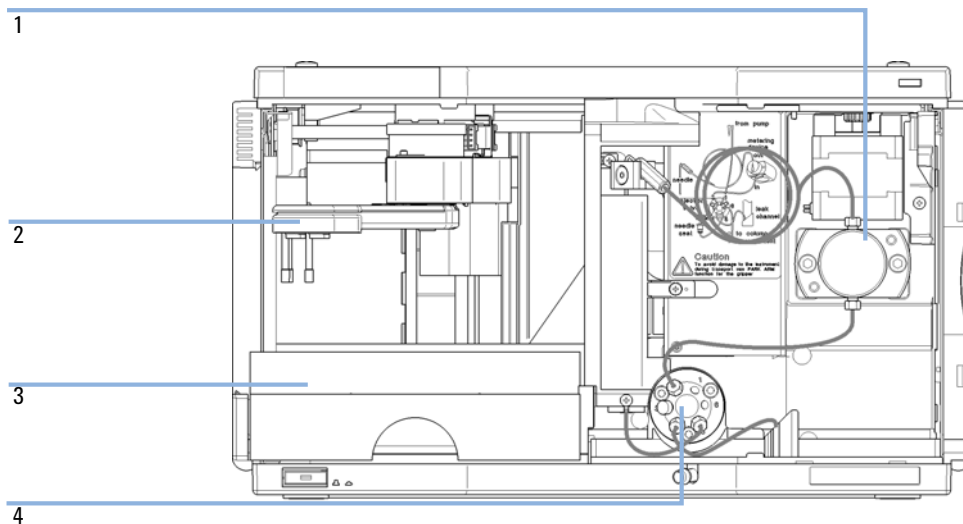


Figure 18 Autosampler Main Assemblies

Item	p/n	Description
1	01078-60003	Analytical head assembly, 100 µL
2	G1313-60010	Gripper assembly
3	G1329-60011	Thermostatable tray for 100 x 2 mL vials
4	0101-1422	Injection valve
	G1351-68701	Interface board (BCD) with external contacts and BCD outputs
	01090-87306	Capillary ST 0.17 mm x 380 nm S/S Heat exchanger

Analytical-Head Assembly

Analytical-Head Assembly, 100 µL

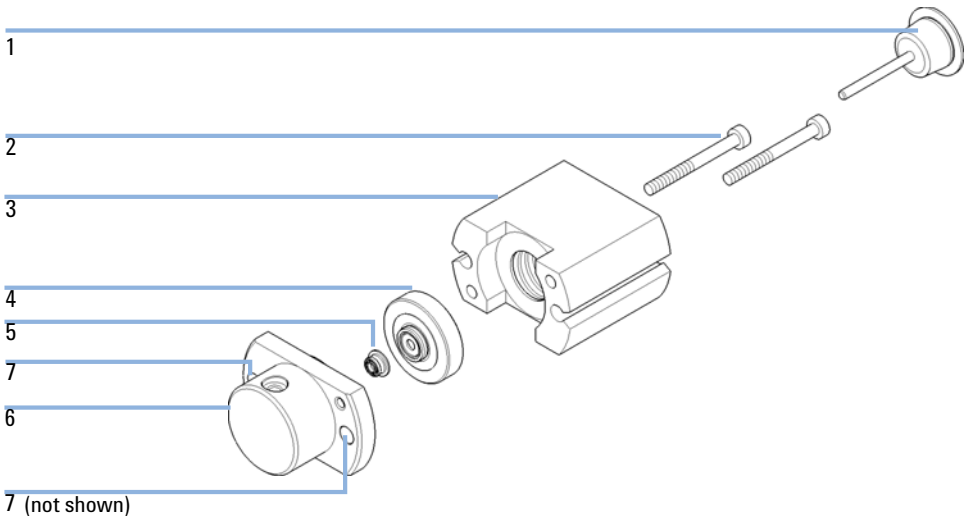


Figure 19 Analytical-Head Assembly

Item	p/n	Description
	01078-60003	Analytical head assembly, 100 µL
1	5063-6586	Sapphire piston
2	0515-0850	Screw M4, 40 mm long
3	01078-23202	Adapter
4	5001-3739	Support Seal assembly
5	5063-6589	Metering seal (pack of 2) for 100 µL analytical head
6	01078-27710	Head body
7	0515-2118	Screw M5, 60 mm long

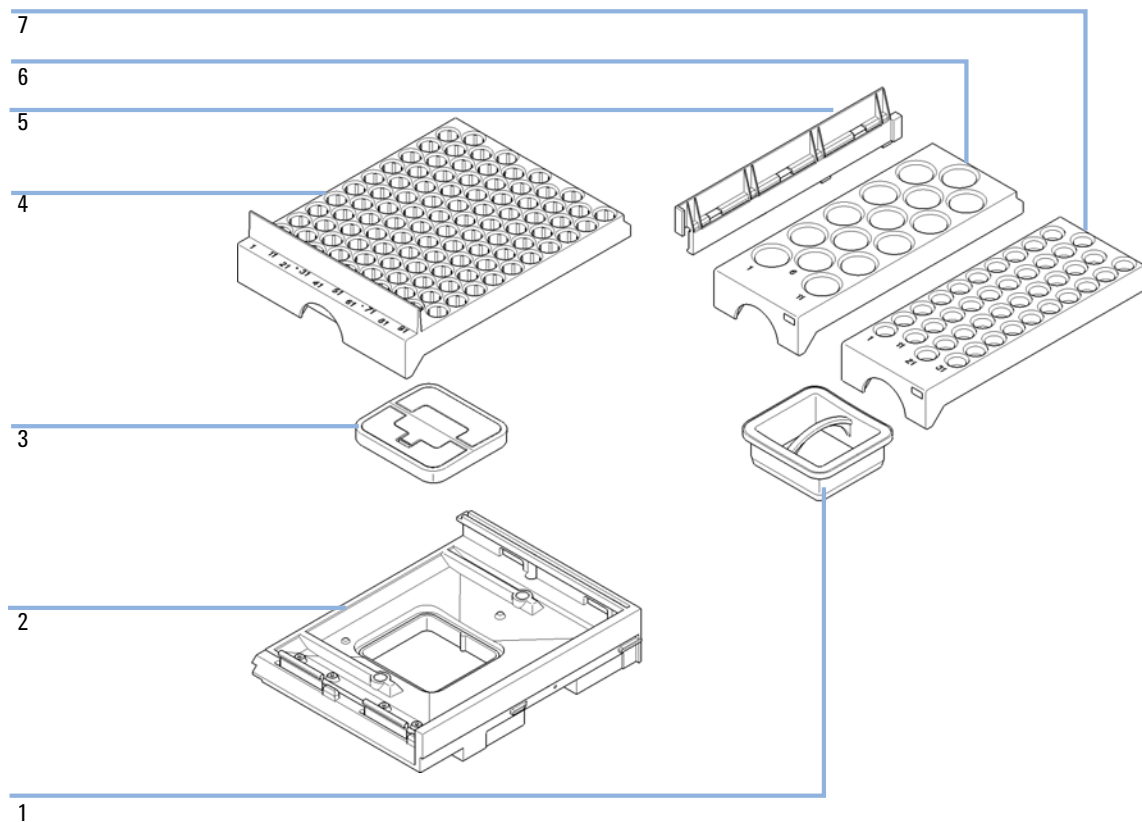
Analytical-Head Assembly, 900 µL

Item	p/n	Description
	G2260-60007	Analytical head assembly (900 µL, maximum pressure 400 bar) only for G1329B
1	5062-8587	Metering piston for 900 µL analytical head
2	0515-0850	Screws
3	01078-23202	Adapter Includes spring
4	5001-3764	Support seal assembly, 900 µL
5	0905-1294	Metering seal, 900 µL
6	G2260-27700	Head body, 900 µL < 400 bar
7	0515-2118	Screw M5, 60 mm long

NOTE

Upgrading the G1329A Standard Autosampler to 900 µL injection volume limits the maximum instrument pressure to 200 bar. Therefore you must order the P/N G1313-60007 for the G1329A instead of P/N G2260-60007. This assembly includes the head body P/N G1313-27700 for 200 bar.

Vial Trays



Item	p/n	Description
1	G1329-43200	Adapter air channel
2	G4226-47200	Tray base
3	G4226-43200	Plug
	G1313-09101	Spring
4	G1329-60011	Thermostatable tray for 100 x 2 mL vials
5	0570-1574	Spring stud
6	G1313-44513	Halftray for 15 x 6 mL vials
7	G1313-44512	Halftray for 40 x 2 mL vials

Standard Autosampler Accessory Kit

p/n	Description
5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
5181-1519	CAN cable, Agilent module to module, 1 m
5959-3890	Label Halftray
9222-0518	Bag - plastics
01090-87306	Capillary ST 0.17 mm x 380 nm S/S Heat exchanger
G1313-44101 (3x)	Finger Cap
G1329-40321	Door Front CA
G1329-43200	Adapter air channel
G1329-44111	Cover insulation
G1329-90122	1200 Sampler Door Upgrade Tech Notes ENG

Maintenance Kit

G1329B PM Kit

p/n	Description
G1313-68719	G1329B PM Kit (including Rotor Seal, Needle, Seat Assy, Metering Seal)
0101-1416	Rotor seal (PEEK) 2 grooves, max. 600 bar
G1313-87201	Needle assembly
G1329-87017	Needle-seat assy (0.17 mm i.d. 2.3 µL)

G1329A PM Kit

p/n	Description
G1313-68730	G1329A PM Kit (including Vespel Rotor Seal (400 bar), Needle, Seat Assy 0.17 mm)
0100-1853	Rotor seal (Vespel) 2 grooves, max. 400 bar
G1313-87201	Needle assembly
G1329-87017	Needle-seat assy (0.17 mm i.d. 2.3 µL)

Seals and Caps

p/n	Description
5063-6589	Metering seal (pack of 2) for 100 µL analytical head
5063-6506	Finger caps (x3) ¹

¹ Reorder gives pack of 15

Injection Upgrade Kit

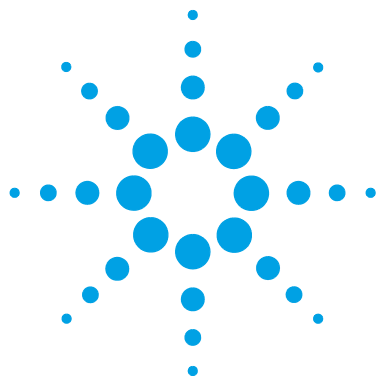
Item	p/n	Description
	G1363A	900 µL Injection Upgrade Kit for G1329B
1	G2260-60007	Analytical head assembly (900 µL, maximum pressure 400 bar) for G1329B only
2	G1313-87303	Loop ext. capillary (900 µL)
3	5022-2133	Union for (900 µL) loop extension capillary
	G1313-87202	Needle assembly (900 µL)

Multi-Draw Kit

p/n	Description
G1313-87307	Seat capillary, 500 µL, 0.5 mm id
G1313-87308	Seat capillary, 1500 µL, 0.9 mm id
0101-0301	Seat capillary, 5000 µL
5022-6515	Union ZDV

External Tray

p/n	Description
G1313-60004	External tray
G1313-27302	Disposal tube



10 Identifying Cables

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Remote Cables	146
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This chapter provides information on cables used with the module.



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 146
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)

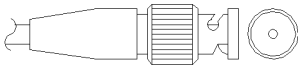
External Contact Cable

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

RS-232 cables

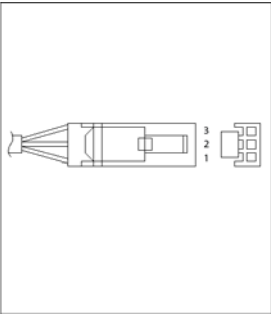
p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between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

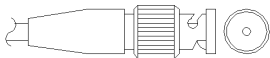


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

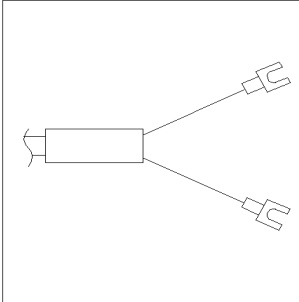
Agilent Module to 3394/6 Integrators

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

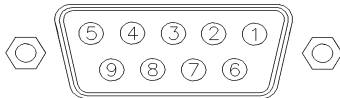
Agilent Module to BNC Connector

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.

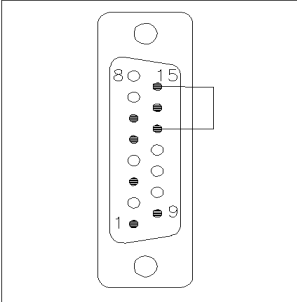
Agilent Module to 3396A Integrators

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	

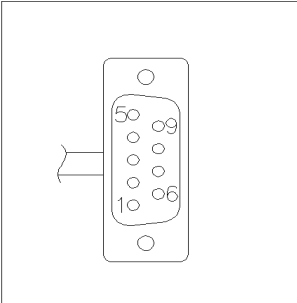
Agilent Module to 3396 Series II / 3395A Integrators

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.

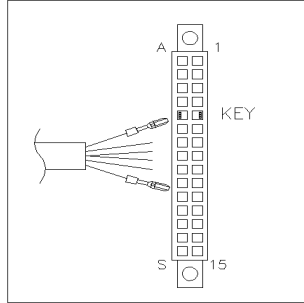
Agilent Module to 3396 Series III / 3395B Integrators

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

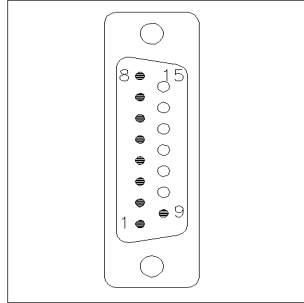


One end of these cables provides a 15-pin BCD connector to be connected to the Agilent modules. The other end depends on the instrument to be connected to

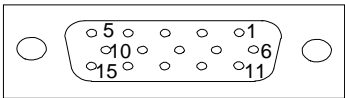
Agilent Module to General Purpose

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

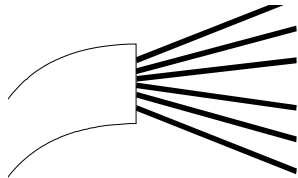
p/n 03396-60560	Pin 3396	Pin Agilent module	Signal Name	BCD Digit
	1	1	BCD 5	20
	2	2	BCD 7	80
	3	3	BCD 6	40
	4	4	BCD 4	10
	5	5	BCD0	1
	6	6	BCD 3	8
	7	7	BCD 2	4
	8	8	BCD 1	2
	9	9	Digital ground	
	NC	15	+ 5 V	Low

External Contact Cable

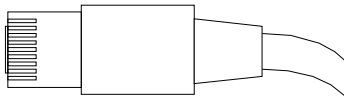


One end of this cable provides a 15-pin plug to be connected to Agilent modules interface board. The other end is for general purpose.

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

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

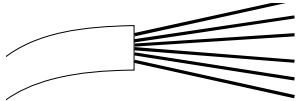
p/n	Description
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5023-0202	Twisted pair network cable, shielded, 7 m (for point to point connection)

Auxiliary Cable



One end of this cable provides a modular plug to be connected to the Agilent vacuum degasser. The other end is for general purpose.

Agilent Vacuum Degasser to general purposes

p/n G1322-81600	Color	Pin Agilent 1100	Signal Name
	White	1	Ground
	Brown	2	Pressure signal
	Green	3	
	Yellow	4	
	Grey	5	DC + 5 V IN
	Pink	6	Vent

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



11 Hardware Information

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This chapter describes the detector 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.

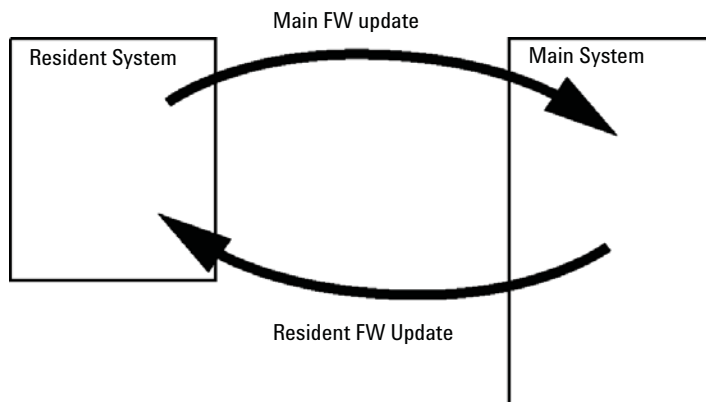


Figure 20 Firmware Update Mechanism

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

Interfaces

The Agilent 1200 Infinity Series modules provide the following interfaces:

Table 12 Agilent 1200 Infinity Series Interfaces

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

11 Hardware Information

Interfaces

Table 12 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 K1314F Clinical Ed.	2	No	Yes	Yes	1	Yes	
G4212A/B DAD K4212B DAD Clinical Ed.	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 K1321B FLD Clinical Ed. G1321C FLD	2	Yes	No	Yes	2	Yes	
G1362A RID	2	Yes	No	Yes	1	Yes	
G4280A ELSD	No	No	No	Yes	Yes	Yes	EXT Contact AUTOZERO
Others							
G1170A Valve Drive	2	No	No	No	No	No	1
G1316A/C TCC K1316C TCC Clinical Ed.	2	No	No	Yes	No	Yes	
G1322A DEG K1322A DEG Clinical Ed.	No	No	No	No	No	Yes	AUX
G1379B DEG	No	No	No	Yes	No	Yes	
G4225A DEG K4225A DEG Clinical Ed.	No	No	No	Yes	No	Yes	

Table 12 Agilent 1200 Infinity Series Interfaces

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

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

NOTE

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

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

Overview Interfaces

CAN

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

LAN

The modules have either an interface slot for 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 13 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

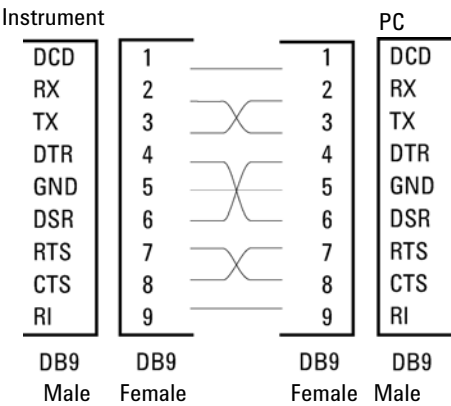


Figure 21 RS-232 Cable

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 14 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

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.

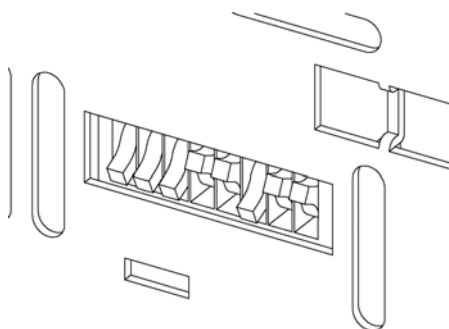


Figure 22 Configuration switch (settings depend on configured mode)

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 15 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 16 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.

11 Hardware Information

Setting the 8-bit Configuration Switch

Table 17 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 18 Data Bit Settings (without on-board LAN)

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

Table 19 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 20 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 21 Forced Cold Start Settings (without on-board LAN)

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

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 interface board slot is used for external contacts and BCD bottle number output or LAN connections.
- 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 \pm 10 % with a line frequency of 50 or 60 Hz. Maximum power consumption varies by module. There is no voltage selector on your module because the power supply has wide-ranging capability. There are no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

NOTE

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

Serial Number Information

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

CCXZZ00000	Format
CC	Country of manufacturing <ul style="list-style-type: none">• DE = Germany• JP = Japan• CN = China
X	Alphabetic character A-Z (used by manufacturing)
ZZ	Alpha-numeric code 0-9, A-Z, where each combination unambiguously denotes a module (there can be more than one code for the same module)
00000	Serial number

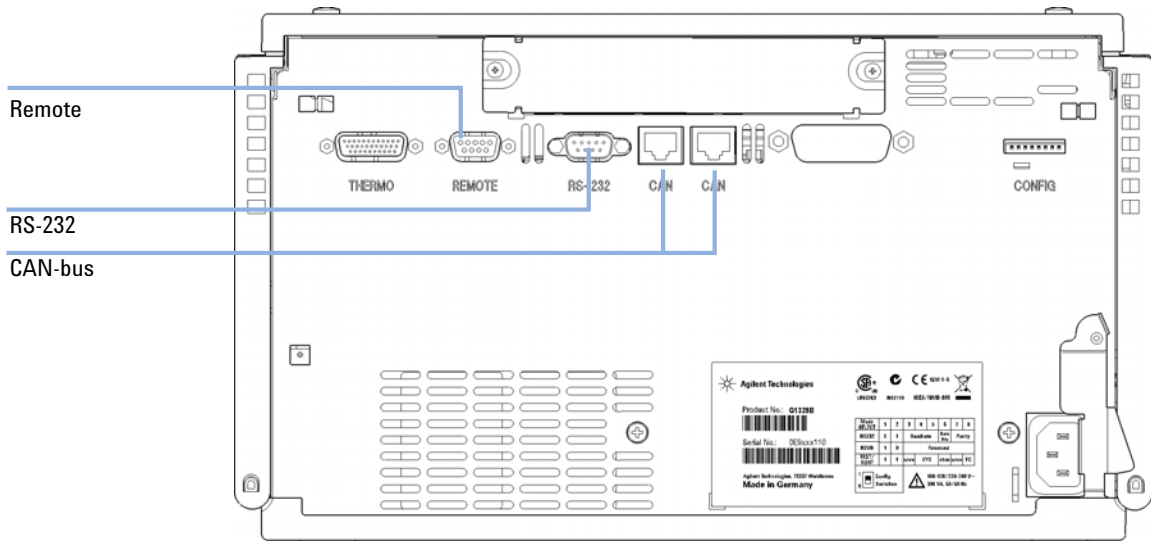


Figure 23 Autosampler Electrical Connections

Early Maintenance Feedback (EMF)

Maintenance requires the exchange of components which are subject to wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of usage of the module and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (**EMF**) feature monitors the usage of specific components in the instrument, and provides feedback when the user-selectable limits have been exceeded. The visual feedback in the user interface provides an indication that maintenance procedures should be scheduled.

EMF Counters

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

Using the EMF Counters

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

Setting the EMF Limits

The setting of the **EMF** limits must be optimized over one or two maintenance cycles. Initially the default **EMF** limits should be set. When instrument performance indicates maintenance is necessary, take note of the values displayed by the **EMF counters**. Enter these values (or values slightly less than the displayed values) as **EMF** limits, and then reset the **EMF counters** to zero. The next time the **EMF counters** exceed the new **EMF** limits, the **EMF** flag will be displayed, providing a reminder that maintenance needs to be scheduled.

Instrument Layout

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

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

11 Hardware Information

Instrument Layout



12 Appendix

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



General Safety Information

General Safety Information

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

WARNING

Ensure the proper usage of the equipment.

The protection provided by the equipment may be impaired.

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

Safety Standards

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

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.

Safety Symbols

Table 22 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.

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 starting with 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.



NOTE

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.

Lithium Batteries Information

WARNING

Lithium batteries may not be disposed-off into the domestic waste. Transportation of discharged Lithium batteries through carriers regulated by IATA/ICAO, ADR, RID, IMDG is not allowed.

Danger of explosion if battery is incorrectly replaced.

- Discharged Lithium batteries shall be disposed off locally according to national waste disposal regulations for batteries.
 - Replace only with the same or equivalent type recommended by the equipment manufacturer.
-



WARNING

Lithiumbatteri - Eksplosionsfare ved fejlagtig håndtering.

Udskiftning må kun ske med batteri af samme fabrikat og type.

- Lever det brugte batteri tilbage til leverandøren.
-

WARNING

Lithiumbatteri - Eksplosionsfare.

Ved udskiftning benyttes kun batteri som anbefalt av apparatfabrikanten.

- Brukt batteri returneres apparatleverandøren.
-

NOTE

Bij dit apparaat zijn batterijen geleverd. Wanneer deze leeg zijn, moet u ze niet weggooien maar inleveren als KCA.

Radio Interference

Cables supplied by Agilent Technologies are screened to provide optimized protection against radio interference. All cables are in compliance with safety or EMC regulations.

Test and Measurement

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

Solvent Information

Observe the following recommendations on the use of solvents.

Flow Cell

Avoid the use of alkaline solutions (pH > 9.5) which can attack quartz and thus impair the optical properties of the flow cell.

Prevent any crystallization of buffer solutions. This will lead into a blockage/damage of the flow cell.

If the flow cell is transported while temperatures are below 5 °C, it must be assured that the cell is filled with alcohol.

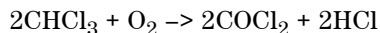
Aqueous solvents in the flow cell can build up algae. Therefore do not leave aqueous solvents sitting in the flow cell. Add small % of organic solvents (e.g. Acetonitrile or Methanol ~5%).

Solvents

Brown glass ware can avoid growth of algae.

Always filter solvents, small particles can permanently block the capillaries. Avoid the use of the following steel-corrosive solvents:

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



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

- Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, 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.

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

Agilent Technologies on Internet

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In This Book

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The manual describes the following:

- introduction to the autosampler,
- site requirements and specifications
- installing the autosampler,
- using the autosampler,
- optimizing performance,
- troubleshooting and diagnostics,
- maintenance,
- parts and materials,
- cable overview,
- safety and warranty

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